DRAFT
31 March 2017

Site Inspection Sample and Analysis Plan

Gamma Walkover Survey and Soil and Sediment Sampling

Former Naval Station Puget Sound
Seattle, Washington

Department of the Navy
Naval Facilities Engineering Command Northwest
1101 Tautog Circle
Silverdale, WA 98315

DRAFT

SITE INSPECTION SAMPLE ANALYSIS PLAN
GAMMA WALKOVER SURVEY
SOIL, SLUDGE AND SEDIMENT SAMPLING

Prepared by
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Prepared for
Naval Facilities Engineering Command Northwest
Silverdale, Washington

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1.0 EXECUTIVE SUMMARY

1.1 PURPOSE OF SITE INVESTIGATION

Naval Facilities Engineering Command Northwest (NAVFAC NW) is conducting a radiological preliminary assessment/site inspection (PA/SI) of the property transferred under the Base Realignment and Closure Act (BRAC) at the former Naval Station Puget Sound (NAVSTA PS). The Final Radiological Preliminary Assessment (U.S. Navy 2016a), recommended additional field activities, to be addressed during the SI. The objective of the SI is to assess the areas identified in the Final Radiological PA at the former NAVSTA PS as potential or known sources of radioactive material and radioactivity. The Sampling and Analysis Plan (SAP) is comprised of two parts: the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP).

1.2 SITE BACKGROUND

Originally named Naval Air Station (NAS) Seattle, portions of the station were built in 1925 on land donated by King County. During World War II, NAS Seattle supported air transport and ship outfitting of personnel for the Alaskan and Western Pacific theaters of operation. After the war, NAS Seattle was designated a Naval Reserve Air Station. From 1945 to 1970, the station maintained naval reserve squadrons for supplementing active duty forces, both in the continental United States and abroad. Aviation activities officially ceased on June 30, 1970, and NAS Seattle was decommissioned.

After the 1970 decommissioning, the Navy facility was designated as Naval Support Activity. Seattle and the Navy subsequently rented buildings to approximately eight federal and institutional tenants. Between 1970 and 1977, the Navy divided the property into three parts, conveying considerable portions that had supported air operations (runways and adjacent structures) to the National Oceanic and Atmospheric Administration (NOAA) (approximately 100 acres) and the City of Seattle (approximately 165 acres). The remainder of the property (approximately 150 acres) was retained by the U.S. Department of the Navy (Navy).

In April 1982, the Navy-retained property was designated Naval Station Seattle. In October 1986, Naval Station Seattle was designated Naval Station Puget Sound (NAVSTA PS) as a result of the station's decreasing support role in the Pacific fleet activities.

A major part of the mission at NAVSTA PS was aircraft overhaul and repair, which included painting of aircraft instrumentation with radioluminescent paint, engine overhaul, welding shops, machine shops, and other activities of potential concern related to radiological contamination. In addition, in the late 1960s the University of Washington Laboratory of Radiation Ecology

conducted research at NAVSTA PS to evaluate the uptake of radioactivity by hermit crabs from exposure to contaminated coral grit resulting from the atmospheric nuclear weapons testing program.

In June 1991, the BRAC Commission announced the closure of former NAVSTA PS. In accordance with the recommendations of the 1991 commission, NAVSTA PS was closed in September 1995.

As part of the BRAC process, the final nine Navy retained parcels were transferred from the Navy to the City of Seattle and other entities from 1998 to 2003.

In 2009, radium contamination that was attributed to painting of aircraft instrumentation with radioluminescent paint was discovered at two buildings (Buildings 2 and 27) at the former NAVSTA PS. In 2010, the Navy conducted a radiological remedial investigation (RI) to determine the extent and magnitude of radioactive contamination (U.S. Navy 2011). A time critical removal action (TCRA) was conducted from 2013 to 2016 to remediate known radioactive contamination in and around Buildings 2 and 27. The Final After Action Report (U.S. Navy 2016b) was completed and documents the TCRA. In 2016, the Final Radiological PA was completed which includes recommendations for the SI activities.

1.3 FIELD INVESTIGATION

The SI is being conducted to assess areas of the BRAC transferred property identified in the Final Radiological PA as having the potential to contain radiological contamination. The potential radionuclides of concern (PROC) include Ra-226, Cs-137, Sr-90, Th-232, and Pu-239.

A general summary of the field activities are provided below. Figure 3-1, in the FSP, shows all field investigation locations, and Figure 3-2 shows the Lake Washington background sampling locations.

1.3.1 Mobilize/Prepare Site

Site mobilization will occur once all plan approvals are received, and URS receives reciprocity with the Washington Department of Health (DOH), Division of Radiation Protection, and the Nuclear Regulatory Commission Region 4 for conducting the work under their Utah Radioactive Materials License (UT1800410). Site access will be coordinated with the Navy Remedial Project Manager (RPM). URS and subcontractors will mobilize to the Site, conduct site-specific training, and establish work staging areas and temporary waste storage areas. Utility locations and clearances will be completed prior to initiating intrusive sampling activities.

1.3.2 GWS and Location Mapping

Gamma Walk-over Surveys (GWS) will be conducted using both a sodium iodide (NaI) detector and a Field Instrument for the Detection of Low Energy Radiation (FIDLER) probe. The NaI detector will be used in areas adjacent to Building 30 and former Building 15, while the FIDLER probe will be used in the area near former Building 15. The same instruments and configurations will be used to collect GWS data in an established background reference area. All surveys will be performed in accordance with Cabrera SOP OP-387, Gamma Walkover Survey.

The survey will be performed over the accessible surface areas by walking straight parallel lines at a speed of 0.5 meter per second over the designated area with the detector kept at a fixed distance from the ground (less than or equal to 4 inches). The GWS system will log the gross gamma reading and position (in Washington State Plane Coordinates) every second.

The raw data will be downloaded from the GPS and transmitted to a data processing specialist for export into a geospatial software program. The results of the surveys near Building 30 and 15 will be compared to the results of the background survey. The GWS results will be processed and evaluated by the Project Health Physicist. Additional soil boring sampling locations and modifications to the proposed existing soil boring locations may result based on the results of the GWS, after consultation with project staff and the RPM.

1.3.3 Soil Sampling

Soil boring locations are shown on Figure 3-1 in the FSP. A direct push drill rig will be used to obtain continuous soil core at each location from the ground surface to first groundwater or to a maximum depth of 10 feet whichever comes first. Each core will be geologically logged and radiologically scanned with a Ludlum 44-10 or Ludlum 44-9 radiation meter, as appropriate. At each location soil samples will be collected at the following intervals:

- surface soil (0 to 0.5 foot),
- a subsurface soil composite from the 0.5 to 3 feet interval,
- a subsurface soil sample from the 0.5-foot interval in the boring where the highest radiological screening result is detected.

1.3.4 Sludge Sampling

The sludge sampling locations are in sediment traps or similar structures, catch basins, and manholes within sections of storm-sewer systems identified in the Final Radiological PA that were not previously investigated for radiological contamination during the RI (U.S. Navy 2011)

or TCRA (U.S. Navy 2016b). A Van Veen Grab Sampler or equivalent will be used in an attempt to collect three samples representative of the surface, middle, and bottom layers of sludge material. Each sample will be placed in a labeled plastic bag, packaged and shipped to an off-site lab for analysis.

1.3.5 Lake Washington Sediment Core Sampling

Lake sediment sampling locations are in stormwater outfall areas of potential concern that were not previously investigated for radiological contamination. A Rossfelder Vibracore will be used to collect a sediment core representative of the 0- to 5-foot depth. Sediment cores will be radiologically scanned using a Ludlum 44-10. Two samples will be collected from each sediment location, a surface sample (0 to 0.5 foot) and one from the interval with the highest radiological scan results. Samples will be packaged and shipped to the off-site analytical laboratory.

1.3.6 Building 30 Interior Screening

A minimal non-invasive radiological scoping survey will be performed of the former instrument shop inside Building 30. The survey will include the instrument shop (1,080 square feet), and a background reference area also inside Building 30. The background area will be identified at the time of the survey but will be in area identified as non-impacted.

The interior screening will include collection of dose rates, gross gamma scans, and alpha/ beta measurements. The alpha/beta measurements may include scans, static measurements, and smear samples. The survey will focus on areas likely to be impacted such as floors and sink drains.

1.3.7 Restore Site and Demobilize

After the completion of field work the Site and staging areas will be restored to a condition similar or equal to that existing prior to the work. If the investigation identifies areas either indoor or outdoor that present a radiological hazard, radiological control areas (RCA) will be established following procedures specified in Radiation Protection Plan (RPP). These areas will be secured to prevent inadvertent access until the exposure hazard is mitigated.

1.3.8 Manage and Disposal Investigation-Derived Waste

Investigation-Derived Waste (IDW) generated during sampling activities will be managed as required by the URS Radioactive Materials License, and the Radiation Protection Program. URS will arrange for manifesting, shipping, and properly disposing of any non-radiological IDW under the Navy's approval and signature. The Navy's low-level radioactive waste (LLRW) contractor will arrange for manifesting, shipping, and properly disposing of any potential LLRW waste.

1.4 POST FIELD ACTIVITIES

1.4.1 Sample Laboratory Analysis and Data Evaluation

All samples will be sent to Test America in Earth City, Missouri for radiological analysis, by gamma spectrometry (GS) gas flow proportional counting (GFPC), liquid scintillation counting (LSC), and alpha spectrometry (AS). The specific analytical requirement for each sample is detailed in Table 3-1 in the FSP and Worksheet 18. The laboratory analytical results will undergo data verification and validation.

1.4.2 Reporting

The SI report will include summary descriptions of the resulting field efforts, including audits or regulatory visits, and the disposition of IDW. The results of all SI activities, including the GWS, soil and sediment boring logs, field photographs, and any field notes, will be provided. Laboratory analytical results will be validated, tabulated, and used to support the conclusions and recommendations. Departures from procedures described in the approved final SAP will be included as a List of Deviations in the SI report.

2.0 INTRODUCTION

This Sample and Analysis Plan (SAP) consists of three parts: the Field Sampling Plan (FSP) the Quality Assurance Project Plan (QAPP) and the Radiation Protection Plan (RPP). Parts 1 and 2 have elements in common and contain some duplicated information, but they are presented as separate documents to facilitate use during the SI field effort. The main features of each of these plans are summarized below.

Part 1 – Field Sampling Plan:

The FSP portion of the SAP focuses on the project objectives and the technical approach for the field work to be conducted. The plan includes discussions of the relevant regulatory framework, Site background and conditions, community relations, the planned work schedule, and a description of the Site investigation activities. Investigation activities include

- Mobilize/prepare Site
- Perform GWS and location mapping
- Sample surface and subsurface soil
- Sample sludge from a manhole, catch basin, or oil/water separator
- Sample Lake Washington sediment core
- Perform Building 30 Instrument Shop screening
- Site restoration and demobilize
- Manage and dispose of IDW

Part 2 – Quality Assurance Project Plan:

The QAPP portion is comprised of worksheets in accordance with U.S. Department of Defense policy, U.S. Environmental Protection Agency guidance, and Naval Facilities Engineering Command (NAVFAC) Southwest Environmental Work Instructions on the Uniform Federal Policy for the Quality Assurance Projects Plans (UFP-QAPP). The purpose of the QAPP is to provide guidance on sampling, analysis, and quality assurance/quality control (QA/QC). The QAPP identifies and discusses sampling strategy, analytical methods used, field methods and sampling procedures, QA objectives, analytical QC procedures, and data quality management, as appropriate.

Part 3 – Radiation Protection Plan:

The radiation protection plan (RPP) details how radiological work will be conducted after applying for and receiving reciprocity with the Washington Department of Health (WDOH),

Division of Radiation Protection, and NRC Region 4 using URS Utah Radioactive material License UT1800410, Amendment 11.

PART 1

Field Sampling Plan

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FIGURES

TABLE

ABBREVIATIONS AND ACRONYMS

AOPC	areas of potential concern
bgs	below ground surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cpm	counts per minute
Cs	cesium
CSM	conceptual site model
DOH	Washington State Department of Health
Dpm	disintegrations per minute
°F	degrees Fahrenheit
Ecology	Washington State Department of Ecology
EDD	Electronic Data Deliverable
EPM	Environmental Project Manager
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FSP	field sampling plan
GPS	Global Positioning System
GWS	gamma walkover survey
HHRA	Human Health Risk Assessment
IDW	investigation-derived waste
LLRW	low-level radioactive waste
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
NaI	sodium iodide detector
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NAVSTA PS	Naval Station Puget Sound
Navy	U.S. Navy
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NTR	Navy Technical Representative
PA	preliminary assessment
PRGs	preliminary remediation goals
PROC	potential radionuclides of concern
Pu	plutonium
QAPP	quality assurance project plan

Ra	radium
RASO	Radiological Affairs Support Office
RCA	radiological control areas
RESRAD	Residual Radioactivity Software
RI	remedial investigation
RML	Radioactive Materials License
RPM	Remedial Project Manager
SAP	sampling and analysis plan
SERA	Screening-level Ecological Risk Assessment
SI	site inspection
SOP	standard operating procedure
Sr	strontium
TCRA	time-critical removal action
Th	thorium

1.0 INTRODUCTION

The Navy performed a Radiological Preliminary Assessment (PA) of nine parcels of the former Naval Station Puget Sound (NAVSTA PS). The Final Radiological PA Report (U.S. Navy 2016a), recommended additional field activities, to be addressed during this Site Investigation (SI). The objective of the SI is to assess the areas identified in the Final Radiological PA Report at the former NAVSTA PS as potential or known sources of radioactive material and radioactivity.

This SI is being conducted in accordance with *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) guidance to determine the potential presence of any further radiological contamination at NAVSTA PS.

The Final Radiological PA verified historical operations involving the use of radioluminescent paint in two buildings (Buildings 2 and 27) and identified other areas of potential concern (AOPCs) at NAVSTA PS. In addition to radioluminescent painting operations, other activities that may have been sources of contamination include welding shops, aircraft wash facilities, engine overhaul shops, waste disposal practices, and laboratory-scale testing that evaluated the effects of residual radiation on biota.

The focus of this SI is implementation of the recommendations presented in the Final Radiological PA Report to determine the presence of any further radiological contamination. The field work activities for the SI include performing gamma walkover surveys (GWSs), collecting soil samples, sludge samples, sediment core sampling, and an interior scoping survey. The investigation results will be evaluated to identify which of the areas need further action and which if any pose no risk to human health.

The following additional activities will be conducted:

- Additional radiological investigations of surface and subsurface soil in the location of former Building 15 and in unpaved areas in the vicinity of Building 30

- Collection of additional sludge samples from certain accessible storm drain locations that have not been previously sampled; locations in the roads east and south of Buildings 2, offsite locations east and northeast of Building 2, locations east and north of Building 30, and the oil/water separator northeast of former Building 283

- Collection of sediment samples from Lake Washington in the vicinity of five outfalls that drained water that originated on the Site; four located within the boundaries of the Site and one outfall near the western end of the NOAA Pier

- Radiological scoping survey of accessible surfaces of the former instrument repair shop area located inside Building 30.

2.0 REGULATORY FRAMEWORK

The SI activities at the former NAVSTA PS are being conducted by the Navy as the lead agency in accordance with the Navy Environmental Restoration Program using the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), with the Washington State Department of Ecology (Ecology) as the state regulatory agency and the Washington State Department of Health (DOH) as the radiological support agency. The SI will follow the requirements of CERCLA, Sections 104 and 121, Executive Order 12580, the National Oil and Hazardous Substances Pollution Contingency Plan, and MARSSIM guidance, and a Reciprocity Radioactive Material License. The SI activities will also address the substantive requirements of the Washington State Model Toxics Control Act (Washington Administrative Code 173-340-515), as applicable.

3.0 BACKGROUND AND SITE CONDITIONS

3.1 LOCATION AND SITE CONDITIONS

The former NAVSTA PS is located approximately 6 miles northeast of downtown Seattle in the Sand Point neighborhood on the western shore of Lake Washington within Warren G. Magnuson Park (Magnuson Park), 7400 NE 74th Street, Seattle, Washington (Figure 3-1). SI activities include nine parcels that were transferred from the Navy to the City of Seattle, University of Washington, and U.S. Fish and Wildlife Service. NAVSTA PS is bounded by residential areas to the west and south, Lake Washington to the north and east, and the National Oceanic and Atmospheric Administration (NOAA) Western Regional Center facilities and Warren G. Magnuson Park to the east. The former NAVSTA PS is located in Township 25 North, Range 4 East, Section 2, in King County, Washington, and has geographical coordinates 47°37'00" north latitude and 122°15'00" west longitude.

3.1.1 Geology

Former NAVSTA PS is located in a structural downfold between the Cascade and Olympic Mountain ranges called the Puget Trough. Most of the natural topography and waterways in the Puget Trough are the result of a 3,000-foot-thick glacier that scoured the area between 13,000 and 15,000 years ago. Glacial till made up of unsorted, non-stratified materials including clay, silt, sand, and boulders is the parent material found on-site. Surface soils at NAVSTA PS consist of Indianola loamy sand deposits formed from sandy glacial outwash as the glaciers approached and receded from the area (SCS 1992). Initially surface topography at the Site ranged from 1 to 30 percent slopes. However, because significant construction has taken place at NAVSTA PS, much of the Site has been leveled by filling the low-lying areas with material available on-site. As indicated by historical photos, discussions with Sand Point personnel, Seattle earthquake maps, and lithological studies of the area, it is known that surficial soils at the north end of the Site are composed predominantly of fill (Washington Surveying and Rating Bureau 1966). The large area north of Building 2 that was formerly occupied by Pontiac Bay was filled as development at the Site progressed. In addition, the presence of lake-bottom peat was indicated by the gradual settlement of the earth-filled portion of Pontiac Bay (Chrzastowski 1983).

A review of soil boring logs produced for the radiological RI for NAVSTA PS (U.S. Navy 2011) indicates that soils in the vicinity of Buildings 2 and 27 typically consist of a silty sand from the ground surface to between 1 and 3 feet below ground surface (bgs) that is underlain by a dense clay at several locations, ranging in thickness from 1 to 2 feet. At several locations interbedded sand was observed in this clay. The available borings extend to maximum depths that range from 2.5 to 5 feet bgs.

3.1.2 Hydrogeology

Shallow groundwater at NAVSTA PS occurs primarily within the relatively permeable, interglacial deposits contained by the low-permeability till units that underlie the Site. The continuity of these units beneath NAVSTA PS has not been defined. Groundwater flow is generally from the uplands area west of the Site eastward toward Lake Washington (U.S. Navy 1993). Lake Washington is the discharge water body for shallow groundwater from the Site, where groundwater is typically found approximately 3 feet bgs (NEESA 1988). During the RI, groundwater was observed at a depth of 5 feet bgs in soil borings installed in the vicinity of Buildings 2 and 27 (U.S. Navy 2011).

3.1.3 Hydrology

Former NAVSTA PS is bordered by Lake Washington to the north and east. There are no perennial streams or freshwater bodies within the boundaries of the Site. The nearest stream, Thornton Creek, is approximately ¼ mile northwest of the Site. Pontiac Bay, which was formerly located at the northern shore of the Site, was filled with earth in the early 1930s (Jones & Jones 1975).

Lake Washington is approximately 22 miles long and ranges in width from 1 to 4 miles, with a maximum depth of 210 feet. The level of Lake Washington is maintained at 21 feet above the lower low mean sea level of Puget Sound by the Hiram M. Chittenden Locks, which are administered and operated by the U.S. Army Corps of Engineers (U.S. Navy 1993). The lake is classified as a Class A water body by Washington State, which requires water quality to meet or exceed the requirements for substantially all of the following uses: anadromous salmon migration, rearing, spawning, and harvesting; fishing; aesthetic enjoyment and contact swimming; water supply (domestic, industrial, and agricultural); and commerce and navigation. Most of the lake's shoreline in the vicinity of the Site is occupied by residential property and recreational park lands (U.S. Navy 1994). The stormwater system at NAVSTA PS is not connected to the City of Seattle Stormwater system but instead discharges directly into Lake Washington at several outfalls on the northern shore of the peninsula. Runoff from impervious surfaces at the Site is routed through this stormwater system into Lake Washington. Site restoration activities conducted by the Seattle Department of Parks and Recreation have restored both the lacustrine and the palustrine systems of wetlands in the southeastern portion of former NAVSTA PS, significantly improving the water storage capacity in this location (SCS 1992).

3.1.4 Climate

The climate in the Seattle area is a mid-latitude west coast marine type with high precipitation and many overcast days. The Olympic Mountains, located to the west, protect the area from

intense winter storms present on the northern Pacific Ocean, while the Cascade Mountain range to the east protects the area from the extreme cold winter temperatures common to eastern Washington (SCS 1992). The prevailing wind direction is from the south or southwest during the fall and winter, gradually shifting to west and northwest during the late spring and summer. The average prevailing wind seldom exceeds 20 miles per hour. Winds during winter storms can range from 20 to 100 miles per hour (SCS 1992). Climate data for Seattle, based on 1961 to 1990 normals, show a mean annual temperature of 52 degrees Fahrenheit (°F), with a low mean monthly temperature of 36 °F in January, and a high mean monthly temperature of 73 °F in August. The mean annual precipitation from these data is 34 inches per year, with the average wettest month being 5.4 inches in January (U.S. Climate Data 2014).

3.2 INVESTIGATIVE HISTORY

The detailed investigative history is provided in the Final Radiological PA Report (U.S. Navy 2016a), and summarized below.

Originally named Naval Air Station (NAS) Seattle, portions were built in 1925 on land donated by King County. During World War II, NAS Seattle supported air transport and ship outfitting of personnel for the Alaskan and Western Pacific theaters of operation. After the war, NAS Seattle was designated a Naval Reserve Air Station. From 1945 to 1970, the station maintained naval reserve squadrons for supplementing active duty forces, both in the continental United States and abroad. Aviation activities officially ceased on June 30, 1970, and NAS Seattle was decommissioned.

After the 1970 decommissioning, the Navy subsequently rented buildings to federal and institutional tenants. Between 1970 and 1977, the Navy divided the property into three parts, conveying 100 acres to NOAA, and 165 acres to the City of Seattle. The remainder of the property (approximately 150 acres) was retained by the U.S. Department of the Navy. In October 1986, Naval Station Seattle was designated Naval Station Puget Sound (NAVSTA PS) as a result of the station's decreasing support role in the Pacific fleet activities.

A major part of the mission at NAVSTA PS was aircraft overhaul and repair, which included painting aircraft instrumentation with radioluminescent paint, engine overhaul, welding shops, machine shops, and other activities of potential concern related to radiological contamination. In addition, in the late 1960s the University Of Washington Laboratory Of Radiation Ecology conducted research at NAVSTA PS to evaluate the uptake of radioactivity by hermit crabs from exposure to contaminated coral grit resulting from the atmospheric nuclear weapons testing program.

In June 1991, the Base Realignment and Closure (BRAC) Commission announced the closure of former NAVSTA PS. In accordance with the recommendations of the 1991 BRAC Commission, NAVSTA PS was closed in September 1995. The final nine Navy retained parcels were transferred from the Navy to the City of Seattle and other entities from 1998 to 2003.

In 2009, radium contamination in and around Buildings 2, 12, and 27 was discovered during a hangar renovation project. Evidence of historical radium painting operations was discovered on as-built drawings during the renovation, and contamination was confirmed by a screening-level survey. A follow-up radiological remedial investigation (RI) (U.S. Navy 2011) and a time-critical removal action (TCRA) (U.S. Navy 2016b) were conducted by the Navy to clean up contaminated areas of the Site

3.3 CURRENT INVESTIGATION

Naval Facilities Engineering Command Northwest (NAVFAC NW) is conducting a radiological PA/SI of the property transferred under BRAC at former NAVSTA PS. The objective of the PA/SI is to assess the potential for radiological contamination at NAVSTA PS resulting from previous naval operations in areas of the BRAC transferred property.

The Final Radiological PA dated November 2, 2016 recommended the following additional SI activities;

- Radiological investigations of surface and subsurface soil in the location of former Building 15
- Radiological investigation of surface and subsurface soil in the unpaved area surrounding Building 30
- Limited radiological scoping survey of the former instrument repair shop area located inside Building 30
- Collection of additional sludge samples from certain accessible storm drain locations that have not been previously sampled; locations in the roads east and south of Building 2, offsite locations east and northeast of Building 2, locations east and north of Building 30, and the oil/water separator northeast of former Building 283.
- Collection of sediment samples from Lake Washington in the vicinity of five outfalls that drained water originating from the Site; four of the outfalls are

located within boundaries of the Site and one outfall is near the western end of the NOAA pier.

The SI is being conducted to assess the areas identified in the Final Radiological PA at the former NAVSTA PS as potential or known sources of radioactive material and radioactivity. The investigation results will be evaluated to identify which of the areas need further action and which if any pose no risk to human health. Implementation will be accomplished with the following field activities:

- Mobilize/prepare Site
- Perform GWS and location mapping
- Perform soil sampling in the vicinity of Building 30 and former Building 15
  - Surface soil – the top layer (0 to 6 inches) of soil, fill, gravel, waste piles, concrete, or asphalt that is available for direct exposure
  - Subsurface soil – solid materials and media found below the surface soils
- Perform sludge sampling
  - Sludge – solid material in the bottom of a manhole, catch basin, or oil/water separator
- Perform Lake Washington sediment core sampling
  - Sediment – representative of the 0 to 5 foot depth interval
- Interior radiological scoping survey of former instrument shop in Building 30
- Site restoration and demobilization
- Perform Investigation-Derived Waste (IDW) management and disposal

Figure 3-1 shows the locations designated for the GWSs as well as soil, sediment and sludge sampling locations. Figure 3-2 provides the locations of the background lake sediment sample locations. Sample and GWS locations were selected based on the information presented in the Final Radiological PA and are near selected buildings/structures that had potential historical use or contact with materials containing low-level radiation. Table 3-1 lists each sample and the proposed geographical coordinates for each sampling location. Minor adjustments to these locations may occur in the field based on conditions encountered during sampling.

Note:
Four background sediment locations (LW-12 through LW-15) in Lake Washington are shown on Figure 3-2.

Temporary Note:
Boundary may be adjusted near NE NOAA Drive. Six soil borings may be included within NE NOAA Drive Area.

Pier No.1
Boat Launch
Boat Launch
Boat Launch
Ramp 1
2005 Beach Repair
Outer Harbor Line
Inner Harbor Line
Lake Washington
NOAA Pier
NOAA
NOAA
NOAA
NOAA
Background GWS Area
Sewage Ejector Pit
2 Fenced Storage Area
NE 80th Street (NE NOAA Drive)
NE 77th Street
NE 74th Street
NE 65th Street
Sand Point Way
63rd Avenue NE
The Brig
USFWS Structures
OWS-283
LW-01
LW-02
LW-03
LW-04
LW-05
LW-06
LW-07
LW-08
LW-09
LW-10
LW-11
MH-110
MH-112
MH-113
MH-114
MH-116
MH-119
MH-122
MH-152
MH-153
CB-15
CB-16
CB-17
CB-18
CB-19
CB-20
CB-21
CB-22
CB-23
B-72
B-73
B-74
B-75
B-76
B-78
B-79
B-80
B-81
B-82
B-83
B-84
D (14, 333)
E (34, 334)
5A
5B
5C
5D
26 N
26 S
A
B
C

0 200 400
SCALE IN FEET

Legend:

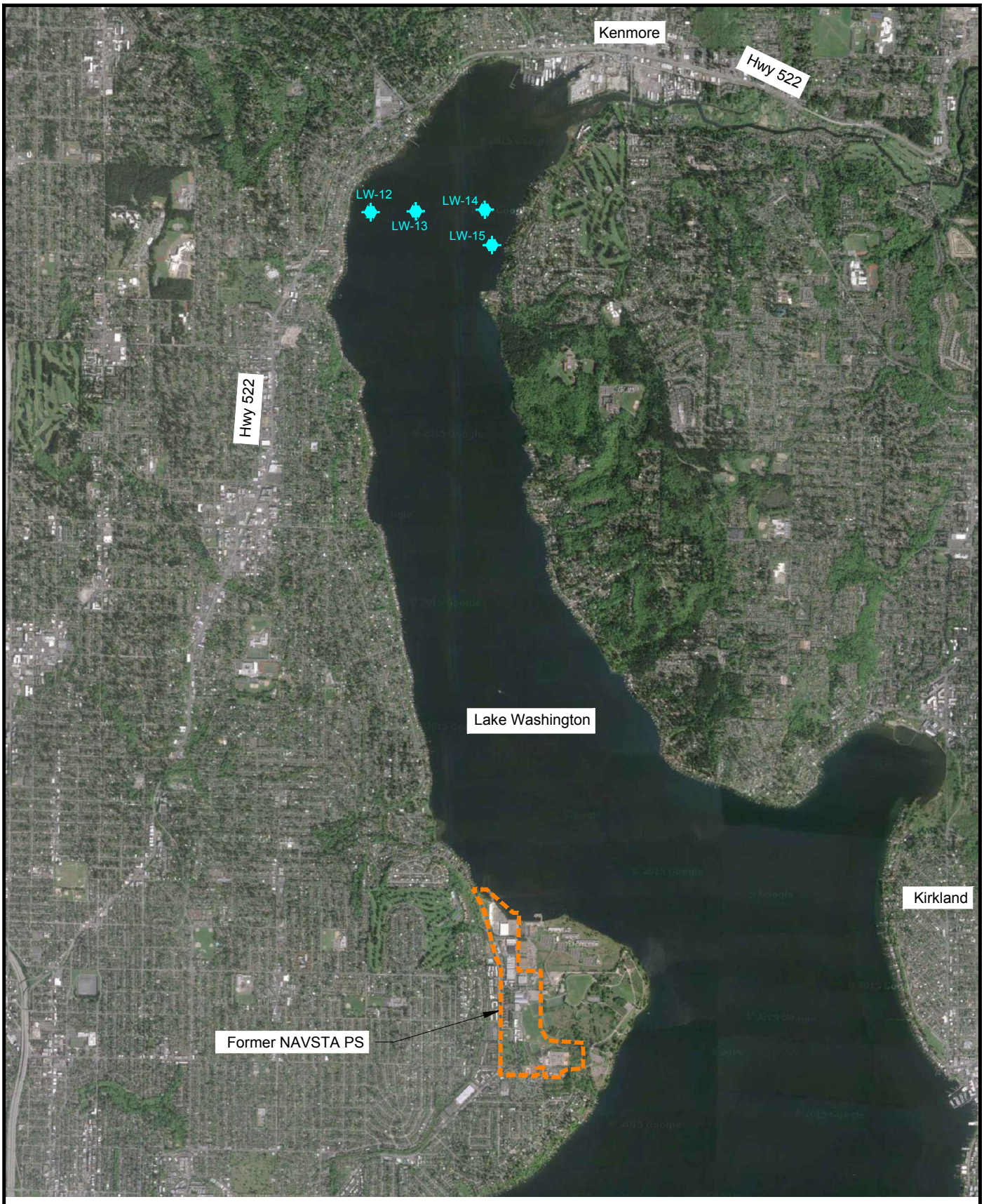
- Site Boundary (Based on City of Seattle and King County GIS Data)
- Building/Structure
- Building/Structure Removed (Note: Size and location are based on historical maps and aerial photograph and are approximate)
- Limits of 1978 Road Construction for NE NOAA Drive
- Sanitary Sewer
- Storm Drain
- Proposed Soil Boring Location
- Proposed Sediment or Sludge Sampling Location
- Structures Having Historical Activities of Potential Concern
- Proposed Areas for Gamma Walkover Survey

Figure 3-1
Site Investigation Activity Locations
Former NAVSTA PS

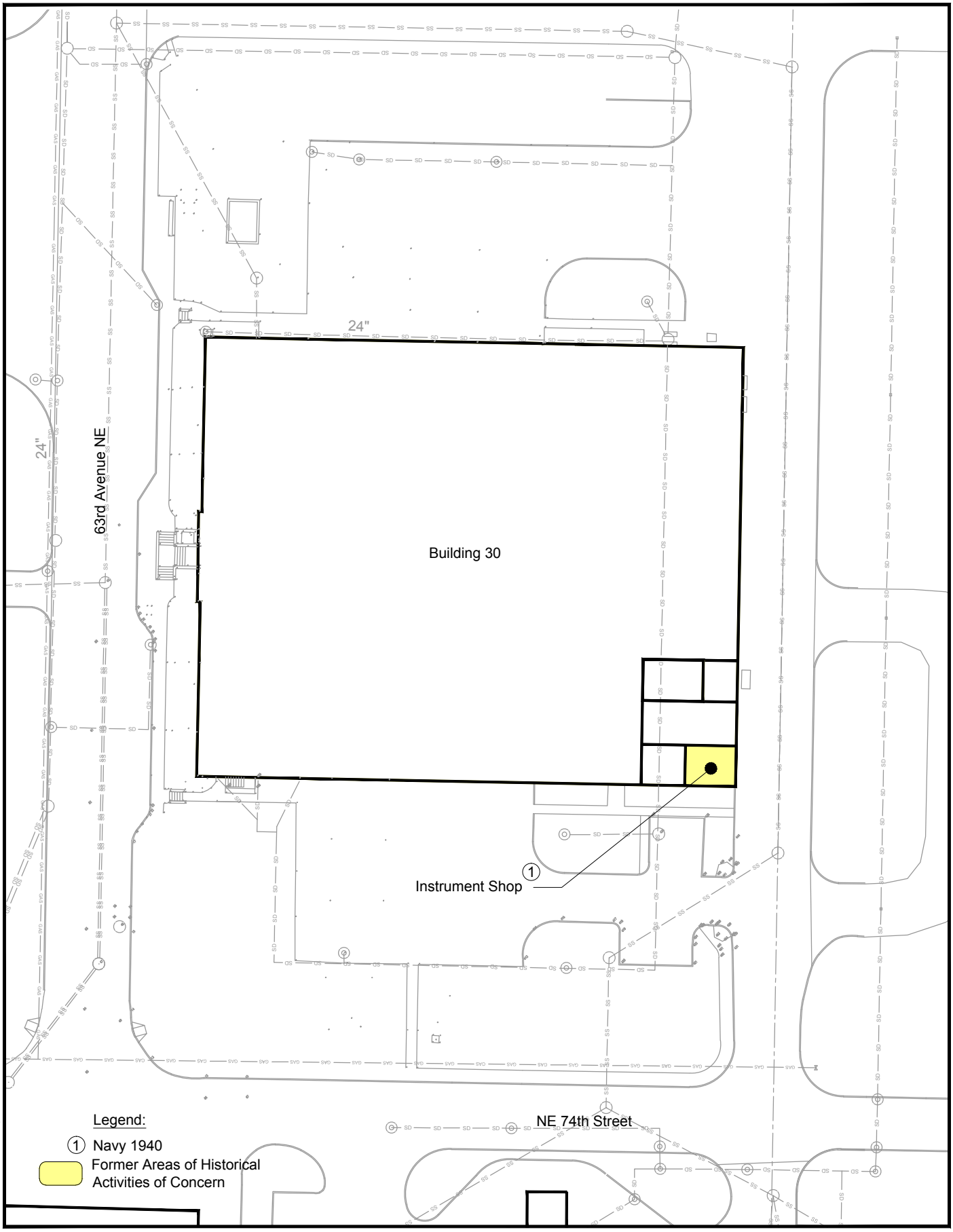
U.S. NAVY

Delivery Order 0076
NAVSTA PS
Seattle, Washington
FIELD SAMPLING PLAN

J:\DCS\Projects\GIS\NAVY\MAGNUSON\DO 76\Work Plan\Field Samp Plan\Fig 3-1 Site Map former NSPS.dwg
Mod: 03/01/2017, 15:41 | Plotted: 03/01/2017, 15:42 | sharon.hou



U.S. NAVY	0 2,000 4,000 SCALE IN FEET	**Figure 3-2** **Background Sediment Sample Locations**	Delivery Order 0076 NAVSTA PS Seattle, Washington FIELD SAMPLING PLAN



J:\DCS\Projects\GIS\NAVY\MAGNUSON\D0 76\Work Plan\Field Samp Plan\Fig 3-3 Interior Survey Bldg 30.dwg
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U.S. NAVY	0 30 60 SCALE IN FEET	**Figure 3-3** **Building 30 Interior Survey Areas**	Delivery Order 0076 NAVSTA PS Seattle, Washington FIELD SAMPLING PLAN

Table 3-1
SI Sample Locations at the Former NAVSTA PS

Type	General Location/Justification	Location ID Map	Coordinates		Depth			Field scan detector	PROC					Analysis*		
			Northing	Easting	0-0.5	0.5-3	FS-1		Ra-226	Th-232	Cs-137	Sr-90	Pu-239	GS	GFPC	AS
Soil/ DPT	Near Building 30	B-72	252515.3398	1288686.1604	G	C	G	44-10	x	x				x		
Soil/ DPT	Near Building 30	B-73	252552.6456	1288795.3954	G	C	G	44-10	x	x				x		
Soil/ DPT	Near Building 30	B-74	252467.1704	1288844.7268	G	C	G	44-10	x	x				x		
Soil Field Duplicate	Near Building 30	B-74 dup	252467.1704	1288844.7268		C		44-10	x	x				x		
Soil/ DPT	Near Building 30	B-75	252351.2173	1288954.4652	G	C	G	44-10	x	x				x		
Soil/ DPT	Near Building 30	B-76	252275.3574	1288951.8868	G	C	G	44-10	x	x				x		
Soil/ DPT	Near Building 30	B-77	252204.601	1288842.6695	G	C	G	44-10	x	x				x		
Soil Field Duplicate	Near Building 30	B-77 dup	252204.601	1288842.6695			G	44-10	x	x				x		
Soil/ DPT	Former Building 15 area	B-78	249895.7653	1288211.7372	G	C	G	44-9				x	x		x	x
Soil Field Duplicate	Former Building 15 area	B-78 dup	249895.7653	1288211.7372	G			44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-79	249899.6361	1288249.3036	G	C	G	44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-80	249929.864	1288243.1283	G	C	G	44-9				x	x		x	x
Soil Field Duplicate if needed	Former Building 15 area	B-80	249929.864	1288243.1283		C		44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-81	249903.3633	1288298.3065	G	C	G	44-9				x	x		x	x
Soil Field Duplicate	Former Building 15 area	B-81 dup	249903.3633	1288298.3065	G			44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-82	249840.2143	1288305.078	G	C	G	44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-83	249875.4803	1288278.7357	G	C	G	44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-84	249833.6751	1288259.6322	G	C	G	44-9				x	x		x	x
Sludge	S Building 2	CB 15	253064.6694	1288351.9405	G				x	x	x	x		x	x	
Sludge	S Building 2	CB 16	253063.0323	1288446.5639	G				x	x	x	x		x	x	
Sludge	E Building 30	CB-17	252367.2615	1288969.5052	G				x	x	x	x		x	x	
Sludge Field duplicate*	E Building 30	CB-17 dup	252367.2615	1288969.5052	G				x	x	x	x		x	x	
Sludge	N Building 30	CB-18	252469.0391	1288867.2768	G				x	x	x			x		
Sludge	NE Building 2	CB-19	253859.3145	1288878.8838	G				x	x	x	x		x	x	
Sludge	NE Building 2	CB-20	253801.2256	1288879.5299	G				x	x	x	x		x	x	
Sludge	NE Building 2	CB-21	253682.5021	1288879.3360	G				x	x	x	x		x	x	
Sludge	E Building 2	CB-22	253594.8018	1288874.8766	G				x	x	x	x		x	x	
Sludge	E Building 2	CB-23	253346.5720	1288603.9960	G				x	x	x	x		x	x	
Sludge Field duplicate*	E Building 2	CB-23-dup	253346.5720	1288603.9960	G				x	x	x	x		x	x	
Sludge	S Building 2	MH 152	253026.7622	1288283.0575	G				x	x	x	x		x	x	
Sludge	S Building 2	MH 153	253020.0653	1288311.3307	G				x	x	x	x		x	x	
Sludge	NE Building 2	MH 110	254055.8129	1289055.1186	G				x	x	x	x		x	x	
Sludge	NE Building 2	MH 112	253951.9975	1288952.0699	G				x	x	x	x		x	x	
Sludge	NE Building 2	MH 113	253645.2673	1288950.3711	G				x	x	x	x		x	x	

Table 3-1 (Continued)
SI Sample Locations at the Former NAVSTA PS

Type	General Location/Justification	Location ID Map	Coordinates		Depth			Field scan detector	PROC					Analysis*		
			Northing	Easting	0-0.5	0.5-3	FS-1		Ra-226	Th-232	Cs-137	Sr-90	Pu-239	GS	GFPC	AS
Sludge	E Building 2	MH 114	253525.0286	1288887.0589	G				x	x	x	x		x	x	
Sludge	Inside Building 32	MH 116	253317.0894	1288882.6689	G				x	x	x	x		x	x	
Sludge	S Building 2	MH 119	253051.4746	1288584.5175	G				x	x	x	x		x	x	
Sludge	Near Building 30	MH-122	252573.648	1288871.321	G				x	x	x	x		x	x	
Sludge	Northeast of Building 283	OWS-283	254429.964	1288034.341	G				x	x	x	x		x	x	
Sediment	Lake Washington	LW-01	254923.4488	1287679.9571	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-02	254822.9596	1287791.737	G		G	44-10	x	x	x	x		x	x	
Sediment Field Duplicate	Lake Washington	LW-02 Dup	254822.9596	1287791.737			G		x	x	x	x		x	x	
Sediment	Lake Washington	LW-03	254472.3575	1288133.7193	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-04	254406.8523	1288209.8515	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-05	254320.0008	1288269.3834	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-06	254377.4344	1288346.4155	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-07	254240.117	1288409.3518	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-08	254479.9412	1288292.1764	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-09	254303.992	1288504.3034	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-10	254220.1436	1288671.4591	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-11	254131.2064	1289064.1684	G		G	44-10	x	x	x	x		x	x	
Sediment	Background	LW-12	275122.5549	1284277.4071	G		G	44-10	x	x	x	x		x	x	
Sediment	Background	LW-13	275145.8568	1285617.9944	G		G	44-10	x	x	x	x		x	x	
Sediment Field Duplicate	Background	LW-13 Dup	275145.8568	1285617.9944	G				x	x	x	x		x	x	
Sediment	Background	LW-14	275192.4603	1287669.6759	G		G	44-10	x	x	x	x		x	x	
Sediment	Background	LW-15	274143.8786	1287879.5069	G		G	44-10	x	x	x	x		x	x	

Notes:
* sludge duplicate may be changed based on the amount of sludge present in the catch basin.
AS - alpha spectroscopy
C - Composite sample
Cs-137 - cesium-137
DPT - direct push sampling technique
FS-1 - the 6-inch interval with the highest field count rate (between 6 inches below the top to the total depth sampled)
G - Grab Sample
GFPC - gas flow proportional counter
GS - gamma spectroscopy
PROC - potential radionuclides of concern
Pu-239 - plutonium-239
Ra-226 - radium-226
Sr-90 - strontium-90
Th-232 - thorium-232

4.0 SITE WORK AND FIELD IMPLEMENTATION

The implementation of the field investigation will meet all the requirements provided in the Navy and regulator-approved final SAP. URS will use Best Management Practices for site investigation activities, health and safety practices, and radiation safety practices to ensure that field work activities meet the project objectives. The SI field work is specifically tailored to each area of potential concern. Field activity standard operating procedures (SOPs) are listed in QAPP Worksheet #21. NAVFAC SOPs will be supplemented with radiological SOPs provided by Cabrera Services, and applicable URS procedures. All SOPs utilized by this project are included as Appendix A of the QAPP. Sampling field forms are to be completed as applicable, together with field logbooks, chain-of-custody forms, and visual inspection forms.

The field program described in this FSP is intended to be implemented over an approximate 2-week time frame. The results of the GWSs, soil, sludge and sediment sampling, and the interior scoping survey will be documented as part of the SI report. Sampling locations and the number of samples to be collected were selected based on the results of the Radiological PA. The number of samples may be modified based on results of the GWS performed at the beginning of this SI.

4.1 ARCHAEOLOGICAL RESOURCES

In the event that archaeological materials (e.g., shell, wood, bone, or stone artifacts) or human remains are found or suspected during project operations, URS will stop work in the area of the discovery, secure the location, and notify the Navy as soon as practicable, but no longer than 24 hours after the discovery. URS will not proceed with work at the discovery location until the Navy has the opportunity to evaluate the find and gives the direction to resume work. No cultural resource specialist is anticipated at this time.

4.2 BIOLOGICAL RESOURCES

No biological specialist will be required at this time. If a biological specialist is required, additional procedures will need to be addressed.

4.3 SITE WORK

The site work is separated into the following eight distinct tasks:

- Mobilization/site preparation
- GWSs and location mapping
- Soil sampling (surface and subsurface)
- Sludge sampling of storm drains
- Lake sediment core sampling
- Interior scoping survey of Building 30 instrument shop
- Site restoration and demobilization
- IDW management and disposal

4.3.1 Mobilization/Site Preparation

Field work will not commence until URS receives a Notice to Proceed, the SAP (FSP, QAPP and RPP) has been approved by NAVFAC and RASO, the Accident Prevention Plan and Site Safety and Health Plan have been approved by the NAVFAC Northwest Navy Technical Representative (NTR), and URS has received license reciprocity with the DOH, and NRC. URS will ensure that subcontractors meet all federal and state certification requirements to perform the field work. URS will coordinate access to the Site with the Navy Remedial Project Manager (RPM).

URS and subcontractors will mobilize to the Site, establish work staging areas, and install barriers and signage as applicable. Site-specific health and safety training and site-specific radiological training will be conducted. URS will, at all times, keep property on which work is in progress and adjacent property free from accumulations of waste material and rubbish.

URS will arrange with Applied Professional Services, Inc., for utility location and clearance prior to initiating intrusive sampling activities.

4.3.2 Gamma Walkover Surveys and Location Mapping

GWSs will be conducted using sodium iodide (NaI) detectors in the Building 15 area, and adjacent to Building 30 as shown in green on Figure 3-1. The proposed GWS areas include locations that were unpaved in 1942 and are still unpaved today. Additionally, for the Building 15 area, GWS will include measurements with a NaI detector and a Field Instrument for the Detection of Low Energy Radiation (FIDLER) probe.

The background reference area designated in the Final After Action Report (U.S. Navy 2016b) will be used to determine background gamma count rates for this GWS investigation. Background GWS measurements will be collected on both bare soil and grass since the building 15 area is covered in grass.

GWSs will be performed in accordance with Cabrera SOP OP-387, Gamma Walkover Survey. Surveys will be performed to measure surface radioactivity in the designated areas. Equipment required for performing the GWSs includes the following:

- Trimble Pathfinder Pro XRS/XH Global Positioning System (GPS), or equivalent
- Ludlum Model 44-10 NaI gamma scintillation detector (or equivalent) coupled to a Ludlum Model 2221 rate meter, equipped with RS-232 data download port
- FIDLER detector coupled to a Ludlum Model 2221 rate meter, equipped with RS-232 data download port
- Software: Trimble Pathfinder Office, ArcGIS (or equivalent computer-aided drawing software) with coordinate geometry capability

The survey will be performed over one hundred percent of accessible surface areas following MARSSIM protocol by walking straight parallel lines at a speed of 0.5 meter per second over the designated area with the detector while moving the detector in a serpentine (S shaped) with the detector less than or equal to 4 inches from the ground. Survey passes will be approximately 0.5 meter apart. Data from the rate meter/scaler will be automatically logged into the GPS unit every second. This system will log the gross gamma reading and position (in Washington State Plane Coordinates) every second. After completing the survey, the raw data will be downloaded from the GPS and transmitted to a data processing specialist for export into a geospatial software program.

Evaluation of the GWS data includes geospatial imaging for visual trend analysis and calculation of z-scores for identification of distribution outliers. Z-scores are calculated by comparing each data point against the mean and standard deviation of the data set as a whole. All scan data will be reviewed and individual data points will be flagged if they exceed three times the standard deviation of the set (or z-score greater than or equal to 3.0 sigma) calculated by:

$$Z = \frac{(L_{cr}) - (M_{ds})}{(STDEV)}$$

Where:

Z = z-score
L_{cr} = location count rate, in gross counts per minute (cpm)
M_{ds} = mean of the data set, in gross cpm
STDEV = standard deviation of the data set

The GWS results will be processed, organized and then evaluated by the Project Health Physicist. The review will combine observation of individual data points that exceed a z-score of 3 with any identifiable spatial patterns or trends that might indicate areas of relatively elevated activity. Data points exceeding a z-score of 3 will be identified as potential outliers requiring additional investigation. The individual data points will be evaluated based on professional judgment using a posting plot. Locations with clusters of multiple individual data points exceeding a z-score of 3 will have biased samples collected to further investigate these locations as potential outliers.

Survey data recorded for each area will include, at a minimum, a drawing of the area and spreadsheets of survey information, including the list of coordinates for corners, starting, ending, and turning locations, reference monuments used in the survey, and other pertinent features of grids or transects, to include, but not be limited to, survey and sampling location data.

Additional soil boring sampling locations and modifications to the proposed existing soil boring locations will be based on the outcome of the GWS.

Standard GPS processing techniques will be used to provide a comma-separated values (csv) file or MS Excel® file with GWS data (northing and easting positions and count rate). Data will be provided using the appropriate Naval Installation Restoration Information Solution electronic data deliverable (EDD) via the web-based data checker.

4.3.3 Soil Sampling

Background Sampling

Soil background values for Ra-226, Th-232, Sr-90, and Cs-137 are taken from the TCRA After Action Report (U.S. Navy 2016b). Background sampling should not be necessary for Pu-239, as it is generally not seen in background. If Pu-239 is detected during sampling, the need for collection and analysis of background samples for Pu-239 will be evaluated.

Sampling Locations

The soil sampling scope of this SI is to verify the presence or absence of radiological impacts from the surface to a maximum of 10 feet bgs adjacent to former and existing buildings/structures of potential concern. The proposed soil sampling locations are shown on Figure 3-1. Additional soil sampling locations may be designated in the field. These additional samples will be based on the results of the GWSs described in Section 4.3.2 and/or site conditions after consultation with the URS Project Manager, Navy RPM, and Navy RASO Environmental Project Manager (EPM). Table 3-1 provides a list of the currently identified sampling locations. If a sample cannot be collected within 5 feet of where planned, or in the

event field conditions are different than expected and could affect the sampling design, then the URS Field Lead will contact the URS Project Manager and Navy RPM to discuss and determine the new course of action and/or whether different sampling location(s) should be identified. Any changes to this FSP resulting in moving a sample location by more than five feet will be documented in a Field Change Request.

Soil Borings

Soil sampling methods are specified in NAVFAC SOP I-B-1. At each sampling location, a direct push sampling rig will be used to advance the borehole to groundwater or a maximum depth of 10 feet. The direct push rig provides a continuous, representative, relatively undisturbed core sample. The core will be geologically logged in accordance with NAVFAC SOP I-F, Direct Push Sampling. Soil cores will be radiologically scanned at 0.5-foot intervals in accordance with Cabrera SOP OP-376. As detailed in Table 3-1, the scans will be completed using a Ludlum 44-10 paired with an appropriate meter at locations near Building 30 or using a Ludlum 44-9 GM detector pared with an appropriate meter at locations near former Building 15. A static reading (1 min) with a Ludlum 44-10 or Ludlum 44-9 will be collected from the ground surface of the boring locations. A maximum of three samples from soil borings will be collected as follows:

- One surface soil sample from the 0 to 0.5 foot interval to support both the human health and ecological risk assessments
- One composite soil sample generated from soil representative of the 0.5 foot to 3 foot interval to support the ecological risk assessment
- One soil sample from a 6-inch interval (i.e., 2.0 to 2.5 foot depth) with the highest radiological field screening result, based on a scan of the entire subsurface core (from 0.5 foot to the total depth). This sample will be collected to support the human health risk assessment.

Each soil sample will be placed in a labeled plastic bag. Samples will be handled, packaged, and shipped to the off-site analytical laboratory. Soil samples will be analyzed as detailed in Table 3-1.

All non-disposable sampling equipment will be decontaminated and radiologically screened in accordance with URS Professional Solutions SOP RP-7 before each sample is collected or equipment used at a new location. To minimize the generation of liquid waste, dry decontamination methods will be used where practical. When wet decontamination methods are used all liquids and other waste will be containerized and managed as IDW waste as described in Section 4.3.10.

4.3.4 Sludge Sampling

Background Sampling

No sludge background samples will be collected. The background values for soil taken from the TCRA After Action Report (U.S. Navy 2016b) will be applied to the sludge samples.

Sampling Locations

Sludge sampling locations are in sediment traps or similar structures, catch basins and manholes within sections of storm-sewer systems that were not previously investigated for radiological contamination. The sludge sampling locations are shown on Figure 3-1 and listed in Table 3-1. If a sample cannot be collected where planned, or in the event field conditions are different than expected and could affect the sampling design, the URS Field Lead will contact the URS Project Manager and Navy RPM to discuss and determine the new course of action and/or whether different sampling location(s) should be identified. All changes to the FSP will be documented as a Field Change Request.

Sludge Sampling

Sludge sampling methods are specified in NAVFAC SOP I-B-8; a Van Veen Grab Sampler or equivalent will be used for collection of sludge samples from catch basins and manholes. Three samples will be collected from the catch basins and manholes identified for sampling. Samples will be collected from the surface, middle, and bottom thirds of the sediment. These depths will be determined in the field based upon the thickness of sludge found in the catch basins and manholes at the time of sampling. Should insufficient sludge be present to collect layered samples, the field team lead will complete a deviation form identifying the reason for the reduced number of samples. Sludge samples will be placed in a labeled plastic bag. Samples will be handled, packaged, and shipped to the off-site analytical laboratory, and analyzed as detailed in Table 3-1.

All non-disposable sampling equipment will be decontaminated and radiologically screened in accordance with URS Professional Solutions SOP RP-7 before each sample is collected or equipment used at a new location. To minimize the generation of liquid waste, dry decontamination methods will be used where practical. When wet decontamination methods are used all liquids and other waste will be containerized and managed as IDW waste as described in Section 4.3.10.

4.3.5 Lake Sediment Core Sampling

Background Sampling

Four background lake sediment sampling locations have been identified as show on Figure 3-2. These samples will be collected using the techniques described below and will undergo analysis as described below. To reduce the effect of cross contamination, the background sediment samples will be collected before the samples from areas of potential concern.

Sampling Locations

Lake sediment sampling locations are from areas of potential concern near storm water outfalls that were not previously investigated for radiological contamination. Two samples will be collected from each sediment location, and samples will be shipped to the off-site analytical laboratory.

The proposed lake sediment sampling locations are shown on Figure 3-1, and listed in Table 3-1. If a sample cannot be collected where planned, or in the event field conditions are different than expected and could affect the sampling design, then the URS Field Lead will contact the URS Project Manager and Navy RPM to discuss and determine the new course of action and/or whether different sampling location(s) should be identified. All changes to the FSP will be documented as a Field Change Request.

A Rossfelder Vibracore will be used to collect a sediment core representative of the 0 to 5 foot depth. The sediment is retained in the clear core liner allowing visual evaluation in the field. The core will be geologically logged in accordance with SOP I-F, Direct Push Sampling. Sediment cores will be radiologically scanned in accordance with Cabrera SOP OP-376, Soil Core Scanning, at 0.5 foot intervals using a Ludlum 44-10 paired with an appropriate meter. Two sediment samples will be collected from each coring location as follows:

- One surface sample from the 0 to 0.5 foot interval for the human health and the ecological risk assessment. This interval includes the biologically active zone.

- One sample from a 6-inch interval with the highest radiological field screening result, based on a scan of the entire sediment core (from 0.5 foot to 5 feet or the total depth should coring be impeded by an obstruction).

Each sediment sample will be placed in a labeled plastic bag. Samples will be handled, packaged, and shipped to the off-site analytical laboratory. Sediment samples will be analyzed as detailed in Table 3-1.

All non-disposable sampling equipment will be decontaminated and radiologically screened in accordance with URS Professional Solutions SOP RP-7 before each sample is collected or equipment used at a new location. To minimize the generation of liquid waste, dry decontamination methods will be used where practical; when wet decontamination methods are used all liquids and other waste will be containerized and managed as IDW waste as detailed in Section 4.3.10.

4.3.6 Sample Packaging and Shipping

URS will containerize, package, and ship soil, sludge and sediment samples for off-site analysis in accordance with chain-of-custody procedures. The samples will be submitted to TestAmerica Earth City for subsequent analysis as detailed in Table 3-1. Additional samples and analyses may be collected as required to profile the IDW (Section 4.3.10).

Laboratory address:
TestAmerica St. Louis,
13715 Rider Trail North
Earth City, MO 63045-1205
ELAP # L2305
POC Mike Franks
Phone 314.298.8566

4.3.7 Interior Surveys Building 30 Instrument shop

A minimal non-invasive radiological scoping survey will be performed of the former instrument shop inside Building 30. The instrument shop, covering approximately 1,080 square feet, was formerly located in the southeast corner of Building 30. This portion of the building has been renovated significantly since the 1940s, and all original floor and wall surfaces are covered with carpeting and drywall. The most recent renovations have occurred within the past few years. The building is currently occupied by the Seattle Department of Parks and Recreations offices. Within this area a radiological scoping survey will be conducted using the radiological instrument described below;

- Dose rates- Bicron Dose Rater meter.
- Gross gamma activity scans -Ludlum Model 44-10 NaI with a Ludlum Model 2221 rate meter.
- Alpha/beta scanning and static measurements - Ludlum Model 43-93 Alpha/Beta Scintillator with a Ludlum Model 2360 Dual Channel Scaler

- Alpha/Beta Smear samples Ludlum Model 2929 Dual Channel Scaler with a Ludlum Model 43-10-1 Alpha/Beta Scintillator

The scoping survey will focus on areas likely to have been impacted by historical instrument shop activities such as floors and sink drains, and exposed surfaces. The surveyor will determine the specific measurement locations based on professional judgement and document those locations. Where practical, the surveyor will measure surfaces that would have been exposed when the instrument shop was operational.

The scoping survey field measurements will be converted to gross alpha and gross beta activity. These results will be compared to the Structures Total Surface Activity Release Criteria from Table 2-2 of the TCRA After Action Report (U.S. Navy 2016b). Field measurements which exceed 90% of these values (100 dpm/100cm^2 alpha and 1,000 dpm/100cm^2 beta) will require additional investigation.

Background Reference area

The background area will be identified at the time of the survey. The area should be within Building 30 and be separate from the instrument shop. It should contain similar surfaces, including drains, as those within the former instrument area. Depending on the current building configuration the reference area may or may not have the same tenant as the former instrument shop. Measurement in the background reference area will include the same types of measurements collected at a similar frequency.

4.3.8 Radiological Control Areas

If the investigation identifies areas, either indoor or outdoor, that present a radiological hazard, radiological control areas (RCA) will be established as described in the Radiation Protection Plan (RPP). These areas will be secured to prevent inadvertent access until the exposure hazard is mitigated or for up to a six month period. Each established RCA will be checked weekly. The weekly check will include completion of a security checklist; and reporting of radiation monitoring, including dose rates. Additionally a monthly contamination survey will be complete which will include the collection and analysis of smear samples.

4.3.9 Site Restoration

URS will keep the Site and adjacent properties free from accumulation of waste materials, rubbish, and windblown debris during progress of the work and at the completion of the work. All non-disposable sampling equipment will be decontaminated prior to demobilization. Decontamination will follow procedures documented in URS Professional Solutions SOP RP-7 (Appendix A of the QAPP).

Wastewater resulting from decontamination procedures will be kept to a minimum volume, managed, and disposed of in accordance with procedures discussed in Section 4.3.10. The areas of concern at the Site, including staging and decontamination areas will be restored by URS to a condition similar or equal to that existing prior to the work.

4.3.10 IDW Management and Disposal

IDW generated during SI activities may include any or all of the following: excess soil core material, plastic sheeting, disposable sampling equipment, personal protective equipment, equipment decontamination fluids, and miscellaneous wastes. URS will coordinate the location of the waste storage area with the City and the Navy's on-site representative. URS will practice waste minimization and waste segregation during the generation and storage of IDW, as detailed in the Radiation Protection Plan. The general approach to waste segregation will be based upon four waste categories described below:

- Category 1 – general waste that does not come into contact with potentially contaminated material, such as boxes and general trash:
  - Dispose of daily as regular trash.
- Category 2 – waste with potential to contact soil/sludge/sediment:
  - Store and sample as appropriate to characterize for disposal.
  - Field screen for detectible gamma radiation (2x background).
  - Reclassify waste exhibiting elevated radiation levels, or with elevated sample results as potential low-level radioactive waste (LLRW).
  - Dispose as non-radiological IDW.
- Category 3 – waste material from sample locations, and decontamination wastes (potential LLRW):
  - Containerize rinsate/decon solution.
  - Field screen for detectible gamma radiation (2x background).
  - Store and sample as appropriate to characterize for disposal.
  - Reclassify waste exhibiting elevated radiation levels, or with elevated sample results as potential LLRW.
  - Dispose as non-radiological IDW. Liquids may be discharged to the sanitary sewer.
- Category 4 potential LLRW – waste with elevated radiation levels, or sample results indicating the waste may contain LLRW:
  - Store and sample as appropriate to characterized for disposal levels.

- Transfer to Navy's LLRW contractor for disposal.

Manage and store all non-category 1 waste per RML reciprocity until it is released for disposal as non-radiological IDW or transferred to the Navy's LLRW contractor for disposal.

If URS encounters an item/commodity during boring and/or sampling, URS will notify the Navy, and the item/commodity will be scanned. If the item measures 0.5 mrem or higher, it will be removed, segregated, bagged separately, and transferred to the Navy's commodity disposal contractor.

URS will arrange for manifesting, shipping, and properly disposing of any non-radiological IDW under the Navy's approval and signature, as the Navy will be identified as the generator. The Navy's LLRW contractor and commodity disposal contractor will arrange for manifesting, shipping and properly disposing of any radiological IDW under the Navy's approval and signature, as the Navy will be identified as the generator.

4.4 COMMUNITY RELATIONS

A formal community relations program is being implemented as part of the CERCLA process for this project. A community involvement plan for this project was completed May 23, 2014. However, URS and its subcontractors shall address this project, the SI activities, and related information about the radiological issues being investigated at the Site as sensitive and confidential information. During SI planning and implementation activities, if anyone asks about the project, URS and subcontractor personnel shall not discuss the project and will direct the individual(s) to the Navy RPM and direct any community questions related to SI activities to:

Bill Franklin
BRAC PMO West
33000 Nixie Road, 2nd Floor, Suite 217
San Diego, CA 92147
(619) 524-5433

4.5 WORK SCHEDULE

SI activities will be performed in accordance with the work schedule established by the URS Field Lead and Cabrera Subcontractor Project Manager. Work hours are tentatively scheduled to be Monday to Friday from 7:00 a.m. to 5:00 p.m., but may be modified based on adjacent on-site activities. Field work is scheduled to be completed in July 2017. GWS work will be initiated prior to soil boring activities. Soil and sediment sampling may be performed concurrently with separate sampling crews, if needed, as long as sufficient supervision and field equipment is

available to support both efforts. The overall schedule for the project is maintained by the URS Seattle office, and a summary is provided in QAPP Worksheet 16.

5.0 SI REPORT

The SI report will provide a summary of the field investigation and analytical results. If results indicate the presence of PROC at concentrations above background levels, the SI report will include a screening-level Human Health risk assessment (HHRA) and screening-level Ecological Risk Assessment (SERA) to evaluate potential Site-associated contamination at:

- Building 30
- Building 15
- Storm drain system south and east of Building 2, north and east of Building 30, and the oil-water separator northeast of former Building 283
- Lake Washington beach area in the vicinity of five storm drain outfalls between the western Site boundary and the NOAA Pier

5.1 FIELD INVESTIGATION AND ANALYTICAL RESULTS

The SI report will include summary descriptions of the site investigation field efforts, including audits or regulatory visits, and the disposition of IDW. The results of all SI activities, including the GWS, final posting plots, soil and sediment boring logs, field photographs, and any field notes, will be provided. Laboratory analytical results will be validated and provided, and used to support the recommendations which will be based on the HHRA and SERA.

5.2 HHRA

For the human health risk assessment, two separate screening-level evaluations will be conducted, and the results will be compared. Conservative risk-based screening levels will consist of the EPA's Preliminary Remediation Goals for radionuclides in soil for residential and industrial receptors. Another set of conservative, risk-based screening levels will be calculated for onsite industrial and recreational receptors using the most current version of Residual Radioactivity (RESRAD) version 7 for Soils. The assumptions and input parameters used in the RESRAD version 7 software will be determined in consultation with the Navy and its representatives to ensure that the appropriate land use scenarios and site-specific conditions are accounted for. This follows the standard used by the Navy during the recently completed TCRA. Exceedance of conservative risk-based screening levels could indicate that further investigation of one or more of the AOPCs is warranted and could necessitate a baseline HHRA. Because the screening levels calculated using RESRAD are likely to be more representative of site-specific exposure conditions, it is assumed that the need for further investigation will be determined

primarily based on the results of the comparison against the screening levels calculated using RESRAD.

5.3 SERA

The SERA will include: updated/revised ecological CSM that describes the primary source, release mechanism, and complete ecological pathways; identification of representative ecological receptors; and comparison of exposure point concentrations (maximum detected concentrations) to background levels for soil (U.S. Navy 2016b) and ecological screening benchmarks (for soil and sediment) for exposure estimation and risk calculation. Conservative ecological screening levels from RESRAD-BIOTA (most current version 1.7) will be used for radionuclides in soil for terrestrial receptors and in sediment for riparian and aquatic receptors. The graded (i.e., tiered) approach for evaluating radiation doses to terrestrial and aquatic biota used to develop RESRAD-BIOTA is appropriate for use in screening for potential radiological impacts for CERCLA sites (DOE 2002, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota. DOE STD-1153).

PART 2

Quality Assurance Project Plan

CONTENTS

APPENDICES

FIGURES

ABBREVIATIONS AND ACRONYMS

AS	alpha spectroscopy
bgs	below ground surface
BRAC PMO	Base Realignment and Closure Project Management Office
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHMM	Certified Hazardous Material Manager
COC	chain of custody
cpm	counts per minute
Cs	cesium
CSM	conceptual site model
dpm	disintegrations per minute
DoD	U.S. Department of Defense
Ecology	Washington State Department of Ecology
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
EPM	Environmental Protection Manager
FWHM	full width at half-maximum
GFPC	gas flow proportional counter
GPS	global positioning system
GS	gamma spectroscopy
GWS	gamma walkover survey
HAZWOPER	Hazardous Waste Operations and Emergency Response
ID	identification
IDW	investigation-derived waste
keV	kiloelectronvolt
LCS	laboratory control sample
LLRW	low-level radioactive waste
LOD	limit of detection
LOQ	limit of quantitation
µCi	microcurie
MDA	minimum detectable activity
MeV	megaelectronvolt
mR	milliroentgens
MS/MSD	matrix spike/matrix spike duplicate
NARA	National Archives and Records Administration
NAS	Naval Air Station
NAVSEADET	Naval Sea Systems Command Detachment
NAVSTA PS	Naval Station Puget Sound
NAVFAC	Naval Facilities Engineering Command
NOAA	National Oceanic and Atmospheric Administration

ABBREVIATIONS AND ACRONYMS (Continued)

PA	preliminary assessment
PID	photoionization detector
PM	Project Manager
PPE	personal protection equipment
Pu	Plutonium
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	quality assurance project plan
QC	quality control
Ra	radium
RASO	Radiological Affairs Support Office
RER	replication error
RI	remedial investigation
PROC	potential radionuclide of concern
RPD	relative percent difference
RPM	Remedial Project Manager
RRPT	Registered Radiation Protection Technologist
RSO	Radiation Safety Officer
SAP	Sampling and Analysis Plan
SI	site inspection
SOP	standard operating procedure
Sr	strontium
TBD	to be determined
TCRA	time-critical removal action
Th	thorium

QAPP Worksheets #1 and 2. Title and Approval Page and Project Identifying Information

Project Name: Site Inspection Sampling and Analysis Plan, Gamma Walkover Survey and Soil and Sediment Sampling

Site Location: Former Naval Station Puget Sound, Seattle Washington

Contract: N44255-09-D-4001, Delivery Order 0076

Lead Organization: Naval Facilities Engineering Command (NAVFAC) Northwest

Approval Signatures:

Greg Burgess/URS Project Manager	Date
Karen Mixon/URS Navy Program QA Manager	Date
Chris Generous/NAVFAC Northwest RPM	Date
Teresie Walker/NAVFAC QAO	Date

Other Stakeholders:

- Navy Radiological Affairs Support Office (RASO)
- Base Realignment and Closure Program Management Office (BRAC PMO)
- Washington State Department of Ecology (regulator)
- Washington State Department of Health (regulator)
- City of Seattle (stakeholder)
- National Oceanic and Atmospheric Administration (stakeholder)

Documents Relevant to the Current Investigation:

- Radiological Remedial Investigation Report, Former Naval Station Puget Sound Seattle, Washington (May 2011)
- Action Memorandum, Time-Critical Removal Action, Former Naval Station Puget Sound, Seattle, Washington (May 2013)
- Final After Action Report, Radiological Materials Time-Critical Removal Action at Former Naval Station Puget Sound, Seattle, Washington (October 2016)
- Final Radiological Preliminary Assessment Report, Former Naval Station Puget Sound, Seattle, Washington, (November 2016).

1 QAPP Worksheet #3. Distribution List

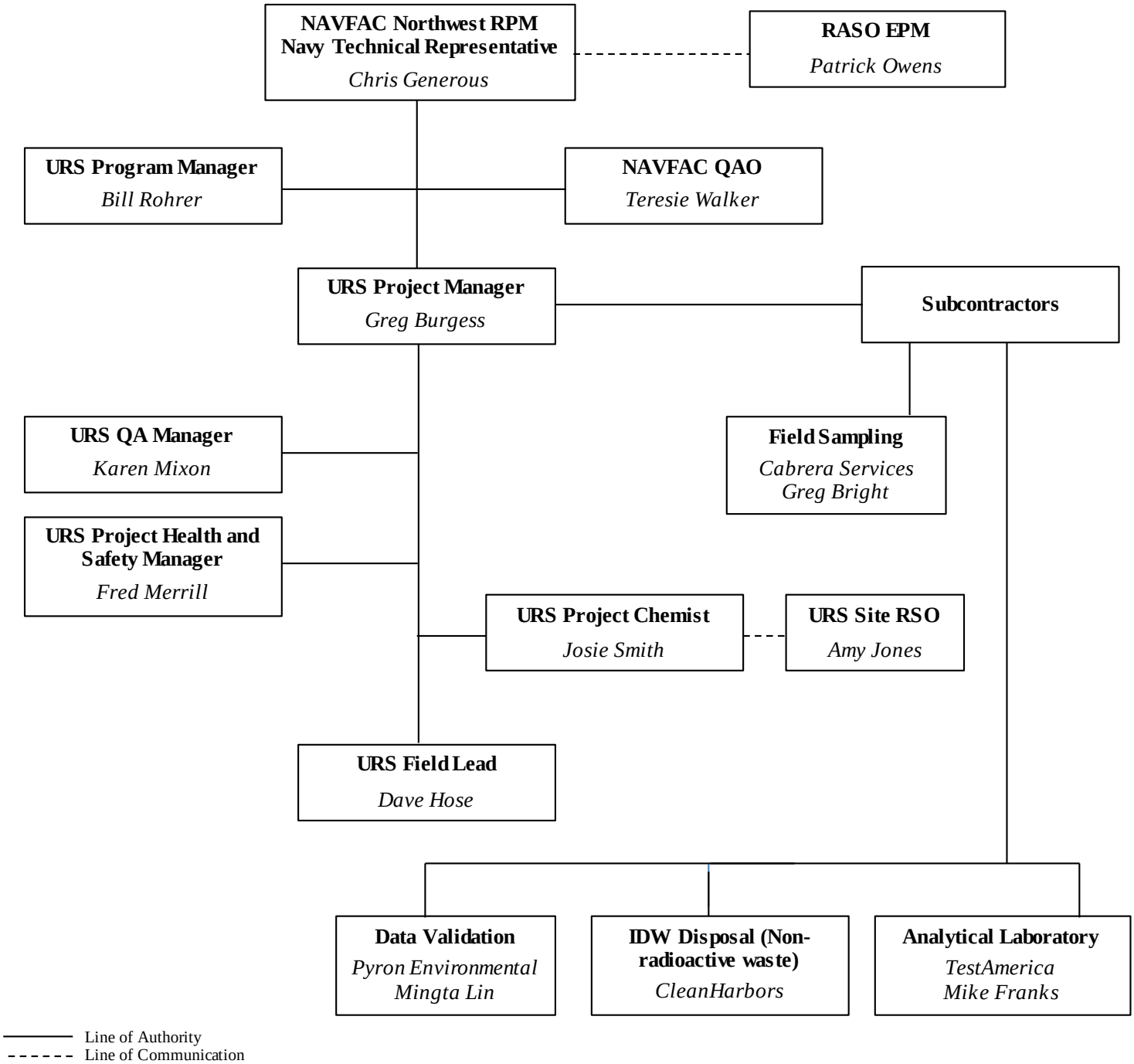
Name	Role	Telephone	E-mail
Naval Facilities Engineering Command			
Chris Generous	Remedial Project Manager (RPM)/Navy Technical Representative	360-396-0014	christopher.generous@navy.mil
Teresie Walker	Quality Assurance Officer (QAO)	757-322-4699	teresie.walker@navy.mil
NAVSEADET Radiological Affairs Support Office			
Patrick Owens	Environmental Protection Manager (EPM)	757-887-4483	Patrick.a.owens@navy.mil
Base Realignment and Closure Project Management Office			
Anthony Megliola	Base Closure Manager	619-524-4496	anthony.megliola@navy.mil
Washington State Department of Ecology (Ecology)			
Ching-Pi Wang	Site Manager	425-649-7134	cwan461@ecy.wa.gov
Washington Department of Health			
Chris Williams	Deputy Director Office of Radiation Protection	360-236-3213	chris.williams@doh.wa.gov
City of Seattle Department of Parks and Recreation			
Maureen Sánchez	Senior Environmental Analyst	206-733-9434	
National Oceanic and Atmospheric Administration			
Ann Aaron Byar	Stakeholder	206-526-6295	ann.byar@noaa.gov
URS Group, Inc.			
Bill Rohrer	Program Manager	206-438-2296	bill.rohrer@aecom.com
Greg Burgess	Project Manager (PM)	206-438-2047	greg.burgess@aecom.com
Karen Mixon	Quality Assurance (QA) Manager	206-438-2234	karen.mixon@aecom.com
Josie Smith	Project Chemist	206-438-2168	josie.smith@aecom.com
Fred Merrill	Project Health and Safety Manager	206-438-2302 206-719-1105	fred.merrill@aecom.com
Dave Hose	Field Lead	206-438-2154 206-245-4643	dave.hose@aecom.com
Amy Jones, RRPT	Site Radiation Safety Officer	801-904-4023 801-913-5199	amy.r.jones@aecom.com
Cabrera Services, Inc.			
Greg Bright, RRPT	Field Support	508-315-6246	gbright@cabreraservices.com
Analytical Laboratory – TestAmerica for Earth Toxics			
Mike Franks	Laboratory PM	314-298-8566	Mike.Franks@testamericainc.com
Independent Data Validator – Pyron Environmental			
Mingta Lin	Data Validation	360-867-9543	mingta_lin@comcast.net

QAPP Worksheets #4, #7, and #8. Personnel Sign-Off Sheet, Responsibilities, and Special Training Requirements

Have copies of this form signed by the project personnel from each organization responsible for implementing portions of the Sampling and Analysis Plan (SAP). Their signatures or e-mail receipt dates indicate that they have read the applicable SAP sections and will perform the tasks as described. If only a portion of the SAP was reviewed, then personnel should note which sections were reviewed.

Name	Organization	Title/Role	Specialized Training/ Certifications	Sections Reviewed	Signature/Date
Chris Generous	NAVFAC Northwest	RPM			
Patrick Owens	NAVSEADET RASO	EPM			
Greg Burgess	URS	Project Manager			
Josie Smith	URS	Project Chemist			
Fred Merrill	URS	Project Health & Safety			
Dave Hose	URS	Field Lead	40-hour HAZWOPER 30-hour OSHA Construction Safety		
Amy Jones	URS	Radiation Safety Officer (RSO)	Registered Radiation Protection Technologist (RRPT)		
Elyssa Dixon	URS	Field Staff	40-hour HAZWOPER 30-hour OSHA Construction Safety		
Field Staff	Drillers	Driller Field Staff	40-hour HAZWOPER		
Greg Bright	Cabrera Services, Inc.	Field support	RRPT		
Field Staff	Cabrera Services, Inc.	Cabrera Field Staff	40-hour HAZWOPER		
Mike Franks	TestAmerica	Laboratory PM			
Mingta Lin	Pyron Environmental	Data validation			

QAPP Worksheet #5. Project Organizational Chart



QAPP Worksheet #6. Communication Pathways

Communication Drivers	Responsible Affiliation	Name[a]	Procedure
Changes in scope or costs	NAVFAC Northwest Contracting Officer	Kimberly Gillette	All changes in scope or costs require written approval from the NAVFAC Northwest Contracting Officer to the URS Program Manager.
SAP modification	NAVFAC Northwest RPM	Chris Generous	All changes to the SAP must be submitted to the NAVFAC Northwest RPM via telephone, e-mail, or in writing. Any field activity that deviates from the SAP will be documented in a Field Change Request form (Appendix B).
SAP modification and/or notification for radiological condition changes/issues	NAVSEADET RASO	Patrick Owen	All changes to the SAP must be submitted to the NAVSEADET RASO via telephone, e-mail, or in writing. Any field activity that deviates from the SAP will be documented in a Field Change Request form (Appendix B). Notification for radiological condition changes/issues must be submitted to the NAVSEADET RASO via telephone, e-mail, or in writing for evaluation and concurrence by RASO.
Changed conditions	URS Project Manager	Greg Burgess	Changes in project conditions that result in changes to this SAP, overall project scope, or costs will be communicated to the NAVFAC Northwest RPM and Contracting Officer via telephone, e-mail, or in writing as soon as recognized.
Radiological sampling issues	NAVFAC Northwest RPM NAVSEADET RASO	Chris Generous Patrick Owens	Notification for radiological sampling issues must be submitted to the NAVFAC Northwest RPM and NAVSEADET RASO EPM via telephone, e-mail, or in writing for evaluation and concurrence.
Laboratory direction	URS Project Chemist	Josie Smith	Preliminary notification of issues affecting data quality will be communicated to the URS PM, who will notify the NAVFAC Northwest RPM within 48 hours of identification via e-mail or telephone. Overall data usability will be documented in the submittal to NAVFAC Northwest.
Data quality issues	URS QA Manager	Karen Mixon	Preliminary notification of issues affecting data quality will be communicated to the URS PM, who will notify the NAVFAC Northwest RPM within 48 hours of identification via e-mail or telephone. Overall data usability will be documented in the submittal to NAVFAC Northwest.
Sampling progress updates	URS PM	Greg Burgess	Periodic progress and schedule updates will be provided to the NAVFAC Northwest RPM via e-mail and telephone.
Results of work	URS PM	Greg Burgess	Reports documenting project work will be submitted to the NAVFAC Northwest RPM in accordance with the Statement of Work.

[a]Contact information is provided in Worksheet #3.

QAPP Worksheet #9. Project Planning Session Summary

Date of Planning Session I: March 26, 2014

Location: URS Seattle Office

Purpose: Site inspection strategy meeting

Participants:

Chris Generous	NAVFAC NW – Remedial Project Manager
Joe Sevcik	NAVSEADET RASO – Environmental Protection Manager
Dave Hose	URS – Senior Scientist
Tobey Clarkin	URS – Senior Engineer
Amy Jones	URS – Registered Radiation Protection Technologist (by phone)
Elizabeth Romano	URS – Senior Scientist – Certified Hazardous Materials Manager (by phone)
JoAnn Grady	Grady and Associates – Community Relations Specialist (by phone)
Eric Zentner	Grady and Associates – Community Relations Specialist (by phone)
Tom Abbott	URS – Project Manager

Notes/comments:

The scope of this Site Inspection (SI) is to verify the presence or absence of radiological impacts. Preliminary proposed soil sampling is in areas around the buildings/structures of potential concern that were not previously investigated for radiological contamination during the Radiological RI and TCRA.

Instrument room wash sinks in Buildings 2 and 27 were connected to storm sewers that drained into Lake Washington.

Sediment sampling locations are proposed in Pontiac Bay, downgradient of the former Building 283 oil water separator, and from catch basins and manholes in sections of the stormwater sewer system not previously sampled.

Consensus decisions made:

Final sampling locations will be determined after completion of the PA.

Action Items:

- Verify whether a walkover survey has been done around the former Building 283 location.
- Find out when welding took place in Building 40 and what type of welding.
- Review sanitary sewer system in the vicinity of Building 27, including clarification on sludge ejector pit and routing direction of sanitary sewer.
- Review possible conduits leading to sediment pit west of Building 2 next to Manhole 134 where cesium was detected.
- Check for evidence of Building 30 infrastructure supporting radiological operations.
- Identify the list of materials found in Building 30 during 1976 RASO Survey.

Date of Planning Session II: September 25, 2014

Location: URS Seattle Office, Coho Room, 13th Floor

Purpose: Comment Resolution Meeting, Internal Draft Site Inspection Planning Documents

Participants:

Chris Generous	NAVFAC NW – Remedial Project Manager
Joe Sevcik	NAVSEADET RASO – Environmental Protection Manager
Bill Rohrer	URS – Program Manager
Dave Hose	URS – Senior Scientist
Amy Jones	URS – Registered Radiation Protection Technologist (by phone)
Elizabeth Romano	URS – Senior Scientist – Certified Hazardous Materials Manager (by phone)
Tom Abbott	URS – Project Manager

Research on Disposal of Plutonium-Contaminated Sediment Used for University of Washington Experiment in Greenhouse, Building 15

To find additional information about this experiment, URS contacted a Nuclear Regulatory Commission representative and Department of Energy historian and archivist who led URS to documents held in the University of Washington's Special Collections Library. Several documents were found that verified that experimentation with Johnston Atoll material was conducted at the greenhouse (former Building 15) in the mid-to-late 1960s by the university's Laboratory of Radiation Ecology, College of Fisheries. A mobile laboratory was also placed adjacent to the greenhouse sometime during the experiment. Available aerial photographs from 1965 and 1970 did not show the presence of the trailer, but they do indicate that there was a new roof structure placed on the building between 1974 and 1976. A photograph in a document from 1966 or 1967 (full copy to be sent from University of Washington Special Collections) suggests that the trailer was placed on the southeast side of the greenhouse.

Because no records for disposal of the coral grit used in the experiment are found, plutonium will be included in analysis from this portion of the Site only.

Catch Basin Near Former Building 17

The catch basin identified on the Site map at the north side of Building 17 (Engine Test Building per a 1938 map, O. and R. Shop Building per a 1949 map, Shop and Laboratory Storage per 1958 map) may be of interest for sampling because radioactive materials (e.g., engine exciters) may have been used in Building 17. The following items were reviewed:

- A 1983 construction drawing for the demolition of Building 17. It showed that the catch basin at the north side of Building 17 is manhole 1024 and is connected to a storm drain.

- A 1988 construction drawing for Building 407 (Hazardous Waste Storage Building). It shows a manhole-like structure, but it is not labelled, and there is no connected storm drain.

- A 1993 construction drawing of the adjacent "Outside Hazardous Waste Retaining Facility." Similarly, it shows an unlabeled manhole-like structure, and there is no connected storm drain. It is not certain whether the manhole or sewer lines in that area exist.

- A photograph of the area as viewed from the east northeast of the area taken 9/24/14. A catch basin is visible the foreground. Tom Abbott stated that there is an open pipe that is present on the west side of the catch basin, and it extends in the general direction of manhole 1024. If it exists, manhole 1024 may be located under the green dumpster shown in the photo or hidden under other material. A second catch basin (not in the photograph exists between the northeast corner of former Building 17 and existing Building 2. These two catch basins and manhole 1024 were not previously sampled.

Action Item: URS will sample the two existing catch basins between the northeast corner of Building 17 and Building 2 and manhole 1024 if it exists (This sampling was subsequently determined to be unnecessary).

Recommended Soil and Sediment Sampling Depths/Approach

The group discussed and slightly revised the approach to sample collection depths for soil/sludge/lake sediment based on a review of related recommendations in an e-mail from Tom Abbott dated 9/18/14.

Soil samples from soil borings: Collect three samples from each boring which would include:

- One sample from 0 to 6 inches below ground surface (bgs) (required for the human health and ecological risk assessments).

- One composite sample from 0.5 to 3 feet bgs (required for ecological risk assessment).

- One sample from the 6-inch interval with the highest count rate based on field screening between 0.5 feet bgs and the bottom of the boring, maximum depth of 10 feet (required for human health risk assessment).

Note that soil borings will be drilled to a maximum of 10 feet bgs or to the depth of groundwater, which may be shallower than 10 feet bgs.

Sludge samples from catch basins and manholes: Collect three samples from the surface, middle, and bottom thirds of the sediment in catch basins and manholes identified for sampling. URS will refer to material sampled from the catch basins and manholes as "sludge" to be consistent with sample nomenclature presented in the RI report.

Sediment samples from Lake Washington: Collect two samples at each sediment sampling location. This would include:

- One sample from the upper 0 to 6 inches of sediment for the human health and ecological risk assessments because this interval includes the biologically active zone.

- One sample from the 6-inch interval with the highest count rate based on field screening within the sediment core between 0.5 feet below the surface to the bottom of the sediment core that is proposed to be approximately 5 feet in depth or to refusal. This deeper sediment sample would not be needed for the risk assessments, but should identify the depth of sediments potentially affected by historical operations at the Site. Washington Department of Ecology generally focuses on analyzing the sediments in the biologically active zone; however, they may be interested in identifying the depth of sediments potentially affected by historical operations in this case. Collecting sediment cores for screening and sample analysis will require more effort than collecting surface sediments. We will need to consider the collection of additional sediment cores to establish background, use of a larger sampling vessel, handling additional waste, and incurring additional labor and screening instrumentation.

- Lake sediments samples will be analyzed for Sr-90, Cs-137, Ra-226, and Th-232.

Status of Research on Dredging Near National Oceanic and Atmospheric Administration (NOAA) Shoreline

Approximately one week prior to this comment resolution meeting, NAVFAC NW asked URS to investigate the dredging history offshore of NOAA's shoreline directly east of the Navy's north shoreline because the storm drain from Building 27 eventually discharges to the area near the NOAA pier. The Navy wanted some samples within the dredged area and outside the dredged area offshore of the NOAA property.

The following related historical documents were shown and discussed during the meeting:

- 1977 revised drawings for the permit application for dredging
- 1976 and 1977 through 1983 aerial photos

The aerial photos show that the shoreline changed substantially between the 1979 and 1980 aerial photographs. It is obvious that the permit application drawing did not match the actual dredging and pier construction. The dredging spoils covered a much larger area located further inland than planned, and one large pier was constructed versus the four large piers that were planned. URS has asked for available dredging information from Dave Petre of NOAA and the Army Corps of Engineers Navigation Section, which is in charge of all Corps dredging operations and should have historical records if available.

During a 9/24/14 site visit, Tom Abbott observed divers (possibly NOAA divers) on the interior side of the L-shaped pier. Joe Sevcik suggested contacting NOAA to ask if the divers have observed depositional areas on the interior side of the pier.

The planned sediment sampling locations near the NOAA pier were moved on the Site map during the meeting. Two locations were deleted, one sample was added to the east of the outfall, and one was moved further offshore in an area that is likely undredged (to be confirmed as additional dredging records are found). The group discussed the possibility of sampling along the beach area along the shoreline north of Building 27. Sampling in this area was rejected because the City of Seattle added several feet of gravel during a 2005 beach renovation in this area, covering the older sediments.

Action Item: Obtain available dredging information from NOAA and the Army Corps of Engineers. This would include the 1979-1980 dredging effort and any more recent dredging.

Action Item: Tom Abbott will check with NOAA divers to ask about possible depositional areas within the interior side of the L-shaped NOAA pier.

Action Item: Explain in the Work Plan that no sediment samples will be collected directly off the north shore because shoreline repairs in 2005 included the placement of several feet of gravel along much of the northern shoreline.

Action Item: URS will include rationale in the Work Plan for not collecting sediment along the portion of the north shore along the bulkhead where people wade in the shallow water.

Site Map Revisions/ Sample Location Revisions

Do we need to conduct any sampling at the former sludge beds area (Structure 207)? A contractor recently trenched through that area in 2014. Samples were collected for analyses. The Navy indicated that the results showed no evidence of elevated radiological activity. The Navy

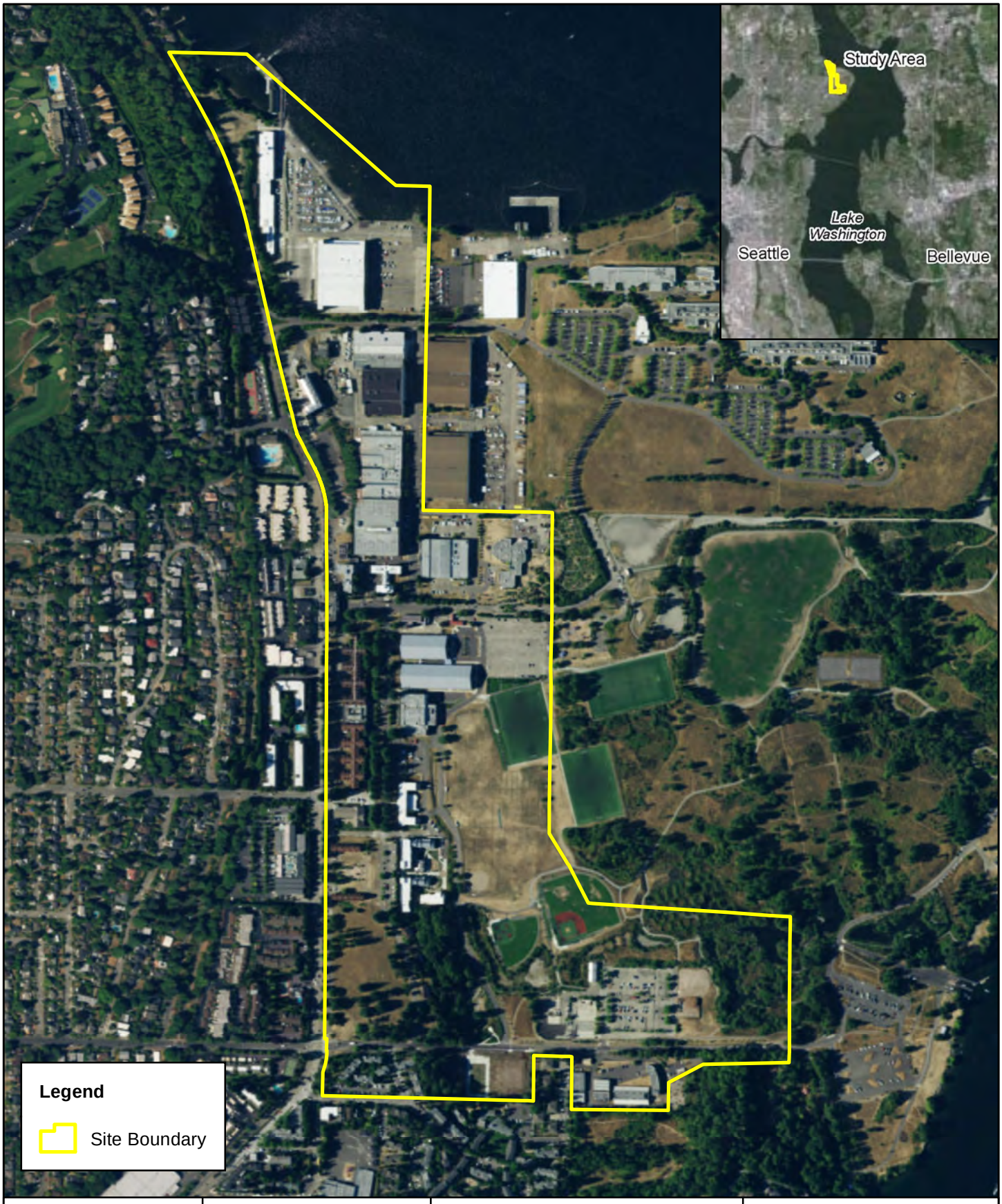
indicated that they may want to install two borings in that area for confirmation (This sampling was subsequently determined to be unnecessary).

Planned sediment sample locations in Pontiac Bay were adjusted. Chris Generous recommended reducing the number of borings in the large grassed areas north and south of Building 30 from three borings in each area down to two (This reduction of sample locations was later reversed). Boring locations will be estimated on the map, but exact locations may be biased based on the results of the gamma walk-over survey. The team had previously discussed that even if no elevated readings are noted during the gamma walk-over survey, borings would still be installed to confirm the absence of radionuclides of concern at concentrations above background.

Action: Joe Sevcik will review the TetraTech data from the sampling effort in that area and make a decision about possible field investigation at that location.

QAPP Worksheet #10. Conceptual Site Model

Figure 10-1 shows the study area for the former NAVSTA PS. For a summary of the site history please refer to Section 1.2 of the Executive Summary of this document. The site investigation history is summarized in Sections 3.2 and 3.3 of the accompanying Field Sampling Plan. The conceptual site model included at the end of this worksheet is recreated from Appendix A of the PA Report.



U.S. NAVY

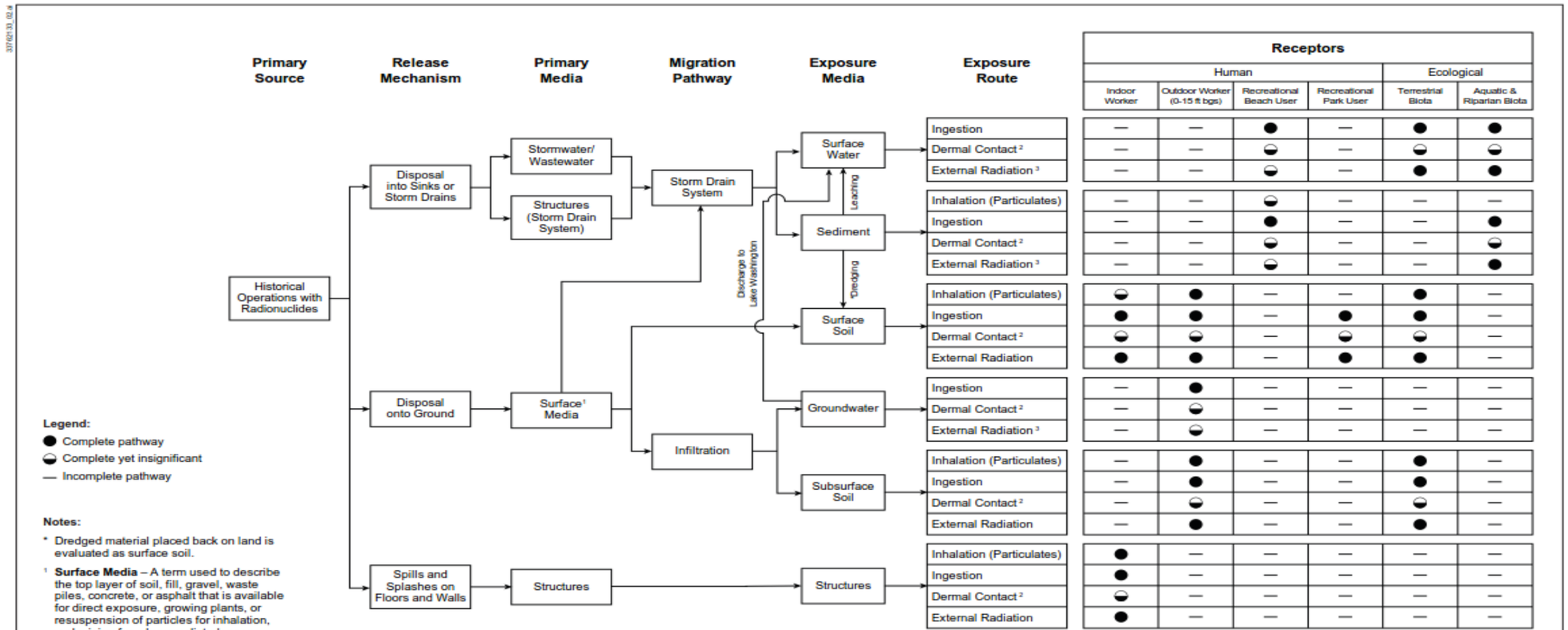
0 350 700

Scale In Feet

Figure 10-1
Study Area
Naval Station Puget Sound
After Initial Land Transfers to NOAA and the City of Seattle

Delivery Order 0076
NAVSTA PS
Seattle, Washington
Quality Assurance Project Plan

Path: J:\DCS\Projects\GIS\NAVY\MAGNUSON\D0076\MXDs\Figure 10-1 Study Area_QAPPReport.mxd Date Saved: 3/3/2017 11:46:25 AM



U.S. NAVY	Delivery Order 0076 Preliminary Assessment Report	**Figure A-1 Updated Conceptual Site Model**

QAPP Worksheet #11. Project/Data Quality Objectives

Data quality objectives are an integrated set of qualitative and quantitative decision statements that define data quality requirements based on the end use of the data. The U.S. Environmental Protection Agency (EPA) has developed a seven-step process to clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

The data generated as a result of executing this plan will be used by NAVFAC Northwest and Ecology to establish the initial full set of monitoring data to evaluate the need for further action within the nine parcels of the former Naval Station Puget Sound (NAVSTA PS) that constitute the study area. The data will be presented in the SI report.

Target potential radionuclides of concern (PROC) will be quantified by an off-site laboratory. Data quality criteria are specified in Worksheet numbers 12, 13, 15, and 20 through 37. The project schedule is presented in Worksheet 14 and #16. The sampling design and rationale for sample collection is presented in Worksheet #17. The data will be documented in a report and archived by NAVFAC Northwest.

Step 1: State the problem. Evaluate the radiological condition of the areas identified in the preliminary assessment (PA) and time-critical removal action (TCRA) within the nine parcels of the former NAVSTA PS as potential or known sources of radioactive material and radioactive contamination and designate these as areas that require further action or that pose no risk to human health.

Step 2: Identify the goals of the study. The goals of the SI are to determine whether radiological contamination is present and above project action levels and whether further action is required. The PROCs for most proposed sample locations at the Site are Ra-226, Cs-137, Sr-90, Th-232, but are limited to Ra-226 and Th-232 near Building 30, and Sr-90 and Pu-239 near former Building 15. Results will be compared to the established project action levels, provided in Worksheet #15.

Step 3: Identify information inputs. The surface areal extent (approximately 1 foot) will be evaluated with a gamma walkover survey (GWS), which will report gamma radiation levels in counts per minute (cpm). These data will be supplemented with soil and sediment sampling and off site Laboratory PROC analysis. The soil sampling will also support evaluation of the vertical extent to groundwater or a 10-foot depth. The sampling within manholes and catch basins will evaluate the total depth of sludge present at the time of sampling. The lake sediment will be evaluated to a depth of 5 feet beneath the surface of the sediment or to refusal. The building interior scoping survey will report dose rates in mrem/hr and alpha and beta smear measurements in dpm/100cm^2. For each sample location site-specific PROC's have been identified as shown

on Worksheet #18, based on historical information as detailed in the Final Radiological PA Report (U.S. Navy 2016a). The specific PROCs are based on historical information and the nature of the release of potential contamination based on historical operations.

To summarize, the following are the exposure screening and target PROCs to be tested for during the SI sampling effort at the former NAVSTA PS:

- Surface radiation exposure based on GWS
- Ra-226
- Cs-137
- Sr-90
- Th-232
- Pu-239
- Dose rates inside Building 30 former instrument room

Step 4: Define the boundaries of the study. The location and boundaries of the former NAVSTA PS are shown on Figure 10-1 in Worksheet #10. This SAP only addresses the SI activities and results, which will be presented in a report specific to this sampling event. The PROCs identified in Step 3 have been targeted based on information obtained during the Radiological PA and TCRA.

Step 5: Develop the analytic approach. Because this QAPP is for a sampling event that addresses data gaps identified in the Radiological RI, the resulting report will summarize the recommendations of the Radiological PA and present the findings of the SI activities. If surface radiation exposure levels and/or PROCs are found to exceed the project action levels, then the Navy, Ecology, and WDOH will discuss the next steps to further evaluate radiological contamination as part of the formal CERCLA process.

Step 6: Specify performance or acceptance criteria. Background scan values will be established for the both GWS detectors, using the same GWS background area established for the TCRA. The surface of the investigation area and background area will consist of the same surface material (grass-covered area). Interior background values for alpha/beta, and dose rates will be established within Building 30 for comparison with results of the interior scoping survey of the former instrument shop. Background sampling will be performed for lake sediment PROCs at background locations shown on Figure 17-2. Twenty site-specific background soil samples were collected as part of the TCRA; the average background soil concentrations for these samples will be used for Ra-226, Cs-137, Th-232 and Sr-90. Background sampling should not be necessary for Pu-239, as it is generally not seen in background. If Pu-239 is detected in the samples, the need for collection of background samples for these PROCs will be evaluated. No sludge background samples will be collected. The background values for soil will be applied to the sludge samples.

Quality control (QC) requirements for specified analytical methods must be met to ensure that data of known quality are produced by the analytical laboratory. Acceptance criteria are provided in Worksheet #12, and project action levels are identified in Worksheet #15. Where feasible, laboratory detection limits should be below the action levels.

Analytical performance criteria are specified on Worksheet #12. All laboratory data and field measurements will be verified for completeness, accuracy, and compliance with method requirements, project requirements, or standard operating procedures (SOPs) as appropriate. In general, 95 percent completeness is required for acceptable analytical data. However, the project team will determine the impact to the project objectives if 95 percent completeness is not achieved. Completeness for this project will be the comparison of the number of valid data to the total amount of data collected.

Based on historical precedent, and Navy protocol, a field duplicate frequency of 1 duplicate per 10 samples at a minimum, or 10 percent, will be established for sampling conducted under this QAPP.

Step 7: Develop the detailed plan for obtaining data. Inspecting the Site for the presence or absence of radiological contamination includes evaluation of analytical results to designate areas that require further action or that pose no risk to human health or the environment. Refer to Worksheet #17 for further details regarding the sampling design and rationale.

QAPP Worksheet #12. Measurement Performance Criteria

Matrix: Soil/Sludge/Sediment
Concentration Level: Low/Medium
Analytical Group: Gamma Spec. (Ra-226, Th-232, Cs-137)
Analytical Method/SOP Reference: HASL 300 GA-01-R/ST-RD-0102
Source: TestAmerica Earth City, MO

Data Quality Indicator	QC Sample	Frequency/ Number	Measurement Performance Criteria
Sensitivity contamination	Method blank	1 per extraction batch of ≤20 samples	Limits: Results less than (<) minimum detectable activity (MDA) or no isotope detected >2 times the blank CSU
Accuracy/precision	Laboratory control sample (LCS)	1 per extraction batch of ≤20 samples	Limits: in-house limits of ± 3 σ of the mean 87-116% americium-241 87-120% Cs-137 87-115% cobalt-60
Precision	Sample duplicate	1 per extraction batch of ≤20 samples	Limits: <25% relative percent difference (RPD) or <1% replication error (RER)

Matrix: Soil/Sludge/Sediment
Concentration Level: Low/Medium
Analytical Group: Alpha Spec. (Pu-239)
Analytical Method/SOP Reference: HASL 300 A-01-R/ST-RD-0210
Source: TestAmerica Earth City, MO

Data Quality Indicator	QC Sample	Frequency/ Number	Measurement Performance Criteria
Sensitivity contamination	Method blank	1 per extraction batch of ≤20 samples	Limits: Results <MDA or no isotope detected >2 times the blank CSU
Accuracy/precision	LCS	1 per extraction batch of ≤20 samples	Limits: in-house limits of ± 3 σ of the mean 81-129% Pu-239
Precision	Sample duplicate	1 per extraction batch of ≤20 samples	Limits: <25% RPD or <1% RER
Accuracy	Tracer (Pu-236 or Pu-242)	Every field and batch QC samples	Limits: 30-110%

QAPP Worksheet #12. Measurement Performance Criteria (Continued)

Matrix: Soil/Sludge/Sediment
Concentration Level: Low/Medium
Analytical Group: Gas Flow Proportional Counter (Sr-90)
Analytical Method/SOP Reference: HASL 300 SR-03-RC/ST-RD-0403
Source: TestAmerica Earth City, MO

Data Quality Indicator	QC Sample	Frequency/ Number	Measurement Performance Criteria
Sensitivity contamination	Method blank	1 per extraction batch of ≤20 samples	Limits: Results < MDA or no isotope detected >2 times the blank CSU
Accuracy/precision	LCS	1 per extraction batch of ≤20 samples	Limits: in-house limits of ± 3 σ of the mean 88-136%
Precision	Sample duplicate	1 per extraction batch of ≤20 samples	Limits: <25% RPD or <1% RER
Accuracy	Sr/Y carrier	Every field and batch QC samples	Limits: 40-110%

QAPP Worksheet #13. Secondary Data Criteria and Limitations Table

Secondary data include all data collected during the TCRA and PA.

Data Type	Source	Data Uses Relative to Current Project	Factors Affecting Reliability of Data and Limitations on Data Use
Radiological gamma walkover data	RI data	Representative gamma radiation levels across the Site	Qualitative information only
Background soil concentrations	TCRA data	Used for comparison with current data	Assumes radiological conditions have not changed since collection
Suspect buildings/structures and associated sewer systems/outfalls with past operations involving radioluminescent paint	Radiological PA findings	Targeted areas for sampling locations	Information based on operational records, drawings and interviews
Past Site uses	Radiological PA findings	Potential location of burn sites for sampling locations	Information based on operational records, drawings and interviews

QAPP Worksheets #14 and #16. Project Tasks and Schedule Summary

The complete project schedule titled "Contract N44255-09-D-4001 Project Schedule for DO 76-PA/SI Former Naval Station Puget Sound Seattle Washington" is maintained by URS Seattle, and is updated as needed. The table below summarizes the schedule for the field work activities included in the schedule. If there is a conflict between this table and the complete schedule, the schedule takes precedence.

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable	Deliverable Due Date
Preparation and mobilization	URS/ Cabrera	6/19/2017	7/5/2017	Not applicable	Not applicable
Field work and data collection	URS/ Cabrera	7/5/2017	7/19/2017	Not applicable	Not applicable
Laboratory analyses and data validation	Subcontractors	7/19/2017	9/8/2017	Validated data	9/8/2017
Internal Draft SI report	URS	8/21/2017	10/15/2017	Report	10/15/2017
Draft SI report	URS	10/15/2017	12/12/2017	Report	12/12/2017
Final SI report	URS	12/12/2017	1/16/2018	Report	1/16/2018

QAPP Worksheet #15. Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil
Analytical Group: Radionuclides in Soil

Analyte	CAS Number	Project Action Limit (pCi/g)	Project Action Limit Reference	Project MDAs (pCi/g)	Analytical Method MDAs (pCi/g)
Radium-226	13982-63-3	1.41	TCRA Cleanup Criteria	0.7	0.7
Cesium-137	10045-97-3	25.63	TCRA Cleanup Criteria	0.2	0.2
Thorium-232	7440-29-1	1.5	150% of the Lab Analytical Method	1	1
Strontium-90	10098-97-2	9.46	TCRA Cleanup Criteria	3	3
Plutonium-239	15117-48-3	1.5	150% of the Lab Analytical Method	1	1

Matrix: Lake Sediment/Sludge
Analytical Group: Radionuclides in Soil

Analyte	CAS Number	Project Action Limit (pCi/g)	Project Action Limit Reference	Project MDAs (pCi/g)	Analytical Method MDAs (pCi/g)
Radium-226	13982-63-3	1.41	TCRA Clean up Criteria	0.7	0.7
Cesium-137	10045-97-3	25.63	TCRA Clean up Criteria	0.2	0.2
Thorium-232	7440-29-1	1.5	150% of the Lab Analytical Method	1	1
Strontium-90	10098-97-2	9.46	TCRA Clean up Criteria	3	3
Plutonium-239	15117-48-3	1.5	150% of the Lab Analytical Method	1	1

QAPP Worksheet #17. Sampling Design and Rationale

The field program described is intended to be implemented over an approximate 2-week time frame. The results of the GWS, soil, sludge, and sediment sampling will be documented as part of the SI report. Sampling locations and the number of samples to be collected were selected based on the results of the PA.

LOGISTICAL CONSIDERATIONS FOR FIELD ACTIVITIES SCHEDULE

Utility location and clearance will occur prior to any intrusive sampling activity. The GWS will be performed as an initial step along areas designated for gamma survey on the Site map (Figure 17-1). Additional biased soil boring sampling locations and modifications to the proposed soil boring locations will be based on the outcome of the GWS designed to target areas with higher readings. If a sample cannot be collected where planned, or in the event field conditions are different than expected and could affect the sampling design, the URS Field Lead will contact the URS PM and NAVFAC Northwest RPM to discuss and determine the new course of action and/or whether a different sampling location should be identified. This decision-making process will be documented in the field logbook and Daily Quality Control Report.

STANDARD OPERATING PROCEDURES AND SPECIFIC INSTRUCTIONS

Field activity SOPs are listed in QAPP Worksheet #21 and included in Appendix A. NAVFAC SOPs URS PS SOPs and Cabrera SOPs are used for all activities affecting the quality of data or measurements conducted for a project. These SOPs provide standardized guidelines for field, laboratory, and reporting operations to be conducted by Navy contractors. The SOPs are clear, concise, and consistent with current regulations and guidelines, and they provide directions that can be followed in a step-by-step manner. The most recent versions of the NAVFAC SOPs will be employed and are referenced herein.

These SOPs and the associated data collection forms (field forms) have been developed for sampling and related data-gathering activities. The purpose of these SOPs is to ensure that the collection of samples represents the environment and contamination under investigation. The SOPs promote consistency in data collection activities and decrease the time needed for plan preparation and review. The field forms are included as Appendix B to this QAPP.

SAMPLING LOCATIONS AND RATIONALE

Figure 17-1 shows the planned GWS areas and proposed on-site soil, sludge and sediment sampling locations. Figure 17-2 shows the proposed background sediment sampling locations.

The location proposed for additional interior scoping survey of Building 30 is shown on Figure 17-3. Worksheet #18 lists the discrete samples to be collected at each sampling location by analytical method. This worksheet is intended to serve as a checklist to ensure that all necessary field measurements and samples are collected as planned for each location and analytical method. Deviations from the plan will be documented on the worksheet or a Field Change Request Form (Appendix B).

Designations such as the Site identification (ID), location ID, matrix type, sample type, and analytical method will be transcribed onto field forms (Appendix B), ensuring consistency in designations of sample type and sample analysis.

Soil, sludge and sediment samples will be collected and analyzed from specified locations to designate areas that require further action or that pose no risk to human health relative to project action limits criteria (see Worksheet #15). Proposed GWS areas and soil, sludge, and sediment sampling locations related to these areas of potential concern are presented on Figure 17-1. Detailed discussions of field activities are provided in Section 4.3 of the FSP.

CONFINED SPACE ENTRY

Confined spaces may be encountered during sludge sampling at the manhole and catch basin sampling locations. Entry of personnel into a confined space is defined to occur whenever any body part crosses the plane of entry of the space. The proposed sampling requires that sludge sampling equipment be lowered into the sewer system to collect samples, using manhole access locations. Sampling procedures specify that all proposed sampling activities within a confined space will be performed using equipment lowered into the space; no body part will enter the confined space. During mobilization a formal assessment of all manhole and catch basins sampling locations will be performed to identify the nature and extent of any hazards and determine if they are permit require confined spaces.

A permit-required confined space is any confined space that has one or more of the following characteristics:

- Contains or potentially contains a hazardous atmosphere.
- Contains a material that could potentially engulf an entrant, such as hoppers and silos for sand and gravel.
- Has an internal configuration that could potentially cause an entrant to be trapped or asphyxiated by inwardly converging walls or by floors that slope downward or taper to a smaller cross section.

- Contains any other recognized serious safety or health hazard.

Should entry into a permit required confined space be determined to be necessary the field sampling team will implement all required confine space entry precautions as outlined in Section 5.2.13 of the Site Safety and Health Plan.

Note:
Four background sediment locations (LW-12 through LW-15) in Lake Washington are shown on Figure 17-2.

Pier No.1
Boat Launch
Boat Launch
Boat Launch
Ramp 1
2005 Beach Repair
Outer Harbor Line
Lake Washington
Inner Harbor Line
NOAA Pier
NOAA
NOAA
NOAA
NE 80th Street (NE NOAA Drive)
Sewage Ejector
Fenced Storage Area
The Brig
NE 77th Street
63rd Avenue NE
Sand Point Way
NE 65th Street
42" FORMER CONCRETE APRON
Trench
6" Alaskan Way
Sand Point Pump Main Way
8th Ave NE
Fish & Wildlife Easement for Water

LW-01 LW-02 LW-03 LW-04 LW-05 LW-06 LW-07 LW-08 LW-09 LW-10 LW-11
OWS-283
MH 160 MH 1005 MH 234 MH 136 MH 135 MH 124 MH 162 MH 192 MH 153 MH 119 MH 122 MH-110 MH-112 MH-113 MH-114 MH-116
CB 8 CB 14 CB 7 CB 9 CB 10 CB 11 CB 12 CB 5 CB 6 CB 15 CB 16 CB 23 CB-17 CB-18 CB-19 CB-20 CB-21 CB-22
MH 149 MH 139 MH 140 MH 138 MH 197 MH 1011 MH 154 MH 1007 MH 1008 MH 1009
MH 226 MH 228 MH 229
K-21 Sewage Ejector Pit
B-1 B-2 B-3 B-4 B-5 B-6 B-7 B-8 B-9 B-10 B-11 B-12 B-13 B-14 B-15 B-16 B-17 B-18 B-19 B-20 B-21 B-22 B-23 B-24 B-25 B-26 B-27 B-28 B-29 B-30 B-31 B-32 B-33 B-34 B-35 B-36 B-37 B-38 B-39 B-40 B-41 B-42 B-43 B-44 B-45 B-46 B-47 B-48 B-49 B-50 B-51 B-52 B-53 B-54 B-55 B-56 B-57 B-58 B-59 B-60 B-61 B-62 B-63 B-64 B-65 B-66 B-67 B-68 B-69 B-70 B-71 B-72 B-73 B-74 B-75 B-76 B-77 B-78 B-79 B-80 B-81 B-82 B-83 B-84

Existing Soil Boring Approximate Locations at Buildings 27 and 2

0 100 200
SCALE IN FEET

0 200 400
SCALE IN FEET

Legend:

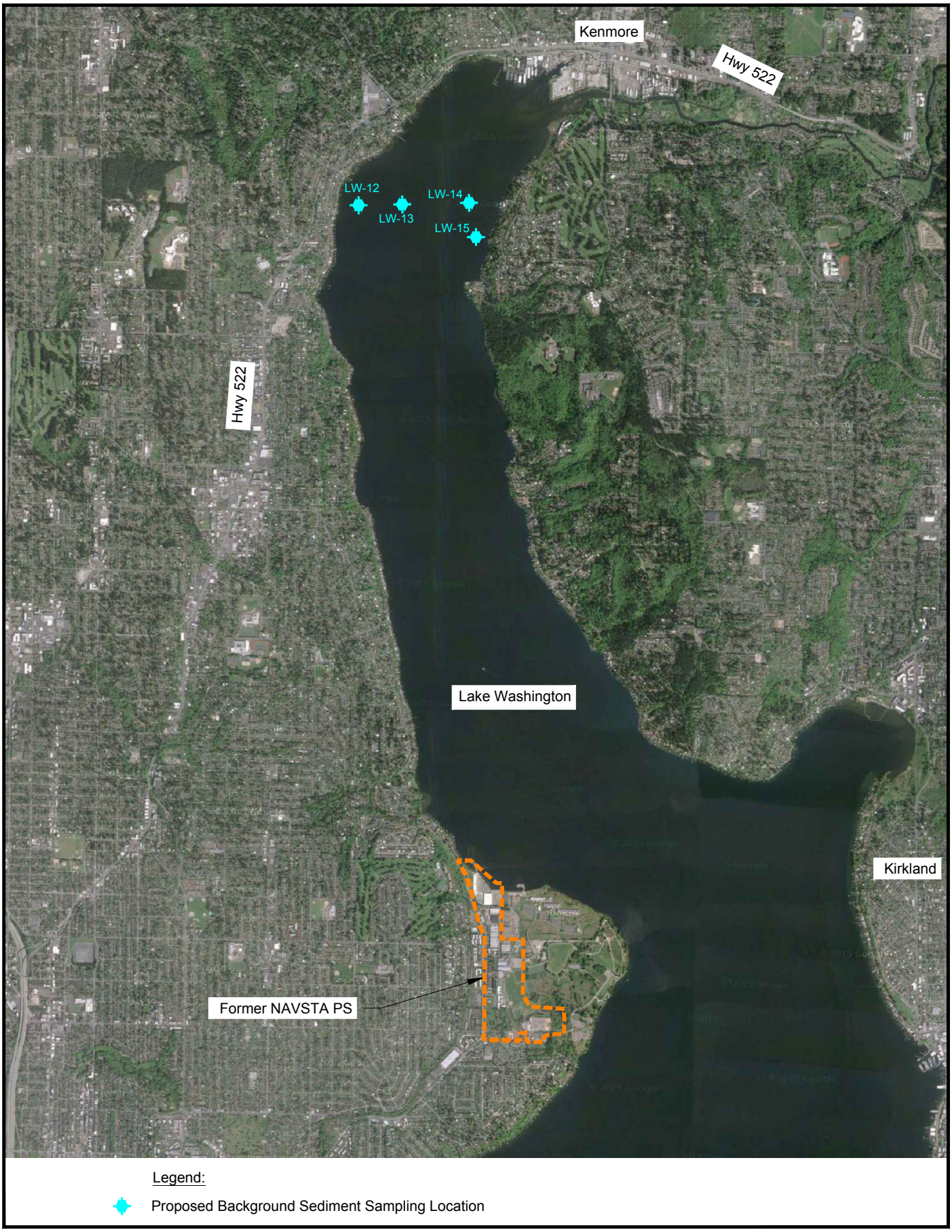
- Site Boundary (Based on City of Seattle and King County GIS Data)
- Building/Structure
- Building/Structure Removed (Note: Size and location are based on historical maps and aerial photograph and are approximate)
- Limits of 1978 Road Construction for NE NOAA Drive
- TCRA Building Removal Action
- TCRA Soil Removal Action
- Completed Gamma Walkover Survey Area
- Structures Having Historical Activities of Potential Concern
- Proposed Areas for Gamma Walkover Survey
- Sanitary Sewer
- Storm Drain
- Existing Sanitary Sewer Sample Location
- Existing Storm Drain Sample Location
- Proposed Soil Boring Location
- Proposed Sediment or Sludge Sampling Location
- Existing Soil Boring Location

Figure 17-1
Site Investigation Activity Locations
Former NAVSTA PS

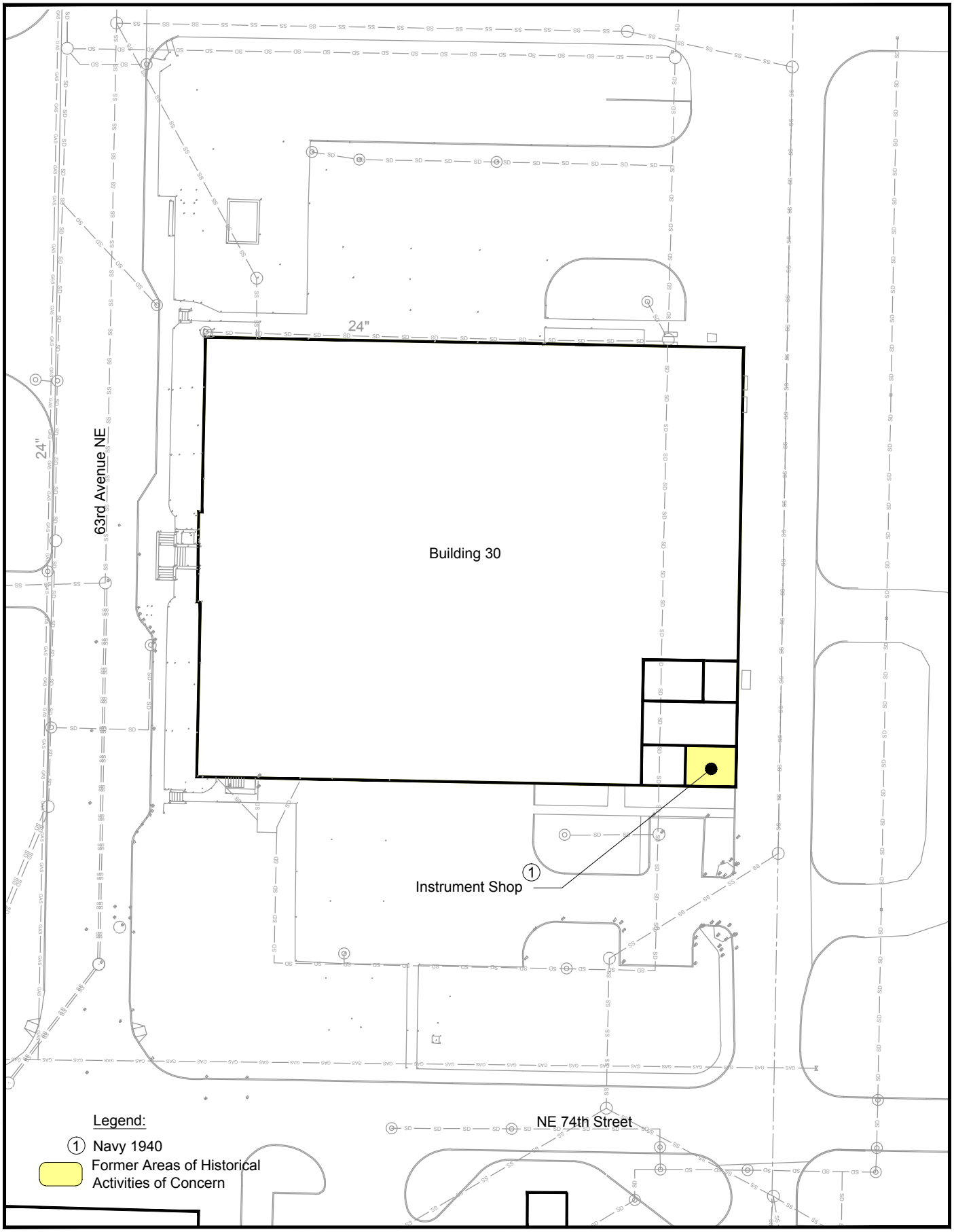
U.S. NAVY

Delivery Order 0076
NAVSTA PS Seattle, Washington
QUALITY ASSURANCE
PROJECT PLAN

J:\DCS\Projects\GIS\NAVY\MAGNUSON\DO 76\Work Plan\Fig 17-1 Site Map former NSPS.dwg
Mod: 03/01/2017, 15:38 | Plotted: 03/01/2017, 15:39 | sharon.hou



U.S. NAVY	0 2,000 4,000 SCALE IN FEET	**Figure 17-2** **Background Sediment Sample Locations**	Delivery Order 0076 NAVSTA PS Seattle, WA QUALITY ASSURANCE PROJECT PLAN



J:\DCS\Projects\GIS\NAVY\MAGNUSON\D0 76\Work Plan\Fig 17-3 Interior Survey Bldg 30.dwg
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U.S. NAVY

0 30 60
SCALE IN FEET

Figure 17-3
Building 30 Interior Survey Areas

Delivery Order 0076
NAVSTA PS Seattle, WA
QUALITY ASSURANCE
PROJECT PLAN

QAPP Worksheet #18. Sampling Locations and Methods

The primary value of this worksheet is as a completeness check for field personnel and auditors/assessors. It facilitates checks to make sure all planned samples have been collected and appropriate methods have been used. Soil and sediment sampling methods are specified in NAVFAC SOPs I-B-1 and I-B-8, respectively. The field measurements will be performed in accordance with NAVFAC SOP I-D-7 and Cabrera SOP OP-076, Soil Core Scanning.

Type	General Location/ Justification	Location ID Map	Coordinates		Depth			Field scan instrument	PROC					Analysis*		
			Northing	Easting	0-0.5	0.5-3	FS-1		Ra-226	Th-232	Cs-137	Sr-90	Pu-239	GS	GFPC	AS
Soil/ DPT	Near Building 30	B-72	252515.3398	1288686.1604	G	C	G	44-10	x	x				x		
Soil/ DPT	Near Building 30	B-73	252552.6456	1288795.3954	G	C	G	44-10	x	x				x		
Soil/ DPT	Near Building 30	B-74	252467.1704	1288844.7268	G	C	G	44-10	x	x				x		
Soil Field Duplicate	Near Building 30	B-74 dup	252467.1704	1288844.7268		C		44-10	x	x				x		
Soil/ DPT	Near Building 30	B-75	252351.2173	1288954.4652	G	C	G	44-10	x	x				x		
Soil/ DPT	Near Building 30	B-76	252275.3574	1288951.8868	G	C	G	44-10	x	x				x		
Soil/ DPT	Near Building 30	B-77	252204.601	1288842.6695	G	C	G	44-10	x	x				x		
Soil Field Duplicate	Near Building 30	B-77 dup	252204.601	1288842.6695			G	44-10	x	x				x		
Soil/ DPT	Former Building 15 area	B-78	249895.7653	1288211.7372	G	C	G	44-9				x	x		x	x
Soil Field Duplicate	Former Building 15 area	B-78 dup	249895.7653	1288211.7372	G			44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-79	249899.6361	1288249.3036	G	C	G	44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-80	249929.864	1288243.1283	G	C	G	44-9				x	x		x	x
Soil Field Duplicate if needed	Former Building 15 area	B-80	249929.864	1288243.1283		C		44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-81	249903.3633	1288298.3065	G	C	G	44-9				x	x		x	x
Soil Field Duplicate	Former Building 15 area	B-81 dup	249903.3633	1288298.3065	G			44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-82	249840.2143	1288305.078	G	C	G	44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-83	249875.4803	1288278.7357	G	C	G	44-9				x	x		x	x
Soil/ DPT	Former Building 15 area	B-84	249833.6751	1288259.6322	G	C	G	44-9				x	x		x	x
Sludge	S Building 2	CB 15	253064.6694	1288351.9405	G				x	x	x	x		x	x	
Sludge	S Building 2	CB 16	253063.0323	1288446.5639	G				x	x	x	x		x	x	
Sludge	E Building 30	CB-17	252367.2615	1288969.5052	G				x	x	x	x		x	x	
Sludge Field duplicate*	E Building 30	CB-17 dup	252367.2615	1288969.5052	G				x	x	x	x		x	x	
Sludge	N Building 30	CB-18	252469.0391	1288867.2768	G				x	x	x			x		
Sludge	NE Building 2	CB-19	253859.3145	1288878.8838	G				x	x	x	x		x	x	
Sludge	NE Building 2	CB-20	253801.2256	1288879.5299	G				x	x	x	x		x	x	
Sludge	NE Building 2	CB-21	253682.5021	1288879.3360	G				x	x	x	x		x	x	
Sludge	E Building 2	CB-22	253594.8018	1288874.8766	G				x	x	x	x		x	x	
Sludge	E Building 2	CB-23	253346.5720	1288603.9960	G				x	x	x	x		x	x	
Sludge Field duplicate*	E Building 2	CB-23-dup	253346.5720	1288603.9960	G				x	x	x	x		x	x	
Sludge	S Building 2	MH 152	253026.7622	1288283.0575	G				x	x	x	x		x	x	
Sludge	S Building 2	MH 153	253020.0653	1288311.3307	G				x	x	x	x		x	x	
Sludge	S Building 2	MH 110	254055.8129	1289055.1186	G				x	x	x	x		x	x	

Type	General Location/ Justification	Location ID Map	Coordinates		Depth			Field scan instrument	PROC					Analysis*		
			Northing	Easting	0-0.5	0.5-3	FS-1		Ra-226	Th-232	Cs-137	Sr-90	Pu-239	GS	GFPC	AS
Sludge	S Building 2	MH 112	253951.9975	1288952.0699	G				x	x	x	x		x	x	
Sludge	S Building 2	MH 113	253645.2673	1288950.3711	G				x	x	x	x		x	x	
Sludge	S Building 2	MH 114	253525.0286	1288887.0589	G				x	x	x	x		x	x	
Sludge	Inside Building 32	MH 116	253317.0894	1288882.6689	G				x	x	x	x		x	x	
Sludge	S Building 2	MH 119	253051.4746	1288584.5175	G				x	x	x	x		x	x	
Sludge	Near Building 30	MH-122	252573.648	1288871.321	G				x	x	x	x		x	x	
Sludge	Northeast of Building 283	OWS-283	254429.964	1288034.341	G				x	x	x	x		x	x	
Sediment	Lake Washington	LW-01	254923.4488	1287679.9571	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-02	254822.9596	1287791.737	G		G	44-10	x	x	x	x		x	x	
Sediment Field Duplicate	Lake Washington	LW-02 Dup	254822.9596	1287791.737			G		x	x	x	x		x	x	
Sediment	Lake Washington	LW-03	254472.3575	1288133.7193	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-04	254406.8523	1288209.8515	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-05	254320.0008	1288269.3834	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-06	254377.4344	1288346.4155	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-07	254240.117	1288409.3518	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-08	254479.9412	1288292.1764	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-09	254303.992	1288504.3034	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-10	254220.1436	1288671.4591	G		G	44-10	x	x	x	x		x	x	
Sediment	Lake Washington	LW-11	254131.2064	1289064.1684	G		G	44-10	x	x	x	x		x	x	
Sediment	Background	LW-12	275122.5549	1284277.4071	G		G	44-10	x	x	x	x		x	x	
Sediment	Background	LW-13	275145.8568	1285617.9944	G		G	44-10	x	x	x	x		x	x	
Sediment Field Duplicate	Background	LW-13 Dup	275145.8568	1285617.9944	G				x	x	x	x		x	x	
Sediment	Background	LW-14	275192.4603	1287669.6759	G		G	44-10	x	x	x	x		x	x	
Sediment	Background	LW-15	274143.8786	1287879.5069	G		G	44-10	x	x	x	x		x	x	

Notes:
* sludge duplicate may be changed based on the amount of sludge present in the catch basin.
AS - alpha spectroscopy
C - Composite sample
Cs-137 - cesium-137
DPT - direct push sampling technique
FS-1 - the 6-inch interval with the highest field count rate (between 6 inches below the top to the total depth sampled)
G - Grab Sample
GFPC - gas flow proportional counter
GS - gamma spectroscopy
PROC - potential radionuclides of concern
Pu-239 - plutonium-239
Ra-226 - radium-226
Sr-90 - strontium-90
Th-232 - thorium-232

QAPP Worksheets #19 and #30. Sample Containers, Preservation, and Hold Times Table

Laboratory contact information: Mike Franks, TestAmerica, 13715 Rider Trail North, Earth City, MO 63045; 314-298-8566; Mike.Franks@testamericainc.com

Back-up laboratory: TestAmerica Richland (to be arranged by Mike Franks, if needed)

Matrix	Isotope	Analyte Group	Method/SOP	Containers (number, size, and type)	Minimum Sample Volume	Preservation	Total Hold Time	Data Package Turnaround
Soil/ Sediment	Ra-226, Cs-137, Th-232	Gamma Spectroscopy	HASL 300 GA-01-R Gamma/ST-RD-0102	Single zip top bag with sufficient volume for all analyses	500 g	None	180 days	28 calendar days
Soil/ Sediment	Sr-90	Gas Flow Proportional Counter	HASL 300 SR-03-RC Sr-90/ST-RD-0403		5 g	None	180 days	28 calendar days
Soil/ Sediment	Pu-239	Alpha Spectroscopy	HASL 300 A-01-R Iso-Pu/ST-RD-0210		5 g	None	180 days	28 calendar days

Notes:
Acceptance of work with elevated activity levels is subject to approval by the laboratory/RSO. Please contact TestAmerica Earth City PRIOR to sending samples with elevated activity to ensure that the laboratory will accept them.

High Rad Level 1: Sample activity in the range of 1 to 5 µCi total alpha activity, **or** 5 to 10 µCi total beta/gamma activity **and/or** sample contact dose rate 1 to 5 mR/hr	**High Rad Level 2:** Sample activity in the range of 5 to 10 µCi total alpha activity **or** 10 to 25 µCi total beta/gamma activity **and/or** sample contact dose rate 5 to 15 mR/hr	**High Rad Level 3:** Sample activity in the range of >10 µCi total alpha activity **or** >25 µCi total beta/gamma activity **and/or** sample contact dose rate >15 mR/hr

g - gram
µCi - microcurie
mR/hr - milliroentgens per hour

QAPP Worksheet #20. Field Quality Control (QC) Sample Summary Table

Matrix	Isotopes	Analytical Method	Field samples	Field Duplicates[a]	Containers to lab
Soil	Ra-226, Th-232	GS	18	2	44
	Sr-90	GFPC	22	2	
	Pu-239	AS	22	2	
Sludge	Ra-226, Cs-137, Th-232	GS	57	6	63
	Sr-90	GFPC	57	6	
	Pu-239	AS	0	0	
Lake Sediment	Ra-226, Cs-137, Th-232	GS	30	2	32
	Sr-90	GFPC	30	2	
	Pu-239	AS	0	0	

[a]Field duplicate samples will be collected at a frequency of 10 percent

Notes:
AS - alpha spectrometry
GFPC - gas flow proportional counter
GS - gamma spectroscopy

QAPP Worksheet #21. Project Sampling SOPs (Continued)

1 **QAPP Worksheet #21. Project Sampling SOPs**

2 See Appendix A for SOPs.

SOP Number	Originating Organization	Title	Rev.	Date	SOP Option	Project Modified (Y/N)
I-A-1	NAVFAC	Planning Field Sampling Activities		Feb. 2015	N/A	No
I-A-6		Utility Clearance		Feb. 2015	N/A	No
I-A-7		IDW Management		Feb. 2015	N/A	No
I-A-8		Data Validation Planning and Coordination		Feb. 2015	N/A	No
I-A-9		General Field Operation		Feb. 2015	N/A	No
I-A-10		Monitoring/Sampling Location Recording		Feb. 2015	N/A	No
I-A-11		Sample Naming		Feb. 2015	N/A	No
I-B-1		Soil Sampling		Feb. 2015	N/A	No
I-B-8		Sediment Sampling		Feb. 2015	N/A	No
I-D-7		Field Parameter Measurements		Mar. 2015	N/A	No
I-F		Direct Push Sampling Techniques		Mar. 2015	N/A	No
I-G-2		GPS Surveying		Aug. 2014	N/A	No
II-A		DVP1 – Data Validation Reports		Mar. 2015	N/A	No
III-D		Logbooks		Apr. 2015	N/A	No
III-E		Record Keeping, Sample Labeling, and Chain-of-Custody Procedures		Apr. 2015	N/A	No
III-G		Sample Handling, Storage, and Shipping		Apr. 2015	N/A	No
III-I		Equipment Decontamination		Apr. 2015	N/A	No
III-J		Equipment Calibration, Operation, and Maintenance		Apr. 2015	N/A	No
IV-E		Auditing		Apr. 2015	N/A	No
IV-F		Nonconformance and Corrective Action		Apr. 2015	N/A	No

QAPP Worksheet #21. Project Sampling SOPs (Continued)

SOP Number	Originating Organization	Title	Rev.	Date	SOP Option	Project Modified (Y/N)
RP-2.0	URS Professional Solutions	Issuing RWPs and HWPs	0	9/23/2014	N/A	No
RP-3.0		Portable Survey Instruments	0	9/23/2014	N/A	No
RP-4.0		Radiation Surveys	0	9/23/2014	N/A	No
RP-5.0		Smear Counter Setup and Operation	0	9/23/2014	N/A	No
RP-6.0		Sample Collection, Handling, and Chain of Custody	0	9/23/2014	N/A	No
RP-7.0		Decontamination	1	1/15/2016	N/A	No
OP-001	Cabrera Services	Radiological Surveys	3	4/8/2013	N/A	No
OP-020		Operation of Contamination Survey Meters	1	4/12/2013	N/A	No
OP-021		Alpha-Beta Counting Instruments	1	4/12/2013	N/A	No
OP-358		Health Physics Instrument General Quality Control Procedure	1	8/27/2013	N/A	No
OP-376		Soil Core Scanning	2	7/9/2015	44-9 or 44-10	No
OP-387		Gamma Walkover Survey	0	3/7/2014	2"NaI	No

QAPP Worksheet #22. Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Photoionization detector (PID) (for Site Safety and Health Officer)	Calibration	Calibrate at the start of the day or anytime unstable readings occur.	Isobutylene at 100 ppm	Recalibrate. Return to vendor if equipment fails additional calibration attempts	Field Lead	NAVFAC III-J, Follow manufacturer's instructions.
Gamma Surveys Ludlum Model 44-10 probe coupled with a Ludlum 2221 meter or equivalent meter probe combination	Calibration	Annually	Date of calibration is within a year	Return to Calibration Vendor	Site Radiation Safety Officer, Subcontractor Lead	OP-020, Operation of Contamination Survey Meters, Rev.1
	Operational checks	Daily	See Cabrera SOP OP-020, Operation of Contamination Survey Meters	Replace batteries. Send for repair and recalibration.	Health Physicist Technicians	
Alpha, beta gamma Surveys Ludlum Model 44-9 probe coupled with a Ludlum 2221 meter or equivalent meter probe combination	Calibration	Annually	Date of calibration is within a year	Return to Calibration Vendor	Site Radiation Safety Officer, Subcontractor Lead	OP-020, Operation of Contamination Survey Meters, Rev.1
	Operational checks	Daily	See Cabrera SOP OP-020, Operation of Contamination Survey Meters	Replace batteries. Send for repair and recalibration.	Health Physicist Technicians	
Alpha beta Surveys Ludlum Model 43-93 probe coupled with a Ludlum 2360 meter or equivalent meter probe combination	Calibration	Annually	Date of calibration is within a year	Return to Calibration Vendor	Site Radiation Safety Officer, Subcontractor Lead	OP-021, Alpha-Beta Counting Instrumentation Rev 1
	Operational checks	Daily	See Cabrera SOP OP-020, Operation of Contamination Survey Meters	Replace batteries. Send for repair and recalibration.	Health Physicist Technicians	

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Floor Monitor Ludlum Model 43-37 probe coupled with a Ludlum 2360 meter or equivalent meter probe combination	Calibration	Annually	Date of calibration is within a year	Return to Calibration Vendor	Site Radiation Safety Officer, Subcontractor Lead	OP-021, Alpha-Beta Counting Instrumentation Rev 1
	Operational checks	Daily	See Cabrera SOP OP-020, Operation of Contamination Survey Meters	Replace batteries. Send for repair and recalibration.	Health Physicist Technicians	
Low energy Gamma Alpha Spectra G-5 FIDLER probe coupled with a Ludlum 2221 meter or equivalent meter probe combination	Calibration	Annually	Date of calibration is within a year	Return to Calibration Vendor	Site Radiation Safety Officer, Subcontractor Lead	OP-020, Operation of Contamination Survey Meters, Rev. 1
	Operational checks	Daily	See Cabrera SOP OP-020, Operation of Contamination Survey Meters	Replace batteries. Send for repair and recalibration.	Health Physicist Technicians	
Alpha Beta Smear samples Ludlum Model 2929 with a Ludlum 43-10-1 detector.	Calibration	Annually	Within the last year	Return to Calibration Vendor	Site Radiation Safety Officer, Subcontractor Lead	OP-021, Alpha-Beta Counting Instrumentation Rev 1
	Operational checks	Daily	See Cabrera SOP OP-021, Alpha-Beta Counting Instrumentation Rev 1	Replace batteries. Send for repair and recalibration.	Health Physicist Technicians	

QAPP Worksheet #23. Analytical SOPs References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis[a]	Modified for Project Work?
ST-RD-0102	Gamma Vision Analysis, Rev. 13, 6/22/2015	Definitive	Soil, Sludge and Sediment Gamma Spec. (Radium-226, Cesium-137, Thorium-232)	HPGe Gamma Spectroscopy System	TestAmerica Earth City	No
ST-RD-0403	Low Background Gas Flow Proportional Counting System Analysis, Rev.16, 05/5/2015	Definitive	Soil, Sludge and Sediment Strontium-90	Gas Flow Proportional Counter	TestAmerica Earth City	No
ST-RD-0210	Alpha Spectroscopy Analysis, Rev. 12, 4/24/2015	Definitive	Soil, Sludge and Sediment Alpha Spec. (Plutonium-239)	Alpha Spectroscopy	TestAmerica Earth City	No

[a]Copies of certificates of accreditation for U.S. Department of Defense Environmental Laboratory Accreditation Program are presented in Appendix C

QAPP Worksheet #24. Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Gas Flow Proportional Counter (TestAmerica)	• Plateau generation and/or verification • Discriminator setting • Initial long background count • Mass attenuated efficiency calibration • Eight source dual/single calibration curves	Annual	• Plot efficiencies vs masses • Calculate equation of curve – degree ≤3 • Remove outliers >15% deviation from theoretical values but not more than 20% of total points • Calculate coefficient of determination (R^2). R^2 must be ≥0.9 • Verify calibration with second source standard count – must be within 30 percent of true value and mean across all detectors <10%	• Recalibrate • Instrument maintenance • Consult with Technical Director	Group Leader	ST-RD-0403

QAPP Worksheet #24. Analytical Instrument Calibration Table (Continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Gamma Spectrometer (TestAmerica)	1. Energy calibration 2. Full width at half-maximum (FWHM) calibration	1. Annual 2. Annual	For Energy and FWHM calibration: • Within 0.5% or 0.1KeV for all calibration points • Within 8% for all calibration points • Verify with second source that always contains at least Am-241, Co-60, and Cs-137 • Must be ± 10%D for each nuclide	• Recalibrate • Instrument maintenance • Consult with Technical Director	Group Leader	STD-RD-0102

QAPP Worksheet #24. Analytical Instrument Calibration Table (Continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Alpha Spectrometer (TestAmerica)	1. Energy calibration 2. Efficiency calibration and background check 3. Subtraction spectrum, 4. Pulser check and background check	1. Monthly 2. Monthly 3. Monthly 4. Daily	1. Three isotopes in 3-6 MeV range all within ± 40 KeV of expected value 2. >20% 3. Ultra Low Level: < 2 CPM Low Level: < 2-4 CPM Routine Level: < 4-10 CPM High Level: < 10-20 CPM 4. Pulser energy, peak centroid, peak resolution, peak area, calibration and background must pass statistical "boundary" out-of-range test	• Recalibrate • Instrument maintenance • Consult with Technical Director If background check is > 20 CPM, then detector requires maintenance	Group Leader	ST-RD-0210

1

QAPP 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
Gas Flow Proportional Counter (TestAmerica)	1. Clean instrument, physical check 2. Inspect windows 3. QA check, background source count	1. Daily 2. High counts and/or background 3. Daily	1. None applicable 2. No physical defects 3. Within 3 sigma of 20 day population	• Recalibrate • Instrument maintenance • Consult with Technical Director	Analyst	ST-RD-0403
Gamma Spectrometer (TestAmerica)	1. Clean cave; fill dewar with N_2; physical check 2. QA check; background source count	1. Weekly 2. Daily	1. Acceptable background 2. Within 3 sigma of measured population	• Recalibrate • Instrument maintenance • Consult with Technical Director	Analyst	ST-RD-0102
Alpha Spectrometer (TestAmerica)	Clean planchette holders; physical check	Monthly	Acceptable background and calibration efficiencies	• Recalibrate • Instrument maintenance • Consult with Technical Director	Analyst	ST-RD-0210

QAPP Worksheets #26 and 27. Sample Handling, Custody, and Disposal

This worksheet is used to document responsibilities for maintaining custody of samples from sample collection through disposal.

Sampling organization: URS/ Subcontractor Cabrera

Laboratory: TestAmerica Earth City, MO

Method of sample delivery (shipper/carrier): Commercial Courier (FedEx Air Cargo)

Number of days from reporting until sample disposal: 180 days

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample labeling	Cabrera Subcontractor Lead	III-E
COC form completion	URS Field Lead	III-E
Packaging	URS Field Lead	RP-06
Shipping coordination	URS Field Lead	RP-06
Sample receipt, inspection, and log in	TestAmerica Earth City Laboratory Sample Custodian	ST-PM-0002
Sample custody and storage	TestAmerica Earth City Laboratory Sample Custodian	ST-PM-0002
Sample disposal	TestAmerica Earth City Laboratory Sample Custodian	ST-HS-0004

QAPP Worksheet #28. Analytical Laboratory Quality Control (QC) and Corrective Action

Worksheet #12, Measurement Performance Criteria Table, provides details on the required QC samples, frequency, method acceptance criteria together with the project-specific measurement performance criteria. Sample data may be qualified in accordance with data validation guidelines if associated field and/or lab QC sample data are outside acceptable precision and accuracy limits.

QAPP Worksheet #29. Project Documents and Records

Record	Generation	Verification	Storage Location/Archival
Field records: • Field logbooks • Daily QC reports • COC records/forms • Instrument calibrations • Daily source checks • QAPP deviations • Communications • Reports • Photographs	URS Field Lead/ CQC System Manager	URS PM	Maintained at URS' office until completion of the project. Copy of field forms submitted to NAVFAC Northwest for 50-year archive at NARA.
Laboratory analytical records: • Raw and summary data • COC • Sample receipt forms • Sample and instrument logs	TestAmerica Earth City	URS PM	Maintained in PDF format at URS' office until completion of the project. Hard copy submitted to NAVFAC Northwest for 50-year archive at NARA.
Data assessment and QA records: • Data validation report • Independent technical review forms • Corrective action communications • Reports	Data Validator and URS Field Lead/ CQC System Manager	URS PM	Maintained at URS' office until completion of the project. Hard-copy data validation report submitted to NAVFAC Northwest for 50-year archive at NARA.
Reports: • Draft and final reports • Communications of progress and deviations	URS Field Lead and URS RSO	URS PM	Maintained at the URS' office or archive facility for the time frame specified by NAVFAC Northwest-issued contract under which this plan is executed.

Note: NARA – National Archives and Records Administration

QAPP Worksheet #31. Planned Project Assessments Table

Assessment Type[a]	Responsible Party and Organization	Number and Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Readiness review	URS Field Lead	Once	Start of field work	Memorandum	24 hours following assessment
Field assessment of definable features of work including mobilization/Site preparation; gamma walkover surveys and location mapping; soil and sediment sampling; Site restoration and demobilization; and IDW management and disposal (refer to Table 7-1 in the Contractor Quality Control Plan).	URS RSO	Once	During field work	Memorandum	24 hours following assessment
Management review	URS PM	Once	Completion of field work	Memorandum	48 hours following review

[a]No laboratory assessment is planned. The laboratory is accredited by the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).

QAPP Worksheet #32. Assessment Findings and Corrective Action Responses

Corrective actions will be defined by the URS PM and QA Manager. The NAVFAC Northwest RPM will be informed of nonconformances and corrective actions as soon as possible and apprised of any issues that impact project objectives, schedule, or budget. If any nonconformances are found in the field procedures, sample collection procedures, field documentation procedures, laboratory analytical and documentation procedures, or data evaluation and quality review procedures, the impact of those nonconformances on the overall project QA objectives will be assessed. Appropriate actions, including recalibration of equipment, preparation of documentation for deviations, reanalysis, and potentially resampling of a sample location, may be recommended by the URS Project Manager so that the project objectives can be accomplished.

If a nonconformance in field sampling is identified via a field audit or other mechanism, the nonconformance will be recorded in the field book and immediately reported to the URS PM and the NAVFAC Northwest RPM. Corrective actions will be determined by the URS Field Lead and PM for NAVFAC Northwest RPM approval. Approved corrective actions will be documented in the field logs and the report of findings.

Upon completion of the corrective action, the URS QA Manager will evaluate the adequacy and completeness of the action taken. If the action is found to be inadequate, the URS QA Manager and PM will confer to resolve the problem and determine any further actions.

Implementation of any further action will be scheduled by the URS PM. The URS QA Manager will issue a suspend or stop-work notice with the concurrence of the URS PM and the NAVFAC Northwest RPM in cases where significant problems continue to occur or a critical situation requires work to prevent further discrepancies, loss of data, or other problems. When the corrective action is found to be adequate, the URS QA Manager will notify the URS PM of the completion of the corrective action and verification.

QAPP Worksheet #33. QA Management Reports Table

Assessment Type	Responsibility for Responding to Assessment Findings	Assessment Response Documentation	Time frame for Response	Responsibility for Implementing Corrective Action	Responsible for Monitoring Corrective Action Implementation
Readiness review	URS PM	Once	Start of field work	Memorandum	URS QA Manager
Field assessment of definable features of work including mobilization/Site preparation; gamma walkover surveys and location mapping; soil and sediment sampling; Site restoration and demobilization; and IDW management and disposal (refer to Table 7-1 in the Contractor Quality Control Plan).	URS /RSO	Refer to Table 7-1, Site Inspection Plan, in Contractor Quality Control Plan	During field work	Memorandum	URS QA Manager
Management review	URS PM	Once	Completion of field work	Memorandum	URS QA Manager

QAPP Worksheet #34. Data Verification and Validation Inputs

Item	Description	Verification (Completeness)	Validation (Conformance to Specification)
Planning Documents/Records			
1	Contract	X	
2	Approved QAPP	X	
3	Field SOPs	X	
4	Laboratory SOPs	X	
Field Records			
5	Field logbooks	X	X
6	Equipment calibration records	X	X
7	COC forms	X	X
8	Sampling forms	X	X
9	Boring logs	X	X
10	Field audit reports	X	X
11	Field corrective action reports	X	X
Analytical Data Package			
12	Cover sheet	X	X
13	Case narrative	X	X
14	Sample receipt records	X	X
15	LOD/LOQ establishment and verification	X	X
16	Standards traceability	X	X
17	Instrument calibration records	X	X
18	Definition of laboratory qualifiers	X	X
19	Results	X	X
20	QC samples	X	X
21	Corrective action reports	X	X
22	Electronic data deliverable	X	X

QAPP Worksheet #35. Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field logbooks and field forms	QAPP/SOP	The logbooks and forms will be reviewed for proper daily entries, such as dates, names of personnel, and weather, and for completeness. In addition, items not understood will be reviewed with the author and updated to clarify.	URS Field Lead URS PM
COC forms		COC forms will be reviewed against cooler contents. The COC will be signed and the original shipped to the laboratory within the cooler. The copy will be kept in project files.	URS Field Lead or Project Chemist
Sample acknowledgment		The sample acknowledgment generated by the laboratory will be reviewed against the COC form for accuracy and for potential analytical issues.	Laboratory QA PM URS Project Chemist
Laboratory data package		Prior to submittal to URS, the laboratory will review the laboratory data and associated pages for completeness and technical readiness.	Laboratory QA PM
Laboratory data package/electronic data		The laboratory data and electronic data will be reviewed by URS to confirm that all sample analyses requested have been provided and the required information for validation has been included in the data package. The URS project chemist and/or data manager will also compare the electronic data to the hard-copy report for consistency. The URS CHP/HP/RSO personnel will review the data for preliminary findings and confirmation of validity of results.	URS Project Chemist URS Data Manager URS CHP/HP/RSO Data validation firm
Data validation report		The data validation report will be reviewed to confirm data qualifiers are applied correctly and adequate explanation is provided	URS Project Chemist

QAPP Worksheet #36. Analytical Data Validation Procedures

Data Validator:
Pyron Environmental
Mingta Lin
360-867-9543

Analytical Group	Gamma Spec (Ra-226, Th-232, Cs-137)	Gas Flow Proportional Counting (Sr-90)	Alpha Spec (Pu-239)
Analytical Method	HASL 300 GA-01-R Gamma/ST-RD-0102	HASL 300 SR-03-RC Sr-90/ST-RD-0403	HASL 300 A-01-R Iso-Pu/ST-RD-0210
Data Deliverable Requirements:	Full Stage IV	Full Stage IV	Full Stage IV
Analytical Specifications	Worksheet #23 and Laboratory SOPs in Appendix A	Worksheet #23 and Laboratory SOPs in Appendix A	Worksheet #23 and Laboratory SOPs in Appendix A
Measurement Performance Criteria	Worksheet #12	Worksheet #12	Worksheet #12
Percent of Data Packages to Be Validated	100%	100%	100%
Percent of Raw Data Reviewed	10%	10%	10%
Percent of Results to Be Recalculated	10%	10%	10%
Validation Code	S4VM	S4VM	S4VM

Notes:
List of data qualifiers to be applied during data validation by a third party. Potential impacts on project-specific data quality objectives will be discussed in the data validation report that will be included in the Final SI report.

S4VM – Stage 4 Validation Manual; Source: EPA 540-R-08-005, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use;* 13 January 2009.

QAPP Worksheet #37. Data Usability Assessment

The data analysis for the sampling event will include a data usability assessment, wherein all data generated will be reconciled with the project objectives. The assessment will describe the initial project objectives and summarize any changes made to the objectives as the project progresses. The rationale for the changes will be discussed, together with any consequences of these changes. The assessment will describe any limitations on the use of the data and how issues were resolved. The assessment will also summarize the procedures used to define data usability (i.e., data reviews or validation reports) and the results of these procedures. The URS Project Chemist, URS CHP/HP/RSO personnel, and PM will be responsible for assessment of radiological sample data and determining data usability. The usability assessment will be included in the project report.

Field measurements and data will be reviewed to determine that the instruments were appropriately calibrated, measurements were collected properly, and the data appear reasonable for the field conditions encountered.

Analytical data will be assessed for precision and accuracy by the independent data validator, and the validator's assessment will be reviewed by the URS Project Chemist. The data assessment criteria for precision and accuracy are described in Worksheets #12, #18, and #24 of this QAPP. Data validation checklists will be completed by the independent data validator to verify that all required data quality criteria have been reviewed.

Ninety-five percent completeness for acceptable analytical data is required. However, the project team will determine the impact to the project objectives if 95 percent completeness is not achieved. Completeness is defined as the percentage of measurements judged to be valid (i.e., a calculation of the number of valid analyte results/number of possible results times 100). The representativeness of the data will be evaluated based on compliance with the sampling design. Comparability of the laboratory analytical data will be evaluated by the URS Project Chemist and/or independent data validator via review of the analytical data packages, laboratory SOPs, and laboratory certifications to confirm that the laboratory holds the appropriate certifications, approved preparation and analytical methods are used, and the analytical data packages contain all of the elements required for full independent data validation.

Generally, data that do not meet the established acceptance criteria are usable but may have specified limitations. However, in some severe cases, data that do not meet acceptance criteria are not usable; resampling or reanalysis may be necessary in these cases. Data that are indicated as usable with limitations are included in the project reports, but are clearly indicated as having limited usability. Indicators of data limitations include data qualifiers, quantitative evaluations, and narrative statements regarding potential bias. The definition of data qualifiers will be included in all data validation reports and an all data summary tables.

REFERENCES

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U.S. Environmental Protection Agency (USEPA). 2014. *Preliminary Remediation Goals (PRGs) for Radionuclides*. May 2014. Available at http://epa-prgs.ornl.gov/radionuclides.

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APPENDIX A

Applicable Standard Operating Procedures

NAVFAC Standard Operating Procedures

Cabrera Standard Operating Procedures

URS Professional Solutions Standard Operating Procedures

Test America Standard Operating Procedures

URS Professional Solutions

Memorandum

Date: January 11, 2016

To: Radioactive Materials License UT1800410 File

From: Amy Robin Jones

Subject: **Review and Approval of Cabrera Procedures for work under UT1800410**

The Site Investigation work at the Former Naval Station Puget Sound will be done under the URS Radioactive Materials License (RML) UT1800410, which will be the basis for reciprocity with the Washington Department of Health, Division of Radiation Protection. Work under the URS RML is done in accordance with URS Radiation Protection Procedure.

Cabrera Services will be working as a subcontractor for this work. As the Radiation Safety Officer for the URS RML license, I have reviewed the Cabrera procedures and determined that for radiation protection activities assigned to Cabrera, the equivalent Cabrera Services procedures and forms may be substituted for the URS procedures. The table below details the approved equivalent procedures. Additionally Cabrera OP-358 "Health Physics Instrument General Quality Control Procedure", Rev 1, 8/27/2013, which provides overall direction on instrument operations is consistent with the requirements of the URS program and approved RP procedures.

URS RP Procedure	**Equivalent Cabrera Services Procedure**
RP-03, "Portable Radiation Instruments," Rev. 0, dated 9/23/2014	OP-020, "Operation of Contamination Survey Meters," Rev. 1, dated 4/12/2013
RP-04, "Radiation Surveys," Rev. 0, dated 9/23/2014	OP-001, "Radiological Surveys," Rev. 3, dated 4/8/2013
RP-05, "Smear Counter Setup and Operations," Rev. 0, dated 9/23/2014	OP-021, "Alpha-Beta Counting Instrumentation," Rev. 1, dated 4-12-2013

cc: file

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

RADIOLOGICAL SURVEYS

OP-001

Revision 3.0

Reviewed by:

David Wunsch, Quality Assurance Manager — 4/8/13 Date

Approved by:

Henry Siegrist, CHP, PE, Radiation Safety Officer — 4/8/13 Date

1.0 PURPOSE

The purpose of this procedure is to establish the framework and to define the requirements for Cabrera Services Inc., (CABRERA) personnel performing radiological surveys. Adherence to this procedure will provide reasonable assurance that the radiological surveys performed yeild reproducible results. In addition, adherence to this procedure will provide adequate control of radiation exposures As Low As Reasonably Achievable (ALARA).

2.0 APPLICABILITY

2.1 This procedure provides the requirements and general guidelines for identifying, scheduling, and performing routine, radiation, contamination, and airborne surveys by radiation safety personnel. Remediation and facility areas that are radiologically controlled (restricted areas) due to the potential for fixed or transferable contamination are considered for routine survey performance.

2.2 The following types of surveys may be performed using this procedure:

- Surveys for shipping radioactive materials (Department of Transportation [DOT] regulations may require additional consideration).
- Surveys performed to characterize facilities, sites, and/or release items potentially contaminated with radioactive materials from restricted areas.
- Surveys performed to provide information used to guide or direct decontamination and decommissioning of facilities and sites.

2.3 This procedure does not include survey requirements for radiation generating devices and survey requirements specified in radiation work permits (RWPs).

2.4 Approved work plans may require more or fewer surveys and controls to be applied at the site than described in this procedure.

3.0 DEFINITIONS

3.1 Radiological Control/Restricted Area – An area to which access is controlled to protect individuals against undue risks from exposure to radiation and radioactive materials.

3.2 Contamination Survey – A survey technique to determine fixed and removable radioactive contamination on components and facilities.

3.3 Radiation Survey – An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

3.4 As Low As Reasonably Achievable (ALARA) – An approach to radiation exposure control to maintain personnel exposures as far below the federal limits as the technical, economical and practical considerations permit.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Instruments used to perform routine surveys should be operated in accordance with the respective operating procedures or manufacturer's recommendations.

4.1.2 Large area smears (LAS) may be used to augment (but not replace) the one hundred square centimeter (100 $cm^{2)}$ smear survey. LAS may be counted with a Ludlum Model 3 and 44-9 probe or Ludlum Model 2224-1 and 43-93 probe or equivalent. LAS are used to obtain immediate information concerning loose contamination for the purpose of radiological protection and to minimize time spent performing smears on an item easily identified as contaminated.

4.1.3 Personnel performing routine surveys must be logged in on a RWP in accordance with AP-012, *Radiation Work Permits* (if applicable).

4.1.4 Audible response instruments should be used during direct scan surveys.

4.1.5 The instruments used for routine surveys must be within current calibration and must have had a performance test check performed daily, or before use, in accordance with the instrument's operating procedure.

4.2 Limitations

4.2.1 The maximum probe speed during direct scan surveys of surfaces must be 3 centimeters per second (cm/sec).

4.2.2 The probe face must be held within ¼ inch of the surface being surveyed for alpha radiation, and within ½ inch of the surface being surveyed for beta-gamma radiation.

4.2.3 If an instrument used to perform routine surveys fails operational checks, it will be removed from service. Data collected during the period of instrument failure must be evaluated by the Radiation Safety Officer (RSO) or duly authorized representative.

4.2.4 Posting of radiological control areas must be performed in accordance with OP-019, *Radiological Posting*.

4.3 Requirements

4.3.1 Individuals performing surveys will obtain and review any previous surveys performed in the area, or on the object, to determine radiation conditions that may be encountered.

4.3.2 Only qualified individuals will perform surveys. Qualification will be determined on a case-by-case basis by the Project Manager, Radiation Safety Officer or their duly authorized representative. Qualification considers prior training, experience, and certifications such as Radiation Protection Technician or National Registry of Radiation Protection Technologists.

4.3.3 Survey samples must be analyzed in a low-background area, whenever practical, to ensure achieving the required sensitivity of measurements.

4.3.4 At a minimum, dose rate surveys must be performed in locations where workers are exposed to radiation levels that might result in: radiation doses in excess of 10% of the occupational dose limits – or – where an individual is working in a dose rate area of 2.0 millirem per hour (mrem/hr), or more.

4.3.5 Prevent access to unrestricted areas if contamination is found and immediately notify the RSO or duly authorized representative.

5.0 EQUIPMENT

5.1 Radiation and Contamination survey meters will be selected based on job specific requirements and be identified in the Site Work Plans.

5.2 Instruments used to perform routine surveys will be used in accordance with the applicable CABRERA administrative and operational procedures.

5.3 Authorized suppliers of properly calibrated and maintained equipment will supply/calibrate instruments; although equipment counting efficiencies may be determined by qualified CABRERA personnel.

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) - The PM is responsible for ensuring that personnel assigned the task of performing routine surveys are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

6.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in performing radiation and contamination surveys. The RSO can also assist in the interpretation of the results obtained during surveys.

6.3 Site Radiation Safety Lead (SRSL) - During field assignments, the SRSL is responsible for ensuring that this procedure is implemented. When the RSO is not on site, the SRSL will act as the RSO's duly authorized representative for radiological issues.

6.4 Radiation Protection Technicians (RPT) - The RPT performing radiation and contamination surveys are responsible for understanding and complying with this procedure.

7.0 PROCEDURE

7.1 Safety Considerations

The safety requirements specified in the job specific Health and Safety Plans (HASPs) and work plans, the Radiation Safety Program (RSP), and other safety documentation must be adhered to when performing surveys.

7.2 Initial Preparations

Obtain and review any previous surveys performed in the area to determine radiation conditions that may be encountered.

7.2.1 Obtain appropriate survey instruments and assure daily quality control (QC) checks have been performed prior to instrument use.

7.2.2 Obtain necessary forms, smears, and protective clothing, which will be used during the survey.

7.2.3 Plan any strategy for performing the survey before entering the area to reduce exposure time within the area.

7.2.4 If smearable contamination is expected to be above allowable limits, set up an entry/exit area which will prevent the spread of contamination.

7.3 Radiation Surveys

7.3.1 If radiation levels are unknown or previous surveys remain in question, first measure general area radiation levels using a Micro-R Meter or equivalent dose rate meter to determine if elevated radiation levels exist in the survey area.

7.3.2 Small Areas/Items/Containers – This survey technique is used to establish exposure rates from small areas, items, or containers that contain radioactive materials.

- Scan the entire surface area of the area, item, or container with a Micro-R or equivalent meter and record locations and readings on the Survey Form, in Attachment B, or an equivalent form.

- Measure the exposure rate at 30 centimeters from all surfaces or sides of the area, item, or container and record the location and readings on the Survey Form, in Attachment B, or an equivalent.
- Large waste containers used for shipment of bulk quantities of soil debris etc., may have a single dose rate measurement per accessible side of the container for ALARA purposes. DOT regulations may require additional dose rate measurements prior to shipping which is not covered by this procedure. Note readings on the Survey Form or an equivalent.

7.3.3 Facility Surveys – This survey technique may be used to release facilities (buildings, etc.) to "unrestricted" status or to determine the status of facilities requiring decontamination and decommissioning. Final release of a facility will be established using the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance.

- Establish a 1 meter by 1 meter grid system [or another work plan-approved grid] for the facility surfaces and use a marking system that assigns a unique number/letter to the center of each grid section. Graphically illustrate the location of the grid system on the Survey Form, in Attachment B, or an equivalent.
- Using a Micro-R Meter or equivalent obtain radiation levels at 1 meter from the grid center point and at contact with the grid center point. Record the reading on the Survey Form, in Attachment B, or an equivalent. If elevated readings are noted, scan the surface of the grid and note the location of any elevated readings with a marker on the form.
- Obtain Micro-R or equivalent readings from locations surrounding the facility, or within the facility, which do not contain activity. This establishes a background level for comparison to the reading taken above.

7.3.4 Area Surveys – This survey technique may be used to release land masses to "unrestricted" status or determine status of areas requiring decontamination before release. Final release of a site area will be established using MARSSIM guidance

- Establish a 10 meter by 10 meter grid system of the area to be surveyed [or another approved grid as provided by the work plan] using surveyor stakes or equivalent, which are numbered with a unique number/letter to identify the center of each grid. List the locations of the "gridded" system on the Survey Form or an equivalent.
- Using a Micro-R meter or equivalent, obtain radiation levels at 1 meter above the ground surface in the center of the grid. Record all readings on the Survey Form or an equivalent.

- Survey the remainder of the grid at the surface using an “S” pattern for the instrument. If elevated readings are noted above or below the grid center point reading, subdivide the grid into additional sub-grids and obtain readings at 1 meter above the ground surface. Record all readings on the Survey Form or an equivalent.

7.4 Contamination Surveys

7.4.1 If removable contamination is suspected or previous surveys are in question, first scan likely contaminated areas with an alpha (α) and/or beta (β) probe and determine if elevated areas of contamination exists. Obtain smear samples from any elevated areas and count smears in sample counter. If smearable contamination above limits set for the job is found, use appropriate protective clothing and entry control techniques to prevent the spread of contamination.

7.4.2 Small Areas/Items/Containers – This survey technique is used to establish total and transferable contamination levels on small areas, items, or containers, which contain radioactive materials.

- If the area, item, or container contains alpha activity, scan the area with an alpha probe at ¼ inch above the surface. Note total (fixed plus transferable) contamination readings on the Survey Form or an equivalent.
- If the area, item, or container contains beta activity, scan the area with a beta probe at approximately ½ inch above the surface to be surveyed and obtain reading following meter stabilization. Record meter reading on the Survey Form or an equivalent. The surface of a container can only be directly surveyed for beta activity if the radiation level from the container does not significantly elevate the beta probe background. Note total (fixed plus transferable) contamination readings on the Survey Form or an equivalent.
- Provide transferable smear contamination survey on the area, item or container by performing 100 cm^2 smears, at routine intervals, on the subject area, item, or container.
- Large waste containers used for shipment of bulk quantities of material will have one or more contact readings taken at routine intervals on the accessible sides of the container. Note total (fixed plus transferable) contamination readings on the Survey Form or an equivalent. **Note:** DOT regulations may require additional survey points.
- For large waste containers used for shipment of bulk quantities of material for disposal (or other large items such as soil moving equipment), determine the transferable surface contamination by taking LAS. Use Masslinn cloth or equivalent material to obtain a

LAS representative of the potentially contaminated area. Count the LAS, in a low background area, using alpha and beta detection equipment. If no transferable contamination above limits is found on the LAS, take several confirmatory 100 cm^2 smears at routine intervals on the object and count smears for alpha and beta activity. Record results on the Survey Form or an equivalent. **Note:** DOT regulations may require additional survey points.

Note: The presence of activity above transferable limits on a LAS signifies potential contamination. Determine actions to be taken with the RSO or SRSL.

7.4.3 Facility Surveys – This survey technique is used to aid in the release of facilities (buildings etc.) to "unrestricted" status or determine status of facilities requiring decontamination and decommissioning. Final release of a facility will be established using MARSSIM guidance.

- The grid system established in Section 7.3.3 will also be utilized for contamination surveys.
- Hold the beta probe at approximately ½ inch above the grid center point and obtain reading following meter stabilization. Record the meter reading on the Survey Form or an equivalent.
- If the readings are at background levels, randomly scan the remainder of the grid, concentrating on cracks, floor/wall joints, top of horizontal surfaces, ventilation ducts and grills, and other areas that might collect radioactive materials. Mark any locations above the release criteria on the Survey Form or an equivalent.
- If readings are at or near the release levels, scan grid surface and identify the portion of the grid that is above the release criteria. Note these areas on the survey form and mark the area of the grid with spray marker (or equivalent) on the Survey Form or an equivalent. Repeat steps 8.3.4 with an alpha probe at ¼ inch above the grid center point. If sufficient documentation of previous history is known about the facility and contamination is known not to be present, the alpha survey may not be required.
- One smear sample from a 100 cm^2 area will be taken in each grid. If the above survey found no elevated readings in the grid, the smear sample will be taken in the center of the grid. If elevated levels readings are identified the smear sample will be taken from the area where the highest reading was obtained.
- Each smear sample will be labeled with the grid location and counted for alpha and beta activity in the sample counter. The smear sample results will be recorded on the Survey Form or an equivalent.

7.4.4 Area Surveys – This survey technique is used to aid release of land masses to "unrestricted" status or determine status of area requiring decontamination before release. Final release of a facility will be established using MARSSIM guidance.

- The grid system established in Section 7.3.4 will be utilized for contamination surveys.
- Hold the beta probe at ½ inch above the grid center point and obtain reading following meter stabilization. Record the meter reading on the Survey Form or an equivalent.
- If readings are at background levels, randomly scan the remainder of the grid. Mark any locations above release criteria on the Survey Form or an equivalent.
- If readings are at or near the release levels scan the grid surface and identify portion of the grid that is above release criteria. Note these areas on the Survey Form or an equivalent.
- Areas contaminated with radioactive materials may require soil sample analysis to determine the activity concentration. The quantity and location of samples will be determined on a case-by-case basis.

7.5 Frequency and Requirements for Routine Surveys

Appropriate routine radiological surveys will be performed at the following frequencies as a minimum:

7.5.1 Radiation Surveys

- Upon initial entry after extended periods of closure,
- Daily, at contamination control points, where the potential exists for personnel to be exposed to dose rates greater than 2 mrem/hr,
- Daily, during continuous operation, and when levels are expected to change,
- Weekly, in routinely occupied areas adjacent to radiological control areas with dose rates greater than 2 mrem/hr,
- Weekly for operating High Efficiency Particulate Air (HEPA)-filtered ventilation units,
- Weekly, for any temporary Radiation Area boundaries to ensure that the Radiation Areas do not extend beyond posted boundaries, and
- Monthly, or upon entry if entries are less than monthly, for Radioactive Material Storage Areas.

7.5.2 Contamination Surveys

- Daily, at contamination control points from areas exhibiting contamination above surface contamination limits for the job site,
- Daily, in office spaces located in the radiological control areas,
- Weekly in lunchrooms or eating areas adjacent to radiological control areas,
- Weekly, in routinely occupied locker rooms or the shower areas adjacent to radiological control areas associated with site radiological work,
- Weekly, or upon entries, if entries are less frequent, in the areas where radioactive materials are handled or stored, and
- Weekly for all project offices on site.

7.5.3 Airborne Surveys

Airborne survey frequency, locations, and methods are determined by the RWPs and by the RSO/SRSL.

7.6 Identifying and Scheduling Routine Radiological Surveys

7.6.1 To assist in assuring surveys are scheduled, the RSO or duly authorized representative will identify and schedule routine surveys, as required by the radiological conditions and work activities.

7.6.2 Routine Survey Schedules or equivalent should be developed using a standard system for designating surveys such as:

Frequency of Survey	
• Daily	D
• Weekly	W
• Monthly	M
• Quarterly	Q
• Semi-Annually	S
• Annually	A
• Upon Entry	U

Type of Survey	
• Radiation	R
• Contamination	C
• Area TLD	T
• Air Sample	A

Example: DRC-1
Where:

D: is the survey frequency (Daily in this example)
R: is the type of survey (Radiation in this example)
C: is a type of survey (Contamination)
1 corresponds to the numerical sequence of the survey

7.6.3 Routine survey schedules should be submitted to, and reviewed by, the RSO or duly authorized representative.

7.6.4 Routine Survey Schedules should be indicated on form in Attachment A or an equivalent. Task Leaders may elect alternate methods of determining the information contained on the Routine Survey Schedule.

7.7 Using ALARA Principles for Scheduling and Performing Surveys

7.7.1 Routine surveys should not be performed in High Radiation Areas unless other work necessitates entry. Boundary verification surveys would be appropriate if an entry is not required.

7.7.2 Routine surveys should be performed in conjunction with other work surveys as much as practicable.

7.8 Performance of Routine Surveys

7.8.1 RPTs and qualified individuals will perform routine surveys in accordance with the applicable operational procedure.

7.8.2 Upon completion of a routine survey, the RPT will initial and date the appropriate Survey Form.

7.9 Periodic Evaluation of Routine Surveys

7.9.1 Routine Survey Schedules should be reviewed and updated periodically to ensure that all areas within the project boundaries are receiving the appropriate routine survey coverage.

7.9.2 Changes of conditions within the project area will be reported to the RSO or duly authorized representative and may require a modification of the routine radiological survey schedule.

7.10 Management Notification

The RSO should be notified, by the PM or duly authorized representative, of failure to complete a routine survey, as scheduled. The missed survey will be completed within 24 hours (or next working day) of discovering the inconsistency.

8.0 REFERENCES

- Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, Subpart E,*Radiological Criteria for License Termination*
- Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, Subpart F,*Surveys and Monitoring*
- Title 10, Code of Federal Regulations, Part 20.2103, *Records of Surveys*
- Radiation Safety Program, Cabrera Services Inc., Manual
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure
- AP-010, *Personnel Protective Equipment Used Within Radiological Controlled Areas*, Cabrera Services Inc., Operating Procedure
- AP-012, *Radiation Work Permits*, Cabrera Services Inc., Operating Procedure
- OP-019, *Radiological Posting*, Cabrera Services Inc., Operating Procedure
- OP-020, *Operation of Contamination Survey Meters*, Cabrera Services Inc., Operating Procedure
- OP-021, *Alpha-Beta Counting Instrumentation*, Cabrera Services Inc., Operating Procedure
- OP-022, *Operation of Ionization Chambers* , Cabrera Services Inc., Operating Procedure
- OP-023, *Operation of Micro-R Meters*, Cabrera Services Inc., Operating Procedure

9.0 REQUIRED RECORDS

9.1 Survey records should include the following, at a minimum:

- A diagram of the area surveyed, if applicable.
- A list of items and equipment surveyed.
- Specific locations on the survey diagram where wipe test were taken.
- Background radiation levels with appropriate units.
- Contamination levels with appropriate units.
- Make, model number, and serial number of instruments used.
- Name of the person making the evaluation and recording the results and date.

9.2 Routine Survey Schedule

9.3 Survey Form

10.0 ATTACHMENTS

- Attachment A – Routine Survey Schedule
- Attachment B – Survey Form

Attachment A

Routine Survey Schedule

Routine Survey Schedule

Survey Designation	Location of Survey

Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____

Attachment B

Survey Form

Survey Form

Location: Site:	RWP#	Survey #	Survey Type:	pg. 1 of __

Smear (CPM/100 cm^2) Direct Count (CPM/Direct Frisk)						circle one
No.	α	β	No.	α	β	
1			26			
2			27			
3			28			
4			29			
5			30			
6			31			
7			32			
8			33			
9			34			
10			35			
11			36			
12			37			
13			38			
14			39			
15			40			
16			41			
17			42			
18			43			
19			44			
20			45			
21			46			
22			47			
23			48			
24			49			
25			50			

Comments	Surveyed By:	Date:	Instrument	Serial #	α Eff.	β Eff.	α Bkg.	β Bkg	γ Bkg	Cal. Due		Key	
												■	A/S Location
												-	Boundary
												○	Smear
												□	Dose Rate _____ /hr
	Reviewed By:	Date:										*	Direct Reading CPM/direct frisk
												△	Grab Sample

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

OPERATION OF CONTAMINATION SURVEY METERS

OP-020

REVISION 1.0

Reviewed by:

4/112/13

David Wunsch, Quality Assurance Manager — Date

Approved by:

Henry Siegrist

4/12/2013

Henry Siegrist, CHP, PE, Radiation Safety Officer — Date

1.0 PURPOSE

This procedure provides the methods for Cabrera Services Inc. (CABRERA) to use when operating alpha/beta survey meters in performing contamination surveys. Adherence to this procedure will provide a reasonable assurance that the surveys performed have reproducible results.

2.0 APPLICABILITY

This procedure will be used by CABRERA personnel to measure fixed and removable alpha and/or beta/gamma emitting radioactive material on facility surfaces, equipment, waste packages, personnel, personnel protective clothing, etc.

3.0 DEFINITIONS

3.1 Restricted Area – An area containing radioactive material(s) to which access is controlled, by the licensee, to protect individuals from exposure to ionizing radiation.

3.2 Alpha/Beta Contamination Survey – A survey technique used to determine fixed and removable alpha/beta contamination.

3.3 Acceptance Range – A range of values that describe an acceptable daily instrument source check result.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Ensure that thin Mylar or mica windows on the probe face are protected from punctures, during survey operations.

4.1.2 In the case of the 44-110 tritium windowless meter, very fragile anode wires are behind the screen. **Note:** Do not allow objects to pass beyond the protective wire screen as damage to the detector can occur.

4.1.3 If any instrument inconsistencies are observed (e.g., unusually high or low background readings, source checks outside the acceptable range, etc.), remove the instrument from use, label it “OUT OF SERVICE” and report the condition to the Radiation Safety Officer (RSO), Site Radiation Safety Lead (SRSL), or a duly authorized representative.

4.2 Limitations

Typical operating temperature ranges for detectors are -20 to 50 degrees Celsius (°C) [-4 to 122 degrees Fahrenheit (°F)].

4.3 Requirements

4.3.1 Calibration sources must be traceable to the National Institutes of Science and Technology.

4.3.2 A battery check, general observation of instrument condition, high voltage check, and source response check will be performed each day before instrument use. An end of daily work activities final verification of instrument operability may also be provided, as required by site work plans.

4.3.3 Survey instrument calibrations will be performed by a calibration facility licensed by the Nuclear Regulatory Commission or an Agreement State.

4.3.4 Instruments used to perform routine surveys will be used in accordance with the applicable CABRERA administrative and operational procedures. Authorized suppliers of properly calibrated and maintained equipment will supply/calibrate instruments.

4.3.5 Prior to field mobilization, project SRSL and identified radiological leads will review approved work plans to ensure identified survey equipment is appropriate. Where practical, equipment familiarization with expected ranges to be used, typical efficiency of detection, and templates to be used in the field with the particular instrument are desired.

4.3.6 Personnel performing the survey will ensure that this procedure is the most current and approved revision.

4.3.7 Personnel performing the survey will review QC records to ensure that the instrument passed the source-check prior to use.

4.3.8 The RSO or their duly authorized representative will review any applicable completed forms and templates for accuracy and completeness.

4.3.9 All entries documented on pertinent forms must be dated and initialed by personnel performing the survey to be valid.

5.0 EQUIPMENT

5.1 Equipment counting efficiencies should be determined by qualified CABRERA personnel to verify efficiencies of calibrated instruments prior to use. Routine survey equipment includes, but is not limited to:

5.1.1 Alpha Surveys – Ludlum Model 43-5 probe and Ludlum Model 3 survey meter or equivalent meter/probe combination.

5.1.2 Beta/Gamma Surveys – Ludlum Model 44-9 probe and Ludlum Model 3 survey meter or equivalent meter/probe combination.

5.2 Proportional meters may be advantageous for use in situations where the suspected contamination type is unknown or the contamination contains mixed alpha and beta/gamma components. Alpha and beta/gamma contamination can be detected simultaneously with proportional meters. Proportional meters that may be used for a contamination survey include, but are not limited to:

5.2.1 Hand-held meters – Ludlum Model 43-93 probe coupled with a Ludlum Model 2360 meter or an equivalent meter/probe combination.

5.2.2 Gas proportional floor meters – Ludlum Model 43-37 probe coupled with a Ludlum Model 2360 meter or an equivalent meter/probe combination.

5.2.3 Radionuclide-specific meters – Includes meters such as a tritium contamination meter: Ludlum Model 44-110 probe coupled with a Ludlum Model 2221 meter or equivalent meter/probe combination.

5.3 Contamination survey meters will be selected based on job-specific requirements identified in site work plans.

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) – Ensuring that personnel assigned the task of operating contamination survey meters know and understand this procedure, are adequately trained, and have access to a current copy.

6.2 Radiation Safety Officer (RSO) – Verifying that personnel comply with this procedure and are trained in the use of the contamination survey meters described in this procedure.

6.3 Site Radiation Safety Lead (SRSL) – During field assignments, the SRSL is responsible for ensuring that this procedure is properly implemented and will review approved work plans to ensure identified survey equipment is appropriate. When the RSO is not on site, the SRSL will act as the RSO's duly authorized representative for radiological issues.

6.4 Radiation Protection Technician (RPT) – The RPT operating contamination survey meters is responsible for knowing, understanding, and complying with this procedure and may be required to review approved work plans to ensure identified survey equipment is appropriate.

7.0 PROCEDURE

7.1 Instrument Inspection

7.1.1 Select the contamination survey meter and probe to be used in the survey.

7.1.2 Before each use, perform the following checks:

- Verify the probe/meter has a current calibration label.
- Visually inspect the probe/meter for physical damage or defects.
- Position the meter switch to “BAT” and check to see that the needle falls within the “Bat Test” checkband.
    - If the needle falls below the “Bat Test” checkband, install new battery(ies).
    - If the needle still falls outside the “Bat Test” checkband after the installation of new batteries, tag the instrument “OUT OF SERVICE” and notify the RSO or their duly authorized representative.
- Check alpha detectors for light leaks by pointing the Mylar window of the detector towards a light source (preferably sunlight) and observing for a change in the meter indication.

7.1.3 Remove and tag the instrument “OUT OF SERVICE” if it fails any of the criteria in steps 7.1.1 and 7.1.2 and notify the RSO or their duly authorized representative.

Note: Any defects, damages, or other physical abnormalities require that the instrument be removed from service and the RSO or their duly authorized representative be notified.

7.2 Initial Preparations

7.2.1 Assure that the necessary daily quality control (QC) checks have been performed prior to instrument use.

7.2.2 Obtain the necessary forms, smears, and protective clothing that will be used during the survey. This information can be obtained from the Radiation Work Permit (RWP) or the SRSL.

7.2.3 Position the meter fast/slow (“F/S”) switch to “S” as appropriate.

7.2.4 Position the meter switch to the appropriate range scale.

7.2.5 Ensure that the QC acceptance range has been calculated utilizing CABRERA count rate templates. Current templates can be obtained from the RSO and may be found in the CCDR.

7.3 Daily QC Check

7.3.1 Ensure both the source and detector are in documented, reproducible positions which will be used each time this check is performed.

7.3.2 Allow the instrument reading to stabilize (approximately 30 seconds) and place the QC source on its designated position, near the detector, and record the value on the QC template.

7.3.3 Compare the reading to the acceptance range and response check criteria on the count rate QC template. If the response reading falls outside of the acceptance range, tag the instrument "OUT OF SERVICE" and notify the RSO or their duly authorized representative.

7.4 Contamination Survey Techniques

CAUTION*:* The window area of the detectors is covered with either a very thin layer of aluminized Mylar or mica. In the case of the tritium windowless detector, small anode wires are present behind the protective screen. Windows and fragile anode wires can be easily punctured or broken when surveying areas that have protruding fragments. Ensure that care is used and that such potentially damaging fragments are removed, prior to performing surveys, or avoided.

Note: To maintain the calibrated detection efficiency, the detector must be held at the appropriate height when surveying, which is determined during calibration. For example, if a beta probe's efficiency was calculated at ½ inch from the calibration source, the detector must be held at ½ inch from the surface being surveyed to maintain calibrated detection efficiency.

Avoid contacting the detector probe to the area being surveyed. This potentially could contaminate the probe.

7.4.1 Initially, verify the instrument selector switch is in the x0.1 position or on the lowest scale. Scale settings may change during surveys.

7.4.2 For a stationary reading, place the detector over the area to be measured and allow the meter to stabilize. Record the average meter indication in either counts per minute (cpm) or total counts recorded on the ratemeter, in a set time interval, on the radiological survey form/template.

7.4.3 For a scan survey, move the detector slowly over the surface, at the rate described in the site work plan and record data, as described by the plan.

7.5 Final Verification

If required by the site work plan, upon completion of work activities, repeat steps 7.1.1 and 7.1.2 as a final verification that the instrument is working properly.

8.0 REFERENCES

- Radiation Safety Program, Cabrera Services Inc., Manual
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure
- OP-001, *Radiological Surveys*, Cabrera Services Inc., Operating Procedure
- OP-009, *Use and Control of Radioactive Sources*, Cabrera Services Inc., Operating Procedure

9.0 REQUIRED RECORDS

Results will be documented electronically in the “Alpha Beta Counting and Smear Worksheet” and Smear and/or Static worksheets should be printed out and filed along with the radiological Survey Form in Attachment B of OP-001. All records, including electronic records, must be managed in accordance with OP-187.

10.0 ATTACHMENTS

None

CABRERA SERVICES
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OPERATING PROCEDURE

FOR

ALPHA-BETA COUNTING INSTRUMENTATION

OP-021

REVISION 1.0

Reviewed by:

David Wunsch, Quality Assurance Manager — 4/12/13 Date

Approved by:

Henry Siegrist

Henry Siegrist, CHP, PE, Radiation Safety Officer — 4/12/2013 Date

1.0 PURPOSE

This procedure provides instruction on the operation and setup of an alpha/beta sample counter. Adherence to this procedure will provide a reasonable assurance that the surveys performed have reproducible results.

2.0 APPLICABILITY

This procedure will be used by Cabrera Services Inc., (CABRERA) personnel operating an alpha/beta sample counter during surveys. Types of surveys that may use an alpha/beta sample counter are:

- Smear surveys performed to determine the removal of alpha and beta contamination on facility surfaces, equipment, waste, source packages, etc.
- Air sample surveys performed in a worker's breathing zone, a work area, or around the perimeter of a work site to determine alpha and beta air concentrations.

3.0 DEFINITIONS

3.1 Restricted Area – An area to which access is controlled to protect individuals against undue risks from exposure to radiation and radioactive materials.

3.2 Smear Sample Survey – A technique using a two-inch diameter filter paper to determine removable contamination of alpha and/or beta emitting radioactive material over a 100 cm^2 area.

3.3 Air Sample Survey – A technique where particulates are collected, from a known volume of air drawn through a filter paper, and the concentrations of airborne alpha and beta activity, associated with the particulates, are determined by sample counting.

3.4 Chi-Square Test – A statistical test used to evaluate the operation of a sample counter by determining how data fit a series of counts to a Poisson distribution.

3.5 Daily Calibration Check – A determination of alpha and beta sample counting efficiency by counting radioactive standards that are traceable to the National Institutes of Science and Technology.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

If any instrument inconsistencies are observed (e.g., unusually high or low background counts, source checks outside the tolerance range), remove the instrument from use and report the condition to the Site Radiation Safety Lead (SRSL) or other duly authorized representative.

4.2 Limitations

This instrumentation should be set up for use in a low background area, as determined by the SRSL or other duly authorized representative.

4.3 Requirements

4.3.1 Calibration sources will be traceable to the National Institutes of Science and Technology (NIST).

4.3.2 Survey instrument calibrations will be performed by a calibration facility licensed by the Nuclear Regulatory Commission or Agreement State.

4.3.3 A battery or power source check, general observation of instrument condition, background check, and source check will be performed each day before instrument use. A second daily quality check that includes all of the above can be performed at the end of daily work activities, if determined to be necessary on a project site.

4.3.4 The alpha/beta sample counter will be checked for proper calibration daily with a NIST-traceable source, when in use.

4.3.5 Chi-Square tests will be verified and noted as currently valid, when performed.

4.3.6 The Radiation Protection Technician (RPT) will ensure that the attachment forms are the most current and approved revisions.

4.3.7 The RPT will review completed forms for accuracy and completeness; all entries must be dated and initialed, by the RPT, to be valid.

4.3.8 The RSO or their duly authorized representative will review any applicable, completed forms for accuracy and completeness.

5.0 EQUIPMENT

Ludlum Model 2929 sample counter, or equivalent, coupled to a Ludlum Model 43-10-1 alpha/beta scintillation detector with sample tray. Equivalent instruments, based on project need, can be utilized (i.e. Ludlum Model 3030, Canberra Tennelec).

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) – Ensuring that personnel assigned the task of operating alpha/beta sample counters know and understand this procedure, are adequately trained in its use, and have easy access to a copy.

6.2 Radiation Safety Officer (RSO) – Verifying that personnel comply with this procedure and are trained in the use of alpha/beta sample counters described in this procedure.

6.3 Site Radiation Safety Lead (SRSL) – During field assignments, the SRSL is responsible for ensuring that this procedure is properly implemented. When the RSO is not on site, the SRSL will act as the RSO's duly authorized representative for radiological issues.

6.4 Radiation Protection Technician (RPT) – The RPTs, using alpha/beta sample counters, are responsible for knowing and complying with this procedure.

6.5 CABRERA personnel – Individuals performing work with an alpha/beta counter will know and understand the requirements set forth in the current and approved version of this procedure.

7.0 PROCEDURE

7.1 Instrument Inspection

7.1.1 Before each use, perform the following checks:

- Verify that the instrument has a current calibration label.
- Visually inspect the instrument for physical damage and defects.
- Verify that the high voltage and high voltage potentiometer settings agree with the calibration sheet.

7.1.2 Remove and tag the instrument "OUT OF SERVICE" if it fails any of the above criteria and notify the SRSL or the duly authorized representative.

Note: Any defects, damages or other physical abnormalities require that the instrument be removed from service and the SRSL, or other duly authorized representative, be notified.

7.2 Chi-Square Test

Note: The Chi-Square Test is not always required, but is a good verification check on the instrument operability and count setup routines, at the beginning of a project. A Chi-Square Test is only required whenever significant changes have been made to the equipment, such as a detector tube (Model 43-10-1) change out and subsequent recalibration or decontamination of the equipment. Contact the SRSL for guidance.

7.2.1 Set up the instrument in a low background area.

7.2.2 Ensure the high voltage potentiometer is positioned according to the posted instrument label. Adjust if necessary.

7.2.3 Set the time multiplier switch to "x1".

7.2.4 Set the instrument-preset timer to one (1) minute.

7.2.5 Insert the alpha calibration standard into center of the sample tray, slide

the sample tray under the detector and depress the “COUNT” button to obtain a one minute count.

7.2.6 Upon completion of the count, record digital counts appearing in the alpha display in the “Xi” column on the Chi-Square Data Sheet (Attachment A).

Note: Approved electronic templates may be used in place of this form as long as the equivalent information is provided as described in this procedure.

7.2.7 Repeat counting sequence, ensuring that the count source is removed and repositioned within the count holder, thus ensuring count position variability consistent with actual use counting. No instrument settings can be changed during this count sequence. Continue until a total of 20 counts have been taken and recorded in the “Xi” column on the Chi-Square Data Sheet (Attachment A).

7.2.8 Add the 20 counts recorded in the “Xi” column and record in the “Sum” column. Then divide by 20 to obtain the mean number of counts (Xm) and record on the line “Xm. “

7.2.9 Calculate the individual count “Xi” difference from the mean (Xm) value and record in the “(Xi-Xm)” column the Chi-Square Data Sheet for all 20 values.

7.2.10 Calculate (Xi-Xm)2, sum the “(Xi-Xm)2 ” column, and record on the Chi-Square Data Sheet.

7.2.11 Calculate the value of Chi- Square using the following formula:

$$X^2 = \frac{\sum (X_i - X_m)^2}{X_m}$$

7.2.12 The value of Chi-Square should be between 8.91 and 32.8 (represents a probability between 0.025 and 0.975). Record this value at “X2.“ If the Chi-Square value falls outside this range, contact the SRSL or other duly authorized representative for further instructions.

7.2.13 Sign and date the Daily Calibration Check form (Attachment B) and forward the results to the SRSL or other duly authorized representative for review. Keep an electronic copy in the project files.

7.3 Initial Quality Control Check

7.3.1 Ensure the high voltage potentiometer is positioned according to the posted instrument label. Adjust slowly, if necessary.

7.3.2 Set time multiplier switch to “x1.”

7.3.3 Set the instrument-preset timer to the pre-determined background count

time set by the SRSL. Counter MDAs need to be setup for 50% of the release limit for the given isotope.

7.3.4 Record the source type to be used and corresponding serial number on the proper line indicated on the Daily Calibration Check form. Use separate rows of the form for each source efficiency to be calculated.

Note: Approved electronic templates may be used in place of this form as long as the equivalent information is provided, as described in this procedure.

7.3.5 Insert a blank sample into the center of the sample tray, slide the sample tray under the detector and depress the "COUNT" button to obtain a background count.

7.3.6 Record the background count rate in the cell labeled "Bkg Count Time" on the Daily Calibration Check form.

7.3.7 Repeat the counting sequence until a total of 10 counts have been taken and recorded in the "Bkgd" row on the Daily Calibration Check form. Calculate the average of the 10 counts and the standard deviation (σ) for the average count.

7.3.8 Reset the instrument-preset timer to the pre-determined source count time set by the SRSL.

7.3.9 Remove the blank sample and insert the alpha or beta calibration standard into the center of the sample tray, slide the sample tray under the detector and depress the "COUNT" button to obtain a source count.

Note: Be sure to turn the source approximately 90 degrees with every count as this will give a wider range since not all sources are uniform in nature.

7.3.10 Record the source count rate in the columns labeled "Source #1 Count Time" and "Source #2 Count Time," respectively, on the Daily Calibration Check form

7.3.11 Repeat the counting sequence until a total of 10 counts have been taken and recorded for both alpha and beta check sources in the "Source #1" and "Source #2" rows on the Daily Calibration Check form. Calculate the average of the 10 counts for each source and (σ) for the average counts.

7.3.12 Remove calibration standards and place in source holders.

7.3.13 Initial and date the Daily Calibration Check form and forward the results to the SRSL, or other duly authorized representative, for review.

7.3.14 Record all data electronically in an alpha/beta counting spreadsheet and keep in project files. All records, including electronic records, must be managed in accordance with OP-187.

7.4 Daily Calibration Check

7.4.1 Ensure the high voltage potentiometer is positioned according to the posted instrument label. Adjust slowly, if necessary.

7.4.2 Set time multiplier switch to “x1”.

7.4.3 Set the instrument-preset timer to the pre-determined background count time, set by the SRSL.

7.4.4 Record the source type to be used and corresponding serial number on the proper line indicated on the Daily Calibration Check form. Use separate rows of the form, for each source efficiency, to be calculated.

7.4.5 Insert a blank sample into the center of the sample tray, slide the sample tray under the detector and depress the “COUNT” button to obtain a background count.

7.4.6 Calculate and record the background total counts and count rate in the columns labeled “Bkgd” and “Bkg Count Time” respectively on the Daily Calibration Check form. The background count rate in CPM (counts per minute) can be calculated as follows:

$$CPM = \frac{Total\ Counts}{Total\ Time}$$

7.4.7 Remove the blank sample and insert the alpha or beta calibration standard into the center of the sample tray, slide the sample tray under the detector and depress the “COUNT” button to obtain a source count.

7.4.8 Upon completion of the measurement, calculate and record the total counts and count rate in the columns labeled “Total Counts” and “CPM” respectively, under ‘Source’ information on the Daily Calibration Check form. The count rate (CPM) can be calculated as listed in Step 7.4.6.

7.4.9 Calculate Net Source CPM, as below, and record on the Daily Calibration Check form under “Net CPM.”

$$Net\ Source\ CPM = CPM - BKG\ CPM$$

Note: Obtain activity (DPM) value from the source certification paperwork. Decay correct activity, if needed.

7.4.10 Use the source disintegration per minute (DPM) to calculate the 4 pi efficiency, as shown below, and check against calibrated efficiency. This data can be recorded in the electronic template.

$$\%\ Efficiency = \frac{Net\ Source\ CPM}{DPM} * 100$$

7.4.11 To calculate the efficiency, for the next source, remove the current source standard and insert a new source standard, then repeat steps 7.4.1 through 7.4.10, as necessary.

7.4.12 Remove calibration standards and place in source holders.

7.4.13 Generate an excel control chart tracking the daily efficiencies and notify the SRSL or duly authorized representative if any point falls outside of 2σ variance.

Note: For the first day on the control chart, use five data points to begin the trend line.

8.0 REFERENCES

- Radiation Safety Program, Cabrera Services Inc., Manual
- AP-005, *ALARA*, Cabrera Services Inc., Operating Procedure
- OP-001, *Radiological Surveys*, Cabrera Services Inc., Operating Procedure
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure
- U.S. Nuclear Regulatory Commission, Consolidated Guidance About Material Licenses, *Vol.11 - Program-Specific Guidance About Licenses of Broad Scope*, NUREG-1556, (1999).

9.0 REQUIRED RECORDS

The following records must be maintained whether paper or electronic:

- Chi-Square Data Sheet (when applicable)
- Daily Calibration Check
- Excel calibration records

10.0 ATTACHMENTS

Attachment A – Chi-Square Data Sheet

Attachment B – Daily Calibration Check

Attachment A

Chi-Square Data Sheet

Chi-Square Data Sheet

Date:_____Instrument:_____Serial Number:_____ X^2_____

Alpha Source No./Activity:_____Beta Source No./Activity:_____

Count Number	X_i	(X_i-X_m)	$(X_i-X_m)^2$
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Sum		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	
X_m		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\

Prepared By: _____ Date: _____
Print/Sign

Reviewed By: _____ Date: _____
Print/Sign

Attachment B

Daily Calibration Check

Daily Calibration Check

Make	Model	S/N	Probe	S/N	Cal Date
Bkg Count Time	**Source #1 Count Time**	**Source #2 Count Time**	**Source #1 ID**	**Source #2 ID**	**Cal Due Date**

Date(s)										
Intial QC's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Init.**
Bkgd											
Source #1											
Source #2											

Daily QC's

Date	Bkgd	Source #1 ( ) α/β/γ	Source #2 ( ) α/β/γ	Battery OK?	Comments	Init.
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

HEALTH PHYSICS INSTRUMENT GENERAL QUALITY CONTROL PROCEDURE

OP-358

Revision 1.0

Revised by:

Michael S. Winters, Principal CHP — 8/27/13 Date

Approved by:

David Wunsch, Corporate QA Manager — 8/27/13 Date

1.0 PURPOSE

The purpose of this Operating Procedure (OP) is to provide the steps necessary to properly perform and document quality control (QC) measurements on Cabrera Services Inc. (CABRERA) field health physics instrumentation.

2.0 APPLICABILITY

This procedure provides the requirements and proper techniques to perform initial and daily QC measurements on a variety of CABRERA field health physics (HP) instruments after the instrument has been received from formal calibration in accordance with ANSI N323A. Actual instrument calibrations are performed in accordance with ANSI/ANS N323A by a third-party and are outside the scope of this procedure. Determinations of Instrument efficiency, source efficiency, and total efficiency using the ISO-7503 approach are addressed in separate Cabrera OP-380. This procedure is to be used in conjunction with other applicable instrument use procedures.

3.0 DEFINITIONS

3.1 Acceptance Criteria – Calculated operability for a given instrument, based on the initial quality control measurements, typically represented in percentage format (i.e., ± 20%) or in terms of standard deviations from the mean (i.e., ± 2-sigma).

3.2 Chi-Square Test (X^2) – A statistical test used to determine how well experimental data fit a series of counts to a Poisson distribution. Chi-square is used for health physics instruments to test for biases that could impact the accurate reporting of the random nature of radioactivity.

3.3 Control Chart – A plot of the results of an instrument's quality control measurements, along with the calculated acceptance criteria shown as upper and lower boundaries.

3.4 Qualitative Instrument – A count rate or dose rate survey instrument that is used for general survey purposes and not for official or release survey purposes. Examples include the Ludlum Measurements, Inc. (Ludlum) Model 3 ratemeter coupled with a Ludlum Model 44-9 Geiger-Mueller (G-M) tube, typically used for routine surveys and general contamination control at step off pads. The Bicron Microrem dose rate meter is also administered as a Qualitative instrument, even though its output may be used for official release purposes.

3.5 Quantitative Instrument – A scaler-capable instrument that is used for demonstrating compliance with established standards or derived release criteria, e.g. disintegrations per 100 square centimeters (dpm/100 cm^2). Examples include the Ludlum Model 2929 dual-scaler alpha-beta counter and a Ludlum Model 2224 ratemeter/scaler coupled with a 43-93 dual phosphor scintillator.

3.6 Sigma (σ or Standard Deviation) – A measure of the dispersion or spread of sample data about the mean of the data. Standard deviation is the square root of the variance.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Health physics instruments operate at high voltage, between 500 and 2000 volts direct current. Caution should always be used when working with these instruments as shocks can occur.

4.1.2 If any instrument inconsistencies are observed (e.g., unusually high or low background counts or source checks outside acceptance criteria), remove the instrument from use and report the condition to the Site Radiation Safety Lead (SRSL) or other duly authorized representative.

4.1.3 Response check sources should be handled carefully to prevent damage to the radiation source or cross-contamination. Report any suspected damage to a standard to the CABRERA Radiation Safety Officer (RSO), or authorized representative, immediately.

4.2 Limitations

4.2.1 Ensure that the sources energy type (i.e., alpha, beta, gamma, and neutron) and overall activity are appropriate for the detector in use.

4.2.2 The worksheets discussed in this procedure are meant to be completed on a PC or portable device and maintained as electronic records. If security or technology limitations prevent use of/access to the electronic files, an alternate hard copy approach may be approved by the PHP or RSO on a case-by-case basis.

4.2.3 Instrument efficiency is not determined using this procedure. The Four-Pi (4π) Instrument efficiency value(s) are typically provided by the calibration organization on the provided label and calibration certificate. Efficiency values, based on the ISO-7503 approach, are determined by Cabrera under separate OP-380. Applicable efficiency/emission energy values will be used as directed by the PHP or Corporate RSO on a project-by-project basis.

4.3 Requirements

4.3.1 Specific protocols in this procedure may be superseded by client/project-specific plan requirements or per direction from the RSO (e.g., efficiency calculations, QC frequency, instrument-specific application as Qualitative vs. Quantitative, MDAs and count times, etc.).

4.3.2 Survey instrument calibrations shall be performed by a U.S. Nuclear Regulatory Commission (NRC) or Agreement State licensed calibration facility.

4.3.3 Out-of-Service equipment shall be clearly tagged or labeled to prevent unauthorized use.

4.3.4 All radioactive sources shall be kept in secure locations and handled in accordance with all CABRERA Radiation Safety Program (RSP) documents.

4.3.5 Instruments used to perform radiological measurements will be operated in accordance with the respective CABRERA OPs or manufacturer's recommendations.

4.3.6 Instruments used to perform radiological measurements will have a current calibration certificate (i.e., one received within the past 12 months).

4.3.7 Active Project QC worksheets shall be reviewed weekly by the assigned SRSL, or designee.

4.3.8 Electronic versions of MS Excel© workbooks shall be backed up from the field computer to semi-permanent media (CD-ROM, thumb drives, CABRERA office hard drives) at least once per week.

5.0 EQUIPMENT

There is no equipment associated with this procedure.

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) – Ensuring that personnel assigned the task of instrument quality control know and understand this procedure, are adequately trained in its use, and have easy access to a copy.

6.2 (Corporate) Radiation Safety Officer (RSO) – Manages CABRERA's Radiation Safety Program, responsible for the management and upkeep of all Radiation Safety Procedures and approved electronic instrument QC spreadsheets.

6.3 Project Health Physicist (PHP) – Serves as the senior-most HP representative assigned to a Project/Task.

6.4 Site Radiation Safety Lead (SRSL) – During field assignments, the SRSL is responsible for ensuring that this procedure is properly implemented and will ensure the safekeeping and review of all project instrument QC data. The SRSL is responsible for the oversight of all health physics-related project field technical aspects. The SRSL will act as the NRC's authorized representative for radiological issues and onsite NRC interactions. Only the SRSL or the (Corporate) RSO may act as an authorized user.

6.5 Radiation Protection Technician(s) (RPTs) – The RPT(s) responsible for the QC of health physics instrumentation are responsible for knowing and complying with this procedure and collecting/documenting instrument QC information.

7.0 PROCEDURE

7.1 Instrument Inspection

7.1.1 Upon receipt, each instrument shall be matched with the coinciding calibration certificate(s). Verify the calibration date on each certificate and if any instruments will need to be calibrated during the duration of the project. If any instrument is out of calibration, mark as "Out of Service" (OOS). Ensure the instrument serial number(s), correct detector(s), and cable length(s) (as appropriate) match with those provided on the certificate. Also, ensure that operating voltages are as shown on the calibration sheet. Notify the SRSL if any discrepancies noted in above steps.

7.1.2 Visually inspect each instrument for damage and other defects that may affect instrument performance (e.g., noticeable dents [but not superficial scratches or dings] or loose wires). If damage is present, inform the SRSL and mark the appropriate instrument as OOS.

7.1.3 Obtain the latest appropriate OP-380 QC Worksheet template from the Controlled Copy Document Repository and complete the basic instrument and source information.

7.2 Initial QC Setup and Measurements

7.2.1 Once the instrument is found to be in proper working condition, it shall be set up according to relevant use procedure and the manufacturer's instructions.

7.2.2 Designate a static location free of obstructions to conduct the daily QC checks for all field instruments. This location shall be posted as a radioactive area and the area clearly marked with radiation tape. Standard radiation area rules apply.

7.2.3 Use an indicator or "jig" to designate where each source and detector is to be placed when conducting QC counts. Use this same position each time the instruments are QC'd to ensure reproducibility. The source should be positioned in the jig so as to align with the effective center of the detector.

7.2.4 Conduct 10 initial background counts for each instrument and record the counts in the respective workbook tabs. The count time is based on project minimum detectable activity (MDA) requirements and should be provided in the project Work Plan, the Field Sampling Plan, or as directed by the SRSL.

7.2.5 Conduct 10 initial source counts for each instrument and record the counts in the respective workbook tabs. The check sources will be determined by instrument type and/or specific project requirements. The count time should be based on project MDA requirements as provided in the project Work Plan, the Field Sampling Plan, or as directed by the SRSL.

7.2.6 Chi-Square calculations will be performed for each AC-powered (onsite counting lab) counting system or for systems/instruments as directed by the project-specific plans or the RSO (Due to their expected performance limitations the Chi-Square Test is not typically performed on battery powered field radiation survey instruments).

Enter the 10 initial source counts for each Instrument and source used into the blue cells in the Chi-Square MS Excel© workbook. Perform 10 additional counts for each instrument and source for a total of 20 counts to complete the calculation. Chi-Square evaluations are performed to evaluate whether the collected data exhibits an expected random variability. If the results of the Chi-Square fall outside the 8.91-32.8 acceptance criteria, there may be conditions (internal or external to the detector) that are introducing counting biases. Consult the SRSL for guidance.

7.2.7 Using the initial QC data and the calculated results in the applicable QC spreadsheet, fill out the "Instrument Pass/Fail Criteria" sheet in the Instrumentation Logbook and post near the instrument QC area in plain view.

NOTE: Posting the Instrument Pass/Fail criteria is done to provide a quick evaluation of each morning's instrument QC count without the need of entering the data into the MS Excel© spreadsheet. However, it is NOT intended to take the place of definitive instrument PASS/FAIL determinations or instrument trending performed in the various MS Excel© workbooks.

7.3 Daily QC

7.3.1 At a minimum, instrument QC checks shall be conducted prior to each day's first use.

7.3.2 The instrument background count shall be conducted prior to the source count(s).

7.3.3 For Qualitative Instruments, if the recorded background or source response check result falls outside the acceptance criteria, the instrument will *"Fail"* and a recount must be performed prior to using the instrument. If a recount *"Fail"* condition occurs, the instrument shall be taken OOS and the SRSL notified.

7.3.4 For Quantitative Instruments, the following steps shall be performed:

- If the daily count is found to be outside of the $\pm 2\sigma$ criteria, a *"Question"* note will appear in the "Alpha Beta Counting and Smear Worksheet.xls" and may be used for that day, pending concurrence by the SRSL. However, if a *"Question"* condition occurs on consecutive days for similar behavior (i.e., falls outside in the same direction), a recount must be performed and recorded as such. If a recount *"Question"* or *"Fail"* condition occurs, the instrument shall be taken OOS and the SRSL notified.
- If the daily count is found to be outside of the $\pm$ 3s criteria, a *"Fail"* note will appear in the "Alpha Beta Counting and Smear Worksheet.xls" and a recount must be done immediately and recorded as such. If a recount *"Fail"* condition occurs, the instrument shall be taken OOS and the SRSL notified.

7.3.5 If an instrument is taken OOS using steps defined in this procedure, concurrence with corrective actions must be obtained by the SRSL before the instrument may be brought back into service.

7.3.6 Recounts and OOS actions shall be noted in the remarks section for the day's QC worksheet entry.

8.0 REFERENCES

- Radiation Safety Program, Cabrera Services, Inc., Manual
- OP-020, *Operation of Contamination Survey Meters*, Cabrera Services, Inc., Operating Procedure.
- OP-021, *Alpha-Beta Counting Instrumentation*, Cabrera Services, Inc., Operating Procedure.
- OP-022, *Operation of Ionization Chambers*, Cabrera Services, Inc., Operating Procedure.
- OP-023, *Operation of micro-R Meters*, Cabrera Services, Inc., Operating Procedure
- OP-187, *Records Management*, Cabrera Services, Inc., Operating Procedure
- OP-380, *Calculating Alpha and Beta Total Efficiency for Field Instruments*, Cabrera Services Inc., Operating Procedure
- U.S. Nuclear Regulatory Commission, Consolidated Guidance about Material Licenses, *Vol. 11 – Program-Specific Guidance about Licenses of Broad Scope*, NUREG-1556, (1999).
- American National Standards Institute, Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments, ANSI N323A , (1997 w/ 2004 errata)

9.0 REQUIRED RECORDS

The following records generated during implementation of this procedure, as required by contract or quality management protocols, are to be kept and archived, as part of the project file, and comprise the quality record:

- Instrument calibration certificates for all instruments used on a project. Electronic copies of instrument calibration certificates are acceptable as a quality record.
- Source calibration certificates for all radiological sources used to calculate instrument efficiencies. Electronic copies of source calibration certificates are acceptable as a quality record.
- Quality Control (QC) forms containing the results of all measurements of radiological sources. Electronic files documenting QC measurements are acceptable as a quality record.
- All total efficiency calculations signed and dated by the reviewer.

10.0 ATTACHMENTS

None

CABRERA SERVICES
RADIOLOGICAL•ENGINEERING•REMEDIATION

OPERATING PROCEDURE

FOR

SOIL CORE SCANNING

OP-376

REVISION 2.0

Prepared by:

2015-07-09

Mike Winters, CHP
Radiation Safety Officer

Date

Approved by:

July 9, 2015

Sean Liddy, CSP
Quality Assurance Manager

Date

1.0 PURPOSE

This Operating Procedure (OP) provides the methods Cabrera Services Inc. (Cabrera) personnel shall utilize to properly perform soil core scan surveys. Adherence to this procedure will provide assurance that the analyses performed have reproducible results.

2.0 APPLICABILITY

This procedure applies to all Cabrera Services Inc. (Cabrera) employees and operations. Personnel shall utilize this procedure for all soil core scan surveys unless specified otherwise through the Project Plans [e.g. Field Sampling Plan (FSP), or Quality Assurance Project Plan (QAPP)]. Personnel must assure that the specifications of this OP agree with the specifications listed in the Project WPs.

3.0 DEFINITIONS

3.1 Project Plans - For the purposes of this procedure, a generic term describing the project implementing plans that contain the information associated with the requirements for mandated sampling. These include, but are not necessarily limited to:

3.1.1 Project Work Plan (PWP) - The over-arching project plan used to manage both project execution and project controls. A primary use is to document planning assumptions and decisions including quality assurance and quality control (QA/QC) measures regarding data gathering and deliverables.

3.1.2 Field Sampling Plan (FSP) - Provides specific directions for conducting each separate field sampling activity and presents the rationale and design, for the work, as well as the field procedures for each specific activity required. Field operations and documentation are also described and may include discussions on field logbooks, photographic records, sample documentation, field analytical records, and procedures for their management and retention.

3.1.3 Quality Assurance Project Plan (QAPP) - Focuses primarily on the analytical methods and QA/QC procedures that are used to analyze and manage environmental samples and their resulting data. The QAPP also presents the project organization, objectives, procedures, functional activities, and specific QA/QC activities associated with sampling, data management and record retention.

3.1.4 Site Safety and Health Plan (SSHP) – Provides evacuation routes for the site and immediate area; site-specific safety information; Safety Data Sheets for any relevant chemicals of concern; and names and telephone numbers of common emergency contact personnel for the worksite. In addition, the SSHP may also contain sampling activities required to monitor worksite safety and health.

3.2 Quality Assurance (QA) - All procedures, practices, records, and other documentation required to provide confirmation that project activities are completed in a manner compliant with regulations, specifications, and/or contract requirements.

3.3 Quality Control (QC) - For the purposes of this procedure, actions taken to control the variable attributes of the sampling and analytical processes to meet the data quality objectives described in the project plans.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

Refer to the SSHP for appropriate PPE outlined for this task. Typical PPE consists of Modified Level D PPE, to include hand protection.

Extreme caution must be used by personnel when cutting liners. Ensure the proper tools (double hook blade knife, electric PVC tube cutter) are being used, along with proper hand protection (leather and/or Kevlar gloves). Cutting of the acetate liner should be performed by the driller, prior to handing the core over for scanning.

Use caution when setting instrumentation down on work surfaces so that it does not become contaminated with residual materials from previous cores (impacted materials). Keep work area clean at all times.

4.2 Limitations

Poor recovery or soil compaction may impact the ability to perform soil scans.

4.3 Requirements

Core scan surveys should be performed with the detector in a shielded geometry (lead, steel, or other appropriate material) to reduce background interference.

Record all sampling activities in the Soil Core Scan Log and field notebook.

Personnel using this procedure shall be familiar with the Project Plans. Field

Personnel shall discuss deviations to the Project Plans with the Project Manager. Any deviations, plus conversations with the PM, shall be documented in the project field notebook.

Instruments must be quality checked and/or calibrated daily, prior to use.

5.0 EQUIPMENT

The instrumentation required to conduct the soil core scanning will be specified in the Project Plans. Examples of the type of instruments include:

- Ludlum 44-9 (pancake GM) with attached scalar capable meter
- Bicron G-1 (1 x 1 NaI) with attached scalar capable meter
- Ludlum 44-10 (2 x 2 NaI) with attached scalar capable meter
- Ludlum 44-20 (3 x 3 NaI) with attached scalar capable meter
- Alpha Spectra G-5 (Fidler) with attached scalar capable meter

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) - The PM is responsible for implementing and ensuring compliance with the contents of the project plans. They also must ensure that project personnel have been trained and are qualified to implement this procedure.

6.2 Field Site Manager (FSM) - The FSM is responsible for: the execution of field activities in discussion with the PM; correctly applying the sampling design and entering information into the field notebooks.

6.3 Project Personnel - All Cabrera personnel are responsible for reading, understanding, and complying with the provisions of this procedure prior to engaging in scanning activities. In addition, site workers should discuss any deviations from the prescribed scanning protocols with the PM or FSM, and document changes in the project field notebook.

7.0 PROCEDURE

Soil cores are typically obtained through the use of Direct Push Technology, which involves advancing a hollow tube into the subsurface under hydraulic pressure. The tube is typically lined with an acetate liner in which the soil core is collected. Samples can be collected continuously or from specified depths. Refer to OP-352, Subsurface Soil Sampling, for additional information on the collection of the soil core.

7.1 Scanning Preparation

Mark acetate sleeve with 1-foot increment markers to guide positioning in scanning jig. Core scans may be performed in a closed sleeve, or one that has been cut open.

Perform a visual inspection of the core and record the condition of the core. Record areas of compaction, poor recovery, and irregular content, i.e. non-soil materials, on a Soil Core Scan Log.

Ensure required calibration and/or quality control checks of the specified field instrumentation are complete prior to use.

7.2 Perform Scan

Scans should begin at the bottom-most section of the core and move at 1-2 inches per second up to the topmost section of the core.

Record scan measurements in 1-ft increments on the Soil Core Scan Log. Continue until all cores removed from the borehole have been scanned. Use as many core scan forms as necessary, labeling each with appropriate page numbering notation, i.e. 1 of 3, 2 of 3, etc.

Sign and date completed Soil Core Scan Log and submit to FSM for review and data processing.

Decontaminate any equipment that may have come into contact with the core prior to its next use per accordance with the Project Plans.

8.0 REFERENCES

- Cabrera OP-352, Subsurface Soil Sampling
- Cabrera OP-359, Field Documentation

9.0 REQUIRED RECORDS

- Soil Core Scan Logs
- All field notebooks and/or sample documentation

10.0 ATTACHMENTS

- Attachment A - Soil Core Scan Log

Attachment A

Soil Core Scan Log

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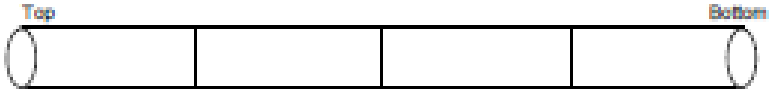
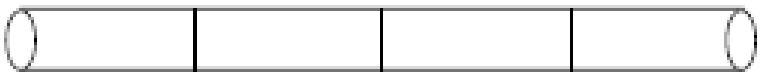
OP-376
Soil Core Scan Log

Project: _____ Date/Time: _____
Project #: _____ Instr. Model / SN: _____
Location ID: _____ Cal Due: _____
Total Depth: _____ Ambient Bkg: _____ cpm
Page: _____ of _____ Technician Init: _____

Sleeve #	Depth Range	Core & Scan Info
1	0' - 4'	Top … Bottom 
		Core Scan Results (cpm): _____
2	4' - 8'	
		Core Scan Results (cpm): _____
3	8 - 12'	
		Core Scan Results (cpm): _____
4	12' - 16'	
		Core Scan Results (cpm): _____
5	16' - 20'	
		Core Scan Results (cpm): _____

Comments: *(record any drilling or sampling issues, e.g., refusal, groundwater, poor recovery, etc. here)*

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

GAMMA WALKOVER SURVEY

OP-387

Revision 0

Prepared/Reviewed by:

Stephan Owe, Scientist — March 7, 2014 (Date)

Approved by:

Michael Winters, CHP, HP Group Manager — March 7, 2014 (Date)

1.0 PURPOSE

This Operating Procedure (OP) provides the instructions for Cabrera Services Inc. (Cabrera) personnel conducting a Gamma Walkover Survey (GWS); correlated with global positioning system (GPS) coordinates. The process presented will guide Cabrera technical staff in conducting surveys, while maintaining high standards of quality and avoiding common errors.

2.0 APPLICABILITY

This procedure applies to all Cabrera personnel conducting a geospatially correlated GWS for the detection of radiological contamination/ radioactivity and contains a complete description of GWS operations.

This procedure may be modified to accommodate site-specific situations; however, modifications must be documented and approved, as outlined in OP-181, Document Control. In addition, any modifications must not compromise data quality or damage equipment.

3.0 DEFINITIONS

3.1 Gamma Walkover Survey (GWS) – Geospatially correlated radiological scanning survey, which typically uses a sodium iodide scintillation probe to detect gamma emitting radionuclides by holding the detector in close proximity to the ground and moving it in a serpentine pattern as the surveyor walks transects over a given area.

3.2 Global Positioning System (GPS) – Radio navigation system comprised of orbiting satellites and receivers that can provide users with positioning, navigation and timing information anywhere on earth. Although GPS is a United States owned utility, other countries have similar systems and modern GPS devices may be able to use foreign systems to aid in navigation.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

- The GPS and radiological survey instruments should be operated in accordance with Cabrera operating procedures and manufacturers recommendations, and shall be in current calibration. Refer to OP 020, Operation of Contamination Survey Meters and OP 058, Health Physics Instrument General Quality Control Procedure and OP 051, Global Positioning Systems for guidance.

- Multiple detectors can be used for conducting GWS. The appropriate detector depends on factors such as potential nuclide present, investigation level, and/or other site conditions. Consult the work plan

or the project technical lead for the project specific detector that should be used to conduct the GWS.

- GWS scan rates can be adjusted depending on the expected detector response and the desired investigation level. A standard scan rate is presented in this procedure; however, consult the work plan or the project technical lead for the project specific scan rate that should be implemented.

- Covering or 'sleeving' the detector and probe in plastic is recommended to protect the instrumentation from cross-contamination or water during inclement weather, wet, dirty or muddy environments.

4.2 Limitations

- When conducting a GWS, radiological readings can only be correlated with a geospatial position when the GPS is receiving a satellite signal. Continually check the GPS during the GWS to ensure it is receiving a satellite signal.

- The preferred method of coupling the Ludlum 2221 to the GPS handheld is through a 9-pin serial cable, due to its durability. Some model 2221s are not equipped with this port, in which a RG-174 coaxial cable must be used.

- Positional accuracy during a GWS is affected by line of sight to orbiting satellites. Note that when conducting a GWS near buildings, trees or any elevated structure; the accuracy of the GPS can be reduced or positioning lost.

4.3 Requirements

- Qualified individuals shall perform surveys. Qualification will be determined by the PM, FSM, SRSL or duly authorized field representative. Qualification considers prior training, experience, and certifications.

- All radiological survey Instruments and the GPS Device used during a GWS must be operated in accordance with applicable operating procedures. Instruments used to perform GWS should be performance checked prior to and at the end of each day's use. Refer to OP 020, Operation of Contamination Survey Meters, OP 058, Health Physics Instrument General Quality Control Procedure and OP 051, Global Positioning Systems Device for guidance.

5.0 EQUIPMENT

GWS requires the use of both radiological instrumentation and a GPS device in order to combine radiological data with a highly accurate geospatial position.

5.1 Radiological Instrumentation

- Appropriate portable Scaler-Ratemeter (typically a Ludlum Model 2221) with RS-232 communications port (RG-174 coaxial port or a 9-pin serial port for some models) for linking to the GPS datalogger.
- Appropriate radiation detector, as specified by the Project HP or in established work plans.

5.2 GPS Equipment

Various GPS models exist that are compatible with the radiological survey instruments described above. Typical models used by Cabrera include the Trimble® Pathfinder® Pro XRT GPS receiver mated with a Trimble® Nomad® handheld data logger, or equivalent. GPS hardware and setup can vary slightly depending on the specific model, but the following hardware is typical of all GPS models. OP 051, Global Positioning Systems for guidance.

- Trimble® GPS Receiver/ Antenna/ Backpack
- Trimble® Handheld Datalogger with Terrasync™ software
- RG-174 coaxial cable to 9-pin serial cable (female) or
- 9-pin serial cable (male/female connection), depending on 2221 specifications
- PC with Trimble® Pathfinder® software for data transfer
- Micro-USB/USB cable (data transfer from datalogger to PC)

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) – Responsible for ensuring that the assigned personnel know and understand this procedure and have access to a current copy.

6.2 Site Radiation Safety Lead (SRSL) - During field assignments, the SRSL is responsible for ensuring that this procedure is properly implemented. The SRSL is responsible for ensuring only properly trained operators use the GPS and GWS instrumentation, reviewing daily operational checks to ensure the unit is operating properly, backing up survey data and transmitting data to the Cabrera server, and communicating any issues to the SRSL. When the RSO

is not on site, the SRSL will act as the RSO's duly authorized representative for all radiological matters. These responsibilities may be delegated to HP support staff with approval of the Corporate RSO.

6.3 Radiation Protection Technician (RPT) – Conduct GWS according to this procedure, project-specific work documents or, direction from the assigned Sr. HP assigned to a Project.

7.0 PROCEDURE

7.1 Connecting Hardware (Ludlum 2221 and GPS Unit)

- Complete Setup of the GPS Unit - GPS hardware can vary depending on the specific model being used. If using an external antenna, connect the GPS receiver to the antenna using the appropriate cable.

  If necessary, check with manufacturers operating manual to complete setup.

- Turn on power switch to GPS receiver and GPS handheld datalogger.

- If connection between the GPS receiver/antenna and the GPS handheld datalogger requires Bluetooth, ensure the Bluetooth device is communicating properly. If necessary, check with manufacturers operating manual to complete setup.

- Connect the Ludlum Model 2221 to the Trimble® handheld datalogger using the RG-174 coaxial cable or a 9-pin serial cable. The 9-pin serial cable is preferred due to the durability, however not all Ludlum Model 2221 are equipped with this port. The RG-174 coaxial port is located below the handle in the center of the meter. If available, the 9-pin serial port is located on the side or front of the meter.

- Connect the 9-pin side of the coaxial cable to the serial port located on the GPS datalogger. If using a serial cable, connect the other end of the serial cable to the GPS datalogger serial port.

- Turn on power switch to the Ludlum Model 2221 and set to the following settings:

  - RESPONSE = F (Fast)

  - DIGITAL CONTROL = Dig. Rate

  - WIN = Out

  - Adjust the Volume dial to an audible level

7.2 GPS and Data Acquisition Software Setup (Terrasync™)

7.2.1 Coordinate System

- Within the Terrasync™ program settings, select the appropriate coordinate system. Consult with the GIS analyst assigned to the project to ensure the correct coordinate system is being used.

- Coordinate system settings can be modified by accessing the drop-down tab and selecting ‘Setup’, then ‘Coordinate System’ option.

7.2.2 Data Logging Settings

- Within the Terrasync™ program settings set the data logging interval setting to one (1) second for all data types (Point_generic, Line_generic, Area_generic). This will ensure that radiological measurements are recorded at a rate of one measurement per second.

- Data logging interval settings can be modified by accessing the drop-down tab and selecting ‘Setup’, then selecting ‘Options’ in the secondary drop-down, then selecting the ‘Logging Settings’ option.

7.2.3 External Sensor

- Within the Terrasync™ program settings ensure that the external sensor is activated and the appropriate settings have been entered.

- External Sensor settings can be modified by accessing the drop-down tab and selecting ‘Setup’, then selecting ‘Options’ in the secondary drop-down, then selecting the ‘External Sensors’ option. The external sensor can be activated by selecting the ‘check box’ next the sensor heading.

- The external sensor settings should already be entered, however for verification, the settings should be as follows:

    - Baud rate = 9600

    - No parity

    - 1 stop bit

    - 8 data bits

7.2.4 Connect GPS to Satellites

- Connect GPS to satellites by accessing the drop-down tab and selecting ‘Setup’, then selecting ‘Options’ in the secondary drop-down, then selecting the ‘GNSS’ button, which will begin the connection process to the GPS receiver.

- When connection is made, the status icon in the top portion of the screen will display an image of a satellite with a number, representing the number of satellites connected.

- It is important to note that if the number of satellites available drops below ‘5’, GPS signal connection is lost and data will not be recorded. The ‘satellite’ icon will also disappear. Continually monitor the ‘satellite’ icon to ensure GPS connection. If the GPS signal is lost, wait for the GPS to regain connection. Move to an open area if necessary.

7.2.5 Create Data File

- Create data file by accessing the drop-down tab and selecting ‘Data’, then selecting ‘New’ in the secondary drop-down.

- Type a unique file name in the ‘File Name:’ dialog box that describes the survey you are about to conduct and the date of the survey. Consult the project work plan or SRSL for specific file name nomenclature.

- After you have entered the file name, select ‘Create’. The program will prompt you to select a data type, select the ‘Line_generic’ for conducting GWS. Data will start to record immediately, the user can pause data collection by selecting the ‘pause’ button.

- To stop collecting data, select the ‘Ok’ button. Data is automatically saved.

- To begin a new survey, create a new data file as described above.

7.2.6 Check connection with Radiological Meter

- It is only possible to verify that the GPS system is receiving radiological count data from the Ludlum 2221 during data collection. After the user has created and begun logging in a file, as described above; access the drop-down tab and select ‘Status’, then select ‘Sensor’ from the secondary drop-down.

- If the GPS system is receiving radiological count data from the Ludlum 2221, the sensor data field will continually change value in accordance to the cpm digital count display located on the Ludlum 2221 meter.

- If the GPS system is registering the correct count values at a rate of one (1) value per second, the system is operating correctly and is ready to conduct the GWS.

7.3 Conduct GWS

7.3.1 Documenting the Survey Area

Before beginning the GWS, the following details about the survey area should be documented in the field log.

- Survey area size, shape and general elevation changes/ sloping

- Terrain cover (vegetation, grass, brush, soil, gravel, etc.)

- Obstructions that prevent survey coverage

- Debris (surface, buried or partially buried)

- Disturbances in terrain (mounding of soil, lack of vegetation growth, soil staining, etc.)

7.3.2 Perform GWS

- Perform Terrasync™ program setup and create data file as described in Section 7.2.

- Technicians should walk the survey area in parallel transects, one meter apart; while moving the detector in a serpentine (S-shaped) pattern with the detector held close to the ground surface (approximately 6 cm or 2.5 in., unless otherwise directed by a project-specific work plan or the Project Health Physicist)

- A scan rate of approximately 0.5 meters per second and a one second interval recording rate ensure that two (2) radiological measurements are collected per square meter. However, scan rates can be adjusted depending on the expected detector response and the desired investigation level. Consult the work plan or the SRSL for the project specific scan rate that should be used.

- Survey coverage should be conducted in accordance with the work plan. Consult the work plan, Sr. HP, or SRSL to determine the survey coverage when conducting a GWS. Absent specific work plan requirements or technical guidance from the Sr. HP assigned to the Project, the following guidelines should be utilized when conducting a GWS to ensure adequate survey coverage throughout the survey area.
    - 100% GWS Coverage – Transects should be 1 meter apart.
    - 50% GWS Coverage – Transects should be 2 meters apart.
    - 25% GWS Coverage – Transects should be 4 meters apart.
- To ensure adequate coverage when surveying large areas, markers should be used to delineate survey lanes. Pin-flags, cones, or similar items should be used as a visual guide to aid in walking straight, parallel transects. Background map files should also be loaded onto the datalogger for use as a guide if available. Background files could consist of property boundaries, survey boundaries, and roads (etc.); and be loaded to the datalogger using Trimble® Pathfinder® Office program. Consult with the GIS technician assigned to the project to create background files.

7.4 Transferring GWS Data from Datalogger to PC

7.4.1 Connect GPS Datalogger to PC

- Connect the GPS datalogger to a PC using the micro-USB-to-USB cable.
- Windows should automatically recognize the external device and establish connection using the 'Windows Mobile Device Center' program.

7.4.2 Transfer Data Files using Trimble® Pathfinder® Office

- Open the 'Trimble® Pathfinder® Office' program on a PC.
- The program will prompt you to select an existing 'Project' or to create a new 'Project'. Pathfinder® 'Projects' allow the user to organize GPS data files into site specific folders. A Pathfinder® 'Project' should be created for each field site.

- Open the ‘Data Transfer’ utility by selecting the ‘Utilities’ drop-down, located on the horizontal task bar at the top of the screen. Or by selecting the ‘Data Transfer’ icon on the left side of the screen.

- The ‘Data Transfer’ utility should automatically connect to the GPS handheld. The connection icon will alert you when connection to the GPS datalogger is complete.

- Ensure that the ‘Receive’ tab is selected (the ‘Send’ tab is used for sending data to the GPS datalogger).

- On the right side of the screen, select the ‘Add’ drop-down tab, then select ‘Data File’.

- A dialog box will appear that contains all GPS data files stored on the GPS datalogger. Select those files in which you want to transfer.

- Select the ‘Transfer All’ button. A message will alert you if the data transfer was successful.

- GPS Data files are stored as ‘.SSF’ and will be located on your PC in the designated project folder.

7.4.3 GIS Process & Mapping

Refer to OP 388, GWS, GIS Process & Mapping for guidance.

8.0 REFERENCES

- Cabrera OP 181, Document Control
- Cabrera Procedure OP-020, Operation of Contamination Survey Meters
- Cabrera Procedure OP-051, Global Positioning Systems
- Cabrera Procedure OP-058, Health Physics Instrument General Quality Control Procedure
- Cabrera OP 388, Gamma Walkover Surveys, GIS Procedures
- MARSSIM, NUREG-1575

9.0 REQUIRED RECORDS

- Annual Calibration Records for Radiological Instrument

- QA/QC Records (logs, notebooks, instrument background and source response check files)
- '.SSF' Data files associated with GWS data

10.0 ATTACHMENTS

None

PROCEDURE APPROVAL:		
Amy Robin Jones		9/23/2014
(printed name)	Radiation Safety Officer *(signature)*	Date

1.0 Purpose

This procedure details the issuance of Radiation Work Permits (RWP) or Hazardous Work Permits (HWP). It also provides detail on how access to Control Areas (CA) will be controlled and posted.

2.0 Equipment

2.1 Radiological signs.

2.2 Rope, barrier tape, and other and posting materials as appropriate.

3.0 Procedure

3.1 Review historical radiation survey information, and complete a radiological survey of the work area.

3.2 Issue RWP or HWP.

3.2.1 Complete an RWP (Attachment 52-2 to Safety Management Standard (SMS) 52) to inform workers of area radiological conditions and entry requirements. Where appropriate, combine radiological requirements with other non-radiological requirements into a single HWP (Attachment 52-3 to SMS 52)

3.2.2 Review radiological survey data, and other information prior to issuing an RWP or HWP.

3.2.3 Consult with the Health and Safety Officer (HSO) to determine any non-radiological PPE or monitoring requirements.

3.2.4 The Radiation Safety Officer (RSO) or designee assigns an RWP number and completes the RWP log.

3.2.4.1 The following RWP/HWP naming convention will be used.

AA-yy-##

Where

AA = site or project specific identifier
Yy= 2 digit year
= sequential number
UT-14-001 is the first RWP issued for general work done in 2014.

3.2.5 Complete the appropriate sections of the RWP or HWP.

3.2.5.1 General RWPs used to document and control access to a specific location may be issued for up to a year, but should be reviewed routinely to ensure conditions have not changed.

3.2.5.2 Task-specific RWPs/ HPS's used to document and control specific tasks are generally issued for the expected duration of the task or no more than a month, but should be reviewed routinely to ensure conditions have not changed.

3.2.6 Contact the HSO and the Project Manager for approval.

3.3 Post RWP/HWP.

3.3.1 Maintain a signed copy of the RWP / HWP at the CA entrance, or if the work does not require establishment of a formal access point, ensure the RWP/HWP is available at the work location.

3.3.2 Each individual assigned to do work under an RWP or entering an RCA is required to review, comply with all requirements, and sign the RWP/HWP.

3.3.3 The RWP will be used to document radiological work activities or entry into an CA. Additional pages may be added as necessary.

3.3.4 An RWP/HWP will be terminated if there is a change in radiological conditions, completion of the job, or as deemed necessary by the RSO.

3.4 Review RWP /HWP.

3.4.1 Upon termination of the RWP/HWP, maintain copies in the project file.

3.5 Establish CA- controlled areas are intended to notify individuals that they are entering an area that is controlled for radiation protection purposes.

3.5.1 Permit only trained, authorized, and qualified personnel to access CAs.

3.5.2 Establish control measures and procedures using an RWP system where necessary to ensure appropriate planning and activities in controlled areas.

3.5.3 Temporary CA's- during transient (<8 hrs) radiological activities where postings are not practical, the area shall be placed under the observation and control of an qualified individual. The qualified individual is responsible for implement access and exposure controls.

3.6 Ensure areas are properly Posted, in accordance with Table 1.

3.6.1 Post a standard radiation symbol in magenta or black on yellow background at each access point to a controlled or restricted area along with appropriate identification and instructions.

Table 1. Posting Requirements

Posting Sign	Definition
Caution Radiation Area	5 mrem in 1 hour at 30 cm
Caution-High Radiation Area or Danger High Radiation Area	100 mrem in 1 hr at 30 cm
Grave Danger-Very High Radiation Area	500 rads in 1 hr at 1 m
Caution Contaminated Area	Removable radioactive contamination in excess of Reg Guide 1.86 Table 1 values
Caution Airborne Radioactivity Area or Danger Airborne Radioactivity Area	>1 DAC or 12 DAC hours/week
Caution, Radioactive Material or Danger Radioactive Material	Radioactive material handled, used or stored

4.0 Documents Generated by this Procedure

Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects, if items are not applicable to the assigned work those entries may be left blank or lined out.

4.1 Issued RWP or HWPs, and all entry log pages.

4.2 RWP or HWP Log.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

5.2 Utah Administrative Code R313-15 “Standards for Protection Against Radiation”

Radiation Work Permit/Hazardous Work Permit Log

Project Name

Permit (RWP or HWP)	Site	Yr	Number	RWP/HWP #	Issue Date	Type (Job or General)	Description	# of pages	Termination Date
			001	--001					
				--					
				--					
				--					
				--					
				--					
				--					
				--					
				--					
				--					
				--					
				--					

PROCEDURE APPROVAL:		
Amy Robin Jones		9/23/2014
(printed name)	Radiation Safety Officer *(signature)*	Date

1.0 Purpose

The purpose of this document is to define the procedure for the use of portable survey instruments. This document is not intended to cover every instrument configuration and field situation, but rather provides general procedures for commonly used instrument configurations and field situations.

2.0 Equipment

Radiation detection instrumentation comes in many configurations provided by several vendors. Some equipment is provided as a single entity containing the radiation detector and meter combined. Other equipment is provided as component parts consisting of a radiation detector or a meter, which can be mixed and matched as the situation requires. For the purposes of this procedure, the term “instrument” means a detector and meter provided as a single entity. The most commonly used equipment is listed below.

2.1 Instruments.

2.1.1 Ludlum Model 19.

2.1.2 Ludlum Model 12s.

2.2 Detectors.

2.2.1 Ludlum Model 44-9 “pancake” GM-probe.

2.2.2 Ludlum Model 44-1 1” NaI probe.

2.2.3 Ludlum Model 44-10 2” NaI probe.

2.2.4 Ludlum Model 44-20 3” NaI probe.

2.2.5 Ludlum Model 43-93 Alpha/Beta Phoswhich probe.

2.3 Meters.

2.3.1 Ludlum Model 3.

2.3.2 Ludlum Model 12.

2.3.3 Ludlum Model 2221.

2.3.4 Ludlum Model 2350-1.

2.3.5 Ludlum Model 2360.

2.3.6 Ludlum Model 2241

2.4 Miscellaneous Equipment.

2.4.1 Exempt Operational Check Sources.

2.4.2 Batteries.

2.4.3 Cables.

3.0 Procedure

3.1 Calibrations.

Instruments must be calibrated annually. Instruments with a separate detector and meter must be calibrated and used together.

3.1.1 Prior to each use, confirm the instrument is in calibration, and is functioning in accordance with the manufacturer's recommendations.

3.1.2 Ensure copies of the calibration documents are maintained in the field with the instruments.

3.2 Establish the Operational Tolerance Limits. (

Operational tolerance limits are established when an instrument is returned from the instrument vendor following calibration, and are used as the basis for the daily operational checks.

3.2.1 Complete this procedure for each instrument (meter/detector combination) upon initial receipt following instrument vendor calibration. These tolerances may also be reestablished during field setup to account for field conditions.

3.2.2 Record all data on URS PS Instrument Setup Worksheet.

3.2.2.1 Record the meter, probe and calibration-specific information (i.e., serial number, cable length, window and voltage settings etc.).

3.2.2.2 Review the instrument calibration documentation and confirm all settings are consistent and documented.

3.2.2.3 Retrieve the specific check source that will be used to conduct the daily operation check, and record the check source ID, source serial number, and activity.

3.2.2.4 Describe the detailed position of the check source relative to the probe. (i.e., source label side down on the bottom of the detector, source label side centered on bottom of box, etc.) Be specific as other users will have to duplicate this position every time the instrument is used.

3.2.2.5 Record all instrument-specific parameters in the notes section (e.g., calibrated efficiencies).

3.2.2.6 Collect 10 background measurements and record them in column BKGD.

NOTE: For instruments that do not allow for timed reading, record the measurement once the needle has generally stabilized.

3.2.2.7 Collect 10 source measurements and record them in column Source.

3.2.2.8 Repeat this procedure for all meter, probe, check source options.

3.3 Daily Check Spreadsheet.

3.3.1 Transfer all the data from the URS PS Instrument Setup Worksheet to the active instrument daily operation spreadsheet.

3.3.2 Once all entries are completed in the worksheet, the spreadsheet calculates the net values and tolerances (within 20% of the mean).

3.3.3 Use this worksheet to record the results of the daily checks if access to the spreadsheet is readily available in the field. Otherwise, ensure that a hard copy of the spreadsheet is available to record the results and confirm the instrument is operating within tolerance.

3.4 Instrument Daily Checks.

When in use, as a minimum check each instrument daily for proper operation prior to use. A background location should be selected and the same area used for these checks during the project.

3.4.1 Complete for each instrument using the specific check source used to establish the instrument tolerances.

3.4.1.1 The instrument allows for fast (F) and slow (S) response. Set the instrument on Fast (F) for checks.

3.4.1.2 Record all the data on the Radiation Instrument Daily Check spreadsheet.

3.4.1.2.1 If daily checks are done at both the start and end of the day use S to indicate start of day check, and E for end of day check.

3.4.1.3 Check the batteries. If the battery indicator is toward the low end of the "acceptable battery range," replace the batteries. Record the result on the form. If you replace the batteries, make a note in the Notes column.

3.4.1.4 Check the high voltage (HV) on the instrument, if provided. Record the high voltage.

3.4.1.5 Do a one-minute background reading.

NOTE: For instruments that do not allow for timed reading, record the measurement once the needle has generally stabilized.

3.4.1.6 Do a one-minute count of the source. Position the check source directly over the instrument and in a position consistent with the operations check location.

3.4.1.7 Enter the data into the Daily Instrument Check spreadsheet. The spreadsheet will indicate if the values are in or out of tolerances. Confirm that daily fluctuations do not exceed 20%.

3.4.2 If the instrument does not pass the daily check:

3.4.2.1 Check over the instrument. Make sure the settings are correct, and confirm the source orientation.

3.4.2.2 If the instrument does not pass the daily check, the following maintenance activities may be required:

- Replace batteries
- Replace cables
- Replace probe Mylar
- Clean battery terminals

3.4.2.3 Repeat the test after addressing the potential cause.

3.4.2.4 Remove any instrument that does not pass this second test from service. Record out of service (OOS) in the notes section.

3.4.3 Maintain a copy of the Daily Instrument Check spreadsheet for each radiation monitoring instrument to record the results of the daily instrument checks.

3.4.4 Keep the completed Daily Instrument Check spreadsheet on file as permanent documentation that the instrument was known to be operating properly for measurements made on any given date according to required retention times for the radioactive materials license and the project.

4.0 Data Analysis

4.1 Instrument Efficiency.

4.1.1 Instrument efficiency is the percentage of radiation detected of a known value. For field instruments, efficiency values are estimated from manufacturer information, or calculated from calibration data or the operational check source.

4.1.2 The basic formula to calculate efficiency (ε), assuming the background count time is consistent, is:

$$\varepsilon = \frac{R_{std}}{A_{std}}$$

R_{std} = gross count rate of the standard in cpm

A_{std} = known activity level of the standard in dpm

4.2 Detection Limits.

4.2.1 Each instrument has a lower boundary for detection of radiation. This value is known as the minimum detectable concentration (MDC). For field instruments, the MDC is used to determine adequate sensitivity of the instrumentation for the intended use.

4.2.2 The basic formula to calculate the MDC at a 95% confidence interval is:

$$MDC = \frac{3 + \left(4.65\sqrt{B}\right)}{T \cdot \varepsilon \cdot \frac{A}{100}}$$

B = background cpm for time interval

T = time interval in minutes

ε = efficiency

A = physical area seen by the detector in cm^2

5.0 Documents Generated by this Procedure

Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects.

5.1 URS PS Instrument Setup Worksheet.

5.2 Daily Instrument Check Spreadsheets.

6.0 References

6.1 URS Safety Management Standard 52 Radiation Protection Program.

6.2 Utah Administrative Code R313-15 “Standards for Protection against Radiation.”

Instrument Setup Worksheet

Instrument Model		Serial Number	
Probe		Serial Number	
Calibration Date			

For the following circle or record the actual instrument values or settings

Cable Length	39"	5 Ft	15 Ft	Other	_____
Instrument readout	cpm	µR/hr		Other	_____
Count time	1 min			Other	_____
Scale	0.1	1	10	Other	_____
Response time	F	S		_____	
Battery	_____		Window	_____	
High Voltage	_____		Threshold	_____	

Source Mantles	2 mantle	Black	Yellow	Blue	Film
	1 Mantle	Pink	1M source #2		
Source Other	Th-230	Cl-36	Co-60	Pb-210	
Tc-99 record SN	_____		Cs-137 record SN		_____

Record a detailed description of how the source was positioned so others can duplicate

Notes _____

Source ID					Bkdg	
1					1	
2					2	
3					3	
4					4	
5					5	
6					6	
7					7	
8					8	
9					9	
10					10	

Daily Source Check Form

Instrument Configuration				
Instrument(Mfg/Mdl)			Serial #	
Probe(Mfg/Mdl)			Serial #	
Cable Length			HV	

Instrument Calibration					
Calibration Date		Certificate #		Due	

Check Source					
Source Name		Serial #		Assay Date	
Nuclide		Half life		Activity	

Detailed description of instrument and source positioning for daily check, and any other notes

Initial QC Set Up			
Source		Bkdg	Net
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Average			
Tolerance			
± 20%			

Date	Project	Initials	Start /end	Batt	Bkgd		Source			Net			Notes
					Reading	Units	Reading	Units	Ok?	Reading	Units	Ok?	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	

PROCEDURE APPROVAL:		
Amy Robin Jones		9/23/2014
(printed name)	Radiation Safety Officer *(signature)*	Date

1.0 Purpose

To provide a method for conducting radiation surveys and identifying area with elevated radiation levels using radiation detection equipment. Surveys are only to be conducted by properly trained and authorized radiation protection personnel.

2.0 Equipment

2.1 Project-specific radiation detection instruments generally include meters for identifying contamination and dose rates.

2.2 Marking materials: chalk, flags, paint, etc.

2.3 Appropriate smear sample materials (wipes/ qtips).

2.4 Survey forms.

3.0 Procedure

3.1 General Survey Types.

3.1.1 Incoming equipment surveys – Document the prior radiological condition of equipment and items to be used on site. Generally focus on items (i.e., drill rig, excavator, sample coolers) with a potential to be in direct contact with potentially contaminated material.

3.1.2 Routine surveys – Document the radiological conditions of controlled areas.

3.1.2.1 Indoors – Includes walls, ceilings, floors, with particular attention to drains, air vents, etc. Surfaces to be surveyed should be relatively clean of loose material, and drains should not contain standing water.

3.1.2.2 Outdoor – Includes ground surfaces, soil, concrete, asphalt, and exterior building surfaces. Surveys shall not be conducted over standing water, snow-covered ground, or areas with saturated soils. In limited situations, where the soil/surface is always

saturated (i.e., drainages) measurements may be collected when the ground is as dry as practical and the condition documented.

3.1.3 Contamination Surveys/Release Surveys – Ensure items and equipment leaving the site are not contaminated, in accordance with the release criteria included in the RPP.

3.1.3.1 Decontamination Confirmation – If water was used for decontamination, ensure items are dry before surveying.

3.1.4 Department of Transportation (DOT) surveys document the package or transport vehicle is in compliance with DOT limits for surface contamination and dose rates.

3.2 Radiation Scanning.

3.2.1 Pass the detector over the surface at the appropriate distance and speed.

3.2.1.1 The speed of detector movement will vary depending upon the radionuclide of concern, the experience of the surveyor, and the required observation interval.

3.2.1.2 Typical survey conditions for each radiation type are listed below.

3.2.1.2.1 Alpha radiation (i.e., Ludlum 43-98): detector distance of 1 cm or less; detector survey speed of no greater than 5 centimeters per second.

3.2.1.2.2 Beta radiation (i.e., Ludlum 44-9): detector distance of 1 cm or less; detector survey speed of no greater than one detector width per second.

3.2.1.2.3 Gamma radiation (i.e., Ludlum 44-10): detector distance of 30 cm or less; detector survey speed of no greater than 1.5 m per second.

3.2.2 Note increases in count rate as indicated by the audible output or meter reading. Compare count rates to the client-provided background data, measurements from the site-specific background area, or an established project investigation level. Investigate any count rate of greater than twice background or established project-specific investigation level.

3.2.2.1 Mark areas that meet or exceed investigation levels.

3.2.2.2 Continue traversing the area at close intervals. Typically, the intervals will be close enough to thoroughly cover the area. However, some situations may have larger intervals.

3.2.3 Record the survey results on the appropriate example survey form or log book.

3.3 Fixed Point Surveys.

3.3.1 Hold the detector over the surface at the appropriate distance.

3.3.2 Collect data for the counting period. The counting period should be less than or equal to the background count time. The count time depends on the radionuclide of concern and the detection requirements of the project. For basic screening, a typical count time is one minute.

3.3.3 Record the survey results on the appropriate form or logbook.

3.3.4 Compare results to the established levels for the project. Mark areas that meet or exceed action levels.

3.3.5 Repeat these steps for all fixed-point survey intervals.

3.3.6 Surveys for loose contamination include collection of both fixed point measurements and smear samples at the same location. Perform the surveys in various representative locations, as determined by the project RSO and the specific circumstances. Examples of locations are listed below:

3.3.6.1 Normal personnel traffic routes and at entrance and egress locations.

3.3.6.2 Building surfaces such as floor, ledges, corners, ventilation ducting, piping runs, lighting fixtures, sinks, drain covers, etc.

3.3.6.3 Equipment surfaces such as wheels, steps, ledges, probes, etc.

3.3.6.4 Collect a minimum of five fixed-point measurements and smear samples from equipment for incoming, and release surveys. Larger items with a high potential for contamination may require up to 20 smear samples.

3.4 Documentation.

3.4.1 Project staff members are responsible for documenting radiation survey activities.

3.4.2 Assign a unique project-specific radiation survey number and record it on the project survey log and the radiation survey form.

3.4.2.1 the following survey naming convention

AA-YY-BB-##
Where
AA = Site or project specific ID
YY= 2 digit year
BB= Survey Type (IN=incoming, OT=outgoing, RT=routine, EX=excavation)
= sequential number
UT-14-RT-001 is the first routine survey done in 2014.

3.4.3 Document all radiation survey results on survey forms or in field log books. Documentation shall include the following:

3.4.3.1 Names of personnel and survey date.

3.4.3.2 Survey type, DOT survey, excavation control, exposure rate, contamination.

3.4.3.3 Location designations.

3.4.3.4 Serial numbers and calibration information for all survey equipment used.

3.4.3.5 Survey results, including background measurements.

3.4.3.6 Other applicable information or project-specific requirements.

4.0 Documents Generated by this Procedure

Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects.

4.1 Project Survey Log.

4.2 Radiation Survey Form examples.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

5.2 Utah Administrative Code R313-15 “Standards for Protection Against Radiation”

Radiation Survey Log

				Project Name				
Site	**Yr**	**Type**	**Number**	**Survey #**	**Date**	**Initials**	**Description**	**# of pages**
			001	---001				

Survey ID _____ URS Survey Page ___ of ___

Project _____

Survey Type _____

Tech _____

Date

Description _____

⬭ Denotes Smear Location

* Denotes Contact Readings

All Readings in cpm unless other wise noted

	Direct Scan	*Fixed Point*
Meter/Probe		
Serial#		
Cal Due		
Bkg		
Units		

Smear Results*

Smear	Location	α cts	βγ cts	Ct time

Inst A _____

Serial# _____

Cal Due _____

Tech _____

Date _____

* See smear counter data sheet for dpm results

Survey ID _____ Hand Equipment/ Items Survey Page ___ of ___

Project

Survey Type _____

Tech _____

Date _____

Direct Scan

Meter/Probe _____

Serial# _____

Cal Due _____

Bkg _____

Units _____

Smear Counting

Inst A _____

Serial# _____

Cal Due _____

Tech _____

Date _____

Item #	*Description*	*Direct Scan*			*Smear#*	*Ct Time*	*Counts **		*notes*
		low	*high*	*avg*			*alpha*	*beta*	

* See smear counter data sheet for dpm results

Survey ID ____________________________

DOT Shipping Release Form

Page ___ of ___

Project		*Direct Scan*		*Dose Rate*		*Smear Counting*	
		Model		Model		Instrument	
Tech		Serial#		Serial#		Serial#	
		Cal Due		Cal Due		Cal Due	
Date		Bkg		Bkg		Tech	

Cooler Package #	Units	1 Top	2 Front	3 Right	4 Left	5 Back	6 Bottom	Location	Smear #	Time	Counts*		[#]Ok to Release
											alpha	beta	
	cpm												
	µR/hr												
	cpm												
	µR/hr												
	cpm												
	µR/hr												
	cpm												
	µR/hr												
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	µR/hr												
	cpm												
	µR/hr												

* See smear counter data sheet for dpm results

Dose rates must below 500 µR/hr

[#]Alpha below 20 dpm/cm^2, beta below 220 dpm/cm^2

Survey ID _____ URS Survey Page ___ of ___

Project

Survey Type _____ **Description** _____

Tech _____ * Denotes Contact Readings

Date All Readings in cpm unless other wise noted

Meter/Probe		**Meter/Probe**	
Serial#		**Serial#**	
Cal Due		**Cal Due**	
Bkg		**Bkg**	
Units		**Units**	

Notes _____

PROCEDURE APPROVAL:		
Amy Robin Jones		9/23/2014
(printed name)	Radiation Safety Officer *(signature)*	Date

1.0 Purpose

Smear surveys are used to detect the amount of loose surface radioactive contamination present. Radioactive contamination is loose radioactive material where it is not wanted. The terms swipe, smear, or wipe survey are used interchangeably. Smear surveys provide information on the potential for radioactive material to enter the body and contribute to internal exposure or the potential for the radioactive material to be spread beyond the boundaries of the licensed facility or radiation control area.

2.0 Equipment

2.1 Ludlum 2929 attached to a Ludlum 43-10-1 or equivalent.

2.2 Alpha and Beta NIST traceable check sources.

2.3 Smears and baggies.

2.4 Gloves.

2.5 Tweezers.

3.0 Procedure

3.1 Instrument Setup.

In order to perform smear counting, the instrumentation needs to be verified during setup. Typically, the instrumentation will come from the rental company already calibrated, which includes the voltage plateau determination. The instrument must be calibrated annually. To set up the instrument, perform the chi-squared determination.

The following procedure is for use with the Ludlum 2929 attached to a Ludlum 43-10-1. This instrument measures both alpha and beta. Typically it is set up to measure both.

3.2 Unpack and Assemble the Instrument.

3.3 Instrument Set Up Calculations, the smear counter worksheet tab labeled **Counter x set up** is set up to perform the chi-square, instrument efficiency, minimum detectable activity (MDA) calculations, and calculating the daily operational check criteria. The

detailed steps for performing these calculations without using the spreadsheet are provided in Sections 3.4 to 3.6 below.

3.3.1 Complete all entries in spreadsheet identifying the specific instrument, and sources used.

3.3.2 Collect and record in the worksheet a minimum of 10 one-minute background counts and 10 one-minute counts for each NIST traceable source (20 one-minute counts is preferred if possible).

3.3.3 To determine the optimum count time, collect a series of background measurements at 2 minutes, 5 minutes, and 10 minutes.

3.3.4 Evaluate the count time results to determine the project-specific smear count times.

3.3.4.1 Count times may be different depending on the release criteria. (i.e., count time for DOT survey may be different than free release).

3.4 Chi-Square Determination.

Chi-square is used to calculate the probability that the differences in count values obtained in a series of count intervals follow the assumed statistical distribution. It also serves as an indication that the counting instrument is operating satisfactorily. During the annual calibration the determination of the operating voltage must be performed prior to performing the chi-square test. A chi-square test is performed by calculating the chi-square value from a series of individual counts and comparing this value to a table or graph of acceptable values. Mathematically, the chi-square value can be calculated with the following equation:

$$X^2 = \frac{1}{x_{avg}} \sum_{1}^{N} \left(x_N - x_{avg}\right)^2$$

Where: X^2 is the chi-square value
x_{avg} is the average of all x values
N is the number of measurements (i.e., 10 counts)
x_N is the x value at N measurement

3.4.1 Calculate the average count rate (cpm) [x_{avg}], for each NIST traceable source.

3.4.2 Subtract the average count rate from each individual count. Note that some values will be negative.

3.4.3 Square the difference (answer) obtained in step 3.4.2.

3.4.4 Add the squares of all the differences obtained in step 3.4.3.

3.4.5 Divide the total of the squares by the average count rate. This result is the chi-square value [X^2].

3.4.6 Determine the N-1 value by subtracting 1 from the number of measurements.

3.4.7 Using Table 1, look up the upper and lower boundary values for the N-1 value.

3.4.8 Compare the calculated chi-square value to the boundary values. The result should be between the two numbers.

3.4.9 If the number is higher than the satisfactory value there is a problem with the instrument and the instrument should be removed from service until the problem is resolved.

Table 1: Chi-Squared Values for N-1 Measurements

N-1	X^2 0.975	X^2 0.025
2	5.02	0.0010
3	7.38	0.0506
4	9.35	0.216
5	11.1	0.484
6	12.8	0.831
7	14.4	1.24
8	16.0	1.69
9	17.5	2.18
10	19.0	2.70
11	20.5	3.25
12	21.9	3.82
13	23.3	4.40
14	24.7	5.01
15	26.1	5.63
16	27.5	6.26
17	28.8	6.91
18	30.2	7.56
19	31.5	8.23
20	32.9	8.91
21	34.2	9.59
22	35.5	10.3

Table 1: Chi-Squared Values for N-1 Measurements

N-1	X^2 0.975	X^2 0.025
23	36.8	11.00
24	38.1	11.7
25	39.4	12.4
26	40.6	13.1
27	41.9	13.8
28	43.2	14.6
29	44.5	15.3
30	45.7	16.0
31	47.0	16.8
41	59.3	24.4
51	71.4	32.4
61	83.3	40.5
71	95.0	48.8
81	106.6	57.2
91	118.1	65.6
101	129.6	74.2

3.5 Instrument Efficiency.

3.5.1 Instrument efficiency is the percentage of radiation detected of a known value.

3.5.2 The basic formula to calculate efficiency (ε), assuming the background is the consistent, is:

$$Ef = \frac{R_{std}}{A_{std}}$$

R_{std} = gross count rate of the standard in cpm
A_{std} = known activity level of the standard in dpm

3.6 Minimum Detectable Activity (MDA).

Each radiation instrument has a lower limit of detection (LLD), which is used to determine the MDA and the appropriate smear count time.

3.6.1 The basic formula to calculate the LLD at a 95% confidence interval is:

$$LLD = \frac{2.71 + (3.29)\left(\sqrt{B * T_s * (T_s + T_b)}\right)}{T_s}$$

B = background count rate (cpm)

T_b = background count time (min)
T_s = sample count time (min)

3.6.2 The basic formula to calculate the MDA is

$$MDA = \frac{LLD}{\varepsilon}$$

LLD= Lower Limit of Detection
ε = efficiency

3.6.3 Evaluate the MDA for count time to identify the appropriate project specific count times.

3.7 Daily Operation Check – Record on the Counter X Daily Check Worksheet.

3.7.1 Collect and record a 1-minute background count and a 1-minute count on each of the NIST traceable sources.

3.7.2 The spreadsheet will indicate if the values are in or out of tolerances. Confirm that daily fluctuations do not exceed 20%.

3.7.3 Collect and record a background count for each of the project-specific count times.

3.8 Smear Collection

3.8.1 Details on when and where smear samples are collected are included in RP-4.0 Section 3.3. Generally smears are collected to support equipment decontamination, release, and DOT shipment requirements. Smears may be collected to identify the presence of loose contamination.

3.8.2 Label the smear sample with the smear number, location, and date before collection.

3.8.3 Wear gloves when taking smears. Gloves shall be considered potentially contaminated until the smear is determined to be within permissible limits.

3.8.4 Take all smear surveys over an area of 100 cm^2, the size of a $1 bill.

3.8.4.1 If the item or area to be surveyed is less than 100 cm2, then survey the largest area possible and record that area on the survey sheet.

3.8.4.2 Use moderate pressure; be sure not to tear the smear.

3.8.4.3 Place smears in a baggie, envelope, or other individual container for transport to the counting area. Once a swipe is taken it must

be considered to be radioactive. Do not place smears in your pocket.

3.9 Smear Counting.

3.9.1 Wearing gloves, remove the smear from the collection paper using tweezers.

3.9.2 Place the smear in the counting drawer, ensuring the active side is facing up towards the detector.

NOTE: The active side is the side that was rubbed against a surface.

3.9.3 When closing the drawer be certain that the actuator switch has engaged. To do this push, the drawer all the way in and listen for a click. When you hear the click, hold the drawer in and lock it in place using the black lever on the side of the detector.

3.9.4 Count the sample and record the number of counts received on the survey form.

3.9.4.1 Typical count times are one (1) or two (2) minutes. Different count times may be required depending upon project requirements, such as detection limits.

3.9.5 Unlock the drawer and remove the smear.

3.9.6 Record the sample results on the smear collection paper, and input the results in the smear log sheet.

3.9.7 Complete all the data indicated on the **Smear Count Results** Tab. This will calculate the smear activity as described in section 3.10

3.9.7.1 Ensure you record the results in the correct column for the counter that was used, and include count time and that day's background value

3.9.8 Sample results that are above the project-specific criteria will be highlighted.

3.9.9 Recount any samples that are flag as exceeding the release criteria, and notify the SRSO.

3.9.10 Store or dispose of the smear according to project requirements.

3.10 Smear Activity.

3.10.1 The basic formula to calculate the activity on a smear in dpm is:

$$dpm = \frac{Sample_{cpm} - Bkgd_{cpm}}{Ef}$$

$Sample_{cpm}$ = gross count rate of the smear in cpm
$Bkgd_{cpm}$= background count rate in cpm
Ef= Detector Efficiency in decimal format

4.0 Documents Generated by this Procedure

Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects.

4.1 Smear count calculation spreadsheet.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

Counter Setup Form

	Background		Tc-99 9240 dpm		Th-230 20100 dpm		Chi beta		Chi Alpha	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	x_i-t	$(x_i$-t$)^2$	x_i-t	$(x_i$-t$)^2$
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
Sum	0	0	0	0	0	0				
Count	0	0	0	0	0	0				
Average										
Sum of squares										
Chi square value										

Instrument Id	
Model	
SN	
Counter	
SN	
Cal due date	

Check Sources		
	Beta	Alpha
Source ID	Tc-99	Th-230
Serial #		
Half-life Yrs	211000	75380
Assay Date		
Activity dpm		

N-1	-1	-1	-1	-1	-1	-1

	Beta	Alpha
Efficiency		

	alpha	beta
LLD		
MDA		

	2	Bkg		5	Bkg		10	Bkg	
	α cpm	βγ cpm		α cpm	βγ cpm		α cpm	βγ cpm	
Sum	0	0		0	0		0	0	
Count	0	0		0	0		0	0	
Average									

Counter A Daily Check Form

Initial QC Set Up		Bkgd			Tc-99			Th-230			Net	
Source		α cpm	βγ cpm		α cpm	βγ cpm		α cpm	βγ cpm		α cpm	βγ cpm
	1	0	0		0	0		0	0		0	0
	2	0	0		0	0		0	0		0	0
	3	0	0		0	0		0	0		0	0
	4	0	0		0	0		0	0		0	0
	5	0	0		0	0		0	0		0	0
	6	0	0		0	0		0	0		0	0
	7	0	0		0	0		0	0		0	0
	8	0	0		0	0		0	0		0	0
	9	0	0		0	0		0	0		0	0
	10	0	0		0	0		0	0		0	0
Average		0	0		0	0		0	0		0	0
Tolerance		0	0		0	0		0	0		0	0
± 20%		0	0		0	0		0	0		0	0

2929#	43-10-1#	eff b	eff a
0	**0**		

Date	Initials	Bkgd		Tc-99			Th-230			Net				2 min bkdg	
		α cpm	βγ cpm	α cpm	βγ cpm	Ok?	α cpm	βγ cpm	Ok?	α cpm	Ok?	βγ cpm	Ok?	α cts	βγ cts
										0	Ok	0	Ok		
										0	Ok	0	Ok		
										0	Ok	0	Ok		
										0	Ok	0	Ok		
										0	Ok	0	Ok		
										0	Ok	0	Ok		
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Smear Count Results Form

Count Date	Survey Id	Smear #	count time	0				Counter B				0.0		Counter B			Notes
				Background		Smear		Background		Smear		Activity		Activity		Total Activity	
				α cts	βγ cts	α cts	βγ cts	α cts	βγ cts	α cts	βγ cts	α dpm	βγ dpm	α dpm	βγ dpm		

PROCEDURE APPROVAL:		
Amy Robin Jones		9/23/2014
(printed name)	Radiation Safety Officer *(signature)*	Date

1.0 Purpose

This procedure details the procedures for handling samples for handling, tracking and preparing samples for shipment under Chain of Custody (COC).

2.0 Equipment

2.1 Shipping containers.

2.2 Samples. These may include media samples (soil, sludge, water), smears or air sample filters.

2.3 Radiation Survey Instruments as needed.

2.4 COC forms and seal if necessary.

3.0 Procedure

3.1 Sample Identification and Labeling.

3.1.1 Ensure samples collected during site activities have unique sample identification (ID) numbers, as directed by the analytical lab, and the project work plan.

3.2 COC Procedures.

3.2.1 Document the custody of all samples on the COC forms. The COC forms document possession of the sample from collection through laboratory receipt. Record the following minimum information on the COC form:

3.2.1.1 Sample ID.

3.2.1.2 Sampling date and time.

3.2.1.3 Required analysis.

3.2.1.4 Number of containers.

3.2.1.5 Sampler signature.

3.2.2 A sample is defined as being in an individual's custody if the following conditions occur:

3.2.2.1 The sample is in that individual's actual physical possession.

3.2.2.2 The sample is in that individual's view after being in their physical possession.

3.2.2.3 The sample is in that individual's physical possession and then locked or otherwise sealed so that tampering would be evident.

3.2.2.4 The sample is maintained in a secure area that is restricted to authorized personnel only.

3.3 Package Samples.

3.3.1 Review project and laboratory requirements for hold times and shipping requirements.

3.3.2 If not previously surveyed during collection, survey the exterior of each sample container using a thin window Geiger-Muller detector or equivalent on the surface of the sample container.

3.3.3 Package the samples for transport taking care not to contaminate the outside of any sample container. Typically soil samples are shipped in coolers or other strong tight containers. Smears and air sample filters may be packaged in Tyvex envelopes.

3.3.4 Place COC and any other required documentation inside the package.

3.4 Radiological Screening of Package.

3.4.1 Complete a radiological survey of the package to confirm compliance with DOT shipping requirements for surface contamination and dose rate.

3.4.2 DOT shipping contamination control requirements are located in 40 CFR 173.443. **NOTE: This procedure does not take precedence over the requirements of 40 CFR 173, or any other regulatory requirements for shipping of radioactive materials.**

3.4.2.1 Complete a smear survey, with an area of 300 cm^2, to determine non-fixed radiological contamination. Non-fixed radiological contamination limits are listed in Table 1.

3.4.2.2 Complete a timed count survey, with an area of 300 cm^2, to determine fixed radiological contamination. Fixed radiological contamination limits are listed in Table 1.

3.4.2.3 Complete dose survey to determine maximum dose rate at the exterior surface of the package. The maximum dose rate must not exceed 0.5 mrem/hr.

Table 1.

Contaminant	**Maximum permissible limits**	
	non-fixed (dpm/cm2)	**Fixed (dpm/cm2)**
Beta and gamma emitters and low toxicity alpha emitters	220	40,000
All other alpha emitting radionuclides	22	4,000

4.0 Documents Generated By This Procedure

Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects.

4.1 Sample Collection Logs.

4.2 Chain-of-Custody Forms.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

PROCEDURE APPROVAL:		
Amy Robin Jones		1/15/2016
(printed name)	Radiation Safety Officer *(signature)*	Date

1.0 Purpose

This procedure describes how personnel, equipment, tools, or other items are screened for radiological contamination and decontaminated. Project staff may assist in decontamination of equipment and tools but radiological scans will be conducted by site radiological personnel. Decontamination personnel will only be conducted under the direct supervision of the RSO. .

2.0 Equipment

2.1 Friskers designed to detect radionuclides of concern. (i.e. Pancake Ludlum M3 with Ludlum 44-9, or dual alpha beta detector Ludlum M2360 with 43-93

2.2 Water, Mild soap (alconox) or radiac wash depending on the radionuclides of concern.

2.3 Swipes & Smear counters

3.0 Procedure

3.1 Equipment screening.

3.1.1 A radiological survey shall be performed on all equipment and materials, which may be contaminated.

3.1.2 If a survey indicates detectible contamination, defined as twice the instrument background level decontamination is required.

3.2 Equipment and Area Decontamination

3.2.1 Equipment and decontamination area decontamination must be performed in an area designated by the Site Manager and RSO, where any fluids or wastes are contained.

3.2.2 To minimize the spread of contamination, decontamination should begin at the least contaminated areas (generally starting at the perimeter and working inward) and progress to the areas of higher contamination.

3.2.3 REMOVE all visible dirt, rocks, dust, and moisture from the area or object.

3.2.4 WASH the object with water, only if required to provide a clean surface for radiological screening.

3.2.4.1 DRY the area or object, allow to air dry or use cloth or paper towels.

3.2.5 SURVEY the cleaned areas to check the effectiveness of the effort. Collect and analyze swipe samples as appropriate

3.2.6 IF necessary, REPEAT steps 3.2.1 through 3.2.4 until the area or object is below the site contamination limits

3.2.7 IF contamination persists, CONSULT with the RSO for other decontamination methods

3.3 Personnel Screening

3.3.1 As a minimum a Hand and Foot frisk is required for anyone handling radiological material, entering a controlled area, or working under a RWP. Additional frisking requirements may be required by the RWP.

3.3.2 Personnel may self-frisk, only if trained and radiation personnel are available to address any detections.

3.3.3 If the frisk indicates detectible contamination, defined as twice the instrument background level Contact the radiation personnel and the RSO.

3.4 Personnel Decontamination

3.4.1 Personnel decontamination must be performed in a controlled location under the direct supervision of the RSO.

3.4.1.1 If the person needs to be transported to another location have them don a clean set of PPE to cover the contaminated area.

3.4.2 **BRUSH** off all visible dirt, rocks, dust, and moisture from the area or object.

DO NOT SCRUB OR USE ANY ABRASIVE MATERIAL

3.4.3 **SURVEY** the applicable areas Procedure to check the effectiveness of the treatment. **IF** necessary, **REPEAT** (no more than twice).

3.4.4 **RINSE** the area with tepid water taking care limit the spread of contamination.

3.4.5 **PAT** the skin dry with disposable towels, **DO NOT** rub.

3.4.6 **SURVEY** the applicable areas Procedure to check the effectiveness of the treatment. **IF** necessary, **REPEAT** (no more than twice).

3.4.7 **WASH** the area using a mild soap and tepid water solution,

3.4.8 Being careful not to spread the contamination, **RINSE** the lather.

3.4.9 **SURVEY** the applicable areas Procedure to check the effectiveness of the treatment. **IF** necessary, **REPEAT** (no more than twice).

4.0 Documents Generated by this Procedure

Radiation survey documents. .

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

5.2 Utah Administrative Code R313-15 “Standards for Protection against Radiation”

5.3 Utah Administrative Code R313-18 “Notices, Instructions and Reports to Workers by Licensees or Registrant-inspections

PLANNING FIELD SAMPLING ACTIVITIES

1.0 PURPOSE

This section sets forth standard operating procedures (SOPs) for planning and scheduling field sampling activities. This SOP shall also be used to determine the number and type of laboratory and field Quality Control (QC) samples required while working on U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) sites/projects, and to prepare and implement Task Order Field Sampling Plans (FSP). For information on the number and type of QC samples required for the various QC Levels, see SOPs III-A, *Laboratory QC Samples (Water and Soil),* III-B, *Field QC Samples (Water and Soil),* III-C *Field and Laboratory QC Samples (Air).*

2.0 PROCEDURES

To prepare a field sampling plan, designated personnel must identify the objectives of the sampling program, determine the number of samples to be collected for each matrix (see SOP I-A-2, *Development of Data Quality Objectives*), and select the analyses to be performed on each sample (see SOPs I-A-3, *Selection of Analytes* and I-A-4, *Analytical Methods Selection*). The duration of sampling for each matrix, the preferred sampling method, the method of shipment, and the type and quantity of supplies (such as coolers, coolant and packing material that will be needed for sample storage and transport) must also be determined. Finally, the number and type of decontamination water sources to be used for each phase of sampling must be identified. The methods of determining each of these elements are addressed below.

2.1 NUMBER OF SAMPLES

Designated project personnel shall determine the number of samples to be collected from each sample matrix (e.g., soil, water), and specify the type of sample analysis. SOPs I-A-2, *Development of Data Quality Objectives,* I-A-3, *Selection of Analytes,* and I-A-4, *Analytical Methods Selection,* shall be used to determine numbers and locations of samples, as well as appropriate analytical methods. These figures will be used to estimate the costs of sample analysis. They will also help determine the number and types of sample containers required; number of field duplicates, field replicates, equipment rinsates, performance evaluation (PE) samples, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks to be collected, and the analyses to be performed on them for each matrix and analytical method; and the number of days required to perform sampling activities.

Sampling intervals for soil borings shall be selected on the basis of potential sources of contamination, the geologic and hydrologic complexity of the site, and the objectives of the sampling program. Areas of high contamination (for example, contamination in the capillary fringe) or complex geology or hydrogeology may require continuous sampling.

2.2 DURATION OF SAMPLING ACTIVITIES

The anticipated number of working days needed to complete field sampling activities shall be determined before fieldwork commences. A schedule should be developed that outlines the approximate number of samples to be collected each day, categorized by sample matrix, method of sample collection, and sample analysis (e.g., 28 soil samples collected using a hand auger and analyzed for organochlorine pesticides and chlorinated herbicides; 15 water samples collected

using a bailer—7 analyzed for volatile organics and 8 analyzed for organic lead). This information will be used to determine the number of field equipment rinsate samples that will be collected (if any), the types of analyses to be performed on them, the number of MS/MSDs and field duplicates, equipment needs, and personnel.

2.3 NUMBER OF SAMPLES TO BE ANALYZED FOR VOLATILE ORGANICS

Prior to initiation of site sampling activities, designated personnel shall determine the number of samples to be analyzed for volatile organic compounds (VOCs). This information will be used to determine the approximate number of coolers that will contain samples to be analyzed for VOCs, which will in turn, dictate the number of VOC trip blanks needed, as specified in SOP III-B, *Field QC Samples (Water, Soil).*

2.4 DECONTAMINATION WATER SOURCES

Prior to initiation of sampling activities, designated personnel shall determine the number and type of decontamination water sources. Decontamination water includes both potable water used for equipment washing, and deionized or distilled water used during the final equipment rinse. The locations of potable water supplies for field decontamination activities shall be identified and designated as the only sources to be used during site sampling activities. Similarly, the source(s) of deionized or distilled water shall be identified and designated as the only source(s) to be used during site sampling activities. The intent of this procedure is to reduce variability in equipment decontamination procedures and to make it possible to easily identify the source of contamination in the event that analysis of field blanks reveals the presence of contaminants of concern.

3.0 DOCUMENTATION

The number of samples to be collected, the proposed duration of sampling activities, the number of samples that will be analyzed for VOCs, and the number and type of decontamination water sources that will be used for field activities will be specified in the FSP and QAPP portions of the Work Plan prepared for each NAVFAC NW Task Order. Records of how this information is actually implemented during field activities will be maintained in field logbooks, as specified in SOP III-D, *Logbooks*.

4.0 REFERENCES

SOP I-A-2, *Development of Data Quality Objectives*
SOP I-A-3, *Selection of Analytes*
SOP I-A-4, *Analytical Methods Selection*
SOP II-B, *Field QC Samples (Water and Soil)*
SOP III-A, *Laboratory QC Samples (Water and Soil)*
SOP III-B, *Field QC Samples (Water, Soil)*
SOP III-C *Field and Laboratory QC Samples (Air)*
SOP III-D, *Logbooks*

5.0 ATTACHMENTS

None.

UTILITY CLEARANCE

1.0 PURPOSE

This standard operating procedure (SOP) describes the process for determining the presence of subsurface utilities and other cultural features (e.g., vault or tank) at locations where planned site activities involve the physical disturbance of subsurface materials. The definition of subsurface disturbance varies by base. Each base may have specific required procedures. These procedures are made available to the contractor through the Naval Technical Representative (NTR), or other government point of contact. The SOP applies to the following activities: soil gas surveying, excavating, trenching, drilling of borings and installation of monitoring and extraction wells, use of soil recovery or slide-hammer hand augers, and all other intrusive sampling activities. The primary purpose of the SOP is to minimize the potential for damaging underground utilities and other subsurface features, which could result in physical injury, disruption of utility service, or disturbance of other subsurface cultural features.

2.0 PROCEDURES

The following steps shall be followed at all sites where subsurface exploration will include excavations, drilling, or any other subsurface investigative method that could damage utilities at a site. In addition to the steps outlined below, personnel must always exercise caution while conducting any subsurface exploratory work.

2.1 PREPARE PRELIMINARY SITE PLAN

A preliminary, scaled site plan depicting the proposed exploratory locations shall be prepared as part of the work plan. This plan should include as many of the cultural and natural features as practical.

2.2 REVIEW BACKGROUND INFORMATION

A search of existing plan files to review the as-built plans is necessary to identify the known location of utilities at the site. Copies of as-built plans shall be copied and maintained for project use. If necessary, the locations of utilities identified shall be plotted onto a preliminary, scaled site plan. Personnel reviewing these files shall inform the Project Manager (PM) if utilities lie within close proximity to a proposed exploration or excavation location. The PM will determine if it is necessary to relocate proposed sampling or excavation locations.

For removal or remedial actions, the utility location information gathered during investigation (e.g., remedial investigation or remedial site evaluation) work shall be included in the project design documents. In this manner, information regarding utility locations collected during implementation of a Task Order can be shared with the Remedial Action Contract (RAC) Contractor during implementation of a particular Delivery Order (DO).

It may be necessary to conduct interviews with onsite and facility personnel familiar with the site in order to obtain information regarding the known and suspected locations of underground utilities. The local 1-800-“Before-U-Dig” service must be contacted a minimum of two business days prior to intrusive work. Other appropriate utility or locating companies should be contacted. The dimensions, orientation, and depth of utilities other than those identified on the as-built plans should be penciled in at their approximate locations on the preliminary plans. The

type of utility, the personnel who provided the information, and the date the information was provided should be entered into the field log.

2.3 SITE VISIT - LOCATE UTILITIES - TONING

Prior to the initiation of field activities, a qualified staff member shall visit the site and note existing structures and evidence of associated utilities, such as fire hydrants, irrigation systems, manhole and vault box covers, standpipes, telephone switch boxes, free-standing light poles, gas or electric meters, pavement cuts, and linear depressions. All areas where subsurface exploration is proposed shall be accurately located or surveyed and clearly marked with stakes, pins, flags, paint, or other suitable devices.

Local private utility contractors, familiar with individual base operations and procedures should be subcontracted to identify utilities not located by the "Before U Dig" service. The private locator may be utilized earlier in the project to conduct map research if they are familiar with the base operations. The locator should utilize appropriate sensing equipment to attempt to locate any utilities that may not have appeared on the as-built plans. This may involve the use of surface geophysical methods (SOP I-B-2, *Geophysical Testing Procedures*). At a minimum, a utility locator, metal detector, and/or magnetometer should be utilized; however, it is important to consider the possibility that non-metallic utilities or tanks may be present at the site. If non-metallic cultural features are likely to be present at the site, other appropriate surface geophysical methods, such as Ground Penetrating Radar, should be used. Proposed exploration areas shall be cleared of all utilities in the immediate area where subsurface exploration is proposed. All anomalous areas should be clearly toned.

Any anomalous areas detected and toned that are in close proximity to the exploration or excavation areas shall be reported to the Field Manager. The Field Manager shall determine the safe distance to maintain from the known or suspected utility. It may be necessary to relocate proposed exploration or excavation areas. If this is required, the field manager or a similarly qualified individual shall relocate them and clearly mark them using the methods described above. The markings at the prior location shall be completely removed. In some instances, such as in areas extremely congested with subsurface utilities, it is strongly recommended to dig by hand to determine the location of the utilities.

2.4 PREPARE SITE PLAN

Prior to the initiation of some field activities, notably remedial action projects, a final site plan shall be drafted which indicates the location of subsurface exploration areas and all known or suspected utilities present at the site. Copies of this site plan shall be provided to the Field Manager, the PM and the subcontractor who is to conduct the subsurface exploration/excavation work. The site plan should be reviewed with the Navy Remedial Project Manager (RPM) to verify its accuracy prior to initiating subsurface sampling activities.

3.0 DOCUMENTATION

An approved field logbook detailing the pertinent activities conducted during the utility locating procedure shall be kept. The logbook will describe any changes and modifications made to the original exploration plan. Details of the appropriate procedures for maintaining a logbook are documented in SOP III-D, *Logbooks*.

4.0 REFERENCES

SOP I-B-2, *Geophysical Testing Procedures*

SOP III-D, *Logbooks*

5.0 ATTACHMENTS

None.

IDW MANAGEMENT

1.0 PURPOSE

This standard operating procedure (SOP) describes the activities and responsibilities of the U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) and their subcontractors with regard to management of investigation-derived waste (IDW). The purpose of this procedure provides guidance for the minimization, handling, labeling, temporary storage, and inventory of IDW generated during site investigations and remediation projects conducted under the direction of NAVFAC NW. **Each base may have specific required procedures**. These procedures are made available to the contractor through the NAVFAC Naval Technical Representative (NTR) or other government point of contact. This SOP is also applicable to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste and other regulated wastes generated during implementation of site investigations and removal or remedial actions. The information presented will be used to prepare and implement Work Plans (WP), Field Sampling Plans (FSP), and Waste Management Plans (WMPs) for IDW-related field activities.

2.0 PROCEDURES

The procedures for IDW management in the field are described below in Sections 2.1 to 2.5. The implementation of these procedures requires Remedial Project Managers (RPMs), Field Managers, their designates and subcontractors to perform the following tasks:

- Minimize generation of IDW,
- Segregate IDW,
- Properly handle IDW containers,
- Properly label IDW containers,
- Apply good management practices in storing IDW drums and containers,
- Prepare IDW drum inventories,
- Update and Report changes to IDW drum inventories,
- Perform inspections of IDW containers and storage areas, as required,
- Prepare IDW containers for proper off-site transportation and disposition, as required.

2.1 IDW MINIMIZATION

Field Managers and their designates shall minimize the generation of onsite IDW to reduce the need for special storage or disposal requirements that may result in substantial additional costs and provide little or no reduction in site risks (EPA 1992). The volume of IDW shall be reduced, by applying minimization practices throughout the course of site investigation activities. These minimization strategies include: 1) material substitution; 2) using proper low-volume drilling techniques; 3) using disposable sampling and PPE; 4) using bucket and drum liners; and 5) segregating non-contaminated IDW and trash from contaminated IDW. Waste minimization strategies and types of IDW expected to be generated shall be documented in the appropriate project plans.

2.1.1 Material Substitution

Material substitution consists of selecting materials that degrade readily or have reduced potential for chemical impacts to the site and the environment. An example of this practice is the use of biodegradable detergents (e.g., Alconox® or non-phosphate detergents) for decontamination of non-consumable PPE and sampling equipment. In addition, field equipment decontamination can be conducted using isopropyl alcohol rather than hexane or other solvents (for most analytes of concern), to reduce the potential onsite chemical impacts of the decontamination solvent. Decontamination solvents shall be selected carefully so that solvents, and their known decomposition products, do not result in generation of RCRA hazardous waste.

2.1.2 Drilling Methods

Drilling methods that minimize potential IDW generation should be given priority. Sonic, Hollow stem auger and air rotary methods should be selected, where feasible, over mud rotary methods. Mud rotary drilling produces waste drilling mud, while hollow stem and air rotary drilling methods produce relatively low volumes of soil waste. Sonic drilling produces the least amount of waste. Small diameter borings and cores shall be used when soil is the only matrix to be sampled at the boring location; the installation of monitoring wells requires the use of larger diameter borings.

Soil, sludge, or sediment removed from borings, containment areas, and shallow test trenches shall not be returned to the source, unless allowed by regulation and included in the approved WP, FSP, or WMP.

2.1.3 Decontamination Fluids

The use of disposable sampling equipment, such as plastic bailers, trowels, and drum thieves (which do not require decontamination) minimizes the quantity of decontamination fluids generated. In general, decontamination fluids, and well development and purge water, should not be minimized because the integrity of the associated analytical data may be affected.

2.1.4 PPE and Disposable Sampling Equipment

Visibly soiled PPE and disposable sampling equipment shall be segregated from non-visibly soiled PPE and sampling equipment. Where investigation involves potentially hazardous waste or other regulated wastes, visibly soiled PPE and disposable sampling equipment may require decontamination. The Field Manager shall use best professional judgment to determine if decontamination is appropriate. This determination should be included in the approved WP, FSP, or WMP. If decontamination is performed, PPE and disposable sampling equipment generated in the decontamination process may be double-bagged and disposed of as non-hazardous waste.

2.1.5 Liners

Bucket liners can be used in the decontamination process to reduce the volume of solid IDW-generated and reduce costs on larger projects. The plastic bucket liners can be crushed into a smaller volume than the buckets, and only a small number of plastic decontamination buckets are required for the entire project. Larger, heavy-duty, 55-gallon drum liners can be used for heavily contaminated IDW to provide secondary containment, and reduce the costs of disposal and drum recycling. Drum liners may extend the containment life of the drums in severe climates and will reduce the costs of cleaning out the drums prior to recycling.

2.1.6 Segregation of non-IDW

All waste materials generated in the support zone are considered non-IDW trash. To minimize the total volume of IDW, all trash shall be separated from IDW, sealed in garbage bags, and properly disposed of offsite as municipal waste.

2.1.7 Monitoring Well Construction

Excess cement, sand, and bentonite grout prepared for monitoring well construction shall be kept to a minimum. Well construction shall be observed by Field Managers to ensure that a sufficient, but not excessive, volume of grout is prepared. Some excess grout may be produced. Unused grout that has not come in contact with potentially contaminated soil or ground water shall be considered non-hazardous trash and shall be disposed of offsite by the drilling subcontractor. Surplus materials from monitoring well installation, such as scrap PVC sections, used bentonite buckets, and cement/sand bags that do not come in contact with potentially contaminated soil, shall be considered non-IDW trash and shall be disposed of offsite by the drilling subcontractor.

2.1.8 Field Analytical Test Kits

IDW generated from the use of field analytical test kits consists of those parts of the kit that have been used and/or come into contact with potentially contaminated site media, or excess extracting solvents and other reagents. Potentially contaminated solid test kit IDW shall be contained in plastic bags and stored with PPE or disposable sampling equipment IDW from the same source area as soil material used for the analyses. The small volumes of waste solvents, reagents, and water samples used in field test kits should be segregated, and disposed of accordingly (based upon the characteristics of the materials, MSDS sheets, and as described in the WMP). Most other test kit materials should be considered non-IDW trash, and be disposed of as municipal waste.

2.2 SEGREGATION OF IDW BY MATRIX AND LOCATION

To facilitate subsequent IDW screening, sampling, classification and/or disposal, IDW shall generally be segregated by matrix and source location at the time it is generated. Each drum of solid IDW shall be completely filled, when possible. For liquid IDW, drums should be left with headspace of approximately 5% by volume to allow for expansion of the liquid and potential volatile contaminants. IDW from each distinct matrix shall be stored in a single drum (e.g., soil, water or PPE shall not be mixed in one drum). In general, IDW from separate sources should not be combined in a single drum.

It is possible that monitoring well development and purge water will contain suspended solids, which will settle to the bottom of the storage drum as sediment. Significant observations on the turbidity or sediment load of the development or purge water shall be included in the logbook and reported in attachments to the quarterly drum inventory report (see SOP III-D, *Logbooks* and Section 2.5). To avoid having mixed matrices in a single drum (i.e., sediment and water), it may be necessary to decant the liquids into a separate drum, after the sediments have settled out. This segregation may be accomplished during subsequent IDW sampling activities or during consolidation in a holding tank prior to disposal. Disposal of liquid IDW into the sanitary sewer shall only occur if approved by the appropriate regulatory agencies, municipal entities, and Naval installation. Appropriate precautions per the approved Health and Safety Plan (HASP) shall be implemented to ensure worker protection during these activities.

Potentially contaminated well construction material shall be placed in separate containers. Soil, sediment, sludge, or liquid IDW shall be segregated from potentially contaminated waste well construction materials. Potentially contaminated well construction materials from different monitoring wells shall not be commingled.

Potentially hazardous PPE and disposable sampling equipment shall be segregated from other IDW. PPE from generally clean field activities, such as water sampling, shall be segregated from visibly soiled PPE, double-bagged and disposed of offsite as municipal waste. Disposable sampling equipment from activities such as soil, sediment, and sludge sampling includes plastic sheeting used as liner material in containment areas around drilling rigs and waste storage areas; disposable sampling equipment; and soiled decontamination equipment. Where investigation involves potentially hazardous waste, visibly soiled PPE and disposable sampling equipment may require decontamination. The Field Manager shall use best professional judgment to determine if decontamination is appropriate. If decontamination is performed, PPE and disposable sampling equipment generated in the decontamination process may be double-bagged and disposed of as non-hazardous waste. PPE and disposable sampling equipment generated on separate days may be commingled.

Decontamination fluids shall be stored in drums separate from other IDW. If practical, decontamination fluids generated from different sources should not be stored in the same drum. If decontamination fluids generated over several days or from different sources are stored in a single container, information regarding dates of generation and sources shall be recorded in the field notebook, on the drum label (Section 2.3.2), and in the drum inventory (Section 2.5). Liquid and sediment portions of the equipment decontamination fluid in the containment unit used by the drilling or excavation field crew should be separated. The contents of this unit normally consist of turbid decontamination fluid above a layer of predominantly coarse-grained sediment. When the contents of the containment unit are to be stored in IDW containers, the Field Manager shall direct the placement of as much liquid into drums as possible and transfer the remaining solids into separate drums. Observations of the turbidity and sediment load of the liquid IDW should be noted in the field notebook, on the drum label (Section 2.3.2), and in attachments to the drum inventory (see Section 2.5). It is likely that decontamination fluids will contain minor amounts of suspended solids that will settle out of suspension to become sediment at the bottom of IDW storage drums. As noted above, it may be necessary to segregate the drummed water from sediment during subsequent IDW sampling or disposal activities.

2.3 DRUM HANDLING AND LABELING

Drum handling consists of those actions necessary to prepare an IDW drum for labeling. Drum labeling consists of those actions required to legibly and permanently identify the contents of an IDW drum. Specific handling, storage, and labeling requirements may differ with the Naval installation or oversight entity. Specific requirements should be determined at the planning stage and documented in the WMP. General requirements are provided in the following sections.

2.3.1 Drum Handling

The drums used for containing IDW shall be approved by the United States Department of Transportation (DOT, 49 CFR 172). The drums shall be made of steel or plastic, have a 55-gallon capacity, be completely painted or opaque, and have removable lids (i.e., 1A1 or 1A2). New steel drums are preferred over recycled drums. For short-term storage of liquid IDW prior to discharge, double-walled bulk steel or plastic storage tanks may be used. Consideration must

be given to scheduling and cost-effectiveness of bulk storage, treatment, and discharge system versus longer-term drum storage.

For long-term IDW storage, the DOT-approved drums with removable lids are recommended. The integrity of the foam or rubber sealing ring located on the underside of some drum lids shall be verified prior to sealing drums containing IDW liquids. If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, a drum lid with sealing ring that is in good condition must be used. At some facilities, drums containing liquid IDW will be required to be stored in protective overpacks.

To prepare IDW drums for labeling, the outer wall surfaces and drum lids shall be wiped clean of all material that may prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, that material shall be wiped from the drum, and the paper towel or rag used to remove the material shall be segregated with visibly soiled PPE and disposable sampling equipment.

2.3.2 Drum Labeling

Proper labeling of IDW drums is essential to the success and cost-effectiveness of subsequent waste screening and disposal activities. Labels shall be permanent and descriptive to facilitate correlation of field analytical data with the contents of individual IDW drums.

2.3.2.1 Preprinted Labels

A preprinted drum label as required by the appropriate Naval installation and/or regulatory agency shall be completed. The label will be affixed to the outside of the drum (or overpack if required) with the label easily readable for inspections and inventory. Label requirements may vary based on the site.

The requested information shall be printed legibly on the drum labels in black, indelible ink. Instructions for entering the required drum-specific information for each label field are provided by the Naval installation.

Painted Labels

An alternative method for labeling drums, if acceptable for the project, is to paint label information directly on the outer surface of the drum. At a minimum, the information placed on the drum shall include the contract/delivery order number, a drum number, the source identification type and number, the type of IDW, the generation date(s), and the government point of contact and telephone number. The drum surface shall be dry and free of material that could prevent legible labeling. Label information shall be confined to the upper two-thirds of the total drum height. The printing on the drum shall be large enough to be easily legible. Yellow, white, or red paint markers (oil-based enamel paint) that are non-photodegradable are recommended to provide maximum durability and contrast with the drum surface.

2.3.2.2 Regulatory Marking and Labeling

Federal and State regulations may require specific labeling for IDW generated (i.e., RCRA, TSCA, NESHAPs). Pre-printed labels shall be used as appropriate and completed in accordance with the specific regulatory requirement. These requirements will be identified in the approved project plans. Once determined to be hazardous, weekly inspections must also be conducted to ensure that labels and markings are in good conditions and to ensure the integrity of containers.

In addition, prior to off-site transportation USDOT requirements for marking and labeling of regulated DOT materials must be complied with. These requirements will be identified in the approved project plans or otherwise coordinated with the Field Manager after the IDW has been characterized and off-site disposition is being planned. Note that personnel (i.e., contractors or subcontractors) who perform USDOT functions must be properly trained in accordance with 49 CFR 172, Subpart G.

2.4 DRUM STORAGE

Drum storage procedures shall be implemented to minimize potential human contact with the stored IDW and prevent extreme weathering of the stored drums. Waste accumulation areas will be pre-designated by NAVFAC NW prior to the start of site work. IDW drums should be placed on pallets. Good management practices should be used in storing drums which include: containers shall be in good condition and closed during storage; wastes must be compatible with containers; where liquids are stored, storage areas should have secondary containment; and spill or leaks should be removed as soon as possible. These good management practices are mandatory requirements where RCRA hazardous wastes are stored.

Waste accumulation areas shall be maintained as prescribed by local regulatory entities and the appropriate Naval installation. In general, drums of IDW shall be stored within the Area of Concern (AOC) so that the site can utilize RCRA regulatory flexibility (i.e., administrative requirements, such as 90-day storage, may not be triggered; and LDRs will not be triggered if IDW is placed back in AOC). If IDW is determined to be RCRA hazardous waste, then RCRA storage, transportation and disposal requirements must be met.

Drums shall be stored at identified waste accumulation areas. All IDW drums generated during field activities at a single AOC shall be placed together, in a secure, fenced onsite area to prevent access to the drums by unauthorized personnel. When a secure area is not available, drums shall be placed in an area of the site with the least volume of human traffic. Plastic sheeting (or individual drum covers) and yellow caution tape shall be placed around the stored drums. Drums from projects involving multiple AOCs should remain at the respective source areas where the IDW was generated. IDW should not be transferred offsite for storage elsewhere, except under rare circumstances, such as the lack of a secure storage area onsite.

Proper drum storage practices shall be implemented to minimize damage to the drums from weathering and possible exposure to humans or the environment. When possible, drums shall be stored in dry, shaded areas and covered with impervious plastic sheeting or tarpaulin material. Every effort shall be made to protect the preprinted drum labels from direct exposure to sunlight, which causes ink on the labels to fade. In addition, drums shall be stored in areas that are not prone to flooding. The impervious drum covers shall be appropriately secured to prevent dislodging by the wind. It may be possible to obtain impervious plastic covers designed to fit over individual drums; however, the labeling information shall be repeated on the outside of these opaque covers.

Drums in storage shall be placed with sufficient space between rows of drum pallets and shall not be stacked, such that authorized personnel may access all drums for inspection. Proper placement will also render subsequent IDW screening, sampling, and disposal more efficient. It is recommended that IDW drums be segregated in separate rows/areas by matrix (i.e., soil, liquid or PPE/other).

If repeated visits are made to the project site, the IDW drums shall be inspected to clear encroaching vegetation, check the condition and integrity of each drum, check and replace labels as necessary, and replace or restore protective covers.

2.5 DRUM INVENTORY

Accurate preparation of an IDW drum inventory is essential to all subsequent activities associated with IDW drum tracking and disposal. An inventory shall be prepared for each project in which IDW is generated, stored, and disposed of. Naval installations and local regulatory authorities may have specific requirements associated with waste inventory and these requirements should be included in the planning process and documented in the WP, FSP, and WMP.

The drum inventory information shall include 11 elements that identify drum contents and indicate their fate.

2.5.1 Navy Activity (Generator)/Site Name

Inventory data shall include the Navy activity and the site name where the IDW was generated (e.g., NASWI, NBK Bangor, etc.).

2.5.2 DO Number

Inventory data shall include the contract and delivery order number associated with each drum (e.g., 0089).

2.5.3 Drum Number

The drum number assigned to each drum shall be included in the inventory database.

2.5.4 Storage Location Prior to Disposal

The storage location of each drum prior to disposal shall be included in the inventory (e.g., Building 394 Battery Disassembly Area, or Adjacent to West end of Building 54).

2.5.5 Origin of Contents

The source identification of the contents of each IDW drum shall be specified in the inventory (e.g., soil boring number, monitoring well number, sediment sampling location, or the multiple sources for PPE- or rinse water-generating activities).

2.5.6 IDW Type

Inventory data shall include the type of IDW in each drum (e.g., soil, PPE, disposable sampling equipment, sludge, sediment, development water, steam cleaning water, decontamination rinse water).

2.5.7 Waste Volume

The amount of waste in each drum shall be specified in the inventory as a percentage of the total drum volume or an estimated percentage-filled level (e.g., 95% maximum for liquid IDW).

2.5.8 Recommended Analytical Methods and Test Results Compared with Applicable Regulatory Standards

The recommended EPA analytical methods that adequately characterize IDW contained in each drum will be summarized in a tabular format and attached to the quarterly IDW drum inventory report (see Attachment I-A-7-1). The methodology for sampling and characterizing IDW shall be specified in the appropriate project plans.

2.5.9 Recommended or Actual Disposition of IDW Drum Contents

The recommended means of IDW disposal for each drum shall be summarized in a tabular format (e.g., Offsite, Encapsulated Onsite, Treatment/Sewer, Offsite Incinerator) and attached to the quarterly IDW drum inventory report (see Attachment I-A-7-1). Additional narrative discussion of the rationale for the recommended disposal option shall be attached to the quarterly IDW drum inventory report as data become available.

2.5.10 Generation Date

Inventory data shall include the date IDW was placed in each drum. If a drum contains IDW-generated over more than one day, the start date for the period shall be specified in dd-month-yy format. This date is not to be confused with an RCRA hazardous waste accumulation date (40 CFR 262). The accumulation start date, if required for RCRA wastes, shall be included on the hazardous waste drum label (Section 2.3.2.2).

2.5.11 Expected Disposal Date

The expected date each drum is to be disposed of shall be specified as part of the inventory in month-yy format. This date is for informational purposes only for the Navy, and shall not be considered contractually binding.

2.5.12 Actual Disposal Date

The actual drum disposal date occurs at the time of onsite disposal, or acceptance by the offsite treatment or disposal facility. It shall only be entered in the drum inventory database when such a date is available in dd-month-yy format.

In order to provide information for all 11 of the inventory elements of the quarterly inventory report described above, the main source of information will be provided by RPMs, or their designees, and summarized in Attachment I-A-7-1.

The recommended analytical test methods and actual test results (compared to applicable regulatory standards) will be provided to the appropriate Navy groups, by the RPM, or their designees, when such data are available. Testing methods shall be documented in the associated project plans. Recommended disposal options or actual disposition of the IDW drum contents will also be provided by RPMs as data become available. The NAVFAC Northwest RPM will forward all IDW data to the appropriate Navy authority as attachments to the quarterly IDW drum inventory report. This information constitutes the results of preparing and implementing an IDW screening, sampling, classification, and disposal program for each site.

3.0 DOCUMENTATION

The RPM or designee is responsible for completing and updating the site-specific IDW drum inventory spreadsheet and submitting it as needed. The RPM is also responsible for submitting backup documentation to the U.S. Navy Program Management Office (PMO) about the

analytical methods recommended to adequately characterize the IDW in each drum (Section 2.5.8). In addition, actual site or drum sampling results shall be forwarded to the PMO, along with a comparison to the applicable regulatory standards, for inclusion as attachments to the quarterly IDW drum inventory. As necessary, the backup documentation to the quarterly IDW drum inventory report shall also include the recommended means for IDW disposal for each drum (Section 2.5.9). After disposal, the actual means and/or location of disposal shall be indicated in tabular format with supporting narrative.

Field Managers and designates are responsible for documenting all IDW-related field activities in the field notebook, including most elements of the IDW drum inventory spreadsheet. The correct methods for developing and maintaining a field notebook are presented in SOP III-D, *Logbooks*.

Upon receipt of analytical data from the investigation, the information will be forwarded to the appropriate Naval authority for comparison to regulatory waste criteria. The Navy will designate the IDW and disposal options will be assessed based on the waste designation, approved transport/disposal facilities, and schedule for disposal. Naval installations may have additional requirements for reviewing analytical data, characterizing waste materials, transporting and off-site disposal. The RPM shall coordinate with the Naval installation early in the planning process to ensure that these requirements are properly identified, incorporated into the approved project plans, as available, and implemented in the field.

The disposal of IDW must be approved by the Navy and, in some cases, pertinent regulatory agencies. The disposal must be documented.

4.0 REFERENCES

Department of Transportation (DOT), Hazardous Materials Transportation Regulations, 49 CFR Parts 171 – 179.

EPA. 1998. EPA530-F-98-026, Management of Remediation Waste Under RCRA

EPA. 1991. Management of Investigative-Derived Wastes During Site Inspections. U.S. Environmental Protection Agency/540/G-91/009. May.

EPA. 1992. Guide to Management of Investigative-Derived Wastes. Quick Reference Guide. U.S. Environmental Protection Agency: 9345.3-03FS. January.

5.0 ATTACHMENTS

Attachment IA71 Example Format – Quarterly IDW Drum Inventory Updates

Attachment I-A-7-1
Quarterly IDW Drum Inventory Updates

Navy Activity / Site Name (Generator Site)	DO Number (0bbb)	Drum Number (xxxx-AA-Dzzz)	Drum Storage Location	Origin of Contents (Source ID #)	IDW Type	Waste Volume (Fill level %)	Waste Generation Date (dd-mm-yy)	Expected Disposal Date (mm-yy)	Actual Disposal Date (dd-mm-yy)
NSC Pearl Harbor/ Landfill	0068	0068-LF-D001	NSC, Bldg 7	SB-1	Soil Cuttings	100	16-Dec-92	Dec-93	Na
		0068-LF-D002	NA	MW-1 MW-2 MW-3	Purge Water	75	20-Dec-92	Jul 93	26-Jul-93
		0068-LF-D003	NA	MW-1 MW-2 MW-3	Decon Water	95	20-Dec-92	Jul-93	26-Jul-93
		0068-LF-D004	NSC, Bldg.16	SB-1 SB-2 SB-3 SB-4 MW-1 MW-2 MW-3	PPE	50	16-Dec-92	Oct-93	NA
NAVSTA Guam/ Drum Storage	0047	0047-DS-001	Hazmat Storage Area	SB-1 SB-2	Soil Cuttings	100	18-Feb-93	Sep-93	NA

NA = Not Applicable

DATA VALIDATION PLANNING AND COORDINATION

1.0 PURPOSE

This standard operating procedure (SOP) describes data validation planning and coordination for all U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) Installation Restoration Program (IRP) sampling projects involving data validation. Data validation planning will be performed in accordance with the requirements of the Project Specific Sampling and Analysis Plan (SAP) or Quality Assurance Project Plan (QAPP), the latest available version of the Department of Defense (DoD) and Department of Energy (DOE) Consolidated Quality Systems Manual for Environmental Laboratories (DoD QSM), the latest available version of the United States Environmental Protection Agency (USEPA) CLP National Functional Guidelines for Superfund Organic and Inorganic Methods Data Review, any applicable state or local guidelines, and analytical method and/or laboratory specific requirements..

2.0 PROCEDURES

Data validation shall be performed by an independent party that is not responsible for the generation of the data. Data validation strategy is discussed in Section 2.1 and planning and coordination associated with data validation are discussed in Section 2.2.

2.1 PROCEDURAL GUIDANCE

The level of detail and requirements for data validation and the process for selection of data for validation must be clearly defined in the project work plan and/or Quality Assurance Project Plan (QAPP). As described below, these requirements will be designed based on the project requirements and in consultation with the Navy Remedial Project Manager (RPM), appropriate regulatory agencies, and associated site documentation such as Records of Decision (RODs), Agreed Orders, Consent Decrees, or other similar binding agreements with regulatory entities.

2.1.1 Defining the Data Validation Scope

The scope of data validation for an environmental project is based on numerous considerations including, but not limited to, 1) regulatory guidance or laws associated with the project area and project scope, 2) methods used to collect and generate the data, and 3) the end use of the data and decisions that the data will effect. Federal, state or local laws, guidance, or criteria or a combination of these may dictate project requirements. Environmental regulatory criteria may result in the use of sampling techniques or analytical methods that are new and not well-established requiring a higher level of scrutiny of the associated data. Decisions that are driven by the data will affect the validation strategy. Data that will be used to complete human health or ecological risk assessments, support site closures, or complete property transfers may be more sensitive than other situations and a higher level of review may be warranted. A more limited validation may be appropriate for sites with well-established monitoring programs, large historical data sets, or that have well-defined and simple environmental concerns.
The data validation scope should define, at a minimum, the following:

- the stringency (e.g. tier or level) of validation and the required support documentation
- the validation criteria

- the data set to be validated
- the percentage of data to be validated

2.1.1.1 Data Validation Stringency and Support Documentation

The stringency of data validation is dependent upon the project requirements and may vary based on the decisions that the data will be used to make. The Navy Installation Restoration Chemical Data Quality Manual (IR CDQM) describes a limited, summary level review for use with non-critical or low risk decisions, especially where some project data have received high level, full scale validation. High level, full scale data validation includes a thorough assessment of data and supporting QC documentation, and is appropriate for data critical to making decisions on projects with either high risk or low tolerance for risk (NFESC 1999). Other levels of data validation more stringent than a summary review, but less stringent than a high level, full scale validation may be appropriate for certain projects based on the general considerations discussed in section 2.1.1. Although specific laboratory criteria are provided in DoD QSM, Appendix H of the the Navy IR CDQM provides guidance for the scope, context, and approach for data validation that is not included in DoD QSM.

Based on the data validation procedures established in the project work plan or QAPP, applicable Navy Standard Operating Procedures (SOPs) for Data Validation, and NFESC contract requirements, most analytical data will be validated under the appropriate NAVFAC NW QA/QC levels of "III" and "IV". These data validation levels are consistent with current data validation guidance documents such as USEPA Functional Guidelines (USEPA 2008, 2010b, 2011, 2014a, 2014d), and the data validation specifications of other NAVFAC divisions (Navy 2001). The specific requirements for Level III and IV data validation are outlined in NAVFAC NW SOPs Data Validation Procedures (DVPs) II-A through II-O. The specific elements evaluated for Level III and IV data validation, along with those outlined in USEPA Functional Guidelines (USEPA 2008, 2010b, 2011, 2014a, and 2014d) and the IR CDQM are summarized in Attachment I-A-8-1.

The type of laboratory data deliverables delineated in the project work plan or QAPP is based on the level of the data validation specified for the project. The laboratory deliverables required may include only summary forms documenting the QA/QC results for a specific analytical procedure, which would be sufficient for a summary level review and Level III validation, or a complete raw data package with forms may be required if the project requires high level, full scale validation such as Level IV validation. Electronic data which includes any laboratory generated data qualification flags may also be required if automated data checking or validation tools will be used.

Other support documentation needed for full level data validation may include SOPs for applicable field and laboratory methods, or published, approved sampling or analytical methods (e.g., SW846 methods (USEPA 1996b) or American Society for Testing and Materials protocols (ASTM 2006)).

NOTE: Alaska Department of Environmental Conservation (DEC) Contaminated Sites (CS) Program Requirements

Special requirements must be followed when submitting Alaska soil and water data related to the DEC CS program under the 18 AAC 75 and 18 AAC 78 regulations. Specific data processing/submittal requirements were created to ensure data quality consistency across the CS. Review the technical memorandum and Lab Data Review Checklist for guidance with submittals of this type. The Lab Data Review Checklist must be included with the analytical data submittal.

Consult the ADEC Web site (http://www.dec.state.ak.us/spar/guidance.htm#csp) for additional guidance and forms.

2.1.1.2 Determining the Validation Criteria

Level III or IV data validation, as outlined in the NAVFAC NW DVPs, is typically required for NAVFAC NW IRP projects where chemical analytical data is generated. The DVPs presented in SOPs II-A though II-O are based principally on the USEPA Functional Guidelines for Organic and Inorganic Data Review (USEPA 2008, 2010b, 2011, 2014a, and 2014d).
The data validation criteria presented in the NAVFAC NW DVPs may be applied to data generated using non-prescriptive methods such as the Environmental Protection Agency (EPA) SW-846 and highly prescriptive methods such as the EPA Contract Laboratory Program (CLP) (USEPA 2007, 2010a, 2014b, 2014c).
If a Level IV data validation is required, and project planning documents or the responsible regulatory authority do not specify the required criteria for data validation, the IR CDQM defines the following hierarchy of applicable references for CLP data:

- Applicable EPA Region Quality Assurance Project Plan Guidance
- EPA Regional Data Validation Functional Guidelines for Evaluating Environmental Analyses
- USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA 2008, 2014a)
- USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA 2010b, 2014c)

For non-CLP data, the IR CDQM provides a table of data elements evaluation criteria for validation of data. These data elements are summarized in Attachment I-A-8-1.
Additional data validation specifications for methods not included in the NAVFAC NW DVPs are provided in the following documents:

- EPA Region 10 SOP For the Validation of Method 1668 Toxic, Dioxin-like, PCB Data (USEPA Region 10, 1995)
- EPA Region 10 SOP For the Validation of Polychlorinated Dibenzodioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data (USEPA Region 10, 1996a)
- USEPA National Functional Guidelines for Chlorinated Dioxin/Furan Data Review (USEPA 2011)

For specialized analyses not covered in the NAVFAC NW DVPs, CLP Functional Guidelines, or the validation guidelines listed above, method specified quality control may be evaluated or used to identify any applicable elements from the CLP Functional guidelines. The validation criteria will be dependent upon the method and project requirements.

2.1.1.3 The Data Set and Percentage of Validated Data

The data set and percentage of data that will be validated will be determined based on the requirements of each project.
The data set that will be validated should be defined by sample type, location and/or dates of collection. The process by which the data set is selected must be included in project planning documents.

The percentage of data that will be validated should be determined based on factors similar to those used for decisions regarding the overall data validation strategy. Attachment I-A-8-2 provides examples of percentages of data for validation based on the noted considerations.

2.1.2 Quality Assurance (QA) Summary Forms Validation

In some cases it may be appropriate to perform a QA Summary Form Validation. This type of validation includes evaluation of the laboratory generated QA summary forms for sample data, method blank results, blank spike results, and field QC results. Additionally, For Levels III and IV, data validation, the surrogate recoveries, calibration information, matrix spike/matrix spike duplicate (MS/MSD) recoveries, gas chromatography/mass spectrometry (GC/MS) tuning, internal standards results, ICP interference check sample results, post digestion spike data, etc. are validated.

It is recommended that all QA summaries be validated at a frequency of 10 to 100 percent. For larger projects, validation of QA summaries for selected samples only may be proposed if regulatory agencies are likely to agree to this and if project-specific data quality objectives (DQOs) allow this.

If significant problems, as defined in the DVPs presented in SOPs II-A through II-O are noted during validation of QA summaries, additional forms and/or raw data validation above that originally planned may be warranted and should be considered.

2.1.3 Amount of Raw Data Acquired

For data sets where data validation requires review of raw data, it is recommended that all raw data be requested and obtained from the laboratory. While not all of the raw data will likely be reviewed, it is more time-efficient and cost-effective to obtain the data at the time of analysis than to request the laboratory to provide them at a later date. In addition, portions of the raw data may be used by project chemists and risk assessors to more fully evaluate analytical data. For projects with quick turnaround time (TAT) requirements, one option is to receive results only for the quick TAT, while receiving QC data (and possibly raw data) at the normal TAT. This will allow the laboratory more time to compile the entire data package. Project-specific DQOs should be consulted to determine if this approach is feasible.

2.1.4 Raw Data Validation

At Level IV QC, a representative portion of all raw data shall be validated, in addition to the review of raw data associated with critical samples.

A representative portion of data may be chosen by selecting random samples and analyses, or more practically by identifying certain representative sample delivery groups (SDGs) or work orders from the laboratory. This may include selecting all samples and analyses from one of the first SDGs for a project for data validation, and also for SDGs with different matrices, subsequent phases of work/mobilizations, and for each laboratory, if more than one is used.

EPA Region 10 has emphasized that all critical samples require raw data validation. Critical samples are defined in footnote (a) of Attachment I-A-8-2, and can also be described as those samples which are critical for making decisions at a site. These typically will include samples whose contaminant concentrations exceed an applicable or relevant and appropriate requirement (ARAR), that may cause the risk assessment to indicate a significant risk because of analyte toxicity at a receptor location, or are unexpected (e.g., higher concentration than expected, unexpected analytes). At least some non-detect sample results may be critical if they support a no-action decision.

Larger projects typically require lower frequencies of raw data review than smaller projects. For example, a project with one SDG would probably require 100 percent validation. A project with five SDGs may include raw data review for the first SDG and other selected critical samples may also require raw data validation, possibly totaling less than 30 percent of the data.
If significant problems, as defined in the DVPs presented in SOPs II-A through II-O, are noted during validation of raw data, additional raw data validation above that originally planned may be warranted and should be considered. Additionally, the first several SDGs validated should be evaluated and corrective actions taken immediately if problems are identified.

2.2 PLANNING AND COORDINATION

During the planning and cost estimating stage of a project, the data validation task leader shall be contacted. The level of quality control, data validation strategy, number of samples per method, number of SDGs, schedule, and due dates shall be discussed. An internal work authorization shall be issued during the implementation plan/cost estimate (IP/CE) task. A data validation cost estimate can then be provided as an attachment to the IP/CE. All planning documents should be copied to the data validation task leader when they are completed (draft and final).
The format required for the hardcopy data validation report (typically as specified in DVP II-A) should be provided to the data validation task leader. The specifications and formats of any project required electronic versions of the data validation report or qualified data should also be provided
Continuing coordination is critical. The data validation task leader must be notified of any changes to the sampling schedule, analytical plan, or number of samples. For every change from the chain of custody/analytical request form in sample numbers and/or requested analyses, the data validators, as well as the laboratory shall be informed. Any changes to analytical methods agreed upon with the laboratory shall be communicated to the data validation task leader. A revised cost estimate shall be requested from the data validators. It is the responsibility of the Project Manager to inform the data validation task leader of the outcome of the change proposal and negotiations.
A schedule, which is updated as needed, is necessary to track the status of data validation activities. Priorities between projects shall be coordinated and set by the Technical Director/QA Program Manager. Attachment I-A-8-4 is an example of a form, which may be used by project personnel to track the data validation status of hardcopy data.
A cross-reference list of field QC samples associated with site samples is required to validate data. This list must be provided by field personnel or from the chain-of-custody logbook (see SOP III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*) and should be provided to the data validator when data is submitted.

3.0 DOCUMENTATION

Changes in the schedule, number of samples, or analytical plan shall be provided to the data validators verbally and in writing.
Hard copy and/or electronic versions of data validation reports and qualified data should be included in project documentation.
For all projects, the data validation reports shall be summarized for inclusion as a section of the report. It is also helpful to summarize the data validation results and distribute them to appropriate project personnel in a memorandum prior to their use of the data. This summary is referred to as an overall analysis of data for the project. The overall analysis should summarize the net results of data validation for each QC parameter evaluated. It is recommended that

precision, accuracy, and percent completeness objectives also be presented in the overall analysis. This task could be conducted by the data validators, or by project staff more familiar with the project DQOs.

As part of the summary, the project personnel shall ensure that all data requested for analysis and validation were actually analyzed and validated. Identification of rejected data (and the reasons) may be the most critical results. Data which have been qualified from detections to nondetections, or data for which numerical values have changed significantly, are also important. The summary may focus on the analytes and samples, which are considered most critical for each project.

The data validation summary may also be an appropriate place to document items required by the QAPP, such as completeness and the other PARCC (precision, accuracy, representativeness, completeness and comparability) parameters. A summary of field QC results by field QC type is suggested.

4.0 REFERENCES

II-A Data Validation Procedure 1 – *Data Validation Reports*
II-B Data Validation Procedure 2 - *Levels III and IV Volatile Organics by GC/MS*
II-C Data Validation Procedure 3 - *Data Validation Levels III and IV Semivolatile Organics by GC/MS*
II-D Data Validation Procedure 4 - *Levels III and IV Organochlorine Pesticides/PCBs by GC*
II-E Data Validation Procedure 5 - *Levels III and IV Metals and Cyanide*
II-F Data Validation Procedure 6 - *Levels III and IV Wet Chemistry Analysis*
II-G Data Validation Procedure 7 - *Levels III and IV Halogenated and Aromatic Volatiles by GC*
II-H Data Validation Procedure 8 - *Levels III and IV Extractable Total Fuel Hydrocarbons*
II-J Data Validation Procedure 10 – *Levels III and IV Phenols by GC*
II-J Data Validation Procedure 10 – *Levels III and IV Phenols by GC*
II-K Data Validation Procedure 11 - *Levels III and IV Organophosphorus Pesticides by GC*
II-L Data Validation Procedure 12 - *Levels III and IV Chlorinated Herbicides by GC*
II-M Data Validation Procedure 13 - *Levels III and IV Ethylene Dibromide/ Dibromochloropropane by GC*
II-N Data Validation Procedure 14 - *Levels III and IV Carbamates and Urea Pesticides by HPLC*
III-E *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*
II-O Data Validation Procedure 15 - *Levels III and IV Polynuclear Aromatic Hydrocarbons by HPLC*

ASTM. 2006. Annual Book of ASTM Standards, American Society for Testing and Materials (ASTM International).

NFESC. 1999. Navy Installation Restoration Chemical Data Quality Manual (IR CDQM), NFESC Special Report SP-2056-ENV. September.

Navy. 2001. Data Validation Guidelines for Chemical Analysis of Environmental Samples. Environmental Work Instruction #1 3EN2.1, Southwest Division Naval Facilities Engineering Command. November.

USEPA Region 10. 1995. EPA Region 10 SOP For the Validation of Method 1668 Toxic, Dioxin-like, PCB Data. December.

USEPA Region 10. 1996a. EPA Region 10 SOP For the Validation of Polychlorinated Dibenzodioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data. January.

USEPA. 1996b. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition. December.

USEPA. 2002. Guidance on Environmental Data Verification and Validation, EPA QA/G-8. November.

USEPA. 2007. Contract Laboratory Program Statement of Work for Organic Analysis Multi-Media, Multi-Concentration (SOM01.2) August.

USEPA. 2008. Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (SOM01.2). June.

USEPA. 2010a. Contract Laboratory Program Statement of Work for Inorganic Superfund Methods, Multi-Media, Multi-Concentration (ISM01.2) January.

USEPA. 2010b. Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (ISM01.2) January.

USEPA. 2011. Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review. September.

USEPA. 2014a. National Functional Guidelines for Superfund Organic Methods Data Review (SOM02.2). June.

USEPA. 2014b. Contract Laboratory Program Statement of Work for Inorganic Superfund Methods, Multi-Media, Multi-Concentration (ISM02.2) August.

USEPA. 2014c. Contract Laboratory Program Statement of Work for Organic Superfund Methods, Multi-Media, Multi-Concentration (SOM02.2) August.

USEPA. 2014d. National Functional Guidelines for Inorganic Superfund Data Review (ISM02.2). August.

5.0 ATTACHMENTS

Attachment I-A-8-1 Data Validation Elements Summary
Attachment I-A-8-2 Data Validation Level of Effort Guidelines
Attachment I-A-8-3 Potential Considerations for Choice of Data Validation Strategy
Attachment I-A-8-4 Example Hardcopy Data Validation Status Tracking Form

Attachment I-A-8-1
Data Validation Element Summary

Data Validation Element	EPA National Functional Guidelines	NAVFAC NW SOP Level III	NAVFAC NW SOP Level IV	Navy IR CDQM Summary Level Review	Navy IR CDQM Full Level Validation
Preliminary Review / Data Completeness	A, B, C, D	X	X	3	4
Holding Times and Preservation	A, B, C, D	X	X	3	4
Chain of Custody		X	X	3	4
Method and reporting limits				3	4
Dilution factors / Concentration units	C, D			3	4
Preparation / Analysis Methods				3	4
GCMS Instrument Performance Check / Tuning (VOA & SVOA)	A, B	X	X		4
GC Instrument Performance		X	X		
LC Instrument Performance		X	X		
Pesticide Degradation Check		X	X		4
GC and LC Resolution		X	X		4
GC and LC Retention Time Windows		X	X		4
Initial Calibration	A, B, C, D	X	X		4
Initial Calibration Verification	C	X	X		4
Continuing Calibration	A, B, C, D	X	X		4
Instrument Performance/Calibration (GC/ECD)	A, B				
Blanks (method, instrument, field, trip, holding, rinsate, etc.)	A, B, C, D	X	X		4
Laboratory Control Sample (LCS)	A, B[1], C, D	X	X		4
Laboratory Control Sample Duplicate (LCSD)		X	X		4
Post Digestion Spike	C				4
Deuterated Monitoring Compounds	A				
Surrogate Recovery / System Monitoring Compounds	B	X	X	3	4
Matrix Spike	A, B[2], C	X	X	3	4
Matrix Spike Duplicate	A, B[2]	X	X		4
Field Duplicates	C	X	X		4
Internal Standards Performance (VOA & SVOA)	A, B	X	X		4
Target Compound Identification (GC)	A, B		X		4
Target Compound Identification (GC/MS)	A, B		X		4
Identification Criteria	D				4
HRGC/HRMS Resolution and Mass Accuracy (Dioxins)	D				4
Dioxin GC Column Performance Check					4
Window Defining Mixture (WDM & ISC)	D				
HRGC/HRMS Instrument Stability	D				
Toxicity Equivalency Factor (TEF) and Isomer Specificity	D				

Attachment I-A-8-1 (continued)
Data Validation Element Summary

Data Validation Element	EPA National Functional Guidelines	NAVFAC NW SOP Level III	NAVFAC NW SOP Level IV	Navy IR CDQM Summary Level Review	Navy IR CDQM Full Level Validation
Second Column Confirmation	D				
Estimated Detection Limit (EDL) and Estimated Maximum Possible Concentration (EMPC)	D				
Labeled Compound Recoveries	D				
Florisil / GPC / Silica Gel Cleanup	A, B	X	X		4
Linear Range					4
Compound Quantitation and Reported Detection Limits	A, B		X		4
Tentatively Identified Compounds (TICs)	A, B		X		
System Performance	A, B		X		
Manual Calculations					4
CRQL Check Standard	C	X	X		
ICPMS Tune	C				
ICP/ICPMS Interference Check Sample	C	X	X		4
Laboratory Duplicate	C	X	X		4
Furnace Atomic Absorption		X	X		
ICP Serial Dilution	C	X	X		4
ICPMS Internal Standards	C				
Analytical Wavelength (ICP, spectrophotometric analysis)					4
Method of Standard Additions (GFAA)					4
High Calibration Standard (ICP)					4
Sample Result Verification			X		4
Regional Quality Assurance and Quality Control / PE Samples	A, B, D				
Overall Assessment of Data	A, B, C, D				4

A - USEPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review, June 2001.

B - USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, October 1999.

C - USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, October 2004.

D - USEPA Analytical Services branch (ASB) National Functional Guidelines for Chlorinated Dioxin and Furan Data Review, September 2005.

1 - Required for Low Concentration VOA/SVOA/Pest/PCB water analysis.

2 - Not required for Low Concentration VOA/SVOA/Pest/PCB water analysis.

3 - Summary level review elements defined in NFESC Special Report SP-2056-ENV Navy Installation Restoration Chemical Data Quality Manual (IR CDQM), September 1999.

4 – Validate EPA/CLP data per Functional Guidelines, non CLP data per NFESC IR CDQM Attachment 1.

Attachment I-A-8-2
Data Validation Level of Effort Guidelines

NAVFAC NW QC Level	Level of Effort Forms Review	Level of Effort Raw Data Review	Amount of Raw Data Acquired
IV	10-100%	10-100%[a]	100%
III	10-100%	5-20%[b]	100%[c]
QA Summary	10-100%	0%	100%
Results Only[d]	0%	0%	0%

(a) At least 10 percent of all samples will be validated, and 100 percent of "critical sample" raw data must be reviewed. Critical samples are defined as samples which produce data that are key in assessing exposure and/or risk at a particular site, or are key in identifying remedial options.

(b) Only critical and "problematic" samples will require that associated raw data be reviewed at NAVFAC NW Level III. Problematic samples are those for which anomalies or control limit exceedances have been noted during the review of quality control samples results. Problematic data are also those data with consistent, identified analytical problems, or which had unexpected results, which are important to the evaluation (i.e., DQOs). Typically, 5 to 20 percent can be used as a general cost estimation guideline (20 percent when low bidder is selected, when a relatively small number of samples are being addressed) or when an unfamiliar laboratory is used. If widespread problems are identified during initial raw data validation, higher percentages of the raw data may require validation.

(c) NAVFAC NW Level III requires raw data for target compound hits only. Many laboratories prefer to provide all raw data for simplicity. Data validators require raw data for associated standards, as well as for samples. The actual deliverables needed to satisfy the DQOs for a specific Task Order will vary and should be clearly defined in the laboratory STO.

(d) Results only consist of the information on Form I for CLP methods, or organic form I or inorganic form I.

Attachment I-A-8-3
Potential Considerations for Choice of Data Validation Strategy (Navy 2001)

Validation Strategy	Intended Use	Risk Assessment	Site Type
10% Level IV and 90% Level III	All Investigation and Confirmations on IR projects	Yes	Non-NPL
10% Level IV and 90% Level III	All Investigations and Confirmations on IR Projects	Yes	NPL
No Formal Data Validation Required	Field Screening Process Monitoring Progress Sampling Waste characterization	No	All

Attachment I-A-8-4
Example Hardcopy Data Validation Status Tracking Form

Task Order Data Validation Report Status Tracking Form

SDG	Expected Delivery Date	VOCs	Pest/ PCBs	TPH		Metals	Cr^{+6}	TOC
				8310	8015m			
DB360	7/30	7/21	8/21	8/21	8/21	8/7	X	5/25
DB383	7/30	7/21	8/21	8/21	8/21		X	5/25
DB401	6/15	6/9	6/9	6/24	6/9	6/9	X	6/9
DC160	8/15	7/21	8/21	8/21	8/21			8/7
DC180	8/15	7/21	8/21	8/21	7/23		7/21	8/21
CK0693	7/30	X	X	X	X	X	7/20	X
CK0694	7/30	X	X	X	X	X	7/20	X
CK0732	7/30	X	X	X	X	X	7/20	X
DC205	9/15		X				X	
DC209	9/15		X				X	
DB429	9/15		X				X	
DB439	9/15		X				X	X
DB458	9/15		X				X	X

7/21 = date data validation report was received
X - no analysis for that method for that SDG
empty box = data validation report not yet received

GENERAL FIELD OPERATION

1.0 PURPOSE

This standard operating procedure (SOP) defines the general field organization and the field structure of sample collection, sample identification, record keeping, field measurements, and data collection. These SOPs are used to ensure the activities used to document sampling and field operations provide standardized background information and identities.

2.0 PROCEDURES

2.1 MOBILIZATION/DEMOBILIZATION

The SM or designee ensures that all purchase requests have been reviewed and approved by the PM. Then, the SM and PM assemble the project team in order to review the scope of work, disseminate the project plans, and complete the field equipment checklist (provided as Attachment I-A-9-1). After review by the project team, if additional items are required, additional purchase requests are prepared and approved by the PM.

The SM and project team upon arrival at the site inspects all equipment. Packing slips, bills of lading, or other documentation received with the shipment are initialed and returned to the purchasing department and a copy placed into the field file. Quantities, types, and makes of items received are checked against the original purchase requests to validate the shipment. Prior to validation of the shipping receipt, equipment is inspected to ensure all components are present and that the equipment calibrates and is fully functional. Any equipment received that is not fully functional is returned immediately and the vendor contacted to arrange a replacement.

The SM provides copies of the appropriate SOPs to the project team prior to the start of field activities. The most current versions of the SOPs are brought to the field. Any revisions to the SOPs must be approved by the PM and recorded in the field logbook.

It is imperative that rental equipment be cleaned (decontaminated), packaged, and returned immediately following the completion of a task. If any problems occurred on site with any equipment, the problems should be noted in detail in the field logbook and the SM notified. The SM will forward this information to the purchasing department and the vendor.

2.2 SHIPPING

If it is possible and /or practical, equipment and supplies should be shipped directly to the field site. If sensitive field equipment is to be shipped to the site, care shall be taken to ensure the equipment is not damaged en route. All original packaging material should be retained for return shipment of the equipment. Additional packing material (e.g., bubble wrap, bubble bags) may be required to provide additional protection for the shipped items. Equipment should always be shipped in its original carrying case. Each piece being shipped must have an address label on the shipping container separate from the shipping air bill.

2.3 CHAIN OF COMMAND

Chain of command protocols are implemented by the PM. These protocols should be strictly followed while performing field tasks. All decisions concerning priorities, project team assignments, sampling procedures, equipment management, and task approach are made by the

PM, the SM, or an approved appointee. The SM or an approved designee will conduct a daily meeting prior to the start of field activities to discuss individual responsibilities. The meeting will also address potential contaminants that may be encountered, safety items (such as use of heavy equipment or protection against noise), special sampling requirements, and site control(s) to be employed to prevent injuries or exposure.

2.4 SAMPLING ORGANIZATION

The SM ensures the sampling design, outlined in project plans, is followed during all phases of the sampling activities at the site. For each sampling activity, field personnel record the information required by the applicable SOPs in their logbooks and on the exhibits provided in the SOPs.

2.5 REVIEW

The PM, SM, and, on occasion, the QAO or an approved designee checks field logbooks, daily logs, and all other documents that result from field operations for completeness and accuracy. Any discrepancies on these documents are noted and returned to the originator for correction. The reviewer acknowledges that review comments have been incorporated into the document by signing and dating the applicable reviewed documents.

3.0 DOCUMENTATION

Project activities shall be recorded in the field logbooks. The logbooks shall be kept current for the daily activities including documentation of all samples collected and the information relevant to the sample collection. All project required field forms shall be completed within a timely manner upon completion of the field task. All required field forms and specific logbook notations should be detailed in the field sampling plan.

4.0 REFERENCES

None.

5.0 ATTACHMENTS

Attachment IA91 Field Equipment Checklist.

Attachment I-A-9-1
Field Equipment Checklist

General

___ 1. Health and Safety Plan
___ 2. Site base map
___ 3. Hand calculator
___ 4. Brunton compass
___ 5. Personal clothing and equipment
___ 6. Personal Protective Equipment (First Aid kit)
___ 7. Cell or radio telephone

Environmental Monitoring Equipment

___ 1. Shovels
___ 2. Keys to well caps
___ 3. pH meter (with calibrating solutions)
___ 4. pH paper
___ 5. Thermometer
___ 6. Conductivity meter (with calibrating solution)
___ 7. Organic vapor analyzer or photoionization detector with calibration gas
___ 8. H2S, O2, combustible gas indicator
___ 9. Draeger tubes

Shipping Supplies

___ 1. Sample preservatives (nitric, hydrochloric, sulfuric acid/sodium hydroxide)
___ 2. Heavy-duty aluminum foil
___ 3. Coolers
___ 4. Ice packs
___ 5. Large zipper locking plastic bags
___ 6. Heavy-duty garbage bags
___ 7. Duct tape
___ 8. Strapping tape
___ 9. Paper towels
___ 10. Bubble pack, foam pellets, or shredded paper
___ 11. Vermiculite
___ 12. Cooler labels (“This Side Up,” “Hazardous Material,” “Fragile”)
___ 13. Federal Express/DHL labels

Sampling Equipment

___ 1. Tool box with assorted tools (pipe wrenches, screwdrivers, socket set and driver, open and box end wrenches, hacksaw, hammer, vice grips)
___ 2. Geologic hammer
___ 3. Trowel
___ 4. Stainless steel and/or Teflon spatula
___ 5. Hand auger
___ 6. Engineer’s tape
___ 7. Steel tape
___ 8. Electric water level sounder
___ 9. Petroleum Interface Probe
___ 10. Batteries
___ 11. Bailers (Teflon, stainless steel, acrylic, PVC)
___ 12. Slug test water displacement tube
___ 13. Vacuum hand pump
___ 14. Electric vacuum pump
___ 15. Displacement hand pump
___ 16. Mechanical pump (centrifugal, submersible, bladder)
___ 17. Portable generator
___ 18. Gasoline for generator
___ 19. Hose
___ 20. Calibrated buckets
___ 21. Stop watch
___ 22. Orifice plate or equivalent flow meter
___ 23. Data logger and pressure transducers
___ 24. Strip chart recorders
___ 25. Sample bottles
___ 26. 0.45-micron filters (prepackaged in holders)
___ 27. Stainless steel bowls
___ 28. SW scoop
___ 29. Peristaltic pump/tubing
___ 30. Sample tags
___ 31. SOPs, HAZWOPER training certificates, MSDs, FSP, QAPP

Decontamination Equipment

___ 1. Non-phosphate laboratory-grade detergent
___ 2. Selected high purity, contaminant free solvents
___ 3. Long-handled brushes
___ 4. Drop cloths (plastic sheeting)
___ 5. Trash container
___ 6. Galvanized tubs or equivalent (e.g., baby pools)
___ 7. Tap Water
___ 8. Contaminant free distilled/deionized water
___ 9. Metal/plastic container for storage and disposal of contaminated wash solutions
___ 10. Pressurized sprayers, H_2O
___ 11. Pressurized sprayers, solvents
___ 12. Aluminum foil
___ 13. Sample containers
___ 14. Emergency eyewash bottle
___ 15. Documentation Supplies

Documentation Supplies

___ 1. Weatherproof, bound field logbooks with numbered pages
___ 2. Daily Drilling Report forms
___ 3. Field Borehole Log forms
___ 4. Monitoring Well Installation Log forms
___ 5. Well Development Data forms
___ 6. Groundwater Sampling Log forms
___ 7. Aquifer Test Data forms
___ 8. Sample Chain-of-Custody forms
___ 9. Custody seals
___ 10. Communication Record forms
___ 11. Documentation of Change forms
___ 12. Camera and film
___ 13. Paper
___ 14. Permanent/indelible ink pens
___ 15. Felt tip markers (indelible ink)
___ 16. Munsell Soil Color Charts

MONITORING/SAMPLING LOCATION RECORDING

1.0 PURPOSE

This standard operating procedure (SOP) describes the guidelines for generating the descriptions and information to be recorded for each physical location where monitoring, or sampling is conducted.

2.0 PROCEDURES

2.1 SAMPLING LOCATION MARKING

Sampling locations are based on criteria presented in the SAP. Whenever possible, each sampling location will be marked by a wooden lathe stake, directly marking the surface with marking paint, or with surveyors flagging. Each should be labeled with the location identifier outlined in the SAP. This should be done during the site visit or as soon as is feasible during field activities. This is to give the utility locators a better idea of the specific area to be cleared. Having the locations marked will also assist the field crew gain a better perspective of the locations to be worked

2.2 PHOTOGRAPHIC DOCUMENTATION

Site photographs showing monitoring/sampling locations with respect to structures or the site in general are encouraged. At certain installations, photography must be approved by the Navy. Prior to commencing work, the Navy must be notified to determine if cameras are allowed at the installation. The Note that the Navy will likely inspect your camera and may purge/delete some pictures if they feel there is a security issue. When possible, a menu board included in the photograph can be used to give relative information regarding the project and location.
For each photograph, record the following information in the field logbook:

- Photo number
- Date and time of the photo
- Orientation of the photo (direction facing)
- Subject-a description of what is contained within the photo. Others may be using the photos that are unfamiliar with the site and locations.

A detailed description of field logbook entries can be found in SOP III-D, *Logbooks*.

2.3 MONITORING/SAMPLING LOCATION INFORMATION FORM

A Monitoring/Sampling Location Information form must be filled out to establish each new sampling location. This form must be provided to the Navy for inclusion into the NAVFAC NW NIRIS Database. Established locations should not be re-established unless new information (such as survey information) is recorded about a location. A location description may be provided about a sampling location. It should contain detailed information regarding the physical features surrounding the location, including relevant site information (i.e., obvious contamination, measurements to physical features, topographical relief, etc.). This description may be a copy of the field logbook or notes on project plan maps. These descriptions shall be attached to the field form. The PM is responsible for insuring that the project personnel have and

use consistent terminology and descriptions as established in the SAP. The reverse of the field form contains a brief discussion of the form and descriptions of the information requested on the front.

3.0 DOCUMENTATION

None.

4.0 REFERENCES

SOP III-D, *Logbooks*

5.0 ATTACHMENTS

Attachment IA101 Example Monitoring/Sampling Location Information Form

FORM 11-1A
MONITORING/SAMPLING LOCATION SUMMARY

Installation ID:	Establishing Contract ID:	Prime Contractor Name:	
Site Name:	DO/CTO:	Establishing Phase:	Date Established:
Survey Contractor:	Local System Description:		

Location Name	Location Type	Projection Specification	Coordinates		Ground Elevation (feet msl)
			Northing (feet)	Easting (feet)	

Location Types

ACID Acid Pit

ADIT Adit

AGT Above ground tank

AIR Air (not inside a building - ambient conditions)

AMB Ambient drinking water aquifer monitoring well

AOVM Ambient organic vapor monitor

ASBTS Asbestos-Containing Area

BAY Bay

BF Backfill

BH Borehole/Soil boring

BIN Roll-off bin

BIOL Biological (plant or animal)

BLDG Building (includes building air and building materials)

BULK Bulk sample

BURN Burn pit

CB Concrete boring

CENT Location surveyed at the center of a UST field

CLGP Canal Level Gauging Point

CPT Cone penetrometer

CY Cryopile

DCON Decontamination pad

DITCH Channel/Ditch

DP Direct Push/Geoprobe

DRN Drain

DRUM Drum/Container contents

DRW Drywell

DU Decision Unit

DW Domestic well

D_RIG_W Drill Rig Fluid Container

EC Electrode

ECT Electrode

EF System effluent

EVAP EVAPORATION POND

EXCV Excavation

FAGT Former above ground tank location

FL Fuel line

FLOOD Flood Plain

FLOOD_GATE Flood Control Gate

FLOOR Floor

FLOOR_SCRP Floor scrapings

FW Faucet/Tap/Spigot

GAGE Gaging station (not USGS)

GW Geoprobe well

GWTH Groundwater Test Hold

HA Hand auger

HDPCH Hydropunch

HOLE Hole

HP Holding pond/Lagoon

ID Indoors

IMP Import material

IN System influent

IT Intertidal

LAGOON Lagoon

LENTIC Freshwater, lentic

LF Landfarm

LGV Landfill Gas Vent

LH Leachate (Landfill)

LK Lake/pond/open reservoir

LOTIC Freshwater, lotic

LYS Lysimeter

MH Manhole/Catch basin

MS Sediment e.g., Marine Sediment

NQ Quality Control sample

ON Ocean, open water (not bay)

OTHER Other

OUTFALL Outfall

OW Oil-Water Separator

PARK Plantation/park/forest

PC Paint chip

PIPE Pipeline

PUBW Public drinking water well

PUMP_STATN Pumping station

RAIN_STATN Rainfall station

REF Reference

RES Residential garden/yard

RV River/stream

RW Recovery well

SBAG Soil bag

SE Seep

SG Soil Gas Probe

SIDEW Side Wall

SLAG Slag heap

SND_BLST Sandblast material pile

SP Spring/Seep

SPT Septic tank

SR Sewer System

SS Ground surface

STEAM_LN Steam Line

STKP Stockpile

STRM_DRN Storm drain

STRM_MH Storm drain manhole

SUBS Ground, sub-surface

SUBSLAB Subslab

SUBT Subtidal

SUMON Survey monument

SUMP Sump

SV Soil vapor extraction system

SWS Surface water body - nonspecific

SWSD Surface Water/Sediment

SWWP Wipe

SYSTEM Treatment system air or water

T Trench

TAA Temporary accumulation area

TAIL Mine tailings pile

TK Tank

TMPM Temperature Monitoring Point

TP Test Pit

TRANS Transformer

TUNNEL Steam tunnel sampling location

TWP Temporary well point

UGA Geophysical anomaly

UNK Unknown

USGS USGS gauging station

UST Underground storage tank

UXO UXO

UXO_G UXO grid

UXO_P UXO point

VAULT Vault

VPB Vertical profile boring

WALL Wall

WEEP Weep hole

WF Waste water treatment facility

WL Well

WLAM Alluvial Monitoring Well

WLBM Bedrock Monitoring Well

WLE Extraction well

WLEA Alluvial Extraction Well

WLEB Bedrock Extraction Well

WLHM Hybrid Monitoring Well

WLI Injection well

WLIA Alluvial Injection Well

WLIM Interface Monitoring Well

WLL Leaching Well

WLM Monitoring well

WLS Sparge well

WLSG Soil gas probe/Well

WRP Waste rock pile

WSFI Water system facility intake

WT Wetlands

WW Waste water

Recorder: _____ Date: _____

Checker: _____ Date: _____

SAMPLE NAMING

1.0 PURPOSE

This standard operating procedure (SOP) describes the naming convention to be used for samples collected, analyzed, and reported for the U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) projects. Unique sample identifiers are used to facilitate tracking by laboratory and project personnel and for purposes of storing, sorting, and querying data in the NAVFAC NW NIRIS database.

2.0 PROCEDURES

The contractor is responsible for assigning a unique sample ID to every individual sample collected. The contractor may use his or her own designations as long as the sample ID does not already exist in the NIRIS database. The contractor must also clearly identify which samples are field duplicates. This applies to both historical and planned sampling events. The used sampling identification scheme shall be identified and outlined in the field sampling plan.

3.0 DOCUMENTATION

All sample collection information must be recorded within the field logbook. Each sample collected will be clearly associated with the sample location (installation, site, and well or sample point location), matrix type, sample type (i.e. environmental, field duplicate, equipment rinsate), collection date and time, sampling method, and sampling depth (if appropriate). Only data codes and location IDs associated with NIRIS and NAVFAC NW's electronic deliverables SOP (NAVFAC NW 2015) shall be used.

Any sample submitted for analysis shall be documented using a completed chain-of-custody (COC) form that must accompany the shipment and a copy retained for the project records. Samples submitted to an EPA laboratory shall also include a completed EPA analysis request form. The COC/analytical request form must be used to track all sample IDs.

4.0 REFERENCES

NAVFAC NW. 2015. Navy Environmental Data Transfer, Version 5.0.

5.0 ATTACHMENTS

None.

SOIL SAMPLING

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to outline the methods by which U.S. Naval Facilities Engineering Command (NAVFAC NW) personnel and contractors should perform soil sampling.

This procedure describes the protocols for collecting a surface or subsurface soil sample. The procedure will provide descriptions of equipment, field procedures, and documentation necessary to collect representative surface and subsurface soil samples.

2.0 PROCEDURE

2.1 SURFACE SOIL PROCEDURES

2.1.1 Surface Soil Sampling Equipment

Equipment and materials used to collect surface soil samples include:

- Stainless steel spoon, trowel, knife, spatula
- Stainless steel bowl
- Personal protective equipment (PPE) as required by the Health and Safety Plan (HASP)
- Decontamination equipment
- Paper towels
- Laboratory supplied sample jars
- Cooler and blue ice or ice
- Stakes for marking sampling location
- Field forms such as chain of custody, sample collection log, air monitoring log, other necessary health and safety documentation
- Field logbook

2.1.2 Surface Soil Sample Collection

The following steps describe the procedures used to collect surface soil samples:

1. Decontaminate sampling equipment.
2. Clear and remove vegetation and any surface debris such as rocks using a decontaminated trowel.
3. Don a clean pair of latex or nitrile or surgical gloves and the appropriate level of protection as specified in the HASP.
4. Collect the surface soil sample from the top 6 inches of soil (or the depth specified in the SAP) using a decontaminated trowel.
5. Special separate collection procedures must be followed if the sample will be analyzed for volatile organic compounds (VOCs). The choice of sampling method/device, container type, and preservation method may be influenced by many factors, including but not limited to the following:
    - Project required detection levels.
    - Expected physical and chemical properties of the soils.

- Whether samples will be preserved in the field vs. in the laboratory.
- Holding times for different preservation methods.
- Elapsed time between sample collection and laboratory delivery.
- Available shipping methods (may be limited for methanol preserved samples).
- Any applicable State requirements.

Detailed sample collection and preservation guidance is provided in Appendix A of SW846 Method 5035A. Additional state guidance is provided in "Collecting and Preparing Soil Samples for VOC Analysis" Implementation Memorandum #5, Washington State Department of Ecology (June 2004). These collection procedures should be used for all Navy Activities in the State of Washington. For Navy Activities in the State of Alaska that include soil sampling in petroleum contaminated sites, the procedures in "Underground Storage Tank Procedures Manual, Guidance for Treatment of Petroleum Contaminated Soil and Water and Standard Sampling Procedures" State of Alaska Department of Environmental Conservation (November, 2002) should be followed.

6. Homogenize the remainder of the sample in a decontaminated stainless steel bowl and fill the remainder of the pre-labeled lab jars for sample analysis.
7. Fill hole with topsoil and replace the vegetative mat over the disturbed area.
8. Record observations in the field logbook
9. Record the sampling location on a site map.
10. Decontaminate sampling device for collection of next sample.

2.2 SUBSURFACE SOIL PROCEDURES

Before conducting subsurface soil sampling, you may need a permit or other form of approval from regulatory agencies overseeing your site before you begin any drilling operations. This is especially true if you are working in a wetland or other sensitive area or are installing wells. Always check with utility companies to verify the locations of underground materials before beginning drilling operations.

Subsurface soil samples can be collected during drilling operations using one of several different sampling devices. Subsurface soil samples can also be collected using an alternate method such as a direct-push sampling device (e.g. Geoprobe™). Procedures for collecting subsurface soil samples will be described in this section.

2.2.1 Subsurface Soil Sampling Equipment

Equipment and materials used during the collection of subsurface soil samples include:

- Drill rig, hollow-stem auger, mud rotary, or direct-push sampling device
- Sampling device (split-barrel sampler, split-spoon sampler, modified California sampler, thin-wall tub sampler, Shelby tube continuous core sampler)
- Stainless steel spoons, trowels, putty knife
- Stainless steel bowl(s)
- Measuring tape
- Laboratory supplied sample jars
- Cooler and blue ice or ice
- Decontamination equipment
- Paper towels
- PPE as required by the HASP

- Field forms such as chain of custody, sample collection log, air monitoring log, other necessary health and safety documentation
- Field logbook

2.2.2 Collection of Subsurface Soil Samples During Drilling Operations

The following procedures should be followed when collecting a subsurface soil sample during drilling operations:

1. Decontaminate all equipment including drill rig and all associated equipment, sampling devices, and stainless steel spoons and trowels.
2. Inspect, clean, and put on appropriate PPE.
3. Advance boring using selected drilling method.
4. Retrieve sample using selected sampling device. If performing the Standard Penetration Test (ASTM D1586), record the number of blows per 6 inches.
5. Observe the soil and measure and record (1) the amount of soil recovered in the sampler, (2) the presence of any free product, (3) any unusual odors, and (4) any stratigraphic changes. Begin to form a description before disturbing the soil.
6. All sample jars should be pre-labeled with appropriate information including date, sample ID, and analyses.
7. Collect a sample using a decontaminated stainless steel spoon or trowel. Special collection procedures must be followed if the sample will be analyzed for volatile organic compounds (VOCs). Refer to section 2.1.2, step 5 for details. Next, place the remaining soil in a stainless steel bowl and collect a homogeneous sample to be analyzed for other parameters. After the laboratory samples are collected, fill a separate sample jar or plastic bag to be used for soil classification. If there is a change in the stratigraphy, set aside some soil from each and place into jars to be used for the soil classification. If the amount of soil is not sufficient, collect another sample immediately below the prior sample interval and homogenize the two samples prior to filling laboratory sample jars.
8. If collecting samples using Shelby Tubes (ASTM D1587), seal the ends, being careful not to disturb the sample.
9. Fill in a detailed description of the soil(s) (ASTM D2488) in the field logbook.
10. Discard any unused soil. See the SOP I-A-7, *Investigation-Derived Waste Management*, for proper storage and disposal procedures.
11. Decontaminate sampling device for collection of next sample.

2.2.3 Procedures for Subsurface Soil Sample Collection Using Direct-Push Technology

There are several different types of direct-push technology. Some direct-push sampling devices may not be able to collect a soil sample from greater than 20 feet below ground surface.
The following procedures should be followed when collecting a subsurface soil using direct-push technology.

1. Decontaminate all equipment including sampling devices, and stainless steel spoons and trowels.
2. Inspect, clean, and put on appropriate PPE. Change latex/nitrile gloves for the collection of each sample.
3. Instruct subcontractor to set up truck-mounted equipment at a sampling location.
4. The subcontractor will advance the sample probe and extract a sample from the required depth using a decontaminated sample collection device. The sample probe will be attached to the bottom of a stainless steel rod. The rod will be pushed below ground

surface with a hydraulic level attached to the truck. The predetermined depth will be reached by connecting rods together. Immediately before the sample depth is reached, the contractor will connect a handle to the rods and turn it to open the sampling depth. The device will be driven through the desired sample interval and extracted.

5. The soil will be collected in a Teflon sleeve, or other non-reactive sleeve inside the sampling device. After sample retrieval, the sleeve will be sliced open to allow access to the soil. Collect a sample using a decontaminated stainless steel spoon or trowel. Special collection procedures must be followed if the sample will be analyzed for volatile organic compounds (VOCs). Refer to section 2.1.2, step 5 for details. Next, place remaining soil in a stainless steel bowl and collect a homogenous sample to be analyzed for other parameters. After the laboratory samples are collected, fill a separate sample jar or plastic bag to be used for soil classification. If there is a change in the stratigraphy, set aside some soil from each and place into jars to be used for the soil classification. If recovery is not sufficient, collect another sample immediately below the prior sample interval and homogenize the two samples prior to filling laboratory sample jars.
6. Log the description of the soil sample in the field logbook.
7. Decontaminate the stainless steel sample rods and sampling device between each sampling location.

2.3 COMPOSITING SOIL SAMPLES

All samples to be composited or split should be homogenized after all aliquots have been combined. DO NOT HOMOGENIZE (MIX OR STIR) SAMPLES FOR VOLATILE COMPOUND ANALYSIS.

If a representative sample is desired over the depth of a shallow hole or if several shallow samples are to be taken to represent an area, composite the samples as follows:

1. As each sample is collected, place the soil in a decontaminated stainless steel bowl.
2. After all samples from each hole or area are collected in the bowl, stir the sample thoroughly with a decontaminated stainless steel trowel or spatula.
3. For organics analyses, a sheet of aluminum foil may be used instead of a stainless steel bowl.

2.4 SPLITTING SAMPLES

Fill the sample containers for the same analyses one after another in a consistent manner (i.e., fill the first lab's container, then fill the second lab's container; then go on to the next analysis and fill the first lab's container and then the second lab's container).

2.5 QA/QC

Quality assurance/quality control (QA/QC) samples are designed to help identify potential sources of sample contamination. Different types of QA/QC samples include field blanks, rinse blanks, trip blanks, and duplicate samples. The frequency of collection and types of QA/QC samples required are indicated in the site-specific sampling plan. All QA/QC samples are labeled with QA/QC identification and sent to the laboratory with the other samples for analysis.

3.0 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the proper acquisition of samples and provide a permanent record. These observations and data will be recorded with black ink in a bound weatherproof field logbook with consecutively numbered

pages. Notes will be recorded daily when in the field. The soil sampling information in the field logbook will include the following as a minimum:

- Project number/name
- Date
- Weather
- Personnel on site (samplers' names, other field crew, observing personnel)
- Boring location
- Start/end time of boring
- Sample ID and depth
- Time sample is collected
- Laboratory sample ID and analytical parameters
- Air monitoring readings taken during drilling or sample collection
- Decontamination procedures
- Presence of free product or unusual observations
- Depth water was first encountered
- Depth rock was encountered
- Borehole abandonment procedures
- Sample description and standard penetration test results may be included in the field logbook, but should also be included on the boring log.

The following information should be included in the field logbook for the completion of a boring log:

- Boring location information including project number/name, location, subcontractor, date, drilling method, type of sampling device, equipment used for standard penetration test, and name of person logging information.
- For each sampling interval, the following should be noted: sampling interval number, time sample was collected, soil description, depth, amount of recovery, and information from standard penetration test. Note any changes in stratigraphy and thickness of each layer in the sample. Note the depth water was first encountered and the depth rock was encountered.
- Also, note the presence of free product, any odors, and air monitoring readings taken during drilling or sample collection, and any other observations that may be used for site characterization in the future.
- After logging is completed, note the total number of samples collected, which ones were sent for laboratory analysis, the laboratory sample IDs, and the parameters requested.
- Note any unusual changes in drilling pressure or drill rig behavior, voids, and unusual conditions encountered during drilling.
- It is important to be as thorough as possible when filling out the boring log. The log may be used to aid in future work at the site, many years down the road, and a complete log will prevent guesswork and the possibility of resampling.

4.0 REFERENCES

ASTM Method D1586-84, Standard Method for Penetration Test and Split-Barrel Sampling of Soils

ASTM Method D1587-83, Standard Practice for Thin Walled Sampling of Soils

ASTM Method D2488, Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)

ASTM D420-87, Standard Guide for Investigating and Sampling Soil and Rock
ASTM Method D1452, Standard Practice for Soil Investigation and Sampling by Auger Borings
ASTM Method D2487, Standard Test Method for Classification of Soils for Engineering Purposes
ASTM D4220-89, Standard Practice for Preserving and Transporting Soil Samples
SOP I-A-7, *Investigation-Derived Waste Management*
U.S. Army Corps of Engineers (USACE). *Work Plan for CERCLA Remedial Investigation/Feasibility Study*. Appendix J, SOP 025 - Soil Sampling
EPA. 1996. Test Methods for Evaluating Solid Waste, Physical Chemical Methods. (SW-846), Third edition. December. Method 5035A, Appendix A (July 2002).
Washington State Department of Ecology, *Collecting and Preparing Soil Samples for VOC Analysis*. Implementation Memorandum #5, June, 2004.
State of Alaska Department of Environmental Conservation (ADEC), *Underground Storage Tank Procedures Manual, Guidance for Treatment of Petroleum Contaminated Soil and Water and Standard Sampling Procedures*, November, 2002.

5.0 ATTACHMENTS

None.

SEDIMENT SAMPLING

1.0 PURPOSE

This standard operating procedure (SOP) describes the methods by which U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) field personnel and their contractors will conduct subareal or subaqueous sediment sampling. This procedure establishes the guidelines for both conventional and undisturbed sediment sample collection and sample containerization with a variety of sampling devices. Sediment compositing and methods of preventing sample and equipment cross-contamination are also included.
Proper sediment sampling ensures that any evaluations of sediment or catchment contamination are based on actual chemical concentrations and are not an artifact of improper sampling techniques.

2.0 PROCEDURE

Project Objectives and/or the Project Plan must be carefully considered when the sediment sampling method is determined. This procedure covers the following methods for sampling sediments in both subareal and subaqueous environments.

2.1 EQUIPMENT

Typical field sampling equipment and material used for sediment sampling include:

- Sampling Plan
- Maps/Site Drawings
- Tape measure
- Survey stakes, flags, or buoys
- Camera and film
- Stainless steel ruler
- Stainless steel, plastic, or other appropriate composition (e.g., Teflon) bucket
- Garden Sprayer
- Bucket for investigative derived waste
- Appropriate Sample Containers
- Packing material for sampling containers
- Ziploc® plastic bags for samples, and sample jars
- Rite in the Rain Logbook
- Disposable gloves (nitrile, vinyl)
- Sample Labels
- Chain-of-Custody Forms
- Field Sample Description Forms
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spatula
- Scoop

- Trowel
- Nylon rope
- Sediment sampling device/support equipment

2.2 SUBAREAL SEDIMENT SAMPLING METHODOLOGY

2.2.1 Sampling Surface Sediments with Trowels or Scoops

Collection of surface sediment with no overlying water or from beneath a thin aqueous layer can be accomplished with tools such as spades, shovels, and scoops. The surface material can be removed to the required depth; then a stainless steel or plastic scoop should be used to collect the sample. This method can be used to collect consolidated sediments, but is limited somewhat by the depth of the aqueous layer. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sampling technician. A stainless steel or plastic scoop or lab spoon will suffice in most applications. Care should be exercised to avoid the use of devices plated with chrome or other materials. Plating is particularly common with garden implements such as planting trowels.
The following procedure will be used to collect the sediment samples:

- Using a pre-cleaned stainless steel scoop or trowel, remove the desired thickness of sediment from the sampling area.
- Provide a characterization of the sediments including observations on sediment color, odor, stratification, texture, consistency, presence of organisms, and distinguishing characteristics (debris or other anthropogenic material).
- Transfer sample into an appropriate sample container.

2.2.2 Sampling Surface Sediments with a Hand Auger

This system consists of an auger, a series of extensions, and a T-handle. The auger is driven into the sediment and used to extract a core. A sample of the core is taken from the appropriate depth.
The following procedure will be used for collecting sediment with a thin-walled auger:

- Insert the auger into the material to be sampled at a 0° to 45° angle from horizontal. This orientation minimizes the spillage of sample from the sampler. Extraction of samples may require tilting of the containers.
- Rotate the T-handle once or twice to cut a core of material.
- Slowly withdraw the auger, making sure that the slot is facing upward.
- An acetate core may be inserted into the auger prior to sampling if characteristics of the sediments or body of water warrant. By using this technique, an intact core can be extracted.
- Transfer sample into an appropriate sample or homogenization container.

2.2.3 Sampling Deep Sediments with Augers and Thin-Wall Tube Samplers

This technique consists of an auger, a series of extensions, a T-handle, and a thin-wall tube sampler. The auger is used to bore a hole to a desired sampling depth and then withdrawn. Next, the auger tip is replaced with a tube core sampler, lowered down the borehole, and driven into the sediment at the completion depth. The core is withdrawn and the sample collected. This method can be used to collect consolidated sediments, but is somewhat limited by depth of the aqueous layer.

Several augers are available, including bucket and posthole augers. Bucket-type augers are better for direct sample recovery, are easy to use, and provide a large volume of sample. Posthole augers have limited utility for sample collection because they are designed for their ability to cut through fibrous, rooted materials.

The following procedures will be used for collecting sediment samples with the hand auger:

- Attach the auger bit to a drill rod extension, and then attach the T handle to the drill rod.
- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter).
- During augering, periodically remove any accumulated sediment from the auger bucket.
- After reaching desired depth, slowly and carefully remove auger from the boring. When sampling directly from the auger, collect the sample after the auger is removed from the boring and transfer the sample to the appropriate containers.
- Remove the auger tip from the drill rods and replace it with a clean thin-wall tube sampler. Install proper cutting tip.
- Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the sediment. Care should be taken to avoid scraping the sides of the borehole. Avoid hammering the drill rods to facilitate coring because the vibrations may cause the boring walls to collapse.
- Remove the tube sampler and unscrew the drill rods.
- Remove the cutting tip and remove the core from device.
- Discard the top of core (approximately one inch), because it represents material collected by the tube sampler before penetration of the layer in question.
- Transfer the sample into an appropriate sample container.

2.3 SUBAQUEOUS SEDIMENT SAMPLING METHODOLOGY

Subaqueous samples may be recovered using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion and depth of the sediment profile required (surface vs. subsurface), the type of sample required (disturbed vs. undisturbed), and the sediment type. Types of subaqueous sampling devices include grab samplers, box cores, dredges and coring devices. Grab samplers and box cores are typically used to collect surficial sediments for the assessment of the horizontal distribution of sediments. Dredge samplers also collect surficial sediments but can cause disruption of sediment and pore water integrity, as well as loss of fine-grained sediments. Core samplers (e.g., vibracore) are used to characterize the vertical distribution of sediment characteristics or to characterize the entire sediment column.

2.3.1 Grab Samplers

Grab samplers consist of a set of jaws, which close on bottom contact through a spring action or by cable pull. Grab samplers are generally small and manageable from a small boat using a davit or boom. A deck winch usually assists deployment and retrieval. Types of grab samplers include a van Veen, Ponar, Smith-McIntyre and Birge-Ekman and Box core.

2.3.1.1 Van Veen Sampler

To minimize the loss of fine-grained material during collection in sub-tidal environments, marine surface sediments will be collected using a 0.1-m^2 stainless-steel van Veen sediment sampler. In areas where use of the van Veen grab sampler is infeasible, a Birge-Ekman, Ponar, Smith-McIntyre, or other acceptable grab sampler will be used.

- Sediments from the 0- to 4-cm horizon will be collected unless directed otherwise in the project plans.
- Weights may be added to the sampler to increase penetration and assure the proper horizon thickness, or removed from the sampler to prevent overfilling in soft sediments.
- When the survey vessel is positioned, the van Veen sampler will be lowered near the bottom at a rate not exceeding 30 cm (1 ft.) per second to avoid pre-tripping the grab and preventing loss of fine-grained surface sediments from the bow wave created in front of the grab.
- At the instant the sampler impacts the bottom (detectable when the lowering wire slackens); a position fix will be taken.
- The sampler will be retrieved at a slow speed, so as not to disturb the grab.
- Once the sampler is secure on the processing stand, the sampler and grab will be observed for signs of overfilling, inadequate penetration, or grab disturbance.

The following acceptability criteria should be satisfied:

- Sediment is not extruded from the upper face of the sampler such that sample material may have been lost
- Overlying water is present (indicates minimal leakage)
- The grab surface is relatively flat (indicates minimal disturbance or winnowing)
- The entire surface of the grab is included in the sampler
- The following penetration distances are achieved at a minimum
    - 4 to 5 cm for medium-coarse sand
    - 6 to 7 cm for fine sand
    - Greater than or equal to 10 cm for muddy sediment
- There is no evidence of sediment loss (incomplete closure of sampler, penetration at an angle with the bottom, or tilting upon retrieval).

Should any of these conditions be observed, the grab will be discarded and the drop repeated. For all acceptable grabs, the overlying water will be removed with a siphon tube and the sampler penetration will be measured. The first grab of a unit will be characterized fully, including observations on sediment color, odor, stratification, texture, consistency, presence of organisms, and distinguishing characteristics (debris or other anthropogenic material). Other grabs in the unit will be examined and differences will be noted, but the subsequent grabs will not be fully characterized. Under the direction of the technical lead, organisms, debris, and other material unrepresentative of sediments will be removed from the grab; such material will be described and documented in the field log.

2.3.1.2 Birge-Ekman Sampler

The following procedures will be used for collecting sediments with a Birge-Ekman Sampler:

- Attach a sturdy nylon or stainless steel cable to the hook provided. For relatively shallow depths, secure the extended handle to the bracket with machine bolts.
- Arrange the Birge-Ekman sampler so that the jaws are in the open position and trip cables are positioned over the release studs.
- Lower the sampler to a point just above the sediment surface.
- Drop the sampler sharply onto the sediment.
- Trigger the jaw release mechanism by lowering a messenger down the line, or by depressing the bottom on the upper end of the extended handle.

- Raise the sampler and slowly decant any free liquid through the top of the sampler by slowly inclining the sampler and collecting the escaping water in a bucket or other suitable container.
- Open the dredge and transfer the sediment into a stainless steel or plastic bucket. Continue to collect additional sediment until sufficient material has been secured. Transfer the sediment to an appropriate sample container.
- Collect samples for volatile organic analysis directly from the bucket to minimize volatilization of contaminants.

2.3.1.3 Box Core

The box core sampler consists of an open bottom stainless steel rectangular box mounted on the end of a sturdy sliding vertical bar. On contact with the bottom, a swing arm closes over the end of the sampler and the unit is raised to the surface. The box core is much heavier (500 lbs.) than the typical grab samplers and is capable of deeper sediment penetration and larger sample volume recovery. The steps for deploying a box core typically include:

- Prior to installing the stainless steel rectangular box in the box core frame assembly, it will be thoroughly decontaminated. In locations with obvious contamination, the interior of the grab sampler should be washed with soap and water and rinsed with potable water.
- The closure plate pivot arm is moved to the horizontal position and the safety rod(s) are inserted into the frame assembly to prevent pre-tripping the mechanism.
- An appropriate amount of weight should be added to the main frame assembly if previous sampling attempts yield insufficient sample penetration.
- The rectangular sampling box is then mounted into position on the main frame.
- Each sampling location should have established coordinates that will be located using a differentially corrected GPS (DGPS) or appropriate field positioning system that provides suitable accuracy (± 3 to 5 m). A marker float may be deployed at the station coordinate to facilitate the reoccupation of the site should additional grabs be required.
- At the desired sample location, the box core is gently positioned outboard of the vessel, and the safety rods are removed.
- The sampler will descend in the water column at a rate no faster than 1 foot per second to omit the creation of a bow wave.
- On contact with the bottom (denoted by slackness in the lowering line), the box core will be slowly raised to the surface so as not to disturb the collected sediment.
- Once the box core is secured on deck, a stainless steel cover plate is inserted between the pivot arm closure plate and the bottom of the rectangular sample box, and then attached in place by either screws or clamp mechanisms.
- The sample box is then detached from the frame assembly and moved in the upright position to a processing location.
- When the recovered sampler is placed on a secure processing stand, the contents of the grab will be inspected for acceptability (Section 2.3.1.1).

When a grab is deemed unacceptable, the contents will be discarded, the box core will be rinsed with site water and the grab repeated. When an acceptable grab is obtained, the following information shall be included in the field log.

- The water depth of the grab. Be sure the boat depth sounder has been offset to represent the water surface.
- Time the box core sampler impacts the bottom

- The penetration depth of the box core sampler in the sediment (centimeters)

Prior to processing of an acceptable grab, the overlying water should be removed with a siphon tube, being careful not to siphon off the upper layer sediments. Remove any large organisms, debris and other material unrepresentative of the sediments and document it in the field log. The grab contents should be thoroughly described before collecting the sediments for chemical analysis. The sediment should be characterized by color according to a Munsell color scale, sediment odor, sheen, stratification, texture, consistency, and presence of organisms and distinguishing characteristics. If necessary, additional grab samples at each location may be required to obtain the required sample volume.

2.3.2 Dredges

The types of devices include Emery and Peterson dredges. The closing mechanism on the dredge buckets will be activated either by impact or by a weighted messenger sent down the deployment line. After the bucket is closed, the sampler is retrieved by hand or with a motorized winch. Dredges will be deployed and recovered following the procedures outlined in Section 2.3.1.1.

2.3.3 Core Samplers

2.3.3.1 Core Logging

The sediment core is usually processed at an established shore facility in order to describe its structure and create subsamples for chemical analysis. It is important to document the core content and to maintain sample quality. Prior to inspection of the samples, the unlined core tubes or plastic core liners are cut lengthwise. This is accomplished using electric reciprocating saws for the thick walled tubes and hooked bladed knives for the thin walled plastic liners. However, Lexan plastics are very tough, and cutting with a razor knife can be dangerous and difficult to control without cutting into the core.

Once the upper portion of the core tube cover is removed, a clean knife or spatula should be used to expose an outer portion of the core that was not in contact with the core liner. Care should be taken that the blade is not introducing contaminants into other segments of the recovered core. Prior to describing the core, a moveable light is positioned and a tape measure is positioned for the full length of the core.

The core will then be visually described in the core log including the following characteristics:

- Station number
- Date and time of collection
- Station coordinates
- Weather conditions
- Names of persons collecting and logging the sample
- Sample recovery
- Physical soil description in accordance with the Unified Soil Classification System (USCS)
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratifications and lenses
- Vegetation
- Debris
- Biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)

- Presence of oil sheen
- Photograph information (time, direction of photograph, roll number/frame number). Photographs should overlap previous core sections.
- Any other distinguishing characteristics or features

Core samples are acceptable if the core has penetrated to an acceptable depth and the core was inserted vertically.

Collect analytical samples from each core interval, as pre-determined in the SAP, from the undisturbed core interior with a clean, stainless steel spoon or spatula. Place the sediment from an individual core interval into a clean stainless steel mixing bowl. Mix the sediment with a clean stainless steel spoon thoroughly or until visually homogeneous.

2.3.3.2 Piston Core

Guidelines for using a piston core include:

- Field personnel will assemble the hand corer according to the manufacturer's specifications.
- Adjust the clearance so that the piston slides in the barrel with only slight resistance, but is tight enough to create ample suction in the barrel.
- Plastic core sleeves, if used, will be either new or thoroughly decontaminated and placed in the corer according to the manufacturer's specifications.
- Lower the corer to the sediment surface or into the borehole to the desired depth. Once the sampler is positioned at the interval to be sampled, secure the piston line and manually drive the core barrel into the sediment in one slow, continuous effort. Handles can be attached to the drive rods to apply additional force when necessary. Retrieve the corer by manually lifting the sampler to the surface with the drive rods. Repeat this process for each specified core interval.
- If the corer is equipped with a plastic sleeve, the sleeve will be removed, sealed, and labeled when the sampler is retrieved from the sediment. The top of the core will be indicated on the sleeve. If the sample is designated for chlorinated organic testing, special provisions will be made to replace the plastic liners with another non-reactive material.
- If the corer is not equipped with plastic sleeves, extrude the sediment core onto a clean surface lined with plastic wrap and aluminum foil. First, wrap the core with the plastic and foil, being careful not to break or damage the core; then wrap this in aluminum foil so that the ends of the foil are folded over, creating a squared-off end. Tape the foil closed on both ends and along the seam. Affix a piece of tape to the core wrapping and label with the sample interval, date, and sampling personnel. Be sure to indicate the orientation of the core on the label (i.e., top and bottom).
- If the core is to be sampled in the field, use a stainless-steel scoop or spoon to remove the samples from the core at the intervals specified in the project plans, and put the samples into the appropriate containers. Discard any leftover sediment according to the specifications in the project plans.

2.3.3.3 Gravity Core

Gravity corers are capable of collecting soft fine-grained sediments cores at depths up to 3 meters. External weights are added to assist core barrel penetration into the sediments. A variety of liner materials are available including stainless steel, Lexan and PVC plastic liners. Guidelines for the gravity core include:

- Field personnel will assemble the corer according to the manufacturer's specifications.
- New or thoroughly decontaminated nonreactive core barrel liners will be installed per the manufacturer's specifications.
- Attach a strong retrieval line or wire rope to the sampler and lower the sampler at a controlled descent of approximately 1 foot per second. When the sampler penetrates the sediment (indicated by a slack retrieval line), immediately pull the sampler free of the bottom, using an electric or hydraulic winch if available.
- Record the bottom depth to the waterline
- Raise the corer at a controlled ascent rate. Once the corer reaches the water surface measure the length from the top of the core tube to the surface of the recovered sediment in the core. Bring it on board and, if possible, secure it to the deck.
- Label the sleeve to properly identify the sample orientation, sample designation, date, core interval, and sampling personnel.
- If the corer is not equipped with plastic sleeves, extrude the sediment core onto a clean surface lined with plastic wrap and aluminum foil. First, wrap the core in the plastic and foil, being careful not to break or damage the core. Then wrap this in aluminum foil so that the ends of the foil are folded over, creating a squared-off end. Tape the foil closed on both ends and along the seam. Affix a piece of tape to the core wrapping and label with the sample interval, date, and sampling personnel. Be sure to indicate the orientation of the core on the label (i.e., top and bottom).

2.3.3.4 Vibracore

Vibracores are hydraulic, pneumatic or electric powered, mechanical vibrators located at the upper end of a coring tube. The vibrating head induces vertical vibrations onto the coring tube to help penetration into the sediment. Depending on the horsepower rating of the vibrating head and its weight, the core tube is cable of penetrations up to 6 meters in compact sediments (U.S. EPA, 2001).

Vibracoring will be performed following the recommended steps.

- Locate the sampling station with an appropriate field positioning system
- Triple anchor the boat or platform to ensure keeping it on station
- Measure the water depth adjusted to the water line.
- Core liners are inserted in the core barrel and held in place by a cutting tip and will contain a core catcher.
- With an electric or hydraulic winch, suspend and lower the vibracorer slowly until the core contacts the bottom. A measuring tape attached to the top shackle of the vibracore is used to calculate the penetration depth.
- Turn on the vibration head and continue penetration until the unit meets refusal or the core tube is fully buried, ensuring the core tube remains vertical.
- Turn off the vibration head.
- Slowly withdraw the core tube by winch, using the vibration only if extraction is difficult.
- Upon reaching the surface, keep the core tube in a vertical position.
- After removing the core catcher, place a plastic cap on the lower end and tape it in place.
- Using a weighed tape, measure the distance from the top of the sediment tube to the surface of the recovered sediment.
- Drill a small hole at the sediment-water interface to drain off all the water above the sample. Cut this section off and place a cap on the top end and tape it in place.

- Label the upper end of the core with date, time and unique station number. Transfer core ashore to an established processing location or laboratory.
- Protect core from sunlight, heat and physical disturbance as much as possible.

Due to the nature of the sediments, the recovery within the core tube may not be uniform throughout the core sample. Compaction of the sediment core can occur in cohesionless or saturated soils. The friction within the core barrel increases with penetration and the length of the sample present in the core tube. Compaction causes the recovered sediments to be under-represented in the recovered core sample. Field collection of penetration and recovery data allows for the identification of under-represented strata.

Once sampling is complete, the vibracore is retrieved and the core liner removed from the core barrel. The core sample will be examined at each end to verify that sufficient sediment was retained for the particular sample. Overlying water will be siphoned from the core tube. If the sample is acceptable, each end of the tube will be capped and sealed with duct tape. Depending on the length of the core, the core sample may be sectioned prior to processing, and each end capped. All core sections will be labeled with the station number, date, time of collection, depth, and directional arrows indicating the top end. The station number, station coordinates, date and time of collection, field crew, and weather conditions will be recorded in the field log. The cores will be stored on ice aboard the vessel until they are processed either on board the boat or onshore.

2.4 DECONTAMINATION

Decontaminate all equipment before sediment sampling. Decontamination of sediment sampling equipment will follow the recommendations of SOP III-I, *Equipment Decontamination*. Sampling grabs and core barrels and liners will be washed with a laboratory-grade detergent (e.g., Alconox) and water solution, rinsed with potable water, 10 percent dilute nitric acid (if metals analysis is required), and a final distilled water rinse prior to field operations. If organic compounds will be analyzed, a solvent rinse such as isopropyl alcohol or hexane will be used. The equipment will then be allowed to air dry. Liners and core barrels will be capped on each end with foil and core caps to prevent contamination during transit or field operations when not in use. Between stations, the sampling device will be rinsed with ambient water.

Decontamination of sampling implements and processing materials such as stainless steel spoons, bowls, rulers and scoops will involve washing the equipment with a laboratory- grade detergent (e.g., Alconox) and water solution, rinsing with tap or site water (e.g., river, lake, ocean), followed by rinses of potable water, 10 percent nitric acid, a solvent such as isopropyl alcohol or hexane, and a final distilled water rinse. Decontaminated equipment will be wrapped or covered with aluminum foil. Subsampling and processing equipment will be decontaminated before use at each station, and between depth intervals at a location in order to prevent cross contamination of samples.

3.0 COMPOSITING

3.1 COMPOSITING SEDIMENT SAMPLES

Sediment samples which will be members of a composite sample should be homogenized once all aliquots have been combined. Sediment samples that will be analyzed for Volatile Organic Compounds (VOCs) should be collected as grab samples from the desired composite member location or depth and aliquotted into the appropriate sample collection containers. Do not homogenize (mix or stir) samples which will be analyzed for VOCs..

If a composite sample is collected to represent a single location over a depth range (such as with a sediment core) or several locations (such as within a marine grid cell), composite the samples as follows:

1. Follow the procedure specified for each sediment collection method.
2. Place each core segment or grab sample to be included in the composite together in a decontaminated stainless steel bowl as they are collected.
3. After all composite member samples from each location or location depth are collected in the bowl, homogenize the sediment thoroughly with a decontaminated stainless steel trowel or spatula until the sediment color and texture are as uniform as possible.
4. Transfer the composited, homogenized sediment to containers appropriate for the desired analysis.
5. Alternative compositing and homogenization container materials may be employed depending on the analysis parameters. For instance, Teflon containers might be used if composites will only be analyzed for metals and aluminum if only organic compounds analysis will be performed.

3.2 SPLITTING SAMPLES

If samples are to be split and analyzed for the same parameters by different laboratories, fill the sample containers for each analysis systematically, one after another in a consistent manner (i.e., fill the first lab's container, then fill the second lab's container for the first analysis; then go on to the next analysis and fill the first lab's container and then the second lab's container).

4.0 DOCUMENTATION

Keep records of all sampling activities in the field notebook following SOP III-D *Logbooks*. Sample custody should be documented on the chain-of-custody forms following procedures described in SOP III-E *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*.

5.0 REFERENCES

SOP III-D, *Logbooks*
SOP III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*
SOP III-F, *Sample Containers and Preservation*
SOP III-I, *Equipment Decontamination*
USEPA. 2001. Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA-823-B-01-002.

6.0 ATTACHMENTS

None.

FIELD PARAMETER MEASUREMENTS

1.0 PURPOSE

This standard operating procedure (SOP) provides instructions for the calibration, use, and checking of instruments and equipment for field measurements.

2.0 PROCEDURES

2.1 WATER QUALITY MEASUREMENTS

All field water quality meters shall be calibrated daily following the manufacturers' specifications. Calibration shall be performed prior to using the instrument for collecting parameters. In addition, the meter's calibration should be checked at mid-day and the end of the day to determine if measurements have drifted from the original calibration numbers. These checks are not intended to be a recalibration of the instrument. All calibration and measurement data shall be recorded in the project logbook. Fluids used for calibration shall be changed at regular intervals to ensure its integrity. Since different fluids have different shelf lives and tolerances, manufacturers' specifications should be checked as appropriate.

Most multi-probe water quality meters utilize a flow-through cell. If the unit being used does not have a flow-through cell, a large enough vessel (i.e. polypropylene beaker) in which the probes will be submerged shall be used. The water to be measured will be pumped continuously through the beaker from the bottom, overflowing the top. The flow-through cells will usually allow for quicker stabilization of dissolved oxygen and oxidation-reduction potential readings. Water shall be allowed to flow continuously through the cell or beaker with water quality measurements being collected at regular intervals, every three to five minutes, until stabilization of the parameters has occurred. A minimum number of seven sets of readings should be collected or as otherwise outlined in the field sampling plan. Stabilization is considered to have occurred when three consecutive readings meet the following guidelines:

pH	+ 0.2 Scientific Units
Specific Conductance	+ 3 % mS/cm
Turbidity	+ 10% or < 10 NTUs
Dissolved Oxygen	+ 10% mg/cm
Salinity	+ 10%
Oxidation-Reduction Potential	+ 10 mV
Temperature	+ 10% °C

In addition to recording the above listed parameters the following information shall also be documented: date, time of measurement, flow rates, purge volumes, total volume purged, and other relative information (i.e. odors, sheen, comments on turbidity, water color)

2.2 ORGANIC VAPORS

Various organic vapor monitors have differing requirements for equipment warm-up and operation. Ensure that all organic vapor monitors are calibrated and operated according to the manufacturer's specification.

For measuring vapors present in soils, expose the monitor to a sample of soil by collecting a sample in sealable plastic baggy and placing the probe tip into the closed bag. In cold weather, the soil may need to be warmed prior to testing.

For measuring breathing zone vapors, hold the probe tip in the area of the breathing zone while field activities are being conducted. Take representative measurements from each different work or sampling area.

For monitoring well head space, place the probe tip just inside of the monitoring well casing immediately after removing the cap.

All readings including calibration information shall be recorded in the field logbook.

3.0 DOCUMENTATION

Record all observations and analysis in the field logbook as defined in SOP III-D, *Logbooks*. If required by the SAP, also complete the Field Measurement Data Form.

Field measurements must also be submitted electronically using the appropriate Naval Electronic Data Deliverable (NEDD) format for loading into NIRIS as defined in the NAVFAC NW SOPs (V5.0 or more current).

4.0 REFERENCES

ASTM International. 2003. D6771-02 Standard Practice for Low-flow Purging and Sampling Wells and Devices Used for Groundwater Quality Investigations

SOP III-D, *Logbooks*

5.0 ATTACHMENTS

Attachment I-D-7-1 Example Field Measurement Data form

FORM 11-3
FIELD MEASUREMENT DATA

Installation ID :	Contract ID :	Prime Contractor Name:
Site Name:	DO/CTO: / Phase:	Measured Date:

Location Name	Sample Name	Sample Matrix	Measured Time	Sampling Depth	Analyte Test Type	Field Result	Units of Measure

Analyte Test Type and Units of Measure

AIRVE Air Velocity - M_SEC
ALK Alkalinity - MG_L
BAL_GAS % balance gas in air space by portable gas meter - PCT
BARO_PRESS Barometric Pressure - IN_HG
BG_NMOC Background non-methane organic compounds - PPM
CACRB Calcium Carbonate - MG_L
CASING VOLUME Casing Volume Removed - GAL
CH4 Methane - PCT
CO Carbon Monoxide - PPM
CO2 Carbon Dioxide - PCT
COLOR Color - COLOR_UNITS
DO Dissolved Oxygen - MG_L
DO-C Dissolved Oxygen by Colometrics - MG_L
DO-T Dissolved Oxygen by Titration - MG_L
FE Total Iron - MG_L
FE2 Ferrous Iron - MG_L
FI Ferrous-Ferric Iron - MG_L
FI3 Ferric Iron - MG_L
FID Flame Ionization Detection - PPM
HS Hydrogen Sulfide - MG_L
LEL Lower explosive limit - PCT
MN Manganese - MG_L
MN2 Manganese, Ion (MN2+) - MG_L
NA2S2O8 Sodium Persulfate - MG_L
NM_VOC Non-methane VOCs - PPM
NO2 Nitrite - MG_L
NO3 Nitrate - MG_L
O2 Oxygen - PCT
ODOR Odor - TONU
ORP Oxidation Reduction Potential - MV
PH pH - PH or SU
PID Photoionization Detector - PPM
PRDTH Product Thickness - FT
PURGERT Purge Rate - GAL_MIN
RECOVFP Recovered Free Product – GAL
SAL Salinity - PCT
SC Specific Conductivity - MS_CM
SG_PRESS Soil gas pressure - IN_H2O
SO4 Sulfate - MG_L
STAGE Stage elevation for surface water - FT
SUL Sulfide - MG_L
TDS Total Dissolved Solids - MG_L
TEMP Temperature - DEG_C or DEG_F
TURB Turbidity - NTU
VOL_PURGED Actual Volume Purged [Prior to Sampling] - GAL
WELL_VOLUME Well Volume Removed - GAL
WTRVE Water Velocity - GAL_MIN

Recorder: _____ Date: _____

Checker: _____ Date: _____

DIRECT PUSH SAMPLING TECHNIQUES

1.0 PURPOSE

This section describes the standard operating procedures (SOP) for direct push sampling techniques to be used by all U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) field personnel and contractors. Direct push techniques may be used as a cost-effective alternative to conventional drilling techniques for obtaining subsurface soil and groundwater samples.

2.0 PROCEDURES

2.1 METHOD SELECTION

The decision to use direct push techniques should be made on the basis of: (1) their ability to achieve the required information at the required level of quality control and (2) their cost effectiveness compared with conventional drilling methods. Major limitations of direct push techniques are their inability to penetrate rock or cobbles and a shallow maximum depth of penetration. The capabilities of direct push systems vary significantly with vendor and these differences must be considered when evaluating the applicability of the method to a specific subsurface exploration program.

2.2 EQUIPMENT

The following is an equipment list for items generally needed to perform direct push sampling:

- Direct push rig capable of installing borings to the desired depth in the expected formation materials and conditions
- Soil sampler(s) with disposable liners
- Retractable screen groundwater sampler(s)
- Peristaltic pump and tubing
- Sample containers with labels
- Bentonite pellets
- Bentonite Grout or Portland Type I or II cement and powdered bentonite for grouting
- High-pressure steamer/cleaner
- Long-handled bristle brushes
- Wash/rinse tubs
- Appropriate decontamination supplies as specified in the SOP for decontamination procedures
- Location map
- Plastic bags (re-sealable)
- Water level probe
- Deionized water
- Logbook
- Boring log sheets

- Drums for containment of cuttings and decontamination water

2.3 INSTRUMENT CALIBRATION

Before going into the field, the sampler should verify that field instruments are operating properly. Calibration times and readings should be recorded in a notebook to be kept by the field sampler. Specific instructions for calibrating the instruments are provided in the respective SOPs.

2.4 INSPECTION OF EQUIPMENT

Direct push equipment should be inspected for operational readiness prior to use in accordance with the manufacturer's recommendations, and for signs of fluid leakage, which could introduce contaminants to the soil. If, at any time during equipment operation, fluid is observed leaking from the rig, operations should cease and the leak immediately repaired or contained. All soil and other materials affected by the leak will be collected, containerized and labeled for proper disposal (see SOP I-A-7, *IDW Management*).

2.5 PREPARATION OF WORK SITE

Prior to field mobilization, the contracted, licensed well driller shall notify the appropriate state agency and obtain a "Start Card" for each location (if required). Installation-specific dig permits and outage requests may also be required. These shall be prepared by the NAVFAC NW contractor and provided to the installation public works department for processing.

The work site should be inspected prior to commencing operations to ensure that no overhead hazards exist that could impact the direct push equipment. In addition, locations planned for subsurface exploration should be cleared of utilities prior to initiation of work in accordance with SOP I-A-6 *Permit and Utility Clearance.* Hand excavation may be required in areas of dense utility corridors.

If the work is to be performed on a grade, the direct push rig should be located so that it is down-slope from the penetration point. The rig should be located downwind or crosswind of the penetration point, if possible. Required exclusion zones and decontamination areas should be established using plastic tape or cones to designate the various areas, in accordance with the site-specific HASP. If needed, traffic control should be established with the site-specific traffic control plan or outage permit.

2.6 EQUIPMENT DECONTAMINATION

To avoid cross-contamination, all equipment used for direct push exploration and sampling should be thoroughly decontaminated as described in SOP III-I, *Equipment Decontamination*. All sampling tools and down hole equipment must be decontaminated between each sampling event and if necessary between penetration points. At a minimum, equipment must be steam cleaned or undergo the wash and rinse process. All wash and rinse water should be collected, containerized and labeled for proper disposal. Clean equipment (e.g., drive rods and samplers) should not come into contact with contaminated soils or other contaminated materials.

2.7 SOIL SAMPLING

Vendors of direct push equipment offer a variety of sampling systems designed specifically for their equipment. Both continuous and discreet soil samples may be obtained using sampling equipment similar to that described in SOP I-B-1, *Soil Sampling*. The preferred methods for soil

sampling using direct push techniques use stainless steel tube samplers with polyethylene terephthlate glycol (PETG) liners that are driven through the horizon to be sampled. Several sizes of core samplers are available, the most common being either 2 or 4-feet long. Liners can either be capped and sent directly to a laboratory, or cut open for field screening and grab sample (jar) collection.

2.8 GROUNDWATER SAMPLING

Direct push technologies offer numerous methods for obtaining groundwater samples. Depth-specific groundwater samples can be collected using a disposable-point, retractable screen mechanism that enables the collection of a one-time groundwater sample. Alternatively, "mini" wells can be installed using pre-pack screens or constructed as small diameter, traditional monitoring wells for longer term, repeatable sampling. Respective state regulations shall be consulted prior to installing "mini" wells because a construction variance is often required. It is the responsibility of the Project Manager to evaluate and determine the appropriateness of direct push systems prior to committing to their use on any project involving groundwater sampling. New technologies are developed every several years and vendors should be consulted to determine if newer technologies are available which will provide quality performance. Unless specified in the field sampling plan, low-flow purging is generally not performed for samples collected using direct push techniques. The procedures described below are the accepted industry standard for the collection of groundwater samples using direct push sampling devices. In circumstances where contaminants of concern may be biased due to higher turbidity readings (inorganics), purging the groundwater sampler until the water is relatively clear may result in less biased readings. This determination should be made during project planning.

2.8.1 Manual Pumping

The following procedures describe direct-push groundwater sample collection using manual pumping to extract groundwater samples.

1. Attach the retractable sampling screen to the bottom of a steel rod. Push the rod below ground surface with a hydraulic lever attached to the truck. Connect rods together to reach the predetermined depth.
2. When the depth is reached, remove the plug at the top of the screen and lift the push rod string back approximately 4 feet to expose the sampling screen. Install a ball check valve at the bottom of the LDPE tubing and insert the tubing (check valve first) into the push rod string. Insert the tubing to the bottom of the push rod string. Lift the tubing up and down by hand to bring water to the surface. Purge a small amount of water (< 1 liter) prior to sample collection.
3. Transfer the sample to the laboratory sample containers.

2.8.2 Peristaltic Pumping

Follow the same procedures as described for manual pumping. Attach the LDPE tubing to the peristaltic pump and operate the pump to retrieve a sample. A tubing check valve is not required for this method.

2.9 BOREHOLE ABANDONMENT

Methods for abandoning boreholes created with direct push systems will vary among vendors. The desired method for abandonment must be coordinated with the vendor in the planning stages

of the project to ensure that proper abandonment will be achieved. All abandonment activities must conform to applicable state regulations.

Some direct push boreholes will close naturally as the drive rods and sampling tools are withdrawn. This may occur in loose, unconsolidated soils, such as sands. However, all boreholes should be closed using one of the procedures described in this SOP, unless natural caving precludes such closure.

The three methods for closing direct push boreholes are

1. Adding granulated or pelletized bentonite and hydrating in layers, proceeding from the bottom of the hole to the surface.
2. Pouring a grout mixture into the hole.
3. Filling the entire hole with granular or pelletized bentonite and hydrating by means of a previously emplaced water tube that is gradually withdrawn as water is supplied to the bentonite.

The first method is recommended in shallow borings. The second method is recommended at deeper borings or where groundwater has been encountered. When grouting, a tremie pipe should be used to ensure that the grout mix is emplaced from the bottom to the top of the borehole. The tremie pipe should be lowered to within 2 inches of the bottom and gradually withdrawn as grout is added, keeping the lower end of the pipe submerged in grout at all times.

Bentonite grout is preferred when abandoning borings. If cement grout is used, the recommended grout mixture for well abandonment is 7 to 9 gallons of water per 94-pound bag of Portland cement, with 3% to 5% by weight of powdered bentonite added to the mixture. Commercial grout products are recommended to achieve the correct proportions.

Boreholes should be sealed to within 0.5 to 2.0 feet of the surface. The abandoned borehole should be inspected after 24 hours to ensure that shrinkage of the grout does not occur. If significant shrinkage has occurred, the borehole should be re-grouted. The remaining portion of the hole can be filled with local topsoil, or appropriate paving materials.

3.0 DOCUMENTATION

Soil classification information, sample information and all other pertinent information collected during soil sampling should be documented into the field logbook with indelible ink in accordance with SOP III-D, *Logbooks*. A borehole log form (or equivalent) (see SOP I-B-1, *Soil Sampling*) may be filled out in addition to the field logbook. Copies of this information should be sent to the Project Manager and to the project files.

4.0 REFERENCES

SOP I-A-7, *IDW Management*
SOP I-B-1, *Soil Sampling*
SOP III-D *Logbooks*
SOP III-I, *Equipment Decontamination*

5.0 ATTACHMENTS

None.

GPS SURVEYING

1.0 PURPOSE

This standard operating procedure (SOP) sets forth the protocols for recording and processing Global Positioning System (GPS) data. This document describes GPS data management for field data collection referencing Trimble systems including Pro 6T/6H, GeoXH 6000, Geo 7x or other handheld units capable of obtaining sub-meter accuracy.

2.0 PROCEDURE

2.1 PROCESS OVERVIEW

Surveyors typically collect GPS data using a data logger and record data both manually and electronically. In addition to the field forms and electronic field data, each surveyor maintains field notebooks summarizing their observations and other pertinent field data. The electronic data is exported electronically from the device, post-processed (if applicable), and then imported into GIS or CAD software.

In many areas of the U.S., GPS data can be recorded in real-time using the Coast Guard Differential GPS beacon system, Omnistar® or other satellite service. However, random positional errors can be encountered when collecting real-time data that makes positional validation difficult. Therefore, it is important to post-process all GPS data if corrections are not applied in real-time. Post-processing removes the random drift of the GPS positional signal by correcting the field rover GPS unit against a GPS base station that has a known position. Most projects will use CORS (Continuously Operated Reference Station) base stations surveyed by the NGS (National Geodetic Survey) to provide the post-processing solutions. This is an accepted industry standard. Using Trimble GPS rover units corrected against CORS base stations should allow projects to achieve sub-meter positional accuracy.

2.2 FIELD DATA COLLECTION

The GPS equipment is portable and uses satellite technology to provide accurate location information. Each object or *feature* collected with a GPS data collector can be one of three shapes: a *point*, a *line*, or an *area / polygon*. Each feature has real-world coordinates, as well as descriptive information or *attributes* such as site name or type, or observations recorded. The location and attribute information gained from the GPS data collection effort can be integrated with existing base data.

Preparatory tasks completed prior to the start of GPS data collection and field work include preparation and loading of “waypoints” to GPS units for field navigation, development of a data dictionary / data structures or interactive data collection forms for collecting survey information, and unit configuration to ensure that only good quality GPS data is recorded.

2.2.1 GPS Operation

Data dictionaries / structures, electronic forms, GIS MXD files and base layer data can be loaded onto the GPS devices. These electronic files facilitate collection of field measurements directly into the GPS device. They also serve to standardize the data collection effort, verify proper data

recording, and ensure that all required data fields are present. This approach also reduces the amount of equipment surveyors will need to carry when they are collecting their measurements.

2.2.2 GPS Accuracy

The accuracy of GPS receivers without real-time or post-processed differential correction is on the order of 100 meters / 330 feet (2dRMS). After differential correction, the horizontal accuracy of each position can be better than 50 cm / 1.6 feet (RMS) + 1 ppm times the distance between the base and rover. The vertical accuracy of each position can be sub-meter + 2 ppm times the distance between the base and rover. Using real-time corrections, the accuracy of each position can be as good as a submeter, but is subject to a number of operational conditions. Note: 2dRMS means that approximately 95% of the positions are within the specified value. RMS means that approximately 68% of the positions are within the specified value.

2.2.3 Increasing GPS Accuracy

To verify the positional accuracy of a survey, standard survey practice requires that a known control be recorded during a survey. At a minimum, one first-order NGS monument (or equivalent) must be recorded during the GPS survey for each day of the survey. Therefore, during post-processing, general errors in the base or rover GPS units may be revealed. However, in recording only one monument, there is no way of fixing the error (only in knowing that error exists). Ideally, three first-order NGS control points completely surrounding the survey area should be recorded during the survey day – ideally one at the start of the survey, and two at the end of the day. This will allow a Professional Land Surveyor (PLS)/GIS post-processor to be able to shift and rotate the data if serious positional errors are found with all three control points.

2.2.4 Field Data Recording

To ensure that only quality data is recorded, the following data collection settings are recommended for the GPS unit:

Number of Satellites: Over-determined 3D (>=5 satellites)
PDOP Mask: 6
SNR: 6
Elevation Mask: 15 degrees

2.2.5 Naming the Data Logger Files

File naming conventions should be developed for all electronic field data. The file name should include information about the field surveyor / crew, date stamp for when the data was collected, and a unique identifier for the file if more than one file is collected throughout the day. It is recommended that the user save data several times throughout the day in the rare case that a data file becomes corrupt. An example file naming convention is shown in the following example:

Field Data File: JGB_20140607_A
JGB: First, second, and third characters represent initials of GPS operator or field crew
20140607: YYYYMMDD
A: Eighth character represents a unique character if more than one file is collected in the day.

2.2.6 Base Station Data Processing

The field staff and the PLS/GIS specialist should review GPS data for attribute correctness. Then, the PLS/GIS specialist should post-processes the data. In the post-processing, the

uncontrolled drift of the measurements recorded in the rover GPS units are corrected against the known drift recorded in the base station GPS units using Trimble Positions (or equivalent / most current) software. The .SSF file created by the GPS device is corrected by use of the base station data. The correction process converts the raw data file (.SSF) to a corrected file (.COR). In addition to post-processing to only one base station, the data can be post-processed to several base stations to give the data more positional accuracy. After post-processing, the data is converted to an ESRI file geodatabase or point file (.csv/.txt) for import to GIS or CAD software.

2.2.7 Field Staff Spatial/Attribute Review

After each survey, all field data should be reviewed by a field crew member for accuracy and completeness. This can be done during or after the post-processing as this review is performed only to ensure that the field crew assigned the proper attribute data to the file. Any incomplete data can be filled-in by referencing the field notes. Field staff compares the number of data points collected in the GPS device file to the number of data points listed on the field forms to make sure they match. During this step, the field crew checks to see that all of the data in the data file is accounted for.

2.2.8 PLS/GIS Specialist Post-Processing

For Trimble GPS units, Positions software is used to download the electronic file to review the source file content, and post-process the data. The post-processor reviews the data file to check the settings the GPS data was collected under by the field crew. This process ensures the field crew used the proper GPS configuration settings while collecting the data. Thereafter, the data is post-processed against a base station. Ideally, it is post-processed against a 5-second base station within close proximity to the survey site. The referenced Trimble GPS units should be able to achieve a horizontal accuracy of 50 cm / 1.6 feet (RMS) at a 1 km base line (distance from the base to the rover). Accuracy degrades by 1 ppm as the distance between the base station and the rover increases. For example, 1 mm of degradation occurs for every kilometer between the base and rover. Data must be captured within 500 km (310 miles) of the base station to obtain sub-meter accuracy (RMS). If a 5-second base is not available, a thirty-second base is acceptable as long as the rover GPS units are recording each position for a minimum of one minute. This process ensures both the rover and the base records a minimum of one epoch per location. Recorded time that is less than this amount causes the position to be interpolated by the software, decreasing its accuracy.

Every 100 km (62 miles) in distance between the rover and base adds 0.1 m (0.33 feet) to the positional accuracy. Therefore, it is best to use a base that is very close to the survey site.

To help guarantee sub-meter results at the 95% (2dRMS) level, three NGS control points can be surveyed as stated above in the “Increasing GPS Accuracy” section. Therefore, if the three NGS control points show corrected horizontal accuracy of 0.2 (0.66 feet) , 0.4 (1.31 feet), and 0.6 meters (2.0 feet) respectively, it can be determined that the average of those values reflects the relative GPS survey accuracy for that day, i.e. 0.4 meters (1.31 feet).

In addition, the GPS field survey positions can be post-processed against several base stations in a short amount of additional time. It also allows the PLS/GIS Specialist to verify the positional accuracy of the GPS data by computing average and standard deviation values for the field survey positions in relation to more than one base. Thus, ensuring there are no errors in the base correction.

The post-processing methods, GPS configuration settings, and GPS collection methods should be recorded in metadata documentation defending the stated accuracy of the GPS survey.

2.2.9 GIS File Production

After the geographic and attribute data has been reviewed, and the file has been post-processed, the data is exported to an ESRI file geodatabase or shapefile format for use in a GIS. A shapefile should only be used if a CAD platform is anticipated for map production. Alternatively, the data may also be exported in a simple ASCII point file (.csv or .txt) with delimiters separating attributes.

3.0 DOCUMENTATION

Surveyors shall record field notes daily using industry accepted practices. The data shall also be neat, legible and easily reproducible. Copies of the surveyor's field notes and calculation forms generated during the work shall be transferred to the Navy.
Surveyor's field notes / documentation shall, at a minimum, clearly indicate:

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

Drawings and calculations submitted by the surveyor shall be signed, sealed and certified by a Professional Land Surveyor (PLS) registered in the state or territory in which the work was done. Dated records of land surveying equipment calibration and equipment serial numbers shall also be provided in the in the submitted documentation.

4.0 REFERENCES

The detailed requirements in the Geographic Data, Survey Specifications subsection of the parent compendium (NAVFAC Northwest SOPs V5.0) also apply and are not repeated here in this field procedure. These should be consulted as part of any GPS Surveying effort. In addition, NAVFAC Northwest Cadastral Team, Record of Survey or other requirements may apply to the project, an example of their requirements can be found with the Survey Specifications referenced above.

5.0 ATTACHMENTS

None.

DVP 1- DATA VALIDATION REPORTS

1.0 PURPOSE

This procedure describes the presentation format and information provided in the data validation reports for U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) activities. Data validation will be performed in accordance with the requirements of the Project Specific Sampling and Analysis Plan (SAP) or Quality Assurance Project Plan (QAPP), the latest available version of the Department of Defense (DoD) and Department of Energy (DOE) Consolidated Quality Systems Manual for Environmental Laboratories (DoD QSM), the latest available version of the United States Environmental Protection Agency (USEPA) CLP National Functional Guidelines for Superfund Organic and Inorganic Methods Data Review, any applicable state or local guidelines, and analytical method and/or laboratory specific requirements. The objective of data validation is to provide data of known quality to the end user. This procedure also establishes the method by which a Project Manager selects and confirms the content of data validation reports.

2.0 PROCEDURE

2.1 INTRODUCTION

Based on the data validation procedures established in the Task Order SAP/QAPP and applicable Navy Standard Operating Procedures for Data Validation, the analytical data will be validated under the appropriate NAVFAC NW QA/QC levels of "III" or "IV". This procedure will establish the required format and content of the validation report.

2.1.1 Data Validation Questionnaire

The Project Manager shall submit to the validators a completed Data Validation Questionnaire (Attachment II-A-3) that outlines the required content of the validation report. The questionnaire should also specify the anticipated number of samples, required analyses, level of validation, whether or not the Overall Data Assessment Summary is to be provided by data validation personnel, and other information required. The questionnaire should be submitted 2 months prior to sampling or as soon as required information can be accurately estimated.

2.1.2 Confirmation of Data Validation Reports

Prior to shipment of all completed data validation reports to the Project Manager, a single draft report for one sample delivery group (SDG) should be submitted. The Project Manager shall review the draft report to confirm that the report contains the requested information, and respond to the Data Validation Project Manager in a timely manner. Once the requested contents are confirmed, the complete data validation packages should be delivered to the Project Manager.

2.2 CONTENT AND FORMAT OF THE DATA VALIDATION REPORT

The data validation report will consist of the following four major components:

1. Cover letter

2. Data validation reference package comprising:
   a) Cover page
   b) Acronyms and abbreviations list
   c) Data qualifier reference table
   d) Qualification code reference table
3. Individual data validation reports by sample delivery group (SDG):
   a) Cover page
   b) Introduction
   c) Data validation findings
   d) Appendix of laboratory reports with applied data qualifiers

A discussion of the contents and format of these components is provided in the following sections.

2.2.1 Cover Letter

The cover letter will contain the generation date of the cover letter, the address of the Task Order office, the Task Order number, and the Project Manager's name or designee. The cover letter will list the specific reports being sent under that cover letter. A senior data reviewer must review the report and sign the cover letter to denote approval. Attachment II-A-4 is an example of the cover letter.

2.2.2 Data Validation Reference Package

One data validation reference package shall be provided per Task Order and shall contain the reference information needed for interpretation of the individual data validation reports. The following sections shall be included:

2.2.2.1 Cover Page

The cover page shall indicate the Task Order title and number to which the reference package applies.

2.2.2.2 Acronyms and Abbreviations List

This list shall present all acronyms and abbreviations used in the individual data validation reports. Attachment II-A-1 is an example of the acronyms and abbreviations list.

2.2.2.3 Data Qualifier Reference Table

Data qualifiers are applied in cases where the data do not meet the required QC criteria or where special consideration by the data user is required.
The data qualifier reference table lists the data qualifiers used in the validation of the analytical data. Attachment II-A-5 is an example of this table. The definitions presented in this table are the most recent EPA definitions.

2.2.2.4 Qualification Code Reference Table

Qualification codes explain why data qualifiers have been applied and identify possible limitations of data use. Attachment II-A-6 is an example of the qualification code reference table. Qualification codes are to be provided by data validation personnel on the annotated laboratory reports discussed in Section 2.2.

2.2.3 Individual Data Validation Reports by SDG

For all analyses, each SDG shall have a unique data validation report. The procedures used to generate the reports are discussed in the following sub-sections.

2.2.3.1 Cover Page

The cover page shall indicate the Task Order title and number, analysis type, and the SDG(s), which the report addresses.

2.2.3.2 Introduction

This section will contain a brief description of the Task Order information that is pertinent to data validation. This information includes the Task Order title and number, Project Manager, the sample matrices and analyses performed on the samples, the NAVFAC NW QC level for the project, and a brief discussion of the methodologies used for data validation. This section will also contain a Sample Identification Table, which lists the identification of each Task Order sample cross-referenced with its associated internal laboratory identification number and EPA sample identification number. Each sample will be listed under every analytical method for which data was validated. Attachment II-A-7 is an example of the sample identification table.

2.2.3.3 Data Validation Findings

This section shall present the data validation findings of the data reviewer for the Task Order data package. The findings shall be determined on the basis of validation criteria established for each analytical method in the Task Order QAPP and Navy DVP II-B through DVP II-T. For NAVFAC NW QA/QC levels "III" and "IV," the data validation findings are divided into the following analytical categories:

- Volatile organics by GC/MS (EPA CLP Method and EPA Method 8260)*
- Semi-volatile organics by GC/MS (EPA CLP Method and EPA Method 8270)*
- Organochlorine pesticides/PCBs by gas chromatography (GC) (EPA CLP Method and EPA Method 8081/8082)*
- Metals and cyanide (EPA Method series 6000/7000/9000)*
- Organic analyses by GC (EPA Methods: 8015, 8021, 8041, 8141, 8151, 504.1, and 619)*
- Organic analyses by HPLC (EPA Methods 632, 8310 and 8330)*
- Inorganic analyses by wet chemistry methods (EPA Methods 1664, 9020 and 9060)*

*Other methods may be included with approval of the Task Order and Data Validation Managers.

For cases where a Summary Forms Validation will be performed, the data validation findings are divided into the following analytical categories:

- Volatile and semi-volatile organics by GC/MS, organochlorine pesticide/PCBs by GC, and other organic analyses by GC and HPLC
- Metals, cyanide, petroleum hydrocarbons by IR, and other inorganic analyses

2.2.4 NAVFAC NW QA/QC Levels "III" and "IV" Data Validation

Data obtained using any analytical methods in the above categories will be validated in terms of meeting criteria for specific QA/QC factors such as holding times, instrument calibration, and blank analyses. A separate discussion of each QA/QC factor under each analytical method will

be presented in the Task Order data validation report. The QA/QC factors used to validate data for NAVFAC NW QA/QC levels "III" and "IV" are presented below for each analytical category.

2.2.4.1 Volatile Organics by GC/MS

1. Sample management (1.1 sample preservation, handling, and transport, 1.2 chain-of-custody, 1.3 holding times)
2. GC/MS tuning
3. Calibration (3.1 initial calibration and 3.2 continuing calibration)
4. Blanks
5. Blank spikes and laboratory control samples (LCS)
6. System monitoring compounds
7. Matrix spike/matrix spike duplicate
8. Field QC samples (8.1 trip blanks, 8.2 equipment rinsates and field blanks, 8.3 field duplicates)
9. Internal standards performance
10. Target Compound identification (Level "IV" only*)
11. Compound quantitation and contract required quantitation limits (CRQLs)(Level "IV" only*)
12. Tentatively identified compounds (Level "IV" only*)
13. System performance (Level "IV" only*)

2.2.4.2 Semi-volatile Organics by GC/MS

1. Sample management (1.1 sample preservation, handling, and transport; 1.2 chain-of-custody; 1.3 holding times)
2. GC/MS tuning
3. Calibration (3.1 initial calibration and 3.2 continuing calibration)
4. Blanks
5. Blank spikes and laboratory control samples
6. System monitoring compounds
7. Matrix spike/matrix spike duplicate
8. Field QC samples (8.1 equipment rinsates and field blanks, 8.2 field duplicates)
9. Internal standards performance
10. Target Compound identification (Level "IV" only*)
11. Compound quantitation and reported contract required quantitation limits (CRQLs)(Level "IV" only*)
12. Tentatively identified compounds (Level "IV" only*)
13. System performance (Level "IV" only*)

2.2.4.3 Organochlorine Pesticides/PCBs by GC

1. Sample management (1.1 sample preservation, handling, and transport; 1.2 chain-of-custody; 1.3 holding times)
2. Pesticides instrument performance (2.1 resolution check, 2.2 retention time evaluation, 2.3 4,4'-DDT/Endrin breakdown evaluation)
3. Calibration (3.1 analytical sequence, 3.2 initial calibration, 3.3 continuing calibration)
4. Blanks (4.1 instrument blanks [where applicable], 4.2 method blanks)

5. Blank spikes and laboratory control samples
6. Surrogate recovery
7. Matrix spike/matrix spike duplicates
8. Sample cleanup performance
9. Field QC samples (9.1 equipment rinsates and field blanks, 9.2 duplicates)
10. Compound identification (Level "IV" only*)
11. Compound quantitation and reported contract required quantitation limits (CRQLs) (Level "IV" only*)

2.2.4.4 Metals and Cyanide

1. Sample management (1.1 sample preservation, handling, and transport; 1.2 chain-of-custody; 1.3 holding times)
2. Calibration (initial and continuing)
3. Blanks (3.1 Calibration blanks and 3.2 Method blanks (preparation))
4. ICP interference check sample
5. Blank spikes and LCSs
6. Duplicates
7. Matrix spike
8. Furnace atomic absorption QC
9. ICP serial dilution
10. Sample result verification (Level "IV" only*)
11. Field QC samples (11.1 equipment rinsates and field blanks, 11.2 field duplicates)

2.2.4.5 Organic Analyses by GC (QA/QC factors may vary depending on analysis type)

1. Sample management (1.1 sample preservation, handling, and transport; 1.2 chain-of-custody; 1.3 holding times)
2. Instrument performance
3. Calibration (initial and continuing)
4. Blanks
5. Blank spikes and laboratory control samples
6. Surrogate recovery
7. Matrix spike/matrix spike duplicates
8. Field QC samples (8.1 equipment rinsates; 8.2 field blanks; 8.3 duplicates)
9. Target compound identification (Level "IV" only*)
10. Compound quantitation and reported detection limits (Level "IV" only*)

2.2.4.6 Organic Analyses by HPLC (QA/QC factors may vary depending on analysis type)

1. Sample management (1.1 sample preservation, handling, and transport; 1.2 chain-of-custody; 1.3 holding times)
2. Instrument performance
3. Calibration (initial and continuing)
4. Blanks
5. Blank spikes and laboratory control samples
6. Surrogate recovery
7. Matrix spike/matrix spike duplicates

8. Field QC samples (8.1 equipment rinsates; 8.2 field blanks; 8.3 duplicates)
9. Target compound identification (Level "IV" only*)
10. Compound quantitation and reported detection limits (Level "IV" only*)

2.2.4.7 Inorganic Analyses by Wet Chemical Methods, Total Recoverable Petroleum Hydrocarbons, Total Organic Halides, Total Organic Carbon (QA/QC factors may vary depending on analysis type)

1. Sample management (sample preservation, handling, and transport; chain-of-custody; and holding times)
2. Calibration (initial and continuing)
3. Blanks
4. Blank spikes and laboratory control samples
5. Laboratory duplicates
6. Matrix spike
7. Sample result verification (Level "IV" only*)
8. Field QC samples (8.1 equipment rinsates; 8.2 field blanks; 8.3 duplicates)

* Sections applicable to Level "IV" only will also appear in Level "III" reports with the notation "not applicable at Level III."

2.2.5 Summary Forms Data Validation

Data that will be subjected to a Summary Forms Validation will be evaluated in terms of meeting criteria for specific QA/QC factors such as holding times, blank spike analyses, and blank analyses. A separate discussion of each QA/QC factor under each analytical method will be presented in the CTO data validation report. The QA/QC elements evaluated in a Summary Forms Validation are presented below.

1. Completeness (correct analytes, Data Quality Objectives (DQOs) or target/action levels met, results correlate with historic data)
2. Sample management (sample preservation, handling, and transport; chain-of-custody; and holding times)
3. Method and reporting limits (within scope of DQQs)
4. Dilution Factors/concentration units
5. Preparation/analysis methods
6. Blanks
7. Blank spikes and laboratory control samples
8. Field QC samples (trip blanks, equipment rinsates, field blanks, and duplicates)
9. Surrogates (organics)
10. Matrix Spikes /Matrix Spike Duplicates(organics)/Laboratory Duplicates (inorganics)
11. ICP Serial Dilutions (metals)

2.2.6 Laboratory Reports

Annotated laboratory reports with the appropriate data qualifiers and qualification codes as specified in the NAVFAC NW Installation Restoration Program (IRP) data validation procedures will be submitted as an appendix to the data validation report. An example is provided as Attachment II-A-8.

3.0 DOCUMENTATION

Copies of all documents generated by data validation personnel will be stored for no less than 10 years.

4.0 REFERENCES

USEPA. 2007. Contract Laboratory Program Statement of Work for Organic Analysis Multi-Media, Multi-Concentration (SOM01.2) August.

USEPA. 2008. Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (SOM01.2). June.

USEPA. 2010a. Contract Laboratory Program Statement of Work for Inorganic Superfund Methods, Multi-Media, Multi-Concentration (ISM01.2) January.

USEPA. 2010b. Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (ISM01.2) January.

USEPA. 2011. Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review. September.

USEPA. 2014a. National Functional Guidelines for Superfund Organic Methods Data Review (SOM02.2). June.

USEPA. 2014b. Contract Laboratory Program Statement of Work for Inorganic Superfund Methods, Multi-Media, Multi-Concentration (ISM02.2) August.

USEPA. 2014c. Contract Laboratory Program Statement of Work for Organic Superfund Methods, Multi-Media, Multi-Concentration (SOM02.2) August.

USEPA. 2014d. National Functional Guidelines for Inorganic Superfund Data Review (ISM02.2). August.

5.0 ATTACHMENTS

Attachment II-A-1 Acronyms and Abbreviations
Attachment II-A-2 Definition of Terms
Attachment II-A-3 Data Validation Questionnaire
Attachment II-A-4 Sample Cover Letter
Attachment II-A-5 Data Qualifier Reference Table
Attachment II-A-6 Qualification Code Reference Table
Attachment II-A-7 Sample Identification Table
Attachment II-A-8 Example Annotated Laboratory Report

Attachment II-A-1
Acronyms and Abbreviations

Following is a list of acronyms and abbreviations that may be used in NAVFAC NW IRP data validation reports.

%D	percent difference
%R	percent recovery
µg/L	micrograms per liter
AA	atomic absorption
ARRF	average relative response factor
BFB	bromofluorobenzene
BNA	base/neutral/acid compounds
CCB	continuing calibration blank
CCC	calibration check compound
CCS	continuing calibration standard
CCV	continuing calibration verification
CF	calibration factor
CLP	Contract Laboratory Program
COC	chain of custody record
CRA	contract required standard at the CRDL for graphite furnace AA method
CRDL	contract required detection limit
CRI	contract required standard at the CRDL for ICP method
CRQL	contract required quantitation limit
CTO	contract task order
CV	coefficient of variation
CVAA	cold vapor atomic absorption
DCB	decachlorobiphenyl
4,4'-DDD	4,4'-dichlorodiphenyldichloroethane
4,4'-DDE	4,4'-dichlorodiphenyldichloroethylene
4,4'-DDT	4,4'-dichlorodiphenyltrichloroethane
DFTPP	decafluorotriphenylphosphine
DQO	data quality objective
EICP	extracted ion current profile
EMSL/LV	Environmental Monitoring System Laboratory/Las Vegas
EPA	U.S. Environmental Protection Agency
ER	equipment rinsate
FB	field blank
GC	gas chromatography
GC/ECD	gas chromatography/electron capture detector
GC/ELCD	gas chromatography/electrolytic conductivity detector (Hall detector)
GC/FPD	gas chromatography/flame photometric detector
GC/PID	gas chromatography/photoionization detector
GC/MS	gas chromatography/mass spectrometry
GFAA	graphite furnace atomic absorption
GPC	gel permeation chromatography
Hg	mercury
HPLC	high-performance liquid chromatography
HT	holding time
ICB	initial calibration blank
ICP	inductively coupled plasma
ICS	interference check sample
ICV	initial calibration verification
IDL	instrument detection limit
IR	infrared spectroscopy
IRDA	inorganic regional data assessment
IRP	installation restoration program
IS	internal standards
LCS	laboratory control sample
MDL	method detection limit
mg/Kg	milligrams per kilogram
MS	matrix spike
MSA	method of standard addition
MSD	matrix spike duplicate
m/z	mass to charge ratio

NEESA	Naval Energy and Environmental Support Activity
NAVFAC NW	Naval Facilities Engineering Command Northwest
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PE	performance evaluation
PEM	performance evaluation mixture
PNA	polynuclear aromatic hydrocarbon
PQL	practical quantitation limit
QA	quality assurance
QAC	quality assurance coordinator
QAPP	quality assurance project plan
QC	quality control
RDL	required detection limit
RF	response factor
RIC	reconstructed ion chromatogram
RPD	relative percent difference
RRF	relative response factor
RRT	relative retention time
RSD	relative standard deviation
RSCC	regional sample control center
RT	retention time
SDG	sample delivery group
SOP	standard operating procedure
SOW	statement of work
SVOC	semi-volatile organic compound
SPCC	system performance check compound
SRM	standard reference material
TB	trip blank
TCX	tetrachloro-m-xylene
TIC	tentatively identified compound
UV/VIS	ultraviolet/visible
VOA	volatile organic analysis
VOC	volatile organic compound
VTSR	validated time of sample receipt

Attachment II-A-2
Definition of Terms

Calibration Curve	– A plot of response versus concentration of standards.
CCB	– Continuing Calibration Blank – a deionized water sample run every 10 samples designed to detect any carryover contamination.
CCV	– Continuing Calibration Verification – a standard run every 10 samples to test instrument performance.
Field Blank	– Field blanks are intended to identify contaminants that may have been introduced in the field through source water.
Field Duplicate	– A duplicate sample generated in the field, not in the laboratory.
Findings	– Any out-of-control, unacceptable, or out of criteria event which may impact the quality of the data or require corrective action.
GPC	– Gel Permeation Chromatography – A sample clean-up technique that separates compounds by size and molecular weight. Generally used to remove oily materials from sample extracts.
Holding Time	– The time from sample collection to sample analysis.
ICB	– Initial Calibration Blank – the first blank standard run to confirm the calibration curve.
ICV	– Initial Calibration Verification – the first standard run to confirm the calibration curve.
Initial Calibration	– The establishment of a calibration curve with the appropriate number of standards and concentration range. The calibration curve plots instrument response versus concentration of standards.
IR	– Infrared Spectroscopy.
IS	– Internal Standards – compounds added to every VOA and BNA standard, blank, matrix spike duplicate, and sample extract at a known concentration, prior to instrumental analysis. Internal standards are used as the basis for quantitation of the target compounds.
MS	– Matrix Spike – introduction of a known concentration of analyte into a sample to provide information about the effect of the sample matrix on the digestion and measurement methodology.
m/z	– The ratio of mass (m) to charge (z) of ions measured by GC/MS.
Post Digestion Spike	– The addition of a known amount of standard after digestion. (Also identified as analytical spike or spike for furnace analysis).
Primary Analysis	– One of two types of pesticide/PCB analysis by GC/EC techniques, the other being confirmation analysis. The primary analysis is used to establish the tentative identification of any pesticides/PCBs detected. The identification is confirmed in the confirmation analysis. If the two analyses are done simultaneously, either may be considered the primary analysis. Either may be used for quantitation if contract criteria are met.
QA	– Quality Assurance – total program for assuring the reliability of data.
QC	– Quality Control – routine application of procedures for controlling the monitoring process.
RPD	– Relative Percent Difference (between matrix spike and matrix spike duplicate, duplicate laboratory control samples, or blank spikes)

Serial Dilution – A sample analyzed at a specific dilution to determine whether any significant chemical or physical interferences exist due to sample matrix effects (ICP only).

SDG – Sample Delivery Group – defined by one of the following, whichever occurs first:

- Case of field samples
- Each 20 field samples within a case
- Each 14-day calendar period during which field samples in a case are received, beginning with receipt of the first sample in the SDG (for VOA contracts, the calendar period is 7 days).

Attachment II-A-3
Data Validation Questionnaire

	U.S. NAVY **DATA VALIDATION QUESTIONNAIRE**

INSTRUCTIONS

Please complete this form, to the extent possible, and return to the Data Validation Coordinator within two months prior to the initiation of sampling or as soon as needed information can be accurately estimated. Upon receipt of a completed form, a cost estimate will be prepared and forwarded to the appropriate CTO manager, normally within one week. If changes in numbers of samples, required analyses, level of validation, or other information provided on this form occur, please fax or call Denver with this new information as soon as possible. Please note under comments if available information is too preliminary to warrant preparing a cost estimate at this time.

CTO NUMBER:	CTO TITLE:		
CTO MANAGER/CTO DATA VALIDATION CONTACT:		OGDEN OFFICE:	TELEPHONE: _____ FACSIMILE: _____
SAMPLING START DATE:	SAMPLING COMPLETION DATE:	CLIENT REPORT DUE DATE:	REQUIRED VALIDATION COMPLETION DATE:
ANTICIPATED VALIDATION LEVEL (III OR IV) ANALYSES:	PERCENT OF SAMPLES TO BE VALIDATED:	LABORATORY(S) PERFORMING:	

Is the overall Data Assessment Summary for the CTO required? ☐ Yes ☐ No (this will approximately double word processing efforts)	NOTE: Will we receive data for validation as it is transmitted from the laboratory or all at once at the end of the project? For large projects, it may be advantageous to receive data as it is generated. If the turnaround time will be shorter than three (3) months.

DETAIL OF ANALYSES TO BE VALIDATED

ANALYSIS	METHOD	MATRIX	NUMBER OF SAMPLES	COMMENTS

COMMENTS

SD-002 10/13/92

Attachment II-A-4
Sample Cover Letter

(Date)
(CTO Manager or designee)
(company address)

Dear ( ):
Enclosed is Revision __ of the data validation reports for CTO (number) as follows:

Semi-volatiles	SDG S0221
	SDG S0350
Pesticides/PCBs	SDG S0201
Metals	SDG S0221
	SDG S0201

The specific sample identifications are listed in the Sample Identification Table(s). The data packages were reviewed according to the data validation procedures referenced in the introduction to each report.
Sincerely,

(Signature)
NAVFAC NW IRP Data Validation Project Manager

Attachment II-A-5
Data Qualifier Reference Table

Qualifier	Organics	Inorganics
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.	The associated value is an estimated quantity.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."	Not applicable.
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.	Not applicable.
UJ	The analyte was not deemed above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.	The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and to meet quality control criteria. The presence or absence of the analyte cannot be verified.	The data are unusable. (Note: Analyte may or may not be present).

Attachment II-A-6
Qualification Code Reference Table

Qualifier	Organics	Inorganics
H	Holding times were exceeded.	Holding times were exceeded.
S	Surrogate recovery was outside QC limits.	The sequence or number of standards used for the calibration was incorrect
C	Calibration %RSD or %D were noncompliant.	Correlation coefficient is <0.995.
R	Calibration RRF was <0.05.	%R for calibration is not within control limits.
B	Presumed contamination from preparation (method) blank.	Presumed contamination from preparation (method) or calibration blank.
L	Laboratory Blank Spike/Blank Spike Duplicate %R was not within control limits.	Laboratory Control Sample %R was not within control limits.
Q	MS/MSD recovery was poor or RPD high.	MS recovery was poor.
E	Not applicable.	Duplicates showed poor agreement.
I	Internal standard performance was unsatisfactory.	ICP ICS results were unsatisfactory.
A	Not applicable.	ICP Serial Dilution %D were not within control limits.
M	Tuning (BFB or DFTPP) was noncompliant.	Not applicable.
T	Presumed contamination from trip blank.	Not applicable.
+	False positive – reported compound was not present. Not applicable.	
-	False negative – compound was present but not reported.	Not applicable.
F	Presumed contamination from FB, or ER.	Presumed contamination from FB or ER.
$	Reported result or other information was incorrect.	Reported result or other information was incorrect.
?	TIC identity or reported retention time has been changed.	Not applicable.
D	The analysis with this flag should not be used because another more technically sound analysis is available.	The analysis with this flag should not be used because another more technically sound analysis is available.
P	Instrument performance for pesticides was poor.	Post Digestion Spike recovery was not within control limits.
*#	Unusual problems found with the data that have been described in Section 2.2.3.3, "Data Validation Findings." The number following the asterisk (*) will indicate the subsection where a description of the problem can be found.	Unusual problems found with the data that have been described in Section 2.2.3.3, "Data Validation Findings." The number following the asterisk (*) will indicate the subsection where a description of the problem can be found.

Attachment II-A-7
Sample Identification Table

Sample	Lab Identification	EPA Sample Identification	Matrix	Method
SD-ER	2720-1		water	
SD-FB-l	2720-2		water	
SD-FB-2	2720-3		water	
SD-l	2720-4		soil	
SD-lD	2720-5		soil	
SD-2	2720-6		soil	
SD-B1	2720-7		soil	
SD-B2	2720-8		soil	
SD-3	2720-9		soil	
SD-4	2720-10		soil	

Attachment II-A-8
Example Annotated Laboratory Report
Volatile Organics Analysis Data Sheet

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
HE784

Lab Name:Recra.LabNet.Phila Contract:06815-017-001-9999-00
Lab Code: RECRA Case No.: SAS No.: SDG No.: HE766
Matrix: (soil/water) WATER Lab Sample ID: 9706L197-007
Sample wt/vol: 25.00 (g/mL) ML Lab File ID: N070411
Level: (low/med) LOW Date Received: 06/27/97
% Moisture: not dec. _____ Date Analyzed: 07/04/97
GC Column: RTX-624 ID: 0.32 (mm) Dilution Factor: 1.0
Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q	REV Qual	DAI Code
74-87-3	Chloromethane	1	U	U	
74-83-9	Bromomethane	1	U	R	R
75-01-4	Vinyl Chloride	0.5	J	J	S
75-00-3	Chloroethane	1	U	U	
75-09-2	Methylene Chloride	2 ~~0.6~~	JB	UJ	B,C
67-64-1	Acetone	16	B	J	R,S
75-15-0	Carbon Disulfide	1	U	U	
75-35-4	1,1-Dichloroethene	1	U		
75-34-3	1,1-Dichloroethane	1	U		
156-60-5	trans-1,2-Dichloroethene	1	U		
67-66-3	Chloroform	1	U		
107-06-2	1,2-Dichloroethane	0.3	J	J	S
78-93-3	2-Butanone	5	U	U	
71-55-6	1,1,1-Trichloroethane	1	U		
56-23-5	Carbon Tetrachloride	1	U		
156-59-2	cis-1,2-Dichloroethene	14		J	S
75-27-4	Bromodichloromethane	1	U	U	
78-87-5	1,2-Dichloropropane	1	U		
10061-01-5	cis-1,3-Dichloropropene	1	U		
79-01-6	Trichloroethene	0.2	J	J	S
124-48-1	Dibromochloromethane	1	U	U	
79-00-5	1,1,2-Trichloroethane	1	U		
71-43-2	Benzene	0.6	J	J	S
10061-02-6	trans-1,3-Dichloropropene	1	U	U	
75-25-2	Bromoform	1	U		
108-10-1	4-Methyl-2-Pentanone	5	U		
591-78-6	2-Hexanone	5	U		
1330-20-7	Xylenes (Total)	9		J	S
127-18-4	Tetrachloroethene	1	U	U	
79-34-5	1,1,2,2-Tetrachloroethane	1	U		
108-88-3	Toluene	0.1	J	J	S
108-90-7	Chlorobenzene	1	U	U	
100-41-4	Ethylbenzene	0.6	J	J	S

FORM I VOA OGDEN VALIDATED 8/5/97 MAC-CLP-1

201

LOGBOOKS

1.0 PURPOSE

This standard operating procedure (SOP) describes the activities and responsibilities of U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) personnel and/or their contractors pertaining to the identification, use, and control of logbooks and associated field data records. This SOP establishes a standard format for recording field observations and describes the methods for use and maintenance of field logbooks.

2.0 PROCEDURE

2.1 EQUIPMENT

- Waterproof hardbound field logbook (typically 4-inch by 7-inch to 8-inch by 10.5-inch) with numbered pages
- Waterproof/indelible marking pen
- Ruler/straight edge
- Clipboard

2.2 LOGBOOK MAINTENANCE

Prior to commencement of field work, logbooks will be assigned to field personnel by the Project Manager. If personnel changes must be made during a project, the successor may use the same logbook. In this case, the logbook cover page will indicate all persons who have made entries and the dates. This may be inappropriate if there are a large number of people involved.
The logbook user is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The logbook user is also responsible for safeguard of the logbook while having custody of it.
Individuals performing specific tasks associated with a field project may keep a separate logbook; however, these logbooks must conform to this procedure and will become a permanent part of the central project file. The Project Manager is responsible for reviewing and signing all field logbooks associated with the project.

2.3 RECORDING FIELD ACTIVITIES

The field team provides a permanent record of daily activities, observations, and measurements through the use of a field logbook. All logbook entries will be made in indelible black or blue ink. No erasures are permitted. If an incorrect entry is made, the data will be crossed out with a single line and initialed and dated by the originator. Entries can be organized into easily understood tables if possible.
All logbook pages will be signed and dated at the bottom. Times will be recorded next to each entry. If a full page is not used during the course of a workday, a diagonal line will be drawn through the unused portion of the page and signed (in this case, it would not be necessary to sign the bottom of the page). If the project is completed and the logbook has not been completely

filled, a diagonal line will be drawn across the first blank page after the last entry, and "no further entries" written before the page is signed and dated.

Daily entries will be made during field activities by, at a minimum, one field team member to provide daily records of all significant events, observations, and measurements during field operations. Notes will start at the beginning of the first blank page and extend through as many pages as necessary. All page numbers will be consecutively numbered as the logbook is filled.

The inside cover page of each logbook will contain the following information:

- Book number
- Project name
- Contract number
- Project number
- Navy Activity/Installation
- Site name
- Start date
- End date
- Person to whom the logbook is assigned
- Agency/Company name
- Agency/Company address
- Agency/Company phone number

The field logbook serves as the primary record of field activities. When possible, the field book should be dedicated to a singular Navy Activity/Installation to facilitate long-term records archiving. Entries shall be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, names of all samples collected shall be included in the logbook even if recorded elsewhere.

All field descriptions and observations are entered into the logbook, as described in Attachment III-D-1.

Typical information to be entered includes, but is not limited to, the following:

- Date and time of all onsite activities
- Site location and description
- Weather conditions
- Field work documentation
- Descriptions of and rationale for approved deviations from the Work Plan or Field Sampling Plan
- Field instrumentation readings
- Personnel present
- Photograph references

- Sample locations
- Sample identifications, as described in SOP I-A-11, Sample Naming
- Field QC sample information
- Field descriptions, equipment used, and field activities accomplished to reconstruct field operations
- Meeting information
- Daily health and safety meeting notes
- Important times and dates of telephone conversations, correspondence, or deliverables
- Field calculations
- PPE level
- Calibration records
- Subcontractors present
- Equipment decontamination procedures and effectiveness
- Procedures used for containerization of investigative-derived waste

Logbook page numbers shall appear on each page to facilitate identification of photocopies.
If a person's initials are used for identification, or if uncommon acronyms are used, these should be identified on a page at the beginning of the logbook.
At least weekly and preferably daily, the preparer shall photocopy and retain the pages completed during that session for backup. This will prevent loss of a large amount of information if the logbook is lost.
A technical review of each logbook shall be performed by a knowledgeable individual such as the Project Manager.

3.0 DOCUMENTATION

The field logbook shall be retained as a permanent project record. If a particular Task Order requires submittal of photocopies of logbooks, this shall be performed as required.

4.0 REFERENCES

SOP I-A-11, *Sample Naming*

5.0 ATTACHMENTS

Attachment III-D-1 Description of Logbook Entries

Attachment 1
Description of Logbook Entries

Logbook entries shall contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms as described previously.

Name of Activity	For example, Asbestos Bulk Sampling, Charcoal Canister Sampling, Aquifer Testing.
Task Team Members and Equipment	Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.
Activity Location	Indicate location of sampling area as specified in the Field Sampling Plan. Record valid Navy Installation/Active and Site, at a minimum.
Weather	Indicate general weather and precipitation conditions.
Level of Personal Protective Equipment	The level of personal protective equipment (PPE), e.g., Level D, should be recorded.
Methods	Indicate method or procedure number employed for the activity.
Sample IDs	Indicate the unique identifier associated with the physical samples. Identify QC samples. Value can be numeric or alphanumeric and must not already exist in the database.
Sample Type and Volume	Indicate the medium, container type, preservative, and the volume for each sample.
Sample Collection Information	Indicate the location of sample, date and time of collection, sample matrix, sample depth interval, sample methods, sample handling, including filtration and preservation, analysis required and packaging and shipping information.
Time and Date	Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year.
Analyses	Indicate the appropriate code for analyses to be performed on each sample, as specified in the Field Sampling Plan.
Field Measurements	Indicate measurements and field instrument readings taken during the activity.
Chain of Custody and Distribution	Indicate chain-of-custody for each sample collected and indicate to whom samples are transferred and the destination.
References	If appropriate, indicate references to other logs or forms, drawings or photographs employed in the activity.

Narrative (including time and location)	Create a factual, chronological record of the team's activities throughout the day, including the time and location of each activity. Include descriptions of any general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact to the work schedule, requested information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself. It should be emphasized that logbook entries are for recording data and chronologies of events. The logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments unless appropriate.
Recorded by	Include the signature of the individual responsible for the entries contained in the logbook and referenced forms.
Checked by	Include the signature of the individual who performs the review of the completed entries.

RECORD KEEPING, SAMPLE LABELING, AND CHAIN-OF-CUSTODY PROCEDURES

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish standard protocols for all U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) field personnel and their contractors for use in maintaining field and sampling activity records, writing sample logs, labeling samples, ensuring that proper sample custody procedures are utilized, and completing chain-of-custody/analytical request forms.

2.0 PROCEDURES

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

2.1 RECORD KEEPING

The field logbook serves as the primary record of field activities. Entries shall be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct each day's events. Field logs such as soil boring logs and ground-water sampling logs will also be used. These procedures are described in SOP III-D, *Logbooks*.

2.2 SAMPLE LABELING

A sample label with adhesive backing shall be affixed to each individual sample container. Clear tape shall be placed over each label (preferably prior to sampling) to prevent the labels from tearing off, falling off, or being smeared, and to prevent loss of information on the label. The following information shall be recorded with a waterproof marker on each label:

- Project name or number (optional)
- Sample ID
- Date and time of collection
- Sampler's initials
- Matrix (optional)
- Sample preservatives (if applicable)
- Analysis to be performed on sample. This shall be identified by the method number or name identified in the subcontract with the laboratory. For water samples, a separate container is typically used for each separate test method, whereas with soil samples, multiple analyses can be performed on the soil obtained from one sample container. In order to avoid lengthy lists on each container and confusion, soil sample containers may not list every analysis to be performed.

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels. The adhesive glue used on the labels must be such that it does not contaminate the sample.

2.3 CUSTODY PROCEDURES

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. Custody of samples shall be maintained in accordance with EPA chain-of-custody guidelines as prescribed in EPA's *NEIC Policies and Procedures*, National Enforcement Investigations Center, Denver, Colorado, revised May 1986; EPA *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (TEGD), *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA OSWER Directive 9355 3-01), Appendix 2 of the *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports*, and *Test Methods for Evaluating Solid Waste* (EPA SW-846). A description of sample custody procedures is provided below.

2.3.1 Sample Collection Custody Procedures

According to EPA's *NEIC Policies and Procedures*, a sample is considered to be in custody if:

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

Custody seals shall be placed on sample containers immediately after sample collection and on shipping coolers if the cooler is to be removed from the sampler's custody. Custody seals will be placed in such a manner that they must be broken to open the containers or coolers. The custody seals shall be labeled with the following information:

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

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

Field personnel shall also log individual samples onto carbon copy chain-of-custody forms when a sample is collected. These forms may also serve as the request for analyses. Procedures for completing these forms are discussed in Section 2.4 indicating sample number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The samplers will also sign the COC form signifying that they were the personnel who collected the samples. The COC form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the person delivering the samples for transport will sign and indicate the date and time on the accompanying COC form. One copy of the COC form will be retained by the sampler and the remaining copies of the COC form shall be placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, both parties shall sign and date the accompanying carbon copy COC forms, and the individual relinquishing the samples shall retain a copy of each form. One exception is when the samples are shipped; the delivery service personnel will not sign or receive a copy because they do not open the coolers. The laboratory shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An example COC form is provided in Attachment III-E-2. An example of a completed COC form is provided in Attachment III-E-3 and described in Section 2.4.

2.3.2 Laboratory Custody Procedures

The following are custody procedures to be followed by an independent laboratory receiving samples for chemical analysis; the procedures in their Laboratory Quality Assurance Plan (LQAP) must follow these same procedures. A designated sample custodian shall take custody of all samples upon their arrival at the analytical laboratory. The custodian shall inspect all sample labels and COC forms to ensure that the information is consistent, and that each is properly completed. The custodian will also measure the temperature of the samples in the coolers upon arrival. The custodian shall also note the condition of the samples including:

- If the samples show signs of damage or tampering.
- If the containers are broken or leaking.
- If headspace is present in sample vials.
- Proper preservation of samples (made by pH measurement, except VOCs and purgeable TPH). The pH of these samples will be checked by the laboratory analyst, after the sample aliquot has been removed from the vial for analysis.
- If any sample holding times have been exceeded.

All of the above information shall be documented on a sample receipt sheet by the custodian. Any discrepancy or improper preservation shall be noted by the laboratory as an out-of-control event and shall be documented on an out-of-control form with corrective action taken. The out-of-control form shall be signed and dated by the sample control custodian and any other persons responsible for corrective action. An example of an out-of-control form is included as Attachment III-E-4.

The custodian shall then assign a unique laboratory number to each sample and distribute the samples to secured storage areas maintained at 4°C. The unique laboratory number for each sample, contractor sample ID, client name, date and time received, analysis due date, and storage details shall also be manually logged onto a sample receipt record and later entered into the laboratory's computerized data management system. The custodian shall also sign the shipping bill and maintain a copy.

Laboratory personnel shall be responsible for the care and custody of samples from the time of their receipt at the laboratory through their exhaustion or disposal. Samples should be logged in and out on internal laboratory COC forms each time they are removed from storage for extraction or analysis.

2.4 COMPLETING CHAIN-OF-CUSTODY/ANALYTICAL REQUEST FORMS

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

Attachment III-E-2 is an example of a generic COC/analytical request form that may be used by field personnel. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Attachment III-E-3 is an example of a completed site-specific COC/analytical request form, with box numbers identified and discussed in text below.

Box 1 Project Manager: This name shall be the name that will appear on the report. Do not write the name of the Project Coordinator or point of contact for the project instead of the Project Manager.

Project Name: Write it, as it is to appear on the report.

Project Number: Write it as it is to appear on the report. It shall include the project number, task number, and general ledger section code. The laboratory subcontract number should also be included.

Box 2 Bill to: List the name and address of the person/company to bill only if it is not in the subcontract with the laboratory.

Box 3 Sample Disposal Instructions: These instructions will be stated in the Basic Ordering Agreement (BOA) or each Task Order statement of work with each laboratory.

Shipment Method: State the method of shipment, e.g., hand carry; air courier via FEDEX, AIRBORNE, DHL or equivalent.

Comment: This area shall be used by the field team to communicate observations, potential hazards, or limitations that may have occurred in the field or additional information regarding analysis. For example: a specific metals list, explanation of Mod 8015, Mod 8015 + Kerosene, samples expected to contain high analyte concentrations.

Box 4 Cooler Number: This will be written somewhere on the inside or outside of the cooler and shall be included on the COC. Some laboratories attach this number to the trip blank identification, which helps track VOC samples. If a number is not on the cooler, field personnel shall assign a number, write it on the cooler, and write it on the COC.

QC Level: Enter the reporting/QC requirements, e.g., NAVFAC NW QC Level C, D, or E.

Turnaround time (TAT): TAT for contract work will be determined by a sample delivery group (SDG), which may be formed over a 14-day period, not to exceed 20 samples. Standard turnaround time once the SDG has been completed is 35 calendar days from receipt of the last sample in the SDG. Entering NORMAL or STANDARD in this field will be acceptable. If quicker TAT is required, it shall be in the subcontract with the laboratory and reiterated on each COC to remind the laboratory.

Box 5 Type of containers: The type of container used, e.g., 1-liter glass amber, for a given parameter in that column.

Preservatives: Field personnel must indicate on the COC the correct preservative used for the analysis requested. Indicate the pH of the sample (if tested) in case there are buffering conditions found in the sample matrix.

Box 6 Sample number: Five-character alpha-numeric identifier to be used by the laboratory to identify samples. The use of this identifier is important since the labs are restricted to the number of characters they are able to use. See SOP I-A-11, Sample Naming.

Description (sample identification): This name will be determined by the location and description of the sample, as described in SOP I-A-11, Sample Naming. This sample identification should not be submitted to the laboratory, but should be left blank. If a computer COC version is used, the sample identification can be input but printed with this block black. A cross-referenced list of sample number and sample identification must be maintained separately.

Date Collected: Collection date must be recorded in order to track the holding time of the sample. Note: For trip blanks, record the date it was placed in company with samples.

Time Collected: When collecting samples, record the time the sample is first collected. Use of the 24-hour military clock will avoid a.m. or p.m. designations; e.g., 1815 instead of 6:15 p.m. Record local time; the laboratory is responsible for calculating holding times to local time.

Lab Identification: This is for laboratory use only.

Box 7	Matrix and QC: Identify the matrix: e.g., water, soil, air, tissue, fresh water sediment, marine sediment, or product. If a sample is expected to contain high analyte concentrations, e.g., a tank bottom sludge or distinct product layer, notify the laboratory in the comment section. Mark an "X" for the sample(s) that have extra volume for laboratory QC matrix spike/matrix spike duplicate (MS/MSD) purposes. The sample provided for MS/MSD purposes is usually a field duplicate.
Box 8	Analytical Parameters: Enter the parameter by descriptor and the method number desired. When requesting metals that are modifications of the standard lists, define the list in the comment section. This would not be necessary when requesting standard list metals such as priority pollutant metals (PPM), target compound list from ILM03.0, and Title 22 metals which are groups of metals commonly requested and should not cause any confusion as to what metals are being analyzed. Whenever possible, list the parameters as they appear in the laboratory subcontract to maintain consistency and avoid confusion. In the boxes below the analytical parameter, indicate the number of containers collected for each parameter by marking an "X". If more than one container is used for a sample, write a number in the desired box to indicate a request for analysis and to indicate the number of containers sent for that analysis.
Box 9	Sampler's Signature: The person who collected samples must sign here. Relinquished By: This space shall contain the signature of the person who turned over the custody of the samples to a second party other than an express mail carrier such as FEDEX, DHL or Air Borne Express. Received By: Typically, this is a written signature by a representative of the receiving laboratory, or a field crewmember who delivered the samples in person from the field to the laboratory. A courier such as FedEx or DHL does not sign because they do not open the coolers. It must also be used by the prime contracting laboratory when samples are sent to a subcontractor. Relinquished By: In the case of subcontracting, the primary laboratory will sign the Relinquished By space and fill out an additional COC to accompany the samples being subcontracted. Received By (Laboratory): This space is for the final destination (e.g., at a subcontracted laboratory).
Box 10	Lab Number and Questions: This box is to be filled in by the laboratory only.
Box 11	Control Number: This number is the "COC" followed by the first sample number in a cooler, or contained on a COC. This control number must be unique and never used twice. Record the date the COC is completed. It should be the same date the samples are collected.
Box 12	Total No. of Containers/row: Sum the number of containers in that row.
Box 13	Total No. of Containers/column: Sum the number of containers in that column.

Because COC forms contain different formats based upon who produced the form, not all of the information listed in items 1 to 13 may be recorded. However, as much of this information as possible shall be included.

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

Complete one COC form per cooler. Whenever possible, reduce the number of trip blanks by placing all samples to be analyzed for VOA, gasoline, and BTEX compounds into one cooler.

Complete all sections and be sure to sign and date the COC form. One copy of the COC form must remain with the field personnel.

3.0 DOCUMENTATION

The COC/analytical request form shall be faxed daily, if possible, to the Task Order Laboratory Coordinator for accuracy verification. Following the completion of sampling activities, the sample logbook and COC forms will be transmitted to the Project Manager for storage in project files. The Project Manager shall review COC forms on a monthly basis at a minimum. The data validators shall also receive a copy. Along with the data delivered, the original COC/analytical request form shall be submitted by the laboratory. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems can be easily identified.

4.0 REFERENCES

SOP I-A-11, *Sample Naming*
SOP III-D, *Logbooks*
State of California Water Resources Control Board. 1988. Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports.
USEPA. 1986. EPA NEIC Policies and Procedures, National Enforcement Investigations Center, Denver, Colorado.
USEPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA OSWER Directive 9355 3-01).
USEPA. 1992. RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD).
USEPA. 1995 and as updated. Test Methods for Evaluating Solid Waste (SW-846), Third edition.

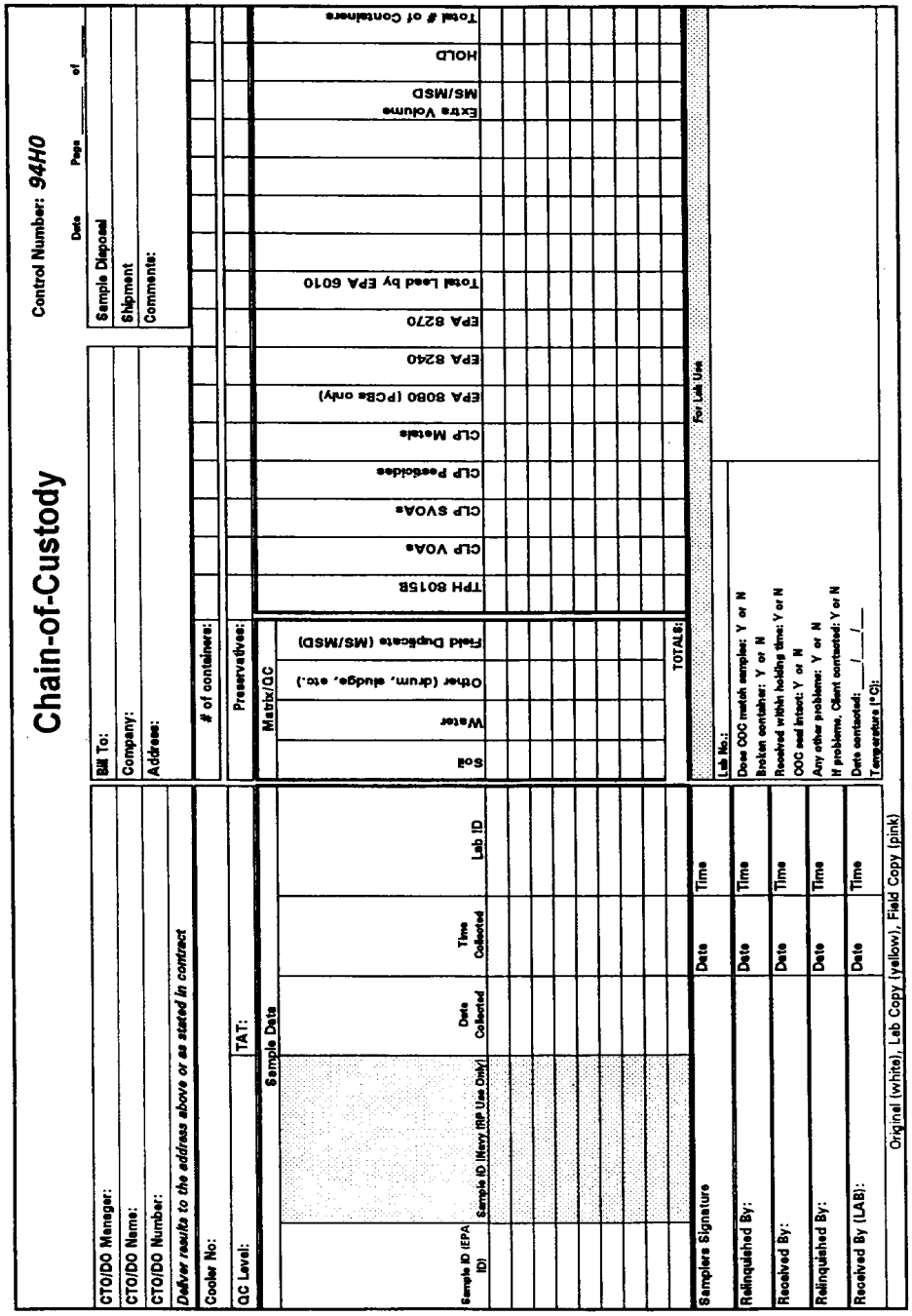
5.0 ATTACHMENTS

Attachment III-E-1 Chain-of-Custody Seal
Attachment III-E-2 Generic Chain-of-Custody/Analytical Request Form
Attachment III-E-3 Sample Completed Chain-of-Custody/Analytical Request Form
Attachment III-E-4 Sample Out-of-Control Form

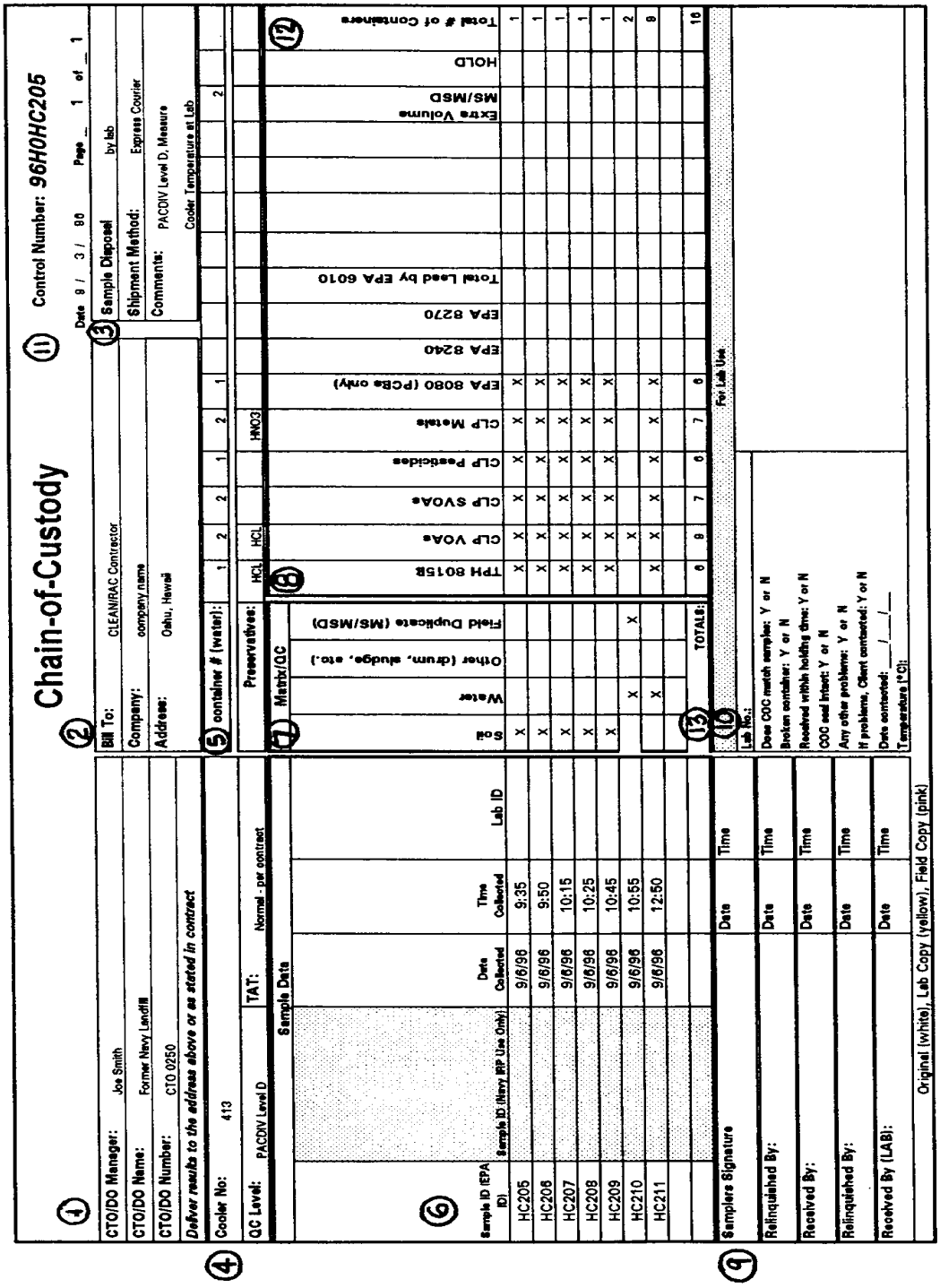
Attachment III-E-1
Chain-of-Custody Seal

<table>
<tr><td rowspan="3">[LABORATORY]</td><td>SAMPLE NO.</td><td>DATE</td><td>SEAL BROKEN BY</td></tr>
<tr><td colspan="2">SIGNATURE</td><td>DATE</td></tr>
<tr><td colspan="3">PRINT NAME AND TITLE (Inspector, Analyst or Technician</td></tr>
</table>

Attachment III-E-2
Generic Chain-of-Custody/Analytical Request Form



Attachment III-E-3
Sample Completed Chain-Of-Custody/
Analytical Request Form



Attachment III-E-4
Sample Out-Of-Control Form

OUT OF CONTROL FORM	Status	Date	Initial
	Noted OOC		
	Submit for CA*		
	Resubmit for CA*		
	Completed		

Date Recognized:	By:
Dated Occurred:	Matrix
Parameter (Test Code):	Method:
Analyst:	Supervisor:

Samples Affected (List by Accession AND Sample No.)

1. Type of Event (Check all that apply)		2. Corrective Action (CA)* (Check all that apply)	
	Calibration Corr. Coefficient <0.995		Repeat calibration
	%RSD>20%		Made new standards
	Blank >MDL		Reran analysis
	Does not meet criteria:		Sample(s) redigested and rerun
	Spike		Sample(s) reextracted and rerun
	Duplicate		Recalculated
	LCS		Cleaned system
	Calibration Verification		Ran standard additions
	Standard Additions		Notified
	MS/MSD		Other (please explain)
	BS/BSD		
	Surrogate Recovery		
	Calculations Error		
	Holding Times Missed		
	Other (Please explain	Comments:	

3. Results of Corrective Action

- ☐ Return to Control (indicated with)
- ☐ Corrective Actions Not Successful - DATA IS TO BE FLAGGED with _____.

Analyst:	Date:
Supervisor:	Date:
QA Department:	Date:

SAMPLE HANDLING, STORAGE, AND SHIPPING

1.0 PURPOSE

This standard operating procedure (SOP) sets forth the methods for use by U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) field personnel and their contractors engaged in handling, storing, and transporting water, soil and/or sediment samples.

2.0 PROCEDURE

2.1 HANDLING AND STORAGE

Immediately following collection, all samples will be labeled according to the procedures in SOP III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*. The lids of the containers shall not be sealed with duct tape, but may be covered with custody seals or placed directly into sealed plastic bags. The sample containers shall be placed in an insulated cooler with frozen gel packs (such as "blue ice") or ice in double, self-sealing bags. Samples should occupy the lower portion of the cooler, while the ice should occupy the upper portion. An absorbent material (e.g., proper absorbent cloth material) may be placed on the bottom of the cooler to contain liquids in case of spillage. All empty space between sample containers shall be filled with bubble wrap, Styrofoam "peanuts," or other appropriate material. Prior to shipping, glass sample containers should be wrapped on the sides, tops, and bottoms with bubble wrap or other appropriate padding and/or surrounded by packing material to prevent breakage during transport. Prior to shipment, the ice or cold packs in the coolers may require replacement to maintain samples as close to 4°C as possible during transport of the samples to the analytical laboratory. Samples shall be shipped as soon as possible to allow the laboratory to meet holding times for analyses. The procedures for maintaining sample temperatures at 4°C, pertains to all water, soil, and sediment field samples.

2.2 SHIPPING

All appropriate U.S. Department of Transportation (DOT) regulations (e.g., 49 Code of Federal Regulations (CFR), Parts 171-179) shall be followed in shipment of air, soil, water, and other samples.

2.2.1 Hazardous Materials Shipment

Field personnel must state whether any sample is suspected to be a hazardous material. A sample should be assumed to be hazardous unless enough evidence exists to indicate it is nonhazardous. If not suspected to be hazardous, shipments may be made as described in the Section 2.2.2 for non-hazardous materials. If hazardous, the procedures summarized below must be followed. Any substance or material that is capable of posing an unreasonable risk to life, health, or property when transported is classified as hazardous. Hazardous materials identification should be performed by checking the list of dangerous goods for that particular mode of transportation. If not on that list, materials can be classified by checking the Hazardous Materials Table (49 CFR

172.102 including Appendix A) or by determining if the material meets the definition of any hazard class or division (49 CFR Part 173), as listed in Attachment III-G-2.

All persons offering for shipment any hazardous material must be properly trained in the appropriate regulations, as required by HM-126F, Training for Safe Transportation of Hazardous Materials. The training covers loading, unloading, handling, storing, and transporting of hazardous materials, as well as emergency preparedness in the case of accidents. Carriers such as commercial couriers must also be trained.

When shipping hazardous materials, including bulk chemicals or samples suspected of being hazardous, the proper shipping papers (49 CFR 172 Subpart C), package marking (49 CFR 172 Subpart D), labeling (49 CFR 172 Subpart E), placarding (49 CFR 172 Subpart F, generally for carriers), and packaging must be used. Attachment III-G-1 shows an example of proper package markings. A copy of 49 CFR should be referred to each time a hazardous material or potentially hazardous samples are shipped.

According to Section 2.7 of the International Air Transport Association (IATA) Dangerous Goods Regulations publication, very small quantities of certain dangerous goods may be transported without certain marking and documentation requirements as described in 49 CFR Part 172. However, other labeling and packing requirements must still be followed. Attachment III-G-2 shows the volume or weight for different classes of substances. A "Dangerous Goods in Excepted Quantities" label must be completed and attached to the associated shipping cooler (Attachment III-G-3). Certain dangerous goods are not allowed on certain airlines in any quantity.

As stated in item 4 of Attachment III-G-4, the Hazardous Materials Regulations do not apply to hydrochloric acid (HCl), nitric acid (HNO_3), sulfuric acid (H_2SO_4), and sodium hydroxide (NaOH) added to water samples if their pH or percentages by weight criteria are met. These samples may be shipped as non-hazardous materials as discussed below.

2.2.2 Nonhazardous Materials Shipment

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

When a cooler is ready for shipment to the laboratory, copies of the chain-of-custody form shall be placed inside a sealed plastic bag and placed inside of an insulated cooler. The coolers will then be sealed with waterproof tape and labeled "Fragile," "This-End-Up" (or directional arrows pointing up), or other appropriate notices. Custody seals will be placed on the coolers as discussed in SOP III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*.

2.2.3 Shipments from Outside the Continental United States

Shipment of sample coolers to the U.S. from locations outside the continental U.S. is controlled by the USDA and is subject to their inspection and regulation. Documentation is required to prove that the analytical laboratory receiving samples is certified. The laboratory must have certification by USDA to receive and properly dispose of soil; this is called a "USDA Soil Import Permit." In addition, all sample coolers must be inspected by a USDA representative, affixed with a label indicating that the coolers contain environmental samples, and shipping forms stamped by the USDA inspector prior to shipment. In addition, samples shipped from U.S. territorial possessions or foreign countries, must be cleared by the U.S. Customs Service upon entry into the United States. As long as the commercial invoice is properly completed (see

below), shipments typically pass through U.S. Customs without the need to open coolers for inspection.

Completion and use of proper paperwork will, in most cases, minimize or eliminate the need of the USDA and U.S. Customs to inspect the contents. Attachment III-G-5 shows an example of how paperwork may be placed on the outside of coolers for nonhazardous materials. For hazardous materials, refer to Section 2.2.1.

In summary, the paperwork listed below should be taped to the outside of the coolers to assist sample shipments. If a shipment is made up of multiple pieces (e.g., more than one cooler), the paperwork need be attached only to one cooler, provided that the courier agrees. All other coolers in the shipment need only be taped and have address and chain-of-custody seals affixed.

1. **Courier Shipping Form & Commercial Invoice** - See Attachments III-G-6, III-G-7, and III-G-8 for examples of the information to be included on these forms. Both forms should be placed inside a clear plastic adhesive-backed pouch, which adheres to the package (typically supplied by the courier) and placed on the cooler lid as shown in Attachment 5.
2. **Soil Import Permit and USDA Letter** (soil only) - See Attachments III-G-9 and III-G-10 for examples. The laboratory shall supply these documents prior to mobilization. The USDA in Hawaii often does stop shipments of soil without these documents. The 2" x 2" USDA label (described below), the USDA letter, and soil impact permit should be stapled together and placed inside a clear plastic pouch. Clear plastic and adhesive-backed pouches are typically supplied by the mailing courier.
3. The analytical laboratory should supply the Soil Import Permit. Although original labels are preferred, copies of this label, which are cut out to the 2" x 2" dimensions, are acceptable. Placing one label (as shown in Attachment III-G-5) covered with clear packing tape and one stapled to the actual permit is suggested.
4. The USDA does not control water samples, thus the requirements for soils listed above do not apply.
5. **Custody Seals**. Task Order personnel must sign and date custody seals. At least two seals should be placed in such a manner that they stick to both the cooler lid and body. The seals shall be placed so the cooler/container cannot be opened without breaking the seal. The custody seals are then covered with clear packing tape. This prevents the seal from coming loose and enables detection of tampering.
6. **Address Label**. A label stating the destination (the sending and laboratory, company, or location address) should be affixed to each cooler. The label should also include both telephone numbers.
7. **Special Requirements for Hazardous Materials** - see Section 2.2.1.

Upon receipt of sample coolers at the laboratory, the sample custodian shall inspect the sample containers as discussed in SOP III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*. The samples shall then be immediately extracted and/or analyzed, or stored in a refrigerated storage area until they are removed for extraction and/or analysis. Whenever the samples are not being extracted or analyzed, they shall be returned to refrigerated storage.

3.0 DOCUMENTATION

Records shall be maintained as required by implementing these procedures.

4.0 REFERENCES

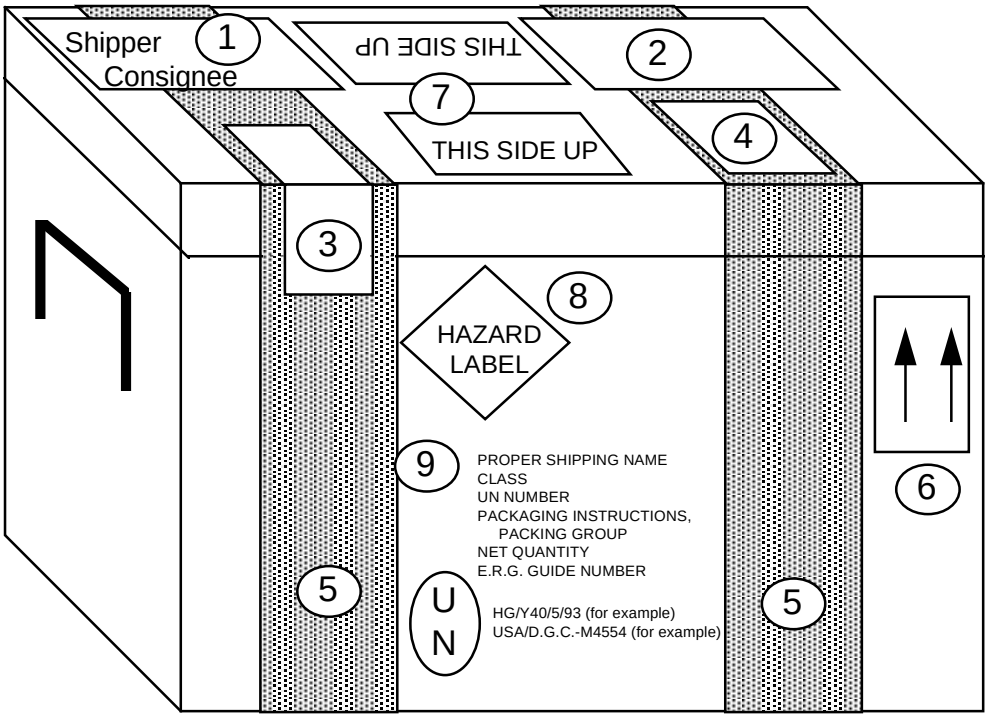
HM-126F, Training for Safe Transportation of Hazardous Materials

SOP III-E, Record Keeping, Sample Labeling, and Chain-of-Custody Procedures

5.0 ATTACHMENTS

Attachment III-G-1 Example Package Marking
Attachment III-G-2 Packing Groups
Attachment III-G-3 Label for Dangerous Goods in Excepted Quantities
Attachment III-G-4 SW-846 Preservative Exception
Attachment III-G-5 Sample Cooler Marking Figure
Attachment III-G-6 Example Courier Form
Attachment III-G-7 Commercial Invoice - Soil
Attachment III-G-8 Commercial Invoice - Water
Attachment III-G-9 Soil Import Permit
Attachment III-G-10 Soil Samples Restricted Entry Labels

Attachment III-G-1
Example Hazardous Material Package Marking



1. **AIR BILL/COMMERCIAL INVOICE**
2. **USDA PERMIT (Letter to Laboratory from USDA)**
3. **CUSTODY SEAL**
4. **USDA 2" X 2" SOIL IMPORT PERMIT**
5. **WATERPROOF STRAPPING TAPE**
6. **DIRECTION ARROWS STICKER - TWO REQUIRED**
7. **THIS SIDE UP STICKERS**
8. **HAZARD LABEL**
9. **HAZARDOUS MATERIAL INFORMATION**
10. **PACKAGE SPECIFICATIONS**

Attachment III-G-2
Packing Groups

Packing Group of the Substance		Packing Group I		Packing Group II		Packing Group III	
CLASS or DIVISION of PRIMARY or SUBSIDIARY RISK		Packagings		Packagings		Packagings	
		Inner	Outer	Inner	Outer	Inner	Outer
1:	Explosives	---------- Forbidden (Note A) ----------					
2.1:	Flammable Gas	---------- Forbidden (Note B) ----------					
2.2:	Non-Flammable, non-toxic gas	---------- See Notes A and B ----------					
2.3:	Toxic gas	---------- Forbidden (Note A) ----------					
3.	Flammable liquid	30 mL	300 mL	30 mL	500 mL	30 mL	1 L
4.1	Self-reactive substances	Forbidden		Forbidden		Forbidden	
4.1:	Other flammable solids	Forbidden		30 g	500 g	30 g	1 kg
4.2:	Pyrophoric substances	Forbidden		Not Applicable		Not Applicable	
4.2	Spontaneously combustible substances	Not Applicable		30 g	500 g	30 g	1 kg
4.3:	Water reactive substances	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.1:	Oxidizers	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.2:	Organic peroxides (Note C)	See Note A		30 g or 30 mL	500 g or 250 mL	Not Applicable	
6.1:	Poisons - Inhalation toxicity	Forbidden		1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1:	Poisons - oral toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1:	Poisons - dermal toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.2:	Infectious substances	---------- Forbidden (Note A) ----------					
7:	Radioactive material (Note D)	---------- Forbidden (Note A) ----------					
8:	Corrosive materials	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
9:	Magnetized materials	---------- Forbidden (Note A) ----------					
9:	Other miscellaneous materials (Note E)	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L

Note A: Packing groups are not used for this class or division.

Note B: For inner packagings, the quantity contained in receptacle with a water capacity of 30 mL. For outer packagings, the sum of the water capacities of all the inner packagings contained must not exceed 1 L.

Note C: Applies only to Organic Peroxides when contained in a chemical kit, first aid kit or polyester resin kit.

Note D: See 6.1.4.1, 6.1.4.2 and 6.2.1.1 through 6.2.1.7, radioactive material in excepted packages.

Note E: For substances in Class 9 for which no packing group is indicated in the List of Dangerous Goods, Packing Group II quantities must be used.

Attachment III-G-3
Label For Dangerous Goods In Excepted Quantities

DANGEROUS GOODS IN EXCEPTED QUANTITIES

This package contains dangerous goods in excepted small quantities and is in all respects in compliance with the applicable international and national government regulations and the IATA Dangerous Goods Regulations.

_____
Signature of Shipper

_____ _____
Title Date

_____

_____
Name and address of Shipper

This package contains substance(s) in Class(es)
(check applicable box(es))

Class:	2	3	4	5	6	8	9
	o	o	o	o	o	o	o

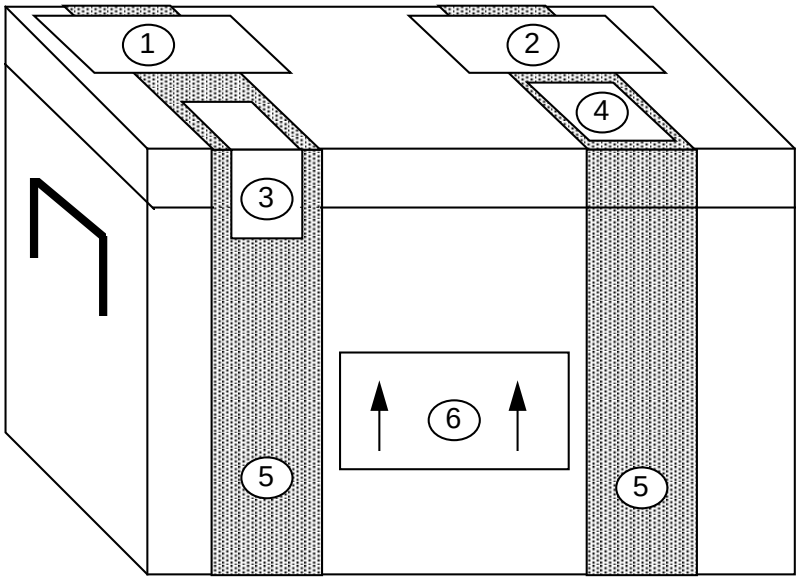
and the applicable UN Numbers are:

ATTACHMENT III-G-4
Preservative Exception

Measurement	Vol. Req. (mL)	Container[2]	Preservative [3,4]	Holding Time[5]
MBAS	50[2]	P,G	Cool, 4ºC	48 Hours
NTA	0[5]	P,G	Cool, 4ºC	24 Hours

1. More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.
2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.
3. Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4ºC until compositing and sample splitting is completed.
4. When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. for the preservation requirements of Table 1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentration of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or grater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
5. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.
6. Should only be used in the presence of residual chlorine.

Attachment III-G-5
Non-Hazardous Material Cooler Marking Figure For Shipment From Outside the Continental United States



1. **AIR BILL/COMMERCIAL INVOICE**
2. **USDA PERMIT (Letter to Laboratory from USDA)**
3. **CUSTODY SEAL**
4. **USDA 2" X 2" SOIL IMPORT PERMIT**
5. **WATERPROOF STRAPPING TAPE**
6. **DIRECTION ARROWS STICKER - TWO REQUIRED**

Attachment III-G-6
Example Courier Form

FedEx. USA Airbill FedEx Tracking Number 801704855619 0200 Form I.D. No. SPL11 Sender's Copy

1 From (please print and press hard)

Date _____ Sender's FedEx Account Number Account Number

Sender's Name Joe Smith Phone (808) 545-2462

Company OGDEN ENVIRONMENTAL/CRC ACCT

Address 680 IWILEI RD STE 660 Dept./Floor/Suite/Room

City HONOLULU State HI ZIP 96817

2 Your Internal Billing Reference Information (Optional) (First 24 characters will appear on invoice)

3 To (please print and press hard)

Recipient's Name Sample Receipt Phone ( ) Lab Phone #

Company Lab Name

Address Lab Address (We Cannot Deliver to P.O. Boxes or P.O. ZIP Codes) Dept./Floor/Suite/Room

Check here if residence (Extra charge applies for FedEx Express Saver)

(To "HOLD" at FedEx location, print FedEx address here)

City State ZIP

For HOLD at FedEx Location check here
Hold Weekday (Not available with FedEx First Overnight) Hold Saturday (Not available at all locations) (Available for FedEx Priority Overnight and FedEx 2Day only)

For Saturday Delivery check here (Extra Charge. Not available to all locations) (Available for FedEx Priority Overnight and FedEx 2Day only)

4a Express Package Service Packages under 150 lbs. Delivery commitment may be later in some areas.
FedEx Priority Overnight (Next business morning) FedEx Standard Overnight (Next business afternoon) FedEx 2Day* (Second business day) FedEx Express Saver* (Third business day) FedEx First Overnight (Earliest next business morning delivery to select locations) (Higher rates apply)
* FedEx Letter Rate not available. Minimum charge: One pound rate.

4b Express Freight Service Packages over 150 lbs. Delivery commitment may be later in some areas.
FedEx Overnight Freight (Next business day) FedEx 2Day Freight (Second business day) FedEx Express Saver Freight (Up to 3 business days)
(Call for delivery schedule. See back for detailed descriptions of freight services.)

5 Packaging FedEx Letter FedEx Pak FedEx Box FedEx Tube Other Pkg. Declared value limit $500

6 Special Handling
Does this shipment contain dangerous goods? Yes (As per attached Shipper's Declaration) Yes (Shipper's Declaration not required)
Dry Ice (Dry Ice, 9, UN 1845 III) x kg. 904 (Dangerous Goods Shipper's Declaration not required)
CA Cargo Aircraft Only

7 Payment
Bill to: Sender (Account no. in section 1 will be billed) Recipient Third Party Credit Card Cash/Check (Enter FedEx account no. or Credit Card no. below)
FedEx Account No.
Credit Card No. Exp. Date

Total Packages	Total Weight	Total Declared Value*	Total Charges
		$ .00	$

* When declaring a value higher than $100 per shipment, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE, AND LIMIT OF LIABILITY section for further information.

8 Release Signature Sign to authorize delivery without obtaining signature.
Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

287

Service Conditions, Declared Value, and Limit of Liability – By using this Airbill, you agree to the service conditions in our current Service Guide or U.S. Government Service Guide. Both are available on request. SEE BACK OF SENDER'S COPY OF THIS AIRBILL FOR INFORMATION AND ADDITIONAL TERMS. We will not be responsible for any claim in excess of $100 per package whether the result of loss, damage, or delay, non-delivery, misdelivery, or misinformation, unless you declare a higher value, pay an additional charge, and document your actual loss in a timely manner. Your right to recover from us for any loss includes intrinsic value of the package, loss of sales, interest, profit, attorney's fees, costs, and other forms of damage, whether direct, incidental, consequential, or special, and is limited to the greater of $100 or the declared value but cannot exceed actual documented loss. The maximum declared value for any FedEx Letter and FedEx Pak is $500. Federal Express may, upon your request, and with some limitations, refund all transportation charges paid. See the FedEx Service Guide for further details.

Questions? Call 1·800·Go·FedEx (800)463-3339 The World On Time

003520091 4

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RETAIN THIS COPY FOR YOUR RECORDS

Attachment III-G-7
Commercial Invoice - Soil

DATE OF EXPORTATION 1/1/94	EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CTO #>
SHIPPER/EXPORTER (complete name and address) Joe Smith Ogden c/o <hotel name> <hotel address>	CONSIGNEE Sample Receipt <Lab Name> <Lab Address>
COUNTRY OF EXPORT Guam, USA	IMPORTER - IF OTHER THAN CONSIGNEE
COUNTRY OF ORIGIN OF GOODS Guam, USA	
COUNTRY OF ULTIMATE DESTINATION USA	

INTERNATIONAL AIR WAYBILL NO. _____ (NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)

MARKS/ NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	3	coolers	Soil samples for laboratory analysis only				$1.00	$3.00

TOTAL NO. OF PKGS.	TOTAL WEIGHT	TOTAL INVOICE VALUE
3		$3.00

Check one
☐ F.O.B.
☐ C&F
☐ C.I.F.

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Joe Smith, Ogden	Joe Smith	1/1/94
Name/Title	Signature	Date

ATTACHMENT III-G-8
Commercial Invoice - Water

DATE OF EXPORTATION 1/1/94	EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CTO #>
SHIPPER/EXPORTER (complete name and address) Joe Smith Ogden c/o <hotel name> <hotel address>	CONSIGNEE Sample Receipt <Lab Name> <Lab Address>
COUNTRY OF EXPORT Guam, USA	IMPORTER - IF OTHER THAN CONSIGNEE
COUNTRY OF ORIGIN OF GOODS Guam, USA	
COUNTRY OF ULTIMATE DESTINATION USA	

INTERNATIONAL AIR WAYBILL NO. _____ (NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)

MARKS/ NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	3	coolers	Water samples for laboratory analysis only				$1.00	$3.00
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE
	3							$3.00
								Check one ☐ F.O.B. ☐ C&F ☐ C.I.F.

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Joe Smith, Ogden	Joe Smith	1/1/94
Name/Title	Signature	Date

Attachment III-G-9
Soil Import Permit

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE PROGRAMS

COMPLIANCE AGREEMENT

1. NAME AND MAILING ADDRESS OF PERSON OR FIRM	2. LOCATION
Ogden Environmental & Energy Service Co. 680 Iwilei Road, Suite 660 Honolulu, HI 96817	680 Iwilei Road, Suite 660 Honolulu, HI 96817 Telephone: 545-2462 Fax: 528-5379

3. REGULATED ARTICLE(S)
Foreign soil samples destined to approved laboratories in the Continental United States transiting through Honolulu International Airport and military facilities on Oahu, Hawaii.

4. APPLICABLE FEDERAL QUARANTINE(S) OR REGULATIONS

7 CFR 330.300

6. I/We agree to the following:

See the attached Addendum, Foreign Soil Samples Destined To Approved Laboratories In The Continental United States Transiting Through Honolulu International Airport And Military Facilities On Oahu, Hawaii

THIS COMPLIANCE AGREEMENT IS VALID FOR 2 YEARS FROM THE DATE OF ISSUANCE.
For renewal, call our office at 861-8446 or Fax 861-8450.

EXPIRATION DATE: SEPTEMBER 30, 2000

7. SIGNATURE	8. TITLE	9. DATE SIGNED
Betsy D. Disparagle	Air & HAZARDOUS WASTE Group MANAGER	9/9/98

The affixing of the signatures below will validate this agreement which shall remain in effect until canceled, but may be revised as necessary or revoked for noncompliance.

10. AGREEMENT NO.
OAHU-ST-002

11. DATE OF AGREEMENT
September 2, 1998

12. PPQ OFFICIAL *(Name and Title)*	13. ADDRESS
Michael M. Jodoi, Supervisor, Satellite Operations	USDA, APHIS, PPQ 3375 Koapaka Street, Suite G330 Honolulu, HI 96819
14. SIGNATURE	
15. STATE AGENCY OFFICIAL *(Name and Title)*	16. ADDRESS
N/A	N/A
17. SIGNATURE	
N/A	

PPQ FORM 519
AUG. 1977

REPLACES PPQ 274, 519, 560, AND AQI 83, WHICH ARE OBSOLETE

Soil - Foreign\Foreign Soil - Transit Comp Agree Form 519.frp

Attachment III-G-10
Soil Samples Restricted Entry Labels

U.S. DEPARTMENT OF AGRICULTURE

ANIMAL AND PLANT HEALTH INSPECTION SERVICE

PLANT PROTECTION AND QUARANTINE

HYATTSVILLE, MARYLAND 20782

soil samples

restricted entry

The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.

For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 550 (JAN 83) Edition of 12/77 may be used

U.S. DEPARTMENT OF AGRICULTURE

ANIMAL AND PLANT HEALTH INSPECTION SERVICE

PLANT PROTECTION AND QUARANTINE

HYATTSVILLE, MARYLAND 20782

soil samples

restricted entry

The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.

For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 550 (JAN 83) Edition of 12/77 may be used

U.S. DEPARTMENT OF AGRICULTURE

ANIMAL AND PLANT HEALTH INSPECTION SERVICE

PLANT PROTECTION AND QUARANTINE

HYATTSVILLE, MARYLAND 20782

soil samples

restricted entry

The material contained in this package
is imported under authority of the
Federal Plant Pest Act of May 23, 1957.

For release without treatment if
addressee is currently listed as
approved by Plant Protection and
Quarantine.

PPQ FORM 550 Edition of 12/77 may be used

(JAN 83)

EQUIPMENT DECONTAMINATION

1.0 PURPOSE

The standard operating procedure (SOP) describes general methods of equipment decontamination (decon) for use by U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) field personnel and their contractors during field sampling activities. Some sites may require additional steps (e.g. nitric rinses for metals, hexane for chlorinated pesticides) to insure equipment is properly deconned. These should be identified and addressed in the Work Plans and/or the Quality Assurance Project Plans (QAPPs)

2.0 PROCEDURES

Decontamination of equipment is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program should include consideration of the following factors:

- The location where the decon procedures will be conducted
- The types of equipment requiring decon
- The frequency of equipment decontamination
- The cleaning technique and types of cleaning solutions appropriate to the contaminants of concern
- The method for containing the residual contaminants and wash water from the deconning process
- The use of a quality control measure to determine the effectiveness of the decontamination procedure (e.g. equipment rinsate samples)

This subsection describes standards for decontamination, including the techniques to be used, frequency of decontamination, cleaning solutions, and effectiveness.

2.1 DECONTAMINATION AREA

An appropriate location for the decontamination area at a site shall be selected on the basis of the ability to control access to the area, control residual material removed from equipment, the need to store dirty and clean equipment, and the ability to restrict access to the area being investigated. The decontamination area shall be located an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment.

2.2 TYPES OF EQUIPMENT

Examples of drilling equipment that must be deconned includes drill bits, auger sections, split spoon samplers, and hand tools. Decontamination of monitoring well development and ground-water sampling equipment includes submersible pumps, non-disposable bailers, interface probes, water level meters, bladder pumps, airlift pumps, and lysimeters. Other sampling equipment that may require decontamination includes, but is not limited to, hand trowels, hand augers, slide hammer samplers, shovels, stainless steel spoons and bowls, soil sample liners and caps, wipe sampling templates, COLIWASA samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and should be properly disposed of after one use.

2.3 FREQUENCY OF EQUIPMENT DECONTAMINATION

Down-hole drilling equipment and equipment used in monitoring well development and purging shall be decontaminated prior to initial use and between each borehole or well. However, down hole drilling equipment may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. When drilling through a shallow contaminated zone and installing a surface casing to seal off the contaminated zone, the drilling tools shall be decontaminated prior to drilling deeper. Groundwater sampling should be initiated by sampling ground water from the monitoring well where the least contamination is suspected. This is more important when not using disposable equipment. All groundwater, surface water, and soil sampling devices shall be decontaminated prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

2.4 CLEANING SOLUTIONS AND TECHNIQUES

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

A rinse decontamination procedure is acceptable for equipment such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: (1) wash with a non-phosphate detergent (Citrinox®, Liquinox®, or other suitable phosphate free detergent) and potable water solution, (2) rinse with potable water, and (3) rinses with deionized or distilled water. Equipment shall be disassembled as much as is practical, prior to cleaning. An initial gross wash scrub down and quick rinse should be completed at the beginning of the process if equipment is heavily soiled. After decontamination, care needs to be taken that the cleaned equipment does not become contaminated. This may require wrapping items in foil or plastic and storing the equipment in a specified “clean” area.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. The pumps shall be decontaminated by circulating fluids through the pump while it is operating. This circulation can be done using a clean 4-inch or greater diameter pipe equipped with an end cap. The pipe shall be filled with enough decon fluid to submerge the pump, the pump placed within the capped pipe, and the pump operated while circulating the fluids within the pipe. The decontamination sequence shall include (1) detergent and potable water, (2) potable water rinse, and (3) deionized or distilled water rinse. The decontamination fluids shall be changed after each cycle. Changing of the fluids may include dumping of the detergent water, mixing detergent in the potable water rinse, using the deionized water as the potable rinse and renewing the distilled/deionized water. All decon water shall be disposed of as outlined in the field work plans.

Decontamination solvent(s) to be used during field activities will be specified in Project Work Plans or QAPPs. If solvents are used, sufficient time must be allowed to insure the solvent has evaporated from the equipment prior to reuse.

Equipment used for measuring field parameters such as pH, temperature, specific conductivity, and turbidity shall be rinsed with deionized or distilled water. New, unused soil sample liners and caps will be cleaned using the three step process, outlined above, to remove any dirt or cutting oils that may be on them prior to use.

2.5 CONTAINMENT OF RESIDUAL CONTAMINANTS AND CLEANING SOLUTIONS

Decontamination program for equipment exposed to potentially hazardous materials requires a provision for catchment and disposal of the contaminated material, cleaning solution, and wash water. This may require setting up a containment area with a system for pumping the water generated decontamination water into proper containers.
Clean equipment should be stored in a separate location to prevent recontamination.
Decontamination fluids contained within the bermed area shall be collected and disposed of as outlined in the field sampling plan.
Containment of fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices shall be accomplished using wash buckets or tubs. The decontamination fluids shall be collected and disposed of as outlined in the field sampling plan.

2.6 EFFECTIVENESS OF DECONTAMINATION PROCEDURES

A decontamination program must incorporate quality control measures to determine the effectiveness of cleaning methods. Quality control measures typically include collection of equipment rinsate samples or wipe testing. Equipment rinsates consist of analyte-free water that has been poured over or through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a cloth over the surface of the equipment after cleaning. Further descriptions of these samples and their required frequency of collection are provided in SOP III-B, *Field QC Samples (Water, Soil).* These quality control measures provide "after-the fact" information that may be useful in determining whether or not cleaning methods were effective in removing the contaminants of concern.

3.0 DOCUMENTATION

The decontamination process shall be recorded in the field logbook.

4.0 REFERENCES

SOP III-B, *Field QC Samples (Water, Soil).*

5.0 ATTACHMENTS

None.

EQUIPMENT CALIBRATION, OPERATION, AND MAINTENANCE

1.0 PURPOSE

This standard operating procedure (SOP) describes the activities and responsibilities of the U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) personnel pertaining to the operating, calibration, and maintenance of equipment used to collect environmental data. Reliable measurements of data required by the field sampling plan are necessary because the information recorded may be the basis for development of remedial action and responses.

2.0 PROCEDURES

2.1 EQUIPMENT CALIBRATION

All water quality monitoring equipment will be calibrated and adjusted to operate within the manufacturers' specifications. Water quality instruments and equipment that require calibration are to be calibrated to specifications prior to field use. In addition, a one-point calibration check is made at midday and at intervals outlined in the field sampling plan. A final check is conducted at the end of each field day. This is not a recalibration of the meter but a check of the calibration to ensure the continued accuracy of the meter. All calibration information shall be recorded in the project logbook.

Special attention shall be paid to instruments that may be affected by the change in the ambient temperature or humidity. Calibration checks should also be performed when sampling conditions change significantly, a change of sample matrix, and/or readings are unstable or there is a change of parameter measurements that appear unusual.

2.2 EQUIPMENT MAINTENANCE

All field monitoring equipment, field sampling equipment, and accessories are to be maintained in accordance with the manufacturer's recommendations and specifications and/or established field practices. All maintenance will be performed by qualified personnel and documented in the field logbook.

Equipment requiring battery charging shall be charged as recommended by the manufacturer. Backup batteries for meters requiring them shall be included as part of the meters accessories. Care must be taken to protect meters from adverse elements. This may involve placing the meter in a large plastic bag to shield it from the weather.

3.0 DOCUMENTATION

All field equipment calibration, maintenance, and operation information shall be recorded within the field logbook. This is to document that appropriate procedures have been followed and to track the equipment operation. All entries in the field logbook must be written accurately and legibly as outlined in the SOP III-D, *Logbooks*.

Logbook entries shall contain, but are not necessarily limited to, the following:

- Equipment model and serial numbers
- Date and time of calibration or maintenance performed
- Calibration standard used

- Calibration lot number and expiration date if listed on bottle
- Calibration procedure used if there are multiple options
- Calibration and calibration check readings including units used
- Problems and solutions regarding use, calibration or maintenance of the equipment
- And other pertinent information

4.0 REFERENCES

SOP III-D, *Logbooks*

5.0 ATTACHMENTS

None.

AUDITING

1.0 PURPOSE

The purpose of this procedure is to establish and maintain uniform procedures for quality assurance audits to assure compliance with site-specific planning documents (e.g., Work Plan (WP), Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP)), associated Standard Operating Procedures (SOP), and applicable contract and regulatory requirements. This procedure provides the requirements and guidance for guidance for implementing both system and performance audits. Audits may be performed voluntarily or as requested by the Navy RPM. These auditing procedures are not required unless an audit has been requested by the Navy for a specific project.

2.0 PROCEDURES

2.1 AUDIT TYPES

Four specific kinds of audits can be used at appropriate times to determine the status of the measurement systems, the adequacy of the data collection systems, the completeness of documentation of data collection activities, and the abilities of the program management to meet the mandated data collection and data quality objectives.
These four audit types are, respectively: Performance Audits, Technical System Audits, Data Quality Audits, and Management System Audits, as follows:

2.1.1 Performance Audit

A performance audit is used to determine the status and effectiveness of both field and laboratory measurement systems. An independent check is made to obtain a quantitative measure of the quality of data generated. For laboratories, this involves the use of standard reference samples or performance evaluation samples. These samples have known concentrations of constituents that are analyzed as unknowns in the laboratory. Results of the laboratory analysis are calculated for accuracy against known concentrations and evaluated in relation to the data quality objectives established for the project. Field performance is evaluated using field blanks and equipment decontamination rinsates. For both laboratory and field performance, the number of and type of control samples are presented in the QAPP. In either instance, the performance audit is conducted following laboratory analysis of the control samples.

2.1.2 Technical System Audit

A technical systems audit is used to confirm the adequacy of the data collection (field operation) and data generation (laboratory operation) systems. This is an on-site audit that is conducted to determine whether the QA plans and standard operating procedures are properly implemented.

- A systems audit of field procedures shall assess and document, at a minimum, sampling methods (including collection, containers, and preservation), equipment decontamination, chain-of-custody, sample tracking and shipment documentation, sample labeling, quality control methodology, pre-field activities, equipment maintenance and calibration,

post-field activities, sampling documentation, and other field activity logs, field team debriefing, and equipment check-in and recalibration.

- A systems audit of laboratory procedures shall assess and document, at a minimum, methods for data qualification, analytical data generation, chain-of-custody documentation and protocol, instrument calibration, data reporting, and quality control methods.

2.1.3 Data Quality Analysis

A data quality analysis is conducted to assess the effectiveness and documentation of the data collection and generation processes. The data assessment parameters and methods set forth in the QAPP are evaluated to determine if the data quality objectives were met. The data quality analysis is conducted following laboratory analysis of the appropriate control samples.

2.1.4 Management Systems Audit

A management system audit is used to evaluate the ability to program management to meet programmatic requirements or the project management team to meet specific data collection and data quality objectives. If substantial non-conformances are identified from other scheduled audits, or if programmatic concern exists for the quality of data and related documentation, then this form of auditing is employed under the guidance and direction of the Quality Assurance Officer (QAO).

2.2 AUDIT SCHEDULING

The QAO will announce audits in advance to the PM, to the audited entity, and to the NAVFAC NW Representative who has the option to attend. Unannounced audits may be undertaken in instances where information indicates the existence of serious quality control problems.

System audits may be scheduled for all activities affecting data quality, and shall be included in the Plan Schedules of such assignments. Field and laboratory system audits will occur prior to or shortly after a system is operational. Field and laboratory performance audits shall be scheduled after a system has been operational for a short time.

The QAO and PM shall identify the entity and activities to be audited and maintain an audit schedule.

2.3 AUDIT TEAM

Audit teams shall be appointed by the QAO. Audit teams will usually consist of the Audit Team Leader and one or more auditors selected from qualified personnel who have had no prior involvement in the audited work assignment. However, audits may be conducted entirely by the Audit Team Leader. The QAO, as appropriate, will brief the audit teams on the specific task(s) of the audit.

2.4 REVIEW

The audit plan shall be prepared by the Audit Team Leader for approval by the QAO. This plan shall include:

- Audited organization;
- Activities to be audited;
- Checklist(s) developed as appropriate to audit the activities to be audited;

- Names of audit team members;
- Listing of equipment and supplies needed during the audit; and
- A tentative schedule of audit activities including a pre-audit meeting with senior personnel, planned audit activities, and a post-audit debriefing meeting of site personnel.

The Audit Team Leader shall provide to the auditor(s), if any, prior to initiation of the audit, pertinent policies, procedures, standards, manuals, plans, codes, regulatory requirements, prior audit reports, and responses for information and review. The Audit Team Leader shall ensure that the auditor(s) understands the internal and external organizational and contractual interfaces and responsibilities of the organization to be audited.

2.5 AUDIT NOTIFICATION

The QAO shall notify the PM and the audited entity of the details of the scheduled audit (audit activities, schedule, and team). This will be done early enough to allow the audited entity to coordinate with the Audit Team Leader any logistic support needed by the audit team, and in general to facilitate conduct of the audit without disruption of the audited entity's normal operations.

2.6 PRE-AUDIT MEETING

The Audit Team Leader, upon arrival at the audited entity, shall meet with the entity's responsible party to:

- Introduce auditor(s) and meet participants;
- Confirm the scope of the audit and present the audit plan, except for checklists;
- Discuss the audit checklists in general terms and discuss audit sequence;
- Review previous audit results, if applicable; and
- Establish channel of communication and arrange post-audit meeting.

2.7 AUDIT PERFORMANCE

Checklists will be used to ensure depth and continuity of audits. The audit checklist is intended for use as a guide and will not restrict the audit investigation when findings raise further questions that are not specifically included in the checklist. Selected elements of the QA program shall be audited to the depth necessary to determine whether they are being implemented effectively.

Conditions requiring prompt corrective action shall be reported immediately to the PM. The QAO or PM, with the concurrence of the NAVFAC NW, has the authority to stop work on the project if deemed necessary.

2.8 POST-AUDIT MEETING

At the conclusion of the audit, the audit team shall meet to review the results and consolidate them for presentation at a post-audit meeting. The Audit Team Leader (and his team) shall hold a post-audit meeting with the audited entity in order to present the team's initial findings. It shall be made clear that the results are tentative and that the final results will be reported in writing. Objectives of the post-audit meeting shall be to:

- Discuss the audit findings and determine and resolve any errors or misunderstandings regarding the findings;
- Discuss required corrective action and recommend improvements;

- Establish a schedule for corrective action development and implementation; and
- Schedule a follow-up audit, if appropriate.

2.9 AUDIT REPORT

Each audit team member shall prepare a report on the findings and include copies of the completed checklists. The Audit Team Leader shall consolidate the reports into a consensus document for review by the QAO. The final report shall be signed by the Audit Team Leader and by the QAO as approving it.

The audit report shall include the following elements:

- Project name;
- Project number;
- Audit Team Leader and audit members;
- Audit date;
- Audit location;
- Audit scope;
- References used as a basis for evaluating conformance to requirements;
- Audit contacts during the pre-audit, audit, and post-audit activities;
- Audit results which summarize any findings or observations. A description of each reported adverse audit finding in sufficient detail to ensure that corrective action can be effectively carried out by the PM. Significant findings shall be identified as such;
- Recommendations for correcting the non-conformances, and improving the quality control procedures as considered appropriate;
- Signature of Audit Team Leader and date; and
- An audit summary including an evaluation of the effectiveness of quality control activities audited.

The QA Audit Report shall be submitted to the QAO for review. The QAO shall issue a memorandum to the PM with copies to the audited entity including requirements for the audited organization to review and investigate audit findings and observations, and to determine and schedule action to correct the identified problem and prevent recurrence of the same or similar problems. The memorandum shall require a response by the audited organization within 30 days of receipt of the Audit Report, giving the results of their investigation and the corrective action. A copy of the Audit Report shall be transmitted to the PM and to Management.

2.10 CORRECTIVE ACTION REPLY

The PM or designee shall determine and schedule any appropriate corrective actions and document his/her response on Section II of the AFR (Attachment IV-E-4) within 30 days of receipt of the audit. The response shall clearly state the corrective action for each finding, including action to prevent recurrence and the date the corrective action has been or will be completed. In the case of significant conditions adverse to quality, the cause of the condition shall be documented and corrective action taken to prevent recurrence. The PM shall sign and date the reply and submit it, together with any backup documentation to QAO with copies to the Audit Team Leader.

2.11 CORRECTIVE ACTION VERIFICATION

Follow-up action shall be performed by the Audit Team Leader to:

- Evaluate the adequacy of the response;
- Ensure that corrective action is identified and scheduled for each nonconformance; and
- Confirm that the corrective action is accomplished as scheduled.

Corrective actions must be completed to the satisfaction of the Audit Team Leader. Follow-up action may be accomplished through written communication, re-audit, or other appropriate means.

2.12 AUDIT COMPLETION

The QAO shall issue an audit completion memo which shall indicate the completion of the audit, any identified non-conformances or deficiencies, corrective action taken, follow-up review of the corrective action, and final recommendations. The QAO shall notify the PM and the audited entity of the completion of the audit with copies to NAVFAC NW.

3.0 DOCUMENTATION

None.

4.0 REFERENCES

None.

5.0 ATTACHMENTS

None.

NONCONFORMANCES AND CORRECTIVE ACTION

1.0 PURPOSE

This procedure outlines the mechanisms for identifying, documenting, segregating, dispositioning, and notifying affected organizations of non-conformances. Procedures are also presented for ensuring the appropriate actions are taken to identify the cause of all non-conformances and the implementation of corrective actions.

2.0 PROCEDURES

2.1 IDENTIFICATION OF A NON-CONFORMANCE

Program personnel engaged in project work that discover or suspect a non-conformance shall immediately mark or tag the non-conforming item(s) in an appropriate manner and initiate a Non-conformance and Corrective Action Report (NCAR) using Attachment IV-F-1. The staff member shall obtain a NCAR form and transmit the report to the PM for evaluation and confirmation of the existence of a non-conformance, with copies to the Quality Assurance Officer (QAO).

The PM or appropriate programmatic personnel shall ensure that no further work dependent on the non-conforming item or activity is performed until approval is obtained from the QAO and the NCAR is closed out. If the non-conformance is related to materials; the PM or Field Coordinator shall mark or identify the non-conforming item (if practical) with the NCAR number. Following closeout of the NCAR, the PM or Field Coordinator shall clear or dispose of the item, as appropriate.

2.2 EVALUATION OF NON-CONFORMANCES

The PM or designee shall confirm and evaluate the suspected non-conformance at the earliest time practicable, and determine its impact on the project as a whole. The PM shall document his evaluation on Attachment IV-F-1, NCAR, and transmit the NCAR to the QAO and NCAR originator, applicable project file, and other affected personnel. If it is determined that the non-conformance has significant impact on final results submitted to the NAVFAC NW RPM, immediate verbal notification shall be made followed by written documentation.

If the PM or designee determines that there is impact and the QAO judges that the non-conformance is significant and seriously jeopardizes project quality, the QAO shall, with the concurrence of the PM, issue a stop work order for the activity in question. If a stop work order has been issued, work cannot restart until corrective action has been taken to the satisfaction of the QAO and the PM. The stop work order shall be rescinded when the QAO has concluded that the non-conformance has been satisfactorily addressed.

2.3 IMPLEMENTATION OF CORRECTIVE ACTION

Within a reasonable time of identifying a non-conformance, the PM or designee shall confer with the QAO on the steps to be taken to correct the non-conformance. The cause shall be determined and those actions deemed necessary to correct the non-conforming item(s) as well as to prevent

recurrence. The QAO shall ensure that the corrective actions(s) will prevent or reduce the likelihood of future non-conformances of a similar nature and are realistic in terms of the resources required for implementation. All selected corrective action measures shall be appropriate to the seriousness of the non-conformance. The corrective action instructions shall be transmitted to the project staff by the QAO via a corrective action meeting, training session, internal memorandum, or other appropriate means.

The PM shall assign qualified personnel to perform and check the corrective and preventive action(s) and document the actions taken on Attachment IV-F-1, NCAR. The response shall include scheduled dates for completion of all corrective actions if such action cannot reasonably be completed within 30 days. The completed NCAR shall then be transmitted to the QAO for review.

2.4 VERIFICATION

When a corrective action is completed, the QAO shall evaluate the adequacy of the response and confirm that corrective action has been accomplished as scheduled by signing the NCAR. Copies of the completed report shall be transmitted to the QAO, PM, originator, and the QA program file. The original signed NCAR shall be placed in the project file.

3.0 DOCUMENTATION

An example non-conformance and corrective action report is provided in Attachment IV-F-1.

4.0 REFERENCES

None.

5.0 ATTACHMENTS

Attachment IV-F-1 Example Non-conformance and Corrective Action Report

Attachment IV-F-1
Example Non-conformance and Corrective Action Report

Non-conformance and Corrective Action Report

NCAR No. _____

Client/Project Name:_____

I. Identification (to be completed by the Originator)

Description of Non-conformance (attach additional pages as required.)

Reported by: _____Date:_____

Originator

II. Evaluation (to be completed by Project Manager or designee)

Evaluation Summary

Impact: Yes o No o

Confirmed by: _____Date:_____

Project Leader

III. Disposition (to be completed by Project Manager or designee)

Cause(s) of Non-conformance

Corrective/Preventative Action(s) Taken: Completion Date: _____

Approved by: _____ Date: _____

Project Manager

IV. Client Notification:

Oral to: _____By/Date: _____

In writing to: _____ By/Date: _____

V. Verification

All corrective action/preventative actions and reporting (as applicable are complete)

Verified by: _____Date:_____

QA Officer

APPENDIX A
Applicable Standard Operating Procedures

Table of Contents

OP-376	Soil Core Scanning (Rev 2)
OP-387	Gamma Walkover Survey

APPENDIX B

Field Forms

SAMPLING DEVIATION FORM

Project Name: _____ Contract No.: _____

Location: _____ Task No.: _____

Site Name: _____ Location.: _____

Inspector(s): _____ Date/Time: _____

Company: _____

Weather/Temperature: _____

Material to Be Sampled:

Measurement Parameter:

Reason for Change in Field Procedure or Analytical Variation:

Variation From Field or Analytical Procedure:

Special Equipment, Materials, or Personnel Required:

Initiator's Name: _____ Date: _____

NAVFAC NW RPM: _____ Date: _____

Project Manager: _____ Date: _____

QA Officer/Reviewer: _____ Date _____

FIELD CHANGE REQUEST FORM

CONTRACT NO.	TASK ORDER NO.	Field Change Request Form No.
N44255-09-D-4001	0076	1
Location Former Naval Station Puget Sound	Date	Page 1 of 1

RE: _____ Drawing No. _____ Title _____

_____ Specification Section _____ Title _____

Other Title _____

Description (items involved, submit sketch, if applicable) (Use continuation sheet if necessary)

Reason for Change (Use continuation sheet if necessary)

Recommended Disposition (submit sketch, if applicable) (Use Continuation Sheet if necessary)

Preparer Print Name:	Eric Lillywhite	Date	Preparer's Title	Project Manager Print Name:		Date
(signature)				(Signature)		
NTR Acknowledgement Print Name:		Date		Navy RPM Print Name:		Date
(signature)				(signature)		
CIH Print Name:		Date		QA Program Manager Print Name:		Date
(signature)				(signature)		
☐ Comments (attached) ☐ No Comments				☐ Comments (attached) ☐ No Comments		
Title		Date		Title		Date
Print Name				Print Name		
(signature)				(signature)		
☐ Comments (attached) ☐ No Comments				☐ Comments (attached) ☐ No Comments		

FORM 11-2
SAMPLE COLLECTION INFORMATION

Installation ID:	Establishing Contract ID:	Prime Contractor Name:
Site Name:	DO/CTO:	Establishing Phase:	Collection Date:

Location Name	Sample Name	Depth Range (feet bgs)		Collection Time	Sample Matrix	Sample Type	Sampling Equipment	Composite (Y/N)
		Start Depth	End Depth					

Sample Matrix

AA	ambient air	PP	precipitate
AX	air	SBS	subsurface soil
BS	brackish sediment	SE	sediment
DF	dust/fallout	SL	sludge
DR	debris/rubble	SN	building material
EF	emissions flux	SO	soil
EW	elutriate water	SS	scrapings
FB	fibers	SU	surface soil
GR	gravel	SW	swab or wipe
GS	soil gas	TX	tissue
IDS	IDW soil	W	water
IDW	IDW water	WB	brackish water
LF	product	WG	groundwater
MR	marine sediment	WM	marine water
NS	near-surface soil	WS	surface water

Sampling Equipment

B	bailer	HA	hand auger
BS	beach seine	HC	hand collected
CC	continuous core sampler	HK	hook and line
CH	charcoal sampling tube	PP	pump–peristaltic
CO	core sampler	PU	pump-standard
CP	pump–centrifugal	SK	skimmer
DG	drill rig	SS	split spoon
DT	drive tube(geoprobe, direct push, CPT rig)	SY	syringe
		T	shelby tube
E2	pump-electric submersible	TB	tedlar bag
		TR	animal trap
G	grab	TL	trawl
		VC	vacuum (gas)
		V V	van veen
		W	swab or wipe

Sample Types

AB	ambient condition blank	N	Normal (Regular)
		PE	performance evaluation
BIOCON	bioassay control sample	RD	regulatory duplicate
		SB	source blank
BS	blank spike	SBD	source blank duplicate
BSD	blanks spike dup	SD	matrix spike duplicate
EB	equipment blank	SPLIT	sample split
EBD	equipment blank / rinsate dup	SRM	standard reference material
FB	field blank	TB	trip blank
FD	field duplicate	TBD	trip blank duplicate
FR	field replicate	TBR	trip blank replicate
FS	field spike		
MB	material blank		
MS	matrix spike		

Recorder: _____ Date: _____

Checker: _____ Date: _____

Instructions
Form 11-2 (Sample Collection Information)

The purpose of this form is to collate sample collection information for data entry to serve as a quick reference for sample information. Every sample that is collected should be recorded on one of these forms. The information recorded on this form must come from the field logbook, which is the official record. This form must be filled out in its entirety; if a value or piece of information is unknown or not applicable, a horizontal line should be drawn through that field.

The information on this form must be checked against the field logbook for accuracy and completeness by a field staff member before the form is submitted for data entry. Data from this form will not be entered without the signature of the individual who checked the form for accuracy and completeness.

Installation ID: Unique identifier for installation associated with the location (example: WHIDBEY)

Establishing Contract ID: Unique contract ID assigned by Division Contraction Office (example: D459559365800)

Prime Contractor Name: Name of company that established location (example: URS)

Site Name: Site name associated with the location (example: Site 11)

DO/CTO: Contract Task Order (CTO) or Delivery Order (DO) number assigned by the Navy. The format is NNNN (example: 0012)

Establishing Phase: Task Phase, Subtask Number or Annual Quarter (example: 1)

Collection Date: Date samples were collected

Location Name: Unique name used for the location (example: MW-2R)

Sample Name: Unique sample name assigned by the contractor and/or derived from historical data submittal (example: MW-1-11/02/98)

Depth Range (feet bgs): Start and end depth of sample collection, if applicable.

Collection Time: Time at which sample was collected

Sample Matrix: Matrix type code from options at the bottom of form (example: MR)

Sample Type: Sample type code from options at bottom of form (example: N)

Sampling Equipment: Sampling equipment code from options at bottom of form (example: G)

Composite: A Y/N field indicating whether or not the sample is a composite

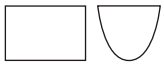
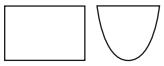
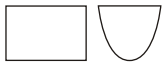
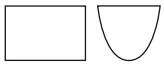
Recorder: Signature of individual who completed form and date completed

Checker: Signature of individual who checked the data against the field logbook and date checked

Van Veen Sample Log

URS

Project Number	Project Name/Location		
Station I.D.	Vessel I.D.	Samplers	Date
Coordinates			Start Time
			Page of

1	2	3	4
Depth of Grab (ft)	Depth of Grab (ft)	Depth of Grab (ft)	Depth of Grab (ft)
Time on Bottom	Time on Bottom	Time on Bottom	Time on Bottom
Penetration (cm)	Penetration (cm)	Penetration (cm)	Penetration (cm)
% Full (shade in) 	% Full (shade in) 	% Full (shade in) 	% Full (shade in) 

Sediment Description (sediment type, color, odor, organisms present, etc.)

Washed Residue Description	Washed Residue Description	Washed Residue Description	Washed Residue Description
% Rock	% Rock	% Rock	% Rock
% Wood	% Wood	% Wood	% Wood

Total Number of Replicates (if additional log sheets are used)

Comments

Checked By	Date

3375618 SAMPLE LOG.cdr

Project: Project Location: Project Number:	Log of Boring Sheet 1 of

Date(s) Drilled			Logged By	Checked By
Drilling Method			Drilling Contractor	Total Depth Drilled (FT BGS) 50.0
Drill Rig Type			Sampler Type	Surface Elevation
Groundwater Level			Drill Bit Size/Type	Top of PVC Elevation
Diameter of Hole (inches)	Diameter of Well (inches)		Type of Well Casing	Screen Perforation
Type of Sand Pack			Type and Depth of Seal(s)	
Comments				

Elevation, feet (MSL)	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Run/ Recovery	SAMPLES: OVM (ppm)	USCS	Graphic Log	MATERIAL DESCRIPTION	Well Completion Log	Drilling Rate (24-hr clock)	REMARKS
	0										
	1										
	2										
	3										
	4										
	5										
	6										
	7										
	8										
	9										
	10										
	11										
	12										

Project: Project Location: Project Number:	Log of Boring Sheet 2 of

Elevation, feet (MSL)	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Run/ Recovery	SAMPLES: OVM (ppm)	USCS	Graphic Log	MATERIAL DESCRIPTION	Well Completion Log	Drilling Rate (24-hr clock)	REMARKS
	12										
	13										
	14										
	15										
	16										
	17										
	18										
	19										
	20										
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										

URS

APPENDIX B
Field Forms

Table of Contents

APPENDIX C

U.S. Department of Defense Environmental Laboratory Accreditation Program

Certifications for Test America, Earth City, MO

LABORATORY ACCREDITATION BUREAU a division of A-S-B

Certificate of Accreditation

ISO/IEC 17025:2005 Certificate Number L2305

TestAmerica Laboratories

St. Louis Facility
13715 Rider Trail North
Earth City Missouri 63045

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: April 6, 2019

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 6th of April 2016

*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).
Form 403.14 – Rev 1 7/3/13

LABORATORY ACCREDITATION BUREAU

Certificate # L2305

Scope of Accreditation For TestAmerica Laboratories

St. Louis Facility
13715 Rider Trail North
Earth City, Missouri 63045
Tony Byrd
314-298-8566

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (LABPR 403 DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V5) based on the TNI Standard - Environmental Laboratory Sector, Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis, Sept 2009 (EL-V1-2009); accreditation is granted to **TestAmerica Laboratories** to perform the following tests:

Accreditation granted through: **April 6, 2019**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Aluminum
ICP-AES	EPA 6010C	Antimony
ICP-AES	EPA 6010C	Arsenic
ICP-AES	EPA 6010C	Barium
ICP-AES	EPA 6010C	Beryllium
ICP-AES	EPA 6010C	Bismuth
ICP-AES	EPA 6010C	Boron
ICP-AES	EPA 6010C	Cadmium
ICP-AES	EPA 6010C	Calcium
ICP-AES	EPA 6010C	Chromium
ICP-AES	EPA 6010C	Cobalt
ICP-AES	EPA 6010C	Copper
ICP-AES	EPA 6010C	Iron
ICP-AES	EPA 6010C	Lead
ICP-AES	EPA 6010C	Lithium
ICP-AES	EPA 6010C	Magnesium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Manganese
ICP-AES	EPA 6010C	Molybdenum
ICP-AES	EPA 6010C	Nickel
ICP-AES	EPA 6010C	Phosphorus
ICP-AES	EPA 6010C	Potassium
ICP-AES	EPA 6010C	Selenium
ICP-AES	EPA 6010C	Silicon
ICP-AES	EPA 6010C	Silver
ICP-AES	EPA 6010C	Sodium
ICP-AES	EPA 6010C	Strontium
ICP-AES	EPA 6010C	Sulfur
ICP-AES	EPA 6010C	Thallium
ICP-AES	EPA 6010C	Thorium
ICP-AES	EPA 6010C	Tin
ICP-AES	EPA 6010C	Titanium
ICP-AES	EPA 6010C	Uranium
ICP-AES	EPA 6010C	Vanadium
ICP-AES	EPA 6010C	Zinc
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	n-Butanol
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Carbon disulfide

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chlorobromomethane
GC/MS	EPA 8260C	2-Chloro-1,3-butadiene
GC/MS	EPA 8260C	Chlorodibromomethane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	Allyl chloride
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	1,1-Dichloropropene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 8260C	Dimethyl disulfide
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl ether
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Freon 113
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	n-Hexane
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutanol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methyl butyl ketone
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Dichloromethane
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	MTBE
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	Nonanal
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	Tetrachloroethene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	Trichlorotrifluoroethane
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	m-Xylene & p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Xylenes (total)
GC/MS	EPA 8260C SIM	1,4-Dioxane
GC/MS	EPA 624	Acetone
GC/MS	EPA 624	Acetonitrile
GC/MS	EPA 624	Acrolein
GC/MS	EPA 624	Acrylonitrile
GC/MS	EPA 624	Benzene
GC/MS	EPA 624	Benzyl chloride
GC/MS	EPA 624	Bromobenzene
GC/MS	EPA 624	Bromochloromethane
GC/MS	EPA 624	Bromodichloromethane
GC/MS	EPA 624	Bromoform
GC/MS	EPA 624	Bromomethane
GC/MS	EPA 624	n-Butanol
GC/MS	EPA 624	2-Butanone
GC/MS	EPA 624	n-Butylbenzene
GC/MS	EPA 624	sec-Butylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624	tert-Butylbenzene
GC/MS	EPA 624	Carbon disulfide
GC/MS	EPA 624	Carbon tetrachloride
GC/MS	EPA 624	Chlorobenzene
GC/MS	EPA 624	Chlorobromomethane
GC/MS	EPA 624	2-Chloro-1,3-butadiene
GC/MS	EPA 624	Chlorodibromomethane
GC/MS	EPA 624	Dibromochloromethane
GC/MS	EPA 624	Chloroethane
GC/MS	EPA 624	2-Chloroethyl vinyl ether
GC/MS	EPA 624	Chloroform
GC/MS	EPA 624	Chloromethane
GC/MS	EPA 624	Allyl chloride
GC/MS	EPA 624	2-Chlorotoluene
GC/MS	EPA 624	4-Chlorotoluene
GC/MS	EPA 624	Cyclohexane
GC/MS	EPA 624	Cyclohexanone
GC/MS	EPA 624	1,2-Dibromo-3-chloropropane
GC/MS	EPA 624	1,2-Dibromoethane
GC/MS	EPA 624	Dibromomethane
GC/MS	EPA 624	1,2-Dichlorobenzene
GC/MS	EPA 624	1,3-Dichlorobenzene
GC/MS	EPA 624	1,4-Dichlorobenzene
GC/MS	EPA 624	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624	Dichlorodifluoromethane
GC/MS	EPA 624	1,1-Dichloroethane
GC/MS	EPA 624	1,2-Dichloroethane
GC/MS	EPA 624	cis-1,2-Dichloroethene
GC/MS	EPA 624	trans-1,2-Dichloroethene
GC/MS	EPA 624	1,1-Dichloroethene
GC/MS	EPA 624	1,2-Dichloroethene (total)
GC/MS	EPA 624	1,2-Dichloropropane
GC/MS	EPA 624	1,3-Dichloropropane
GC/MS	EPA 624	2,2-Dichloropropane
GC/MS	EPA 624	cis-1,3-Dichloropropene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624	trans-1,3-Dichloropropene
GC/MS	EPA 624	1,1-Dichloropropene
GC/MS	EPA 624	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 624	Dimethyl disulfide
GC/MS	EPA 624	1,4-Dioxane
GC/MS	EPA 624	Ethyl acetate
GC/MS	EPA 624	Ethylbenzene
GC/MS	EPA 624	Ethyl ether
GC/MS	EPA 624	Diethyl ether
GC/MS	EPA 624	Ethyl methacrylate
GC/MS	EPA 624	Freon 113
GC/MS	EPA 624	Hexachlorobutadiene
GC/MS	EPA 624	n-Hexane
GC/MS	EPA 624	2-Hexanone
GC/MS	EPA 624	Iodomethane
GC/MS	EPA 624	Isobutanol
GC/MS	EPA 624	Isopropylbenzene
GC/MS	EPA 624	p-Isopropyltoluene
GC/MS	EPA 624	Methacrylonitrile
GC/MS	EPA 624	Methyl acetate
GC/MS	EPA 624	Methyl butyl ketone
GC/MS	EPA 624	Methylcyclohexane
GC/MS	EPA 624	Dichloromethane
GC/MS	EPA 624	Methylene chloride
GC/MS	EPA 624	Methyl methacrylate
GC/MS	EPA 624	4-Methyl-2-pentanone
GC/MS	EPA 624	MTBE
GC/MS	EPA 624	Naphthalene
GC/MS	EPA 624	2-Nitropropane
GC/MS	EPA 624	Nonanal
GC/MS	EPA 624	Pentachloroethane
GC/MS	EPA 624	Propionitrile
GC/MS	EPA 624	n-Propylbenzene
GC/MS	EPA 624	Styrene
GC/MS	EPA 624	1,1,1,2-Tetrachloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624	Tetrachloroethene
GC/MS	EPA 624	Tetrahydrofuran
GC/MS	EPA 624	Toluene
GC/MS	EPA 624	1,3,5-Trichlorobenzene
GC/MS	EPA 624	1,2,3-Trichlorobenzene
GC/MS	EPA 624	1,2,4-Trichlorobenzene
GC/MS	EPA 624	1,1,1-Trichloroethane
GC/MS	EPA 624	1,1,2-Trichloroethane
GC/MS	EPA 624	Trichloroethene
GC/MS	EPA 624	Trichlorofluoromethane
GC/MS	EPA 624	1,2,3-Trichloropropane
GC/MS	EPA 624	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 624	Trichlorotrifluoroethane
GC/MS	EPA 624	1,2,4-Trimethylbenzene
GC/MS	EPA 624	1,3,5-Trimethylbenzene
GC/MS	EPA 624	Vinyl acetate
GC/MS	EPA 624	Vinyl chloride
GC/MS	EPA 624	m-Xylene & p-Xylene
GC/MS	EPA 624	o-Xylene
GC/MS	EPA 624	Xylenes (total)
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite (total)
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(b)fluoranthene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzo(ghi)perylene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	1,1'-Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	n-Butylbenzenesulfonamide
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	p-Chlorobenzilate
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Cresols (total)
GC/MS	EPA 8270D	Cyclohexanol
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dichlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	p-Dimethylaminoazobenzene
GC/MS	EPA 8270D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	Dimethylformamide
GC/MS	EPA 8270D	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	1,3-Dinitrobenzene
GC/MS	EPA 8270D	1,4-Dinitrobenzene
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Ethyl methacrylate
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	2-Methylbenzenamine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 8270D	Methyl methacrylate
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 8270D	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 8270D	Methylphenols (total)
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270D	N-Nitrosodi-n-butylamine
GC/MS	EPA 8270D	N-Nitrosodiethylamine
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	N-Nitrosomethylethylamine
GC/MS	EPA 8270D	N-Nitrosomorpholine
GC/MS	EPA 8270D	N-Nitrosopiperidine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	5-Nitro-o-toluidine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	Parathion
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	p-Phenylene diamine
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	2-Picoline
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 8270D	Thionazin
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Tributyl phosphate
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270D	Tris(2-chloroethyl)phosphate
GC/MS	EPA 8270D	1-Methyl naphthalene
GC/MS	EPA 625	Acenaphthene
GC/MS	EPA 625	Acenaphthylene
GC/MS	EPA 625	Acetophenone
GC/MS	EPA 625	2-Acetylaminofluorene
GC/MS	EPA 625	4-Aminobiphenyl
GC/MS	EPA 625	Aniline

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	Anthracene
GC/MS	EPA 625	Aramite (total)
GC/MS	EPA 625	Atrazine
GC/MS	EPA 625	Azobenzene
GC/MS	EPA 625	Benzaldehyde
GC/MS	EPA 625	Benzidine
GC/MS	EPA 625	Benzo(a)anthracene
GC/MS	EPA 625	Benzo(b)fluoranthene
GC/MS	EPA 625	Benzo(k)fluoranthene
GC/MS	EPA 625	Benzoic acid
GC/MS	EPA 625	Benzo(ghi)perylene
GC/MS	EPA 625	Benzo(a)pyrene
GC/MS	EPA 625	Benzyl alcohol
GC/MS	EPA 625	1,1'-Biphenyl
GC/MS	EPA 625	bis(2-Chloroethoxy)methane
GC/MS	EPA 625	bis(2-Chloroethyl) ether
GC/MS	EPA 625	bis(2-Chloroisopropyl) ether
GC/MS	EPA 625	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 625	4-Bromophenyl phenyl ether
GC/MS	EPA 625	n-Butylbenzenesulfonamide
GC/MS	EPA 625	Butyl benzyl phthalate
GC/MS	EPA 625	Caprolactam
GC/MS	EPA 625	Carbazole
GC/MS	EPA 625	4-Chloroaniline
GC/MS	EPA 625	Chlorobenzilate
GC/MS	EPA 625	p-Chlorobenzilate
GC/MS	EPA 625	4-Chloro-3-methylphenol
GC/MS	EPA 625	2-Chloronaphthalene
GC/MS	EPA 625	2-Chlorophenol
GC/MS	EPA 625	4-Chlorophenyl phenyl ether
GC/MS	EPA 625	Chrysene
GC/MS	EPA 625	Cresols (total)
GC/MS	EPA 625	Cyclohexanol
GC/MS	EPA 625	Diallate
GC/MS	EPA 625	Dibenz(a,h)anthracene
GC/MS	EPA 625	Dibenzo(a,h)anthracene
GC/MS	EPA 625	Dibenzofuran
GC/MS	EPA 625	Di-n-butyl phthalate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	1,2-Dichlorobenzene
GC/MS	EPA 625	1,3-Dichlorobenzene
GC/MS	EPA 625	1,4-Dichlorobenzene
GC/MS	EPA 625	3,3'-Dichlorobenzidine
GC/MS	EPA 625	2,4-Dichlorophenol
GC/MS	EPA 625	2,6-Dichlorophenol
GC/MS	EPA 625	Diethyl phthalate
GC/MS	EPA 625	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 625	Dimethoate
GC/MS	EPA 625	p-Dimethylaminoazobenzene
GC/MS	EPA 625	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 625	3,3'-Dimethylbenzidine
GC/MS	EPA 625	Dimethylformamide
GC/MS	EPA 625	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 625	2,4-Dimethylphenol
GC/MS	EPA 625	Dimethyl phthalate
GC/MS	EPA 625	1,3-Dinitrobenzene
GC/MS	EPA 625	1,4-Dinitrobenzene
GC/MS	EPA 625	4,6-Dinitro-2-methylphenol
GC/MS	EPA 625	2,4-Dinitrophenol
GC/MS	EPA 625	2,4-Dinitrotoluene
GC/MS	EPA 625	2,6-Dinitrotoluene
GC/MS	EPA 625	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 625	Dinoseb
GC/MS	EPA 625	Di-n-octyl phthalate
GC/MS	EPA 625	1,4-Dioxane
GC/MS	EPA 625	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 625	Disulfoton
GC/MS	EPA 625	Ethyl methacrylate
GC/MS	EPA 625	Ethyl methanesulfonate
GC/MS	EPA 625	Famphur
GC/MS	EPA 625	Fluoranthene
GC/MS	EPA 625	Fluorene
GC/MS	EPA 625	Hexachlorobenzene
GC/MS	EPA 625	Hexachlorobutadiene
GC/MS	EPA 625	Hexachlorocyclopentadiene
GC/MS	EPA 625	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 625	Hexachloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	Hexachlorophene
GC/MS	EPA 625	Hexachloropropene
GC/MS	EPA 625	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 625	Isodrin
GC/MS	EPA 625	Isophorone
GC/MS	EPA 625	Isosafrole
GC/MS	EPA 625	Kepone
GC/MS	EPA 625	Methapyrilene
GC/MS	EPA 625	2-Methylbenzenamine
GC/MS	EPA 625	3-Methylcholanthrene
GC/MS	EPA 625	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 625	Methyl methacrylate
GC/MS	EPA 625	Methyl methanesulfonate
GC/MS	EPA 625	2-Methylnaphthalene
GC/MS	EPA 625	Methyl parathion
GC/MS	EPA 625	2-Methylphenol
GC/MS	EPA 625	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 625	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 625	Methylphenols (total)
GC/MS	EPA 625	Naphthalene
GC/MS	EPA 625	1,4-Naphthoquinone
GC/MS	EPA 625	1-Naphthylamine
GC/MS	EPA 625	2-Naphthylamine
GC/MS	EPA 625	2-Nitroaniline
GC/MS	EPA 625	3-Nitroaniline
GC/MS	EPA 625	4-Nitroaniline
GC/MS	EPA 625	Nitrobenzene
GC/MS	EPA 625	2-Nitrophenol
GC/MS	EPA 625	4-Nitrophenol
GC/MS	EPA 625	4-Nitroquinoline-1-oxide
GC/MS	EPA 625	N-Nitrosodi-n-butylamine
GC/MS	EPA 625	N-Nitrosodiethylamine
GC/MS	EPA 625	N-Nitrosodimethylamine
GC/MS	EPA 625	N-Nitrosodiphenylamine
GC/MS	EPA 625	N-Nitrosodi-n-propylamine
GC/MS	EPA 625	N-Nitrosomethylethylamine
GC/MS	EPA 625	N-Nitrosomorpholine
GC/MS	EPA 625	N-Nitrosopiperidine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	N-Nitrosopyrrolidine
GC/MS	EPA 625	5-Nitro-o-toluidine
GC/MS	EPA 625	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 625	Parathion
GC/MS	EPA 625	Pentachlorobenzene
GC/MS	EPA 625	Pentachloroethane
GC/MS	EPA 625	Pentachloronitrobenzene
GC/MS	EPA 625	Pentachlorophenol
GC/MS	EPA 625	Phenacetin
GC/MS	EPA 625	Phenanthrene
GC/MS	EPA 625	Phenol
GC/MS	EPA 625	p-Phenylene diamine
GC/MS	EPA 625	Phorate
GC/MS	EPA 625	2-Picoline
GC/MS	EPA 625	Pronamide
GC/MS	EPA 625	Pyrene
GC/MS	EPA 625	Pyridine
GC/MS	EPA 625	Safrole
GC/MS	EPA 625	Sulfotepp
GC/MS	EPA 625	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 625	Thionazin
GC/MS	EPA 625	o-Toluidine
GC/MS	EPA 625	Tributyl phosphate
GC/MS	EPA 625	1,2,4-Trichlorobenzene
GC/MS	EPA 625	2,4,5-Trichlorophenol
GC/MS	EPA 625	2,4,6-Trichlorophenol
GC/MS	EPA 625	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 625	1,3,5-Trinitrobenzene
GC/MS	EPA 625	Tris(2-chloroethyl)phosphate
GC/MS	EPA 625	1-Methyl naphthalene
GC-ECD	EPA 8081B	Aldrin
GC-ECD	EPA 8081B	alpha-BHC
GC-ECD	EPA 8081B	beta-BHC
GC-ECD	EPA 8081B	delta-BHC
GC-ECD	EPA 8081B	gamma-BHC (Lindane)
GC-ECD	EPA 8081B	alpha-Chlordane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8081B	gamma-Chlordane
GC-ECD	EPA 8081B	Chlordane (technical)
GC-ECD	EPA 8081B	4,4'-DDD
GC-ECD	EPA 8081B	2,4'-DDD
GC-ECD	EPA 8081B	4,4'-DDE
GC-ECD	EPA 8081B	2,4'-DDE
GC-ECD	EPA 8081B	4,4'-DDT
GC-ECD	EPA 8081B	2,4'-DDT
GC-ECD	EPA 8081B	Dieldrin
GC-ECD	EPA 8081B	Endosulfan I
GC-ECD	EPA 8081B	Endosulfan II
GC-ECD	EPA 8081B	Endosulfan sulfate
GC-ECD	EPA 8081B	Endrin
GC-ECD	EPA 8081B	Endrin aldehyde
GC-ECD	EPA 8081B	Endrin ketone
GC-ECD	EPA 8081B	Heptachlor
GC-ECD	EPA 8081B	Heptachlor epoxide
GC-ECD	EPA 8081B	Methoxychlor
GC-ECD	EPA 8081B	Toxaphene
GC-ECD	EPA 608	Aldrin
GC-ECD	EPA 608	alpha-BHC
GC-ECD	EPA 608	beta-BHC
GC-ECD	EPA 608	delta-BHC
GC-ECD	EPA 608	gamma-BHC (Lindane)
GC-ECD	EPA 608	alpha-Chlordane
GC-ECD	EPA 608	gamma-Chlordane
GC-ECD	EPA 608	Chlordane (technical)
GC-ECD	EPA 608	4,4'-DDD
GC-ECD	EPA 608	2,4'-DDD
GC-ECD	EPA 608	4,4'-DDE
GC-ECD	EPA 608	2,4'-DDE
GC-ECD	EPA 608	4,4'-DDT
GC-ECD	EPA 608	2,4'-DDT
GC-ECD	EPA 608	Dieldrin
GC-ECD	EPA 608	Endosulfan I
GC-ECD	EPA 608	Endosulfan II

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-ECD	EPA 608	Endosulfan sulfate
GC-ECD	EPA 608	Endrin
GC-ECD	EPA 608	Endrin aldehyde
GC-ECD	EPA 608	Endrin ketone
GC-ECD	EPA 608	Heptachlor
GC-ECD	EPA 608	Heptachlor epoxide
GC-ECD	EPA 608	Methoxychlor
GC-ECD	EPA 608	Toxaphene
GC-ECD	EPA 608	Aroclor 1016
GC-ECD	EPA 608	Aroclor 1221
GC-ECD	EPA 608	Aroclor 1232
GC-ECD	EPA 608	Aroclor 1242
GC-ECD	EPA 608	Aroclor 1248
GC-ECD	EPA 608	Aroclor 1254
GC-ECD	EPA 608	Aroclor 1260
GC-ECD	EPA 608	Aroclor 1262
GC-ECD	EPA 608	Aroclor 1268
GC-ECD	EPA 8082A	Aroclor 1016
GC-ECD	EPA 8082A	Aroclor 1221
GC-ECD	EPA 8082A	Aroclor 1232
GC-ECD	EPA 8082A	Aroclor 1242
GC-ECD	EPA 8082A	Aroclor 1248
GC-ECD	EPA 8082A	Aroclor 1254
GC-ECD	EPA 8082A	Aroclor 1260
GC-ECD	EPA 8082A	Aroclor 1262
GC-ECD	EPA 8082A	Aroclor 1268
GC-ECD	EPA 8151A	2,4-D
GC-ECD	EPA 8151A	Dalapon
GC-ECD	EPA 8151A	2,4-DB
GC-ECD	EPA 8151A	Dicamba
GC-ECD	EPA 8151A	Dichlorprop
GC-ECD	EPA 8151A	Dinoseb
GC-ECD	EPA 8151A	2,4,5-TP (Silvex)
GC-ECD	EPA 8151A	2,4,5-T
GC-FID	RSK-175	Methane
GC-FID	RSK-175	Ethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-FID	RSK-175	Ethene
GC-FID	RSK-175	Acetylene
GC-FID	EPA 8015B	Ethanol
GC-FID	EPA 8015B	Methanol
GC-FID	EPA 8015B	Ethylene glycol
GC-FID	EPA 8015B	Propylene glycol
GC-FID	EPA 8015B	Diesel Range Organics
GC-FID	EPA 8015B	Motor Oil Range Organics
GC-FID	EPA 8015B	TPH (as Diesel)
GC-FID	EPA 8015B	Gasoline Range Organics
LC/MS/MS	EPA 8321A	2-Amino-4,6-dinitrotoluene
LC/MS/MS	EPA 8321A	4-Amino-2,6-dinitrotoluene
LC/MS/MS	EPA 8321A	3,5-Dinitroaniline
LC/MS/MS	EPA 8321A	1,3-Dinitrobenzene
LC/MS/MS	EPA 8321A	2,4-Dinitrotoluene
LC/MS/MS	EPA 8321A	2,6-Dinitrotoluene
LC/MS/MS	EPA 8321A	DNX
LC/MS/MS	EPA 8321A	HMX
LC/MS/MS	EPA 8321A	HNAB
LC/MS/MS	EPA 8321A	HNS
LC/MS/MS	EPA 8321A	MNX
LC/MS/MS	EPA 8321A	Nitrobenzene
LC/MS/MS	EPA 8321A	Nitroglycerin
LC/MS/MS	EPA 8321A	4-Nitrotoluene
LC/MS/MS	EPA 8321A	3-Nitrotoluene
LC/MS/MS	EPA 8321A	2-Nitrotoluene
LC/MS/MS	EPA 8321A	PETN
LC/MS/MS	EPA 8321A	RDX
LC/MS/MS	EPA 8321A	TATB
LC/MS/MS	EPA 8321A	Tetryl
LC/MS/MS	EPA 8321A	TNX
LC/MS/MS	EPA 8321A	1,3,5-Trinitrobenzene
LC/MS/MS	EPA 8321A	2,4,6-Trinitrotoluene
LC/MS/MS	EPA 8321A	Tris (o-cresyl) Phosphate
LC/MS/MS	EPA 8321A	2,4-diamino-6-nitrotoluene
LC/MS/MS	EPA 8321A	2,6-diamino-4-nitrotoluene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B	1,3-Dinitrobenzene
HPLC	EPA 8330B	2,4-Dinitrotoluene
HPLC	EPA 8330B	2,6-Dinitrotoluene
HPLC	EPA 8330B	HMX
HPLC	EPA 8330B	HNAB
HPLC	EPA 8330B	HNS
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	PETN
HPLC	EPA 8330B	RDX
HPLC	EPA 8330B	TATB
HPLC	EPA 8330B	Tetryl
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8330B	1,3,5-Trinitrobenzene
HPLC	EPA 8330B	2,4,6-Trinitrotoluene
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(ghi)perylene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	Naphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
LC/MS/MS	EPA 6850	Perchlorate
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Bismuth
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Cerium
ICP-MS	EPA 6020A	Cesium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Hafnium
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lanthanum
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Neodymium
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Niobium
ICP-MS	EPA 6020A	Palladium
ICP-MS	EPA 6020A	Phosphorus
ICP-MS	EPA 6020A	Platinum
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Praseodymium
ICP-MS	EPA 6020A	Rhodium
ICP-MS	EPA 6020A	Ruthenium
ICP-MS	EPA 6020A	Samarium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silicon
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Sulfur
ICP-MS	EPA 6020A	Tantalum
ICP-MS	EPA 6020A	Tellurium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Thorium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Uranium 233
ICP-MS	EPA 6020A	Uranium 234
ICP-MS	EPA 6020A	Uranium 235
ICP-MS	EPA 6020A	Uranium 236
ICP-MS	EPA 6020A	Uranium 238
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Yttrium
ICP-MS	EPA 6020A	Zinc
ICP-MS	EPA 6020A	Zirconium
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Bismuth
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Cerium
ICP-MS	EPA 200.8	Cesium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Hafnium
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lanthanum
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Neodymium
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Niobium
ICP-MS	EPA 200.8	Palladium
ICP-MS	EPA 200.8	Phosphorus
ICP-MS	EPA 200.8	Platinum
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Praseodymium
ICP-MS	EPA 200.8	Rhodium
ICP-MS	EPA 200.8	Ruthenium
ICP-MS	EPA 200.8	Samarium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silicon
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Sulfur
ICP-MS	EPA 200.8	Tantalum
ICP-MS	EPA 200.8	Tellurium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Thorium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Tungsten
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Yttrium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Zinc
ICP-MS	EPA 200.8	Zirconium
ICP-AES	EPA 200.7	Aluminum
ICP-AES	EPA 200.7	Antimony
ICP-AES	EPA 200.7	Arsenic
ICP-AES	EPA 200.7	Barium
ICP-AES	EPA 200.7	Beryllium
ICP-AES	EPA 200.7	Bismuth
ICP-AES	EPA 200.7	Boron
ICP-AES	EPA 200.7	Cadmium
ICP-AES	EPA 200.7	Calcium
ICP-AES	EPA 200.7	Chromium
ICP-AES	EPA 200.7	Cobalt
ICP-AES	EPA 200.7	Copper
ICP-AES	EPA 200.7	Iron
ICP-AES	EPA 200.7	Lead
ICP-AES	EPA 200.7	Lithium
ICP-AES	EPA 200.7	Magnesium
ICP-AES	EPA 200.7	Manganese
ICP-AES	EPA 200.7	Molybdenum
ICP-AES	EPA 200.7	Nickel
ICP-AES	EPA 200.7	Phosphorus
ICP-AES	EPA 200.7	Potassium
ICP-AES	EPA 200.7	Selenium
ICP-AES	EPA 200.7	Silicon
ICP-AES	EPA 200.7	Silver
ICP-AES	EPA 200.7	Sodium
ICP-AES	EPA 200.7	Strontium
ICP-AES	EPA 200.7	Sulfur
ICP-AES	EPA 200.7	Thallium
ICP-AES	EPA 200.7	Thorium
ICP-AES	EPA 200.7	Tin
ICP-AES	EPA 200.7	Titanium
ICP-AES	EPA 200.7	Uranium
ICP-AES	EPA 200.7	Vanadium
ICP-AES	EPA 200.7	Zinc

Non-Potable Water		
Technology	**Method**	**Analyte**
CVAA	EPA 7470A	Mercury
Colorimetric	EPA 9010C EPA 9012B	Cyanide
Ion Chromatrography	EPA 300.0/9056A	Bromide
Ion Chromatrography	EPA 300.0/9056A	Chloride
Ion Chromatrography	EPA 300.0/9056A	Fluoride
Ion Chromatrography	EPA 300.0/9056A	Nitrate
Ion Chromatrography	EPA 300.0/9056A	Nitrite
Ion Chromatrography	EPA 300.0/9056A	Sulfate
Ion Chromatrography	EPA 300.0/9056A	Ortho-phosphate
Ion Chromatrography	EPA 300.0/9056A	Iodide
Ion Chromatrography	EPA 314.0	Perchlorate
Gravimetric	SM 2540B SM 2540C SM 2540D	Solids
Probe	EPA 9040C EPA 9045D EPA 150.1	pH
Titration	SM 2320B EPA 310.1	Alkalinity
Titration	EPA 9030	Sulfide
Penske-Martin	EPA 1010A	Ignitability
Colormetric	EPA 353.1	nitrate/Nitrite
Colormetric	EPA 350.1	Ammonia
TOC Analyzer	EPA 9060A	TOC
Tritrmetric	EPA 9020B	TOX
Colormetric	EPA 7196A	Hex Chromium
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	TPH
Probe	EPA 9050A	Conductivity
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium

Non-Potable Water		
Technology	**Method**	**Analyte**
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE	Calcium-45

Non-Potable Water		
Technology	**Method**	**Analyte**
	HASL 300 Ga-01-R	
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Uranium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium

Non-Potable Water		
Technology	**Method**	**Analyte**
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	Laboratory SOP ST-RC-0210	Polonium-210
Liquid Scintillation Counter	Eichrom Technologies FEW01	Iron-55
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63
Liquid Scintillation Counter	SM 7500-IB	Iodine-129
Preparation	**Method**	**Type**
Organic Extraction & Sample Prep	EPA 3500C	Organic Extraction & Sample Prep
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Organic prep/analysis	EPA 8000C	Determinative Chromatographic Separations
Acid Digestion (Aqueous samples)	EPA 3010A	Acid Digestion for Metals (Aqueous samples)
Purge & Trap	EPA 5030C	Purge & Trap for Aqueous Volatile
Sep Funnel Liquid-Liquid Extraction	EPA 3510C	Sep Funnel Liquid-Liquid Extraction
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Florisil Cleanup	EPA 3620C	Florisil Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup
Acid Clean Up	EPA 3665A	Acid Clean Up for PCBs
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction
Solid Phase Extraction	EPA 3535A	Solid Phase Extraction

Drinking Water		
Technology	**Method**	**Analyte**
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Aluminum
ICP-AES	EPA 6010C	Antimony
ICP-AES	EPA 6010C	Arsenic
ICP-AES	EPA 6010C	Barium
ICP-AES	EPA 6010C	Beryllium
ICP-AES	EPA 6010C	Bismuth
ICP-AES	EPA 6010C	Boron
ICP-AES	EPA 6010C	Cadmium
ICP-AES	EPA 6010C	Calcium
ICP-AES	EPA 6010C	Chromium
ICP-AES	EPA 6010C	Cobalt
ICP-AES	EPA 6010C	Copper
ICP-AES	EPA 6010C	Iron
ICP-AES	EPA 6010C	Lead
ICP-AES	EPA 6010C	Lithium
ICP-AES	EPA 6010C	Magnesium
ICP-AES	EPA 6010C	Manganese
ICP-AES	EPA 6010C	Molybdenum
ICP-AES	EPA 6010C	Nickel
ICP-AES	EPA 6010C	Phosphorus
ICP-AES	EPA 6010C	Potassium
ICP-AES	EPA 6010C	Selenium
ICP-AES	EPA 6010C	Silicon
ICP-AES	EPA 6010C	Silver
ICP-AES	EPA 6010C	Sodium
ICP-AES	EPA 6010C	Strontium
ICP-AES	EPA 6010C	Sulfur

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Thallium
ICP-AES	EPA 6010C	Thorium
ICP-AES	EPA 6010C	Tin
ICP-AES	EPA 6010C	Titanium
ICP-AES	EPA 6010C	Uranium
ICP-AES	EPA 6010C	Vanadium
ICP-AES	EPA 6010C	Zinc
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	n-Butanol
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chlorobromomethane
GC/MS	EPA 8260C	2-Chloro-1,3-butadiene
GC/MS	EPA 8260C	Chlorodibromomethane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	Allyl chloride
GC/MS	EPA 8260C	2-Chlorotoluene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 8260C	Dimethyl disulfide
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl ether
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Freon 113
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	n-Hexane
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	Iodomethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Isobutanol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methyl butyl ketone
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Dichloromethane
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	MTBE
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	Nonanal
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	Tetrachloroethene
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	Trichlorotrifluoroethane
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	m-Xylene & p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Xylenes (total)
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite (total)
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzo(ghi)perylene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	1,1'-Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	n-Butylbenzenesulfonamide
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	Chlorobenzilate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	p-Chlorobenzilate
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Cresols (total)
GC/MS	EPA 8270D	Cyclohexanol
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	p-Dimethylaminoazobenzene
GC/MS	EPA 8270D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	Dimethylformamide
GC/MS	EPA 8270D	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	1,3-Dinitrobenzene
GC/MS	EPA 8270D	1,4-Dinitrobenzene
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-sec-Butyl-4,6-dinitrophenol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Ethyl methacrylate
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	2-Methylbenzenamine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 8270D	Methyl methacrylate
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 8270D	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 8270D	Methylphenols (total)
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	1,4-Naphthoquinone

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270D	N-Nitrosodi-n-butylamine
GC/MS	EPA 8270D	N-Nitrosodiethylamine
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	N-Nitrosomethylethylamine
GC/MS	EPA 8270D	N-Nitrosomorpholine
GC/MS	EPA 8270D	N-Nitrosopiperidine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	Parathion
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	p-Phenylene diamine
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	2-Picoline
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Sulfotepp

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 8270D	Thionazin
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Tributyl phosphate
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270D	Tris(2-chloroethyl)phosphate
GC/MS	EPA 8270D	1-Methyl naphthalene
GC-ECD	EPA 8081B	Aldrin
GC-ECD	EPA 8081B	alpha-BHC
GC-ECD	EPA 8081B	beta-BHC
GC-ECD	EPA 8081B	delta-BHC
GC-ECD	EPA 8081B	gamma-BHC (Lindane)
GC-ECD	EPA 8081B	alpha-Chlordane
GC-ECD	EPA 8081B	gamma-Chlordane
GC-ECD	EPA 8081B	Chlordane (technical)
GC-ECD	EPA 8081B	4,4'-DDD
GC-ECD	EPA 8081B	2,4'-DDD
GC-ECD	EPA 8081B	4,4'-DDE
GC-ECD	EPA 8081B	2,4'-DDE
GC-ECD	EPA 8081B	4,4'-DDT
GC-ECD	EPA 8081B	2,4'-DDT
GC-ECD	EPA 8081B	Dieldrin
GC-ECD	EPA 8081B	Endosulfan I
GC-ECD	EPA 8081B	Endosulfan II
GC-ECD	EPA 8081B	Endosulfan sulfate
GC-ECD	EPA 8081B	Endrin
GC-ECD	EPA 8081B	Endrin aldehyde
GC-ECD	EPA 8081B	Endrin ketone
GC-ECD	EPA 8081B	Heptachlor
GC-ECD	EPA 8081B	Heptachlor epoxide

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8081B	Methoxychlor
GC-ECD	EPA 8081B	Toxaphene
GC-ECD	EPA 8082A	Aroclor 1016
GC-ECD	EPA 8082A	Aroclor 1221
GC-ECD	EPA 8082A	Aroclor 1232
GC-ECD	EPA 8082A	Aroclor 1242
GC-ECD	EPA 8082A	Aroclor 1248
GC-ECD	EPA 8082A	Aroclor 1254
GC-ECD	EPA 8082A	Aroclor 1260
GC-ECD	EPA 8082A	Aroclor 1262
GC-ECD	EPA 8082A	Aroclor 1268
GC-ECD	EPA 8151A	2,4-D
GC-ECD	EPA 8151A	Dalapon
GC-ECD	EPA 8151A	2,4-DB
GC-ECD	EPA 8151A	Dicamba
GC-ECD	EPA 8151A	Dichlorprop
GC-ECD	EPA 8151A	Dinoseb
GC-ECD	EPA 8151A	2,4,5-TP (Silvex)
GC-ECD	EPA 8151A	2,4,5-T
LC/MS/MS	EPA 8321A	2-Amino-4,6-dinitrotoluene
LC/MS/MS	EPA 8321A	4-Amino-2,6-dinitrotoluene
LC/MS/MS	EPA 8321A	3,5-Dinitroaniline
LC/MS/MS	EPA 8321A	1,3-Dinitrobenzene
LC/MS/MS	EPA 8321A	2,4-Dinitrotoluene
LC/MS/MS	EPA 8321A	2,6-Dinitrotoluene
LC/MS/MS	EPA 8321A	DNX
LC/MS/MS	EPA 8321A	HMX
LC/MS/MS	EPA 8321A	HNAB
LC/MS/MS	EPA 8321A	HNS
LC/MS/MS	EPA 8321A	MNX
LC/MS/MS	EPA 8321A	Nitrobenzene
LC/MS/MS	EPA 8321A	Nitroglycerin
LC/MS/MS	EPA 8321A	4-Nitrotoluene
LC/MS/MS	EPA 8321A	3-Nitrotoluene
LC/MS/MS	EPA 8321A	2-Nitrotoluene
LC/MS/MS	EPA 8321A	PETN

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 8321A	RDX
LC/MS/MS	EPA 8321A	TATB
LC/MS/MS	EPA 8321A	Tetryl
LC/MS/MS	EPA 8321A	TNX
LC/MS/MS	EPA 8321A	1,3,5-Trinitrobenzene
LC/MS/MS	EPA 8321A	2,4,6-Trinitrotoluene
LC/MS/MS	EPA 8321A	Tris (o-cresyl) Phosphate
LC/MS/MS	EPA 8321A	2,4-diamino-6-nitrotoluene
LC/MS/MS	EPA 8321A	2,6-diamino-4-nitrotoluene
HPLC	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B	1,3-Dinitrobenzene
HPLC	EPA 8330B	2,4-Dinitrotoluene
HPLC	EPA 8330B	2,6-Dinitrotoluene
HPLC	EPA 8330B	HMX
HPLC	EPA 8330B	HNAB
HPLC	EPA 8330B	HNS
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	PETN
HPLC	EPA 8330B	RDX
HPLC	EPA 8330B	TATB
HPLC	EPA 8330B	Tetryl
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8330B	1,3,5-Trinitrobenzene
HPLC	EPA 8330B	2,4,6-Trinitrotoluene
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(ghi)perylene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
GC/MS	EPA 8260C SIM	1,4- dioxane
GC-FID	EPA 8015B	Diesel Range Organics
GC-FID	EPA 8015B	Motor Oil Range Organics
GC-FID	EPA 8015B	TPH (as Diesel)
GC-FID	EPA 8015B	Gasoline Range Organics
GC-FID	EPA 8015B	Ethanol
GC-FID	EPA 8015B	Methanol
GC-FID	EPA 8015B	Ethylene glycol
GC-FID	EPA 8015B	Propylene glycol
LC/MS/MS	EPA 6850	Perchlorate
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Bismuth
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Cerium
ICP-MS	EPA 6020A	Cesium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Hafnium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lanthanum
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Neodymium
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Niobium
ICP-MS	EPA 6020A	Palladium
ICP-MS	EPA 6020A	Phosphorus
ICP-MS	EPA 6020A	Platinum
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Praseodymium
ICP-MS	EPA 6020A	Rhodium
ICP-MS	EPA 6020A	Ruthenium
ICP-MS	EPA 6020A	Samarium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silicon
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Sulfur
ICP-MS	EPA 6020A	Tantalum
ICP-MS	EPA 6020A	Technetium-99
ICP-MS	EPA 6020A	Tellurium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Thorium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Uranium 233
ICP-MS	EPA 6020A	Uranium 234
ICP-MS	EPA 6020A	Uranium 235

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Uranium 236
ICP-MS	EPA 6020A	Uranium 238
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Yttrium
ICP-MS	EPA 6020A	Zinc
ICP-MS	EPA 6020A	Zirconium
CVAA	EPA 7471B	Mercury
Colormetric	EPA 9010C EPA 9012B	Cyanide
Ion Chromatrography	EPA 300.0 EPA 9056A	Bromide
Ion Chromatrography	EPA 300.0 EPA 9056A	Chloride
Ion Chromatrography	EPA 300.0 EPA 9056A	Fluoride
Ion Chromatrography	EPA 300.0 EPA 9056A	Nitrate
Ion Chromatrography	EPA 300.0 EPA 9056A	Nitrite
Ion Chromatrography	EPA 300.0 EPA 9056A	Sulfate
Ion Chromatrography	EPA 300.0 EPA 9056A	Ortho-phosph
Ion Chromatrography	EPA 300.0 EPA 9056A	Iodide
Ion Chromatrography	EPA 314.0	Perchlorate
Gravimetric	SM 2540B SM 2540C SM 2540D	Solids
Probe	EPA 9040C EPA 9045D EPA 150.1	pH
Titration	SM 2320B EPA 310.1	Alkalinity
Titration	EPA 9030	Sulfide
Penske-Martin	EPA 1010A	Ignitability
Colormetric	EPA 353.1	nitrate/Nitrite
Colormetric	EPA 350.1	Ammonia
TOC Analyzer	EPA 9060A	TOC
Colormetric	EPA 7196A	Hex Chromium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	TPH
Probe	EPA 9050A	Conductivity
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Uranium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	Laboratory SOP ST-RC-0210	Polonium-210
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63
Liquid Scintillation Counter	SM 7500-IB	Iodine-129
Preparation	**Method**	**Type**
Organic Extraction & Sample Prep	EPA 3500C	Organic Extraction & Sample Prep
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Organic prep/analysis	EPA 8000C	Determinative Chromatographic Separations
Acid Digestion (Aqueous samples)	EPA 3010A	Acid Digestion for Metals (Aqueous samples)
Acid Digestion (solids)	EPA 3050B	Acid Digestion for Metals of Sedimtent/Soils
Purge & Trap	EPA 5030C	Purge & Trap for Aqueous Volatile Samples
Closed System Purge & Trap and Extraction for Volatiles	EPA 5035A	Closed System Purge & Trap and Extraction for Volatiles
Sep Funnel Liquid-Liquid Extraction	EPA 3510C	Sep Funnel Liquid-Liquid Extraction
Ultrasonic Extraction	EPA 3550C	Ultrasonic Extraction Organic Soils
Solid Phase Extraction	EPA 3535A	Solid Phase Extraction
Acid Clean-up	EPA 3665A	Acid Clean Up for PCBs
Florisil Cleanup	EPA 3620C	Florisil Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup
Waste Dilution	EPA 3585	Waste Dilution Volatile Organics

Solid and Chemical Materials		
Preparation	**Method**	**Type**
Waste Dilution	EPA 3580A	Waste Dilution SemiVolatile Organics
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction
Alkaline Digestion	EPA 3060A	Alkaline Digestion for Hexavalent Chromium

Notes:

1) This laboratory offers commercial testing service.

Approved by: _____ Date: April 6, 2016

R. Douglas Leonard
Chief Technical Officer

Re-Issued: 4/6/16

PART 3

Radiation Protection Plan

CONTENTS

CONTENTS (Continued)

ABBREVIATIONS AND ACRONYMS

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
Cabrera	Cabrera Services, Inc.
Ce	cesium
CFR	Code of Federal Regulations
cm	centimeter
cpm	counts per minute
DAC	derived air concentration
DOH	Washington State Department of Health
DOT	U.S. Department of Transportation
dpm	disintegration per minute
EM-385-1-1	USACE *Safety and Health Requirements Manual*
HWP	Hazardous Work Permit
LLRW	low-level radioactive waste
mrem	millirem
NAVSTA PS	Naval Station Puget Sound
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
pCi/g	picocurie per gram
PPE	personal protective equipment
PROC	potential radionuclide of concern
Pu	plutonium
Ra	radium
RASO	Radiological Affairs Support Office
RCA	radiological controlled area
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RML	radioactive material license
RSO	Radiation Safety Officer
RPP	radiation protection plan
RWP	Radiation Work Permit
SI	site inspection
SMS	Safety Management Standard
Sr	strontium
SRSO	Site Radiation Safety Officer

ABBREVIATIONS AND ACRONYMS (Continued)

1	SSHP	site safety and health plan
2	TCRA	time critical removal action
3	TEDE	total effective dose equivalent
4	Th	thorium
5	USACE	U.S. Army Corps of Engineers
6	WAC	Washington Administrative Code

GLOSSARY

Airborne radioactivity area – Area where the measured concentration of airborne radioactivity above natural background exceeds a peak concentration of 1 derived air concentration (DAC) or 12 DAC-hours during a work week.

As low as reasonably achievable (ALARA) – An approach to radiological control or a process to manage and control exposures to the work force and the general public at levels as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations.

Bioassay – Measurement of radioactive material deposited within or excreted from the body. This process includes whole body, urine and organ counting, and others.

Contaminated area – An area in which radioactive contamination is present that exceeds removable levels (presented in Table 10-1).

Controlled area – An area in which access is controlled to protect personnel from exposure to radiation and radioactive materials. An area in which the existing or potential radiation and radioactivity levels are above normal background, but are less than that designating a radiological area or a restricted area.

Derived air concentration (DAC) – The concentration of a radionuclide in air that, if breathed over the period of a work year, would result in the annual limit on intake being reached.

Disintegration per minute (dpm) – The rate of emission by radioactive material as determined by correcting the counts per minute observed by a detector for background, efficiency, and window size associated with the instrument.

Dose – A generic term for the amount of energy deposited in body tissue because of radiation exposure. Technical definitions for dose terms necessary for various exposure calculations and recordkeeping purposes include the following:

- Absorbed dose (D): Energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. The units of absorbed dose are the rad and the gray (Gy).

- Dose equivalent (HT): The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

- Effective dose equivalent (HE): The sum of the products of the dose equivalent to the organ or tissue (HT) and the weighting factors (WT) applicable to each of the body organs or tissues that are irradiated (HE = WT x HT).

- Committed dose equivalent (HT,50): The dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by a person during the 50-year period following the intake.

- Committed effective dose equivalent (HE,50): The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues (HE,50 = WT x HT,50)

- Total effective dose equivalent: The sum of the deep dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

- Total organ dose equivalent: The sum of the deep dose equivalent (for external exposures) and the committed dose equivalent to an individual organ or tissue (for internal exposures).

Frisking – Process of monitoring personnel for contamination.

Hazardous Work Permit (HWP) – Permit that identifies both chemical and radiological conditions and health and safety hazards, establishes worker protection and monitoring requirements, and contains specific approvals for chemical and radiological work activities. The HWP serves as an administrative process for planning and controlling chemical and radiological work and informing the worker of the chemical, radiological, health, and safety issues. HWPs are only used when both chemical and radiological hazards are present. Refer to Radiation Work Permit (RWP) for radiological conditions only.

High radiation area – An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent to or in excess of 100 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

Mixed waste – Waste containing low-level radioactive waste as well as Resource Conservation and Recovery Act (RCRA) waste.

Occupational dose – The dose received by a person during employment in which the person's assigned duties involve exposure to radiation and to radioactive material. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the public.

Personnel dosimetry – Devices designed to be worn by a single person for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters, optically stimulated luminescence, and pocket ionization chambers.

Personnel monitoring – Systematic and periodic estimate of radiation dose received by personnel during work hours.

Radiation – Ionizing radiation includes alpha particulate, beta particulate, X-rays, gamma rays, neutrons, and other particulates capable of producing ions.

Radiation area – An area accessible to individuals in which radiation levels could result in an individual receiving a dose in excess of 0.005 rem in 1 hour at 30 cm from the source of radiation or from any surface that the radiation penetrates.

Radiation Work Permit (RWP) – A permit that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. The RWP serves as an administrative process for planning and controlling radiological work and informing the worker of the radiological, health, and safety issues. If non-radiological hazards are also present, the HWP is used to provide a single permit which addresses all hazards.

Radioactive material area – A controlled area or structure where radioactive material is used, handled, or stored.

Radiological worker – A worker whose job assignment requires work on, with, or in the proximity of radiation production machines or radioactive materials. A radiological worker has the potential to be exposed to more than 100 mrem per year, which is the sum of the dose equivalent to external irradiation and the committed effective dose equivalent to internal irradiation.

Removable contamination – Radioactive material that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.

Survey – An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other source of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Unrestricted area – An area designated by the Nuclear Regulatory Commission (NRC) as being an area to which access is neither limited nor controlled by a NRC licensee.

1.0 PURPOSE AND SCOPE

This radiation protection plan (RPP) was prepared for Site Inspection (SI) work at the former Naval Station Puget Sound (NAVSTA PS). Radiological work will be conducted after applying for and receiving reciprocity with the Washington Department of Health (DOH), Division of Radiation Protection, and the Nuclear Regulatory Commission Region 4 using the URS Utah Radioactive Materials License UT1800410, Amendment 11 (Appendix A). This RPP has been developed to ensure the requirements of the URS corporate radiation protection program Safety Management Standard (SMS) 052 (Appendix B), and reciprocity license requirements are followed for this work. This plan is compliant with U.S. regulations and the requirements of the U.S. Army Corps of Engineers (USACE) *Safety and Health Requirements Manual* (EM-385-1-1), Section 6E (Radiation Safety Program). The RPP provides site-specific information to facilitate the implementation of SMS 052 and ensure the following:

- Site inspection (SI) activities at NAVSTA PS are conducted in accordance with the DOH reciprocity license, and consistent with sound radiological practices.
- Radiological exposure to site personnel and the environment are maintained as low as reasonably achievable (ALARA).
- Activities at NAVSTA PS are performed in a manner consistent with applicable federal, state, and local regulations.

This RPP was prepared pursuant to the requirements of USACE EM-385-1-1, Section 6E (Radiation Safety Program) and is consistent with State of Washington requirements for a Radiation Protection Program presented at Washington Administrative Code 246-221-005.

2.0 APPLICABILITY

The work practices specified in this RPP are applicable to the SI work conducted by assigned project personnel (including subcontractors) at the NAVSTA PS (Site). This work includes conducting gamma walkover surveys, advancing boreholes, and the collection of soil, sludge, and sediment samples. The presence of low levels of radiation and radioactivity at the Site may result in the exposure of employees to ionizing radiation. The potential radionuclides of concern (PROCs) at the Site include radium-226 (Ra-226), cesium-137 (Cs-137), strontium-90 (Sr-90), thorium-232 (Th-232), and plutonium-239 (Pu-239). A radiological remedial investigation (RI) was conducted at the Site in 2010 and the report generated in 2011, and Table 2-1 provides a summary of the maximum soil and sediment concentrations reported during the radiological RI. The maximum gamma radiation exposure rate recorded outside during the radiological RI was 340 microroentgens per hour (µR/hr), and was associated with a point source. A Time Critical Removal Action (TCRA) occurred at the Site between 2013 and 2015, with the final report generated in 2016. During this TCRA the locations with the maximum soil and gamma concentrations were remediated. However, these values do provide an upper bound on the radiation levels that may be encountered during the SI.

All work performed under this RPP will be conducted under supervision of a Site Radiation Safety Officer (SRSO).

Table 2-1
Potential Radionuclides of Concern & Historic Site Specific Concentrations

Potential Radionuclide of Concern (PROC)	TCRA Background (pCi/g)	RI Maximum Soil (pCi/g)	RI Maximum Sediment (pCi/g)	Half-Life (Years)
Radium-226	0.337	2,150	17.9	1,600
Cesium-137	0.0025	N/A	6.03	30
Strontium-90	0.0099	N/A	N/A	29
Thorium-232	0.3532	N/A	N/A	14 billion
Plutonium-239	N/A	N/A	N/A	24,100

Notes:
N/A - not available
pCi/g - picocurie per gram
TCRA - Time Critical Removal Action
RI Remedial Investigation

3.0 PROJECT ORGANIZATION

The URS corporate RSO provides programmatic oversight as detailed in SMS 052, Radiation Project Program. The corporate RSO is not listed on UT 1800410 but has designated the Site RSO (SRSO) who is listed, on the Utah License.

3.1 PROJECT MANAGER

The URS Project Manager is responsible for the following:

- Reviewing each scope of work to identify potential radiation hazards
- Ensuring that radioactive material license reciprocity application has been submitted to the State of Washington and formal reciprocity has been granted by the Washington State Department of Health, Radiation Protection, prior to starting invasive work.
- Arranging for employees on the project to receive appropriate radiation safety training

The Project Manager ensures that all employees under his or her control are knowledgeable of applicable radiological safety requirements for their work area and compliance with these requirements. The Project Managers emphasizes the need for high standards for radiological control through direct communication, support of radiation control goals, and a presence in the workplace.

3.2 SITE RADIATION SAFETY OFFICER

The SRSO is technically qualified and meets the following experience, training, and education minimal requirements:

- Formal training in radiation protection that covers the following topics: physics of radiation; radiation interaction with matter; mathematics necessary for the subject matter; biological effects of radiation; radiation instrument type, and detector theory
- Hands-on training will include the use of portable radiation instrumentation for monitoring and surveying

- Knowledge of regulations (Nuclear Regulatory Commission, U.S. Environmental Protection Agency, U.S. Department of Transportation, U.S. Department of Defense, and State of Washington) to include all applicable components pertaining to radioactive materials, and radioactive and mixed waste

The Site RSO develops and coordinates implementation of the corporate (Safety Management Standard 52), this RPP, and reciprocity license requirements. They are also responsible for:

- Conducting site radiological training
- Reviewing the qualifications of site radiation safety personnel
- Reviewing and approving the standard operating procedures that implement specific elements of the RPP
- Evaluating potential site/employee radiation exposure and recommending appropriate workplace and administrative controls

The Site RSO is responsible to ensure all project employees working on site, are knowledgeable of applicable radiological safety requirements for their work activities and areas, and will comply with these requirements.

Operations involving radiation hazards, use of radioactive material, or site personnel self-screening (frisking) are performed under the supervision of a person designated by the SRSO who is qualified and responsible for radiation safety.

3.3 HEALTH PHYSICS TECHNICIANS

Health Physics Technicians from Cabrera Services, Inc. (Cabrera), a subcontractor to URS, are responsible for conducting all site activities in accordance with the Cabrera license and assisting the SRSO in the implementation of radiological controls at each sampling site. Specific responsibilities include the following:

- Performing radiological surveys
- Collecting samples (air and water)
- In conjunction with the SRSO, assessing radiological hazards during work changes and making adjustments to ensure that worker radiological exposures and releases to the environment are maintained ALARA

Qualifications of Health Physics personnel are reviewed by the SRSO to ensure the level of expertise is commensurate with the assigned duties.

3.4 EMPLOYEES/CONTRACTORS

Employees/Contractors are responsible for knowing radiological protection requirements for their work areas and complying with these requirements. All employees working at the Site have authorization to stop work if an unsafe condition exists, and shall immediately notify the SRSO or Field Lead.

4.0 ALARA PROGRAM

4.1 POLICY STATEMENT

All work with ionizing radiation will be conducted in accordance with established good practices in radiation protection and in all cases to incorporate radiological criteria to ensure safety and maintain radiation exposures ALARA. To this end, the Project Managers is responsible for implementing all plans and procedures prepared in accordance with regulatory and contract documents. Project Managers are responsible for demonstrating the commitment through direct communication, instruction, and inspections of the workplace. Project Managers use facility and equipment design features as the primary method to maintain exposures ALARA. In most cases, decontamination operations represent an uncommon activity in facilities designed for specific purposes. Design features of temporary facilities and special equipment are in general augmented by administrative and procedural requirements.

4.2 ADMINISTRATIVE IMPLEMENTATION PROCEDURES

Implementation of specific steps aimed at maintaining radiation exposures ALARA are determined on a task-specific basis and are commensurate with the nature of both the radiological work being performed and the radiation hazards present. The TCRA After Action Report (U.S. Navy 2016b) stated “no processed personnel dosimetry badges revealed gamma doses above background.” Given this information the SI work is not expected to result in a radiation dose above background.

4.3 ALARA COMMITTEE

A formal ALARA Committee will not be established at the NAVSTA PS Site, as the work has a limited duration (less than 1 month) and the upper bound exposures estimate is less than the annual public dose limit. However, the ALARA principals of Time, Distance and shielding will be followed as they are applicable and will be included as part of the routine safety training.

5.0 EXPOSURE LIMITS

5.1 ADMINISTRATIVE GOALS

Administrative goals for radiological protection performance are established corporately. These limits are more conservative than regulatory limits, commensurate with the work plan and level of hazard and in accordance with the ALARA principle. Based on the TCRA after action report doses to project personnel are not anticipated to be above background. However the URS annual radiological goals (not to be exceeded) are retained in this plan and are as follows:

- Maximum individual total effective dose equivalent (TEDE): 500 mrem
- Maximum embryo/fetus total organ dose equivalent for a declared pregnancy: 100 mrem
- Maximum TEDE to a member of the public or visitor (excluding radon and thoron): 100 mrem

5.2 OCCUPATIONAL EXPOSURE LIMITS

The occupational exposure to employees performing the duties of radiation workers will be controlled so that the limits in Table 5-1 are not exceeded in 1 year. Furthermore, measures will be taken to maintain doses as far below these limits as reasonably achievable through the use of administrative goals, engineering controls, and application of the ALARA process. All URS employee occupational exposure received during the year, including exposures while employed elsewhere, will be included in the determination of occupational exposure. Contractor personnel are responsible for tracking occupational exposures that occur at other work sites. Radiation exposures from normal background, therapeutic and diagnostic medical radiation, and voluntary participation in medical research programs will not be included in the determination of occupational exposure. Planned special exposures will not be used.

5.3 EMBRYO/FETUS EXPOSURE LIMITS

The occupational dose equivalent limits applicable to the embryo/fetus are detailed in Table 5-1 and apply to a "declared pregnancy." In such a case, a woman elects to declare the pregnancy and limit the dose received by the embryo/fetus as provided in regulatory requirements. In this case, the dose equivalent goal for the embryo/fetus, from the period of conception to birth, from occupational exposure will be no more than 100 mrem. Declaration of Pregnancy Form, SMS Attachment 052-4 (Appendix B), will be used to document this decision. Embryo/Fetus Initial

Dose Calculation, SMS Attachment 052-5, will be used to assess the radiation exposure to the embryo/fetus at the time of declaration. Withdrawal of Declaration of Pregnancy, SMS Attachment 052-6, will be used to withdraw a pregnancy declaration.

5.4 MINOR EXPOSURE LIMITS

URS's policy is that no worker under 18 years of age will be allowed to work on site where there is the potential for exposure to radiation. This requirement is consistent with EM-385-1-1, Section 6E, which does not allow the occupational radiation exposure of minors.

5.5 MEMBERS OF THE PUBLIC EXPOSURE LIMITS

The annual exposure limit for licensed activities to any member of the public will be limited to 100 mrem TEDE. The dose equivalent in any unrestricted area from external sources will not exceed 2 mrem in any 1 hour, or 50 mrem per year, regardless of occupancy by a member of the public. Monitoring is only required at locations where licensed activities are being performed or radioactive material are being stored. Access restrictions will be implemented if exposure rate monitoring conducted during licensed activities are >10 µR/hr above background; additional restrictions will be implemented at >50 µR/hr.

5.6 AIR AND LIQUID EFFLUENTS

The release of air or liquid effluents is not anticipated based on the NAVSTA PS scope of work. If a release of radioactivity in air or liquid effluents occurs the areas will be monitored and controlled in accordance with the requirements of Washington Administrative Code 246-221-070. Air Monitoring conducted during the TCRA has demonstrated low risk; therefore air monitoring is not anticipated for SI activities.

Table 5-1
Occupational Dose Limits

Category	Project ALARA Limit		WAC 246-221-Limit	
	mrem/yr	mSv/yr	rem/yr	Sv/yr
Total effective dose equivalent	500	5	5	0.05
Total organ dose equivalent	5,000	50	50,	0.5
Lens of eye	1,500	15	15	0.15
Shallow dose	5,000	50	50	0.5
Embryo/fetus	100/gestation	1/gestation	0.5/gestation	0.005/ gestation
Minor	N/A	N/A	0.5	0.005
General public	100	1	0.1	0.001

Notes:
ALARA - as low as reasonably achievable
WAC – Washington Administrative Code
mrem/yr - millirem per year
mSv/yr - millisievert per year

6.0 CONDUCT OF RADIOLOGICAL WORK

6.1 PLANNING

Incorporation of radiological protection requirements such as engineering controls and dose and contamination reduction considerations is the key to the successful execution of work activities in areas where there is a potential for exposure to radiation or radioactive materials. Review and incorporation of such controls and considerations will be made on a task-by-task basis and will be commensurate with the quantity and type of radioactive materials present. Work will be done in accordance with the applicable URS radiation procedures and approved subcontractor procedures provided in Appendix A of the QAPP . The exposure rate estimates for this work indicate exposure will not require formal ALARA reviews.

6.2 WORK PERMITS

RWPs, SMS Attachment 052-2 (Appendix B), will be used at NAVSTA PS to inform workers of area conditions and radiological requirements. For activities where both hazardous conditions or materials and radiological work are being conducted a combined Hazardous Work Permit (HWP), SMS Attachment 052-3, will be used. RWPs/HWPs will have the following minimum requirements:

- Will be issued in accordance with RP-02, “Issuing RWPs and HWPs”
- Will be written based on radiological survey data that are appropriate to characterize the expected work conditions
- Will detail the work area and activity that are within their scope and will contain detailed specifications required for protective measures, including dosimetry, air sampling, personal protective equipment (PPE), respiratory protection, work area preparation, and health physics oversight
- Will be reviewed and approved by the SRSO, and the Site Health and Safety Officer. Modifications to existing RWPs/HWPs require the concurrence of the Site RSO or designee
- Will be present at temporary work locations or posted in a conspicuous area
- Workers will acknowledge by signature that they have read, understand, and will comply with the RWP/HWPs daily and after any permit revisions

- Will be updated if radiological conditions change to the extent that protective requirements need modification

- For NAVSTA PS work the following RWP/HWP sequential numbering/naming convention will be used: NAVSTA PS-2017-##

6.3 CONTROL ZONES

6.3.1 Access/Egress Procedures

Only appropriately trained, authorized, and qualified personnel are permitted access to radiological controlled areas (RCA), these may include temporary areas established around individual sampling locations. The degree of control will be commensurate with the existing and potential radiological hazards within the area and may include, for example, signs and barricades, active observation or administrative controls.

Control measures and established procedures will incorporate an RWP/HWP system to ensure appropriate planning, control, hazard communication, and documentation of work activities in RCA that include temporary work areas established around invasive work locations, (i.e., sampling locations), radiation areas, or contamination areas. Task-specific RWP/HWPs will be used for short-term work in these RCAs.

Personnel frisking and/or monitoring will be conducted before exiting radiological contamination areas and other areas where contamination is suspected. If the instruments indicate detectable radiological contamination above background (see Table 10-1), a Health Physics Technician will be contacted for decontamination of personnel.

6.3.2 Posting and Labeling

The standard radiation symbol (American National Standards Institute [ANSI] N2.1/12.1) in magenta or black on a yellow background (or alternate as provided by regulations) will be used to warn individuals of the presence of radiation and/or radioactive material. Each access point to a controlled or restricted area will be posted with the appropriate identification and instructions. Temporary work locations are not required to be posted if they are under constant Health Physics supervision. For controlled or restricted areas, each area will be posted as detailed in Table 6-1.

Additionally, the Washington State Department of Health Radiation Protection, Notices to Employees, will be posted at the job site in a location visible to all employees who work with or around radioactive materials.

Table 6-1
Posting Requirements

Posting Sign	Definition
Controlled Area	50 µR/hour at 1 m
Caution, Radiation Area	5 mrem in 1 hour at 30 cm
Caution, Contaminated Area	Removable radioactive contamination in excess of Table 10-1values
Caution, Radioactive Material, or Danger, Radioactive Material	Radioactive material handled, used, or stored

Notes:
cm - centimeter
DAC - derived air concentration
µR - microroentgen
mrem - millirem

7.0 MONITORING

7.1 PERSONNEL MONITORING

Monitoring applies to any individual likely to receive an annual external whole body exposure in excess of 500 mrem. Based on the project dose rate estimate no dosimetry will be issued under this plan for work at the Site.

7.2 MEDICAL SURVEILLANCE

Based on the site-specific dose estimate, radiological medical surveillance is not required.

7.3 WORKPLACE MONITORING

7.3.1 Surveys

Radiological monitoring and surveys of radiation exposure levels, contamination, and airborne radioactivity will be conducted to:

- Characterize workplace conditions and detect changes in those conditions
- Demonstrate regulatory compliance
- Detect the gradual buildup of radioactive material
- Identify and control potential sources of personnel exposure
- Identify areas requiring postings

Monitoring will be performed only by trained and qualified personnel and conducted as specified in RP-04 "Radiation Surveys," or if assigned to Cabrera the equivalent procedure "OP-001, "Radiological Surveys," Rev. 3, dated 4/8/2013." At a minimum, radiological surveys will be conducted as follows:

- Weekly in radiation and/or contamination areas
- As specified on RWPs/HWPs

7.3.2 Air Sampling

General area air sampling for airborne radioactivity will not be required, since there is minimal potential for airborne radioactivity, based on the results of the TCRA air monitoring.

7.4 RELEASE OF MATERIALS FROM CONTAMINATION AREAS

Equipment, materials, and property used in any RCA, including temporary ones, established for contamination control will be considered as potentially contaminated and will not be released to an uncontrolled or unrestricted area until they have been surveyed and meet the unconditional release limits listed in Section 11.2. These surveys will be performed as in accordance with RP-04 Radiation Surveys or an approved subcontractor procedure.

7.5 INSTRUMENT CALIBRATION

Radiation detection instrumentation will be provided as listed in Table 7-1 as appropriate for performing necessary surveys and monitoring. The instrumentation will be selected based upon the type of radiation detected, measurement capability, and range in accordance with the radiological hazards present or anticipated for the project.

Calibration of radiological instruments and equipment will be performed by the vendor or a calibration service in accordance with ANSI N323, 1997, using standards traceable to the NIST primary standards. Copies of the calibration certificate will be provided to the SRSO. Calibration certificates will be cross referenced to equipment ID numbers and documented in field notes.

Field calibration of counting instrumentation in accordance with RP-5.0, "Smear Counter Setup and Operation," or equivalent subcontractor procedure OP-021, "Alpha-Beta Counting Instrumentation," Rev. 1, dated 4-12-2013 is authorized if it meets the previous requirements and the source calibration certificate and if documented detection efficiency determinations are maintained in the site-specific project file. Each instrument or piece of equipment will have a calibration sticker with an expiration date affixed.

At a minimum, performance tests of radiological instruments will be conducted before use in accordance with RP-03, "Portable Radiation Instruments.", or Cabrera OP-020, "Operation of Contamination Survey Meters," Rev. 1, dated 4/12/2013. Satisfactory performance test results will be within ±20 percent of the expected response. Instruments that do not meet performance test criteria, are found to be out of calibration, or are defective will be removed from service until repaired and/or calibrated.

Table 7-1
NAVSTA PS RP Instrumentation

Instrument	Detector	Function
Bicron Dose Rate Meter	Internal Tissue-Equivalent Organic Scintillator	Beta gamma dose rate
Ludlum Model 2360 Dual Channel Scaler	Ludlum Model 43-93 Alpha/Beta Scintillator	Frisking – personnel, equipment
Ludlum Model 2929 Dual Channel Scaler	Ludlum Model 43-10-1 Alpha/Beta Scintillator	Smear counting

8.0 PERSONAL PROTECTIVE EQUIPMENT

8.1 USE AND SELECTION OF PROTECTIVE CLOTHING

PPE will be selected based on the contamination levels in the work area and the anticipated work activity, ALARA and safety considerations, and consideration of non-radiological hazardous materials that may be present. Surfaces are considered radiologically contaminated if they are above Table 10-1 levels. PPE provided will be in good condition and free of chemical or radioactive contamination.

Protective clothing and equipment selected for project tasks are described in the SSHP, together with procedures for donning and removing PPE without spreading contamination or contaminating the worker. Task-specific RWP/HWPs will be generated for each definable feature of work (i.e., task) that involves radiological and/or chemical hazards**.**

8.2 USE AND SELECTION OF RESPIRATORY PROTECTION DEVICES

URS's Respiratory Protection Program (URS SMS 042, Respiratory Protection) details specific procedures for respiratory usage, fit, and cleaning. Respiratory protection devices are not anticipated to be necessary for the work at NAVSTA PS.

9.0 RADIOACTIVE MATERIAL ACCOUNTABILITY AND CONTROL

The SRSO will be immediately notified when check sources or other radioactive material is brought on site. Radioactive material will be stored in a designated secure location and removed from the site at the completion of work. A secure storage location for radiological investigation derived waste will be established during mobilization, after consultation with the Navy.

Transportation of radioactive material (i.e. performance test sources, and samples) (specific activity greater than 2,000 pCi/g) in commerce, generally off site, will be in accordance with DOT requirements in 49 CFR 170 through 180, International Air Transport Association regulations, and other federal, state, and local regulations, as applicable.

10.0 DECONTAMINATION

10.1 PERSONNEL

The guideline for determining the presence of skin contamination on personnel is detectable radiological contamination above background. Detection is defined as twice the site background level when frisking if completed using an alpha probe or combined alpha beta probe.

If necessary, decontamination of personnel will be performed only under the direct supervision of the SRSO, and RP-07 "Decontamination." Generally, dry, nonabrasive methods will be attempted first (i.e. brushing dirt/soil off clothing). If this is not successful, the Navy RPM and RASO will be contacted prior to washing with soap and water. Material generated during decontamination, including wipes, tape, and water, will be collected and disposed of as radioactive waste. Nonradiological decontamination procedures are presented in the SSHP (Appendix A).

10.2 EQUIPMENT

Project Health Physics Technicians will perform release surveys of equipment and materials from RCAs. These surveys will be performed in accordance with RP-04, "Radiation Surveys" or the approved subcontractor procedure.

Surface contamination levels presented in Table 10-1 will be used to determine whether a piece of equipment is contaminated with radioactive materials. When decontamination is necessary, decontamination will be performed using techniques that are appropriate based on site-specific conditions. Generally, dry decontamination methods such as high-efficiency particulate air vacuuming or wipe downs are preferred when facilities for the collection of radiological contaminated wastewater are not in place. If adequate facilities exist for the collection of such fluids, it may be appropriate to use a wet decontamination technique. Given the nature of the sampling (sediment) wet decontamination may be necessary. Rinsate will be containerized, and sampled for the PROC's to characterize it for disposal. As with all decontamination efforts, waste generation will be minimized to the extent possible. Nonradiological equipment decontamination procedures are presented in the SSHP (Appendix A).

Table 10-1
Surface Contamination Release Limits

Radionuclide	Removable (dpm/100 cm^2)	Total (Fixed + Removable) (dpm/100 cm^2)
Alpha emitters (Pu-239, Ra-226)	20	100
Beta emitters (Th-232, Sr-90, Cs-137)	200	1,000

Note: - dpm/100 cm^2 – disintegration per minute per 100 square centimeters

11.0 WASTE MANAGEMENT

The generation, treatment, storage, packaging, and transport of radioactive waste for disposal will be in accordance with the applicable requirements of WAC 246-221-170, depending on the cognizant regulatory authority. Materials suspected of being mixed waste (RCRA hazardous substances combined with radioactive materials) will be identified and segregated as soon as practical to avoid combining mixed waste with other waste forms.

Investigation-derived waste that may have a radiological component will be controlled and stored in a secure location. The waste will be transferred to the Department of Defense Executive Agent's LLRW contractor for disposal. Coordination for the transfer will be with the Radiological Affairs Support Office (RASO) Environmental Protection Manager.

Provisions for the minimization of radioactive waste generation will be implemented as appropriate. Although the scope of this waste minimization program will be commensurate with the level of radioactive materials present and activities conducted at each site, at a minimum, the following guidelines will be followed:

- Removal of excess/unnecessary packaging material prior to bringing materials into radiological controlled areas
- Restriction of materials entering controlled areas to those materials necessary for performance of work
- Restriction of the quantities of hazardous materials, such as paints, solvents, chemicals, cleaners, and fuels, entering radiological areas
- Substitution of reusable items in place of disposable ones, when practical
- Selection of consumable materials such as PPE that are compatible with waste-processing systems, volume reduction, and waste acceptance criteria
- Survey of potentially contaminated material leaving controlled areas to separate uncontaminated from contaminated materials
- Emphasis on waste reduction methodologies in training

12.0 EMERGENCY PROCEDURES

Site-specific emergency procedures are detailed in the site-specific accident prevention plan. Emergencies involving radioactive material will include the notification of NAVFAC and RASO. All site personnel will be instructed in their emergency responsibilities and the emergency procedures. If practical, personnel decontamination in accordance with Section 10.1 may be completed before medical treatment. However, in an emergency situation, lifesaving and critical medical treatment take precedence over radiological considerations, based on the radiological hazards present on the site.

13.0 TRAINING

Site-specific radiological worker training will be provided to general employees and contractors who will be working at the NAVSTA PS Site, prior to starting onsite work. A minimum retraining frequency of 2 years will be implemented.

Formal training will be conducted, the training will include a presentation and an examination, which requires a passing score of 80% or better. Documentation of training will be generated consisting of the individual's name, date of training, topic(s) covered, pass or fail, and name of the certifying official. No employee will be permitted to independently perform tasks inside of a radiological controlled area until the appropriate training and qualification requirements are met.

At a minimum, all personnel entering an area where licensed activities, or radioactive material are used and there is a potential for an individual to receive a total effective dose equivalent of 100 mrem or more in 1 year will receive instruction in the following:

- The presence of the material or device
- Health and safety problems associated with exposure to radiation, including the potential effects of radiation on a pregnant female, the fetus, or the embryo
- Precautions and controls used to control exposure
- This Radiation Protection Program
- Their rights and responsibilities

14.0 AUDITS

URS conducts internal audits of Corporate Radiation Protection Program (SMS 52), and an annual audit of UT1800410 as required by the license. No project specific RPP audits will be conducted.

15.0 RECORDS MANAGEMENT

Radiation Protection Program records will be maintained to document compliance with regulatory requirements and the exercise of due diligence in the control of radiological hazards for the protection of employees, members of the public, and the environment. These records will be transferred to both the license file and project file at the conclusion of the project.

Exposure monitoring is not required for the SI work at NAVSTA PS, so documentation of exposure records and reporting as required by WAC 246-220-040, will not be conducted.

If exposure records are generated, they will be maintained by URS in a manner consistent with applicable Privacy Act requirements. The records will be available for retrieval over a period of not less than 75 years after the date of creation of the record. All quantities used in the records will be in special units of curie, rad, or rem, including multiples and subdivisions of these units. Records identified with an individual's name or identifying number will be available upon request from that individual.

Records to be maintained include the following (as available):

- Records of radiological training completed, including general employee radiological training
- Written declarations of pregnancy
- Written withdrawal of declaration of pregnancy
- Results of calibrations performed on radiological instruments and quality control checks for radiological instrumentation and personal monitoring devices
- Results of surveys for radiation and radioactive material in the workplace and outside of controlled or unrestricted areas as required by regulatory requirements or the Radiation Protection Program
- Results of surveys for the release of material or equipment to uncontrolled or unrestricted areas
- Records of effluents and radioactive waste disposal under control
- Records of internal reviews and audits with corrective actions closeout

- Records of regulatory agency inspections and audits with corrective actions closeout.

Interim storage of these radiological records will be the responsibility of the Site RSO and will be maintained in a readily retrievable, controlled manner. Upon completion of each site project, and upon request, copies of all radiation exposure records will be made available to the client.

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APPENDIX A

URS Utah Radioactive Materials License UT1800410, Amendment 11

DRC-03
October 1989

UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF RADIATION CONTROL
RADIOACTIVE MATERIAL LICENSE

Pursuant to Utah Code Ann. Title 19, Chapter 3 and the Radiation Control Rules, Utah Administrative Code R313, and in reliance on statements and representations heretofore made by the licensee designated below, a license is hereby issued authorizing such licensee to transfer, receive, possess, and use the radioactive material designated below; and to use such radioactive material for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, and orders now or hereafter in effect and to any conditions specified below.

****

LICENSEE

1. Name: URS Professional Solutions LLC

2. Address: 756 East Winchester Street, Suite 400
Salt Lake City, Utah 84107

3. License Number UT 1800410
Amendment # 11

****

4. Expiration Date
July 31, 2023

****

5. License Category – 3-n
Administrative amendment action

****

Effective February 14, 2014, Utah Administrative Code Subsection R313-22-34(1) states that specific licenses for a renewed license shall expire ten years after the expiration date of the previous version of the license. Consequently, the Utah Division of Radiation Control is extending the expiration dates of all previously renewed specific licenses by five (5) years.

This Radioactive Materials License is amended as follows:

Item 4. to read: July 31, 2023

UTAH DIVISION OF RADIATION CONTROL

6/17/2014
Date

Rusty Lundberg
Rusty Lundberg, Director

DRC-03
October 1989

RENEWAL

UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF RADIATION CONTROL
RADIOACTIVE MATERIAL LICENSE

Pursuant to Utah Code Ann. Title 19, Chapter 3 and the Radiation Control Rules, Utah Administrative Code R313, and in reliance on statements and representations heretofore made by the licensee designated below, a license is hereby issued authorizing such licensee to transfer, receive, possess and use the radioactive material designated below; and to use such radioactive material for the purpose(s) and at the places(s) designated below. This licensee is subject to all applicable rules, and orders now or hereafter in effect and to any conditions specified below.

****

LICENSEE

1. Name: URS Professional Solutions LLC

2. Address: 756 East Winchester Street, Suite 400
Salt Lake City, Utah 84107

3. License Number UT 1800410
Amendment #10

4. Expiration Date
July 31, 2018

5. License Category - 3-n
In accordance with letter dated January 10, 2013, and electronic mail dated July 3, 2013, this license is amended in its entirety.

****

6. Radioactive material (element and mass number)	7. Chemical and/or physical form	8. Maximum quantity licensee may possess at any one time
A. Radionuclides with atomic numbers 3 through 92, inclusive; depleted Uranium; natural Uranium; natural Thorium	A. Environmental or wipe sample(s)	A. Not to exceed 296 kilobecquerels (8 μCi) of Radium-226; and 1.85 gigabecquerels (50 mCi) total activity; 150 kilograms $U_{depleted}$; 73 kilograms U_{nat}; 227 kilograms Th_{nat}
B. Radionuclides with atomic numbers 3 through 92, inclusive; depleted Uranium; natural Uranium; natural Thorium	B. Metal, sludge, soil type materials, debris, including sample size quantities stored in U.S. Department of Transportation approved shipping containers	B. Not to exceed 37 gigabecquerels (1 Ci) total activity; 3,000 kilograms $U_{depleted}$; 1,465 kilograms U_{nat}; 4,541 kilograms Th_{nat}
C. Radionuclides with atomic numbers 10 through 92, inclusive	C. Standard Reference Materials: commercial check sources and solids sealed in laboratory assay containers	C. Not to exceed activity limits specified in R313-15-1401(2)(c); Ra-226 not to exceed 74 kilobecquerels (2 μCi) per container or 222 kilobecquerels (6μCi) total

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****

9. AUTHORIZED USE

A. For possession and use as contamination incidental to sample analysis.

B. For possession incidental to decontamination, decommissioning, surveying, packaging, and transfer in accordance with R313-19-41.

C. For possession and use as check, calibration, or reference sources.

****

CONDITIONS

10. A. Licensed materials in Item 6.A and 6.B shall be used only at temporary job sites of the licensee anywhere in the State of Utah where the Division maintains jurisdiction for regulating the use of licensed material. Except for calibration sources, reference standards, and radioactive contaminated equipment owned by the licensee, possession of licensed material at each temporary job site shall be limited to material originating from each site. This material must either be transferred to an authorized recipient or remain at the site after licensee activities are completed.

B. Licensed material in Item 6.C shall be used at the licensee's facilities located at 756 East Winchester Street, Suite 400, Salt Lake City, Utah, and at temporary job sites of the licensee anywhere in the State of Utah where the Division maintains jurisdiction.

11. The licensee shall comply with the provisions of R313-18 "Notices, Instructions and Reports to Workers, by Licensees or Registrant--Inspections" and R313-15, "Standards for Protection Against Radiation."

12. Licensed material shall be used by, or under the supervision and in the physical presence of, individuals who have been trained, as specified in the licensee's application dated May 28, 2008 and who have been designated by the licensee's Radiation Safety Officer. The licensee shall maintain records of individuals so designated.

13. The Radiation Safety Officer for the activities authorized by this license is Amy Robin Jones.

14. The Radiation Safety Officer may delegate certain duties to specific individuals provided that:

A. The licensee maintain, for a period of three years, records of all individuals designated by the Radiation Safety Officer to perform duties or meet regulatory requirements that would otherwise be required as a duty of the Radiation Safety Officer. These records shall include:

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(1) The name of the individual;

(2) A list of all duties the Radiation Safety Officer's designee is authorized to perform;

(3) The date upon which the designation became effective;

(4) The signature of the Radiation Safety Officer's designee; and

(5) The signature of the Radiation Safety Officer.

B. The Radiation Safety Officer shall review records generated by designees and the performance of designees quarterly. In addition, the licensee shall maintain for Division inspection for a period of three years, records of the quarterly reviews of records generated by designees and quarterly reviews of designee's performance. These records shall include:

(1) The date of the review;

(2) The records being reviewed and the name of the designee being reviewed;

(3) A list of all duties performed by the designee;

(4) The results of the Radiation Safety Officer's review and any corrective measures taken, if applicable, based on the review; and

(5) The signature of the Radiation Safety Officer.

15. The licensee shall notify the Director in writing at least 14 days before initiating activities under this license at a temporary job site located in the State of Utah. This notification shall include:

A. The estimated type, quantity, and physical/chemical forms of licensed material to be used;

B. The specific site location;

C. A description of planned activities including waste management and disposition;

D. The estimated start date and completion date for the job; and

E. The name and title of a point of contact for the job, including information on how to contact the individual.

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16. This license does not authorize the use of licensed material at temporary job sites for uses already specifically authorized by a customer's license. If a customer also holds a license issued by the Director, Nuclear Regulatory Commission or an Agreement State, the licensee shall establish a written agreement between the licensee and the customer specifying which licensee activities shall be performed under the customer's license and supervision, and which licensee activities shall be performed under the licensee's supervision pursuant to this license. The agreement shall include a commitment by the licensee and the customer to ensure safety, and any commitments by the licensee to help the customer clean up the temporary job site if there is an accident. A copy of this agreement shall be included in the notification required by License Condition 15.

17. The licensee shall maintain records of information important to decommissioning each temporary job site at the applicable job site pursuant to R313-22-35(7) or equivalent Nuclear Regulatory or Agreement State regulations. The records shall be made available to the customer upon request. At the completion of activities at a temporary job site, the licensee shall transfer these records to the customer for retention.

18. Pursuant to R313-12-55, and License Condition 10, the licensee is exempted from the requirements of R313-22-35 to establish decommissioning financial assurance.

19. Notwithstanding the requirements in R313-22-32(8), the licensee is not required to establish an emergency plan. Before taking possession of licensed material at a temporary job site in quantities requiring an emergency plan the licensee shall either:

    A. Obtain the Director's approval of an evaluation demonstrating that an emergency plan is not required pursuant to R313-22-32(8); or

    B. Submit written confirmation to the Director, that licensee personnel have been trained and will follow the provisions of an existing emergency plan approved by the Division, Nuclear Regulatory Commission or an Agreement State for the temporary job site.

20. If approved by the Radiation Safety Officer specifically identified in this license, the licensee may take reasonable action in an emergency that departs from conditions in this license when the action is immediately needed to protect public health and safety and no action consistent with all license conditions that can provide adequate or equivalent protection is immediately apparent. The licensee shall notify the Director before, if practicable, and in any case immediately after taking such emergency action using the reporting procedure specified in R313-19-50(3).

21. Within 30 days of completing activities at each job site location, the licensee shall notify the Director in writing of the temporary job site status and the disposition of any licensed material used.

22. The licensee shall conduct a physical inventory every six months to account for all licensed material possessed under this license. The records of the inventories shall be maintained for three years from the date of the inventory for inspection by the Division, and shall include the quantities and kinds of radioactive

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material, the location of the radioactive material, and the date of the inventory.

23. Radioactive material shall not be used in products distributed to the public.

24. The licensee shall not use licensed material in or on human beings except as provided otherwise by specific condition of this license.

25. This license does not authorize commercial distribution of licensed material.

26. The licensee shall transport licensed material or deliver licensed material to a carrier for transportation only in accordance with the provisions of R313-19-100 "Transportation."

27. The licensee shall notify the Division in writing when the licensee decides to permanently discontinue activities in Utah involving materials authorized under the license, and report to the Division the disposition of the material.

28. Except as specifically provided otherwise, by this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Utah Radiation Control Rules shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the rules.

    A. Letter dated January 10, 2013 [LA# 9-2013]
    B. Electronic mail dated July 3, 2013 [LA# 112-2013]

UTAH DIVISION OF RADIATION CONTROL

8/1/2013
Date

Rusty Lundberg
Rusty Lundberg, Director

APPENDIX B

Safety Management Standard 052

URS SAFETY MANAGEMENT STANDARD

Radiation Protection Program

1. Applicability

This standard applies to URS field projects with known radioactive contamination that may result in the exposure of employees to ionizing radiation. This does not include sites where portable gauges may be in use. Refer to SMS 044 – Radiation Safety for Portable Gauges for additional information. Note: Use of a client's radiation safety program (e.g., Department of Energy, Department of Defense) may preclude the use of this SMS.

2. Purpose and Scope

The purpose of this standard is to ensure the following:

A. Activities conducted at those project sites where the potential for exposure to ionizing radiation exists are conducted in a manner consistent with sound radiological practices.

B. Radiological exposure to site personnel and the environment is maintained As Low as Reasonably Achievable (ALARA).

3. Implementation

Implementation of this standard is the responsibility of the URS manager directing activities of the facility, site, or project.

4. Requirements

A. Appoint a Site Radiation Safety Officer (SRSO), who will have the following responsibilities:

1. Coordinate implementation of the Radiation Protection Program (Attachment 052-1 AMER) and any site-specific addenda or programs.

2. Evaluate potential site/employee radiation exposure.

3. Recommend workplace and administrative controls.

4. Ensure that all employees are knowledgeable of applicable radiological safety requirements for their work area and comply with these requirements.

B. Implement steps to maintain radiation exposures ALARA. At a minimum, the following steps will be implemented on all sites:

1. Estimate radiation exposure and use the estimates to set project ALARA dose goals.

2. Review actual radiation exposures and compare with projected dose values. If necessary, make adjustments to the administrative and engineering controls that are in place.

C. Form an ALARA Committee for each site at which there is a potential for exposure to ionizing radiation at levels that significantly exceed natural background. At a minimum, this Committee will be made up of the SRSO, the Project or Site Manager, the Health Physics Supervisor (if applicable), and one representative of the site labor force. The Committee will meet periodically to review previous site radiation exposure, air monitoring, effluent monitoring, and contamination level data to assess the presence of unacceptable trends. The Committee will also assess the success of the radiological controls, serve as a forum for recommendations for improvements, and maintain a written record of the Committee's activities in the project files.

D. Establish site-specific administrative goals for radiological protection. The annual administrative goals will not exceed those specified in Section 5.0 of the Radiation Protection Program (Attachment 052-1 AMER).

E. Complete a Radiation Work Permit (RWP) (Attachment 052-2 AMER) to inform workers of area radiological conditions and entry requirements. Use the RWP at all sites that have a potential for exposure to radiation or radioactive materials. Where appropriate, combine radiological requirements with other nonradiological requirements onto a single Hazardous Work Permit (Attachment 052-3 AMER).

F. Control Zones/Procedures

1. Permit only trained, authorized, and qualified personnel to access radiological control areas. Establish control measures and procedures using an RWP system to ensure appropriate planning, control, hazard communication, and documentation of work activities in controlled areas.

2. Post a standard radiation symbol in magenta or black on a yellow background at each access point to a controlled or restricted area along with appropriate identification and instructions.

G. Monitoring

1. Enroll the following personnel in an appropriate bioassay program:

    a. Radiation workers who have the potential to receive intakes of radioactive materials that may result in a committed effective dose equivalent of 500 mrem.

    b. All personnel who perform routine field activities where the potential for removable surface or airborne radioactive contamination exists.

2. Perform external dosimetry on the following personnel:

    a. Any individual likely to receive an annual external whole body exposure in excess of 10% of the occupational limit.

    b. Any individual who enters a High or Very High Radiation Area.

3. Acquire the work-related radiation exposure history of personnel from past employers where radiation monitoring was required.

H. Medical Surveillance

All personnel performing work where a potential for exposure to ionizing radiation exists will participate in URS' medical surveillance program. Personnel will be required to be medically qualified for work with ionizing radiation. All cases of overexposure and suspected ingestion or inhalation of radioactive materials must be reported to the SRSO immediately. URS' Medical Consultant will advise the SRSO on the type(s) of test(s) required to accurately assess the effects of exposure.

I. Workplace Monitoring

1. Conduct radiological monitoring and surveys of radiation exposure levels, contamination, and airborne radioactivity. Surveys will be performed only by trained and qualified personnel and will be conducted as specified in the site-specific health and safety plan (HASP) and associated RWPs.

2. Conduct air sampling as specified in the site-specific HASP.

J. Establish radiological contamination survey, documentation, and labeling requirements for release of all property/material from a controlled area. All equipment, materials, and property used in a controlled area will be considered contaminated and will not be released to an uncontrolled or unrestricted area until they have been surveyed and meet either the release limits provided in the Radiation Protection Program (Attachment 052-1 AMER) or site-specific requirements.

K. Personal Protective Equipment

1. Select personal protective equipment (PPE) based on the contamination levels in the work area, the anticipated work activity, ALARA and safety considerations, and consideration of nonradiological hazardous materials that may be present. PPE provided will be in good condition and free of chemical or radioactive contamination. Refer to SMS 029 – Personal Protective Equipment for additional information.

2. Use respiratory protection, where necessary, in accordance with SMS 042 – Respiratory Protection.

3. Use the protection factors listed in Appendix A of 10 CFR 20 in the assessment of potential radioactive material intake.

L. Decontamination

1. Personnel

a. Decontaminate personnel, if necessary, using soap and water. Decontamination fluids will be collected and disposed of as radioactive waste.

b. If contamination has been transferred to the skin with chemical carriers or if repeated decontamination attempts with soap and water are unsuccessful, additional decontamination steps may be required. Prior to attempting any additional methods, medical assistance and direction will be sought.

2. Equipment

a. Perform decontamination using techniques that are appropriate based on site-specific conditions.

b. Collect and dispose of decontamination wastes as radioactive waste.

M. Waste Management

1. Identify and segregate materials suspected of being mixed waste (Resource Conservation and Recovery Act [RCRA], Toxic Substances Control Act [TSCA], etc. hazardous substances combined with radioactive materials) as soon as practical to avoid combining mixed waste with other waste forms.

2. Implement radioactive waste minimization techniques, as appropriate.

N. Develop site-specific radiological emergency procedures commensurate with the level of hazard. The procedures will address the following, at a minimum:

1. Severe weather.

2. Transportation accidents or spills.

3. Personnel contamination and medical emergencies.

4. Emergency response and notification requirements involving radioactive materials.

5. Responsibilities of emergency response agencies and site personnel.

O. Training

1. All personnel entering an area where radioactive material or radiation-generating devices are used will receive instruction in the following:

a. The presence of the material or device.

b. Health and safety problems associated with exposure to radiation, including the potential effects of radiation on a pregnant female, the fetus, or the embryo.

c. Precautions and controls used to control exposure.

d. This safety management standard and the Radiation Protection Program (Attachment 052-1 AMER).

e. Their rights and responsibilities.

A minimum retraining frequency of two years will be implemented.

2. Training documentation, including the individual's name, date of training, topics covered, the results of an appropriate examination, and the name of the certifying official, will be generated. No employee will be permitted to independently perform tasks inside a radiological controlled area until the appropriate training and qualification requirements are met.

3. Additional training requirements will be determined on a site-specific basis and documented in the applicable HASP.

P. Records Management

1. At the completion of site activities, send copies of exposure monitoring records to URS' Health Services Administrator for inclusion into each respective employee's medical file.

2. Transfer exposure monitoring records for subcontract personnel to each respective subcontract organization.

3. Interim storage of radiological records will be the responsibility of the SRSO and will be maintained in a readily retrievable, controlled manner.

5. Documentation Summary

The following documentation will be maintained in the project file:

A. Doses received by individuals during previous and current employment.

B. Medical clearance documentation.

C. Written declarations of pregnancy and withdrawal of pregnancy.

D. Written records of ALARA committee activities, evaluations, and controls.

E. Results of surveys for radiation and radioactive material.

F. Results of calibrations performed on radiological instruments and quality control checks for radiological instrumentation and personal monitoring devices.

G. Records of completed radiological training.

H. Radiation Work Permits and/or Hazardous Work Permits.

I. Records of internal and/or regulatory agency inspections, reviews, and audits with corrective actions closeout.

6. Resources

A. U.S. Occupational Safety and Health Administration (OSHA) Standard – Ionizing Radiation – 29 CFR 1910.1096

B. U.S. OSHA Standard – Ionizing Radiation – 29 CFR 1926.53

C. Department of Transportation Standard – Transportation: Hazardous Materials Regulations – 49 CFR 171-177

D. Nuclear Regulatory Commission Standard – Standards for Protection Against Radiation – 10 CFR 20

E. SMS 029 – Personal Protective Equipment

F. SMS 042 – Respiratory Protection

G. SMS 044 – Radiation Safety for Portable Gauges

H. Attachment 052-1 AMER – Radiation Protection Program

I. Attachment 052-2 AMER – Radiation Work Permit

J. Attachment 052-3 AMER – Hazardous Work Permit

K. Attachment 052-4 AMER – Declaration of Pregnancy Form

L. Attachment 052-5 AMER – Embryo/Fetus Initial Dose Calculation

M. Attachment 052-6 AMER – Withdrawal of Declaration of Pregnancy

1.0 PURPOSE AND SCOPE

This Radiation Protection Program was prepared for use on URS field projects with known radioactive contamination that may result in the exposure of employees to ionizing radiation, particularly projects at Formerly Utilized Sites Remedial Action Program (FUSRAP) sites. This document was developed to ensure that

- Activities at these sites are conducted in a manner consistent with sound radiological practices,
- Radiological exposure to site personnel and the environment are maintained As Low as Reasonably Achievable (ALARA), and
- Activities at these sites are performed in a manner consistent with applicable federal, state, and local regulations.

This Radiation Protection Program was prepared pursuant to the requirements of U.S. Army Corps of Engineers (USACE) EM-385-1-1, Section 6E (*Radiation Safety Program*) and is consistent with the requirements for a Radiation Protection Program presented at 10 CFR 20.1101 (commensurate with the types of activities that URS will perform at FUSRAP sites). Note: None of these sites are licensed by the Nuclear Regulatory Commission (NRC), and as such, URS is not considered a licensee of the Nuclear Regulatory Commission (or any other Agreement State program) in regard to activities on these sites. Use or possession of licensable quantities of radioactive materials requires the issuance of a radioactive materials license from the NRC or an Agreement State.

An annual review of this Radiation Protection Program's content and implementation will be conducted by URS' Corporate Radiation Safety Officer, in accordance with 10 CFR 20.1101(c) and EM-385-1-1, Section 6E.

2.0 APPLICABILITY

The work practices specified in this Radiation Protection Program apply to work conducted by URS personnel involved in contracts that may result in the exposure of employees to ionizing radiation. Each URS employee working in a radiation area or a restricted area is responsible for following this Program. The URS Project Manager is responsible for ensuring that the Program is implemented at a particular site.

The majority of URS' contracts under the purview of this Program are expected to be at construction and environmental investigation/restoration projects involving materials containing low levels of radiation and radioactivity. Although this Program has been tailored for these types of activities, implementation of Program elements will be commensurate with the nature of each site-specific project. Implementation of this Program will be performed through the applicable site-specific health and safety plan (HASP) and associated standard operating procedures.

3.0 GENERAL

3.1 References

- Department of Transportation (DOT) – Transportation: Hazardous Materials Regulations – 49 CFR 171-177
- NRC – Standards for Protection Against Radiation – 10 CFR 20

- U.S. Occupational Safety and Health Administration (OSHA) – Ionizing Radiation – 29 CFR 1910.96
- U.S. OSHA – Ionizing Radiation – 29 CFR 1926.53
- USACE – Ionizing Radiation – EM-385-1-1, Section 6E

3.2 Definitions

Airborne Radioactivity Area - Area where the measured concentration of airborne radioactivity above natural background exceeds a peak concentration of 1 DAC or 12 DAC-hours during a work week.

As Low As Reasonably Achievable (ALARA) - An approach to radiological control or a process to manage and control exposures to the work force and to the general public at levels as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations.

Bioassay - Measurement of radioactive material deposited within or excreted from the body. This process includes whole body, urine and organ counting and others.

Contaminated Area - An area in which radioactive contamination is present that exceeds removable levels presented in Table 7.1.

Controlled Area - An area in which access is controlled in order to protect personnel from exposure to radiation and radioactive materials. An area in which the existing or potential radiation and radioactivity levels are above normal background but are less than that designating a Radiological Area or a restricted area.

Derived Air Concentration (DAC) - The concentration of a radionuclide in air that, if breathed over the period of a work year, would result in the annual limit on intake being reached.

Disintegration per Minute (dpm) - The rate of emission by radioactive material as determined by correcting the counts per minute observed by a detector for background, efficiency, and window size associated with the instrument.

Dose - A generic term for the amount of energy deposited in body tissue due to radiation exposure. Technical definitions for dose terms necessary for various exposure calculations and recordkeeping purposes include the following:

absorbed dose (D): Energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. The units of absorbed dose are the rad and the gray (Gy).

dose equivalent (HT): The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

effective dose equivalent (HE): The sum of the products of the dose equivalent to the organ or tissue (HT) and the weighting factors (WT) applicable to each of the body organs or tissues that are irradiated (HE = SWT x HT)

committed dose equivalent (HT,50): The dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by a person during the 50-year period following the intake.

committed effective dose equivalent (HE,50): The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues (HE,50 = SWT x HT,50)

total effective dose equivalent (TEDE): The sum of the deep dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

total organ dose equivalent (TODE): The sum of the deep dose equivalent (for external exposures) and the committed dose equivalent to an individual organ or tissue (for internal exposures).

Fixed Contamination - Radioactive material that cannot readily be removed from surfaces by nondestructive means such as causal contact, wiping, brushing, or washing.

Frisking - Process of monitoring personnel for contamination.

Hazardous Work Permit (HWP) - Permit that identifies radiological conditions and health and safety hazards, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. The HWP serves as an administrative process for planning and controlling radiological work and informing the worker of the radiological, health, and safety issues.

High Radiation Area - An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent to or in excess of 100 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

Internal Dose - The portion of the dose equivalent to that received from radioactive material taken into the body.

Lifetime Dose - Total occupational exposure over a worker's lifetime, including external and committed internal dose.

Low Level Radioactive Waste - Waste that contains radioactivity and is not classified as high level waste, transuranic waste, spent nuclear fuel, or by-product material as defined in Section 11e(2) of the Atomic Energy Act.

Mixed Waste - Waste containing low level radioactive waste as well as Resource Conservation and Recovery Act (RCRA) or Toxic Substances Control Act (TSCA) waste.

Naturally Occurring Radioactive Material (NORM) - Includes radioactive elements found in the environment. Long-lived radioactive elements of interest include uranium, thorium and potassium, and any of their radioactive decay products, such as radium and radon. These elements have always been present in the earth's crust and within the tissues of all living beings.

Occupational Dose - The dose received by a person during employment in which the person's assigned duties involve exposure to radiation and to radioactive material. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the public.

Personnel Dosimetry - Devices designed to be worn by a single person for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), and pocket ionization chambers.

Personnel Monitoring - Systematic and periodic estimate of radiation dose received by personnel during work hours.

Radiation - Ionizing radiation includes alpha particulate, beta particulate, X-rays, gamma rays, neutrons, and other particulates capable of producing ions.

Radiation Area - An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent to or in excess of 0.005 rem in 1 hour at 30 cm from the source of radiation or from any surface that the radiation penetrates.

Radiation Work Permit (RWP) - Permit that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. The RWP serves as an administrative process for planning and controlling radiological work and informing the worker of the radiological, health, and safety issues.

Radioactive Material Area - A controlled area or structure where radioactive material is used, handled, or stored.

Radiological Worker - Worker whose job assignment requires work on, with, or in the proximity of radiation production machines or radioactive materials. A radiological worker has the potential to be exposed to more than 100 mrem per year, which is the sum of the dose equivalent to external irradiation and the committed effective dose equivalent to internal irradiation.

Removable Contamination - Radioactive material that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.

Survey - An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other source of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) - Any naturally occurring radioactive materials not subject to regulation under the Atomic Energy Act whose radionuclide concentrations or potential for human exposure have been increased above levels encountered in the natural state by human activities.

Thermoluminescent Dosimeter (TLD) - Radiation detection and measuring device used to record the radiological exposure of personnel or area to certain types of radiation.

Unrestricted Area - An area designated by the NRC as being an area to which access is neither limited nor controlled by a NRC licensee.

3.3 Organization

3.3.1 Vice President of Safety

URS' Vice President Safety is responsible for overall administration of the environmental safety program, including the Radiation Protection Program.

3.3.2 Business Radiation Safety Officer

URS' Business Radiation Safety Officer is responsible for:

- Continuing to develop and implement the Radiation Protection Program;
- Reviewing the qualifications of site radiation safety personnel (Site Radiation Safety Officer and Health Physics Technicians);

- Reviewing and approving the standard operating procedures that implement specific elements of the Radiation Protection Program;
- Conducting audits of site radiation safety programs; and
- Periodic reviewing of personnel radiation monitoring results.

3.3.3 Site Radiation Safety Officer

The Site Radiation Safety Officer (SRSO) will develop and coordinate implementation of the Radiation Protection Program. The SRSO will evaluate potential site/employee radiation exposure and recommend workplace and administrative controls, as necessary. The SRSO will be responsible for the development and administration of the Radiation Protection Program that will be incorporated in the HASP and associated standard operating procedures. The SRSO will be responsible for implementing and managing the site-specific Radiation Protection Program, as well as ensuring that all employees under the SRSO's control are knowledgeable of applicable radiological safety requirements for their work area and comply with these requirements.

The SRSO will be technically qualified and will meet the following experience, training, and education minimal requirements:

- Formal training in radiation protection that covers the following topics: physics of radiation, radiation interaction with matter, mathematics necessary for the subject matter, biological effects of radiation, and type and use of instruments for detection, monitoring, and surveying radiation;
- Hands-on training in the theory and uses of radiation monitoring equipment, and procedures; and
- Knowledge of regulations (NRC, Environmental Protection Agency, DOT, and Department of Defense) to include all applicable components pertaining to radioactive materials, radiation-generating devices, and radioactive and mixed waste.

Operations involving radiation hazards or use of radioactive material or radiation-generating devices will be performed under the direct supervision of a person, designated in writing by the SRSO, who is qualified and responsible for radiation safety. This person will conduct surveys and evaluate and secure any specialized assistance to assure compliance with radiation protection standards.

3.3.4 Health Physics Technicians

Health Physics Technicians will be responsible for assisting the SRSO in the implementation of radiological controls on each site. Specific responsibilities will include

- Performing radiological surveys;
- Collecting effluent samples (air and water); and
- In conjunction with the SRSO, assessing radiological hazards during work changes and making adjustments to ensure that worker radiological exposures and releases to the environment are maintained ALARA.

Qualifications of Health Physics Technician personnel will be reviewed by the SRSO to ensure that the level of expertise is commensurate with the assigned duties. Minimally, Health Physics Technicians will meet the experience and training requirements contained in American National Standards Institute (ANSI) 18.1, 1969. Personnel who do not yet meet

these minimal requirements may be allowed to perform limited radiological monitoring tasks, under the supervision of a qualified Health Physics Technician.

3.3.5 URS Project Manager

The URS Project Manager will be responsible for

- Reviewing each scope of work to identify potential radiation hazards;
- Designating a SRSO;
- Arranging for employees on the project to receive appropriate radiation safety training;
- Ensuring that employees working on the project are monitored for radiation exposures; and
- Arranging for employee monitoring results to be sent to the URS Occupational Health Specialist.

The URS Project Manager ensures that all employees under his or her control are knowledgeable of applicable radiological safety requirements for their work area and compliance with these requirements. Project Managers emphasize the need for high standards for radiological control through direct communication, support of radiation control goals, and a presence in the workplace.

3.3.6 Employees

Employees are responsible for knowing radiological protection requirements for their work areas and complying with these requirements.

4.0 ALARA PROGRAM

4.1 Policy Statement

It is URS' policy to conduct all work with ionizing radiation in accordance with established good practices in radiation protection, and in all cases, to incorporate radiological criteria to ensure safety and maintain radiation exposures ALARA. To this end, URS business management holds its Project Managers responsible for implementing all plans and procedures prepared in accordance with regulatory and contract documents. Project Managers will be responsible for demonstrating URS' commitment through direct communication, instruction, and inspections of the workplace. Project Managers will use facility and equipment design features as the primary method to maintain exposures ALARA. In most cases, decontamination operations represent an uncommon activity in facilities designed for specific purposes. Design features of temporary facilities and special equipment will be in general augmented by administrative and procedural requirements.

4.2 Administrative Implementation Procedures

Implementation of specific steps aimed at maintaining radiation exposures ALARA will be determined on a site-specific basis and will be commensurate with the nature of both the radiological work being performed and the radiation hazards present. Minimally, the following steps will be implemented on all sites:

- Radiation exposure estimates will be made and used to set project ALARA dose goals;

- Periodic review of actual radiation exposures against projected dose values will be conducted; if necessary, adjustments will be made to the administrative and engineering controls that are in place; and
- An ALARA Committee will be formed, consisting of the SRSO, Site Manager, Health Physics Supervisor (if applicable), and representatives of the workforce. This committee will meet periodically (at least every quarter); the frequency will be dependent on the nature of the radiological work being conducted and radiation levels present. Activities of the ALARA Committee are detailed in Section 4.3, ALARA Committee.

Commensurate with the nature of the work being performed and radiation levels present, the following additional measures will be considered (specific implementation of these additional program measures will be documented in the HASP):

- Inclusion of Radiation Control Hold Points in Work Documents;
- Work Processes and Special Tools to Reduce Exposures;
- Engineering Controls to Minimize the Spread of Activity;
- Special Radiological Training or Monitoring Requirements;
- Mockups for High Exposure or Complex Tasks;
- Engineering, Design, and Use of Temporary Shielding;
- Walkdown or Dry-run of the Activity Using Applicable Procedures;
- Staging and Preparation of Necessary Materials/Special Tools; and
- Maximization of Prefabrication and Shop Work.

4.3 ALARA Committee

An ALARA Committee will be formed for each site at which there is a potential for exposure to radiation at levels that significantly exceed natural background. This Committee will be minimally composed of the SRSO, Project Manager, Health Physics Supervisor (if applicable), and one representative of the site labor force.

The ALARA Committee will meet periodically (at a minimum of once each quarter) and will review previous site radiation exposure, air monitoring, effluent monitoring, and contamination level data to assess the presence of unacceptable trends. Additionally, this Committee will periodically assess the success of the radiological controls and serve as a forum for recommendations for improvements. A written record (minutes) of the Committee's activities will be maintained. The ALARA Committee will serve the function of the Ionizing Radiation Safety Committee (ISRC), referenced in EM-385-1-1, Section 6E.

5.0 EXPOSURE LIMITS

5.1 Administrative Goals

Administrative goals for radiological protection performance will be established for each site. These limits are more conservative than regulatory limits, commensurate with the work plan and level of hazard, and in accordance with the ALARA principle. Annual radiological goals (not to be exceeded) are as follows:

- Maximum individual total effective dose equivalent: 500 mrem

- Maximum embryo/fetus total organ dose equivalent for a declared pregnancy:100 mrem
- Maximum total effective dose equivalent to a member of the public, or visitor (excluding radon and thoron): 10 mrem.

5.2 Occupational Exposure Limits

The occupational exposure to employees performing the duties of radiation workers will be controlled so that the limits in Table 5.1 are not exceeded in one year. Furthermore, measures will be taken to maintain doses as far below these limits as reasonably achievable through the use of administrative goals, engineering controls, and application of the ALARA process. All of the occupational exposure received during the year, including exposures while employed elsewhere, will be included in the determination of occupational exposure. Radiation exposures from normal background, therapeutic and diagnostic medical radiation, and voluntary participation in medical research programs will not be included in the determination of occupational exposure. Planned special exposures will not be used.

Table 5.1 Occupational Radiation Exposure Limits

Part of the Body	Annual Dose Equivalent Limit[1]
Stochastic Effects	
Whole body, head, trunk, arm, and leg, including elbow and knee	5 rem total effective dose equivalent - sum of deep dose equivalent and the committed effective dose equivalent
Non-Stochastic (Deterministic) Effects	
Arms and legs (includes hands and feet) below knee	50 rem total dose equivalent from shallow and/or deep dose equivalent
Skin of whole body	50 rem shallow dose equivalent
Individual organ or tissue	50 rem sum of deep dose equivalent and the committed dose equivalent
Lens of eye	15 rem dose equivalent
Embryo/fetus during entire gestation period - declared pregnancy	0.5 rem dose equivalent - sum of deep dose equivalent and dose equivalent from internal radionuclides

[1]In addition to the annual dose limits, soluble uranium intake will be limited to 10 milligrams per week in consideration of chemical toxicity.

5.3 Embryo/Fetus Exposure Limits

The occupational dose equivalent limits applicable to the embryo/fetus are detailed in Table 5.1 and apply to a "declared pregnancy." In such a case, a woman elects to declare the pregnancy and limit the dose received by the embryo/fetus as provided in regulatory requirements. In this case, the dose equivalent goal for the embryo/fetus, from the period of conception to birth, from occupational exposure will be no more than 100 mrem.

Efforts will be made to maintain exposures ALARA and to avoid significant variations above a uniform monthly exposure during the pregnancy. If the dose equivalent has exceeded 500 mrem by the time the pregnancy is declared, steps will be taken to ensure that additional occupational exposure is unlikely. Declaration of Pregnancy Form – Attachment 052-4

AMER will be used to document this decision. Embryo/Fetus Initial Dose Calculation – Attachment 052-5 AMER will be used to assess the radiation exposure to the embryo/fetus at the time of declaration. Withdrawal of Declaration of Pregnancy – Attachment 052-6 AMER will be used to withdraw a pregnancy declaration.

5.4 Minor Exposure Limits

URS' policy is that no worker under 18 years of age will be allowed to work on site where there is the potential for exposure to radiation. This requirement is consistent with EM-385-1-1, Section 6E, which does not allow the occupational radiation exposure of minors.

5.5 Members of the Public Exposure Limits

The annual exposure limit for any member of the public will be limited to 100 mrem total effective dose equivalent, regardless of whether the individual is inside or outside of a controlled area. The dose equivalent in any unrestricted area from external sources will not exceed 2 mrem in any one hour or 50 mrem per year, regardless of occupancy by a member of the public.

5.6 Air and Liquid Effluents

The release of radioactivity in air or liquid effluents to unrestricted areas will be monitored and controlled in accordance with the requirements of 10 CFR 20.1302. Projects subject to state or local regulatory requirements will comply with the effluent limitations in those requirements. For projects at low hazard sites, workplace monitoring and/or conservative modeling can be used to determine compliance with effluent limitations. Records of radioactive effluent monitoring and/or modeling will be generated and maintained to demonstrate compliance with effluent limitation requirements.

6.0 CONDUCT OF RADIOLOGICAL WORK

6.1 Planning

Incorporation of radiological protection requirements such as engineering controls and dose and contamination reduction considerations is the key to the successful execution of work activities in areas where there is a potential for exposure to radiation or radioactive materials. Review and incorporation of such controls and considerations will be made on a site-by-site basis and will be commensurate with the quantity and type of radioactive materials present. Appropriate requirements will be documented in applicable work plans and procedures, and in the HASP.

Projected radiation dose (internal and external) estimates will be made for all jobs involving potential exposure to radiation or radioactive materials. The complexity of these exposure estimates will be commensurate with the levels of radiation and radioactive materials present and the types of activities involved. At a minimum, documentation of these exposure estimates will be placed in the site-specific project file.

Trigger levels for the development and execution of formal ALARA reviews will be adopted on a site-specific basis and documented in the HASP or associated standard operating procedures (SOPs). At a minimum, formal ALARA reviews will be conducted any time a projected individual dose exceeds 200 mrem or collective dose estimates exceed 2,000 person-mrem.

6.2 Work Permits

Radiation Work Permits (RWP; see Radiation Work Permit – Attachment 052-2 AMER) will be used to inform workers of area radiological conditions and entry requirements, and to provide a mechanism to relate worker exposure to specific work activities. They will be used at all sites that have a potential for exposure to radiation or radioactive materials. If appropriate, radiological requirements will be combined with other, nonradiological requirements, onto a single Hazardous Work Permit (HWP; see Hazardous Work Permit – Attachment 052-3 AMER). Implementation of a work permit program will be made on a site-specific basis, as specified in the HASP and any associated SMSs. However, the following minimum requirements will be met:

- RWP/HWPs will be written based on radiological survey data that are appropriate to characterize the expected work conditions;
- RWP/HWPs will detail the work area and activity that are within their scope and will contain detailed specifications required for protective measures, including dosimetry, air sampling, PPE, respiratory protection, work area preparation, and health physics oversight;
- RWP/HWPs will be reviewed and approved by the SRSO. Modifications to existing RWP/HWPs require the concurrence of the SRSO or designee;
- RWP/HWPS will be posted in a conspicuous area (if possible, they will be posted at the access point to the applicable radiological work area);
- Workers will acknowledge by signature that they have read, understand, and will comply with the RWP/HWPs prior to initial entry to the area and after any revisions to the RWP/HWPs; and
- RWP/HWPs will be updated if radiological conditions change to the extent that protective requirements need modification.

6.3 Control Zones

6.3.1 Access/Egress Procedures

Only appropriately trained, authorized, and qualified personnel are permitted access to radiological controlled areas. The degree of control will be commensurate with the existing and potential radiological hazards within the area and may include, for example, signs and barricades, entranceways locked against ingress, control devices or alarms, or administrative controls. Additional access control measures for High and Very High Radiation Areas will be established in accordance with NRC-specific requirements, as appropriate. The controls will be established so that rapid egress from the controlled area in an emergency is not prevented.

Control measures and established procedures will incorporate a hazardous work permit (HWP) system to ensure appropriate planning, control, hazard communication, and documentation of work activities in Radiological Controlled Areas (RCA) that include Radiation Areas, Contamination Areas, or Airborne Radioactivity Areas. Task-specific HWPs will be used for short-term work in these RCAs with the potential for changing radiological conditions. General HWPs may be used for longer-term activities in RCAs with known, stable radiological conditions.

Personnel frisking and/or monitoring will be conducted before exiting radiological contaminationed areas and other areas where contamination is suspect. If the instruments

indicate greater than 100 cpm over background, a Health Physics Technician will be contacted for decontamination of personnel.

6.3.2 Posting and Labeling

The standard radiation symbol (ANSI N2.1/12.1) in magenta or black on a yellow background (or alternate as provided by regulations) will be used to warn individuals of the presence of radiation and/or radioactive material. Each access point to a controlled or restricted area will be posted with the appropriate identification and instructions. For controlled or restricted areas, each area will be posted as detailed in Table 6.1.

Table 6.1 Posting Requirements

Posting	Definition
Caution Radiation Area	5 mrem in 1 hr at 30 cm
Danger High Radiation Area	100 mrem in 1 hr at 30 cm
Grave Danger, Very High Radiation Area	500 rads in 1 hr at 1 m
Caution Airborne Radiation Area	>1 DAC or 12 DAC hr/week
Caution Radioactive Materials	Radioactive material handled, used, or stored
Contamination Area	Removable radioactive contamination in excess of values listed in Table 7.1

Additionally, NRC Form 3, "Notices to Employees," will be posted in a location visible to all employees who work with or around radioactive materials.

7.0 MONITORING

7.1 Personnel Monitoring

7.1.1 Internal Dosimetry

All personnel who have the potential to receive intakes of radioactive materials that may result in a committed effective dose equivalent of 500 mrem will participate in an appropriate bioassay program. This program will be reviewed and approved by a qualified Health Physicist and will be capable of detecting internal radioactive materials at a level below 10% of the Annual Limit of Intake listed in Appendix B of 10 CFR 20 for each radionuclide for which exposure at this level is likely.

Prior to beginning work in restricted or controlled areas with the potential for internal exposure in excess of the levels stated previously, each radiation worker will have an appropriate baseline bioassay performed. These individuals will also have an appropriate exit bioassay performed when they leave the project.

All personnel who perform routine field activities where the potential for removable surface or airborne radioactive contamination exists will participate in an appropriate routine bioassay program. Special follow-up bioassay procedures will be implemented whenever a suspected intake has occurred or routine bioassay results are above a derived investigation level.

7.1.2 External Dosimetry

Monitoring applies to any individual likely to receive an annual external whole body exposure in excess of 10% of the occupational limit. In addition, personnel monitoring is required for any individual who enters a High or Very High Radiation Area. All personnel dosimetry used will be processed and evaluated by a processor holding a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST). The work-related radiation exposure history will be acquired from past employers where radiation monitoring was required.

7.1.3 Summation of Internal and External Exposures

Internal committed effective dose equivalents and external effective dose equivalents during the year will be combined to determine the annual total effective dose equivalent in accordance with the requirements of federal and state regulations. Generally, summation will be required when intakes exceed 10% of the annual limit on intake, may result in a total effective dose equivalent of 50 mrem for minors or visitors, or may result in a dose equivalent of 50 mrem to the embryo/fetus for declared pregnant women. The deep dose equivalent to the whole body may be used as the effective dose equivalent for external exposures. The quality factors (Q) prescribed by the applicable regulatory jurisdiction will be used to calculate the dose equivalent in rem from the absorbed dose.

7.2 Medical Surveillance

No specific medical surveillance requirements exist for exposure to radiation levels at occupational levels. General medical surveillance requirements for all hazardous waste sites are contained in each HASP. URS' medical monitoring program is administered in accordance with the URS SMS 024 – Medical Screening and Surveillance.

All cases of overexposure and suspected ingestion or inhalation of radioactive materials must be reported to the SRSO immediately. The URS Medical Consultant will advise the SRSO on the type(s) of test(s) required to accurately assess exposure effects.

7.3 Workplace Monitoring

7.3.1 Surveys

Radiological monitoring and surveys of radiation exposure levels, contamination, and airborne radioactivity will be conducted to

- Characterize workplace conditions and detect changes in those conditions;
- Verify the effectiveness of physical design features, engineering and process controls, and administrative control procedures;
- Demonstrate regulatory compliance;
- Detect the gradual buildup of radioactive material;
- Identify and control potential sources of personnel exposure; and
- Identify areas requiring postings.

Monitoring will be performed only by trained and qualified personnel and will be conducted as specified in the HASP and associated RWPs.

At a minimum, radiological surveys will be conducted:

- Once per shift at entrance or exit points between contamination areas and clean areas;
- Daily in RCAs;
- Weekly in radiation and/or contamination areas;
- Weekly in clean areas; and
- As specified on RWPs/HWPs.

7.3.2 Air Sampling

General area and personal air sampling will be conducted in accordance with the guidance in NRC Regulatory Guide 8.25. Air sampling will be employed when necessary to determine whether confinement of radioactive material is effective, to determine workplace administrative controls required, to estimate worker intakes, and to determine what PPE is appropriate.

General area air sampling for airborne radioactivity will be conducted with high-volume air samplers where the potential for airborne radioactivity is above background levels. High-volume air samplers are those with sufficient flow rate to achieve a minimum detectable activity (MDA) of 10% of the applicable derived air concentration (DAC) in an 8-hour shift. For small jobs with documented minimal airborne radioactivity potential, general area air sampling for airborne radioactivity will not be required. Air samples will be analyzed in accordance with written procedures**.** In areas with a potential for short-term airborne excursions, representative grab samples will be collected in the immediate vicinity of work being performed to determine whether the area is an airborne radioactivity area requiring additional work controls and whether personal breathing-zone air sampling is necessary to assess the worker's intake of airborne radioactive materials. As with the protocol for personal sampling, high-volume sample results will be compared with the most conservative DAC.

When required to estimate worker intakes, representative personal air sampling from each field team working in radiologically contaminated areas will be conducted for airborne radioactivity in the breathing zone. To gauge employee exposure potential, the data will be compared with the DAC that is the most conservative for the contaminant(s) expected to be present. DACs for radioactive contaminants in Appendix B to 10 CFR 20 will be used to assess exposure potentials, as appropriate.

7.4 Release of Materials from Contamination Areas

Radiological contamination survey, documentation, and labeling requirements will be established for all property/material released from an RCA. All equipment, materials, and property used in an RCA established for contamination control will be considered as potentially contaminated and will not be released to an uncontrolled or unrestricted area until they have been surveyed and meet the unconditional release limits listed in Table 7.1 or site-specific requirements.

If the property/material to be released either cannot be monitored using standard survey techniques or is a volume or bulk material, such as liquids, soils, etc., it will be considered potentially contaminated. A special property/waste release evaluation will be conducted prior to release. The release limits for these materials will be established in accordance with specific guidance from the cognizant regulatory authority. All surveys and evaluations for release of potentially contaminated property/material to uncontrolled or unrestricted areas will be documented.

Table 7.1 Surface Radioactivity Release Limits

Radionuclide	Removable dpm/100 cm^2	Total (Fixed + Removable) dpm/100 cm^2
U-natural, U-235, U-238, and associated decay products	1,000	5,000
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	100
Th-natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (i.e., those with other than alpha emitters or spontaneous fission) except Sr-90 or radionuclides listed in this table	1,000	5,000

7.5 Instrument Calibration

Radiation detection instrumentation will be provided as appropriate for performing necessary surveys and monitoring. The instrumentation will be selected based upon the type of radiation detected, measurement capability, and range in accordance with the radiological hazards present or anticipated for the project.

Calibration of radiological instruments and equipment will be performed by the vendor or a calibration service in accordance with ANSI N323, 1997, using standards traceable to the NIST primary standards. The calibration certificate will be maintained by the SRSO.

Field calibration of counting instrumentation in accordance with approved written procedures is authorized if it meets the previous requirements and the source calibration certificate and if documented detection efficiency determinations are maintained in the site-specific project file. Each instrument or piece of equipment will have a calibration sticker with an expiration date affixed.

At a minimum, performance tests of radiological instruments will be conducted before use. Unless more stringent site-specific criteria have been established (as documented in the HASP), satisfactory performance test results will be within +/- 20% of the expected response. Instruments that do not meet performance test criteria, are found to be out of calibration, or are defective will be removed from service until repaired and/or calibrated. The results of these checks will be recorded in a daily source check log by the performer and will be maintained in the site-specific project file. All performance tests will be conducted in accordance with ANSI N323, 1997, guidance using the manufacturer's recommendations and approved written procedures.

8.0 PERSONNEL PROTECTIVE EQUIPMENT

8.1 Use and Selection of Protective Clothing

Personal protective equipment (PPE) will be selected based on the contamination levels in the work area and the anticipated work activity, ALARA and safety considerations, and consideration of nonradiological hazardous materials that may be present. Surfaces are considered radiologically contaminated if they are above Table 7.1 levels. PPE provided will be in good condition and free of chemical or radioactive contamination.

Full Set	**Double Set**
a. Coveralls (Tyvek® or cotton)	a. Two pairs of coveralls
b. Cotton glove liners	b. Cotton glove liners
c. Rubber or chemical resistant gloves	c. Two pairs of gloves
d. Shoe covers	d. Two pairs of shoe covers
e. Protective overshoes	e. Protective overshoes
f. Hood (Tyvek® or cotton)	f. Hood (Tyvek® or cotton)

Protective clothing and equipment selected for project tasks will be described in the HASP, together with procedures for donning and removing PPE without spreading contamination or contaminating the worker. For projects using a RWP system, the necessary PPE for a task will be specified by the RWP.

8.2 Use and Selection of Respiratory Protection Devices

URS' Respiratory Protection Program (URS SMS 042 – Respiratory Protection) details specific procedures for respiratory usage, fit, cleaning, etc.

Engineering control measures will be provided to limit the concentrations of radioactivity in air to levels below those that constitute an airborne radioactivity area to the extent feasible. When this level is not feasible, other methods such as administrative controls and respiratory protection will be used to limit the potential for intake of radioactive material.

Only respiratory protection equipment that is tested and certified by the National Institute for Occupational Safety and Health (NIOSH) will be used. Protection factors listed in Appendix A of 10 CFR 20 will be used in the assessment of potential radioactive material intake.

Selection of appropriate respiratory protection devices will be designated within either the HASP or RWP. At a minimum, respiratory protection devices will be selected so that a protection factor greater than the multiple by which peak concentrations or airborne radioactivity exceed the values specified in Appendix B of 10 CFR 20 is not exceeded. Only respiratory protection equipment that has been specifically certified for emergency use by National Institute for Occupational Safety and Health (NIOSH)/ Mine Safety and Health Administration (MSHA) will be used as emergency devices.

Whenever respiratory protection will be used at a site, the following additional minimum requirements will be met:

- Air sampling will be performed to identify the potential hazard, permit proper equipment selection, and estimate exposures;
- Surveys and bioassays as appropriate will be performed to evaluate actual intakes;
- Respirators will be tested for operability immediately prior to each use; and
- Written procedures will be available regarding selection, fitting, issuance, maintenance, and testing of respirators (including testing for operability prior to each use), supervision and training of personnel, monitoring (including air sampling and bioassays), and recordkeeping.

9.0 RADIOACTIVE MATERIAL ACCOUNTABILITY AND CONTROL

All procurement, receipt, and storage of radioactive material will be coordinated with the individual or organization responsible for radiation protection at the project site. A source custodian and documented inventory record will be established and maintained for radioactive sources. All sources brought on site by external organizations will not be allowed into areas under company control without prior notification and approval by the company individual or organization responsible for radiation protection. Radioactive materials licenses will be required for sources that exceed exempt quantities.

Transportation of radioactive material (specific activity >2000 pCi/g) in commerce, generally off site, will be in accordance with DOT requirements in 49 CFR 170 through 180, International Air Transport Association (IATA) regulations, and other federal, state, and local regulations, as applicable.

10.0 DECONTAMINATION

10.1 Personnel

The guideline for determining the presence of skin contamination on personnel is detectable radiological contamination above background.

If necessary, decontamination of personnel will be performed using soap and water, taking care to ensure that loose contamination is prevented from entering body openings. Decontamination fluids will be collected and disposed of as radioactive waste. If contamination has been transferred to the skin with chemical carriers or if repeated decontamination attempts with soap and water are unsuccessful, additional decontamination steps may be required. If possible, sufficient radiological measurements will be collected prior to decontamination so that exposure to the skin may be evaluated.

Prior to attempting any additional methods, medical assistance and direction will be sought. Potential skin decontamination methods that may be used (under direction of medical staff) include titanium dioxide paste followed by rinsing, a saturated solution of potassium permanganate followed by a rinse using a 5% solution of sodium acid sulfate, and complexing agents such as ethlylene diamine tetraceticacid (EDTA) or diethylenetriaminepenta-acetic acid (DTPA).

Specific decontamination procedures and documentation requirements are contained in site-specific SOPs. Nonradiological decontamination procedures are contained within the HASP.

10.2 Equipment

Surface contamination levels presented in Table 7.1 will be used to determine whether a piece of equipment is contaminated with radioactive materials. When decontamination is necessary, decontamination will be performed using techniques that are appropriate based on site-specific conditions. Generally, dry decontamination methods such as high-efficiency particulate air (HEPA) vacuuming or wipe downs are preferred when facilities for the collection of radiological contaminated wastewater are not in place. If adequate facilities exist for the collection of such fluids, it may be appropriate to use a wet decontamination technique. Additional decontamination methods include sand or other abrasive blasting.

Specific decontamination procedures and decontamination requirements are contained in the site-specific SOPs. Nonradiological equipment decontamination procedures are contained within the HASP.

11.0 WASTE MANAGEMENT

The generation, treatment, storage, packaging, and transport of radioactive waste for disposal will be in accordance with the applicable requirements of 10 CFR 20 Subpart K, depending on the cognizant regulatory authority. Materials suspected of being mixed waste (RCRA/TSCA/etc. hazardous substances combined with radioactive materials) will be identified and segregated as soon as practical to avoid combining mixed waste with other waste forms.

Radioactive waste will not be disposed of except through coordination with the designated authority (the USACE Hazardous, Toxic and Radioactive Waste Center of Expertise).

Provisions for the minimization of radioactive waste generation will be implemented on each site, as appropriate. Although the scope of this waste minimization program will be commensurate with the level of radioactive materials present and activities conducted at each site, at a minimum, the following guidelines will be followed:

- Removal of excess/unnecessary packaging material prior to bringing materials into radiological controlled areas;
- Restriction of materials entering controlled areas to those materials necessary for performance of work;
- Restriction of the quantities of hazardous materials, such as paints, solvents, chemicals, cleaners, and fuels, entering radiological areas;
- Substitution of reusable items in place of disposable ones, when practical;
- Selection of consumable materials such as PPE that is compatible with waste processing systems, volume reduction, and waste acceptance criteria;
- Survey of potentially contaminated material leaving controlled areas to separate uncontaminated materials from contaminated materials; and
- Emphasis on waste reduction methodologies in training.

Additional waste minimization procedures and/or requirements will be identified in each site-specific work plan and will be commensurate with the levels of radioactive materials present and activities being performed.

12.0 EMERGENCY PROCEDURES

Site-specific radiological emergency procedures commensurate with the level of hazard will be developed or client procedures will be adopted prior to the initiation of work. The procedures will address, as appropriate, severe weather actions, transportation accidents or spills, medical emergencies, personnel contamination, and onsite emergency response and notification requirements involving radioactive materials. The scope of the procedures will be based on a contractual agreement with the client with respect to the role employees are expected to fulfill in an emergency event.

At a minimum, emergency procedures will take into account client emergency response procedures and the responsibilities of offsite state and local emergency response agencies.

All site personnel will be instructed in their emergency responsibilities and the emergency procedures. For high hazard projects, if the client has not done so, nearby hospitals and fire department(s) will be contacted and briefed on what hazards may be expected from radioactive material or toxic substances during an emergency.

13.0 TRAINING

Training will be provided to general employees, radiation workers, and radiological control staff at a project site under this Radiological Protection Program. Periodic retraining will be conducted whenever a significant change to the Radiation Protection Program or implementing procedures occurs or at a frequency consistent with applicable regulatory or client requirements and commensurate with radiological hazards present on the site. A minimum retraining frequency of two years will be implemented.

All formal training under the program will verify individual knowledge by an appropriate examination. Documentation of training, consisting of the individual's name, date of training, topic(s) covered, pass or fail, and the name of the certifying official, will be generated. No employee will be permitted to independently perform tasks inside of a radiological controlled area until the appropriate training and qualification requirements are met.

Radiological Worker Training. At a minimum, all personnel entering an area where radioactive material or radiation-generating devices are used, and where there is a potential for an individual to receive a Total Effective Dose Equivalent (TEDE) of 100 mrem or more in one year, will receive instruction in:

- The presence of the material or device;
- Health and safety problems associated with exposure to radiation, including the potential effects of radiation on a pregnant female, the fetus, or the embryo;
- Precautions and controls used to control exposure;
- This Radiation Protection Program; and
- Their rights and responsibilities.

Additional training requirements will be determined on a site-specific basis and will be commensurate with the radiological hazards present on each site. These additional requirements will be documented in the applicable HASP.

14.0 AUDITS

An internal audit of the content and field implementation of this Radiation Protection Program will be conducted at least once per year by the Business Radiation Safety Officer, Vice President Safety, or designee. Audit findings will be reported in writing to the appropriate personnel within URS.

15.0 RECORDS MANAGEMENT

Radiation Protection Program records will be maintained to document compliance with regulatory requirements and the exercise of due diligence in the control of radiological hazards for the protection of employees, members of the public, and the environment. These records will be transferred to the project file at the conclusion of the project.

At the completion of site activities, copies of exposure monitoring records will be sent to URS' Occupational Health Specialist for inclusion into each respective employee's medical file. Exposure monitoring records for subcontract personnel will be transferred to each respective subcontract organization. Copies of radiation monitoring results for all site personnel will be provided to an individual consistent with the requirements of 10 CFR 19.13. Upon completion of work at a site, exposure data pursuant to the 10 CFR 19.13 requirement will be provided for URS employees only. Subcontract personnel will be required to make requests for exposure records directly to their respective employer.

Exposure records that are maintained by URS will be maintained in a manner consistent with applicable Privacy Act requirements. The records will be available for retrieval over a period not less than 75 years after the date of creation of the record. All quantities used in the records will be in special units of curie, rad, or rem, including multiples and subdivisions of these units. Records identified with an individual's name or identifying number will be available upon request from that individual.

Records to be maintained include the following (as available):

- Doses received by individuals, for whom monitoring was required, during previous employment;
- Doses received by individuals for whom monitoring was required;
- Dose assessments and organ burdens for individuals for whom bioassay was performed.
- Doses to the embryo/fetus of a declared pregnant employee;
- Written declarations of pregnancy;
- Written withdrawal of declaration of pregnancy;
- Results of surveys for radiation and radioactive material in the workplace and outside of controlled or unrestricted areas as required by regulatory requirements or the Radiation Protection Program;
- Results of surveys for the release of material or equipment to uncontrolled or unrestricted areas;
- Records of effluents and radioactive waste disposal under control;
- Results of calibrations performed on radiological instruments and quality control checks for radiological instrumentation and personal monitoring devices;
- Records of ALARA evaluations and control actions;
- Records of radiological training completed, including general employee radiological training;
- Records of internal reviews and audits with corrective actions closeout; and
- Records of regulatory agency inspections and audits with corrective actions closeout.

Interim storage of these radiological records will be the responsibility of the SRSO and will be maintained in a readily retrievable, controlled manner. Upon completion of each site project, and upon request, copies of all radiation exposure records will be made available to USACE.

URS	Safety Management Standard **RADIATION WORK PERMIT**	Attachment 052-2 AMER Issue Date: July 2000 Revision 2: December 2009

RWP Number:	Work Location:
RWP Job Description:	Start Date/Time:
	Expiration Date/Time:
	Requested By:
Type of RWP: ☐ General ☐ Job-Specific	Request Date:

Rad Training Requirements	ALARA Requirements	Survey Frequency	Pre-Job Radiation Levels
☐ Rad Worker I ☐ Rad Worker II ☐ Rad Safety Officer ☐ Site Specific ☐ Other (specify)	☐ ALARA Review ☐ Pre-Job Briefing ☐ Air Sampling ☐ Other (specify)	☐ Constant HP Coverage ☐ Periodic HP Coverage* * Define periodic coverage:	☐ General Area Dose Rate: ☐ Job Specific Dose Rate: ☐ Contamination Level: ☐ % DAC: ☐ Other (specify):

Required Personnel Protective Clothing and Equipment

Anti-Cs		Monitoring
☐ Hood ☐ Coveralls ☐ Coveralls (2 pair) ☐ Rubber Shoe Covers ☐ Cloth Boot Covers ☐ Latex Gloves ☐ Cotton Work Gloves	☐ Rubber Gloves ☐ Cotton Glove Liners ☐ Tape Coveralls at Wrist and Ankles ☐ Other (specify):	☐ TLD ☐ Extremity TLD ☐ Pocket dosimeter ☐ Hand-held monitor ☐ Hand/foot monitor/frisker ☐ Whole body frisk ☐ Other (specify):

Respiratory Protection	Special Precautions	Additional Precautions/Requirements
☐ Full-face (Negative Pressure)* ☐ Powered Air-Purifying* ☐ Supplied Air ☐ Self-contained Breathing Apparatus ☐ Other (specify): *Specify cartridge or canister type	☐ "Buddy System" in Effect ☐ Special Training or Pre-Job Briefing Required ☐ Special Personnel Frisking Considerations ☐ Dose/Contamination Reduction Considerations ☐ Stay Time Controls ☐ Other (specify)	Describe:

Radiological Work Zone Entry Log

Print Name	Signature	Employee #	TLD Initial	TLD Exit	Total Dose	Time Enter	Time Exit	Time Enter	Time Exit

Approvals	Date	Termination	Date
Site RSO:		Site RSO:	
Site SHO:		Reason:	
Site Manager:			

URS	Safety Management Standard **HAZARDOUS WORK PERMIT**	Attachment 052-3 AMER Issue Date: July 2000 Revision 2: December 2009

HWP Number:	Work Location:
HWP Job Description:	Start Date/Time:
	Expiration Date/Time:
	Requested By:
Type of HWP: ☐ General ☐ Job-Specific	Request Date:
Is a Radiological/ALARA Review Required? ☐ No ☐ Yes	

Chemicals/Substances Present	Combustible/Flammable Vapors	Pre-Job Radiation Levels	Site Surveys			
		General Area Dose Rate:	Type	Number	Date	By
		Job-Specific Dose Rate:				
		Contamination Level:				
		%DAC:				
		Other (specify):				

Required Personnel Protective Clothing and Equipment

Hands	Feet/Legs	Body
☐ Cotton Work Gloves	☐ Steel-Toe/Shank Boots/Shoes	☐ Cotton Coveralls
☐ Latex Gloves	☐ Disposable Shoe Covers	☐ Tyvek® Coveralls (regular)
☐ Rubber Gloves	☐ Other (specify):	☐ Tyvek® Coveralls (coated)
☐ Other (specify):		☐ Other (specify):
Respiratory	**Head/Eyes**	**Miscellaneous**
☐ Full-face (Negative Pressure)*	☐ Hard Hat	☐ Tape Coveralls to Gloves & Boots
☐ Powered Air-Purifying*	☐ Safety Glasses	☐ Fall Protection
☐ Supplied Air/SCBA	☐ Goggles	☐ Hearing Protection
☐ Other (specify):	☐ Face Shield	☐ Other (specify):
*Specify cartridge or canister type:	☐ Other (specify):	

Special Instructions, Requirements, and Limiting Hazardous Conditions		Dosimetry	Indiv.	Group
☐ MSDS	☐ "Buddy System" in Effect	TLD Badge		
☐ Fire Watch	☐ Safety and Health Personnel	Extremity TLD		
☐ Portable Fire Extinguisher	☐ Special Training/Pre-Job Briefing	Pocket dosimeter		
☐ Lockout/Tagout	☐ Excavation Permit	Other (specify)		
☐ Confined Space Entry	☐ Fire Retardant Clothing	**IH Monitoring**	**Indiv.**	**Group**
☐ Pre-Entry Monitoring	☐ Special Personnel Frisking Considerations	Air sampler		
☐ Emergency Response Equipment	☐ Dose/Contaminant Reduction Considerations	Passive sampler		
☐ Radio Communication	☐ Stay Time Controls	Grab sampler		
☐ Portable Eyewash	☐ Other (specify):	Other (specify)		

Work Zone Entry Log

Print Name	Signature	Employee #	TLD Initial	TLD Exit	Total Dose	Time Enter	Time Exit	Time Enter	Time Exit

Approvals	Date	Termination	Date
Site RSO:		Site RSO:	
Site SHO:		Reason:	
Site Manager:			

URS	**Safety Management Standard** **- STRICTLY PRIVATE -** **DECLARATION OF PREGNANCY FORM**	Attachment 052-4 AMER Issue Date: July 2000 Revision 2: December 2009

To be completed by radiological worker:

Name: _____ Employer: _____ ID#: _____

Date/Time: _____ Work Location: _____ Supervisor: _____

Estimated Date of Conception _____ Estimated Delivery Date _____

I am voluntarily declaring my pregnancy for the purpose of providing additional protection from exposure to ionizing radiation to my embryo/fetus. I understand that, as a result of this declaration, I may be offered a temporary work assignment that does not involve occupational radiation exposure. However, if I choose to continue work involving occupational radiation exposure, my activities will be restricted so that any occupational radiation exposure received by my embryo/fetus does not exceed the limits set forth by the US NRC. I agree to comply with these restrictions. I also understand that I may revoke this declaration in writing at any time and must do so in order to have these restrictions lifted.

Signature: _____ Date: _____

The shaded areas are to be completed by Site Radiation Safety Officer:

Estimated external dose from estimated conception date until declaration date:

_____

Estimated internal dose equivalent to embryo/fetus from estimated conception date until declaration date:

_____

Remaining dose for balance of gestation period:

_____

Adjusted uniform monthly dose limit:

_____

Determined by: _____ Date: _____

Site Manager: Specify any work restrictions:

_____

_____

_____

Acknowledgment of Receipt from Worker and Acceptance of Indicated Work Restrictions:

_____ _____

Project Manager Signature: Date:

_____ _____

Radiation Safety Officer Signature: Date:

Name:		Employer/ID:
Declaration Date/Time:		
Estimated Conception Date:		Estimated Delivery Date:
A.	Estimated External Dose Equivalent to embryo/fetus from estimated conception date until declaration date:	mrem
B.	Estimated Internal Dose Equivalent to embryo/fetus from intakes occurring from estimated conception date until declaration date:	mrem
C.	Total Current Dose Estimate *(sum of A and B, above)*:	mrem
D.	Remaining dose for balance of gestation period *(450 mrem − Dose from C, above)*:	mrem
E.	Adjusted Uniform Monthly Dose Limit *(Divide remaining dose from D by the number of months from declaration date to estimated delivery date;should not exceed 50 mrem)*:	mrem

***Note to analyst**: After completing information required on this form, transfer information regarding Estimated External Dose (A), Estimated Internal Dose (B), Remaining Dose (D), and Adjusted Uniform Monthly Dose Limit (E) to Worker's Declaration of Pregnancy form.*

Above data transferred by: Date:

URS	**Safety Management Standard** **- STRICTLY PRIVATE -** **WITHDRAWAL OF DECLARATION OF PREGNANCY**	Attachment 052-6 AMER Issue Date: July 2000 Revision 2: December 2009

Name: Employer ID:

I am withdrawing my declaration of pregnancy which was executed on (Date) _____. I understand that, as a result of signing below and submitting this form, any work restrictions that have been imposed as a result of my previously submitted pregnancy declaration will be lifted.

Worker's Signature	Date
Project Manager's Signature	Date
Radiation Safety Officer's Signature	Date

APPENDIX C

Site Radiation Safety Officer Resume

Amy Jones

Senior Environmental Engineer

Areas of Expertise

Radiation Safety Officer
Radiological Site Assessment, Remediation and Verification
Data Analysis and Interpretation
Procedure development

Years of Experience

With URS: 14 Years
With Other Firms: 9 Years

Education

MS/Environmental Policy and Management/2000/University of Denver
BS/Science Biology/1990/Mesa State College

Registration/Certification

Registered Radiation Protection Technologist #15872

Overview

Ms. Jones has over 23 years of experience in radiological assessment and verification surveys; analyzing radiological and site data, and 6 years' Project Management experience. .She is the Radiation Safety Officer on the Utah 3-N Radioactive Materials License UT1800410. She is responsible for conducting all licensed radiological work in compliance with the regulatory requirements and the URS radiation safety program. Her area of expertise include radiological assessments, radioactive material regulatory compliance, developing, reviewing and, implementing radiological work plans, radiation safety procedures, and radiological training programs to ensure safe handling of radioactive materials. She has also assisted in the development of project-specific procedures for commercial and industrial clients, along with data management practices to handle large volumes of electronic data generated during radiological surveys, paired with a global positioning system. She has participated in evaluations of facilities involving radioactive materials such as low-level radioactive waste, uranium mill tailings, and naturally occurring radioactive materials (NORM).

Project-Specific Experience

Technical staff, Western Zirconium Decommissioning Cost Estimate 2015 update, 2015. Reviewed the 2009 cost estimate and supported the cost estimator to update the costs and regulatory assessment included in the cost estimate.

Radiological Lead, Final Status Survey Plan Addendum, Chemical Waste Management Model City, 2015. Developed an addendum to the Final Status Survey plan for facultative Pond 8. This addendum addressed modification to the approved survey procedures, and documentation related to the TENORM material found during the remediation that will remain onsite.

Local Quality Assurance Lead, Dynegy Coal Combustion Residuals Compliance Support 2015-present. Served as the local Quality Assurance lead for CCR compliance support work. Work was conducted in accordance with the AECOM Quality Management System program requirements for detail checks and independent technical reviews (ITR). Local team includes staff from multiple AECOM offices. Conducted project specific training to ensure all assigned staff are familiar with project QA requirements, and have access to appropriate procedures, and forms. Worked with project manager to identify appropriate staff for ITR and detail checks.

Radiation Safety Officer/Radiological lead, Preliminary Assessment /Site Inspection Former Naval Station Puget Sound, Seattle WA2013-present: Drafted the Site investigation work plan, QAPP, health

and safety Plan, Accident Prevention Plan and Radiation Protection Plan and implementing procedures for a site investigation at the Former Naval Station Puget Sound. Contaminates include radium paint, strontium, and cesium. Field activities will include oversight of radiological contractor tasked to conduct gamma walk over surveys, collection of soil samples, manhole sludge samples, and sediment core samples from Lake Washington. Will be the onsite Radiation Safety officer for all radiological work under reciprocity with the State of Washington.

Radiation Safety Officer, UMETCO Residual Radioactive Material Characterization/Remedial Action, Green River Utah, 2010-present: Drafted a site characterization/remedial action plan for residual radioactive material adjacent to the Green River Utah UMTRA site. Site RSO supervising the removal action in 2011 and 2013. Drafted the MARSSIM Final Status Survey Report which is under State review.

Radiation Safety Officer, Davis Monthan Air Force Base RW-16, Tucson Arizona, 2013-present: Requested reciprocity with Arizona to conduct radiological scoping surveys at a former Radiological Waste storage area. Developed decommissioning plan and a MARSSIM remedial action work plan for removal and disposal of the material in the waste storage area.

Radiation Safety Officer, Holloman Air Force Base, Alamogordo New Mexico, 2015-ongoing: Drafted remedial action work plan for a former Radiological Waste storage area. Will request reciprocity and conduct work under the URS RML.

Radiological Lead, Kelly Air Force Base Building 375 Former C-5 Flight Controls Shop, San Antonio Texas, 2013-present: Reviewed historical radiological survey data to develop a scoping survey to characterize depleted uranium contamination in drains in an operating hanger.

Radiological Lead, Lockheed Martin Sub Slab Depressurization facility, Lake Success New York, 2014-present: Provided radiological expertise to address radiological health and safety issues resulting from NORM at the facility. Conducted site training, facility radiation surveys and Radon testing.

Radiation Safety Officer, Luke Air Force Base, Phoenix Arizona, 2013-ongoing: Drafted remedial action work plan for a former Radiological Waste storage area. Will request reciprocity and conduct work under the URS RML.

Radiological Technical Support, Abandoned Uranium Mine OU I EE/CA support, Grand Canyon Arizona, 2013-present: Provided radiological expertise on the EE/CA documents.

Radiological Lead, Lignite Gas Plant NORM Survey ONEOK, Lignite ND 2014: Conducted a NORM radiation Survey at the Lignite Gas plant.

Radiological Lead, NORM Surveyor Training, Whiting Petroleum. Lignite ND 2014: Conducted NORM surveyor training and provided technical expertise for URS personnel conducting survey NORM surveys at facilities in North Dakota.

Quality Assurance Lead, Duke Energy, Coal Combustion Product (CCP) Operation and Maintenance (O&M) Manuals, 14 Power Stations throughout the Southeast United States2014-2015. Served as Quality Assurance lead for the preparation of CCP Operation and Maintenance Manuals for 14 power stations. The fast track schedule is in direct response to support Duke Energy management's commitment to the Duke CEO to have all 14 O&M Manuals final by March 31, 2015. Followed the AECOM Quality Assurance program requirements for detail checks and independent technical reviews (ITR) for over 100 individual documents, which make up the 14 O&M Manuals. Coordinated the work of a team of over 25 engineers and technical support staff to complete all reviews and ITR's, using SharePoint to ensure team member working at location across the country were able to access the documents and resources necessary to facilitate the fast track schedule.

Compliance External Assessment, Waste Isolation Pilot Plant 2014, Participated in a technical review of external audit reports, corrective action plans and objective evidence of closure of issues pertaining to the Fire and Rad event. The review focused on 46 audits/ assessments which had been conducted prior to the Events. The findings and observations identified during these prior assessments were reviewed and evaluated to identify if they were adequately addressed, closed by the corrective action plans and objective evidence was documented.

Radiation Safety Officer, Building 80N Tritium and Carbon-14 Subsurface Investigation, Merck Sharp & Dohme Corp. Site Rahway, New Jersey2014: Requested reciprocity with the State of New Jersey, and functioned as the radiation safety officer for an investigation of tritium and carbon contamination. Soil core samples/scans were completed at 13 locations. Conducted worker training, issued Radiation Work Permits, evaluated bioassay results, conducted incoming and outgoing equipment release surveys. Collected and analyzed tritium and carbon swipe samples.

Radiation Safety Officer, Balance of Plant Soil Investigation Niagara Falls Storage Site, Niagara Falls NY, 2013-2014: Conducted GPS gamma walkover surveys at 380 soil sample locations, and 8 investigation trench locations. Functioned as the Site Radiation Safety Officer and coordinated the efforts of the assigned field radiological technicians. Conducted Authorized Use and Authorized User assistance training for all onsite URS and contract personnel. RSO duties included

managing dosimetry and bioassay program, conducting incoming and outgoing equipment surveys, and issuing Radiation Work Permits. Developed the site specific Radiation Safety Program developed to comply with U.S. Army Corps of Engineers Radiation regulations.

Radiological Safety Officer, URS RML UT1800200, Salt Lake City Utah 2013: Prior to termination, responsible for operation and radiation safety of URS environmental sample analysis laboratory operating under State of Utah license UT1800200. Maintain procedures and records in full compliance with license requirements; State of Utah audits identified no findings or out-of-compliance issues. Successfully terminated the license. Completed a MARSSIM release survey of the URS Salt Lake City sample laboratory, and arranged for disposal of all remaining regulated material

Technical Input, Maxey Flats Cap Project, Maxey Flats KY, 2013. Reviewed and revised the sites existing health and safety and radiation safety programs to ensure they address the current sites radiological conditions and health physics practices. Provided on site radiological training and oversight for the geotechnical investigation.

Site Radiation Safety Officer, Niagara Falls Storage Site Niagara Falls NY, 2012-2013: Provided Radiation Safety oversight during monitoring well installation, investigation trenching, and sealing of water pipelines exiting the site. RSO duties included managing dosimetry and bioassay program, conducting incoming and outgoing equipment surveys, and issuing Radiation Work Permits. Additional responsibilities include borehole gamma logging,, core scanning and excavation support surveys. Work was done under a site specific Radiation Safety Program developed to comply with U.S. Army Corps of Engineers Radiation regulations.

Site Radiation Safety Officer, Green Brook River Basin Flood Damage Reduction Project, Middlesex Municipal Landfill, Middlesex New Jersey, 2012: Collected radiation data at 25 borehole locations across the site, and collected 80 soils samples for radiological analysis. Work was done under Reciprocity with New Jersey.

Radiological Survey Lead, Abandoned Uranium Mine OU 2, Orphan Mine Site, Grand Canyon Arizona, 2012-present: Provided technical input on the approach to characterize the radiological condition of mine site below the canyon rim. Reviewed the approach to have ASPECT conduct a flyover gamma radiation survey.

Radiological Survey Lead, Abandoned Uranium Mine OU I Radon and Surface Gamma Characterization, Orphan Mine Site, Grand Canyon Arizona, 2010-present: Developed work plans, quality assurance project plan, project specific procedures and provided input on radiological safety practices for project Health and Safety plan. Work included a yearlong effort including both passive and active Radon monitoring, with a Short Term Continuous Radon Monitor deployed inside the partially sealed mineshaft to collect data at the site. Conducted a GPS linked gamma

radiation surface survey across the 31 acre site, collecting approximately 500,000 measurements. Drafted the Site Investigation Data Report, and the Radon & Meteorological Monitoring Report, and revised based on client comments.

Corehart Refractory Site Radiological Data Validation, State of Kentucky, 2012: Reviewed soil sample data and generated the Corehart Radiological Data Validation Report, for soil samples analyzed by the State of Kentucky Laboratory.

Radiological Survey Lead, Chevron NORM Survey Hass Shepard Site, Pascagoula MS, 2012: Conducted a radiation assessment at a site with suspected NORM material from a nearby phosphogypsum facility.

Technical Reviewer Licensing Support, Denison Decommissioning Plan Review, Salt Lake City, Utah, Utah Division of Radiation Control, 2012: Critically evaluated licensees' and applicants' submittals to Utah Division of Radiation Control with a focus on compliance with current decommissioning guidance, and radiation protection regulations.

Radiological Survey Lead, Chevron NORM Survey, Santa Maria California, 2011: Conducted a radiation assessment of abandoned oil field pipe currently being used as waterlines, pipe segments, and pipes used in the construction of corral and cattle guards.

Quality Assurance Technical Support, LLRW Facility Licensing & Construction Oversight Waste Control Specialists. 2004-2011: Assist the project quality assurance manager with the development and implementation of the project specific quality assurance project plan, to support the 5 year licensing effort, and subsequent construction. Included development and management of the document & drawing control system to manage the 15 license application revisions, construction drawings and issuance of final record drawings. Controlled document sets were issued to regulators, client, internally, and to construction contractors. Developed project specific work instructions to supplement design engineering, and project filing procedures. Trained project personnel and conducted internal audits and surveillances to ensure compliance with client requirements.

Quality Assurance Technical Support, Byproduct Facility Construction Waste Control Specialists. Assist the project quality assurance manager with the development and implementation of the Nuclear Quality Assurance (NQA)-1 project specific quality assurance project plan. Developed project specific work instructions to supplement design engineering, project filing procedures, and methods to track personnel training. Trained project personnel and conducted internal audits and surveillances to ensure compliance with NQA-1 requirements.

Technical Support, Environmental Monitoring Waste Control Specialists, 2010–present: Prepared the WCS environmental data for

statistical analysis to support the development of Investigation Levels (IL) and Action Levels (AL) as part of the Data Quality Objective process. Developed the Quality Assurance Project Plan for the WCS Environmental Monitoring program

Site Radiation Safety Officer, Client Site Los Angeles California, Aman Environmental Construction, 2009: Developed a Site Specific Radiation Safety Plan and implementing procedures to support remediation of Thorium 232 and Uranium 238 contaminated material from Site. Conducted radiological training for project staff, issued dosimetry, directed a radiation staff, of 3 senior technicians, and maintained records to document survey activities. Excavation activities were conducted under Radiation/ Hazardous Work Permits, to properly control the excavation and ensure personnel were using appropriate PPE. Directed the excavation using portable radiation instruments such as, dose rate meters, NaI, gas proportional and GM detectors, and collected excavation control samples. Incoming and outgoing DOT radiation surveys were conducted on all trucks used for the transport of contaminated material.

Radiological Survey Team Lead, Grand Canyon High School Athletic Fields, Grand Canyon Arizona, 2008:. Lead the team conducting the radiological survey for the presence of uranium mine rock at the Athletic Field located at the Grand Canyon High School.

Project Manager, Radioactive Materials 11e.(2) Licensing Support, Salt Lake City, Utah, Utah Division of Radiation Control, 2006–Present: Critically evaluated licensees' and applicants' submittals to Utah Division of Radiation Control (addressing facility design and construction; environmental monitoring; radiation protection; site characteristics; quality assurance programs; operations; procedures; and performance assessments of radiological impacts and structural stability). Evaluated information submitted by licensees and applicants against regulatory requirements and guidance.

Project Manager, DoD Radiological Support Defense Distribution Center (DDC), 2007–Present: Provide general Health Physics support to the DDC for their NRC radioactive materials license. Including updating and revising the existing training program, and providing onsite support as needed.

Project Manager, DoD Radiation Training DDC (DDC), 2008: Updated and conducted the DoD 2 week Radiation Protection Officer Qualification Course. Updated and conducted both Radiation Worker Training and Packaging and Transportation of Radioactive Material course, for the Anniston Depot

Team Lead, Supplemental Radiological Assessment Crude Chlorinations, Western Zirconium Little Mountain Facility, 2007–2008: Conducted a supplemental radiological assessment of the crude chlorination areas to support the development of a Decontamination and

Decommissioning Plan for the areas of the facility that are no longer in use.

Team Lead, Radiological Survey and Support, Noble Gas, 2007: Led a team providing 24/7 radiological monitoring at an oil and gas rig drilling within 3 miles of the Rulison Blast Site.

Environmental Engineer, Waste Control Specialists, 2005–Present: Reviewed and modified as necessary existing Radiation Safety, Health and Safety, and Emergency Response Procedures and modified procedures for inclusion in the Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste for consistency. Modified operational procedures to address facility design changes generated during the license review process. Developed operational procedures to address handling of waste received in shipping casks.

Team Member, Radiological Scoping Survey, Carteret Site, New Jersey, 2005–Present: Conducted radiological scoping survey of 35-acre property to determine the presence of naturally occurring radioactive material (NORM) contaminants resulting from historical fertilizer at the site. Used Visual Sample Plan to establish MARSSIM survey units and identify specific sample locations for the work plan to fully characterize surface and subsurface contamination at the facility.

Technical Support, Waste Control Specialists, 2004–Present: Reviewed the Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste for consistency. Assisted in the development of a database to track and document technical and administrative comments on the license application. Modified the tracking database used to coordinate responses and changes to the license application resulting from both administrative and technical notices of deficiencies from the Texas Department of Environmental Quality

Data Transcription and Database Manager, Adams & Reese, 2002–present: Supervised analysis and transcription of over 500,000 pages of historical operating documents, covering 14 years, into a 98 MB database. Developed procedures, databases, and data control programs to support data analysis. Provided oversight and training for staff of 10 to ensure consistent data evaluation. Provide testimony in depositions as an expert witness summarizing results and data transcription efforts.

Martha Oil Site Field Radiation Verification, State of Kentucky, 2006: Conducted field radiation verification surveys at sites associated with the Martha Oil field. Reviewed contractor data to determine if sites should be recommended for unrestricted release.

Environmental Engineer, Utah Department of Radiation Control, 2005–2006: Supported the Utah Division of Radiation Control for review of EnergySolutions 11e.(2) disposal facility license renewal. Responsible for determination of completeness, correctness, accuracy, and regulatory

compliance for license application sections on Operations and Quality Assurance.

Team Lead, Radiological Assessment, Western Zirconium Little Mountain Facility, 2005–2006: Conducted a radiological assessment of the reclaimed ponds to characterize the volumes and concentrations of NORM radioactive materials, and a radiological survey of select plant operational areas.

Environmental Engineer, Utah Department of Radiation Control, 2005: Reviewed existing perpetual care regulations for Resource Conservation and Recovery Act and radiological disposal facilities for the state of Utah.

Team Member, Radiological Assessment, Kraft Site, Chicago, 2003: Conducted radiological assessment of building and parking lot.

Laboratory Staff, Graysill Uranium Mine, 2003: Following chain of custody procedures, received, analyzed, and validated Radon canister samples.

Team Lead, Radiological Assessment, Santa Barbara Airport, California, 2003: Conducted radiological assessment of a building used for munitions testing. Based on physical evidence and historical records located onsite, determined the facility had been previously surveyed and released by the State of California.

Environmental Engineer, Radiological Assessment, Park City Water Treatment Facility, 2002: Conducted radiological assessment of NORM at a water treatment plant. Conducted site radiological survey and collected samples for laboratory analysis. Assisted in the development of a facility radiation safety plan and associated procedures. Conducted training for facility personnel on new procedures and the radiation safety program resulting from the radiation safety plan.

Laboratory Staff, BP Amoco, 2001–2002: Following chain of custody procedures, received, analyzed, and returned radioactive soil samples. Laboratory analysis was performed using a high purity germanium system. Generated sample analysis reports including data validation. Quality assurance review of final status radiological survey data.

Technical Support, Confidential Client, 2001: Contacted radioactive waste generators to assess the market viability for the development and operation of a new facility for the disposal of radioactive materials.

Team Member, Radiological Assessment, Norton Air Force Base, 2001: Conducted radiological verification and data analysis of final status surveys at Building 752, Norton Air Force Base. Specific duties included conducting surveys, oversight of remediation contractor, analysis of radiological data, and review of data for final report.

Team Member, Radiological Assessment, Colorado School of Mines, 2001: Conducted radiological assessment of uranium decay product contamination in building foundations and soil. Quality assurance review of radiological survey data.

Team Leader, Radiological Assessment, Monticello Millsite Remedial Action Project, 1992–1999: Specific duties included conducting radiological verification surveys, evaluating survey data, and generating project reports. Performed independent evaluation of radiological survey methods and procedures used to verify sites met site criteria. Developed operational procedures for a system combining radiological survey data and global positioning data to better evaluate radiological contamination. Reviewed historical assessment, construction, remedial action, and verification data to ensure sites met appropriate criteria.

Team Leader, Radiological Assessment, Monticello Vicinity Properties, 1992–1999: Specific duties included conducting radiological surveys, evaluating survey data, and generating project reports. Performed independent evaluation of radiological survey methods and procedures used to verify sites met site criteria. Reviewed historical assessment, construction, remedial action, and verification data to ensure sites met criteria to support deletion from the National Priorities List.

Team Leader, Radiological Assessment, Uranium Mill Tailings Remedial Action Project, 1992–1999: Specific duties included conducting radiological surveys at 11 different Uranium Mill Tailings Remedial Action (UMTRA) sites across the United States, evaluating survey data, and generating inclusion and verification reports. Performed independent evaluation of remediation contractor radiological survey methods and procedures used to verify sites met site criteria.

Radon Team Leader, U.S. Postal Service, Midwest, 1997–1998: Led a team to conduct Radon, asbestos, and lead-based paint surveys of postal facilities in the Midwestern United States. Duties included placing radon monitors, organizing and validating all data gathered, and transmitting data to be incorporated into a database.

Team Leader, Radiological Assessment, Rocky Flats Environmental Technology Site, 1996: Conducted verification surveys in former uranium and plutonium processing building. Specific duties included conducting radiological surveys and evaluating resulting data.

Team Leader, Radiological Assessment, Grand Junction Project Office Remedial Action Project, 1994–1999: Conducted independent verification activities for the DOE Grand Junction Project Office Remedial Action Project.

Team Member, Radiological Assessment, CS-10 BOMARC Facility, 1998: Radiological survey team member of the CS-10 BOMARC Facility at the Otis Air National Guard Base, Massachusetts Military Reservation.

Team Member, Radiological Assessment, DOE Y-12 Facility, 1994: Radiological survey team member for radiological characterization of the Water Treatment Plant at the U.S. DOE's Y-12 Facility.

Team Member, Radiological Assessment, DOE Oak Ridge Reservation, 1995: Conducted radiological characterization and radiation protection surveys at the White Wing dump DOE Oak Ridge Reservation.

Team Member, Radiological Assessment, Oak Ridge National Laboratory, 1993: Conducted general radiological characterization assessment surveys at site associated with the DOE Oak Ridge National Laboratory.

Professional Societies / Affiliates

Health Physics Society
National Registry of Radiation Protection Technologists #15872

Specialized Training

2015/ 40 Hr Radiation Safety Officer Training Dade Moeller
2015 DOT NRC & IATA Requirements for shipping Radioactive Materials
1991-2015 8 Hr Annual HAZWOPER Refresher.
1997/Technical Writing Course, American Management Association
1994/8-hour Supervisor Hazardous Waste Operations and Emergency Response Training
1991/40-hour Hazardous Waste Operations and Emergency Response Training
1991/Safe Use of Radionuclides, Oak Ridge Associated Universities Professional Training Program

Security Clearance

DOE Q (inactive)

Awards

2012/Pyramid Award for Health and Safety
2012/Presidents Award for Health and Safety

Publications

Nielson, K.K., A.R. Jones, G.M. Sandquist" Gamma Radiation Scanning Survey Designs for Large Land Areas," 13th International Conference on Nuclear Engineering Beijing China, May 16-20, 2005.

Egidi, P.V., M.K. Jensen, A. R. Jones, M.J. Wilson-Nichols, S.M. Smith, G.A. Pierce, and J.L. Zutman, "Use of Global Positioning System for Accelerated Independent Verification of Clean up at A Superfund Site," Health Physics Society 33rd Annual Mid Year Meeting

'Instrumentation, Measurements, and Electronic Dosimetry' Site Characterization Session January 30 – February 2, 2000.
Pierce, G. A., A. R. Jones, and S. M. Smith, "Combining a Global Positioning System with Environmental Detection Instruments," presented at the U.S. Army Corps of Engineers Combined Military Programs Environmental Technical Conference and Biennial Safety and Occupational Health, Albuquerque, NM, March 16, 1998.

Chronology

2001–Present: URS Corporation, Salt Lake City, Utah
1993–1999: Oak Ridge National Laboratory, Grand Junction, Colorado
1990–1993: Oak Ridge Associated Universities, Grand Junction, Colorado

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