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SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BASE REALIGNMENT AND CLOSURE PARCELS AT TRUMAN ANNEX NAS KEY WEST FL

3/1/1999

TETRA TECH NUS

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SUPPLEMENTAL SITE INSPECTION WORKPLAN

for

BRAC Parcels at Truman Annex

Naval Air Station Key West, Florida

Southern Division
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

Contract Task Order 0032

March 1999

Revision 1

AIK-98-0521

SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BRAC PARCELS AT TRUMAN ANNEX

NAVAL AIR STATION
KEY WEST, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
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North Charleston, South Carolina 29406

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ACRONYMS

ABB	ABB Environmental Services, Inc.
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society of Testing and Materials
AVG	Average
B&R Environmental	Brown and Root Environmental
Bls	below land surface
BRAC	base realignment and closure
CAR	Contamination Assessment Report
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
Cm	centimeter
CofA	Certificate of Analysis
COC	Chain of custody
CTO	Contract Task Order
DOD	Department of Defense
DOT	Department of Transportation
DPT	Direct Push Technology
DQO	Data Quality Objective
DRMO	Defense Reutilization and Marketing Office
EBS	Environmental Baseline Study
EPA	United States Environmental Protection Agency
EQL	Estimated Quantitation Limit
FB	field blank
FDEP	Florida Department of Environmental Protection
FID	flame ionization detector
FKAA	Florida Keys Aqueduct Authority
FOL	field operations leader
FWS	United States Fish and Wildlife Service
GC/MS	gas chromatograph/mass spectrometer
GW	groundwater
HASP	Health and Safety Plan

HSM	Health and Safety Manager
ID	inner diameter
IDW	investigation-derived waste
IR	installation restoration
IRA	Interim Remedial Action
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mgd	millirem gallons per day
MS	matrix spike
MSD	matrix spike duplicate
msl	mean sea level
NA	not applicable
NAS	Naval Air Station
Navy	United States Navy
NFESC	Naval Facilities Engineering Service Center
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NK	not known
NSF	National Sanitation Foundation
NTU	nephelometric turbidity unit
OD	outside diameter
PCB	polychlorinated biphenyl
PM	program manager
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QAM	quality assurance manager
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RPD	relative percent difference
RPM	Restoration Project Manager
SAL	Screening Action Level
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	Site Inspection

SO	Soil
SOPs	standard operating procedures
SOUTHDIV	Southern Division, Naval Facilities Engineering Command
SOW	statement of work
SS	surface soil
SSI	Supplemental Site Inspection
SVOC	semivolatile organic compound
SW	surface water
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOM	task order manager
TtNUS	Tetra Tech NUS, Inc.
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µS/cm	microSiemens per centimeter
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound
VTSR	validated time of sample receipt

1.0 INTRODUCTION

This Workplan was developed to conduct the Supplemental Site Inspection (SSI) of Base Realignment and Closure (BRAC) Parcels at Truman Annex at the Naval Air Station (NAS) Key West, Florida. The Workplan presents the approach used for the SSI and support activities for the Interim Remedial Action (IRA) activities associated with the findings of the BRAC Site Inspection (SI). Tetra Tech NUS, Inc. (TtNUS) prepared this SSI Workplan on behalf of the United States Navy (Navy), Naval Facilities Engineering Command, Southern Division (SOUTHDIV) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62467-94-D-0888, Contract Task Order 032.

The Workplan addresses the following elements applied during the investigation process: (1) Data Quality Objectives (DQOs), (2) Sampling and Analysis Plan (SAP), (3) Data Management Plan, (4) Investigation-Derived Waste (IDW) Plan, (5) Health and Safety Plan (HASP), and (6) Quality Assurance (QA) Elements. The document is based on available NAS Key West background information and findings from the Draft SI Report for Nine BRAC Parcels (B&R Environmental, 1998a), the Predraft Environmental Baseline Study (EBS) Truman Annex, Excess Property (USN-NFEC, 1996), and the Draft EBS Truman Annex Outer Mole Pier (USN-NFEC, 1997).

1.1 PURPOSE AND SCOPE

TtNUS (formerly Brown & Root Environmental) will conduct the SSI at NAS Key West under the authority of the BRAC Act of 1992. The execution of the SSI will be performed in accordance with the guidelines in place under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). BRAC Parcels A, B, C, D, E, F, G, H, and K are currently classified as property category "grey" (i.e., areas that have not been evaluated or require additional evaluation) and cannot be considered for deed transfer until necessary actions have been taken and the property has been reclassified into a property category eligible for deed transfer. The objective of the SSI is to gather information to support a reclassification of some of these properties. The SI was not conclusive in determining the condition of media (soil and groundwater) beneath the footprints of Buildings 102, 103, and 104 at Parcel E. The SSI will support an evaluation of these media to determine the need for any remedial activities at Parcel E for reclassification of the property. This Workplan also includes IRA support activities to support reclassification of Parcels A, C, D, E, and F. During the SI conducted in 1997-98, contaminants were detected in soil (all Parcels) and sediment (Parcel A) at these areas at levels indicative of potential human health or ecological risks. The IRA support activities include delineation of contaminants in soil at Parcels C and E to determine areas for soil excavation. IRA confirmation sampling at Parcels A, C, D, E, and F will confirm the effectiveness of IRAs in these areas which will be performed to address remediation of soil and sediment contamination.

The scope of the investigation at Buildings 102, 103, and 104 at Parcel E will include the collection of suspected contaminant source samples within the sumps to evaluate the types and concentrations of any hazardous substances, and the collection of soil and groundwater samples to evaluate the migration of any hazardous substances that are found to be present. Collection of delineation samples at Parcels C [former Defense Reutilization and Marketing Office (DRMO) Storage Area] and E (former Building 136) is for the purpose of identifying the nature and extent of contaminated soils to be excavated as part of IRA activities. Lastly, the collection of confirmation samples at Parcels A, C, D, E, and F is for the purpose of confirming the IRA effectiveness.

During the SSI process, modifications to the scope of work or sample collection procedures may be required to satisfy program objectives. In the event that factors or conditions are revealed that require a modification of the Workplan, technical memoranda will be used to document the modification. The modification would be enacted upon gaining consensus between the United States Environmental Protection Agency (EPA), the Florida Department of Environmental Protection (FDEP), Navy reviewers, and the contractor responsible for executing the program. Collectively, this group is known as the NAS Key West Partnering Team.

1.2 REPORT ORGANIZATION

This Workplan consists of six chapters and five Appendixes. Chapters 1 and 2 provide the Introduction, Purpose, and Scope of the document; facility description; an overview of the environmental setting at Truman Annex NAS Key West; and a characterization of the BRAC Parcel portions addressed in this Workplan. Chapters 3 through 6 provide the elements of the investigation process used during the SSI. Appendix A presents the response to comments on the SSI Workplan submitted by FDEP and EPA. Appendix B provides the HASP for the SSI. Appendix C provides documentation in support of the DQO Process including DQO subzone summaries, BRAC SSI action levels, the BRAC background data subset, and an example of DQO sample number calculations. Appendix D includes TtNUS Forms used in the SSI field activities and IRA support activities. Appendix E presents QA Elements.

1.3 NAS KEY WEST DESCRIPTION

Several installations in various parts of the lower Florida Keys comprise NAS Key West. The Navy manages 6,323 acres of land divided into 20 separate tracts in the lower Florida Keys, concentrated around Key West and Boca Chica Key (Figure 1-1) in Southern Monroe County (B&R Environmental, 1998b). Key West, one of the two most western major islands of the Florida Keys, is approximately 150 miles southwest of Miami and 90 miles north of Havana, Cuba. Key West connects to the mainland by the Overseas Highway (U.S. Highway No. 1).

The 1992 BRAC Act identified a series of Department of Defense (DOD) properties for closure. The closure could involve the turnover of a property to another government agency or sale of the property. On NAS Key West, the Navy has identified several BRAC Parcels for closure. This Workplan addresses SSI and IRA delineation activities at portions of two BRAC Parcels at Truman Annex (Figure 1-2). Descriptions of the portions of the two BRAC Parcels addressed in this Workplan are found below.

1.3.1 Truman Annex

Truman Annex has had a long history as a defense facility. In 1823, after its purchase by an American citizen, the Navy was dispatched to Key West to remove pirates inhabiting most of the island. The Navy then occupied the northernmost portion of the west end of Key West. The Army acquired land on the western end of Key West in 1845 to build Fort Zachary Taylor, which provided support during the Mexican-American War. Seminole Battery was constructed to carry out defenses during the Civil War. Much of the land consisted of salt ponds, limiting further construction. The United States conducted landfill operations on the northern portion of the island in the area from the Army pier to the Naval Station from 1909 to 1919.

Gradually, the Navy assumed control of the entire western tip of Key West. As early as 1918 and particularly during the 1940s through the early 1970s, submarines were berthed at eight finger piers in the turning basin. Most of the buildings along the quay supported schools, units, and activities relating to submarines. The majority of the support buildings were demolished after 1982.

1.3.1.1 Parcel C (DRMO Waste Storage Area)

Parcel C (Figure 1-3) includes Buildings 795, 284, and 261 and two large areas that house the DRMO. The DRMO receives excess government materials. In the recent past, Building 261 stored hazardous materials and Building 795 stored inert materials. A cleared area in front of Building 795, known as IR 2, has been investigated for polychlorinated biphenyl (PCB) contamination under the Navy's Installation Restoration (IR) Program (Decision Document Letter Report for Installation Restoration Site 2: Transformer Oil Disposal Area and Installation Restoration Site 6: Dredgers Key Refuse Disposal Area; Brown & Root Environmental, 1997a). The PCBs were the result of PCB-contaminated oil used for dust suppression in the area. The investigation recommended no further action for the site based on sampling and risk assessment results. The two large storage areas have primarily stored metal debris. In addition, motors, vehicles, boats, refugee debris, and fuel trucks have been stored in those areas. Currently, metal debris including some machinery with motors is present (B&R Environmental, 1997a). A review of maps from the 1940s and 1950s also indicated the presence of oil racks within a portion of the storage areas.

1.3.1.2 Parcel E (Buildings 102, 103, and 104)

Parcel E (Figure 1-4), the area known as the Inner Mole Pier at Truman Annex, has served as a naval docking and support facility for more than a century. Most records of the area date to the period of World War II. In the late 1980s, the Inner Mole Pier waterfront was refurbished. Building 102 (former Torpedo Overhaul and Storehouse), Building 103 (former Central Power Plant), and Building 104 (former Battery Overhaul and Storage) are still standing but are out of service. Knowledge of the operations in these buildings is limited to activities supporting naval submarines. Hazardous materials, specifically volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganics, are believed to have been used in each of the buildings. PCBs are known to have been present in transformers at Building 103. In the mid 1980s, these transformers were removed from the building. All PCB contaminated materials have been removed from Building 103 (CH2M Hill, 1992). A petroleum Contamination Assessment Report (CAR) was prepared for the area around the three buildings. The CAR recommended the preparation of a Remedial Action Plan that was approved in April 1995 by FDEP (USN-NFEC, 1992, 1993a).

1.4 KEY WEST ENVIRONMENTAL SETTING

The island of Key West is approximately 4 miles long and 1.5 miles wide. The City of Key West is the county seat for Monroe County. The principal industry in Key West is tourism, which draws 1.5 million tourists annually (Roberts, 1998). Tourism, fishing, wholesale and retail trade, services, construction, finance, insurance, real estate, Federal government, state and local government, and transportation industries make up the major sources of employment in Key West.

The following subsections present a summary of existing conditions common to all Parcels located at Key West.

1.4.1 <u>Climate and Meteorology</u>

Of the Florida Keys, the Lower Keys have the least rainfall with an average annual rainfall of 39.4 inches. Temperature is fairly uniform across the Florida Keys with a July average temperature of 84 degrees Fahrenheit (°F), a January temperature of 64 to 70°F, and an average annual temperature of 76.3°F. Freezing temperatures are rare in the Florida Keys due to their proximity to the Gulf Stream and the Gulf of Mexico, both of which modify advancing cold fronts. Freezes, when they occur, have the long-lasting effect of killing cold-sensitive species that might otherwise become established. Easterly tradewinds and sea breezes suppress summer heat from June to September (B&R Environmental, 1998a).

Hurricanes normally form in the warm, moist air over the tropical seas around the Lesser Antilles and occasionally in the Caribbean. They tend to move in a westerly to northwesterly direction, gradually turning northward and eastward. Most hurricanes that approach Key West do so from the south and east. Severe hurricanes have struck Key West from each direction. Tidal flooding causes an estimated 75 percent of all damage that occurs during a hurricane (B&R Environmental, 1998a).

Dry and wet seasons characterize the climate of Key West. From December through May, the Keys receive approximately 20 to 25 percent of their total annual precipitation. Approximately 75 to 80 percent of the annual rainfall occurs from June through November. Rainfall usually occurs in advance of a cold front in the form of a few heavy showers, with generally five to eight light showers per month. Overland flow or storm drains that drain approximately 50 percent of the island's surface area carry rainfall runoff from Key West to the tidal waters; however, much of the rainfall percolates directly into the subsurface (B&R Environmental, 1998a).

1.4.2 Topography

Key West lies in the southeastern Coastal Plain physiographic province. A series of ancient marine reefs, formed during the Pleistocene period when the sea level was higher than it is at present, control the topography of the Coastal Plain in southern Florida (B&R Environmental, 1998a).

Ground elevations in the Key West area average between 4 and 5 feet above mean sea level (msl), and the highest point on Key West is approximately 18 feet above msl. The Key West area is characterized by a sparse veneer of residual soil and surface vegetation overlying eroded limestone. The topography of the lower Keys, generally smooth and flat in the center of the key, slopes gently toward the shoreline. Except in the filled areas that underlie the Overseas Highway, Key West is generally flat. With the exception of central Key West, most areas are within the 100-year floodplain (B&R Environmental, 1998a).

1.4.3 Surface-water Hydrology

The surrounding saltwater bodies, the Atlantic Ocean and the Gulf of Mexico, dominate the surface-water regime in the Florida Keys. FDEP classifies surface water in the Florida Keys as Class G-III Waters - Recreational, Propagation, and Management of Fish and Wildlife. In the immediate area of Key West are the Great White Heron National Wildlife Refuge and the Key West National Wildlife Refuge, which FDEP classifies as Outstanding Florida Waters to receive the highest degree of protection by the State. The residents of Florida consider these waters of exceptional recreational and ecological significance (B&R Environmental, 1998a).

Freshwater recharge in the lower Keys occurs directly through rainfall. The nearly flat topography and porous nature of exposed limestone allows much of the rainfall to infiltrate to shallow groundwater tables, forming freshwater lenses. Overland flow or storm drains in most of the more developed areas carry remaining rainfall to tidal waters. Accelerated runoff and increased saltwater intrusion from canals, housing, dewatering (as a mosquito control measure), and marinas decrease the freshwater lens on the Florida Keys and affect water quality. During the dry season, freshwater tends to disappear quickly by seepage to the sea and evaporation. Evaporation exerts an important effect on the Florida Keys' hydrologic budget, with transpiration affecting a more localized and confined area on individual islands (B&R Environmental, 1998a).

1.4.4 Geology and Soil

The lower Keys, which are within the southern or distal geomorphic division of Florida, were formed during the Pleistocene era. Commonly referred to as the "Oolite Keys," they are underlain by the Oolitic Member (Miami Oolite) of the Miami Limestone. The Oolitic Member consists of variably sandy, fossiliferous limestone composed primarily of ooids [spherical calcareous grains 0.25 to 2.0 millimeters (mm) in diameter] that were created through eustatic elevation of the limestone. In the lower Keys, the Oolitic Member consists of the Ooid Calcarenite and the Oomoldic-recrystalline lithofacies. The Ooid Calcarenite lithofacies consists of very fine to coarse sand-size, spherical carbonate grains concentrically laminated around a silt-size to fine-sand-size nucleus. The Oomoldic-recrystalline lithofacies consists of slightly sandy to very sandy well- to moderately well-consolidated micritic calcite. The Miami Oolite overlies the Key Largo Limestone, a geologic unit consisting of light grey to light yellow coralline limestone comprised of coral heads encased in a matrix of calcarenite.

The Miami Oolite is reported to be 27 feet thick. The Key Largo limestone is greater than 270 feet thick in the western portion of Key West. The Key Largo Limestone is generally more porous than the Miami Oolite, but it contains only saltwater. Figure 1-5 shows a geologic cross-section of the Florida Keys.

Many areas of the Florida Keys have been filled and graded. Undisturbed soil in the Keys consists of shallow marl over limestone with the substrate rock outcropping at the surface.

1.4.5 Hydrogeology

The surficial aquifer system found in the lower Keys consists of the Oolitic Member, which is very porous and highly permeable due to the dissolution of carbonate by groundwater as it recharges the aquifer system. The aquifer is tidally controlled and fluctuates constantly. It is extremely porous, and solution holes and caverns are ubiquitous. The Tamiami Formation lies below the Key Largo Limestone unit, between 300 and 900 feet below land surface (bls). The formation contains mineralized water that does not meet Florida drinking water standards. Underlying the Tamiami Formation are the Hawthorn and Tampa Formations, which together act as an aquiclude confining the underlying limestone units. Below the confining units of the Hawthorn and Tampa Formations is the Suwannee Limestone, fossiliferous limestone representing the top of the water-producing zone in the Florida Keys. The Avon Park Limestone is 1,300 feet bls and, although it has a higher transmissivity than the Suwannee Limestone and supplies large quantities of drinking water in central Florida, is of poor quality in the Florida Keys (B&R Environmental, 1998a).

The surficial aquifer is the principal aquifer of concern in Key West because of its reported use as a potable water resource to a limited extent (although not at NAS Key West) and because of its groundwater-to-surface-water contaminant migration route (ABB, 1995). The water table ranges in depths from 0.8 to 2.4 feet above msl at the center of Key West and from 0.4 to 2.2 feet above msl near the coast. The water table fluctuates diurnally because of tidal effects. Head differentials associated with tidal variations near the shore can further accelerate groundwater movement in the area. A reconnaissance water-quality sampling study completed in 1990 by the U.S. Geological Survey in cooperation with the South Florida Water Management District indicates that the freshwater lens contains nonpotable water (B&R Environmental, 1998a). The State of Florida classifies groundwater in unconfined aquifers that have a total dissolved solids content of 10,000 milligrams per liter (mg/L) or greater as Class G-III (nonpotable water). The City Engineer of Key West also reports that water from some wells in unconfined aquifers might be used for drinking after treatment such as reverse osmosis. The freshwater lens averages 5 feet in thickness below the center of the western half of Key West. The lens contains between 20 and 30 million gallons of fresh water, depending on the season. Underlying the freshwater lens is a 40-foot transition zone of brackish water (B&R Environmental, 1998a).

1.4.6 Potable Water Supply

Potable water is supplied to all the Florida Keys. The Florida Keys Aqueduct Authority (FKAA) operates and maintains the Florida Keys Aqueduct that supplies potable water throughout the Florida Keys. The water is drawn from wells near Florida City in southeastern Dade County and pumped 130 miles through a water main that parallels U.S. Highway No. 1 and terminates in Key West. Water is distributed along the length of the main. In 1984, the FKAA supplied the City of Key West with an average flow of 11.7 million gallons per day (mgd). The Navy at NAS Key West received 14.35 percent of the average flow (B&R Environmental, 1998a). In some instances, potable water is also obtained by rainwater catchment (the only source prior to the construction of the pipeline in the 1940s).

Alternative sources of potable and nonpotable water used in the Florida Keys include private cisterns, private wells, home desalination systems, and bottled water. The Monroe County Health Department recognizes the public water supply as the only potable water source available on Key West. In addition to managing the centralized public water supply system, the FKAA has the authority to regulate all potable water supplies in the Keys, including alternative sources of water such as those mentioned above. Those residences using a dual system of private and public water are required to use a reduced-pressure valve to prevent back-flow of water into the water supply system. The FKAA does, however, report that private wells in the freshwater lens in the surficial aquifer may be used for both potable and nonpotable purposes (B&R Environmental, 1998a). The number of people who use water from private wells in Key West for drinking or nonpotable domestic purposes is unknown. The best estimate of the number of people using local groundwater for nonpotable domestic purposes is less than 500 (B&R Environmental, 1998a).

1.4.7 Key West Population and Land Use

The City of Key West has a residential population of approximately 24,800 (USCBS, 1990). The principal industry is tourism with approximately 1.5 million tourists visiting the city annually (Roberts, 1998). The Monroe County population is approximately 78,000, and the average age is approximately 39 years (USCBS, 1990). The average household size is 2.3 persons. The median cost of housing is $164,000. Key West has five elementary schools, three parochial elementary schools, one public high school, the Florida Keys Community College, and May Sands Exceptional Center. Monroe County has 33 churches, one synagogue, and two Florida Health System Hospitals. Land use in the City of Key West consists primarily of commercial and residential areas.

1.4.8 Key West General Area Ecology

Truman Annex NAS Key West complex includes areas that have been developed by the Navy and retain little natural resource value. The Truman Annex BRAC Parcels addressed in this Workplan are considered fill areas with no natural communities.

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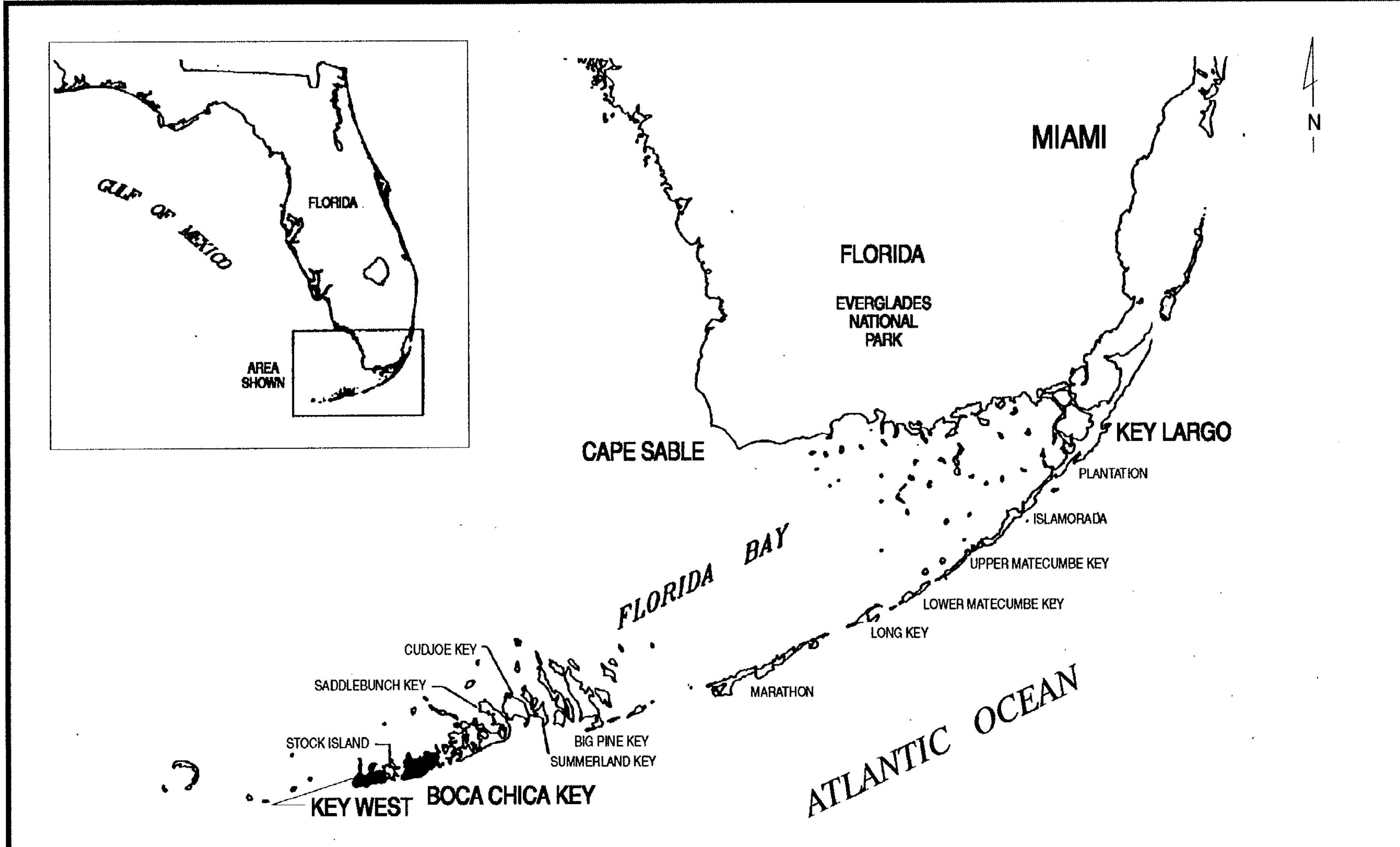

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COST/SCHED-AREA			APPROVED BY / DATE
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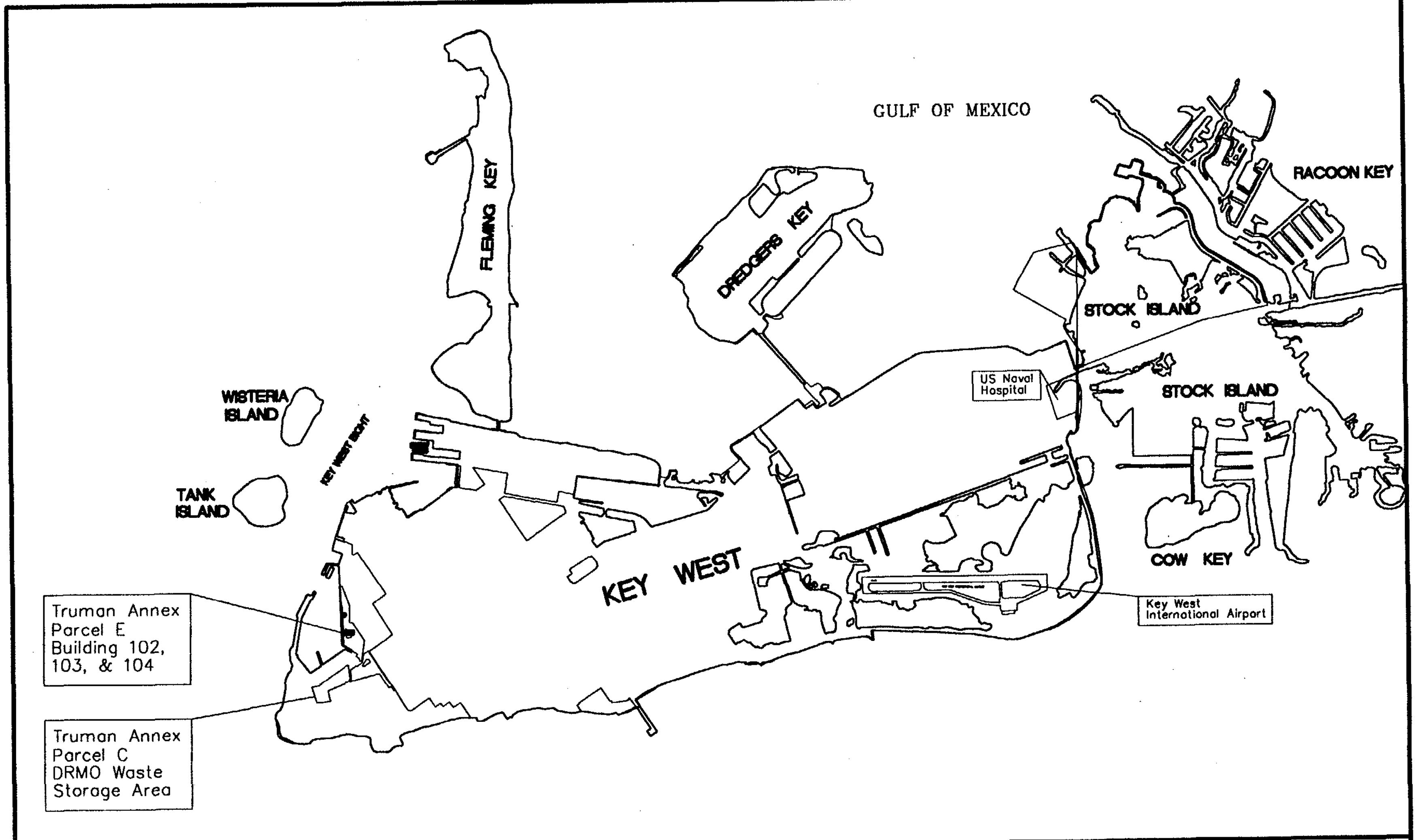

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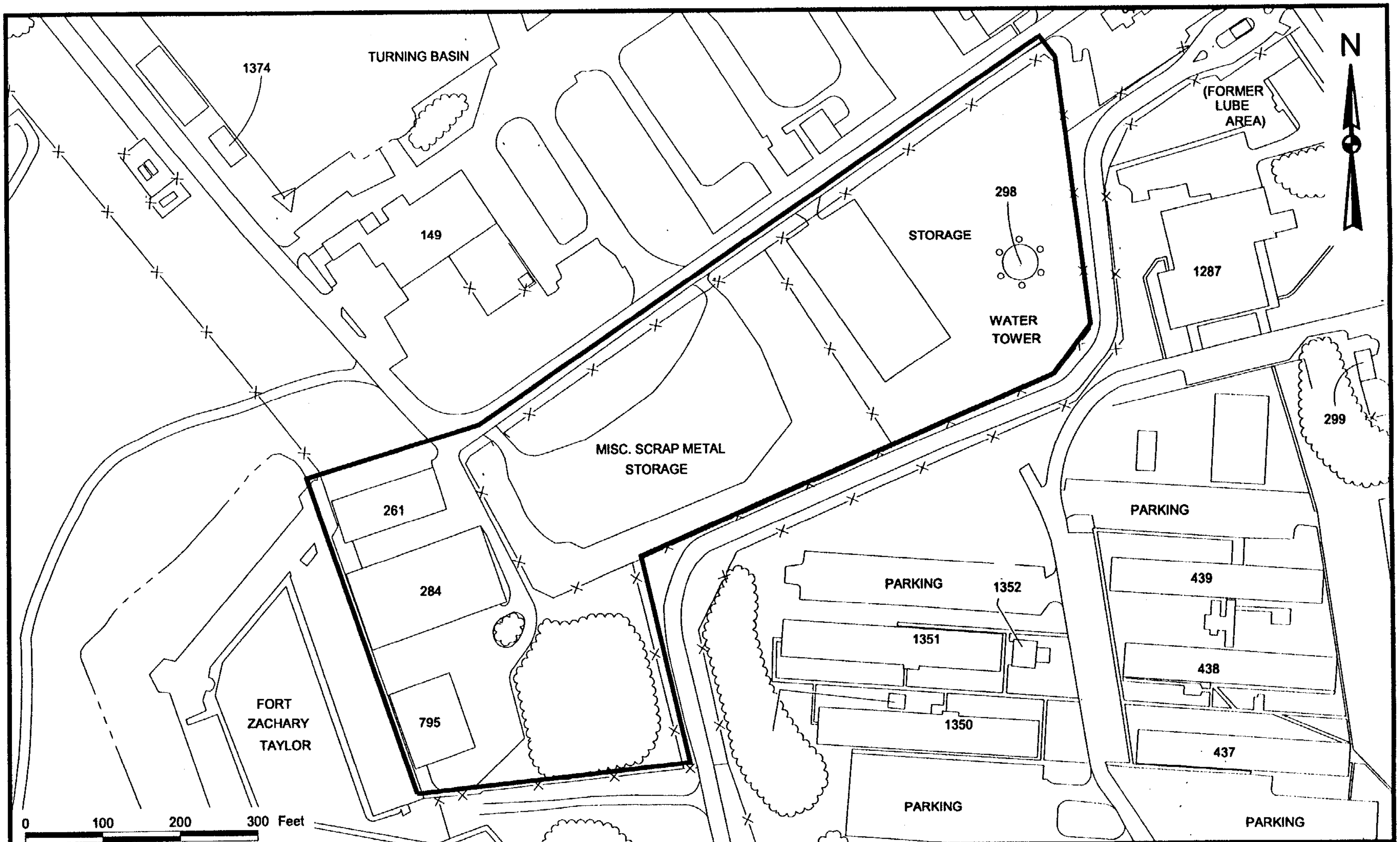

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SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BRAC PARCELS AT TRUMAN ANNEX

FIGURE 1-3. BRAC PARCEL C - DRMO WASTE STORAGE AREA

NAVY SOUTHERN DIVISION

NAS KEY WEST, FLORIDA

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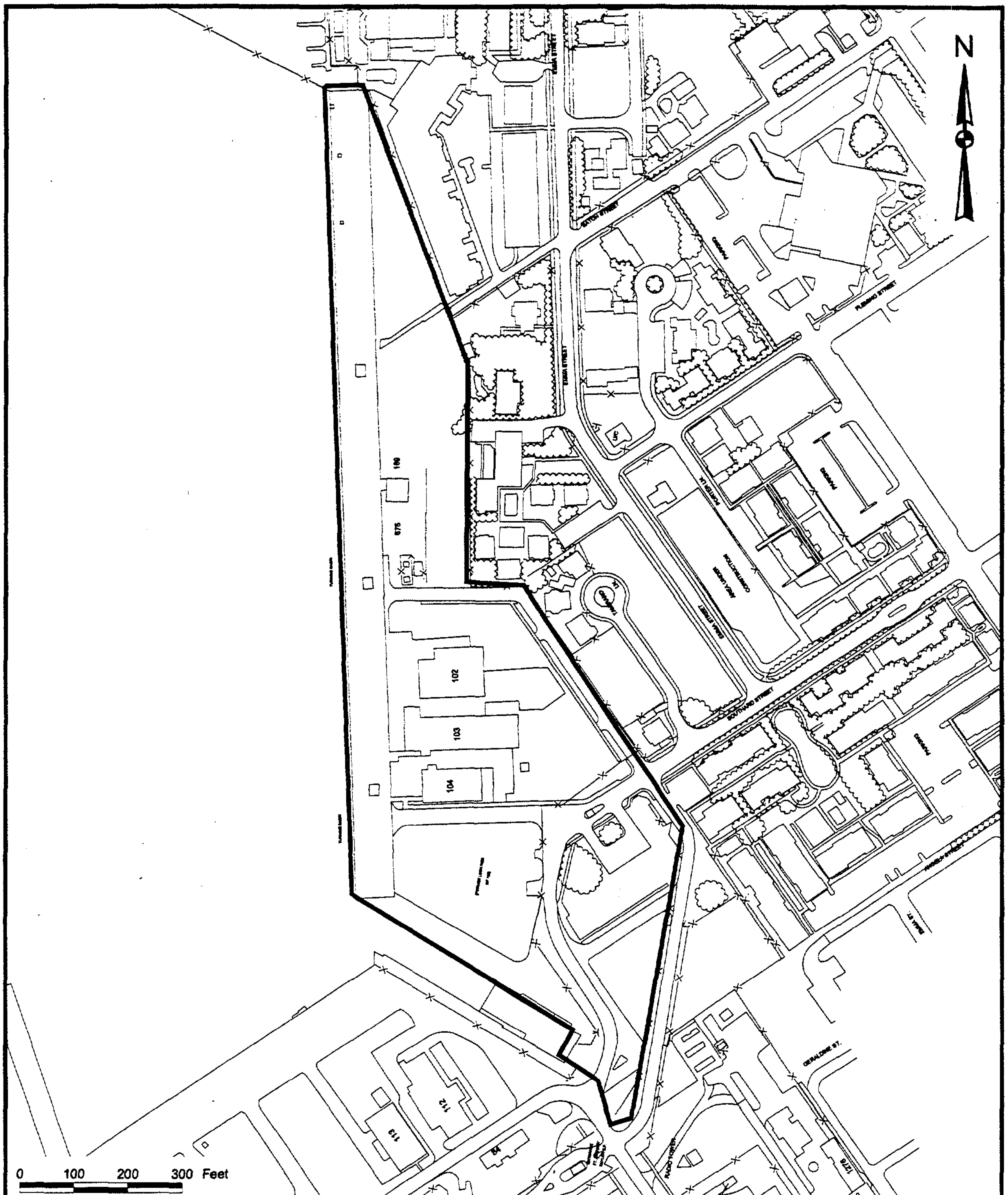

DRAWN BY TMH — DATE 05-AUG-98		SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BRAC PARCELS AT TRUMAN ANNEX FIGURE 1-4. BRAC PARCEL E - BUILDINGS 102, 103, AND 104 NAVY SOUTHERN DIVISION NAS KEY WEST, FLORIDA	CONTRACT NUMBER 7593
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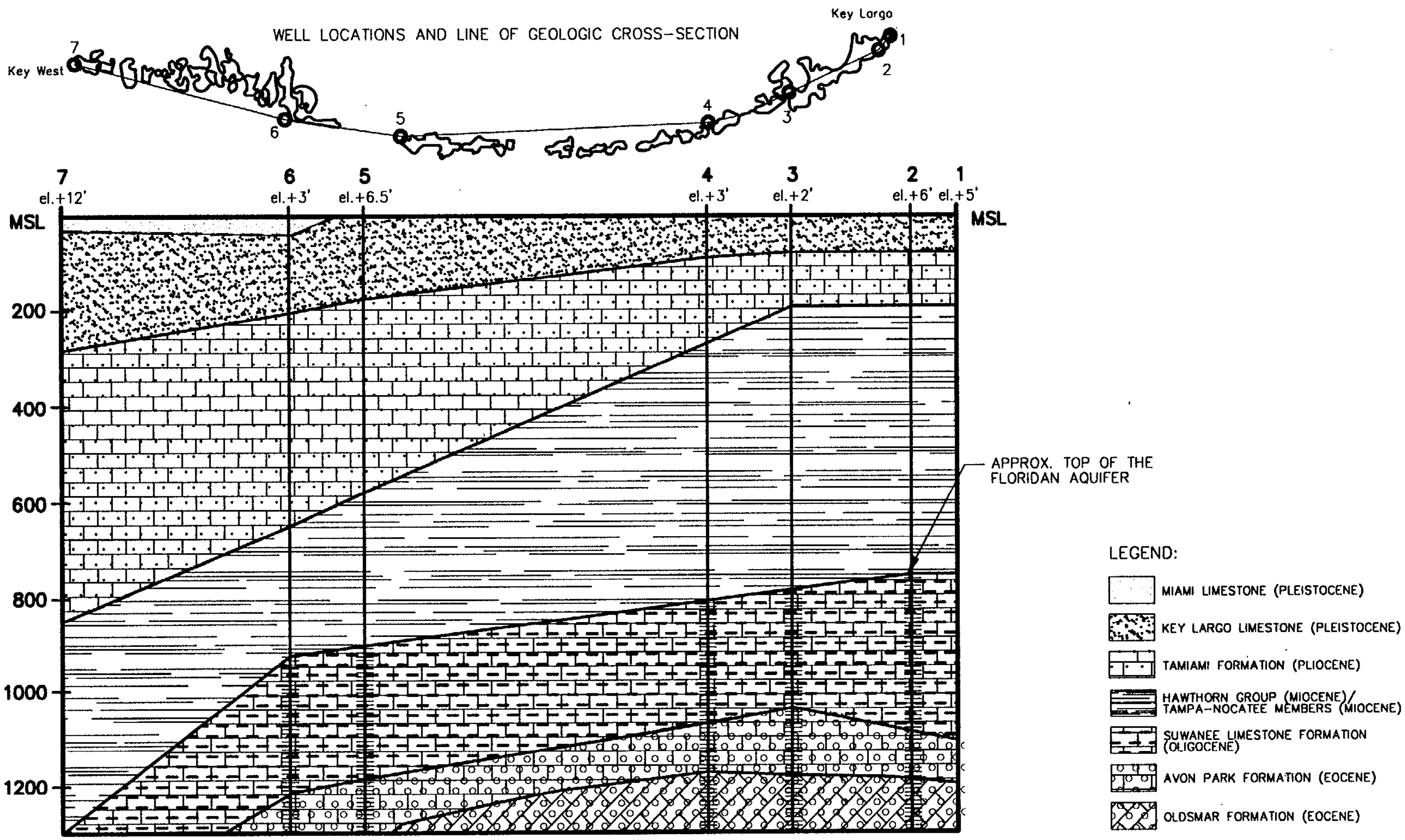

rtment of Health, Education and Welfare, 1975) (Florida Geological Survey - Special Publication No. 32, 1992)

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SCALE N.T.S.	

SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BRAC PARCELS AT TRUMAN ANNEX
FIGURE 1-5 GEOLOGIC CROSS-SECTION
FLORIDA KEYS
NAVY SOUTHERN DIVISION
NAS KEY WEST, FLORIDA

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2.0 DATA QUALITY OBJECTIVE PROCESS

2.1 DATA QUALITY OBJECTIVES PROCESS

The DQO Process (EPA, 1994) was used as a tool in the SSI Workplan to determine the type, quantity, and quality of data needed to support the conclusions and recommendations for BRAC Parcels categorized as "grey." As a systematic planning tool based on the scientific method, the seven-step DQO Process helps establish criteria for defensible decision-making at the onset of a study and develops a data-collection design based on these criteria. The steps identify such information as the goal of the investigation, the inputs needed to reach the goal and make a decision, the temporal and areal boundaries of the investigation, the level of confidence required to support a decision, and finally, a sampling design that is adequate to support the decision-making process. This Workplan addresses specific portions of two BRAC Parcels at Truman Annex which were investigated during the SSI.

2.2 DATA QUALITY OBJECTIVES PROCESS FOR THE SSI OF BRAC PARCELS C AND E AT TRUMAN ANNEX

Early in the SSI DQO Process, the two BRAC Parcels were divided into subzones based on surface features and the individual site's previous uses. Each subzone consists of a single environmental medium (e.g., groundwater, sediment, soil, or surface water), but the subzones within a given Parcel are not necessarily spatially distinct. Groundwater is always considered at the Parcel level and is never subdivided because subsurface features are generally homogeneous over a much broader area than surface features. The subzone structure developed in the SI is also used here. The following are subzones of interest in this Workplan.

- Parcel C, DRMO Waste Storage Area
  - Subzone 1, soil - Building 261, Hazardous Material Storage
  - Subzone 3, soil - Former Oil Container (Pre-1942) and Scrap Metal and Refugee Item Storage Areas
  - Subzone 4, soil - Former Scrap Metal Storage Area (former DRMO)

- Parcel E, Inner Mole Pier
  - Subzone 2, soil - Former Building 136
  - Subzone 3, soil - Buildings 102 and 104
  - Subzone 7, groundwater - Buildings 102, 103, and 104
  - Subzone 9, soil - Building 103

The planning team, consisting of Navy and TtNUS staff, completed all seven steps of the DQO Process for each subzone. Decisions needed to facilitate the process were reached jointly by members of the NAS Key West Partnering Team, including representatives of the Navy, TtNUS, Bechtel Environmental, Inc. (BEI), FDEP, and EPA Region IV. The steps, as identified in the EPA Guidance for the DQO Process, are as follows:

- **Step 1:** State the Problem – The first step in the DQO Process was to generate a problem statement for each subzone. At Parcel E, the potential impact of activities in Buildings 102, 103, and 104 on soil and groundwater is the problem. The unanswered question is – is there soil and groundwater contamination under the footprints of these buildings (which includes subzones 3, 7, and 9). To address contamination detected at Parcel E, former Building 136 (subzone 2) and Parcel C (subzones 3 and 4) during the SI, the Partnering Team decided to perform prescriptive soil removals (IRAs). The problem in these subzones is to what extent to excavate soils.

- **Step 2:** Identify the Decision – The second step in the DQO Process establishes the principal study question for each subzone and presents the various alternative actions that could result from resolving the question. The principal study question identifies the medium and parameter group that is of interest in each subzone (Table 2-1). The parameter groups were selected based on the SI analytical data for each subzone. The history of operations in Buildings 102, 103, and 104 was also considered.

- **Step 3:** Identify the Inputs to the Decision – A number of existing sources of information were identified as potentially being of use in site characterization in the SSI. Reports from previous investigations, maps, and drawings have been located for many of the subzones. In some cases, site visits were also used as information sources.

  Additional information needed for decision resolution takes the form of analytical data in subzones for the SSI and IRA support activities. Since various methods provide data on different environmental parameters, specific methods were selected based on the correlation between the parameters assessed by the method and known or suspected contaminants on the properties. Table 2-2 identifies the parameters and the analytical methods selected to quantify them. In the event that quantitation limits of the selected method are not low enough to meet the action levels, frequency of detection may be used as the primary tool in resolving the decision. The Partnering Team will be actively involved in resolving any decisions of this nature.

  A variety of Applicable or Relevant and Appropriate Requirements (ARARs) and Screening Action Levels (SALs) were considered for use as action levels in the decision-making process for the BRAC sites. These various lists of screening criteria were obtained from state agencies, Federal agencies, and research institutions. Additionally, twice the average background concentration of a subset of the data presented in the Comprehensive Background Report [Appendix F of the Supplemental RFI/SSI for Eight Sites (B&R Environmental, 1998b)] were also considered as a potential action level. The potential action levels considered for soil and groundwater contaminants are included in Appendix C. The actual selection of action levels for use in resolving the decision was performed in Step 5 of the DQO Process.

- **Step 4:** Define the Study Boundaries – The fourth step in the DQO Process describes the environmental medium of interest in each subzone and identifies any potential boundaries or limitations that must be recognized and addressed prior to data collection. The spatial boundaries of each subzone are addressed, as well the temporal boundaries. Spatially, the decisions apply to the medium of interest in each subzone (i.e., soil in Parcel E, subzones 2, 3, and 9; groundwater in Parcel E, subzone 7). Temporally, it is assumed that any analytical data obtained to facilitate the decision-making process are representative of current site conditions.

- **Step 5:** Develop a Decision Rule – This step states the decision rule for each subzone and addresses the elements that contributed to decision rule development. The decision at each site will be based on a comparison of analytical results with action levels. For SSI sampling at Parcel E, if the comparison is favorable (i.e., parameter mean concentrations are less than the selected action level), then the subzone will be considered "clean" and a decision of no further action will be made. For IRA delineation sampling, if the comparison is favorable for a given area within a subzone, that area will not be excavated.

  In order to ultimately make the decision, it is necessary to select a media-specific action level for each parameter. Various sources of action levels were evaluated, and three medium-specific tables (Appendix C, Part 2) were generated depicting the results of the evaluation. Legally binding action levels, guidance values, and potentially applicable guidance values from other media were all evaluated as part of the selection process. For inorganic compounds, commonly found in background samples from the vicinity of NAS Key West, twice the average background concentration was considered as an action level. The decision logic used to compare these various values and select the action levels is shown in Figure 2-1.

- **Step 6:** Specify Tolerable Limits on Decision Errors – The sixth step in the DQO Process quantifies the level of confidence that is necessary in the decisions resulting from the SSI and IRA support activities. The planning team determined that any decisions for IRA delineation must have a confidence level of 90 percent. This is the confidence level that is used in the statistical calculations relating to the sample collection process. Samples at the three buildings will be spaced to detect contamination plumes with a radius greater than 20 feet in Buildings 102, 103, and 104.

- **Step 7:** Optimize the Design – The seventh and final step in the DQO Process uses the information from the preceding steps to choose the optimal design for data collection. For SSI sampling at

Buildings 102, 103, and 104, biased sampling was the data collection design of choice in combination with spatial considerations. IRA delineation sampling was based on 100-foot by 100-foot grids. Each grid contains five sample points which will be composited for each sample grid/location. A VOC grab sample will be collected from the center point of each grid. For IRA delineation sampling, one-fifth of the selected SSI action level will be used since IRA delineation samples will be composited from five points within a grid yielding one analytical sample result per grid cell. The comparison of IRA action levels to analytical results will be made yielding a favorable or nonfavorable comparison for each grid. If a grid is not favorable, it will be slated for excavation. Within a grid, grab samples from each of the five points will be field tested for lead content. These results will refine delineation boundaries within grid cells.

TABLE 2-1

PARAMETER GROUPS AND MEDIA OF INTEREST
NAS KEY WEST

Building/Area	Parcel/ Subzone	Medium	Number of Samples	Parameter Group				
				VOCs	SVOCs	Inorganics	PCBs	Pest
IRA DELINEATION SAMPLING								
Former Oil Container (Pre-1942) and Scrap Metal and Refugee Item Storage Area	C/3	SO	150	X	X	X		
Former Scrap Metal Storage Area (Former DRMO)	C/4	SO						
Former Building 136	E/2	SO	18	X	X	X		
SSI SAMPLING								
Buildings 102 and 104	E/3	SO	48	X	X	X		
Building 103	E/9	SO		X	X	X	X	
Groundwater Area Associated with Buildings 102, 103, and 104	E/7	GW	19	X	X	X		
CONFIRMATION SAMPLING								
Sewage Lift Station	A/4	SO	7			X		
Area Around Sample SD-08	A/9	SD	7			X		X
Area Around Sample SD-05	A/9		9			X		X
Between Buildings 261 and 284	C/1	SO	12			X	X	
Former Oil Container (Pre-1947) and Scrap Metal and Refugee Item Storage Area	C/3	SO	99			X		
Former Scrap Metal Storage Area (Former DRMO)	C/4	SO						
Seminole Battery	D/1	SO	7		X	X		
Former Location of Building 136	E/2	SO	13		X	X		
Area Around Buildings 102 and 104	E/3	SO	9		X	X		
Area Around Building 103	E/9	SO	18		X		X	
Former Lube Area	F/1	SO	7			X		
Building 223	F/3	SO	7			X		

SO = Soil
GW = Groundwater

TABLE 2-2

PARAMETERS AND ANALYTICAL METHODS FOR BRAC[1] SUPPLEMENTAL SITE INSPECTION AT NAS KEY WEST PAGE 1 OF 2

Parameters	SW-846 Method
INORGANICS	
Aluminum	6010b and 7000a
Antimony	6010b and 7000a
Arsenic	6010b and 7000a
Barium	6010b and 7000a
Beryllium	6010b and 7000a
Cadmium	6010b and 7000a
Calcium	6010b and 7000a
Chromium	6010b and 7000a
Cobalt	6010b and 7000a
Copper	6010b and 7000a
Iron	6010b and 7000a
Lead	6010b and 7000a
Magnesium	6010b and 7000a
Manganese	6010b and 7000a
Mercury	6010b and 7000a
Nickel	6010b and 7000a
Potassium	6010b and 7000a
Selenium	6010b and 7000a
Silver	6010b and 7000a
Sodium	6010b and 7000a
Thallium	6010b and 7000a
Tin	6010b and 7000a
Vanadium	6010b and 7000a
Zinc	6010b and 7000a
POLYCHLORINATED BIPHENYLS	
Aroclor-1016	8082
Aroclor-1221	8082
Aroclor-1232	8082
Aroclor-1242	8082
Aroclor-1248	8082
Aroclor-1254	8082
Aroclor-1260	8082
PESTICIDES	
4,4'-DDD	8081a
4,4'-DDE	8081a
4,4'-DDT	8081a
Aldrin	8081a
Alpha-BHC	8081a
Alpha-chlordane	8081a
Beta-BHC	8081a
Delta-BHC	8081a
Dieldrin	8081a

Parameters	SW-846 Method
Endosulfan I	8081a
Endosulfan II	8081a
Endosulfan sulfate	8081a
Endrin	8081a
Endrin aldehyde	8081a
Endrin ketone	8081a
Gamma-BHC (lindane)	8081a
Gamma-chlordane	8081a
Heptachlor	8081a
Heptachlor epoxide	8081a
Methoxychlor	8081a
Toxaphene	8081a
SEMIVOLATILE ORGANIC COMPOUNDS	
1,2,4-trichlorobenzene	8270c
1,2-dichlorobenzene	8260b
1,3-dichlorobenzene	8260b
1,4-dichlorobenzene	8260b
2,4,5-trichlorophenol	8270c
2,4,6-trichlorophenol	8270c
2,4-dichlorophenol	8270c
2,4-dimethylphenol	8270c
2,4-dinitrophenol	8270c
2,4-dinitrotoluene	8270c
2,6-dinitrotoluene	8270c
2-chloronaphthalene	8270c
2-chlorophenol	8270c
2-methyl-4,6-dinitrophenol	8270c
2-methylnaphthalene	8270c
2-methylphenol	8270c
2-nitroaniline	8270c
2-nitrophenol	8270c
3 & 4-methylphenol	8270c
3,3'-dichlorobenzidine	8270c
3-nitroaniline	8270c
4-bromophenyl phenyl ether	8270c
4-chloro-3-methylphenol	8270c
4-chloroaniline	8270c
4-chlorophenyl phenyl ether	8270c
4-nitroaniline	8270c
4-nitrophenol	8270c
Acenaphthene	8270c
Acenaphthylene	8270c
Anthracene	8270c

TABLE 2-2

PARAMETERS AND ANALYTICAL METHODS FOR BRAC[1] SUPPLEMENTAL SITE INSPECTION AT NAS KEY WEST
PAGE 2 OF 2

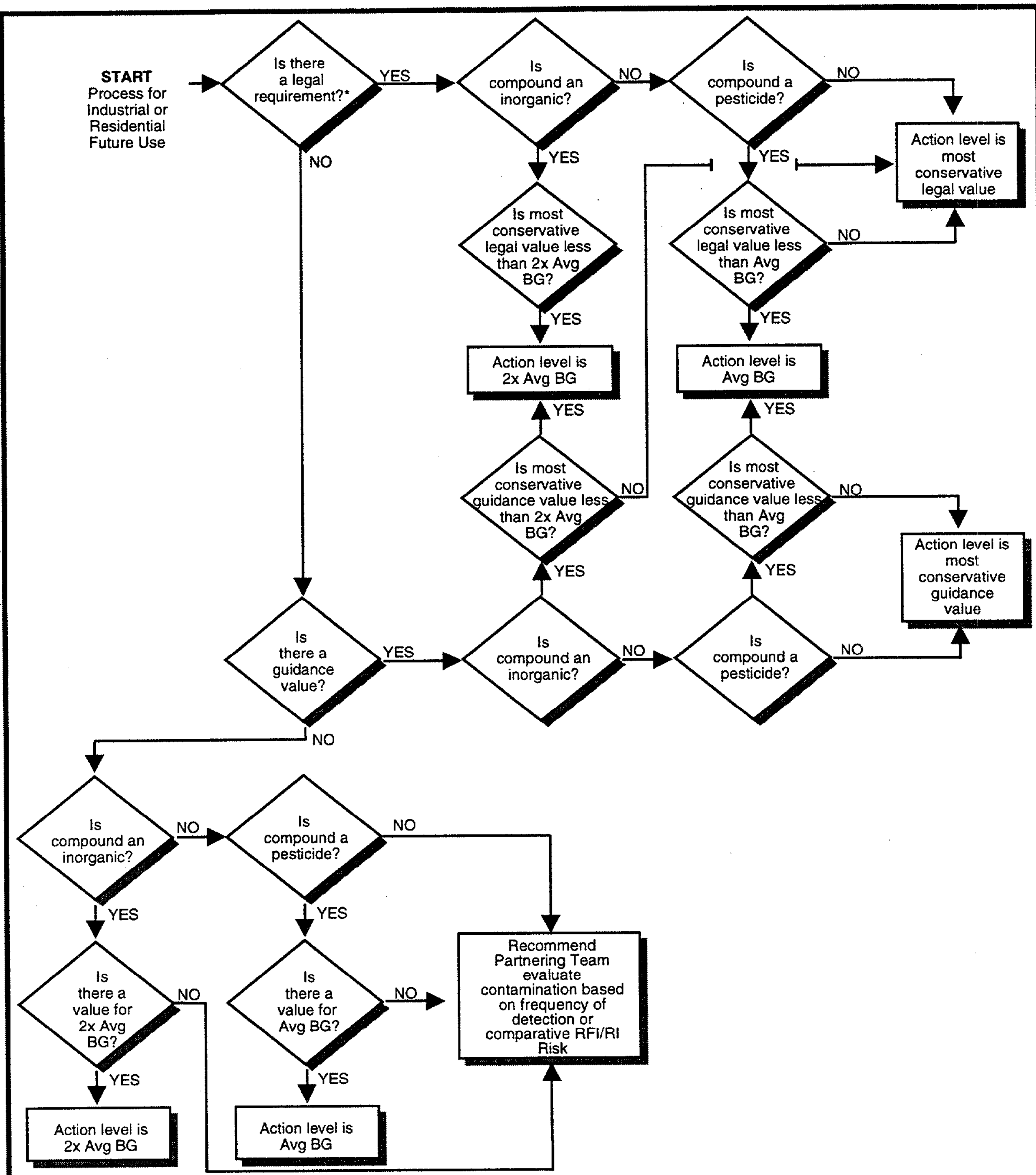
Parameters	SW-846 Method
Benzo(a)anthracene	8270c
Benzo(a)pyrene	8270c
Benzo(b)fluoranthene	8270c
Benzo(g,h,i)perylene	8270c
Benzo(k)fluoranthene	8270c
Bis(2-chloroethoxy)methane	8270c
Bis(2-chloroethyl)ether	8270c
Bis(2-ethylhexyl)phthalate	8270c
Butyl benzyl phthalate	8270c
Carbazole	8270c
Chrysene	8270c
Di-n-butyl phthalate	8270c
Di-n-octyl phthalate	8270c
Dibenzo(a,h)anthracene	8270c
Dibenzofuran	8270c
Diethyl phthalate	8270c
Dimethyl phthalate	8270c
Fluoranthene	8270c
Fluorene	8270c
Hexachlorobenzene	8270c
Hexachlorobutadiene	8270c
Hexachlorocyclopentadiene	8270c
Hexachloroethane	8270c
Indeno(1,2,3-cd)pyrene	8270c
Isophorone	8270c
n-nitrosodiphenylamine	8270c
Naphthalene	8270c
Nitrobenzene	8270c
Pentachlorophenol	8270c
Phenanthrene	8270c
Phenol	8270c
Pyrene	8270c
VOLATILE ORGANIC COMPOUNDS	
1,1,1-trichloroethane	8260b
1,1,2,2-tetrachloroethane	8260b
1,1,2-trichloroethane	8260b
1,1-dichloroethane	8260b
1,1-dichloroethene	8260b
1,2-dichloroethane	8260b
1,2-dichloropropane	8260b
2-butanone	8260b
2-hexanone	8260b

Parameters	SW-846 Method
4-methyl-2-pentanone	8260b
Acetone	/8260b
Benzene	8260b
Bis(2-chloroisopropyl)ether	8270c
Bromodichloromethane	8260b
Bromoform	8260b
Bromomethane	8260b
Carbon disulfide	8260b
Carbon tetrachloride	8260b
Chlorobenzene	8260b
Chloroethane	8260b
Chloroform	8260b
Chloromethane	8260b
Cis-1,2-dichloroethene	8260b
Cis-1,3-dichloropropene	8260b
Dibromochloromethane	8260b
Ethylbenzene	8260b
Methylene chloride	8260b
Styrene	8260b
Tetrachloroethene	8260b
Toluene	8260b
Trans-1,2-dichloroethene	8260b
Trans-1,3-dichloropropene	8260b
Trichloroethene	8260b
Vinyl chloride	8260b
Xylenes, total	8260b

1 Base Realignment and Closure

Source: Table 3-4 in Site Investigation Workplan for Ten BRAC Properties, NAS Key West (B&R Environmental, 1998b).

P: KEY WEST/BRAC(CTO 032)/MOD 04-BRAC SSI/SSI WORK PLAN/PUBS ONLY/REV1/GRFX/F2-1DEC.PPT**F1-1LINK.TIF



*A residential or industrial set of action levels were considered for the Parcels based on the future use determination made in the Key West Reuse Plan (BAP, 1997).

DRAWN BY RBP — DATE ----		**SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BRAC PARCELS AT TRUMAN ANNEX**	CONTRACT NO. 7593
CHECKED BY — DATE		**FIGURE 2-1. DECISION LOGIC FOR ACTION LEVEL SELECTION**	APPROVED BY — DATE
COST/SCHED-AREA		**NAVY SOUTHERN DIVISION**	APPROVED BY — DATE
SCALE -		**NAS KEY WEST, FLORIDA**	DRAWING NO. F2-1DEC.PPT — REV. 0

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3.0 SAMPLING AND ANALYSIS PLAN

This Chapter describes the SAP, including sampling objectives; sample types, frequencies, and locations; sampling procedures; sampling handling and analysis; surveying; performance system audits; and quality assurance (QA) reports.

3.1 SAMPLING OBJECTIVES

The analytical results from environmental samples collected during the SSI will support the evaluation of the human health or environmental threats that may be posed by the BRAC property. The nature and extent of potential contaminants were not fully characterized at Buildings 102, 103, and 104 in Parcel E (subzones 3, 7, and 9) during SI activities. Suspected contamination under the footprints of these buildings will be evaluated in the SSI. Ultimately, sample results will be used to determine whether further study and characterization, possibly leading to a remedial action, are needed in Buildings 102, 103, and 104 at Parcel E to reclassify the property to be eligible for transfer under BRAC.

The analytical results from IRA Delineation Sampling and Confirmation in support of IRAs at Parcels C and E (former Building 136) will be used to determine the areas that will require excavation or other remedial actions and confirm the effectiveness of IRA activities.

3.2 SAMPLE TYPES, FREQUENCIES, AND LOCATIONS

The SSI area is divided by sample type based on each site's history of use and the environmental media present there. There will be three types of sampling performed as part of the SSI within Parcels A, C, D, E, and F: IRA Delineation and Confirmation Sampling, IRA Confirmation (only) Sampling, and SSI Sampling (includes groundwater, soil, and swipe samples). Table 3-1 presents the parameter groups and media of interest based on results from the SI conducted during 1997-98 and historical activities for the sample areas. Delineation sampling will be performed at Former Building 136 (Parcel E, Subzone 2) and the Former DRMO Storage Area, which includes the Former Oil Container (Pre-1942) and Scrap Metal and Refugee Item Storage Area, and the Former Scrap Metal Storage Area (Parcel C, Subzones 3 and 4). Confirmation Sampling will be conducted at Parcels A, C, D, E, and F. SSI sampling will be performed at Buildings 102, 103, and 104 (Parcel E, Subzones 3 and 9), and the surrounding area associated with groundwater at Buildings 102, 103, and 104 (Parcel E, Subzone 7). These sample types, frequencies, and their locations are described in the following sections.

3.2.1 IRA Delineation Sampling

Based on results from the SI conducted during 1997-98, soil is the media of interest in the Former Building 136 and Former DRMO Storage Area. These sites will require soil sampling and analysis.

3.2.1.1 Former Building 136

A total of 18 soil samples will be collected at the Former Building 136 (Figure 3-1) area for delineation of contaminants. A 100-foot by 100-foot grid was used to determine delineation sample locations. Within each gridblock, 5 sample locations will be sampled and composited to yield 3 samples – surface soil sample, 5 feet bls sample, and 10 feet bls or saturated zone sample. At least one sample must be taken in the saturated zones at each sample location.

3.2.1.2 Former DRMO Waste Storage Area

A total of 150 soil samples will be collected at the Former Oil Container (Pre-1942) and Scrap Metal and Refugee Item Storage Area, and the Former Scrap Metal Storage Area of the Former DRMO Waste Storage Area for delineation of contaminants (Figure 3-2). A 100-foot by 100-foot grid was used to determine delineation sample locations. Within each gridblock, 5 sample locations will be sampled and composited to yield 3 samples – surface soil sample, 5 feet bls sample, and 10 feet bls or saturated zone sample. This method was chosen due to its cost effectiveness regarding analytical costs in conjunction with the percent of accuracy in finding contaminated plume areas.

3.2.2 SSI Sampling

TtNUS used a biased sampling approach to locate the environmental samples within each area. The biased sampling approach placed samples in the area where available information indicated the likely location of contaminated media. Buildings 102, 103, and 104 and their surrounding areas were identified for investigation as part of the SI field effort. Based on SI results and suspicion that historical activities at these buildings impacted soil and groundwater beneath their footprints, three subzones in this area were identified for further investigation under the SSI. Soil is the media of interest at Buildings 102, 103, and 104 (subzones 3 and 9). Groundwater is the media of interest in subzone 7, the area surrounding Buildings 102, 103, and 104. Groundwater screening samples were located based on information that lead to particular areas of concern. In cases where an obstruction interferes with the collection of a sample as specified in this Workplan, professional judgement will be used to relocate the sample to the nearest non-obstructed location within the area.

3.2.2.1 Soil Sampling at Buildings 102, 103, and 104

Soil is the most prevalent medium in the footprint area of Buildings 102, 103, and 104, which comprise subzones 3 and 9. A total of 48 soil samples will be collected from 16 locations. At each location a soil sample will be collected at the surface, 5 feet bls sample, and 10 feet bls or saturated zone sample. At least one sample must be taken in the saturated zones at each sample location. The location of soil samples in subzones 3 and 9 is shown in Figure 3-3.

3.2.2.2 Groundwater Sampling in Surrounding Area of Buildings 102, 103, and 104

Due to the generally homogeneous nature of subsurface features and the propensity for contaminant migration, groundwater was considered at the Parcel level during the BRAC SI. One groundwater subzone has been identified for sampling and analysis under the SSI. Sixteen temporary well points will be installed and sampled: eight in Building 103, four in Building 102, and four in Building 104 (Figure 3-4). In addition, one permanent 2-inch well will be installed and sampled in each building. The groundwater screening samples were sited in order to obtain samples in areas most likely to contain contamination. Since FDEP does not accept conclusions based on data from temporary well points, the data from the groundwater screening samples will be used only as a tool in the placement of permanent monitoring wells, not in making recommendations and conclusions in the SSI. The groundwater screening sample results will be reviewed by the Partnering Team and used to locate the permanent monitoring wells in each building. The temporary well points and permanent 2-inch wells will be installed using a skid mounted direct push rig.

3.2.2.3 Swipe Sampling at Buildings 102, 103, and 104

Due to concerns that surface contamination is prevalent in these buildings, swipe samples from wall and floor surfaces will be collected. Five swipe samples will be collected from each building. Locations will be determined by the Field Operations Leader (FOL) based on site conditions.

3.2.3 <u>IRA Confirmation Sampling</u>

This section describes the SAP for the confirmation sampling at part of the IRA at the BRAC Parcels A, C, D, E, and F at NAS Key West. Sample types, frequencies, and locations are described. Sampling procedures, sample handling, surveying, performance system audits, and QA objectives are described in Section 3.0.

3.2.3.1 Sampling Methodology and Objectives

Excavation will be performed as part of the Interim Remedial Action (IRA) for Parcels A, C, D, E, and F (Table 3-1). TtNUS will perform confirmation sampling at these same Parcels following the IRA to confirm that all contaminated soils are removed. The number of samples in each excavation area is based on the size of the areas and the location of contamination found during the BRAC Site Inspection (SI) and delineation sampling. The methods used to determine number of samples is described in *The Guidance Document for Verification of Soil Remediation* (Michigan DEQ, 1994). This document describes three different sampling strategies for cleanup verification based on the size of the excavation areas: (1) small sites (less than 10,890 ft^2), (2) medium sites (10,890 – 130,680 ft^2), and (3) large sites (larger than 130,680 ft^2).

The sites that will be sampled under the "small site" strategy (Table 3-2) will be sampled using a biased sampling approach. The number of floor and side samples required to verify successful excavation of contaminated soils were obtained from Tables 1 and 2 in *The Guidance Document for Verification of Soil Remediation* (Michigan DEQ, 1994). These numbers are based on the size and depth of the excavation area. There will be no less than one sample taken on each sidewall (i.e., four). In the case of irregularly shaped excavations, where four walls are not readily discernible, the total wall area will be divided into four segments of approximately equal size (Michigan DEQ, 1994). Figures illustrating the "smallest site" excavation areas can be found in the Remedial Work Plan, Delivery Order No. 101, BRAC Parcels Fast Track Soil Removals [Bechtel Environmental, Inc. (BEI), 1998].

The "medium site" sampling strategy applies to both DRMO Storage Area (C/3 and C/4) and the Former Building 136 Area (E/2) as shown in Table 3-2. This strategy uses grids to facilitate the unbiased selection of sampling points and accepted statistical tools for evaluating the resultant data (Michigan DEQ, 1994). A grid system will be established over the area after excavation. Both the sidewalls and floors of the excavated areas will be included in the calculation of the size of the area. Calculation of the grid interval for medium sites (10,890 – 130,680 ft^2) uses the following formula:

$$GI = \frac{\sqrt{\frac{A}{\Pi}}}{4}$$

Where: A = Area to be gridded (square feet)
GI = Grid interval

After the grid interval is calculated, each grid cell will be subdivided into nine subcells. A subcell in each grid cell will be chosen randomly for sampling using a random numbers table. A minimum of 12 samples or 25 percent of the total grid stations, whichever is greater, will be sampled and analyzed initially to allow a large enough data pool for statistical analysis (Michigan DEQ, 1994).

The calculation of grid interval for one of four excavation sites in the former oil container (pre 1942) Area was established at approximately 28 feet. Based on the total number of grid intervals, 19 confirmation samples will be taken in the "medium site" at the former oil container area (C/3). At the Scrap Metal Storage Area (C/4), the "medium site" grid has a 36-foot grid interval which contained 56 grid cells, 14 samples (25 percent) will be taken. Figure 3-5 presents the areas to be excavated and the proposed locations of confirmation samples at DRMO.

The grid interval for the excavated area at the Former Building 136 site is approximately 22 feet. Thirteen samples will be taken in this area. Figure 3-6 presents the excavation area and the proposed locations of confirmation samples at the former Building 136 site. Table 3-2 describes the sampling strategy for each excavated area being considered in this confirmation sampling, the number of samples that will be collected, and the analyses that will be performed. Figures illustrating the "small site" excavation areas can be found in the *Remedial Work Plan, Delivery Order No. 101, BRAC Parcels Fast Track Soil Removals* [Bechtel Environmental, Inc. (BEI), 1998].

3.2.3.2 Palintest Scanning Analyzer

Areas where lead is a contaminant of concern include Hawk Missile Site (sediment samples around SD-08 and SD-05) and Truman Annex DRMO Storage Area (soils between buildings 261 and 284, the former oil container area, and the Scrap Metal Storage Area). In these areas, the confirmation samples will be analyzed for lead on site using the Palintest Scanning Analyzer and offsite using a fixed-based laboratory. The onsite lead analysis is necessary so that immediate lead content results can be obtained for decision making purposes. To produce effective data and make efficient field decisions, 3 analyses per sample will be performed. The results will be evaluated using the percent relative standard deviation with a limit of 20 percent for acceptability. Additional excavation can be performed if needed based on these results.

3.2.3.3 Additional Excavation

If verification sampling indicates that the contaminant removal is incomplete, the extent of additional excavation should be based on the established grid system interval. Where a subset of grid points has indicated that the entire area exceeds the cleanup standard, the nodes adjacent to the sampled nodes that are causing the exceedance should be sampled, and this process repeated until the "hot spots" requiring removal have been defined (Michigan DEQ, 1994). The radius of excavation around the contaminated sample points would be equal to the grid interval (GI = r). Excavation will be set at 2 feet bls unless noted in the IRA Workplan (BEI, 1998).

3.3 SAMPLING PROCEDURES AND EQUIPMENT

Any sample obtained during a field sampling event should be representative of the sample location and free of contaminants from sources other than the sampling point. The equipment and the techniques that will be employed to obtain representative samples will be in accordance with approved sampling procedures as described in Section 3.4.10.

3.4 QUALITY ASSURANCE OBJECTIVES

This SAP describes measures that will be undertaken by TtNUS and its subcontractors to perform quality work to accomplish project objectives and be responsive to the QA requirements of the EPA and FDEP. The EPA and FDEP QA requirements focus on the acquisition of environmental data of acceptable quality. A detailed discussion of QA requirements including objectives for parameter measurement, laboratory analysis, and data review are presented in Appendix E (QA Elements).

3.4.1 Prevention of Cross-Contamination

Before being moved to a site, all sampling equipment will be cleaned to remove foreign material and prevent the introduction of contamination to the site. All drilling equipment that will be in contact with the soil will be decontaminated before use. All monitoring well screen and blank casing in contact with groundwater will be decontaminated unless packaged from the factory. Sampling equipment will be decontaminated before use at each sample location. Procedures for decontamination of drilling and sampling equipment are provided in Section 3.4.11. Disposal of decontamination byproducts is discussed in Section 6.0.

3.4.2 Sample Turnaround Time

Sample analyses will be scheduled based on SSI needs and will be consistent with the sample holding times. The laboratory will provide a turnaround time of approximately 48 hours for confirmation sampling and 7 days for delineation and SSI sampling. This timeframe will meet the project schedule and objectives.

contaminated sample points would be equal to the grid interval (GI = r). Excavation depth ~~would be to the deepest point of contamination or to the depth where acceptable levels are anticipated. After excavation, the impacted points must be resampled at their new elevations to verify that the area meets the selected cleanup criteria. If continued contamination is detected, the excavation format is repeated until a satisfactory result is obtained (Michigan DEQ, 1994).~~ will be set at two feet bls unless otherwise noted in the IRA Workplan (BEI, 1998)

3.3 SAMPLING PROCEDURES AND EQUIPMENT

Any sample obtained during a field sampling event should be representative of the sample location and free of contaminants from sources other than the sampling point. The equipment and the techniques that will be employed to obtain representative samples will be in accordance with approved sampling procedures as described in Section 3.4.10.

3.4 QUALITY ASSURANCE OBJECTIVES

This SAP describes measures that will be undertaken by TtNUS and its subcontractors to perform quality work to accomplish project objectives and be responsive to the QA requirements of the EPA and FDEP. The EPA and FDEP QA requirements focus on the acquisition of environmental data of acceptable quality. A detailed discussion of QA requirements including objectives for parameter measurement, laboratory analysis, and data review are presented in Appendix E (QA Elements).

3.4.1 Prevention of Cross-Contamination

Before being moved to a site, all sampling equipment will be cleaned to remove foreign material and prevent the introduction of contamination to the site. All drilling equipment that will be in contact with the soil will be decontaminated before use. All monitoring well screen and blank casing in contact with groundwater will be decontaminated unless packaged from the factory. Sampling equipment will be decontaminated before use at each sample location. Procedures for decontamination of drilling and sampling equipment are provided in Section 3.4.11. Disposal of decontamination byproducts is discussed in Section 6.0.

3.4.2 Sample Turnaround Time

Sample analyses will be scheduled based on SSI needs and will be consistent with the sample holding times. The laboratory will provide a turnaround time of approximately 48 hours for confirmation sampling and 7 days for delineation and SSI sampling. This timeframe will meet the project schedule and objectives.

3.4.3 Field Documentation

An integral part of the SAP field activities will be maintaining the site logbook and associated sample logsheets. The site logbook is a controlled document that records all major on-site activities during the SSI. At a minimum, the following activities/events shall be recorded in the site logbook:

- Date
- Start time
- Weather
- Health and safety issues (tail gate meetings, conditions, concerns, etc.)
- Field personnel
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Levels of personnel protection
- Ambient air monitoring
- Start and completion of borehole/monitoring well installation or sampling activities
- Sampling activities and logsheet references
- Sample pickup (carrier, chain-of custody forms, time etc.)
- Photographs (numbered to correspond to logbook entries)

The site logbook is initiated at the start of the first on-site activity (e.g., initial reconnaissance survey). Entries are made for every day of on-site activities involving TtNUS or its subcontractors. One current logbook will be maintained per Parcel. The TtNUS FOL will maintain a daily operations logbook.

Field-generated data forms will be used to document sample collection and soil boring and monitoring well construction. Examples of these forms are found in Appendix D (TtNUS Forms). All sample description, identification, and location information will be recorded in field logbooks. Data to be recorded include identification of the monitored location (e.g., boring number, well number), the type of sample, and other data obtained during the sampling activity.

3.4.4 Field Data Management

Field data will be generated and used to assess the SSI subzones. Field data allow for the identification, evaluation, and support of recommended appropriate actions.

Field data including instrument readings, recordings, measurements, and tests will be documented and reviewed by TtNUS personnel. Field records will be kept in legible condition and should be sufficient to reconstruct the daily activities by a qualified individual other than the FOL. Field-generated data forms will be collected and reviewed every week for accuracy and completeness by the FOL. The data forms will be assembled into packages that represent each borehole, monitoring well, etc. for use in preparing the SSI reports.

3.4.5 Sample Bottle Preparation and Preservation

All sample bottles used by TtNUS will be shipped to NAS Key West by the laboratory in sealed containers and will be EPA-certified clean. For recordkeeping purposes, the documentation certifying the level of cleanliness will be maintained on file. Additionally, as containers are used for sampling, the lot numbers will be noted on the applicable sample collection forms and in the logbook. Table 3-3 presents the types and volumes of sample bottles that may be used for the collection of environmental samples during the field activities, as well as the sample preservation required for each analytical method. Table 3-4 presents the same information for solid investigation-derived waste (IDW) samples that will be analyzed for the full regulatory list of Toxicity Characteristic Leaching Procedure (TCLP) parameters.

3.4.6 Quality Control of Field Data

Field data generated in accordance with this Workplan will consist primarily of soil classification, soil boring advancement data, and monitoring well installation and development data (i.e., field temperature, pH, turbidity, and specific conductance data). These data will be validated by review of the project documentation to check that all forms specified in the field sampling plan have been completely and correctly filled out and that documentation exists for the required instrument calibration. This documentation will be considered sufficient to ensure that procedures have been followed properly during the field investigation.

3.4.7 Field Equipment Calibration

The calibration or standardization of monitoring, measuring, or test equipment is necessary to ensure the proper operation and response of the equipment. In addition, it is necessary to document the accuracy, precision, or sensitivity of the measurement, and determine if correction should be applied.

3.4.7.1 Calibration Procedures

All measuring and/or test equipment used in the field shall be controlled and subject to a formal calibration program. For field equipment, documentation of calibration of the equipment shall be at the time of calibration. Equipment will be stored in secure areas. The calibration program shall provide equipment for the proper type, range, accuracy, and precision to supply data compatible with project requirements and desired results.

The TtNUS FOL is responsible for ensuring proper calibration of project-specific field equipment.

Documented and approved procedures shall be used for calibrating measuring and/or test equipment [i.e., water quality meters and flame ionization detectors (FID)]. Whenever possible, widely accepted procedures or procedures provided by manufacturers shall be adopted. Where pre-established information is not available, procedures shall be developed considering the type of equipment, stability characteristic of the equipment, required accuracy, precision, and the effect of error on the quantities measured. At a minimum, procedures shall include but not be limited to:

- Type of equipment to be calibrated
- Reference equipment and/or standard to be used
- Calibration method and sequential actions
- Acceptable tolerances
- Frequency of calibration
- Data recording format

3.4.7.2 Equipment Identification

Calibrated equipment shall be uniquely identified by using the manufacturer's serial number, TtNUS identification number, or other means. This identification, along with a label indicating when the next calibration is due (only for equipment requiring periodic calibration), shall be attached to the equipment. If this is not possible, records traceable to the equipment shall be readily available for reference. It is the responsibility of all personnel to verify the calibration status from the due date labels or records prior to using the equipment.

3.4.7.3 Calibration Frequency

Field equipment calibration shall be performed and documented on a daily basis. Field calibration procedures and frequencies are summarized in Table 3-5. For field equipment that is not continuously in use, the scheduled periodic calibration will not be performed. The equipment shall be calibrated on an "as needed" basis prior to use. At a minimum, equipment in use will be calibrated once daily, prior to the first sample, and will be verified at the end of each day.

3.4.7.4 Calibration Standards

Whenever possible, equipment shall be calibrated using standards that have known relationships to nationally recognized standards (e.g., National Bureau of Standards) or accepted values of natural constants.

3.4.7.5 Calibration Failure

Equipment that fails to calibrate shall be removed from service and tagged to prevent inadvertent use. The equipment shall be repaired and re-calibrated to the satisfaction of the FOL.

It is the responsibility of all personnel to verify that their field equipment is properly functioning. If an equipment malfunction is suspected, the device should be tagged, removed from service, recalibrated, or replaced.

3.4.7.6 Calibration Records

A calibration record shall be kept for each piece of field equipment to indicate that established procedures have been followed. Records for calibrated equipment shall include, as appropriate:

- Type and identification number of equipment
- Calibration frequency and acceptance tolerances
- Standards and numbers
- Calibration dates
- Names of individuals performing the calibration
- Standards used for each calibration
- Statements concerning calibration acceptance or failure and repair of failed equipment

A copy of the TtNUS Calibration Form is included in Appendix D.

3.4.8 Preventive Maintenance

Periodic preventive maintenance is required for equipment whose performance can impact results. The objective of a maintenance program is to avoid generating erroneous measurements that could endanger site personnel or lead to inappropriate environmental response. Instrument manuals will be kept on file for reference if equipment needs minor repair. Instructions on minor repairs are often addressed in the troubleshooting section of an equipment manual, or assistance can be obtained from the equipment manufacturer technical support line, or possibly the TtNUS Pittsburgh Warehouse Manager (1-800-245-2730).

Appropriate and sufficient replacement parts or backup equipment will be available to avoid a substantial delay of field tasks.

3.4.8.1 Sampling and Analytical Equipment

Field sampling and analytical equipment will be maintained to manufacturer's specifications. Routine preventative maintenance in the form of inspections and checkout procedures will be conducted to verify proper operation of each piece of equipment.

3.4.8.2 Support Equipment

Support equipment includes vehicles, containers, safety devices, radios, and phones that may be required for completing a field monitoring or measurement task. The support equipment will be periodically inspected to maintain the performance necessary for proper and efficient execution of field activities.

3.4.9 Ambient Air Monitoring

Air monitoring will be performed with an FID or Photoionization Detector (PID). The FID or PID will be used to monitor the presence of VOCs in media during drilling and sampling activities. The actions to be taken by personnel for results that fall above background levels are addressed in the Health and Safety Plan.

Ambient air samples will be collected at the source of the activity (e.g., the borehole or well annulus) and in the "breathing zone" of the personnel present (e.g., the area where personnel are taking in air to breath). All air monitoring results will be recorded in the field logbooks and/or boring logs to document the presence or absence of VOCs.

3.4.10 Sampling Techniques

When possible, samples within a given media will be collected from the least contaminated to the most contaminated locations at a site. At a given sampling location, sample bottles should be filled in the following order, where applicable: VOCs, extractable organics, PCBs, total metals, and other inorganics.

Media-specific sampling requirements are discussed below. Several general sampling precautions will be used to enhance sample integrity:

- Samples will be collected in order from least contaminated to most contaminated, when known. Anticipated or known direction of groundwater flow will be used to determine sampling order when no chemical data are available. Areas upgradient from contaminant source areas will be sampled first and sampling will then proceed from areas furthest downgradient, working toward the source areas.

- When sampling monitoring wells, wells will be purged to ensure representative sampling of groundwater in the saturated zone.

- Medical-grade or Nitrile gloves will always be worn during and changed between each sample collection, and sample handling will be kept to a minimum.

- Samples, preservatives, and sample containers will be handled carefully to minimize exposure time and potential for evaporative loss and/or airborne contamination.

- Upon completion of a round of sampling for a site, all stainless steel sampling equipment will be scrubbed with tap water and laboratory grade soap and rinsed thoroughly with tap water, rinsed with deionized water and rinsed twice with a pesticide-grade isopropanol and then with organic-free water. The equipment will then be allowed to air dry.

- Samples will be delivered to the analyzing laboratory as soon as possible following sample collection, typically via overnight express.

3.4.10.1 Soil Sampling Technique

Surface soil and subsurface soil sampling are the only types of sampling to be performed at Parcels C and F. The sample collection will be done with the use of a direct-push technology (DPT) system.

The DPT system consists of a truck or van equipped with a hydraulic ram. The hydraulic ram drives a threaded, 1-inch outside diameter (OD), hollow-steel rod assembly attached to an interchangeable stainless-steel sleeve to the desired sample collection depth. An acetate sleeve will be placed inside the stainless steel sleeve. The sample collection depths will be surface, and approximately 5 and 10 feet bls (saturated zone). At the sample collection depth, the tip of the direct-push sampler will be retracted from a rigid leading position while hydraulic pressure is applied to advance the sample collection sleeve. As hydraulic pressure is applied, the tip of the sampler is retracted upward with in the sleeve, and material enters the acetate sample collection sleeve. Upon retrieval, the acetate sleeve will be cut longitudinally and the entire sample screened with an FID or PID, then the sample will be placed in appropriate sample jars. EnCore® samplers will be used to collect all soil VOC samples. The FID or PID screening results and a description of the soil sample will be made on a soil sample log sheet and in the field logbook. In order to obtain an appropriate amount of sample for the full suite of chemical analyses and field lead screening analysis, it may be necessary to collect several sample sleeves of soil from the same location. Where this is necessary, any VOC samples will be collected from a discrete interval other than the saturated zone, then the remaining sample will be composited prior to collection. This involves mixing the soil in a stainless steel bowl to obtain a homogeneous medium.

Surface and subsurface soil sampling at Parcel E for the SSI will be conducted using a skid-mounted DPT rig.

Following collection, the soil sample will be placed in a cooler on ice for transport to the offsite laboratory. Boreholes will be grouted and abandoned in accordance with FDEP requirements.

3.4.10.2 Groundwater Sampling Technique

Standard activities involved with groundwater sampling include: temporary well installation using the skid mounted DPT rig, monitoring well drilling, construction and development, monitoring well elevation survey, water level measurements, removal of standing water in wells (i.e., well evacuation or purging), and retrieval of groundwater samples.

3.4.10.2.1 Groundwater Screening Sample Collection

Where subsurface features permit, groundwater screening samples will be collected. To locate the water bearing zone, continuous soil borings will be taken at selected groundwater screening sample locations. It is anticipated water will be encountered 4 to 8 feet bls. Then a detachable drive tip attached to a 24- to 60-inch screen encased in a probe tube will be advanced into the water-bearing zone. The probe then will be withdrawn 24 to 60 inches, allowing the retractable screen to open to the formation. Screening sample collection will adhere to development, water level measurement, purging, and sampling techniques outlined in Sections 3.4.10.2.3 through 3.4.10.2.6.

For groundwater recovery, a length of Teflon® tube will be inserted into the probe and connected to a peristaltic pump. Three to five volumes will be purged from the probe. Three volumes are sufficient if field parameters (measured with a Horiba U-10 Water Quality Checker) have stabilized as outlined in Section 3.4.10.2.5.5. If parameters do not stabilize within three well volumes then up to five volumes will be purged prior to sampling. All purge water will be either placed directly into 55-gallon drums for later characterization and disposal or collected in 5-gallon containers and ferried to 55-gallon drums placed at a central location.

After sufficient purging, all samples except VOC samples will be collected by pumping directly into the sample container. Once water has been drawn into the tubing by pump suction, the pump will be shut off, the tubing will be crimped and disconnected from the pump, the tubing will be extracted from the boring, and VOC samples will be collected by uncrimping the tubing and filling sample vials by gravity-flow. The specific parameter groups will be handled and preserved as discussed in Section 3.5.

3.4.10.2.2 Monitoring Well Installation and Sampling

All permanent monitoring wells will be installed in a consistent manner. Boreholes will be drilled using DPT, and appropriate field forms will be prepared documenting the construction and completion of each well. The following sections describe the process for monitoring well installation and sampling.

Borings will be installed by DPT. The need for split-spoon sample collection and collection intervals will be determined in the field by the scientist. The interval at which a split-spoon sample is collected will be based on the specific purpose or needs of the sampling effort.

All split spoon samples obtained from the boreholes will be monitored immediately upon opening with an FID or PID. These readings will be recorded on the boring logs.

The boreholes will be logged as the drilling proceeds. Boring and test logs will be generated to document subsurface conditions on the Visual Classification of Soils form, based on the American Society of Testing and Material's (ASTM's) D2488 Standard Practice for description identification of soils and the Unified Soil Classification System. The lithologic borehole descriptions submitted to EPA as part of the SSI Report will include the following:

- Detailed lithologic description of each unit
- Depth to first water encountered
- Termination depth of borehole

The methods and procedures for subsurface investigations under ASTM D1586 Method Penetration Test and Split Barrel Sampling of Soils will be followed during this investigation.

The drilling contractor will be responsible for securing boring or well drilling permits as required by the state and/or local authorities and for complying with state or local regulations with regard to the submission of driller's well logs, etc. TtNUS also will be responsible for complying with regulations regarding boring/well drilling safety as described in the HASP document. Field activity logs will be filled out on a daily basis to indicate drilling activities such as footage drilled and materials used. Well installation will follow all of the commonly accepted professional drilling procedures.

3.4.10.2.2.1 Well Installation

Monitoring well installation will be recorded on the Monitor Well Installation Sheet as illustrated in Appendix D. All lines on the form will be filled in. The letter designation "NA" for not applicable or "NK" for not known will be used in all blank spaces. If some steps or procedures were not performed as described, the reason will be stated as completely as is practicable on the appropriate form or submitted as an attachment thereto. Actual materials utilized in the well construction will be documented on the well-specific forms.

Each monitoring well will be constructed in the following manner:

- A borehole will be constructed using hollow stem augers technique to an approximate depth of 12 to 15 feet bls.
- The well will be constructed with National Sanitation Foundation (NSF) approved, 10-foot long, 2-inch inner diameter (ID) schedule 40 PVC 0.010-inch slot well screen with flush threaded joints.
- The bottom of the screen will be fitted with a flush-threatened PVC endcap.
- Monitoring wells will be cased using blank 2-inch ID schedule 40 PVC riser pipe to the surface. Joints will be flush threaded. Length of PVC riser will be 10 feet, and it will also be NSF approved.
- Filter sand pack material will be a U.S. Standard sieve size 20/30 silica sand.
- The annulus between the well and the boring will be backfilled with the sand pack to a height of at least 2 feet above the top of the well screen if the depth to water is in excess of 4 feet bls. With a shallow water table less than 4 feet bls, the sand pack will extend at least 1 foot above the top of the well screen. As the sand pack is installed, the hollow stem auger will be pulled. Sand will always be maintained several inches up inside the augers to ensure adequate sand pack around the well.
- Where possible, approximately 1 to 2 feet of 1/4- to 3/8-inch bentonite pellets consisting of 90 percent montmorillonite clay will be placed above the sand pack and hydrated. The bentonite pellets will be allowed to hydrate for minimum of 8 hours before the well is grouted. With a shallow water table, the top of the sand pack may be less than 2 feet below the land surface. In this event, most Florida Water

Management Districts, the FDEP, and the SOUTHDIV Draft Monitoring Well Installation Guidelines recommend the use of a fine sand (30/65) secondary filter pack topped by grout in place of bentonite and grout.

- Wells will be grouted to the surface with a cement/bentonite mixture. Type 1 Portland cement will be used.

- Due to the shallow nature of the wells, grout materials will be placed by pouring the grout into the annulus of the boring.

- All wells will be fitted with bolted flush mount well covers.

- The well apron will be approximately 2 feet by 2 feet by 0.5 foot thick concrete. The concrete for the apron will extend into the borehole to top of the grout.

- A notch representing the top of casing measuring point will be filed or made permanently on the inner casing of each well and will be identified on the notes and well sketches.

A well completion report will be prepared for the installed well. This report will be included with the final report submitted to the EPA. The well completion report will contain the following:

- Survey of well location map with scale and orientation
- Type of casing material
- Length and diameter of casing material
- Elevation of the notched top of the casing, height of notched casing above ground level, and name of licensed surveyor
- Borehole depth and diameter
- Detailed lithologic borehole descriptions
- Size of screen slot and statement that the slot size was manufactured rather than field slotted
- Screened interval
- Materials and methods used to fill annulus of the boring
- Size and type of filter pack
- Method of installation and date
- Well development procedures and disposal method of development water, drilling fluids, and soils
- Security devices
- Decontamination procedures used on equipment between borings
- Any problems encountered during boring or well installation

- Method of coupling casing sections and screens
- Driller's and/or geologist's complete name(s)

3.4.10.2.3 Monitoring Well Development

The following procedure is presented for the proper development of monitoring wells for groundwater sampling purposes. Monitoring well development will be performed after the bentonite seal has hydrated a minimum of 20 minutes.

Equipment and materials used in development will be properly cleaned and decontaminated prior to use as described in the following section. Development shall be accomplished with a small pump such as a centrifugal pump.

Well development will be performed to remove fine-grained material from around the well screen and sand pack and to obtain maximum achievable water clarity. Three to five times the amount of the standing water in the well will be removed. Within the three to five volumes, monitoring well development will continue until three consecutive field parameter readings are within the following criteria: pH+/-0.2 standard units, temperature +/-0.2°C., dissolved oxygen +/-0.2 milligrams per liter, specific conductance +/-10 microSiemens per centimeter (µS/cm), and turbidity less than or equal to 5 nephelometric turbidity unit (NTUs). Well development records will be maintained on well development forms, provided in Appendix D.

All water generated during well development will be collected in 5-gallon buckets and ferried to 55-gallon drums or a larger storage container. It is assumed that this material is non-hazardous in nature and will be disposed of on-site at a later date. However, if contaminant levels in aqueous IDW are above set limits, proper disposal of the water will be documented.

The following data will be recorded on the Well Completion Log contained in Appendix D, or an attachment thereof, as part of development:

- Well designation
- Date(s) of well installation
- Date(s) and time of well development
- Static water level before and after development
- Physical character of the removed water to include changes during development of clarity, color, and particulates
- Type and size/capacity of pump and/or bailer used

3.4.10.2.4 Water Level Measurements

All water level measurements in each monitoring well will be made from a surveyed measuring point located at the top of well casing. The measuring point will usually be positioned on the north side of the well casing and will be conspicuously marked for each measurement. Water level measurements will be made using an electronic probe.

Using an electronic water level indicator, the technician will lower the probe down the center of the well casing. When the probe enters the water, an alarm will sound. The depth to water from the measuring point will be recorded in a field log. The measurement will be repeated two more times to ensure the reading is accurate. The average depth to water will then be subtracted from the measuring point elevation to find the elevation of the water level in the well to the nearest 0.01 foot.

Water level measurements must be obtained at each sampling point every time water samples are collected. After each water level measurement, the probe will be decontaminated according to the following procedure:

- Wash with laboratory detergent and tap water.
- Rinse with tap water.
- Rinse with deionized water.

Total depth of each well will be determined by physical measurement (i.e., tape) and recorded on the appropriate forms when the well is completed.

3.4.10.2.5 Well Purging

All wells will be purged using a peristaltic pump with precleaned Teflon® tubing interfacing with silicon tubing at the pump head. All purged groundwater will be collected and containerized pending results of the laboratory analyses and determination of disposal options. To help minimize cross contamination, plastic sheeting will be placed around each well during purge events to prevent release of well water to the ground surface.

3.4.10.2.5.1 Volume Determination

Prior to purging a well, it will be necessary to determine the volume of water being held in the well casing. The calculation of the well volume will be conducted as follows:

- Measure inside diameter of well casing.
- Measure the static water level (as described above).
- Determine the total depth of the well from the measuring point.
- Calculate the number of linear feet of static water (total depth of well minus the static water level).
- Calculate the volume of water in 1-inch and 2-inch ID well casings using the following equations:

$$\text{1-inch ID} - V = 0.0816h$$

$$\text{2-inch ID} - V = 0.1632h$$

Where,

V	=	Volume of water (gallons)
0.1632	=	Conversion factor constant for well diameter of 2 inches
h	=	height of water in well (feet)

3.4.10.2.5.2 Placement of Intake Hosing

Monitoring wells will be purged from the top of the water column, even if a monitoring well is likely to go dry. This will force water to move up the well casing to the pump. Otherwise, water standing in the well above the screen may not be evacuated.

3.4.10.2.5.3 Pumping Rate

The pumping rate used for monitoring well purging will be kept to a minimum. While purging the pumping rate shall be 300 mL per minute or less, to allow the well to stabilize and maintain a low turbidity. The flow rate of the pump may be measured using a graduated plastic bucket, graduated cylinder, or a totalizing flow meter.

3.4.10.2.5.4 Volume Purged

Three to five casing volumes will be removed prior to sample collection from the monitoring well. If field parameters including pH, temperature, specific conductivity, and turbidity have stabilized (see Section 3.4.10.2.5.5) after three casing volumes, the well will be sampled; otherwise, up to five volumes will be purged prior to sampling. If the monitoring well goes dry during purging, it will be allowed to recover and then it will be sampled.

3.4.10.2.5.5 Well Stabilization

In addition to keeping track of the volume of water pumped from a monitoring well, the pH, specific conductivity, and temperature of discharge water will be monitored. A monitoring well will be considered to be sufficiently purged when these three parameters meet the stabilization criterion stated below, provided that a minimum of three casing volumes have been purged (Refer to Section 3.4.10.2.5.4). Temperature will be considered to be stabilized when three consecutive temperature readings are within +/-0.2°C of one another. When three consecutive pH readings are within +/-0.2 standard pH units, pH will be considered stabilized. Conductivity will be considered stabilized when each of three conductivity values are within 10 µS/cm of each other. Turbidity will be considered stabilized when the reading is less than 5 NTUs for three consecutive readings. Temperature, pH, turbidity, and conductivity values obtained during well purging will be recorded in field logbooks. It should be noted that after five well volumes have been purged, the well will be considered stabilized regardless of fluctuations in the above parameters.

3.4.10.2.6 Sample Collection

Immediately after a monitoring well has been properly purged, it will be sampled, unless the well has a very slow recharge rate, in which case, the monitoring well will be sampled within 3 hours. For all parameters except VOCs, wells will be sampled using a peristaltic pump and precleaned Teflon® tubing, interfaced with silicon tubing at the pump head. Metal and SVOC samples will be collected first with the standard peristaltic pump setup, where the sample runs through both the Teflon® tubing and the silicon tubing in the pump head. Following this, VOC samples will be drawn into the teflon tubing by pump suction, the tubing will be crimped and disconnected from the pump, and VOC samples will be collected by gravity-flow induced by uncrimping the tubing. All information will be recorded on a sample collection log form. An example of a sample collection log form used by TtNUS for recording well purging and sample collection data during groundwater sample collection is contained in Appendix D.

Water sample collection for VOCs, SVOCs, and Target Analyte List (TAL) metals plus tin will be performed in accordance with the procedures outlined in Sections 3.4.10.2.6.1 through 3.4.10.2.6.3.

3.4.10.2.6.1 Volatile Organic Compounds

- VOC sample vials will not be preserved by the laboratory with concentrated HCl due to the reaction between HCl and calcium prevalent in groundwater at Key West.

- Three screw cap vials with Teflon®-lined silicone rubber septa (EPA-approved vials) will be filled to overflowing and sealed without any entrapped air bubbles. These vials will be 40 ml or larger.

- Each vial will be placed in a secure cooler.

- The samples will not be composited.

- A sample collection log, a chain-of-custody form, a laboratory request-for-analysis form, and a sample label will be filled out in the field. These forms, except for the sample collection log, will accompany the samples to the laboratory.

- The sample vials will be placed in a cooler with sufficient packing to prevent breakage during shipment.

- Collected samples will be stored prior to shipping in an ice chest filled with wet ice and maintained at approximately 4°C or stored in an on-site dedicated refrigerator at approximately 4°C.

- The cooler will be packed with wet ice to maintain the samples at approximately 4°C during shipment, sealed, and transported to the laboratory. To protect sample container integrity during shipment, the cooler will be packed with vermiculite and absorbent material.

3.4.10.2.6.2 Semivolatile Compounds

- One liter amber glass sample bottles complete with teflon-lined caps will be filled to 90 percent capacity and sealed to allow 10 percent headspace to compensate for any pressure and/or temperature changes.

- The sample bottles will be placed in a cooler with sufficient packing to prevent breakage during shipment.

- A sample collection log, a chain-of-custody form, a request-for-analysis form, and a sample label will be filled out in the field. These forms, except for the sample collection log, will accompany the samples to the laboratory.

- Collected samples will be stored prior to shipping in an ice chest filled with wet ice and maintained at approximately 4°C or stored in an on-site dedicated refrigerator at approximately 4°C.

- The cooler will be packed with wet ice to maintain the samples at approximately 4°C during shipment, sealed, and transported to the laboratory. To protect sample container integrity during shipment, the cooler will be packed with vermiculite and absorbent material.

3.4.10.2.6.3 Metals

- Samples will be placed in 1-liter polyethylene or glass bottles that have been pre-preserved with HNO_3.
- Bottles will be filled to within 10 mls of capacity.
- Samples will be stored on wet ice until packing for shipment to the laboratory or stored in an on-site dedicated refrigerator at approximately 4°C. To protect sample container integrity during shipment, the cooler will be packed with vermiculite and absorbent material.

3.4.10.3 Swipe Sampling Technique

Three cotton swabs will be used at each sample location. Cotton swabs will be dampened with a preservative allowing adhesion of surface particles that will be analyzed for specific parameters. For SVOC analysis, methylene chloride will be used as the preservative on one swab. Hexane will be used for the PCB swabs. Deionized water will be used to dampen the third sample swab for metals analysis, which does not require a preservative.

The FOL will determine sample location based on site conditions. Each of the three parameter sample swabs will be taken from the same general area, not from the exact location as this would affect sample results. Each sample swab will be placed in individual sample jars and handled as described in Section 3.5.

3.4.11 Decontamination

All drilling equipment is expected to arrive at NAS Key West clean of rust, soil, and other material from any previous activities. Any equipment with an extreme amount of rust will not be accepted to perform drilling activities. An inspection of the drilling apparatus (i.e., drill rig, direct push rig, etc.) will be performed to ensure that all oil, grease, and hydraulic fluid has been removed from the rig and all gaskets and seals are intact with no major leaks.

3.4.11.1 Drilling Equipment

Drilling equipment should be considered in two parts: the drilling apparatus (i.e., drill rig, direct push rig, etc.) and the downhole sampling equipment.

The drilling apparatus will be decontaminated by the following steps:

- Step 1: Steam clean and brush apparatus using tap water or wash apparatus with a brush using tap water and a laboratory grade detergent.
- Step 2: Rinse thoroughly with tap water.
- Step 3: Allow to air dry.

The downhole stainless steel sampling equipment will be decontaminated by the following steps:

- Step 1: Steam clean and brush apparatus using tap water or wash apparatus with a brush using tap water and a laboratory grade detergent.
- Step 2: Rinse thoroughly with tap water.
- Step 3: Rinse thoroughly with organic-free water.
- Step 4: Rinse with pesticide-grade isopropanol.*
- Step 5: Rinse thoroughly with organic-free water.
- Step 6: Allow to air dry.
- Step 7: Repeat Step 5.

All drilling equipment will be decontaminated after it arrives at NAS Key West. Decontamination locations will be designed at specified locations on NAS Key West. A temporary decontamination catchment with sump will be erected to collect all decontamination liquids and solids. The IDW Plan (Section 5.0) addresses the containerization, storage, and disposal of these wastes.

The drilling apparatus will be decontaminated between each subzone for the SSI and each sampling grid for the delineation sampling and decontaminated downhole sampling equipment will be used for each borehole.

3.4.11.2 Sampling Equipment

A variety of sampling equipment will be utilized during the execution of the SAP. This equipment includes reusable items such as stainless steel bowls, spoons, augers, and trowels. To limit the amount of IDW, disposable sampling items such as bailers and tubing may be used to reduce decontamination waste.

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*If non-stainless steel equipment is used, also rinse with a 10 percent solution of nitric acid.

A designated area will be set aside for the decontamination of reusable sampling equipment. Following use, all reusable equipment will be placed in this area and decontaminated as needed. It will be assumed that any reusable equipment not wrapped in aluminum foil requires decontamination. As decontamination is carried out, the quantities of equipment decontaminated will be noted in the logbook. In order to ensure that all used equipment has undergone decontamination, the FOL will then compare the quantity of equipment decontaminated to the quantity of equipment used for sample collection.

The reusable sampling equipment will be decontaminated by the following steps:

- Step 1: Wash apparatus with a brush using tap water and a laboratory grade detergent.
- Step 2: Rinse thoroughly with tap water.
- Step 3: Rinse thoroughly with organic-free water.
- Step 4: Rinse with pesticide-grade isopropanol.
- Step 5: Rinse with organic-free water.
- Step 6: Allow to air dry.
- Step 7: Wrap in aluminum foil.

All waste soap, tap water, and organic-free water solutions will be disposed on-site. All waste solvents will be collected, containerized, and turned over to the base for disposal.

3.5 SAMPLE HANDLING AND ANALYSIS

All samples will be labeled, tracked, shipped, and analyzed based on the requirements outlined below.

3.5.1 Sample Custody

To support the integrity of the field data, it is necessary to document the location of sample collection and demonstrate that samples reach the laboratory without being altered prior to analysis. To accomplish this, evidence of the collection, shipment, laboratory receipt, and custody until disposal must be documented. The documentation will be performed with a chain-of-custody record. The chain-of-custody record tracks each sample and the individuals responsible for sample collection, shipment, and receipt. A sample will be considered in custody if it is in the possession of an authorized individual, in view after being in physical possession, or sealed and in a secured area restricted to authorized personnel.

TtNUS personnel will use the following chain-of-custody process for sample tracking:

- Sample identification and labeling
- Sample chain-of-custody form (includes laboratory request analysis)
- Container and custody seals
- Carrier airbill for shipping samples

3.5.1.1 Sample Identification and Labeling

All sample labels will be marked with a unique identifier (includes location and sample type), analyses, date and time of collection, preservative, and initials of sampler.

3.5.1.2 Laboratory Analysis Request and Chain-of-Custody Form

The laboratory analysis request will be accomplished with the use of the chain-of-custody form. The chain-of-custody form includes the sampling location, sample type and amount, date and time of collection, name(s) of persons responsible for sample collection, the number and type of laboratory analyses, date and time of all custody transfers, signature of the person relinquishing or accepting sample custody, and an explanation field. An example of this form is found in Appendix D. A copy of the completed chain-of-custody form will be maintained in the field file.

3.5.1.3 Sample Logsheet

A sample logsheet will be prepared for each media sampled to record information pertaining to the location, condition, and collection of a sample. The sample logsheets will be prepared either in the field or from field logbook notes in the office following field activities. The information to be recorded includes the following:

- Project name and number
- Date and time of collection
- Field personnel responsible for sample collection
- Sample identification and type (e.g., soil, water, sediment, etc.)
- Any field testing results (e.g., FID/PID readings, pH, temperature, specific conductance, etc.)
- Sketch of sample location
- Weather conditions
- General field observation
- Depth of sample

3.5.1.4 Sample Packing and Shipment

3.5.1.4.1 Sample Storage

All samples will be collected and properly labeled, placed in individual zip-lock type plastic bags, and placed in field coolers packed with ice. The field coolers will be sturdy and have the drain plug duct-taped if present. Samples will be transferred from the field coolers to a refrigerator or be repacked for shipment. The refrigerator will be monitored to verify acceptable storage conditions daily, and the temperature will be taken and recorded daily in a log book. Clean field coolers will be received from the laboratory, and the coolers will be cleaned as necessary during the sample collection, storage, and shipment process to ensure that no samples are packed in contaminated shipping containers.

3.5.1.4.2 Sample Packing

Packaging of samples will be accomplished by the following steps:

- Step 1: Double bag ice in one-gallon sealing plastic bags (e.g., typically 5 bags to a cooler).
- Step 2: Record sample container and analysis on chain-of-custody record.
- Step 3: Ensure that all sample containers have been sealed in plastic bags.
- Step 4: Wrap all glass sample containers with packing material.
- Step 5: If present, duct-tape the drain plug of a sturdy cooler.
- Step 6: Line the cooler with a large heavy duty plastic bag (e.g., garbage bag).
- Step 7: Place 2 inches of vermiculite or comparable material the bottom of the bag.
- Step 8: Place samples upright in the bottom of the prepared cooler.
- Step 9: Place temperature blank bottle in cooler with samples.
- Step 10: Place ice bags into the cooler around upright samples.
- Step 11: Pour vermiculite or a comparable material into the cooler to fill any voids between samples.
- Step 12: To prevent breakage, check to see that none of the sample containers come into direct contact with one another.

- Step 13: Place ice bags on top of the samples.
- Step 14: Tape or tie shut heavy plastic bag to seal in samples.
- Step 15: Tape shut cooler lid(s) across top and down sides with packing tape (EXCEPT ONE COOLER TO PLACE COMPLETED CHAIN-OF-CUSTODY FORM INSIDE).
- Step 16: Place two chain-of-custody seals on each cooler, one on each side.

3.5.1.4.3 Shipment

Samples will be shipped on average within 24 hours of collection. There may be instances where sampling will be conducted on the weekend and shipping will not be available until the following Monday. Samples will be secured in refrigerators or iced coolers while awaiting shipment. Shipment will be accomplished by the following steps:

- Step 1: Place complete chain-of-custody record for entire shipment in a sealable plastic bag and tape to the inside of one cooler lid (HAVE SHIPPING AIRBILL NUMBER RECORDED ON CHAIN-OF-CUSTODY FORM. BE SURE TO SIGN AND RELINQUISH TO SHIPPER WITH DATE AND TIME).
- Step 2: Tape shut cooler lid across top and down sides with packing tape.
- Step 3: Place two chain-of custody seals on either side of the cooler.

3.5.1.4.4 Transportation

Samples will be shipped in a manner to protect the integrity of the sample. TtNUS expects to sample only media (e.g., soil and groundwater) during the SSI field effort. Therefore, the samples will be shipped as nonhazardous environmental samples. If there is any doubt as to the nonhazardous nature of the environmental samples, Department of Transportation (DOT) procedures (49 CFR) for packing, marking, labeling, and shipping will be utilized.

3.5.1.5 Laboratory Receipt

A controlled offsite laboratory will perform the analytical work associated with this Workplan. The offsite laboratory will be responsible for the following:

- Delivery of appropriate sample containers with preservatives
- Sample receipt and check-in
- Storage of samples
- Initiation of testing program
- Sample disposal
- Issuance of certificate of analysis

3.5.2 Sample Analysis

Analytical procedures were selected for the SSI based on site history and existing data generated during the BRAC SI. Quality control (QC) samples will be collected and analyzed by the same procedures to ensure that the data are adequate and representative. Analytical procedures and QC samples are addressed in more detail below.

3.5.2.1 Analytical Procedures

Standard analytical methods have been selected to characterize the parameter groups of interest at the SSI sites. Based on existing data and site history, sets of analytical parameters were defined for each subzone. Table 3-1 identifies the selected methods and the parameters selected for inclusion under each method. The methods were generally defined as described below:

- Target Compound List (TCL) VOCs by SW-846 method 8260b
- TCL SVOCs by SW-846 method 8270c
- TCL PCBs by SW-846 method 8082
- TAL metals and tin by SW-846 method 6010A and the 7000a series

3.5.2.2 Sample Quality Control

QC procedures are designed to ensure the consistency and continuity of data. The frequency of QC checks is based on the type of analysis. Standard sample QC analyses include, but are not limited to, duplicate samples, equipment rinsate blanks, trip blanks, matrix spike and matrix spike duplicate samples, and field water blanks. All QC samples will be analyzed by the offsite laboratory performing analyses at

DQO Level III. QC samples will be analyzed for the same parameters as the environmental samples collected during the site-specific sampling event, except for trip blanks, which will be analyzed for TCL VOCs only. Quantities and types of QC samples are provided in Table 3-6.

Other internal QC activities are undertaken during the performance of work to ensure that the service, designs, and documents produced meet currently accepted professional standards. QC on this assignment will entail periodic discussions among the technical staff, Project Manager, and Program Manager. An internal audit will be performed as described in Section 3.7.

3.6 SURVEYING

All permanent monitoring well locations will be surveyed by a certified land surveyor. Global positioning system or direct measurements will be used to locate all other sample locations. An X-Y-Z coordinate system will be used to identify locations. Each location will be measured from a reference point tied to the state plane system, where the X coordinate describes the east-west axis location (Easting) and the Y coordinate describes the north-south axis location (Northing). The vertical coordinates (Z coordinates) of each well will be surveyed in reference to the National Geodetic Vertical Datum.

All surveyed locations will be reported using the Florida State Plane Coordinate System-Eastern Zone. Existing installation benchmarks will serve as the horizontal and vertical data for the survey. Elevations and horizontal locations will be measured to the nearest hundredth of a foot. The elevations of all monitoring wells will be surveyed at the water-level measuring notch on the riser pipe and on the undisturbed ground surface adjacent to the pad, as well as on the pad itself.

3.7 PERFORMANCE SYSTEM AUDITS AND FREQUENCY

Audits are performed to confirm that work being completed within the SSI/IRA program complies with QA program goals. Internal audits of laboratory subcontractors are routinely conducted, and subcontracted laboratories must be both Contract Laboratory Program (CLP) and SW-846 qualified and Naval Facilities Engineering Service Center (NFESC) approved. The laboratory must also be certified by the Florida Department of Health-Division of Laboratory Services and have a current Florida Department of Environmental Protection (FDEP) approved Comprehensive Quality Assurance Plan (CompQAP).

All primary documents will receive internal technical reviews, and a minimum of one internal audit will be scheduled for the SSI program. Technical reviews and internal audits will be performed in accordance with the QA elements in the Workplan and Appendix E. A minimum of one internal audit will be scheduled by the QA Manager in coordination with the FOL during the SSI sampling activities. All audit records, including audit plans, reports, written responses, and corrective action forms, will be maintained with the project files.

3.8 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Management personnel at all levels will receive QA reports appropriate to their level of responsibility. The QA Manager will receive copies of all QA documents. QC documentation will be maintained in the project files. Other types of QA reports may include periodic assessment of measurement data accuracy, precision, and completeness; results of performance audits and/or systems audits; significant QA problems and recommended solutions for future projects; and status of solutions to any problems previously identified. Additionally, incidents requiring corrective action will be fully documented. These reports will be provided to the QA Manager and, in turn, will be submitted to management. The summary of findings will be factual, concise, and complete. Supporting information will be appended to the report.

TABLE 3-1

PARAMETER GROUPS AND MEDIA OF INTEREST
NAS KEY WEST

Building/Area	Parcel/ Subzone	Medium	Number of Samples	Parameter Group				
				VOCs	SVOCs	Inorganics	PCBs	Pest
IRA DELINEATION SAMPLING								
Former Oil Container (Pre-1942) and Scrap Metal and Refugee Item Storage Area	C/3	SO	150	X	X	X		
Former Scrap Metal Storage Area (Former DRMO)	C/4	SO						
Former Building 136	E/2	SO	18	X	X	X		
SSI SAMPLING								
Buildings 102 and 104	E/3	SO	48	X	X	X		
Building 103	E/9	SO		X	X	X	X	
Groundwater Area Associated with Buildings 102, 103, and 104	E/7	GW	19	X	X	X		
Buildings 102 and 104	E/3	SP	10		X	X		
Building 103	E/9	SP	5		X	X	X	
CONFIRMATION SAMPLING								
Sewage Lift Station	A/4		7			X		
Area Around Sample 5D-08	A/9		7			X		X
Area Around Sample 5D-05	A/9		9			X		X
Between Buildings 261 and 284	C/1		12			X	X	
Former Oil Container (Pre-1947) and Scrap Metal and Refugee Item Storage Area	C/3	SO	99			X		
Former Scrap Metal Storage Area (Former DRMO)	C/4	SO						
Seminole Battery	D/1		7		X	X		
Former Location of Building 136	E/2		13		X	X		
Area Around Buildings 102 and 104	E/3		9		X	X		
Area Around Building 103	E/9		18		X		X	
Former Lube Area	R/1		7			X		
Building 223	F/3		7			X		

SO = Soil
GW = Groundwater
SP = Swipe

TABLE 3-2

CONFIRMATION SAMPLING LOCATIONS

Building/Area		Parcel/ Subzone	Sampling Strategy	# Floor Samples	# Side Samples	Total Samples	Analysis
HAWK MISSILE SITE							
Sewage Lift Station		A/4	Small Site	3	4	7	Inorganics
Area around Sample SD-08 – sediment		A/9	Small Site	3	4	7	Inorganics Pesticides
Area around Sample SD-05 – sediment		A/9	Small Site	5	4	9	Inorganics Pesticides
TRUMAN ANNEX DRMO STORAGE AREA							
Between Buildings 261 and 284		C/1	Small Site	7	5	12	Inorganics PCBs
Soils Around Water Tower	50'x50'x2'	C/3	Small Site 1	6	4	10	Inorganics
	100'x100'x4'		Small Site 2	9	7	16	
	100'x100'x4'		Small Site 3	9	7	16	
	37500sf x 2'		Medium Site	10	9	19	
DRMO Scrap Metal Storage Area	7500sf x 4'	C/4	Small Site 1	8	6	14	Inorganics
	50'x50'x2'		Small Site 2	6	4	10	
	65000sf x 2'		Medium Site	9	5	14	
TRUMAN ANNEX – SEMINOLE BATTERY							
Seminole Battery		D/1	Small Site	3	4	7	Inorganics SVOCs
BUILDINGS 102, 103, AND 104							
Former Location of Building 136		E/2	Medium Site	10	3	13	Inorganics SVOCs
Areas around Buildings 102 and 104		E/9	Small Site	5	4	9	Inorganics SVOCs
Areas around Building 103		E/9	Small Site	10	8	18	PCBs SVOCs
TRUMAN ANNEX BUILDING 223							
Former Lube Area		F/1	Small Site	3	4	7	Inorganics
Building 223		F/3	Small Site	3	4	7	Inorganics

TABLE 3-3

TYPES AND VOLUMES OF SAMPLE BOTTLES FOR ENVIRONMENTAL SAMPLE ANALYSES NAS KEY WEST

Matrix	Container	Volume Referenced for Analysis[1]	Preservative[1]	Holding Times[1]
TCL VOLATILES BY SW-846 METHOD 8260B				
Aqueous	3 glass vials with Teflon® septa	40 mL	Cool to 4°C, HCl to pH < 2	14 days from VTSR[2]
Solid	2 Encore® container 1 glass jar	5 gram 20 oz	Cool to 4°C	14 days from VTSR[2]
TCL SEMIVOLATILES BY SW-846 METHOD 8270C				
Aqueous	1 amber glass bottles with Teflon®-lined cap	1,000 mL	Cool to 4°C	7 days from VTSR[2] to extraction, 40 days after extraction
Solid	1 widemouth glass jar with Teflon®-lined cap	8 oz	Cool to 4°C	14 days from VTSR[2] to extraction, 40 days after extraction
Swipes	1 3-inch by 3-inch cotton swab contained in a wide-mouth jar with Teflon®-lined cap	8 oz	Methylene chloride	7 days from VTSR[2]
TCL PESTICIDES BY SW-846 METHOD 8081A				
Aqueous	1 amber glass bottles with Teflon®-lined cap	1,000 mL	Cool to 4°C	7 days from VTSR[2] to extraction, 40 days after extraction
Solid	1 widemouth glass jar with Teflon®-lined cap	8 oz	Cool to 4°C	14 days from VTSR[2] to extraction, 40 days after extraction
TCL PCBs BY SW-846 METHOD 8082				
Solid	1 widemouth glass jar with Teflon®-lined cap	8 oz	Cool to 4°C	14 days from VTSR[2] to extraction, 40 days after extraction
Swipes	1 3-inch by 3-inch cotton swab contained in a wide-mouth jar with Teflon®-lined cap	8 oz	Hexane	7 days from VTSR[2]
TAL METALS PLUS TIN BY SW-846 METHODS 6010B AND THE 7000A SERIES				
Aqueous	1 polyethylene bottle	1,000 mL	Cool to 4°C, HNO_3 to pH < 2	28 days from VTSR[2,3]
Solid	1 widemouth glass jar with Teflon®-lined cap	8 oz	Cool to 4°C	28 days from VTSR[2,3]
Swipes	1 3-inch by 3-inch cotton swab contained in a wide-mouth jar with Teflon®-lined cap	8 oz	Deionized water	7 days from VTSR[2]

1 40 CFR Part 136.
2 VTSR – Validated time of sample receipt.
3 The short holding time is due to the inclusion of mercury analysis. Without mercury analysis, the holding time for inorganics is 180 days from VTSR.

TABLE 3-4

TYPES AND VOLUMES OF SAMPLE BOTTLES FOR FULL TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP) ANALYSIS (REGULATORY LIST PARAMETERS) FOR INVESTIGATION-DERIVED WASTE NAS KEY WEST

Matrix	Container	Volume Referenced for Analysis	Preservative	Holding Times
TCLP VOCs SW-846 METHOD 1311 FOLLOWED BY METHOD 8260B				
Solid	3 Encore® containers 1 glass jar	5 grams, 2 ounces	Cool to 4°C	14 days from VTSR[1] to TCLP extraction, 14 days from extraction to analysis
TCLP SVOCs SW-846 METHOD 1311 FOLLOWED BY METHOD 8270C				
Solid	1 widemouth glass jar with Teflon®-lined cap	8 ounces	Cool to 4°C	14 days from VTSR[1] to TCLP extraction, 40 days from extraction to analysis
TCLP PESTICIDE SW-846 METHOD 1311 FOLLOWED BY METHOD 8081A				
Solid	1 widemouth glass jar with Teflon®-lined cap	8 ounces	Cool to 4°C	14 days from VTSR[1] to TCLP extraction, 40 days from extraction to analysis
TCLP HERBICIDES SW-846 METHOD 1311 FOLLOWED BY METHOD 8151A				
Solid	1 widemouth glass jar with Teflon®-lined cap	8 ounces	Cool to 4°C	14 days from VTSR[1] to TCLP extraction, 40 days from extraction to analysis
TCLP METALS SW-846 METHOD 1311 FOLLOWED BY METHOD 6010B				
Solid	1 widemouth glass jar with Teflon®-lined cap	8 ounces	Cool to 4°C	28 days from VTSR[2] to TCLP extraction, 28 days from extraction to analysis

1 VTSR – Validated time of sample receipt.

TABLE 3-5

**FIELD CALIBRATION PROCEDURES AND FREQUENCIES
NAS KEY WEST**

Instrument	Calibration Standards Used	Acceptance Limits	Corrective Action	Documentation
Horiba U-10 water quality checker	Daily: Calibration Solution	Auto 1-point calibration; repeatability requirements: pH ± .05 pH units Conductivity ± 1% Turbidity ± 3% DO ± 0.1 mg/L Temperature ± 0.1 °C	Recalibrate to standards, clean or replace electrode, service unit	Logbook and calibration forms
Sensodyne Flame Ionization Detector	Daily: Known gas standards, Methane at 100 ppm	± 10 %	Recalibrate to standards or replace if faulty	Logbook and calibration forms
Photoionization Detector	Daily: Known gas standards, Isobutylene at 100 ppm	± 10 %	Recalibrate to standards or replace if faulty	Logbook and calibration forms
O_2, NO_2, CO, and LEL	Daily: Standard calibration gas provided by manufacturer	± 10 %	Recalibrate to standards or replace if faulty	Logbook and calibration forms

LEL = Lower explosive limit.

TABLE 3-6

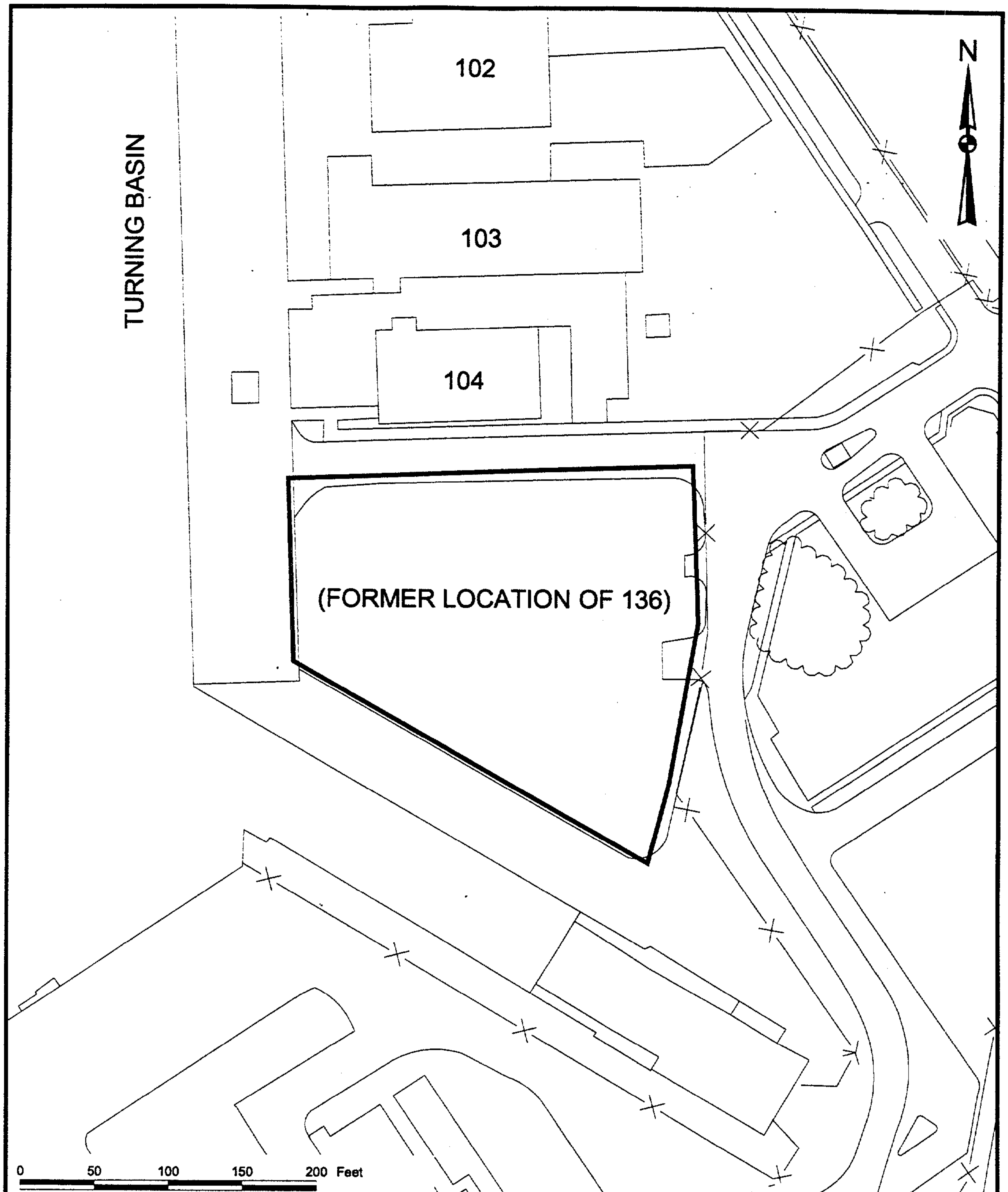
SAMPLE ANALYSIS, MATRIX, AND EXPECTED NUMBER OF QC SAMPLES NAS KEY WEST

Matrix	Number of Samples	Laboratory QC Samples[1]	Field QC Samples[2]
TCL VOLATILES BY SW-846 METHOD 8260B			
Solid	84 (SS)	1 MS/1 MSD	10 TB, 2 RB, 9 Dups
Aqueous	22 (GW)	1 MS/1 MSD	10 TB, 3 Dups, 1 RB, 2 FB
TCL SEMIVOLATILES BY SW-846 METHOD 8270C			
Solid	156 (SS)	1 MS/1 MSD	2 RB, 16 Dups
Aqueous	22 (GW)	1 MS/1 MSD	3 Dups, 1 RB, 4 FB
TCL PESTICIDES BY SW-846 METHOD 8081			
Solid	24 (SS)	1 MS/1 MSD	1RB, 3 Dups
Aqueous	0	--	--
TCL PCBs BY SW-846 METHOD 8082			
Solid	24 (SS)	1 MS/1 MSD	1 RB, 3 Dups
Aqueous	0	--	--
TAL METALS PLUS TIN BY SW-846 METHODS 6010B/7000A			
Solid	156 (SS)	1 MS/1 MSD	2 RB, 16 Dups
Aqueous	22 (GW)	1 MS/1 MSD	3 Dups, 1 RB, 2 FB
FULL TCLP BY SW-846 METHOD 1311 AND VARIOUS ANALYTICAL METHODS			
Solid	6[3]	1 MS/1 MSD	1 RB, 1 Dup

1 Laboratory QC samples [matrix spikes (MS) and matrix spike duplicates (MSD)] will be collected at a rate of one per every 20 samples (or 5 percent). When calculating the quantity of laboratory QC samples, all samples, blanks, and duplicates were considered.

2 Field water blanks (FB) will be collected from every water source used during the investigation. One trip blank will be analyzed per cooler of samples submitted for volatile organic analysis (VOA). It is estimated that 12 VOA samples will fit in a single cooler. Rinsate blanks (RB) will be collected from one of every 20 pieces of sampling equipment cleaned. The number may vary depending on the quantity of equipment used. One duplicate (Dup) sample will be collected for every 10 environmental samples.

3 The number of samples analyzed by Toxicity Characteristic Leaching Procedure (TCLP) will depend on the quantity of solid investigation-derived waste (IDW) that is containerized. One sample will be analyzed for TCLP per 55-gallon drum of solid IDW. Solid IDW will be containerized only at those sites where the field operations leader (FOL) has reason to believe the IDW may qualify as hazardous waste. At this time, it is estimated that 6 drums or less of solid IDW will be containerized.



DRAWN BY TMH	DATE 05-AUG-98	SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BRAC PARCELS AT TRUMAN ANNEX	CONTRACT NUMBER 7593
CHECKED BY	DATE	FIGURE 3-1. SUBZONE 2 - FORMER BUILDING 136	APPROVED BY — DATE —
COST/SCHEDULE-AREA		BRAC PARCEL E - BUILDINGS 102, 103, AND 104	APPROVED BY — DATE —
SCALE AS NOTED		NAVY SOUTHERN DIVISION NAS KEY WEST, FLORIDA	DRAWING NO. — REV 0

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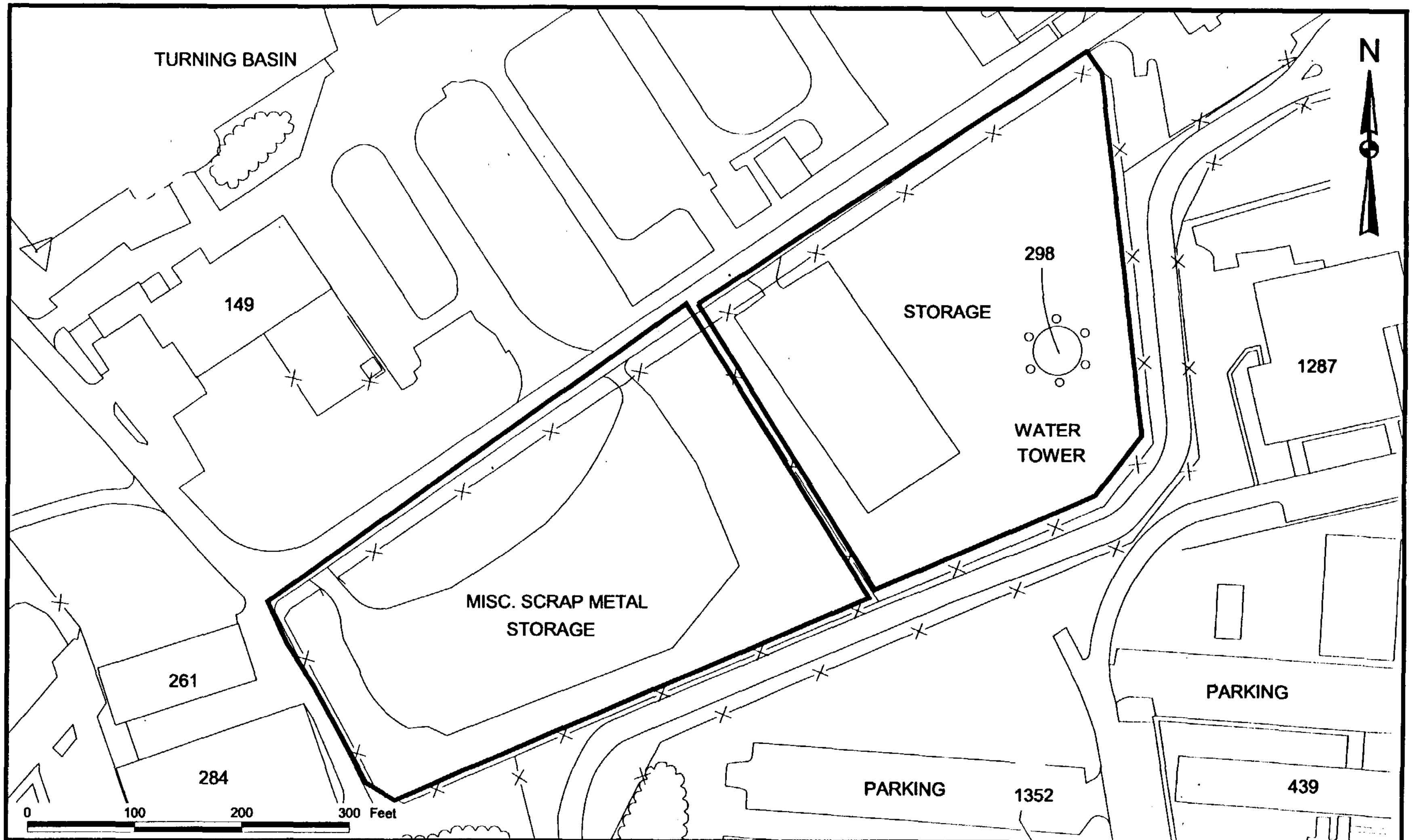
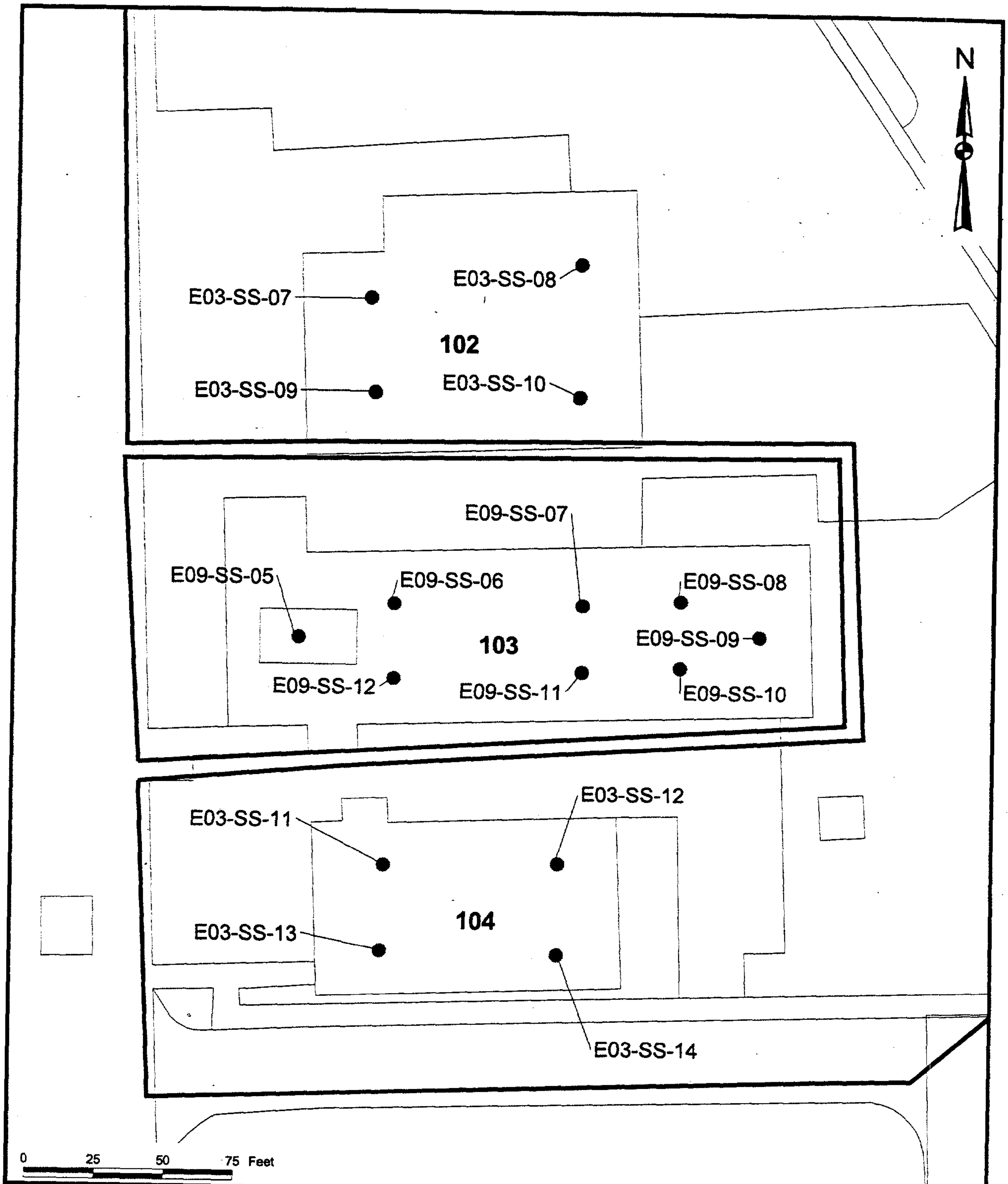


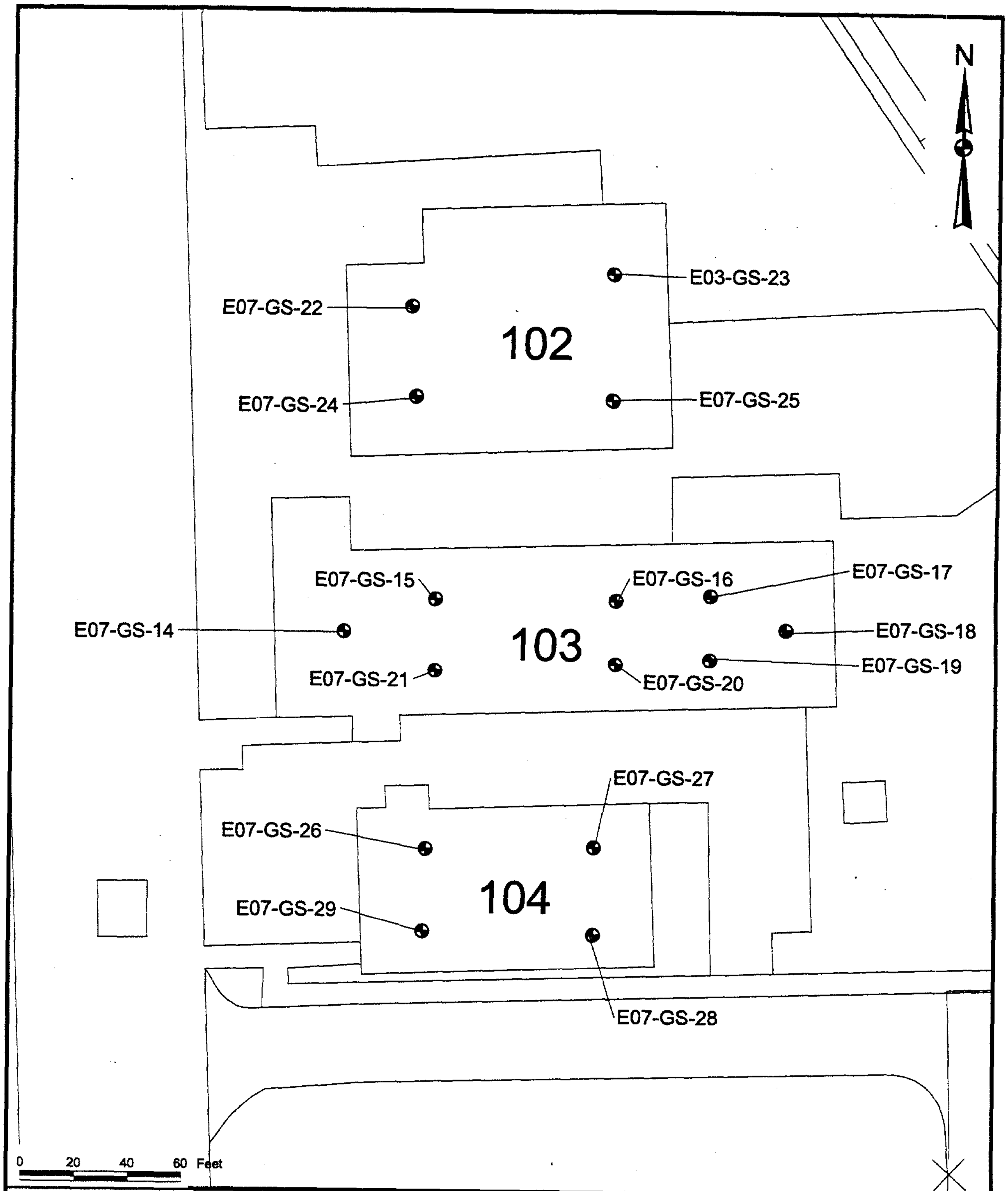
DRAWN BY TMH	DATE 05-AUG-98		SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BRAC PARCELS AT TRUMAN ANNEX	CONTRACT NUMBER 7593
CHECKED BY	DATE		FIGURE 3-2. SUBZONES 3 AND 4	APPROVED BY / DATE
COST/SCHEDULE-AREA			BRAC PARCEL C - DRMO WASTE STORAGE AREA	APPROVED BY / DATE
SCALE AS NOTED			NAVY SOUTHERN DIVISION	DRAWING NO. / REV 0
			NAS KEY WEST, FLORIDA	

C:\GIS\KEYWEST\SSI-FIGURES.APR 05-AUG-98 TMH



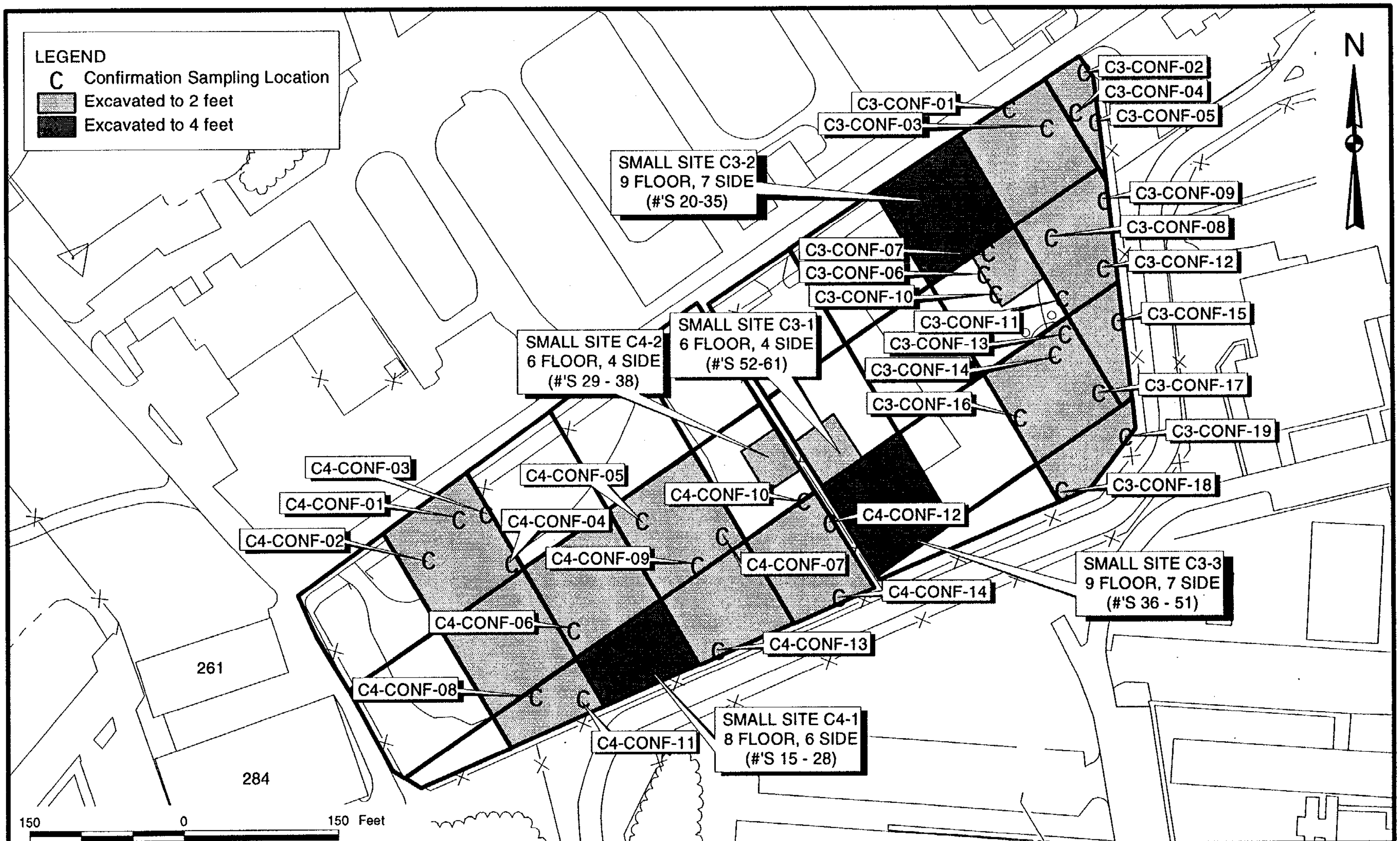
DRAWN BY TMH	DATE 05-AUG-98		SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BRAC PARCELS AT TRUMAN ANNEX FIGURE 3-3. SUBZONES 3 AND 9 BRAC PARCEL E - BUILDINGS 102, 103, AND 104 NAVY SOUTHERN DIVISION NAS KEY WEST, FLORIDA	CONTRACT NUMBER 7593
CHECKED BY	DATE			APPROVED BY / DATE
COST/SCHEDULE-AREA				APPROVED BY / DATE
SCALE AS NOTED				DRAWING NO. / REV 0

C:\GIS\KEYWEST\SSI-FIGURES.APR 05-AUG-98 TMH



DRAWN BY TMH / DATE 05-AUG-98		SUPPLEMENTAL SITE INSPECTION WORKPLAN FOR BRAC PARCELS AT TRUMAN ANNEX FIGURE 3-4. SUBZONE 7 BRAC PARCEL E - BUILDINGS 102, 103, AND 104 NAVY SOUTHERN DIVISION NAS KEY WEST, FLORIDA	CONTRACT NUMBER 7593
CHECKED BY / DATE			APPROVED BY / DATE
COST/SCHEDULE-AREA			APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. / REV 0

C:\GIS\KEYWEST\SSI-FIGURES.APR 05-AUG-98 TMH



DRAWN BY	DATE
D. PERRY	24-NOV-98
CHECKED BY	DATE
COST/SCHEDULE-AREA	
SCALE AS NOTED	

FIGURE 3-5

DRMO EXCAVATION AREAS AND CONFIRMATION SAMPLE LOCATIONS

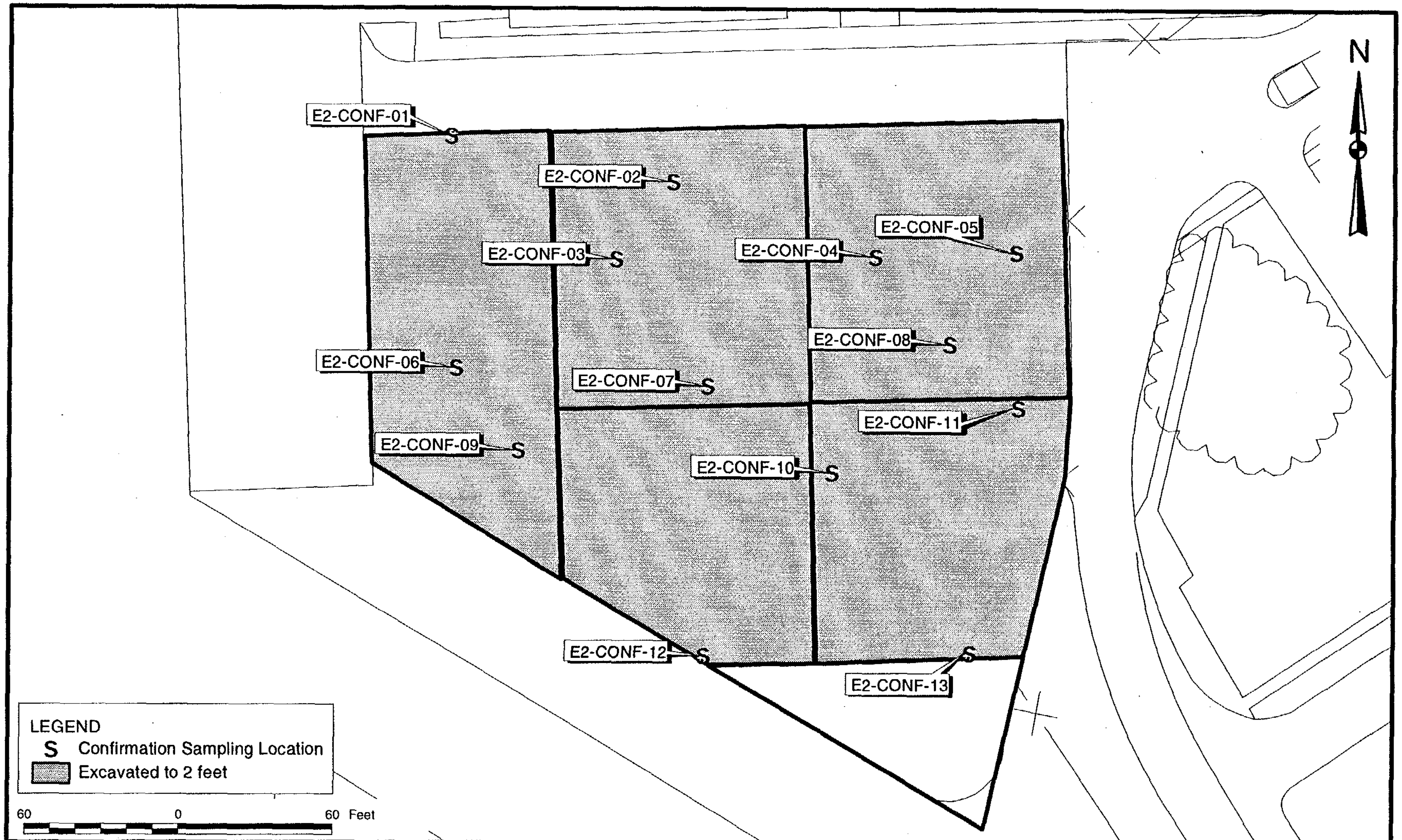
BRAC PARCEL C

NAVY SOUTHERN DIVISION

NAS KEY WEST, FLORIDA

CONTRACT NUMBER	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV 0

P:\GIS\NAS_KEY_WEST\7593_SSI_FIG.APR 24-NOV-98 DNP IRA - C-3 CONFIRMATION SAMPLING POINTS AT PARCEL C, SUBZONES 3 AND 4 AH LAYOUT



DRAWN BY	DATE			CONTRACT NUMBER
D. PERRY	19-NOV-98		FIGURE 3-6	
CHECKED BY	DATE		BUILDING 136 - EXCAVATION AREA AND CONFIRMATION SAMPLE LOCATIONS	APPROVED BY — DATE
COST/SCHEDULE-AREA			BRAC PARCEL E	APPROVED BY — DATE
			NAVY SOUTHERN DIVISION	
SCALE AS NOTED			NAS KEY WEST, FLORIDA	DRAWING NO. — REV 0

P:\GIS\WAS_KEY_WEST\7593_SSI_FIG.APR 19-NOV-98 DNP WP PARCEL E, SUBZONE 2 - CONFIRMATION SAMPLING POINTS AH LAYOUT

4.0 DATA MANAGEMENT PLAN

The Data Management Plan describes how the results of the sampling and field measurements will be assessed, validated, documented, tracked, and reported. Project documentation procedures, filing requirements, and formats used to report data and conclusions are described in this section.

4.1 DATA QUALITY ASSESSMENT

Data collected from the investigation activities include survey data and laboratory analytical data. All survey calculations will be reviewed and verified. All analytical data will undergo a data review. Results from QC samples including duplicates, matrix spikes and matrix spike duplicates, and blanks will be reviewed and used as a potential basis for rejecting analytical data points. Data review will also entail calculations of accuracy, precision, representativeness, comparability, and completeness that are designed to assess the general quality of the data set. All electronic data will be verified against supporting documentation. Any inconsistencies between the electronic data supplied by the laboratory and the corresponding Certificate of Analysis (CofAs) or COCs will be clarified and corrected.

4.2 MAPS

Maps will be prepared showing features including potential receptors, study areas, and sampling and field measurement locations. To provide a spatial representation of site data, maps also will be employed.

4.3 DATA PRESENTATION FORMAT

The reduction of field and analytical data will consist of summarizing water level measurements, soil boring logs, well logs, field parameters, and analytical results. These summaries will be presented as tables, illustrations, and/or graphics. The complete array of this data will be available in appendices to the reports, while summaries of pertinent information will be included in the main body of the reports. Chemical data and some physical data will be stored and managed with a data management system. The system will be capable of sorting data by a number of different parameters and presenting the data in tabular form. All detections of each analytical parameter at a given site will be presented in a table and will be sorted by fraction, parameter, and result.

Several types of data will be represented pictorially. Soil boring logs and well logs will be included in an appendix to the reports. Groundwater level measurements will be documented numerically in the appendix that includes field data forms. Additionally, in order to clearly document the nature and extent of contamination at the sites under investigation, any data points in excess of action levels will be depicted on site maps.

All raw data will be appended to the reports. This will include an electronic copy of the analytical database, descriptions of soil borings, well logs, surveying data, and all field data collection forms. Additionally, an appendix will be included documenting the modifications to the Comprehensive Background Dataset (B&R Environmental, 1997b) that were necessary in support of the SSI.

5.0 INVESTIGATION-DERIVED WASTE PLAN

Based on previous sampling efforts and the history of the properties under investigation, it is unlikely that Resource Conservation and Recovery Act (RCRA) hazardous IDW will be generated by the SSI at Truman Annex BRAC Parcels C, E, and F. It is assumed that the solid [e.g., soil and personal protective equipment (PPE)] and aqueous wastes (e.g., groundwater and decontamination fluids) generated during the SSI will be RCRA nonhazardous wastes. Professional judgment will be used along with field screening and analytical results to evaluate each IDW stream to ensure its RCRA-nonhazardous nature.

All aqueous waste streams will be containerized in 55-gallon drums and left at or near the investigation site. Each drum will be labeled to identify the source of the contents. The results of groundwater analyses from the monitoring well that corresponds to a given drum will be used to characterize its contents.

Solid IDW will be generated from the installation of monitoring wells with the DPT. In accordance with EPA's guidance on the handling of IDW, solid material will be left at the location of origin, unless the FOL has reason to believe it may constitute a RCRA hazardous waste (EPA, 1992). In this event, the solid IDW will also be containerized in 55-gallon drums and ferried to a central storage location. A sample will be collected from each drum of solid IDW and submitted for a full TCLP analysis under SW-846 Method 1311.

Waste containers and characterization information will be remanded into base custody for disposal. If the characterization information confirms the nonhazardous nature of the IDW, it will be disposed of onsite. In the event any of the waste is determined to be RCRA hazardous, it will be containerized, handled, and disposed of accordingly.

5.1 METHODS OF WASTE QUANTITY MINIMIZATION

The SSI soil boring, monitoring well installation, and sampling will be conducted to minimize the quantities of solid and aqueous IDW. Since the water table is very shallow on Key West, surface soil borings will be shallow in nature (0 to 2 feet bls) and the subsurface borings for the monitoring wells will be no more than 12 feet bls on average. Surface and subsurface borings also will be performed using DPT drilling methods.

Cardboard, glass, paper, metal, and plastic will be transported for recycling at NAS Key West Trumbo Point Recycling Center or stored for reuse on future NAS Key West field activities if possible. Onsite recycling was performed during the BRAC SI activities (November 1997 through February 1998) with great success, significantly reducing the amount of solid waste generated.

5.2 TYPES AND QUANTITY OF WASTES

IDW generated during the field effort will include liquid and solid waste from Building 103 sumps, groundwater from well development and purging, decontamination water, PPE, and sanitary wastes. Soil waste will be generated from surface and subsurface borings. It is estimated that 450 gallons of groundwater IDW will be produced during the course of the field investigation (approximately 25 gallons of development and purge water per screening sample and monitoring well). Decontamination fluids will include those fluids resulting from the decontamination of spoons and bowls used for soil sampling, direct-push sampling equipment, and drilling equipment. It is estimated that the total amount of decontamination fluid will be less than two 55-gallon drums (110 gallons). Sanitary solid waste will be generated from nonrecyclable containers, plastic, waste foods, and PPE (e.g., gloves). It is estimated that 150 pounds of sanitary wastes could be generated.

5.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

If collected, each container of solid IDW will be characterized through TCLP testing unless associated liquid waste is present. The TCLP limits established by EPA will be used to evaluate the results of the analyses.

The contents of each container of aqueous IDW will be characterized based on the analytical results that correspond to the monitoring well where the waste fluids originated. The analytical results will be evaluated through a comparison with the groundwater action levels, as well as a comparison to EPA's TCLP limits.

5.4 ONSITE HANDLING METHODS

IDW will be handled as follows:

- All aqueous IDW will be containerized and labeled with the medium, date generated, and the source.
- All solid IDW that is suspected of constituting a hazardous waste will be containerized.
- All solid IDW for sites where existing information supports a nonhazardous classification will be left at the location of origin.

- All containers of solid IDW will be characterized through laboratory analyses unless associated aqueous IDW is present (TCLP testing).
- All containers of aqueous IDW will be characterized based on groundwater analytical data.
- Nonhazardous groundwater and decontamination fluids will either be poured onto the ground to allow infiltration or will be treated at the base Federally-Owned Treatment Works.
- Any hazardous aqueous IDW will be disposed of in accordance with the provisions of RCRA.
- All waste solvents from the decontamination process will be containerized, labeled, and turned over to base personnel for proper disposal.
- Decontaminated PPE will be double bagged and deposited in a site dumpster as sanitary waste. The NAS Hazardous Waste Manager or IR Program Manager will be notified of any decontaminated PPE so disposed, including its location and date of disposal.

5.5 CONTAINERIZATION, STORAGE, AND TESTING OF WASTE

Any solid IDW suspected of being hazardous and all containerized aqueous IDW in 55-gallon drums will be left at the investigation site. The containers will be labeled with a subzone identifier, the date of generation, and the media type. A sample from each container of solid IDW will undergo TCLP testing to determine the nature of the waste.

6.0 PROJECT MANAGEMENT PLAN

This section identifies key roles in the project and program organization and specifies the proposed project schedule.

6.1 KEY PROJECT PERSONNEL

The following sections highlight key individuals in the TtNUS CLEAN program and this SSI. Project organization is depicted on Figure 6-1.

SOUTHDIV is responsible for establishing policy guidance for the CLEAN program. SOUTHDIV awards contracts, approves funding, and has primary control of report release and interagency communication.

6.1.1 SOUTHDIV Remedial Project Manager

The SOUTHDIV Remedial Project Engineer, Mr. Dudley Patrick, is responsible for the technical and financial management of the SSI activities at NAS Key West. Mr. Patrick is the primary project contact. He prepares the project statement of work; manages the project scope, schedule, and budget; and provides technical review and approval of all deliverables. Mr. Patrick will be responsible for approving changes in the scope of work identified during Project Manager's Meetings.

6.1.2 BRAC Partnering Team

The Partnering Team is a structured approach for SOUTHDIV, NAS Key West Public Works, the SOUTHDIV contractor, FDEP, and EPA Region IV to work together in the interest of a project. For the BRAC SSI, the Partnering Team met to determine the DQOs for the project. The role of the Partnering Team is to come to consensus on the pertinent decisions for the project prior to the execution of the investigation. The Partnering Team will continue to review decisions for the project until the final report is completed.

6.1.3 TtNUS Task Order Manager

The Task Order Manager (TOM) for the SSI is responsible for evaluating the appropriateness and TOM adequacy of the technical and engineering services provided. He/she is responsible for financial and schedule management and for ensuring that the project fulfills and remains within the contracted scope of work. He/she will be responsible for identifying necessary changes in the scope of work during Project Manager's Meetings. The TOM is also responsible for the daily conduct of work, including integration of input from supporting disciplines and subcontractors, and will serve as the primary project contact.

6.1.4 BRAC Planning Team

The BRAC Planning Team is a subgroup of the BRAC Partnering Team made up primarily of the Navy and its contractors. The Planning Team is often tasked with the action items of the Partnering Team or the DQO issues of the investigation.

6.1.5 TtNUS QA Manager

The TOM and FOL are supported by a QA Manager who will report to the Program Manager (PM). The QA Manager will oversee the implementation of appropriate NFESC and EPA protocols. The QA Manager will also work with the TOM to establish QC procedures.

6.1.6 TtNUS Health and Safety Manager

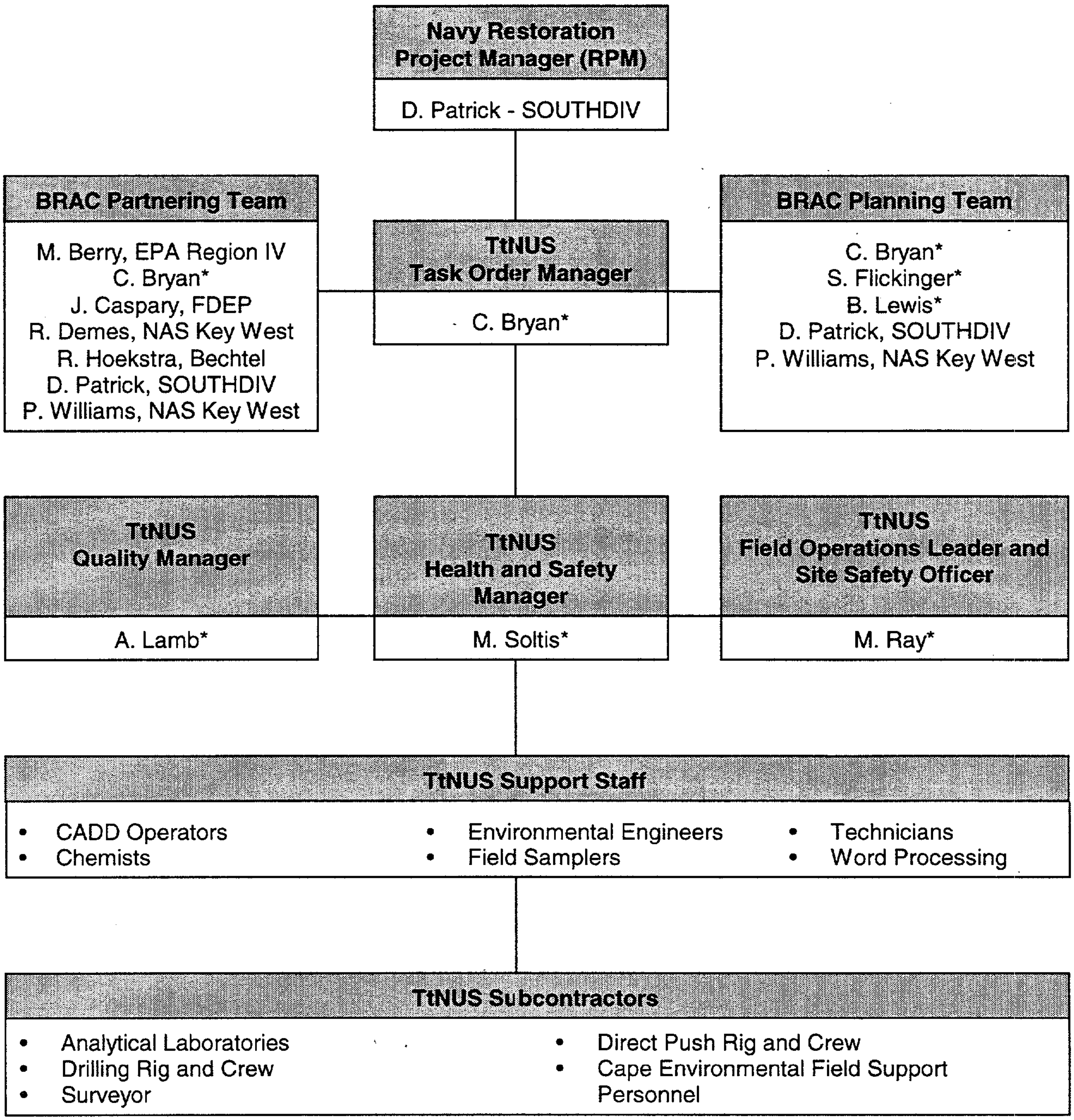
The TOM and FOL are supported by the Health and Safety Manager (HSM) who will report to the Project Manager. The HSM will oversee the implementation of the appropriate corporate health and safety requirements and the CLEAN Program HASP.

6.1.7 TtNUS Field Operations Leader

The FOL is responsible for the field support staff and subcontractors executing the SSI SAP in the field. The FOL will be the field liaison between SOUTHDIV and the NAS Key West point of contact. The FOL will also act as the Site Safety Officer.

6.1.8 Site Safety Officer

The Site Safety Officer is responsible for field support staff and subcontractor compliance with corporate health and safety requirements and the CLEAN program HASP. Conformance with safety protocols will be assessed though periodic site visits and daily supervision by the FOL. For this project, the FOL will act in this role.



* Personnel employed by TtNUS.

FIGURE 6-1. PROJECT ORGANIZATION CHART – NAS KEY WEST BASE REALIGNMENT AND CLOSURE SITE INVESTIGATION

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Appendix A

Response to Comments

APPENDIX A. RESPONSE TO COMMENTS

Note: Responses to comments on Rev. 1 will be included in Rev. 2.

Appendix B

Health and Safety Plan

Health and Safety Plan
for
CERCLA Remedial Investigation

Naval Air Station Key West
Key West, Florida

Southern Division
Naval Facilities Engineering Command
Contract No. N62467-94-D-0888
Contract Task Order 0032

July 1998

HEALTH AND SAFETY PLAN
FOR
CERCLA REMEDIAL INVESTIGATION
AT
NAVAL AIR STATION KEY WEST
KEY WEST, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Brown & Root Environmental
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NO. N62467-94-D-0888
CONTRACT TASK ORDER 0032

JULY 1998

SUBMITTED BY:

CHUCK BRYAN
TASK ORDER MANAGER
BROWN & ROOT ENVIRONMENTAL
AIKEN, SOUTH CAROLINA

APPROVED BY:

MATTHEW M. SOLTIS, CIH, CSP
CLEAN HEALTH & SAFETY MANAGER
BROWN & ROOT ENVIRONMENTAL
PITTSBURGH, PENNSYLVANIA

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1.0 INTRODUCTION

The objective of this Health and Safety Plan (HASP) is to provide the minimum safety practices and procedures for Brown & Root Environmental (B&R Environmental) personnel conducting various CERCLA Remedial Investigation (RI) activities at the Naval Air Station (NAS) Key West, located in Key West, Florida. Specifically, the following activities will be conducted within the Truman Annex of NAS Key West:

- A Focused RI within Zone E at Buildings 102, 103, and 104
- Support of an Interim Remedial Action (IRA) at Zones C and D
- Field Investigation in support of the RI at five subzones within Zones C, D and F

This HASP has been designed to be used in conjunction with the Brown & Root Environmental Health and Safety Guidance Manual. The Guidance Manual provides detailed information pertaining to procedures to be performed on site as directed by the HASP, as well as B&R Environmental standard operating procedures. This HASP and the contents of the Guidance Manual were developed to comply with the requirements stipulated in 29 CFR 1910.120 (OSHA's Hazardous Waste Operations and Emergency Response Standard). It is recommended that both documents be present at the site to satisfy these requirements.

This HASP has been written to support proposed tasks and techniques associated with the scope of work as presented in Section 4.0. It has been developed using the latest available information regarding known or suspected chemical contaminants and potential physical hazards associated with the proposed work at the site. Should the proposed work site conditions and/or suspected hazards change, or if new information becomes available, this document will be modified. All changes to the HASP will be made with the approval of the B&R Environmental Site Safety Officer (SSO) and the B&R Environmental Health and Safety Manager (HSM). Requests for modifications to the HASP will be directed to the SSO who will determine whether to make the changes. The SSO will notify the Task Order Manager (TOM), who will notify all affected personnel of changes.

1.1 AUTHORITY

This work is authorized under the Comprehensive Long - Term Environmental Action Navy (CLEAN) contract, administered through the U.S. Navy Southern Division Naval Facilities Engineering Command, as defined under Contract No. N62467-94-D-0888; Contract Task Order Number 0032.

1.2 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibilities for site safety and health for B&R Environmental and subcontractor employees conducting environmental sampling and other field activities. Personnel assigned to these positions shall exercise the primary responsibility for all on site health and safety. These persons will be the primary point of contact for any questions regarding the safety and health procedures and the selected control measures.

- The B&R Environmental TOM is responsible for the overall direction and implementation of health and safety for this work.

- The B&R Environmental Field Operations Leader (FOL) is responsible for implementation of this HASP. The FOL manages field activities, executes the work plan, and enforces safety procedures as applicable to the work plan. Specifically, the FOL will:

  - Verify training and medical status of on-site personnel in relation to site activities.
  - Assist and represent B&R Environmental with emergency services (if needed)
  - Provide elements site-specific training for all on site personnel.

- The B&R Environmental Site Safety Officer or their representative supports the FOL concerning all aspects of health and safety including, but not limited to:

  - Coordinating all health and safety activities
  - Selecting, applying, inspecting, and maintaining personal protective equipment
  - Establishing work zones and control points
  - Implementing air monitoring procedures
  - Implementing hazard communication, respiratory protection, and other associated safety and health programs
  - Coordinating emergency services
  - Providing elements of site-specific training

- Compliance with these requirements is monitored by the Project Health and Safety Officer (PHSO) and is coordinated through the HSM.

1.3 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: Naval Air Station (NAS) Key West **Address:** Key West, Florida

Site Point of Contact: Mr. Phillip Williams **Phone Number:** (305)293-2061

Purpose of Site Visit: B&R Environmental will conduct various environmental sampling and field activities under this CERCLA Remedial Investigation. See Sections 3.0 and 4.0 for details concerning the site background and scope of work.

Proposed Dates of Work: July - September 1998

Project Team:

B&R Environmental Personnel:	Discipline/Tasks Assigned:
Chuck Bryan	Task Order Manager (TOM)
Marty Ray	Field Operations Leader (FOL)
Matthew M. Soltis, CIH, CSP	Health and Safety Manager (HSM)
Delwyn E. Kubeldis, CIH, CSP	Project Health and Safety Officer (PHSO)
Emily Harrison, Rich Davis, Steve Jackson, Paul Halverson, Skip Valiancourt, Glenn Colvin	Sampler
Marty Ray	Site Safety Officer (SSO)
To be determined	Surveyor

Subcontractor Personnel:	Discipline/Tasks Assigned:
TEG Southeast (Delineation Sampling)	Direct Push Technology Subcontractor
Precision Sampling (SSI Sampling)	Direct Push Technology Subcontractor
John Webster	Geologist
Jamie Sayer	Sampler

Prepared by: Delwyn E. Kubeldis, CIH, CSP

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2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a preplanning effort to direct and guide field personnel in the event of an emergency. However, given the nature of the work planned significant emergencies are not anticipated. Also, since a majority of potential emergency situations will require assistance from outside emergency responders, B&R Environmental personnel will not provide emergency response support for emergency events beyond the capabilities of on site personnel. In the event of emergencies that cannot be handled by personnel, an evacuation will be initiated. In an evacuation, site personnel will move to a safe place of refuge and the appropriate emergency response agencies will be notified. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of operations, which ensures adequate emergency response time. This emergency action plan conforms to the requirements of OSHA Standard 29 CFR 1910.38(a), as allowed in OSHA 29 CFR 1910.120(l)(1)(ii).

B&R Environmental personnel will, through the necessary actions, provide incidental response measures for incidents such as:

- Incipient Fire and spill prevention and response
- Removal of personnel from emergency situations
- Provision of initial medical support for injury/illnesses requiring only first-aid level support
- Provision of site control and security measures, as necessary

2.2 PRE-EMERGENCY PLANNING

Through the initial hazard/risk assessment effort, there is very minor potential for injury or illnesses resulting from exposure to chemical, physical, or other hazards, and subsequently little likelihood of emergency situations. To further minimize or eliminate potential emergency situations, pre-emergency planning activities associated with this project shall be implemented. The FOL is responsible for:

- Coordinating response actions with NAS Key West Emergency Services personnel to ensure that B&R Environmental emergency action activities are compatible with existing facility emergency response procedures.

- Identifying a chain of command for emergency action.

- Educating site workers to the hazards and control measures associated with planned activities at the site, and providing early recognition and prevention, where possible.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 Recognition

Foreseeable emergency situations that may be encountered during site activities will generally be recognizable by visual observation. Visual observation will be the principal method of identifying any hazards that may be associated with the proposed scope of work. These potential hazards, the activities with which they have been associated, and the recommended control methods are discussed in detail in Sections 5.0 and 6.0 of this document.

2.3.2 Prevention

B&R Environmental personnel will minimize the potential for emergencies by ensuring compliance with the HASP, the Health and Safety Guidance Manual, applicable OSHA regulations, and by following directions given by those persons responsible for the health, safety, and welfare of personnel.

2.4 SAFE DISTANCES AND PLACES OF REFUGE

In the event that the site must be evacuated, all personnel will immediately stop activities and report to a pre-determined safe place of refuge. The safe place of refuge may also serve as the telephone communication point, as communication with emergency response agencies may be necessary. Telephone communication points and safe places of refuge will be determined prior to the commencement of site activities and will be conveyed to personnel as part pre-site training. Upon reporting to the refuge location, personnel will remain there until directed otherwise by the

TABLE 2-1.

**EMERGENCY REFERENCE
NAS KEY WEST
KEY WEST, FLORIDA**

AGENCY	TELEPHONE
Key West Police/Rescue Services	911 or (305) 293-2971
NAS Key West Point of Contact Phillip Williams	(305)293-2016
Base Police	(305)293-2114
Base Fire Department Boca Chica	(305)293-3333
Hospital: Lower Florida Keys Health System	(305)294-5531
Base Officer of the Day (OOD)	(305)293-2971
Chemtrec National Response Center	(800)424-9300 (800)424-8802
Project Specific Contacts:	
B&R Environmental, Aiken Office	(800)368-5497
Task Order Manager Chuck Bryan	(803)649-7963 x345
Field Operations Leader/Site Safety Officer Marty Ray	(803)649-7963 x340
B&R Environmental, Pittsburgh Office	(800)245-2730
Health and Safety Manager Matthew M. Soltis, CIH, CSP	(412)921-8912
Project Health and Safety Officer Delwyn E. Kubeldis, CIH, CSP	(412)921-8529

B&R Environmental FOL or the On-Scene Incident Commander. The FOL will take a head count at this location to confirm the presence of all site personnel. Emergency response agencies will be notified of any unaccounted for personnel.

2.5 EVACUATION ROUTES AND PROCEDURES

Once an evacuation is initiated, personnel will terminate site activities and proceed immediately to the designated place of refuge, unless doing so would further jeopardize the welfare of workers. In such an event, personnel will proceed to a designated alternate location and remain there until further notification from the FOL. The use of these locations as assembly points provides communication and a direction point for emergency services, should they be needed.

2.6 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

Since B&R Environmental personnel will be working in close proximity to each other, voice commands will comprise the mechanisms to alert site personnel of an emergency. If an incident occurs, site personnel will initiate the following procedures:

- Initiate incident alerting procedures (if needed) verbally.
- Describe to the FOL (who will serve as the Incident Coordinator) what has occurred and provide as many details as possible.
- If the FOL determines that the situation is beyond the capabilities of the site personnel emergency services will be contact using the emergency reference information listed in Table 2-1. Explain the situation and the appropriate emergency services will be dispatched. **Stay on the phone and follow the instructions of the emergency contact.**

2.7 EMERGENCY CONTACTS

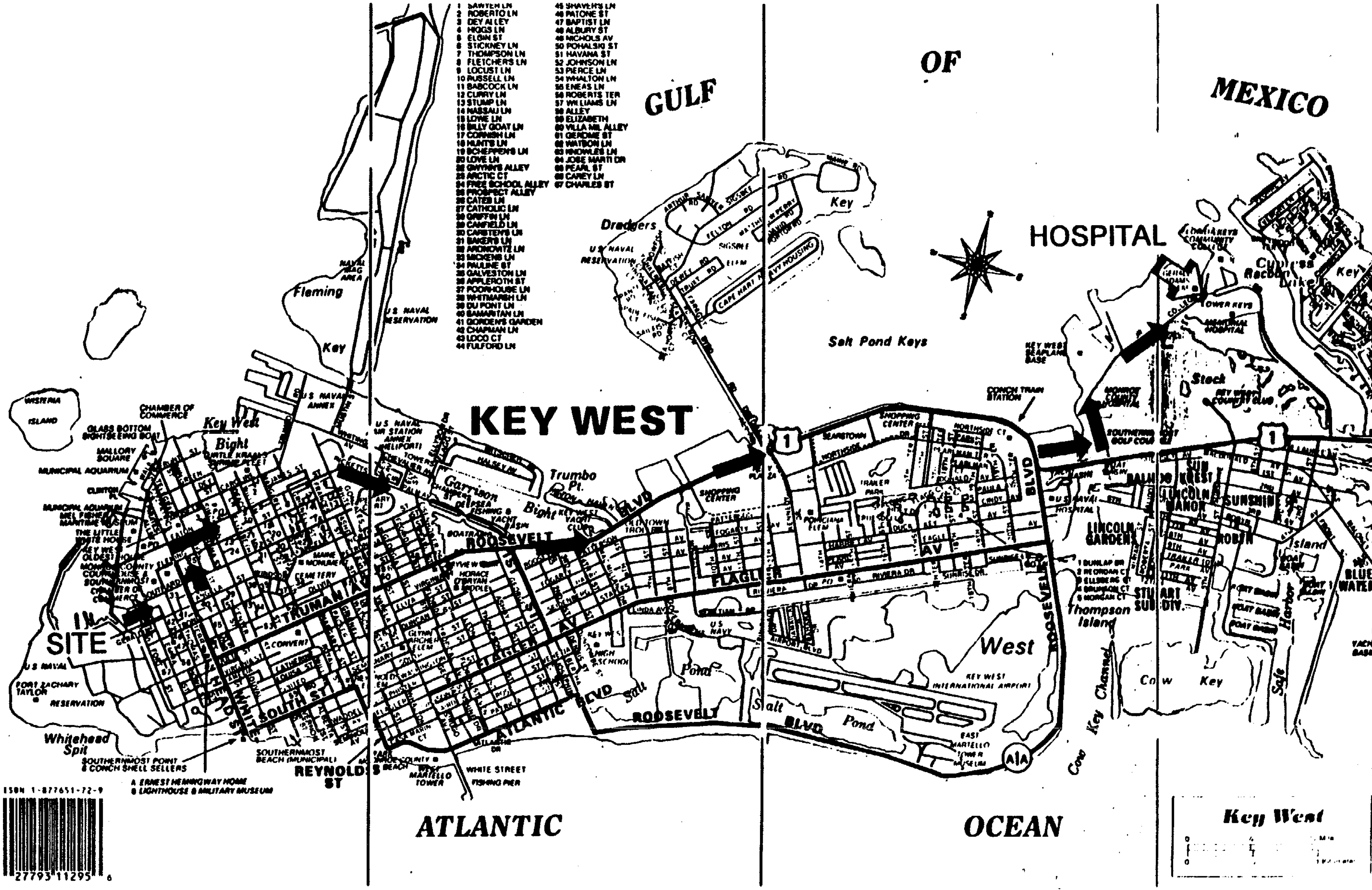
Prior to performing work at the site, all personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an accident. As indicated earlier, Table 2-1 provides a list of emergency contacts and their corresponding telephone numbers. This table will be made readily available to all site personnel.

2.8 EMERGENCY ROUTE TO HOSPITAL

The closest hospital to NAS Key West is Lower Florida Keys Health System. An area map showing the proximity of NAS Key West to the hospital is incorporated into this HASP as Figure 2-1. Directions are as follows:

From TRUMAN ANNEX, use the SOUTHARD STREET GATE EXIT and proceed 2 blocks to WHITEHEAD STREET. Turn LEFT and proceed 2 blocks to EATON STREET. Turn RIGHT and proceed to ROOSEVELT BOULEVARD (U.S. 1). Turn LEFT and proceed off island of Key West to first traffic light at JUNIOR COLLEGE ROAD. Turn LEFT and proceed on JUNIOR COLLEGE ROAD and you will see HOSPITAL SIGN. Follow road to HOSPITAL which will be on the RIGHT. Hospital is located at 5900 COLLEGE ROAD ON STOCK ISLAND.

FIGURE 2-1. LOWER FLORIDA KEYS HEALTH SYSTEM HOSPITAL



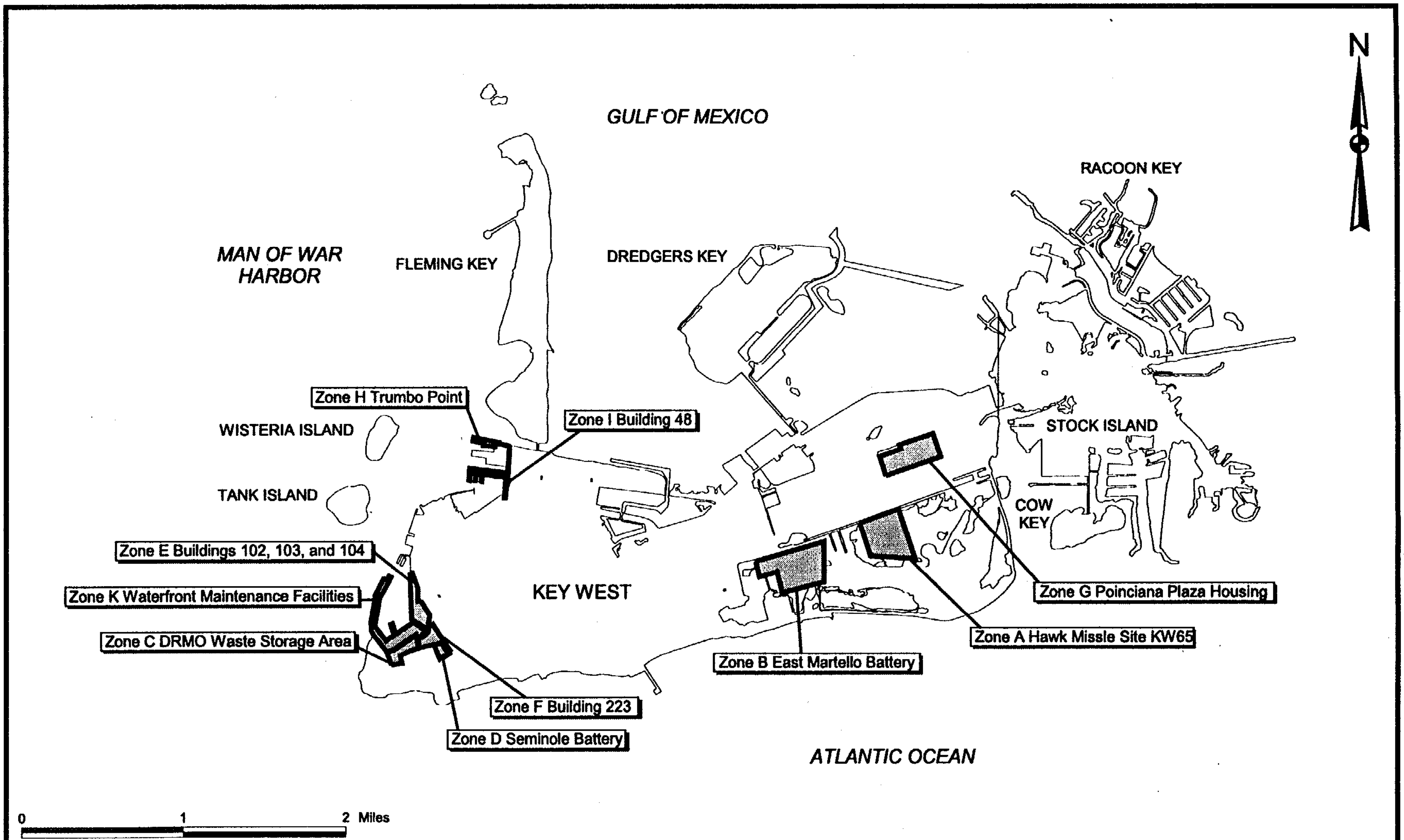
3.0 SITE BACKGROUND

NAS Key West is in southern Monroe County, Florida. The U.S. Navy manages 6,323 acres of land divided into twenty separate tracts in the lower Florida Keys, concentrated around Key West and Boca Chica Key (see Figure 2-1 of the Work Plan). The Naval Station at Key West was disestablished in 1974, resulting in the relocation of several units. At present, NAS Key West is proceeding with realignment of aviation operations, a research laboratory, communications intelligence, counternarcotics air surveillance operations, a weather service, and several other activities on Key West. In addition to the Naval activities and units, other DOD and Federal agencies at NAS Key West include the U.S. Air Force, U.S. Army, and U.S. Coast Guard.

Several installations in various parts of the lower Florida Keys comprise the Naval Complex at Key West. Most of these are on Key West and Boca Chica Key. Key West, one of the two westernmost major islands of the Florida Keys, is approximately 150 miles southwest of Miami and 90 miles north of Havana, Cuba. Key West connects to the mainland by the Overseas Highway (U.S. Highway No. 1). The topography at the NAS Key West is generally flat.

3.1 STUDY SITES

On NAS Key West proper, there have been various properties included in the BRAC program and which are the subject of this CERCLA RI. The portions of the BRAC properties (which may encompass the entire property or small portions of a contiguous property) are known as BRAC Zones. All Zones to be addressed within the scope of this HASP are in the Truman Annex area of NAS Key West. Specifically, the Truman Annex BRAC properties included are Zone C (Defense Reutilization and Marketing Office [DRMO] Waste Storage Area); Zone D (Seminole Battery); Zone E (Buildings 102, 103, and 104); and Zone F (Building 223). These Truman Annex BRAC Zones make up a contiguous land parcel on the southwest end of Key West. The area is flat terrain that slopes gently to the southwest. A discussion of each of these Zones follows.



DRAWN BY TMH — DATE 12-AUG-98		HEALTH AND SAFETY PLAN FOR CERCLA REMEDIAL INVESTIGATION FIGURE 3-1. BRAC ZONE LOCATION MAP NAVY SOUTHERN DIVISION KEY WEST, FLORIDA	CONTRACT NUMBER 7593
CHECKED BY — DATE			APPROVED BY — DATE
COST/SCHEDULE-AREA			APPROVED BY — DATE
SCALE APPROXIMATE SCALE AS NOTED			DRAWING NO. — REV 1

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3.1.1 Zone C (DRMO Waste Storage Area)

This Zone includes Buildings 795, 284 and 261 and two large storage areas that house DRMO. DRMO receives excess government materials. In the recent past, Building 261 stored hazardous materials. Buildings 284 and 795 stored inert material. A cleared area in front of Building 795, known as IR 2, has been investigated for PCB contamination under the Navy's Installation Restoration Program. The PCBs were the result of PCB contaminated oil used for dust suppression in the area. The investigation recommended that no further action be taken based on sampling and risk assessment results. The two large storage areas have primarily stored metal debris. In addition motors, vehicles, boats, refugee debris and fuel trucks have been stored in those areas (B&RE 1997a,b). Currently, there is metal debris including some machinery with motors present (B&RE 1997c). A review of historic maps indicates that oil racks were present within the storage areas during the 1940s and 1950s (USN-NAS 1942, 1957).

3.1.2 Zone D (Seminole Battery)

Zone D includes the Seminole Battery and an adjacent area known to include a fueling area and grease rack that operated in the 1940s and 1950s. The battery was constructed during the Civil War and a modern battery addition was added to the existing structure in the 1950s. The addition was similar in construction to the East Martello Battery. Both structures are currently unused and entry is restricted. The materials used while the batteries were in operation are unknown. The old portion of the battery has the remnants of a generator exhaust system (USN-NAS 1996a).

The former fueling area is known as 248 Tanks A&B, and is located to the west of Seminole Battery. The fueling island and the tanks were removed in August 1995. The area is now covered in asphalt. The UST Closure Report recommends a study of groundwater in the area. To the northeast of the 248 Tanks A&B site concrete slabs are present from former grease racks used to lubricate and service vehicles. No visible stains are present on the slabs (USN-NAS 1957a).

3.1.3 Zone E (Buildings 102, 103, and 104)

Zone E includes the waterfront property around Buildings 102, 103, and 104, and includes the area known as the Inner Mole Pier. The area has served as a naval docking and support facility for over a century. Building 102 (former Torpedo Overhaul and Storehouse), Building 103 (former Central Power Plant), and Building 104 (former Battery Overhaul and Storage) are out of service. Knowledge of the operations in the buildings are limited to activities supporting naval submarines. Hazardous materials believed to have been used in each of the buildings include volatiles, semivolatiles, and inorganics. PCBs are known to have been present in transformers at Building 103 (B&RE 1997d). In the mid 1980s, these transformers were removed from the building. A petroleum Contamination Assessment Report (CAR) was prepared for the area around the three buildings. The CAR recommended the preparation of a Remedial Action Plan (RAP) that was approved in April 1995 by the Florida Department of Environmental Protection (FDEP) (USN-NFEC 1994a).

Building 189 (former Liquor Store) is adjacent to an area discovered to have been impacted by a petroleum leak from an underground pipeline that serviced the docks. The pipeline enters the Zone from Eaton Street and runs along the waterfront across Zone E and Zone K ending on Outer Mole Pier. A petroleum CAR was prepared for the area north of Building 189. The CAR recommended the preparation of a RAP that was approved in November 1995 by FDEP (USN-NFEC 1994b).

Former Building 136 (Shipfitter's Shop and prior to 1951 the Plate and Mold Shop) was demolished and the debris was buried in and around the building's footprint. According to base personnel the debris in the area was later removed for disposal and is believed to have failed TCLP testing for lead. The area around the former Building 136 is currently level-graded crushed limestone. Other former buildings in the Zone that have been razed according to the draft EBS (USN-NAS 1996a) include the following:

- 26 - Cistern (distilled water)
- 59 - Storehouse
- 60 - Boiler Shop
- 79 - Electrical Shop
- 100 - Cold Storage
- 101 - Submarine General Shops and Offices
- 115 - Diesel Oil Storage Tank
- 116 - Steam Plant
- 117 - Fuel Oil Storage
- 118 - Battery Water Storage Tank
- 122 - Fire Station
- 123 - Public Works Maintenance Office, Garage and Shops
- 136 - Shipfitter's Shop and former Plate and Mold Shop (pre 1951)
- 147 - Sound School Shop and Laboratory
- 148 - Fresh Water Tank
- 156 - Submarine Storage Shed
- 157 - Equipment Shed
- 160 - Ordnance Warehouse former Anti-Aircraft Trainer (pre 1951)
- 168 - Storage Building
- 169 - General Storage

- 171 - Storehouse
- 172 - WAVE Officers' Quarters
- 173 - WAVE Officers' Quarters
- 174 - Cistern

3.1.4 Zone F (Building 223)

Building 223 (Equipment Repair Shop) is currently used as storage for Port Services. Little is known about the activities in the building; however, from the name of the building it can be inferred that naval support equipment was repaired at the building. A closed hazardous waste storage area is present to the south of Building 223. Building 1287 is a closed galley facility that operated during the 1960s. Building 1287 was supported by an aboveground storage tank (AST) that has been removed. In June 1997, sampling of soil and groundwater was conducted to prepare a petroleum CAR on the site. Adjacent to Building 1287 was a motor pool area that operated during the 1950s (B&RE 1996).

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4.0 SCOPE OF WORK

This section of the HASP addresses all proposed site activities that are to be conducted while performing the CERCLA RI. The activities will be performed to identify the nature and extent of actual or potential site contamination. The investigative methods and activities to be conducted include, but may not be limited to:

- Mobilization/demobilization
- Soil borings (using Direct Push Technology [DPT] and hollow stem augers)
- Monitoring well installation (temporary and permanent)
- Monitoring well development and purging
- Multi-media sampling:
  - Surface and subsurface soils
  - Groundwater
  - Investigation derived waste (IDW), if necessary
- Miscellaneous activities, including cleaning of sump pits and concrete debris removal
- Decontamination of sampling and heavy equipment
- Sample, geophysical, and well location surveys
- IDW management

The above listing represents a summarization of the tasks as they apply to the scope and application of this HASP. For more detailed description of the associated tasks, refer to the Sampling and Analysis Plan (SAP) and/or the Work Plan (WP). Any tasks to be conducted outside of the elements listed here will be considered a change in scope requiring modification of this document. All requested modifications to this document will be submitted to the HSM by the TOM or a designated representative.

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5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION

Table 5-1 of this section lists the anticipated hazards, recommended control measures, monitoring recommendations, required Personal Protective Equipment (PPE), and decontamination measures for each site task. Through using the table, the FOL and SSO can determine which hazards are associated with each task and what associated control measures are necessary to minimize exposure or injuries related to those hazards. This table also assists the FOL and SSO in determining which PPE and decontamination procedures to use based on proper air monitoring techniques and project-specific conditions. This information can then be transposed to the Safe Work Permit (Section 9.4) for directing field crews within those specific duties. This table and the associated control measures will be changed if the scope of work, contaminants of concern, or other conditions change.

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TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR NAVAL AIR STATION KEY WEST, KEY WEST, FLORIDA PAGE 1 OF 6

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Soil borings and installation of monitoring wells. (using Direct Push Technology and Hollow Stem Augers)	*Chemical Hazards* 1) Air/particulate/water borne contaminants including SVOCs (primarily benzo(a)pyrene), pesticides (primarily DDT, DDE, and DDD), PCBs (e.g., Aroclor-1260) and metals (primarily arsenic, lead, and antimony). Except for lead at Parcel C, none of the contaminants are expected to be present in significant concentrations to present an inhalation hazard during planned site activities. Personnel exposure is most likely to occur through inhalation of airborne particulate matter containing these compounds, or through ingestion of contaminated soil or water by hand-to-mouth contact during soil disturbance activities. Hazardous concentrations of carbon monoxide or nitrogen dioxide may be generated while operating equipment within buildings. Further information on all potential site contaminants is presented in Table 6-1. 2) Transfer of contamination into clean areas or onto persons *Physical hazards* 3) Contact/entanglement with rotating equipment or machinery 4) Noise 5) Energized systems 6) Lifting 7) Natural Hazards (insect/animal bites and stings) 8) Inclement weather 9) Confined Space Entry Hazards	1) Although not likely to be present in significant concentrations to present an inhalation hazard, screening for VOCs will be performed using real-time monitoring instrumentation. During operations within buildings, ventilation and air movement through work areas will be increased to aid in removing equipment exhaust gases. If possible, external venting of exhaust gases from the drill rig (or other internal combustion equipment) via flexible tubing to roof vents or windows will be used. If equipment is operated indoors for extended periods of time (e.g., greater than 30 minutes), the level of carbon monoxide (gasoline-powered equipment) or nitrogen dioxide (diesel-powered equipment) will be monitored using portable instruments. Also, generation of dusts should be minimized to the greatest extent possible to avoid exposure to particulates. If airborne dusts are observed, area wetting methods will be used to reduce the generation of dusts created during drilling activities. If area wetting methods are not feasible, upgraded levels of protection or termination of activities will be used to minimize exposure to observed airborne dusts. 2) Decontaminate all equipment and supplies between boreholes and prior to leaving the site. 3) All equipment to be used will be - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturers design and documented as such using the Equipment Record Sheet (See Section 10.0 of the B&R Environmental health and Safety Guidance Manual). - Operated by knowledgeable operators and ground crew. - Used within establish safe zones and routes of approach - Only manufacturer approved equipment may be used in conjunction with equipment (e.g., auger pins). In addition, the following safe operating procedures will be incorporated: - All personnel not directly supporting this operation will remain at least 25 feet from the point of operation. - Drilling, drill masts, or other projecting devices shall be at least 20 feet from overhead power sources and a minimum of 3 feet from underground utilities. - Hand signals will be established prior to the commencement of the operation. - The driller and helper can simultaneously handle moving augers or flights only when there is a standby person to activate the emergency stop device. - Only manufacturer approved equipment may be used in conjunction with equipment repair procedures (e.g., auger pins). - Work areas will be kept clear of clutter. - Secure all loose articles to avoid possible entanglement. - All equipment shall be equipped with movement warning systems. - All personnel working in high equipment traffic areas are required to wear reflective vests for high visibility, and to establish unimpeded work areas around the operation. This activity may require areas of the building to be cordoned off during this operation. - All personnel will be instructed in the location and operations of the emergency shut off device(s). This device will be tested initially (and then periodically) to insure its operational status. - Areas will be inspected prior to the movement of drilling and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. - Drill rigs and support vehicles will be moved no closer than 3 feet to floor openings, sidewalls, and excavations. 4) Hearing protection will be used during all subsurface activities. 5) All utility clearances shall be obtained prior to subsurface activities. Prior to any subsurface investigations, the locations of all underground utilities will be identified and marked. 6) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 7) Avoid nesting areas, employ repellents. Report potential hazards to the SSO. 8) Suspend or terminate operations until directed otherwise by SSO 9) Sump pits that are to be entered will be treated as permit required confined spaces until proven otherwise. Operations will be performed consistent with the requirements of the B&R Environmental Confined Space Entry Program (Attachment A of this HASP). The SSO will be responsible for performing confined space monitoring and completing confined space permits.	**It is anticipated that potential contaminant concentrations at outdoor locations will be below levels that could present a health hazard. Concentrations of carbon monoxide and nitrogen dioxide inside buildings, however, may reach hazardous levels depending on the duration of equipment use and other factors.** Although VOCs are not anticipated to be present in significant quantities to represent an inhalation hazard, a Photoionization Detector w/ 10.6 eV UV lamp source or a Flame Ionization Detector will be used to screen for VOCs. The following guidance applies: Source (e.g., borehole) monitoring will be conducted at regular intervals determined by the SSO. The SSO will also monitor the breathing zone (BZ) of all potentially affected employees. Workers must evacuate to a safe area if sustained BZ concentrations exceed 10 ppm. Many of the contaminants of concern are solids, and are non-detectable using PID/FID direct reading instruments. Also, other site contaminants may adhere to or be part of airborne dusts or particulates generated during site activities. At Parcel C, significant concentrations of lead were detected in the soil to potentially present an inhalation hazard. Generation of dusts at all Parcels, and particularly Parcel C, should be minimized to the greatest extent possible to avoid inhalation of contaminated dusts or particulates. Evaluation of dust concentrations will be qualitative by observing work conditions for visible dust clouds or accumulations. Potential exposure to contaminants attached to dust particles will be controlled by using water to suppress dusts or by avoiding dust plumes. When working in Parcel C, upgrade to Level C protection shall occur anytime sustained visible dust is present in a worker's BZ and termination of activities or otherwise controlling dust are not options. When operating equipment the SSO will also monitor the BZ of all workers potentially exposed to carbon monoxide or nitrogen dioxide (depending on the type of equipment), with the following guidance: - Workers must evacuate to a safe area if sustained BZ concentrations of carbon monoxide exceed 25 ppm averaged over a 5 minute period. OR - Workers must evacuate to a safe area if sustained BZ concentrations of nitrogen dioxide exceed 3 ppm averaged over a 5 minute period. Where the utility clearance cannot be obtained in a reasonable period, or not located, intrusive activities shall proceed with extreme caution using a magnetometer for periodic downhole surveys every 2 feet to a depth of at least 6 feet.	All subsurface operations are to be initiated in Level D protection. Level D protection constitutes the following minimum protection - Standard field attire (sleeved shirt; long pants) - Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential exists for soiling work attire. - Nitrile gloves or leather gloves with surgical style inner gloves - Safety shoes (Steel toe/shank) - Safety glasses - Hardhat - Reflective vest for high traffic areas - Hearing protection for high noise areas, as directed by the SSO. **Level C (at Parcel C only)** Upgrade to Level C protection may be necessary as discussed under Hazard Monitoring if excessive dust is observed in worker BZs at Parcel C, including: - full-face Air-Purifying Respirator (APR) with a High Efficiency Particulate Air (HEPA) filter. - Standard field attire (long sleeve shirt; long pants) - Tyvek coveralls and disposable boot covers. Note: PVC splash suit and impermeable boot covers required if a potential exists for contact with free product. Personnel must closely inspect all PPE prior to beginning any on-site activities. - Nitrile gloves or leather gloves with surgical style inner gloves - Safety shoes (Steel toe/shank) - Hardhat (when overhead hazards exists, or identified as an operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, as directed by the SSO	**Personnel Decontamination** will consist of a soap/water wash and rinse for outer protective equipment (boots, gloves, PVC splash suits, etc.). This function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Soap/water wash and rinse of outer reusable boots and gloves **Note:** For PPE Level C, cartridge change out would take place at this point, if necessary. - Soap/water wash and rinse of the outer reusable splash suit, as applicable - Outer suit, boot covers, outer glove removal - Removal/disposal of non-reusable PPE (e.g., gloves) - Respiratory (face mask) protection removal - Wash hands and face, leave contamination reduction zone

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TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR NAVAL AIR STATION KEY WEST, KEY WEST, FLORIDA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Multi-media sampling including soils (surface and subsurface) and groundwater IDW sampling is included in this task	*Chemical Hazards* 1). SVOCs (primarily benzo(a)pyrene), pesticides (primarily DDT, DDE, and DDD), PCBs (e.g., Aroclor-1260) and metals (primarily arsenic, lead, and antimony). Except for lead at Parcel C, none of the contaminants are expected to be present in significant concentrations to present an inhalation hazard during planned site activities. Personnel exposure is most likely to occur through inhalation of airborne particulate matter containing these compounds, or through ingestion of contaminated soil or water by hand-to-mouth contact during soil disturbance activities. Further information on these contaminants is presented in Table 6-1. 2) Transfer of contamination into clean areas *Physical hazards* 3) Noise 4) Lifting (muscle strains and pulls) 5) Pinches and compressions 6) Slip, trips, and falls 7) Natural hazards (Insect/animal bites and stings) 8) Inclement weather	1) Although not likely to be present in significant concentrations to present an inhalation hazard, screening for VOCs will be performed using real-time monitoring instrumentation. Action levels and identified PPE will be used to control exposures to potentially contaminated media (air, water, soils, etc.). Generation of dusts should be minimized to the greatest extent possible. If airborne dusts are observed, area wetting methods will be used to reduce the generation of dusts created during drilling activities. If area wetting methods are not feasible, upgraded levels of protection or termination of activities will be used to minimize exposure to observed airborne dusts. 2) Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. 3) When sampling at the drilling rig use hearing protection. The use of hearing protection to protect against excessive noise outside of 25 feet from the point of operations should be incorporated under the following condition: Hearing protection during sample acquisition outside of the boring sample will be determine on a case by case scenario. As a general rule of thumb, if you have to raise your voice to talk to someone who is within 2 feet of your location, noise levels may becoming excessive. 4) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 5) Use pinch bars or other equipment to keep hands from the point of operation. 6) Preview work locations for unstable/uneven terrain.. 7) Avoid nesting areas, employ repellents. Report potential hazards to the SSO. 8) Suspend or terminate operations until directed otherwise by SSO	Monitoring instrumentation will be used as specified in the Sampling and Analyses Plan to bias samples. **It is anticipated that potential contaminant concentrations will be below levels that could present a health hazard.** Although VOCs are not anticipated to be present in significant quantities to represent an inhalation hazard, a Photoionization Detector w/ 10.6 eV UV lamp source or a Flame Ionization Detector will be used to screen for VOCs. The following guidance applies: Source (e.g., borehole) monitoring will be conducted at regular intervals determined by the SSO. The SSO will also monitor the breathing zone (BZ) of all potentially affected employees. Workers must evacuate to a safe area if sustained BZ concentrations exceed 10 ppm. Many of the contaminants of concern are solids, and are non-detectable using PID/FID direct reading instruments. Also, other site contaminants may adhere to or be part of airborne particulates generated during site activities. At Parcel C, significant concentrations of lead were detected in the soil to potentially present an inhalation hazard. Generation of dusts at all Parcels, and particularly Parcel C, should be minimized to the greatest extent possible to avoid inhalation of contaminated particulates. Evaluation of dust concentrations will be qualitative by observing work conditions for visible dust clouds or accumulations. Potential exposure to contaminants attached to dust particles will be controlled by using water to suppress dusts or by avoiding dust plumes. When working in Parcel C, upgrade to Level C protection shall occur anytime sustained visible dust is present in a worker's BZ and termination of activities or otherwise controlling dust are not options.	Level D protection will be utilized for the initiation of all sampling activities. Level D - (Minimum Requirements) - Standard field attire (sleeved shirt; long pants) - Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential for soiling work attire exists. - Nitrile gloves with surgical style inner gloves for soil and groundwater sampling - Safety shoes (steel toe/shank) - Safety glasses - Hardhat (when overhead hazards exists, or identified as a operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, or as directed on an operation by operation scenario. **Excessive chemical contaminant concentrations impacting field crews during this task are not anticipated. The following information is based on a contingency action only.** **Level C (at Parcel C only)** Upgrade to Level C protection may be necessary as discussed under Hazard Monitoring if excessive dust is observed in worker BZs at Parcel C, including: - full-face Air-Purifying Respirator (APR) with a High Efficiency Particulate Air (HEPA) filter. - Standard field attire (long sleeve shirt; long pants) - Tyvek coveralls and disposable boot covers. Note: PVC splash suit and impermeable boot covers required if a potential for splashes or contact with free product exists. Personnel must closely inspect all PPE prior to beginning any on-site activities. - Nitrile gloves or leather gloves with surgical style inner gloves - Safety shoes (Steel toe/shank) - Hardhat (when overhead hazards exists, or identified as an operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, as directed by the SSO.	**Personnel Decontamination** will consist of a soap/water wash and rinse for outer protective equipment (boots, gloves, PVC splash suits, etc.). Disposable PPE will be bagged between sampling events. This procedure will consist of - Sample acquisition - Clean (Deionized water spray) the outside of the sample containers/label/bag Decon will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Soap/water wash and rinse of outer boots and gloves **Note:** For PPE Level C, cartridge change out would take place at this point, if necessary. - Soap/water wash and rinse of the outer reusable splash suit, as applicable - Outer suit, boot covers, outer glove removal - Removal/disposal of non-reusable PPE (e.g., gloves) - Respiratory (face mask) protection removal - Wash hands and face, leave contamination reduction zone
Mobilization/ Demobilization	*Physical Hazards* 1) Lifting (muscle strains and pulls) 2) Pinches and compressions 3) Slip, trips, and falls 4) Moving machinery 5) Natural hazards (Insect/animal bites and stings) 6) Vehicular and foot traffic	1) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 2) Use pinch bars or other equipment if caught in the machine point of operation. 3) Preview work locations for unstable/uneven terrain. Barricade all excavations from access closer than two feet from the edge. 4) All equipment will be - Inspected in accordance with OSHA, and manufacturers design. - Operated by knowledgeable operators and ground crew. 5) Avoid nesting areas, use repellents. Report potential hazards to the SSO. 6) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom + 3 feet). - Secure all loose articles to avoid possible entanglement. - All equipment shall be equipped with movement warning systems. - Employ safety belts and follow the site traffic rules. Traffic patterns will be dictated supporting onsite activities. However, regulated patterns in and about the work zones will be established to safely control moving equipment, vehicles, and pedestrians.	Not required	Level D - (Minimum Requirements) - Standard field attire (sleeved shirt; long pants) - Safety shoes (Steel toe/shank) - *Safety glasses* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Reflective vest for high traffic areas* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.* *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Not required

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR NAVAL AIR STATION KEY WEST, KEY WEST, FLORIDA PAGE 3 OF 6

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Decontamination of Sampling and Heavy Equipment	*Chemical Hazards* 1) Air/particulate/water borne contaminants including SVOCs (primarily benzo(a)pyrene), pesticides (primarily DDT, DDE, and DDD), PCBs (e.g., Aroclor-1260) and metals (primarily arsenic, lead, and antimony). Except for lead at Parcel C, none of the contaminants are expected to be present in significant concentrations to present an inhalation hazard during planned site activities. Personnel exposure is most likely to occur through inhalation of airborne particulate matter containing these compounds, or through ingestion of contaminated soil or water by hand-to-mouth contact during soil disturbance activities. Further information on these contaminants is presented in Table 6-1. 2) Decontamination fluids - Liquinox (detergent), acetone or methanol, and hexane *Physical Hazards* 3) Lifting (muscle strains and pulls) 4) Inclement weather 5) Noise 6) Flying projectiles	1) and 2) Use protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Obtain manufacturer's MSDS for any decontamination solvents used onsite. Use appropriate PPE as identified on MSDS. 3) Use multiple persons where necessary for lifting and handling sampling equipment for decontamination purposes. 4) Suspend or terminate operations until directed otherwise by SSO 5) Use hearing protection when operating high pressure washer for extended periods of time (e.g., 30 minutes or longer). 6) Wear appropriate PPE (i.e., splash shield & safety glasses)	Use visual observation, and real-time monitoring instrumentation to ensure all equipment has been properly cleaned of contamination and dried.	*For Heavy Equipment* This applies to high pressure soap/water, steam cleaning wash and rinse procedures. Level D Minimum requirements - - Standard field attire (sleeved shirt; long pants) - Safety shoes (Steel toe/shank) - Chemical resistant boot covers - Nitrile outer gloves, cotton liners - PVC Rainsuits or PE or PVC coated Tyvek - Safety glasses underneath a splash shield - Ear plugs or ear muffs Respiratory protection is not anticipated for this activity. *For sampling equipment (trowels, MacroCore Samplers, bailers, etc.),* the following PPE is required Level D Minimum requirements - - Standard field attire (sleeved shirt; long pants) - Safety shoes (Steel toe/shank) - Nitrile outer gloves, cotton liners - Safety glasses underneath a splash shield In the event of overspray of chemical decontamination fluids employ PVC Rainsuits or PE or PVC coated Tyvek as necessary.	This decontamination procedure for **Level D** protection will consist of - Soap/water wash and rinse of outer reusable gloves - Soap/water wash and rinse of the outer reusable splash suit, as applicable - Removal/disposable of non-reusable PPE (e.g, gloves) - Wash hands and face, leave contamination reduction zone **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing steam or pressure washers. Heavy equipment, such as the drill rig will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. Roadways shall be cleared of any debris resulting from the onsite activity. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving onsite and that which is to leave the site. No equipment will be authorized access or exit without this authorization. Evaluation will consist of - Visual inspection - Scanning equipment with monitoring instruments **Equipment Decontamination -** Sampling equipment will be decontaminated as per the requirements in the Sampling and Analysis Plan and/or Work Plan. MSDS for any decon solutions (Alconox, isopropanol, etc.) will be obtained and used to determine proper handling / disposal methods and protective measures (PPE, first-aid, etc.).
Surveying	*Physical Hazards* 1) Slip, trips, and falls 2) Natural hazards (Insect/animal bites and stings) 3) Ambient temperature extremes (heat stress)	1) Preview work locations for unstable/uneven terrain. 2) Avoid nesting areas, use repellents. Report potential hazards to the SSO. 3) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold/heat stress concerns is provided in section 4 of the Brown & Root Environmental Health and Safety Guidance Manual.	Not required	Level D - (Minimum Requirements) - Standard field attire (sleeved shirt; long pants). Tuck pants into boots/socks and apply tape in grassy areas. - Safety shoes (Steel toe/shank) - *Snake chaps in grass areas* - *Safety glasses* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Reflective vest for high traffic areas* *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Not anticipated given nature of task.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR NAVAL AIR STATION KEY WEST, KEY WEST, FLORIDA PAGE 4 OF 6

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Monitoring well development and purging .	*Chemical Hazards* 1) Air/particulate/water borne contaminants including SVOCs (primarily benzo(a)pyrene), pesticides (primarily DDT, DDE, and DDD), PCBs (e.g., Aroclor-1260) and metals (primarily arsenic, lead, and antimony). Except for lead at Parcel C, none of the contaminants are expected to be present in significant concentrations to present an inhalation hazard during planned site activities. Personnel exposure is most likely to occur through inhalation of airborne particulate matter containing these compounds, or through ingestion of contaminated soil or water by hand-to-mouth contact during soil disturbance activities 2) Transfer of contamination into clean areas or onto persons *Physical hazards* 3) Pinch/compression points 4) Noise	1) Although not likely to be present in significant concentrations to present an inhalation hazard, screening for VOCs will be performed using real-time monitoring instrumentation. Action levels and identified PPE will be used to control exposures to potentially contaminated media (air, water, soils, etc.). Generation of dusts should be minimized to the greatest extent possible. If airborne dusts are observed, area wetting methods will be used to reduce the generation of dusts created during drilling activities. If area wetting methods are not feasible, upgraded levels of protection or termination of activities will be used to minimize exposure to observed airborne dusts. 2) Decontaminate all equipment and supplies between boreholes and prior to leaving the site. 3) All equipment to be used will be - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturers design. - Operated by knowledgeable operators and ground crew. - Used within establish safe zones and routes of approach - Only manufacturer approved equipment may be used in conjunction with equipment repair procedures (e.g., auger pins). In addition to equipment considerations, the safe operating procedures specified for the installation of monitoring wells task (page 1 of 5 of this table) must be observed during this task. 4) Hearing protection will be used during all subsurface activities until the SSO can quantify associated noise levels.	**It is anticipated that potential contaminant concentrations will be below levels that could present a health hazard.** Although VOCs are not anticipated to be present in significant quantities to represent an inhalation hazard, a Photoionization Detector w/ 10.6 eV UV lamp source or a Flame Ionization Detector will be used to screen for VOCs. The following guidance applies: Source (e.g., borehole) monitoring will be conducted at regular intervals determined by the SSO. The SSO will also monitor the breathing zone (BZ) of all potentially affected employees. Workers must evacuate to a safe area if sustained BZ concentrations exceed 10 ppm. Many of the contaminants of concern are solids, and are non-detectable using PID/FID direct reading instruments. Also, other site contaminants may adhere to or be part of airborne dusts or particulates generated during site activities. At Parcel C, significant concentrations of lead were detected in the soil to potentially present an inhalation hazard. Generation of dusts at all Parcels, and particularly Parcel C, should be minimized to the greatest extent possible to avoid inhalation of contaminated dusts or particulates. Evaluation of dust concentrations will be qualitative by observing work conditions for visible dust clouds or accumulations. Potential exposure to contaminants attached to dust particles will be controlled by using water to suppress dusts or by avoiding dust plumes. When working in Parcel C, upgrade to Level C protection shall occur anytime sustained visible dust is present in a worker's BZ and termination of activities or otherwise controlling dust are not options.	Level D protection will be utilized for the initiation of activities. Level D - (Minimum Requirements) - Standard field attire (sleeved shirt; long pants) - Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential for soiling work attire exists. - Nitrile gloves with surgical style inner gloves for soil and groundwater sampling - Safety shoes (steel toe/shank) - Safety glasses - Hardhat (when overhead hazards exists, or identified as a operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, or as directed on an operation by operation scenario. **Excessive contaminant concentrations impacting field crews during this task are not anticipated. The following information is based on a contingency action only.** **Level C (at Parcel C only)** Upgrade to Level C protection may be necessary as discussed under Hazard Monitoring if excessive dust is observed in worker BZs at Parcel C, including: - full-face Air-Purifying Respirator (APR) with a High Efficiency Particulate Air (HEPA) filter. - Standard field attire (long sleeve shirt; long pants) - Tyvek coveralls and disposable boot covers. Note: PVC splash suit and impermeable boot covers required if a potential for splashes or contact with free product exists. Personnel must closely inspect all PPE prior to beginning any on-site activities. - Nitrile gloves or leather gloves with surgical style inner gloves - Safety shoes (Steel toe/shank) - Hardhat (when overhead hazards exists, or identified as an operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, as directed by the SSO.	**Personnel Decontamination** will consist of a soap/water wash and rinse for outer protective equipment (boots, gloves, PVC splash suits, etc.). This function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Soap/water wash and rinse of outer boots and gloves **Note:** For PPE Level C, cartridge change out would take place at this point, if necessary. - Soap/water wash and rinse of the outer splash suit, as applicable - Outer suit, boot covers, outer glove removal - Respiratory (face mask) protection removal - Wash hands and face, leave contamination reduction zone

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR NAVAL AIR STATION KEY WEST, KEY WEST, FLORIDA PAGE 5 OF 6

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
IDW management and moving IDW drums to storage area	*Chemical Hazards* 1) Air/particulate/water borne contaminants including SVOCs (primarily benzo(a)pyrene), pesticides (primarily DDT, DDE, and DDD), PCBs (e.g., Aroclor-1260) and metals (primarily arsenic, lead, and antimony). Except for lead at Parcel C, none of the contaminants are expected to be present in significant concentrations to present an inhalation hazard during planned site activities. Personnel exposure is most likely to occur through inhalation of airborne particulate matter containing these compounds, or through ingestion of contaminated soil or water by hand-to-mouth contact during soil disturbance activities. Hazardous concentrations of carbon monoxide or nitrogen dioxide may be generated while operating equipment within buildings. Further information on all potential site contaminants is presented in Table 6-1. 2) Transfer of contamination into clean areas *Physical hazards* 3) Noise 4) Lifting (muscle strains and pulls) 5) Pinches and compressions 6) Slip, trips, and falls 7) Natural hazards (Insect/animal bites and stings) 8) Inclement weather	1) Although not likely to be present in significant concentrations to present an inhalation hazard, screening for VOCs will be performed using real-time monitoring instrumentation. During operations within buildings, ventilation and air movement through work areas will be increased to aid in removing equipment exhaust gases. If possible, external venting of exhaust gases from the drill rig (or other internal combustion equipment) via flexible tubing to roof vents or windows will be used. If equipment is operated indoors for extended periods of time (e.g., greater than 30 minutes), the level of carbon monoxide (gasoline-powered equipment) or nitrogen dioxide (diesel-powered equipment) will be monitored using portable instruments. Also, generation of dusts should be minimized to the greatest extent possible to avoid exposure to particulates. If airborne dusts are observed, area wetting methods will be used to reduce the generation of dusts created during drilling activities. If area wetting methods are not feasible, upgraded levels of protection or termination of activities will be used to minimize exposure to observed airborne dusts. 2) Decontaminate all equipment and supplies, if they become contaminated, between locations and prior to leaving the site. 3) When working near heavy equipment, use hearing protection. 4) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 5) Use pinch bars or other equipment to keep hands from the point of operation. 6) Preview work locations for unstable/uneven terrain. 7) Avoid nesting areas, employ repellents. Report potential hazards to the SSO. 8) Suspend or terminate operations until directed otherwise by SSO	**It is anticipated that potential contaminant**	Level D protection will be utilized for the initiation of all activities. Level D - (Minimum Requirements) - Standard field attire (sleeved shirt; long pants) - Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential for soiling work attire exists. - Nitrile gloves with surgical style inner gloves for soil and groundwater sampling - Safety shoes (steel toe/shank) - Safety glasses - Hardhat (when overhead hazards exists, or identified as a operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, or as directed on an operation by operation scenario. **Excessive chemical contaminant concentrations impacting field crews during this task are not anticipated. The following information is based on a contingency action only.** **Level C (at Parcel C only)** Upgrade to Level C protection may be necessary as discussed under Hazard Monitoring if excessive dust is observed in worker BZs at Parcel C, including: - full-face Air-Purifying Respirator (APR) with a High Efficiency Particulate Air (HEPA) filter. - Standard field attire (long sleeve shirt; long pants) - Tyvek coveralls and disposable boot covers. Note: PVC splash suit and impermeable boot covers required if a potential for splashes or contact with free product exists. Personnel must closely inspect all PPE prior to beginning any on-site activities. - Nitrile gloves or leather gloves with surgical style inner gloves - Safety shoes (Steel toe/shank) - Hardhat (when overhead hazards exists, or identified as an operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, as directed by the SSO.	**Personnel Decontamination** will consist of a soap/water wash and rinse for outer protective equipment (boots, gloves, PVC splash suits, etc.). This function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Soap/water wash and rinse of outer boots and gloves **Note:** For PPE Level C, cartridge change out would take place at this point, if necessary. - Soap/water wash and rinse of the outer splash suit, as applicable - Outer suit, boot covers, outer glove removal - Respiratory (face mask) protection removal - Wash hands and face, leave contamination reduction zone

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR NAVAL AIR STATION KEY WEST, KEY WEST, FLORIDA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Miscellaneous tasks, including cleaning of sump pits in Building 103 (prior to soil borings) and removal of concrete at Building 104.	*Chemical Hazards* 1) Air/particulate/water borne contaminants including SVOCs (represented as waste oils) and VOCs (represented as gasoline) present in sump pit liquids. Hazardous concentrations of carbon monoxide or nitrogen dioxide may be generated if operating equipment within buildings. Further information on all potential site contaminants is presented in Table 6-1. 2) Transfer of contamination into clean areas or onto persons *Physical hazards* 3) Contact/entanglement with rotating equipment or machinery 4) Noise 5) Energized systems 6) Lifting 7) Foot and equipment traffic 8) Inclement weather 9) Confined Space Entry Hazards 10) Pinch/compression points	1) Although not likely to be present in significant concentrations to present an inhalation hazard, screening for VOCs will be performed using real-time monitoring instrumentation. During operations within buildings, ventilation and air movement through work areas will be increased to aid in removing equipment exhaust gases. If possible, external venting of exhaust gases from vacuum truck (or other internal combustion equipment) via flexible tubing to roof vents or windows will be used. If equipment is operated indoors for extended periods of time (e.g., greater than 30 minutes), the level of carbon monoxide (gasoline-powered equipment) or nitrogen dioxide (diesel-powered equipment) will be monitored using instruments. 2) Decontaminate all equipment and supplies prior to leaving the site. 3) All equipment to be used will be - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturers design and documented as such using the Equipment Record Sheet (See Section 10.0 of the B&R Environmental Health and Safety Guidance Manual). - Operated by knowledgeable operators and ground crew. - Used within establish safe zones and routes of approach - Only manufacturer approved equipment may be used in conjunction with equipment. In addition, the following safe operating procedures will be incorporated: - All personnel not directly supporting this operation will remain at least 25 feet from the point of operation. - Excavator buckets or other projecting devices shall be at least 20 feet from overhead power sources and a minimum of 3 feet from underground utilities. - Hand signals will be established prior to the commencement of the operation. - Work areas will be kept clear of clutter. - Secure all loose articles to avoid possible entanglement. - All equipment shall be equipped with movement warning systems. - All personnel working in high equipment traffic areas are required to wear reflective vests for high visibility, and to establish unimpeded work areas around the operation. This activity may require areas of the building to be cordoned off during this operation. - All personnel will be instructed in the location and operations of the emergency shut off device(s) if available. This device will be tested initially (and then periodically) to insure its operational status. - Areas will be inspected prior to the movement of excavator and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. - Excavators, vacuum trucks, and support vehicles will be moved no closer than 3 feet to floor openings, sidewalls, and pits. 4) Excessive noise levels will be controlled through the use of hearing protection. Anticipated excessive noise level operations include the following: - Heavy equipment operation including backhoes and multi-axle vehicles, etc. Any piece of equipment or operation that has the potential to generate excessive noise levels (You must raise your voice to speak to someone within two feet of where you are standing) will require hearing protection until sound level measurements and/or noise dosimetry may be conducted to quantify the associated noise levels. 5) All utility clearances shall be obtained and/or related systems de-energized prior to equipment entering sump pits or moving concrete. Confirmation shall be obtained from Base personnel that systems are de-energized. Failure to energize a system shall not be considered the sole indicator of whether or not the system is de-energized 6) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. Unless the approximate weight of debris is known, assume it is too heavy for personnel to lift and use mechanical assistance for the lift. 7) Traffic and equipment considerations are to include the following: - Establish safe zones of approach for personnel (i.e. bucket arm + 3 feet). - Secure all loose articles of clothing. - All equipment shall be equipped with movement warning systems. - Use safety belts and follow the site traffic rules. Traffic patterns will be dictated supporting onsite activities. However, regulated patterns in and about the work zones will be established to safely control moving equipment, vehicles, and pedestrians around the area of operation. 8) Suspend or terminate operations until directed otherwise by SSO 9) Sump pits that are to be entered will be treated as permit required confined spaces until proven otherwise. Operations will be performed consistent with the requirements of the B&R Environmental Confined Space Entry Program (Attachment A of this HASP). The SSO will be responsible for performing confined space monitoring and completing confined space permits. 10) Use pinch bars, other devices, or personnel avoidance to keep hands from the point of operation during concrete or equipment handling. Extreme caution must be practiced while excavator/backhoe is loaded with concrete.	**It is anticipated that potential contaminant concentrations at outdoor locations will be below levels that could present a health hazard. Concentrations of carbon monoxide and nitrogen dioxide inside buildings, however, may reach hazardous levels depending on the duration of equipment use and other factors.** Although VOCs are not anticipated to be present in significant quantities to represent an inhalation hazard, a Photoionization Detector w/ 10.6 eV UV lamp source or a Flame Ionization Detector will be used to screen for VOCs. The following guidance applies: Source (e.g., sump pit) monitoring will be conducted at regular intervals determined by the SSO. The SSO will also monitor the breathing zone (BZ) of all potentially affected employees. Workers must evacuate to a safe area if sustained BZ concentrations exceed 10 ppm. Generation of dusts should be minimized to the greatest extent possible to avoid inhalation of contaminated dusts or particulates. Evaluation of dust concentrations will be qualitative by observing work conditions for visible dust clouds or accumulations. Exposure to dust will be controlled by using water to suppress dusts or by avoiding dust plumes. When operating equipment the SSO will also monitor the BZ of all workers potentially exposed to carbon monoxide or nitrogen dioxide (depending on the type of equipment), with the following guidance: - Workers must evacuate to a safe area if sustained BZ concentrations of carbon monoxide exceed 25 ppm averaged over a 5 minute period. OR - Workers must evacuate to a safe area if sustained BZ concentrations of nitrogen dioxide exceed 3 ppm averaged over a 5 minute period.	All operations are to be initiated in Level D protection. Level D protection constitutes the following minimum protection - Standard field attire (sleeved shirt; long pants) - Safety shoes (Steel toe/shank) - Safety glasses - Hardhat (for excavator operations and when overhead hazards exist) - Reflective vest for high traffic areas - Hearing protection for high noise areas, as directed by the SSO. - Tyvek coveralls if the potential exists for soiling work attire (or PVC-coated coveralls depending on the degree of free product present). - Nitrile gloves with surgical style inner gloves (if contacting sump pit liquids) or leather gloves (if handling concrete or other debris) - Rubber boots when entering sump pits where liquid is present or anytime contact with liquids is anticipated.	**Personnel Decontamination** will consist of a soap/water wash and rinse for outer protective equipment (boots, gloves, PVC splash suits, etc.). This function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Soap/water wash and rinse of outer boots and gloves - Soap/water wash and rinse of the outer reusable splash suit, as applicable - Outer suit, boots, and outer glove removal - Removal/disposal of non-reusable PPE (e.g., gloves) - Wash hands and face, leave contamination reduction zone

6.0 HAZARD ASSESSMENT AND CONTROLS

This section provides reference information regarding the chemical and physical hazards which may be associated with activities that are to be conducted as part of the scope of work. Table 6-1 provides specific information related to the various chemical hazards that may be present or generated at the planned project areas within NAS Key West. Specifically, toxicological information, exposure limits, symptoms of exposure, physical properties, and air monitoring and sampling data are discussed in the table.

6.1 CHEMICAL HAZARDS

6.1.1 Site Contaminants

Information provided regarding previous site activities and potential sources of contamination indicates the following classes of contaminants:

- Volatile organic compounds, primarily gasoline (assumed contaminant of sump pits)
- Semi-volatile organic compounds (SVOCs), primarily benzo(a)pyrene and waste oils (assumed contaminant of sump pits)
- Polychlorinated Biphenyls (PCBs)
- Pesticides, primarily DDT, DDE, and DDD
- Metals, primarily lead, arsenic, and antimony

It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (soil borings, soil sampling, and groundwater sampling). Except for lead at Parcel C, none of the contaminants are expected to be present in significant concentrations to present an inhalation hazard during planned site activities. Therefore, the likelihood of exposure to chemical hazards is considered to be minimal based on the number of locations to be investigated and the contaminant concentrations identified during prior sampling programs. Personnel exposure is most likely to occur through inhalation of airborne particulate matter containing these compounds, or through ingestion of contaminated soil or water by hand-to-mouth contact during soil disturbance activities. For this reason, Personal Protective Equipment (PPE) and basic hygiene practices (washing face and hands before leaving site) will be

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA FOR NAVAL AIR STATION KEY WEST
KEY WEST, FLORIDA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Lead	7439-92-1	Particulate form - Unable to be detected by either PID or FID.	Air sample using a mixed cellulose ester filter; or HNO_3 or H_2O_2 desorption; or Atomic absorption detection. NIOSH Method #7082 or #7300.	OSHA: 0.05 mg/m³ ACGIH: 0.15 mg/m³ NIOSH: 0.10 mg/m³ IDLH: 100 mg/m³ as lead	The use of a air purifying, full-face respirator with high efficiency particulate air filter for up to 2.5 mg/m³. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 3164°F; 1740°C **Melting Pt:** 621°F; 327°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 11.34 **Incompatibilities:** Strong oxidizers, peroxides, sodium acetylide, zirconium, and acids **Appearance and Odor:** Metal: A heavy ductile, soft gray solid.	Overexposure to this substance via ingestion or inhalation may result in metallic taste in the mouth, dry throat, thirst, Gastrointestinal disorders (burning stomach pain, nausea, vomiting, possible diarrhea sometimes bloody or black, accompanied by severe bouts of colic), CNS effects (muscular weakness, pain, cramps, headaches, insomnia, depression, partial paralysis possibly coma and death. Extended exposure may result in damage to the kidneys, gingival lead line, brain, and anemia.
Carbon monoxide	630-08-0	PID: Ionization potential 14.01 eV, relative response is unknown. FID: Relative response ratio is unknown however is considered detectable. For this operation an Ultra PhD 4 Gas meter will be used to identify and quantify levels of carbon monoxide generated within the area of operation.	Air sample using bag collection; Electrochemical analysis. Sampling and analytical protocol in accordance with NIOSH Method #S340	NIOSH/OSHA: 35 ppm; 200 ppm (Ceiling) ACGIH: 25 ppm IDLH: 1200 ppm	This material is a colorless, odorless gas - Warning properties are considered poor (Odor threshold: 100,000 ppm). Carbon monoxide canister with a window-cator can be used for concentrations not to exceed 1,500 ppm. This material exhibits no associated skin hazard unless in its cryogenic form which is not the case. Therefore any gloves suitable for the operations identified.	**Boiling Pt:** -313°F; -192°C **Melting Pt:** <-337°F; <-205° C **Solubility:** 2% **Flash Pt:** Not applicable (Gas) **LEL/LFL:** 12.5% **UEL/UFL:** 74% **Vapor Density:** RGasD 0.97 **Vapor Pressure:** >35 atm **Specific Gravity:** 0.97 **Incompatibilities:** Strong oxidizers, bromine trifluoride, chlorine trifluoride, lithium **Appearance and Odor:** Colorless odorless gas.	Signs and symptoms associated with overexposure to carbon monoxide are typically associated with its oxygen depriving capabilities to the cells of the body. As with other chemical asphyxiants most signs and symptoms are associated with the brain and heart which are most sensitive to the affects brought on by deprivation of oxygen. Some signs and symptoms may include cherry red color of the skin or possible pallor and cyanosis, mild headache with increasing severity as carboxyhemoglobin concentrations build, irritability, impaired judgement, rapid fatigue, dizziness, confusion, severe ataxia, possible coma, and respiratory failure and death.

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CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA FOR NAVAL AIR STATION KEY WEST
KEY WEST, FLORIDA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Arsenic	7440-38-2	Particulate form - This substance is unable to be detected by PID/FID.	Air sample using a particulate filter; acid desorption; AAS detection. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7900.	OSHA: Organic compounds 0.5 mg/m³ Inorganic compounds 0.01 mg/m³ NIOSH: (Ceiling) 0.002 mg/m³ ACGIH: 0.2 mg/m³ IDLH: 5 mg/m³ as arsenic	No identifiable warning properties to indicate presence and thereby detection. **Recommended APR Cartridge:** Suitable for dust and fume. Organic vapor acid gases with HEPA filter. This substance may be presented as a pesticide, therefore a cartridge suitable for pesticides (MSA-GMP). **Recommended Gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** sublimation @ 1134°F; 612°C **Melting Pt:** 1497°F; 814°C @ 36 atm **Solubility:** Insoluble in water; soluble in nitric acid **Flash Pt:** Nonflammable, however, airborne in the form of a dust this substance will support combustion **LEL/LFL:** Nonflammable **UEL/UFL:** Nonflammable **Vapor Density:** Not available **Vapor Pressure:** 1 mmHg @ 372°C (sublimes) **Specific Gravity:** 5.73 **Incompatibilities:** Oxidizers, halogens,zinc, lithium, azides, and acetylides **Appearance and odor:** Gray to black, brittle, crystalline, amorphous, odorless.	Overexposure to this substance through inhalation or ingestion may result in ulceration of the nasal septum, GI disturbances resulting in violent purging and vomiting, hoarse voice, sore throat, excessive salivation, peripheral neuropathy (numbness and burning sensations beginning at the extremities followed by motor weakness), respiratory irritation leading to possible pulmonary edema. Skin or eye contact may result in irritation, conjunctiva, dermatitis, and hyperpigmentation (darkening of the areas exposed) of the skin. This substance has been judged to be a Human carcinogen by NTP, and IARC.
Benzo(a) pyrene	50-32-8	Particulate form - This substance is not detectable using a PID or FID	Air sample using a glass fiber or silver membrane filter; analysis by gas chromatography/infrared or other spectrophotometric method or colorimeter. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #1(186).	OSHA: 0.2 mg/m³ NIOSH: 0.1 mg/m³	Adequate - use a full-face air-purifying respirator with dust/mist cartridge up to 10 mg/m³. **Recommended glove:** Nitrile	**Boiling Pt:** 594°F; 312°C **Melting Pt:** 354°F; 179°C **Solubility:** Insoluble **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 10 mmHg @ 594°F; 312°C **Specific Gravity:** Not available **Incompatibilities:** Not available **Appearance and Odor:** Yellow odorless crystals.	Regulated primarily as a result of potential carcinogenic properties. Listed by NTP, IARC, and ACGIH as carcinogenic.

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CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA FOR NAVAL AIR STATION KEY WEST
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Nitrogen dioxide	10101-44-0	PID: Ionization potential 9.75 eV. FID: Non-combustible NO_2-specific instruments are available and should be used whenever exposure is anticipated.	Molecular sieve tube followed by visible spectrophotometry analysis, detector tubes, or other direct-reading instruments. Sampling and analytical protocol in accordance with NIOSH Method #6014	OSHA: 5 ppm (Ceiling) NIOSH/OSHA: 1 ppm (STEL) ACGIH: 3 ppm (TWA); 5 ppm (STEL) IDLH: 20 ppm	This material is a reddish-brown gas with a pungent, acrid odor - Warning properties are considered poor (Odor threshold: 5 ppm). This material exhibits no associated skin hazard unless in its liquid form or at high concentrations. Therefore any gloves suitable for the operations identified would be appropriate.	**Boiling Pt:** 70°F **Melting Pt:** 11.8°F **Solubility:** Miscible in all proportions (reacts to form nitric acid and nitric oxide) **Flash Pt:** Not applicable (Gas) **LEL/LFL:** NA **UEL/UFL:** NA **Vapor Density:** 2.83 **Vapor Pressure:** 720 mm Hg **Specific Gravity:** 1.44 **Incompatibilities:** Combustible material, water, chlorinated hydrocarbons, carbon disulfide, ammonia. Reacts with water to form nitric acid. **Appearance and Odor:** Reddish-brown gas with a pungent, acrid odor.	Exposure to nitrogen dioxide may cause severe breathing difficulties which are usually delayed in onset and which may cause death. Recovery may be slow (2-3 weeks) with possible relapse and possible permanent lung damage. Pneumonia may occur. Irritation of the eyes, nose, throat, and wet skin may occur with acute exposures. Nitrogen dioxide is a respiratory irritant.
DDT and the major metabolites; DDD and DDE.	50-29-3 72-54-8 72-55-9	Substance is not volatile, I.P. is unknown, detection by PID is unknown. Substance non-combustible, therefore a FID is anticipated to have reduced response to DDT.	Air sample using a binder free, glass fiber filter; isoctane desorption; gas chromatography-electron capture detector. Sampling and analytical protocol will proceed in accordance with NIOSH Method #3(S274).	OSHA; ACGIH: 1 mg/m³ NIOSH: 0.5 mg/m³	Adequate - Can use air purifying respirator with high efficiency particulate air filter (HEPA). **Recommended glove:** Nitrile acceptable for incidental contact.	**Boiling Pt:** 230°F; 110°C **Melting Pt:** 226°F; 108°C **Solubility:** Insoluble **Flash Pt:** 162-171°F; 72-77° C **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** Low **Specific Gravity:** 0.99 **Incompatibilities:** Strong oxidizers and alkalis **Appearance and Odor:** Colorless crystals or off-white powder with a slight aromatic odor	Large doses are followed by vomiting due to gastric irritation, diarrhea may follow. Numbness and parethesias of the lips tongue and face associated with malaise, headache, sorethroat, fatigue and weakness. Coarse tremors (usually first of the neck, head, and eyelids). This may be accompanied by confusion, apprehension, and depression. Convulsions may result and death may occur from respiratory failure. DDT is absorbed and retained in the fat of humans. Chronic exposure may result in damage to the liver, kidneys and Peripheral Nervous System. DDT is recognized as possessing carcinogenic properties by IARC and NTP.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA FOR NAVAL AIR STATION KEY WEST
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Aroclor-1260 (Polychlorinated Biphenyl, PCB) It should be noted that this substance is representative of the more common isomers Aroclor - 1242, 1254, which may be encountered.	11096-82-5 53469-21-9 (42%) 11097-69-1 (54%)	Substance is not volatile (VP=0.00006 mmHg), I.P. is unknown however is anticipated to be elevated, therefore, PID is not anticipated to detect substance. Substance is non combustible and as a result will not be detected by FID.	Air sample using a particulate filter, Florisil sorbent tube with glass fiber filter; hexane desorption; gas chromatography-electron capture detector. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #5503 (PCBs).	OSHA; ACGIH: 0.5 mg/m³ (skin) NIOSH: 0.001 mg/m³ IDLH: 5 mg/m³	Inadequate - However due to the low volatility it is assumed unless agitated this substance does not present a volatile vapor or gas respiratory threat. For dusty conditions where this material may cling to particulates, use a HEPA filter. APRs are approved for escape only when concentrations exceed the exposure limits. Concentrations greater than the exposure limits require PAPR or supplied air respirators. **Recommended glove:** Butyl rubber >24 hrs; Neoprene rubber >24.00 hrs; Silver shield or Viton (for pure product).	**Boiling Pt:** distillation range 689- 734°F; 365-390°C **Melting Pt:** -2 to 50°F; -19 to 10°C **Solubility:** Insoluble **Flash Pt:** Not applicable **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable Nonflammable liquid, however, exposure to fire results in black soot containing PCBs, dibenzofurans, & chlorinated dibenzo-p-dioxins **Vapor Density:** Not available **Vapor Pressure:** 0.00006 - 0.001 mmHg **Specific Gravity:** 1.566 @ 60°F; 15.5°C **Incompatibilities:** Strong oxidizers **Appearance and Odor:** Colorless to pale yellow, viscous liquid or solid (Aroclor 54 below 50°F) with a mild, hydrocarbon odor	This substance is irritating to the eyes and skin. Chronic effects of overexposure may include potential to cause liver damage, chloracne, and reproductive effects. Recognized as possessing carcinogenic properties by NIOSH, and NTP.
Gasoline	8006-61-9	Relative response ratios for the components of gasoline range from 100 - 200% for PID and FID detection.	See components for measurement considerations.	ACGIH & OSHA: 300 ppm 500 ppm STEL NIOSH: Reduce to lowest feasible concentration.	**Respiratory Protection:** Odor threshold 0.7 ppm, adequate air purifying respirator with organic vapor cartridges up to 100 ppm. **Recommended Gloves:** Nitrile >6.00 hrs; PV alcohol >6.00 hrs; Viton/neoprene >8.00 hrs	**Boiling Pt:** 102°F; 39°C **Melting Pt:** Not available **Solubility:** Negligible **Flash Pt:** -50°F; -45°C **LEL/LFL:** 1.4% **UEL/UFL:** 7.6% **Vapor Density:** ~5 **Vapor Pressure:** 38-300 mmHg (varies seasonally) **Specific Gravity:** 0.74 @ 20/20°C **Incompatibilities:** Strong oxidizers, peroxides, strong acids, and perchlorates	Overexposure to this substance may result in irritation to the eyes, skin, and mucous membranes. Systemically, headache, fatigue, blurred vision, dizziness, slurred speech, confusion, possible convulsion, and chemical pneumonia (aspiration). Prolonged or chronic exposures may result in possible liver or kidney damage. Components of this substance have been determined to be confirmed human carcinogens.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA FOR NAVAL AIR STATION KEY WEST KEY WEST, FLORIDA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Waste Oils All information is based on mineral oil	N.E. 8012-95-1 for mineral oil	Varies between fractions however waste oils tend to be less volatile. The FID tends to handle the longer chained aliphatic hydrocarbons more efficiently than its PID counterpart and would be selected as the instrument of choice.	Sampling and analytical protocol shall be in accordance with NIOSH Method #5026 is the recommended method for mineral oil mist.	ACGIH; NIOSH: 5 mg/m³ (Oil mists); 10 mg/m³ STEL OSHA: 5 mg/m³ (Oil mists)	Non-volatile substance, therefore no respiratory protection is required. In an aerosol form dust and mist respirator would be considered acceptable for up to 500 mg/m³. **Recommended gloves:** Any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances, and will be acceptable).	**Boiling Pt:** 680°F; 360°C **Melting Pt:** Not available **Solubility:** Insoluble **Flash Pt:** 275-500°F; 135-260°C depends on the distillation fraction **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** <0.5 mmHg **Specific Gravity:** 0.90 **Incompatibilities:** None reported **Appearance and odor:** Colorless, oily, with an odor of burned lubricating oil.	Minor irritation to the eyes, skin, and respiratory system.
Antimony	7440-36-0	Particulate form - unable to be detected by PID/FID.	Air sample using particulate filter; acid desorption; atomic absorption spectrometry PeCam Sampling and analytical protocol shall proceed in accordance with NIOSH Method #261.	OSHA/NIOSH/ACGIH: 0.5 mg/m³ IDLH: 50 mg/m³	Metallic taste resulting from exposure. **Recommended Air Purifying Cartridges:** Protect from dusts, fumes, and mists use HEPA filters. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact.	**Boiling Pt:** 2975°F; 1635°C **Melting Pt:** 1166°F; 630°C **Solubility:** Insoluble **Flash Pt:** Nonflammable **LEL/LFL:** Nonflammable **UEL/UFL:** Nonflammable NOTE: This substance is nonflammable but may present a moderate explosion hazard when airborne dusts of an adequate concentration are exposed to flames. **Vapor Density:** Not available **Vapor Pressure:** 1 mmHg @ 1627°F; 886°C **Specific Gravity:** 6.684 @ 77°F; 25°C **Incompatibles:** Acids, oxidizers, halogens **Appearance and odor:** silvery gray, lustrous metal	This substance is considered a poison by ingestion, irritating to the skin and mucous membranes causing inflammation to the nose, mouth, and throat. Chronic exposure may result in some forms of dermatitis. Ingestion may result in a metallic taste, vomiting, colic, and diarrhea. Chronic exposure may result in addition to those stated above indigestion, loss of appetite and weight, and diarrhea. Sores in the mouth along with a sore throat help distinguish this form of poisoning from other forms of metallic poisoning such as lead and arsenic. Inhalation at excessive concentrations may result in difficulty in breathing, headaches and a bloody discharge from the nose, and chemical pneumonitis.

extremely important. Wetting procedures will be initiated if any tasks produce visible dust in workers' breathing zones. Additional information on these and other potential contaminants is presented in Table 6-1.

6.1.2 Activity-Generated Contaminants

Some work activities will involve the use of diesel or gasoline-powered equipment (drill rigs) within a building. The potential exists, therefore, for workers to be exposed to constituents of exhaust gases such as carbon monoxide or nitrogen dioxide (primary concern associated with nitrogen oxides). Carbon monoxide is more the contaminant of concern when gasoline-powered equipment is operated; nitrogen oxides are more the concern when diesel-powered equipment is used.

Carbon monoxide is a lethal, colorless and odorless gas that, even at non-lethal concentrations, can temporarily impair a worker's coordination and thinking because of a decrease in the amount of oxygen being carried to the body tissues (including the brain). The extent of this impairment is highly dependent upon the worker's health, the workload, and the amount of carbon monoxide intake from non-occupational sources, such as cigarette smoking. If the impairment is significant, a worker performing potentially dangerous operations, such as drilling, could become fatally injured as a result of the worker's inability to avoid the work-related hazards.

Nitrogen dioxide is a dark brown gas with a pungent, acrid odor. Overexposure may cause severe breathing difficulties which are usually delayed in onset and which may cause death. Recovery may be slow (2-3 weeks) with possible relapse and possible permanent lung damage. Irritation of the eyes, nose, throat, and wet skin may occur with acute exposures. Additional information on the effects of carbon monoxide and nitrogen dioxide exposure is provided in Table 6-1.

To control potential exposures to these products of combustion while working inside buildings, ventilation and air movement through work areas will be increased to aid in removing equipment exhaust gases. If possible, external venting of exhaust gases from the drill rig (or other internal combustion equipment) via flexible tubing to roof vents or windows will be used during all drilling activities performed inside of buildings or other enclosed structures. If equipment is operated indoors for extended periods of time (e.g., greater than 30 minutes), the level of carbon monoxide (gasoline-powered equipment) or nitrogen dioxide (diesel-powered equipment) will be monitored using portable instruments. Action Levels of 25 ppm for carbon monoxide and 3 ppm for nitrogen dioxide will be used to trigger ceasing operations and/or evacuating personnel from the building

6.2 PHYSICAL HAZARDS

The following is a list of physical hazards that may be encountered at the site or may be present during the performance of site activities.

- Slip, trip, and fall hazards
- Strain/muscle pulls from manual lifting
- Noise in excess of 85 dBA
- Exposure to pinch or compression points
- Contact/entanglement with rotating machinery
- Contact with energized sources (aboveground and underground utilities)
- Ambient temperature extremes
- Inclement weather
- Confined Space Entry hazards (associated with drilling activities inside sump pits of Building 103)
- Natural Hazards (ticks, snakes, plants, etc.)
- Foot and equipment traffic
- Flying projectiles

Many of these physical hazards are discussed in detail in Section 4.0 of the Health and Safety Guidance Manual. Additional information regarding physical hazards associated with each task to be performed is provided in Table 5-1 of this HASP. Specific discussion on some of these hazards is presented below.

6.2.1 Contact/Entanglement with Rotating Machinery

Often the hazards associated with drilling operations are the most dangerous to be encountered during site activities. The SSO will thoroughly discuss safe drilling procedures as part of site-specific training and/or during daily safety meetings using safe work permits (Figure 9-1) presented in this HASP. The following rules will apply to all drilling operations:

- Utilities must be cleared prior to prior to breaking ground.

- Each rig must be equipped with emergency stop devices which will be tested daily to ensure that they are operational.

- Long handled shovels or equivalent shall be used to clear cuttings from the borehole and rotating equipment.

- The driller may not leave the controls when the augers are rotating.

6.2.2 Contact with Energized Sources (Aboveground or Underground Utilities)

Underground utilities such as pressurized lines, water lines, telephone lines, buried utility lines, and high voltage power lines are known to be present throughout the facility. Clearance of underground and overhead utilities for each sample location will be coordinated with NAS Key West Public Works personnel. Additionally, drilling operations will be conducted at a safe distance (>20 feet) from overhead power lines unless they are shielded. Whenever underground utilities are suspected within close proximity to subsurface sampling locations, the borehole will be advanced to a minimum of 5.0 feet with a hand auger prior to drilling. As built drawings may also be utilized for additional clarification. In certain cases, NAS Key West Public Works personnel may need to deenergize electrical cables using facility lockout/tagout procedures to insure electrical hazards are controlled.

6.2.3 Inclement Weather

Many of the project tasks under this Scope of Work will be performed outdoors. As a result, inclement weather may be encountered. In the event that adverse weather (electrical storms, tornadoes, etc.) conditions arise, the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

6.2.4 Ambient Temperature Extremes

Overexposure to high ambient temperatures (heat stress) may exist during performance of this work depending on the project schedule. Work performed when ambient temperatures exceed 70 °F may result in varying levels of heat stress (heat rash, heat cramps, heat exhaustion, and/or heat stroke) depending on variables such as wind speed, humidity, and percent sunshine, as well as physiological factors such as metabolic rate and skin moisture content. Additionally, work load and level of protective equipment will affect the degree of exposure. Site personnel will be encouraged to drink plenty of fluids to replace those lost through perspiration. Additional information such as Work-Rest Regimens and personnel monitoring may be found in section 4.0 of the Health & Safety Guidance Manual.

6.2.5 Confined Space Entry Hazards

Installation of monitoring wells within Building 103 will require entry into sump pits with an estimated depth of 3-4 feet. The sump pits will be pumped dry prior to entry. Although the pits are unlikely to contain a hazardous atmosphere, the quality of the air in the pits and the potential for any other hazards to endanger workers will be thoroughly evaluated prior to anyone entering the pits. Entries into the sump pits will be performed consistent with the requirements of the B&R Environmental Confined Space Entry Program (Attachment A of this HASP).

6.3 NATURAL HAZARDS

During warm months (spring through early fall), tick-borne Lyme Disease may pose a potential health hazard. The longer a disease-carrying tick remains attached to the body, the greater the potential for contracting the disease. Wearing long sleeved shirts and long pants (tucked into boots and taped) will prevent initial tick attachment, while performing frequent body checks will help prevent long term attachment. Site first aid kits should be equipped with medical forceps and rubbing alcohol to assist in tick removal. For more information on ticks consult Section 4.0 of the Health and Safety Guidance Manual.

Contact with poisonous plants and bites or stings from poisonous insects are other potential natural hazards. Long sleeved shirts and long pants (tucked into boots), and avoiding potential nesting areas, will minimize the potential for exposure. All site personnel who are allergic to stinging insects (such as bees, wasps and hornets) must be particularly careful since severe illness and death may result from allergic reactions. As with any medical condition or allergy, information regarding the condition must be listed on the Medical Data Sheet (see Section 7 of the Guidance Manual), and the FOL or SSO notified.

7.0 AIR MONITORING

Except for lead at Parcel C, none of the contaminants are expected to be present in significant concentrations to present an inhalation hazard during planned site activities. Nonetheless, various direct reading instruments will be used to detect and monitor worker exposures to chemical hazards that may be present at the site. Specifically, a Photoionization Detector (PID) or Flame Ionization Detector(FID) will be used to screen for the presence of VOCs and other ionizable agents as indicated in Table 6-1. An Oxygen/Lower Explosive Limit (O_2/LEL) meter will be used to evaluated confined spaces prior to entry. A carbon monoxide meter or a nitrogen dioxide meter may be used to monitor contaminant concentrations inside Building 103 during activities.

The specific type of monitoring and the associated instruments, frequency of use, and applicable action levels are dependent upon the specific scope of work and the contaminants of concern. As a result, specific air monitoring measures and requirements have been established in Table 5-1 of this site-specific HASP. Additionally, Section 1.0 of the B&R Environmental Health and Safety Guidance Manual contains detailed information regarding direct reading instrumentation and personal and area air sampling procedures, as well as general calibration procedures of various instruments.

In most cases, however, the contaminants of concern are unable to be detected or are difficult to detect with the use of a PID or FID. In particular, SVOCs, PCBs, pesticides, and metals cannot be detected due to their solid nature, low vapor pressure, or non-ionizing properties. The greatest potential for exposure to these contaminants generally would be as a result of inhalation or ingestion of contaminant-laden particulates (i.e., dusts). As a result, any observations of airborne particulates will indicate a potential for exposure, and will require control measures such as area wetting, upgrade of PPE, or evacuation. Given the proposed activities, however, it is not anticipated that airborne particulates will be generated in concentrations to present a significant health hazard.

7.1 INSTRUMENTS AND USE

Instruments will be used primarily to monitor source points and worker breathing zone areas, while observing instrument action levels. Action levels are discussed in Table 5-1 as they may apply to a specific task or location.

7.1.1 Photoionization Detector (PID) or Flame Ionization Detector (FID)

In order to accurately monitor for any substances which may present an exposure potential to site personnel, a photoionization detector (PID) using a lamp energy of 10.6 or higher, or a Flame Ionization Detector (FID) will be used. The selected instrument will be used to monitor potential source areas and to screen the breathing zones of employees during site activities. The PID or FID has been selected because it is capable of detecting the organic vapors of concern.

Prior to the commencement of any field activities, the background levels of the site must be determined and noted. Daily background readings will be taken away from any areas of potential contamination. These readings, any influencing conditions (i.e., weather, temperature, humidity) and site location must be documented in the field operations logbook or other site documentation (e.g., sample log sheet).

7.1.2 Carbon Monoxide (CO) or Nitrogen Dioxide (NO_2) Meter

A carbon monoxide meter (when gasoline-powered equipment is operated) or a nitrogen dioxide meter (when diesel-powered equipment is used) may be used to monitor contaminant concentrations inside Building 103 during activities. Every effort will be made prior to using this equipment to control personnel exposures to CO and/or NO_2 by increasing room ventilation or using a hose to transfer equipment exhaust to the outside. These instruments will be used to screen the breathing zones of employees while equipment is operating indoors for extended (e.g., over 30 minute) periods. Instruments used to monitor personnel exposures to these agents must be calibrated and specifically designed to detect the suspected contaminant.

7.1.3 Hazard Monitoring Frequency

Table 5-1 presents the frequencies that hazard monitoring will be performed as well as the action levels which will initiate the use of elevated levels of protection. The SSO may decide to increases these frequencies based on instrument responses and site observations. The frequency at which monitoring is performed will not be reduced without the prior consent of the PHSO or HSM.

7.2 INSTRUMENT MAINTENANCE AND CALIBRATION

Hazard monitoring instruments will be maintained and pre-field calibrated by the B&R Environmental Equipment Manager. Operational checks and field calibration will be performed on all instruments each day prior to their use. Field calibration will be performed on instruments according to manufacturer's recommendations (for example, the PID must be field calibrated daily and an additional field calibration must be performed at the end of each day to determine any significant instrument drift). These operational checks and calibration efforts will be performed in a manner that complies with the employees health and safety training, the manufacturer's recommendations, and with the applicable manufacturer standard operating procedure (copies of which can be found in the Health & Safety Guidance Manual which will be maintained on site for reference). All calibration efforts must be documented. Figure 7-1 is provided for documenting these calibration efforts. This information may instead be recorded in a field operations logbook, provided that all of the information specified in Figure 7-1 is recorded. This required information includes the following:

- Date calibration was performed
- Individual calibrating the instrument
- Instrument name, model, and serial number
- Any relevant instrument settings and resultant readings (before and after) calibration
- Identification of the calibration standard (lot no., source concentration, supplier)
- Any relevant comments or remarks

FIGURE 7-1

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: ______________________________ **PROJECT NO.:** ____________________

Date of Calibration	Instrument Name and Model	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre-Calibration	Post-Calibration	Pre-Calibration	Post-Calibration		

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section is included to specify health and safety training and medical surveillance requirements for B&R Environmental personnel participating in on site activities. All B&R Environmental personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at the NAS Key West. B&R Environmental personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of B&R Environmental introductory, supervisory, and refresher training as well as site-specific training will be maintained at the site. Copies of certificates or other official documentation will be used to fulfill this requirement.

8.1.1 <u>Requirements for Subcontractors</u>

Identified B&R Environmental subcontractor personnel must have completed introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) and 8 hours of refresher training meeting the requirements of 29 CFR 1910.120(e)(8) prior to performing field work at the NAS Key West. B&R Environmental subcontractors must certify that each employee has had such training by sending B&R Environmental a letter, on company letterhead, containing the information in the example letter provided in Figure 8-1. This letter will be accompanied by training certificates or some other form of official documentation for all subcontractor personnel participating in site activities.

8.2 SITE-SPECIFIC TRAINING

B&R Environmental will provide site-specific training to all B&R Environmental personnel who will perform work on this project. Site-specific training will include:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment

The following statements must be typed on company letterhead and signed by an officer of the company and accompanied by copies of personnel training certificates:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Mr. Chuck Bryan
Task Order Manager
Brown & Root Environmental
900 Trail Ridge Road
Aiken, South Carolina 29803

Subject: HAZWOPER Training for Naval Air Station Key West (NAS Key West), Key West, Florida

Dear Mr. Bryan:

As an officer of XYZ Corporation, I hereby state that I am aware of the potential hazardous nature of the subject project. I also understand that it is our responsibility to comply with all applicable occupational safety and health regulations, including those stipulated in Title 29 of the Code of Federal Regulations (CFR), Parts 1900 through 1910 and Part 1926.

I also understand that Title 29 CFR 1910.120, entitled "Hazardous Waste Operations and Emergency Response," requires an appropriate level of training for certain employees engaged in hazardous waste operations. In this regard, I hereby state that the following employees have had 40 hours of introductory hazardous waste site training or equivalent work experience as required by 29 CFR 1910.120(e) and have had 8 hours of refresher training as required by 29 CFR 1910.120(e)(8) and site supervisory personnel have had training in accordance with 29 CFR 1910.120(e)(4).

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

Enclosed - Copies of Training Certificates

FIGURE 8-1. EXAMPLE TRAINING LETTER

- Work practices to minimize risks from hazards
- Medical surveillance requirements
- Contents of the Health and Safety Plan
- Signs and symptoms of overexposure to site contaminants
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of the contents of relevant Material Safety Data Sheets
- Emergency response procedures (evacuation and assembly points)
- Associated hazards and restricted areas within the NAS Key West.

Site-specific training documentation will be established through the use of Figure 8-2.

8.3 MEDICAL SURVEILLANCE

All B&R Environmental personnel participating in project field activities will have had a physical examination meeting the requirements of B&R Environmental's medical surveillance program. Documentation for medical clearances will be maintained in the B&R Environmental Aiken office and made available, as necessary.

8.3.1 Medical Surveillance Requirements for Subcontractors

Identified subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" provided in Figure 8-3 shall be used to satisfy this requirement, providing it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA 29 CFR 1910.120 can substitute "Subcontractor Medical Approval Form" with a letter, on company letterhead, containing all of the information in the example letter presented in Figure 8-4 of this HASP.

My signature below indicates that I am aware of the potential hazardous nature of performing remedial activities at Naval Air Station Key West (NAS Key West), Key West, Florida, and that I have received site-specific training which included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Medical surveillance requirements
- Contents of the Health and Safety Plan
- Signs and symptoms of overexposure to site contaminants
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of the contents of relevant Material Safety Data Sheets
- Emergency response procedures (evacuation and assembly points)
- Associated hazards and restricted areas within the NAS Key West.

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

I further state, by the presence of my signature below that, the date of my training (introductory, refresher, and supervisory, as applicable) and my medical surveillance requirements are accurate and correct to the best of my knowledge.

Name	40-Hour General Site Worker Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Date of Medical Surveillance	SIGNATURE

FIGURE 8-2. SITE-SPECIFIC TRAINING DOCUMENTATION

For employees of ____
Company Name

Participant Name: ______________________ Date of Exam: ______________

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f), and was found to be medically -

   ( ) qualified to perform work at the Naval Air Station Key West; Key West, Florida

   ( ) not qualified to perform work at the Naval Air Station Key West; Key West, Florida

and,

2. Undergone a physical examination in accordance with OSHA 29 CFR 1910.134(b)(10) and was found to be medically -

   ( ) qualified to wear respiratory protection
   ( ) not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

( ) A copy of OSHA Standard 29 CFR 1910.120 and appendices.
( ) A description of the employee's duties as they relate to the employee's exposures.
( ) A list of known/suspected contaminants and their concentrations (if known).
( ) A description of any personal protective equipment used or to be used.
( ) Information from previous medical examinations of the employee that is not readily available to the examining physician.

Part B

I, ______________________, have examined ______________________
Physician's Name (print) Participant's Name (print)

and have determined the following information:

FIGURE 8-3. SUBCONTRACTOR MEDICAL APPROVAL FORM (PAGE 1 OF 2)

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

   ____
   ____
   ____

2. Any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health:

   ____
   ____
   ____

3. Recommended limitations upon the employee's assigned work:

   ____
   ____
   ____

I have informed this participant of the results of this medical examination and any medical conditions which require further examination of treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the Naval Air Station Key West; Key West, Florida, this participant

( ) may
( ) may not

perform his/her assigned task.

Physician's Signature ______________________

Address ______________________

Phone Number ______________________

NOTE: Copies of test results are maintained and available at:

____
Address

FIGURE 8-3. SUBCONTRACTOR MEDICAL APPROVAL FORM (PAGE 2 OF 2)

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Mr. Chuck Bryan
Task Order Manager
Brown & Root Environmental
900 Trail Ridge Road
Aiken, South Carolina 29803

Subject: Medical Surveillance for Naval Air Station Key West (NAS Key West), Key West, Florida

Dear Mr. Bryan:

As an officer of XYZ Corporation, I hereby state that the persons listed below participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response: Final Rule." I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive- and negative- pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at the NAS Key West, Key West, Florida.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

FIGURE 8-4. EXAMPLE MEDICAL SURVEILLANCE LETTER

8.3.2 Requirements for All Field Personnel

Each field team member, including subcontractors and visitors, entering the exclusion zone(s) shall be required to complete and submit a copy of the Medical Data Sheet found in Section 7 of the B&R Environmental Health and Safety Guidance Manual. This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SUBCONTRACTOR EXCEPTIONS

In situations in which the exclusion zone is not entered or when there is no potential for exposure to site contaminants, subcontractor personnel may be exempt from some of the training and medical surveillance requirements. All subcontractors and visiting personnel are required to receive site-specific training (as discussed in Section 8.2) regarding information provided in this HASP. Examples of subcontractors who may be exempt from training and medical surveillance requirements may include surveyors who perform surveying activities at the site perimeters or in areas were there is no potential for exposure to site contaminants, and in this case the subcontractor providing concrete coring services.

The use of the subcontractor exception is strictly limited to the authority of the CLEAN Health and Safety Manager.

9.0 SITE CONTROL

This section outlines the means by which B&R Environmental will delineate work zones and use these work zones in conjunction with decontamination procedures to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a fractured three-zone approach will be used during work at this site. This three zone approach will utilize an exclusion zone, a contamination reduction zone, and a support zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize the potential for the spread of contaminants, and protect individuals who are not cleared to enter work areas.

9.1 EXCLUSION ZONE

The exclusion zone will be considered those areas of the site of known or suspected contamination. It is not anticipated that significant amounts of surface contamination are present in the proposed work areas of this site. It is anticipated that this will remain so unless contaminants are brought to the surface by intrusive activities, such as when conducting the soil boring and sampling as slated for this statement of work. Furthermore, once intrusive activities have been completed and surface contamination has been removed, the potential for exposure is again diminished and the area can then be reclassified as part of the contamination reduction zone. Therefore, the exclusion zones for this project will be limited to those areas of the site where active work is being performed plus a designated area surrounding the point of operation (see Table 5-1 for a list of specific operations). The exclusion zone for most site activities will be fragmented to represent the areas where the soils are disturbed through soil boring or sampling activities. All exclusion zones will be delineated using barrier tape, cones, and postings to inform and direct facility personnel.

9.1.1 Exclusion Zone Clearance

A pre-startup site visit will be conducted by members of the identified field team in an effort to identify proposed subsurface investigation locations, conduct utility clearances, and provide upfront notices concerning scheduled activities within the facility.

In all cases, no subsurface activities will proceed without utility clearance. In the event that a utility is struck during a subsurface investigative activity, the emergency numbers provided in Section 2.7, Table 2-1, will be notified.

When base personnel are working within the proximity of this investigation, they will be moved or their operation temporarily discontinued to remove them from potential hazards associated with this operation.

9.2 CONTAMINATION REDUCTION ZONE

The contamination reduction zone (CRZ) will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. This area will also serve as a focal point in supporting exclusion zone activities. This area will be delineated using barrier tape, cones, and postings to inform and direct facility personnel. Decontamination will be conducted at a central location. All equipment potentially contaminated will be bagged and taken to that location for decontamination. Given this consideration, equipment required to complete this operation may include hand augers and stainless steel bowls and spatulas for each location.

9.3 SUPPORT ZONE

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

9.4 SAFE WORK PERMITS

All exclusion zone activities conducted in support of this project will be done so using this HASP as a reference guide and Safe Work Permits to incorporate site-specific information to guide and direct field crews on a task by task basis. An example of the Safe Work Permit to be used during site activities is illustrated in Figure 9-1. All permits will be issued by the SSO or his/her on site representative in the morning prior to the commencement of on site activities.

Safe Work Permits are to be completed in accordance with the specifications contained in Table 5-1, and the other sections of the HASP as appropriate.

All personnel identified on the permit as participating in the task will be made aware of its contents by the supervisor accepting the permit. Any problems which occurred throughout the task will be documented by the supervisor on the permit.

All permits will be returned to the FOL or the SSO at the end of the day.

Permit No. ______________ Date: ________________ Time: From ____________ to ____________

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): ______________________

II. Names: ______________________

III. Onsite Inspection conducted Yes No Initials of Inspector ____________ ____________
B&RE

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Protective equipment required		Respiratory equipment required	
Level D	Level B	Full face APR	Escape Pack
Level C	Level A	Half face APR	SCBA
Detailed on Reverse		SKA-PAC SAR	Bottle Trailer
		Skid Rig	None

Modifications/Exceptions: ______________________

V. Chemicals of Concern / Action Level(s) / Response Measures

Chemicals of Concern	Action Level(s)	Response Measures

VI. Additional Safety Equipment/Procedures

Hardhat	Yes	No	Hearing Protection (Plugs/Muffs)	Yes	No
Safety Glasses	Yes	No	Safety belt/harness	Yes	No
Chemical/splash goggles	Yes	No	Radio	Yes	No
Splash Shield	Yes	No	Barricades	Yes	No
Splash suits/coveralls	Yes	No	Gloves (Type)	Yes	No
Steel toe/shank Workboots	Yes	No	Work/rest regimen	Yes	No

Modifications/Exceptions: ______________________

VII. Procedure review with permit acceptors Yes NA / Yes NA

		Yes NA
Safety shower/eyewash (Location & Use)	Emergency alarms	
Procedure for safe job completion	Evacuation routes	
Contractor tools/equipment inspected	Assembly points	

VIII. Equipment Preparation Yes NA

- Equipment drained/depressured
- Equipment purged/cleaned
- Isolation checklist completed
- Electrical lockout required/field switch tested
- Blinds/misalignments/blocks & bleeds in place
- Hazardous materials on walls/behind liners considered

IX. Additional Permits required (Hot work, confined space entry, excavation etc.) Yes No
If yes, fill out appropriate section(s) on safety work permit addendum

X. Special instructions, precautions: ______________________

Permit Issued by: ______________ Permit Accepted by: ______________
Job Completed by: ______________ Date: ______________

FIGURE 9-1. EXAMPLE SAFE WORK PERMIT

9.5 SITE VISITORS

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by B&R Environmental
- Regulatory personnel (i.e., DOD, EPA, OSHA)
- Southern Division Navy Personnel
- Other authorized visitors

All non-DOD personnel working on this project are required to gain initial access to the base by coordinating with the B&R Environmental FOL or designee and following established base access procedures.

Once access to the base is obtained, all personnel who require site access into areas of ongoing operations will be required to obtain permission from the FOL and the Base Contact. Upon gaining access to the site, all site visitors wishing to observe operations in progress will be escorted by a B&R Environmental representative and shall be required to meet the minimum requirements discussed below:

- All site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), the entity which they represent, and the purpose of the visit.

- All site visitors will be required to produce the necessary information supporting clearance to the site. This shall include information attesting to applicable training and medical surveillance as stipulated in Section 8.0 of this document. In addition, to enter the site operational zones during planned activities, all visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this HASP.

Once the site visitors have completed the above items, they will be permitted to enter the operational zone. All visitors are required to observe the protective equipment and site restrictions in effect at the site at the time of their visit. All visitors entering the exclusion zones during ongoing operations will be accompanied by a B&R Environmental representative. Any and all visitors not meeting the requirements, as stipulated in this plan, for site clearance will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause the termination of all on site activities until the unauthorized visitor is removed from the premises. Removal of unauthorized visitors will be accomplished with support from the Base Contact. If necessary, the Base Contact will be notified of any unauthorized visitors.

9.6 SITE SECURITY

Site security will be accomplished using B&R Environmental field personnel. B&R Environmental will retain complete control over active operational areas. As this activity takes place at a Navy facility open to public access, the first line of security will take place using exclusive zone barriers, site work permits, and any existing barriers at the sites to restrict the general public. The second line of security will take place at the work site referring interested parties to the Base Contact. The Base Contact will serve as a focal point for base personnel, interested parties, and serve as the final line of security and the primary enforcement contact.

9.7 SITE MAP

Once the areas of contamination, access routes, topography, and dispersion routes are determined, a site map will be generated and adjusted as site conditions change. These maps will be posted to illustrate up-to-date collection of contaminants and adjustment of zones and access points.

9.8 BUDDY SYSTEM

Personnel engaged in on site activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

9.9 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

B&R Environmental and subcontractor personnel will provide MSDSs for all chemicals brought on site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of all chemicals used on site will be developed using the Health and Safety Guidance Manual. The MSDSs will then be maintained in a central location (i.e., temporary office) and will be available for anyone to review upon request.

9.10 COMMUNICATION

As personnel will be working in proximity to one another during field activities, a supported means of communication between field crews members will not be necessary.

External communication will be accomplished by using the telephones at predetermined and approved locations. External communication will primarily be used for the purpose of resource and emergency resource communications. Prior to the commencement of activities at the NAS Key West, the FOL will determine and arrange for telephone communications.

10.0 SPILL CONTAINMENT PROGRAM

10.1 SCOPE AND APPLICATION

It is not anticipated that bulk hazardous materials (over 55-gallons) will be handles at any given time as part of this scope of work. It is also not anticipated that such spillage would constitute a danger to human health or the environment. However, as the job progresses, the potential may exist for accumulating Investigative Derived Wastes (IDW) such as decontamination fluids, soil cuttings, and purge and well development waters, in a central staging area. Once these fluids and other materials have been characterized, they can be removed from this area and properly disposed.

10.2 POTENTIAL SPILL AREAS

Potential spill areas will be periodically monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, limited areas are vulnerable to this hazard including:

- Resource deployment
- Waste transfer
- Central staging

It is anticipated that all IDW generated as a result of this scope of work will be containerized, labeled, and staged to await further analyses. The results of these analyses will determine the method of disposal.

10.3 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, a periodic walk-around by the personnel staging or disposing of drums area will be conducted during working hours to visually determine that storage vessels are not leaking. If a leak is detected, the contents will be transferred, using a hand pump, into a new vessel. The leak will be collected and contained using absorbents such as Oil-Dry, vermiculite, or sand, which are stored at the vulnerable areas in a conspicuously marked drum. This used material, too, will be containerized for disposal pending analysis. All inspections will be documented in the project logbook.

10.4 PERSONNEL TRAINING AND SPILL PREVENTION

All personnel will be instructed in the procedures for incipient spill prevention, containment, and collection of hazardous materials in the site-specific training. The FOL and the SSO will serve as the Spill Response Coordinators for this operation, should the need arise.

10.5 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the minimum equipment that will be maintained at the staging areas at all times for the purpose of supporting this Spill Prevention/Containment Program.

- Sand, clean fill, vermiculite, or other non combustible absorbent (Oil-dry)
- Drums (55-gallon U.S. DOT 17-E or 17-H)
- Shovels, rakes, and brooms
- Container labels

10.6 SPILL CONTROL PLAN

This section describes the procedures the B&R Environmental field crew members will employ upon the detection of a spill or leak.

1. Notify the SSO or FOL immediately upon detection of a leak or spill. Activate emergency alerting procedures for that area to remove all non-essential personnel.

2. Employ the personal protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the container or raising the leak to the highest point in the vessel. Spread the absorbent material in the area of the spill, covering it completely.

3. Transfer the material to a new vessel; collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment and disposal options.

4. Re-containerize spills, including 2-inch of top cover impacted by the spill. Await test results for treatment or disposal options.

It is not anticipated that a spill will occur that the field crew cannot handle. Should this occur, notification of the appropriate Emergency Response agencies will be carried out by the FOL or SSO in accordance with the procedures discussed in Section 2.0 of this HASP.

11.0 CONFINED-SPACE ENTRY

Personnel under the provisions of this HASP may enter sump pits within Building 103 that could be considered confined spaces. The sump pits will be pumped dry prior to entry. Although the pits are unlikely to contain a hazardous atmosphere, the quality of the air in the pits and the potential for any other hazards to endanger workers will be thoroughly evaluated prior to anyone entering the pits. Entries into the sump pits will be performed consistent with the requirements of the B&R Environmental Confined Space Entry Program (Attachment A of this HASP). Other potential confined spaces will likewise be evaluated prior to entry.

A confined space is defined as an area that has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, manholes, sewers, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

Additionally, a Permit-Required Confined Space must also have one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly caving walls or by a floor that slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

For further information on confined space operations, consult the Health and Safety Guidance Manual or call the PHSO or HSM.

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12.0 MATERIALS AND DOCUMENTATION

The B&R Environmental Field Operations Leader (FOL) shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- Material Safety Data Sheets for all chemicals brought on site, including decontamination solutions, fuels, sample preservatives, calibration gases, etc.
- Follow-up Reports (to be completed by the FOL)
- A full-size OSHA Job Safety and Health Poster (posted in the site trailer)
- Training/Medical Surveillance Documentation Form (Blank)
- First-Aid Supply Usage Form
- Emergency Reference Form (Section 2.0, extra copy for posting)
- Soil Boring Log Forms for logging the soil borings
- Directions to the Hospital

12.1 MATERIALS TO BE POSTED AT THE SITE

The following documentation is to be posted at the site for quick reference purposes. In situations where posting of these documents is not feasible (such as no office trailer), these documents should be separated and be immediately accessible to site personnel.

Chemical Inventory Listing - This list represents all chemicals brought on site, including decontamination solutions, sample preservatives, fuel, calibration gases, etc. This list should be posted in a central area.

Material Safety Data Sheets (MSDSs) - The MSDSs should also be in a central area accessible to all site personnel. These documents should match all the listings on the chemical inventory list for all substances employed on site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

The OSHA Job Safety & Health Protection Poster - This poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaced, altered, or covered by other material.

Site Clearance Posting - This listing is found within the training section of the HASP (See Figure 8-1). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. This list indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) - This list of numbers and the directions will be maintained at all phone communications points and in each site vehicle.

Medical Data Sheets/Cards - Medical Data Sheets will be filled out by all on site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility. A copy of this sheet or a wallet card will be given to all personnel to be carried on their person.

Hearing Conservation Standard (29 CFR 1910.95) - This standard will be posted anytime hearing protection or other noise abatement procedures are employed.

Personnel Monitoring - All results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels - Where chemical inventories have been separated, because of quantities and incompatibilities, these areas will be conspicuously marked using Department of Transportation (DOT) placards and acceptable [Hazard Communication 29 CFR 1910.1200 (f)] labels.

13.0 ACRONYMS/ABBREVIATIONS

CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CSP	Certified Safety Professional
DRI	Direct Reading Instrument
EBS	Environmental Baseline Survey
FOL	Field Operations Leader
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSM	Health and Safety Manager
IDW	Investigation Derived Waste
NAS	Naval Air Station
N/A	Not Available
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PCB	Polychlorinated Biphenyls
PHSO	Project Health and Safety Officer
PPE	Personal Protective Equipment
SVOCs	Semi-Volatile Organic Compounds
TBD	To be determined
TOM	Task Order Manager
VOCs	Volatile Organic Compounds

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14.0 REFERENCES

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USN - NFEC (U.S. Navy - Naval Facilities Engineering Command), 1994a. *Remedial Action Plan (RAP) for Electric Power Plant Building 103.* August.

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ATTACHMENT A

CONFINED SPACE ENTRY PROGRAM

BROWN & ROOT ENVIRONMENTAL UNIT
CONFINED SPACE ENTRY OPERATIONS PROGRAM

1.0 PURPOSE

To establish a uniform procedure specifying the minimum requirements for confined space entry operations performed by (or managed by) the Environmental Unit of Brown & Root (the "Unit").

2.0 SCOPE

This procedure applies to all Unit projects with a scope of work that includes the performance of confined space entry operations by Unit or subcontracted personnel. This program has been developed on the basis of two principle requirements. These are as follows:

- That this program will be implemented on a **SITE SPECIFIC** basis, establishing flexibility to provide for the protection of the health and safety of Unit and subcontractor personnel, as well as for internal and regulatory compliance. This concept recognizes that Environmental Unit personnel work on many different sites, often with only brief field operations tasks, as opposed to longer term project sites commonly associated with other Brown & Root units. Therefore, this performance-based program has been developed to establish the minimum requirements for confined space entry operations at any individual Unit office location or project site.

- That all confined space entry operations will be performed using a **PERMIT-REQUIRED** system, with the requirements of this procedure followed as minimum requirements. Recognizing the Federal OSHA regulatory delineation between a Non-permit Confined Space and a Permit-Required Confined Space[1], and also recognizing that OSHA standards are minimum requirements, it is Unit policy that all confined space entry operations will be performed in accordance with the written permit system specified in this procedure.

3.0 RESPONSIBILITIES

[1] Occupational Safety and Health Administration Title 29 CFR 1910.146, Permit-Required Confined Spaces, paragraph (b) "Definitions".

Unit President: Has the overall responsibility for the health and safety of all personnel and operations in the Unit, including those involved with confined space entry operations. This responsibility is principally satisfied through delegating the necessary authority and accountability to the Unit Office Management level. Successful accomplishment and maintenance of this and other health and safety programs will be achieved through such means as ensuring that health and safety is a principal component of personnel annual performance reviews ranging from Unit top management through to each employee.

Unit Office Management: Provide labor and equipment resources necessary to comply with the requirements of this program. Other responsibilities include:

- Establish office policy on confined space entry operations. Offices setting policy that no personnel at their location will participate in confined space entry operations are exempt from this program, with the possible exception of addressing program requirements for contractor personnel if such work will be subcontracted.

- Supporting the office health and safety Point of Contact in the implementation and maintenance of this program for that office.

Unit Health and Safety Manager (HSM): Provide technical management and oversight of this program, and to aid all Unit locations in effectively implementing these requirements. The Unit HSM will also be responsible for monitoring the overall effectiveness of this program. This will be accomplished by:

- Reviewing all completed permits on an annual basis
- Performing field audits of select project sites where confined space entry operations are performed
- Eliciting feedback from Unit office health and safety Points of Contact
- Maintaining proficiency in regulatory requirements on confined space entry matters
- Modifying elements of this program, when or as appropriate

Other specific responsibilities of the Unit HSM include:

- Establishing minimum components of confined space entry training course material, both for in-house and subcontractor-provided training courses
- Maintaining appropriate recordkeeping for this program
- Regularly communicating with Brown & Root Corporate Health and Safety, to satisfy overall company requirements

Office Health and Safety Points of Contact (POCs): Ensure that the requirements of this program are satisfied for all confined space entry operations performed or managed at their location, whether by Unit personnel or by subcontractors. Other responsibilities include ensuring that:

- If training is provided by subcontractors, that an appropriate organization is selected, and that the training course material satisfies the Unit requirements.
- No individual participates in any confined space entry operations unless they are fully compliant with all program requirements
- All avenues to accomplish a specific task in a manner where confined space entry operations are not necessary (such as the use of remote sampling techniques) are exhausted, and that confined space entry is selected as a field activity approach only as a last resort
- The HSM is alerted when activities at a project site will involve confined space entry operations
- A properly completed written program is present at every site where confined spaces exist
- Appropriate documentation is maintained for that office, and that written permits are submitted to the HSM at the conclusion of project activities to facilitate the annual permit review requirement.

4.0 PROCEDURES

4.1 Introduction

Brown & Root recognizes that the participation of Environmental Unit personnel in confined space entry operations can be one of the most potentially dangerous types of field activities that they may encounter in their work. The risks associated with this type of work are most remarkable because they can be immediate and severe. It is for this reason that the requirements of this program will be strictly enforced at all Unit locations.

There are two scenarios that are commonly encountered in Unit operations and projects. These include project sites where we are a contractor performing work at a client location, and project sites where we are the prime contractor, and we have a subcontractor working under our direction. Also, specific to addressing confined space concerns, we need to address sites where confined spaces exist but our work scope will not involve entry versus sites where actual entry is necessary. As the regulatory requirements for each of these scenarios vary, separate procedures are established in the following sections of this overall program. These procedures all involve the use of a simple, fill-in-the-blank written program that is to be completed by the site Health and Safety Officer (HSO).

4.2 Definitions

A confined space is any space that meets at least one of the following criteria:

- Is large enough and so configured that an employee can bodily enter and perform assigned work (Note: This does **not** mean only spaces large enough to house an employee's entire body. For example, a container where operations involve an employee inserting only their head for a visual inspection or some other limited task would still be considered a confined space)

- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers vaults, test pits, excavations, sewers, building crawl spaces, chemical process vessels, and other such spaces)

- Is not designed for continuous employee occupancy

4.3 General Requirements

The following are General Requirements for the Environmental Unit's Confined Space Entry policy and program.

Confined space entry operations on any Environmental Unit project site will be performed only a last resort. All available alternative means to accomplish the task objectives must be exhausted before commencing any confined space entry activities.

Any project site where planned activities may involve work in or near a confined space must have a written Confined Space Entry Program completed on site and available prior to the commencement of site activities. This includes projects where such spaces exist in the work area, even when no plans to enter the space(s) exist (see section 4.7). The program must be attached to the Health and Safety Plan prepared for that project. The written program shall be completed by the assigned Site Safety Officer, and will be kept current and available for review by the Unit HSM.

All work involving entry into a confined space will be performed by written permit only. There will be no exceptions to this requirement without the express, written consent of the Unit HSM.

4.4 Projects Sites Involving Confined Space Entry Operations

The frequency that Unit projects involve both confined spaces in the work area and a work scope that requires personnel to actually enter a space is very low. This cannot be interpreted as indicating that the level of concern for a Confined Space Entry Program is not a priority. In fact, because this type of activity is infrequent, the level of concern is greater. The nonroutine nature of these operations inhibit our ability to develop and maintain a high level of proficiency. Therefore, the need for an effective program to control or minimize the potentially severe hazards of confined space entry work is a very high priority.

The written program presented in Attachment 1 of this procedure will be used at all Unit project sites where confined space entry operations are planned. That program has been developed to provide the site HSO with a standardized tool to serve two purposes:

1. To protect the health and safety of Unit personnel working in or near confined spaces
2. To comply with Federal regulatory requirements

Role of the Site Health and Safety Officer

For applicable projects, the assigned HSO must be thoroughly familiar with this procedure and with the OSHA regulation on Permit-Required Confined Spaces, and will be responsible for completing Attachment 1. The HSO will also be responsible for implementing the specific requirements of the program on his/her site, including ensuring that:

- All confined spaces at the site are properly identified and labeled
- All site personnel are made aware of these spaces, and that unauthorized entry is prohibited. This is to be covered as part of the site-specific health and safety training
- All entries are performed using the written permit system specified in the site written program
- All necessary training requirements are satisfied, and that appropriate training documents are collected and maintained
- All necessary entry equipment is on hand, and maintained in proper working order
- Permits are completed specifying a duration only long enough to perform the job
- A trained and equipped rescue team is on standby prior to the beginning of the confined space activity

The HSO will serve as the Entry Supervisor, which means that he/she is responsible for determining that acceptable entry conditions are present before and during entry, for authorizing (by completing and signing the written permits) and overseeing entries, and for terminating entries and canceling permits.

Testing and Monitoring

Air monitoring in the space must be performed before and during all entry operations. The frequency, types, and sequence of air monitoring are clearly specified in the site specific program included as Attachment 1. While that program specifies that periodic air monitoring during an entry may be acceptable for an isolated space, it is recommended that continuos monitoring always be performed, even for a completely isolated space. Acceptable entry conditions are as specified in Table 1, below.

Table 1
Acceptable Entry Conditions

Atmospheric Parameter	Acceptable Entry Condition
Oxygen content in air	$\geq$ 19.5% and $\leq$ 23.5%
Flammable or explosive conditions	$\leq$ 10% of an LEL* for gases, vapors or mists $\leq$ LEL for airborne combustible dusts
Toxic concentrations of chemical hazards	Any exposure reaching a substances published Action Level, Permissible Exposure Limit, Threshold Limit Value, or

	Recommended Exposure Limit. These will all be specified in the site Health and Safety Plan
Any other atmospheric condition that is Immediately Dangerous to Life or Health	Varies by specific parameter

*LEL = Lower Explosive Limit, sometimes also referred to as LFL for Lower Flammability Limit. For dusts, this may be approximated as a visual condition where the dust obscures vision at a distance of 5 feet or less

If the acceptable entry conditions do not exist, or appear that they may not be constant throughout the entry, the HSO can use the following approach:

1. Ensure that the space is properly isolated (block and bleed lines, use Lockout/Tagout procedures, etc.
2. Purge, inert, flush, or ventilate the space to control or eliminate the hazard

If acceptable entry conditions still do not exist due to flammability or explosive concerns, the entry must not be authorized. If the limiting factor is toxic airborne concerns, appropriate PPE may be used to allow the entry (Note: As with all environmental work, use of PPE is chosen as a control option always only as a last resort).

Rescue

When confined space entry operations are performed, personnel and equipment must be adequate and available to effect non-entry rescue operations in the event of an emergency. This shall include items such as body harnesses (or wristlets, as a second choice), tie-offs, mechanical retrieval apparatus, etc. This equipment must be available and in use during all entry operations. This will enable the Attendant and other authorized personnel to perform an emergency rescue and extract an injured person from outside of the space. **Rescue procedures requiring other personnel to enter a space to assist or evacuate an injured or incapacitated entrant are expressly prohibited.** Also, unauthorized personnel must be prohibited from participating in emergency rescue operations.

It is anticipated that in most instances, we will be prepared to provide emergency rescue services ourselves, at least to the point of removing an injured person and stabilizing them until professional emergency services can be summoned. The identity of the specific emergency response service and the method for contacting them will be clearly identified on the permit completed by the Health and Safety Officer (HSO). At least one member of the team serving in the role of Attendant or Rescue member (a non-entrant) must have current certification in First Aid and CPR. (Note: The POC must ensure that Bloodborne Pathogen Program requirements are satisfied whenever First Aid or CPR practice is authorized.)

4.5 Employee Training

All personnel must be adequately trained in order to be authorized to participate in confined space operations. Training must be performance-based so that participants can successfully demonstrate proficiency in performing their assigned duties. Training shall take place before an individuals first assignment, when their assigned duties change, or when changes occur in the site's written program. Also, if a new hazard is suspected that was not addressed in the employee's training, supplemental training will be required.

Whether training is provided in-house or by a training contractor, the contents of the training must satisfy the requirements of this program, and will be held to the criteria published by the Hazardous Waste Action Coalition Risk Management Committee, Health and Safety Subcommittee (entitled "Confined Space Entry Training Courses", published in 1996). A copy of these criteria are available from the Unit HSM. These criteria are directly applicable as they have been specifically developed by health and safety representatives of firms in our industry (hazardous waste/environmental consulting).

The HSO will ensure that appropriate training has taken place for all authorized individuals, and will have on-hand at the site documentation for each involved employee attesting to:

1. Employee name
2. Signature or initials of the instructor
3. dates of training

Site-specific training for authorized individuals will cover the duties of the entrants and attendants. This will address the aspects for each of these positions as presented below.

<u>Authorized Entrants</u>
Hazards that may be encountered in the space
How to properly use the necessary equipment
Communication methods with the Attendant
Recognizing when emergency exit of the space is necessary

<u>Attendants</u>
Hazards that may be encountered in the space
Behavioral effects of hazard exposure
To continuously maintain an accurate count of entrants and know their identity
To never leave the space unless relieved by another authorized entrant
Communication methods and aspects with Entrants
Monitoring of the space
How and when to summon emergency services
Control unauthorized personnel issues
Performance of nonentry rescues

<u>Entry Supervisor (the HSO)*</u>
Hazards that may be encountered in the space
Verifies that all tests have been conducted (by checking permit entries)
Verifies that all procedures and equipment specified in the permit are in place before signing it and putting it into effect
When and how to terminate the entry and cancel the permit

Verify that rescue services are available at the time of the entry and that the means for summoning them are operable
Removes or prevents unauthorized personnel from entering the space

Offsite emergency rescue services will be contacted by the HSO as part of task mobilization. They will be made aware of the potential hazards that may be encountered in providing assistance, and (when appropriate), they will be provided with Material Safety Data Sheets or similar information for substances that they may be exposed to.

4.6 Coordination With Clients

In nearly all instances, Unit operations will involve arrangements where we are serving as a contractor to a client facility. That is, we will not be addressing entering spaces that we own or control. Therefore, appropriate coordination with the client will be essential to properly understand the nature of any confined spaces and to successfully perform the work. When the scope of work entails (or may entail) working in or near confined spaces, the Project Manager must gather the following information as part of the initial data gathering process:

1. Obtain any available information regarding confined spaces, including descriptions, potential or known hazards, and the client's confined space entry program information
2. Determine if the client has located and designated confined spaces in the work area
3. Establish how the client desires to coordinate our work with their operations, relative to the confined spaces
4. If the scope of work will involve actual entry by Unit personnel, inform the client of our program

Gathered information is to be provided to the Health and Safety individual responsible for preparing the site-specific Health and Safety Plan.

At the conclusion of any confined space entry work done at a client location, the Project Manager is to request a debriefing meeting so that a representative from the project team can communicate hazards that were encountered in the work.

4.7 Project Sites Involving Confined Spaces Where Entries Will Not be Performed

In many instances, we may be performing work at sites where confined spaces exist and our scope of work does not involve any entry into those spaces. In this application, the HSO has only to ensure that spaces in our work area are adequately identified and posted, and complete the one-page written program in Attachment 2 and post it on site in the work area.

4.8 Confined Space Entry Operations involving Subcontractors

For some projects, the scope of work may require a specialized service or capability that we do not have in-house, and a subcontractor will be needed. When that work involves requiring our subcontractor to perform a confined space entry, The HSO must complete and utilize the written program included as Attachment 3. Also, the information presented previously in section 4.6 (when we are the subcontractor) must be gathered by our Project Manager and provided to our subcontractor. Again, in most instances, all or most of that information will have to be obtained from our client. We must provide our subcontractor with the following information:

1. Information regarding the confined space(s), including descriptions, potential or known hazards, and the details of our confined space entry program
2. information on the location and designations (postings) of the confined spaces in the work area
3. Establish how we desire to coordinate our work with their operations, relative to the confined spaces
4. If the scope of work will involve actual entry by subcontractor personnel, inquire if they have their own Permit-Required Confined Space Program and obtain it for our review
5. If the nature of the work is such that Unit and subcontractor personnel will have to perform concurrent operations in or near a confined space, very close coordination will be necessary and the Unit HSM must be contacted for guidance.

At the conclusion of any confined space entry work done by a subcontractor, a debriefing meeting will be held by the HSO to learn of any hazards that were encountered in the work.

4.9 Program Evaluations and Availability

The Unit HSM is responsible for performing evaluations of this overall Program to ensure its continued effectiveness. These reviews will be properly documented, and will occur as follows:

1. Annually, at the end of each calendar year
2. At any time when an indication is discovered that a component of the program is not effective
3. In the event of any modifications in the regulatory requirements for confined space operations
4. If the event of changes or mandates from Brown & Root Corporate Health and Safety

Annual Program evaluations will entail a review of all canceled written permits prepared and used during the course of that year by all Unit locations. The various site-specific written programs that these permits were prepared under are also subject to review. Canceled permits will be retained by the Unit HSM for no less than one calendar year.

Field audits of project work sites where confined space operations are conducted will also be performed. These will be coordinated through the various office safety POCs, and will done on an unannounced, random basis.

Information gathered and program modifications that become necessary will be communicated by the Unit HSM to appropriate Brown & Root Corporate Health and Safety.

ATTACHMENT 1

CONFINED SPACE ENTRY PROGRAM
For
Projects Involving Entry Operations

CONFINED SPACE ENTRY PROGRAM
For
Projects Involving Entry Operations

Site Name and Address:______________________________ Project No.__________
____

Project Manager: ______________________________
Site Manager: ______________________________
Site Health and Safety Officer: ______________________________

Confined spaces that exist (or that may be created by project activities) at this site include the following: ______________________________
____
____
____
____
____
____

Each of these spaces have been (or will be, upon creation) clearly posted with signs stating "DANGER - PERMIT REQUIRED CONFINED SPACE - DO NOT ENTER". Unauthorized entry into any of these spaces is strictly prohibited.

On this project, entry into the following space(s) is (are) anticipated:

Space	Reason For Entry	Associated Hazards

ENTRIES WILL BE BY WRITTEN PERMIT ONLY. Figure 1 will be used as the written permit on this site. Permits will be prepared, issued, and canceled by the Site Health and Safety Officer, who will also serve in the role of Entry Supervisor. Permits must be completed before any entry operations begin. Completed permits will be reviewed with all involved personnel as part of their task-specific training, and then posted at or near the entrance to the space.

Equipment and Evaluation of Confined Spaces

All spaces must be properly evaluated before and during entry operations. Figure 2 specifies the equipment that will be maintained on this site to evaluate and support Confined Space Entry operations.

Figure 2
On Site Confined Space Equipment
(Check and Describe All That Apply)

Type of Equipment	Description
______Testing/monitoring equipment	______________________
______Ventilating equipment	______________________
______Communications equipment	______________________
______Personnel protective equipment	______________________
______Lighting equipment	______________________
______Barriers/shields to protect entrants	______________________
______Ingress/egress equipment	______________________
______Rescue/emergency equipment	______________________
______Other equipment	______________________

Spaces will be evaluated by the Site Health and Safety Officer as follows:

- Pre-entry, to determine that satisfactory entry conditions exist
- Continuously, if the space cannot be isolated
- Periodically, if the space can be isolated (at least once every __ minutes)

The sequence for conducting these evaluations will be (from first to last):

1. Oxygen level
2. Lower Explosive Level (for gases, vapors, mists, or particulates)
3. Toxic gases or vapors

Specific equipment and instrument action levels are specified on the permit.

General Requirements and Responsibilities

Only properly authorized and trained personnel will be permitted to participate in entry operations. The Entry Supervisor (the site Health and Safety Officer) will be responsible for conducting these authorizations and for ensuring that training requirements are satisfied. All persons involved with entry operations will be properly designated on the Permit. At least one Entry Attendant will be stationed outside of the space at all times during any confined space entry operation. The identity of the Attendant(s) will be clearly indicated on the entry permit. Attendants will not be assigned any additional duties that could interfere with fulfilling their responsibilities as space Attendants. **Multiple spaces will not be monitored by a single attendant**. This type of approach is strictly prohibited.

Emergency rescue operations will be non-entry means only. Emergency procedures will be specified on the entry permit.

If entry operations will involve the use of contractor personnel, the Subcontractor Permit Required Confined Space Program (See Attachment 3 of the Brown & Root

Environmental Unit Confined Space Entry Operations Program) must be completed by the site Health and Safety Officer and maintained onsite.

At the conclusion of entry operations, the site Health and Safety Officer will ensure that all personnel and equipment have been removed from the space, that a final space evaluation is performed, and the permit will be canceled and filed. A copy of the canceled permit must be sent to the Unit Health and Safety Manager at the conclusion of the project, and not later than by November 30 for projects where work continues toward the end of a calendar year in order to facilitate the annual program evaluation process.

FIGURE 1
CONFINED SPACE ENTRY PERMIT

CONFINED SPACE ENTRY PERMIT No.: ____

GENERAL INFORMATION:

DESCRIPTION OF THE CONFINED SPACE

DATE ISSUED	TIME ISSUED	DATE EXPIRES	TIME EXPIRES
	:		:

ENTRY SUPERVISOR

ATTENDANT(S)

COMMUNICATION BETWEEN ATTENDANT(S) - ENTRANTS

☐ VOICE ☐ LIGHT ☐ RADIO ☐ OTHER

DESCRIPTION OF WORK

CHECKLIST FOR ISOLATION AND UNAUTHORIZED ACCESS PREVENTION

	Yes	NO	NA	INITIAL
External Battery(ies) in Place	☐	☐	☐	____
Mechanical Lockout/Tagout	☐	☐	☐	____
Lines/Pipes Disconnected	☐	☐	☐	____
Lines/Pipes Blocked	☐	☐	☐	____
Lines/Pipes Capped	☐	☐	☐	____
Lines/Pipes Blinded	☐	☐	☐	____
Hot Work Permit	☐	☐	☐	____
Warning Signs	☐	☐	☐	____
Other: ____	☐	☐	☐	____

REPORT ANY UNAUTHORIZED ENTRY TO:	PHONE NO.	RADIO NO.	PAGER NO.
Health Sciences Department and Project Management			

PRE-ENTRY CHECKLIST

PURGING, INERTING, OR FLUSHING

PERFORMED ☐ YES ☐ NO ☐ NA

METHOD USED ☐ Nitrogen ☐ Steam ☐ Water ☐ Other (specify) ____

MECHANICAL VENTILATION

	Initial	Continuous	Partial	Description
Fresh Air Injection	☐ ____hrs.	☐	☐	____
General	☐ ____hrs.	☐	☐	____
Local Exhaust	☐ ____hrs.	☐	☐	____

SPECIFIC HAZARDOUS TASKS

Certain tasks performed in confined spaces greatly increase the risks to entrants. Check all tasks to be performed.

☐ WELDING/GRINDING

☐ THERMAL CUTTING

☐ SOLDERING/BRAZING

☐ ELECTRICAL

☐ OTHER, EXPLAIN: ____

☐ PAINTING OR CLEANING WITH SOLVENTS

☐ CLEANING/SWEEPING/VACUUMING

☐ SCRAPING/REMOVING RESIDUE

☐ CHEMICAL USE

CONFINED SPACE ENTRY PERMIT No.__________

PERIODIC ATMOSPHERIC TEST RESULTS

TESTER INFORMATION	ATMOSPHERIC HAZARD TESTED	ACCEPTABLE RANGE OF HAZARD		ACCEPTABLE RANGE OF HAZARD	ACCEPTABLE YES	ACCEPTABLE NO
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		
Date	Oxygen Content ($\%O_2$)	19.5%-23.5%		%		
Time:	Combustible Gas (%LEL)	0%-10%		%		
Initials:	Other (Specify)	PEL	ppm	ppm		

CONFINED SPACE ENTRY PERMIT — No: ______

INITIAL ATMOSPHERIC TESTS PERFORMED

CAUTION: Toxic or flammable gasses or vapors may ________ in the confined space. Be sure to vent at various intervals and locations within the confined space. Always check the oxygen content first.

INITIAL TESTING						
HAZARD TESTED	ACCEPTABLE RANGE	READING	DATE AND TIME	TESTER INITIALS	ACCEPTABLE	
					YES	NO
%Oxygen	19.5-23.5%	%				
%LEL	10% or less	%				
	PEL=	PPM=				
	PEL=	PPM=				
	PEL=	PPM=				

RESCUE PROCEDURE

PLAN DESCRIPTION

______

______

______

______

ONSITE RESCUE CONTACTS			OUTSIDE SOURCES AND PHONE
PHONE NUMBER	RADIO NUMBER	PAGER NUMBER	
			FIRE DEPARTMENT
			AMBULANCE
			HOSPITAL
			OTHER

SPECIAL EQUIPMENT NEEDED

- ☐ RESPIRATORS (Type): ______
- ☐ SAFETY HARNESSES/WRISTLETS
- ☐ LIFELINES
- ☐ HOISTING APPARATUS
- ☐ VENTILATION EQUIPMENT: ______
- ☐ TEMPORARY LIGHTING (Type): ______
- ☐ NON-SPARKING TOOLS
- ☐ PROTECTIVE CLOTHING: ______
- ☐ OTHER:

ENTRY SUPERVISOR'S SIGNATURE	DATE	PERMIT ISSUER SIGNATURE	DATE

CONFINED SPACE ENTRY PERMIT **No:**

PERSONNEL ENTRY LOG

DESCRIPTIONOF CONFINED SPACE

ENTRY SUPERVISOR **DATE**

ATTENDANT(S)

ENTRANT'S NAME	TIMES IN AND OUT							
	IN	OUT	IN	OUT	IN	OUT	IN	OUT

ATTACHMENT 2

CONFINED SPACE ENTRY PROGRAM
For
Project Sites Involving Confined Spaces
Where Entries Will Not be Performed

CONFINED SPACE ENTRY PROGRAM
For
Project Sites Involving Confined Spaces
Where Entries Will Not be Performed

Site Name and Address: ______________________ Project No.________

____

Project Manager: ______________________
Site Manager: ______________________
Site Health and Safety Officer: ______________________

Confined spaces that exist (or that may be created by project activities) at this site include the following: ______________________

____

____

____

____

____

____

Each of these spaces have been (or will be, upon creation) clearly posted with signs stating "DANGER - PERMIT REQUIRED CONFINED SPACE - DO NOT ENTER".

Entry into any of these spaces is NOT permitted by site personnel is for any reason.

Site Manager: ______________________ Date / /

Site Health and Safety Officer:______________________ Date / /

POST THIS ON SITE

ATTACHMENT 3

SUBCONTRACTOR PERMIT-REQUIRED CONFINED SPACE ENTRY OPERATIONS

SUBCONTRACTOR PERMIT-REQUIRED CONFINED SPACE ENTRY OPERATIONS

Site Name and Address:______________________________ Project No.__________

____

Project Manager: ______________________________
Telephone Number: (_____) ____-__________

Site Manager: ______________________________

Site Health and Safety Officer:______________________________

Subcontractor Performing Confined Space Entry Operations:______________________

1.0 General

This project site contains the confined spaces specified in Table 1. Entry into any of these spaces will be written permit only, and in compliance with the requirements of OSHA 29 CFR 1910.146. Permits will be coordinated with and submitted to the site Health and Safety Officer.

Table 1
Confined Spaces
at the
______________________ Site

Space	Reason For Entry	Associated Hazards

2.0 Space Description and History (Note to site Health and Safety Officer: this section must be filled out for EACH space to be entered by the subcontractor personnel. Attach additional pages to this program as appropriate.)

The nature of the work to be performed by ______________________________
(name of subcontractor)
is ____

____

This will involve/require entry into ______________________________
(description of space)

The hazards recognized or anticipated with this space include or may include (check and describe all that apply):

______a hazardous atmosphere involving ______________________________

______Material that could engulf an entrant, specifically______________________

______An internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section ______________________________

______Other serious safety or health hazards______________________________

____

____

Brown & Root Environmental has implemented the following precautions/procedures for the protection of our employees in or near this space:

- Education and training on confined space recognition
- Posting with "DANGER - PERMIT REQUIRED CONFINED SPACE - DO NOT ENTER" signs
- Other means as follows:______________________________

____

If Brown & Root Environmental and ________________________ will need to perform concurrent operations in or near the space, activities will be conducted in accordance with the following coordinated system:______________________________

____

____

____

____

____

3.0 Subcontractor Debrief

Work was concluded on ___/___/___. The following confined space hazards were confronted or created during entry operations.

____

____

____

____

____

____

____

____

Problems encountered in administering or complying with the site Confined Space Entry Program were as follows:______________________________

____

____

Suggestions for improvements of this program discussed during the debrief included

Signature of Subcontractor Agent

HSO Signature

Appendix C

Data Quality Objective Process Documentation

Appendix C

Part 1 - Data Quality Objective Subzone Summaries

Zone C - Truman Annex DRMO Waste Storage Area

Subzone GRYZNC-SZN3-- Soil-- Former Oil Container (pre1942) and Scrap Metal and Refugee Item Storage Areas

Step 1. State the Problem

(1) Planning Team Members

- Chuck Bryan- Brown and Root Environmental
- Scott Flickinger- Brown and Root Environmental
- Brian Lewis- Brown and Root Environmental
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(2) Decision Makers- NAS Key West Tier I Partnering Team

- Martha Berry- EPA Region IV
- Chuck Bryan- Brown and Root Environmental
- Jorge Caspary- FDEP
- Ron Demes- NAS Key West
- Roy Hoekstra- Bechtel
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(3) Problem Statement

Potential contamination in soil (fuels, oil, metal) from past oil and metal storage activities.

(4) Available Resources and Deadlines

Budget-	$200,000
Deadline-	9/29/97
Personnel-	Listed above as Planning Team and Decision Makers
Guidance-	DQO Process (EPA QA/G-4); Data Quality Assessment (EPA QA/G-9)
Site Knowledge-	RFI/RI and CMS fieldwork; EBS; RAB Meeting Support
Experience-	Prior workplan review and preparation experience on the part of Planning Team and Decision Makers

Step 2. Identify the Decision

(1) Principal study question

Is the soil contaminated by VOCs, SVOCs, and inorganics?

(2) Alternative actions that could result from resolution of the principal question

(a) No further action
(b) Further action
  (i) Additional sampling
  (ii) RI/FS
  (iii) IRA and RI/FS

(3) Decision Statement

Determine whether or not soil is contaminated (by VOCs, SVOCs, and inorganics) whether (1) no action will be taken or (2) further study is needed (e.g., additional sampling or place Zone C - Truman Annex DRMO Waste Storage Area, Former Oil Container (pre1942) and Scrap Metal and Refugee Item Storage Areas in RI/FS or IRA and RI/FS program).

Step 3. Identify the Inputs to the Decision

(1) Information needed to resolve the decision

(a) Background information on site
(b) Existing soil analytical data
(c) New soil analytical data
(d) Statistical analyses

(2) Sources of the information needed to resolve the decision

(a) Background Information
  (i) Existing documents (reports, drawings, maps, etc.)
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Condition Map of NAS Key West, No drawing number. 1942.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Predraft EBS Truman Annex; Excess Property. 1996d.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. PWO Dwg No. P- 2536; Master Shore Station Development Plan; Utilities Fresh/Salt Water Distribution, Dwg. No. P-2536 - 752891. 1957e.

  (ii) Site visits (reports, drawings, maps, etc.)
  - Brown and Root Environmental (B&R Environmental). B&RE/Navy Site Visit. 1996a.
  - Brown and Root Environmental (B&R Environmental). Partners Site Visit and Teleconference. 1997b.

  (iii) Current/on-going activities

(iii) Current/on-going activities

(b) Existing soil analytical data

(c) New soil analytical data

Through the following analytical methods, the planning team needs to obtain measurements of VOCs, SVOCs, and Inorganics in soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Oil Container (pre1942) and Scrap Metal and Refugee Item Storage Areas.

- Metals; SW-846 Methods 6010a/6010b and 7000a series
- Semivolatile Organic Compounds; SW-846 Methods 8270b/8270c
- Volatile Organic Compounds; SW-846 Methods 8260a/8260b

(d) Statistical Analyses

(i) Student's t-test

(ii) Variance of background data set

(3) Information necessary for establishing action levels

(a) Legal action levels

- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.

(b) Guidance action levels

- Residential Soil RBCs-- U. S. Environmental Protection Agency (EPA), Risk-Based Concentration Table, 1997.

(c) Background Concentrations

A subset of applicable background data has been extracted from the Comprehensive Background Report for NAS Key West (Appendix H of the Supplemental RFI/RI for Eight Sites, 1997).

(4) Measurement Methods for Analytical data

The appropriate measurement methods have been selected, as stated above. In order to adequately resolve the decision, method detection limits must be less than action levels. This will be ensured by supplying the selected action levels with the statement of laboratory Statement of Work. In the event that it is not is not technically possible to achieve a low enough MDL for a given parameter with the selected method, the partnering team will evaluate the results on a case-by-case basis, using frequency of detection to determine whether detected concentrations represent significant contamination. Action levels were not available for some parameters, as shown below. Regardless of MDL, these parameters will require an individual evaluation, if detected.

- Inorganics SW-846 Methods 6010a/6010b and 7000a Series-- Thallium
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-methyl-4,6-dinitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-nitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 4-chlorophenyl phenyl ether
- Volatile Organic Compounds SW-846 Methods 8260a/8260b-- 2-hexanone

Step 4. Define the Study Boundaries

(1) Characteristics that define the population of interest

Soil is assumed to be a homogeneous layer of the land surface. Therefore, soil typically will be found everywhere there is not an obstruction to the land surface such as a building, significant vegetation, concrete, or water. Soil extends down into the groundwater. In the Key West area, soil is typically found at the surface and is supported by underlying limestone 8 to 12 feet below the land surface.

(2) Spatial boundary of the decision statement

(a) Define the geographic area to which the decision statement applies.

Decisions apply to the soil within the subzone.

(b) When appropriate, divide the population into strata that have relatively homogeneous characteristics.

Stratification is not necessary since the soil within the subzone is assumed to homogeneous.

(3) Temporal boundary of the decision statement

(a) Determine the timeframe to which the decision applies.

It will be assumed that the sample data represents the current concentration of chemicals present within the soil.

(b) Determine when to collect data.

Samples will be collected during the daylight hours.

(4) Scale of the decision statement

The scale of the decision-making will be at the subzone level.

(5) Physical constraints on data collection

The ability to easily sample soil could increase the cost of sampling. Special equipment such as a direct-push unit or power auger are r equired to take samples in surface soil.

Step 5. Develop a Decision Rule

Decision Rule

If the mean chemical concentration in the soil is less than the action level, soil will be considered uncontaminated and no action will be taken. If the mean chemical concentration in the soil exceeds the action level, further study of the soil will be considered.

The following elements will be considered in the development of the decision rule:

(1) The statistical parameter that characterizes the population of interest

The planning team is interested in the mean concentration of VOCs, SVOCs, and inorganics being analyzed in the soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Oil Container (pre1942) and Scrap Metal and Refugee Item Storage Areas.

(2) The action levels for the study

Various sources of information were used in defining the appropriate action level for each parameter.For VOCs, SVOCs, and PCBs, the most conservative legal requirement will be adopted as the action level. In the event that no legal level has been established, the most conservative guidance level will be employed. For inorganics commonly detected in background in the vicinity of NAS Key West, twice the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. Likewise for pesticide compounds detected in background, the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. In the event that no legal, guidance or background concentrations are available for a parameter, the planning team needs to agree on a reasonable basis for action. Based on the criteria discussed here, action levels have been selected for each of the parameters that will be evaluated at Zone C - Truman Annex DRMO Waste Storage Area, Former Oil Container (pre1942) and Scrap Metal and Refugee Item Storage Areas. Parameters which may specifically require the attention of the planning team are identified here with the notation 'NA' and are also presented in Step 3 under 'Measurement methods for analytical data'.

Inorganics (mg/kg)		
Aluminum	75000	FDEP Residential Goals
Antimony	26	FDEP Residential Goals
Arsenic	2.66	2x Avg Background
Barium	5200	FDEP Residential Goals
Beryllium	0.2	FDEP Residential Goals
Cadmium	37	FDEP Residential Goals
Calcium	0	NA
Chromium	290	FDEP Residential Goals
Cobalt	4700	FDEP Residential Goals
Copper	3100	Residential Soil RBCs
Iron	23000	Residential Soil RBCs
Lead	500	FDEP Residential Goals
Magnesium	0	NA
Manganese	370	FDEP Residential Goals
Mercury	23	FDEP Residential Goals
Nickel	1500	FDEP Residential Goals
Potassium	0	NA
Selenium	390	FDEP Residential Goals
Silver	390	FDEP Residential Goals
Sodium	0	NA
Thallium	0	NA
Tin	44000	FDEP Residential Goals
Vanadium	490	FDEP Residential Goals
Zinc	23000	FDEP Residential Goals
Semivolatile Organic Compounds (ug/kg)		
1,2,4-trichlorobenzene	780000	Residential Soil RBCs
2,4,5-trichlorophenol	7100000	FDEP Residential Goals
2,4,6-trichlorophenol	87000	FDEP Residential Goals
2,4-dichlorophenol	220000	FDEP Residential Goals
2,4-dimethylphenol	1200000	FDEP Residential Goals
2,4-dinitrophenol	160000	Residential Soil RBCs
2,4-dinitrotoluene	130000	FDEP Residential Goals
2,6-dinitrotoluene	71000	FDEP Residential Goals
2-chloronaphthalene	560000	FDEP Residential Goals
2-chlorophenol	280000	FDEP Residential Goals
2-methyl-4,6-dinitrophenol	0	NA
2-methylnaphthalene	960000	FDEP Residential Goals
2-methylphenol	2600000	FDEP Residential Goals
2-nitroaniline	4000	FDEP Residential Goals
2-nitrophenol	0	NA
3 & 4-methylphenol	340000	FDEP Residential Goals
3,3'-dichlorobenzidine	1400	Residential Soil RBCs
3-nitroaniline	230000	Residential Soil RBCs
4-bromophenyl phenyl ether	4500000	Residential Soil RBCs
4-chloro-3-methylphenol	1.4E+08	FDEP Residential Goals
4-chloroaniline	240000	FDEP Residential Goals
4-chlorophenyl phenyl ether	0	NA
4-nitroaniline	230000	FDEP Residential Goals
4-nitrophenol	4800000	Residential Soil RBCs
Acenaphthene	2800000	FDEP Residential Goals
Acenaphthylene	670000	FDEP Residential Goals
Anthracene	20000000	FDEP Residential Goals
Benzo(a)anthracene	1400	FDEP Residential Goals
Benzo(a)pyrene	100	FDEP Residential Goals
Benzo(b)fluoranthene	1400	FDEP Residential Goals
Benzo(g,h,i)perylene	14000	FDEP Residential Goals
Benzo(k)fluoranthene	14000	FDEP Residential Goals
Bis(2-chloroethoxy)methane	170000	FDEP Residential Goals
Bis(2-chloroethyl)ether	500	FDEP Residential Goals
Bis(2-ethylhexyl)phthalate	48000	FDEP Residential Goals
Butyl benzyl phthalate	15000000	FDEP Residential Goals
Carbazole	42000	FDEP Residential Goals
Chrysene	140000	FDEP Residential Goals
Di-n-butyl phthalate	7300000	FDEP Residential Goals
Di-n-octyl phthalate	1500000	FDEP Residential Goals
Dibenzo(a,h)anthracene	100	FDEP Residential Goals
Dibenzofuran	240000	FDEP Residential Goals
Diethyl phthalate	56000000	FDEP Residential Goals

Dimethyl phthalate	6.3E+08	FDEP Residential Goals
Fluoranthene	2900000	FDEP Residential Goals
Fluorene	2400000	FDEP Residential Goals
Hexachlorobenzene	600	FDEP Residential Goals
Hexachlorobutadiene	3100	FDEP Residential Goals
Hexachlorocyclopentadiene	550000	Residential Soil RBCs
Hexachloroethane	27000	FDEP Residential Goals
Indeno(1,2,3-cd)pyrene	1400	FDEP Residential Goals
Isophorone	670000	Residential Soil RBCs
n-nitrosodiphenylamine	73000	FDEP Residential Goals
Naphthalene	1300000	FDEP Residential Goals
Nitrobenzene	22000	FDEP Residential Goals
Pentachlorophenol	5400	FDEP Residential Goals
Phenanthrene	1700000	FDEP Residential Goals
Phenol	34000000	FDEP Residential Goals
Pyrene	2200000	FDEP Residential Goals
Volatile Organic Compounds (ug/kg)		
1,1,1-trichloroethane	610000	FDEP Residential Goals
1,1,2,2-tetrachloroethane	900	FDEP Residential Goals
1,1,2-trichloroethane	2000	FDEP Residential Goals
1,1-dichloroethane	310000	FDEP Residential Goals
1,1-dichloroethene	100	FDEP Residential Goals
1,2-dichloroethane	700	FDEP Residential Goals
1,2-dichloropropane	800	FDEP Residential Goals
2-butanone	2200000	FDEP Residential Goals
2-hexanone	0	NA
4-methyl-2-pentanone	520000	FDEP Residential Goals
Acetone	260000	FDEP Residential Goals
Benzene	1400	FDEP Residential Goals
Bromodichloromethane	700	FDEP Residential Goals
Bromoform	65000	FDEP Residential Goals
Bromomethane	110000	Residential Soil RBCs
Carbon disulfide	5200	FDEP Residential Goals
Carbon tetrachloride	600	FDEP Residential Goals
Chlorobenzene	44000	FDEP Residential Goals
Chloroethane	31000000	Residential Soil RBCs
Chloroform	600	FDEP Residential Goals
Chloromethane	200	FDEP Residential Goals
cis-1,2-dichloroethene	26000	FDEP Residential Goals
cis-1,3-dichloropropene	300	FDEP Residential Goals
Dibromochloromethane	1200	FDEP Residential Goals
Ethylbenzene	1400000	FDEP Residential Goals
Methylene chloride	16000	FDEP Residential Goals
Styrene	4100000	FDEP Residential Goals
Tetrachloroethene	12000	FDEP Residential Goals
Toluene	520000	FDEP Residential Goals
trans-1,2-dichloroethene	62000	FDEP Residential Goals
trans-1,3-dichloropropene	300	FDEP Residential Goals
Trichloroethene	6500	FDEP Residential Goals
Vinyl chloride	5	FDEP Residential Goals
Xylenes, total	13000000	FDEP Residential Goals

Step 6. Specify Tolerable Limits on Decision Errors

(1) Possible range of the parameter of interest

The range of parameters is expected to be below the selected action levels.

(2) Identify the decision errors and choose the null hypothesis

(a) Possible decision errors

(i) Deciding that the subzone is contaminated when it truly is not.
(ii) Deciding that the subzone is not contaminated when it truly is.

(b) True state of nature for each decision error

(i) The true state of nature for decision error (i) is that the subzone is not contaminated.
(ii) The true state of nature for decision error (ii) is that the subzone is contaminated.

(c) Potential consequences of each decision error

(i) The potential consequences of deciding that the subzone is contaminated when it truly is not include the expenditure of money and effort on additional studies, monitoring, or remediation when they are not really necessary. Additionally, the Navy will have to delay realignment of the site until the issue of the potential contamination is properly addressed and resolved.

(ii) The potential consequences of deciding that the subzone is not contaminated when it really is will be that the Navy may realign a property that contains levels of contamination that could possibly endanger human health or the environment. In this situation, the Navy may be liable for future damages and environmental cleanup costs. Also, the reputation of the Navy might be damaged.

(d) Which decision error has more severe consequences near the action level?

Decision error (ii) has more severe consequences near the action level since the risk of jeopardizing human health outweighs the consequences of additional expense to the Navy.

(e) Define the null hypothesis and the alternative hypothesis

(i) Null Hypothesis: The soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Oil Container (pre1942) and Scrap Metal and Refugee Item Storage Areas is not contaminated.

(ii) Alternative Hypothesis: The soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Oil Container (pre1942) and Scrap Metal and Refugee Item Storage Areas is contaminated.

(f) Assignment of terms "false positive" and "false negative" to the appropriate decision error

(i) A false positive occurs when the null hypothesis is rejected but is actually true. In this case, a false positive decision error occurs when the decision maker decides that the soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Oil Container (pre1942) and Scrap Metal and Refugee Item Storage Areas is contaminated when it truly is not.

(ii) A false negative occurs when the null hypothesis is not rejected but is truly false. In this case, a false negative decision error occurs when the decision maker decides that the soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Oil Container (pre1942) and Scrap Metal and Refugee Item Storage Areas is not contaminated when it truly is.

(3) Range of possible values of parameters of interest where the consequences of decision errors are relatively minor (gray region)

For soil, the planning team has selected a gray region of 1.5 times the action level for each parameter.

(4) Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors

The planning team has assumed a 5 percent decision error rate.

Step 7. Optimize the Design

(1) Review the DQO outputs and existing environmental data

Because the statistician has participated in the DQO process for this problem, there is no need to review the DQO outputs further.

(2) Develop general data collection design alternatives

Simple random sampling will be used except in areas where site history or existing data indicate a likely area of contamination that will require a biased approach to sample design.

(3) For each data collection design alternative, select the optimal sample size that satisfies the DQOs

The formula for determining the sample size is chosen based on the hypothesis test and data collection design. The Gilbert's equation is the standard formula utilized to select the optimal sample size. Based on this formula, the optimal number of soil samples is four.

(4) Select the most resource-effective data collection design that satisfies the DQOs

Simple random sampling will be performed in the subzone based on the number of samples determined by Gilbert's equation. This is the only method that meets the DQOs established for this project.

(5) Document the operational details and theoretical sampling assumptions of the selected design in the sampling and analysis plan

Unless site history or existing data indicate a probable area of contamination that would be best delineated through a biased approach, a random sample design will be used to determine whether the soil is contaminated in excess of the action levels. Four discrete samples should be collected and analyzed at the laboratory. Sample locations will be randomly generated.

Zone C - Truman Annex DRMO Waste Storage Area

Subzone GRYZNC-SZN4-- Soil-- Former Scrap Metal Storage Area (former DRMO)

Step 1. State the Problem

(1) Planning Team Members

- Chuck Bryan- Brown and Root Environmental
- Scott Flickinger- Brown and Root Environmental
- Brian Lewis- Brown and Root Environmental
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(2) Decision Makers- NAS Key West Tier I Partnering Team

- Martha Berry- EPA Region IV
- Chuck Bryan- Brown and Root Environmental
- Jorge Caspary- FDEP
- Ron Demes- NAS Key West
- Roy Hoekstra- Bechtel
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(3) Problem Statement

Potential contamination in soil (metal debris) from past metal storage activities.

(4) Available Resources and Deadlines

Budget-	$200,000
Deadline-	9/29/97
Personnel-	Listed above as Planning Team and Decision Makers
Guidance-	DQO Process (EPA QA/G-4); Data Quality Assessment (EPA QA/G-9)
Site Knowledge-	RFI/RI and CMS fieldwork; EBS; RAB Meeting Support
Experience-	Prior workplan review and preparation experience on the part of Planning Team and Decision Makers

Step 2. Identify the Decision

(1) Principal study question

Is the soil contaminated by inorganics?

(2) Alternative actions that could result from resolution of the principal question

(a) No further action
(b) Further action
  (i) Additional sampling
  (ii) RI/FS
  (iii) IRA and RI/FS

(3) Decision Statement

Determine whether or not soil is contaminated (by inorganics) whether (1) no action will be taken or (2) further study is needed (e.g., additional sampling or place Zone C - Truman Annex DRMO Waste Storage Area, Former Scrap Metal Storage Area (former DRMO) in RI/FS or IRA and RI/FS program).

Step 3. Identify the Inputs to the Decision

(1) Information needed to resolve the decision

(a) Background information on site
(b) Existing soil analytical data
(c) New soil analytical data
(d) Statistical analyses

(2) Sources of the information needed to resolve the decision

(a) Background Information
  (i) Existing documents (reports, drawings, maps, etc.)
   – U.S. Navy - Naval Air Station (USN - NAS) Key West. Condition Map of NAS Key West, No drawing number. 1942.
   – U.S. Navy - Naval Air Station (USN - NAS) Key West. Predraft EBS Truman Annex; Excess Property. 1996d.
   – U.S. Navy - Naval Air Station (USN - NAS) Key West. PWO Dwg No. P- 2536; Master Shore Station Development Plan; Utilities Fresh/Salt Water Distribution, Dwg. No. P-2536 - 752891. 1957e.
  (ii) Site visits (reports, drawings, maps, etc.)
   – Brown and Root Environmental (B&R Environmental). B&RE/Navy Site Visit. 1996a.
   – Brown and Root Environmental (B&R Environmental). Partners Site Visit and Teleconference. 1997b.
  (iii) Current/on-going activities
(b) Existing soil analytical data

(c) New soil analytical data

Through the following analytical methods, the planning team needs to obtain measurements of inorganics in soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Scrap Metal Storage Area (former DRMO).

- Metals; SW-846 Methods 6010a/6010b and 7000a series

(d) Statistical Analyses

(i) Student's t-test

(ii) Variance of background data set

(3) Information necessary for establishing action levels

(a) Legal action levels

- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.

(b) Guidance action levels

- Residential Soil RBCs-- U. S. Environmental Protection Agency (EPA), Risk-Based Concentration Table, 1997.

(c) Background Concentrations

A subset of applicable background data has been extracted from the Comprehensive Background Report for NAS Key West (Appendix H of the Supplemental RFI/RI for Eight Sites, 1997).

(4) Measurement Methods for Analytical data

The appropriate measurement methods have been selected, as stated above. In order to adequately resolve the decision, method detection limits must be less than action levels. This will be ensured by supplying the selected action levels with the statement of laboratory Statement of Work. In the event that it is not is not technically possible to achieve a low enough MDL for a given parameter with the selected method, the partnering team will evaluate the results on a case-by-case basis, using frequency of detection to determine whether detected concentrations represent significant contamination. Action levels were not available for some parameters, as shown below. Regardless of MDL, these parameters will require an individual evaluation, if detected.

- Inorganics SW-846 Methods 6010a/6010b and 7000a Series-- Thallium

Step 4. Define the Study Boundaries

(1) Characteristics that define the population of interest

Soil is assumed to be a homogeneous layer of the land surface. Therefore, soil typically will be found everywhere there is not an obstruction to the land surface such as a building, significant vegetation, concrete, or water. Soil extends down into the groundwater. In the Key West area, soil is typically found at the surface and is supported by underlying limestone 8 to 12 feet below the land surface.

(2) Spatial boundary of the decision statement

(a) Define the geographic area to which the decision statement applies.

Decisions apply to the soil within the subzone.

(b) When appropriate, divide the population into strata that have relatively homogeneous characteristics.

Stratification is not necessary since the soil within the subzone is assumed to homogeneous.

(3) Temporal boundary of the decision statement

(a) Determine the timeframe to which the decision applies.

It will be assumed that the sample data represents the current concentration of chemicals present within the soil.

(b) Determine when to collect data.

Samples will be collected during the daylight hours.

(4) Scale of the decision statement

The scale of the decision-making will be at the subzone level.

(5) Physical constraints on data collection

The ability to easily sample soil could increase the cost of sampling. Special equipment such as a direct-push unit or power auger are required to take samples in surface soil.

Step 5. Develop a Decision Rule

Decision Rule

If the mean chemical concentration in the soil is less than the action level, soil will be considered uncontaminated and no action will be taken. If the mean chemical concentration in the soil exceeds the action level, further study of the soil will be considered.

The following elements will be considered in the development of the decision rule:

(1) The statistical parameter that characterizes the population of interest

The planning team is interested in the mean concentration of inorganics being analyzed in the soil at Zone C - Truman Annex DRMO

Waste Storage Area, Former Scrap Metal Storage Area (former DRMO).

(2) The action levels for the study

Various sources of information were used in defining the appropriate action level for each parameter.For VOCs, SVOCs, and PCBs, the most conservative legal requirement will be adopted as the action level. In the event that no legal level has been established, the most conservative guidance level will be employed. For inorganics commonly detected in background in the vicinity of NAS Key West, twice the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. Likewise for pesticide compounds detected in background, the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. In the event that no legal, guidance or background concentrations are available for a parameter, the planning team needs to agree on a reasonable basis for action. Based on the criteria discussed here, action levels have been selected for each of the parameters that will be evaluated at Zone C - Truman Annex DRMO Waste Storage Area, Former Scrap Metal Storage Area (former DRMO). Parameters which may specifically require the attention of the planning team are identified here with the notation 'NA' and are also presented in Step 3 under 'Measurement methods for analytical data'.

Inorganics (mg/kg)

Aluminum	75000	FDEP Residential Goals
Antimony	26	FDEP Residential Goals
Arsenic	2.66	2x Avg Background
Barium	5200	FDEP Residential Goals
Beryllium	0.2	FDEP Residential Goals
Cadmium	37	FDEP Residential Goals
Calcium	0	NA
Chromium	290	FDEP Residential Goals
Cobalt	4700	FDEP Residential Goals
Copper	3100	Residential Soil RBCs
Iron	23000	Residential Soil RBCs
Lead	500	FDEP Residential Goals
Magnesium	0	NA
Manganese	370	FDEP Residential Goals
Mercury	23	FDEP Residential Goals
Nickel	1500	FDEP Residential Goals
Potassium	0	NA
Selenium	390	FDEP Residential Goals
Silver	390	FDEP Residential Goals
Sodium	0	NA
Thallium	0	NA
Tin	44000	FDEP Residential Goals
Vanadium	490	FDEP Residential Goals
Zinc	23000	FDEP Residential Goals

Step 6. Specify Tolerable Limits on Decision Errors

(1) Possible range of the parameter of interest

The range of parameters is expected to be below the selected action levels.

(2) Identify the decision errors and choose the null hypothesis

(a) Possible decision errors

(i) Deciding that the subzone is contaminated when it truly is not.
(ii) Deciding that the subzone is not contaminated when it truly is.

(b) True state of nature for each decision error

(i) The true state of nature for decision error (i) is that the subzone is not contaminated.
(ii) The true state of nature for decision error (ii) is that the subzone is contaminated.

(c) Potential consequences of each decision error

(i) The potential consequences of deciding that the subzone is contaminated when it truly is not include the expenditure of money and effort on additional studies, monitoring, or remediation when they are not really necessary. Additionally, the Navy will have to delay realignment of the site until the issue of the potential contamination is properly addressed and resolved.
(ii) The potential consequences of deciding that the subzone is not contaminated when it really is will be that the Navy may realign a property that contains levels of contamination that could possibly endanger human health or the environment. In this situation, the Navy may be liable for future damages and environmental cleanup costs. Also, the reputation of the Navy might be damaged.

(d) Which decision error has more severe consequences near the action level?

Decision error (ii) has more severe consequences near the action level since the risk of jeopardizing human health outweighs the consequences of additional expense to the Navy.

(e) Define the null hypothesis and the alternative hypothesis

(i) Null Hypothesis: The soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Scrap Metal Storage Area (former DRMO) is not contaminated.

(ii) Alternative Hypothesis: The soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Scrap Metal Storage Area (former DRMO) is contaminated.

(f) Assignment of terms "false positive" and "false negative" to the appropriate decision error

(i) A false positive occurs when the null hypothesis is rejected but is actually true. In this case, a false positive decision error occurs when the decision maker decides that the soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Scrap Metal Storage Area (former DRMO) is contaminated when it truly is not.

(ii) A false negative occurs when the null hypothesis is not rejected but is truly false. In this case, a false negative decision error occurs when the decision maker decides that the soil at Zone C - Truman Annex DRMO Waste Storage Area, Former Scrap Metal Storage Area (former DRMO) is not contaminated when it truly is.

(3) Range of possible values of parameters of interest where the consequences of decision errors are relatively minor (gray region)

For soil, the planning team has selected a gray region of 1.5 times the action level for each parameter.

(4) Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors

The planning team has assumed a 5 percent decision error rate.

Step 7. Optimize the Design

(1) Review the DQO outputs and existing environmental data

Because the statistician has participated in the DQO process for this problem, there is no need to review the DQO outputs further.

(2) Develop general data collection design alternatives

Simple random sampling will be used except in areas where site history or existing data indicate a likely area of contamination that will require a biased approach to sample design.

(3) For each data collection design alternative, select the optimal sample size that satisfies the DQOs

The formula for determining the sample size is chosen based on the hypothesis test and data collection design. The Gilbert's equation is the standard formula utilized to select the optimal sample size. Based on this formula, the optimal number of soil samples is four.

(4) Select the most resource-effective data collection design that satisfies the DQOs

Simple random sampling will be performed in the subzone based on the number of samples determined by Gilbert's equation. This is the only method that meets the DQOs established for this project.

(5) Document the operational details and theoretical sampling assumptions of the selected design in the sampling and analysis plan

Unless site history or existing data indicate a probable area of contamination that would be best delineated through a biased approach, a random sample design will be used to determine whether the soil is contaminated in excess of the action levels. Four discrete samples should be collected and analyzed at the laboratory. Sample locations will be randomly generated.

Zone E - Truman Annex Buildings 102, 103 and 104

Subzone GRYZNE-SZN2-- Soil-- Former Building 136

Step 1. State the Problem

(1) Planning Team Members

- Chuck Bryan- Brown and Root Environmental
- Scott Flickinger- Brown and Root Environmental
- Brian Lewis- Brown and Root Environmental
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(2) Decision Makers- NAS Key West Tier I Partnering Team

- Martha Berry- EPA Region IV
- Chuck Bryan- Brown and Root Environmental
- Jorge Caspary- FDEP
- Ron Demes- NAS Key West
- Roy Hoekstra- Bechtel
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(3) Problem Statement

Potential contamination in soil (debris, lead, metals, solvents, oils) from building operations from Plate and Mold Shop and demolished Building 136 buried onsite.

(4) Available Resources and Deadlines

Budget-	$200,000
Deadline-	9/29/97
Personnel-	Listed above as Planning Team and Decision Makers
Guidance-	DQO Process (EPA QA/G-4); Data Quality Assessment (EPA QA/G-9)
Site Knowledge-	RFI/RI and CMS fieldwork; EBS; RAB Meeting Support
Experience-	Prior workplan review and preparation experience on the part of Planning Team and Decision Makers

Step 2. Identify the Decision

(1) Principal study question

Is the soil contaminated by VOCs, SVOCs, and inorganics?

(2) Alternative actions that could result from resolution of the principal question

(a) No further action
(b) Further action
  (i) Additional sampling
  (ii) RI/FS
  (iii) IRA and RI/FS

(3) Decision Statement

Determine whether or not soil is contaminated (by VOCs, SVOCs, and inorganics) whether (1) further study is needed (e.g., additional sampling or place Subzone E in RI/FS or IRA and RI/FS program) or (2) no action will be taken.

Step 3. Identify the Inputs to the Decision

(1) Information needed to resolve the decision

(a) Background information on site
(b) Existing soil analytical data
(c) New soil analytical data
(d) Statistical analyses

(2) Sources of the information needed to resolve the decision

(a) Background Information
  (i) Existing documents (reports, drawings, maps, etc.)
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Condition Map of NAS Key West, No drawing number. 1942.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Draft EBS Truman Annex Outer Mole Pier 8/Bldgs 149, 1374, 4080. 1997a.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Predraft EBS Truman Annex; Excess Property. 1996d.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. PWO Dwg No. 2534; Master Shore Station Development Plan; Utilities Distilled and Softened Water, Dwg. No. P-2534 - 752889. 1957c.

  (ii) Site visits (reports, drawings, maps, etc.)
  - Brown and Root Environmental (B&R Environmental). B&RE/Navy Site Visit. 1996a.

- Brown and Root Environmental (B&R Environmental). Partners Site Visit and Teleconference. 1997b.

(iii) Current/on-going activities

(b) Existing soil analytical data

(c) New soil analytical data

Through the following analytical methods, the planning team needs to obtain measurements of VOCs, SVOCs, and inorganics in soil at Zone E - Truman Annex Buildings 102, 103 and 104, Former Building 136.

- Metals; SW-846 Methods 6010a/6010b and 7000a series
- Semivolatile Organic Compounds; SW-846 Methods 8270b/8270c
- Volatile Organic Compounds; SW-846 Methods 8260a/8260b

(d) Statistical Analyses

(i) Student's t-test

(ii) Variance of background data set

(3) Information necessary for establishing action levels

(a) Legal action levels

- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.

(b) Guidance action levels

- Residential Soil RBCs-- U. S. Environmental Protection Agency (EPA), Risk-Based Concentration Table, 1997.

(c) Background Concentrations

A subset of applicable background data has been extracted from the Comprehensive Background Report for NAS Key West (Appendix H of the Supplemental RFI/RI for Eight Sites, 1997).

(4) Measurement Methods for Analytical data

The appropriate measurement methods have been selected, as stated above. In order to adequately resolve the decision, method detection limits must be less than action levels. This will be ensured by supplying the selected action levels with the statement of laboratory Statement of Work. In the event that it is not is not technically possible to achieve a low enough MDL for a given parameter with the selected method, the partnering team will evaluate the results on a case-by-case basis, using frequency of detection to determine whether detected concentrations represent significant contamination. Action levels were not available for some parameters, as shown below. Regardless of MDL, these parameters will require an individual evaluation, if detected.

- Inorganics SW-846 Methods 6010a/6010b and 7000a Series-- Thallium
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-methyl-4,6-dinitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-nitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 4-chlorophenyl phenyl ether
- Volatile Organic Compounds SW-846 Methods 8260a/8260b-- 2-hexanone

Step 4. Define the Study Boundaries

(1) Characteristics that define the population of interest

Soil is assumed to be a homogeneous layer of the land surface. Therefore, soil typically will be found everywhere there is not an obstruction to the land surface such as a building, significant vegetation, concrete, or water. Soil extends down into the groundwater. In the Key West area, soil is typically found at the surface and is supported by underlying limestone 8 to 12 feet below the land surface.

(2) Spatial boundary of the decision statement

(a) Define the geographic area to which the decision statement applies.

Decisions apply to the soil within the subzone.

(b) When appropriate, divide the population into strata that have relatively homogeneous characteristics.

Stratification is not necessary since the soil within the subzone is assumed to homogeneous.

(3) Temporal boundary of the decision statement

(a) Determine the timeframe to which the decision applies.

It will be assumed that the sample data represents the current concentration of chemicals present within the soil.

(b) Determine when to collect data.

Samples will be collected during the daylight hours.

(4) Scale of the decision statement

The scale of the decision-making will be at the subzone level.

(5) Physical constraints on data collection

The ability to easily sample soil could increase the cost of sampling. Special equipment such as a direct-push unit or power auger are required to take samples in surface soil.

Step 5. Develop a Decision Rule

Decision Rule

If the mean chemical concentration in the soil is less than the action level, soil will be considered uncontaminated and no action will be taken. If the mean chemical concentration in the soil exceeds the action level, further study of the soil will be considered.

The following elements will be considered in the development of the decision rule:

(1) The statistical parameter that characterizes the population of interest

The planning team is interested in the mean concentration of VOCs, SVOCs, and inorganics being analyzed in the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Former Building 136.

(2) The action levels for the study

Various sources of information were used in defining the appropriate action level for each parameter.For VOCs, SVOCs, and PCBs, the most conservative legal requirement will be adopted as the action level. In the event that no legal level has been established, the most conservative guidance level will be employed. For inorganics commonly detected in background in the vicinity of NAS Key West, twice the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. Likewise for pesticide compounds detected in background, the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. In the event that no legal, guidance or background concentrations are available for a parameter, the planning team needs to agree on a reasonable basis for action. Based on the criteria discussed here, action levels have been selected for each of the parameters that will be evaluated at Zone E - Truman Annex Buildings 102, 103 and 104, Former Building 136. Parameters which may specifically require the attention of the planning team are identified here with the notation 'NA' and are also presented in Step 3 under 'Measurement methods for analytical data'.

Inorganics (mg/kg)		
Aluminum	1000000	FDEP Industrial Goals
Antimony	220	FDEP Industrial Goals
Arsenic	3.7	FDEP Industrial Goals
Barium	84000	FDEP Industrial Goals
Beryllium	1	FDEP Industrial Goals
Cadmium	600	FDEP Industrial Goals
Calcium	0	NA
Chromium	430	FDEP Industrial Goals
Cobalt	110000	FDEP Industrial Goals
Copper	3100	Residential Soil RBCs
Iron	23000	Residential Soil RBCs
Lead	1000	FDEP Industrial Goals
Magnesium	0	NA
Manganese	5500	FDEP Industrial Goals
Mercury	480	FDEP Industrial Goals
Nickel	26000	FDEP Industrial Goals
Potassium	0	NA
Selenium	9900	FDEP Industrial Goals
Silver	9000	FDEP Industrial Goals
Sodium	0	NA
Thallium	0	NA
Tin	670000	FDEP Industrial Goals
Vanadium	4800	FDEP Industrial Goals
Zinc	560000	FDEP Industrial Goals
Semivolatile Organic Compounds (ug/kg)		
1,2,4-trichlorobenzene	780000	Residential Soil RBCs
2,4,5-trichlorophenol	1.3E+08	FDEP Industrial Goals
2,4,6-trichlorophenol	280000	FDEP Industrial Goals
2,4-dichlorophenol	4000000	FDEP Industrial Goals
2,4-dimethylphenol	16000000	FDEP Industrial Goals
2,4-dinitrophenol	160000	Residential Soil RBCs
2,4-dinitrotoluene	2000000	FDEP Industrial Goals
2,6-dinitrotoluene	1300000	FDEP Industrial Goals
2-chloronaphthalene	4000000	FDEP Industrial Goals
2-chlorophenol	3700000	FDEP Industrial Goals
2-methyl-4,6-dinitrophenol	0	NA
2-methylnaphthalene	8800000	FDEP Industrial Goals
2-methylphenol	32000000	FDEP Industrial Goals
2-nitroaniline	73000	FDEP Industrial Goals
2-nitrophenol	0	NA
3 & 4-methylphenol	5500000	FDEP Industrial Goals
3,3'-dichlorobenzidine	1400	Residential Soil RBCs
3-nitroaniline	230000	Residential Soil RBCs
4-bromophenyl phenyl ether	4500000	Residential Soil RBCs
4-chloro-3-methylphenol	1E+09	FDEP Industrial Goals
4-chloroaniline	3300000	FDEP Industrial Goals
4-chlorophenyl phenyl ether	0	NA
4-nitroaniline	4700000	FDEP Industrial Goals
4-nitrophenol	4800000	Residential Soil RBCs
Acenaphthene	30000000	FDEP Industrial Goals
Acenaphthylene	5600000	FDEP Industrial Goals
Anthracene	3E+08	FDEP Industrial Goals
Benzo(a)anthracene	4900	FDEP Industrial Goals
Benzo(a)pyrene	500	FDEP Industrial Goals
Benzo(b)fluoranthene	5000	FDEP Industrial Goals
Benzo(g,h,i)perylene	50000	FDEP Industrial Goals
Benzo(k)fluoranthene	48000	FDEP Industrial Goals
Bis(2-chloroethoxy)methane	3000000	FDEP Industrial Goals
Bis(2-chloroethyl)ether	900	FDEP Industrial Goals
Bis(2-ethylhexyl)phthalate	110000	FDEP Industrial Goals
Butyl benzyl phthalate	3.1E+08	FDEP Industrial Goals
Carbazole	120000	FDEP Industrial Goals
Chrysene	500000	FDEP Industrial Goals
Di-n-butyl phthalate	1.4E+08	FDEP Industrial Goals
Di-n-octyl phthalate	32000000	FDEP Industrial Goals
Dibenzo(a,h)anthracene	500	FDEP Industrial Goals

Dibenzofuran	3500000	FDEP Industrial Goals
Diethyl phthalate	9.7E+08	FDEP Industrial Goals
Dimethyl phthalate	1E+09	FDEP Industrial Goals
Fluoranthene	48000000	FDEP Industrial Goals
Fluorene	30000000	FDEP Industrial Goals
Hexachlorobenzene	1600	FDEP Industrial Goals
Hexachlorobutadiene	4900	FDEP Industrial Goals
Hexachlorocyclopentadiene	550000	Residential Soil RBCs
Hexachloroethane	120000	FDEP Industrial Goals
Indeno(1,2,3-cd)pyrene	5000	FDEP Industrial Goals
Isophorone	670000	Residential Soil RBCs
n-nitrosodiphenylamine	130000	FDEP Industrial Goals
Naphthalene	12000000	FDEP Industrial Goals
Nitrobenzene	250000	FDEP Industrial Goals
Pentachlorophenol	12000	FDEP Industrial Goals
Phenanthrene	21000000	FDEP Industrial Goals
Phenol	4.4E+08	FDEP Industrial Goals
Pyrene	41000000	FDEP Industrial Goals
Volatile Organic Compounds (ug/kg)		
1,1,1-trichloroethane	4300000	FDEP Industrial Goals
1,1,2,2-tetrachloroethane	1400	FDEP Industrial Goals
1,1,2-trichloroethane	3000	FDEP Industrial Goals
1,1-dichloroethane	2100000	FDEP Industrial Goals
1,1-dichloroethene	100	FDEP Industrial Goals
1,2-dichloroethane	1000	FDEP Industrial Goals
1,2-dichloropropane	1200	FDEP Industrial Goals
2-butanone	15000000	FDEP Industrial Goals
2-hexanone	0	NA
4-methyl-2-pentanone	3700000	FDEP Industrial Goals
Acetone	1800000	FDEP Industrial Goals
Benzene	2000	FDEP Industrial Goals
Bromodichloromethane	1000	FDEP Industrial Goals
Bromoform	130000	FDEP Industrial Goals
Bromomethane	110000	Residential Soil RBCs
Carbon disulfide	34000	FDEP Industrial Goals
Carbon tetrachloride	800	FDEP Industrial Goals
Chlorobenzene	300000	FDEP Industrial Goals
Chloroethane	31000000	Residential Soil RBCs
Chloroform	800	FDEP Industrial Goals
Chloromethane	300	FDEP Industrial Goals
cis-1,2-dichloroethene	180000	FDEP Industrial Goals
cis-1,3-dichloropropene	400	FDEP Industrial Goals
Dibromochloromethane	1700	FDEP Industrial Goals
Ethylbenzene	10000000	FDEP Industrial Goals
Methylene chloride	23000	FDEP Industrial Goals
Styrene	34000000	FDEP Industrial Goals
Tetrachloroethene	28000	FDEP Industrial Goals
Toluene	3500000	FDEP Industrial Goals
trans-1,2-dichloroethene	430000	FDEP Industrial Goals
trans-1,3-dichloropropene	400	FDEP Industrial Goals
Trichloroethene	9300	FDEP Industrial Goals
Vinyl chloride	7	FDEP Industrial Goals
Xylenes, total	92000000	FDEP Industrial Goals

Step 6. Specify Tolerable Limits on Decision Errors

(1) Possible range of the parameter of interest

The range of parameters is expected to be above the selected action levels.

(2) Identify the decision errors and choose the null hypothesis

(a) Possible decision errors

(i) Deciding that the subzone is contaminated when it truly is not.
(ii) Deciding that the subzone is not contaminated when it truly is.

(b) True state of nature for each decision error

(i) The true state of nature for decision error (i) is that the subzone is not contaminated.
(ii) The true state of nature for decision error (ii) is that the subzone is contaminated.

(c) Potential consequences of each decision error

(i) The potential consequences of deciding that the subzone is contaminated when it truly is not include the expenditure of money and effort on additional studies, monitoring, or remediation when they are not really necessary. Additionally, the Navy will have to delay realignment of the site until the issue of the potential contamination is properly addressed and resolved.
(ii) The potential consequences of deciding that the subzone is not contaminated when it really is will be that the Navy may realign a property that contains levels of contamination that could possibly endanger human health or the environment. In this situation, the Navy may be liable for future damages and environmental cleanup costs. Also, the reputation of the Navy might be damaged.

(d) Which decision error has more severe consequences near the action level?

Decision error (ii) has more severe consequences near the action level since the risk of jeopardizing human health outweighs the consequences of additional expense to the Navy.

(e) Define the null hypothesis and the alternative hypothesis

(i) Null Hypothesis: The soil at Zone E - Truman Annex Buildings 102, 103 and 104, Former Building 136 is contaminated.

(ii) Alternative Hypothesis: The soil at Zone E - Truman Annex Buildings 102, 103 and 104, Former Building 136 is not contaminated.

(f) Assignment of terms "false positive" and "false negative" to the appropriate decision error

(i) A false positive occurs when the null hypothesis is rejected but is actually true. In this case, a false positive decision error occurs when the decision maker decides that the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Former Building 136 is not contaminated when it truly is.

(ii) A false negative occurs when the null hypothesis is not rejected but is truly false. In this case, a false negative decision error occurs when the decision maker decides that the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Former Building 136 is contaminated when it truly is not.

(3) Range of possible values of parameters of interest where the consequences of decision errors are relatively minor (gray region)

For soil, the planning team has selected a gray region of 1.5 times the action level for each parameter.

(4) Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors

The planning team has assumed a 5 percent decision error rate.

Step 7. Optimize the Design

(1) Review the DQO outputs and existing environmental data

Because the statistician has participated in the DQO process for this problem, there is no need to review the DQO outputs further.

(2) Develop general data collection design alternatives

Simple random sampling will be used except in areas where site history or existing data indicate a likely area of contamination that will require a biased approach to sample design.

(3) For each data collection design alternative, select the optimal sample size that satisfies the DQOs

The formula for determining the sample size is chosen based on the hypothesis test and data collection design. The Gilbert's equation is the standard formula utilized to select the optimal sample size. Based on this formula, the optimal number of soil samples is four.

(4) Select the most resource-effective data collection design that satisfies the DQOs

Simple random sampling will be performed in the subzone based on the number of samples determined by Gilbert's equation. This is the only method that meets the DQOs established for this project.

(5) Document the operational details and theoretical sampling assumptions of the selected design in the sampling and analysis plan

Unless site history or existing data indicate a probable area of contamination that would be best delineated through a biased approach, a random sample design will be used to determine whether the soil is contaminated in excess of the action levels. Four discrete samples should be collected and analyzed at the laboratory. Sample locations will be randomly generated.

Zone E - Truman Annex Buildings 102, 103 and 104

Subzone GRYZNE-SZN3-- Soil-- Buildings 102 and 104

Step 1. State the Problem

(1) Planning Team Members

- Chuck Bryan- Brown and Root Environmental
- Scott Flickinger- Brown and Root Environmental
- Brian Lewis- Brown and Root Environmental
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(2) Decision Makers- NAS Key West Tier I Partnering Team

- Martha Berry- EPA Region IV
- Chuck Bryan- Brown and Root Environmental
- Jorge Caspary- FDEP
- Ron Demes- NAS Key West
- Roy Hoekstra- Bechtel
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(3) Problem Statement

Potential contamination in soil (acids, solvents, fuel) from building operations.

(4) Available Resources and Deadlines

Budget-	$200,000
Deadline-	9/29/97
Personnel-	Listed above as Planning Team and Decision Makers
Guidance-	DQO Process (EPA QA/G-4); Data Quality Assessment (EPA QA/G-9)
Site Knowledge-	RFI/RI and CMS fieldwork; EBS; RAB Meeting Support
Experience-	Prior workplan review and preparation experience on the part of Planning Team and Decision Makers

Step 2. Identify the Decision

(1) Principal study question

Is the soil contaminated by VOCs, SVOCs, and Inorganics?

(2) Alternative actions that could result from resolution of the principal question

(a) No further action
(b) Further action
  (i) Additional sampling
  (ii) RI/FS
  (iii) IRA and RI/FS

(3) Decision Statement

No hypothesis was made

Step 3. Identify the Inputs to the Decision

(1) Information needed to resolve the decision

(a) Background information on site
(b) Existing soil analytical data
(c) New soil analytical data
(d) Statistical analyses

(2) Sources of the information needed to resolve the decision

(a) Background Information
  (i) Existing documents (reports, drawings, maps, etc.)
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Condition Map of NAS Key West, No drawing number. 1942.
  - U.S. Navy - Naval Facilities Engineering Command (USN - NFEC). Contamination Assessment Report (CAR) Addendum for Electric Power Plant Building 103. 1993a.
  - U.S. Navy - Naval Facilities Engineering Command (USN - NFEC). Contamination Assessment Report (CAR) for Electric Power Plant Building 103. 1992a.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Draft EBS Truman Annex Outer Mole Pier 8/Bldgs 149, 1374, 4080. 1997a.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Predraft EBS Truman Annex; Excess Property. 1996d.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. PWO Dwg No. 2534; Master Shore Station Development Plan; Utilities Distilled and Softened Water, Dwg. No. P-2534 - 752889. 1957c.

- U.S. Navy - Naval Facilities Engineering Command (USN - NFEC). Remedial Action Plan (RAP) for Electric Power Plant Building 103. 1994c.

(ii) Site visits (reports, drawings, maps, etc.)

- Brown and Root Environmental (B&R Environmental). B&RE/Navy Site Visit. 1996a.
- Brown and Root Environmental (B&R Environmental). Partners Site Visit and Teleconference. 1997b.

(iii) Current/on-going activities

(b) Existing soil analytical data

(c) New soil analytical data

Through the following analytical methods, the planning team needs to obtain measurements of VOCs, SVOCs, and Inorganics in soil at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 102 and 104.

- Metals; SW-846 Methods 6010a/6010b and 7000a series
- Semivolatile Organic Compounds; SW-846 Methods 8270b/8270c
- Volatile Organic Compounds; SW-846 Methods 8260a/8260b

(d) Statistical Analyses

(i) Student's t-test

(ii) Variance of background data set

(3) Information necessary for establishing action levels

(a) Legal action levels

- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.

(b) Guidance action levels

- Residential Soil RBCs-- U. S. Environmental Protection Agency (EPA), Risk-Based Concentration Table, 1997.

(c) Background Concentrations

A subset of applicable background data has been extracted from the Comprehensive Background Report for NAS Key West (Appendix H of the Supplemental RFI/RI for Eight Sites, 1997).

(4) Measurement Methods for Analytical data

The appropriate measurement methods have been selected, as stated above. In order to adequately resolve the decision, method detection limits must be less than action levels. This will be ensured by supplying the selected action levels with the statement of laboratory Statement of Work. In the event that it is not is not technically possible to achieve a low enough MDL for a given parameter with the selected method, the partnering team will evaluate the results on a case-by-case basis, using frequency of detection to determine whether detected concentrations represent significant contamination. Action levels were not available for some parameters, as shown below. Regardless of MDL, these parameters will require an individual evaluation, if detected.

- Inorganics SW-846 Methods 6010a/6010b and 7000a Series-- Thallium
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-methyl-4,6-dinitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-nitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 4-chlorophenyl phenyl ether
- Volatile Organic Compounds SW-846 Methods 8260a/8260b-- 2-hexanone

Step 4. Define the Study Boundaries

(1) Characteristics that define the population of interest

Soil is assumed to be a homogeneous layer of the land surface. Therefore, soil typically will be found everywhere there is not an obstruction to the land surface such as a building, significant vegetation, concrete, or water. Soil extends down into the groundwater. In the Key West area, soil is typically found at the surface and is supported by underlying limestone 8 to 12 feet below the land surface.

(2) Spatial boundary of the decision statement

(a) Define the geographic area to which the decision statement applies.

Decisions apply to the soil within the subzone.

(b) When appropriate, divide the population into strata that have relatively homogeneous characteristics.

Stratification is not necessary since the soil within the subzone is assumed to homogeneous.

(3) Temporal boundary of the decision statement

(a) Determine the timeframe to which the decision applies.

It will be assumed that the sample data represents the current concentration of chemicals present within the soil.

(b) Determine when to collect data.

Samples will be collected during the daylight hours.

(4) Scale of the decision statement

The scale of the decision-making will be at the subzone level.

(5) Physical constraints on data collection

The ability to easily sample soil could increase the cost of sampling. Special equipment such as a direct-push unit or power auger are required to take samples in surface soil.

Step 5. Develop a Decision Rule

Decision Rule

If the mean chemical concentration in the soil is less than the action level, soil will be considered uncontaminated and no action will be taken. If the mean chemical concentration in the soil exceeds the action level, further study of the soil will be considered.

The following elements will be considered in the development of the decision rule:

(1) The statistical parameter that characterizes the population of interest

The planning team is interested in the mean concentration of VOCs, SVOCs, and Inorganics being analyzed in the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 102 and 104.

(2) The action levels for the study

Various sources of information were used in defining the appropriate action level for each parameter.For VOCs, SVOCs, and PCBs, the most conservative legal requirement will be adopted as the action level. In the event that no legal level has been established, the most conservative guidance level will be employed. For inorganics commonly detected in background in the vicinity of NAS Key West, twice the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. Likewise for pesticide compounds detected in background, the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. In the event that no legal, guidance or background concentrations are available for a parameter, the planning team needs to agree on a reasonable basis for action. Based on the criteria discussed here, action levels have been selected for each of the parameters that will be evaluated at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 102 and 104. Parameters which may specifically require the attention of the planning team are identified here with the notation 'NA' and are also presented in Step 3 under 'Measurement methods for analytical data'.

Inorganics (mg/kg)		
Aluminum	1000000	FDEP Industrial Goals
Antimony	220	FDEP Industrial Goals
Arsenic	3.7	FDEP Industrial Goals
Barium	84000	FDEP Industrial Goals
Beryllium	1	FDEP Industrial Goals
Cadmium	600	FDEP Industrial Goals
Calcium	0	NA
Chromium	430	FDEP Industrial Goals
Cobalt	110000	FDEP Industrial Goals
Copper	3100	Residential Soil RBCs
Iron	23000	Residential Soil RBCs
Lead	1000	FDEP Industrial Goals
Magnesium	0	NA
Manganese	5500	FDEP Industrial Goals
Mercury	480	FDEP Industrial Goals
Nickel	26000	FDEP Industrial Goals
Potassium	0	NA
Selenium	9900	FDEP Industrial Goals
Silver	9000	FDEP Industrial Goals
Sodium	0	NA
Thallium	0	NA
Tin	670000	FDEP Industrial Goals
Vanadium	4800	FDEP Industrial Goals
Zinc	560000	FDEP Industrial Goals
Semivolatile Organic Compounds (ug/kg)		
1,2,4-trichlorobenzene	780000	Residential Soil RBCs
2,4,5-trichlorophenol	1.3E+08	FDEP Industrial Goals
2,4,6-trichlorophenol	280000	FDEP Industrial Goals
2,4-dichlorophenol	4000000	FDEP Industrial Goals
2,4-dimethylphenol	16000000	FDEP Industrial Goals
2,4-dinitrophenol	160000	Residential Soil RBCs
2,4-dinitrotoluene	2000000	FDEP Industrial Goals
2,6-dinitrotoluene	1300000	FDEP Industrial Goals
2-chloronaphthalene	4000000	FDEP Industrial Goals
2-chlorophenol	3700000	FDEP Industrial Goals
2-methyl-4,6-dinitrophenol	0	NA
2-methylnaphthalene	8800000	FDEP Industrial Goals
2-methylphenol	32000000	FDEP Industrial Goals
2-nitroaniline	73000	FDEP Industrial Goals
2-nitrophenol	0	NA
3 & 4-methylphenol	5500000	FDEP Industrial Goals
3,3'-dichlorobenzidine	1400	Residential Soil RBCs
3-nitroaniline	230000	Residential Soil RBCs
4-bromophenyl phenyl ether	4500000	Residential Soil RBCs
4-chloro-3-methylphenol	1E+09	FDEP Industrial Goals
4-chloroaniline	3300000	FDEP Industrial Goals
4-chlorophenyl phenyl ether	0	NA
4-nitroaniline	4700000	FDEP Industrial Goals
4-nitrophenol	4800000	Residential Soil RBCs
Acenaphthene	30000000	FDEP Industrial Goals
Acenaphthylene	5600000	FDEP Industrial Goals
Anthracene	3E+08	FDEP Industrial Goals
Benzo(a)anthracene	4900	FDEP Industrial Goals
Benzo(a)pyrene	500	FDEP Industrial Goals
Benzo(b)fluoranthene	5000	FDEP Industrial Goals
Benzo(g,h,i)perylene	50000	FDEP Industrial Goals
Benzo(k)fluoranthene	48000	FDEP Industrial Goals
Bis(2-chloroethoxy)methane	3000000	FDEP Industrial Goals
Bis(2-chloroethyl)ether	900	FDEP Industrial Goals

Bis(2-ethylhexyl)phthalate	110000	FDEP Industrial Goals
Butyl benzyl phthalate	3.1E+08	FDEP Industrial Goals
Carbazole	120000	FDEP Industrial Goals
Chrysene	500000	FDEP Industrial Goals
Di-n-butyl phthalate	1.4E+08	FDEP Industrial Goals
Di-n-octyl phthalate	32000000	FDEP Industrial Goals
Dibenzo(a,h)anthracene	500	FDEP Industrial Goals
Dibenzofuran	3500000	FDEP Industrial Goals
Diethyl phthalate	9.7E+08	FDEP Industrial Goals
Dimethyl phthalate	1E+09	FDEP Industrial Goals
Fluoranthene	48000000	FDEP Industrial Goals
Fluorene	30000000	FDEP Industrial Goals
Hexachlorobenzene	1600	FDEP Industrial Goals
Hexachlorobutadiene	4900	FDEP Industrial Goals
Hexachlorocyclopentadiene	550000	Residential Soil RBCs
Hexachloroethane	120000	FDEP Industrial Goals
Indeno(1,2,3-cd)pyrene	5000	FDEP Industrial Goals
Isophorone	670000	Residential Soil RBCs
n-nitrosodiphenylamine	130000	FDEP Industrial Goals
Naphthalene	12000000	FDEP Industrial Goals
Nitrobenzene	250000	FDEP Industrial Goals
Pentachlorophenol	12000	FDEP Industrial Goals
Phenanthrene	21000000	FDEP Industrial Goals
Phenol	4.4E+08	FDEP Industrial Goals
Pyrene	41000000	FDEP Industrial Goals
Volatile Organic Compounds (ug/kg)		
1,1,1-trichloroethane	4300000	FDEP Industrial Goals
1,1,2,2-tetrachloroethane	1400	FDEP Industrial Goals
1,1,2-trichloroethane	3000	FDEP Industrial Goals
1,1-dichloroethane	2100000	FDEP Industrial Goals
1,1-dichloroethene	100	FDEP Industrial Goals
1,2-dichloroethane	1000	FDEP Industrial Goals
1,2-dichloropropane	1200	FDEP Industrial Goals
2-butanone	15000000	FDEP Industrial Goals
2-hexanone	0	NA
4-methyl-2-pentanone	3700000	FDEP Industrial Goals
Acetone	1800000	FDEP Industrial Goals
Benzene	2000	FDEP Industrial Goals
Bromodichloromethane	1000	FDEP Industrial Goals
Bromoform	130000	FDEP Industrial Goals
Bromomethane	110000	Residential Soil RBCs
Carbon disulfide	34000	FDEP Industrial Goals
Carbon tetrachloride	800	FDEP Industrial Goals
Chlorobenzene	300000	FDEP Industrial Goals
Chloroethane	31000000	Residential Soil RBCs
Chloroform	800	FDEP Industrial Goals
Chloromethane	300	FDEP Industrial Goals
cis-1,2-dichloroethene	180000	FDEP Industrial Goals
cis-1,3-dichloropropene	400	FDEP Industrial Goals
Dibromochloromethane	1700	FDEP Industrial Goals
Ethylbenzene	10000000	FDEP Industrial Goals
Methylene chloride	23000	FDEP Industrial Goals
Styrene	34000000	FDEP Industrial Goals
Tetrachloroethene	28000	FDEP Industrial Goals
Toluene	3500000	FDEP Industrial Goals
trans-1,2-dichloroethene	430000	FDEP Industrial Goals
trans-1,3-dichloropropene	400	FDEP Industrial Goals
Trichloroethene	9300	FDEP Industrial Goals
Vinyl chloride	7	FDEP Industrial Goals
Xylenes, total	92000000	FDEP Industrial Goals

Step 6. Specify Tolerable Limits on Decision Errors

(1) Possible range of the parameter of interest

(2) Identify the decision errors and choose the null hypothesis

(a) Possible decision errors

(i) Deciding that the subzone is contaminated when it truly is not.
(ii) Deciding that the subzone is not contaminated when it truly is.

(b) True state of nature for each decision error

(i) The true state of nature for decision error (i) is that the subzone is not contaminated.
(ii) The true state of nature for decision error (ii) is that the subzone is contaminated.

(c) Potential consequences of each decision error

(i) The potential consequences of deciding that the subzone is contaminated when it truly is not include the expenditure of money and effort on additional studies, monitoring, or remediation when they are not really necessary. Additionally, the Navy will have to delay realignment of the site until the issue of the potential contamination is properly addressed and resolved.
(ii) The potential consequences of deciding that the subzone is not contaminated when it really is will be that the Navy may realign a property that contains levels of contamination that could possibly endanger human health or the environment. In this situation, the Navy may be liable for future damages and environmental cleanup costs. Also, the reputation of the Navy might be damaged.

(d) Which decision error has more severe consequences near the action level?

Decision error (ii) has more severe consequences near the action level since the risk of jeopardizing human health outweighs the consequences of additional expense to the Navy.

(e) Define the null hypothesis and the alternative hypothesis

No hypothesis made.

No hypothesis made.

(f) Assignment of terms "false positive" and "false negative" to the appropriate decision error

(i) A false positive occurs when the null hypothesis is rejected but is actually true. No hypothesis made.

(ii) A false negative occurs when the null hypothesis is not rejected but is truly false. No hypothesis made.

(3) Range of possible values of parameters of interest where the consequences of decision errors are relatively minor (gray region)

For soil, the planning team has selected a gray region of 1.5 times the action level for each parameter.

(4) Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors

The planning team has assumed a 5 percent decision error rate.

Step 7. Optimize the Design

(1) Review the DQO outputs and existing environmental data

Because the statistician has participated in the DQO process for this problem, there is no need to review the DQO outputs further.

(2) Develop general data collection design alternatives

Simple random sampling will be used except in areas where site history or existing data indicate a likely area of contamination that will require a biased approach to sample design.

(3) For each data collection design alternative, select the optimal sample size that satisfies the DQOs

The formula for determining the sample size is chosen based on the hypothesis test and data collection design. The Gilbert's equation is the standard formula utilized to select the optimal sample size. Based on this formula, the optimal number of soil samples is four.

(4) Select the most resource-effective data collection design that satisfies the DQOs

Simple random sampling will be performed in the subzone based on the number of samples determined by Gilbert's equation. This is the only method that meets the DQOs established for this project.

(5) Document the operational details and theoretical sampling assumptions of the selected design in the sampling and analysis plan

Unless site history or existing data indicate a probable area of contamination that would be best delineated through a biased approach, a random sample design will be used to determine whether the soil is contaminated in excess of the action levels. Four discrete samples should be collected and analyzed at the laboratory. Sample locations will be randomly generated.

Zone E - Truman Annex Buildings 102, 103 and 104

Subzone GRYZNE-SZN4-- Soil-- Transformer Site near Building 675

Step 1. State the Problem

(1) Planning Team Members

- Chuck Bryan- Brown and Root Environmental
- Scott Flickinger- Brown and Root Environmental
- Brian Lewis- Brown and Root Environmental
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(2) Decision Makers- NAS Key West Tier I Partnering Team

- Martha Berry- EPA Region IV
- Chuck Bryan- Brown and Root Environmental
- Jorge Caspary- FDEP
- Ron Demes- NAS Key West
- Roy Hoekstra- Bechtel
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(3) Problem Statement

Potential contamination in soil (PCBs) from former transformer site.

(4) Available Resources and Deadlines

Budget-	$200,000
Deadline-	9/29/97
Personnel-	Listed above as Planning Team and Decision Makers
Guidance-	DQO Process (EPA QA/G-4); Data Quality Assessment (EPA QA/G-9)
Site Knowledge-	RFI/RI and CMS fieldwork; EBS; RAB Meeting Support
Experience-	Prior workplan review and preparation experience on the part of Planning Team and Decision Makers

Step 2. Identify the Decision

(1) Principal study question

Is the soil contaminated by SVOCs, PCBs, and inorganics?

(2) Alternative actions that could result from resolution of the principal question

(a) No further action
(b) Further action
  (i) Additional sampling
  (ii) RI/FS
  (iii) IRA and RI/FS

(3) Decision Statement

Determine whether or not soil is contaminated (by SVOCs, PCBs, and inorganics) whether (1) no action will be taken or (2) further study is needed (e.g., additional sampling or place Zone E - Truman Annex Buildings 102, 103 and 104, Transformer Site near Building 675 in RI/FS or IRA and RI/FS program).

Step 3. Identify the Inputs to the Decision

(1) Information needed to resolve the decision

(a) Background information on site
(b) Existing soil analytical data
(c) New soil analytical data
(d) Statistical analyses

(2) Sources of the information needed to resolve the decision

(a) Background Information
  (i) Existing documents (reports, drawings, maps, etc.)
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Condition Map of NAS Key West, No drawing number. 1942.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. Draft EBS Truman Annex Outer Mole Pier 8/Bldgs 149, 1374, 4080. 1997a.
  - U.S. Navy - Naval Air Station (USN - NAS) Key West. PWO Dwg No. 2534; Master Shore Station Development Plan; Utilities Distilled and Softened Water, Dwg. No. P-2534 - 752889. 1957c.

  (ii) Site visits (reports, drawings, maps, etc.)
  - Brown and Root Environmental (B&R Environmental). B&RE/Navy Site Visit. 1997a.
  - Brown and Root Environmental (B&R Environmental). Partners Site Visit and Teleconference. 1997b.

  (iii) Current/on-going activities

(b) Existing soil analytical data

(c) New soil analytical data

Through the following analytical methods, the planning team needs to obtain measurements of SVOCs, PCBs, and inorganics in soil at Zone E - Truman Annex Buildings 102, 103 and 104, Transformer Site near Building 675.

- Metals; SW-846 Methods 6010a/6010b and 7000a series
- PCBs; SW-846 Methods 8081/8082
- Semivolatile Organic Compounds; SW-846 Methods 8270b/8270c

(d) Statistical Analyses

(i) Student's t-test

(ii) Variance of background data set

(3) Information necessary for establishing action levels

(a) Legal action levels

- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.

(b) Guidance action levels

- Residential Soil RBCs-- U. S. Environmental Protection Agency (EPA), Risk-Based Concentration Table, 1997.

(c) Background Concentrations

A subset of applicable background data has been extracted from the Comprehensive Background Report for NAS Key West (Appendix H of the Supplemental RFI/RI for Eight Sites, 1997).

(4) Measurement Methods for Analytical data

The appropriate measurement methods have been selected, as stated above. In order to adequately resolve the decision, method detection limits must be less than action levels. This will be ensured by supplying the selected action levels with the statement of laboratory Statement of Work. In the event that it is not is not technically possible to achieve a low enough MDL for a given parameter with the selected method, the partnering team will evaluate the results on a case-by-case basis, using frequency of detection to determine whether detected concentrations represent significant contamination. Action levels were not available for some parameters, as shown below. Regardless of MDL, these parameters will require an individual evaluation, if detected.

- Inorganics SW-846 Methods 6010a/6010b and 7000a Series-- Thallium
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-methyl-4,6-dinitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-nitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 4-chlorophenyl phenyl ether

Step 4. Define the Study Boundaries

(1) Characteristics that define the population of interest

Soil is assumed to be a homogeneous layer of the land surface. Therefore, soil typically will be found everywhere there is not an obstruction to the land surface such as a building, significant vegetation, concrete, or water. Soil extends down into the groundwater. In the Key West area, soil is typically found at the surface and is supported by underlying limestone 8 to 12 feet below the land surface.

(2) Spatial boundary of the decision statement

(a) Define the geographic area to which the decision statement applies.

Decisions apply to the soil within the subzone.

(b) When appropriate, divide the population into strata that have relatively homogeneous characteristics.

Stratification is not necessary since the soil within the subzone is assumed to homogeneous.

(3) Temporal boundary of the decision statement

(a) Determine the timeframe to which the decision applies.

It will be assumed that the sample data represents the current concentration of chemicals present within the soil.

(b) Determine when to collect data.

Samples will be collected during the daylight hours.

(4) Scale of the decision statement

The scale of the decision-making will be at the subzone level.

(5) Physical constraints on data collection

The ability to easily sample soil could increase the cost of sampling. Special equipment such as a direct-push unit or power auger are required to take samples in surface soil.

Step 5. Develop a Decision Rule

Decision Rule

If the mean chemical concentration in the soil is less than the action level, soil will be considered uncontaminated and no action will be taken. If the mean chemical concentration in the soil exceeds the action level, further study of the soil will be considered.

The following elements will be considered in the development of the decision rule:

(1) The statistical parameter that characterizes the population of interest

The planning team is interested in the mean concentration of SVOCs, PCBs, and inorganics being analyzed in the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Transformer Site near Building 675.

(2) The action levels for the study

Various sources of information were used in defining the appropriate action level for each parameter.For VOCs, SVOCs, and PCBs, the most conservative legal requirement will be adopted as the action level. In the event that no legal level has been established, the most conservative guidance level will be employed. For inorganics commonly detected in background in the vicinity of NAS Key West, twice the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. Likewise for pesticide compounds detected in background, the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. In the event that no legal, guidance or background concentrations are available for a parameter, the planning team needs to agree on a reasonable basis for action. Based on the criteria discussed here, action levels have been selected for each of the parameters that will be evaluated at Zone E - Truman Annex Buildings 102, 103 and 104, Transformer Site near Building 675. Parameters which may specifically require the attention of the planning team are identified here with the notation 'NA' and are also presented in Step 3 under 'Measurement methods for analytical data'.

Inorganics (mg/kg)		
Aluminum	1000000	FDEP Industrial Goals
Antimony	220	FDEP Industrial Goals
Arsenic	3.7	FDEP Industrial Goals
Barium	84000	FDEP Industrial Goals
Beryllium	1	FDEP Industrial Goals
Cadmium	600	FDEP Industrial Goals
Calcium	0	NA
Chromium	430	FDEP Industrial Goals
Cobalt	110000	FDEP Industrial Goals
Copper	3100	Residential Soil RBCs
Iron	23000	Residential Soil RBCs
Lead	1000	FDEP Industrial Goals
Magnesium	0	NA
Manganese	5500	FDEP Industrial Goals
Mercury	480	FDEP Industrial Goals
Nickel	26000	FDEP Industrial Goals
Potassium	0	NA
Selenium	9900	FDEP Industrial Goals
Silver	9000	FDEP Industrial Goals
Sodium	0	NA
Thallium	0	NA
Tin	670000	FDEP Industrial Goals
Vanadium	4800	FDEP Industrial Goals
Zinc	560000	FDEP Industrial Goals
PCB Compounds (ug/kg)		
Aroclor-1016	3500	FDEP Industrial Goals
Aroclor-1221	3500	FDEP Industrial Goals
Aroclor-1232	3500	FDEP Industrial Goals
Aroclor-1242	3500	FDEP Industrial Goals
Aroclor-1248	3500	FDEP Industrial Goals
Aroclor-1254	3500	FDEP Industrial Goals
Aroclor-1260	3500	FDEP Industrial Goals
Semivolatile Organic Compounds (ug/kg)		
1,2,4-trichlorobenzene	780000	Residential Soil RBCs
2,4,5-trichlorophenol	1.3E+08	FDEP Industrial Goals
2,4,6-trichlorophenol	280000	FDEP Industrial Goals
2,4-dichlorophenol	4000000	FDEP Industrial Goals
2,4-dimethylphenol	16000000	FDEP Industrial Goals
2,4-dinitrophenol	160000	Residential Soil RBCs
2,4-dinitrotoluene	2000000	FDEP Industrial Goals
2,6-dinitrotoluene	1300000	FDEP Industrial Goals
2-chloronaphthalene	4000000	FDEP Industrial Goals
2-chlorophenol	3700000	FDEP Industrial Goals
2-methyl-4,6-dinitrophenol	0	NA
2-methylnaphthalene	8800000	FDEP Industrial Goals
2-methylphenol	32000000	FDEP Industrial Goals
2-nitroaniline	73000	FDEP Industrial Goals
2-nitrophenol	0	NA
3 & 4-methylphenol	5500000	FDEP Industrial Goals
3,3'-dichlorobenzidine	1400	Residential Soil RBCs
3-nitroaniline	230000	Residential Soil RBCs
4-bromophenyl phenyl ether	4500000	Residential Soil RBCs
4-chloro-3-methylphenol	1E+09	FDEP Industrial Goals
4-chloroaniline	3300000	FDEP Industrial Goals
4-chlorophenyl phenyl ether	0	NA
4-nitroaniline	4700000	FDEP Industrial Goals
4-nitrophenol	4800000	Residential Soil RBCs
Acenaphthene	30000000	FDEP Industrial Goals
Acenaphthylene	5600000	FDEP Industrial Goals
Anthracene	3E+08	FDEP Industrial Goals
Benzo(a)anthracene	4900	FDEP Industrial Goals
Benzo(a)pyrene	500	FDEP Industrial Goals
Benzo(b)fluoranthene	5000	FDEP Industrial Goals
Benzo(g,h,i)perylene	50000	FDEP Industrial Goals
Benzo(k)fluoranthene	48000	FDEP Industrial Goals
Bis(2-chloroethoxy)methane	3000000	FDEP Industrial Goals
Bis(2-chloroethyl)ether	900	FDEP Industrial Goals
Bis(2-ethylhexyl)phthalate	110000	FDEP Industrial Goals
Butyl benzyl phthalate	3.1E+08	FDEP Industrial Goals
Carbazole	120000	FDEP Industrial Goals

Chrysene	500000	FDEP Industrial Goals
Di-n-butyl phthalate	1.4E+08	FDEP Industrial Goals
Di-n-octyl phthalate	32000000	FDEP Industrial Goals
Dibenzo(a,h)anthracene	500	FDEP Industrial Goals
Dibenzofuran	3500000	FDEP Industrial Goals
Diethyl phthalate	9.7E+08	FDEP Industrial Goals
Dimethyl phthalate	1E+09	FDEP Industrial Goals
Fluoranthene	48000000	FDEP Industrial Goals
Fluorene	30000000	FDEP Industrial Goals
Hexachlorobenzene	1600	FDEP Industrial Goals
Hexachlorobutadiene	4900	FDEP Industrial Goals
Hexachlorocyclopentadiene	550000	Residential Soil RBCs
Hexachloroethane	120000	FDEP Industrial Goals
Indeno(1,2,3-cd)pyrene	5000	FDEP Industrial Goals
Isophorone	670000	Residential Soil RBCs
n-nitrosodiphenylamine	130000	FDEP Industrial Goals
Naphthalene	12000000	FDEP Industrial Goals
Nitrobenzene	250000	FDEP Industrial Goals
Pentachlorophenol	12000	FDEP Industrial Goals
Phenanthrene	21000000	FDEP Industrial Goals
Phenol	4.4E+08	FDEP Industrial Goals
Pyrene	41000000	FDEP Industrial Goals

Step 6. Specify Tolerable Limits on Decision Errors

(1) Possible range of the parameter of interest

The range of parameters is expected to be below the selected action levels.

(2) Identify the decision errors and choose the null hypothesis

(a) Possible decision errors

(i) Deciding that the subzone is contaminated when it truly is not.
(ii) Deciding that the subzone is not contaminated when it truly is.

(b) True state of nature for each decision error

(i) The true state of nature for decision error (i) is that the subzone is not contaminated.
(ii) The true state of nature for decision error (ii) is that the subzone is contaminated.

(c) Potential consequences of each decision error

(i) The potential consequences of deciding that the subzone is contaminated when it truly is not include the expenditure of money and effort on additional studies, monitoring, or remediation when they are not really necessary. Additionally, the Navy will have to delay realignment of the site until the issue of the potential contamination is properly addressed and resolved.
(ii) The potential consequences of deciding that the subzone is not contaminated when it really is will be that the Navy may realign a property that contains levels of contamination that could possibly endanger human health or the environment. In this situation, the Navy may be liable for future damages and environmental cleanup costs. Also, the reputation of the Navy might be damaged.

(d) Which decision error has more severe consequences near the action level?

Decision error (ii) has more severe consequences near the action level since the risk of jeopardizing human health outweighs the consequences of additional expense to the Navy.

(e) Define the null hypothesis and the alternative hypothesis

(i) Null Hypothesis: The soil at Zone E - Truman Annex Buildings 102, 103 and 104, Transformer Site near Building 675 is not contaminated.

(ii) Alternative Hypothesis: The soil at Zone E - Truman Annex Buildings 102, 103 and 104, Transformer Site near Building 675 is contaminated.

(f) Assignment of terms "false positive" and "false negative" to the appropriate decision error

(i) A false positive occurs when the null hypothesis is rejected but is actually true. In this case, a false positive decision error occurs when the decision maker decides that the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Transformer Site near Building 675 is contaminated when it truly is not.

(ii) A false negative occurs when the null hypothesis is not rejected but is truly false. In this case, a false negative decision error occurs when the decision maker decides that the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Transformer Site near Building 675 is not contaminated when it truly is.

(3) Range of possible values of parameters of interest where the consequences of decision errors are relatively minor (gray region)

For soil, the planning team has selected a gray region of 1.5 times the action level for each parameter.

(4) Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors

The planning team has assumed a 5 percent decision error rate.

Step 7. Optimize the Design

(1) Review the DQO outputs and existing environmental data

Because the statistician has participated in the DQO process for this problem, there is no need to review the DQO outputs further.

(2) Develop general data collection design alternatives

Simple random sampling will be used except in areas where site history or existing data indicate a likely area of contamination that will require a biased approach to sample design.

(3) For each data collection design alternative, select the optimal sample size that satisfies the DQOs

The formula for determining the sample size is chosen based on the hypothesis test and data collection design. The Gilbert's equation is the standard formula utilized to select the optimal sample size. Based on this formula, the optimal number of soil samples is four.

(4) Select the most resource-effective data collection design that satisfies the DQOs

Simple random sampling will be performed in the subzone based on the number of samples determined by Gilbert's equation. This is the only method that meets the DQOs established for this project.

(5) Document the operational details and theoretical sampling assumptions of the selected design in the sampling and analysis plan

Unless site history or existing data indicate a probable area of contamination that would be best delineated through a biased approach, a random sample design will be used to determine whether the soil is contaminated in excess of the action levels. Four discrete samples should be collected and analyzed at the laboratory. Sample locations will be randomly generated.

Zone E - Truman Annex Buildings 102, 103 and 104

Subzone GRYZNE-SZN7-- Groundwater

Step 1. State the Problem

(1) Planning Team Members

- Chuck Bryan- Brown and Root Environmental
- Scott Flickinger- Brown and Root Environmental
- Brian Lewis- Brown and Root Environmental
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(2) Decision Makers- NAS Key West Tier I Partnering Team

- Martha Berry- EPA Region IV
- Chuck Bryan- Brown and Root Environmental
- Jorge Caspary- FDEP
- Ron Demes- NAS Key West
- Roy Hoekstra- Bechtel
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(3) Problem Statement

Potential contamination in groundwater (fuels, pcbs, oils, metals, solvents) from past industrial naval activities, demolition debris and possible releases from former and existing buildings.

(4) Available Resources and Deadlines

Budget-	$200,000
Deadline-	9/29/97
Personnel-	Listed above as Planning Team and Decision Makers
Guidance-	DQO Process (EPA QA/G-4); Data Quality Assessment (EPA QA/G-9)
Site Knowledge-	RFI/RI and CMS fieldwork; EBS; RAB Meeting Support
Experience-	Prior workplan review and preparation experience on the part of Planning Team and Decision Makers

Step 2. Identify the Decision

(1) Principal study question

Is the groundwater contaminated by VOCs, SVOCs, and inorganics?

(2) Alternative actions that could result from resolution of the principal question

(a) No further action
(b) Further action
  (i) Additional sampling
  (ii) RI/FS
  (iii) IRA and RI/FS

(3) Decision Statement

Determine whether or not groundwater is contaminated (by VOCs, SVOCs, and inorganics) whether (1) further study is needed (e.g., additional sampling or place Subzone E in RI/FS or IRA and RI/FS program) or (2) no action will be taken.

Step 3. Identify the Inputs to the Decision

(1) Information needed to resolve the decision

(a) Background information on site
(b) Existing groundwater analytical data
(c) New groundwater analytical data
(d) Statistical analyses

(2) Sources of the information needed to resolve the decision

(a) Background Information
  (i) Existing documents (reports, drawings, maps, etc.)
    – U.S. Navy - Naval Air Station (USN - NAS) Key West. Condition Map of NAS Key West, No drawing number. 1942.
    – U.S. Navy - Naval Air Station (USN - NAS) Key West. PWO Dwg No. 2534; Master Shore Station Development Plan; Utilities Distilled and Softened Water, Dwg. No. P-2534 - 752889. 1957c.
  (ii) Site visits (reports, drawings, maps, etc.)
    – Brown and Root Environmental (B&R Environmental). B&RE/Navy Site Visit. 1996a.
    – Brown and Root Environmental (B&R Environmental). Partners Site Visit and Teleconference. 1997b.
  (iii) Current/on-going activities
(b) Existing groundwater analytical data

(c) New groundwater analytical data

Through the following analytical methods, the planning team needs to obtain measurements of VOCs, SVOCs, and inorganics in groundwater at Zone E - Truman Annex Buildings 102, 103 and 104.

- Metals; SW-846 Methods 6010a/6010b and 7000a series
- Semivolatile Organic Compounds; SW-846 Methods 8270b/8270c
- Volatile Organic Compounds; SW-846 Methods 8260a/8260b

(d) Statistical Analyses

(i) Student's t-test

(ii) Variance of background data set

(3) Information necessary for establishing action levels

(a) Legal action levels

- MCL-- U. S. Environmental Protection Agency (EPA), Drinking Water Regulations and Health Advisories, 1996a.
- FL MCL-- Florida Department of Environmental Protection (FDEP), Drinking Water Standards, Monitoring and Reporting, 1995a.

(b) Guidance action levels

- Tap Water RBCs-- U. S. Environmental Protection Agency (EPA), Risk-Based Concentration Table, 1997.

(c) Background Concentrations

A subset of applicable background data has been extracted from the Comprehensive Background Report for NAS Key West (Appendix H of the Supplemental RFI/RI for Eight Sites, 1997).

(4) Measurement Methods for Analytical data

The appropriate measurement methods have been selected, as stated above. In order to adequately resolve the decision, method detection limits must be less than action levels. This will be ensured by supplying the selected action levels with the statement of laboratory Statement of Work. In the event that it is not is not technically possible to achieve a low enough MDL for a given parameter with the selected method, the partnering team will evaluate the results on a case-by-case basis, using frequency of detection to determine whether detected concentrations represent significant contamination. Action levels were not available for some parameters, as shown below. Regardless of MDL, these parameters will require an individual evaluation, if detected.

- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-chloronaphthalene
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-methyl-4,6-dinitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-methylnaphthalene
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-nitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 4-chloro-3-methylphenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 4-chlorophenyl phenyl ether
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- Acenaphthylene
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- Benzo(g,h,i)perylene
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- Bis(2-chloroethoxy)methane
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- Phenanthrene
- Volatile Organic Compounds SW-846 Methods 8260a/8260b-- 2-hexanone

Step 4. Define the Study Boundaries

(1) Characteristics that define the population of interest

Groundwater is assumed to be a homogeneous body of water found beneath the land surface. Therefore, groundwater typically will be found beneath the land surface of a soil subzone. The typical depth to groundwater at NAS Key West is three feet.

(2) Spatial boundary of the decision statement

(a) Define the geographic area to which the decision statement applies.

Decisions apply to the groundwater within the subzone.

(b) When appropriate, divide the population into strata that have relatively homogeneous characteristics.

Stratification is not necessary since the groundwater within the subzone is assumed to homogeneous.

(3) Temporal boundary of the decision statement

(a) Determine the timeframe to which the decision applies.

It will be assumed that the sample data represents the current concentration of chemicals present within the groundwater.

(b) Determine when to collect data.

Samples will be collected during the daylight hours.

(4) Scale of the decision statement

The scale of the decision-making will be at the subzone level.

(5) Physical constraints on data collection

The ability to easily sample groundwater could increase the cost of sampling. Special equipment such as a direct-push unit, power auger or drilling rig are required to take samples in groundwater. During the recent RFI/RI, turbidity of groundwater interfered with metal results. Low-flow sampling will be conducted and turbidity closely monitored to minimize this problem.

Step 5. Develop a Decision Rule

Decision Rule

If the mean chemical concentration in the groundwater is less than the action level, groundwater will be considered uncontaminated and no action will be taken. If the mean chemical concentration in the groundwater exceeds the action level, further study of the groundwater will be considered.

The following elements will be considered in the development of the decision rule:

(1) The statistical parameter that characterizes the population of interest

The planning team is interested in the mean concentration of VOCs, SVOCs, and inorganics being analyzed in the groundwater at Zone E - Truman Annex Buildings 102, 103 and 104.

(2) The action levels for the study

Various sources of information were used in defining the appropriate action level for each parameter.For VOCs, SVOCs, and PCBs, the most conservative legal requirement will be adopted as the action level. In the event that no legal level has been established, the most conservative guidance level will be employed. For inorganics commonly detected in background in the vicinity of NAS Key West, twice the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. Likewise for pesticide compounds detected in background, the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. In the event that no legal, guidance or background concentrations are available for a parameter, the planning team needs to agree on a reasonable basis for action. Based on the criteria discussed here, action levels have been selected for each of the parameters that will be evaluated at Zone E - Truman Annex Buildings 102, 103 and 104. Parameters which may specifically require the attention of the planning team are identified here with the notation 'NA' and are also presented in Step 3 under 'Measurement methods for analytical data'.

Inorganics (ug/l)		
Aluminum	37000	Tap Water RBCs
Antimony	6	MCL
Arsenic	50	MCL
Barium	2000	MCL
Beryllium	4	MCL
Cadmium	5	MCL
Calcium	0	NA
Chromium	100	MCL
Cobalt	2200	Tap Water RBCs
Copper	1500	Tap Water RBCs
Iron	11000	Tap Water RBCs
Lead	15	MCL
Magnesium	0	NA
Manganese	840	Tap Water RBCs
Mercury	2	MCL
Nickel	100	MCL
Potassium	0	NA
Selenium	50	MCL
Silver	180	Tap Water RBCs
Sodium	160000	FI MCL
Thallium	4.62	2x Avg Background
Tin	22000	Tap Water RBCs
Vanadium	260	Tap Water RBCs
Zinc	11000	Tap Water RBCs
Semivolatile Organic Compounds (ug/l)		
1,2,4-trichlorobenzene	70	MCL
2,4,5-trichlorophenol	3700	Tap Water RBCs
2,4,6-trichlorophenol	6.1	Tap Water RBCs
2,4-dichlorophenol	110	Tap Water RBCs
2,4-dimethylphenol	730	Tap Water RBCs
2,4-dinitrophenol	73	Tap Water RBCs
2,4-dinitrotoluene	73	Tap Water RBCs
2,6-dinitrotoluene	37	Tap Water RBCs
2-chloronaphthalene	0	NA
2-chlorophenol	180	Tap Water RBCs
2-methyl-4,6-dinitrophenol	0	NA
2-methylnaphthalene	0	NA
2-methylphenol	1800	Tap Water RBCs
2-nitroaniline	2.2	Tap Water RBCs
2-nitrophenol	0	NA
3 & 4-methylphenol	1800	Tap Water RBCs
3,3'-dichlorobenzidine	0.15	Tap Water RBCs
3-nitroaniline	110	Tap Water RBCs
4-bromophenyl phenyl ether	2100	Tap Water RBCs
4-chloro-3-methylphenol	0	NA
4-chloroaniline	150	Tap Water RBCs
4-chlorophenyl phenyl ether	0	NA
4-nitroaniline	110	Tap Water RBCs
4-nitrophenol	2300	Tap Water RBCs
Acenaphthene	2200	Tap Water RBCs
Acenaphthylene	0	NA
Anthracene	11000	Tap Water RBCs
Benzo(a)anthracene	0.092	Tap Water RBCs
Benzo(a)pyrene	0.2	MCL
Benzo(b)fluoranthene	0.092	Tap Water RBCs
Benzo(g,h,i)perylene	0	NA
Benzo(k)fluoranthene	0.92	Tap Water RBCs
Bis(2-chloroethoxy)methane	0	NA
Bis(2-chloroethyl)ether	0.0092	Tap Water RBCs
Bis(2-ethylhexyl)phthalate	6	MCL
Butyl benzyl phthalate	7300	Tap Water RBCs
Carbazole	3.4	Tap Water RBCs
Chrysene	9.2	Tap Water RBCs
Di-n-butyl phthalate	3700	Tap Water RBCs
Di-n-octyl phthalate	730	Tap Water RBCs
Dibenzo(a,h)anthracene	0.0092	Tap Water RBCs
Dibenzofuran	150	Tap Water RBCs
Diethyl phthalate	29000	Tap Water RBCs

Dimethyl phthalate	370000	Tap Water RBCs
Fluoranthene	1500	Tap Water RBCs
Fluorene	1500	Tap Water RBCs
Hexachlorobenzene	1	MCL
Hexachlorobutadiene	0.14	Tap Water RBCs
Hexachlorocyclopentadiene	50	MCL
Hexachloroethane	0.75	Tap Water RBCs
Indeno(1,2,3-cd)pyrene	0.092	Tap Water RBCs
Isophorone	71	Tap Water RBCs
n-nitrosodiphenylamine	14	Tap Water RBCs
Naphthalene	1500	Tap Water RBCs
Nitrobenzene	3.4	Tap Water RBCs
Pentachlorophenol	1	MCL
Phenanthrene	0	NA
Phenol	22000	Tap Water RBCs
Pyrene	1100	Tap Water RBCs
Volatile Organic Compounds (ug/l)		
1,1,1-trichloroethane	200	MCL
1,1,2,2-tetrachloroethane	0.052	Tap Water RBCs
1,1,2-trichloroethane	5	MCL
1,1-dichloroethane	810	Tap Water RBCs
1,1-dichloroethene	7	MCL
1,2-dichloroethane	3	FI MCL
1,2-dichloropropane	5	MCL
2-butanone	1900	Tap Water RBCs
2-hexanone	0	NA
4-methyl-2-pentanone	2900	Tap Water RBCs
Acetone	3700	Tap Water RBCs
Benzene	1	FI MCL
Bromodichloromethane	100	MCL
Bromoform	100	MCL
Bromomethane	8.7	Tap Water RBCs
Carbon disulfide	1000	Tap Water RBCs
Carbon tetrachloride	3	FI MCL
Chlorobenzene	100	MCL
Chloroethane	8600	Tap Water RBCs
Chloroform	100	MCL
Chloromethane	1.4	Tap Water RBCs
cis-1,2-dichloroethene	70	MCL
cis-1,3-dichloropropene	0.077	Tap Water RBCs
Dibromochloromethane	100	MCL
Ethylbenzene	700	MCL
Methylene chloride	5	FI MCL
Styrene	100	MCL
Tetrachloroethene	3	FI MCL
Toluene	1000	MCL
trans-1,2-dichloroethene	100	MCL
trans-1,3-dichloropropene	0.077	Tap Water RBCs
Trichloroethene	3	FI MCL
Vinyl chloride	1	FI MCL
Xylenes, total	10000	MCL

Step 6. Specify Tolerable Limits on Decision Errors

(1) Possible range of the parameter of interest

The range of parameters is expected to be above the selected action levels.

(2) Identify the decision errors and choose the null hypothesis

(a) Possible decision errors

(i) Deciding that the subzone is contaminated when it truly is not.
(ii) Deciding that the subzone is not contaminated when it truly is.

(b) True state of nature for each decision error

(i) The true state of nature for decision error (i) is that the subzone is not contaminated.
(ii) The true state of nature for decision error (ii) is that the subzone is contaminated.

(c) Potential consequences of each decision error

(i) The potential consequences of deciding that the subzone is contaminated when it truly is not include the expenditure of money and effort on additional studies, monitoring, or remediation when they are not really necessary. Additionally, the Navy will have to delay realignment of the site until the issue of the potential contamination is properly addressed and resolved.
(ii) The potential consequences of deciding that the subzone is not contaminated when it really is will be that the Navy may realign a property that contains levels of contamination that could possibly endanger human health or the environment. In this situation, the Navy may be liable for future damages and environmental cleanup costs. Also, the reputation of the Navy might be damaged.

(d) Which decision error has more severe consequences near the action level?

Decision error (ii) has more severe consequences near the action level since the risk of jeopardizing human health outweighs the consequences of additional expense to the Navy.

(e) Define the null hypothesis and the alternative hypothesis

(i) Null Hypothesis: The groundwater at Zone E - Truman Annex Buildings 102, 103 and 104. is contaminated.
(ii) Alternative Hypothesis: The groundwater at Zone E - Truman Annex Buildings 102, 103 and 104. is not contaminated.

(f) Assignment of terms "false positive" and "false negative" to the appropriate decision error

(i) A false positive occurs when the null hypothesis is rejected but is actually true. In this case, a false positive decision error occurs when the decision maker decides that the groundwater at Zone E - Truman Annex Buildings 102, 103 and 104. is not contaminated when it truly is.
(ii) A false negative occurs when the null hypothesis is not rejected but is truly false. In this case, a false negative decision error occurs when the decision maker decides that the groundwater at Zone E - Truman Annex Buildings 102, 103 and 104. is contaminated when it truly is not.

(3) Range of possible values of parameters of interest where the consequences of decision errors are relatively minor (gray region)

Since legally binding action levels exist for groundwater, a gray zone above the action level is not acceptable. However, for the purposes of statistical analysis, the planning team has established a gray region of one-half the action level below the action level for each parameter.

(4) Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors

The planning team has assumed a 5 percent decision error rate.

Step 7. Optimize the Design

(1) Review the DQO outputs and existing environmental data

Because the statistician has participated in the DQO process for this problem, there is no need to review the DQO outputs further.

(2) Develop general data collection design alternatives

Simple random sampling will be used except in areas where site history or existing data indicate a likely area of contamination that will require a biased approach to sample design.

(3) For each data collection design alternative, select the optimal sample size that satisfies the DQOs

The formula for determining the sample size is chosen based on the hypothesis test and data collection design. The Gilbert's equation is the standard formula utilized to select the optimal sample size. For groundwater, a minimum of three samples will be taken in order to perform a meaningful statistical analysis of the sample data. Gilbert's equation calculated that two groundwater samples were necessary with a gray region of 1.5 times the action level for each parameter.

(4) Select the most resource-effective data collection design that satisfies the DQOs

Simple random sampling will be performed in the subzone based on the number of samples determined by Gilbert's equation. This is the only method that meets the DQOs established for this project.

(5) Document the operational details and theoretical sampling assumptions of the selected design in the sampling and analysis plan

Approximately nine screening samples will be randomly placed unless site history or existing data indicate a probable area of contamination that would be best delineated through a biased approach. The three permanent monitoring wells will be placed in order to best delineate possible contamination based on the screening sample results.

Zone E - Truman Annex Buildings 102, 103 and 104
Subzone GRYZNE-SZN9-- Soil-- Buildings 103

Step 1. State the Problem

(1) Planning Team Members

- Chuck Bryan- Brown and Root Environmental
- Scott Flickinger- Brown and Root Environmental
- Brian Lewis- Brown and Root Environmental
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(2) Decision Makers- NAS Key West Tier I Partnering Team

- Martha Berry- EPA Region IV
- Chuck Bryan- Brown and Root Environmental
- Jorge Caspary- FDEP
- Ron Demes- NAS Key West
- Roy Hoekstra- Bechtel
- Dudley Patrick- SOUTHDIV
- Phillip Williams- NAS Key West

(3) Problem Statement

Potential contamination in soil (fuel, oils, PCBs) from Building 103 used as a Power Plant.

(4) Available Resources and Deadlines

Budget-	$200,000
Deadline-	9/29/97
Personnel-	Listed above as Planning Team and Decision Makers
Guidance-	DQO Process (EPA QA/G-4); Data Quality Assessment (EPA QA/G-9)
Site Knowledge-	RFI/RI and CMS fieldwork; EBS; RAB Meeting Support
Experience-	Prior workplan review and preparation experience on the part of Planning Team and Decision Makers

Step 2. Identify the Decision

(1) Principal study question

Is the soil contaminated by VOCs, SVOCs, PCBs, and Inorganics?

(2) Alternative actions that could result from resolution of the principal question

(a) No further action
(b) Further action
  (i) Additional sampling
  (ii) RI/FS
  (iii) IRA and RI/FS

(3) Decision Statement

Determine whether or not soil is contaminated (by VOCs, SVOCs, PCBs, and Inorganics) whether (1) further study is needed (e.g., additional sampling or place Subzone E in RI/FS or IRA and RI/FS program) or (2) no action will be taken.

Step 3. Identify the Inputs to the Decision

(1) Information needed to resolve the decision

(a) Background information on site
(b) Existing soil analytical data
(c) New soil analytical data
(d) Statistical analyses

(2) Sources of the information needed to resolve the decision

(a) Background Information
  (i) Existing documents (reports, drawings, maps, etc.)
  (ii) Site visits (reports, drawings, maps, etc.)
  (iii) Current/on-going activities
(b) Existing soil analytical data
(c) New soil analytical data

Through the following analytical methods, the planning team needs to obtain measurements of VOCs, SVOCs, PCBs, and Inorganics in soil at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 103.

- Metals; SW-846 Methods 6010a/6010b and 7000a series
- PCBs; SW-846 Methods 8081/8082
- Semivolatile Organic Compounds; SW-846 Methods 8270b/8270c

- Volatile Organic Compounds; SW-846 Methods 8260a/8260b

(d) Statistical Analyses

(i) Student's t-test

(ii) Variance of background data set

(3) Information necessary for establishing action levels

(a) Legal action levels

- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Applicability of Soil Cleanup Goals for Florida, 1996a.
- FDEP Industrial Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.
- FDEP Residential Goals-- Florida Department of Environmental Protection (FDEP), Soil Cleanup Goals for Florida, 1995b.

(b) Guidance action levels

- Residential Soil RBCs-- U. S. Environmental Protection Agency (EPA), Risk-Based Concentration Table, 1997.

(c) Background Concentrations

A subset of applicable background data has been extracted from the Comprehensive Background Report for NAS Key West (Appendix H of the Supplemental RFI/RI for Eight Sites, 1997).

(4) Measurement Methods for Analytical data

The appropriate measurement methods have been selected, as stated above. In order to adequately resolve the decision, method detection limits must be less than action levels. This will be ensured by supplying the selected action levels with the statement of laboratory Statement of Work. In the event that it is not is not technically possible to achieve a low enough MDL for a given parameter with the selected method, the partnering team will evaluate the results on a case-by-case basis, using frequency of detection to determine whether detected concentrations represent significant contamination. Action levels were not available for some parameters, as shown below. Regardless of MDL, these parameters will require an individual evaluation, if detected.

- Inorganics SW-846 Methods 6010a/6010b and 7000a Series-- Thallium
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-methyl-4,6-dinitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 2-nitrophenol
- Semivolatile Organic Compounds SW-846 Methods 8270b/8270c-- 4-chlorophenyl phenyl ether
- Volatile Organic Compounds SW-846 Methods 8260a/8260b-- 2-hexanone

Step 4. Define the Study Boundaries

(1) Characteristics that define the population of interest

Soil is assumed to be a homogeneous layer of the land surface. Therefore, soil typically will be found everywhere there is not an obstruction to the land surface such as a building, significant vegetation, concrete, or water. Soil extends down into the groundwater. In the Key West area, soil is typically found at the surface and is supported by underlying limestone 8 to 12 feet below the land surface.

(2) Spatial boundary of the decision statement

(a) Define the geographic area to which the decision statement applies.

Decisions apply to the soil within the subzone.

(b) When appropriate, divide the population into strata that have relatively homogeneous characteristics.

Stratification is not necessary since the soil within the subzone is assumed to homogeneous.

(3) Temporal boundary of the decision statement

(a) Determine the timeframe to which the decision applies.

It will be assumed that the sample data represents the current concentration of chemicals present within the soil.

(b) Determine when to collect data.

Samples will be collected during the daylight hours.

(4) Scale of the decision statement

The scale of the decision-making will be at the subzone level.

(5) Physical constraints on data collection

The ability to easily sample soil could increase the cost of sampling. Special equipment such as a direct-push unit or power auger are required to take samples in surface soil.

Step 5. Develop a Decision Rule

Decision Rule

If the mean chemical concentration in the soil is less than the action level, soil will be considered uncontaminated and no action will be taken. If the mean chemical concentration in the soil exceeds the action level, further study of the soil will be considered.

The following elements will be considered in the development of the decision rule:

(1) The statistical parameter that characterizes the population of interest

(1) The statistical parameter that characterizes the population of interest

The planning team is interested in the mean concentration of VOCs, SVOCs, PCBs, and Inorganics being analyzed in the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 103.

(2) The action levels for the study

Various sources of information were used in defining the appropriate action level for each parameter.For VOCs, SVOCs, and PCBs, the most conservative legal requirement will be adopted as the action level. In the event that no legal level has been established, the most conservative guidance level will be employed. For inorganics commonly detected in background in the vicinity of NAS Key West, twice the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. Likewise for pesticide compounds detected in background, the mean background concentration will be used as the action level, unless the most conservative legal requirement (or guidance value, in the event a legal level has not been established) is higher. In the event that no legal, guidance or background concentrations are available for a parameter, the planning team needs to agree on a reasonable basis for action. Based on the criteria discussed here, action levels have been selected for each of the parameters that will be evaluated at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 103. Parameters which may specifically require the attention of the planning team are identified here with the notation 'NA' and are also presented in Step 3 under 'Measurement methods for analytical data'.

Inorganics (mg/kg)		
Aluminum	1000000	FDEP Industrial Goals
Antimony	220	FDEP Industrial Goals
Arsenic	3.7	FDEP Industrial Goals
Barium	84000	FDEP Industrial Goals
Beryllium	1	FDEP Industrial Goals
Cadmium	600	FDEP Industrial Goals
Calcium	0	NA
Chromium	430	FDEP Industrial Goals
Cobalt	110000	FDEP Industrial Goals
Copper	3100	Residential Soil RBCs
Iron	23000	Residential Soil RBCs
Lead	1000	FDEP Industrial Goals
Magnesium	0	NA
Manganese	5500	FDEP Industrial Goals
Mercury	480	FDEP Industrial Goals
Nickel	26000	FDEP Industrial Goals
Potassium	0	NA
Selenium	9900	FDEP Industrial Goals
Silver	9000	FDEP Industrial Goals
Sodium	0	NA
Thallium	0	NA
Tin	670000	FDEP Industrial Goals
Vanadium	4800	FDEP Industrial Goals
Zinc	560000	FDEP Industrial Goals
PCB Compounds (ug/kg)		
Aroclor-1016	3500	FDEP Industrial Goals
Aroclor-1221	3500	FDEP Industrial Goals
Aroclor-1232	3500	FDEP Industrial Goals
Aroclor-1242	3500	FDEP Industrial Goals
Aroclor-1248	3500	FDEP Industrial Goals
Aroclor-1254	3500	FDEP Industrial Goals
Aroclor-1260	3500	FDEP Industrial Goals
Semivolatile Organic Compounds (ug/kg)		
1,2,4-trichlorobenzene	780000	Residential Soil RBCs
2,4,5-trichlorophenol	1.3E+08	FDEP Industrial Goals
2,4,6-trichlorophenol	280000	FDEP Industrial Goals
2,4-dichlorophenol	4000000	FDEP Industrial Goals
2,4-dimethylphenol	16000000	FDEP Industrial Goals
2,4-dinitrophenol	160000	Residential Soil RBCs
2,4-dinitrotoluene	2000000	FDEP Industrial Goals
2,6-dinitrotoluene	1300000	FDEP Industrial Goals
2-chloronaphthalene	4000000	FDEP Industrial Goals
2-chlorophenol	3700000	FDEP Industrial Goals
2-methyl-4,6-dinitrophenol	0	NA
2-methylnaphthalene	8800000	FDEP Industrial Goals
2-methylphenol	32000000	FDEP Industrial Goals
2-nitroaniline	73000	FDEP Industrial Goals
2-nitrophenol	0	NA
3 & 4-methylphenol	5500000	FDEP Industrial Goals
3,3'-dichlorobenzidine	1400	Residential Soil RBCs
3-nitroaniline	230000	Residential Soil RBCs
4-bromophenyl phenyl ether	4500000	Residential Soil RBCs
4-chloro-3-methylphenol	1E+09	FDEP Industrial Goals
4-chloroaniline	3300000	FDEP Industrial Goals
4-chlorophenyl phenyl ether	0	NA
4-nitroaniline	4700000	FDEP Industrial Goals
4-nitrophenol	4800000	Residential Soil RBCs
Acenaphthene	30000000	FDEP Industrial Goals
Acenaphthylene	5600000	FDEP Industrial Goals
Anthracene	3E+08	FDEP Industrial Goals
Benzo(a)anthracene	4900	FDEP Industrial Goals
Benzo(a)pyrene	500	FDEP Industrial Goals
Benzo(b)fluoranthene	5000	FDEP Industrial Goals
Benzo(g,h,i)perylene	50000	FDEP Industrial Goals
Benzo(k)fluoranthene	48000	FDEP Industrial Goals
Bis(2-chloroethoxy)methane	3000000	FDEP Industrial Goals
Bis(2-chloroethyl)ether	900	FDEP Industrial Goals
Bis(2-ethylhexyl)phthalate	110000	FDEP Industrial Goals
Butyl benzyl phthalate	3.1E+08	FDEP Industrial Goals
Carbazole	120000	FDEP Industrial Goals
Chrysene	500000	FDEP Industrial Goals
Di-n-butyl phthalate	1.4E+08	FDEP Industrial Goals
Di-n-octyl phthalate	32000000	FDEP Industrial Goals
Dibenzo(a,h)anthracene	500	FDEP Industrial Goals
Dibenzofuran	3500000	FDEP Industrial Goals
Diethyl phthalate	9.7E+08	FDEP Industrial Goals
Dimethyl phthalate	1E+09	FDEP Industrial Goals
Fluoranthene	48000000	FDEP Industrial Goals
Fluorene	30000000	FDEP Industrial Goals
Hexachlorobenzene	1600	FDEP Industrial Goals
Hexachlorobutadiene	4900	FDEP Industrial Goals
Hexachlorocyclopentadiene	550000	Residential Soil RBCs
Hexachloroethane	120000	FDEP Industrial Goals

Indeno(1,2,3-cd)pyrene	5000	FDEP Industrial Goals
Isophorone	670000	Residential Soil RBCs
n-nitrosodiphenylamine	130000	FDEP Industrial Goals
Naphthalene	12000000	FDEP Industrial Goals
Nitrobenzene	250000	FDEP Industrial Goals
Pentachlorophenol	12000	FDEP Industrial Goals
Phenanthrene	21000000	FDEP Industrial Goals
Phenol	4.4E+08	FDEP Industrial Goals
Pyrene	41000000	FDEP Industrial Goals
Volatile Organic Compounds (ug/kg)		
1,1,1-trichloroethane	4300000	FDEP Industrial Goals
1,1,2,2-tetrachloroethane	1400	FDEP Industrial Goals
1,1,2-trichloroethane	3000	FDEP Industrial Goals
1,1-dichloroethane	2100000	FDEP Industrial Goals
1,1-dichloroethene	100	FDEP Industrial Goals
1,2-dichloroethane	1000	FDEP Industrial Goals
1,2-dichloropropane	1200	FDEP Industrial Goals
2-butanone	15000000	FDEP Industrial Goals
2-hexanone	0	NA
4-methyl-2-pentanone	3700000	FDEP Industrial Goals
Acetone	1800000	FDEP Industrial Goals
Benzene	2000	FDEP Industrial Goals
Bromodichloromethane	1000	FDEP Industrial Goals
Bromoform	130000	FDEP Industrial Goals
Bromomethane	110000	Residential Soil RBCs
Carbon disulfide	34000	FDEP Industrial Goals
Carbon tetrachloride	800	FDEP Industrial Goals
Chlorobenzene	300000	FDEP Industrial Goals
Chloroethane	31000000	Residential Soil RBCs
Chloroform	800	FDEP Industrial Goals
Chloromethane	300	FDEP Industrial Goals
cis-1,2-dichloroethene	180000	FDEP Industrial Goals
cis-1,3-dichloropropene	400	FDEP Industrial Goals
Dibromochloromethane	1700	FDEP Industrial Goals
Ethylbenzene	10000000	FDEP Industrial Goals
Methylene chloride	23000	FDEP Industrial Goals
Styrene	34000000	FDEP Industrial Goals
Tetrachloroethene	28000	FDEP Industrial Goals
Toluene	3500000	FDEP Industrial Goals
trans-1,2-dichloroethene	430000	FDEP Industrial Goals
trans-1,3-dichloropropene	400	FDEP Industrial Goals
Trichloroethene	9300	FDEP Industrial Goals
Vinyl chloride	7	FDEP Industrial Goals
Xylenes, total	92000000	FDEP Industrial Goals

Step 6. Specify Tolerable Limits on Decision Errors

(1) Possible range of the parameter of interest

The range of parameters is expected to be above the selected action levels.

(2) Identify the decision errors and choose the null hypothesis

(a) Possible decision errors

(i) Deciding that the subzone is contaminated when it truly is not.
(ii) Deciding that the subzone is not contaminated when it truly is.

(b) True state of nature for each decision error

(i) The true state of nature for decision error (i) is that the subzone is not contaminated.
(ii) The true state of nature for decision error (ii) is that the subzone is contaminated.

(c) Potential consequences of each decision error

(c) Potential consequences of each decision error

(i) The potential consequences of deciding that the subzone is contaminated when it truly is not include the expenditure of money and effort on additional studies, monitoring, or remediation when they are not really necessary. Additionally, the Navy will have to delay realignment of the site until the issue of the potential contamination is properly addressed and resolved.
(ii) The potential consequences of deciding that the subzone is not contaminated when it really is will be that the Navy may realign a property that contains levels of contamination that could possibly endanger human health or the environment. In this situation, the Navy may be liable for future damages and environmental cleanup costs. Also, the reputation of the Navy might be damaged.

(d) Which decision error has more severe consequences near the action level?

Decision error (ii) has more severe consequences near the action level since the risk of jeopardizing human health outweighs the consequences of additional expense to the Navy.

(e) Define the null hypothesis and the alternative hypothesis

(i) Null Hypothesis: The soil at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 103 is contaminated.

(ii) Alternative Hypothesis: The soil at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 103 is not contaminated.

(f) Assignment of terms "false positive" and "false negative" to the appropriate decision error

(i) A false positive occurs when the null hypothesis is rejected but is actually true. In this case, a false positive decision error occurs when the decision maker decides that the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 103 is not contaminated when it truly is.

(ii) A false negative occurs when the null hypothesis is not rejected but is truly false. In this case, a false negative decision error occurs when the decision maker decides that the soil at Zone E - Truman Annex Buildings 102, 103 and 104, Buildings 103 is contaminated when it truly is not.

(3) Range of possible values of parameters of interest where the consequences of decision errors are relatively minor (gray region)

For soil, the planning team has selected a gray region of 1.5 times the action level for each parameter.

(4) Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors

The planning team has assumed a 5 percent decision error rate.

Step 7. Optimize the Design

(1) Review the DQO outputs and existing environmental data

Because the statistician has participated in the DQO process for this problem, there is no need to review the DQO outputs further.

(2) Develop general data collection design alternatives

Simple random sampling will be used except in areas where site history or existing data indicate a likely area of contamination that will require a biased approach to sample design.

(3) For each data collection design alternative, select the optimal sample size that satisfies the DQOs

The formula for determining the sample size is chosen based on the hypothesis test and data collection design. The Gilbert's equation is the standard formula utilized to select the optimal sample size. Based on this formula, the optimal number of soil samples is four.

(4) Select the most resource-effective data collection design that satisfies the DQOs

Simple random sampling will be performed in the subzone based on the number of samples determined by Gilbert's equation. This is the only method that meets the DQOs established for this project.

(5) Document the operational details and theoretical sampling assumptions of the selected design in the sampling and analysis plan

Unless site history or existing data indicate a probable area of contamination that would be best delineated through a biased approach, a random sample design will be used to determine whether the soil is contaminated in excess of the action levels. Four discrete samples should be collected and analyzed at the laboratory. Sample locations will be randomly generated.

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Appendix C

Part 2 - Base Realignment and Closure Site Investigation Action Levels

TABLE C-1

SELECTION OF SOIL ACTION LEVELS FOR POTENTIAL FUTURE RESIDENTIAL SITES
NAS KEY WEST
PAGE 1 OF 4

Parameter	FDEP Residential Goals[1]	Residential Soil RBCs[2]	2x Average BG[3]	Selected Action Level	Source of Action Level	Units
INORGANICS						
Aluminum	75,000	78,000	3774.57	75,000	FDEP Residential Goals	mg/kg
Antimony	26	31	0.58	26	FDEP Residential Goals	mg/kg
Arsenic	0.8	0.43	2.66	2.66	2x Avg Background	mg/kg
Barium	5,200	5,500	21.9	5,200	FDEP Residential Goals	mg/kg
Beryllium	0.2	0.15	0.08	0.2	FDEP Residential Goals	mg/kg
Cadmium	37	39	0.28	37	FDEP Residential Goals	mg/kg
Calcium	NA	NA	NA	NA	NA	mg/kg
Chromium	290	390	12.34	290	FDEP Residential Goals	mg/kg
Cobalt	4,700	4,700	0.46	4,700	FDEP Residential Goals	mg/kg
Copper	NA	3,100	11.54	3,100	Residential Soil RBCs	mg/kg
Iron	NA	23,000	2334.88	23,000	Residential Soil RBCs	mg/kg
Lead	500	NA	33.32	500	FDEP Residential Goals	mg/kg
Magnesium	NA	NA	NA	NA	NA	mg/kg
Manganese	370	1,800	35.3	370	FDEP Residential Goals	mg/kg
Mercury	23	23	0.06	23	FDEP Residential Goals	mg/kg
Nickel	1,500	1,600	3.4	1,500	FDEP Residential Goals	mg/kg
Potassium	NA	NA	NA	NA	NA	mg/kg
Selenium	390	390	1.3	390	FDEP Residential Goals	mg/kg
Silver	390	390	NA	390	FDEP Residential Goals	mg/kg
Sodium	NA	NA	NA	NA	NA	mg/kg
Thallium	NA	5.5	NA	5.5	Residential Soil RBCs	mg/kg
Tin	44,000	47,000	3.92	44,000	FDEP Residential Goals	mg/kg
Vanadium	490	550	8.32	490	FDEP Residential Goals	mg/kg
Zinc	23,000	23,000	32.18	23,000	FDEP Residential Goals	mg/kg
PESTICIDES						
4,4'-DDD	4,500	2,700	27.2	4,500	FDEP Residential Goals	µg/kg
4,4'-DDE	3,000	1,900	83.3	3,000	FDEP Residential Goals	µg/kg
4,4'-DDT	3,100	1,900	61.24	3,100	FDEP Residential Goals	µg/kg
Aldrin	60	38	NA	60	FDEP Residential Goals	µg/kg
alpha-BHC	200	100	NA	200	FDEP Residential Goals	µg/kg
alpha-chlordane	NA	490	NA	490	Residential Soil RBCs	µg/kg
beta-BHC	600	350	NA	600	FDEP Residential Goals	µg/kg
delta-BHC	23,000	NA	NA	23,000	FDEP Residential Goals	µg/kg
Dieldrin	70	40	NA	70	FDEP Residential Goals	µg/kg
Endosulfan I	390,000	470,000	6.26	390,000	FDEP Residential Goals	µg/kg
Endosulfan II	390,000	470,000	NA	390,000	FDEP Residential Goals	µg/kg
Endosulfan sulfate	NA	NA	NA	NA	NA	µg/kg
Endrin	23,000	23,000	11.8	23,000	FDEP Residential Goals	µg/kg
Endrin aldehyde	23,000	NA	NA	23,000	FDEP Residential Goals	µg/kg
Endrin ketone	NA	NA	NA	NA	NA	µg/kg

TABLE C-1

SELECTION OF SOIL ACTION LEVELS FOR POTENTIAL FUTURE RESIDENTIAL SITES NAS KEY WEST PAGE 2 OF 4

Parameter	FDEP Residential Goals[1]	Residential Soil RBCs[2]	2x Average BG[3]	Selected Action Level	Source of Action Level	Units
gamma-BHC (lindane)	800	490	NA	800	FDEP Residential Goals	µg/kg
gamma-chlordane	NA	490	NA	490	Residential Soil RBCs	µg/kg
Heptachlor	200	140	NA	200	FDEP Residential Goals	µg/kg
Heptachlor epoxide	100	70	NA	100	FDEP Residential Goals	µg/kg
Methoxychlor	380,000	390,000	59.86	380,000	FDEP Residential Goals	µg/kg
Toxaphene	900	580	NA	900	FDEP Residential Goals	µg/kg
POLYCHLORINATED BIPHENYLS						
Aroclor-1016	900	320	NA	900	FDEP Residential Goals	µg/kg
Aroclor-1221	900	320	NA	900	FDEP Residential Goals	µg/kg
Aroclor-1232	900	320	NA	900	FDEP Residential Goals	µg/kg
Aroclor-1242	900	320	NA	900	FDEP Residential Goals	µg/kg
Aroclor-1248	900	320	NA	900	FDEP Residential Goals	µg/kg
Aroclor-1254	900	320	NA	900	FDEP Residential Goals	µg/kg
Aroclor-1260	900	320	NA	900	FDEP Residential Goals	µg/kg
SEMIVOLATILE ORGANIC COMPOUNDS						
1,2,4-trichlorobenzene	NA	780,000	NA	780,000	Residential Soil RBCs	µg/kg
1,2-dichlorobenzene	820,000	7,000,000	NA	820,000	FDEP Residential Goals	µg/kg
1,3-dichlorobenzene	1,700,000	7,000,000	NA	1,700,000	FDEP Residential Goals	µg/kg
1,4-dichlorobenzene	7,500	27,000	NA	7,500	FDEP Residential Goals	µg/kg
2,4,5-trichlorophenol	7,100,000	7,800,000	NA	7,100,000	FDEP Residential Goals	µg/kg
2,4,6-trichlorophenol	87,000	58,000	NA	87,000	FDEP Residential Goals	µg/kg
2,4-dichlorophenol	220,000	230,000	NA	220,000	FDEP Residential Goals	µg/kg
2,4-dimethylphenol	1,200,000	1,600,000	NA	1,200,000	FDEP Residential Goals	µg/kg
2,4-dinitrophenol	NA	160,000	NA	160,000	Residential Soil RBCs	µg/kg
2,4-dinitrotoluene	130,000	160,000	NA	130,000	FDEP Residential Goals	µg/kg
2,6-dinitrotoluene	71,000	78,000	NA	71,000	FDEP Residential Goals	µg/kg
2-chloronaphthalene	560,000	NA	NA	560,000	FDEP Residential Goals	µg/kg
2-chlorophenol	280,000	390,000	NA	280,000	FDEP Residential Goals	µg/kg
2-methyl-4,6-dinitrophenol	NA	NA	NA	NA	NA	µg/kg
2-methylnaphthalene	960,000	NA	NA	960,000	FDEP Residential Goals	µg/kg
2-methylphenol	2,600,000	3,900,000	NA	2,600,000	FDEP Residential Goals	µg/kg
2-nitroaniline	4,000	4,700	NA	4,000	FDEP Residential Goals	µg/kg
2-nitrophenol	NA	NA	NA	NA	NA	µg/kg
3 & 4-methylphenol	340,000	3,900,000	NA	340,000	FDEP Residential Goals	µg/kg
3,3'-dichlorobenzidine	NA	1,400	NA	1,400	Residential Soil RBCs	µg/kg
3-nitroaniline	NA	230,000	NA	230,000	Residential Soil RBCs	µg/kg
4-bromophenyl phenyl ether	NA	4,500,000	NA	4,500,000	Residential Soil RBCs	µg/kg
4-chloro-3-methylphenol	1.40E+08	NA	NA	1.4E+08	FDEP Residential Goals	µg/kg
4-chloroaniline	240,000	310,000	NA	240,000	FDEP Residential Goals	µg/kg
4-chlorophenyl phenyl ether	NA	NA	NA	NA	NA	µg/kg

TABLE C-1

SELECTION OF SOIL ACTION LEVELS FOR POTENTIAL FUTURE RESIDENTIAL SITES
NAS KEY WEST
PAGE 3 OF 4

Parameter	FDEP Residential Goals[1]	Residential Soil RBCs[2]	2x Average BG[3]	Selected Action Level	Source of Action Level	Units
4-nitroaniline	230,000	230,000	NA	230,000	FDEP Residential Goals	µg/kg
4-nitrophenol	NA	4,800,000	NA	4,800,000	Residential Soil RBCs	µg/kg
Acenaphthene	2,800,000	4,700,000	NA	2,800,000	FDEP Residential Goals	µg/kg
Acenaphthylene	670,000	NA	NA	670,000	FDEP Residential Goals	µg/kg
Anthracene	20,000,000	23,000,000	NA	20,000,000	FDEP Residential Goals	µg/kg
Benzo(a)anthracene	1,400	880	NA	1,400	FDEP Residential Goals	µg/kg
Benzo(a)pyrene	100	88	NA	100	FDEP Residential Goals	µg/kg
Benzo(b)fluoranthene	1,400	880	NA	1,400	FDEP Residential Goals	µg/kg
Benzo(g,h,i)perylene	14,000	NA	NA	14,000	FDEP Residential Goals	µg/kg
Benzo(k)fluoranthene	14,000	8,800	NA	14,000	FDEP Residential Goals	µg/kg
Bis(2-chloroethoxy)methane	170,000	NA	NA	170,000	FDEP Residential Goals	µg/kg
Bis(2-chloroethyl)ether	500	580	NA	500	FDEP Residential Goals	µg/kg
Bis(2-ethylhexyl)phthalate	48,000	46,000	NA	48,000	FDEP Residential Goals	µg/kg
Butyl benzyl phthalate	15,000,000	16,000,000	NA	15,000,000	FDEP Residential Goals	µg/kg
Carbazole	42,000	32,000	NA	42,000	FDEP Residential Goals	µg/kg
Chrysene	140,000	88,000	NA	140,000	FDEP Residential Goals	µg/kg
Di-n-butyl phthalate	7,300,000	7,800,000	NA	7,300,000	FDEP Residential Goals	µg/kg
Di-n-octyl phthalate	1,500,000	1,600,000	NA	1,500,000	FDEP Residential Goals	µg/kg
Dibenzo(a,h)anthracene	100	88	NA	100	FDEP Residential Goals	µg/kg
Dibenzofuran	240,000	310,000	NA	240,000	FDEP Residential Goals	µg/kg
Diethyl phthalate	56,000,000	63,000,000	NA	56,000,000	FDEP Residential Goals	µg/kg
Dimethyl phthalate	630,000,000	780,000,000	NA	6.3E+08	FDEP Residential Goals	µg/kg
Fluoranthene	2,900,000	3,100,000	NA	2,900,000	FDEP Residential Goals	µg/kg
Fluorene	2,400,000	3,100,000	NA	2,400,000	FDEP Residential Goals	µg/kg
Hexachlorobenzene	600	400	NA	600	FDEP Residential Goals	µg/kg
Hexachlorobutadiene	3,100	8,200	NA	3,100	FDEP Residential Goals	µg/kg
Hexachlorocyclopentadiene	NA	550,000	NA	550,000	Residential Soil RBCs	µg/kg
Hexachloroethane	27,000	46,000	NA	27,000	FDEP Residential Goals	µg/kg
Indeno(1,2,3-cd)pyrene	1,400	880	NA	1,400	FDEP Residential Goals	µg/kg
Isophorone	NA	670,000	NA	670,000	Residential Soil RBCs	µg/kg
n-nitrosodiphenylamine	73,000	130,000	NA	73,000	FDEP Residential Goals	µg/kg
Naphthalene	1,300,000	3,100,000	NA	1,300,000	FDEP Residential Goals	µg/kg
Nitrobenzene	22,000	39,000	NA	22,000	FDEP Residential Goals	µg/kg
Pentachlorophenol	5,400	5300	NA	5,400	FDEP Residential Goals	µg/kg
Phenanthrene	1,700,000	NA	NA	1,700,000	FDEP Residential Goals	µg/kg
Phenol	34,000,000	47,000,000	NA	34,000,000	FDEP Residential Goals	µg/kg
Pyrene	2,200,000	2,300,000	NA	2,200,000	FDEP Residential Goals	µg/kg
VOLATILE ORGANIC COMPOUNDS						
1,1,1-trichloroethane	610,000	2,700,000	NA	610,000	FDEP Residential Goals	µg/kg
1,1,2,2-tetrachloroethane	900	3,200	NA	900	FDEP Residential Goals	µg/kg

TABLE C-1

SELECTION OF SOIL ACTION LEVELS FOR POTENTIAL FUTURE RESIDENTIAL SITES
NAS KEY WEST
PAGE 4 OF 4

Parameter	FDEP Residential Goals[1]	Residential Soil RBCs[2]	2x Average BG[3]	Selected Action Level	Source of Action Level	Units
1,1,2-trichloroethane	2,000	11,000	NA	2,000	FDEP Residential Goals	µg/kg
1,1-dichloroethane	310,000	7,800,000	NA	310,000	FDEP Residential Goals	µg/kg
1,1-dichloroethene	100	1,100	NA	100	FDEP Residential Goals	µg/kg
1,2-dichloroethane	700	7,000	NA	700	FDEP Residential Goals	µg/kg
1,2-dichloropropane	800	9,400	NA	800	FDEP Residential Goals	µg/kg
2-butanone	2,200,000	47,000,000	NA	2,200,000	FDEP Residential Goals	µg/kg
2-hexanone	NA	3,100,000	NA	3,100,000	Residential Soil RBCs	µg/kg
4-methyl-2-pentanone	520,000	6,300,000	NA	520,000	FDEP Residential Goals	µg/kg
Acetone	260,000	7,800,000	NA	260,000	FDEP Residential Goals	µg/kg
Benzene	1,400	22,000	NA	1,400	FDEP Residential Goals	µg/kg
Bis(2-chloroisopropyl)ether	NA	9,100	NA	9,100	Residential Soil RBCs	µg/kg
Bromodichloromethane	700	10,000	NA	700	FDEP Residential Goals	µg/kg
Bromoform	65,000	81,000	NA	65,000	FDEP Residential Goals	µg/kg
Bromomethane	NA	110,000	NA	110,000	Residential Soil RBCs	µg/kg
Carbon disulfide	5,200	7,800,000	NA	5,200	FDEP Residential Goals	µg/kg
Carbon tetrachloride	600	4,900	NA	600	FDEP Residential Goals	µg/kg
Chlorobenzene	44,000	1,600,000	NA	44,000	FDEP Residential Goals	µg/kg
Chloroethane	NA	31,000,000	NA	31,000,000	Residential Soil RBCs	µg/kg
Chloroform	600	100,000	NA	600	FDEP Residential Goals	µg/kg
Chloromethane	200	49,000	NA	200	FDEP Residential Goals	µg/kg
cis-1,2-dichloroethene	26,000	780,000	NA	26,000	FDEP Residential Goals	µg/kg
cis-1,3-dichloropropene	300	3,700	NA	300	FDEP Residential Goals	µg/kg
Dibromochloromethane	1,200	7,600	NA	1200	FDEP Residential Goals	µg/kg
Ethylbenzene	1,400,000	7,800,000	NA	1,400,000	FDEP Residential Goals	µg/kg
Methylene chloride	16,000	85,000	5.6	16,000	FDEP Residential Goals	µg/kg
Styrene	4,100,000	16,000,000	NA	4,100,000	FDEP Residential Goals	µg/kg
Tetrachloroethene	12,000	12,000	NA	12,000	FDEP Residential Goals	µg/kg
Toluene	520,000	16,000,000	NA	520,000	FDEP Residential Goals	µg/kg
trans-1,2-dichloroethene	62,000	1,600,000	NA	62,000	FDEP Residential Goals	µg/kg
trans-1,3-dichloropropene	300	3,700	NA	300	FDEP Residential Goals	µg/kg
Trichloroethene	6,500	58,000	NA	6,500	FDEP Residential Goals	µg/kg
Vinyl chloride	5	340	NA	5	FDEP Residential Goals	µg/kg
Xylenes, total	13,000,000	160,000,000	NA	13,000,000	FDEP Residential Goals	µg/kg

1 Florida Residential Soil Cleanup Goals (FDEP 1995b and 1996a).
2 Soil Risk-Based Concentrations (EPA, 1997 and 1998).
3 As agreed by the NAS Key West Partnering Team, 2x average background values are presented here for inorganics, while average background values are presented here for pesticides. This data is based on a subset of data from Appendix F of the Supplemental RFI/RI for Eight Sites as NAS Key West.

TABLE C-2

SELECTION OF SOIL ACTION LEVELS FOR IRA DELINEATION
NAS KEY WEST
PAGE 1 OF 3

Parameter	Action Level[1]	IRA Delineation Action Level[2]	Source of Action Level	Units
INORGANICS				
Aluminum	75,000	15,000	FDEP Residential Goals	mg/kg
Antimony	26	5.2	FDEP Residential Goals	mg/kg
Arsenic	2.66	0.532	2x Avg Background	mg/kg
Barium	5,200	1,040	FDEP Residential Goals	mg/kg
Beryllium	0.2	0.04	FDEP Residential Goals	mg/kg
Cadmium	37	7.4	FDEP Residential Goals	mg/kg
Calcium	NA	NA	NA	mg/kg
Chromium	290	58	FDEP Residential Goals	mg/kg
Cobalt	4,700	940	FDEP Residential Goals	mg/kg
Copper	3,100	620	Residential Soil RBCs	mg/kg
Iron	23,000	4,600	Residential Soil RBCs	mg/kg
Lead	500	100	FDEP Residential Goals	mg/kg
Magnesium	NA	NA	NA	mg/kg
Manganese	370	74	FDEP Residential Goals	mg/kg
Mercury	23	4.6	FDEP Residential Goals	mg/kg
Nickel	1,500	300	FDEP Residential Goals	mg/kg
Potassium	NA	NA	NA	mg/kg
Selenium	390	78	FDEP Residential Goals	mg/kg
Silver	390	78	FDEP Residential Goals	mg/kg
Sodium	NA	NA	NA	mg/kg
Thallium	5.5	1.1	Residential Soil RBCs	mg/kg
Tin	44,000	8,800	FDEP Residential Goals	mg/kg
Vanadium	490	98	FDEP Residential Goals	mg/kg
Zinc	23,000	4,600	FDEP Residential Goals	mg/kg
SEMIVOLATILE ORGANIC COMPOUNDS				
1,2,4-trichlorobenzene	780,000	156,000	Residential Soil RBCs	µg/kg
1,2-dichlorobenzene	820,000	164,000	FDEP Residential Goals	µg/kg
1,3-dichlorobenzene	1,700,000	340,000	FDEP Residential Goals	µg/kg
1,4-dichlorobenzene	7,500	1,500	FDEP Residential Goals	µg/kg
2,4,5-trichlorophenol	7,100,000	1,420,000	FDEP Residential Goals	µg/kg
2,4,6-trichlorophenol	87,000	17,400	FDEP Residential Goals	µg/kg
2,4-dichlorophenol	220,000	44,000	FDEP Residential Goals	µg/kg
2,4-dimethylphenol	1,200,000	240,000	FDEP Residential Goals	µg/kg
2,4-dinitrophenol	160,000	32,000	Residential Soil RBCs	µg/kg
2,4-dinitrotoluene	130,000	26,000	FDEP Residential Goals	µg/kg
2,6-dinitrotoluene	71,000	14,200	FDEP Residential Goals	µg/kg
2-chloronaphthalene	560,000	112,000	FDEP Residential Goals	µg/kg
2-chlorophenol	280,000	56,000	FDEP Residential Goals	µg/kg
2-methyl-4,6-dinitrophenol	NA	NA	NA	µg/kg
2-methylnaphthalene	960,000	192,000	FDEP Residential Goals	µg/kg
2-methylphenol	2,600,000	520,000	FDEP Residential Goals	µg/kg
2-nitroaniline	4,000	800	FDEP Residential Goals	µg/kg
2-nitrophenol	NA	NA	NA	µg/kg
3 & 4-methylphenol	340,000	68,000	FDEP Residential Goals	µg/kg
3,3'-dichlorobenzidine	1,400	280	Residential Soil RBCs	µg/kg

TABLE C-2

SELECTION OF SOIL ACTION LEVELS FOR IRA DELINEATION
NAS KEY WEST
PAGE 2 OF 3

Parameter	Action Level[1]	IRA Delineation Action Level[2]	Source of Action Level	Units
3-nitroaniline	230,000	46,000	Residential Soil RBCs	µg/kg
4-bromophenyl phenyl ether	4,500,000	900,000	Residential Soil RBCs	µg/kg
4-chloro-3-methylphenol	1.4E+08	28,000,000	FDEP Residential Goals	µg/kg
4-chloroaniline	240,000	48,000	FDEP Residential Goals	µg/kg
4-chlorophenyl phenyl ether	NA	NA	NA	µg/kg
4-nitroaniline	230,000	46,000	FDEP Residential Goals	µg/kg
4-nitrophenol	4,800,000	960,000	Residential Soil RBCs	µg/kg
Acenaphthene	2,800,000	560,000	FDEP Residential Goals	µg/kg
Acenaphthylene	670,000	134,000	FDEP Residential Goals	µg/kg
Anthracene	20,000,000	4,000,000	FDEP Residential Goals	µg/kg
Benzo(a)anthracene	1,400	280	FDEP Residential Goals	µg/kg
Benzo(a)pyrene	100	20	FDEP Residential Goals	µg/kg
Benzo(b)fluoranthene	1,400	280	FDEP Residential Goals	µg/kg
Benzo(g,h,i)perylene	14,000	2,800	FDEP Residential Goals	µg/kg
Benzo(k)fluoranthene	14,000	2,800	FDEP Residential Goals	µg/kg
Bis(2-chloroethoxy)methane	170,000	34,000	FDEP Residential Goals	µg/kg
Bis(2-chloroethyl)ether	500	100	FDEP Residential Goals	µg/kg
Bis(2-ethylhexyl)phthalate	48,000	9,600	FDEP Residential Goals	µg/kg
Butyl benzyl phthalate	15,000,000	3,000,000	FDEP Residential Goals	µg/kg
Carbazole	42,000	8,400	FDEP Residential Goals	µg/kg
Chrysene	140,000	28,000	FDEP Residential Goals	µg/kg
Di-n-butyl phthalate	7,300,000	1,460,000	FDEP Residential Goals	µg/kg
Di-n-octyl phthalate	1,500,000	300,000	FDEP Residential Goals	µg/kg
Dibenzo(a,h)anthracene	100	20	FDEP Residential Goals	µg/kg
Dibenzofuran	240,000	48,000	FDEP Residential Goals	µg/kg
Diethyl phthalate	56,000,000	11,200,000	FDEP Residential Goals	µg/kg
Dimethyl phthalate	6.3E08	1.26E08	FDEP Residential Goals	µg/kg
Fluoranthene	2,900,000	580,000	FDEP Residential Goals	µg/kg
Fluorene	2,400,000	480,000	FDEP Residential Goals	µg/kg
Hexachlorobenzene	600	120	FDEP Residential Goals	µg/kg
Hexachlorobutadiene	3,100	620	FDEP Residential Goals	µg/kg
Hexachlorocyclopentadiene	550,000	110,000	Residential Soil RBCs	µg/kg
Hexachloroethane	27,000	5,400	FDEP Residential Goals	µg/kg
Indeno(1,2,3-cd)pyrene	1,400	280	FDEP Residential Goals	µg/kg
Isophorone	670,000	134,000	Residential Soil RBCs	µg/kg
n-nitrosodiphenylamine	73,000	14,600	FDEP Residential Goals	µg/kg
Naphthalene	1,300,000	260,000	FDEP Residential Goals	µg/kg
Nitrobenzene	22,000	4,400	FDEP Residential Goals	µg/kg
Pentachlorophenol	5,400	1,080	FDEP Residential Goals	µg/kg
Phenanthrene	1,700,000	340,000	FDEP Residential Goals	µg/kg
Phenol	34,000,000	6,800,000	FDEP Residential Goals	µg/kg
Pyrene	2,200,000	440,000	FDEP Residential Goals	µg/kg

TABLE C-2

SELECTION OF SOIL ACTION LEVELS FOR IRA DELINEATION
NAS KEY WEST
PAGE 3 OF 3

Parameter	Action Level[1]	IRA Delineation Action Level[2]	Source of Action Level	Units
VOLATILE ORGANIC COMPOUNDS				
1,1,1-trichloroethane	610,000	122,000	FDEP Residential Goals	µg/kg
1,1,2,2-tetrachloroethane	900	180	FDEP Residential Goals	µg/kg
1,1,2-trichloroethane	2,000	400	FDEP Residential Goals	µg/kg
1,1-dichloroethane	310,000	62,000	FDEP Residential Goals	µg/kg
1,1-dichloroethene	100	20	FDEP Residential Goals	µg/kg
1,2-dichloroethane	700	140	FDEP Residential Goals	µg/kg
1,2-dichloropropane	800	160	FDEP Residential Goals	µg/kg
2-butanone	2,200,000	440,000	FDEP Residential Goals	µg/kg
2-hexanone	3,100,000	620,000	Residential Soil RBCs	µg/kg
4-methyl-2-pentanone	520,000	104,000	FDEP Residential Goals	µg/kg
Acetone	260,000	52,000	FDEP Residential Goals	µg/kg
Benzene	1,400	280	FDEP Residential Goals	µg/kg
Bis(2-chloroisopropyl)ether	9,100	1,820	Residential Soil RBCs	µg/kg
Bromodichloromethane	700	140	FDEP Residential Goals	µg/kg
Bromoform	65,000	13,000	FDEP Residential Goals	µg/kg
Bromomethane	110,000	22,000	Residential Soil RBCs	µg/kg
Carbon disulfide	5,200	1,040	FDEP Residential Goals	µg/kg
Carbon tetrachloride	600	120	FDEP Residential Goals	µg/kg
Chlorobenzene	44,000	8,800	FDEP Residential Goals	µg/kg
Chloroethane	31,000,000	6,200,000	Residential Soil RBCs	µg/kg
Chloroform	600	120	FDEP Residential Goals	µg/kg
Chloromethane	200	40	FDEP Residential Goals	µg/kg
cis-1,2-dichloroethene	26,000	5,200	FDEP Residential Goals	µg/kg
cis-1,3-dichloropropene	300	60	FDEP Residential Goals	µg/kg
Dibromochloromethane	1200	240	FDEP Residential Goals	µg/kg
Ethylbenzene	1,400,000	280,000	FDEP Residential Goals	µg/kg
Methylene chloride	16,000	3,200	FDEP Residential Goals	µg/kg
Styrene	4,100,000	820,000	FDEP Residential Goals	µg/kg
Tetrachloroethene	12,000	2,400	FDEP Residential Goals	µg/kg
Toluene	520,000	104,000	FDEP Residential Goals	µg/kg
trans-1,2-dichloroethene	62,000	12,400	FDEP Residential Goals	µg/kg
trans-1,3-dichloropropene	300	60	FDEP Residential Goals	µg/kg
Trichloroethene	6,500	1,300	FDEP Residential Goals	µg/kg
Vinyl chloride	5	1	FDEP Residential Goals	µg/kg
Xylenes, total	13,000,000	2,600,000	FDEP Residential Goals	µg/kg

IRA = Interim Remedial Action

1 See Table C-1.
2 Action level divided by five.

TABLE C-3

SELECTION OF GROUNDWATER ACTION LEVELS
NAS KEY WEST
PAGE 1 OF 4

Parameter	MCL[1]	Florida MCL[2]	Tap Water RBCs[3]	2x Average BG[4]	Selected Level Action	Source of Selected Action Level	Units
INORGANICS							
Aluminum	NA	NA	37,000	NA	37,000	Tap Water RBCs	µg/L
Antimony	6	6	15	NA	6	MCL	µg/L
Arsenic	50	50	0.045	9.9	50	MCL	µg/L
Barium	2,000	2,000	2,600	19.16	2,000	MCL	µg/L
Beryllium	4	4	0.016	NA	4	MCL	µg/L
Cadmium	5	5	18	NA	5	MCL	µg/L
Calcium	NA	NA	NA	NA	NA	NA	µg/L
Chromium	100	100	180	1.92	100	MCL	µg/L
Cobalt	NA	NA	2,200	NA	2,200	Tap Water RBCs	µg/L
Copper	NA	NA	1,500	3.36	1,500	Tap Water RBCs	µg/L
Cyanide	200	200	730	2.94	200	MCL	µg/L
Iron	NA	NA	11,000	83.44	11,000	Tap Water RBCs	µg/L
Lead	15	15	NA	NA	15	MCL	µg/L
Magnesium	NA	NA	NA	NA	NA	NA	µg/L
Manganese	NA	NA	840	7.56	840	Tap Water RBCs	µg/L
Mercury	2	2	11	0.2	2	MCL	µg/L
Nickel	100	100	730	NA	100	MCL	µg/L
Potassium	NA	NA	NA	NA	NA	NA	µg/L
Selenium	50	50	180	4.3	50	MCL	µg/L
Silver	NA	NA	180	2.06	180	Tap Water RBCs	µg/L
Sodium	NA	160,000	NA	NA	160,000	Fl MCL	µg/L
Thallium	2	2	NA	4.62	4.62	2x Average BG	µg/L
Tin	NA	NA	22,000	NA	22,000	Tap Water RBCs	µg/L
Vanadium	NA	NA	260	3.8	260	Tap Water RBCs	µg/L
Zinc	NA	NA	11,000	2.34	11,000	Tap Water RBCs	µg/L
PESTICIDES							
4,4'-DDD	NA	NA	0.28	NA	0.28	Tap Water RBCs	µg/L
4,4'-DDE	NA	NA	0.2	NA	0.2	Tap Water RBCs	µg/L
4,4'-DDT	NA	NA	0.2	NA	0.2	Tap Water RBCs	µg/L
Aldrin	NA	NA	0.004	NA	0.004	Tap Water RBCs	µg/L
alpha-BHC	NA	NA	0.011	NA	0.011	Tap Water RBCs	µg/L
alpha-chlordane	NA	NA	0.052	NA	0.052	Tap Water RBCs	µg/L
beta-BHC	NA	NA	0.037	NA	0.037	Tap Water RBCs	µg/L
delta-BHC	NA	NA	NA	NA	NA	NA	µg/L
Dieldrin	NA	NA	0.0042	NA	0.0042	Tap Water RBCs	µg/L
Endosulfan I	NA	NA	220	NA	220	Tap Water RBCs	µg/L
Endosulfan II	NA	NA	220	NA	220	Tap Water RBCs	µg/L
Endosulfan sulfate	NA	NA	NA	NA	NA	NA	µg/L
Endrin	2	2	11	NA	2	MCL	µg/L
Endrin aldehyde	NA	NA	NA	NA	NA	NA	µg/L

TABLE C-3

SELECTION OF GROUNDWATER ACTION LEVELS
NAS KEY WEST
PAGE 2 OF 4

Parameter	MCL[1]	Florida MCL[2]	Tap Water RBCs[3]	2x Average BG[4]	Selected Level Action	Source of Selected Action Level	Units
Endrin ketone	NA	NA	NA	NA	NA	NA	µg/L
gamma-BHC (lindane)	0.2	0.2	0.052	NA	0.2	MCL	µg/L
gamma-chlordane	NA	NA	0.052	NA	0.052	Tap Water RBCs	µg/L
Heptachlor	0.4	0.4	0.0023	NA	0.4	MCL	µg/L
Heptachlor epoxide	0.2	0.2	0.0012	NA	0.2	MCL	µg/L
Methoxychlor	40	40	180	NA	40	MCL	µg/L
Toxaphene	3	3	0.061	NA	3	MCL	µg/L
POLYCHLORINATED BIPHENYLS							
Aroclor-1016	0.5	0.5	0.0335	NA	0.5	MCL	µg/L
Aroclor-1221	0.5	0.5	0.0335	NA	0.5	MCL	µg/L
Aroclor-1232	0.5	0.5	0.0335	NA	0.5	MCL	µg/L
Aroclor-1242	0.5	0.5	0.0335	NA	0.5	MCL	µg/L
Aroclor-1248	0.5	0.5	0.0335	NA	0.5	MCL	µg/L
Aroclor-1254	0.5	0.5	0.0335	NA	0.5	MCL	µg/L
Aroclor-1260	0.5	0.5	0.0335	NA	0.5	MCL	µg/L
SEMIVOLATILE ORGANIC COMPOUNDS							
1,2,4-trichlorobenzene	70	70	190	NA	70	MCL	µg/L
1,2-dichlorobenzene	600	600	270	NA	600	MCL	µg/L
1,3-dichlorobenzene	NA	NA	540	NA	540	Tap Water RBCs	µg/L
1,4-dichlorobenzene	75	75	0.44	NA	0.44	MCL	µg/L
2,4,5-trichlorophenol	NA	NA	3,700	NA	3,700	Tap Water RBCs	µg/L
2,4,6-trichlorophenol	NA	NA	6.1	NA	6.1	Tap Water RBCs	µg/L
2,4-dichlorophenol	NA	NA	110	NA	110	Tap Water RBCs	µg/L
2,4-dimethylphenol	NA	NA	730	NA	730	Tap Water RBCs	µg/L
2,4-dinitrophenol	NA	NA	73	NA	73	Tap Water RBCs	µg/L
2,4-dinitrotoluene	NA	NA	73	NA	73	Tap Water RBCs	µg/L
2,6-dinitrotoluene	NA	NA	37	NA	37	Tap Water RBCs	µg/L
2-chloronaphthalene	NA	NA	NA	NA	NA	NA	µg/L
2-chlorophenol	NA	NA	180	NA	180	Tap Water RBCs	µg/L
2-methyl-4,6-dinitrophenol	NA	NA	NA	NA	NA	NA	µg/L
2-methylnaphthalene	NA	NA	NA	NA	NA	NA	µg/L
2-methylphenol	NA	NA	1,800	NA	1,800	Tap Water RBCs	µg/L
2-nitroaniline	NA	NA	2.2	NA	2.2	Tap Water RBCs	µg/L
2-nitrophenol	NA	NA	NA	NA	NA	NA	µg/L
3 and 4-methylphenol	NA	NA	1,800	NA	1,800	Tap Water RBCs	µg/L
3,3'-dichlorobenzidine	NA	NA	0.15	NA	0.15	Tap Water RBCs	µg/L
3-nitroaniline	NA	NA	110	NA	110	Tap Water RBCs	µg/L
4-bromophenyl phenyl ether	NA	NA	2,100	NA	2,100	Tap Water RBCs	µg/L
4-chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	µg/L
4-chloroaniline	NA	NA	150	NA	150	Tap Water RBCs	µg/L
4-chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	µg/L

TABLE C-3

SELECTION OF GROUNDWATER ACTION LEVELS
NAS KEY WEST
PAGE 3 OF 4

Parameter	MCL[1]	Florida MCL[2]	Tap Water RBCs[3]	2x Average BG[4]	Selected Level Action	Source of Selected Action Level	Units
4-nitroaniline	NA	NA	110	NA	110	Tap Water RBCs	μg/L
4-nitrophenol	NA	NA	2,300	NA	2,300	Tap Water RBCs	μg/L
Acenaphthene	NA	NA	2,200	NA	2,200	Tap Water RBCs	μg/L
Acenaphthylene	NA	NA	NA	NA	NA	NA	μg/L
Anthracene	NA	NA	11,000	NA	11,000	Tap Water RBCs	μg/L
Benzo(a)anthracene	NA	NA	0.092	NA	0.092	Tap Water RBCs	μg/L
Benzo(a)pyrene	0.2	0.2	0.0092	NA	0.2	MCL	μg/L
Benzo(b)fluoranthene	NA	NA	0.092	NA	0.092	Tap Water RBCs	μg/L
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	μg/L
Benzo(k)fluoranthene	NA	NA	0.92	NA	0.92	Tap Water RBCs	μg/L
Bis(2-chloroethoxy)methane	NA	NA	NA	NA	NA	NA	μg/L
Bis(2-chloroethyl)ether	NA	NA	0.0092	NA	0.0092	Tap Water RBCs	μg/L
Bis(2-ethylhexyl)phthalate	6	6	4.8	NA	6	MCL	μg/L
Butyl benzyl phthalate	NA	NA	7,300	NA	7,300	Tap Water RBCs	μg/L
Carbazole	NA	NA	3.4	NA	3.4	Tap Water RBCs	μg/L
Chrysene	NA	NA	9.2	NA	9.2	Tap Water RBCs	μg/L
Di-n-butyl phthalate	NA	NA	3,700	NA	3,700	Tap Water RBCs	μg/L
Di-n-octyl phthalate	NA	NA	730	NA	730	Tap Water RBCs	μg/L
Dibenzo(a,h)anthracene	NA	NA	0.0092	NA	0.0092	Tap Water RBCs	μg/L
Dibenzofuran	NA	NA	150	NA	150	Tap Water RBCs	μg/L
Diethyl phthalate	NA	NA	29,000	NA	29,000	Tap Water RBCs	μg/L
Dimethyl phthalate	NA	NA	370,000	NA	370,000	Tap Water RBCs	μg/L
Fluoranthene	NA	NA	1,500	NA	1,500	Tap Water RBCs	μg/L
Fluorene	NA	NA	1,500	NA	1,500	Tap Water RBCs	μg/L
Hexachlorobenzene	1	1	0.0066	NA	1	MCL	μg/L
Hexachlorobutadiene	NA	NA	0.14	NA	0.14	Tap Water RBCs	μg/L
Hexachlorocyclopentadiene	50	50	0.15	NA	50	MCL	μg/L
Hexachloroethane	NA	NA	0.75	NA	0.75	Tap Water RBCs	μg/L
Indeno(1,2,3-cd)pyrene	NA	NA	0.092	NA	0.092	Tap Water RBCs	μg/L
Isophorone	NA	NA	71	NA	71	Tap Water RBCs	μg/L
n-nitrosodiphenylamine	NA	NA	14	NA	14	Tap Water RBCs	μg/L
Naphthalene	NA	NA	1,500	NA	1,500	Tap Water RBCs	μg/L
Nitrobenzene	NA	NA	3.4	NA	3.4	Tap Water RBCs	μg/L
Pentachlorophenol	1	1	0.56	NA	1	MCL	μg/L
Phenanthrene	NA	NA	NA	NA	NA	NA	μg/L
Phenol	NA	NA	22,000	NA	22,000	Tap Water RBCs	μg/L
Pyrene	NA	NA	1,100	NA	1,100	Tap Water RBCs	μg/L
VOLATILE ORGANIC COMPOUNDS							
1,1,1-trichloroethane	200	200	790	NA	200	MCL	μg/L
1,1,2,2-tetrachloroethane	NA	NA	0.052	NA	0.052	Tap Water RBCs	μg/L
1,1,2-trichloroethane	5	5	0.19	NA	5	MCL	μg/L

TABLE C-3

SELECTION OF GROUNDWATER ACTION LEVELS
NAS KEY WEST
PAGE 4 OF 4

Parameter	MCL[1]	Florida MCL[2]	Tap Water RBCs[3]	2x Average BG[4]	Selected Level Action	Source of Selected Action Level	Units
1,1-dichloroethane	NA	NA	810	NA	810	Tap Water RBCs	µg/L
1,1-dichloroethene	7	7	0.044	NA	7	MCL	µg/L
1,2-dichloroethane	5	3	0.12	NA	3	Fl MCL	µg/L
1,2-dichloropropane	5	5	0.16	NA	5	MCL	µg/L
2-butanone	NA	NA	1,900	NA	1,900	Tap Water RBCs	µg/L
2-hexanone	NA	NA	NA	NA	428,000	Other[5]	µg/L
4-methyl-2-pentanone	NA	NA	2,900	NA	2,900	Tap Water RBCs	µg/L
Acetone	NA	NA	3,700	NA	3,700	Tap Water RBCs	µg/L
Benzene	5	1	0.36	NA	1	Fl MCL	µg/L
Bis(2-chloroisopropyl)ether	NA	NA	0.26	NA	0.26	Tap Water RBCs	µg/L
Bromodichloromethane	100	NA	0.17	NA	100	MCL	µg/L
Bromoform	100	NA	2.4	NA	100	MCL	µg/L
Bromomethane	NA	NA	8.7	NA	8.7	Tap Water RBCs	µg/L
Carbon disulfide	NA	NA	1,000	NA	1,000	Tap Water RBCs	µg/L
Carbon tetrachloride	5	3	0.16	NA	3	Fl MCL	µg/L
Chlorobenzene	100	100	39	NA	100	MCL	µg/L
Chloroethane	NA	NA	8,600	NA	8,600	Tap Water RBCs	µg/L
Chloroform	100	NA	0.15	NA	100	MCL	µg/L
Chloromethane	NA	NA	1.4	NA	1.4	Tap Water RBCs	µg/L
cis-1,2-dichloroethene	70	70	61	NA	70	MCL	µg/L
cis-1,3-dichloropropene	NA	NA	0.077	NA	0.077	Tap Water RBCs	µg/L
Dibromochloromethane	100	NA	0.13	NA	100	MCL	µg/L
Ethylbenzene	700	700	1,300	NA	700	MCL	µg/L
Methylene chloride	NA	5	4.1	NA	5	Fl MCL	µg/L
Styrene	100	100	1,600	NA	100	MCL	µg/L
Tetrachloroethene	5	3	1.1	NA	3	Fl MCL	µg/L
Toluene	1,000	1,000	750	NA	1,000	MCL	µg/L
trans-1,2-dichloroethene	100	100	120	NA	100	MCL	µg/L
trans-1,3-dichloropropene	NA	NA	0.077	NA	0.077	Tap Water RBCs	µg/L
Trichloroethene	5	3	1.6	NA	3	Fl MCL	µg/L
Vinyl chloride	2	1	0.019	NA	1	Fl MCL	µg/L
Xylenes, total	10,000	10,000	12,000	NA	10,000	MCL	µg/L

1 Safe Drinking Water Act Maximum Contaminant Levels (EPA, 1996a).
2 Florida Maximum Contaminant Levels (FDEP, 1995a).
3 Tap Water Risk Based Concentrations (EPA, 1997).
4 Twice the average background concentration based on a subset of data from Appendix F of the Supplemental RFI/RI for Eight Sites as NAS Key West.
5 EPA Region 3 Biological Technical Assistance Group Screening Levels (EPA, 1995).

Appendix C

Part 3 - NAS Key West Base Realignment and Closure Background Data Subset

BRAC Background Samples
Soil Data Set

BG 1

BG1SS-01	BG1SS-01	B&RE	0 ft

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	3620	
Antimony	0.58	U
Arsenic	2.7	U
Barium	13	
Beryllium	0.07	U
Cadmium	0.41	
Chromium	5.8	
Cobalt	0.29	
Copper	5.1	
Cyanide	1.2	U
Iron	1710	
Lead	10.5	
Manganese	33.7	
Mercury	0.07	U
Nickel	2	
Selenium	1.1	U
Silver	0.16	U
Thallium	1	UJ
Tin	4.91	U
Vanadium	3.6	
Zinc	5.9	
Pesticides/PCBs (µg/kg)		
2,4,5-T	54.8	U
2,4,5-TP (silvex)	27.4	U
2,4-D	54.8	U
Chlorobenzilate	2280	U
Dimethoate	2280	U
Dinoseb	455	U
Disulfoton	455	U
Famphur	455	U
Isodrin	455	U
Kepone	455	U
Sulfotep	455	U
Thionazin	455	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	455	U
1,2,4-trichlorobenzene	455	U
1,2-dichlorobenzene	455	U
1,3,5-trinitrobenzene	2280	U
1,3-dichlorobenzene	455	U
1,3-dinitrobenzene	455	U
1,4-dichlorobenzene	455	U
1,4-dioxane	455	U
1,4-naphthoquinone	455	U
1-naphthylamine	455	U
2,3,4,6-tetrachlorophenol	455	U
2,4,5-trichlorophenol	455	U
2,4,6-trichlorophenol	455	U
2,4-dichlorophenol	455	U
2,4-dimethylphenol	455	U
2,4-dinitrophenol	910	U
2,4-dinitrotoluene	455	U
2,6-dichlorophenol	455	U
2,6-dinitrotoluene	455	U
2-acetylaminofluorene	455	U
2-chloronaphthalene	455	U
2-chlorophenol	455	U
2-methyl-4,6-dinitrophenol	455	U
2-methylnaphthalene	455	U
2-methylphenol	455	U
2-naphthylamine	455	UR
2-nitroaniline	455	U
2-nitrophenol	455	U
2-picoline	455	U
3 & 4-methylphenol	455	U
3,3'-dichlorobenzidine	2280	U
3,3'-dimethylbenzidine	2280	UR
3-methylcholanthrene	455	U
3-nitroaniline	455	U
4-aminobiphenyl	455	U
4-bromophenyl phenyl ether	455	U
4-chloro-3-methylphenol	455	U
4-chloroaniline	455	UR
4-chlorophenyl phenyl ether	455	U
4-nitroaniline	455	U
4-nitrophenol	455	U
4-nitroquinoline-1-oxide	455	U
5-nitro-o-toluidine	455	U
7,12-dimethylbenz(a)anthracene	455	U
a,a-dimethylphenethylamine	455	UR
Acenaphthene	455	U
Acenaphthylene	455	U
Acetophenone	455	U
Aniline	455	U
Anthracene	455	U
Aramite	455	U
Benzo(a)anthracene	455	U
Benzo(a)pyrene	455	U
Benzo(b)fluoranthene	455	U
Benzo(g,h,i)perylene	455	U
Benzo(k)fluoranthene	455	U
Benzyl alcohol	455	U
Bis(2-chloroethoxy)methane	455	U
Bis(2-chloroethyl)ether	455	U
Bis(2-ethylhexyl)phthalate	455	U
Butyl benzyl phthalate	455	U
Chrysene	455	U
Di-n-butyl phthalate	455	U
Di-n-octyl phthalate	455	U
Diallate	455	U
Dibenzo(a,h)anthracene	455	U
Dibenzofuran	455	U
Diethyl phthalate	455	U
Dimethyl phthalate	455	U
Diphenylamine	455	U
Ethyl methacrylate	455	U
Ethyl methanesulfonate	455	U
Fluoranthene	455	U
Fluorene	455	U
Hexachlorobenzene	455	U
Hexachlorobutadiene	455	U
Hexachlorocyclopentadiene	455	U
Hexachloroethane	455	U
Hexachloropropene	455	U
Indeno(1,2,3-cd)pyrene	455	U
Isophorone	455	U
Isosafrole	455	U
Methapyrilene	2280	U
Methyl methanesulfonate	455	U
N-nitroso-di-n-butylamine	455	U
N-nitroso-di-n-propylamine	455	U
N-nitrosodiethylamine	455	U
N-nitrosodimethylamine	455	U
N-nitrosodiphenylamine	455	U
N-nitrosomethylethylamine	455	U
N-nitrosomorpholine	455	U
N-nitrosopiperidine	455	U
N-nitrosopyrrolidine	455	U
Naphthalene	455	U
Nitrobenzene	455	U
o,o,o-triethylphosphorothioate	455	U
o-toluidine	455	U
p-dimethylaminoazobenzene	455	U
p-phenylenediamine	910	U
Pentachlorobenzene	455	U
Pentachloroethane	455	U
Pentachloronitrobenzene	455	U
Pentachlorophenol	455	U
Phenacetin	455	U
Phenanthrene	455	U
Phenol	455	U
Pronamide	455	U
Pyrene	455	U
Pyridine	455	U
Safrole	455	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	3	U
1,1,1-trichloroethane	3	U
1,1,2,2-tetrachloroethane	3	U
1,1,2-trichloroethane	3	U
1,1-dichloroethane	3	U
1,1-dichloroethene	3	U
1,2,3-trichloropropane	3	U
1,2-dibromo-3-chloropropane	3	U
1,2-dibromoethane	3	U
1,2-dichloroethane	3	U
1,2-dichloropropane	3	U
2-butanone	7	U
2-chloro-1,3-butadiene	3	U
2-hexanone	7	U
3-chloropropene	14	U
4-methyl-2-pentanone	7	U
Acetone	3	U
Acetonitrile	14	U
Acrolein	27	UR
Acrylonitrile	27	U
Benzene	3	U
Bis(2-chloroisopropyl)ether	27	U
Bromodichloromethane	3	U
Bromoform	3	U
Bromomethane	3	U
Carbon disulfide	7	U
Carbon tetrachloride	3	U
Chlorobenzene	3	U
Chloroethane	3	U
Chloroform	3	U
Chloromethane	4	
Cis-1,3-dichloropropene	3	U
Dibromochloromethane	3	U
Dibromomethane	3	U
Dichlorodifluoromethane	3	U
Ethyl cyanide	27	UR
Ethylbenzene	3	U
Iodomethane	7	U
Isobutanol	27	U
Methacrylonitrile	14	U
Methyl methacrylate	14	U
Methylene chloride	0.11	J
Styrene	3	U
Tetrachloroethene	3	U
Toluene	3	U
Trans-1,2-dichloroethene	3	U
Trans-1,3-dichloropropene	3	U
Trans-1,4-dichloro-2-butene	14	U
Trichloroethene	3	U
Trichlorofluoromethane	3	U
Vinyl acetate	7	U

BRAC Backgro d Samples
Soil Data Set

PARAMETER	RESULT	QUAL
Vinyl chloride	3	U
Xylenes, total	8	U
BG1SS-02 BG1SS-02 B&RE	**0 ft**	
Inorganics (mg/kg)		
Aluminum	3950	
Antimony	0.49	U
Arsenic	0.95	
Barium	15.6	
Beryllium	0.06	U
Cadmium	0.08	U
Chromium	5.5	
Cobalt	0.32	J
Copper	4.3	J
Cyanide	0.23	U
Iron	1730	
Lead	6.1	J
Manganese	28.1	J
Mercury	0.06	U
Nickel	2.1	
Selenium	0.9	UJ
Silver	0.13	U
Thallium	0.64	UJ
Vanadium	3.7	
Zinc	6.5	J
Pesticides/PCBs (µg/kg)		
2,4,5-T	50	UJ
2,4,5-TP (silvex)	25	UJ
2,4-D	50	UJ
4,4'-DDD	1.6	U
4,4'-DDE	53.3	
4,4'-DDT	2.6	J
Aldrin	0.83	U
alpha-BHC	0.83	U
Aroclor-1016	5.2	U
Aroclor-1221	5.2	U
Aroclor-1232	5.2	U
Aroclor-1242	5.2	U
Aroclor-1248	5.2	U
Aroclor-1254	5.2	U
Aroclor-1260	5.2	U
beta-BHC	0.83	U
Chlordane	10.3	U
Chlorobenzilate	2000	U
delta-BHC	0.83	U
Dieldrin	1.6	U
Dimethoate	2000	UJ
Dinoseb	410	U
Disulfoton	410	U
Endosulfan I	0.83	U
Endosulfan II	1.6	U

PARAMETER	RESULT	QUAL
Endosulfan sulfate	1.6	U
Endrin	1.6	U
Endrin aldehyde	1.6	U
Famphur	410	UJ
gamma-BHC (lindane)	0.83	U
Heptachlor	0.83	U
Heptachlor epoxide	0.83	U
Isodrin	410	U
Kepone	410	UJ
Methoxychlor	8.3	U
Methyl parathion	2.1	U
Parathion	2.1	U
Phorate	2.1	U
Sulfotep	410	U
Thionazin	410	U
Toxaphene	41	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	410	U
1,2,4-trichlorobenzene	410	U
1,2-dichlorobenzene	410	U
1,3,5-trinitrobenzene	2000	UJ
1,3-dichlorobenzene	410	U
1,3-dinitrobenzene	410	U
1,4-dichlorobenzene	410	U
1,4-dioxane	410	UJ
1,4-naphthoquinone	410	UJ
1-naphthylamine	410	U
2,3,4,6-tetrachlorophenol	410	U
2,4,5-trichlorophenol	410	U
2,4,6-trichlorophenol	410	U
2,4-dichlorophenol	410	U
2,4-dimethylphenol	410	U
2,4-dinitrophenol	820	U
2,4-dinitrotoluene	410	U
2,6-dichlorophenol	410	U
2,6-dinitrotoluene	410	U
2-acetylaminofluorene	410	U
2-chloronaphthalene	410	U
2-chlorophenol	410	U
2-methyl-4,6-dinitrophenol	410	U
2-methylnaphthalene	410	U
2-methylphenol	410	U
2-naphthylamine	410	UR
2-nitroaniline	410	U
2-nitrophenol	410	U
2-picoline	410	U
3 & 4-methylphenol	410	U
3,3'-dichlorobenzidine	2000	UJ
3,3'-dimethylbenzidine	2000	UR
3-methylcholanthrene	410	UJ

PARAMETER	RESULT	QUAL
3-nitroaniline	410	UR
4-aminobiphenyl	410	U
4-bromophenyl phenyl ether	410	U
4-chloro-3-methylphenol	410	U
4-chloroaniline	410	UR
4-chlorophenyl phenyl ether	410	U
4-nitroaniline	410	U
4-nitrophenol	820	U
4-nitroquinoline-1-oxide	410	UR
5-nitro-o-toluidine	410	U
7,12-dimethylbenz(a)anthracene	410	UJ
a,a-dimethylphenethylamine	410	U
Acenaphthene	410	U
Acenaphthylene	410	U
Acetophenone	410	U
Aniline	410	U
Anthracene	410	U
Aramite	410	UJ
Benzo(a)anthracene	410	U
Benzo(a)pyrene	410	U
Benzo(b)fluoranthene	410	U
Benzo(g,h,i)perylene	410	U
Benzo(k)fluoranthene	410	U
Benzyl alcohol	410	U
Bis(2-chloroethoxy)methane	410	U
Bis(2-chloroethyl)ether	410	U
Bis(2-ethylhexyl)phthalate	410	U
Butyl benzyl phthalate	410	U
Chrysene	410	U
Di-n-butyl phthalate	410	U
Di-n-octyl phthalate	410	U
Diallate	410	U
Dibenzo(a,h)anthracene	410	UJ
Dibenzofuran	410	U
Diethyl phthalate	410	U
Dimethyl phthalate	410	U
Diphenylamine	410	U
Ethyl methacrylate	410	UJ
Ethyl methanesulfonate	410	U
Fluoranthene	410	U
Fluorene	410	U
Hexachlorobenzene	410	U
Hexachlorobutadiene	410	U
Hexachlorocyclopentadiene	410	U
Hexachloroethane	410	U
Hexachloropropene	410	U
Indeno(1,2,3-cd)pyrene	410	U
Isophorone	410	U
Isosafrole	410	U
Methapyrilene	2000	U

PARAMETER	RESULT	QUAL
Methyl methanesulfonate	410	UJ
N-nitroso-di-n-butylamine	410	U
N-nitroso-di-n-propylamine	410	U
N-nitrosodiethylamine	410	U
N-nitrosodimethylamine	410	UJ
N-nitrosodiphenylamine	410	U
N-nitrosomethylethylamine	410	UJ
N-nitrosomorpholine	410	U
N-nitrosopiperidine	410	UJ
N-nitrosopyrrolidine	410	U
Naphthalene	410	U
Nitrobenzene	410	U
o,o,o-triethylphosphorothioate	410	U
o-toluidine	410	UJ
p-dimethylaminoazobenzene	410	U
p-phenylenediamine	820	UJ
Pentachlorobenzene	410	U
Pentachloroethane	410	U
Pentachloronitrobenzene	410	U
Pentachlorophenol	410	U
Phenacetin	410	U
Phenanthrene	410	U
Phenol	410	U
Pronamide	410	U
Pyrene	410	U
Pyridine	410	U
Safrole	410	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	2	UJ
1,1,1-trichloroethane	2	U
1,1,2,2-tetrachloroethane	2	UJ
1,1,2-trichloroethane	2	UJ
1,1-dichloroethane	2	U
1,1-dichloroethene	2	U
1,2,3-trichloropropane	2	UJ
1,2-dibromo-3-chloropropane	2	UJ
1,2-dibromoethane	2	UJ
1,2-dichloroethane	2	U
1,2-dichloropropane	2	U
2-butanone	6	U
2-chloro-1,3-butadiene	2	UR
2-hexanone	6	UJ
3-chloropropene	12	U
4-methyl-2-pentanone	6	UJ
Acetone	6	U
Acetonitrile	12	U
Acrolein	25	UR
Acrylonitrile	25	U
Benzene	3	U
Bis(2-chloroisopropyl)ether	25	UJ

BRAC Background Samples
Soil Data Set

PARAMETER	RESULT	QUAL
Bromodichloromethane	2	UJ
Bromoform	2	U
Bromomethane	2	U
Carbon disulfide	6	U
Carbon tetrachloride	2	U
Chlorobenzene	2	U
Chloroethane	2	U
Chloroform	2	U
Chloromethane	2	U
Cis-1,3-dichloropropene	2	UJ
Dibromochloromethane	2	U
Dibromomethane	2	U
Dichlorodifluoromethane	2	U
Ethyl cyanide	25	UR
Ethylbenzene	2	UJ
Iodomethane	6	U
Isobutanol	25	U
Methacrylonitrile	12	U
Methyl methacrylate	12	UJ
Methylene chloride	1	J
Styrene	2	UJ
Tetrachloroethene	2	UJ
Toluene	2	UJ
Trans-1,2-dichloroethene	2	U
Trans-1,3-dichloropropene	2	UJ
Trans-1,4-dichloro-2-butene	12	UR
Trichloroethene	2	U
Trichlorofluoromethane	2	U
Vinyl acetate	6	U
Vinyl chloride	2	U
Xylenes, total	8	UJ
BG1SS-03 BG1SS-03 B&RE 0 ft		
Inorganics (mg/kg)		
Aluminum	4250	
Antimony	0.64	U
Arsenic	2.7	
Barium	17.7	
Beryllium	0.08	U
Cadmium	0.4	U
Chromium	9.5	
Cobalt	0.43	J
Copper	15.6	J
Cyanide	0.18	U
Iron	2250	
Lead	43.5	J
Manganese	30	J
Mercury	0.07	U
Nickel	3.3	
Selenium	1.5	J
Silver	0.17	U

PARAMETER	RESULT	QUAL
Thallium	1.1	UJ
Vanadium	7.8	
Zinc	36.6	J
Pesticides/PCBs (µg/kg)		
2,4,5-T	60.6	U
2,4,5-TP (silvex)	30.3	U
2,4-D	60.6	U
4,4'-DDD	10	U
4,4'-DDE	10	U
4,4'-DDT	10	U
Aldrin	5	U
alpha-BHC	5	U
Aroclor-1016	31.4	U
Aroclor-1221	31.4	U
Aroclor-1232	31.4	U
Aroclor-1242	31.4	U
Aroclor-1248	31.4	U
Aroclor-1254	31.4	U
Aroclor-1260	31.4	U
beta-BHC	5	U
Chlordane	62.7	U
Chlorobenzilate	2500	U
delta-BHC	5	U
Dieldrin	10	U
Dimethoate	2500	UJ
Dinoseb	500	U
Disulfoton	500	U
Endosulfan I	5	U
Endosulfan II	10	U
Endosulfan sulfate	10	U
Endrin	10	U
Endrin aldehyde	10	U
Famphur	500	UJ
gamma-BHC (lindane)	5	U
Heptachlor	5	U
Heptachlor epoxide	5	U
Isodrin	500	U
Kepone	500	UJ
Methoxychlor	50.2	U
Methyl parathion	12.6	U
Parathion	12.6	U
Phorate	12.6	U
Sulfotep	500	U
Thionazin	500	U
Toxaphene	249	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	500	U
1,2,4-trichlorobenzene	500	U
1,2-dichlorobenzene	500	U
1,3,5-trinitrobenzene	2500	UJ

PARAMETER	RESULT	QUAL
1,3-dichlorobenzene	500	U
1,3-dinitrobenzene	500	U
1,4-dichlorobenzene	500	U
1,4-dioxane	500	UJ
1,4-naphthoquinone	500	UJ
1-naphthylamine	500	U
2,3,4,6-tetrachlorophenol	500	U
2,4,5-trichlorophenol	500	U
2,4,6-trichlorophenol	500	U
2,4-dichlorophenol	500	U
2,4-dimethylphenol	500	U
2,4-dinitrophenol	1000	U
2,4-dinitrotoluene	500	U
2,6-dichlorophenol	500	U
2,6-dinitrotoluene	500	U
2-acetylaminofluorene	500	U
2-chloronaphthalene	500	U
2-chlorophenol	500	U
2-methyl-4,6-dinitrophenol	500	U
2-methylnaphthalene	500	U
2-methylphenol	500	U
2-naphthylamine	500	UR
2-nitroaniline	500	U
2-nitrophenol	500	U
2-picoline	500	U
3 & 4-methylphenol	500	U
3,3'-dichlorobenzidine	2500	UJ
3,3'-dimethylbenzidine	2500	UR
3-methylcholanthrene	500	UJ
3-nitroaniline	500	UR
4-aminobiphenyl	500	U
4-bromophenyl phenyl ether	500	U
4-chloro-3-methylphenol	500	U
4-chloroaniline	500	UR
4-chlorophenyl phenyl ether	500	U
4-nitroaniline	500	U
4-nitrophenol	1000	U
4-nitroquinoline-1-oxide	500	UR
5-nitro-o-toluidine	500	U
7,12-dimethylbenz(a)anthracene	500	UJ
a,a-dimethylphenethylamine	500	U
Acenaphthene	500	U
Acenaphthylene	500	U
Acetophenone	500	U
Aniline	500	U
Anthracene	390	J
Aramite	500	UJ
Benzo(a)anthracene	500	U
Benzo(a)pyrene	500	U
Benzo(b)fluoranthene	390	J

PARAMETER	RESULT	QUAL
Benzo(g,h,i)perylene	500	U
Benzo(k)fluoranthene	500	U
Benzyl alcohol	500	U
Bis(2-chloroethoxy)methane	500	U
Bis(2-chloroethyl)ether	500	U
Bis(2-ethylhexyl)phthalate	500	U
Butyl benzyl phthalate	500	U
Chrysene	280	J
Di-n-butyl phthalate	500	U
Di-n-octyl phthalate	500	U
Diallate	500	U
Dibenzo(a,h)anthracene	500	UJ
Dibenzofuran	500	U
Diethyl phthalate	500	U
Dimethyl phthalate	500	U
Diphenylamine	500	U
Ethyl methacrylate	500	UJ
Ethyl methanesulfonate	500	U
Fluoranthene	660	
Fluorene	500	U
Hexachlorobenzene	500	U
Hexachlorobutadiene	500	U
Hexachlorocyclopentadiene	500	U
Hexachloroethane	500	U
Hexachloropropene	500	U
Indeno(1,2,3-cd)pyrene	500	U
Isophorone	500	U
Isosafrole	500	U
Methapyrilene	2500	U
Methyl methanesulfonate	500	UJ
N-nitroso-di-n-butylamine	500	U
N-nitroso-di-n-propylamine	500	U
N-nitrosodiethylamine	500	U
N-nitrosodimethylamine	500	UJ
N-nitrosodiphenylamine	500	U
N-nitrosomethylethylamine	500	UJ
N-nitrosomorpholine	500	U
N-nitrosopiperidine	500	UJ
N-nitrosopyrrolidine	500	U
Naphthalene	500	U
Nitrobenzene	500	U
o,o,o-triethylphosphorothioate	500	U
o-toluidine	500	UJ
p-dimethylaminoazobenzene	500	U
p-phenylenediamine	1000	UJ
Pentachlorobenzene	500	U
Pentachloroethane	500	U
Pentachloronitrobenzene	500	U
Pentachlorophenol	500	U
Phenacetin	500	U

BRAC Backgro[illegible]d Samples
Soil Data Set

PARAMETER	RESULT	QUAL
Phenanthrene	500	U
Phenol	500	U
Pronamide	500	U
Pyrene	470	J
Pyridine	500	U
Safrole	500	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	3	UJ
1,1,1-trichloroethane	3	U
1,1,2,2-tetrachloroethane	3	UJ
1,1,2-trichloroethane	3	UJ
1,1-dichloroethane	3	U
1,1-dichloroethene	3	U
1,2,3-trichloropropane	3	UJ
1,2-dibromo-3-chloropropane	3	UJ
1,2-dibromoethane	3	UJ
1,2-dichloroethane	3	U
1,2-dichloropropane	3	U
2-butanone	8	U
2-chloro-1,3-butadiene	3	UR
2-hexanone	8	UJ
3-chloropropene	15	U
4-methyl-2-pentanone	8	UJ
Acetone	8	U
Acetonitrile	15	U
Acrolein	30	UR
Acrylonitrile	30	U
Benzene	4	U
Bis(2-chloroisopropyl)ether	30	UJ
Bromodichloromethane	3	UJ
Bromoform	3	UJ
Bromomethane	3	U
Carbon disulfide	8	U
Carbon tetrachloride	3	U
Chlorobenzene	3	UJ
Chloroethane	3	U
Chloroform	3	U
Chloromethane	3	U
Cis-1,3-dichloropropene	3	UJ
Dibromochloromethane	3	UJ
Dibromomethane	3	U
Dichlorodifluoromethane	3	U
Ethyl cyanide	30	UR
Ethylbenzene	3	UJ
Iodomethane	8	U
Isobutanol	30	U
Methacrylonitrile	15	U
Methyl methacrylate	15	UJ
Methylene chloride	2	J
Styrene	3	UJ

PARAMETER	RESULT	QUAL
Tetrachloroethene	3	UJ
Toluene	3	UJ
Trans-1,2-dichloroethene	3	U
Trans-1,3-dichloropropene	3	UJ
Trans-1,4-dichloro-2-butene	15	UR
Trichloroethene	3	U
Trichlorofluoromethane	3	U
Vinyl acetate	8	U
Vinyl chloride	3	U
Xylenes, total	9	UJ

BG 2

BG2SS-01	BG2SS-01	B&RE	0 ft

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	993	
Antimony	0.58	U
Arsenic	2.7	U
Barium	9.2	
Beryllium	0.07	U
Cadmium	0.09	U
Chromium	3.2	
Cobalt	0.18	U
Copper	1.7	
Cyanide	0.65	U
Iron	532	
Lead	0.4	U
Manganese	15	
Mercury	0.06	U
Nickel	0.63	
Selenium	1.1	U
Silver	0.16	U
Thallium	1	UJ
Tin	4.99	U
Vanadium	4.1	
Zinc	0.63	
Pesticides/PCBs (µg/kg)		
2,4,5-T	51.3	U
2,4,5-TP (silvex)	25.6	U
2,4-D	51.3	U
Chlorobenzilate	2120	U
Dimethoate	2120	U
Dinoseb	423	U
Disulfoton	423	U
Famphur	423	U
Isodrin	423	U
Kepone	423	U
Sulfotep	423	U
Thionazin	423	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	423	U
1,2,4-trichlorobenzene	423	U

PARAMETER	RESULT	QUAL
1,2-dichlorobenzene	423	U
1,3,5-trinitrobenzene	2120	U
1,3-dichlorobenzene	423	U
1,3-dinitrobenzene	423	U
1,4-dichlorobenzene	423	U
1,4-dioxane	423	U
1,4-naphthoquinone	423	U
1-naphthylamine	423	U
2,3,4,6-tetrachlorophenol	423	U
2,4,5-trichlorophenol	423	U
2,4,6-trichlorophenol	423	U
2,4-dichlorophenol	423	U
2,4-dimethylphenol	423	U
2,4-dinitrophenol	846	U
2,4-dinitrotoluene	423	U
2,6-dichlorophenol	423	U
2,6-dinitrotoluene	423	U
2-acetylaminofluorene	423	U
2-chloronaphthalene	423	U
2-chlorophenol	423	U
2-methyl-4,6-dinitrophenol	423	U
2-methylnaphthalene	423	U
2-methylphenol	423	U
2-naphthylamine	423	UR
2-nitroaniline	423	U
2-nitrophenol	423	U
2-picoline	423	U
3 & 4-methylphenol	423	U
3,3'-dichlorobenzidine	2120	U
3,3'-dimethylbenzidine	2120	UR
3-methylcholanthrene	423	U
3-nitroaniline	423	U
4-aminobiphenyl	423	U
4-bromophenyl phenyl ether	423	U
4-chloro-3-methylphenol	423	U
4-chloroaniline	423	UR
4-chlorophenyl phenyl ether	423	U
4-nitroaniline	423	U
4-nitrophenol	423	U
4-nitroquinoline-1-oxide	423	U
5-nitro-o-toluidine	423	U
7,12-dimethylbenz(a)anthracene	423	U
a,a-dimethylphenethylamine	423	UR
Acenaphthene	423	U
Acenaphthylene	423	U
Acetophenone	423	U
Aniline	423	U
Anthracene	423	U
Aramite	423	U
Benzo(a)anthracene	423	U

PARAMETER	RESULT	QUAL
Benzo(a)pyrene	423	U
Benzo(b)fluoranthene	423	U
Benzo(g,h,i)perylene	423	U
Benzo(k)fluoranthene	423	U
Benzyl alcohol	423	U
Bis(2-chloroethoxy)methane	423	U
Bis(2-chloroethyl)ether	423	U
Bis(2-ethylhexyl)phthalate	423	U
Butyl benzyl phthalate	423	U
Chrysene	423	U
Di-n-butyl phthalate	423	U
Di-n-octyl phthalate	423	U
Diallate	423	U
Dibenzo(a,h)anthracene	423	U
Dibenzofuran	423	U
Diethyl phthalate	423	U
Dimethyl phthalate	423	U
Diphenylamine	423	U
Ethyl methacrylate	423	U
Ethyl methanesulfonate	423	U
Fluoranthene	423	U
Fluorene	423	U
Hexachlorobenzene	423	U
Hexachlorobutadiene	423	U
Hexachlorocyclopentadiene	423	U
Hexachloroethane	423	U
Hexachloropropene	423	U
Indeno(1,2,3-cd)pyrene	423	U
Isophorone	423	U
Isosafrole	423	U
Methapyrilene	2120	U
Methyl methanesulfonate	423	U
N-nitroso-di-n-butylamine	423	U
N-nitroso-di-n-propylamine	423	U
N-nitrosodiethylamine	423	U
N-nitrosodimethylamine	423	U
N-nitrosodiphenylamine	423	U
N-nitrosomethylethylamine	423	U
N-nitrosomorpholine	423	U
N-nitrosopiperidine	423	U
N-nitrosopyrrolidine	423	U
Naphthalene	423	U
Nitrobenzene	423	U
o,o,o-triethylphosphorothioate	423	U
o-toluidine	423	U
p-dimethylaminoazobenzene	423	U
p-phenylenediamine	846	U
Pentachlorobenzene	423	U
Pentachloroethane	423	U
Pentachloronitrobenzene	423	U

BRAC Background Samples
Soil Data Set

PARAMETER	RESULT	QUAL
Pentachlorophenol	423	U
Phenacetin	423	U
Phenanthrene	423	U
Phenol	423	U
Pronamide	423	U
Pyrene	423	U
Pyridine	423	U
Safrole	423	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	3	U
1,1,1-trichloroethane	3	U
1,1,2,2-tetrachloroethane	3	U
1,1,2-trichloroethane	3	U
1,1-dichloroethane	3	U
1,1-dichloroethene	3	U
1,2,3-trichloropropane	3	U
1,2-dibromo-3-chloropropane	3	U
1,2-dibromoethane	3	U
1,2-dichloroethane	3	U
1,2-dichloropropane	3	U
2-butanone	6	U
2-chloro-1,3-butadiene	3	U
2-hexanone	6	U
3-chloropropene	13	U
4-methyl-2-pentanone	6	U
Acetone	3	U
Acetonitrile	13	U
Acrolein	26	UR
Acrylonitrile	26	U
Benzene	3	U
Bis(2-chloroisopropyl)ether	26	U
Bromodichloromethane	3	U
Bromoform	3	U
Bromomethane	3	U
Carbon disulfide	6	U
Carbon tetrachloride	3	U
Chlorobenzene	3	U
Chloroethane	3	U
Chloroform	3	U
Chloromethane	3	U
Cis-1,3-dichloropropene	3	U
Dibromochloromethane	3	U
Dibromomethane	3	U
Dichlorodifluoromethane	3	U
Ethyl cyanide	26	UR
Ethylbenzene	3	U
Iodomethane	6	U
Isobutanol	26	U
Methacrylonitrile	13	U
Methyl methacrylate	13	U
Methylene chloride	3	U
Styrene	3	U
Tetrachloroethene	3	U
Toluene	3	U
Trans-1,2-dichloroethene	3	U
Trans-1,3-dichloropropene	3	U
Trans-1,4-dichloro-2-butene	13	U
Trichloroethene	3	U
Trichlorofluoromethane	3	U
Vinyl acetate	6	U
Vinyl chloride	3	U
Xylenes, total	8	U
BG2SS-02 BG2SS-02 B&RE	**0 ft**	
Inorganics (mg/kg)		
Aluminum	145	
Antimony	0.42	U
Arsenic	1.8	
Barium	7.3	J
Beryllium	0.05	U
Cadmium	0.07	U
Chromium	1.9	
Cobalt	0.13	U
Copper	4	J
Cyanide	0.07	U
Iron	758	
Lead	34.4	J
Manganese	5.5	J
Mercury	0.05	U
Nickel	0.68	U
Selenium	0.78	UJ
Silver	0.11	U
Thallium	0.74	UJ
Vanadium	2.1	
Zinc	3.8	J
Pesticides/PCBs (µg/kg)		
2,4,5-T	43.5	U
2,4,5-TP (silvex)	21.7	U
2,4-D	43.5	U
4,4'-DDD	1.4	UJ
4,4'-DDE	1.4	UJ
4,4'-DDT	9.3	J
Aldrin	0.72	UJ
alpha-BHC	0.72	UJ
Aroclor-1016	4.5	UJ
Aroclor-1221	4.5	UJ
Aroclor-1232	4.5	UJ
Aroclor-1242	4.5	UJ
Aroclor-1248	4.5	UJ
Aroclor-1254	4.5	UJ
Aroclor-1260	4.5	UJ
beta-BHC	0.72	UJ
Chlordane	9	UJ
Chlorobenzilate	1800	U
delta-BHC	0.72	UJ
Dieldrin	1.4	UJ
Dimethoate	1800	UJ
Dinoseb	360	U
Disulfoton	360	U
Endosulfan I	0.72	UJ
Endosulfan II	1.4	UJ
Endosulfan sulfate	1.4	UJ
Endrin	1.4	UJ
Endrin aldehyde	1.4	UJ
Famphur	360	UJ
gamma-BHC (lindane)	0.72	UJ
Heptachlor	0.72	UJ
Heptachlor epoxide	0.72	UJ
Isodrin	360	U
Kepone	360	UJ
Methoxychlor	7.2	UJ
Methyl parathion	2.2	J
Parathion	1.8	UJ
Phorate	1.8	UJ
Sulfotep	360	U
Thionazin	360	U
Toxaphene	35.7	UJ
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	360	U
1,2,4-trichlorobenzene	360	U
1,2-dichlorobenzene	360	U
1,3,5-trinitrobenzene	1800	UJ
1,3-dichlorobenzene	360	U
1,3-dinitrobenzene	360	U
1,4-dichlorobenzene	360	U
1,4-dioxane	360	UJ
1,4-naphthoquinone	360	UJ
1-naphthylamine	360	U
2,3,4,6-tetrachlorophenol	360	U
2,4,5-trichlorophenol	360	U
2,4,6-trichlorophenol	360	U
2,4-dichlorophenol	360	U
2,4-dimethylphenol	360	U
2,4-dinitrophenol	720	U
2,4-dinitrotoluene	360	U
2,6-dichlorophenol	360	U
2,6-dinitrotoluene	360	U
2-acetylaminofluorene	360	U
2-chloronaphthalene	360	U
2-chlorophenol	360	U
2-methyl-4,6-dinitrophenol	360	U
2-methylnaphthalene	360	U
2-methylphenol	360	U
2-naphthylamine	360	UR
2-nitroaniline	360	U
2-nitrophenol	360	U
2-picoline	360	U
3 & 4-methylphenol	360	U
3,3'-dichlorobenzidine	1800	UJ
3,3'-dimethylbenzidine	1800	UR
3-methylcholanthrene	360	UJ
3-nitroaniline	360	UR
4-aminobiphenyl	360	U
4-bromophenyl phenyl ether	360	U
4-chloro-3-methylphenol	360	U
4-chloroaniline	360	UR
4-chlorophenyl phenyl ether	360	U
4-nitroaniline	360	U
4-nitrophenol	720	U
4-nitroquinoline-1-oxide	360	UR
5-nitro-o-toluidine	360	U
7,12-dimethylbenz(a)anthracene	360	UJ
a,a-dimethylphenethylamine	360	U
Acenaphthene	360	U
Acenaphthylene	360	U
Acetophenone	360	U
Aniline	360	U
Anthracene	360	U
Aramite	360	UJ
Benzo(a)anthracene	360	U
Benzo(a)pyrene	360	U
Benzo(b)fluoranthene	360	U
Benzo(g,h,i)perylene	360	U
Benzo(k)fluoranthene	360	U
Benzyl alcohol	360	U
Bis(2-chloroethoxy)methane	360	U
Bis(2-chloroethyl)ether	360	U
Bis(2-ethylhexyl)phthalate	360	U
Butyl benzyl phthalate	360	U
Chrysene	360	U
Di-n-butyl phthalate	360	U
Di-n-octyl phthalate	360	U
Diallate	360	U
Dibenzo(a,h)anthracene	360	UJ
Dibenzofuran	360	U
Diethyl phthalate	360	U
Dimethyl phthalate	360	U
Diphenylamine	360	U
Ethyl methacrylate	360	UJ
Ethyl methanesulfonate	360	U
Fluoranthene	360	U

BRAC Backgro[illegible] Samples
Soil Data Set

PARAMETER	RESULT	QUAL
Fluorene	360	U
Hexachlorobenzene	360	U
Hexachlorobutadiene	360	U
Hexachlorocyclopentadiene	360	U
Hexachloroethane	360	U
Hexachloropropene	360	U
Indeno(1,2,3-cd)pyrene	360	U
Isophorone	360	U
Isosafrole	360	U
Methapyrilene	1800	U
Methyl methanesulfonate	360	UJ
N-nitroso-di-n-butylamine	360	U
N-nitroso-di-n-propylamine	360	U
N-nitrosodiethylamine	360	U
N-nitrosodimethylamine	360	UJ
N-nitrosodiphenylamine	360	U
N-nitrosomethylethylamine	360	UJ
N-nitrosomorpholine	360	U
N-nitrosopiperidine	360	UJ
N-nitrosopyrrolidine	360	U
Naphthalene	360	U
Nitrobenzene	360	U
o,o,o-triethylphosphorothioate	360	U
o-toluidine	360	UJ
p-dimethylaminoazobenzene	360	U
p-phenylenediamine	720	UJ
Pentachlorobenzene	360	U
Pentachloroethane	360	U
Pentachloronitrobenzene	360	U
Pentachlorophenol	360	U
Phenacetin	360	U
Phenanthrene	360	U
Phenol	360	U
Pronamide	360	U
Pyrene	360	U
Pyridine	360	U
Safrole	360	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	2	U
1,1,1-trichloroethane	2	U
1,1,2,2-tetrachloroethane	2	U
1,1,2-trichloroethane	2	U
1,1-dichloroethane	2	U
1,1-dichloroethene	2	U
1,2,3-trichloropropane	2	U
1,2-dibromo-3-chloropropane	2	U
1,2-dibromoethane	2	U
1,2-dichloroethane	2	U
1,2-dichloropropane	2	U
2-butanone	5	U

PARAMETER	RESULT	QUAL
2-chloro-1,3-butadiene	2	UR
2-hexanone	5	U
3-chloropropene	11	U
4-methyl-2-pentanone	5	U
Acetone	5	U
Acetonitrile	11	U
Acrolein	22	UR
Acrylonitrile	22	U
Benzene	2	U
Bis(2-chloroisopropyl)ether	22	U
Bromodichloromethane	2	U
Bromoform	2	U
Bromomethane	2	U
Carbon disulfide	5	U
Carbon tetrachloride	2	U
Chlorobenzene	2	U
Chloroethane	2	U
Chloroform	2	U
Chloromethane	2	U
Cis-1,3-dichloropropene	2	UJ
Dibromochloromethane	2	U
Dibromomethane	2	U
Dichlorodifluoromethane	2	U
Ethyl cyanide	22	UR
Ethylbenzene	2	U
Iodomethane	5	U
Isobutanol	22	U
Methacrylonitrile	11	U
Methyl methacrylate	11	U
Methylene chloride	5	U
Styrene	2	UJ
Tetrachloroethene	2	U
Toluene	2	U
Trans-1,2-dichloroethene	2	U
Trans-1,3-dichloropropene	2	U
Trans-1,4-dichloro-2-butene	11	UR
Trichloroethene	2	U
Trichlorofluoromethane	2	U
Vinyl acetate	5	U
Vinyl chloride	2	U
Xylenes, total	7	UJ

BG2SS-03	BG2SS-03	B&RE	2 ft

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	120	
Antimony	0.6	U
Arsenic	1.1	U
Barium	7.9	
Beryllium	0.07	U
Cadmium	0.12	U
Chromium	2	
Cobalt	0.18	U
Copper	2.2	J
Cyanide	0.25	U
Iron	118	
Lead	1.4	J
Manganese	6.1	J
Mercury	0.05	U
Nickel	0.44	U
Selenium	1.1	UJ
Silver	0.16	U
Thallium	1	UJ
Vanadium	1	
Zinc	2.5	J
Pesticides/PCBs (µg/kg)		
2,4,5-T	60.6	U
2,4,5-TP (silvex)	30.3	U
2,4-D	60.6	U
4,4'-DDD	40	UJ
4,4'-DDE	40	UJ
4,4'-DDT	40	UJ
Aldrin	20	UJ
alpha-BHC	20	UJ
Aroclor-1016	125	UJ
Aroclor-1221	125	UJ
Aroclor-1232	125	UJ
Aroclor-1242	125	UJ
Aroclor-1248	125	UJ
Aroclor-1254	125	UJ
Aroclor-1260	125	UJ
beta-BHC	20	UJ
Chlordane	250	UJ
Chlorobenzilate	2500	U
delta-BHC	20	UJ
Dieldrin	40	UJ
Dimethoate	2500	UJ
Dinoseb	500	U
Disulfoton	500	U
Endosulfan I	20	UJ
Endosulfan II	40	UJ
Endosulfan sulfate	40	UJ
Endrin	40	UJ
Endrin aldehyde	40	UJ
Famphur	500	UJ
gamma-BHC (lindane)	20	UJ
Heptachlor	20	UJ
Heptachlor epoxide	20	UJ
Isodrin	500	U
Kepone	500	UJ
Methoxychlor	200	UJ
Methyl parathion	50.1	UJ
Parathion	50.1	UJ
Phorate	50.1	UJ
Sulfotep	500	U
Thionazin	500	U
Toxaphene	992	UJ
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	500	U
1,2,4-trichlorobenzene	500	U
1,2-dichlorobenzene	500	U
1,3,5-trinitrobenzene	2500	UJ
1,3-dichlorobenzene	500	U
1,3-dinitrobenzene	500	U
1,4-dichlorobenzene	500	U
1,4-dioxane	500	UJ
1,4-naphthoquinone	500	UJ
1-naphthylamine	500	U
2,3,4,6-tetrachlorophenol	500	U
2,4,5-trichlorophenol	500	U
2,4,6-trichlorophenol	500	U
2,4-dichlorophenol	500	U
2,4-dimethylphenol	500	U
2,4-dinitrophenol	1000	U
2,4-dinitrotoluene	500	U
2,6-dichlorophenol	500	U
2,6-dinitrotoluene	500	U
2-acetylaminofluorene	500	U
2-chloronaphthalene	500	U
2-chlorophenol	500	U
2-methyl-4,6-dinitrophenol	500	U
2-methylnaphthalene	500	U
2-methylphenol	500	U
2-naphthylamine	500	UR
2-nitroaniline	500	U
2-nitrophenol	500	U
2-picoline	500	U
3 & 4-methylphenol	500	U
3,3'-dichlorobenzidine	2500	UJ
3,3'-dimethylbenzidine	2500	UR
3-methylcholanthrene	500	UJ
3-nitroaniline	500	UR
4-aminobiphenyl	500	U
4-bromophenyl phenyl ether	500	U
4-chloro-3-methylphenol	500	U
4-chloroaniline	500	UR
4-chlorophenyl phenyl ether	500	U
4-nitroaniline	500	U
4-nitrophenol	1000	U
4-nitroquinoline-1-oxide	500	UR
5-nitro-o-toluidine	500	U
7,12-dimethylbenz(a)anthracene	500	UJ

BRAC Backgro l Samples
Soil Data Set

PARAMETER	RESULT	QUAL
a,a-dimethylphenethylamine	500	U
Acenaphthene	500	U
Acenaphthylene	500	U
Acetophenone	500	U
Aniline	500	U
Anthracene	500	U
Aramite	500	UJ
Benzo(a)anthracene	500	U
Benzo(a)pyrene	500	U
Benzo(b)fluoranthene	500	U
Benzo(g,h,i)perylene	500	U
Benzo(k)fluoranthene	500	U
Benzyl alcohol	500	U
Bis(2-chloroethoxy)methane	500	U
Bis(2-chloroethyl)ether	500	U
Bis(2-ethylhexyl)phthalate	500	U
Butyl benzyl phthalate	500	U
Chrysene	500	U
Di-n-butyl phthalate	500	U
Di-n-octyl phthalate	500	U
Diallate	500	U
Dibenzo(a,h)anthracene	500	UJ
Dibenzofuran	500	U
Diethyl phthalate	500	U
Dimethyl phthalate	500	U
Diphenylamine	500	U
Ethyl methacrylate	500	UJ
Ethyl methanesulfonate	500	U
Fluoranthene	500	U
Fluorene	500	U
Hexachlorobenzene	500	U
Hexachlorobutadiene	500	U
Hexachlorocyclopentadiene	500	U
Hexachloroethane	500	U
Hexachloropropene	500	U
Indeno(1,2,3-cd)pyrene	500	U
Isophorone	500	U
Isosafrole	500	U
Methapyrilene	2500	U
Methyl methanesulfonate	500	UJ
N-nitroso-di-n-butylamine	500	U
N-nitroso-di-n-propylamine	500	U
N-nitrosodiethylamine	500	U
N-nitrosodimethylamine	500	UJ
N-nitrosodiphenylamine	500	U
N-nitrosomethylethylamine	500	UJ
N-nitrosomorpholine	500	U
N-nitrosopiperidine	500	UJ
N-nitrosopyrrolidine	500	U
Naphthalene	500	U

PARAMETER	RESULT	QUAL
Nitrobenzene	500	U
o,o,o-triethylphosphorothioate	500	U
o-toluidine	500	UJ
p-dimethylaminoazobenzene	500	U
p-phenylenediamine	1000	UJ
Pentachlorobenzene	500	U
Pentachloroethane	500	U
Pentachloronitrobenzene	500	U
Pentachlorophenol	500	U
Phenacetin	500	U
Phenanthrene	500	U
Phenol	500	U
Pronamide	500	U
Pyrene	500	U
Pyridine	500	U
Safrole	500	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	3	U
1,1,1-trichloroethane	3	U
1,1,2,2-tetrachloroethane	3	U
1,1,2-trichloroethane	3	U
1,1-dichloroethane	3	U
1,1-dichloroethene	3	U
1,2,3-trichloropropane	3	U
1,2-dibromo-3-chloropropane	3	U
1,2-dibromoethane	3	U
1,2-dichloroethane	3	U
1,2-dichloropropane	3	U
2-butanone	8	U
2-chloro-1,3-butadiene	3	UR
2-hexanone	8	U
3-chloropropene	15	U
4-methyl-2-pentanone	8	U
Acetone	8	U
Acetonitrile	15	U
Acrolein	30	UR
Acrylonitrile	30	U
Benzene	3	U
Bis(2-chloroisopropyl)ether	30	U
Bromodichloromethane	3	U
Bromoform	3	U
Bromomethane	3	U
Carbon disulfide	8	U
Carbon tetrachloride	3	U
Chlorobenzene	3	U
Chloroethane	3	U
Chloroform	3	U
Chloromethane	3	U
Cis-1,3-dichloropropene	3	UJ
Dibromochloromethane	3	U

PARAMETER	RESULT	QUAL
Dibromomethane	3	U
Dichlorodifluoromethane	3	U
Ethyl cyanide	30	UR
Ethylbenzene	3	U
Iodomethane	8	U
Isobutanol	30	U
Methacrylonitrile	15	U
Methyl methacrylate	15	U
Methylene chloride	1	J
Styrene	3	U
Tetrachloroethene	3	UJ
Toluene	3	U
Trans-1,2-dichloroethene	3	U
Trans-1,3-dichloropropene	3	U
Trans-1,4-dichloro-2-butene	15	UR
Trichloroethene	3	U
Trichlorofluoromethane	3	U
Vinyl acetate	8	U
Vinyl chloride	3	U
Xylenes, total	9	UJ

BG 3

BG3SS-01	BG3SS-01	B&RE	0 ft

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	1640	
Antimony	0.67	U
Arsenic	2.6	U
Barium	11.2	
Beryllium	0.08	U
Cadmium	0.27	
Chromium	9.3	
Cobalt	0.33	
Copper	9.7	
Cyanide	0.55	U
Iron	2260	
Lead	48.3	
Manganese	25.9	
Mercury	0.08	
Nickel	2	
Selenium	1.8	
Silver	0.18	U
Thallium	1.2	UJ
Vanadium	3.6	
Zinc	89.1	
Pesticides/PCBs (µg/kg)		
2,4,5-T	64.5	U
2,4,5-TP (silvex)	32.2	U
2,4-D	64.5	U
Chlorobenzilate	26800	U
Dimethoate	26800	U
Dinoseb	5370	U

PARAMETER	RESULT	QUAL
Disulfoton	5370	U
Famphur	5370	U
Isodrin	5370	U
Kepone	5370	U
Sulfotep	5370	U
Thionazin	5370	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	5370	U
1,2,4-trichlorobenzene	5370	U
1,2-dichlorobenzene	5370	U
1,3,5-trinitrobenzene	26800	U
1,3-dichlorobenzene	5370	U
1,3-dinitrobenzene	5370	U
1,4-dichlorobenzene	5370	U
1,4-dioxane	5370	U
1,4-naphthoquinone	5370	U
1-naphthylamine	5370	U
2,3,4,6-tetrachlorophenol	5370	U
2,4,5-trichlorophenol	5370	U
2,4,6-trichlorophenol	5370	U
2,4-dichlorophenol	5370	U
2,4-dimethylphenol	5370	U
2,4-dinitrophenol	10700	U
2,4-dinitrotoluene	5370	U
2,6-dichlorophenol	5370	U
2,6-dinitrotoluene	5370	U
2-acetylaminofluorene	5370	U
2-chloronaphthalene	5370	U
2-chlorophenol	5370	U
2-methyl-4,6-dinitrophenol	5370	U
2-methylnaphthalene	5370	U
2-methylphenol	5370	U
2-naphthylamine	5370	UR
2-nitroaniline	5370	U
2-nitrophenol	5370	U
2-picoline	5370	U
3 & 4-methylphenol	5370	U
3,3'-dichlorobenzidine	26800	U
3,3'-dimethylbenzidine	26800	UR
3-methylcholanthrene	5370	U
3-nitroaniline	5370	U
4-aminobiphenyl	5370	U
4-bromophenyl phenyl ether	5370	U
4-chloro-3-methylphenol	5370	U
4-chloroaniline	5370	U
4-chlorophenyl phenyl ether	5370	U
4-nitroaniline	5370	U
4-nitrophenol	5370	U
4-nitroquinoline-1-oxide	5370	U
5-nitro-o-toluidine	5370	U

PARAMETER	RESULT	QUAL
7,12-dimethylbenz(a)anthracene	5370	U
a,a-dimethylphenethylamine	5370	U
Acenaphthene	5370	U
Acenaphthylene	5370	U
Acetophenone	5370	U
Aniline	5370	U
Anthracene	5370	U
Aramite	5370	U
Benzo(a)anthracene	5370	U
Benzo(a)pyrene	5370	U
Benzo(b)fluoranthene	5370	U
Benzo(g,h,i)perylene	5370	U
Benzo(k)fluoranthene	5370	U
Benzyl alcohol	5370	U
Bis(2-chloroethoxy)methane	5370	U
Bis(2-chloroethyl)ether	5370	U
Bis(2-ethylhexyl)phthalate	5370	U
Butyl benzyl phthalate	5370	U
Chrysene	5370	U
Di-n-butyl phthalate	5370	U
Di-n-octyl phthalate	5370	U
Diallate	5370	U
Dibenzo(a,h)anthracene	5370	U
Dibenzofuran	5370	U
Diethyl phthalate	5370	U
Dimethyl phthalate	5370	U
Diphenylamine	5370	U
Ethyl methacrylate	5370	U
Ethyl methanesulfonate	5370	U
Fluoranthene	5370	U
Fluorene	5370	U
Hexachlorobenzene	5370	U
Hexachlorobutadiene	5370	U
Hexachlorocyclopentadiene	5370	U
Hexachloroethane	5370	U
Hexachloropropene	5370	U
Indeno(1,2,3-cd)pyrene	5370	U
Isophorone	5370	U
Isosafrole	5370	U
Methapyrilene	26800	U
Methyl methanesulfonate	5370	U
N-nitroso-di-n-butylamine	5370	U
N-nitroso-di-n-propylamine	5370	U
N-nitrosodiethylamine	5370	U
N-nitrosodimethylamine	5370	U
N-nitrosodiphenylamine	5370	U
N-nitrosomethylethylamine	5370	U
N-nitrosomorpholine	5370	U
N-nitrosopiperidine	5370	U
N-nitrosopyrrolidine	5370	U

PARAMETER	RESULT	QUAL
Naphthalene	5370	U
Nitrobenzene	5370	U
o,o,o-triethylphosphorothioate	5370	U
o-toluidine	5370	U
p-dimethylaminoazobenzene	5370	U
p-phenylenediamine	10700	U
Pentachlorobenzene	5370	U
Pentachloroethane	5370	U
Pentachloronitrobenzene	5370	U
Pentachlorophenol	5370	U
Phenacetin	5370	U
Phenanthrene	5370	U
Phenol	5370	U
Pronamide	5370	U
Pyrene	5370	U
Pyridine	5370	U
Safrole	5370	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	3	U
1,1,1-trichloroethane	3	U
1,1,2,2-tetrachloroethane	4	
1,1,2-trichloroethane	3	U
1,1-dichloroethane	3	U
1,1-dichloroethene	3	U
1,2,3-trichloropropane	3	U
1,2-dibromo-3-chloropropane	3	U
1,2-dibromoethane	3	U
1,2-dichloroethane	3	U
1,2-dichloropropane	3	U
2-butanone	8	U
2-chloro-1,3-butadiene	3	UR
2-hexanone	2	J
3-chloropropene	16	U
4-methyl-2-pentanone	8	U
Acetone	3	U
Acetonitrile	16	U
Acrolein	32	UR
Acrylonitrile	32	U
Benzene	3	U
Bis(2-chloroisopropyl)ether	21	J
Bromodichloromethane	3	U
Bromoform	3	U
Bromomethane	3	U
Carbon disulfide	8	U
Carbon tetrachloride	3	U
Chlorobenzene	3	U
Chloroethane	3	U
Chloroform	1	J
Chloromethane	3	U
Cis-1,3-dichloropropene	3	U

PARAMETER	RESULT	QUAL
Dibromochloromethane	3	U
Dibromomethane	3	U
Dichlorodifluoromethane	3	U
Ethyl cyanide	32	UR
Ethylbenzene	3	U
Iodomethane	8	U
Isobutanol	32	U
Methacrylonitrile	16	U
Methyl methacrylate	16	U
Methylene chloride	1	J
Styrene	3	U
Tetrachloroethene	3	U
Toluene	3	U
Trans-1,2-dichloroethene	3	U
Trans-1,3-dichloropropene	3	U
Trans-1,4-dichloro-2-butene	16	UR
Trichloroethene	3	U
Trichlorofluoromethane	3	U
Vinyl acetate	8	U
Vinyl chloride	3	U
Xylenes, total	10	U
BG3SS-02 BG3SS-02 B&RE	**0 ft**	
Inorganics (mg/kg)		
Aluminum	216	
Antimony	0.48	U
Arsenic	0.91	U
Barium	6.5	
Beryllium	0.06	U
Cadmium	0.07	U
Chromium	2.1	
Cobalt	0.15	U
Copper	2.3	J
Cyanide	0.31	U
Iron	98.1	
Lead	0.82	J
Manganese	2.6	J
Mercury	0.06	U
Nickel	0.76	U
Selenium	0.89	UJ
Silver	0.13	U
Thallium	0.83	UJ
Vanadium	0.8	
Zinc	4.1	J
Pesticides/PCBs (µg/kg)		
2,4,5-T	48.2	U
2,4,5-TP (silvex)	24.1	U
2,4-D	48.2	U
4,4'-DDD	1.6	U
4,4'-DDE	1.6	U
4,4'-DDT	1.6	U

PARAMETER	RESULT	QUAL
Aldrin	0.79	U
alpha-BHC	0.79	U
Aroclor-1016	5	U
Aroclor-1221	5	U
Aroclor-1232	5	U
Aroclor-1242	5	U
Aroclor-1248	5	U
Aroclor-1254	5	U
Aroclor-1260	5	U
beta-BHC	0.79	U
Chlordane	9.9	U
Chlorobenzilate	2000	U
delta-BHC	0.79	U
Dieldrin	1.6	U
Dimethoate	2000	UJ
Dinoseb	400	U
Disulfoton	400	U
Endosulfan I	0.79	U
Endosulfan II	1.6	U
Endosulfan sulfate	1.6	U
Endrin	1.6	U
Endrin aldehyde	1.6	U
Famphur	400	UJ
gamma-BHC (lindane)	0.79	U
Heptachlor	0.79	U
Heptachlor epoxide	0.79	U
Isodrin	400	U
Kepone	400	UJ
Methoxychlor	7.9	U
Methyl parathion	2	U
Parathion	2	U
Phorate	2	U
Sulfotep	400	U
Thionazin	400	U
Toxaphene	39.3	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	400	U
1,2,4-trichlorobenzene	400	U
1,2-dichlorobenzene	400	U
1,3,5-trinitrobenzene	2000	UJ
1,3-dichlorobenzene	400	U
1,3-dinitrobenzene	400	U
1,4-dichlorobenzene	400	U
1,4-dioxane	400	UJ
1,4-naphthoquinone	400	UJ
1-naphthylamine	400	U
2,3,4,6-tetrachlorophenol	400	U
2,4,5-trichlorophenol	400	U
2,4,6-trichlorophenol	400	U
2,4-dichlorophenol	400	U

BRAC Background Samples
Soil Data Set

PARAMETER	RESULT	QUAL
2,4-dimethylphenol	400	U
2,4-dinitrophenol	800	U
2,4-dinitrotoluene	400	U
2,6-dichlorophenol	400	U
2,6-dinitrotoluene	400	U
2-acetylaminofluorene	400	U
2-chloronaphthalene	400	U
2-chlorophenol	400	U
2-methyl-4,6-dinitrophenol	400	U
2-methylnaphthalene	400	U
2-methylphenol	400	U
2-naphthylamine	400	UR
2-nitroaniline	400	U
2-nitrophenol	400	U
2-picoline	400	U
3 & 4-methylphenol	400	U
3,3'-dichlorobenzidine	2000	UJ
3,3'-dimethylbenzidine	2000	UR
3-methylcholanthrene	400	UJ
3-nitroaniline	400	UR
4-aminobiphenyl	400	U
4-bromophenyl phenyl ether	400	U
4-chloro-3-methylphenol	400	U
4-chloroaniline	400	UR
4-chlorophenyl phenyl ether	400	U
4-nitroaniline	400	U
4-nitrophenol	800	U
4-nitroquinoline-1-oxide	400	UR
5-nitro-o-toluidine	400	U
7,12-dimethylbenz(a)anthracene	400	UJ
a,a-dimethylphenethylamine	400	U
Acenaphthene	400	U
Acenaphthylene	400	U
Acetophenone	400	U
Aniline	400	U
Anthracene	400	U
Aramite	400	UJ
Benzo(a)anthracene	400	U
Benzo(a)pyrene	400	U
Benzo(b)fluoranthene	400	U
Benzo(g,h,i)perylene	400	U
Benzo(k)fluoranthene	400	U
Benzyl alcohol	400	U
Bis(2-chloroethoxy)methane	400	U
Bis(2-chloroethyl)ether	400	U
Bis(2-ethylhexyl)phthalate	400	U
Butyl benzyl phthalate	400	U
Chrysene	400	U
Di-n-butyl phthalate	400	U
Di-n-octyl phthalate	400	U

PARAMETER	RESULT	QUAL
Diallate	400	U
Dibenzo(a,h)anthracene	400	UJ
Dibenzofuran	400	U
Diethyl phthalate	400	U
Dimethyl phthalate	400	U
Diphenylamine	400	U
Ethyl methacrylate	400	UJ
Ethyl methanesulfonate	400	U
Fluoranthene	400	U
Fluorene	400	U
Hexachlorobenzene	400	U
Hexachlorobutadiene	400	U
Hexachlorocyclopentadiene	400	U
Hexachloroethane	400	U
Hexachloropropene	400	U
Indeno(1,2,3-cd)pyrene	400	U
Isophorone	400	U
Isosafrole	400	U
Methapyrilene	2000	U
Methyl methanesulfonate	400	UJ
N-nitroso-di-n-butylamine	400	U
N-nitroso-di-n-propylamine	400	U
N-nitrosodiethylamine	400	U
N-nitrosodimethylamine	400	UJ
N-nitrosodiphenylamine	400	U
N-nitrosomethylethylamine	400	UJ
N-nitrosomorpholine	400	U
N-nitrosopiperidine	400	UJ
N-nitrosopyrrolidine	400	U
Naphthalene	400	U
Nitrobenzene	400	U
o,o,o-triethylphosphorothioate	400	U
o-toluidine	400	UJ
p-dimethylaminoazobenzene	400	U
p-phenylenediamine	800	UJ
Pentachlorobenzene	400	U
Pentachloroethane	400	U
Pentachloronitrobenzene	400	U
Pentachlorophenol	400	U
Phenacetin	400	U
Phenanthrene	400	U
Phenol	400	U
Pronamide	400	U
Pyrene	400	U
Pyridine	400	U
Safrole	400	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	2	U
1,1,1-trichloroethane	2	U
1,1,2,2-tetrachloroethane	2	U

PARAMETER	RESULT	QUAL
1,1,2-trichloroethane	2	U
1,1-dichloroethane	2	U
1,1-dichloroethene	2	U
1,2,3-trichloropropane	2	U
1,2-dibromo-3-chloropropane	2	U
1,2-dibromoethane	2	U
1,2-dichloroethane	2	U
1,2-dichloropropane	2	U
2-butanone	6	U
2-chloro-1,3-butadiene	2	U
2-hexanone	6	U
3-chloropropene	12	U
4-methyl-2-pentanone	6	U
Acetone	6	U
Acetonitrile	12	U
Acrolein	24	UR
Acrylonitrile	24	U
Benzene	3	U
Bis(2-chloroisopropyl)ether	24	U
Bromodichloromethane	2	U
Bromoform	2	U
Bromomethane	2	U
Carbon disulfide	6	U
Carbon tetrachloride	2	U
Chlorobenzene	2	U
Chloroethane	2	U
Chloroform	2	U
Chloromethane	2	U
Cis-1,3-dichloropropene	2	U
Dibromochloromethane	2	U
Dibromomethane	2	U
Dichlorodifluoromethane	2	U
Ethyl cyanide	24	UR
Ethylbenzene	2	U
Iodomethane	6	U
Isobutanol	24	U
Methacrylonitrile	12	U
Methyl methacrylate	12	U
Methylene chloride	6	U
Styrene	2	U
Tetrachloroethene	2	U
Toluene	2	U
Trans-1,2-dichloroethene	2	U
Trans-1,3-dichloropropene	2	U
Trans-1,4-dichloro-2-butene	12	UR
Trichloroethene	2	U
Trichlorofluoromethane	2	U
Vinyl acetate	6	U
Vinyl chloride	2	U
Xylenes, total	7	UJ

PARAMETER	RESULT	QUAL
BG 4		
B4SB B4SB B&RE 0 ft		
Inorganics (mg/kg)		
Aluminum	379	
Antimony	0.5	UJ
Arsenic	1.1	U
Barium	4.9	
Beryllium	0.02	U
Cadmium	0.08	U
Chromium	4.9	
Cobalt	0.25	U
Copper	7.4	
Cyanide	0.09	UJ
Iron	448	
Lead	14.2	
Manganese	9.7	
Mercury	0.03	
Nickel	1.1	
Selenium	0.5	UJ
Silver	0.25	U
Thallium	0.5	UJ
Vanadium	2.3	
Zinc	0.25	U
Pesticides/PCBs (µg/kg)		
2,4,5-T	2.6	U
2,4,5-TP (silvex)	2.6	U
2,4-D	2.6	U
4,4'-DDD	233	J
4,4'-DDE	741	
4,4'-DDT	557	
Aldrin	84.7	U
alpha-BHC	84.7	U
Aroclor-1016	530	U
Aroclor-1221	530	U
Aroclor-1232	530	U
Aroclor-1242	530	U
Aroclor-1248	530	U
Aroclor-1254	530	U
Aroclor-1260	530	U
beta-BHC	84.7	U
Chlordane	1060	U
delta-BHC	84.7	U
Dieldrin	169	U
Endosulfan I	84.7	U
Endosulfan II	169	U
Endosulfan sulfate	169	U
Endrin	169	U
Endrin aldehyde	169	U
gamma-BHC (lindane)	84.7	U
Heptachlor	84.7	U

BRAC Background Samples
Soil Data Set

PARAMETER	RESULT	QUAL
Heptachlor epoxide	84.7	U
Methoxychlor	847	U
Methyl parathion	212	U
Parathion	212	U
Phorate	212	U
Toxaphene	4240	U
Semivolatile Organic Compounds (µg/kg)		
1,2-dichlorobenzene	2.6	U
1,3-dichlorobenzene	2.6	U
1,4-dichlorobenzene	2.6	U
Acenaphthene	416	U
Acenaphthylene	416	U
Anthracene	416	U
Benzo(a)anthracene	416	U
Benzo(a)pyrene	416	U
Benzo(b)fluoranthene	416	U
Benzo(g,h,i)perylene	416	U
Benzo(k)fluoranthene	416	U
Chrysene	416	U
Dibenzo(a,h)anthracene	416	U
Fluoranthene	416	U
Fluorene	416	U
Indeno(1,2,3-cd)pyrene	416	U
Naphthalene	416	U
Phenanthrene	416	U
Pyrene	416	U
Volatile Organic Compounds (µg/kg)		
Benzene	2.6	U
Chlorobenzene	2.6	U
Ethylbenzene	2.6	U
Toluene	3	U
Xylenes, total	7.7	U

BG 6

B6SB	B6SB	B&RE	0 ft

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	2220	
Antimony	0.53	UJ
Arsenic	3.1	U
Barium	13.8	
Beryllium	0.03	U
Cadmium	0.16	U
Chromium	7.2	
Cobalt	0.27	U
Copper	5.2	
Cyanide	0.09	UJ
Iron	1290	
Lead	8.8	
Manganese	17.5	
Mercury	0.03	
Nickel	1.6	

PARAMETER	RESULT	QUAL
Selenium	0.53	UJ
Silver	0.27	U
Thallium	0.53	UJ
Vanadium	4.5	
Zinc	0.27	U
Pesticides/PCBs (µg/kg)		
2,4,5-T	2.6	U
2,4,5-TP (silvex)	2.6	U
2,4-D	2.6	U
4,4'-DDD	2	
4,4'-DDE	1.8	U
4,4'-DDT	2.1	
Aldrin	0.88	U
alpha-BHC	0.88	U
Aroclor-1016	5.5	U
Aroclor-1221	5.5	U
Aroclor-1232	5.5	U
Aroclor-1242	5.5	U
Aroclor-1248	5.5	U
Aroclor-1254	5.5	U
Aroclor-1260	5.5	U
beta-BHC	0.88	U
Chlordane	11	U
delta-BHC	0.88	U
Dieldrin	1.8	U
Endosulfan I	3.5	J
Endosulfan II	1.8	U
Endosulfan sulfate	1.8	U
Endrin	1.2	J
Endrin aldehyde	1.8	U
gamma-BHC (lindane)	0.88	U
Heptachlor	0.88	U
Heptachlor epoxide	0.88	U
Methoxychlor	13.2	
Methyl parathion	2.2	U
Parathion	2.2	U
Phorate	2.2	U
Toxaphene	41	U
Semivolatile Organic Compounds (µg/kg)		
1,2-dichlorobenzene	2.7	U
1,3-dichlorobenzene	2.7	U
1,4-dichlorobenzene	2.7	U
Acenaphthene	441	U
Acenaphthylene	441	U
Anthracene	441	U
Benzo(a)anthracene	441	U
Benzo(a)pyrene	441	U
Benzo(b)fluoranthene	441	U
Benzo(g,h,i)perylene	441	U
Benzo(k)fluoranthene	441	U

PARAMETER	RESULT	QUAL
Chrysene	441	U
Dibenzo(a,h)anthracene	441	U
Fluoranthene	441	U
Fluorene	441	U
Indeno(1,2,3-cd)pyrene	441	U
Naphthalene	441	U
Phenanthrene	441	U
Pyrene	441	U
Volatile Organic Compounds (µg/kg)		
Benzene	2.7	U
Chlorobenzene	2.7	U
Ethylbenzene	2.7	U
Toluene	2.6	U
Xylenes, total	8	U

BG 8

B8SB	B8SB	B&RE	0 ft

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	429	
Antimony	0.48	UJ
Arsenic	0.78	U
Barium	7.1	
Beryllium	0.02	U
Cadmium	0.05	U
Chromium	3.6	
Cobalt	0.24	U
Copper	5.4	
Cyanide	0.08	UJ
Iron	390	
Lead	10.4	
Manganese	6	
Mercury	0.03	
Nickel	2.8	
Selenium	0.51	J
Silver	0.24	U
Thallium	0.48	UJ
Vanadium	8.2	
Zinc	0.24	U
Pesticides/PCBs (µg/kg)		
2,4,5-T	2.4	U
2,4,5-TP (silvex)	2.4	U
2,4-D	2.4	U
4,4'-DDD	1.6	U
4,4'-DDE	1.8	
4,4'-DDT	1.8	
Aldrin	0.81	U
alpha-BHC	0.81	U
Aroclor-1016	5	U
Aroclor-1221	5	U
Aroclor-1232	5	U
Aroclor-1242	5	U

PARAMETER	RESULT	QUAL
Aroclor-1248	5	U
Aroclor-1254	5	U
Aroclor-1260	5	U
beta-BHC	0.81	U
Chlordane	10.1	U
delta-BHC	0.81	U
Dieldrin	1.6	U
Endosulfan I	1	
Endosulfan II	1.6	U
Endosulfan sulfate	1.6	U
Endrin	1.6	U
Endrin aldehyde	1.6	U
gamma-BHC (lindane)	0.81	U
Heptachlor	0.81	U
Heptachlor epoxide	0.81	U
Methoxychlor	8.1	U
Methyl parathion	2	U
Parathion	2	U
Phorate	2	U
Toxaphene	40.4	U
Semivolatile Organic Compounds (µg/kg)		
1,2-dichlorobenzene	2.4	U
1,3-dichlorobenzene	2.4	U
1,4-dichlorobenzene	2.4	U
Acenaphthene	398	U
Acenaphthylene	398	U
Anthracene	398	U
Benzo(a)anthracene	398	U
Benzo(a)pyrene	398	U
Benzo(b)fluoranthene	398	U
Benzo(g,h,i)perylene	398	U
Benzo(k)fluoranthene	398	U
Chrysene	398	U
Dibenzo(a,h)anthracene	398	U
Fluoranthene	398	U
Fluorene	398	U
Indeno(1,2,3-cd)pyrene	398	U
Naphthalene	398	U
Phenanthrene	398	U
Pyrene	398	U
Volatile Organic Compounds (µg/kg)		
Benzene	2.4	U
Chlorobenzene	2.4	U
Ethylbenzene	2.4	U
Toluene	2	U
Xylenes, total	2.1	J

SWMU 1

S1SS-4	S1SS-4	B&RE	0 ft

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	3910	

BRAC Background Samples
Soil Data Set

PARAMETER	RESULT	QUAL
Antimony	0.64	U
Arsenic	3.8	U
Barium	17	
Beryllium	0.07	U
Cadmium	0.23	U
Chromium	10.6	
Cobalt	0.37	
Copper	6.2	
Cyanide	0.28	UJ
Iron	2050	
Lead	17.2	
Manganese	25.8	
Mercury	0.05	U
Nickel	4.1	
Selenium	1.2	U
Silver	0.17	U
Thallium	1.1	U
Vanadium	8.8	
Zinc	20.7	
Pesticides/PCBs (µg/kg)		
2,4,5-T	51.9	U
2,4,5-TP (silvex)	26	U
2,4-D	51.9	U
Chlorobenzilate	2120	U
Dimethoate	2120	U
Dinoseb	424	U
Disulfoton	424	U
Famphur	424	U
Isodrin	424	U
Kepone	424	U
Sulfotep	424	U
Thionazin	424	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	424	U
1,2,4-trichlorobenzene	424	U
1,2-dichlorobenzene	424	U
1,3,5-trinitrobenzene	2120	U
1,3-dichlorobenzene	424	U
1,3-dinitrobenzene	424	U
1,4-dichlorobenzene	424	U
1,4-dioxane	424	U
1,4-naphthoquinone	424	U
1-naphthylamine	424	U
2,3,4,6-tetrachlorophenol	424	U
2,4,5-trichlorophenol	424	U
2,4,6-trichlorophenol	424	U
2,4-dichlorophenol	424	U
2,4-dimethylphenol	424	U
2,4-dinitrophenol	848	U
2,4-dinitrotoluene	424	U
2,6-dichlorophenol	424	U
2,6-dinitrotoluene	424	U
2-acetylaminofluorene	424	U
2-chloronaphthalene	424	U
2-chlorophenol	424	U
2-methyl-4,6-dinitrophenol	424	U
2-methylnaphthalene	424	U
2-naphthylamine	424	U
2-nitroaniline	424	U
2-nitrophenol	424	U
2-picoline	424	U
3 & 4-methylphenol	424	U
3,3'-dichlorobenzidine	2120	U
3,3'-dimethylbenzidine	2120	UR
3-methylcholanthrene	424	U
3-nitroaniline	424	U
4-aminobiphenyl	424	U
4-bromophenyl phenyl ether	424	U
4-chloro-3-methylphenol	424	U
4-chloroaniline	424	U
4-chlorophenyl phenyl ether	424	U
4-nitroaniline	424	U
4-nitrophenol	424	U
4-nitroquinoline-1-oxide	424	U
5-nitro-o-toluidine	424	U
7,12-dimethylbenz(a)anthracene	424	U
a,a-dimethylphenethylamine	424	U
Acenaphthene	424	U
Acenaphthylene	424	U
Acetophenone	424	U
Aniline	424	U
Anthracene	424	U
Aramite	424	U
Benzo(a)anthracene	424	U
Benzo(a)pyrene	424	U
Benzo(b)fluoranthene	424	U
Benzo(g,h,i)perylene	424	U
Benzo(k)fluoranthene	424	U
Benzyl alcohol	424	U
Bis(2-chloroethoxy)methane	424	U
Bis(2-chloroethyl)ether	424	U
Bis(2-ethylhexyl)phthalate	424	U
Butyl benzyl phthalate	424	U
Chrysene	424	U
Di-n-butyl phthalate	424	U
Di-n-octyl phthalate	424	U
Diallate	424	U
Dibenzo(a,h)anthracene	424	U
Dibenzofuran	424	U
Diethyl phthalate	424	U
Dimethyl phthalate	424	U
Diphenylamine	424	U
Ethyl methacrylate	424	U
Ethyl methanesulfonate	424	U
Fluoranthene	424	U
Fluorene	424	U
Hexachlorobenzene	424	U
Hexachlorobutadiene	424	U
Hexachlorocyclopentadiene	424	U
Hexachloroethane	424	U
Hexachloropropene	424	U
Indeno(1,2,3-cd)pyrene	424	U
Isophorone	424	U
Isosafrole	424	U
Methapyrilene	2120	U
Methyl methanesulfonate	424	U
N-nitroso-di-n-butylamine	424	U
N-nitroso-di-n-propylamine	424	U
N-nitrosodiethylamine	424	U
N-nitrosodimethylamine	424	U
N-nitrosodiphenylamine	424	U
N-nitrosomethylethylamine	424	U
N-nitrosomorpholine	424	U
N-nitrosopiperidine	424	U
N-nitrosopyrrolidine	424	U
Naphthalene	424	U
Nitrobenzene	424	U
o,o,o-triethylphosphorothioate	424	U
o-toluidine	424	U
p-dimethylaminoazobenzene	424	U
p-phenylenediamine	848	U
Pentachlorobenzene	424	U
Pentachloroethane	424	U
Pentachloronitrobenzene	424	U
Pentachlorophenol	424	U
Phenacetin	424	U
Phenanthrene	424	U
Phenol	424	U
Pronamide	424	U
Pyrene	424	U
Pyridine	424	U
Safrole	424	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	3	U
1,1,1-trichloroethane	3	U
1,1,2,2-tetrachloroethane	3	U
1,1,2-trichloroethane	3	U
1,1-dichloroethane	3	U
1,1-dichloroethene	3	U
1,2,3-trichloropropane	3	U
1,2-dibromo-3-chloropropane	3	U
1,2-dibromoethane	3	U
1,2-dichloroethane	3	U
1,2-dichloropropane	3	U
2-butanone	7	U
2-chloro-1,3-butadiene	3	U
2-hexanone	7	U
3-chloropropene	13	U
4-methyl-2-pentanone	7	U
Acetone	1	J
Acetonitrile	13	U
Acrolein	26	UR
Acrylonitrile	26	U
Benzene	3	U
Bis(2-chloroisopropyl)ether	26	U
Bromodichloromethane	3	U
Bromoform	3	U
Bromomethane	3	U
Carbon disulfide	7	U
Carbon tetrachloride	3	U
Chlorobenzene	3	U
Chloroethane	3	U
Chloroform	3	U
Chloromethane	3	U
Cis-1,3-dichloropropene	3	U
Dibromochloromethane	3	U
Dibromomethane	3	U
Dichlorodifluoromethane	3	U
Ethyl cyanide	26	UR
Ethylbenzene	0.31	J
Iodomethane	7	U
Isobutanol	26	U
Methacrylonitrile	13	U
Methyl methacrylate	13	U
Methylene chloride	3	U
Styrene	3	U
Tetrachloroethene	3	U
Toluene	1	J
Trans-1,2-dichloroethene	3	U
Trans-1,3-dichloropropene	3	U
Trans-1,4-dichloro-2-butene	13	U
Trichloroethene	3	U
Trichlorofluoromethane	3	U
Vinyl acetate	7	U
Vinyl chloride	3	U
Xylenes, total	8	U
S1SB-7 KW02561	**BEI(d)**	**0 ft**
Inorganics (mg/kg)		
Aluminum	2800	
Antimony	0.48	

BRAC Background Samples
Soil Data Set

PARAMETER	RESULT	QUAL
Arsenic	1.1	
Barium	12.8	
Beryllium	0.15	
Cadmium	0.45	
Chromium	15.5	
Cobalt	0.51	
Copper	10.4	
Cyanide	0.75	U
Iron	1620	
Lead	38.7	
Manganese	25.3	
Mercury	0.048	
Nickel	2.5	
Selenium	0.79	
Silver	0.18	U
Thallium	0.41	U
Tin	2.1	
Vanadium	4.9	
Zinc	52.5	
Pesticides/PCBs (µg/kg)		
4,4'-DDD	4.4	U
4,4'-DDE	5.9	
4,4'-DDT	4.7	
Aldrin	2.2	U
alpha-BHC	2.2	U
Aroclor-1016	22	U
Aroclor-1221	22	U
Aroclor-1232	22	U
Aroclor-1242	22	U
Aroclor-1248	22	U
Aroclor-1254	22	U
Aroclor-1260	69	
beta-BHC	2.2	U
Chlordane	22	U
Chlorobenzilate	850	U
delta-BHC	2.2	U
Dieldrin	4.4	U
Endosulfan I	2.2	U
Endosulfan II	4.4	U
Endosulfan sulfate	4.4	U
Endrin	4.4	U
Endrin aldehyde	4.4	U
Endrin ketone	4.4	U
gamma-BHC (lindane)	2.2	U
Heptachlor	2.2	U
Heptachlor epoxide	2.2	U
Isodrin	850	U
Kepone	1700	U
Methoxychlor	22	U
Toxaphene	220	U

PARAMETER	RESULT	QUAL
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	850	U
1,2,4-trichlorobenzene	850	U
1,2-dichlorobenzene	850	U
1,3,5-trinitrobenzene	850	U
1,3-dichlorobenzene	850	U
1,3-dinitrobenzene	850	U
1,4-dichlorobenzene	850	U
1,4-naphthoquinone	850	U
1-naphthylamine	850	U
2,3,4,6-tetrachlorophenol	1700	U
2,4,5-trichlorophenol	4100	U
2,4,6-trichlorophenol	850	U
2,4-dichlorophenol	850	U
2,4-dimethylphenol	850	U
2,4-dinitrophenol	4100	U
2,4-dinitrotoluene	850	U
2,6-dichlorophenol	850	U
2,6-dinitrotoluene	850	U
2-acetylaminofluorene	1700	U
2-chloronaphthalene	850	U
2-chlorophenol	850	U
2-methyl-4,6-dinitrophenol	4100	U
2-methylnaphthalene	850	U
2-methylphenol	850	U
2-naphthylamine	850	U
2-nitroaniline	4100	U
2-nitrophenol	850	U
2-picoline	850	U
3 & 4-methylphenol	850	U
3,3'-dichlorobenzidine	1700	U
3-methylcholanthrene	850	U
3-nitroaniline	4100	U
4-aminobiphenyl	850	U
4-bromophenyl phenyl ether	850	U
4-chloro-3-methylphenol	1700	U
4-chloroaniline	1700	U
4-chlorophenyl phenyl ether	850	U
4-nitroaniline	4100	U
4-nitrophenol	4100	U
4-nitroquinoline-1-oxide	850	U
5-nitro-o-toluidine	850	U
7,12-dimethylbenz(a)anthracene	850	U
a,a-dimethylphenethylamine	1700	U
Acenaphthene	850	U
Acenaphthylene	850	U
Acetophenone	850	U
Aniline	850	U
Anthracene	850	U
Aramite	1700	U

PARAMETER	RESULT	QUAL
Benzo(a)anthracene	850	U
Benzo(a)pyrene	850	U
Benzo(b)fluoranthene	850	U
Benzo(g,h,i)perylene	850	U
Benzo(k)fluoranthene	850	U
Benzyl alcohol	1700	U
Bis(2-chloroethoxy)methane	850	U
Bis(2-chloroethyl)ether	850	U
Bis(2-ethylhexyl)phthalate	850	U
Butyl benzyl phthalate	850	U
Carbazole	850	U
Chrysene	850	U
Di-n-butyl phthalate	82	J
Di-n-octyl phthalate	850	U
Diallate	1700	U
Dibenzo(a,h)anthracene	850	U
Dibenzofuran	850	U
Diethyl phthalate	850	U
Dimethyl phthalate	850	U
Diphenylamine	850	U
Ethyl methacrylate	850	U
Ethyl methanesulfonate	850	U
Fluoranthene	850	U
Fluorene	850	U
Hexachlorobenzene	850	U
Hexachlorobutadiene	850	U
Hexachlorocyclopentadiene	850	U
Hexachloroethane	850	U
Hexachlorophene	51	
Hexachloropropene	850	U
Indeno(1,2,3-cd)pyrene	850	U
Isophorone	850	U
Isosafrole	850	U
Methapyrilene	850	U
Methyl methanesulfonate	850	U
N-nitroso-di-n-butylamine	850	U
N-nitroso-di-n-propylamine	850	U
N-nitrosodiethylamine	850	U
N-nitrosodimethylamine	850	U
N-nitrosomethylethylamine	850	U
N-nitrosomorpholine	850	U
N-nitrosopiperidine	850	U
N-nitrosopyrrolidine	850	U
Naphthalene	850	U
Nitrobenzene	850	U
o,o,o-triethylphosphorothioate	850	U
o-toluidine	850	U
p-dimethylaminoazobenzene	850	U
p-phenylenediamine	5400	U
Pentachlorobenzene	850	U

PARAMETER	RESULT	QUAL
Pentachloroethane	850	U
Pentachloronitrobenzene	1700	U
Pentachlorophenol	4100	U
Phenacetin	850	U
Phenanthrene	850	U
Phenol	850	U
Pronamide	1700	U
Pyrene	850	U
Pyridine	850	U
Safrole	850	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	6	U
1,1,1-trichloroethane	6	U
1,1,2,2-tetrachloroethane	6	U
1,1,2-trichloroethane	6	U
1,1-dichloroethane	6	U
1,1-dichloroethene	6	U
1,2,3-trichloropropane	6	U
1,2-dibromo-3-chloropropane	6	U
1,2-dibromoethane	6	U
1,2-dichloroethane	6	U
1,2-dichloroethene	6	U
1,2-dichloropropane	6	U
2-butanone	13	U
2-chloro-1,3-butadiene	25	U
2-hexanone	13	U
3-chloropropene	6	U
4-methyl-2-pentanone	13	U
Acetone	13	U
Acrolein	25	U
Acrylonitrile	13	U
Benzene	6	U
Bis(2-chloroisopropyl)ether	850	U
Bromodichloromethane	6	U
Bromoform	6	U
Bromomethane	13	U
Carbon disulfide	6	U
Carbon tetrachloride	6	U
Chlorobenzene	6	U
Chloroethane	13	U
Chloroform	6	U
Chloromethane	13	U
Cis-1,2-dichloroethene	6	U
Cis-1,3-dichloropropene	6	U
Dibromochloromethane	6	U
Dibromomethane	6	U
Dichlorodifluoromethane	6	U
Ethyl cyanide	6	U
Ethylbenzene	6	U
Iodomethane	6	U

PARAMETER	RESULT	QUAL
Methacrylonitrile	6	U
Methyl methacrylate	6	U
Methylene chloride	6	U
Styrene	6	U
Tetrachloroethene	6	U
Toluene	6	U
Trans-1,2-dichloroethene	6	U
Trans-1,3-dichloropropene	6	U
Trans-1,4-dichloro-2-butene	6	U
Trichloroethene	1	J
Trichlorofluoromethane	6	U
Vinyl acetate	13	U
Vinyl chloride	13	U
Xylenes, total	6	U

SWMU 2

S2SB-9 KW02592 BEI(d) 0 ft

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	1750	
Antimony	0.26	
Arsenic	2.7	
Barium	9.3	
Beryllium	0.13	
Cadmium	0.11	
Chromium	5.3	
Cobalt	0.22	
Copper	1.3	
Cyanide	0.49	U
Iron	1090	
Lead	0.65	
Manganese	15.9	
Mercury	0.044	U
Nickel	0.78	
Selenium	0.46	
Silver	0.16	U
Thallium	0.38	U
Tin	0.78	
Vanadium	2.8	
Zinc	2.6	
Pesticides/PCBs (µg/kg)		
4,4'-DDD	6.7	
4,4'-DDE	3.9	J
4,4'-DDT	9.1	
Aldrin	2	U
alpha-BHC	2	U
Aroclor-1016	20	U
Aroclor-1221	20	U
Aroclor-1232	20	U
Aroclor-1242	20	U
Aroclor-1248	20	U
Aroclor-1254	20	U
Aroclor-1260	20	U
beta-BHC	2	U
Chlordane	20	U
delta-BHC	2	U
Dieldrin	4	U
Endosulfan I	2	U
Endosulfan II	4	U
Endosulfan sulfate	4	U
Endrin	4	U
Endrin aldehyde	4	U
Endrin ketone	4	U
gamma-BHC (lindane)	2	U
Heptachlor	2	U
Heptachlor epoxide	2	U
Methoxychlor	20	U
Toxaphene	200	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	6	U
1,1,1-trichloroethane	6	U
1,1,2,2-tetrachloroethane	6	U
1,1,2-trichloroethane	6	U
1,1-dichloroethane	6	U
1,1-dichloroethene	6	U
1,2,3-trichloropropane	6	U
1,2-dibromo-3-chloropropane	6	U
1,2-dibromoethane	6	U
1,2-dichloroethane	6	U
1,2-dichloroethene	6	U
1,2-dichloropropane	6	U
2-butanone	12	U
2-chloro-1,3-butadiene	24	U
2-hexanone	12	U
3-chloropropene	6	U
4-methyl-2-pentanone	12	U
Acetone	12	U
Acrolein	24	U
Acrylonitrile	12	U
Benzene	6	U
Bromodichloromethane	6	U
Bromoform	6	U
Bromomethane	12	U
Carbon disulfide	6	U
Carbon tetrachloride	6	U
Chlorobenzene	6	U
Chloroethane	12	U
Chloroform	6	U
Chloromethane	12	U
Cis-1,2-dichloroethene	6	U
Cis-1,3-dichloropropene	6	U
Dibromochloromethane	6	U
Dibromomethane	6	U
Dichlorodifluoromethane	6	U
Ethyl cyanide	6	U
Ethylbenzene	6	U
Iodomethane	6	U
Methacrylonitrile	6	U
Methyl methacrylate	6	U
Methylene chloride	6	U
Styrene	6	U
Tetrachloroethene	6	U
Toluene	6	U
Trans-1,2-dichloroethene	6	U
Trans-1,3-dichloropropene	6	U
Trans-1,4-dichloro-2-butene	6	U
Trichloroethene	6	U
Trichlorofluoromethane	6	U
Vinyl acetate	12	U
Vinyl chloride	12	U
Xylenes, total	6	U

BRAC Backgro d Samples
Sediment Data Set

PARAMETER	RESULT	QUAL
BG 1		
BG1SD-01 BG1SD-01 B&RE 0 in		
Inorganics (mg/kg)		
Aluminum	3350	
Antimony	1.2	U
Arsenic	4.3	U
Barium	12.2	
Beryllium	0.14	U
Cadmium	0.9	
Chromium	11.7	
Cobalt	0.56	
Copper	34.6	
Cyanide	0.69	U
Iron	2600	
Lead	56.5	
Manganese	38.5	
Mercury	0.14	U
Nickel	5.5	
Selenium	2.2	U
Silver	0.32	U
Thallium	2.1	UJ
Vanadium	8.9	
Zinc	58.2	
Pesticides/PCBs (µg/kg)		
2,4,5-T	133	U
2,4,5-TP (silvex)	66.7	U
2,4-D	133	U
Chlorobenzilate	21900	U
Dimethoate	21900	U
Dinoseb	4380	U
Disulfoton	4380	U
Famphur	4380	U
Isodrin	4380	U
Kepone	4380	U
Sulfotep	4380	U
Thionazin	4380	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	4380	U
1,2,4-trichlorobenzene	4380	U
1,2-dichlorobenzene	4380	U
1,3,5-trinitrobenzene	21900	U
1,3-dichlorobenzene	4380	U
1,3-dinitrobenzene	4380	U
1,4-dichlorobenzene	4380	U
1,4-dioxane	4380	U
1,4-naphthoquinone	4380	U
1-naphthylamine	4380	U
2,3,4,6-tetrachlorophenol	4380	U
2,4,5-trichlorophenol	4380	U
2,4,6-trichlorophenol	4380	U
2,4-dichlorophenol	4380	U
2,4-dimethylphenol	4380	U
2,4-dinitrophenol	8770	U
2,4-dinitrotoluene	4380	U
2,6-dichlorophenol	4380	U
2,6-dinitrotoluene	4380	U
2-acetylaminofluorene	4380	U
2-chloronaphthalene	4380	U
2-chlorophenol	4380	U
2-methyl-4,6-dinitrophenol	4380	U
2-methylnaphthalene	4380	U
2-methylphenol	4380	U
2-naphthylamine	4380	UR
2-nitroaniline	4380	U
2-nitrophenol	4380	U
2-picoline	4380	U
3 & 4-methylphenol	4380	U
3,3'-dichlorobenzidine	21900	U
3,3'-dimethylbenzidine	21900	UR
3-methylcholanthrene	4380	U
3-nitroaniline	4380	U
4-aminobiphenyl	4380	U
4-bromophenyl phenyl ether	4380	U
4-chloro-3-methylphenol	4380	U
4-chloroaniline	4380	UR
4-chlorophenyl phenyl ether	4380	U
4-nitroaniline	4380	U
4-nitrophenol	4380	U
4-nitroquinoline-1-oxide	4380	U
5-nitro-o-toluidine	4380	U
7,12-dimethylbenz(a)anthracene	4380	U
a,a-dimethylphenethylamine	4380	UR
Acenaphthene	4380	U
Acenaphthylene	4380	U
Acetophenone	4380	U
Aniline	4380	U
Anthracene	4380	U
Aramite	4380	U
Benzo(a)anthracene	4380	U
Benzo(a)pyrene	4380	U
Benzo(b)fluoranthene	4380	U
Benzo(g,h,i)perylene	4380	U
Benzo(k)fluoranthene	4380	U
Benzyl alcohol	4380	U
Bis(2-chloroethoxy)methane	4380	U
Bis(2-chloroethyl)ether	4380	U
Bis(2-ethylhexyl)phthalate	4380	U
Butyl benzyl phthalate	4380	U
Chrysene	4380	U
Di-n-butyl phthalate	4380	U
Di-n-octyl phthalate	4380	U
Diallate	4380	U
Dibenzo(a,h)anthracene	4380	U
Dibenzofuran	4380	U
Diethyl phthalate	4380	U
Dimethyl phthalate	4380	U
Diphenylamine	4380	U
Ethyl methacrylate	4380	U
Ethyl methanesulfonate	4380	U
Fluoranthene	4380	U
Fluorene	4380	U
Hexachlorobenzene	4380	U
Hexachlorobutadiene	4380	U
Hexachlorocyclopentadiene	4380	U
Hexachloroethane	4380	U
Hexachloropropene	4380	U
Indeno(1,2,3-cd)pyrene	4380	U
Isophorone	4380	U
Isosafrole	4380	U
Methapyrilene	21900	U
Methyl methanesulfonate	4380	U
N-nitroso-di-n-butylamine	4380	U
N-nitroso-di-n-propylamine	4380	U
N-nitrosodiethylamine	4380	U
N-nitrosodimethylamine	4380	U
N-nitrosodiphenylamine	4380	U
N-nitrosomethylethylamine	4380	U
N-nitrosomorpholine	4380	U
N-nitrosopiperidine	4380	U
N-nitrosopyrrolidine	4380	U
Naphthalene	4380	U
Nitrobenzene	4380	U
o,o,o-triethylphosphorothioate	4380	U
o-toluidine	4380	U
p-dimethylaminoazobenzene	4380	U
p-phenylenediamine	8770	U
Pentachlorobenzene	4380	U
Pentachloroethane	4380	U
Pentachloronitrobenzene	4380	U
Pentachlorophenol	4380	U
Phenacetin	4380	U
Phenanthrene	4380	U
Phenol	4380	U
Pronamide	4380	U
Pyrene	4380	U
Pyridine	4380	U
Safrole	4380	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	7	U
1,1,1-trichloroethane	7	U
1,1,2,2-tetrachloroethane	7	U
1,1,2-trichloroethane	7	U
1,1-dichloroethane	7	U
1,1-dichloroethene	7	U
1,2,3-trichloropropane	7	U
1,2-dibromo-3-chloropropane	7	U
1,2-dibromoethane	7	U
1,2-dichloroethane	7	U
1,2-dichloropropane	7	U
2-butanone	17	U
2-chloro-1,3-butadiene	7	U
2-hexanone	17	U
3-chloropropene	33	U
4-methyl-2-pentanone	17	U
Acetone	4	J
Acetonitrile	33	U
Acrolein	67	UR
Acrylonitrile	67	U
Benzene	7	U
Bis(2-chloroisopropyl)ether	67	U
Bromodichloromethane	7	U
Bromoform	7	U
Bromomethane	7	U
Carbon disulfide	17	U
Carbon tetrachloride	7	U
Chlorobenzene	7	U
Chloroethane	7	U
Chloroform	7	U
Chloromethane	7	U
Cis-1,3-dichloropropene	7	U
Dibromochloromethane	7	U
Dibromomethane	7	U
Dichlorodifluoromethane	7	U
Ethyl cyanide	67	UR
Ethylbenzene	7	U
Iodomethane	17	U
Isobutanol	67	U
Methacrylonitrile	33	U
Methyl methacrylate	33	U
Methylene chloride	5	J
Styrene	7	U
Tetrachloroethene	7	U
Toluene	7	U
Trans-1,2-dichloroethene	7	U
Trans-1,3-dichloropropene	7	U
Trans-1,4-dichloro-2-butene	33	U
Trichloroethene	7	U
Trichlorofluoromethane	7	U
Vinyl acetate	17	U
Vinyl chloride	7	U

BRAC Backgro[illegible] Samples
Sediment Data Set

PARAMETER	RESULT	QUAL
Xylenes, total	19	U
BG 2		
BG2SD-01 BG2SD-01 B&RE	0 in	
Inorganics (mg/kg)		
Aluminum	2350	
Antimony	3	U
Barium	15.2	
Beryllium	0.35	U
Cadmium	0.47	U
Chromium	5.8	
Cobalt	0.93	U
Copper	1.6	
Cyanide	1.5	U
Iron	1360	
Lead	5.5	
Manganese	14.9	
Mercury	0.35	U
Nickel	2.3	
Selenium	5.6	U
Silver	0.62	U
Thallium	5.2	UJ
Vanadium	5.4	
Zinc	19.9	
Pesticides/PCBs (µg/kg)		
2,4,5-T	308	U
2,4,5-TP (silvex)	154	U
2,4-D	308	U
Chlorobenzilate	12600	U
Dimethoate	12600	U
Dinoseb	2530	U
Disulfoton	2530	U
Famphur	2530	U
Isodrin	2530	U
Kepone	2530	U
Sulfotep	2530	U
Thionazin	2530	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	2530	U
1,2,4-trichlorobenzene	2530	U
1,2-dichlorobenzene	2530	U
1,3,5-trinitrobenzene	12600	U
1,3-dichlorobenzene	2530	U
1,3-dinitrobenzene	2530	U
1,4-dichlorobenzene	2530	U
1,4-dioxane	2530	U
1,4-naphthoquinone	2530	U
1-naphthylamine	2530	U
2,3,4,6-tetrachlorophenol	2530	U
2,4,5-trichlorophenol	2530	U
2,4,6-trichlorophenol	2530	U

PARAMETER	RESULT	QUAL
2,4-dichlorophenol	2530	U
2,4-dimethylphenol	2530	U
2,4-dinitrophenol	5050	U
2,4-dinitrotoluene	2530	U
2,6-dichlorophenol	2530	U
2,6-dinitrotoluene	2530	U
2-acetylaminofluorene	2530	U
2-chloronaphthalene	2530	U
2-chlorophenol	2530	U
2-methyl-4,6-dinitrophenol	2530	U
2-methylnaphthalene	2530	U
2-methylphenol	2530	U
2-naphthylamine	2530	UR
2-nitroaniline	2530	U
2-nitrophenol	2530	U
2-picoline	2530	U
3 & 4-methylphenol	2530	U
3,3'-dichlorobenzidine	12600	U
3,3'-dimethylbenzidine	12600	UR
3-methylcholanthrene	2530	U
3-nitroaniline	2530	U
4-aminobiphenyl	2530	U
4-bromophenyl phenyl ether	2530	U
4-chloro-3-methylphenol	2530	U
4-chloroaniline	2530	UR
4-chlorophenyl phenyl ether	2530	U
4-nitroaniline	2530	U
4-nitrophenol	2530	U
4-nitroquinoline-1-oxide	2530	U
5-nitro-o-toluidine	2530	U
7,12-dimethylbenz(a)anthracene	2530	U
a,a-dimethylphenethylamine	2530	UR
Acenaphthene	2530	U
Acenaphthylene	2530	U
Acetophenone	2530	U
Aniline	2530	U
Anthracene	2530	U
Aramite	2530	U
Benzo(a)anthracene	2530	U
Benzo(a)pyrene	2530	U
Benzo(b)fluoranthene	2530	U
Benzo(g,h,i)perylene	2530	U
Benzo(k)fluoranthene	2530	U
Benzyl alcohol	2530	U
Bis(2-chloroethoxy)methane	2530	U
Bis(2-chloroethyl)ether	2530	U
Bis(2-ethylhexyl)phthalate	2530	U
Butyl benzyl phthalate	2530	U
Chrysene	2530	U
Di-n-butyl phthalate	2530	U

PARAMETER	RESULT	QUAL
Di-n-octyl phthalate	2530	U
Diallate	2530	U
Dibenzo(a,h)anthracene	2530	U
Dibenzofuran	2530	U
Diethyl phthalate	2530	U
Dimethyl phthalate	2530	U
Diphenylamine	2530	U
Ethyl methacrylate	2530	U
Ethyl methanesulfonate	2530	U
Fluoranthene	2530	U
Fluorene	2530	U
Hexachlorobenzene	2530	U
Hexachlorobutadiene	2530	U
Hexachlorocyclopentadiene	2530	U
Hexachloroethane	2530	U
Hexachloropropene	2530	U
Indeno(1,2,3-cd)pyrene	2530	U
Isophorone	2530	U
Isosafrole	2530	U
Methapyrilene	12600	U
Methyl methanesulfonate	2530	U
N-nitroso-di-n-butylamine	2530	U
N-nitroso-di-n-propylamine	2530	U
N-nitrosodiethylamine	2530	U
N-nitrosodimethylamine	2530	U
N-nitrosodiphenylamine	2530	U
N-nitrosomethylethylamine	2530	U
N-nitrosomorpholine	2530	U
N-nitrosopiperidine	2530	U
N-nitrosopyrrolidine	2530	U
Naphthalene	2530	U
Nitrobenzene	2530	U
o,o,o-triethylphosphorothioate	2530	U
o-toluidine	2530	U
p-dimethylaminoazobenzene	2530	U
p-phenylenediamine	5050	U
Pentachlorobenzene	2530	U
Pentachloroethane	2530	U
Pentachloronitrobenzene	2530	U
Pentachlorophenol	2530	U
Phenacetin	2530	U
Phenanthrene	2530	U
Phenol	2530	U
Pronamide	2530	U
Pyrene	2530	U
Pyridine	2530	U
Safrole	2530	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	15	U
1,1,1-trichloroethane	15	U

PARAMETER	RESULT	QUAL
1,1,2,2-tetrachloroethane	15	U
1,1,2-trichloroethane	15	U
1,1-dichloroethane	15	U
1,1-dichloroethene	15	U
1,2,3-trichloropropane	15	U
1,2-dibromo-3-chloropropane	15	U
1,2-dibromoethane	15	U
1,2-dichloroethane	15	U
1,2-dichloropropane	15	U
2-butanone	39	U
2-chloro-1,3-butadiene	15	U
2-hexanone	39	U
3-chloropropene	77	U
4-methyl-2-pentanone	39	U
Acetone	38	
Acetonitrile	77	U
Acrolein	154	UR
Acrylonitrile	154	U
Benzene	15	U
Bis(2-chloroisopropyl)ether	154	U
Bromodichloromethane	15	U
Bromoform	15	U
Bromomethane	15	U
Carbon disulfide	39	U
Carbon tetrachloride	15	U
Chlorobenzene	15	U
Chloroethane	15	U
Chloroform	15	U
Chloromethane	15	U
Cis-1,3-dichloropropene	15	U
Dibromochloromethane	15	U
Dibromomethane	15	U
Dichlorodifluoromethane	15	U
Ethyl cyanide	154	UR
Ethylbenzene	15	U
Iodomethane	39	U
Isobutanol	154	U
Methacrylonitrile	77	U
Methyl methacrylate	77	U
Methylene chloride	15	U
Styrene	15	U
Tetrachloroethene	15	U
Toluene	15	U
Trans-1,2-dichloroethene	15	U
Trans-1,3-dichloropropene	15	U
Trans-1,4-dichloro-2-butene	77	U
Trichloroethene	15	U
Trichlorofluoromethane	15	U
Vinyl acetate	39	U
Vinyl chloride	15	U

BRAC Background Samples
Sediment Data Set

PARAMETER	RESULT	QUAL
Xylenes, total	46	U
BG 3		
BG3SD-01 BG3SD-01 B&RE	0 in	
Inorganics (mg/kg)		
Aluminum	497	
Antimony	0.79	U
Arsenic	3.2	U
Barium	5	
Beryllium	0.09	U
Cadmium	0.12	U
Chromium	2.1	
Cobalt	0.24	U
Copper	3.2	
Cyanide	1.1	U
Iron	363	
Lead	32.6	
Manganese	17.3	
Mercury	0.09	U
Nickel	0.7	
Selenium	1.5	U
Silver	0.21	U
Thallium	1.4	UJ
Vanadium	2.8	
Zinc	15.7	
Pesticides/PCBs (µg/kg)		
2,4,5-T	75.5	U
2,4,5-TP (silvex)	37.7	U
2,4-D	75.5	U
Chlorobenzilate	30700	U
Dimethoate	30700	U
Dinoseb	6150	U
Disulfoton	6150	U
Famphur	6150	U
Isodrin	6150	U
Kepone	6150	U
Sulfotep	6150	U
Thionazin	6150	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	6150	U
1,2,4-trichlorobenzene	6150	U
1,2-dichlorobenzene	6150	U
1,3,5-trinitrobenzene	30700	U
1,3-dichlorobenzene	6150	U
1,3-dinitrobenzene	6150	U
1,4-dichlorobenzene	6150	U
1,4-dioxane	6150	U
1,4-naphthoquinone	6150	U
1-naphthylamine	6150	U
2,3,4,6-tetrachlorophenol	6150	U
2,4,5-trichlorophenol	6150	U

PARAMETER	RESULT	QUAL
2,4,6-trichlorophenol	6150	U
2,4-dichlorophenol	6150	U
2,4-dimethylphenol	6150	U
2,4-dinitrophenol	12300	U
2,4-dinitrotoluene	6150	U
2,6-dichlorophenol	6150	U
2,6-dinitrotoluene	6150	U
2-acetylaminofluorene	6150	U
2-chloronaphthalene	6150	U
2-chlorophenol	6150	U
2-methyl-4,6-dinitrophenol	6150	U
2-methylnaphthalene	6150	U
2-methylphenol	6150	U
2-naphthylamine	6150	UR
2-nitroaniline	6150	U
2-nitrophenol	6150	U
2-picoline	6150	U
3 & 4-methylphenol	6150	U
3,3'-dichlorobenzidine	30700	U
3,3'-dimethylbenzidine	30700	UR
3-methylcholanthrene	6150	U
3-nitroaniline	6150	U
4-aminobiphenyl	6150	U
4-bromophenyl phenyl ether	6150	U
4-chloro-3-methylphenol	6150	U
4-chloroaniline	6150	U
4-chlorophenyl phenyl ether	6150	U
4-nitroaniline	6150	U
4-nitrophenol	6150	U
4-nitroquinoline-1-oxide	6150	U
5-nitro-o-toluidine	6150	U
7,12-dimethylbenz(a)anthracene	6150	U
a,a-dimethylphenethylamine	6150	U
Acenaphthene	6150	U
Acenaphthylene	6150	U
Acetophenone	6150	U
Aniline	6150	U
Anthracene	6150	U
Aramite	6150	U
Benzo(a)anthracene	6150	U
Benzo(a)pyrene	6150	U
Benzo(b)fluoranthene	6150	U
Benzo(g,h,i)perylene	6150	U
Benzo(k)fluoranthene	6150	U
Benzyl alcohol	6150	U
Bis(2-chloroethoxy)methane	6150	U
Bis(2-chloroethyl)ether	6150	U
Bis(2-ethylhexyl)phthalate	6150	U
Butyl benzyl phthalate	6150	U
Chrysene	6150	U

PARAMETER	RESULT	QUAL
Di-n-butyl phthalate	6150	U
Di-n-octyl phthalate	6150	U
Diallate	6150	U
Dibenzo(a,h)anthracene	6150	U
Dibenzofuran	6150	U
Diethyl phthalate	6150	U
Dimethyl phthalate	6150	U
Diphenylamine	6150	U
Ethyl methacrylate	6150	U
Ethyl methanesulfonate	6150	U
Fluoranthene	6150	U
Fluorene	6150	U
Hexachlorobenzene	6150	U
Hexachlorobutadiene	6150	U
Hexachlorocyclopentadiene	6150	U
Hexachloroethane	6150	U
Hexachloropropene	6150	U
Indeno(1,2,3-cd)pyrene	6150	U
Isophorone	6150	U
Isosafrole	6150	U
Methapyrilene	30700	U
Methyl methanesulfonate	6150	U
N-nitroso-di-n-butylamine	6150	U
N-nitroso-di-n-propylamine	6150	U
N-nitrosodiethylamine	6150	U
N-nitrosodimethylamine	6150	U
N-nitrosodiphenylamine	6150	U
N-nitrosomethylethylamine	6150	U
N-nitrosomorpholine	6150	U
N-nitrosopiperidine	6150	U
N-nitrosopyrrolidine	6150	U
Naphthalene	6150	U
Nitrobenzene	6150	U
o,o,o-triethylphosphorothioate	6150	U
o-toluidine	6150	U
p-dimethylaminoazobenzene	6150	U
p-phenylenediamine	12300	U
Pentachlorobenzene	6150	U
Pentachloroethane	6150	U
Pentachloronitrobenzene	6150	U
Pentachlorophenol	6150	U
Phenacetin	6150	U
Phenanthrene	6150	U
Phenol	6150	U
Pronamide	6150	U
Pyrene	6150	U
Pyridine	6150	U
Safrole	6150	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	4	U

PARAMETER	RESULT	QUAL
1,1,1-trichloroethane	4	U
1,1,2,2-tetrachloroethane	4	U
1,1,2-trichloroethane	4	U
1,1-dichloroethane	4	U
1,1-dichloroethene	4	U
1,2,3-trichloropropane	4	U
1,2-dibromo-3-chloropropane	4	U
1,2-dibromoethane	4	U
1,2-dichloroethane	4	U
1,2-dichloropropane	4	U
2-butanone	9	U
2-chloro-1,3-butadiene	4	U
2-hexanone	9	U
3-chloropropene	19	U
4-methyl-2-pentanone	9	U
Acetone	4	U
Acetonitrile	19	U
Acrolein	38	UR
Acrylonitrile	38	U
Benzene	4	U
Bis(2-chloroisopropyl)ether	38	U
Bromodichloromethane	4	U
Bromoform	4	U
Bromomethane	4	U
Carbon disulfide	9	U
Carbon tetrachloride	4	U
Chlorobenzene	4	U
Chloroethane	4	U
Chloroform	4	U
Chloromethane	4	U
Cis-1,3-dichloropropene	4	U
Dibromochloromethane	4	U
Dibromomethane	4	U
Dichlorodifluoromethane	4	U
Ethyl cyanide	38	UR
Ethylbenzene	4	U
Iodomethane	9	U
Isobutanol	38	U
Methacrylonitrile	19	U
Methyl methacrylate	19	U
Methylene chloride	4	U
Styrene	4	U
Tetrachloroethene	4	U
Toluene	4	U
Trans-1,2-dichloroethene	4	U
Trans-1,3-dichloropropene	4	U
Trans-1,4-dichloro-2-butene	19	U
Trichloroethene	4	U
Trichlorofluoromethane	4	U
Vinyl acetate	9	U

BRAC Backgr[illegible] Samples
Sediment Data Set

PARAMETER	RESULT	QUAL
Vinyl chloride	4	U
Xylenes, total	11	U

BG 4

B4SS-1	B4SS-1	B&RE	0 in

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	97.7	
Antimony	0.57	UJ
Arsenic	3.4	
Barium	8.3	J
Beryllium	0.03	U
Cadmium	0.07	U
Chromium	1.2	U
Cobalt	0.28	U
Copper	4.6	
Cyanide	0.22	U
Iron	109	
Lead	7	
Manganese	4	
Mercury	0.02	U
Nickel	0.57	U
Selenium	0.57	UJ
Silver	0.28	U
Thallium	0.57	UJ
Vanadium	1.6	
Zinc	0.57	UJ
Pesticides/PCBs (µg/kg)		
2,4,5-T	2.9	U
2,4,5-TP (silvex)	2.9	U
2,4-D	2.9	U
4,4'-DDD	1.9	U
4,4'-DDE	1.9	U
4,4'-DDT	1.9	U
Aldrin	0.96	U
alpha-BHC	1.1	
Aroclor-1016	6	U
Aroclor-1221	6	U
Aroclor-1232	6	U
Aroclor-1242	6	U
Aroclor-1248	6	U
Aroclor-1254	6	U
Aroclor-1260	6	U
beta-BHC	0.96	U
Chlordane	12.1	U
delta-BHC	0.96	U
Dieldrin	1.9	U
Endosulfan I	0.96	U
Endosulfan II	1.9	U
Endosulfan sulfate	1.9	U
Endrin	1.9	U
Endrin aldehyde	1.9	U
gamma-BHC (lindane)	0.96	U
Heptachlor	1.1	
Heptachlor epoxide	0.96	U
Methoxychlor	9.6	U
Methyl parathion	2.4	U
Parathion	2.4	U
Phorate	2.4	U
Toxaphene	48.3	U
Semivolatile Organic Compounds (µg/kg)		
1,2-dichlorobenzene	2.9	U
1,3-dichlorobenzene	2.9	U
1,4-dichlorobenzene	2.9	U
Acenaphthene	487	UJ
Acenaphthylene	487	UJ
Anthracene	487	UJ
Benzo(a)anthracene	487	UJ
Benzo(a)pyrene	487	UJ
Benzo(b)fluoranthene	487	UJ
Benzo(g,h,i)perylene	487	UJ
Benzo(k)fluoranthene	487	UJ
Chrysene	487	UJ
Dibenzo(a,h)anthracene	487	UJ
Fluoranthene	487	UJ
Fluorene	487	UJ
Indeno(1,2,3-cd)pyrene	487	UJ
Naphthalene	487	UJ
Phenanthrene	487	UJ
Pyrene	487	UJ
Volatile Organic Compounds (µg/kg)		
Benzene	2.9	U
Chlorobenzene	2.9	U
Ethylbenzene	2.9	U
Toluene	2.9	U
Xylenes, total	8.8	U

B4SS-2	B4SS-2	B&RE	0 in

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	186	
Antimony	0.66	UJ
Arsenic	1.8	
Barium	7.6	J
Beryllium	0.03	U
Cadmium	0.08	U
Chromium	1.7	U
Cobalt	0.33	U
Copper	5.7	
Cyanide	0.12	UJ
Iron	272	
Lead	8.4	
Manganese	6.6	
Mercury	0.07	
Nickel	0.66	U
Selenium	0.66	UJ
Silver	0.33	U
Thallium	0.66	UJ
Vanadium	2.4	J
Zinc	0.66	UJ
Pesticides/PCBs (µg/kg)		
2,4,5-T	3.4	U
2,4,5-TP (silvex)	3.4	U
2,4-D	24.7	J
4,4'-DDD	2.3	U
4,4'-DDE	2.3	U
4,4'-DDT	2.3	U
Aldrin	1.1	U
alpha-BHC	1.2	
Aroclor-1016	7.2	U
Aroclor-1221	7.2	U
Aroclor-1232	7.2	U
Aroclor-1242	7.2	U
Aroclor-1248	7.2	U
Aroclor-1254	7.2	U
Aroclor-1260	7.2	U
beta-BHC	1.1	U
Chlordane	14.4	U
delta-BHC	1.1	U
Dieldrin	2.3	U
Endosulfan I	1.2	
Endosulfan II	2.3	U
Endosulfan sulfate	2.3	U
Endrin	2.3	U
Endrin aldehyde	2.3	U
gamma-BHC (lindane)	1.3	J
Heptachlor	1.3	J
Heptachlor epoxide	1.1	U
Methoxychlor	11.5	U
Methyl parathion	2.9	U
Parathion	2.9	U
Phorate	2.9	U
Toxaphene	57.5	U
Semivolatile Organic Compounds (µg/kg)		
1,2-dichlorobenzene	3.5	U
1,3-dichlorobenzene	5.9	
1,4-dichlorobenzene	3.5	U
Acenaphthene	577	UJ
Acenaphthylene	577	UJ
Anthracene	577	UJ
Benzo(a)anthracene	577	UJ
Benzo(a)pyrene	577	UJ
Benzo(b)fluoranthene	577	UJ
Benzo(g,h,i)perylene	577	UJ
Benzo(k)fluoranthene	577	UJ
Chrysene	577	UJ
Dibenzo(a,h)anthracene	577	UJ
Fluoranthene	577	UJ
Fluorene	577	UJ
Indeno(1,2,3-cd)pyrene	577	UJ
Naphthalene	577	UJ
Phenanthrene	577	UJ
Pyrene	577	UJ
Volatile Organic Compounds (µg/kg)		
Benzene	3.5	U
Chlorobenzene	3.5	U
Ethylbenzene	3.5	U
Toluene	16.9	
Xylenes, total	10.5	U

BG 5

B5SS-1	B5SS-1	B&RE	0 in

PARAMETER	RESULT	QUAL
Inorganics (mg/kg)		
Aluminum	636	
Antimony	0.81	UJ
Arsenic	2.3	
Barium	13.2	J
Beryllium	0.04	U
Cadmium	0.15	U
Chromium	4.9	U
Cobalt	0.4	U
Copper	6.2	
Cyanide	0.29	U
Iron	528	
Lead	6.8	
Manganese	12.5	
Mercury	0.04	
Nickel	1.3	
Selenium	0.81	UJ
Silver	0.4	U
Thallium	0.81	UJ
Vanadium	3.4	J
Zinc	0.81	UJ
Pesticides/PCBs (µg/kg)		
2,4,5-T	4	UR
2,4,5-TP (silvex)	4	UR
2,4-D	4	UR
4,4'-DDD	2.7	U
4,4'-DDE	2.7	U
4,4'-DDT	2.7	U
Aldrin	1.3	U
alpha-BHC	1.5	
Aroclor-1016	8.4	U
Aroclor-1221	8.4	U
Aroclor-1232	8.4	U

BRAC Backgro[illegible] Samples
Sediment Data Set

PARAMETER	RESULT	QUAL
Aroclor-1242	8.4	U
Aroclor-1248	8.4	U
Aroclor-1254	8.4	U
Aroclor-1260	8.4	U
beta-BHC	1.3	U
Chlordane	16.7	U
delta-BHC	1.3	U
Dieldrin	2.7	U
Endosulfan I	1.3	U
Endosulfan II	2.7	U
Endosulfan sulfate	2.7	U
Endrin	2.7	U
Endrin aldehyde	2.7	U
gamma-BHC (lindane)	2.1	
Heptachlor	1.3	U
Heptachlor epoxide	1.3	U
Methoxychlor	13.4	U
Methyl parathion	3.3	U
Parathion	3.3	U
Phorate	3.3	U
Toxaphene	66.8	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4-trichlorobenzene	669	UJ
1,2-dichlorobenzene	4.1	U
1,3-dichlorobenzene	4.1	U
1,4-dichlorobenzene	4.1	U
2,4-dinitrotoluene	669	UJ
Acenaphthene	669	UJ
Acenaphthylene	669	UJ
Anthracene	669	UJ
Benzo(a)anthracene	669	UJ
Benzo(a)pyrene	669	UJ
Benzo(b)fluoranthene	669	UJ
Benzo(g,h,i)perylene	669	UJ
Benzo(k)fluoranthene	669	UJ
Chrysene	669	UJ
Dibenzo(a,h)anthracene	669	UJ
Fluoranthene	669	UJ
Fluorene	669	UJ
Indeno(1,2,3-cd)pyrene	669	UJ
N-nitroso-di-n-propylamine	669	UJ
Naphthalene	669	UJ
Phenanthrene	669	UJ
Pyrene	669	UJ
Volatile Organic Compounds (µg/kg)		
Benzene	4.1	U
Chlorobenzene	4.1	U
Ethylbenzene	4.1	U
Toluene	3.5	J
Xylenes, total	12	U

PARAMETER	RESULT	QUAL
BG 6		
B6SS B6SS B&RE 0 in		
Inorganics (mg/kg)		
Aluminum	945	
Antimony	0.98	UJ
Arsenic	8.1	U
Barium	7.2	
Beryllium	0.05	U
Cadmium	0.72	U
Chromium	6.2	
Cobalt	0.49	U
Copper	14	
Cyanide	0.17	UJ
Iron	3640	
Lead	23.7	
Manganese	14.3	
Mercury	0.05	
Nickel	3.6	
Selenium	0.98	UJ
Silver	0.49	U
Thallium	0.98	UJ
Vanadium	11.7	
Zinc	140	
Pesticides/PCBs (µg/kg)		
2,4,5-T	5.1	U
2,4,5-TP (silvex)	5.1	U
2,4-D	5.1	U
4,4'-DDD	3.9	
4,4'-DDE	3.9	
4,4'-DDT	3.7	
Aldrin	1.7	U
alpha-BHC	1.7	U
Aroclor-1016	10.6	U
Aroclor-1221	10.6	U
Aroclor-1232	10.6	U
Aroclor-1242	10.6	U
Aroclor-1248	10.6	U
Aroclor-1254	10.6	U
Aroclor-1260	10.6	U
beta-BHC	1.7	U
Chlordane	21.2	U
delta-BHC	2.8	J
Dieldrin	3.4	U
Endosulfan I	2.7	J
Endosulfan II	3.4	U
Endosulfan sulfate	3.4	U
Endrin	3.4	U
Endrin aldehyde	3.4	U
gamma-BHC (lindane)	2	J
Heptachlor	1.7	U

PARAMETER	RESULT	QUAL
Heptachlor epoxide	1.7	U
Methoxychlor	16.9	U
Methyl parathion	4.2	U
Parathion	4.2	U
Phorate	4.2	U
Toxaphene	84.7	U
Semivolatile Organic Compounds (µg/kg)		
1,2-dichlorobenzene	5.1	U
1,3-dichlorobenzene	5.1	U
1,4-dichlorobenzene	5.1	U
Acenaphthene	844	U
Acenaphthylene	844	U
Anthracene	844	U
Benzo(a)anthracene	844	U
Benzo(a)pyrene	844	U
Benzo(b)fluoranthene	844	U
Benzo(g,h,i)perylene	844	U
Benzo(k)fluoranthene	844	U
Chrysene	844	U
Dibenzo(a,h)anthracene	844	U
Fluoranthene	844	U
Fluorene	844	U
Indeno(1,2,3-cd)pyrene	844	U
Naphthalene	844	U
Phenanthrene	844	U
Pyrene	844	U
Volatile Organic Compounds (µg/kg)		
Benzene	5.1	U
Chlorobenzene	5.1	U
Ethylbenzene	5.1	U
Toluene	5	U
Xylenes, total	15.4	U
BG 7		
B7SS-1 B7SS-1 B&RE 0 in		
Inorganics (mg/kg)		
Aluminum	741	
Antimony	0.88	U
Arsenic	2.7	
Barium	6.5	
Beryllium	0.04	U
Cadmium	0.19	U
Chromium	5.6	U
Cobalt	0.44	U
Copper	12.3	
Cyanide	0.14	U
Iron	736	
Lead	12	
Manganese	4.4	
Mercury	0.03	U
Nickel	2.4	

PARAMETER	RESULT	QUAL
Selenium	0.88	U
Silver	0.5	
Thallium	0.88	U
Vanadium	6.2	
Zinc	11.6	
Pesticides/PCBs (µg/kg)		
2,4,5-T	4.5	UJ
2,4,5-TP (silvex)	4.5	UJ
2,4-D	4.5	UJ
4,4'-DDD	3	U
4,4'-DDE	2.2	J
4,4'-DDT	3	U
Aldrin	1.5	U
Aroclor-1016	9.3	U
Aroclor-1221	9.3	U
Aroclor-1232	9.3	U
Aroclor-1242	9.3	U
Aroclor-1248	9.3	U
Aroclor-1254	9.3	U
Aroclor-1260	9.3	U
beta-BHC	1.5	U
Chlordane	18.6	U
delta-BHC	1.5	U
Dieldrin	3	U
Endosulfan I	1.5	U
Endosulfan II	3	U
Endosulfan sulfate	3	U
Endrin	3	U
Endrin aldehyde	3	U
gamma-BHC (lindane)	1.2	J
Heptachlor	1.5	U
Heptachlor epoxide	1.5	U
Methoxychlor	14.9	U
Methyl parathion	3.7	U
Parathion	3.7	U
Phorate	3.7	U
Toxaphene	74.4	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4-trichlorobenzene	739	U
1,2-dichlorobenzene	4.5	U
1,3-dichlorobenzene	4.5	U
1,4-dichlorobenzene	4.5	U
2,4-dinitrotoluene	739	U
Acenaphthene	739	U
Acenaphthylene	739	U
Anthracene	739	U
Benzo(a)anthracene	739	U
Benzo(a)pyrene	739	U
Benzo(b)fluoranthene	739	U
Benzo(g,h,i)perylene	739	U

BRAC Background Samples
Sediment Data Set

PARAMETER	RESULT	QUAL
Benzo(k)fluoranthene	739	U
Chrysene	739	U
Dibenzo(a,h)anthracene	739	U
Fluoranthene	739	U
Fluorene	739	U
Indeno(1,2,3-cd)pyrene	739	U
N-nitroso-di-n-propylamine	739	U
Naphthalene	739	U
Phenanthrene	739	U
Pyrene	739	U
Volatile Organic Compounds (µg/kg)		
Benzene	4.5	U
Chlorobenzene	4.5	U
Ethylbenzene	4.5	U
Toluene	5	U
Xylenes, total	13.6	U
B7SS-2 B7SS-2 B&RE 0 In		
Inorganics (mg/kg)		
Aluminum	2280	
Antimony	1.2	U
Arsenic	7	
Barium	13.2	
Beryllium	0.06	U
Cadmium	0.12	U
Chromium	9.2	U
Cobalt	0.59	U
Copper	13.8	
Cyanide	0.2	U
Iron	1370	
Lead	19.8	
Manganese	12.1	
Mercury	0.05	U
Nickel	4.1	
Selenium	1.2	U
Silver	0.59	U
Thallium	1.2	U
Vanadium	7.7	
Zinc	29.6	
Pesticides/PCBs (µg/kg)		
2,4,5-T	6.1	UJ
2,4,5-TP (silvex)	6.1	UJ
2,4-D	6.1	UJ
4,4'-DDD	4.1	U
4,4'-DDE	4.1	U
4,4'-DDT	4.1	U
Aldrin	2.1	U
alpha-BHC	2.1	U
Aroclor-1016	12.9	U
Aroclor-1221	12.9	U
Aroclor-1232	12.9	U

PARAMETER	RESULT	QUAL
Aroclor-1242	12.9	U
Aroclor-1248	12.9	U
Aroclor-1254	12.9	U
Aroclor-1260	12.9	U
beta-BHC	2.1	U
Chlordane	25.8	U
delta-BHC	2.1	U
Dieldrin	4.1	U
Endosulfan I	2.1	U
Endosulfan II	4.1	U
Endosulfan sulfate	4.1	U
Endrin	4.1	U
Endrin aldehyde	4.1	U
gamma-BHC (lindane)	2.1	U
Heptachlor	2.1	U
Heptachlor epoxide	2.1	U
Methoxychlor	43.8	
Methyl parathion	5.2	U
Parathion	5.2	U
Phorate	5.2	U
Toxaphene	103	U
Semivolatile Organic Compounds (µg/kg)		
1,2-dichlorobenzene	6.2	U
1,3-dichlorobenzene	6.2	U
1,4-dichlorobenzene	6.2	U
Acenaphthene	1040	U
Acenaphthylene	1040	U
Anthracene	1040	U
Benzo(a)anthracene	1040	U
Benzo(a)pyrene	1040	U
Benzo(b)fluoranthene	1040	U
Benzo(g,h,i)perylene	1040	U
Benzo(k)fluoranthene	1040	U
Chrysene	1040	U
Dibenzo(a,h)anthracene	1040	U
Fluoranthene	1040	U
Fluorene	1040	U
Indeno(1,2,3-cd)pyrene	1040	U
Naphthalene	1040	U
Phenanthrene	1040	U
Pyrene	1040	U
Volatile Organic Compounds (µg/kg)		
Benzene	6.2	U
Chlorobenzene	6.2	U
Ethylbenzene	6.2	U
Toluene	6	U
Xylenes, total	18.8	U
BG 8		
B8SS B8SS B&RE 0 In		
Inorganics (mg/kg)		

PARAMETER	RESULT	QUAL
Aluminum	120	
Antimony	0.57	UJ
Arsenic	1.1	U
Barium	5.3	
Beryllium	0.03	U
Cadmium	0.06	
Chromium	3	
Cobalt	0.28	U
Copper	5.3	
Cyanide	0.1	UJ
Iron	452	
Lead	8.4	
Manganese	4.4	
Mercury	0.02	U
Nickel	0.93	
Selenium	0.59	J
Silver	0.28	U
Thallium	0.57	UJ
Vanadium	2.6	
Zinc	0.28	U
Pesticides/PCBs (µg/kg)		
2,4,5-T	28.4	U
2,4,5-TP (silvex)	28.4	U
2,4-D	28.4	U
4,4'-DDD	1.9	U
4,4'-DDE	1.9	U
4,4'-DDT	1.9	U
Aldrin	0.93	U
alpha-BHC	0.93	U
Aroclor-1016	5.8	U
Aroclor-1221	5.8	U
Aroclor-1232	5.8	U
Aroclor-1242	5.8	U
Aroclor-1248	5.8	U
Aroclor-1254	5.8	U
Aroclor-1260	5.8	U
beta-BHC	0.93	U
Chlordane	11.6	U
delta-BHC	0.93	U
Dieldrin	1.9	U
Endosulfan I	1.6	J
Endosulfan II	1.9	U
Endosulfan sulfate	1.9	U
Endrin	1.4	J
Endrin aldehyde	1.9	U
gamma-BHC (lindane)	0.93	U
Heptachlor	0.93	U
Heptachlor epoxide	0.93	U
Methoxychlor	9.3	U
Methyl parathion	2.3	U

PARAMETER	RESULT	QUAL
Parathion	2.3	U
Phorate	2.3	U
Toxaphene	46.6	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4-trichlorobenzene	467	UJ
1,2-dichlorobenzene	2.8	U
1,3-dichlorobenzene	2.8	U
1,4-dichlorobenzene	2.8	U
2,4-dinitrotoluene	467	UJ
Acenaphthene	467	UJ
Acenaphthylene	467	UJ
Anthracene	467	UJ
Benzo(a)anthracene	467	UJ
Benzo(a)pyrene	467	UJ
Benzo(b)fluoranthene	489	J
Benzo(g,h,i)perylene	467	UJ
Benzo(k)fluoranthene	467	UJ
Chrysene	417	J
Dibenzo(a,h)anthracene	467	UJ
Fluoranthene	690	J
Fluorene	467	UJ
Indeno(1,2,3-cd)pyrene	467	UJ
N-nitroso-di-n-propylamine	467	UJ
Naphthalene	467	UJ
Phenanthrene	467	UJ
Pyrene	509	J
Volatile Organic Compounds (µg/kg)		
Benzene	2.8	U
Chlorobenzene	2.8	U
Ethylbenzene	2.8	U
Toluene	3	U
Xylenes, total	8.6	U
SWMU 1		
S1SS-7SD KW02569 BEI(d) 0 In		
Inorganics (mg/kg)		
Aluminum	1970	
Antimony	0.19	U
Arsenic	1.5	
Barium	10.9	
Beryllium	0.12	
Cadmium	0.12	
Chromium	5.3	
Cobalt	0.12	
Copper	0.76	
Cyanide	0.59	U
Iron	898	
Lead	0.14	U
Manganese	17.1	
Mercury	0.013	U
Nickel	0.78	

BRAC Backgro l Samples
Sediment Data Set

PARAMETER	RESULT	QUAL
Selenium	0.24	
Silver	0.12	U
Thallium	0.28	U
Tin	0.99	
Vanadium	3.7	
Zinc	3.5	
Pesticides/PCBs (µg/kg)		
4,4'-DDD	4.8	U
4,4'-DDE	4.8	U
4,4'-DDT	4.8	U
Aldrin	2.4	U
alpha-BHC	2.4	U
Aroclor-1016	24	U
Aroclor-1221	24	U
Aroclor-1232	24	U
Aroclor-1242	24	U
Aroclor-1248	24	U
Aroclor-1254	24	U
Aroclor-1260	24	U
beta-BHC	2.4	U
Chlordane	24	U
Chlorobenzilate	930	U
delta-BHC	2.4	U
Dieldrin	4.8	U
Endosulfan I	2.4	U
Endosulfan II	4.8	U
Endosulfan sulfate	4.8	U
Endrin	4.8	U
Endrin aldehyde	4.8	U
Endrin ketone	4.8	U
gamma-BHC (lindane)	2.4	U
Heptachlor	2.4	U
Heptachlor epoxide	2.4	U
Isodrin	930	U
Kepone	1800	U
Methoxychlor	24	U
Toxaphene	240	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	930	U
1,2,4-trichlorobenzene	930	U
1,2-dichlorobenzene	930	U
1,3,5-trinitrobenzene	930	U
1,3-dichlorobenzene	930	U
1,3-dinitrobenzene	930	U
1,4-dichlorobenzene	930	U
1,4-naphthoquinone	930	U
1-naphthylamine	930	U
2,3,4,6-tetrachlorophenol	1800	U
2,4,5-trichlorophenol	4500	U
2,4,6-trichlorophenol	930	U

PARAMETER	RESULT	QUAL
2,4-dichlorophenol	930	U
2,4-dimethylphenol	930	U
2,4-dinitrophenol	4500	U
2,4-dinitrotoluene	930	U
2,6-dichlorophenol	930	U
2,6-dinitrotoluene	930	U
2-acetylaminofluorene	1800	U
2-chloronaphthalene	930	U
2-chlorophenol	930	U
2-methyl-4,6-dinitrophenol	4500	U
2-methylnaphthalene	930	U
2-methylphenol	930	U
2-naphthylamine	930	U
2-nitroaniline	4500	U
2-nitrophenol	930	U
2-picoline	930	U
3 & 4-methylphenol	930	U
3,3'-dichlorobenzidine	1800	U
3-methylcholanthrene	930	U
3-nitroaniline	4500	U
4-aminobiphenyl	930	U
4-bromophenyl phenyl ether	930	U
4-chloro-3-methylphenol	1800	U
4-chloroaniline	1800	U
4-chlorophenyl phenyl ether	930	U
4-nitroaniline	4500	U
4-nitrophenol	4500	U
4-nitroquinoline-1-oxide	930	U
5-nitro-o-toluidine	930	U
7,12-dimethylbenz(a)anthracene	930	U
a,a-dimethylphenethylamine	1800	U
Acenaphthene	930	U
Acenaphthylene	930	U
Acetophenone	930	U
Aniline	930	U
Anthracene	930	U
Aramite	1800	U
Benzo(a)anthracene	930	U
Benzo(a)pyrene	930	U
Benzo(b)fluoranthene	930	U
Benzo(g,h,i)perylene	930	U
Benzo(k)fluoranthene	930	U
Benzyl alcohol	1800	U
Bis(2-chloroethoxy)methane	930	U
Bis(2-chloroethyl)ether	930	U
Bis(2-ethylhexyl)phthalate	930	U
Butyl benzyl phthalate	930	U
Carbazole	930	U
Chrysene	930	U
Di-n-butyl phthalate	930	U

PARAMETER	RESULT	QUAL
Di-n-octyl phthalate	930	U
Diallate	1800	U
Dibenzo(a,h)anthracene	930	U
Dibenzofuran	930	U
Diethyl phthalate	930	U
Dimethyl phthalate	930	U
Diphenylamine	930	U
Ethyl methacrylate	930	U
Ethyl methanesulfonate	930	U
Fluoranthene	930	U
Fluorene	930	U
Hexachlorobenzene	930	U
Hexachlorobutadiene	930	U
Hexachlorocyclopentadiene	930	U
Hexachloroethane	930	U
Hexachlorophene	820	
Hexachloropropene	930	U
Indeno(1,2,3-cd)pyrene	930	U
Isophorone	930	U
Isosafrole	930	U
Methapyrilene	930	U
Methyl methanesulfonate	930	U
N-nitroso-di-n-butylamine	930	U
N-nitroso-di-n-propylamine	930	U
N-nitrosodiethylamine	930	U
N-nitrosodimethylamine	930	U
N-nitrosomethylethylamine	930	U
N-nitrosomorpholine	930	U
N-nitrosopiperidine	930	U
N-nitrosopyrrolidine	930	U
Naphthalene	930	U
Nitrobenzene	930	U
o,o,o-triethylphosphorothioate	930	U
o-toluidine	930	U
p-dimethylaminoazobenzene	930	U
p-phenylenediamine	5900	U
Pentachlorobenzene	930	U
Pentachloroethane	930	U
Pentachloronitrobenzene	1800	U
Pentachlorophenol	4500	U
Phenacetin	930	U
Phenanthrene	930	U
Phenol	930	U
Pronamide	1800	U
Pyrene	930	U
Pyridine	930	U
Safrole	930	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	7	U
1,1,1-trichloroethane	7	U

PARAMETER	RESULT	QUAL
1,1,2,2-tetrachloroethane	7	U
1,1,2-trichloroethane	7	U
1,1-dichloroethane	7	U
1,1-dichloroethene	7	U
1,2,3-trichloropropane	7	U
1,2-dibromo-3-chloropropane	7	U
1,2-dibromoethane	7	U
1,2-dichloroethane	7	U
1,2-dichloroethene	7	U
1,2-dichloropropane	7	U
2-butanone	15	U
2-chloro-1,3-butadiene	29	U
2-hexanone	15	U
3-chloropropene	7	U
4-methyl-2-pentanone	15	U
Acetone	15	U
Acrolein	29	U
Acrylonitrile	15	U
Benzene	7	U
Bis(2-chloroisopropyl)ether	930	U
Bromodichloromethane	7	U
Bromoform	7	U
Bromomethane	15	U
Carbon disulfide	7	U
Carbon tetrachloride	7	U
Chlorobenzene	7	U
Chloroethane	15	U
Chloroform	7	U
Chloromethane	15	U
Cis-1,2-dichloroethene	7	U
Cis-1,3-dichloropropene	7	U
Dibromochloromethane	7	U
Dibromomethane	7	U
Dichlorodifluoromethane	7	U
Ethyl cyanide	7	U
Ethylbenzene	7	U
Iodomethane	7	U
Methacrylonitrile	7	U
Methyl methacrylate	7	U
Methylene chloride	7	U
Styrene	7	U
Tetrachloroethene	7	U
Toluene	7	U
Trans-1,2-dichloroethene	7	U
Trans-1,3-dichloropropene	7	U
Trans-1,4-dichloro-2-butene	7	U
Trichloroethene	7	U
Trichlorofluoromethane	7	U
Vinyl acetate	15	U
Vinyl chloride	15	U

BRAC Background Samples
Sediment Data Set

PARAMETER	RESULT	QUAL
Xylenes, total	7	U
SWMU 4		
S4SS-4 S4SS-4 B&RE	0 in	
Inorganics (mg/kg)		
Aluminum	2810	
Antimony	1	U
Arsenic	2.9	
Barium	9.8	
Beryllium	0.05	U
Cadmium	0.1	U
Chromium	9.9	
Cobalt	0.52	U
Copper	8.5	
Cyanide	0.19	UJ
Iron	2060	
Lead	24.3	
Manganese	38.6	
Mercury	0.04	
Nickel	2.6	
Selenium	1	U
Silver	0.52	U
Thallium	1	U
Vanadium	6.2	
Zinc	0.52	U
Pesticides/PCBs (µg/kg)		
Chlorobenzilate	4580	U
Dimethoate	4580	U
Dinoseb	916	U
Disulfoton	916	U
Famphur	916	U
Isodrin	916	U
Kepone	916	U
Sulfotep	916	U
Thionazin	916	U
Semivolatile Organic Compounds (µg/kg)		
1,2,4,5-tetrachlorobenzene	916	U
1,2,4-trichlorobenzene	916	U
1,2-dichlorobenzene	916	U
1,3,5-trinitrobenzene	4580	U
1,3-dichlorobenzene	916	U
1,3-dinitrobenzene	916	U
1,4-dichlorobenzene	916	U
1,4-dioxane	916	U
1,4-naphthoquinone	916	U
1-naphthylamine	916	U
2,3,4,6-tetrachlorophenol	916	U
2,4,5-trichlorophenol	916	U
2,4,6-trichlorophenol	916	U
2,4-dichlorophenol	916	U
2,4-dimethylphenol	916	U

PARAMETER	RESULT	QUAL
2,4-dinitrophenol	1830	U
2,4-dinitrotoluene	916	U
2,6-dichlorophenol	916	U
2,6-dinitrotoluene	916	U
2-acetylaminofluorene	916	U
2-chloronaphthalene	916	U
2-chlorophenol	916	U
2-methyl-4,6-dinitrophenol	916	U
2-methylnaphthalene	916	U
2-methylphenol	916	U
2-naphthylamine	916	U
2-nitroaniline	916	U
2-nitrophenol	916	U
2-picoline	916	U
3,3'-dichlorobenzidine	1830	U
3,3'-dimethylbenzidine	4580	U
3-methylcholanthrene	916	U
3-nitroaniline	916	U
4-aminobiphenyl	916	U
4-bromophenyl phenyl ether	916	U
4-chloro-3-methylphenol	916	U
4-chloroaniline	916	U
4-chlorophenyl phenyl ether	916	U
4-methylphenol	916	U
4-nitroaniline	916	U
4-nitrophenol	916	U
4-nitroquinoline-1-oxide	916	U
5-nitro-o-toluidine	916	U
7,12-dimethylbenz(a)anthracene	916	U
a,a-dimethylphenethylamine	916	U
Acenaphthene	916	U
Acenaphthylene	916	U
Acetophenone	916	U
Aniline	916	U
Anthracene	916	U
Aramite	916	U
Benzo(a)anthracene	916	U
Benzo(a)pyrene	916	U
Benzo(b)fluoranthene	916	U
Benzo(g,h,i)perylene	916	U
Benzo(k)fluoranthene	916	U
Benzyl alcohol	916	U
Bis(2-chloroethoxy)methane	916	U
~~Bis(2-chloroethyl)ether~~	916	U
Bis(2-ethylhexyl)phthalate	916	U
Butyl benzyl phthalate	916	U
Chrysene	916	U
Di-n-butyl phthalate	916	U
Di-n-octyl phthalate	916	U
Diallate	916	U

PARAMETER	RESULT	QUAL
Dibenzo(a,h)anthracene	916	U
Dibenzofuran	916	U
Diethyl phthalate	916	U
Dimethyl phthalate	916	U
Diphenylamine	916	U
Ethyl methacrylate	916	U
Ethyl methanesulfonate	916	U
Fluoranthene	916	U
Fluorene	916	U
Hexachlorobenzene	916	U
Hexachlorobutadiene	916	U
Hexachlorocyclopentadiene	916	U
Hexachloroethane	916	U
Hexachloropropene	916	U
Indeno(1,2,3-cd)pyrene	916	U
Isophorone	916	U
Isosafrole	916	U
Methapyrilene	4580	U
Methyl methanesulfonate	916	U
N-nitroso-di-n-butylamine	916	U
N-nitroso-di-n-propylamine	916	U
N-nitrosodiethylamine	916	U
N-nitrosodimethylamine	916	U
N-nitrosodiphenylamine	916	U
N-nitrosomethylethylamine	916	U
N-nitrosomorpholine	916	U
N-nitrosopiperidine	916	U
N-nitrosopyrrolidine	916	U
Naphthalene	916	U
Nitrobenzene	916	U
o,o,o-triethylphosphorothioate	916	U
o-toluidine	916	U
p-dimethylaminoazobenzene	916	U
p-phenylenediamine	1830	U
Pentachlorobenzene	916	U
Pentachloroethane	916	U
Pentachloronitrobenzene	916	U
Pentachlorophenol	916	U
Phenacetin	916	U
Phenanthrene	916	U
Phenol	916	U
Pronamide	916	U
Pyrene	916	U
Pyridine	916	U
Safrole	916	U
Volatile Organic Compounds (µg/kg)		
1,1,1,2-tetrachloroethane	5.6	U
1,1,1-trichloroethane	5.6	U
1,1,2,2-tetrachloroethane	5.6	U
1,1,2-trichloroethane	5.6	U

PARAMETER	RESULT	QUAL
1,1-dichloroethane	5.6	U
1,1-dichloroethene	5.6	U
1,2,3-trichloropropane	2.8	U
1,2-dibromo-3-chloropropane	2.8	U
1,2-dibromoethane	2.8	U
1,2-dichloroethane	5.6	U
1,2-dichloropropane	5.6	U
2-butanone	13.9	U
2-chloro-1,3-butadiene	2.8	UR
2-hexanone	13.9	U
3-chloropropene	13.9	U
4-methyl-2-pentanone	13.9	U
Acetone	27.8	U
Acetonitrile	13.9	U
Acrolein	27.8	UR
Acrylonitrile	27.8	U
Benzene	5.6	U
Bis(2-chloroisopropyl)ether	27.8	U
Bromodichloromethane	5.6	U
Bromoform	5.6	U
Bromomethane	5.6	U
Carbon disulfide	13.9	U
Carbon tetrachloride	5.6	U
Chlorobenzene	5.6	U
Chloroethane	5.6	U
Chloroform	5.6	U
Chloromethane	5.6	U
Cis-1,3-dichloropropene	5.6	U
Dibromochloromethane	5.6	U
Dibromomethane	5.6	U
Dichlorodifluoromethane	5.6	U
Ethyl cyanide	27.8	UR
Ethylbenzene	5.6	U
Iodomethane	6.9	U
Isobutanol	27.8	UR
Methacrylonitrile	13.9	UR
Methyl methacrylate	13.9	U
Methylene chloride	14	U
Styrene	5.6	U
Tetrachloroethene	2	J
Toluene	6	U
Trans-1,2-dichloroethene	5.6	U
Trans-1,3-dichloropropene	5.6	U
Trans-1,4-dichloro-2-butene	13.9	U
Trichloroethene	5.6	U
Trichlorofluoromethane	5.6	U
Vinyl acetate	13.9	U
Vinyl chloride	5.6	U
Xylenes, total	11.1	U

BRAC Background Samples
Surface-Water Data Set

PARAMETER	RESULT	QUAL
BG 1		
BG1SW-01 BG1SW-01	B&RE	
Inorganics		
Aluminum	11.1	U
Antimony	2.6	U
Arsenic	4.9	U
Barium	7.9	
Beryllium	0.3	U
Cadmium	0.4	U
Chromium	0.9	U
Cobalt	0.8	U
Copper	1.2	U
Cyanide	2.5	U
Iron	3	U
Lead	1.8	U
Manganese	0.6	U
Mercury	0.48	
Nickel	1.3	U
Selenium	4.8	U
Silver	0.7	U
Thallium	4.5	U
Vanadium	0.7	U
Zinc	1.4	U
Pesticides/PCBs		
2,4,5-T	0.19	U
2,4,5-TP (silvex)	0.096	U
2,4-D	0.19	U
4,4'-DDD	0.039	U
4,4'-DDE	0.039	U
4,4'-DDT	0.039	U
Aldrin	0.019	U
alpha-BHC	0.019	U
Aroclor-1016	0.12	U
Aroclor-1221	0.12	U
Aroclor-1232	0.12	U
Aroclor-1242	0.12	U
Aroclor-1248	0.12	U
Aroclor-1254	0.12	U
Aroclor-1260	0.12	U
beta-BHC	0.019	U
Chlordane	0.24	U
Chlorobenzilate	50	U
delta-BHC	0.019	U
Dieldrin	0.039	U
Dimethoate	50	U
Dinoseb	10	U
Disulfoton	10	U
Endosulfan I	0.019	U
Endosulfan II	0.039	U
Endosulfan sulfate	0.039	U

PARAMETER	RESULT	QUAL
Endrin	0.039	U
Endrin aldehyde	0.039	U
Famphur	10	U
gamma-BHC (lindane)	0.019	U
Heptachlor	0.019	U
Heptachlor epoxide	0.019	U
Isodrin	10	U
Kepone	10	U
Methoxychlor	0.19	U
Methyl parathion	0.048	U
Parathion	0.048	U
Phorate	0.048	U
Sulfotep	10	U
Thionazin	10	U
Toxaphene	0.97	U
Semivolatile Organic Compounds		
1,2,4,5-tetrachlorobenzene	10	U
1,2,4-trichlorobenzene	10	U
1,2-dichlorobenzene	10	U
1,3,5-trinitrobenzene	50	U
1,3-dichlorobenzene	10	U
1,3-dinitrobenzene	10	U
1,4-dichlorobenzene	10	U
1,4-dioxane	10	U
1,4-naphthoquinone	10	U
1-naphthylamine	10	U
2,3,4,6-tetrachlorophenol	10	U
2,4,5-trichlorophenol	10	U
2,4,6-trichlorophenol	10	U
2,4-dichlorophenol	10	U
2,4-dimethylphenol	10	U
2,4-dinitrophenol	20	U
2,4-dinitrotoluene	10	U
2,6-dichlorophenol	10	U
2,6-dinitrotoluene	10	U
2-acetylaminofluorene	10	U
2-chloronaphthalene	10	U
2-chlorophenol	10	U
2-methyl-4,6-dinitrophenol	10	U
2-methylnaphthalene	10	U
2-methylphenol	10	U
2-naphthylamine	10	U
2-nitroaniline	10	U
2-nitrophenol	10	U
2-picoline	10	U
3 & 4-methylphenol	10	U
3,3'-dichlorobenzidine	50	U
3,3'-dimethylbenzidine	50	UR
3-methylcholanthrene	10	U
3-nitroaniline	10	U

PARAMETER	RESULT	QUAL
4-aminobiphenyl	10	U
4-bromophenyl phenyl ether	10	U
4-chloro-3-methylphenol	10	U
4-chloroaniline	10	U
4-chlorophenyl phenyl ether	10	U
4-nitroaniline	10	U
4-nitrophenol	10	U
4-nitroquinoline-1-oxide	10	UR
5-nitro-o-toluidine	10	U
7,12-dimethylbenz(a)anthracene	10	U
a,a-dimethylphenethylamine	10	U
Acenaphthene	10	U
Acenaphthylene	10	U
Acetophenone	10	U
Aniline	10	U
Anthracene	10	U
Aramite	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Benzyl alcohol	10	U
Bis(2-chloroethoxy)methane	10	U
Bis(2-chloroethyl)ether	10	U
Bis(2-ethylhexyl)phthalate	10	U
Butyl benzyl phthalate	10	U
Chrysene	10	U
Di-n-butyl phthalate	10	U
Di-n-octyl phthalate	10	U
Diallate	10	U
Dibenzo(a,h)anthracene	10	U
Dibenzofuran	10	U
Diethyl phthalate	10	U
Dimethyl phthalate	10	U
Diphenylamine	10	U
Ethyl methacrylate	10	U
Ethyl methanesulfonate	10	U
Fluoranthene	10	U
Fluorene	10	U
Hexachlorobenzene	10	U
Hexachlorobutadiene	10	U
Hexachlorocyclopentadiene	10	U
Hexachloroethane	10	U
Hexachloropropene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Isophorone	10	U
Isosafrole	10	U
Methapyrilene	50	U
Methyl methanesulfonate	10	U

PARAMETER	RESULT	QUAL
N-nitroso-di-n-butylamine	10	U
N-nitroso-di-n-propylamine	10	U
N-nitrosodiethylamine	10	U
N-nitrosodimethylamine	10	U
N-nitrosodiphenylamine	10	U
N-nitrosomethylethylamine	10	U
N-nitrosomorpholine	10	U
N-nitrosopiperidine	10	U
N-nitrosopyrrolidine	10	U
Naphthalene	10	U
Nitrobenzene	10	U
o,o,o-triethylphosphorothioate	10	U
o-toluidine	10	U
p-dimethylaminoazobenzene	10	U
p-phenylenediamine	20	U
Pentachlorobenzene	10	U
Pentachloroethane	10	U
Pentachloronitrobenzene	10	U
Pentachlorophenol	10	U
Phenacetin	10	U
Phenanthrene	10	U
Phenol	10	U
Pronamide	10	U
Pyrene	10	U
Pyridine	10	U
Safrole	10	U
Volatile Organic Compounds		
1,1,1,2-tetrachloroethane	2	U
1,1,1-trichloroethane	2	U
1,1,2,2-tetrachloroethane	2	U
1,1,2-trichloroethane	2	U
1,1-dichloroethane	2	U
1,1-dichloroethene	2	U
1,2,3-trichloropropane	2	U
1,2-dibromo-3-chloropropane	2	U
1,2-dibromoethane	2	U
1,2-dichloroethane	2	U
1,2-dichloropropane	2	U
2-butanone	5	U
2-chloro-1,3-butadiene	2	U
2-hexanone	5	U
3-chloropropene	10	U
4-methyl-2-pentanone	5	U
Acetone	2	U
Acetonitrile	10	U
Acrolein	20	UR
Acrylonitrile	20	U
Benzene	2	U
Bis(2-chloroisopropyl)ether	20	U
Bromodichloromethane	2	U

BRAC Background Samples
Surface-Water Data Set

PARAMETER	RESULT	QUAL
Bromoform	2	U
Bromomethane	2	U
Carbon disulfide	5	U
Carbon tetrachloride	2	U
Chlorobenzene	2	U
Chloroethane	2	U
Chloroform	2	U
Chloromethane	2	U
Cis-1,3-dichloropropene	2	U
Dibromochloromethane	2	U
Dibromomethane	2	U
Dichlorodifluoromethane	2	U
Ethyl cyanide	20	UR
Ethylbenzene	2	U
Iodomethane	5	U
Isobutanol	20	U
Methacrylonitrile	10	U
Methyl methacrylate	10	U
Methylene chloride	2	U
Styrene	2	U
Tetrachloroethene	2	U
Toluene	2	U
Trans-1,2-dichloroethene	2	U
Trans-1,3-dichloropropene	2	U
Trans-1,4-dichloro-2-butene	10	U
Trichloroethene	2	U
Trichlorofluoromethane	2	U
Vinyl acetate	5	U
Vinyl chloride	2	U
Xylenes, total	6	U

BG 2

BG2SW-01 BG2SW-01 B&RE

PARAMETER	RESULT	QUAL
Inorganics		
Aluminum	11.1	U
Antimony	3.5	
Arsenic	5.5	U
Barium	7	
Beryllium	0.3	U
Cadmium	0.4	U
Chromium	0.9	U
Cobalt	0.8	U
Copper	1.2	U
Cyanide	3.1	U
Iron	3	U
Lead	1.8	U
Manganese	1.2	U
Mercury	0.1	U
Nickel	1.3	U
Selenium	4.8	U
Silver	0.7	U

PARAMETER	RESULT	QUAL
Thallium	12	
Vanadium	0.7	U
Zinc	2.8	U
Pesticides/PCBs		
2,4,5-T	0.2	U
2,4,5-TP (silvex)	0.1	U
2,4-D	0.2	U
4,4'-DDD	0.04	U
4,4'-DDE	0.04	U
4,4'-DDT	0.04	U
Aldrin	0.02	U
alpha-BHC	0.02	U
Aroclor-1016	0.12	U
Aroclor-1221	0.12	U
Aroclor-1232	0.12	U
Aroclor-1242	0.12	U
Aroclor-1248	0.12	U
Aroclor-1254	0.12	U
Aroclor-1260	0.12	U
beta-BHC	0.02	U
Chlordane	0.25	U
Chlorobenzilate	50	U
delta-BHC	0.02	U
Dieldrin	0.04	U
Dimethoate	50	U
Dinoseb	10	U
Disulfoton	10	U
Endosulfan I	0.02	U
Endosulfan II	0.04	U
Endosulfan sulfate	0.04	U
Endrin	0.04	U
Endrin aldehyde	0.04	U
Famphur	10	U
gamma-BHC (lindane)	0.02	U
Heptachlor	0.02	U
Heptachlor epoxide	0.02	U
Isodrin	10	U
Kepone	10	U
Methoxychlor	0.2	U
Methyl parathion	0.05	U
Parathion	0.05	U
Phorate	0.05	U
Sulfotep	10	U
Thionazin	10	U
Toxaphene	1	U
Semivolatile Organic Compounds		
1,2,4,5-tetrachlorobenzene	10	U
1,2,4-trichlorobenzene	10	U
1,2-dichlorobenzene	10	U
1,3,5-trinitrobenzene	50	U

PARAMETER	RESULT	QUAL
1,3-dichlorobenzene	10	U
1,3-dinitrobenzene	10	U
1,4-dichlorobenzene	10	U
1,4-dioxane	10	U
1,4-naphthoquinone	10	U
1-naphthylamine	10	U
2,3,4,6-tetrachlorophenol	10	U
2,4,5-trichlorophenol	10	U
2,4,6-trichlorophenol	10	U
2,4-dichlorophenol	10	U
2,4-dimethylphenol	10	U
2,4-dinitrophenol	20	U
2,4-dinitrotoluene	10	U
2,6-dichlorophenol	10	U
2,6-dinitrotoluene	10	U
2-acetylaminofluorene	10	U
2-chloronaphthalene	10	U
2-chlorophenol	10	U
2-methyl-4,6-dinitrophenol	10	U
2-methylnaphthalene	10	U
2-methylphenol	10	U
2-naphthylamine	10	U
2-nitroaniline	10	U
2-nitrophenol	10	U
2-picoline	10	U
3 & 4-methylphenol	10	U
3,3'-dichlorobenzidine	50	U
3,3'-dimethylbenzidine	50	UR
3-methylcholanthrene	10	U
3-nitroaniline	10	U
4-aminobiphenyl	10	U
4-bromophenyl phenyl ether	10	U
4-chloro-3-methylphenol	10	U
4-chloroaniline	10	U
4-chlorophenyl phenyl ether	10	U
4-nitroaniline	10	U
4-nitrophenol	10	U
4-nitroquinoline-1-oxide	10	UR
5-nitro-o-toluidine	10	U
7,12-dimethylbenz(a)anthracene	10	U
a,a-dimethylphenethylamine	10	U
Acenaphthene	10	U
Acenaphthylene	10	U
Acetophenone	10	U
Aniline	10	U
Anthracene	10	U
Aramite	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U

PARAMETER	RESULT	QUAL
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Benzyl alcohol	10	U
Bis(2-chloroethoxy)methane	10	U
Bis(2-chloroethyl)ether	10	U
Bis(2-ethylhexyl)phthalate	10	U
Butyl benzyl phthalate	10	U
Chrysene	10	U
Di-n-butyl phthalate	10	U
Di-n-octyl phthalate	10	U
Diallate	10	U
Dibenzo(a,h)anthracene	10	U
Dibenzofuran	10	U
Diethyl phthalate	10	U
Dimethyl phthalate	10	U
Diphenylamine	10	U
Ethyl methacrylate	10	U
Ethyl methanesulfonate	10	U
Fluoranthene	10	U
Fluorene	10	U
Hexachlorobenzene	10	U
Hexachlorobutadiene	10	U
Hexachlorocyclopentadiene	10	U
Hexachloroethane	10	U
Hexachloropropene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Isophorone	10	U
Isosafrole	10	U
Methapyrilene	50	U
Methyl methanesulfonate	10	U
N-nitroso-di-n-butylamine	10	U
N-nitroso-di-n-propylamine	10	U
N-nitrosodiethylamine	10	U
N-nitrosodimethylamine	10	U
N-nitrosodiphenylamine	10	U
N-nitrosomethylethylamine	10	U
N-nitrosomorpholine	10	U
N-nitrosopiperidine	10	U
N-nitrosopyrrolidine	10	U
Naphthalene	10	U
Nitrobenzene	10	U
o,o,o-triethylphosphorothioate	10	U
o-toluidine	10	U
p-dimethylaminoazobenzene	10	U
p-phenylenediamine	20	U
Pentachlorobenzene	10	U
Pentachloroethane	10	U
Pentachloronitrobenzene	10	U
Pentachlorophenol	10	U
Phenacetin	10	U

BRAC Background Samples
Surface-Water Data Set

PARAMETER	RESULT	QUAL
Phenanthrene	10	U
Phenol	10	U
Pronamide	10	U
Pyrene	10	U
Pyridine	10	U
Safrole	10	U
Volatile Organic Compounds		
1,1,1,2-tetrachloroethane	2	U
1,1,1-trichloroethane	2	U
1,1,2,2-tetrachloroethane	2	U
1,1,2-trichloroethane	2	U
1,1-dichloroethane	2	U
1,1-dichloroethene	2	U
1,2,3-trichloropropane	2	U
1,2-dibromo-3-chloropropane	2	U
1,2-dibromoethane	2	U
1,2-dichloroethane	2	U
1,2-dichloropropane	2	U
2-butanone	5	U
2-chloro-1,3-butadiene	2	U
2-hexanone	5	U
3-chloropropene	10	U
4-methyl-2-pentanone	5	U
Acetone	2	U
Acetonitrile	10	U
Acrolein	20	UR
Acrylonitrile	20	U
Benzene	2	U
Bis(2-chloroisopropyl)ether	20	U
Bromodichloromethane	2	U
Bromoform	2	U
Bromomethane	2	U
Carbon disulfide	5	U
Carbon tetrachloride	2	U
Chlorobenzene	2	U
Chloroethane	2	U
Chloroform	2	U
Chloromethane	2	U
Cis-1,3-dichloropropene	2	U
Dibromochloromethane	2	U
Dibromomethane	2	U
Dichlorodifluoromethane	2	U
Ethyl cyanide	20	UR
Ethylbenzene	2	U
Iodomethane	5	U
Isobutanol	20	U
Methacrylonitrile	10	U
Methyl methacrylate	10	U
Methylene chloride	2	U
Styrene	2	U

PARAMETER	RESULT	QUAL
Tetrachloroethene	2	U
Toluene	2	U
Trans-1,2-dichloroethene	2	U
Trans-1,3-dichloropropene	2	U
Trans-1,4-dichloro-2-butene	10	U
Trichloroethene	2	U
Trichlorofluoromethane	2	U
Vinyl acetate	5	U
Vinyl chloride	2	U
Xylenes, total	6	U

BG 3

BG3SW-01	BG3SW-01	B&RE
Inorganics		
Aluminum	11.1	U
Antimony	7.3	
Arsenic	4.9	U
Barium	5.8	
Beryllium	0.3	U
Cadmium	0.4	U
Chromium	0.9	U
Cobalt	0.8	U
Copper	1.2	U
Cyanide	0.97	U
Iron	3	U
Lead	3.9	U
Manganese	1.2	U
Mercury	0.1	U
Nickel	1.3	U
Selenium	4.8	U
Silver	0.7	U
Thallium	7.4	
Vanadium	0.7	U
Zinc	2.8	U
Pesticides/PCBs		
2,4,5-T	0.2	U
2,4,5-TP (silvex)	0.098	U
2,4-D	0.2	U
4,4'-DDD	0.04	U
4,4'-DDE	0.04	U
4,4'-DDT	0.04	U
Aldrin	0.02	U
alpha-BHC	0.02	U
Aroclor-1016	0.12	U
Aroclor-1221	0.12	U
Aroclor-1232	0.12	U
Aroclor-1242	0.12	U
Aroclor-1248	0.12	U
Aroclor-1254	0.12	U
Aroclor-1260	0.12	U
beta-BHC	0.02	U

PARAMETER	RESULT	QUAL
Chlordane	0.25	U
Chlorobenzilate	50	U
delta-BHC	0.02	U
Dieldrin	0.04	U
Dimethoate	50	U
Dinoseb	10	U
Disulfoton	10	U
Endosulfan I	0.02	U
Endosulfan II	0.04	U
Endosulfan sulfate	0.04	U
Endrin	0.04	U
Endrin aldehyde	0.04	U
Famphur	10	U
gamma-BHC (lindane)	0.02	U
Heptachlor	0.02	U
Heptachlor epoxide	0.02	U
Isodrin	10	U
Kepone	10	U
Methoxychlor	0.2	U
Methyl parathion	0.05	U
Parathion	0.05	U
Phorate	0.05	U
Sulfotep	10	U
Thionazin	10	U
Toxaphene	1	U
Semivolatile Organic Compounds		
1,2,4,5-tetrachlorobenzene	10	U
1,2,4-trichlorobenzene	10	U
1,2-dichlorobenzene	10	U
1,3,5-trinitrobenzene	50	U
1,3-dichlorobenzene	10	U
1,3-dinitrobenzene	10	U
1,4-dichlorobenzene	10	U
1,4-dioxane	10	U
1,4-naphthoquinone	10	U
1-naphthylamine	10	U
2,3,4,6-tetrachlorophenol	10	U
2,4,5-trichlorophenol	10	U
2,4,6-trichlorophenol	10	U
2,4-dichlorophenol	10	U
2,4-dimethylphenol	10	U
2,4-dinitrophenol	20	U
2,4-dinitrotoluene	10	U
2,6-dichlorophenol	10	U
2,6-dinitrotoluene	10	U
2-acetylaminofluorene	10	U
2-chloronaphthalene	10	U
2-chlorophenol	10	U
2-methyl-4,6-dinitrophenol	10	U
2-methylnaphthalene	10	U

PARAMETER	RESULT	QUAL
2-methylphenol	10	U
2-naphthylamine	10	U
2-nitroaniline	10	U
2-nitrophenol	10	U
2-picoline	10	U
3 & 4-methylphenol	10	U
3,3'-dichlorobenzidine	50	U
3,3'-dimethylbenzidine	50	UR
3-methylcholanthrene	10	U
3-nitroaniline	10	U
4-aminobiphenyl	10	U
4-bromophenyl phenyl ether	10	U
4-chloro-3-methylphenol	10	U
4-chloroaniline	10	U
4-chlorophenyl phenyl ether	10	U
4-nitroaniline	10	U
4-nitrophenol	10	U
4-nitroquinoline-1-oxide	10	UR
5-nitro-o-toluidine	10	U
7,12-dimethylbenz(a)anthracene	10	U
a,a-dimethylphenethylamine	10	U
Acenaphthene	10	U
Acenaphthylene	10	U
Acetophenone	10	U
Aniline	10	U
Anthracene	10	U
Aramite	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Benzyl alcohol	10	U
Bis(2-chloroethoxy)methane	10	U
Bis(2-chloroethyl)ether	10	U
Bis(2-ethylhexyl)phthalate	10	U
Butyl benzyl phthalate	10	U
Chrysene	10	U
Di-n-butyl phthalate	10	U
Di-n-octyl phthalate	10	U
Diallate	10	U
Dibenzo(a,h)anthracene	10	U
Dibenzofuran	10	U
Diethyl phthalate	10	U
Dimethyl phthalate	10	U
Diphenylamine	10	U
Ethyl methacrylate	10	U
Ethyl methanesulfonate	10	U
Fluoranthene	10	U
Fluorene	10	U

BRAC Backgro l Samples
Surface-Water Data Set

PARAMETER	RESULT	QUAL
Hexachlorobenzene	10	U
Hexachlorobutadiene	10	U
Hexachlorocyclopentadiene	10	U
Hexachloroethane	10	U
Hexachloropropene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Isophorone	10	U
Isosafrole	10	U
Methapyrilene	50	U
Methyl methanesulfonate	10	U
N-nitroso-di-n-butylamine	10	U
N-nitroso-di-n-propylamine	10	U
N-nitrosodiethylamine	10	U
N-nitrosodimethylamine	10	U
N-nitrosodiphenylamine	10	U
N-nitrosomethylethylamine	10	U
N-nitrosomorpholine	10	U
N-nitrosopiperidine	10	U
N-nitrosopyrrolidine	10	U
Naphthalene	10	U
Nitrobenzene	10	U
o,o,o-triethylphosphorothioate	10	U
o-toluidine	10	U
p-dimethylaminoazobenzene	10	U
p-phenylenediamine	20	U
Pentachlorobenzene	10	U
Pentachloroethane	10	U
Pentachloronitrobenzene	10	U
Pentachlorophenol	10	U
Phenacetin	10	U
Phenanthrene	10	U
Phenol	10	U
Pronamide	10	U
Pyrene	10	U
Pyridine	10	U
Safrole	10	U
Volatile Organic Compounds		
1,1,1,2-tetrachloroethane	2	U
1,1,1-trichloroethane	2	U
1,1,2,2-tetrachloroethane	2	U
1,1,2-trichloroethane	2	U
1,1-dichloroethane	2	U
1,1-dichloroethene	2	U
1,2,3-trichloropropane	2	U
1,2-dibromo-3-chloropropane	2	U
1,2-dibromoethane	2	U
1,2-dichloroethane	2	U
1,2-dichloropropane	2	U
2-butanone	5	U
2-chloro-1,3-butadiene	2	U

PARAMETER	RESULT	QUAL
2-hexanone	5	U
3-chloropropene	10	U
4-methyl-2-pentanone	5	U
Acetone	2	U
Acetonitrile	10	U
Acrolein	20	UR
Acrylonitrile	20	U
Benzene	2	U
Bis(2-chloroisopropyl)ether	20	U
Bromodichloromethane	2	U
Bromoform	2	U
Bromomethane	2	U
Carbon disulfide	5	U
Carbon tetrachloride	2	U
Chlorobenzene	2	U
Chloroethane	2	U
Chloroform	2	U
Chloromethane	2	U
Cis-1,3-dichloropropene	2	U
Dibromochloromethane	2	U
Dibromomethane	2	U
Dichlorodifluoromethane	2	U
Ethyl cyanide	20	UR
Ethylbenzene	2	U
Iodomethane	5	U
Isobutanol	20	U
Methacrylonitrile	10	U
Methyl methacrylate	10	U
Methylene chloride	2	U
Styrene	2	U
Tetrachloroethene	2	U
Toluene	2	U
Trans-1,2-dichloroethene	2	U
Trans-1,3-dichloropropene	2	U
Trans-1,4-dichloro-2-butene	10	U
Trichloroethene	2	U
Trichlorofluoromethane	2	U
Vinyl acetate	5	U
Vinyl chloride	2	U
Xylenes, total	6	U

BG 4

B4SW	B4SW	B&RE
Inorganics		
Aluminum	28	U
Antimony	4	UJ
Arsenic	6.1	U
Barium	6.6	J
Beryllium	0.2	U
Cadmium	0.4	UJ
Chromium	2	U

PARAMETER	RESULT	QUAL
Cobalt	2	U
Copper	4	UJ
Cyanide	1.5	UR
Iron	4	U
Lead	3.2	U
Manganese	2	UJ
Mercury	0.36	
Nickel	4	U
Selenium	4	U
Silver	2	U
Thallium	4	UJ
Vanadium	2	U
Zinc	2	UJ
Pesticides/PCBs		
2,4,5-T	0.097	U
2,4,5-TP (silvex)	0.097	U
2,4-D	0.097	U
4,4'-DDD	0.04	U
4,4'-DDE	0.04	U
4,4'-DDT	0.04	U
Aldrin	0.02	U
alpha-BHC	0.02	U
Aroclor-1016	0.12	U
Aroclor-1221	0.12	U
Aroclor-1232	0.12	U
Aroclor-1242	0.12	U
Aroclor-1248	0.12	U
Aroclor-1254	0.12	U
Aroclor-1260	0.12	U
beta-BHC	0.02	U
Chlordane	0.25	U
delta-BHC	0.02	U
Dieldrin	0.04	U
Endosulfan I	0.02	U
Endosulfan II	0.04	U
Endosulfan sulfate	0.04	U
Endrin	0.04	U
Endrin aldehyde	0.04	U
gamma-BHC (lindane)	0.02	U
Heptachlor	0.02	U
Heptachlor epoxide	0.02	U
Methoxychlor	0.2	U
Methyl parathion	0.05	U
~~Parathion~~	~~0.05~~	~~U~~
Phorate	0.05	U
Toxaphene	1	U
Semivolatile Organic Compounds		
1,2-dichlorobenzene	2	U
1,3-dichlorobenzene	2	U
1,4-dichlorobenzene	2	U

PARAMETER	RESULT	QUAL
1-methylnaphthalene	10	U
2-methylnaphthalene	10	U
Acenaphthene	10	U
Acenaphthylene	10	U
Anthracene	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Chrysene	10	U
Dibenzo(a,h)anthracene	10	U
Fluoranthene	10	U
Fluorene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Naphthalene	10	U
Phenanthrene	10	U
Pyrene	10	U
Volatile Organic Compounds		
Benzene	2	U
Chlorobenzene	2	U
Ethylbenzene	2	U
Toluene	2	U
Xylenes, total	6	U

BG 5

B5SW	B5SW	B&RE
Inorganics		
Aluminum	28	U
Antimony	4	UJ
Arsenic	4	U
Barium	6.5	J
Beryllium	0.2	U
Cadmium	0.4	UJ
Chromium	2	U
Cobalt	2	U
Copper	4	UJ
Cyanide	1.4	UR
Iron	4	U
Lead	5.1	U
Manganese	2	UJ
Mercury	0.41	
Nickel	4	U
Selenium	4	U
Silver	2	U
Thallium	4	UJ
Vanadium	2	U
Zinc	2	UJ
Pesticides/PCBs		
2,4,5-T	0.096	U
2,4,5-TP (silvex)	0.096	U

BRAC Background Samples
Surface-Water Data Set

PARAMETER	RESULT	QUAL
2,4-D	0.096	U
4,4'-DDD	0.04	U
4,4'-DDE	0.04	U
4,4'-DDT	0.04	U
Aldrin	0.02	U
alpha-BHC	0.02	U
Aroclor-1016	0.12	U
Aroclor-1221	0.12	U
Aroclor-1232	0.12	U
Aroclor-1242	0.12	U
Aroclor-1248	0.12	U
Aroclor-1254	0.12	U
Aroclor-1260	0.12	U
beta-BHC	0.02	U
Chlordane	0.25	U
delta-BHC	0.02	U
Dieldrin	0.04	U
Endosulfan I	0.02	U
Endosulfan II	0.04	U
Endosulfan sulfate	0.04	U
Endrin	0.04	U
Endrin aldehyde	0.04	U
gamma-BHC (lindane)	0.02	U
Heptachlor	0.02	U
Heptachlor epoxide	0.02	U
Methoxychlor	0.2	U
Methyl parathion	0.05	U
Parathion	0.05	U
Phorate	0.05	U
Toxaphene	1	U
Semivolatile Organic Compounds		
1,2-dichlorobenzene	2	U
1,3-dichlorobenzene	2	U
1,4-dichlorobenzene	2	U
1-methylnaphthalene	10	U
2-methylnaphthalene	10	U
Acenaphthene	10	U
Acenaphthylene	10	U
Anthracene	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Chrysene	10	U
Dibenzo(a,h)anthracene	10	U
Fluoranthene	10	U
Fluorene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Naphthalene	10	U

PARAMETER	RESULT	QUAL
Phenanthrene	10	U
Pyrene	10	U
Volatile Organic Compounds		
Benzene	2	U
Chlorobenzene	2	U
Ethylbenzene	2	U
Toluene	2	U
Xylenes, total	6	U
BG 6		
B6SW	**B6SW**	**B&RE**
Inorganics		
Aluminum	28	U
Antimony	4	U
Arsenic	4	U
Barium	8.1	
Beryllium	0.2	U
Cadmium	0.4	U
Chromium	2	U
Cobalt	2	U
Copper	4	U
Cyanide	1.4	U
Iron	4	U
Lead	3	U
Manganese	2	U
Mercury	0.1	U
Nickel	4	U
Selenium	4	U
Silver	2	U
Thallium	4	U
Vanadium	2	U
Zinc	2	U
Pesticides/PCBs		
2,4,5-T	0.097	U
2,4,5-TP (silvex)	0.097	U
2,4-D	0.097	U
4,4'-DDD	0.047	U
4,4'-DDE	0.047	U
4,4'-DDT	0.047	U
Aldrin	0.024	U
alpha-BHC	0.024	U
Aroclor-1016	0.15	U
Aroclor-1221	0.15	U
Aroclor-1232	0.15	U
Aroclor-1242	0.15	U
Aroclor-1254	0.15	U
Aroclor-1260	0.15	U
beta-BHC	0.024	U
Chlordane	0.29	U
delta-BHC	0.024	U
Dieldrin	0.047	U

PARAMETER	RESULT	QUAL
Endosulfan I	0.024	U
Endosulfan II	0.047	U
Endosulfan sulfate	0.047	U
Endrin	0.047	U
Endrin aldehyde	0.047	U
gamma-BHC (lindane)	0.024	U
Heptachlor	0.024	U
Heptachlor epoxide	0.024	U
Methoxychlor	0.24	U
Methyl parathion	0.059	U
Parathion	0.059	U
Phorate	0.059	U
Toxaphene	1.2	U
Semivolatile Organic Compounds		
1,2-dichlorobenzene	2	U
1,3-dichlorobenzene	2	U
1,4-dichlorobenzene	2	U
Acenaphthene	10	U
Acenaphthylene	10	U
Anthracene	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Chrysene	10	U
Dibenzo(a,h)anthracene	10	U
Fluoranthene	10	U
Fluorene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Naphthalene	10	U
Phenanthrene	10	U
Pyrene	10	U
Volatile Organic Compounds		
Benzene	2	U
Chlorobenzene	2	U
Ethylbenzene	2	U
Toluene	2	U
Xylenes, total	6	U
BG 7		
B7SW-1	**B7SW-1**	**B&RE**
Inorganics		
Aluminum	28	U
Antimony	4	UJ
Arsenic	4	U
Barium	6.8	U
Beryllium	0.2	U
Cadmium	0.4	UJ
Chromium	2	U
Cobalt	2	U

PARAMETER	RESULT	QUAL
Copper	4	U
Cyanide	1.4	U
Iron	14.7	U
Lead	3	UJ
Manganese	2	UJ
Mercury	4.2	
Nickel	4	U
Selenium	4	UJ
Silver	2	U
Thallium	6.6	U
Vanadium	2	U
Zinc	2	UJ
Pesticides/PCBs		
2,4,5-T	0.097	U
2,4,5-TP (silvex)	0.097	U
2,4-D	0.097	U
4,4'-DDD	0.08	U
4,4'-DDE	0.08	U
4,4'-DDT	0.08	U
Aldrin	0.04	U
alpha-BHC	0.04	U
Aroclor-1016	0.25	U
Aroclor-1221	0.25	U
Aroclor-1232	0.25	U
Aroclor-1242	0.25	U
Aroclor-1248	0.25	U
Aroclor-1254	0.25	U
Aroclor-1260	0.25	U
beta-BHC	0.04	U
Chlordane	0.5	U
delta-BHC	0.04	U
Dieldrin	0.08	U
Endosulfan I	0.04	U
Endosulfan II	0.08	U
Endosulfan sulfate	0.08	U
Endrin	0.08	U
Endrin aldehyde	0.08	U
gamma-BHC (lindane)	0.04	U
Heptachlor	0.04	U
Heptachlor epoxide	0.04	U
Methoxychlor	0.4	U
Methyl parathion	0.1	U
Parathion	0.1	U
Phorate	0.1	U
Toxaphene	2	U
Semivolatile Organic Compounds		
1,2-dichlorobenzene	2	U
1,3-dichlorobenzene	2	U
1,4-dichlorobenzene	2	U
Acenaphthene	10	U

BRAC Backgro[illegible]d Samples
Surface-Water Data Set

PARAMETER	RESULT	QUAL
Acenaphthylene	10	U
Anthracene	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Chrysene	10	U
Dibenzo(a,h)anthracene	10	U
Fluoranthene	10	U
Fluorene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Naphthalene	10	U
Phenanthrene	10	U
Pyrene	10	U
Volatile Organic Compounds		
Benzene	2	U
Chlorobenzene	2	U
Ethylbenzene	2	U
Toluene	2	U
Xylenes, total	6	U

SWMU 1

S1SS-7SW	KW02568	BEI(d)
Inorganics		
Aluminum	148	
Antimony	2.4	U
Arsenic	2.6	
Barium	7.4	
Beryllium	0.17	
Cadmium	0.2	U
Chromium	1.3	U
Cobalt	0.8	U
Copper	2	
Cyanide	10	U
Iron	170	
Lead	1.7	U
Manganese	12.3	
Mercury	0.08	U
Nickel	1.6	U
Selenium	3	U
Silver	1.5	U
Thallium	3.5	U
Tin	5	U
Vanadium	2.8	
Zinc	12.8	
Pesticides/PCBs		
4,4'-DDD	0.1	U
4,4'-DDE	0.1	U
4,4'-DDT	0.1	U
Aldrin	0.051	U

PARAMETER	RESULT	QUAL
alpha-BHC	0.051	U
Aroclor-1016	0.51	U
Aroclor-1221	0.51	U
Aroclor-1232	0.51	U
Aroclor-1242	0.51	U
Aroclor-1248	0.51	U
Aroclor-1254	0.51	U
Aroclor-1260	0.51	U
beta-BHC	0.051	U
Chlordane	0.51	U
Chlorobenzilate	10	U
delta-BHC	0.051	U
Dieldrin	0.1	U
Endosulfan I	0.051	U
Endosulfan II	0.1	U
Endosulfan sulfate	0.1	U
Endrin	0.1	U
Endrin aldehyde	0.1	U
Endrin ketone	0.1	U
gamma-BHC (lindane)	0.051	U
Heptachlor	0.051	U
Heptachlor epoxide	0.051	U
Isodrin	10	U
Kepone	20	U
Methoxychlor	0.51	U
Toxaphene	5.1	U
Semivolatile Organic Compounds		
1,2,4,5-tetrachlorobenzene	10	U
1,2,4-trichlorobenzene	10	U
1,2-dichlorobenzene	10	U
1,3,5-trinitrobenzene	10	U
1,3-dichlorobenzene	10	U
1,3-dinitrobenzene	10	U
1,4-dichlorobenzene	10	U
1,4-naphthoquinone	10	U
1-naphthylamine	10	U
2,3,4,6-tetrachlorophenol	20	U
2,4,5-trichlorophenol	50	U
2,4,6-trichlorophenol	10	U
2,4-dichlorophenol	10	U
2,4-dimethylphenol	10	U
2,4-dinitrophenol	50	U
2,4-dinitrotoluene	10	U
2,6-dichlorophenol	10	U
2,6-dinitrotoluene	10	U
2-acetylaminofluorene	20	U
2-chloronaphthalene	10	U
2-chlorophenol	10	U
2-methyl-4,6-dinitrophenol	50	U
2-methylnaphthalene	10	U

PARAMETER	RESULT	QUAL
2-methylphenol	10	U
2-naphthylamine	10	U
2-nitroaniline	50	U
2-nitrophenol	10	U
2-picoline	10	U
3 & 4-methylphenol	10	U
3,3'-dichlorobenzidine	20	U
3-methylcholanthrene	10	U
3-nitroaniline	50	U
4-aminobiphenyl	10	U
4-bromophenyl phenyl ether	10	U
4-chloro-3-methylphenol	20	U
4-chloroaniline	20	U
4-chlorophenyl phenyl ether	10	U
4-nitroaniline	50	U
4-nitrophenol	50	U
4-nitroquinoline-1-oxide	10	U
5-nitro-o-toluidine	10	U
7,12-dimethylbenz(a)anthracene	10	U
a,a-dimethylphenethylamine	20	U
Acenaphthene	10	U
Acenaphthylene	10	U
Acetophenone	10	U
Aniline	10	U
Anthracene	10	U
Aramite	20	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Benzyl alcohol	20	U
Bis(2-chloroethoxy)methane	10	U
Bis(2-chloroethyl)ether	10	U
Bis(2-ethylhexyl)phthalate	10	U
Butyl benzyl phthalate	10	U
Carbazole	10	U
Chrysene	10	U
Di-n-butyl phthalate	2	J
Di-n-octyl phthalate	10	U
Diallate	20	U
Dibenzo(a,h)anthracene	10	U
Dibenzofuran	10	U
Diethyl phthalate	10	U
Dimethyl phthalate	10	U
Diphenylamine	10	U
Ethyl methacrylate	10	U
Ethyl methanesulfonate	10	U
Fluoranthene	10	U
Fluorene	10	U

PARAMETER	RESULT	QUAL
Hexachlorobenzene	10	U
Hexachlorobutadiene	10	U
Hexachlorocyclopentadiene	10	U
Hexachloroethane	10	U
Hexachloropropene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Isophorone	10	U
Isosafrole	10	U
Methapyrilene	10	U
Methyl methanesulfonate	10	U
N-nitroso-di-n-butylamine	10	U
N-nitroso-di-n-propylamine	10	U
N-nitrosodiethylamine	10	U
N-nitrosodimethylamine	10	U
N-nitrosomethylethylamine	10	U
N-nitrosomorpholine	10	U
N-nitrosopiperidine	10	U
N-nitrosopyrrolidine	10	U
Naphthalene	10	U
Nitrobenzene	10	U
o,o,o-triethylphosphorothioate	10	U
o-toluidine	10	U
p-dimethylaminoazobenzene	10	U
p-phenylenediamine	65	U
Pentachlorobenzene	10	U
Pentachloroethane	10	U
Pentachloronitrobenzene	20	U
Pentachlorophenol	50	U
Phenacetin	10	U
Phenanthrene	10	U
Phenol	10	U
Pronamide	20	U
Pyrene	10	U
Pyridine	10	U
Safrole	10	U
Volatile Organic Compounds		
1,1,1,2-tetrachloroethane	5	U
1,1,1-trichloroethane	5	U
1,1,2,2-tetrachloroethane	5	U
1,1,2-trichloroethane	5	U
1,1-dichloroethane	5	U
1,1-dichloroethene	5	U
1,2,3-trichloropropane	5	U
1,2-dibromo-3-chloropropane	5	U
1,2-dibromoethane	5	U
1,2-dichloroethane	5	U
1,2-dichloroethene	5	U
1,2-dichloropropane	5	U
2-butanone	10	U
2-chloro-1,3-butadiene	5	U

BRAC Background Samples
Surface-Water Data Set

PARAMETER	RESULT	QUAL
2-hexanone	10	U
3-chloropropene	5	U
4-methyl-2-pentanone	10	U
Acetone	12	
Acrolein	20	U
Acrylonitrile	10	U
Benzene	5	U
Bis(2-chloroisopropyl)ether	10	U
Bromodichloromethane	5	U
Bromoform	5	U
Bromomethane	10	U
Carbon disulfide	5	U
Carbon tetrachloride	5	U
Chlorobenzene	5	U
Chloroethane	10	U
Chloroform	5	U
Chloromethane	10	U
Cis-1,2-dichloroethene	5	U
Cis-1,3-dichloropropene	5	U
Dibromochloromethane	5	U
Dibromomethane	5	U
Dichlorodifluoromethane	5	U
Ethyl cyanide	5	U
Ethylbenzene	5	U
Iodomethane	5	U
Methacrylonitrile	5	U
Methyl methacrylate	5	U
Methylene chloride	5	U
Styrene	5	U
Tetrachloroethene	5	U
Toluene	5	U
Trans-1,2-dichloroethene	5	U
Trans-1,3-dichloropropene	5	U
Trans-1,4-dichloro-2-butene	5	U
Trichloroethene	5	U
Trichlorofluoromethane	5	U
Vinyl acetate	5	U
Vinyl chloride	10	U
Xylenes, total	5	U

SWMU 2

S2SS-4SW	KW02590	BEI(d)

PARAMETER	RESULT	QUAL
Inorganics		
Aluminum	25	
Antimony	2.4	U
Arsenic	4.1	
Barium	9.9	
Beryllium	0.26	
Cadmium	0.2	U
Chromium	1.3	U
Cobalt	0.8	U
Copper	1.1	U
Cyanide	5	U
Iron	61.6	
Lead	1.7	U
Manganese	3.2	
Mercury	0.08	U
Nickel	1.6	U
Selenium	3	U
Silver	1.5	U
Thallium	3.5	U
Tin	5	U
Vanadium	2	
Zinc	1.4	
Pesticides/PCBs		
4,4'-DDD	0.11	U
4,4'-DDE	0.11	U
4,4'-DDT	0.11	U
Aldrin	0.056	U
alpha-BHC	0.056	U
Aroclor-1016	0.56	U
Aroclor-1221	0.56	U
Aroclor-1232	0.56	U
Aroclor-1242	0.56	U
Aroclor-1248	0.56	U
Aroclor-1254	0.56	U
Aroclor-1260	0.56	U
beta-BHC	0.056	U
Chlordane	0.56	U
delta-BHC	0.056	U
Dieldrin	0.11	U
Endosulfan I	0.056	U
Endosulfan II	0.11	U
Endosulfan sulfate	0.11	U
Endrin	0.11	U
Endrin aldehyde	0.11	U
Endrin ketone	0.11	U
gamma-BHC (lindane)	0.056	U
Heptachlor	0.056	U
Heptachlor epoxide	0.056	U
Methoxychlor	0.56	U
Toxaphene	5.6	U
Volatile Organic Compounds		
1,1,1,2-tetrachloroethane	5	U
1,1,1-trichloroethane	5	U
1,1,2,2-tetrachloroethane	5	U
1,1,2-trichloroethane	5	U
1,1-dichloroethane	5	U
1,1-dichloroethene	5	U
1,2,3-trichloropropane	5	U
1,2-dibromo-3-chloropropane	5	U
1,2-dibromoethane	5	U
1,2-dichloroethane	5	U
1,2-dichloroethene	5	U
1,2-dichloropropane	5	U
2-butanone	10	U
2-chloro-1,3-butadiene	5	U
2-hexanone	10	U
3-chloropropene	5	U
4-methyl-2-pentanone	10	U
Acetone	10	U
Acrolein	20	U
Acrylonitrile	10	U
Benzene	5	U
Bromodichloromethane	5	U
Bromoform	5	U
Bromomethane	10	U
Carbon disulfide	5	U
Carbon tetrachloride	5	U
Chlorobenzene	5	U
Chloroethane	10	U
Chloroform	5	U
Chloromethane	10	U
Cis-1,2-dichloroethene	5	U
Cis-1,3-dichloropropene	5	U
Dibromochloromethane	5	U
Dibromomethane	5	U
Dichlorodifluoromethane	5	U
Ethyl cyanide	5	U
Ethylbenzene	5	U
Iodomethane	5	U
Methacrylonitrile	5	U
Methyl methacrylate	5	U
Methylene chloride	5	U
Styrene	5	U
Tetrachloroethene	5	U
Toluene	5	U
Trans-1,2-dichloroethene	5	U
Trans-1,3-dichloropropene	5	U
Trans-1,4-dichloro-2-butene	5	U
Trichloroethene	5	U
Trichlorofluoromethane	5	U
Vinyl acetate	5	U
Vinyl chloride	10	U
Xylenes, total	5	U

SWMU 4

S4SW-1	S4SW-1	B&RE

PARAMETER	RESULT	QUAL
Inorganics		
Aluminum	28	U
Antimony	4	UJ
Arsenic	4	U
Barium	3.4	U
Beryllium	0.2	U
Cadmium	0.4	UJ
Chromium	2	U
Cobalt	2	U
Copper	4	UJ
Cyanide	1.4	UR
Iron	8.5	
Lead	3.5	U
Manganese	2	UJ
Mercury	0.6	
Nickel	4	U
Selenium	4	U
Silver	2	U
Thallium	4	UJ
Vanadium	2	U
Zinc	2	UJ
Pesticides/PCBs		
Chlorobenzilate	50	U
Dimethoate	50	U
Disulfoton	10	U
Famphur	10	U
Isodrin	10	U
Kepone	10	U
Sulfotep	10	U
Thionazin	10	U
Semivolatile Organic Compounds		
1,2,4,5-tetrachlorobenzene	10	U
1,2,4-trichlorobenzene	10	U
1,2-dichlorobenzene	10	U
1,3,5-trinitrobenzene	50	U
1,3-dichlorobenzene	10	U
1,3-dinitrobenzene	10	U
1,4-dichlorobenzene	10	U
1,4-dioxane	10	U
1,4-naphthoquinone	10	U
1-naphthylamine	10	U
2,3,4,6-tetrachlorophenol	10	U
2,4,5-trichlorophenol	10	U
2,4,6-trichlorophenol	10	U
2,4-dichlorophenol	10	U
2,4-dimethylphenol	10	U
2,4-dinitrophenol	20	U
2,4-dinitrotoluene	10	U
2,6-dichlorophenol	10	U
2,6-dinitrotoluene	10	U
2-acetylaminofluorene	10	U
2-chloronaphthalene	10	U
2-chlorophenol	10	U
2-methyl-4,6-dinitrophenol	10	U

BRAC Backgro d Samples
Surface-Water Data Set

PARAMETER	RESULT	QUAL
2-methylnaphthalene	10	U
2-methylphenol	10	U
2-naphthylamine	10	U
2-nitroaniline	10	U
2-nitrophenol	10	U
2-picoline	10	U
3,3'-dichlorobenzidine	50	U
3,3'-dimethylbenzidine	50	U
3-methylcholanthrene	10	U
3-nitroaniline	10	U
4-aminobiphenyl	10	U
4-bromophenyl phenyl ether	10	U
4-chloro-3-methylphenol	10	U
4-chloroaniline	10	U
4-chlorophenyl phenyl ether	10	U
4-methylphenol	10	U
4-nitroaniline	10	U
4-nitrophenol	20	U
4-nitroquinoline-1-oxide	10	U
5-nitro-o-toluidine	10	U
7,12-dimethylbenz(a)anthracene	10	U
a,a-dimethylphenethylamine	10	U
Acenaphthene	10	U
Acenaphthylene	10	U
Acetophenone	10	U
Aniline	10	U
Anthracene	10	U
Aramite	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Benzyl alcohol	10	U
Bis(2-chloroethoxy)methane	10	U
Bis(2-chloroethyl)ether	10	U
Bis(2-ethylhexyl)phthalate	10	U
Butyl benzyl phthalate	10	U
Chrysene	10	U
Di-n-butyl phthalate	10	U
Di-n-octyl phthalate	10	U
Diallate	10	U
Dibenzo(a,h)anthracene	10	U
Dibenzofuran	10	U
Diethyl phthalate	10	U
Dimethyl phthalate	10	U
Diphenylamine	10	U
Ethyl methacrylate	10	U
Ethyl methanesulfonate	10	U
Fluoranthene	10	U

PARAMETER	RESULT	QUAL
Fluorene	10	U
Hexachlorobenzene	10	U
Hexachlorobutadiene	10	U
Hexachlorocyclopentadiene	10	U
Hexachloroethane	10	U
Hexachloropropene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Isophorone	10	U
Isosafrole	10	U
Methapyrilene	50	U
Methyl methanesulfonate	10	U
N-nitroso-di-n-butylamine	10	U
N-nitroso-di-n-propylamine	10	U
N-nitrosodiethylamine	10	U
N-nitrosodimethylamine	10	U
N-nitrosodiphenylamine	10	U
N-nitrosomethylethylamine	10	U
N-nitrosomorpholine	10	U
N-nitrosopiperidine	10	U
N-nitrosopyrrolidine	10	U
Naphthalene	10	U
Nitrobenzene	10	U
o,o,o-triethylphosphorothioate	10	U
o-toluidine	10	U
p-dimethylaminoazobenzene	10	U
p-phenylenediamine	20	U
Pentachlorobenzene	10	U
Pentachloroethane	10	U
Pentachloronitrobenzene	10	U
Pentachlorophenol	10	U
Phenacetin	10	U
Phenanthrene	10	U
Phenol	10	U
Pronamide	10	U
Pyrene	10	U
Pyridine	10	U
Safrole	10	U
Volatile Organic Compounds		
1,1,1,2-tetrachloroethane	2	U
1,1,1-trichloroethane	2	U
1,1,2,2-tetrachloroethane	2	U
1,1,2-trichloroethane	2	U
1,1-dichloroethane	2	U
1,1-dichloroethene	2	U
1,2,3-trichloropropane	2	U
1,2-dibromo-3-chloropropane	2	U
1,2-dibromoethane	2	U
1,2-dichloroethane	2	U
1,2-dichloropropane	2	U
2-butanone	5	U

PARAMETER	RESULT	QUAL
2-chloro-1,3-butadiene	2	U
2-hexanone	5	U
3-chloropropene	10	U
4-methyl-2-pentanone	5	U
Acetone	10	UJ
Acetonitrile	10	U
Acrolein	20	UR
Acrylonitrile	20	U
Benzene	2	U
Bis(2-chloroisopropyl)ether	10	U
Bromodichloromethane	2	U
Bromoform	2	U
Bromomethane	2	U
Carbon disulfide	5	U
Carbon tetrachloride	2	U
Chlorobenzene	2	U
Chloroethane	2	U
Chloroform	2	U
Chloromethane	2	U
Cis-1,3-dichloropropene	2	U
Dibromochloromethane	2	U
Dibromomethane	2	U
Dichlorodifluoromethane	2	UJ
Ethyl cyanide	20	U
Ethylbenzene	2	U
Iodomethane	5	U
Isobutanol	20	UR
Methacrylonitrile	10	UJ
Methyl methacrylate	10	U
Methylene chloride	5	U
Styrene	2	U
Tetrachloroethene	2	U
Toluene	2	U
Trans-1,2-dichloroethene	2	U
Trans-1,3-dichloropropene	2	U
Trans-1,4-dichloro-2-butene	10	U
Trichloroethene	2	U
Trichlorofluoromethane	2	U
Vinyl acetate	5	UJ
Vinyl chloride	2	U
Xylenes, total	4	U

PARAMETER	RESULT	QUAL

BRAC Backgro Samples
Groundwater Data Set

PARAMETER	RESULT	QUAL
IR 1		
I1MW-6 I1MW-6	**B&RE**	
Inorganics (µg/L)		
Aluminum	28	U
Antimony	4	U
Arsenic	4	U
Barium	9.9	U
Beryllium	0.2	U
Cadmium	0.4	U
Chromium	2	U
Cobalt	2	U
Copper	4	U
Cyanide	1.4	U
Iron	4	U
Lead	3	U
Manganese	3.2	
Mercury	0.1	U
Nickel	4	U
Selenium	4	U
Silver	2	U
Thallium	4	U
Vanadium	3.4	
Zinc	2	U
Pesticides/PCBs (µg/L)		
2,4,5-T	0.1	U
2,4,5-TP (silvex)	0.1	U
2,4-D	0.1	U
4,4'-DDD	0.04	U
4,4'-DDE	0.04	U
4,4'-DDT	0.04	U
Aldrin	0.02	U
alpha-BHC	0.02	U
Aroclor-1016	0.12	U
Aroclor-1221	0.12	U
Aroclor-1232	0.12	U
Aroclor-1242	0.12	U
Aroclor-1248	0.12	U
Aroclor-1254	0.12	U
Aroclor-1260	0.12	U
beta-BHC	0.02	U
Chlordane	0.25	U
delta-BHC	0.02	U
Dieldrin	0.04	U
Endosulfan I	0.02	U
Endosulfan II	0.04	U
Endosulfan sulfate	0.04	U
Endrin	0.04	U
Endrin aldehyde	0.04	U
gamma-BHC (lindane)	0.02	U
Heptachlor	0.02	U

PARAMETER	RESULT	QUAL
Heptachlor epoxide	0.02	U
Methoxychlor	0.2	U
Methyl parathion	0.05	U
Parathion	0.05	U
Phorate	0.05	U
Toxaphene	0.99	U
I1MW-7 I1DPGW-2	**B&RE**	
Inorganics (µg/L)		
Aluminum	28	U
Antimony	4	UJ
Arsenic	4	U
Barium	8.4	J
Beryllium	0.2	U
Cadmium	0.4	UJ
Chromium	2	U
Cobalt	2	U
Copper	4.3	J
Cyanide	1.4	UR
Iron	4	U
Lead	3	U
Manganese	4.5	J
Mercury	0.1	U
Nickel	4	U
Selenium	4.1	J
Silver	2	U
Thallium	4	UJ
Vanadium	3.7	J
Zinc	2	UJ
Pesticides/PCBs (µg/L)		
2,4,5-T	0.1	U
2,4,5-TP (silvex)	0.1	U
2,4-D	0.1	U
4,4'-DDD	0.04	U
4,4'-DDE	0.04	U
4,4'-DDT	0.04	U
Aldrin	0.02	U
alpha-BHC	0.02	U
Aroclor-1016	0.12	U
Aroclor-1221	0.12	U
Aroclor-1232	0.12	U
Aroclor-1242	0.12	U
Aroclor-1248	0.12	U
Aroclor-1254	0.12	U
Aroclor-1260	0.12	U
beta-BHC	0.02	U
Chlordane	0.25	U
delta-BHC	0.02	U
Dieldrin	0.04	U
Endosulfan I	0.02	U
Endosulfan II	0.04	U

PARAMETER	RESULT	QUAL
Endosulfan sulfate	0.04	U
Endrin	0.04	U
Endrin aldehyde	0.04	U
gamma-BHC (lindane)	0.02	U
Heptachlor	0.02	U
Heptachlor epoxide	0.02	U
Methoxychlor	0.2	U
Methyl parathion	0.05	U
Parathion	0.05	U
Phorate	0.05	U
Toxaphene	1	U
I1MW-7 I1MW-7	**B&RE**	
Inorganics (µg/L)		
Aluminum	28	U
Antimony	4	UJ
Arsenic	4	U
Barium	7	J
Beryllium	0.2	U
Cadmium	0.4	UJ
Chromium	2	U
Cobalt	2	U
Copper	4	UJ
Cyanide	1.4	UR
Iron	4	U
Lead	3.7	U
Manganese	4.1	J
Mercury	0.1	U
Nickel	4	U
Selenium	4	U
Silver	2	U
Thallium	4	UJ
Vanadium	4.1	J
Zinc	2	UJ
Pesticides/PCBs (µg/L)		
2,4,5-T	0.097	U
2,4,5-TP (silvex)	0.097	U
2,4-D	0.097	U
4,4'-DDD	0.04	U
4,4'-DDE	0.04	U
4,4'-DDT	0.04	U
Aldrin	0.02	U
alpha-BHC	0.02	U
Aroclor-1016	0.12	U
Aroclor-1221	0.12	U
Aroclor-1232	0.12	U
Aroclor-1242	0.12	U
Aroclor-1248	0.12	U
Aroclor-1254	0.12	U
Aroclor-1260	0.12	U
beta-BHC	0.02	U

PARAMETER	RESULT	QUAL
Chlordane	0.25	U
delta-BHC	0.02	U
Dieldrin	0.04	U
Endosulfan I	0.02	U
Endosulfan II	0.04	U
Endosulfan sulfate	0.04	U
Endrin	0.04	U
Endrin aldehyde	0.04	U
gamma-BHC (lindane)	0.02	U
Heptachlor	0.02	U
Heptachlor epoxide	0.02	U
Methoxychlor	0.2	U
Methyl parathion	0.05	U
Parathion	0.05	U
Phorate	0.05	U
Toxaphene	1	U
IR 3		
I3MW-6 I3MW-6	**B&RE**	
Inorganics (µg/L)		
Aluminum	28	U
Antimony	4	UJ
Arsenic	4	U
Barium	11.1	U
Beryllium	0.2	U
Cadmium	0.4	U
Chromium	2	U
Cobalt	2	U
Copper	4	U
Iron	141	U
Lead	3	U
Manganese	2	U
Mercury	0.1	U
Nickel	4	U
Selenium	4	UJ
Silver	2	U
Thallium	4	U
Vanadium	3.8	
Zinc	2	U
Pesticides/PCBs (µg/L)		
2,4,5-T	0.1	U
2,4,5-TP (silvex)	0.1	U
2,4-D	0.1	U
4,4'-DDD	0.08	U
4,4'-DDE	0.08	U
4,4'-DDT	0.08	U
Aldrin	0.04	U
alpha-BHC	0.04	U
Aroclor-1016	0.25	U
Aroclor-1221	0.25	U
Aroclor-1232	0.25	U

BRAC Backgro l Samples
Groundwater Data Set

PARAMETER	RESULT	QUAL
Aroclor-1242	0.25	U
Aroclor-1248	0.25	U
Aroclor-1254	0.25	U
Aroclor-1260	0.25	U
beta-BHC	0.04	U
Chlordane	0.5	U
delta-BHC	0.04	U
Dieldrin	0.08	U
Endosulfan I	0.04	U
Endosulfan II	0.08	U
Endosulfan sulfate	0.08	U
Endrin	0.08	U
Endrin aldehyde	0.08	U
gamma-BHC (lindane)	0.04	U
Heptachlor	0.04	U
Heptachlor epoxide	0.04	U
Methoxychlor	0.4	U
Methyl parathion	0.1	U
Parathion	0.1	U
Phorate	0.1	U
Toxaphene	2	U

SWMU 1

S1MW-3	S1DPGW-01	B&RE
Inorganics (µg/L)		
Aluminum	8.3	U
Antimony	2.6	U
Arsenic	11.7	
Barium	19.3	J
Beryllium	0.2	U
Cadmium	0.3	UJ
Chromium	0.6	U
Cobalt	0.6	U
Copper	0.9	U
Cyanide	4.7	U
Iron	77.6	J
Lead	1.3	UJ
Manganese	0.4	UJ
Mercury	0	U
Nickel	0.9	UJ
Selenium	4.8	UR
Silver	0.5	U
Thallium	5.7	UJ
Vanadium	0.5	U
Zinc	1	U
Pesticides/PCBs (µg/L)		
2,4,5-T	0.1	U
2,4,5-TP (silvex)	0	U
2,4-D	0.1	U
4,4'-DDD	0.1	U
4,4'-DDE	0.1	U

PARAMETER	RESULT	QUAL
4,4'-DDT	0.1	U
Aldrin	0	U
alpha-BHC	0	U
Aroclor-1016	0.4	U
Aroclor-1221	0.4	U
Aroclor-1232	0.4	U
Aroclor-1242	0.4	U
Aroclor-1248	0.4	U
Aroclor-1254	0.4	U
Aroclor-1260	0.4	U
beta-BHC	0	U
Chlordane	0.8	U
Chlorobenzilate	37.7	U
delta-BHC	0	U
Dieldrin	0.1	U
Dimethoate	37.7	U
Dinoseb	7.5	U
Disulfoton	7.5	UJ
Endosulfan I	0	U
Endosulfan II	0.1	U
Endosulfan sulfate	0.1	U
Endrin	0.1	U
Endrin aldehyde	0.1	U
Famphur	7.5	U
gamma-BHC (lindane)	0	U
Heptachlor	0	U
Heptachlor epoxide	0	U
Isodrin	7.5	U
Kepone	7.5	U
Methoxychlor	0.6	U
Methyl parathion	0.1	U
Parathion	0.1	U
Phorate	0.1	U
Sulfotep	10	U
Thionazin	7.5	U
Toxaphene	3.2	U
Semivolatile Organic Compounds (µg/L)		
1,2,4,5-tetrachlorobenzene	7.5	U
1,2,4-trichlorobenzene	7.5	U
1,2-dichlorobenzene	7.5	U
1,3,5-trinitrobenzene	37.7	UJ
1,3-dichlorobenzene	7.5	U
1,3-dinitrobenzene	7.5	U
1,4-dichlorobenzene	7.5	U
1,4-dioxane	7.5	U
1,4-naphthoquinone	7.5	UJ
1-naphthylamine	7.5	U
2,3,4,6-tetrachlorophenol	7.5	U
2,4,5-trichlorophenol	7.5	U
2,4,6-trichlorophenol	7.5	U

PARAMETER	RESULT	QUAL
2,4-dichlorophenol	7.5	U
2,4-dimethylphenol	7.5	U
2,4-dinitrophenol	15	U
2,4-dinitrotoluene	7.5	U
2,6-dichlorophenol	7.5	U
2,6-dinitrotoluene	7.5	U
2-acetylaminofluorene	7.5	U
2-chloronaphthalene	7.5	U
2-chlorophenol	7.5	U
2-methyl-4,6-dinitrophenol	7.5	U
2-methylnaphthalene	7.5	U
2-methylphenol	7.5	U
2-naphthylamine	7.5	U
2-nitroaniline	7.5	U
2-nitrophenol	7.5	U
2-picoline	7.5	U
3 & 4-methylphenol	7.5	U
3,3'-dichlorobenzidine	37.7	UJ
3,3'-dimethylbenzidine	37.7	U
3-methylcholanthrene	7.5	UJ
3-nitroaniline	7.5	U
4-aminobiphenyl	7.5	U
4-bromophenyl phenyl ether	7.5	U
4-chloro-3-methylphenol	7.5	U
4-chloroaniline	7.5	U
4-chlorophenyl phenyl ether	7.5	U
4-nitroaniline	7.5	U
4-nitrophenol	15	U
4-nitroquinoline-1-oxide	10	UR
5-nitro-o-toluidine	7.5	U
7,12-dimethylbenz(a)anthracene	7.5	UJ
a,a-dimethylphenethylamine	7.5	UJ
Acenaphthene	7.5	U
Acenaphthylene	7.5	U
Acetophenone	7.5	U
Aniline	7.5	U
Anthracene	7.5	U
Aramite	7.5	U
Benzo(a)anthracene	7.5	U
Benzo(a)pyrene	7.5	UJ
Benzo(b)fluoranthene	7.5	UJ
Benzo(g,h,i)perylene	7.5	UJ
Benzo(k)fluoranthene	7.5	UJ
Benzyl alcohol	7.5	U
Bis(2-chloroethoxy)methane	7.5	U
Bis(2-chloroethyl)ether	7.5	U
Bis(2-ethylhexyl)phthalate	7.5	U
Butyl benzyl phthalate	7.5	U
Chrysene	7.5	U
Di-n-butyl phthalate	7.5	UJ

PARAMETER	RESULT	QUAL
Di-n-octyl phthalate	7.5	UJ
Diallate	7.5	U
Dibenzo(a,h)anthracene	7.5	UJ
Dibenzofuran	7.5	U
Diethyl phthalate	7.5	U
Dimethyl phthalate	7.5	U
Diphenylamine	7.5	U
Ethyl methacrylate	7.5	U
Ethyl methanesulfonate	7.5	U
Fluoranthene	7.5	U
Fluorene	7.5	U
Hexachlorobenzene	7.5	U
Hexachlorobutadiene	7.5	U
Hexachlorocyclopentadiene	7.5	U
Hexachloroethane	7.5	U
Hexachloropropene	7.5	U
Indeno(1,2,3-cd)pyrene	7.5	UJ
Isophorone	7.5	U
Isosafrole	7.5	U
Methapyrilene	37.7	U
Methyl methanesulfonate	7.5	U
N-nitroso-di-n-butylamine	7.5	U
N-nitroso-di-n-propylamine	7.5	U
N-nitrosodiethylamine	7.5	U
N-nitrosodimethylamine	7.5	U
N-nitrosodiphenylamine	7.5	U
N-nitrosomethylethylamine	7.5	U
N-nitrosomorpholine	7.5	UJ
N-nitrosopiperidine	7.5	UJ
N-nitrosopyrrolidine	7.5	U
Naphthalene	7.5	U
Nitrobenzene	7.5	U
o,o,o-triethylphosphorothioate	7.5	U
o-toluidine	7.5	U
p-dimethylaminoazobenzene	7.5	U
p-phenylenediamine	15	UJ
Pentachlorobenzene	7.5	UJ
Pentachloroethane	7.5	U
Pentachloronitrobenzene	7.5	UJ
Pentachlorophenol	7.5	U
Phenacetin	7.5	U
Phenanthrene	7.5	U
Phenol	7.5	U
Pronamide	7.5	U
Pyrene	7.5	U
Pyridine	7.5	U
Safrole	7.5	U

S1MW-3	S1MW-3	B&RE
Inorganics (µg/L)		
Aluminum	11.1	U

BRAC Backgro[illegible] Samples
Groundwater Data Set

PARAMETER	RESULT	QUAL
Antimony	3.7	U
Arsenic	12.1	
Barium	19.6	J
Beryllium	0.3	U
Cadmium	0.4	UJ
Chromium	0.9	U
Cobalt	0.8	U
Copper	1.2	U
Cyanide	8.7	
Iron	76.2	J
Lead	1.8	UJ
Manganese	0.6	UJ
Mercury	0.1	U
Nickel	1.3	U
Selenium	4.8	UR
Silver	0.7	U
Thallium	7	J
Vanadium	0.7	U
Zinc	1.4	U
Pesticides/PCBs (µg/L)		
2,4,5-T	0.21	U
2,4,5-TP (silvex)	0.1	U
2,4-D	0.21	U
4,4'-DDD	0.43	U
4,4'-DDE	0.43	U
4,4'-DDT	0.43	U
Aldrin	0.22	U
alpha-BHC	0.22	U
Aroclor-1016	1.4	U
Aroclor-1221	1.4	U
Aroclor-1232	1.4	U
Aroclor-1242	1.4	U
Aroclor-1248	1.4	U
Aroclor-1254	1.4	U
Aroclor-1260	1.4	U
beta-BHC	0.22	U
Chlordane	2.7	U
Chlorobenzilate	51	U
delta-BHC	0.22	U
Dieldrin	0.43	U
Dimethoate	51	U
Dinoseb	10	UJ
Disulfoton	10	UJ
Endosulfan I	0.22	U
Endosulfan II	0.43	U
Endosulfan sulfate	0.43	U
Endrin	0.43	U
Endrin aldehyde	0.43	U
Famphur	10	U
gamma-BHC (lindane)	0.22	U

PARAMETER	RESULT	QUAL
Heptachlor	0.22	U
Heptachlor epoxide	0.22	U
Isodrin	10	U
Kepone	10	U
Methoxychlor	2.2	U
Methyl parathion	0.54	U
Parathion	0.54	U
Phorate	0.54	U
Sulfotep	10	U
Thionazin	10	U
Toxaphene	10.9	U
Semivolatile Organic Compounds (µg/L)		
1,2,4,5-tetrachlorobenzene	10	U
1,2,4-trichlorobenzene	10	U
1,2-dichlorobenzene	10	U
1,3,5-trinitrobenzene	51	UJ
1,3-dichlorobenzene	10	U
1,3-dinitrobenzene	10	U
1,4-dichlorobenzene	10	U
1,4-dioxane	10	U
1,4-naphthoquinone	10	UJ
1-naphthylamine	10	U
2,3,4,6-tetrachlorophenol	10	UJ
2,4,5-trichlorophenol	10	UJ
2,4,6-trichlorophenol	10	UJ
2,4-dichlorophenol	10	UJ
2,4-dimethylphenol	10	UJ
2,4-dinitrophenol	20	UJ
2,4-dinitrotoluene	10	U
2,6-dichlorophenol	10	UJ
2,6-dinitrotoluene	10	U
2-acetylaminofluorene	10	U
2-chloronaphthalene	10	U
2-chlorophenol	10	UJ
2-methyl-4,6-dinitrophenol	10	UJ
2-methylnaphthalene	10	U
2-methylphenol	10	UJ
2-naphthylamine	10	U
2-nitroaniline	10	U
2-nitrophenol	10	UJ
2-picoline	10	U
3 & 4-methylphenol	10	UJ
3,3'-dichlorobenzidine	51	UJ
3,3'-dimethylbenzidine	51	U
3-methylcholanthrene	10	UJ
3-nitroaniline	10	U
4-aminobiphenyl	10	U
4-bromophenyl phenyl ether	10	U
4-chloro-3-methylphenol	10	UJ
4-chloroaniline	10	U

PARAMETER	RESULT	QUAL
4-chlorophenyl phenyl ether	10	U
4-nitroaniline	10	U
4-nitrophenol	20	UJ
4-nitroquinoline-1-oxide	10	UR
5-nitro-o-toluidine	10	U
7,12-dimethylbenz(a)anthracene	10	UJ
a,a-dimethylphenethylamine	10	UJ
Acenaphthene	10	U
Acenaphthylene	10	U
Acetophenone	10	U
Aniline	10	U
Anthracene	10	U
Aramite	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	UJ
Benzo(k)fluoranthene	10	U
Benzyl alcohol	10	U
Bis(2-chloroethoxy)methane	10	U
Bis(2-chloroethyl)ether	10	U
Bis(2-ethylhexyl)phthalate	10	U
Butyl benzyl phthalate	10	U
Chrysene	10	U
Di-n-butyl phthalate	10	UJ
Di-n-octyl phthalate	10	U
Diallate	10	U
Dibenzo(a,h)anthracene	10	U
Dibenzofuran	10	U
Diethyl phthalate	10	U
Dimethyl phthalate	10	U
Diphenylamine	10	U
Ethyl methacrylate	10	U
Ethyl methanesulfonate	10	U
Fluoranthene	10	U
Fluorene	10	U
Hexachlorobenzene	10	U
Hexachlorobutadiene	10	U
Hexachlorocyclopentadiene	10	U
Hexachloroethane	10	U
Hexachloropropene	10	U
Indeno(1,2,3-cd)pyrene	10	UJ
Isophorone	10	U
Isosafrole	10	U
Methapyrilene	51	U
Methyl methanesulfonate	10	U
N-nitroso-di-n-butylamine	10	U
N-nitroso-di-n-propylamine	10	U
N-nitrosodiethylamine	10	U
N-nitrosodimethylamine	10	U

PARAMETER	RESULT	QUAL
N-nitrosodiphenylamine	10	U
N-nitrosomethylethylamine	10	U
N-nitrosomorpholine	10	UJ
N-nitrosopiperidine	10	UJ
N-nitrosopyrrolidine	10	U
Naphthalene	10	U
Nitrobenzene	10	U
o,o,o-triethylphosphorothioate	10	U
o-toluidine	10	U
p-dimethylaminoazobenzene	10	U
p-phenylenediamine	20	UJ
Pentachlorobenzene	10	UJ
Pentachloroethane	10	U
Pentachloronitrobenzene	10	UJ
Pentachlorophenol	10	UJ
Phenacetin	10	U
Phenanthrene	10	U
Phenol	10	UJ
Pronamide	10	U
Pyrene	10	U
Pyridine	10	U
Safrole	10	U

SWMU 2

S2MW-1 S2DPGW-01 B&RE

PARAMETER	RESULT	QUAL
Inorganics (µg/L)		
Aluminum	56.2	U
Antimony	1.9	U
Arsenic	3.6	U
Barium	10.5	J
Beryllium	0.2	U
Cadmium	0.3	UJ
Chromium	0.9	U
Cobalt	0.6	U
Copper	0.9	U
Cyanide	0.6	U
Iron	16.4	U
Lead	1.3	UJ
Manganese	3.7	J
Mercury	0	U
Nickel	1.6	U
Selenium	4.8	UR
Silver	0.5	U
Thallium	3.3	UJ
Vanadium	0.6	U
Zinc	3.3	U
Pesticides/PCBs (µg/L)		
2,4,5-T	2.1	U
2,4,5-TP (silvex)	1	U
2,4-D	2.1	U
4,4'-DDD	0	U

BRAC Backgro[illegible] Samples
Groundwater Data Set

PARAMETER	RESULT	QUAL
4,4'-DDE	0	U
4,4'-DDT	0	U
Aldrin	0	U
alpha-BHC	0	U
Aroclor-1016	0	U
Aroclor-1221	0	U
Aroclor-1232	0	U
Aroclor-1242	0	U
Aroclor-1248	0	U
Aroclor-1254	0	U
Aroclor-1260	0	U
beta-BHC	0	U
Chlordane	0.1	U
delta-BHC	0	U
Dieldrin	0	U
Endosulfan I	0	U
Endosulfan II	0	U
Endosulfan sulfate	0	U
Endrin	0	U
Endrin aldehyde	0	U
gamma-BHC (lindane)	0	U
Heptachlor	0	U
Heptachlor epoxide	0	U
Methoxychlor	0.1	U
Methyl parathion	0	U
Parathion	0	U
Phorate	0	U
Toxaphene	0.7	U
S2MW-1	**S2MW-1**	**B&RE**
Inorganics (µg/L)		
Aluminum	93.9	U
Antimony	2.6	U
Arsenic	4.9	U
Barium	10.6	J
Beryllium	0.3	U
Cadmium	0.4	UJ
Chromium	0.97	
Cobalt	0.8	U
Copper	1.2	U
Cyanide	0.8	U
Iron	37	U
Lead	1.8	UJ
Manganese	4.1	J
Mercury	0.1	U
Nickel	2.7	U
Selenium	4.8	UR
Silver	0.7	U
Thallium	4.5	UJ
Vanadium	0.88	U
Zinc	5.2	

PARAMETER	RESULT	QUAL
Pesticides/PCBs (µg/L)		
2,4,5-T	0.21	U
2,4,5-TP (silvex)	0.1	U
2,4-D	0.21	U
4,4'-DDD	0.039	U
4,4'-DDE	0.039	U
4,4'-DDT	0.039	U
Aldrin	0.02	U
alpha-BHC	0.02	U
Aroclor-1016	0.12	U
Aroclor-1221	0.12	U
Aroclor-1232	0.12	U
Aroclor-1242	0.12	U
Aroclor-1248	0.12	U
Aroclor-1254	0.12	U
Aroclor-1260	0.12	U
beta-BHC	0.02	U
Chlordane	0.25	U
delta-BHC	0.02	U
Dieldrin	0.039	U
Endosulfan I	0.02	U
Endosulfan II	0.039	U
Endosulfan sulfate	0.039	U
Endrin	0.039	U
Endrin aldehyde	0.039	U
gamma-BHC (lindane)	0.02	U
Heptachlor	0.02	U
Heptachlor epoxide	0.02	U
Methoxychlor	0.2	U
Methyl parathion	0.049	U
Parathion	0.049	U
Phorate	0.049	U
Toxaphene	0.98	U
S2MW-4	**S2MW-4**	**B&RE**
Inorganics (µg/L)		
Aluminum	11.1	U
Antimony	2.6	U
Arsenic	4.9	U
Barium	16.5	J
Beryllium	0.3	U
Cadmium	0.4	UJ
Chromium	0.9	U
Cobalt	0.8	U
Copper	1.2	U
Cyanide	2.4	
Iron	97.4	J
Lead	1.8	UJ
Manganese	10.3	J
Mercury	0.13	
Nickel	1.7	U

PARAMETER	RESULT	QUAL
Selenium	4.8	UR
Silver	0.7	U
Thallium	4.5	UJ
Vanadium	0.7	U
Zinc	1.4	U
Pesticides/PCBs (µg/L)		
2,4,5-T	0.21	U
2,4,5-TP (silvex)	0.1	U
2,4-D	0.21	U
4,4'-DDD	0.042	U
4,4'-DDE	0.042	U
4,4'-DDT	0.042	U
Aldrin	0.021	U
alpha-BHC	0.021	U
Aroclor-1016	0.13	U
Aroclor-1221	0.13	U
Aroclor-1232	0.13	U
Aroclor-1242	0.13	U
Aroclor-1248	0.13	U
Aroclor-1254	0.13	U
Aroclor-1260	0.13	U
beta-BHC	0.021	U
Chlordane	0.26	U
delta-BHC	0.021	U
Dieldrin	0.042	U
Endosulfan I	0.021	U
Endosulfan II	0.042	U
Endosulfan sulfate	0.042	U
Endrin	0.042	U
Endrin aldehyde	0.042	U
gamma-BHC (lindane)	0.021	U
Heptachlor	0.021	U
Heptachlor epoxide	0.021	U
Methoxychlor	0.21	U
Methyl parathion	0.053	U
Parathion	0.053	U
Phorate	0.053	U
Toxaphene	1	U
SWMU 4		
S4MW-4	**S4MW-4**	**B&RE**
Inorganics (µg/L)		
Aluminum	28	U
Antimony	4	UJ
Arsenic	13.7	U
Barium	11	U
Beryllium	0.2	U
Cadmium	0.4	UJ
Chromium	2	U
Cobalt	2	U
Copper	4	U

PARAMETER	RESULT	QUAL
Cyanide	1.4	U
Iron	229	U
Lead	3	UJ
Manganese	11.9	U
Mercury	0.1	U
Nickel	4	U
Selenium	4	UJ
Silver	2	U
Thallium	4	U
Vanadium	2	U
Zinc	2	UJ
Pesticides/PCBs (µg/L)		
Chlorobenzilate	10	U
Dimethoate	10	U
Dinoseb	10	U
Disulfoton	10	U
Famphur	10	U
Isodrin	10	U
Kepone	10	U
Sulfotep	10	U
Thionazin	10	U
Semivolatile Organic Compounds (µg/L)		
1,2,4,5-tetrachlorobenzene	10	U
1,2,4-trichlorobenzene	10	U
1,2-dichlorobenzene	10	U
1,3,5-trinitrobenzene	20	U
1,3-dichlorobenzene	10	U
1,3-dinitrobenzene	10	U
1,4-dichlorobenzene	10	U
1,4-dioxane	10	U
1,4-naphthoquinone	10	U
1-naphthylamine	10	U
2,3,4,6-tetrachlorophenol	10	U
2,4,5-trichlorophenol	10	U
2,4,6-trichlorophenol	10	U
2,4-dichlorophenol	10	U
2,4-dimethylphenol	10	U
2,4-dinitrophenol	20	U
2,4-dinitrotoluene	10	U
2,6-dichlorophenol	10	U
2,6-dinitrotoluene	10	U
2-acetylaminofluorene	10	U
2-chloronaphthalene	10	U
2-chlorophenol	10	U
2-methyl-4,6-dinitrophenol	10	U
2-methylnaphthalene	10	U
2-methylphenol	10	U
2-naphthylamine	10	U
2-nitroaniline	10	U
2-nitrophenol	10	U

BRAC Backgro[illegible] Samples
Groundwater Data Set

PARAMETER	RESULT	QUAL
2-picoline	10	U
3,3'-dichlorobenzidine	50	U
3,3'-dimethylbenzidine	20	U
3-methylcholanthrene	10	U
3-nitroaniline	10	U
4-aminobiphenyl	10	U
4-bromophenyl phenyl ether	10	U
4-chloro-3-methylphenol	10	U
4-chloroaniline	10	U
4-chlorophenyl phenyl ether	10	U
4-methylphenol	10	U
4-nitroaniline	10	U
4-nitrophenol	10	U
4-nitroquinoline-1-oxide	10	U
5-nitro-o-toluidine	10	U
7,12-dimethylbenz(a)anthracene	10	U
a,a-dimethylphenethylamine	10	U
Acenaphthene	10	U
Acenaphthylene	10	U
Acetophenone	10	U
Aniline	10	U
Anthracene	10	U
Aramite	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Benzyl alcohol	10	U
Bis(2-chloroethoxy)methane	10	U
Bis(2-chloroethyl)ether	10	U
Bis(2-ethylhexyl)phthalate	10	U
Butyl benzyl phthalate	10	U
Chrysene	10	U
Di-n-butyl phthalate	10	U
Di-n-octyl phthalate	10	U
Diallate	10	U
Dibenzo(a,h)anthracene	10	U
Dibenzofuran	10	U
Diethyl phthalate	10	U
Dimethyl phthalate	10	U
Diphenylamine	10	U
Ethyl methacrylate	10	U
Ethyl methanesulfonate	10	U
Fluoranthene	10	U
Fluorene	10	U
Hexachlorobenzene	10	U
Hexachlorobutadiene	10	U
Hexachlorocyclopentadiene	10	U
Hexachloroethane	10	U

PARAMETER	RESULT	QUAL
Hexachloropropene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Isophorone	10	U
Isosafrole	10	U
Methapyrilene	10	U
Methyl methanesulfonate	10	U
N-nitroso-di-n-butylamine	10	U
N-nitroso-di-n-propylamine	10	U
N-nitrosodiethylamine	10	U
N-nitrosodimethylamine	10	U
N-nitrosodiphenylamine	10	U
N-nitrosomethylethylamine	10	U
N-nitrosomorpholine	10	U
N-nitrosopiperidine	10	U
N-nitrosopyrrolidine	10	U
Naphthalene	10	U
Nitrobenzene	10	U
o,o,o-triethylphosphorothioate	10	U
o-toluidine	10	U
p-dimethylaminoazobenzene	10	U
p-phenylenediamine	20	U
Pentachlorobenzene	10	U
Pentachloroethane	10	U
Pentachloronitrobenzene	10	U
Pentachlorophenol	10	U
Phenacetin	10	U
Phenanthrene	10	U
Phenol	10	U
Pronamide	10	U
Pyrene	10	U
Pyridine	10	U
Safrole	10	U
Volatile Organic Compounds (µg/L)		
1,1,1,2-tetrachloroethane	2	U
1,1,1-trichloroethane	2	U
1,1,2,2-tetrachloroethane	2	U
1,1,2-trichloroethane	2	U
1,1-dichloroethane	2	U
1,1-dichloroethene	2	U
1,2,3-trichloropropane	2	U
1,2-dibromo-3-chloropropane	2	U
1,2-dibromoethane	2	U
1,2-dichloroethane	2	U
1,2-dichloropropane	2	U
2-butanone	5	U
2-chloro-1,3-butadiene	2	U
2-hexanone	5	U
3-chloropropene	10	U
4-methyl-2-pentanone	5	U
Acetone	10	U

PARAMETER	RESULT	QUAL
Acetonitrile	10	U
Acrolein	20	U
Acrylonitrile	20	U
Benzene	2	U
Bis(2-chloroisopropyl)ether	10	U
Bromodichloromethane	2	U
Bromoform	2	U
Bromomethane	2	U
Carbon disulfide	5	U
Carbon tetrachloride	2	U
Chlorobenzene	2	U
Chloroethane	2	U
Chloroform	2	U
Chloromethane	2	U
Cis-1,3-dichloropropene	2	U
Dibromochloromethane	2	U
Dibromomethane	2	U
Dichlorodifluoromethane	2	U
Ethyl cyanide	20	U
Ethylbenzene	2	U
Iodomethane	5	U
Isobutanol	20	U
Methacrylonitrile	10	U
Methyl methacrylate	10	U
Methylene chloride	5	U
Styrene	3.4	
Tetrachloroethene	2	U
Toluene	2	U
Trans-1,2-dichloroethene	1.2	J
Trans-1,3-dichloropropene	2	U
Trans-1,4-dichloro-2-butene	10	U
Trichloroethene	2	U
Trichlorofluoromethane	2	U
Vinyl acetate	5	U
Vinyl chloride	2.4	
Xylenes, total	4	U

SWMU 5

S5MW-4	S5MW-4	B&RE
Inorganics (µg/L)		
Aluminum	28	U
Antimony	12.6	U
Arsenic	6.4	U
Barium	8	
Beryllium	1.2	U
Cadmium	1.2	U
Chromium	2.1	
Cobalt	2	U
Copper	4	U
Cyanide	1.4	U
Iron	31.1	U

PARAMETER	RESULT	QUAL
Lead	3	U
Manganese	2.2	
Mercury	0.24	
Nickel	4	U
Selenium	4	U
Silver	3.3	
Thallium	4	U
Vanadium	3.9	
Zinc	2	U
Pesticides/PCBs (µg/L)		
Chlorobenzilate	50	U
Dimethoate	50	U
Dinoseb	10	U
Disulfoton	10	U
Famphur	10	U
Isodrin	10	U
Kepone	10	U
Sulfotep	10	U
Thionazin	10	U
Semivolatile Organic Compounds (µg/L)		
1,2,4,5-tetrachlorobenzene	10	U
1,2,4-trichlorobenzene	10	U
1,2-dichlorobenzene	10	U
1,3,5-trinitrobenzene	50	U
1,3-dichlorobenzene	10	U
1,3-dinitrobenzene	10	U
1,4-dichlorobenzene	10	U
1,4-dioxane	10	U
1,4-naphthoquinone	10	U
1-naphthylamine	10	U
2,3,4,6-tetrachlorophenol	10	U
2,4,5-trichlorophenol	10	U
2,4,6-trichlorophenol	10	U
2,4-dichlorophenol	10	U
2,4-dimethylphenol	10	U
2,4-dinitrophenol	20	U
2,4-dinitrotoluene	10	U
2,6-dichlorophenol	10	U
2,6-dinitrotoluene	10	U
2-acetylaminofluorene	10	U
2-chloronaphthalene	10	U
2-chlorophenol	10	U
2-methyl-4,6-dinitrophenol	10	U
2-methylnaphthalene	10	U
2-methylphenol	10	U
2-naphthylamine	10	U
2-nitroaniline	10	U
2-nitrophenol	10	U
2-picoline	10	U
3,3'-dichlorobenzidine	50	U

BRAC Background Samples
Groundwater Data Set

PARAMETER	RESULT	QUAL
3,3'-dimethylbenzidine	50	U
3-methylcholanthrene	10	U
3-nitroaniline	10	U
4-aminobiphenyl	10	U
4-bromophenyl phenyl ether	10	U
4-chloro-3-methylphenol	10	U
4-chloroaniline	10	U
4-chlorophenyl phenyl ether	10	U
4-methylphenol	10	U
4-nitroaniline	10	U
4-nitrophenol	20	U
4-nitroquinoline-1-oxide	10	UR
5-nitro-o-toluidine	10	U
7,12-dimethylbenz(a)anthracene	10	U
a,a-dimethylphenethylamine	10	U
Acenaphthene	10	U
Acenaphthylene	10	U
Acetophenone	10	U
Aniline	10	U
Anthracene	10	U
Aramite	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Benzyl alcohol	10	U
Bis(2-chloroethoxy)methane	10	U
Bis(2-chloroethyl)ether	10	U
Bis(2-ethylhexyl)phthalate	10	U
Butyl benzyl phthalate	10	U
Chrysene	10	U
Di-n-butyl phthalate	10	U
Di-n-octyl phthalate	10	U
Diallate	10	U
Dibenzo(a,h)anthracene	10	U
Dibenzofuran	10	U
Diethyl phthalate	10	U
Dimethyl phthalate	10	U
Diphenylamine	10	U
Ethyl methacrylate	10	U
Ethyl methanesulfonate	10	U
Fluoranthene	10	U
Fluorene	10	U
Hexachlorobenzene	10	U
Hexachlorobutadiene	10	U
Hexachlorocyclopentadiene	10	U
Hexachloroethane	10	U
Hexachloropropene	10	U
Indeno(1,2,3-cd)pyrene	10	U

PARAMETER	RESULT	QUAL
Isophorone	10	U
Isosafrole	10	U
Methapyrilene	50	U
Methyl methanesulfonate	10	U
N-nitroso-di-n-butylamine	10	U
N-nitroso-di-n-propylamine	10	U
N-nitrosodiethylamine	10	U
N-nitrosodimethylamine	10	U
N-nitrosodiphenylamine	10	U
N-nitrosomethylethylamine	10	U
N-nitrosomorpholine	10	U
N-nitrosopiperidine	10	U
N-nitrosopyrrolidine	10	U
Naphthalene	10	U
Nitrobenzene	10	U
o,o,o-triethylphosphorothioate	10	U
o-toluidine	10	U
p-dimethylaminoazobenzene	10	U
p-phenylenediamine	20	U
Pentachlorobenzene	10	U
Pentachloroethane	10	U
Pentachloronitrobenzene	10	U
Pentachlorophenol	10	U
Phenacetin	10	U
Phenanthrene	10	U
Phenol	10	U
Pronamide	10	U
Pyrene	10	U
Pyridine	10	U
Safrole	10	U
Volatile Organic Compounds (µg/L)		
Methyl methacrylate	10	U
S5MW-5	**S5MW-5**	**B&RE**
Inorganics (µg/L)		
Aluminum	28	U
Antimony	4	U
Arsenic	27.3	U
Barium	11.2	
Beryllium	0.2	U
Cadmium	0.48	U
Chromium	2	U
Cobalt	2	U
Copper	4	U
Cyanide	1.4	U
Iron	20.2	U
Lead	3	U
Manganese	4.4	
Mercury	0.19	
Nickel	4	U
Selenium	4	U

PARAMETER	RESULT	QUAL
Silver	2	U
Thallium	4	U
Vanadium	2	U
Zinc	2	U
Pesticides/PCBs (µg/L)		
Chlorobenzilate	50	U
Dimethoate	50	U
Dinoseb	10	U
Disulfoton	10	U
Famphur	10	U
Isodrin	10	U
Kepone	10	U
Sulfotep	10	U
Thionazin	10	U
Semivolatile Organic Compounds (µg/L)		
1,2,4,5-tetrachlorobenzene	10	U
1,2,4-trichlorobenzene	10	U
1,2-dichlorobenzene	10	U
1,3,5-trinitrobenzene	50	U
1,3-dichlorobenzene	10	U
1,3-dinitrobenzene	10	U
1,4-dichlorobenzene	10	U
1,4-dioxane	10	U
1,4-naphthoquinone	10	U
1-naphthylamine	10	U
2,3,4,6-tetrachlorophenol	10	U
2,4,5-trichlorophenol	10	U
2,4,6-trichlorophenol	10	U
2,4-dichlorophenol	10	U
2,4-dimethylphenol	10	U
2,4-dinitrophenol	20	U
2,4-dinitrotoluene	10	U
2,6-dichlorophenol	10	U
2,6-dinitrotoluene	10	U
2-acetylaminofluorene	10	U
2-chloronaphthalene	10	U
2-chlorophenol	10	U
2-methyl-4,6-dinitrophenol	10	U
2-methylnaphthalene	10	U
2-methylphenol	10	U
2-naphthylamine	10	U
2-nitroaniline	10	U
2-nitrophenol	10	U
2-picoline	10	U
3,3'-dichlorobenzidine	50	U
3,3'-dimethylbenzidine	50	U
3-methylcholanthrene	10	U
3-nitroaniline	10	U
4-aminobiphenyl	10	U
4-bromophenyl phenyl ether	10	U

PARAMETER	RESULT	QUAL
4-chloro-3-methylphenol	10	U
4-chloroaniline	10	U
4-chlorophenyl phenyl ether	10	U
4-methylphenol	10	U
4-nitroaniline	10	U
4-nitrophenol	20	U
4-nitroquinoline-1-oxide	10	UR
5-nitro-o-toluidine	10	U
7,12-dimethylbenz(a)anthracene	10	U
a,a-dimethylphenethylamine	10	U
Acenaphthene	10	U
Acenaphthylene	10	U
Acetophenone	10	U
Aniline	10	U
Anthracene	10	U
Aramite	10	U
Benzo(a)anthracene	10	U
Benzo(a)pyrene	10	U
Benzo(b)fluoranthene	10	U
Benzo(g,h,i)perylene	10	U
Benzo(k)fluoranthene	10	U
Benzyl alcohol	10	U
Bis(2-chloroethoxy)methane	10	U
Bis(2-chloroethyl)ether	10	U
Bis(2-ethylhexyl)phthalate	10	U
Butyl benzyl phthalate	10	U
Chrysene	10	U
Di-n-butyl phthalate	10	U
Di-n-octyl phthalate	10	U
Diallate	10	U
Dibenzo(a,h)anthracene	10	U
Dibenzofuran	10	U
Diethyl phthalate	10	U
Dimethyl phthalate	10	U
Diphenylamine	10	U
Ethyl methacrylate	10	U
Ethyl methanesulfonate	10	U
Fluoranthene	10	U
Fluorene	10	U
Hexachlorobenzene	10	U
Hexachlorobutadiene	10	U
Hexachlorocyclopentadiene	10	U
Hexachloroethane	10	U
Hexachloropropene	10	U
Indeno(1,2,3-cd)pyrene	10	U
Isophorone	10	U
Isosafrole	10	U
Methapyrilene	50	U
Methyl methanesulfonate	10	U
N-nitroso-di-n-butylamine	10	U

PARAMETER	RESULT	QUAL
N-nitroso-di-n-propylamine	10	U
N-nitrosodiethylamine	10	U
N-nitrosodimethylamine	10	U
N-nitrosodiphenylamine	10	U
N-nitrosomethylethylamine	10	U
N-nitrosomorpholine	10	U
N-nitrosopiperidine	10	U
N-nitrosopyrrolidine	10	U
Naphthalene	10	U
Nitrobenzene	10	U
o,o,o-triethylphosphorothioate	10	U
o-toluidine	10	U
p-dimethylaminoazobenzene	10	U
p-phenylenediamine	20	U
Pentachlorobenzene	10	U
Pentachloroethane	10	U
Pentachloronitrobenzene	10	U
Pentachlorophenol	10	U
Phenacetin	10	U
Phenanthrene	10	U
Phenol	10	U
Pronamide	10	U
Pyrene	10	U
Pyridine	10	U
Safrole	10	U
Volatile Organic Compounds (µg/L)		
Methyl methacrylate	10	U

SWMU 7

S7MW-2	S7MW-2	B&RE
Herbicides (µg/L)		
2,4,5-T	0.1	U
2,4,5-TP (silvex)	0.1	U
2,4-D	0.1	U
Inorganics (µg/L)		
Aluminum	28	U
Antimony	4	U
Arsenic	6.7	U
Barium	6.4	
Beryllium	0.2	U
Cadmium	0.4	U
Chromium	2	U
Cobalt	2	U
Copper	4	U
Cyanide	1.4	U
Iron	29.8	U
Lead	3	U
Manganese	2.3	
Mercury	0.23	
Nickel	4	U
Selenium	4	U

PARAMETER	RESULT	QUAL
Silver	2	U
Thallium	4	U
Vanadium	2	U
Zinc	2	U
Pesticides/PCBs (µg/L)		
4,4'-DDD	0.08	U
4,4'-DDE	0.08	U
4,4'-DDT	0.08	U
Aldrin	0.04	U
alpha-BHC	0.04	U
Aroclor-1016	0.25	U
Aroclor-1221	0.25	U
Aroclor-1232	0.25	U
Aroclor-1242	0.25	U
Aroclor-1248	0.25	U
Aroclor-1254	0.25	U
Aroclor-1260	0.25	U
beta-BHC	0.04	U
Chlordane	0.5	U
delta-BHC	0.04	U
Dieldrin	0.08	U
Endosulfan I	0.04	U
Endosulfan II	0.08	U
Endosulfan sulfate	0.08	U
Endrin	0.08	U
Endrin aldehyde	0.08	U
gamma-BHC (lindane)	0.04	U
Heptachlor	0.04	U
Heptachlor epoxide	0.04	U
Methoxychlor	0.4	U
Methyl parathion	0.1	U
Parathion	0.1	U
Phorate	0.1	U
Toxaphene	2	U

PARAMETER	RESULT	QUAL

PARAMETER	RESULT	QUAL

Appendix C

Part 4 - Data Quality Objectives Sample Number Calculation

Most Conservative Optimal Sample Size Estimates by Medium from Gilbert Equation[(1)]

Media	Chemical Group	Parameter	Mean	Standard Deviation	2 x Avg. Background	95% UCL	Strictest Action Level	Basis for Action Level	NUMBER OF SAMPLES NEEDED Lenient $\Delta = 1 \times AL$ $1-\beta=0.90$	Tough $\Delta = 0.5 \times AL$ $1-\beta=0.95$	Stringent $\Delta = 0.25 \times AL$ $1-\beta=0.95$	Extreme $\Delta = 0.1 \times AL$ $1-\beta=0.99$
SOIL	INORGANIC (mg/kg)	Beryllium	0.044	0.042	0.088	0.067	0.200	FDEP Residential	1	1	1	12
	SVOC (ug/kg)	Benzo(b)fluoranthene	431.808	681.166	863.616	843.432	1,400.000	FDEP Residential	1	1	1	10
	VOC (ug/kg)	Chloromethane	2.455	2.055	4.910	3.836	200.000	FDEP Residential	1	1	2	16
	PEST (ug/kg)	Methoxychlor	59.855	131.070	119.710	153.617	380,000.000	FDEP Residential	1	1	1	14
	PCB (ug/kg)	Aroclor-1260	43.480	81.898	86.960	98.500	9,000.000	FDEP Residential	1	2	7	47
GW	INORGANIC (mg/kg)	Iron	41.720	43.240	83.440	72.652	11,000.000	Tap Water RBCs	1	1	3	21
	VOC (ug/l)	Styrene	3.400	0.450	6.800	3.400	100.000	MCL / FL MCL	1	1	1	1

Appendix D

TtNUS Environmental Forms

Equipment Calibration Log

Instrument (Name/Model Number/ Serial Number): ______________________________

Manufacturer: ______________________________ **Date Purchased:** ______________________________

Name and Number of Rental Agency (if applicable): ______________________________

Calibration Date/Time	Initial Settings	Standard/ Gas	Procedure	Adjustments Made	Final Settings	Signature	Comments

BROWN and ROOT ENVIRONMENTAL

FIELD LOG OF BORING

WELL NO. ____________

SHEET ______ OF ______

PROJECT:	JOB NO.:	BORING NO.:
	LOGGED BY:	TOTAL DEPTH:

DRILLING CONTRACTOR:	SURFACE ELEV.:	DATUM:
DRILLER'S NAME:	START, TIME:	DATE:
DRILL RIG TYPE:	FINISH, TIME:	DATE:

BORING METHOD:	WATER DEPTH:			
HOLE DIAMETER:	DATE:			
SAMPLING METHOD:	TIME:			

HAMMER WGT.:	DROP HGT:	BACKFILLED, TIME:	DATE:
CONDITIONS:		LOCATION OF BORING:	

SAMPLE DEPTH	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED				OVA READING (ppm)	LAB SAMPLE	DEPTH IN FEET		LITHOLOGY	

NOTES: ____

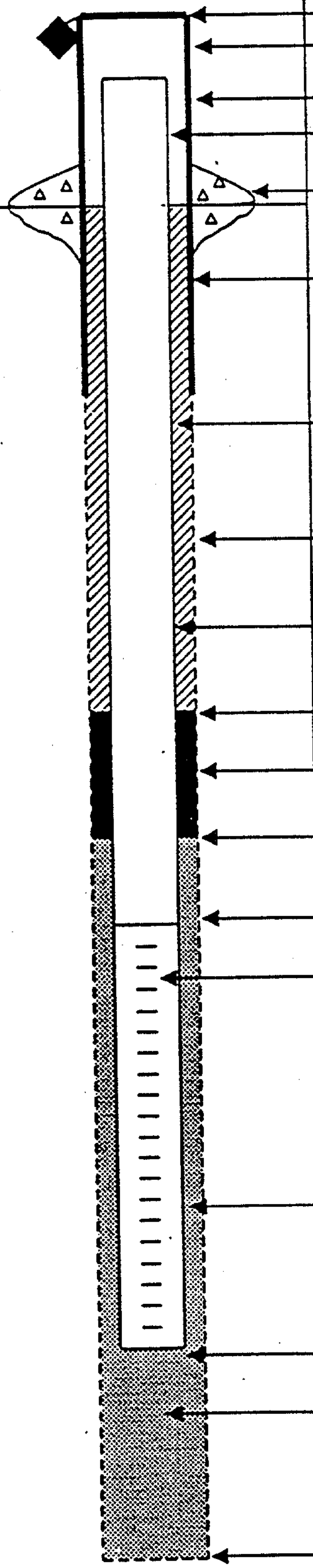
EDITED BY/DATE: ____________________

OVERBURDEN
MONITORING WELL SHEET

PROJECT ____________________ LOCATION ____________________
PROJECT NO. ____________________ BORING ____________________
ELEVATION ____________________ DATE ____________________
FIELD GEOLOGIST ____________________

DRILLER ____________________
DRILLING METHOD ____________________
DEVELOPMENT METHOD ____________________

GROUND ELEVATION



ELEVATION OF TOP OF SURFACE CASING: ____________

ELEVATION OF TOP OF RISER PIPE: ____________

STICK - UP TOP OF SURFACE CASING: ____________

STICK - UP RISER PIPE: ____________

TYPE OF SURFACE SEAL: ____________

I.D. OF SURFACE CASING: ____________

TYPE OF SURFACE CASING: ____________

RISER PIPE I.D. ____________

TYPE OF RISER PIPE: ____________

BOREHOLE DIAMETER: ____________

TYPE OF BACKFILL: ____________

ELEVATION / DEPTH TOP OF SEAL: ______ / ______

TYPE OF SEAL: ____________

DEPTH TOP OF SAND PACK: ____________

ELEVATION / DEPTH TOP OF SCREEN: ______ / ______

TYPE OF SCREEN: ____________

SLOT SIZE x LENGTH: ____________

I.D. OF SCREEN: ____________

TYPE OF SAND PACK: ____________

ELEVATION / DEPTH BOTTOM OF SCREEN: ______ / ______

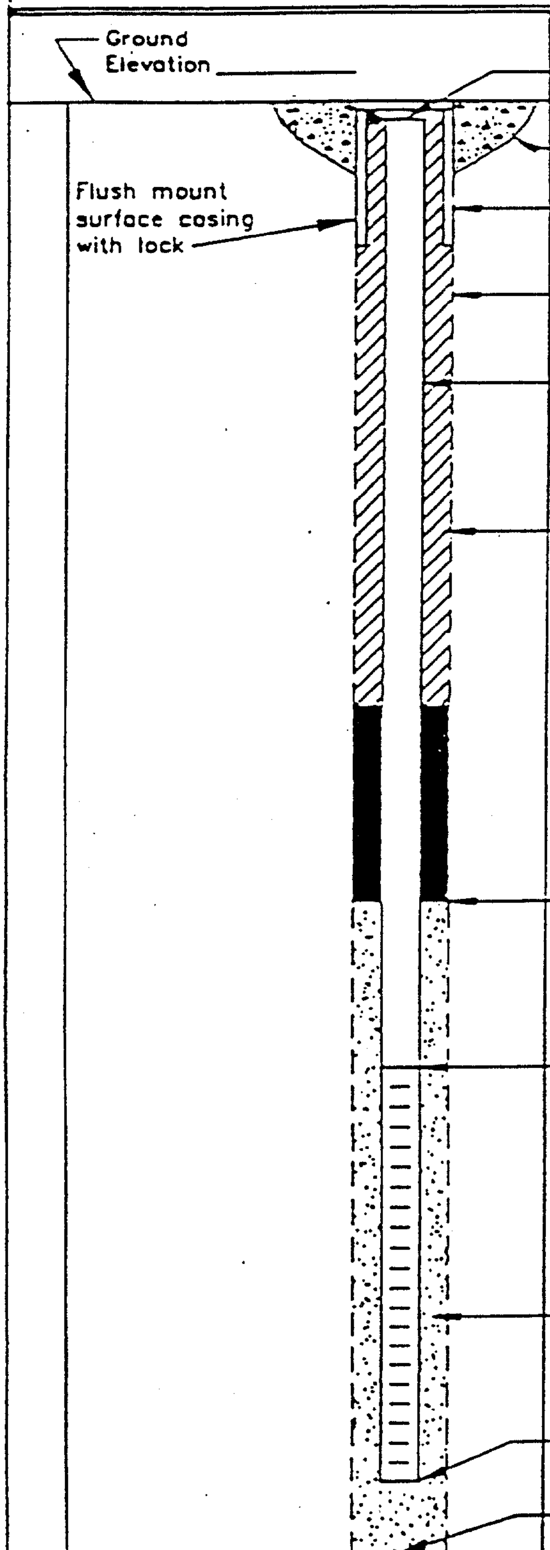
ELEVATION / DEPTH BOTTOM OF SAND PACK: ______ / ______

TYPE OF BACKFILL BELOW OBSERVATION WELL: ____________

ELEVATION / DEPTH OF HOLE: ______ / ______

MONITORING WELL SHEET

PROJECT ________	LOCATION ________	DRILLER ________
PROJECT NO. ________	BORING ________	DRILLING METHOD ________
ELEVATION ________	DATE ________	DEVELOPMENT METHOD ________
FIELD GEOLOGIST ________		



ELEVATION TOP OF RISER: ________

TYPE OF SURFACE SEAL: ________

TYPE OF PROTECTIVE CASING: ________

I.D. OF PROTECTIVE CASING: ________

DIAMETER OF HOLE: ________

TYPE OF RISER PIPE: ________

RISER PIPE I.D.: ________

TYPE OF BACKFILL/SEAL: ________

____

DEPTH/ELEVATION TOP OF SAND: ____/____

DEPTH/ELEVATION TOP OF SCREEN: ____/____

TYPE OF SCREEN: ________

SLOT SIZE x LENGTH: ________

TYPE OF SAND PACK: ________

DIAMETER OF HOLE IN BEDROCK: ________

DEPTH/ELEVATION BOTTOM OF SCREEN: ____/____

DEPTH/ELEVATION BOTTOM OF SAND: ____/____

DEPTH/ELEVATION BOTTOM OF HOLE: ____/____

BACKFILL MATERIAL BELOW SAND: ________

ACFILE: L870\OCOL\OBURD1.DWG

Brown & Root Environmental

WELL DEVELOPMENT FORM

Well Number ____________________

Site Name ____________________

Date and Time Well Installed ____________________

Well Stickup ____________________ ft above/below grade

Total Depth Of Well ____________________ ft below top of casing

Static Level Before Purging ____________________ ft below top of casing

Inside Diameter of Well ____________________ inches

One Casing Volume ____________________ gallons

V=0.1632h (2 inch diameter casing)

h=height of water column

WELL DEVELOPMENT NOTES

Date__________ Time Begun ____________________

Developed By ________________________________

Method(s) Used____

____

Time	Temp (C°)	pH	Conductivity (mS/cm)	Color	Turbidity (NTU)	Total Volume Removed (gals)

Casing Volumes Removed ______________

Time Completed ____________________

SAMPLE LOG SHEET

Brown & Root Environmental

☐ Monitoring Well Data
☐ Domestic Well Data
☐ Other________

Page ____ of____

By________

Project Site Name ____________________ Project Site Number ____________________

B&RE Sample ID ____________________ Source Location ____________________

	Purge Data					
Total Well Depth:						
Well Stickup:	Volume	pH	S.C.	Temp. (°C)	Color & Turbidity	D.O.
Well Casing Size:						
Static Water Level:						
One Casing Volume:						
Start Purge (hrs.):						
End Purge (hrs.):						
Total Purge Time (min.):						
Total Amount Purged (gal.):						
Monitoring Reading:						
Purge Method:						
Sample Method:						
Depth Sampled:						

	Sample Data				
Sample Data & Time:	pH	S.C.	Temp. (°C)	Color & Turbidity	D.O.
Sampled By:					
Signature(s):	Observations/Notes:				

Type of Sample

☐ Low Concentration
☐ High Concentration
☐ Grab
☐ Composite
☐ Grab - Composite

Analysis:	Preservative:

Dup #	
MSMSD	☐

Air Bill #	
Date Shipped	
Time Shipped	
Lab	
Other	

Brown & Root Environmental

SAMPLE LOG SHEET

☐ Surface Water
☐ Water QA/QC Blank Sample
- ☐ Trip Blank
- ☐ Rinsate Blank
- ☐ Field Blank
- ☐ Ambient Condition Blank

Project Site Name ____________________ Project Site Number ____________________

B&RE Sample Name ____________________ Sample Source or Location ____________________

____

Surface Water Data

pH	Temp. (°C)	Dissolv. O_2	Color	Elect. Conduct.(mS/cm)

Sample Date and Time:	Observations/Notes:
Sampled By (Print):	
Sampled By (Signatures):	

Analysis	Preserv.	Bottle Lot #s	Laboratory	Ship Date/Time	Airbill #

COC #

Brown & Root Environmental

SAMPLE LOG SHEET

Page ______ of ______

☐ Surface Soil
☐ Subsurface Soil
☐ Sediment
☐ Other

Project Site Name ______________________ Project Site Number ______________________

B&RE Sample Name ______________________ Sample Source or Location ______________________

____

Sample Method:	Sample Date and Time:
Sample Depth:	Color:
Sampled By (Print):	Sample Description:
Sampled By (Signatures):	FID Reading of Sample (if appropriate):
Concentration of Sample: ☐ Low ☐ Medium ☐ High	Type of Sample: ☐ Composite ☐ Grab

Observations/Notes:

Analyses

Analysis	Bottle Lot #

Shipment

Laboratory	Ship Date/Time	Airbill #

Appendix E

Quality Assurance Elements

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1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

This quality assurance (QA) document has been prepared by Tetra Tech NUS, Inc. (TtNUS) on behalf of the United States Navy Southern Division Naval Facilities Engineering Command and the Naval Air Station (NAS) Key West, Key West, Florida, under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-90-D-1298, Contract Task Order (CTO) 032. This QA document and other associated documents, including the Workplan and Health and Safety Plan (HASP), and the Tetra Tech NUS, Inc., FDEP CompQAP No. 980038, August 24, 1998, constitute the project planning documents for the Supplemental Site Investigation (SSI) to be performed at the NAS Key West.

This quality assurance document presents the organization, objectives, planned activities, and specific Quality Assurance/Quality Control (QA/QC) procedures associated with the Workplan for the SSI. Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses are described. All QA/QC procedures are structured in accordance with applicable technical standards, the Naval Facilities Engineering Service Center (NFESC) guidance document "Navy Installation Restoration Laboratory Quality Assurance Guide (February 1996), and United States Environmental Protection Agency (U.S. EPA) Region IV and the Florida Department of Environmental Protection (FDEP) requirements, regulations, guidance, and technical standards.

1.2 FACILITY DESCRIPTION

A description of the NAS Key West, including its location, size and borders, site condition, and natural and manmade features, is provided in Section 1.3 of the SSI Workplan.

1.3 PROJECT OBJECTIVES

This section discusses the overall project objectives and the anticipated target parameters and intended data uses for both field and laboratory analytical data.

1.3.1 <u>Overall Project Objectives</u>

The objective of the work will be to investigate and characterize several properties identified for closure under the Base Realignment and Closure (BRAC) Act of 1992. The investigation will include collecting surface soil, subsurface soils, groundwater screening samples, and swipe samples and installing and sampling permanent groundwater monitoring wells. The characterization of the BRAC sites is necessary in order to facilitate the closure and transfer of the property.

1.3.2 Project Target Parameters and Intended Data Uses

This section discusses the field and laboratory analytical information to be generated during the course of the investigation. Field parameters and intended data uses are discussed in Section 1.4.2.1. Laboratory parameters and intended data uses are discussed in Section 1.4.2.2.

1.3.2.1 Field Parameters

Field parameters will include those associated with the completion of soil borings, installation and development of monitoring wells, and collection of soil and groundwater samples. Field measurements will include only those measurements completed with simple field instrumentation.

Field measurements of total VOCs will be completed using a Flame Ionization Detector (FID). These measurements will be used to screen samples and verify that organic concentrations are not of a magnitude that would cause health and safety concerns.

Field parameters including pH, specific conductance, turbidity, and temperature will be completed for all aqueous phase samples. These measurements will be used to support monitoring well development and purging of stagnant water from well casings. Specific conductance and pH will also be used as general indicators of water quality.

1.3.2.2 Laboratory Parameters

The analytical methods to be used for analysis of the NAS Key West samples have been selected based on existing information regarding the use of the facility. The suite of analyses for environmental samples collected during the NAS Key West BRAC SSI includes Target Compound List (TCL) volatiles (VOCs) TCL semivolatiles (SVOCs), TCL polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) metals. Additionally, if associated aqueous waste is not present, any drums of solid investigation derived waste (IDW) will be sampled as discussed in Section 6.0 of the Workplan. These samples will be analyzed for the full regulatory list of Toxicity Characteristic Leaching Procedure (TCLP) parameters. Tables E-1-1 through E-1-4 provide a summary of all target laboratory analytes and associated estimated quantitation

TABLE E-1-1

**ESTIMATED QUANTITATION LIMITS (EQLs) - TARGET COMPOUND LIST ORGANICS
NAS KEY WEST, FLORIDA
PAGE 1 OF 3**

Parameter	EQL[1] Aqueous Samples[2] (μg/L)	EQL[1] Solid Samples[3] (μg/kg)
VOLATILE ORGANIC COMPOUNDS SW-846 METHOD 8260a/8260b		
1,1-Dichloroethane	1	1
1,1-Dichloroethene	1	1
1,1,1-Trichloroethane	1	1
1,1,2,2-Tetrachloroethane	1	1
1,1,2-Trichloroethane	1	1
1,2-Dichlorobenzene	1	1
1,2-Dichloroethane	1	1
1,2-Dichloropropane	1	1
1,3-Dichlorobenzene	1	1
1,4-Dichlorobenzene	1	1
2-Butanone	5	5
2-Hexanone	5	5
4-Methyl-2-pentanone	5	5
Acetone	5	5
Benzene	1	1
Bromodichloromethane	1	1
Bromoform	1	1
Bromomethane	1	1
Carbon disulfide	5	5
Carbon tetrachloride	1	1
Chlorobenzene	1	1
Chloroethane	1	1
Chloroform	1	1
Chloromethane	1	1
cis-1,2-Dichloroethene	1	1
cis-1,3-Dichloropropene	1	1
Dibromochloromethane	1	1
Ethylbenzene	1	1
Methylene chloride	1	1
Styrene	1	1
Tetrachloroethene	1	1
Toluene	1	1
trans-1,2-Dichloroethene	1	1
trans-1,3-Dichloropropene	1	1
Trichloroethene	1	1
Vinyl chloride	1	1

TABLE E-1-1

ESTIMATED QUANTITATION LIMITS (EQLs) - TARGET COMPOUND LIST ORGANICS
NAS KEY WEST, FLORIDA
PAGE 2 OF 3

Parameter	EQL[1] Aqueous Samples[2] (µg/L)	EQL[1] Solid Samples[3] (µg/kg)
SEMIVOLATILE ORGANIC COMPOUNDS SW-846 METHOD 8270b/8270c		
1,2,4-Trichlorobenzene	10	333
2,4,5-Trichlorophenol	10	333
2,4,6-Trichlorophenol	10	333
2,4-Dichlorophenol	10	333
2,4-Dimethylphenol	10	333
2,4-Dinitrophenol	20	667
2,4-Dinitrotoluene	10	333
2,6-Dinitrotoluene	10	333
2-Chloronaphthalene	10	333
2-Chlorophenol	10	333
2-Methylnaphthalene	10	333
2-Methylphenol	10	333
2-Nitroaniline	10	333
2-Nitrophenol	10	333
3,3'-Dichlorobenzidine	50	1,670
3&4-Methylphenol	10	333
3-Nitroaniline	10	333
4,6-Dinitro-2-methylphenol	10	333
4-Bromophenyl-phenylether	10	333
4-Chloro-3-methylphenol	10	333
4-Chloroaniline	20	667
4-Chlorophenyl-phenylether	10	333
4-Nitroaniline	10	333
4-Nitrophenol	20	667
Acenaphthene	10	333
Acenaphthylene	10	333
Anthracene	10	333
Benzo(a)anthracene	10	333
Benzo(a)pyrene	10	333
Benzo(b)fluoranthene	10	333
Benzo(g,h,i)perylene	10	333
Benzo(k)fluoranthene	20	333
Bis(2-chloroethoxy)methane	10	333
Bis(2-chloroethyl)ether	10	333
Bis(2-chloroisopropyl)ether	10	333
Bis(2-ethylhexyl)phthalate	10	333

TABLE E-1-1

ESTIMATED QUANTITATION LIMITS (EQLs) - TARGET COMPOUND LIST ORGANICS
NAS KEY WEST, FLORIDA
PAGE 3 OF 3

Parameter	EQL[1] Aqueous Samples[2] (µg/L)	EQL[1] Solid Samples[3] (µg/kg)
SEMIVOLATILE ORGANIC COMPOUNDS SW-846 METHOD 8270b/8270c		
Butylbenzylphthalate	10	333
Carbazole	10	333
Chrysene	10	333
Dibenz(a,h)anthracene	10	333
Dibenzofuran	10	333
Diethylphthalate	10	333
Di-n-butylphthalate	10	333
Di-n-octylphthalate	10	333
Dimethylphthalate	10	333
Fluoranthene	10	333
Fluorene	10	333
Hexachlorobenzene	10	333
Hexachlorobutadiene	10	333
Hexachlorocyclopentadiene	10	333
Hexachloroethane	10	333
Indeno(1,2,3-cd)pyrene	10	333
Isophorone	10	333
Naphthalene	10	333
Nitrobenzene	10	333
N-nitrosodiphenylamine	10	333
Pentachlorophenol	10	333
Phenanthrene	10	333
Phenol	10	333
Pyrene	10	333
PCBs SW-846 METHOD 8081/8082		
Aroclor-1016	0.125	4.17
Aroclor-1221	0.125	4.17
Aroclor-1232	0.125	4.17
Aroclor-1242	0.125	4.17
Aroclor-1248	0.125	4.17
Aroclor-1254	0.125	4.17
Aroclor-1260	0.125	4.17

1 Estimated Quantitation Limit; as specified by General Engineering Laboratories in their 21 October 1997 RFP response.
2 Aqueous (groundwater, surface water) samples.
3 Solid (surface soil, sediment) samples.

TABLE E-1-2

ESTIMATED QUANTITATION LIMITS - TARGET ANALYTE LIST (TAL) INORGANICS NAS KEY WEST, FLORIDA

Parameter	Estimated Quantitation Limit[1]	
	Aqueous Samples[2] (µg/L)	Solid Samples[3] (mg/kg)
Aluminum	50	2.5
Antimony	10	0.500
Arsenic	5	0.250
Barium	5	0.250
Beryllium	5	0.250
Cadmium	50	0.250
Calcium	100	5.0
Chromium	5	0.250
Cobalt	5	0.250
Copper	5	0.250
Iron	50	2.5
Lead	5	0.250
Magnesium	10	0.500
Manganese	10	0.500
Mercury	0.2	0.033
Nickel	5	0.250
Potassium	100	5.0
Selenium	5	0.250
Silver	5	0.250
Sodium	100	5.0
Thallium	10	0.500
Tin	10	0.250
Vanadium	5	0.250
Zinc	5	0.250

1 As specified by General Engineering Laboratories in their 21 October 1997 RFP response.
2 Aqueous (groundwater, surface water) samples.
3 Solid (soil, sediment) samples.

TABLE E-1-3

ESTIMATED QUANTITATION LIMITS (EQLs) - TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP) ORGANICS NAS KEY WEST, FLORIDA

Parameter	EQL[1] Solid Samples[2] (mg/L)
VOLATILE ORGANIC COMPOUNDS SW-846 METHOD 1311 FOLLOWED BY METHOD 8260a/8260b	
1,1-Dichloroethene	0.001
1,2-Dichloroethane	0.001
1,4-Dichlorobenzene	0.001
2-Butanone	0.005
Benzene	0.001
Carbon tetrachloride	0.001
Chlorobenzene	0.001
Chloroform	0.001
Trichloroethene	0.001
Tetrachloroethene	0.001
Vinyl chloride	0.001
SEMIVOLATILE ORGANIC COMPOUNDS SW-846 METHOD 1311 FOLLOWED BY METHOD 8270b/8270c	
2,4,5-Trichlorophenol	0.01
2,4,6-Trichlorophenol	0.01
2,4-Dinitrotoluene	0.01
2-Methylphenol	0.01
3&4-Methylphenol	0.01
Hexachlorobenzene	0.01
Hexachlorobutadiene	0.01
Hexachloroethane	0.01
Nitrobenzene	0.01
Pentachlorophenol	0.01
Pyridine	NA
HERBICIDES SW-846 METHOD 1311 FOLLOWED BY METHOD 8151/8151a	
2,4-D	NA
2,4,5-T	NA
PESTICIDES SW-846 METHOD 1311 FOLLOWED BY METHOD 8081/8081a	
alpha-Chlordane	2E-05
Endrin	4E-05
gamma-BHC (Lindane)	2E-05
gamma-Chlordane	2E-05
Heptachlor	2E-05
Methoxychlor	2E-05
Toxaphene	0.001

NA - This information was not available from General Engineering Laboratories as part of their 21 October 1997 RFP response at the time of publication. It will be obtained from the lab prior to analysis.

1 Estimated quantitation limit, as specified by General Engineering Laboratories in their 21 October 1997 RFP response.

2 Solid investigation-derived waste (IDW) samples.

TABLE E-1-4

ESTIMATION QUANTITATION LIMITS - TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP) INORGANICS NAS KEY WEST, FLORIDA

Parameter	Solid Samples[2] (mg/L)
Arsenic	0.005
Barium	0.005
Cadmium	0.005
Chromium	0.005
Lead	0.005
Mercury	0.002
Selenium	0.005
Silver	0.005

1 As specified by General Engineering Laboratories in their 21 October 1997 RFP response.
2 Solid investigation-derived waste (IDW) samples.

limits (EQLs). Analytical methods are further discussed in Section 7.0 of this QA document. As discussed in Section 3.0 of the Workplan and presented in Appendix B of the Workplan, medium-specific action levels have been selected for each analytical parameter. In some cases, the standard EQLs associated with the applicable SW-846 methods may not be sufficient to meet the specified action levels. The action levels will be incorporated into the laboratory statement of work (SOW) so that, where possible, methods can be modified to decrease the EQLs to an acceptable level. In the event this is not technically possible, then action levels will be re-evaluated on a case-by-case basis.

1.4 SAMPLE NETWORK DESIGN AND RATIONALE

The design and rationale of the sampling and analysis plan is discussed in detail in Section 3.0 of the Workplan. Figures displaying the location of all proposed sampling locations are provided therein.

2.0 PROJECT ORGANIZATION

The management of all QA aspects of the project are the ultimate responsibility of the Navy. Each contractor assigned to individual tasks has the responsibility to fulfill the objectives of each task and ensure the quality of the data generated by the task. At the direction of the Navy, TtNUS has overall responsibility for the BRAC SSI to be performed at NAS Key West. Further discussion of project organization and management is provided in Section 6.0 of the Workplan.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall Quality Assurance (QA) objective for this project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will ensure quality, representative data. Intended data uses are described in Section 1.3.2 of this QA document. Procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field and laboratory equipment, and corrective action are described in other sections of this QA document.

The PARCC parameters (precision, accuracy, representativeness, comparability, and completeness) are qualitative and/or quantitative statements regarding the quality characteristics of the data used to support project objectives and ultimately, environmental decisions. These parameters are discussed in the remainder of this section. Specific routine procedures used to assess the quantitative parameters (precision, accuracy, and completeness) are provided in Chapter 12.0 of this Appendix.

3.1 PRECISION

3.1.1 Definition

Precision is a measure of the amount of variability and bias inherent in a data set. Precision describes the reproducibility of measurements of the same parameter for samples under similar conditions. The equation for determining precision is as follows:

$$RPD = \frac{\text{Amount in Sample} - \text{Amount in Duplicate}}{0.5\ (\text{Amount in Sample} + \text{Amount in Duplicate})} \text{ X } 100\,\%$$

3.1.2 Field Precision Objectives

Field duplicate precision monitors the consistency with which environmental samples were obtained and analyzed. Field duplicate results for solid matrix samples are considered to be precise if the relative percent difference (RPD) is less than or equal to 50 percent. Field duplicate results for aqueous matrix samples are considered to be precise if the RPD is less than or equal to 30 percent. Field precision is assessed through the collection and measurement of field duplicates at a rate of 1 duplicate per 10 environmental samples.

3.1.3 Laboratory Precision Objectives

Laboratory precision QC samples are analyzed at a frequency of 5 percent (i.e., one quality control sample per 20 environmental samples). Laboratory precision is measured via comparison of calculated RPD values and Precision Control Limits specified in the analytical method or by the laboratory's QA/QC Program.

Precision for organic analyses will be measured via the RPDs for matrix spike/matrix spike duplicate (MS/MSD) samples. Precision for inorganic analyses will be measured via RPDs for laboratory duplicates. Internal laboratory control limits for precision, which are typically set at three times the standard deviation of a series of RPDs, will be used by the laboratory for evaluation of precision.

3.2 ACCURACY

3.2.1 Definition

Accuracy is the degree of agreement between an observed value and an accepted reference value. The equation for determining accuracy is as follows:

$$\%R = \frac{\text{Amount in Spiked Sample} - \text{Amount in Sample}}{\text{Known Amount Added}} \times 100\,\%$$

(%R = Percent Recovery)

3.2.2 Field Accuracy Objectives

Accuracy in the field is assessed through the use of rinsate and trip blanks and is ensured through adherence to all sample handling, preservation, and holding times. Accuracy and precision requirements for field measurements (total VOCs, pH, specific conductivity, temperature, and turbidity) are ensured through calibration as discussed in Chapter 6.0.

3.2.3 Laboratory Accuracy Objectives

Accuracy in the laboratory is measured through the comparison of a spiked sample result against a known or calculated value expressed as a percent recovery (%R). Percent recoveries are derived from the analysis of known amounts of compounds spiked into deionized water [i.e., laboratory control sample (LCS) analysis], or into actual samples (i.e., surrogate or matrix spike analysis). Laboratory control samples measure the accuracy of laboratory operations, while surrogate and matrix spike analyses measure the accuracy of laboratory operations as affected by matrix. Laboratory control sample and/or matrix spike analyses are performed with a frequency of one per twenty associated samples of like matrix. Surrogate spike analysis is performed for all chromatographic organic analyses. Laboratory accuracy is assessed via comparison of calculated %R values with Accuracy Control Limits specified in the analytical method or by the laboratory's QA/QC Program. Evaluation of laboratory method blanks and calibrations is also a means of assessing laboratory accuracy.

Accuracy for organic analyses will be measured via the percent recoveries for surrogate spikes and matrix spike/matrix spike duplicates. Accuracy for inorganic analyses will be measured via percent recoveries for matrix spikes and laboratory control samples. Internal laboratory control limits for accuracy, which are typically set at three times the standard deviation of a series of %R values, will be used by the laboratory for evaluation of accuracy.

3.3 COMPLETENESS

3.3.1 Definition

Completeness is a measure of the amount of usable, valid analytical data obtained, compared to the amount expected to be obtained. Completeness is typically expressed as a percentage. The equation for completeness is as follows:

$$\text{Completeness} = \frac{\text{(number of valid measurements)}}{\text{(number of measurements planned)}} \times 100\,\%$$

The ideal objective for completeness is 100 percent (i.e., every sample planned to be collected is collected; every sample submitted for analysis yields valid data). However, samples can be rendered unusable during shipping or preparation (e.g., bottles broken or extracts accidentally destroyed), errors can be introduced during analysis (e.g., exceedance of holding time, loss of instrument sensitivity, introduction of ambient laboratory contamination), or lack of homogenousness in the sample can become apparent (e.g., extremely high field duplicate RPDs).

These instances result in data that do not meet QC criteria. Based on these considerations, 95 percent is considered an acceptable target for the data completeness objective. If critical data points are lost, resampling and/or reanalysis may be required.

Laboratory data for the NAS Key West SSI will be reviewed, involving the evaluation of results based on holding times, blank contamination, and field duplicate precision. Data rejected as a result of this review process will be treated as incomplete data.

3.3.2 Field Completeness Objectives

Field completeness is a measure of the amount of valid field measurements obtained from all the field measurements taken in the project. Field completeness for this project is expected to be at least 95 percent.

3.3.3 Laboratory Completeness Objectives

Laboratory completeness is a measure of the amount of valid laboratory measurements obtained from all the laboratory measurements taken in the project. Laboratory completeness for this project is expected to be at least 95 percent. If critical data points are lost, resampling and/or reanalysis may be required.

3.4 REPRESENTATIVENESS

3.4.1 Definition

Representativeness is an expression of the degree to which the data accurately and precisely depict the actual characteristics of a population or environmental condition existing at an individual sampling point.

Use of standardized sampling, handling, analytical, and reporting procedures ensures that the final data accurately represent actual site conditions.

3.4.2 Measures to Ensure Representativeness of Field Data

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the Workplan is followed and that proper sampling techniques are used. The sampling and analysis plan for the NAS Key West SSI was designed to provide data representative of facility conditions. During development of the sampling and analysis plan, consideration was given to past waste disposal practices, existing analytical data, physical setting and processes, and constraints inherent to the CERCLA program. The rationale of the sampling and analysis plan is discussed in detail in Chapter 4.0 of the Workplan.

3.4.3 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing duplicate samples.

3.5 COMPARABILITY

3.5.1 Definition

Comparability is defined as the confidence with which one data set can be compared to another (e.g., between sampling points; between sampling events). Comparability is achieved by using standardized sampling and analysis methods and data reporting formats (including use of consistent units of measure and reporting of solid matrix sample results on a dry-weight basis). Additionally, consideration is given to seasonal conditions and other environmental variations that could exist to influence data results.

3.5.2 Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the Workplan is followed and that proper sampling techniques are used. It is also dependent on recording field measurements using the correct units. Field measurement units are further discussed in Section 9.1.1.

3.5.3 Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when similar sampling and analytical methods are used and documented. Results will be reported in units that ensure comparability with previous data and with current state and Federal standards and guidelines. Laboratory measurement units are further discussed in Section 9.1.2.

3.6 LEVEL OF QUALITY CONTROL EFFORT

Trip blank, rinsate blank, method blank, field water blank, field and laboratory duplicate, laboratory control, and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs. In addition, duplicate field measurements will be completed for temperature, pH, specific conductance, and turbidity.

External QC measures (i.e., field quality control samples) consist of field duplicates, trip blanks, and equipment rinsate blanks. Information gained from these analyses further characterizes the level of data quality obtained to support project goals. Each of these types of field quality control samples undergo the same preservation, analysis, and reporting procedures as the related environmental samples. Each type of field quality control sample is discussed below.

Field duplicates are either two samples collected independently at a sampling location (e.g., surface water), or a single sample homogenized and split into two portions. (Where VOCs are to be analyzed, the VOC sample aliquots are containerized first to avoid loss of constituents, then the remaining sample matrix is homogenized.) Field duplicates are collected and analyzed for chemical constituents to measure the precision of the sampling and analysis methods employed. The level of the QC effort will be one field duplicate for every 10 or fewer investigative samples.

Trip blanks, consisting of distilled water, will be submitted to the laboratory to provide the means to assess the quality of the data resulting from the field sampling program. Trip blanks pertain to samples for VOC analysis only. Trip blanks are used to assess the potential for contamination of VOCs resulting from contaminant migration into sample containers during sample shipment and storage. Trip blanks are prepared by the laboratory prior to the sampling event, shipped to the site with the sample containers, and kept with the investigative samples throughout the sampling event. They are then packaged for shipment with other VOC samples and sent for analysis. There should be one trip blank included in each sample shipping container that contains samples for VOC analysis. At no time after trip blank preparation are their sample containers opened before they reach the laboratory.

Equipment rinsate blanks are obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through sample collection equipment after decontamination and prior to use. One equipment blank will be collected per 20 pieces of like-equipment. If pre-cleaned, dedicated, or disposable sampling equipment is used, one rinsate blank per type of equipment used must be collected as a "batch blank." Rinsate blanks are analyzed for the same chemical constituents as the associated environmental samples.

One field water blank will be collected for each different water source used in cleaning and decontamination. These blanks will be analyzed for the complete set of environmental parameters presented in Tables E-1-1 and E-1-2, and will be used to ensure that field water sources are not a source of contamination.

Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures. Laboratory duplicate samples are analyzed for inorganic parameters to check for sampling and analytical reproducibility. Matrix spikes provide information about the effect of the sample matrix on the digestion and measurement methodology. All matrix spikes for organic analyses are performed in duplicate and are hereinafter referred to as MS/MSD samples.

MS/MSD samples are investigative samples. Soil MS/MSD samples require no extra volume for VOCs or extractable organics. However, aqueous MS/MSD samples must be collected at triple the volume for VOCs and extractable organics. One MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per sample matrix.

The level of QC effort provided by the laboratory will be equivalent to the level of QC effort specified under the appropriate SW-846 method parameters to be tested.

4.0 SAMPLING PROCEDURES

Field sampling procedures for the NAS Key West BRAC SSI are discussed in detail in Section 3.0 of the Workplan. The Workplan addresses the following sampling procedures and field investigation tasks:

- Field Documentation - Section 3.4.3
- Sample containers, preservatives, and volume requirements - Section 3.4.5
- Field equipment calibration - Section 3.4.7
- Soil sampling technique – 3.4.10.1
- Groundwater screening sample collection – 3.4.10.2.1
- Monitoring well installation and sampling - Section 3.4.10.2.2
- Groundwater-level measurement - Section 3.4.10.2.4
- Decontamination procedures - Section 3.4.11
- Sample packaging and shipment - Section 3.5.1.4
- Sample Quality Control - Section 3.5.2.2
- Surveying - Section 3.6
- Waste handling - Section 5.0

5.0 CUSTODY PROCEDURES

Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area. A sample or evidence file is under custody if:

- The item is in the actual physical possession of an authorized person
- The item is in view of the person after being in his or her possession
- The item was placed in a secure area to prevent tampering
- The item is in a designated and identified secure area with access restricted to authorized personnel only

The chain-of-custody (COC) report is a multi-part, standardized form used to summarize and document pertinent sample information, such as sample identification and type, matrix, date and time of collection, preservation, and requested analyses. Furthermore, through the sequential signatures of various sample custodians (e.g., sampler, airbill number, laboratory sample custodian), the COC report documents sample custody and tracking. Custody procedures apply to all environmental and associated field quality control samples obtained as part of the data collection system.

5.1 FIELD CUSTODY PROCEDURES

The FOL (or designee) is responsible for the care and custody of the samples collected until they are relinquished to the analyzing laboratory or entrusted to a commercial overnight courier. COC reports are completed for each sample shipment. The reports are filled out in a legible manner using waterproof ink and are signed (and dated) by the sampler. Pertinent notes, such as whether the sample was field filtered, or whether the sample is suspected to be high in contaminant concentration, are also indicated on the COC report. Information similar to that contained in the COC report is also provided on the sample label, which is securely attached to the sample bottle. COC report forms and sample labels will be supplied by the laboratory subcontractor. In accordance with NFESC guidelines, samples for chemical constituent analysis must be sent (for next-day receipt) to the laboratory within 24 hours of collection.

Full details regarding sample chain-of-custody (including use of custody seals and sample shipment protocols) are contained in Section 3.5 of the BRAC SSI Workplan. Section 3.4.3 of the BRAC SSI Workplan discusses other field records. Copies of all field data forms are provided in Appendix C of the BRAC SSI Workplan. All sample records are eventually docketed into the TtNUS project central file.

5.2 LABORATORY CUSTODY PROCEDURES

When samples are received by the laboratory subcontractor, the laboratory's sample custodian examines each cooler's custody seals to verify that they are intact and that the integrity of the environmental samples has been maintained. The sample custodian then signs the COC report. The custodian then opens the cooler and measures its internal temperature. The temperature reading is noted on the accompanying COC report. The sample custodian then examines the contents of the cooler. Sample container breakages or discrepancies between the COC report and sample label documentation are recorded. The pH of chemically preserved samples is checked using Hydrion paper and recorded. All problems or discrepancies noted during this process are to be promptly reported to the TtNUS Task Order Manager. Inter-laboratory chain-of-custody procedures and specific procedures for sample handling, storage, dispersement for analysis, and remnant disposal will be followed as specified by the subcontract laboratory's SOPs and/or QA Plan.

5.3 FINAL EVIDENCE FILES

The TtNUS central file will be the repository for all documents that constitute evidence relevant to sampling and analysis activities as described in this QA document. TtNUS is the custodian of the evidence file and maintains the contents of these files, including all relevant records, reports, logs, field notebooks, photographs, subcontractor reports and data reviews in a secure, limited access location and under custody of the TtNUS facility manager. The control file will include at a minimum:

- Field logbooks
- Field data and data deliverables
- Photographs
- Drawings
- Soil boring logs
- Laboratory data deliverables
- Data review reports
- Data assessment reports
- Progress reports, QA reports, interim project reports, etc.
- All custody documentation (chain-of-custody forms, airbills, etc.)

Upon completion of the contract, all pertinent files will be relinquished to the custody of the Navy.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

All instrumentation used to perform chemical measurements must be properly calibrated prior to use in order to obtain valid and usable results. The requirement to properly calibrate instruments prior to use applies equally to field instruments as it does to fixed laboratory instruments. Field instrument calibration is discussed in Section 6.1. Laboratory instrument calibration is discussed in Section 6.2.

6.1 FIELD INSTRUMENT CALIBRATION

Field instrument calibration is discussed in Section 3.4.7 of the attendant Workplan.

6.2 LABORATORY INSTRUMENT CALIBRATION

Calibration procedures for a specific laboratory instrument will consist of initial calibration (generally 3 to 5 points), initial calibration verification (inorganic methods only), and continuing calibration verification. In all cases, the initial calibration will be verified using an independently prepared calibration verification solution.

All standards used to calibrate analytical instruments must be obtained from National Institute of Standards and Technology (NIST) or through a reliable commercial supplier with a proven record for quality standards. All commercially supplied standards must be traceable to NIST reference standards, where possible, and appropriate documentation will be obtained from the supplier. In cases where documentation is not available, the laboratory will analyze the standard and compare the results to an EPA-supplied known or previous NIST-traceable standard.

The calibration procedures and frequencies used by the subcontract laboratory will comply with the applicable SW-846 analytical method. Brief descriptions of calibration procedures for major instrument types follow.

6.2.1 <u>GC/MS Volatile Organic Compound Analyses</u>

For VOCs, the gas chromatograph/mass spectrometer (GC/MS) system will be tuned and calibrated in accordance with SW-846 method 8260a/8260b. A bromofluorobenzene (BFB) instrument performance check (tuning check) must be run prior to the initial and each continuing calibration and must meet all method-specified criteria before analyses may continue. Initial calibration is required before any samples are analyzed and must include a blank and a minimum of five different concentrations as specified in the method. A BFB tuning check and a continuing calibration check, including the mid-range standard and a blank, must be performed at the beginning of each 12-hour shift during which analyses are performed.

6.2.2 GC/MS Semivolatile Organic Compound Analyses

For SVOCs, the GC/MS system will be tuned and calibrated in accordance with the SW-846 method 8270b/8270c. A decafluorotriphenyl phosphine (DFTPP) instrument performance check (tuning check) must be run prior to the initial and each continuing calibration and must meet all method-specified criteria before analyses may continue. Initial calibration is required before any samples are analyzed and must include a blank plus five different concentrations as specified in the method. A DFTPP tuning check and a continuing calibration check, including the mid-range standard and a blank, must be performed at the beginning of each 12-hour shift during which analyses are performed.

6.2.3 GC PCB Analyses Under SW-846 Method 8082

For PCB analyses, the GC system will be calibrated in accordance with SW-846 method 8081/8082. Initial calibration is required before any samples are analyzed. SW-846 method 8000 describes the proper calibration techniques for initial calibration and calibration verification. PCBs are to be determined as Aroclors for the NAS Key West BRAC SSI. Therefore, the initial calibration includes the analysis of five standards containing a mixture of Aroclor 1016 and Aroclor 1260 as well as the analysis of a single standard of each of the other five Aroclors for pattern recognition.

Every 12 hours, a calibration verification standard must be injected prior to conducting any additional sample analyses. A calibration standard must also be injected at intervals of not less than every 20 samples and at the end of the analysis sequence.

6.2.4 GC Herbicide Analyses

For herbicide analyses, the GC system will be calibrated in accordance with SW-846 method 8151a. SW-846 method 8000 describes the proper calibration techniques for initial calibration and calibration verification. A minimum of five calibration standards should be prepared and analyzed for initial calibration of each parameter of interest. One of the standards should be at a concentration near, but above, the detection limit. The remaining standards should correspond to the expected range of concentrations found in environmental samples or the working range of the GC. Calibration verification must be performed using a mid-point standard at the beginning of each 12-hour shift. A calibration standard must be injected at intervals of no less than every 20 samples and at the end of the analysis sequence.

6.2.5 Metals Analyses

6.2.5.1 Inductively Coupled Argon Plasma Analyses

Inductively coupled plasma (ICP) spectrometry systems will be calibrated for the analysis TAL metals in accordance with the SW-846 method 6010a/6010b. For all analytes and determinations, the laboratory must analyze a check standard and calibration blank immediately following the daily calibration, after every tenth sample, and at the end of the sample run. The calibration verification must be analyzed immediately following the daily calibration. Analysis of the check standard, calibration verification, and calibration blank must verify that the instrument is within 10 percent of calibration with a relative standard deviation of <3 percent from replicate (more than two) integrations.

6.2.5.2 Atomic Absorption Analyses

Graphite furnace and cold vapor atomic absorption (GFAA and CVAA) analyses will be calibrated in accordance with the appropriate SW-846 methods. Calibration curves are always required. A blank and at least three calibration standards in graduated amounts in the appropriate range of the linear portion of the curve should be prepared. A mid-range check standard must be run after every ten samples.

7.0 ANALYTICAL AND MEASUREMENT PROCEDURES

Samples will be subjected to field and laboratory parameter measurement as necessary based on the sample location under investigation. The analytical program for environmental samples collected at each anticipated location is provided in Chapter 3.0 of the Workplan.

Chemical/physical parameters to be measured using field instrumentation include VOCs as methane equivalents (breathing zone air and soil vapors), temperature, specific conductance, pH, and turbidity (groundwater samples). Measurement of field parameters and calibration of field instruments are discussed in Section 3.4.7 of the Workplan.

All groundwater and soil collected for fixed-laboratory analysis during the NAS Key West SSI will be analyzed by a NFESC-approved laboratory. The laboratory must also be certified by the Florida Department of Health-Division of Laboratory Services certified to perform the request analysis and have a current Florida Department of Environmental Protection (FDEP) approved comprehensive Quality Assurance Plan (CompQAP). Table 7-1 provides a summary of the laboratory analytical methods for the NAS Key West SSI.

A complete list of the target compounds/analytes and Estimated Quantitation Limits is provided in Section 1.3.2.2 of this QA document. All environmental data generated through use of SW-846 methods will be reported to the analyte's EQL. An analyte's EQL is based on the method detection limit with consideration given to required adjustments to ensure that the precision and accuracy requirements of the method are attainable. The EQLs provided in the tables in Section 1.3.2.2 are estimated since these values may vary based on the laboratory.

All solid sample results will be reported on a dry-weight basis. Quantitation limits will also be adjusted, as necessary, based on dilutions and sample volume.

TABLE E-7-1

SUMMARY OF ORGANIC AND INORGANIC ANALYTICAL PROCEDURES[1]
SOLID AND AQUEOUS MATRICES
NAS KEY WEST

Analytical Parameter	Analytical Method
TCL Volatile Organics	SW-846 Method 8260b
TCL Semivolatile Organics	SW-846 Method 8270c
TCL PCBs	SW-846 Method 8082
TAL Metals	SW-846 Method 6010b and 7000a Series
TCLP Herbicides (Regulatory List)	SW-846 Method 1311 Followed by Method 8151a
TCLP Volatile Organics (Regulatory List)	SW-846 Method 1311 Followed by Method 8260b
TCLP Semivolatile Organics (Regulatory List)	SW-846 Method 1311 Followed by Method 8270c
TCLP Organochlorine Pesticides (Regulatory List)	SW-846 Method 1311 Followed by Method 8081a
TCLP Metals (Regulatory List)	SW-846 Method 1311 Followed by Method 6010b and 7000a Series

1 U.S. EPA, 1997. Update and revisions to Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. SW-846, 3rd ed.

8.0 INTERNAL QUALITY CONTROL CHECKS

Field-related Quality Control checks were discussed in Chapter 3.0 of this QA document and in Section 3.5.2.2 of the attendant Workplan. This chapter provides additional information regarding internal quality control checks for the field and the laboratory.

8.1 FIELD QUALITY CONTROL CHECKS

Quality Control procedures for pH, specific conductance, temperature, and turbidity will include calibrating the instruments as described in Section 3.4.7 of the BRAC SSI Workplan. Assessment of field sampling precision and bias will be made by collection of field duplicates and rinsate blanks for laboratory analysis as discussed in Section 3.6 of these QA Elements.

8.2 LABORATORY QUALITY CONTROL CHECKS

The subcontract laboratory will have a Quality Control program that ensures the reliability and validity of the analyses performed at the laboratory. Internal quality control procedures for SW-846 will comply with the applicable analytical method requirements.

Several internal laboratory Quality Control checks are briefly discussed in the remainder of this section.

Laboratory method blanks are prepared and analyzed in accordance with the analytical method employed to determine whether contaminants originating from laboratory sources have been introduced and have affected environmental sample analyses. A method blank generally consists of an aliquot of analyte-free water (or purified sodium sulfate for soil/sediment samples) that is subjected to the same preparation and analysis procedures as the environmental samples undergoing analysis. With the exception of recognized volatile and semivolatile common laboratory contaminants (i.e., methylene chloride, acetone, 2-butanone, and phthalate esters) detected through use of the organic method, method blanks must not contain levels of target analytes above the reported quantitation limits. If method blank contamination is found to exist above allowable limits, corrective actions indicated in the appropriate method or laboratory SOPs must be followed. Under no circumstances are laboratory method blank contaminant values subtracted from environmental sample analysis results.

Matrix spike analysis for organic fraction analyses is performed in duplicate as a measure of laboratory precision. For inorganic analyses, one matrix spike and one **laboratory duplicate** analysis are performed for every 20 environmental sample analyses of like matrix. With the exception of VOC MSD analyses, laboratory duplicates are prepared by thoroughly mixing and splitting a sample aliquot into two portions and analyzing each portion following the same analytical procedures that are used for the environmental sample analyses. For VOC MSD analyses, a second sample aliquot is used for analysis in order to avoid VOC constituent loss through the homogenization process. The field crew provides extra volumes of sample matrices designated for laboratory quality control analyses, as required. As discussed in Chapter 3.0 of this QA document, control limits for matrix spike and laboratory duplicate analyses are established by the laboratory for SW-846 analyses.

Surrogates are organic compounds (typically brominated, fluorinated, or isotopically labeled), which are similar in nature to the compounds of concern, and which are not likely to be present in environmental media. Surrogates are spiked into each sample, standard, and method blank prior to analysis, and are used only in organic chromatographic analysis procedures as a check of method effectiveness. As discussed in Chapter 3.0, surrogate recoveries are evaluated against control limits specified in the method, where applicable, or laboratory-derived control limits.

Laboratory control samples (LCS) serve to monitor the overall performance of each step during the analysis, including the sample preparation. Laboratory control sample analysis will be performed as specified in the applicable analytical method. Aqueous LCS results must fall within control limits specified in the method, where applicable, or established by the laboratory. Solid LCS results must fall within the control limits established by the supplier of the LCS standard. Aqueous and solid LCSs shall be analyzed utilizing the same sample preparations, analytical methods, and QA/QC procedures as employed for the samples.

Internal standard performance criteria ensure that GC/MS analysis sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (- 50% to + 100%) from the associated 12-hour calibration standard. The retention time of the internal standards in samples and blanks must not vary by more than ±30 seconds from the retention time of the associated 12-hour calibration standard.

9.0 DATA REDUCTION, REVIEW, AND REPORTING

This section describes the procedures to be used for data reduction, review, and reporting for the NAS Key West SSI. All data generated during the course of the investigation will be stored by TtNUS in the Aiken Office central files. Upon completion of the contract, all files will be relinquished to the United States Navy.

9.1 DATA REDUCTION

Data reduction will be completed for both field measurements and laboratory-generated analytical data. Field data reduction will be relatively limited versus the degree of laboratory data reduction required for the project. Reduction of both field data and laboratory data are discussed in the remainder of this section.

9.1.1 Field Data Reduction

Field data will be generated as a result of real time measurement of organic vapor concentrations via a PID or FID (for health and safety monitoring and soil screening) and through on-site water quality testing for general indicator parameters including pH, specific conductance, turbidity, and temperature.

Field measurements of organic vapor concentrations (parts per million on a volume/volume basis relative to methane or benzene) will be recorded in the site logbook and incorporated into the BRAC SSI Report. General water quality indicator parameters will also be recorded in the site logbook and on sample logsheets immediately after the measurements are taken and later encoded in the NAS Key West data base for presentation in the SSI Report. If an error is made in the logbook, the error will be legibly crossed out (single-line strikeout), initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. No calculations will be necessary to reduce these data for inclusion in the SSI Report. Field data will be entered in the electronic data base manually, and the entries will be verified by an independent reviewer to make sure that no "transcription" errors occurred. General groundwater quality data and field screening data will be recorded and reported in the following units:

- Hydronium ion concentration (standard pH units)
- Temperature (degrees Celsius)
- Specific Conductance (microohms)
- Turbidity (Nephelometric turbidity units)

Standard pH units as specified above is the negative logarithm (base 10) of the hydronium ion concentration in moles/liter.

9.1.2 Laboratory Data Reduction

Data reduction for laboratory analytical data generated via SW-846 analyses will be completed in accordance with the applicable analytical method. Laboratory analytical data will be reported using standard concentration units to ensure comparability with regulatory standards/guidelines and previous analytical results. Reporting units for solid and aqueous matrices for the classes of chemicals under consideration are as follows:

- Groundwater samples/aqueous waste:
  - TCL volatiles, semivolatiles, and PCBs - µg/L
  - TAL metals - µg/L
- Soil samples/solid waste:
  - TCL volatiles, semivolatiles, and PCBs - µg/kg
  - TAL metals - mg/kg
  - TCLP parameters - mg/L

Field Quality Control sample results will be included in the data base for the NAS Key West SSI. Specifically, the analytical results for trip blanks, rinsate blanks, and field water blanks will be provided. The results for field Quality Control Samples will be considered during the course of data review (in concert with laboratory method blanks) to eliminate false positive results according to the 5- and 10-times rules specified in the National Functional Guidelines for Organic and Inorganic Data Review. The results for laboratory Quality Control samples such as method blanks will not be presented in the SSI Report data base. In addition, only the original (unspiked) sample results for MS/MSD samples will be provided in the data base.

9.2 DATA REVIEW

Review of field measurements and laboratory analytical data are discussed in this section. Validation of field measurements is discussed in Section 9.2.1. Review of laboratory analytical data is discussed in Section 9.2.2.

9.2.1 Field Measurement Data Review

Field measurements will not be subjected to a formal data validation process. However, field technicians will ensure that the equipment used for field measurement is performing accurately via compliance with the Standard Operating Procedures discussed in Chapter 6.0 of this QA document. As described in Section 9.1.1, all field data entered into the electronic database will be independently reviewed for transcription errors.

9.2.2 Laboratory Data Review

All electronic laboratory data will be completely verified against supporting documentation including the COC and the results reported on the certificate of analysis.

All QC sample results will be reviewed, evaluated, and used as basis for rejecting sample data. Particular emphasis will be placed on holding time compliance, calibrations, duplicate results, and blank results.

9.3 DATA REPORTING

9.3.1 Field Measurement Data Reporting

Field data will be reported in the units discussed in Section 9.1.1. The SSI Report will include a comprehensive data base including all field measurements (specifically organic vapor concentrations, pH, specific conductance, temperature, and turbidity). Field measurements will be transferred manually from the site logbook or sample logsheets to the electronic data base and will be reviewed for accuracy by an independent reviewer. Transcription of field measurements to the electronic data base will be completed shortly after completion of the field investigation.

All records regarding field measurements (i.e., field logbooks, sampling logbooks, and sample logsheets) will be placed in the Aiken Office central files upon completion of the field effort. Entry of these results in the data base will require removal of these results from the files. Outcards will be used to document the removal of any such documentation from the files (date, person, subject matter). Field measurement data will be reported in an appendix of the SSI Report at a minimum and may also be reported in summary fashion if they are indicative of the presence of contamination (e.g., high specific conductance readings).

9.3.2 Laboratory Data Reporting

Certificates of analysis (consisting of analytical results and qualifiers for each parameter) and associated initial and continuing calibration summaries will be provided by the laboratory for each Sample Delivery Group for all environmental samples, field quality control samples, and laboratory method blanks. Case narratives will also be provided.

All environmental and field Quality Control sample results (trip blanks, duplicates, rinsate blanks, field water blanks) will be included in the SSI Report as an appendix. The data base will include pertinent sampling information such as sample number, sampling date, general location, depth, and survey coordinates (if applicable). Sample-specific detection limits will be reported for nondetected analytes. Units will be clearly summarized in the data base and will conform to those identified in Section 9.1.2. The analytical data may also be reported in summary fashion within the body of the SSI Report text in tabular and graphic fashion.

Data will be handled electronically pursuant to the electronic deliverable requirements specified in TtNUS's Basic Ordering Agreement with analytical laboratories. This agreement requires the analytical laboratories to provide data in both hardcopy and electronic form (DBF files). The original electronic diskettes and the original hardcopy analytical data are maintained in the Aiken Office central files as received.

The data review process, as described in Section 9.2, will be completed using the hard copy data. Upon completion of the data review process, any rejected data will be appropriately qualified in the electronic database, and all electronic data will then be independently verified against the supporting documentation. Any discrepancies will be brought to the attention of the laboratory, as needed, clarified, and corrected.

10.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits will be performed periodically to ensure that work is being implemented in accordance with the approved Project Plans and in an overall satisfactory manner. Such audits will be performed by various personnel and will include evaluation of field, laboratory, data review, and data reporting processes. Examples of pertinent audits are as follows:

- The FOL will supervise and check daily that the field measurements are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and fieldwork is documented accurately and neatly.

- Performance and system audits for the laboratory will be performed regularly by a U.S. Navy contractor in accordance with Naval Facilities Engineering Services Command (NFESC) requirements, and in accordance with the Laboratory Quality Assurance Plan.

- Data review, as described in Section 9.2, will occur in a timely manner. The data reviewer will generate a summary report describing data limitations, which will be reviewed internally by the Data Validation Coordinator prior to submittal to the Task Order Manager.

- A formal audit of the field sampling procedures may be conducted by the TtNUS Quality Assurance Manager (QAM) or designee in addition to the auditing that is an inherent part of the daily project activities. The purpose of this audit is to ensure that sample collection, handling, and shipping protocols, as well as equipment decontamination and field documentation procedures, are being performed in accordance with the approved Project Plans and SOPs.

- The Task Order Manager will maintain contact with the FOL and Data Review Coordinator to ensure that management of the acquired data proceeds in an organized and expeditious manner.

11.0 PREVENTIVE MAINTENANCE PROCEDURES

Measuring equipment used in environmental monitoring or analysis for the NAS Key West SSI shall be maintained in accordance with the manufacturer's operation and maintenance manuals. Equipment and instruments shall be calibrated in accordance with the procedures, and at the frequency, discussed in Chapter 6.0 (Calibration Procedures and Frequency). Preventive maintenance for field and laboratory equipment is discussed in the remainder of this section.

11.1 FIELD EQUIPMENT PREVENTIVE MAINTENANCE

TtNUS has established a program for the maintenance of field equipment to ensure the availability of equipment in good working order when and where it is needed. This program consists of the following elements:

- The TtNUS equipment manager keeps an inventory of the equipment in terms of items (model and serial number), quantity, and condition. Each item of equipment is signed out when in use, and its operating condition and cleanliness checked upon return.

- The equipment manager conducts routine checks on the status of equipment and is responsible for the stocking of spare parts and equipment readiness. The equipment manager also maintains the equipment manual library.

- The FOL is responsible for working with the equipment manager to make sure that the equipment is tested, cleaned, charged, and calibrated in accordance with the manufacturer's instructions and TtNUS SOPs before being taken to the job site and during field activities.

- During calibration, an appropriate maintenance check is performed on each piece of equipment. Any problems encountered while operating the instrument will be recorded in the field log book including a description of the symptoms and corrective actions taken.

- If problem equipment is detected or should require service, the equipment will be logged, tagged, and segregated from equipment in proper working order. Use of the instrument will not be resumed until the problem is resolved.

Preventive maintenance of field equipment is further described in Section 4.5.10 of the attendant Workplan.

11.2 LABORATORY INSTRUMENT PREVENTIVE MAINTENANCE

Proper maintenance of laboratory instruments and equipment is essential to ensuring their readiness when needed. Dependent on manufacturer's recommendations, maintenance intervals are established for each instrument. All instruments must be labeled with a model number and serial number, and a maintenance logbook must be maintained for each instrument. Personnel must be alert to the maintenance status of the equipment they are using at all times.

11.2.1 Major Instruments

Table E-11-1 provides a summary of preventive maintenance procedures typically performed for key analytical instruments. Maintenance of key instruments is sometimes covered under service contracts with external firms. These contracts provide for periodic routine maintenance to help guard against unexpected instrument downtime. The contracts also provide for quick response for unscheduled service calls when malfunctions are observed by the operator.

The use of manufacturer recommended grades or better of supporting supplies and reagents is also a form of preventive maintenance. For example, gases used in the various gas chromatography and metals instruments are of sufficient grade to minimize fouling of the instrument. The routine use of septa, chromatographic columns, ferrules, AA furnace tubes, and other supporting supplies from reputable manufacturers will assist in averting unnecessary periods of instrument downtime.

11.2.2 Refrigerators/Ovens

The temperatures of refrigerators used for sample storage and drying ovens will be monitored a minimum of once daily. The acceptable range for refrigerator temperatures is 4°C ± 2°C. Required temperatures of ovens will vary based on the analytical methods for which the ovens are used. The temperatures will be recorded on temperature logs. The logs will contain the following information at a minimum:

- Date
- Temperature
- Initials of person performing the check

TABLE E-11-1

**TYPICAL PREVENTIVE MAINTENANCE FOR KEY ANALYTICAL INSTRUMENTS
NAS KEY WEST**

Instrument	Preventive Maintenance	Maintenance Frequency
GC/MS	Volatiles: Bake oven, replace septum, check carrier gas. Semivolatiles: Replace the septum, clean injection port, replace liner, bake oven, check carrier gas, clean the source. Replace solvent washes and clean syringe.	As required. As required. Daily.
GC	Replace solvent washes and clean syringe. Clip column, clean injection port, replace liner, and bake oven.	Daily. As required.
ICP	Change sample introduction tubing, clean nebulizer, clean spray chamber, clean torch, manual profile, and automatic profile optics.	As required.
GFAA	Clean contact cylinders, replace/clean tube, check lamp alignment.	As required.
CVAA	Change sample introduction tubing, change drying cell, re-zero detector.	As required.

Maintenance of the logs is typically the responsibility of the sample custodian. However, assignment of responsibilities for temperature monitoring to specific personnel does not preclude the participation of other laboratory personnel. If unusual temperature fluctuations are noted, it is the responsibility of the observer to immediately notify the person in charge of the discrepancy before the condition of the samples is compromised.

Unstable or fluctuating temperatures may be indicative of malfunctions in the cooling or heating system. On the other hand, the instability may be due to frequent opening of the door. Regardless of the cause, such an observation must be investigated, and modifications must be made to access procedures or repairs to equipment must be made to prevent jeopardizing the integrity of the samples.

12.0 CORRECTIVE ACTION

Under the TtNUS QA/QC program, it is required that any and all personnel noting conditions adverse to quality report these conditions immediately to the Task Order Manager and QAM. These parties, in turn, are charged with performing root-cause analyses and implementing appropriate corrective action in a timely manner. It is ultimately the responsibility of the QAM to document all findings and corrective actions taken and to monitor the effectiveness of the corrective measures performed.

12.1 FIELD CORRECTIVE ACTION

Field nonconformances or conditions adverse to quality must be identified and corrected as quickly as possible so that work integrity or quality of product is not compromised. The need for corrective action may arise based on deviations from Project Plans and procedures, adverse field conditions, or other unforeseen circumstances. Corrective action needs may become apparent during the performance of daily work tasks or as a consequence of internal or external field audits.

Corrective action may include resampling and may involve amending previously approved field procedures. If warranted by the severity of the problem (e.g., if a change in the approved Project Plan documents or SOPs is required), the Navy will be notified in writing via a Field Task Modification Request (FTMR), and Navy (in conjunction with U.S. EPA Region IV and FDEP) approvals will be obtained. The FOL is responsible for initiating FTMRs; an FTMR will be initiated for all deviations from the Project Plan documents, as applicable. An example of an FTMR is provided as Figure 13-1. Copies of all FTMRs will be maintained with the onsite project planning documents and will be placed in the final evidence file.

Minor modifications to field activities such as a slight offset of a boring location will be initiated at the discretion of the FOL, subject to onsite approval by NAS Key West personnel. Approval for major modifications (e.g., elimination of a sampling point) must be obtained via an FTMR.

12.2 LABORATORY CORRECTIVE ACTION

In general, laboratory corrective actions are warranted whenever an out-of-control event or potential out-of-control event is noted. The specific corrective action taken depends on the specific analysis and the

Client Identification | Project Number | TMR Number

To ______________ Location ______________ Date ________

Description:

Reason for Change:

Recommended Disposition:

Field Operations Leader (Signature, if applicable) Date

Disposition:

Task Order Manager (Signature, if required) Date

Distribution:
Program Manager
Quality Assurance Officer
Task Order Manager
Field Operations Leader

Others as required ______________

FIGURE E-12-1

TETRA TECH NUS, INC.
FIELD TASK MODIFICATION REQUEST FORM

nature of the event. Generally, the following occurrences alert laboratory personnel that corrective action may be necessary:

- QC data are outside established warning or control limits
- Method blank analyses yield concentrations of target analytes above acceptable levels
- Undesirable trends are detected in spike recoveries or in duplicate RPDs
- There is an unexplained change in compound detection capability
- Inquiries concerning data quality are received
- Deficiencies are detected by laboratory QA staff audits or from performance evaluation sample test results.

Corrective actions are typically documented for out-of-control situations on a corrective action form. Using a corrective action form, any employee may notify the QA/QC Officer of a problem. The QA/QC Officer generally initiates the corrective action by relating the problem to the appropriate Laboratory Manager and/or Internal Coordinator, who then investigates or assigns responsibility for investigating the problem and its cause. Once determined, an appropriate corrective action is approved by the QA/QC Officer. Its implementation is verified and documented on the corrective action form and is further documented through audits.

12.3 CORRECTIVE ACTION DURING DATA REVIEW AND DATA ASSESSMENT

The need for corrective action may become apparent during data review, interpretation, or presentation activities, or problems may be identified as a result of oversight findings. The performance of rework, instituting a change in work procedures, or providing additional/refresher training are possible corrective actions relevant to data evaluation activities. The Task Order Manager will be responsible for approving the implementation of corrective action.

13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance reports to management will be provided in three primary formats during the course of the NAS Key West investigation. A data review summary will be prepared to summarize Quality Assurance issues for the subcontract laboratory data. In addition, written weekly reports summarizing accomplishments and Quality Assurance/Quality Control issues during the field investigation will be provided by the Field Operations Leader. Finally, monthly progress reports will be provided by the Task Order Manager.

13.1 CONTENTS OF PROJECT QUALITY ASSURANCE REPORTS

The contents of the specific Quality Assurance reports are as follows. The data review summary will address all major laboratory noncompliances as well as noted sample matrix effects. In the event that major problems occur with the analytical laboratory (e.g., extreme holding time exceedances or calibration noncompliances, etc.) the Data Review Coordinator will notify the Task Order Manager, the Technical Program Manager, and the Laboratory Services Coordinator. Such notifications (if necessary) are typically provided via internal memoranda and are placed in the project file. Such reports contain a summary of the noncompliance, a synopsis of the impact on individual projects, and recommendations regarding corrective action and compensational adjustments. Corrective actions are initiated at the program level.

The Field Operations Leader will provide the Task Order Manager with weekly reports regarding accomplishments, deviations from the Workplan, upcoming activities, and a Quality Assurance summary during the course of the field investigation. In addition, monthly project review meetings are held for all active Navy CLEAN projects. Issues discussed at the project review meeting include all aspects of budget and schedule compliance, and Quality Assurance/Quality Control problems. The Task Order Manager provides a monthly progress report to the Navy which addresses the project budget, schedule, accomplishments, planned activities, required revisions of this QA document, and Quality Assurance/Quality Control issues and intended corrective actions.

13.2 INDIVIDUALS RECEIVING/REVIEWING QUALITY ASSURANCE REPORTS

Data review summaries are provided to the Task Order Manager for inclusion in the project files. In the event that major problems are observed for a given laboratory, the Program Manager, Deputy Program Manager, Quality Assurance Manager, Task Order Manager, and Laboratory Services Coordinator are provided with copies of the QA report. Weekly field progress reports are provided to the Task Order Manager. Monthly progress reports are provided to the Navy CLEAN Program Manager.