PROJECT OPERATIONS PLAN FOR SITE INVESTIGATIONS AND REMEDIAL INVESTIGATIONS VOLUME I OF II NTC ORLANDO FL

8/1/1997

ABB ENVIRONMENTAL SERVICES, INC

PROJECT OPERATIONS PLAN FOR SITE INVESTIGATIONS AND REMEDIAL INVESTIGATIONS

VOLUME I OF II

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

UNIT IDENTIFICATION CODE: N65928
CONTRACT NO.: N62467-89-D-0317/107

AUGUST 1997

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

NAVAL AIR STATION
ORLANDO, FLORIDA
VOLUME I OF II

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Prepared by:

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Barbara Nwokike, Code 1873, Remedial Project Manager

August 1997

UNITED STATES NAVY
NAVAL FACILITIES ENGINEERING COMMAND

CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/107 are complete and accurate and comply with all requirements of this contract.

DATE: September 10, 1997

NAME AND TITLE OF CERTIFYING OFFICIAL: John Kaiser
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Richard Allen
Project Technical Lead

(DFAR 252.227-7036)

This planning document describes the Project Operations Plan, Naval Training Center, Orlando and has been prepared under the direction of a Florida-registered professional geologist. The work and professional opinions rendered in this report were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice.

P. Greg Mudd, P.G.

Professional Geologist
License No. 1521
Expires July 31, 1998

FOREWORD

The process used to determine installations for closure or realignment was identified in the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510, 104 Statute 1808). Installations recommended for closure or realignment were selected based on force structure provided by the Joint Chiefs of Staff and criteria established by the Secretary of Defense. These criteria were approved by Congress and published in the Federal Register. A consolidated Department of Defense (DOD) list was submitted by the Secretary of Defense to a bipartisan commission appointed by the President and confirmed by the Senate. This Commission evaluated the Secretary's recommendations and sent its finding to the President. In 1993, the Commission recommended the closure of Naval Training Center (NTC), Orlando, Florida.

Pertinent environmental legal provisions with jurisdiction at Base Realignment and Closure installations include the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, amended by the 1986 Superfund Amendments and Reauthorization Act, the Resource Conservation and Recovery Act, and the 1984 Hazardous and Solid Waste Amendments. The DOD conducts an Installation Restoration (IR) program for evaluating and remediating problems related to releases and disposal of toxic and hazardous materials at DOD facilities. The Naval Assessment and Control of Installation Pollutants program was developed by the Navy to implement the IR program for all Naval and Marine Corps facilities. Southern Division, Naval Facilities Engineering Command has the responsibility for administration of the Navy IR program in the southeastern United States.

This Project Operations Plan (POP) has been developed by ABB Environmental Services, Inc. (ABB-ES), to ensure proper conduct of work at NTC, Orlando. The POP has been designed to incorporate the requirements of a Quality Assurance Project Plan, Health and Safety Plan, and elements of a Field Sampling Plan (FSP) related to sampling equipment, procedures, and sample handling and analysis. Other FSP elements, including sampling objectives and sample location and frequency, will be addressed in task-specific workplans.

This POP is a dynamic document and will be modified as necessary during the course of investigations at NTC, Orlando. A revision block has been included at the top of each page to track subsequent generations of the document. ABB-ES has prepared this document to include specific procedures that are standards for ABB-ES and subcontractors selected for the NTC, Orlando effort.

Questions regarding this plan should be addressed to the Southern Division BRAC Environmental Coordinator for NTC, Orlando, Mr. Wayne Hansel, at (407) 646-5294 or the Southern Division Remedial Project Manager, Ms. Barbara Nwokike at (803) 820-5566.

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
ASTM	American Standards and Test Methods
BCT	BRAC Cleanup Team
bls	below land surface
BOCC	Board of County Commissioners
BRAC	Base Realignment and Closure
°C	degrees Celsius
CA	contamination assessment
CAF	Corrective Action Form
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action, Navy
CLP	Contract Laboratory Program
CLP-RAS	Contract Laboratory Program, Routine Analytical Services
COC	chain of custody
CompQAP	Comprehensive Quality Assurance Plan
CPT	cone penetrometer testing
CTO	contract task order
dbh	diameter at breast height
DERP	Defense Environmental Restoration Program
DO	dissolved oxygen
DOD	Department of Defense
DON	Department of Navy
DOT	Department of Transportation
DPDO	Defense Property Disposal Office
DPT	direct-push technology
DQOs	data quality objectives
DRMO	Defense Reutilization and Marketing Office
EBS	Environmental Baseline Survey
EISOPQAM	Environmental Investigation Standard Operating Procedures and Quality Assurance Manual
ECD	electron capture detector
EIC	Engineer-in-Charge
EOD	explosive ordnance disposal
°F	degrees Fahrenheit
FDEP	Florida Department of Environmental Protection
FGFWFC	Florida Game and Freshwater Fish Commission
FID	flame ionization detector
FOL	Field Operations Leader
GC	gas chromatograph
GC/MS	gas chromatograph/mass spectrometer
GPR	ground-penetrating radar

GLOSSARY (Continued)

HASP	Health and Safety Plan
HSA	hollow-stem auger
IAS	Initial Assessment Study
ID	inside diameter
IDW	investigation-derived wastes
IR	Installation Restoration
IRA	interim remedial action
ℓ/min	liters per minute
µg/ℓ	micrograms per liter
msl	mean sea level
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NCR	Nonconformance Report
NEESA	Naval Energy and Environmental Support Activity
NGVD	National Geodetic Vertical Datum
NTC	Naval Training Center
NTUs	nephelometric turbidity units
OAFB	Orlando Air Force Base
OD	outside diameter
OPT	Orlando Partnering Team
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OU	operable unit
OVA	organic vapor analyzer
OVM	organic vapor meter
PARCC	precision, accuracy, representativeness, completeness, and comparability
PBS&J	Post, Buckley, Schuh, & Jernigan, Inc.
PCBs	polychlorinated biphenyls
PCE	perchloroethylene or tetrachloroethene
%D	percent difference
PID	photoionization detector
POI	point of interest
PM	project manager
POP	Project Operations Plan
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
PWC	public works center
QA	quality assurance
QAC	Quality Assurance Coordinator
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	quality control

GLOSSARY (Continued)

RAP	remedial action plan
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SI	Site Investigation
SMSA	Standard Metropolitan Statistical Area
SOPs	standard operating procedures
SOUTHNAV-FACENGCOM	Southern Division, Naval Facilities Engineering Command
SS	site screening
SVOCs	semivolatile organic compounds
TC	terrain conductivity
TCE	trichloroethene
TCLP	Toxicity Characteristic Leachate Procedure
TDMD	time domain metal detection
TIP	total ionizables present
TOC	total organic carbon
TOM	Task Order Manager
TPH	total petroleum hydrocarbons
TSS	total suspended solids
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UST	underground storage tank
UXO	unexploded ordnance
VOA	volatile organic analytes
VOCs	volatile organic compounds
WWTP	wastewater treatment plant

1.0 PROJECT DESCRIPTION AND RATIONALE

1.1 PURPOSE. This Project Operations Plan (POP) has been prepared as a component of Contract Task Order (CTO) 107 under Navy Contract N62467-C-0317 as guidance for the conduct of environmental investigations under Base Realignment and Closure (BRAC) 1993. It addresses tasks completed under CTOs 107, 135, and 136. The purpose of this plan is to define responsibilities and authorities for data quality and to prescribe requirements for assuring that the field exploration activities undertaken by all consultants at Naval Training Center (NTC), Orlando, Florida, are planned and executed in a manner consistent with Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), U.S. Environmental Protection Agency (USEPA) Region IV Environmental Investigation Standard Operating Procedures and Quality Assurance Manual (EISOPQAM) (USEPA, 1996), and Florida Department of Environmental Protection (FDEP) quality assurance (QA) program objectives. In the event of a conflict, USEPA Region IV guidelines will be followed. This POP includes specific elements of a Sampling and Analysis Plan (SAP) and Health and Safety Plan (HASP). The USEPA (1984) has prepared guidance on the preparation of a POP in *Guidance for Preparation of Combined Work/Quality Assurance Project Plans for Environmental Monitoring*. The guidance was designed to eliminate the necessity for preparation of multiple, redundant documents.

This POP provides guidance and specifications to ensure that

- samples are obtained under controlled conditions, using appropriate and documented procedures;
- samples are identified uniquely and controlled through sample tracking systems and chain-of-custody (COC) protocols;
- field determinations and laboratory analytical results are of known quality and are valid and consistent through the use of certified methods, preventive maintenance, calibration and analytical protocols, quality control (QC) measurements, review, correction of out-of-control situations, and audits;
- calculations and evaluations are accurate, appropriate, and consistent throughout the project;
- generated data are validated and their use in calculations is documented;
- safety is maintained by requiring that health and safety staff are included in the project organization; and
- records are retained as documentary evidence of the quality of samples, applied processes, equipment, and results.

The requirements of this POP apply to all consultant and subcontractor activities related to the collection of environmental measurements at NTC, Orlando. The POP adheres to the requirements and guidelines contained in the USEPA Region IV EISOPQAM (USEPA, 1996) and *Comprehensive Quality Assurance Plan, Florida*

Operations and CLEAN Operations (ABB Environmental Services, Inc. [ABB-ES], 1993) for collection and analysis of samples.

Installation of borings and monitoring wells and land survey locations will be consistent with SOUTHNAVFACENGCOM *Monitoring Well Design, Installation, Construction, and Development Guidelines* (Appendix A) and USEPA Region IV EISOPQAM guidance. In the event of a conflict, the USEPA specifications will be followed with the exception of the use of well materials (see Appendix A).

The organizational responsibilities and interactions outlined in Chapter 2.0 extend to all quality-related controls and activities. The QC and QA elements described in each subsequent chapter are designed to prevent systematic or random deviations in quality from the prescribed protocols and to document the quality of all data.

The laboratory analytical program will be conducted by an FDEP and Naval Energy and Environmental Support Activity (NEESA)-approved Contract Laboratory program (CLP) laboratory. Samples will be analyzed by USEPA-approved methods and will be subject to QA and QC requirements specified by USEPA.

The HASP (Volume II of this POP) has been prepared in conformance with Occupational Safety and Health Administration (OSHA) Regulations 29 Code of Federal Regulations (CFR), Part 1910.120, and NTC, Orlando safety requirements. The HASP references appropriate information contained in previous investigative documents from NTC, Orlando.

1.2 PROJECT DESCRIPTION. The objective of the overall project at NTC, Orlando is to perform site screening (SS) surveys, site investigations (SIs), and remedial investigations (RIs) in accordance with all relevant State and USEPA guidance. Preliminary Assessment activities are summarized in the Environmental Baseline Survey (EBS) for NTC, Orlando (ABB-ES, 1994).

The SS/SI/RI program can include, but is not limited to, any of the following basic elements:

- monitoring well installation and groundwater sampling,
- soil boring and soil sampling,
- test pitting and soil sampling,
- geophysical surveying,
- soil gas sampling,
- surface water and sediment sampling,
- surface soil sampling,
- unexploded ordnance (UXO) clearance surveying,
- water-level measurement and aquifer testing,

- TerraProbe[SM] (direct push) soil and groundwater sampling and microwell installation,
- field gas chromatograph (GC) and immunoassay analyses,
- cone penetrometer testing (CPT),
- geotechnical laboratory testing,
- investigation-derived waste (IDW) management,
- chemical analysis,
- location and elevation surveying,
- site characterization, and
- public health evaluation and environmental assessment.

Samples from a variety of environmental media will be collected during the NTC, Orlando field program. Media to be sampled include surface soils, subsurface soils, surface water, sediment, and groundwater. These samples will be analyzed for a variety of inorganic and organic chemicals. Analyses may include

- volatile organic compounds (VOCs);
- semivolatile organic compounds (SVOCs);
- total petroleum hydrocarbons (TPH);
- inorganic compounds;
- pesticides and polychlorinated biphenyls (PCBs);
- herbicides;
- radionuclides;
- explosives;
- Toxicity Characteristic Leachate Procedure (TCLP) for specific elements;
- Resource Conservation and Recovery Act waste characterization parameters (ignitability, reactivity, and corrosivity);
- total organic carbon (TOC);
- anions and cations such as chloride, sulfate, and nonspecific nitrate plus nitrite; and
- water quality parameters such as pH, hardness, alkalinity, and total suspended solids (TSS).

1.3 FACILITY BACKGROUND. NTC, Orlando encompasses 2,072 acres in Orange County, Florida, and consists of four discrete facilities: Main Base, Area C, Herndon Annex, and McCoy Annex (Figures 1-1 and 1-2).

1.3.1 Facility Location and Land Use The Main Base occupies 1,095 acres located approximately 3 miles east of Interstate 4 and north of State Road 50 (Figures 1-2 and 1-3). The Main Base is surrounded by urban development, including single and multifamily housing, schools, and commercial buildings. Land uses directly west and northeast of the area are primarily residential. Small areas of commercial development occur to the southwest. Herndon Airport is located 1.5 miles south of the Main Base. No industrial facilities exist adjacent to the Main Base, with the exception of automotive repair facilities along Bennett Road on the southwest property line.

Area C occupies 46 acres and is located approximately 1 mile west of the Main Base off Maguire Boulevard (Figure 1-3). Area C is surrounded by urban development, with multifamily residential development to the north, an office park to the east, single family residences to the west and south, and a single family residential development to the north, across Lake Druid. No industrial facilities exist adjacent to Area C.

Herndon Annex occupies 54 acres approximately 1.5 miles south of the Main Base (Figure 1-3), within the confines of the general aviation Herndon Public Airport and on the fringe of a major residential area.

The McCoy Annex includes 877 acres and is located 12 miles south of the Main Base, west of Orlando International Airport (Figure 1-4). The western boundary of the McCoy Annex is flanked by industrially zoned property. The zoning allows heavy industry and aviation related development, although the area is not currently developed. The Beeline Expressway, a major highway running east and west through Orange County, forms the northern boundary of the Annex. The property north of the Beeline and within 0.75 mile of the McCoy Annex is used primarily by businesses directly related to the airport, such as rental agencies, hotels, and restaurants. Adjacent to the southern boundary are undeveloped woodlands (C.C. Johnson, 1985).

1.3.2 History of Operations The land-use history of NTC, Orlando dates to the construction of the original Orlando Municipal Airport prior to 1940. In August 1940, the municipal airport was taken over by the Army Air Corps. Shortly thereafter, the construction program for Orlando Air Base began, culminating in its official opening on December 1, 1940. During the following 2 years, the Army Air Corps acquired additional property, and auxiliary landing fields were built in the surrounding area. The Army Air Corps conducted operations at the Main Base and Area C from 1940 to 1947.

In 1947, the Air Force assumed command of the facilities as the Orlando Air Force Base (OAFB). The base was deactivated on October 28, 1949, and remained on standby status until January 1, 1951, when it was reactivated as an Aviation Engineers' training site. Other Air Force units arrived, and the Military Airlift Command assumed full jurisdiction of the base in 1953.

The Navy began moving its Training Device Center from Port Washington, New York, to OAFB on September 15, 1965, and finished the move in June 1967. In 1968, the

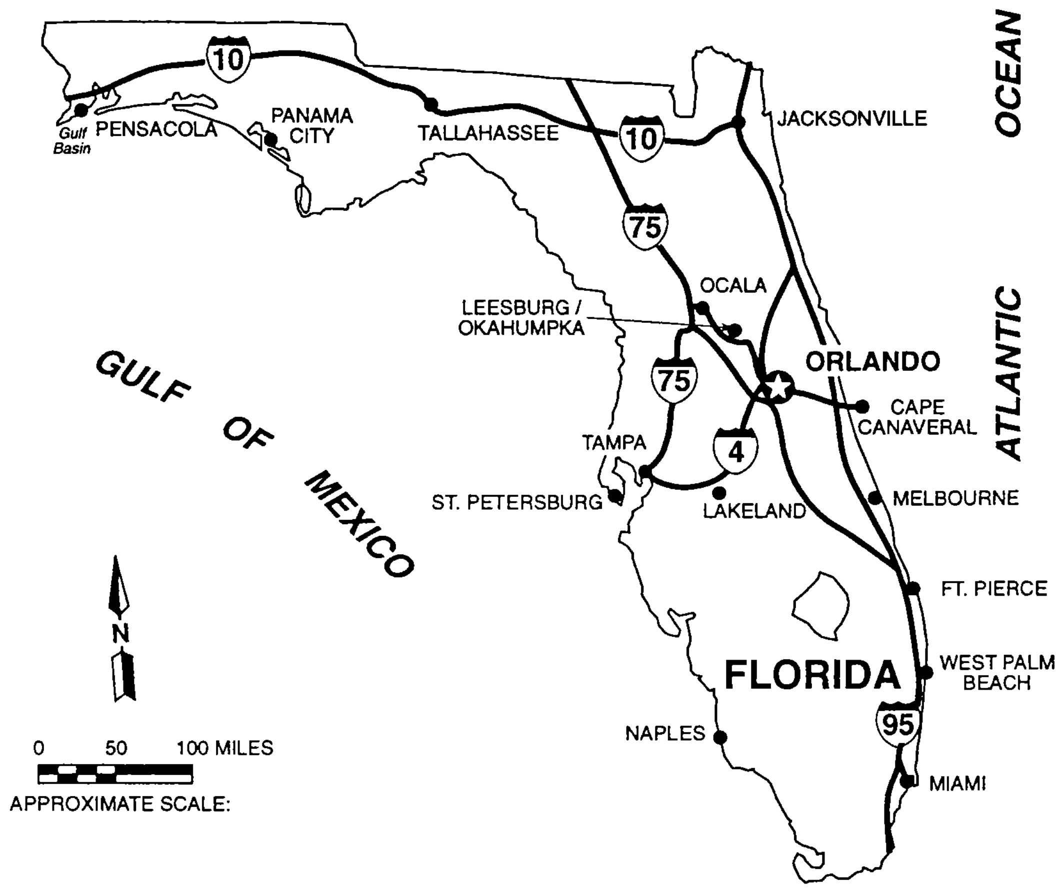

FIGURE 1-1

REGIONAL MAP

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER ORLANDO, FLORIDA

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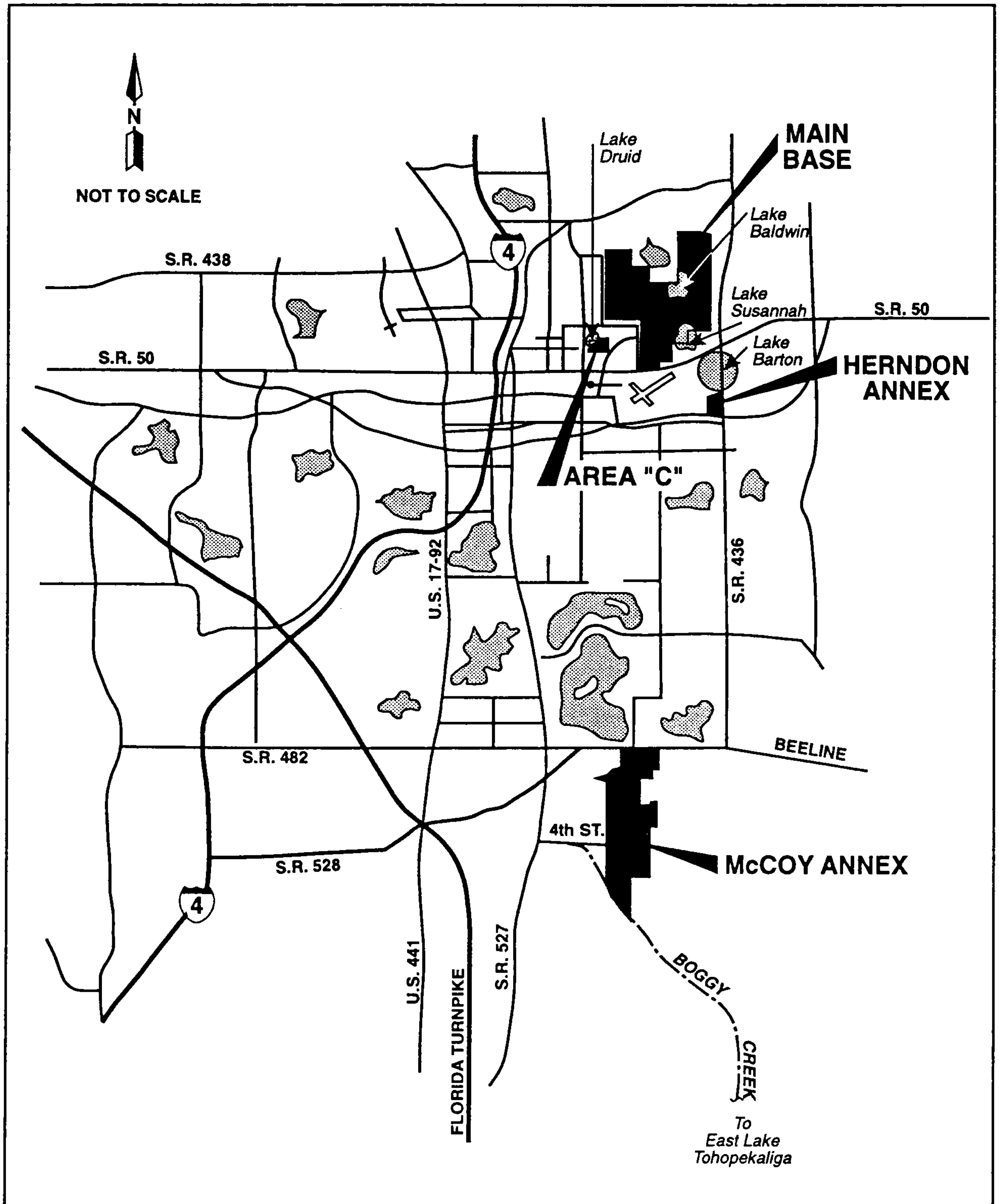

FIGURE 1-2

VICINITY MAP

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

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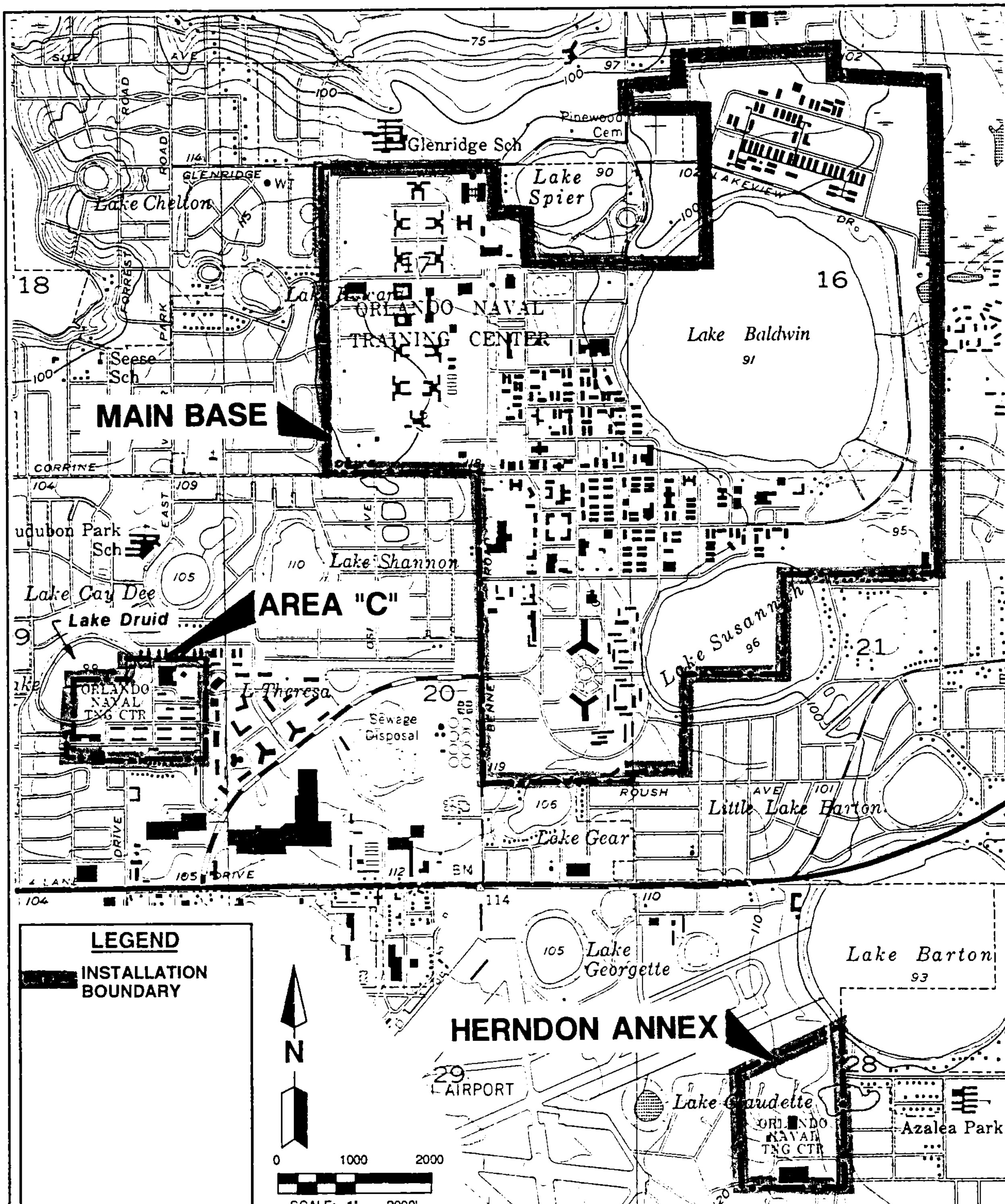

REFERENCE: U.S.G.S. QUADRANGLE FOR ORLANDO EAST, FLORIDA 1953, PHOTOREVISED 1980.

FIGURE 1-3 MAIN BASE, HERNDON ANNEX, AND AREA "C" SITE LOCATION MAP	PROJECT OPERATIONS PLAN NAVAL TRAINING CENTER ORLANDO, FLORIDA

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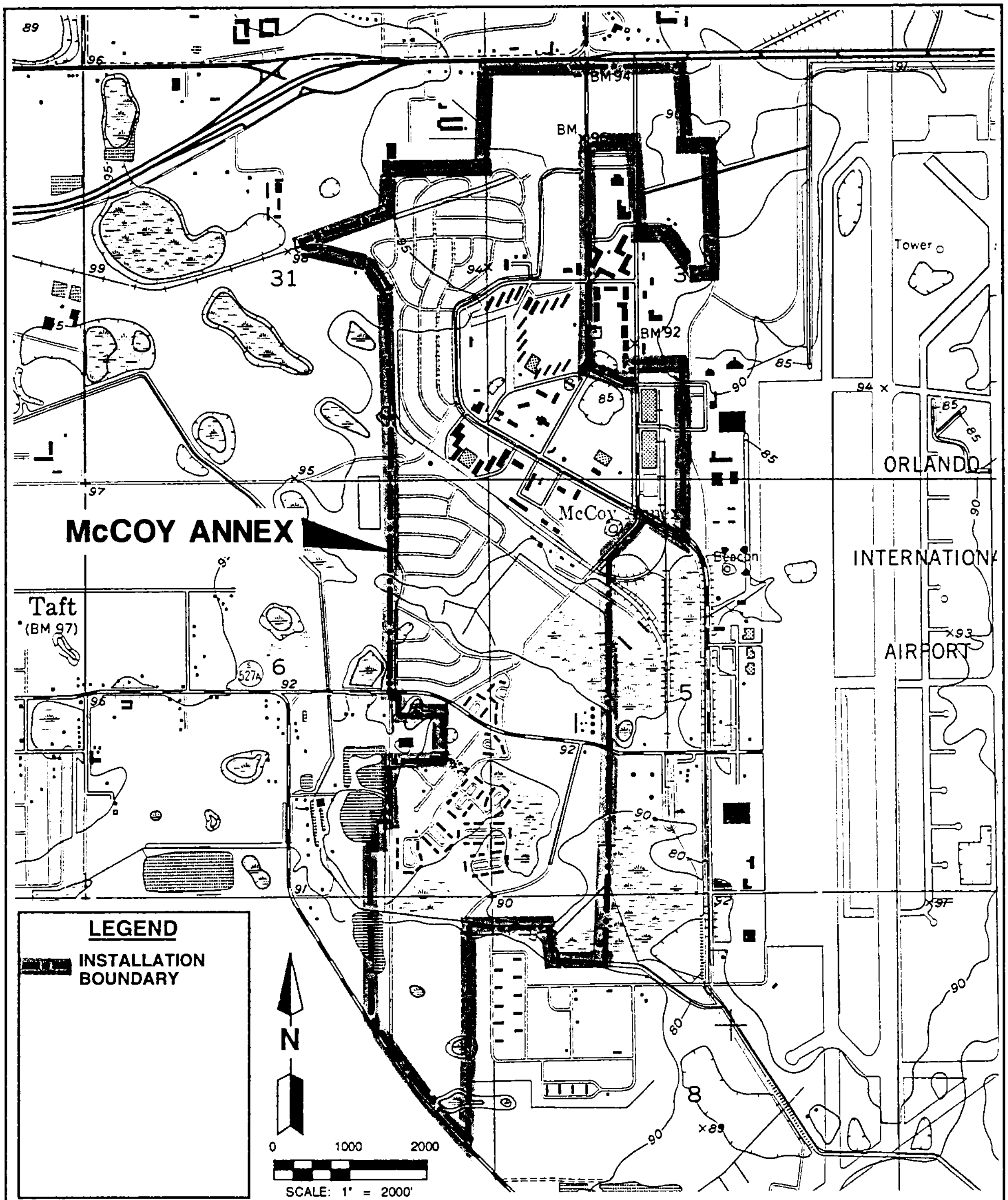


REFERENCE: U.S.G.S. QUADRANGLE FOR PINE CASTLE, FLORIDA 1953, PHOTOREVISED 1980.

FIGURE 1-4 **McCOY ANNEX SITE LOCATION MAP**	**PROJECT OPERATIONS PLAN** **NAVAL TRAINING CENTER ORLANDO, FLORIDA**

8519-03 940308WEM

Air Force ceased operations at OAFB, Area C, and Herndon Annex. The property was commissioned as the Naval Training Center Orlando on July 1, 1968.

The history of McCoy Annex dates to 1941 with the construction of Orlando Municipal Airport No. 2 in Pinecastle, Florida. The new airport was needed due to the acquisition of the original municipal airport for construction of Orlando Air Base to the north. Prior to construction of the new airport, the property was undeveloped swampland. In 1942, the city leased the Pinecastle property to the Army Air Corps to construct Pinecastle Army Air Field with acquired additional lands. The field was ready for operation in April 1943. At the end of World War II, the base was deactivated and the property returned to the City. The terms of the property transfer included a "reverter for reactivation" clause in case of a national emergency. This clause was exercised in 1952 during the Korean Conflict, and the base was reopened as Pinecastle Air Force Base. The base was renamed McCoy Air Force Base in honor of Colonel Michael N.W. McCoy on May 7, 1958. On August 5, 1959, the Capehart Housing project, a large construction program consisting of 668 family quarters for officers and airmen, was begun. The last unit was completed in March 1961. The Air Force retained command of the base until its closure in 1973. At that time, NTC, Orlando acquired title to part of the property and changed the name to McCoy Annex. McCoy Annex was acquired to serve as a community support annex for NTC, Orlando. The majority of the property, including runways, aircraft hangars, and maintenance facilities previously used by the Air Force, was never acquired by the Navy. Currently, that property is owned and used by the Orlando International Airport (ABB-ES, 1996a).

__1.3.3 Current Operations__ The stated mission of NTC, Orlando is to exercise command over, and coordinate the efforts of, the assigned subordinate activities in recruit training of enlisted personnel; provide initial skill, advanced, and/or specialized training for officer and enlisted personnel of the regular Navy and Naval Reserve; and to support other activities as directed by a higher authority (ABB-ES, 1996a). The base is currently scheduled for closure in 1999.

The Main Base is composed primarily of operational and training facilities. Area C mainly serves as a supply center for NTC, Orlando, and includes a dry cleaner, warehouses, and the Defense Reutilization and Marketing Office (DRMO). The dry-cleaning facility is no longer in operation.

The Herndon Annex provides research, design, development, testing, evaluation, procurement, fabrication, maintenance, and logistic support for naval training devices and equipment. The Herndon Annex includes a computer center, flight-training building, uniform supply warehouse, and several office buildings.

The McCoy Annex serves primarily as a housing and community support activity for NTC, Orlando (C.C. Johnson, 1985).

__1.4 ENVIRONMENTAL SETTING__. The four discrete land areas comprising what is now known as NTC, Orlando, located in the city of Orlando, Florida (Figures 1-3 and 1-4), have functioned as military facilities since 1940. During that time, the city has developed and surrounded NTC, Orlando. The following paragraphs describe the climate, topography, surface water, drainage, geology, hydrogeology, and potential environmental receptors associated with NTC, Orlando.

1.4.1 Climate The climate of Orange County is subtropical, with an average annual temperature of about 72 degrees Fahrenheit (°F). Orange County receives an average of 52 inches of rainfall each year. More than 50 percent of this precipitation is received from June through September during thunderstorms that occur an average of 83 days per year (Lichtler and others, 1968).

1.4.2 Topography, Surface Water, and Drainage NTC, Orlando is situated in central Orange County, Florida, part of the Atlantic Coastal Plain physiographic province as defined by Meinzer (1923). Most of the city of Orlando, as well as the NTC, Orlando facilities, are considered to be in the highland topographic region of the county, where elevations are generally greater than 105 feet above mean sea level (msl). The topography of this region is characterized by closed depressions and sinkhole lakes, which commonly facilitate groundwater recharge (Lichtler and others, 1968).

The topography in the Orlando area is generally flat, with elevations ranging from approximately 65 feet to 125 feet above msl. The lakes in the area are prone to flooding. Regional drainage is poorly developed, but generally flows toward the south. All surface waters in the vicinity of NTC, Orlando are classified by the State of Florida as Class III waters suitable for fish and wildlife propagation and water contact sports (Department of Navy [DON], 1992).

The area of the Main Base varies in elevation from approximately 125 feet above msl at the Recruit Training Command to approximately 91 feet above msl at Lake Baldwin. Surface water runoff from the Main Base flows through the storm drainage system and small intermittent streams to Lake Susannah and Lake Baldwin, and eventually to the Little Econlockhatchee River, approximately 3 miles east of the Main Base (DON, 1992; Figures 1-2 and 1-3).

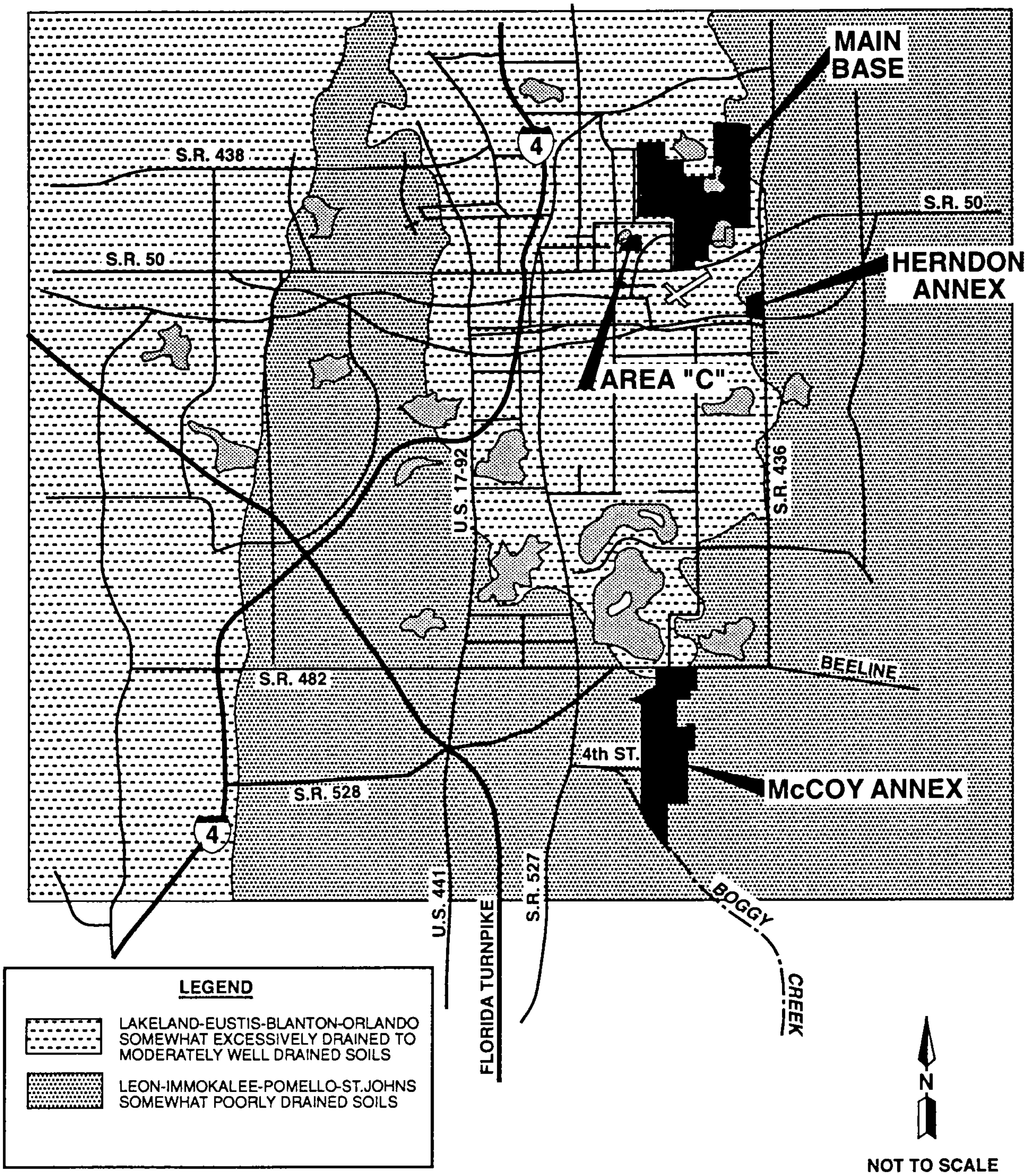
Area C land surface elevations range from approximately 115 feet above msl near the southeast corner of the facility to 99 feet above msl along Lake Druid, which receives most of the surface water runoff from the area (U.S. Geological Survey [USGS], 1980a).

The Herndon Annex land surface slopes from a high of approximately 120 feet above msl at the southwest corner to its low point of about 93 above feet msl at the northeast corner, adjacent to Lake Barton. Surface water runoff flows into Lake Barton or to a closed depression with a small sinkhole lake located on the east side of the area (USGS, 1980b; Figure 1-3).

The land surface at McCoy Annex is generally flat, with a very gentle slope from north to south. The land surface elevations range approximately from 85 feet to 95 feet above msl. Surface water flows south through drainage canals into Boggy Creek Drainage Basin, approximately 4 miles south of McCoy Annex. Surface water from Boggy Creek then flows into East Lake Tohopekaliga approximately 12.5 miles south of McCoy Annex (DON, 1992; Figure 1-2).

1.4.3 Regional Hydrogeology

1.4.3.1 Soils and Geology The surface and near-surface deposits in the Orlando area range from unconsolidated sands to well indurated limestones and dolomites. The soil at the Main Base and Area C is primarily of the Lakeland-Eustis-Blanton-Orlando type and is excessively to moderately well drained (Figure 1-5). The soil at the McCoy and Herndon Annexes is primarily of the Leon-Immokalee-Pomello-



SOURCE: C.C. JOHNSON & ASSOCIATES, INC., 1985.

FIGURE 1-5

GENERAL SOIL MAP

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8519-03 940321WEM

St. Johns type, which is generally poorly drained. The surface soil at NTC, Orlando consists of clayey sands with limestone deposits underneath. Soil conditions are favorable for development and do not pose any constraints to development. However, sinkholes have been known to develop in the Orlando area. No sinkholes have been found on NTC, Orlando property to date (DON, 1992).

The geologic units of interest in the vicinity of NTC, Orlando are in descending order: undifferentiated sediments of Recent and Pleistocene age, the Miocene age Hawthorn Group, and the Eocene age Ocala Group, Avon Park Limestone, and Lake City Limestone (see Figure 1-6). The Recent and Pleistocene sediments occur at a thickness of zero to 200 feet and consist predominantly of quartz sand with varying amounts of clay and shell (Lichtler and others, 1968).

The Hawthorn Group in the study area consists of gray-green, clayey, quartz sand and silt; phosphatic sand; and buff, phosphatic limestone, mostly near the base of the unit, and may include shell or gravel beds (Lichtler and others, 1968). Included in the Hawthorn Group are, in descending order, the Peace River Formation and the Arcadia Formation (Scott, 1988). This group varies in thickness from zero foot (not present) to 200 feet (Lichtler and others, 1968).

The Ocala Group consists of cream to tan, fine- to medium-grained, soft to hard, limestone, which is locally dolomitic. This unit varies in thickness from zero foot (not present) to 125 feet (Lichtler and others, 1968).

The Avon Park Limestone is composed of an upper section of cream to tan, granular limestone with abundant cone-shaped foraminifera and a lower section of mostly dense, hard, brown, crystalline dolomite. In total, this unit ranges from 400 to 600 feet in thickness (Lichtler and others, 1968).

The Lake City Limestone consists of alternating layers of dark brown crystalline dolomite and chalky, fossiliferous limestone. The total thickness of this unit exceeds 700 feet (Lichtler and others, 1968).

1.4.3.2 **Aquifer Systems** Three aquifer systems are present in the Orlando area: (1) the surficial aquifer system, (2) an intermediate aquifer, and (3) the Floridan aquifer system. The surficial aquifer system is composed of Recent-, Pleistocene-, and Pliocene-aged sediments. The Floridan aquifer system is composed of carbonate rocks of the Eocene Epoch (Miller, 1990). The Hawthorn Formation forms an intermediate aquifer between these two systems. The relationship between the geologic units and the hydrostratigraphic units in the area is presented schematically on Figure 1-6.

The surficial aquifer system extends to depths of 70 feet below land surface (bls) (Figure 1-6) and is composed primarily of quartz sands with varying amounts of clay and shells. The lower part of the surficial aquifer system contains predominantly marine sediments. Water is generally found at depths of 3 to 9 feet bls. Depth to water in the surficial aquifer system varies with the seasons and proximity to discharge areas. Seasonal fluctuations range from a few feet in eastern Orange County, where the topography is predominantly flat, to approximately 15 feet in the western highland areas (Board of County Commissioners [BOCC], 1991). The direction of groundwater flow in the surficial aquifer is variable (Figures 1-7 and 1-8) and generally follows topography, according to data collected from very limited areas during the previous investigations (see Section 1.5 of this document).

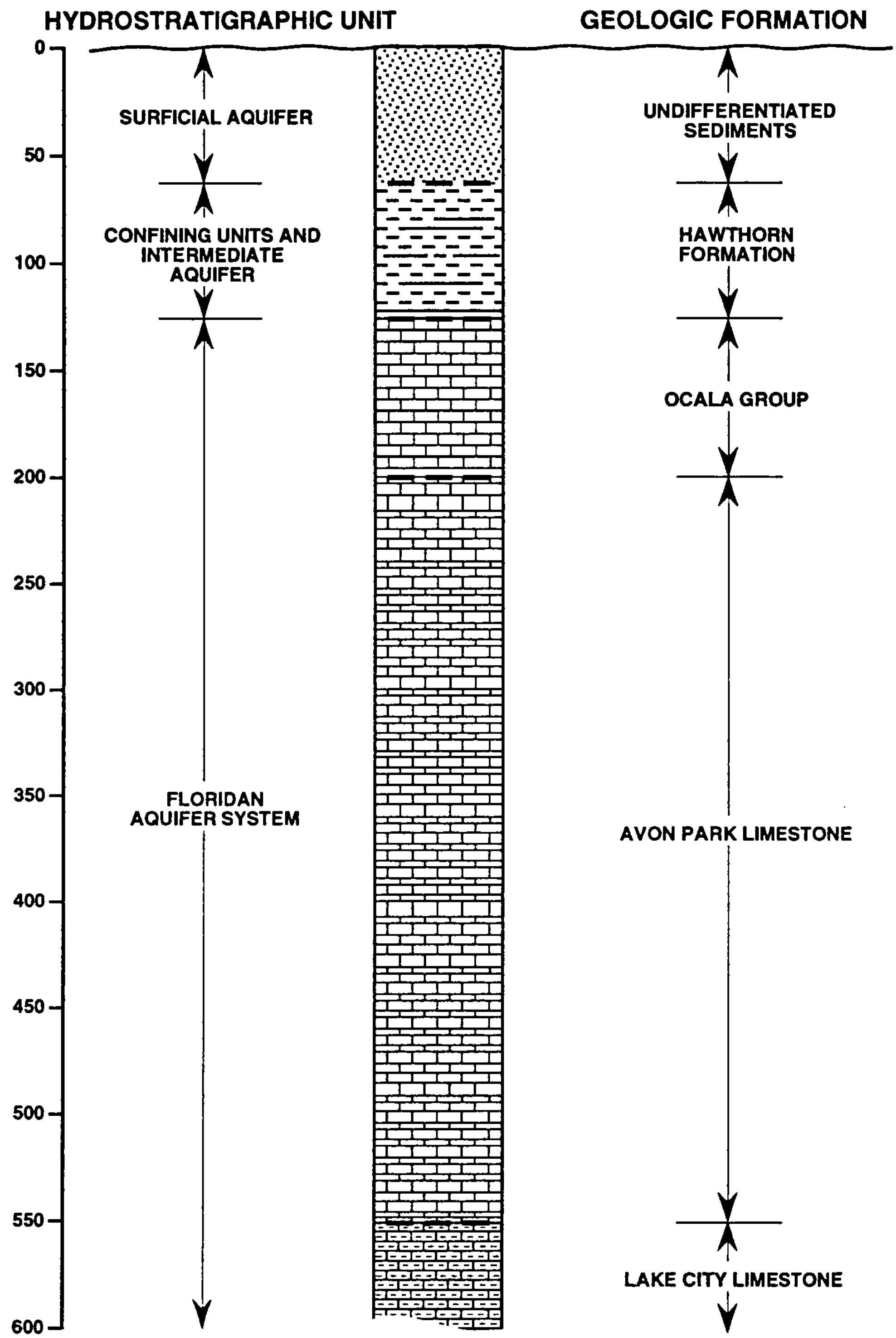


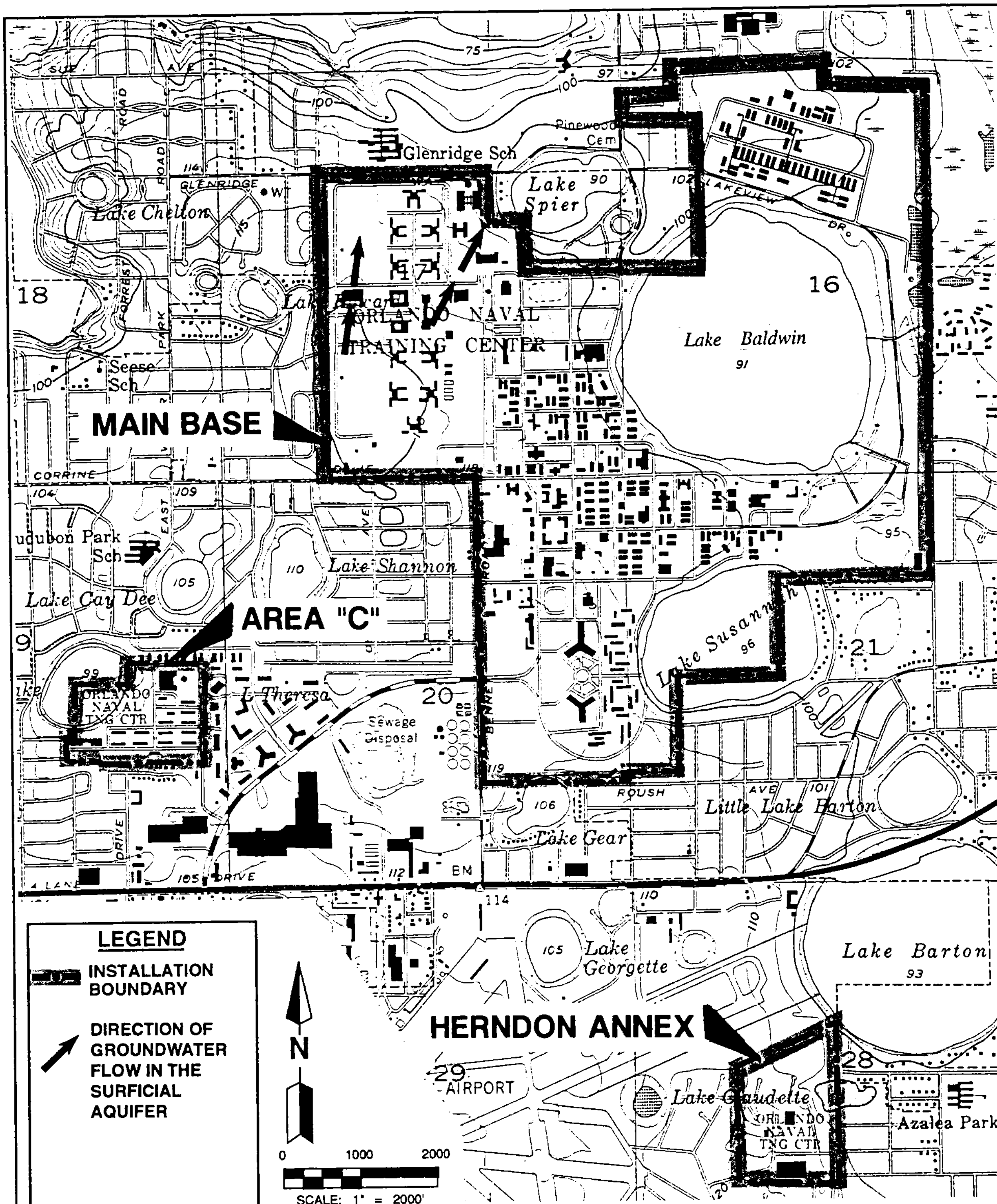
FIGURE 1-6

TYPICAL GEOLOGIC STRATIGRAPHIC COLUMN

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8519-03 940321WEM



REFERENCE: U.S.G.S. QUADRANGLE FOR ORLANDO EAST, FLORIDA 1953, PHOTOREVISED 1980.

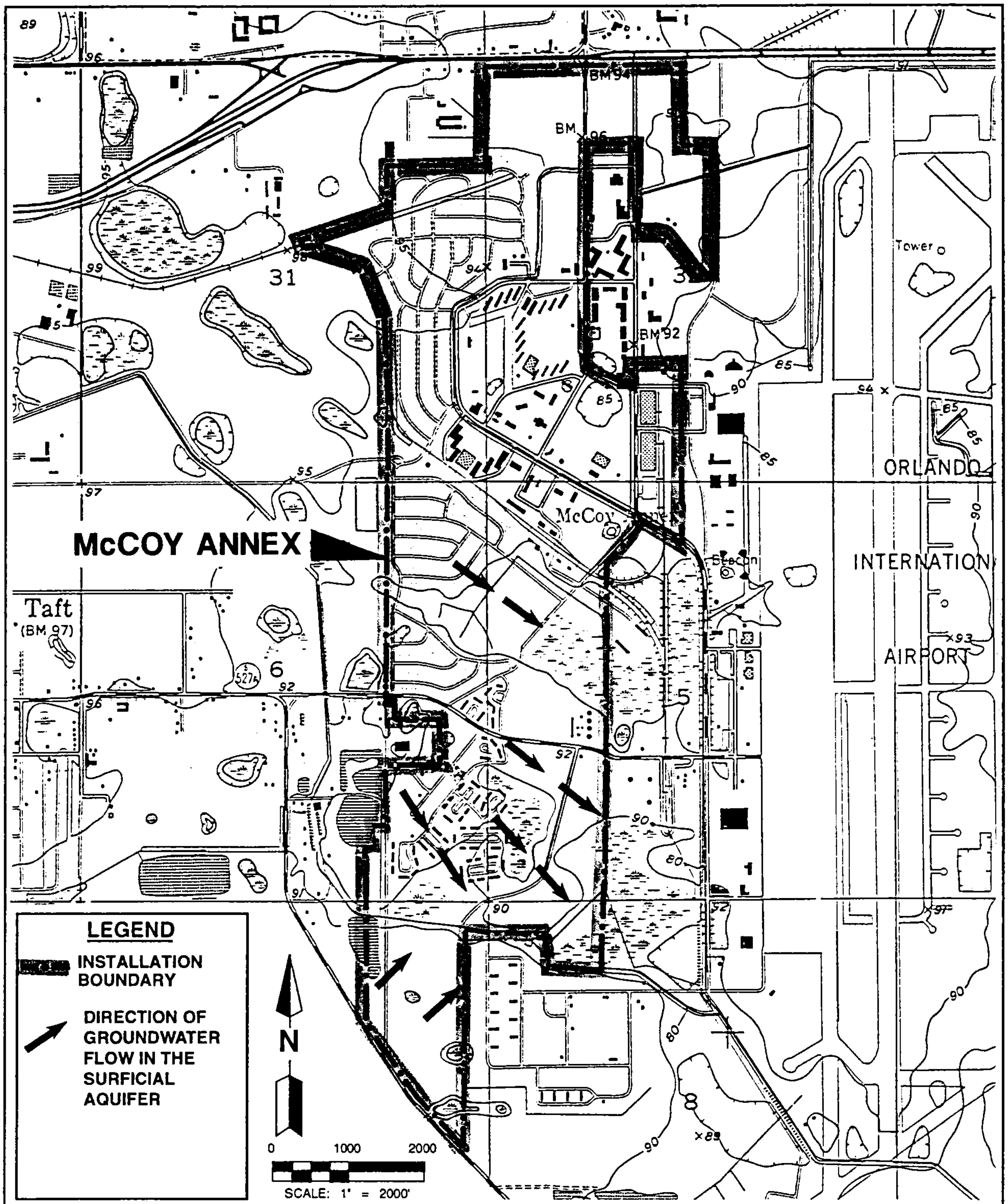
FIGURE 1-7

MAIN BASE
GROUNDWATER FLOW MAP,
SURFICIAL AQUIFER SYSTEM

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8545-14 FIG 1-7 081297MAW



REFERENCE: U.S.G.S. QUADRANGLE FOR PINE CASTLE, FLORIDA 1953, PHOTOREVISED 1980.

FIGURE 1-8

McCOY ANNEX GROUNDWATER FLOW MAP, SURFICIAL AQUIFER SYSTEM

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER ORLANDO, FLORIDA

8545-14 FIG 1-8 081297MAW

The Hawthorn Formation underlies the surficial aquifer system throughout most of the region. The thickness of the Hawthorn Formation varies from zero (not present) in northwest Orange County to 200 feet thick in southeast Orange County. The thickness at NTC, Orlando is approximately 85 feet (C.C. Johnson, 1985). Lithology of the Hawthorn Formation is highly variable, ranging from interfingered sands, clayey sands, and sandy clays in the upper parts to limestones and dolomites in the lower part of the unit. Variable amounts of clays and sands are also present with the carbonate rocks. The sandy layers comprise an intermediate artesian aquifer within the clayey confining beds. The Hawthorn Formation, where present, is also considered an upper aquitard for the Floridan aquifer system (BOCC, 1991).

The Floridan aquifer system lies below the Hawthorn Formation and is the principal water supply source for Orange County. The Floridan aquifer system is over 1,400 feet in thickness and consists primarily of limestones and dolomites. Three major rock units make up the Floridan aquifer system. These are the Ocala Group, the Avon Park Limestone, and the Lake City Limestone.

At NTC, Orlando, two major water producing zones are present in the Floridan aquifer system. The two zones correspond to the Avon Park and Lake City Limestones (Figure 1-6). The upper zone lies approximately 150 feet to 600 feet bls, and the lower zone lies approximately 1,100 to 1,500 feet bls. The lower zone is the primary water supply source in the vicinity of NTC, Orlando (BOCC, 1991).

Recharge to the Floridan aquifer system in Orange County has been divided into four areas based on the estimated amount of recharge likely to occur in 1 year. These areas have been defined as (1) generally no recharge, (2) very low recharge (less than 2 inches per year), (3) low to moderate recharge (2 to 10 inches per year), and (4) high recharge (up to 20 inches per year). The Main Base is located in an area of high recharge, and the McCoy Annex is in an area of low recharge (BOCC, 1991).

1.4.4 Potential Human Receptors NTC, Orlando is located within the Orlando Standard Metropolitan Statistical Area (SMSA), which is composed of Orange, Osceola, and Seminole Counties, and has been one of the fastest growing population centers in Florida in recent years. From 1984 to 1990, the population in the SMSA increased from 818,721 to 960,000 people. Orange County is the most populated county in the SMSA (ABB-ES, 1992a).

The following subsections describe the land use, population characteristics, and potential human and ecological receptors that may be exposed to contamination at the four distinct facilities that comprise NTC, Orlando (Main Base, McCoy Annex, Herndon Annex, and Area C). Unless indicated otherwise, the information contained in the following subsections was obtained from the NTC, Orlando Hazard Ranking System II scoring document (ABB-ES, 1992a).

1.4.4.1 NTC, Orlando Land Use The Main Base occupies approximately 1,095 acres within the Orlando city limits and is composed mainly of operational and training facilities. These facilities are used for training new and recently graduated recruits, as well as enlisted and officer personnel in the nuclear engineering program. Land use at the Main Base is dominated by barracks, training facilities, administrative buildings, drill fields, and recreational areas. The population near the Main Base is transitional because of the influx of military personnel for temporary (1 to 3 years) periods of time. There are approximately 15,820 enlisted personnel onsite at the Main Base at any given time, along with an average of 4 dependents, with approximately 50 children attending the day care facility each day. There are two lakes within the Main Base property (Lakes Baldwin and Susannah) and four lakes (Spier, Forest, Shannon, and Gear) located in the residential areas adjacent to the facility (Figure 1-3).

The McCoy Annex occupies 877 acres and is located adjacent to Orlando International Airport, approximately 12 miles south of the Main Base and outside of the Orlando city limits (Figure 1-4). There are two elementary schools located within 1 mile west of the McCoy Annex. Between 1974 and 1984, approximately 12,000 military and 2,600 civilian personnel were assigned to the McCoy Annex (C.C. Johnson, 1985). At McCoy Annex, there are approximately 676 enlisted personnel and 1,900 dependents. The golf course at the Annex is used by approximately 2,500 to 3,000 people per month (ABB-ES, 1992a).

Area C covers approximately 46 acres and is located approximately 1 mile west of the Main Base. This region mainly serves as a supply center for the NTC, Orlando installation.

Herndon Annex, a 54-acre parcel of property, is located approximately 1.5 miles south of the Main Base, adjacent to the Herndon Public Airport. This developed parcel of property is used to provide a variety of support services for the Navy, including research, development, design, and logistics support.

1.4.4.2 **Water Supply** Both the Main Base and McCoy Annex facilities obtain their potable water supplies from the Orlando Utilities Commission and Winter Park Utilities. Potable water is supplied by numerous wells completed in the Floridan aquifer system. The Orlando Utilities Commission operates production wells off the southeast corner of the Main Base, obtaining water from a depth of 1,400 feet bls. There are 10 utility companies in Orange County providing potable water to residents and businesses. There are a number of inactive production or irrigation wells located at Main Base and McCoy Annex. As of 1996, there were two active production wells (non-Navy) and four irrigation wells at Main Base, and one active irrigation well at McCoy Annex (ABB-ES, 1996b and 1996c). There are 10 irrigation wells at the Main Base and 3 at McCoy Annex. None of these wells are used for potable water and each of them draws water from a depth of 500 feet bls, within the Avon Park Limestone unit, which is the upper of the two producing zones of the Floridan aquifer system. One production well, located at Area C, was abandoned in 1996.

A wellhead protection program is being established in Orange County through the utility companies in cooperation with the South Florida and St. Johns River Water Management District offices. An interim Wellhead Protection Plan is currently being enforced by the Orange County Planning Department, but no wellhead protection areas have been delineated.

Regional drainage is poorly developed but generally flows toward the south to the canals and tributaries leading to the Kissimmee River. Surface water drainage at the Main Base is directed to Lake Susannah and Lake Baldwin, which are used for fishing and recreation. The most likely contaminant migration pathway to these lakes is through small intermittent streams and the storm drainage system at the facility. Water from each of these lakes eventually flows into the Little Econlockhatchee River and then to the St. Johns River. Both of the lakes are a source of fish and wildlife habitat, and may be habitats for endangered or threatened species.

All surface waters in the vicinity of NTC, Orlando are classified by the State of Florida as Class III waters suitable for fish and wildlife propagation and water contact sports.

1.4.4.3 **Ecological Setting** NTC, Orlando is within the Florida section of the Atlantic Coastal Plain; the four areas at NTC, Orlando all share similar ecological features (C.C. Johnson, 1985). Of the 2,072 acres of land at NTC, Orlando, approximately 100 acres (5 percent of the total area at NTC, Orlando) is undeveloped. Although not extensive, these undeveloped areas may provide habitat for a variety of terrestrial and aquatic ecological receptors.

Terrestrial and Wetland Vegetative Cover. In addition to a variety of ornamental plantings, three species of native flora are predominant at the Main Base are (1) live oak (*Quercus virginiana*), (2) slash pine (*Pinus elliottii*), and (3) cabbage palm (*Sabal palmetto*). These native woody species are also found at Area C, along with a nonnative tree, Australian pine (*Casuarina equisetifolia*). Virtually all undeveloped land at Area C occurs in the areas bordering Lake Druid (Figure 1-3). The limited undeveloped areas at the McCoy Annex include uplands dominated by slash pines and live oak, as well as wetland habitat dominated by bald cypress (*Taxodium distichum*) (C.C. Johnson, 1985).

Aquatic Flora and Fauna. Lake Baldwin and Lake Susannah are both located partially within the boundaries of NTC, Orlando. Lake Baldwin is approximately 196 acres in size. Several other smaller lakes are located adjacent to the installation. Lakes Baldwin and Susannah are infested with an invasive weed, Florida elodea (*Hydrilla verticillata*) (C.C. Johnson, 1985). Fish species occurring in the lakes at NTC, Orlando include bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), golden shiner (*Notemigonus crysoleuca*), yellow bullheads (*Ictalurus natalis*), and killifish (*Fundulus* spp.). According to the NTC, Orlando Master Plan Update (SOUTHNAVFACENGCOM, 1985), grass carp (*Ctenopharyngodon idella*), an oriental species, have been introduced into several of the larger lakes at NTC, Orlando to control Florida elodea.

Fauna. Limited information is available regarding faunal ecological receptors at NTC, Orlando. It is likely that the invertebrate biomass at the installation's few undeveloped sites serves as a forage base for fish and wildlife species, including amphibians, reptiles, birds, and mammals.

Amphibians that may occur at NTC, Orlando include several species of mole salamander (*Ambystoma* spp.) that spend at least part of the year in woodlands. A number of other salamanders, frogs (including members of the genera *Hyla*, *Rana*, and *Pseudacris*), and toads (*Bufo* spp.) may also occur at NTC, Orlando. Several lizard species and various colubrid snakes may also occur in the pine forest communities at the installation (Ashton and Ashton, 1988). Turtles and other aquatic reptiles may occur in Lake Baldwin and some of the other lakes in the vicinity of NTC, Orlando.

Small mammals that may occur at the site include the cottontail rabbit (*Sylvilagus floridanus*), hispid cotton rat (*Sigmodon hispidus*), and cotton mouse (*Peromyscus gossypinus*). Predatory mammals such as the red fox (*Vulpes vulpes*) and gray fox (*Urocyon cinereoargenteus*) may feed on small mammals at NTC, Orlando. In wetland regions at the installation, mammals such as the raccoon (*Procyon lotor*) and beaver (*Castor canadensis*) may occur.

Birds of prey such as the black vulture (*Coragyps atratus*), turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), and red-shouldered hawk (*B. lineatus*) may search for prey items in the more open regions at NTC, Orlando, and granivorous birds such as the mourning dove (*Zenaida macroura*) are likely to occur in the grassy cover type habitats at the facility. Other avifauna that may occur at NTC, Orlando include the brown-headed cowbird (*Molothrus ater*), brown thrasher (*Toxostoma rufum*), bobwhite quail (*Colinus virginianus*), mockingbird (*Mimus polyglottus*), common grackle (*Quiscalus quiscula*), killdeer (*Charadrius voviferus*), northern cardinal (*Cardinalis cardinalis*), blue jay (*Cyanocitta cristata*), rufous-sided towhee (*Pipilo erythrophthalmus*), common flicker (*Colaptes auratus*), and red-bellied woodpecker (*Centurus carolinus*). Birds that may occur in wetland regions at NTC, Orlando include swamp sparrow (*Melospiza georgiana*), Carolina wren (*Thryothorus ludovicianus*), northern cardinal, and common yellowthroat (*Geothlypis trichas*), as well as waterfowl such as the mallard duck (*Anas platyrhynchos*).

Threatened and Endangered Species (State and Federal). The gopher tortoise (*Gopherus polyphemus*) is listed as a "species of special concern" by the State of Florida (ABB-ES, 1994) and has been identified as a "candidate species for special listing" by the U.S. Fish and Wildlife Service. Studies and visual observations of new burrows by base personnel support the supposition that the gopher tortoise is a confirmed resident. This species typically resides on the southern end of McCoy Annex and Herndon Annex (ABB-ES, 1994). Gopher tortoise burrows have been seen at the golf course on Main Base. The indigo snake (*Drymarchon corais*), listed as "threatened" by the U.S. Fish and Wildlife Service and by the State of Florida, typically co-winters with the gopher tortoise. In a 1992 study, no indigo snakes were found at NTC, Orlando (SOUTHNAVFACENGCOM, 1992).

The American alligator (*Alligator mississippiensis*), listed as a "species of special concern" in the State of Florida and "threatened due to similar appearances" by the U.S. Fish and Wildlife services, is a confirmed resident. The species typically resides in wetlands, lakes, and swamps found on the base (ABB-ES, 1994). Alligators currently inhabit several of the wetland areas on the base (SOUTHNAVFACENGCOM, 1987a).

The Main Base is in the habitat range of the threatened Florida scrub jay (*Aphelocoma coerulescens*), but none have been sighted on the base. McCoy Annex has the greatest potential for habitat for the jay, but none were sighted in a 1984 survey. It was concluded that the chances were small that the bird would take up residence because of dwindling habitat.

The Main Base is also in the habitat range of the southeastern American kestrel (*Falco sparverius*), which is listed as "threatened" by the State of Florida. In a 1987 study, the kestrel was not located at NTC, Orlando and, as a result, is not considered a likely or confirmed resident. The Main Base is also in the habitat range of the Florida mouse (*Podomys floridanus*), which is listed as "threatened" by the State of Florida. In a study conducted in 1987, efforts to locate the mouse through trapping failed. As a result, it was determined that the Florida mouse is probably not a resident (SOUTHNAVFACENGCOM, 1987b).

The bald eagle (*Haliaeetus leucocephalus*) is a confirmed visitor to Lake Baldwin (Main Base). This species is listed as "endangered" by the U.S. Fish and Wildlife Service and "threatened" by Florida Game and Freshwater Fish Commission (FGFWFC, 1991).

1.5 SUMMARY OF PREVIOUS INVESTIGATIONS. The Defense Environmental Restoration Program (DERP) requires the Department of Defense (DOD) to expeditiously remediate environmental contamination from hazardous substances due to past practices. The Installation Restoration (IR) program, a subcomponent of DERP, is designed to identify, investigate, and clean up contaminated sites in a manner that is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The IR program is conducted in multiple phases. The IR program has identified 10 potentially contaminated sites at NTC, Orlando (Table 1-1). Investigation or remedial action has been implemented at some of these sites. In addition to the IR program sites, other sites have undergone contamination assessment (CA) and/or remedial action. Results of investigations conducted under IR and non-IR programs formed the basis for future SS/SI/RI activities to be conducted under BRAC through the IR program.

1.5.1 Installation Restoration Sites The first phase of the IR program at NTC, Orlando was the Initial Assessment Study (IAS) conducted in 1985 (C.C Johnson, 1985). This program included an archival search and site walkovers at all four parcels of NTC, Orlando. Nine potentially contaminated sites were identified. The IR program sites are all located on one of three parcels: Main Base, McCoy Annex, or Area C. The sites included two trench-and-fill landfills (Sites 1 and 3), a wastewater treatment sludge lagoon (Site 2), a yard waste disposal area (Site 4), a boiler room with extensive asbestos-containing material (Site 5), the former Defense Property Disposal Office (DPDO) (now the DRMO, Site 6), a demolition debris landfill (Site 7), a pesticide storage building (Site 8), and Lake Baldwin (Site 9). A site verification study was recommended for Sites 1, 3, 6, 8, and 9. The verification study was performed in 1986 and an additional IR program site (Site 10, a wastewater treatment plant [WWTP] at McCoy Annex) was identified (Geraghty & Miller, 1986).

The verification study suggested that the contamination at Lake Baldwin (Site 9) did not represent a significant risk to human health or the environment, although a risk assessment was not performed (Geraghty & Miller, 1986). The study also determined that the spillage noted in the IAS at the former DPDO at McCoy Annex (Site 6) had not contaminated the soil. The former landfill at the Main Base (Site 1), the former landfill at McCoy Annex (Site 3), the pesticide storage building (Site 8), and the WWTP at McCoy Annex (Site 10) were recommended for additional investigation.

No work was conducted under the IR program, due to lack of funding, until NTC, Orlando was placed on the closure list. Since then the former landfill at the Main Base (Site 1) and the landfill at McCoy Annex (Site 3) have been designated Operable Units (OUs) 1 and 2, respectively. Remedial Investigation and Feasibility Study (RI/FS) workplans have been written for both OUs, and the RI/FS, Record of Decision, and Proposed Plan have been completed. The RI/FS Workplan for OU 2 has been reviewed by the Orlando Partnering Team (OPT) and is awaiting the resolution of formal comments. The other eight sites identified in the IAS and Verification Study have been included in the SS activities discussed in Subsection 1.5.3. In general, "grey" areas identified by the basewide EBS (a Phase I assessment) will not be formally introduced into the IR

Table 1-1
Installation Restoration Site Summary Table

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Study Area	Site No.	Description	Materials Disposed	Dates of Operation
Main Base	1	Trench-and-fill landfill	Photochemical waste, film, paint thinner, garbage, medical waste, tree limbs, construction waste, and perchloroethylene.	1940s to 1967
Main Base	2	Filled lagoon	WWTP sludge, tree limbs, yard waste, soil, sand, asphalt, demolition debris, and stainless-steel mixing tank.	1977 to 1978
McCoy Annex	3	Trench-and-fill landfill	Photochemical wastes, paint, paint thinners, plastics, trees, construction debris, medical wastes, oil, transformers, cable, airplane parts, and low-level radioactive waste.	1960 to 1978
Main Base	4	Pit disposal area	Yard wastes	1968 to 1969
Area C	5	Laundry boiler building.	Asbestos-containing material	Closed in 1972. Demolished in 1979 and 1993.
McCoy Annex	6	DPDO yard	Oil, antifreeze, and transmission and hydraulic oil	Pre-1984
McCoy Annex	7	Quarry	Demolished barracks and demolition debris	1968
Main Base	8	Pesticide storage building.	Pesticides	Early 1950s to 1972
Main Base	9	Lake Baldwin	Film processing chemicals	Early 1950s to 1978
McCoy Annex	10	Wastewater treatment plant.	WWTP effluent and sludge	Mid-1960s to 1988

Source: *Initial Assessment Study* (C.C. Johnson, 1985).

Notes: DPDO = Defense Property Disposal Office.
WWTP = wastewater treatment plant.

program until Phase II assessments are conducted and sufficient data have been collected to support an acknowledgement or confirmation of the presence of contamination.

__1.5.2 Noninstallation Restoration Program Sites__ Other contaminated sites have undergone CA and/or remedial action at NTC, Orlando. Non-IR program sites involving remedial actions include the dry-cleaning facility and DRMO, both located in Area C; Building 2080 and Rusk Memorial Chapel (Building 250), both located on the Main Base; and Buildings 7174 and 7175 located at McCoy Annex.

Both DRMO and the base laundry (Area C) had tetrachloroethene (PCE) spills in 1989. In each case, soil containing greater than 1 part per million (ppm) PCE was excavated. Contaminated soil from the DRMO spill was disposed of at a hazardous waste disposal facility by DRMO. Contaminated soil at the dry-cleaning facility was disposed of at a hazardous waste landfill by the contractor responsible for the spill (Raspet, 1994). Studies continue at the DRMO and former base laundry. PCE and trichloroethene (TCE) have been detected above soil cleanup goals and maximum contaminant levels for soil and groundwater. A chlorinated solvent plume may exist between Lake Druid and the laundry. The laundry and DRMO areas have been collectively designated OU 4, and RI activities are ongoing.

Prior to May 1989, a spill of PCB-contaminated oil from an electrical transformer occurred in the uncovered (outdoor) mechanical room of Rusk Memorial Chapel (Building 250). Contaminated soil was excavated, containerized, and removed by DRMO. Soil was cleaned up to a level of approximately 68 ppm PCBs (Raspet, 1987). No regulatory concurrence of cleanup could be determined. SS studies for Rusk Memorial Chapel (Site Screening Study Area 4) have concluded that no significant PCB contamination exists and the site has been approved for transfer by the OPT.

Three of the non-IR program sites involve spillage or leakage from petroleum storage tank systems. These sites are described briefly in this subsection. Building 2080, a service station, had four underground storage tanks (USTs): (1) a 7,000-gallon tank for diesel fuel, (2) a 1,000-gallon tank for leaded gasoline, and (3) two 10,000-gallon tanks for unleaded gasoline. All four tanks were constructed of asphalt-coated steel. One tank was removed in 1980, and the remaining three tanks were removed in 1988. The tanks were replaced with three 10,000-gallon double-walled Owens-Corning fiberglass tanks. In 1988, during removal of the tanks, a petroleum release was noted by the contractor. The release was reported to the FDEP and a monitoring only plan was approved for monitoring groundwater at the site (ABB-ES, 1991). Groundwater samples were collected quarterly for 1 year. FDEP concurred on June 4, 1992, that no further action was necessary at the Building 2080 site (Roberts, 1994).

Building 7174 is a service station located at McCoy Annex. Six gasoline and diesel fuel USTs were abandoned in place after showing fuel losses. In 1986, four new fiberglass USTs, along with four groundwater compliance wells, were installed. Petroleum product was noted in the compliance wells in 1988. A CA was initiated, and the CA report was submitted to FDEP in October 1991. Precision tank testing indicated that the tanks were not leaking. The suspected source of the petroleum product was fill ports that were insufficiently grouted during construction. It was believed that excess product entered the soil via the ungrouted fill ports, and migrated through the soil to the groundwater (ABB-ES, 1992b). A remedial action plan (RAP) was prepared and submitted in April 1993. Two addendums to the RAP have been submitted in the meantime (May 1993 and

March 1995). Additional soil assessment at Building 7174 in preparation of an RAP addendum revealed that petroleum contamination had migrated farther downgradient. Additional remedial action has been implemented at the site. A tank closure survey of the four fiberglass USTs was conducted in January 1995.

Building 7175 is the motor pool facility at McCoy Annex. A CA is scheduled to be conducted after an initial remedial action (IRA) (soil excavation) is performed by the remedial action contractor.

Early removal actions for IR program and non-IR program sites are summarized in Table 1-2.

<u>1.5.3 Installationwide Source Discovery and Assessment Status</u> There have been two installationwide environmental assessments conducted after the IAS. The first survey, performed as part of the general permit application process for a National Pollution Discharge Elimination System stormwater discharge permit, was conducted by Post, Buckley, Schuh, & Jernigan, Inc. (PBS&J), in 1993 to identify potential illicit (i.e., nonstormwater) discharges from the stormwater discharge system at the facility. The second survey is the EBS, part of the bottom-up program review for all BRAC installations (ABB-ES, 1996a). The field component of the EBS, which involved the inspection of more than 598 buildings and parcels, is complete. These results were used to identify points of interest (POIs), defined as base properties that are potentially contaminated and may require further investigation prior to transfer. Investigation and potential remedial actions at these POIs will be conducted in accordance with this document.

PBS&J investigated stormwater outfalls at all four parcels that comprise the installation. For the purpose of the EBS, the sources of illicit discharges to the outfalls were considered to be POIs that may require further investigation. The POIs that were identified from a review of the PBS&J report include the Fire Training Facility (Building 200), the Automotive Hobby Shop, the Pest Control Facility, and the Bulk Fuel Storage Area on the Main Base. At McCoy Annex, the Motor Pool and the fuel storage area of the Construction Battalion are suspected of discharging petroleum products to discharge ditches and swales (ABB-ES, 1996a).

Approximately 85 properties have been identified by the EBS as areas where potential environmental concerns are present. Properties surveyed in the EBS that are POIs have been assigned to a category based on the following DOD guidance for EBS:

- Category 7 (Grey), properties requiring further investigation, excluding those sites that have been assigned this category only because of the presence of an UST or an aboveground storage tank;
- Category 6 (Red), properties where a release of hazardous substances has occurred excluding those sites that have been assigned this category only because of the presence of damaged friable asbestos; and
- Category 5 (Yellow), properties where storage, release, disposal, and/or migration has occurred, and action is underway, but not final.

All sites identified as requiring additional investigation will be evaluated through the SS/SI/RI process. Table 1-3 summarizes the status of all SIs identified through 1997.

Table 1-2
Early Action Status

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Area	Restoration Site	Action	Purpose	Status
Area C	DRMO (Building 1063)	Excavated PCE-contaminated soil, filling thirty 55-gallon drums.	To remove potential contaminant source following spill.	Soil removed to less than 1 ppm PCE.
Area C	Dry-cleaning Facility (Building 1100)	Excavated PCE-contaminated asphalt and soil.	To remove potential contaminant source following spill.	Soil removed to less than 1 ppm PCE.
Main Base	Rusk Memorial Chapel (Building 250)	Cleaned up PCB-contaminated oil spill.	To remove potential contaminant source following spill.	Soil removed to 68 ppm PCB.
McCoy Annex	Naval Training Systems Center Warehouse (Buildings 7191 and 7193)	Cleaned up PCB-contaminated fluid.	To remove potential contaminant source following spill.	Soil removed and site backfilled with clean soil.
McCoy Annex	Service Station (Building 7175)	Excavated contaminated soil from area of Tank 7175B.	To remove potential contaminant source following spill.	Approximately 134 tons of contaminated soil removed to Soil Treatment Services of Kissimmee, Florida, for disposal.
McCoy Annex	Annex Gymnasium (Building 7247)	Excavated contaminated soil from area of heating oil tank.	To remove potential contaminant source following spill.	Removed contaminated soil that filled four 55-gallon drums. These drums are in storage until the soil is tested. The site has not been filled. It is covered with boards and a tarpaulin.

Notes: DRMO = Defense Reutilization and Marketing Office.
PCE = perchloroethylene.
PCB = polychlorinated biphenyls.
ppm = parts per million.

Table 1-3
Installation Restoration Program Non-UST/AST Investigation Synopsis*

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
SA	**Location**	**BRAC Color Code**	**Building Number**	**Name**	**Reason for Investigation**	**Current Status**
1 GRP I	MB	1/White	3126	Hospital Civilian BEQ	Forty-square-foot stain on ground outside mechanical room.	No significant detections in soil or groundwater. One groundwater sample had a lead level of 17.1 μg/ℓ versus a Florida MCL of 15 μg/ℓ. The monitoring well was resampled on June 7, 1995, and no lead was detected. There was no evidence of landfilling operations. Property was approved for transfer by OPT 7/24/96.
		1/White	UNF-12	Alleged Hospital Landfill	Used as a landfill in the late 1970s, contents unknown.	
3 GRP I	MB	7/Gray	73/2817 2818	RTC 1st Lt. Storage	Hazardous materials are stored on the property and are regularly transferred to and from Building 2817. Former USAF Tactical Air Command operations involving Matador missile testing and personnel training.	PCE (tetrachloroethene) detections of 9 μg/ℓ and 12 μg/ℓ (versus Florida MCL of 3 μg/ℓ) were detected in groundwater samples. The two most recent rounds of sampling showed a decrease in PCE concentrations to 5.9 and 0.088 μg/ℓ, respectively, in the two monitoring wells. ABB-ES will sample groundwater over the next several months to monitor concentrations of volatile organic compounds. ***Report submitted for signature to OPT. Recommendations were to restrict groundwater use near well OLD-03-04 and to continue groundwater monitoring until MCLs were achieved and color could be changed to 4/Dark Green.***
4 GRP I	MB	4/Dark Green	250/8	Rusk Memorial Chapel and covered walkways	PCB spill of unknown quantity in the mid 1980s.	No significant detections in soil. No groundwater samples taken. Property was approved for transfer by OPT 7/24/96. Building 250/8 is 4/Dark Green and Building 251 is 1/White.
		1/White	251	Rusk Memorial Chapel Annex	PCB spill at adjoining property (Building 250) of unknown quantity.	
5 GRP I	MB	1/White	UNF-13	Septic Tank/Leachfield	Unknown environmental impacts from a previously existing motorboat maintenance facility and septic tank.	No significant detections in soil or groundwater. Geophysical surveys showed some buried pipes and/or metal objects. Property was approved for transfer by OPT 7/24/96.

See notes at end of table.

Table 1-3 (Continued)
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SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
6 GRP I	MB	1/White		Lake Baldwin	Likelihood of contamination from stormwater runoff from golf course, photo lab, lead from former skeet range, drainage from firefighter training facility and motorboat maintenance facility, and alleged drum disposal in lake.	Surface water had no significant detections. Sediments had elevated levels of lead and 4,4′-DDE, though below the Florida probable effects level (PEL). One sample had elevated PAHs. Divers have investigated seven magnetic anomalies and observed various ferrous debris, but no items of environmental significance. Property was approved for transfer by OPT 7/24/96.
7 GRP I	MB	1/White		Lake Susannah	Receives stormwater runoff from other suspect areas and alleged drum disposal in lake.	Surface water had no significant detections. Sediments had elevated metals and PAHs, but below Florida PELs. The lake was approved for transfer by OPT 7/24/96.
8 GRP I	MB	6/Red	2134	Greenskeeper Storage	Likelihood of petroleum and pesticide spills.	Arsenic in surface soil and groundwater at Greenskeeper Storage Area will require further study; SA 9 has been designated as OU 3 ***(see listing for OU 3, page 1-32)***.
		3/Light Green	UNF-15	Former WWTP - Main Base	Burial of sludges from former WWTP and hospital demolition debris in WWTP lagoons.	Evidence of demolition debris buried under golf course. Gross alpha, Na, and Mn levels exceed screening criteria in three wells. Wells OLD-08-05 and -09 were resampled 12/29/95 due to elevated Mn (69.9 $\mu g/\ell$ versus FDEPG of 50 $\mu g/\ell$) and Na (248,000 $\mu g/\ell$ versus 160,000 $\mu g/\ell$). Mn/Na levels were measured at 97.4 and 59,800 $\mu g/\ell$. OLD-08-06 was resampled 6/17/96 for gross alpha, resulting in a gross alpha concentration of 0.39 pCi/ℓ versus 18.1 pCi/ℓ during the initial sampling. ***Property was approved for transfer in June 1997 with color change from 7/Gray to 3/Light Green.***
9 GRP I	MB	6/Red	UNF-14	Former Pesticide/Herbicide Storage	Pesticide and herbicide releases may have occurred during operation of facility.	Chlordane and arsenic in surface soil and groundwater will require further study; SA 8 (Greenskeeper Storage Area) has been designated as OU 3 ***(see listing for OU 3, page 1-32)***.

See notes at end of table.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis*

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SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
[2]10 GRP I	MB	1/White	IAS-4	Former Yard Waste Disposal Area	Contents of disposal area unknown.	No significant detections in soil or groundwater. Property was approved for transfer by OPT 7/24/96.
27 GRP IV	MB	7/Gray	111	Visitors Pass Office	Evidence of cleaning solvent and paint product disposal in the retention pond.	Site-screening investigation completed in June 1996. Analytical results indicate that two surface soil samples had concentrations of BEHP or arsenic elevated slightly above residential screening levels but below industrial screening levels. A third sample had three PAHs with elevated concentrations. ABB-ES ***has completed supplemental investigation to delineate limits of PAHs in surface soils. Analytical results are forthcoming***.
		7/Gray	2010	Security Building		
		7/Gray	2073	Armory/Hurricane Storage Locker	Cleaning solution draining into retention pond.	
28 GRP IV	MB	7/Gray	114	Bowling/Arts & Crafts Center	Drip drying from silk-screen operation may have impacted the soil and/or groundwater.	Fieldwork ***began in June 1997***.
29 GRP IV	MB	7/Gray	127	Grounds Maintenance	Stained soil and stressed vegetation near a storage locker.	Fieldwork ***began in June 1997***.
30 GRP IV	MB	7/Gray	129	Automotive Hobby Shop	Waste oil storage and antifreeze-water separator.	Fieldwork ***began in June 1997***.
	MB	7/Gray	131	Paint Shop Materials Storage	Diesel fuel staining and stressed vegetation under an AST.	
		7/Gray	2262	Custodial Contractor	Past use as a pest control facility.	
31 GRP IV	MB	7/Gray	354	Nuclear Power Field "A" School	Impacts from UST and the oil-water separator.	Fieldwork ***began in June 1997***.
32 GRP IV	MB	7/Gray	358	BEQ/Heating Plant	Alleged dumping of paints, thinners, and petroleum products when this area was a motor pool.	Fieldwork ***began in June 1997***.
33 GRP IV	MB	7/Gray	2001	Administration Building	Dry well located on property.	Fieldwork ***began in June 1997***.
		7/Gray	2002	NTC Headquarters	Same as above.	
		7/Gray	2003	DFAS Office		
		7/Gray	2004	Administration Building	Stains on floor and walls of boiler shed and mechanical room, and a dry well located on the property.	

See notes at end of table.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis*

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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)

SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
34 GRP IV	MB	7/Gray	2024	NTC Supply	Unused supply well on site.	Appropriate well abandonment recommended for supply well. Fieldwork ***began in June 1997***.
35 GRP V	MB	7/Gray	2078	Auto Maintenance Facility	Soil staining associated with drum storage area.	The (final) work plan for Group V Screening was submitted to the Navy in September 1995. Fieldwork ***began in June 1997***.
		7/Gray	2079	Auto Maintenance Facility Storage	Unlabeled drum and unknown storage practices concerning the hazardous materials at the facility.	
36 GRP V	MB	7/Gray	2121	PW Lumber Storage	Soil staining from an oil spill, drum storage area.	Fieldwork ***began in June 1997***.
		7/Gray	2122	PW Shops	Suspect past and present storage and disposal of paints and solvents, solvents, and questionable oil collection practices.	
37 GRP V	MB	7/Gray	2414	Flammable hazardous waste storage	Possibility of thinner and solvent spills, unknown hazardous materials handling practices.	Fieldwork ***began in June 1997***.
38 GRP V	MB	7/Gray	4001	Storage and use of pesticides and herbicides	Extensive oil and fuel staining to the floor.	Fieldwork ***began in June 1997***.
39 AF SITES[5]	MB	7/Gray	4060	Loading Platform (Building 137)	Potential landfilling in this area.	Site-screening studies completed 4/96. Soil gas results indicate the presence of BTEX parameters and PCE. Lab results indicate exceedances in surface soil for benzo(a)pyrene (in 4 of 16 locations, 180J to 520 mg/kg) and arsenic (5 out of 16 locations, 1.1 to 6.7 mg/kg). Groundwater had minor exceedances for PCE (1 sample, 10 $\mu g/\ell$) and gross alpha and gross beta (1 gross alpha sample at 38.5 pCi/ℓ, 4 gross beta samples at up to 39.3 pCi/ℓ). Additional soil and groundwater resampling to evaluate RADs indicate very low activity levels in soil and below background levels in groundwater. Fieldwork to characterize PAHs/arsenic in surface soil complete, ***focused HHRA completed in April 1997. Field investigation to evaluate PCE in groundwater completed in May 1997. Report of findings scheduled for July 1997***.
		7/Gray	4067	Loading Platform (Building 137)	Potential landfilling in this area.	
		7/Gray	15109	Irrigation Well	In close proximity to the old coal storage area, out-of-service well on site.	
		7/Gray	UNF-10	Open Area (west of Nuclear Power School)	Unknown nature of coal staging area, west side of property allegedly used as a landfill.	

See notes at end of table.

Table 1-3 (Continued)
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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)

SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
40 AF SITES[5]	MB	7/Gray	21022	Softball Field	In close proximity to the bottle landfill (UNF-6) to the south, may be additional landfilling activities here.	Site-screening studies were completed in April 1996. Soil gas results indicate the presence of BTEX parameters and some PCE. Lab results indicate minor exceedances in surface soil from benzo(a)pyrene (200 J mg/kg) and arsenic (1.1 mg/kg); groundwater had minor exceedances for gross beta (31.8 pCi/ℓ). Additional soil and groundwater sampling indicates very low RAD activity in soil and below background RAD levels in groundwater. Fieldwork to characterize PAHs/arsenic in surface soil complete, ***focused HHRA completed April 1997. Report scheduled for August 1997.*** No indication of additional landfilling in this area.
		7/Gray	21023	Softball Field	In close proximity to the bottle landfill (UNF-6) to the southwest, may be additional landfilling activities here.	
		7/Gray	UNF-6	Bottle Landfill	Landfill with unknown contents.	
41 GRP V	MB	7/Gray	UNF-8	Open Area	Previous existence of buildings and storage tanks warrant further investigation.	Former USTs and/or ASTs will be evaluated in the Tank Management Plan (TMP). Site screening will evaluate potential PCB releases at former transformer sites. Fieldwork ***began in June 1997.***
42 GRP V	MB	7/Gray	2055	Maintenance Shop	Storage of hazardous materials, two filled-in sumps on site of unknown past use.	Fieldwork ***began in June 1997.***
43 AF SITES[5,6]	MB	1/White		North Grinder Landfill skeet range	Potential lead contamination.	Six surface soil samples (and 1 duplicate) collected and submitted for lead analysis in December 1995. No exceedances were noted.
	MB	3/Light Green	229	Indoor rifle and pistol range	Potential lead contamination. (See also Herndon Annex, Building 601)	Eighteen surface soil samples (and 2 duplicates) submitted for lead analysis 12/95. One sample slightly exceeded screening criteria. TCLP analysis for lead at the location of the highest lead concentration was below the RCRA regulatory limit, and lead is, therefore, not of environmental concern. This site was approved for transfer on 12/10/96.

See notes at end of table.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis[*]

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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)

SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
44/AF SITES[5,6]	MB	***4/Dark Green***	2816 & 2817	Former Missile Training Range	Possible PCE plume (Missile Training Range) and BTEX contamination (former motor pool).	Site-screening studies completed 11/95. Field screening indicates localized BTEX and possible PCE/TCE contamination, but neither confirmed by monitoring wells. Six piezometers installed to evaluate groundwater flow anomaly. OPT recommended resampling of two SA 3 wells with PCE exceedances. Resampling did not detect PCE, but did reveal fuel-related compounds below screening criteria (benzene at 1 $\mu g/\ell$). ABB-ES submitted report recommending transfer of property with a color change from 7/Gray to 4/Dark Green. OPT is reviewing report.
		4/Dark Green	Former 2721	Silk-screening facility	Alleged disposal area for solvents and paints when silk-screening operation closed.	Site-screening studies completed 11/95. Geophysical anomalies were investigated with two monitoring wells. Groundwater has no exceedances, but ABB-ES recommended a limited test-pitting program to determine source of geophysical anomalies. Test pitting completed 9/96, uncovered the buried foundations of Buildings 2721 and 2722. Site approved for transfer.
45 AF SITES[5]	MB	***1/White***	125	Alleged disposal area near Building 125	Alleged landfill with unknown contents.	Field screening completed in March 1996. The analytical results indicate no environmental concerns. Site has been approved for transfer pending a review of Florida secondary drinking water standards (FSDWS) exceedances in groundwater. ***Site approved for transfer on June 19, 1997.***

See notes at end of table.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis*

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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
OU 1[3] (MAIN BASE)	MB	3/Light Green	21	RTC Fitness Trail	Potential impact from North Grinder Landfill (contents of landfill not well documented).	Draft remedial investigation report submitted to Navy on 4/4/96. ABB-ES concluded (1) PAH contamination in surface soil does not pose unacceptable risks (USEPA and FDEP concur); (2) elevated gross alpha/gross beta in several wells adjacent to landfill are due to naturally occurring radionuclides that have been mobilized by altered groundwater chemistry near and under the landfill; (3) a landfill cap will not be required (USEPA and FDEP concur); and (4) groundwater should be monitored in downgradient wells to determine if there are any changes in contaminant concentrations as a function of time (USEPA and FDEP concur). At the request of the OPT, ABB-ES installed two upgradient wells (one at intermediate depth [OLD-U1-28B] and one deep in the shallow aquifer [OLD-U1-29C]) to evaluate a potential upgradient RADs source. The lab results indicate RADs activity above background in both wells (gross alpha/beta in OLD-U1-28B 44.2/31.7 pCi/ℓ versus background screening value of 13/9.5 pCi/ℓ, in OLD-U1-29C 22.9/32.1 pCi/ℓ). However, filtered samples had RADs activity significantly lower than background in both wells. The OPT approved all comment responses and the final RI report was submitted on 12/19/96. The (draft) Proposed Plan, which contains a recommendation of groundwater monitoring, was submitted in April and the (draft) Record of Decision document ***was submitted in June. The final Proposed Plan was also submitted in June, and a public meeting for the Proposed Plan was held on May 22, 1997.***
		3/Light Green	4004	North Grinder (paved)		
		3/Light Green	4005	North Grinder (grass)		
		3/Light Green	4021	South Grinder (paved)		
		3/Light Green	4022	South Grinder (grass)		

See notes at end of table.

Table 1-3 (Continued)
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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)

SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
OU 3	MB	6/Red	2134	Greenskeeper Storage	Confirmed arsenic in soils; an interim remedial action (IRA) will be required, which is anticipated to be soil removal.	Soil samples had elevated levels of arsenic (up to 577 mg/kg) versus a noncarcinogenic RBC of 23 mg/kg. Soil also had elevated levels of benzo(a)pyrene. Groundwater had elevated levels of arsenic (up to 425 µg/ℓ versus 50 µg/ℓ MCL). A PRE was conducted and indicated no ecological risk; however, health risk was higher than $1x10^{-6}$. The Greenskeeper Storage Area will require further study and, along with SA 9, has been designated OU 3. ***The draft RI/FS Workplan was completed in June 1997. Fieldwork is anticipated to begin in Fall 1997.***
OU 3	MB	6/Red	UNF-14	Former Pesticide and Herbicide Storage	Pesticide and herbicide releases may have occurred during operation of facility; an IRA will be required.	Soils had benzo(a)pyrene above SCGs. Also chlordane up to 2900 mg/kg versus screening value of 490 mg/kg. A PRE was conducted indicating no ecological risk, but human health risk was higher than $1x10^{-6}$, and the site will require remediation and, along with the Greenskeeper Storage Area in SA 8, has been designated OU 3. *Fieldwork is anticipated to begin* ***in Fall*** *1997.*
16 GRP III	MA	***2/Blue***	7168	Maintenance Yard	Potential release from an oil-water separator.	Fieldwork for Group III sites began on 3/13/95 and concluded on 6/5/95. The (draft) Group III report was submitted to the Navy on December 15, 1995. There were significant detections of PAHs in four surface soil samples that slightly exceeded SCGs for some PAH compounds; there were small exceedances of magnesium, Mn, and zinc in four subsurface soil samples. Mineral spirits were present as free product in a well adjacent to an oil-water separator in the northern corner of the site. The site has been transferred to the UST program for evaluation. ***Site transferred to NTC TMP in October 1996 with color change to 2/Blue.***
		2/Blue	7171	Army Motor Transportation	Potential release from an oil-water separator.	
			7172	Army Battery Shop	Stained soil associated with used battery storage, possible release of sulfuric acid from inside.	

See notes at end of table.

Table 1-3 (Continued)
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SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
17 GRP III	MA	7/Gray	7178	Training Material Storage	Evidence of paint dumped down the drains of adjacent wash rack.	Analytical results for SA 17 are indicated below. One groundwater sample showed significant detections of chlorinated hydrocarbons exceeding MCLs (TCE at 42 $\mu g/\ell$, VC at 190 $\mu g/\ell$, and cis-1,2-DCE at 200 $\mu g/\ell$); there were also exceedances of FDEPG for vanadium, aluminum, Mn, and iron. Surface soils had exceedances of several PAHs in two samples; subsurface soils had exceedances of several PAHs in three samples. A test-pitting study to determine source of geophysical anomaly revealed items of no environmental significance. A workplan to address chlorinated hydrocarbons in groundwater has been approved. ***Fieldwork is scheduled for Fall 1997.*** PAH delineation is on hold pending results of groundwater delineation. Color code should become 6/Red for Motor Pool Compound and drum storage area, but 7/Gray for the remaining area pending chlorinated solvent groundwater plume assessment and resolution of PAH contamination.
		7/Gray	7191	DPDO Warehouse	Ground staining and paint dumping evident.	
		7/Gray		Army Maintenance Office	Hazardous waste drum storage and alleged burial.	
		6/Red	7190	Army Motor Pool Compound and drum storage area adjacent to 7190	Site used as a motor pool and vehicle storage compound.	

See notes at end of table.

Table 1-3 (Continued)
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SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
18 GRP III	MA	7/Gray	7182	Housing Office	Hazardous materials including paint, solvents, compressed gases, and petroleum products stored there.	Analytical results for SA 18 are indicated below. Aluminum, iron, lead, Mn, thallium, and vanadium exceed background screening concentrations in one groundwater sample, which may have been affected by suspended particulates (TSS = 106 mg/ℓ); resampling on 6/18/96 had significantly lower concentrations for all prior exceedances, with aluminum and iron the only analytes still exceeding background screening concentrations (5,620 and 5,410 μg/ℓ, respectively). Surface soil detections of PAHs at two locations slightly exceeded their respective SCGs. ABB-ES has prepared a letter with recommendations for additional studies for SA 18 and other sites with PAHs in surface soil. ABB-ES also prepared a letter with recommendations for language to discuss FSDWS exceedances in groundwater; OPT is reviewing both letters. Color code should remain 7/Gray pending PAH issue.
19 GRP III	MA	1/White	7184	Auto Hobby Shop	Use of site as an auto hobby shop soil staining from waste oil evident.	Analytical results for SA 19 indicate no significant detections in any media sampled. The site was approved for transfer during the March OPT meeting. OPT will be reviewing the final report, which recommends No Further Action (NFA).
20 GRP III	MA	2/Blue	7187	Storage	Probability of pesticide storage.	Analytical results for SA 20 indicate no significant detections in any medium sampled. The site was approved for transfer during the March OPT meeting. Color code will remain 2/Blue due to petroleum contamination. ***Property approved for transfer in June 1997.***
21 GRP III	MA	7/Gray	7203	Maintenance Shop	Diesel fuel spill in 1993 from a leaking AST and former pesticide storage.	Analytical results for SA 21 indicate slight exceedances of SCGs for PAHs and arsenic in surface soil. Concerns regarding arsenic have prompted FDEP to have SA 21 reviewed by their risk assessment group. ***Field investigation to evaluate PAHs in surface soil completed in June 1997. Analytical results are forthcoming.*** Color code should remain 7/Gray pending resolution of PAH issue and exceedances of FSDWS.

See notes at end of table.

Table 1-3 (Continued)
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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
SA	**Location**	**BRAC Color Code**	**Building Number**	**Name**	**Reason for Investigation**	**Current Status**
22 GRP III	MA	1/White	UNF-1	Old Golf Course	Alleged disposal of engines, bomb shells, and spent ordnance in Lake Stanley.	Analytical results for SA 22 indicated no significant detections in surface water, sediment, or groundwater. Aluminum, iron, and lead exceeded surface water standards. Sampling to evaluate allegations of landfilling have been completed and a limited test-pitting program to evaluate geophysical anomalies was completed in September 1996 with no findings of environmental concern. A UXO survey performed by the Mayport EOD team did not reveal any items related to UXO disposal. *Color code change from 7/Gray to 1/White and transfer approved in **June 1997**.*
23 GRP III	MA	7/Gray	UNF-2	Former officers swimming pool and bathhouse (Building 7119)	Area used as a disposal pit for demolition debris, possibility of an unidentified UST.	Analytical results for SA 23 indicate exceedances for PAHs in one surface soil sample at the end of the 12-inch drain to the former swimming pool, leading to a recommendation to further evaluate the source of PAHs and "hot spot" delineation. Resampling of surface water/sediment at the drain opening during a storm event resulted in nondetects for SW, but exceedances of regulatory criteria for 5 PAHs in SED (a benzo[a]pyrene concentration of 5,400 μg/kg versus an RBC of 88 μg/kg).
24 GRP III	MA	***1/White***	UNF-4	Northwest Swamp	Former disposal area for construction debris.	Analytical results for SA 24 indicate exceedances of some inorganics (aluminum, iron, Mn, potassium, vanadium) in groundwater, which may have been affected by the high suspended particulate (TSS = 500 and 360 mg/ℓ).
		1/White	UNF-5	Southeast Swamp	Former domestic wastewater treatment plant (DWTP) at the southeastern area, demolition debris.	ABB-ES presented results of a study to determine the relationship between high TSS/turbidity and elevated concentrations of inorganics above secondary groundwater standards. ***Property approved for transfer by OPT in June 1997 with color change from 7/Gray to 1/White.***

See notes at end of table.

Table 1-3 (Continued)
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SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
25 GRP III	MA	7/Gray		Former DWTP - McCoy Annex	Suspect due to the nature of the facility.	Analytical results for SA 25 indicate iron and Mn exceedances in groundwater and slight exceedances of PAHs and pesticides in surface and subsurface soils. Resampling of OLD-25-03 for Mn on 7/25/96 determined a concentration of 662 $\mu g/\ell$ versus a FSDWS of 50 $\mu g/\ell$. ABB-ES will recommend color code change from 7/Gray to 1/White.
26 GRP III	MA	1/White	7351	Camp Bath House (RV Park)	Past use as an airfield strip and drum storage area.	Analytical results for SA 26 indicate no significant contamination in any medium sampled, with the exception of PAH exceedances in adjacent surface soil samples reported in the Background Sampling Report . SA 26 was approved for NFA during the March OPT meeting. Evaluation of PAH contamination in the vicinity of the two background surface soil samples was completed, confirming prior detections of PAHs, although at somewhat lower total PAH concentrations. ***Field investigation to delineate limits of PAH impact completed in July 1997. Analytical results are forthcoming.*** ABB-ES finalized report recommending color code change from 7/Gray to 1/White. Signed by OPT ***in June 1997***.
		1/White	7352	Camp Laundry	Same as above.	
		1/White	7357	Family Camp Office	In close proximity to the old airstrip, drums once stored here.	
		1/White	7358	Family Camp	Past use as an airstrip and drum storage area.	
46 AF SITES[5]	MA	1/White		Sewage disposal pit as part of DWTP	Within SA 25 (GRP III); alleged disposal of nondomestic wastes.	SA 46 designated AEC-MC-01 in Technical Memorandum, U.S. Air Force Records Search. Screening investigation completed in June 1996, and results indicated no evidence of environmental impact. Site has been approved for transfer; color change from 7/Gray to 1/White.
47 AF SITES[5]	MA	1/White		Former skeet range	Potential lead contamination; near SAs 25 and 26.	SA 47 designated AEC-MC-06 in Technical Memorandum, U.S. Air Force Records Search. Screening investigation completed in June 1996, and results indicated no evidence of environmental impact. Site has been approved for transfer; color change from 7/Gray to 1/White.

See notes at end of table.

Table 1-3 (Continued)
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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)

SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
48 AF SITES[5]	MA			Former auto, boat, and carpentry hobby shop	Potential contamination from past site use.	Site-screening investigations were completed in May 1996. The analytical results revealed a single pesticide (DDE) slightly above the screening level in one groundwater sample and a metal detector anomaly indicated a possible UST. Well OLD-48-03 was resampled for DDE 11/96: no pesticides were detected. GPR survey did not reveal a potential UST. ***Property approved for transfer in June 1997 with color change from 7/Gray to 1/White.***
49 AF SITES[5]	MA	7/Gray		Former disposal area	Potential contamination due to landfill with unknown contents; near SAs 24, 46, and 47.	SA 49 designated AEC-MC-17 in Technical Memorandum, U.S. Air Force Records Search. Screening investigation completed 6/96. Preliminary geophysical results show no evidence of disposal activities. There are FSDWS exceedances in groundwater (aluminum and iron). ABB-ES prepared a letter with recommendations for language to discuss FSDWS exceedances in groundwater; OPT is reviewing the letter.
50 AF SITES[5]	MA	1/White 7/Gray 2/Blue 7/Gray 1/White 7/Gray	7189 7178 7253 7174 RV Storage 7182	Former civil engineering yards (Buildings 7179 and 7182 investigated as SA 18; Building 7178 investigated as SA 17).	Potential contamination due to past site use activities.	Site-screening activities began in April 96, completed in May 1996. Analytical results indicate two surface soil samples with benzo(a)pyrene concentrations exceeding residential soil screening levels, but below industrial screening levels. ABB-ES will recommend NFA for all structures except Building 7174, which is still being evaluated because of the release of petroleum substances. ABB-ES has recommended color code change for Building 7189 and RV storage area from 7/Gray to 1/White; Building 7253 and RV storage compound were investigated under TMP, resulting in clean closures. Building 7174 requires remediation of petroleum groundwater plume. Site is transferable with a restriction to future industrial reuse.

See notes at end of table.

Table 1-3 (Continued)
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SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
51 AF SITES[5]	MA	1/White	7159	Former electrical substation	Potential PCB contamination due to spills and other incidents.	Site-screening activities were completed in August 1996. No PCBs were detected during field screening (immunoassay test kits) or in confirmatory samples submitted to laboratory. Site has been approved for transfer with color code change from 7/Gray to 1/White.
52	MA	6/Red	Former Building 7261	Former Entomology Lab	Potential pesticide contamination due to past use of building.	Site-screening investigations were completed in May 1996. Two surface soil samples had up to four pesticides above screening levels. Also, two groundwater samples had exceedances for pesticides. ABB-ES has recommended color code change to 6/Red due to pesticide contamination. Additional site investigations (pesticide immunoassay test kits, piezometers, monitoring wells) have confirmed pesticide exceedances in surface soil and groundwater. Results were submitted to OPT in February. A soil removal action is planned to remediate the site.
53	MA	3/Light Green	Building 7262	Kwik Shoppe	Potential contamination due to past use as a coin-operated dry-cleaning facility.	Workplan submitted to Navy on April 3, 1996. Site screening began in April. Screening investigation completed in June 1996. Field screening results indicated minimal impact to surface/subsurface soil from PCE/TCE. Analytical results below screening criteria. Site has been approved for transfer with color change to 3/Light Green.

See notes at end of table.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis*

Project Operations Plan for Site Investigations
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SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
OU 2	MA	6/Red	7355	McCoy Annex Golf Course	OU 2 is a 99-acre landfill operated by the Air Force from 1960 until 1972 when the Navy took over the property. The Navy closed the landfill in 1978. A 9-hole golf course was constructed over the site, which is drained by a series of canals and retention ponds that discharge to Boggy Creek and Boggy Creek Swamp to the south. It is estimated that over 1,000,000 cubic yards of waste were disposed of in the landfill, and that the waste included paints and other solvents, asbestos, transformers, hospital wastes, low-level radiological waste, scrap metal, demolition debris, and yard waste.	The OU 2 workplan is being finalized by Brown & Root (B&R). All future work at OU 2 will be accomplished by B&R. The OU 2 workplan was finalized. The fieldwork has been approved and field efforts began May 5, 1997.
		6/Red	7354	Greenskeeper Storage		
		6/Red	7353	Golf Course Club House		
		6/Red	7356	Lawn Equipment Storage		

See notes at end of table.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis*

Project Operations Plan for Site Investigations
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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)

SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
2 GRP I	HA	1/White	6001	Septic Tank/Leachfield	Exact contents of septic tank and drain field unknown (see "Other Areas" notes below for Herndon Annex Landfill).	No significant detections in shallow soil or shallow groundwater. No further investigation is required for Facility 6001, which is considered transferable (1/White). Field screening of the deep wells installed east of Building 606 and south of Building 610 indicate benzene concentrations of 21 and 32 $\mu g/\ell$, possibly related to former landfills at Herndon Annex. Additional field investigations indicate a probable off-site benzene source. A U.S. Army Corps of Engineers survey conducted for GOAA along the southern boundary of Herndon Annex was inconclusive in determining the benzene source. The presence of known landfilled areas may restrict future uses of the site. This land parcel was leased to the City of Orlando in December 1996. Additional groundwater screening was recently completed by ABB-ES to determine extent and source of benzene plume. Results indicate an upgradient source for benzene and other VOCs. Recent sampling of surface water in Lake Barton has occurred, ***resulting in detections of PCE at concentrations below surface water standards. Future screening east of the parcel to determine the extent of benzene plume will begin during Summer 1997.***
		7/Gray		Herndon landfill(s)	Potential contamination from unknown landfilled materials.	
43 AF SITES[5,6]	HA	3/Light Green	601	Indoor rifle and pistol range	Herndon Annex, potential lead contamination; see the remainder of SA 43 at Main Base (North Grinder Landfill skeet range, Building 229).	Eighteen surface soil samples (and 2 duplicates) collected and submitted for lead analysis in December 1995. One sample exceeded regulatory screening level. TCLP analysis for lead at the location of the highest lead concentration was below the RCRA regulatory limit, and lead is, therefore, not of environmental concern. The site has been approved for transfer with color change to 3/Light Green.

See notes at end of table.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis*

Project Operations Plan for Site Investigations
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Naval Training Center
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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
11 GRP II	AC	1/White	148	Cold Storage Warehouse (Area C)	Abandoned half-buried drum - Soil staining around generator pad transferred to UST program.	The field investigation for Group II sites was completed on April 6, 1995. Analytical results for SA 11 indicate no contaminants exceed guidance levels. Property has been approved for transfer.
12 GRP II	AC	6/Red	1061, 1063	DRMO warehouses and salvage yard		Transferred to OU 4, below.
13 GRP II	AC	6/Red	1100, 1101	NTC laundry and old heating plant		Transferred to OU 4, below.
14 GRP II	AC	6/Red	1102	Disposal, salvage and scrap building		Transferred to OU 4, below.
15 GRP II	AC	1/White	1053	CBU-419 Maintenance Shop	Diesel fuel spill reported.	Transferred to UST Program.
OU 4	AC	6/Red	1063 and 1061	DRMO Warehouses and salvage yard	Former hazardous waste handling and storage area; spills are suspected, and a former production well is on site.	Analytical results from initial screening investigation at SA 12 indicate no significant detections for soil, but that groundwater has PCE at 8 mg/ℓ versus an MCL of 5 $\mu g/\ell$. Results from supplemental screening activities indicated that shallow groundwater between Building 1100 (SA 13) and Lake Druid, as well as the surface water and sediment along the eastern edge of the lake, was significantly impacted with PCE and its daughter products (TCE, DCE, and VC). The IRA is a well-stripping system scheduled for installation in the fall of 1997. The RI/FS ***workplan was completed in July 1997. Fieldwork scheduled for Fall 1997.***

See notes at end of table.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis*

Project Operations Plan for Site Investigations
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SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
OU 4 (cont.) (SA 12 GRP II)						SA 12 has been grouped with SAs 13 and 14 and designated as OU 4. An RI/FS will be conducted at OU 4, but in the interim, a focused field investigation was started in May 1996 in order to better define the limits of impact for implementation of an IRA. The IRA focused field investigation is complete, and a pumping well and several observation wells have been installed to evaluate aquifer properties useful in evaluating treatment options. "In-well stripping" technology has been approved for the site. The system is currently being designed. An out-of-service production water well in the north-central portion of the area was abandoned in September 1996 to prevent contamination of the Floridan aquifer.
OU 4 (cont.) (SA 13 GRP II)	AC	6/Red	1100 (1101)	Laundry Dry Cleaners (Area C)	Several PCE spills documented; history of poor handling practices.	Passive soil gas and laboratory results from the initial screening investigation at SA 13 confirmed PCE and TCE contamination. Soil and groundwater have elevated levels of PCE and TCE. The highest contaminant concentration in soil was PCE at 220 mg/kg versus an SCG of 30 mg/kg. The highest levels in groundwater were PCE at 680 $\mu g/\ell$ and TCE at 52 $\mu g/\ell$ versus MCLs for both compounds of 3 $\mu g/\ell$.
OU 4 (cont.) (SA 14 GRP II)	AC	6/Red	1102	Disposal Salvage Scrap Building	Three-gallon spill of PCE.	Analytical results from the site screening indicate no significant detections for soil, but that groundwater has PCE and TCE concentrations of 46 and 20 $\mu g/\ell$ versus MCLs for both compounds of 3 $\mu g/\ell$.

See notes at end of table.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis*

Project Operations Plan for Site Investigations
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Site-Screening SAs/Operable Units for Main Base (MB), McCoy Annex (MA), Area C (AC), and Herndon Annex (HA)						
SA	Location	BRAC Color Code	Building Number	Name	Reason for Investigation	Current Status
Other Areas.						
ACM		7/Gray	2713	Administration Building		
ACM		7/Gray	2651	Recycling Center		
ACM		7/Gray	2450	Demolished		
ACM/LBP		1/White		Capehart Housing	Currently designated as 1/White.	ACM and LBP surveys completed in September 1995.

[1] Subject to change based on evolving evidence or knowledge.
[2] This area is in the southern portion of the Main Base golf course, near the small arms ammunition bunkers.
[3] This area also includes Building 208, the USS Bluejacket. The primary responsibility for this facility, however, lies within the UST program.
[4] Upon installation of additional monitoring wells and analysis of groundwater, a decision will be made regarding additional investigator requirements at this landfill.
[5] Sites discovered and/or reported in *Technical Memorandum, U.S. Air Force Records Search, Naval Training Center, Orlando, Florida* (ABB-ES, 1995a), and which will be investigated in accordance with workplan entitled *Site Screening Plan, Air Force Sites, Addendum 2, Naval Training Center, Orlando, Florida* (ABB-ES, 1995b).
[6] Sites previously considered, but which will be investigated in accordance with workplan entitled *Site Screening Plan, Groups I through V SAs and Miscellaneous Additional Sites, Addendum 1, Naval Training Center, Orlando, Florida* (ABB-ES, 1995c).

* = Changes for this revision are bolded and italicized.

Regulatory Limits and Guidelines for Analytical Parameters

- Groundwater - Maximum Contamination Limits (MCL), Federal and State promulgated
- Surface Water - FDEP Surface Water Quality Criteria (SWQC) Classes I through IV
- Soils - Risk-Based Concentrations (RBC) from USEPA Region III, Target Action Levels from FDEP (Screening guidelines only)
- Sediments - FDEP Sediment Quality Guidelines (SQG)
- No Observable Effects Level (NOEL)
- Probable Effects Level (PEL)
- (Screening Guidelines Only)

Notes continued on next page.

Table 1-3 (Continued)
Installation Restoration Program Non-UST/AST Investigation Synopsis*

Project Operations Plan for Site Investigations
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Notes (Continued):

UST/AST = underground storage tank/aboveground storage tank.
SA = site assessment.
BRAC = Base Realignment and Closure (Act).
GRP = Group.
UNF = unnumbered facility.
BEQ = Bachelor Enlisted Quarters
μg/ℓ = micrograms per liter.
MCL = maximum contaminant level.
OPT = Orlando Partnering Team.
RTC = Recruit Training Center.
Lt = lieutenant.
USAF = U.S. Air Force.
ABB-ES = ABB Environmental Services, Inc.
PCB = polychlorinated biphenyl.
DDE = dichlorodiphenyldichloroethane.
PAH = polynuclear aromatic hydrocarbon.
WWTP = wastewater treatment plant.
OU = operable unit.
Mn = manganese.
FDEPG = Florida Department of Environmental Protection Guidance.
Na = sodium.
pCi/ℓ = picocuries per liter.
IAS = initial assessment study.
BEHP = bis(2-ethylhexyl)phthalate.
NTC = Naval Training Center.
DFAS = Defense Finance Accounting Service.
PW = public works.
AF = Air Force.
BTEX = benzene, toluene, ethylbenzene, and xylenes.
J = estimated value.
mg/kg = milligrams per kilogram.
RAD = radiation.
HHRA = human health risk assessment.
TCLP = toxicity characteristic leachate procedure.
RCRA = Resource Conservation and Recovery Act.
PCE/TCE = perchloroethylene and trichloroethene.
USEPA = U.S. Environmental Protection Agency.
FDEP = Florida Department of Environmental Protection.
RBC = risk-based concentration.
RI = remedial investigation.
PRE = Preliminary Risk Evaluation.
FS = feasibility study.
SCG = soil cleanup goal.
DPDO = Defense Property Disposal Office.
VC = vinyl chloride.
DCE = dichloroethene.
TSS = total suspended solids.
mg/ℓ = milligrams per liter.
UXO = unexploded ordnance.
EOD = explosive ordnance disposal.
SW = surface water.
SED = sediment.
μg/kg = micrograms per kilogram.
GPR = ground-penetrating radar.
GOAA = Greater Orlando Aviation Authority.
VOC = volatile organic compound.
DRMO = Defense Reutilization and Marketing Office.
CBU = construction batallion unit.
ACM = asbestos-containing material.
LBP = lead-based paint.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This portion of the POP addresses project organization, and specifically outlines QC coordination and responsibilities. Those individuals assigned to a project or task (i.e., the project team) are responsible for conducting project work by using the resources assigned by the project management organization. In this way, resources are available to each task, but responsibility for initiating services and for ensuring acceptable results remains within the project organization. This responsibility carries with it the authority to initiate, modify, and, if necessary, stop activities as appropriate for the assurance of project quality. It is the QA Manager's (QAM) role to assist the Task Order Manager (TOM) in meeting project goals while providing an independent evaluation of product quality to the TOM.

2.1 PROJECT STAFFING AND RESPONSIBILITIES.

2.1.1 BRAC Environmental Coordinator The BRAC Environmental Coordinator for NTC, Orlando is Mr. Wayne Hansel. Mr. Hansel is the Navy representative on the OPT and the primary project contact. He is responsible for the execution of all environmental cleanup programs related to the transfer of NTC, Orlando's real property. This responsibility includes acting as the liaison and coordinator with appropriate NTC, Orlando and SOUTHNAVFACENGCOM personnel, and negotiating appropriate cleanup and abatement actions with USEPA and FDEP OPT members.

2.1.2 SOUTHNAVFACENGCOM Engineer-in-Charge (EIC) The SOUTHNAVFACENGCOM EIC, Ms. Barbara Nwokike, is responsible for the technical and financial management of the IR program activities at NTC, Orlando. She prepares the project statement of work; manages the project scope, schedule, and budget; and provides technical review and approval of all deliverables. Ms. Nwokike will be responsible for approving changes in the IR program scope of work.

2.1.3 Consultant TOM The consultant TOM for BRAC activities at NTC, Orlando is Mr. John Kaiser. Mr. Kaiser is responsible for evaluating the appropriateness and adequacy of the technical and engineering services provided. He is responsible for financial and schedule management and for ensuring that the project fulfills and remains within the contracted scope of work. Mr. Kaiser will be responsible for identifying necessary changes in the scope of work. Mr. Kaiser 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. Other TOMs may be assigned for individual components of the work.

2.1.4 Project Review Committee Mr. Richard Allen will serve as chairman of the review committee. The function of this group of senior technical and management personnel is to provide guidance and oversight on the technical aspects of the project. This is accomplished through periodic reviews of the services provided to ensure they represent the accumulated experience of the firm, are being produced in accordance with corporate policy, and live up to the objectives of the program as established by ABB-ES and the client.

2.1.5 QAM The TOM is supported by a QAM. The QAM, Mr. Robert Burns, will oversee the implementation of appropriate NEESA, USEPA, and FDEP protocols. The QAM will also work with the TOM to establish QA procedures.

2.1.6 Health and Safety Manager The Health and Safety Manager, Ms. Cynthia Sundquist, is responsible for project team compliance with corporate health and safety requirements and the NTC, Orlando project HASP. Conformance with safety protocols will be assessed through periodic site visits and daily supervision by the site leaders.

3.0 QUALITY ASSURANCE OBJECTIVES

Data quality objectives (DQOs) have been developed for the NTC, Orlando project to ensure that analytical data collected during the field investigations will be of sufficient quality to support the data's intended use. Specific objectives will be addressed in the applicable task-specific workplans. Task-specific questions such as how the data will be used and how much data are required will be considered when developing DQOs. The DQO process is defined in USEPA's *Data Quality Objectives Process for Superfund, Interim Final* (September 1993).

3.1 GENERALIZED SCOPE OF WORK. The SS, SI, RI and IRA field efforts will involve several activities relative to the acquisition of physical and chemical data. Each investigation will involve a task-based approach that will allow the decision-making process to modify future investigative and remedial tasks. The DQOs for soil, groundwater, surface water, and sediment sample collection and analysis performed in the field will be applicable to the confirmation of the presence or absence of contamination and the nature and extent of any contamination encountered in those media. TerraProbe℠ sampling and field GC, infrared, and immunoassay analyses will, in some instances, be the initial chemical data gathering task. Field analysis will not be used alone to evaluate a study area. The results of these field analyses will be used to confirm or modify the proposed sample locations from which samples will be collected for laboratory analysis. Specific DQOs will be developed and identified for each investigation in accordance with USEPA's DQO process (USEPA, 1993). At a minimum, DQO information included in site-specific workplans will include sample types and locations, sampling procedures, data types and use, and field QA/QC.

3.2 DQOs. DQOs are qualitative or quantitative statements developed by the data user to specify the quality of data needed from a particular data activity to support specific decisions. The DQOs are the starting point in the design of the investigation. The DQO development process matches sampling and analytical capabilities to the data targeted for specific uses and ensures that the quality of the data does not underestimate project requirements.

3.2.1 Analytical Levels The USEPA has identified five general levels of analytical data quality as being potentially applicable to field investigations conducted at potential hazardous waste sites under the CERCLA. These levels are summarized as follows.

(1) Level I, Field Screening. This level is characterized by the use of portable instruments that can provide real-time data to assist in the optimization of sampling point locations and for health and safety support. Qualitative data can be generated regarding the presence or absence of certain contaminants (especially volatiles) at sampling locations.

Level I sampling requirements include the use of equipment and sampling containers that are clean (soap and tap water), visibly free of contamination, and free of analytes detectable by the screening method employed.

(2) Level II, Field Analysis. This level is characterized by the use of portable analytical instruments that can be used on site or in mobile laboratories stationed near a site. Depending on the types of contaminants, sample matrix, and personnel skills, qualitative and quantitative data can be obtained.

Level II sampling and equipment requirements include the use of sampling equipment constructed of material that is compatible with the parameters being analyzed (e.g., polyvinyl chloride [PVC] for inorganic parameter analyses, or chrome-plated material for organic parameter analyses) and field cleaning procedures that include a potable water and soap scrub followed by a potable water rinse (or steam cleaning or high pressure washing).

(3) Level III, Laboratory analysis. This level is characterized by the use of methods other than the CLP Routine Analytical Services (CLP-RAS). This level is used primarily in support of engineering studies using standard USEPA-approved procedures. Some procedures may be equivalent to the USEPA CLP-RAS, without the CLP requirements for documentation.

Level III field methods, decontamination procedures, and sampling equipment construction materials are as specified in the USEPA EISOPQAM (USEPA, 1996). Cleaning of downhole drilling or excavation equipment must be performed as with Level IV requirements with the exclusion of the deionized water rinse, the double rinse with pesticide grade isopropanol, and the rinse with organic-free water. All other cleaning and decontamination guidance must be followed.

When wells are constructed using materials that are not inert with respect to the contaminants being analyzed, data collected from those wells are Level III or lower for those incompatible analytes, even if Level IV analytical procedures are used.

Level III QA/QC sampling blank requirements include

- a minimum of one equipment rinsate blank per week for each week sampling equipment is field cleaned;
- if samples are preserved, a preservative blank must be collected and analyzed at the beginning and end of the study; and
- a blank of the rinse water must be collected and analyzed prior to beginning the study and at the end of each week that sampling equipment is field cleaned.

A minimum of 5 percent of samples collected for Level III analysis will be split for Level IV analysis. These samples must be representative of all samples submitted for Level III analysis (USEPA, 1996).

(4) Level IV, Laboratory Analysis CLP-RAS. This level is characterized by all requirements for Level III, plus more rigorous QA/QC protocols and documentation, and provide qualitative and quantitative analytical data.

(5) Level V, Nonstandard methods. This level includes analyses that may require modification and/or development. CLP Special Analytical Services are considered Level V.

3.2.2 Data Types USEPA Region IV recognizes four types of data (USEPA, 1996). These are described below.

- **Field Screening:** This level is characterized by the use of portable instruments that can provide real-time data to assist in the optimization of sampling locations and health and safety support. Data can be generated regarding the presence or absence of certain contaminants at sampling locations.

- **Field Analyses:** This level is characterized by the use of portable analytical instruments that can be used on site or in a mobile laboratory stationed near a site. Depending on the types of contaminants, sample matrix, and personnel skills, qualitative and quantitative data can be obtained.

- **Screening Data with Definitive Confirmation:** These data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provides analyte identification and quantification, although the quantification may be relatively imprecise. At least 10 percent of the screening data should be confirmed using appropriate analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data are not considered to be data of known quality.

- **Definitive Data:** These data are generated using rigorous analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. These methods produce tangible raw data (e.g., chromatograms, spectra or digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. To be definitive, either the analytical or total measurement error must be determined.

3.2.3 Task-Specific Objectives Tasks for the SS/SI/RI/IRA at NTC, Orlando will involve data collection of the full range of data types. The following discusses the typical SS/SI/RI/IRA tasks for NTC, Orlando and the associated data types and DQO objectives. The tasks performed for each Study Area will be specified in the task-specific workplans.

- **Air Quality Monitoring, Field Screening:** Readings from an organic vapor analyzer (OVA), photoionization detector (PID), MSA Model 260 02/Explosimeter, or other such devices, will constitute Level I field analytical data.

- **Geophysical Survey, Field Screening:** Terrain conductivity (TC), magnetometer, or ground-penetrating radar (GPR) surveys will be used to define potential or suspected contaminant plumes. Data generated as a result of the surveys will indicate the presence or absence of metallic objects and the relative subsurface conductivity. Data requirements are primarily qualitative.

- **Soil Sample Screening, Field Screening**: TerraProbe℠ soil samples and split-spoon samples from discrete depths in soil borings will be screened in the field with an OVA or flame ionization detector (FID) and a PID providing Level I data concerning the presence or absence of volatile compounds. A field GC may be used to augment field screening methods.

- **Field Parameter Analysis, Field Analyses or Screening Data with Confirmation**: More sophisticated instrumentation (such as the HNu Model 311 GC and the Mach Portable Infrared Spectrometer) used for onsite analysis of volatiles and TPH will generate Level II analytical data. These data are supported by more extensive logbook documentation, calibration, and QC. Immunoassay test kits may also be used for Level II analytical data and will usually require 10 percent laboratory confirmatory sampling. These analyses will be performed in accordance with the manufacturers' and USEPA recommendations for QC.

- **Passive Soil Gas Survey, Field Analyses**: Passive soil gas samples will be analyzed at an off-site laboratory. The data conform to Level II analysis and are used to provide a preliminary survey of the presence and distribution of shallow VOC contamination.

- **Soil Headspace and Active Gas Screening, Field Analyses**: Soil gas will be collected from TerraProbe℠ soil borings (on site) using headspace and active gas methods. The resulting data will conform to Level II analysis.

- **TOC Analysis, Definitive Data**: Soil and sediment samples may be collected for TOC analysis. These samples will be collected and analyzed to conform to Level III DQOs.

- **Soil, Sediment, Surface Water, and Groundwater Analysis, Definitive Data**: Environmental samples obtained during SS investigations will be collected and analyzed to conform to Level III analyses. These data will be used to further characterize the presence and extent of contamination at each POI.

- **Characterization and Confirmatory Sampling, Definitive Data**: Groundwater and soil samples collected from monitoring wells, and split-spoon soil samples will be collected and analyzed in accordance with Level IV analyses for confirmatory investigations. Surface water and sediment samples collected during RI-stage field programs will be collected and analyzed to conform to Level IV DQOs.

- **Treatability Studies, Definitive Data**: Samples collected to evaluate the effectiveness and feasibility of selected remedial alternatives will be analyzed to conform to Level III analyses.

- **Remedial Monitoring and Confirmatory Sampling, Definitive Data**: Samples collected to monitor or confirm the input and output of treatment methods and samples collected to confirm the effectiveness of remedial actions will be analyzed to conform to Level IV analyses.

- **Risk Assessment, Field Screening, Screening Data with Confirmation, and Definitive Data**: Levels II, III, and IV data may be used in preliminary risk screening evaluations. For more quantitative risk assessments, Level III and Level IV data are preferred.

The sampling approaches presented in Chapter 4.0 of this POP and the laboratory analytical procedures described in Chapter 7.0 have been selected to meet the applicable DQOs.

3.3 QA/QC APPROACH. The approach to providing reliable data that meet the DQOs will include QA/QC requirements for each of the analytical data types generated during the field investigation. The details of field measurement QA/QC are included in Chapter 4.0 of this POP where sample collection techniques are presented. The QA/QC efforts for laboratory analyses will include collection and submittal of QC samples and the assessment and validation of data from the subcontract laboratories.

DQOs are based on the premise that different data uses require different levels of data quality. Data quality refers to a degree of uncertainty with respect to precision, accuracy, representativeness, completeness, and comparability (PARCC).

Parameters used within the data validation process to evaluate data quality include determination of PARCC. The achievable limits for these parameters vary with the DQO level of the data. The objectives used for laboratory analytical data in this program will be those set by the CLP for Level IV analyses and as specified in the USEPA methods for Level III. The specific QA objectives applicable to data generated from SIs at NTC, Orlando are summarized in Tables 3-1 and 3-2. These parameters are defined here, and methods of calculation are shown.

Precision. Precision is defined as the agreement among individual measurements of the same chemical constituent in a sample obtained under similar conditions.

Field precision will be expressed as relative percent difference (RPD) of field duplicates using the formula:

$$RPD = \frac{|X1 - X2|}{(X1 + X2)/2} \times 100 \qquad (1)$$

where

RPD = relative percent difference between duplicate results,
X1 and X2 = results of duplicate analyses, and
|X1 - X2| = absolute difference between duplicates X1 and X2.

Field duplicates take into account the level of error introduced by field sampling techniques, field conditions, and analytical variability. The RPD of field duplicates will be calculated during the data validation process to evaluate the sample precision.

Table 3-1
Analytical Methods and Data Precision, Accuracy, and Completeness Objectives for Site Investigations

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Air Station
Orlando, Florida

		Method	Precision[1]	Accuracy[1]	Completeness	Practical Quantitation Limit
Parameter	Matrix	Analysis	Percent RPD of Duplicate[2]	Spike Percent Recovery Range[3]	Percent	[4]Water = µg/ℓ Soil = [4]mg/kg
Metals						
Aluminum	Water	200.7 CLP-M	0 to 20	75 to 125	96	50
	Soil/Sediment	200.7 CLP-M	0 to 35	75 to 125	96	5
Antimony	Water	200.7 CLP-M	0 to 20	75 to 125	96	50
	Soil/Sediment	200.7 CLP-M	0 to 30	75 to 125	96	5
Arsenic	Water	206.2 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	206.2 CLP-M	0 to 30	75 to 125	96	1
Barium	Water	200.7 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	200.7 CLP-M	0 to 30	75 to 125	96	1
Beryllium	Water	200.7 CLP-M	0 to 20	75 to 125	96	5
	Soil/Sediment	200.7 CLP-M	0 to 30	75 to 125	96	0.5
Cadmium	Ground Water	200.7 CLP-M	0 to 20	75 to 125	96	5
	Surface Water	213.2 CLP-M	0 to 20	75 to 125	96	1
Calcium	Water	200.7 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	200.7 CLP-M	0 to 35	75 to 125	96	5
Chromium	Water	200.7 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	200.7 CLP-M	0 to 30	75 to 125	96	1
Cobalt	Water	200.7 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	200.7 CLP-M	0 to 35	75 to 125	96	5
Copper	Water	200.7 CLP-M	0 to 20	75 to 125	96	25
	Soil/Sediment	200.7 CLP-M	0 to 30	75 to 125	96	2.5
Iron	Water	200.7 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	200.7 CLP-M	0 to 35	75 to 125	96	5
Lead	Water	239.2 CLP-M	0 to 20	75 to 125	96	5
	Soil/Sediment	239.2 CLP-M	0 to 30	75 to 125	96	0.5
Magnesium	Water	200.7 CLP-M	0 to 20	75 to 125	96	50
	Soil/Sediment	200.7 CLP-M	0 to 35	75 to 125	96	5
Manganese	Water	200.7 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	200.7 CLP-M	0 to 35	75 to 125	96	5
Mercury	Water (all)	245.1 CLP-M	0 to 20	75 to 125	96	0.2
	Soil/Sediment	245.5 CLP-M	0 to 30	75 to 125	96	0.03

See notes at end of table.

Table 3-1 (Continued)
Analytical Methods and Data Precision, Accuracy, and Completeness Objectives for Site Investigations

Project Operations Plan for Site Investigations
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		Method	Precision[1]	Accuracy[1]	Completeness	Practical Quantitation Limit
Parameter	Matrix	Analysis	Percent RPD of Duplicate[2]	Spike Percent Recovery Range[3]	Percent	[4]Water = μg/ℓ [4]Soil = mg/kg
Metals (Continued)						
Nickel	Water	200.7 CLP-M	0 to 20	75 to 125	96	40
	Soil/Sediment	200.7 CLP-M	0 to 30	75 to 125	96	4
Potassium	Water	200.7 CLP-M	0 to 20	75 to 125	96	Dependent on
	Soil/Sediment	200.7 CLP-M	0 to 35	75 to 125	96	ICP conditions
Selenium	Water	270.2 CLP-M	0 to 20	75 to 125	96	5
	Soil/Sediment	270.2 CLP-M	0 to 30	75 to 125	96	1
Silver	Ground Water	200.7 CLP-M	0 to 20	75 to 125	96	10
	Surface Water	272.2 CLP-M	0 to 20	75 to 125	96	1
	Soil/Sediment	200.7 CLP-M	0 to 30	75 to 125	96	1
Sodium	Water	200.7 CLP-M	0 to 20	75 to 125	96	50
	Soil/Sediment	200.7 CLP-M	0 to 35	75 to 125	96	5
Thallium	Water	279.2 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	279.2 CLP-M	0 to 30	75 to 125	96	1
Vanadium	Water	200.7 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	200.7 CLP-M	0 to 35	75 to 125	96	5
Zinc	Water	200.7 CLP-M	0 to 20	75 to 125	96	20
	Soil/Sediment	200.7 CLP-M	0 to 30	75 to 125	96	2
Other						
Cyanide	Water	335.2 CLP-M	0 to 20	75 to 125	96	10
	Soil/Sediment	335.2 CLP-M	0 to 35	75 to 125	96	5
Radiological						
Water	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2	
	Soil/Sediment	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2
Organics						
Volatiles	Water	624 CLP-M	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2
	Soil/Sediment	624 CLP-M	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2
Base-Neutral	Water	625 CLP-M	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2
Acid Extractables	Soil/Sediment	625 CLP-M	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2
PCBs	Water	608 CLP-M	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2

See notes at end of table.

Table 3-1 (Continued)
Analytical Methods and Data Precision, Accuracy, and Completeness Objectives for Site Investigations

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		Method	Precision[1]	Accuracy[1]	Completeness	Practical Quantitation Limit
Parameter	Matrix	Analysis	Percent RPD of Duplicate[2]	Spike Percent Recovery Range[3]	Percent	[4]Water = $\mu g/\ell$ [4]Soil = mg/kg
Organics (Continued)						
PCBs	Soil/Sediment	608 CLP-M	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2
Dioxin	Soil	8280	See Table 3-2	See Table 3-2	See Table 3-2	See Table 3-2

[1] Precision and accuracy where applicable will be evaluated according to procedures in U.S. Environmental Protection Agency (USEPA) *Methods for Chemical Analysis of Water and Wastes* (EPA-600/4-79-020 [revised March 1983]), and in *Contract Laboratory Program Statement of Work for Organics Analysis* (USEPA, 1991b).
[2] RPD = [(S-D)/(S+D)/2] x 100 for samples greater than 5 times relative detection limit.
RPD not calculated, result less than detection limit (DL).
For results less than 5 times the DL, values must agree within ±DL as specified by USEPA-CLP data.
Contract Laboratory Program Statement of Work for Inorganics Analysis (USEPA, 1991a).
[3] Percent Relative standard deviation.
[4] Detection limit will vary depending on matrix differences that result in sample dilution and for soils, detection limit will also vary depending on moisture content of sample if results are reported as dry weight.

Notes: RPD = relative percent difference.
$\mu g/\ell$ = micrograms per liter.
mg/kg = milligrams per kilogram.
CLP-M = Contract Laboratory program–modified.
ICP = inductively coupled plasma.
PCBs = polychlorinated biphenyls.

Table 3-2
Practical Quantitation Limits, Accuracy, Precision, and Completeness Objectives of Organics Analyses for Site Investigations

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Parameters	Precision[1]		Accuracy[1,2]		Completeness	Practical Quantitation Limit[3]	
	Percent RPD of Duplicates		Spike Percent Recovery		Percent	Water (μg/ℓ)	Soils (μg/kg)
	Water	Soils	Water	Soils			
Volatile Organics (TCL 624 CLP-M)							
Acetone	0 to 40	0 to 47	47 to 143	32 to 163	96	25	25
Benzene	0 to 11	0 to 21	76 to 127	66 to 142	96	5	5
Bromodichloromethane	0 to 40	0 to 42	35 to 155	37 to 160	96	5	5
Bromoform	0 to 40	0 to 33	46 to 169	48 to 152	96	5	5
Bromomethane	0 to 65	0 to 61	10 to 170	10 to 160	96	10	10
2-Butanone	0 to 40	0 to 38	46 to 153	37 to 161	96	10	10
Carbon disulfide	0 to 40	0 to 40	53 to 148	43 to 169	96	5	5
Carbon tetrachloride	0 to 40	0 to 36	71 to 140	67 to 138	96	5	5
Chlorobenzene	0 to 13	0 to 21	75 to 130	60 to 133	96	5	5
Chloroethane	0 to 80	0 to 72	10 to 160	12 to 147	96	10	10
2-Chloroethylvinyl ether	0 to 94	0 to 83	10 to 199	10 to 184	96	10	10
Chloroform	0 to 40	0 to 43	60 to 140	51 to 139	96	5	5
Chloromethane	0 to 60	0 to 87	10 to 140	10 to 130	96	10	10
Dibromochloromethane	0 to 40	0 to 49	56 to 142	53 to 140	96	5	5
1,1-Dichloroethane	0 to 43	0 to 38	10 to 169	58 to 161	96	5	5
1,2-Dichloroethane	0 to 40	0 to 37	56 to 146	47 to 143	96	5	5
1,1-Dichloroethene	0 to 14	0 to 22	61 to 145	59 to 172	96	5	5
trans-1,2-Dichloroethene	0 to 40	0 to 40	56 to 146	56 to 146	96	5	5
1,2-Dichloropropane	0 to 55	0 to 46	10 to 162	10 to 178	96	5	5
cis-1,3-Dichloropropene	0 to 62	0 to 53	10 to 162	10 to 163	96	5	5
trans-1,3-Dichloropropene	0 to 45	0 to 49	26 to 160	21 to 139	96	5	5
2-Hexanone	0 to 40	0 to 38	49 to 151	47 to 153	96	10	10
Ethylbenzene	0 to 40	0 to 40	38 to 152	27 to 161	96	5	5
4-Methyl-2-pentanone	0 to 40	0 to 49	46 to 152	40 to 163	96	10	10
Methylene chloride	0 to 40	0 to 39	41 to 177	40 to 162	96	5	5
Styrene	0 to 42	0 to 40	34 to 176	37 to 163	96	5	5
1,1,2,2-Tetrachloroethane	0 to 40	0 to 38	54 to 142	47 to 138	96	5	5
Tetrachloroethene	0 to 40	0 to 29	70 to 140	52 to 139	96	5	5

See notes at end of table.

Table 3-2 (Continued)
Practical Quantitation Limits, Accuracy, Precision, and Completeness Objectives of Organics Analyses for Site Investigations

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Parameters	Precision[1]		Accuracy[1,2]		Completeness	Practical Quantitation Limit[3]	
	Percent RPD of Duplicates		Spike Percent Recovery		Percent	Water (µg/ℓ)	Soils (µg/kg)
	Water	Soils	Water	Soils			
Volatile Organics (TCL 624 CLP-M) (Continued)							
Toluene	0 to 13	0 to 21	76 to 125	59 to 139	96	5	5
1,1,1-Trichloroethane	0 to 40	0 to 28	55 to 150	42 to 147	96	5	5
1,1,2-Trichloroethane	0 to 40	0 to 34	53 to 152	41 to 183	96	5	5
Trichloroethene	0 to 14	0 to 24	71 to 120	62 to 137	96	5	5
Vinyl Acetate	0 to 50	0 to 54	39 to 151	36 to 173	96	10	10
Vinyl Chloride	0 to 87	0 to 69	10 to 181	10 to 168	96	10	10
Xylenes (total)	0 to 40	0 to 39	50 to 150	38 to 137	96	5	5
Miscellaneous Volatile Organics (624 CLP-M)							
n-Butyl acetate	0 to 40	0 to 50	50 to 140	40 to 160	96	50	50
Ethyl acetate	0 to 40	0 to 50	40 to 150	35 to 170	96	50	50
Base-Neutral Extractables (TCL) (625 CLP-M)							
Acenaphthene	0 to 31	0 to 19	46 to 118	31 to 137	96	10	330
Acenaphthylene	0 to 40	0 to 40	36 to 140	36 to 140	96	10	330
Anthracene	0 to 40	0 to 25	40 to 140	40 to 125	96	10	330
Benzo(a)anthracene	0 to 40	0 to 32	29 to 140	29 to 112	96	10	330
Benzo(b)fluoranthene	0 to 40	0 to 40	20 to 140	20 to 118	96	10	330
Benzo(k)fluoranthene	0 to 42	0 to 42	25 to 140	25 to 130	96	10	330
Benzo(g,h,i)perylene	0 to 56	0 to 56	10 to 140	10 to 102	96	10	330
Benzo(a)pyrene	0 to 40	0 to 38	25 to 160	25 to 160	96	10	330
Benzyl Alcohol	0 to 50	0 to 50	15 to 140	15 to 112	96	10	330
Butyl benzyl phthalate	0 to 40	0 to 20	10 to 140	10 to 118	96	10	330
Bis(2-chloroethoxy)methane	0 to 43	0 to 43	36 to 160	36 to 160	96	10	330
Bis(2-chloroethyl)ether	0 to 40	0 to 33	34 to 168	34 to 168	96	10	330
Bis(2-chloroisopropyl)ether	0 to 46	0 to 46	14 to 153	14 to 153	96	10	330
Bis(2-ethylhexyl)phthalate	0 to 40	0 to 40	10 to 153	10 to 153	96	10	330
4-Bromophenyl phenyl ether	0 to 40	0 to 23	53 to 140	53 to 126	96	10	330
4-Chloroaniline	0 to 50	0 to 50	10 to 150	10 to 150	96	10	330
2-Chloronaphthalene	0 to 40	0 to 20	60 to 140	66 to 118	96	10	330
4-Chlorophenyl phenyl ether	0 to 33	0 to 33	25 to 158	25 to 158	96	10	330

See notes at end of table.

Table 3-2 (Continued)
Practical Quantitation Limits, Accuracy, Precision, and Completeness Objectives of Organics Analyses for Site Investigations

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Parameters	Precision[1] Percent RPD of Duplicates		Accuracy[1,2] Spike Percent Recovery		Completeness	Practical Quantitation Limit[3]	
	Water	Soils	Water	Soils	Percent	Water (μg/ℓ)	Soils (μg/kg)
Base-Neutral Extractables (TCL) (625 CLP-M) (Continued)							
Chrysene	0 to 48	0 to 48	17 to 168	17 to 168	96	10	330
Dibenz(a,h)anthracene	0 to 70	0 to 70	10 to 227	10 to 227	96	10	330
Dibenzofuran	0 to 40	0 to 25	25 to 140	25 to 120	96	10	330
Di-n-butyl phthalate	0 to 50	0 to 50	10 to 140	10 to 120	96	10	330
1,2-Dichlorobenzene	0 to 40	0 to 31	32 to 140	32 to 129	96	10	330
1,3-Dichlorobenzene	0 to 41	0 to 41	25 to 140	25 to 115	96	10	330
1,4-Dichlorobenzene	0 to 28	0 to 27	36 to 97	28 to 104	96	10	330
3,3-Dichlorobenzidine	0 to 80	0 to 80	10 to 260	10 to 260	96	20	670
Diethylphthalate	0 to 40	0 to 30	10 to 140	10 to 114	96	10	330
Dimethylphthalate	0 to 40	0 to 27	10 to 140	10 to 112	96	10	330
2,4-Dinitrotoluene	0 to 38	0 to 47	24 to 96	28 to 89	96	10	330
2,6-Dinitrotoluene	0 to 40	0 to 29	50 to 158	50 to 158	96	10	330
Di-n-octylphthalate	0 to 50	0 to 50	10 to 150	10 to 150	96	10	330
Fluoranthene	0 to 40	0 to 33	26 to 140	26 to 137	96	10	330
Fluorene	0 to 40	0 to 21	59 to 140	59 to 121	96	10	330
Hexachlorobenzene	0 to 40	0 to 25	10 to 152	10 to 152	96	10	330
Hexachlorobutadiene	0 to 40	0 to 26	24 to 140	24 to 116	96	10	330
Hexachlorocyclopentadiene	0 to 50	0 to 50	10 to 150	10 to 150	96	10	330
Hexachloroethane	0 to 40	0 to 25	40 to 140	40 to 113	96	10	330
Indeno(1,2,3-cd)pyrene	0 to 45	0 to 45	10 to 171	10 to 171	96	10	330
Isophorone	0 to 60	0 to 60	21 to 196	21 to 196	96	10	330
2-Methylnaphthalene	0 to 40	0 to 30	35 to 140	35 to 125	96	10	330
Naphthalene	0 to 40	0 to 32	39 to 140	39 to 127	96	10	330
2-Nitroaniline	0 to 50	0 to 50	10 to 150	10 to 150	96	50	1,700
3-Nitroaniline	0 to 50	0 to 50	10 to 150	10 to 150	96	50	1,700
4-Nitroaniline	0 to 50	0 to 50	10 to 150	10 to 150	96	50	1,700
Nitrobenzene	0 to 40	0 to 39	35 to 180	35 to 180	96	10	330
N-Nitrosodi-n-propylamine	0 to 50	0 to 38	10 to 150	41 to 126	96	10	330
N-Nitroso-diphenylamine	0 to 50	0 to 50	10 to 150	10 to 150	96	10	330
Phenanthrene	0 to 40	0 to 21	54 to 140	54 to 120	96	10	330
Pyrene	0 to 31	0 to 36	26 to 127	35 to 142	96	10	330
1,2,4-Trichlorobenzene	0 to 28	0.23	39 to 98	38 to 107	96	10	330

See notes at end of the table.

Table 3-2 (Continued)
Practical Quantitation Limits, Accuracy, Precision, and Completeness Objectives of Organics Analyses for Site Investigations

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Parameters	Precision[1] Percent RPD of Duplicates Water	Precision[1] Percent RPD of Duplicates Soils	Accuracy[1,2] Spike Percent Recovery Water	Accuracy[1,2] Spike Percent Recovery Soils	Completeness Percent	Practical Quantitation Limit[3] Water (µg/ℓ)	Practical Quantitation Limit[3] Soils (µg/kg)
Acid Extractables (TCL) (625 CLP-M)							
Benzoic acid	0 to 50	0 to 50	10 to 150	10 to 150	96	50	1,700
4-Chloro-3-methylphenol	0 to 42	0 to 33	23 to 97	26 to 103	96	10	330
2-Chlorophenol	0 to 40	0 to 50	27 to 123	25 to 102	96	10	330
2,4-Dichlorophenol	0 to 40	0 to 26	39 to 140	39 to 135	96	10	330
2,4-Dimethylphenol	0 to 40	0 to 26	32 to 140	32 to 119	96	10	330
2,4-Dinitrophenol	0 to 49	0 to 49	24 to 140	24 to 96	96	50	1,700
4,6-Dinitro-2-methylphenol	0 to 93	0 to 93	10 to 181	10 to 181	96	50	1,700
2-Methylphenol	0 to 50	0 to 50	10 to 150	10 to 150	96	10	330
4-Methylphenol	0 to 50	0 to 50	10 to 150	10 to 150	96	10	330
4-Nitrophenol	0 to 50	0 to 50	10 to 80	11 to 114	96	50	1,700
2-Nitrophenol	0 to 40	0 to 35	29 to 182	29 to 182	96	10	330
Pentachlorophenol	0 to 50	0 to 47	9 to 103	17 to 109	96	50	1,700
Phenol	0 to 42	0 to 35	12 to 89	26 to 90	96	10	330
2,4,5-Trichlorophenol	0 to 40	0 to 35	25 to 137	25 to 137	96	10	330
2,4,6-Trichlorophenol	0 to 40	0 to 32	37 to 144	37 to 144	96	10	330
PCBs (608 CLP-M)							
PCB-1016	0 to 40	0 to 50	50 to 120	50 to 130	96	0.5	80
PCB-1221	0 to 40	0 to 50	50 to 120	50 to 130	96	0.5	80
PCB-1232	0 to 40	0 to 50	50 to 120	50 to 130	96	0.5	80
PCB-1242	0 to 40	0 to 50	50 to 120	50 to 130	96	0.5	80
PCB-1248	0 to 40	0 to 50	50 to 120	50 to 130	96	0.5	80
PCB-1254	0 to 40	0 to 50	50 to 120	50 to 130	96	0.5	80
PCB-1260	0 to 40	0 to 50	50 to 120	50 to 130	96	0.5	80
Polychlorinated Dibenzo-P-Dioxins and Polychlorinated Dibenzofurans-8280							
1 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (2,3,7,8-TCDD)	0 to 50	0 to 50	60 to 140	60 to 140	80	0.01	1
2 Polychlorinated Dibenzofurans (PCDFs)	0 to 50	0 to 50	60 to 140	60 to 140	80	0.01	1

See notes at end of table.

Table 3-2 (Continued)
Practical Quantitation Limits, Accuracy, Precision, and Completeness Objectives of Organics Analyses for Site Investigations

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Naval Air Station
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Parameters	Precision[1]		Accuracy[1,2]		Completeness	Practical Quantitation Limit[3]	
	Percent RPD of Duplicates		Spike Percent Recovery		Percent	Water (µg/ℓ)	Soils (µg/kg)
	Water	Soils	Water	Soils			
Polychlorinated Dibenzo-P-Dioxins and Polychlorinated Dibenzofurans-8280 (Continued)							
3 Polychlorinated Dibenzo-P-Dioxins (PCDDs)	0 to 50	0 to 50	60 to 140	60 to 140	80	0.01	1
Radiological Parameters							
Gross alpha	0 to 17	0 to 17	77 to 111	77 to 111	95	0.1 pCi/ℓ	0.5 pCi/kg
Gross beta	0 to 24	0 to 24	73 to 121	73 to 121	95	0.3 pCi/ℓ	0.5 pCi/kg
Radium-226	0 to 40	0 to 40	55 to 135	55 to 135	95	0.5 pCi/ℓ	0.5 pCi/kg
Radium-228	0 to 23	0 to 23	76 to 122	76 to 122	95	0.5 pCi/ℓ	0.5 pCi/kg

[1] As applied to project methods specified in Table 3-1.
[2] As determined from spiking actual sample matrix, these objectives are very near to those specified by U.S. Environmental Protection Agency in SW-846, 3rd ed., September 1986.
[3] Practical quantitation limits will vary depending on matrix differences that result in sample dilution and for soils, practical quantitation limit will also very depending on moisture content of sample if results are reported as dry weight. Instrument detection limits are approximately 10 times less than the practical quantitation limits. Any compound detected between the detection limit and practical quantitation limit will be reported and qualified as estimated (J flag).

Notes: RPD = relative percent difference.
µg/ℓ = micrograms per liter.
µg/kg = micrograms per kilogram.
TCL = target compound list.
CLP-M = Contract Laboratory Program–modified.
PCB = polychlorinated biphenyl.
pCi/ℓ = picocuries per liter.
pCi/kg = picocuries per kilogram.

Accuracy. Accuracy is defined as the degree to which the analytical measurement reflects the true concentration level present. Accuracy will be measured as percent recovery for matrix spikes as the primary criteria and for surrogate spikes as a secondary criteria.

A matrix spike is a sample (of a particular matrix) to which predetermined quantities of standard solutions of certain target analytes are added prior to sample extraction, digestion, and analysis. Samples are split into replicates, one replicate is spiked, and both aliquots are analyzed.

Accuracy can also be evaluated using the recovery of surrogate spikes in the organic analyses. These spikes consist of organic compounds that are similar to the analytes of interest in chemical composition, extraction, and chromatography, but that are not normally found in environmental samples. These compounds are spiked into all blanks, standards, and samples prior to analysis.

Percent recoveries of the surrogate, blank spike, and matrix spikes will be reported by the laboratory for all analytes associated with the samples. Variations from 100 percent recovery may be due to matrix interferences, laboratory spike handling procedures, or sample heterogeneities between replicates. The percent recovery of the spikes can be calculated from the following equation:

$$Percent\ recovery = \left(\frac{X-B}{T}\right) x\ 100 \qquad (2)$$

where

X = measured amount in sample after spiking,
B = background amount in sample, and
T = amount of spike added.

Accuracy is difficult to evaluate for the entire data collection activity, especially the sampling component. Field and trip blanks will be used in addition to the matrix and surrogate spiked samples to evaluate data accuracy in the investigations.

Representativeness. Representativeness is defined as the degree to which the data accurately and precisely represent the true environmental condition existing at each POI. Representativeness is accomplished through proper selection of sampling locations and sampling techniques and collection of a sufficient number of samples.

The sampling locations in this SS/SI/RI will be chosen in a biased approach based on previous analytical data, screening data collected in the field, and apparent and measured flow directions.

Representativeness of samples will be achieved to the greatest degree possible by adhering to the applicable task-specific workplan and the sampling procedures described in Chapter 4.0.

Completeness. Completeness is a measure of the amount of valid data obtained compared to the amount of data originally specified in the workplan. Completeness will be evaluated by carefully comparing project objectives with the proposed data acquisition and resulting potential shortfalls in needed information. The completeness goal for DQO Level III and IV has been chosen as 80 percent, which is consistent with the CLP requirement of 80 to 85 percent.

Field activities performed at DQO Levels I and II are onsite measurement techniques that provide information in real-time or after minimal delay. The completeness achieved for these methods may be more variable than those for standard analytical methods. A higher degree of completeness may be achieved because measurements can be readily repeated. However, site conditions may constrain the use of some techniques, resulting in fewer valid analyses than anticipated.

Comparability. Comparability expresses the confidence with which one set of data can be compared with another. Quantitatively, comparability can be assessed in terms of the precision and accuracy of two sets of data. Qualitatively, data subjected to strict QA/QC procedures will be deemed more reliable than data obtained without the use of these procedures. To maintain comparability, proper sampling methods, COC protocols, CLP analytical methods, and strict QA/QC procedures will provide the basis for uniformity in all data collection and analysis activities.

4.0 FIELD PROGRAM PROCEDURES AND REQUIREMENTS

4.1 FIELD SAMPLE NUMBERING. Samples, other than those collected for *in situ* measurements or analyses, will be identified by using a sample label attached to a sample container. Each sample label will be numbered to correspond with the appropriate sample(s) to be collected.

Samples collected for laboratory analysis during the field investigation will be labeled in accordance with the standard sample identification protocol described below. Specific sample numbering schemes will be included in workplans for individual tasks.

The standard sample identifier consists of four fields, each containing a code. These fields, including their length in characters, are listed below.

1. Site identifier--two characters (alphanumeric, characters one and two).
2. Sample type--one character (alphabetic only, character three).
3. Sample location number--three characters (numeric only, characters four through six).
4. Sequence or qualifier indicator--two characters (alphanumeric, characters seven and eight).

A data dictionary for these fields follows.

1. Site identifier: an identifier for the largest area of interest within a base; for instance, a POI number, a building number, or a study area number.

2. Type of sample being taken, including information about media, matrix, and field QC samples. Categories and codings include the following:

   H = groundwater, filtered
   G = groundwater, unfiltered
   X = surface water, filtered
   W = surface water, unfiltered
   S = surface soil (0 to 1 foot)
   B = subsurface soil (greater than 1 foot)
   D = sediment
   A = air
   Q = TerraProbe℠, water
   P = TerraProbe℠, soil/sediment
   M = microbiological
   Y = organic-free water source blank
   E = plant tissue
   I = test pit
   F = field blank
   T = trip blank
   R = rinse blank
   C = blind sample
   N = animal tissue
   L = sludge
   U = toxicological
   J = potable water source
   K = tap water source blank
   V = soil vapor
   Z = other

3. Sample location number within the site and matrix. This number would be unique within a site and matrix, i.e., the first surface water sample taken would be 001, the fifth groundwater sample would be 005, and the first soil boring would be 001. The last available sample location number is 999.

4. Sequence or qualifier indicator: a project specific (but consistent within a project) indicator. The intended use is a sequential indicator of relative depth (or height) of a sample, relative to other samples of the same type at the same sample location, if appropriate. With this use, the sample closest to the land or water surface will be coded as 01; the sample that is ninth closest to the land or water surface will be coded as 09. Using this convention, if depth or height of sample has no meaning (plant tissue, for example), the sample may be coded as 00.

   Project-specific coding in this field is acceptable. Any such project-specific coding must be documented in permanent records.

   Duplicates, matrix spikes, and matrix spike duplicates will be indicated by appending a "D," "MS," or "MSD" (respectively) to the end of this basic sample identifier.

4.2 PREPARATION OF SAMPLE CONTAINERS. For the majority of sampling episodes, ABB-ES will obtain sample containers from a subcontract laboratory with an FDEP-approved Comprehensive Quality Assurance Plan (CompQAP). However, there may be instances when sample containers will be obtained in a precleaned condition from a commercial source. The origin of sample containers for each project will be noted in the project field log. The consultant may obtain sample containers from suppliers that provide USEPA certification. Records of precleaned bottles and the certification paperwork for each bottle lot will be maintained by the consultant's equipment manager.

In general, sample container selection will be based on the following standards for water:

- Teflon™ septum-sealed glass vials for volatile compounds,
- amber glass bottles with Teflon™-lined lids for organic constituents other than volatiles, and
- polyethylene bottles for inorganic analytes.

For soil and sediment samples, widemouth glass bottles will be used. All sample bottles will be prepared in accordance with the procedures specified in the CompQAP (ABB-ES, 1993).

A summary of specific containers and representative sample volumes is provided, by parameter, in Table 4-1 along with preservation and holding time requirements.

4.3 DECONTAMINATION. The following methods of decontamination will be implemented to prevent cross contamination between sampling points and exploration locations. All sampling, drilling, and excavation equipment will be decontaminated before arriving and prior to leaving the base and between each exploration location.

Table 4-1
Sample Container and Preservation Requirements

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Parameter	Matrix	Holding Time (from time of collection)	Container	Preservative	Minimum Sample Size[1]
Volatile organic aromatics	Water	14 days	Two 40 mℓ vials with Teflon™-lined caps	4 drops concentrated HCl, 4°C	40 mℓ
	Soil	14 days	Glass with Teflon™-lined septum	4°C	10 g
Volatile organic halogenated compounds 4°C	Water	14 days	Two 40 mℓ vials with Teflon™-lined caps	4 drops concentrated HCl, 4°C	40 mℓ
	Soil	14 days	Glass with Teflon™-lined septum	4°C	10 g
Extractable organics	Water	7 days extraction 40 days analysis	1 ℓ amber glass with Teflon™ liner	4°C	1,000 mℓ
	Soil	14 days extraction 40 days analysis	Amber glass jar with Teflon™ liner or core tube	4°C	50 g
Acrolein 40 days analysis	Water	14 days	Glass with Teflon™-lined septum	0.008% $Na_2S_2O_3$ adjust pH to 4 to 5, 4°C	40 mℓ
	Soil	14 days	Glass with Teflon™-lined septum	4°C	enough to fill two 40 mℓ vials
Organophosphorus pesticides	Water	7 days extraction 40 days analysis	1 ℓ borosilicate glass	Adjust pH to 6.0 to 8.0 with H_2SO_4 or 10 N NaOH, 4°C	1,000 mℓ
	Soil	7 days extraction 30 days analysis	1 ℓ borosilicate glass	4°C	100 g
Chlorinated herbicides	Water	7 days extraction 30 days analysis	1 ℓ borosilicate glass	4°C	1,000 mℓ
	Soil	7 days extraction 30 days analysis	1 ℓ borosilicate glass	4°C	100 g
Organochlorine pesticides and PCB	Water	7 days extraction 30 days analysis	1 ℓ borosilicate glass	4°C	1,000 mℓ
	Soil	7 days extraction 30 days analysis	1 ℓ borosilicate glass	Adjust pH to 6.0-8.0 with 1:1 H_2SO_4 or NaOH, 4°C	100 g
Metals (other than chromium VI and mercury)	Water	180 days	Polyethylene or glass	HNO_3 to pH [2]<2	100 mℓ
	Soil	180 days	Polyethylene or glass	4°C	10 g

See notes at end of table.

Table 4-1 (Continued)
Sample Container and Preservation Requirements

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Parameter	Matrix	Holding Time (from time of collection)	Container	Preservative	Minimum Sample Size[1]
Chromium VI	Water	24 hours	Polyethylene or glass	4°C	100 mℓ
	Soil	24 hours	Polyethylene or glass	4°C	10 g
Mercury	Water	28 days	Polyethylene or glass	HNO_3 to pH [2]<2	100 mℓ
	Soil	28 days	Polyethylene or glass	4°C	10 g
Cyanide	Water	14 days	Polyethylene or glass	0.6 g ascorbic acid, NaOH to pH >12, 4°C	100 mℓ
	Soil	14 days	Polyethylene or glass	4°C	10 g
Dioxins/furans	Water	7 days extraction 40 days analysis	Glass	4°C	1,000 mℓ
	Soil/waste	14 days extraction 40 days analysis	Core tube	4°C	50 g
Petroleum hydrocarbons as gasoline	Water	14 days	Two 40 mℓ vials with Teflon™ liners	4°C, HCl to pH <2	40 mℓ
	Soil/waste	14 days	Core tube	4°C	50 g
Petroleum hydrocarbons as diesel	Water	14 days extraction 40 days analytical	Glass	4°C	500 mℓ
	Soil/waste	14 days extraction 40 days analytical	Core tube	4°C	50 g
Total Petroleum hydrocarbons (TPH)	Water	28 days	Glass	4°C, HCl to pH <2	1,000 mℓ
	Soil	28 days	Glass jar with Teflon™ liner or core tube	4°C	50 g
Oil and grease	Water	28 days	Glass bottle	Adjust pH to <2.0 with H_2SO_4, 4°C	1,000 mℓ
	Soil	28 days	Glass jar with Teflon™ liner	4°C	50 g
Residue, settable	Water	48 hours	Polyethylene or glass bottle	4°C	1,000 mℓ
Residue, all others (TSS, VSS, TDS)	Water	7 days	Polyethylene or glass bottle	4°C	500 mℓ

See notes at end of table.

Table 4-1 (Continued)
Sample Container and Preservation Requirements

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Parameter	Matrix	Holding Time (from time of collection)	Container	Preservative	Minimum Sample Size[1]
Biochemical oxygen demand	Water	48 hours	Polyethylene or glass bottle	4°C	1,000 mℓ
Chemical oxygen demand	Water	28 days	Polyethylene or glass bottle	Adjust pH to <2.0 with H_2SO_4, 4°C	1,000 mℓ
Metals (ICP)	Water	6 months	Polyethylene	HNO_3 to pH <2	100 mℓ
	Soil	6 months	Core tube or glass jar	4°C	10 g
Arsenic (GFAA)	Water	6 months	Polyethylene	HNO_3 to pH <2	100 mℓ
	Soil/waste	6 months	Core tube or glass jar	4°C	10 g
Mercury (CVAA)	Water	28 days	Polyethylene	HNO_3 to pH <2	100 mℓ
	Soil/waste	28 days	Core tube or glass jar	4°C	10 g
Selenium (GFAA)	Water	6 months	Polyethylene	HNO_3 to pH <2	100 mℓ
	Soil/waste	6 months	Core tube or glass jar	4°C	10 g
Thallium (GFAA)	Water	6 months	Polyethylene	HNO_3 to pH <2	100 l
	Soil/waste	6 months	Core tube or glass jar	4°C	10 g
Lead (GFAA)	Water	6 months	Polyethylene	HNO_3 to pH <2	100 mℓ
	Soil/waste	6 months	Core tube or glass jar	4°C	10 g
Chromium (VI)	Water	24 hours	Polyethylene	4°C	100 mℓ
	Soil/waste	24 hours	Core tube or glass jar	4°C	10 g
Cyanide	Water	14 days	Polyethylene or glass	0.6 g ascorbic acid, NaOH to pH ≥12, 4°C	100 mℓ
	Soil/waste	14 days	Polyethylene or glass bottle	4°C	10 g
Coliform, fecal and total	Water	6 hours	Polyethylene or glass bottle	0.08% $Na_2S_2O_3$ 4°C	500 mℓ
Fecal streptococci	Water	6 hours	Polyethylene or glass bottle	0.08% $Na_2S_2O_3$ 4°C	500 mℓ

See notes at end of table.

Table 4-1 (Continued)
Sample Container and Preservation Requirements

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Parameter	Matrix	Holding Time (from time of collection)	Container	Preservative	Minimum Sample Size[1]
Nitrogen, organic and Kjeldahl	Water	28 days	Polyethylene or glass bottle	Adjust pH to <2.0 with H_2SO_4, 4°C	500 mℓ
Nitrate	Water	48 hours	Polyethylene or glass bottle	4°C	125 mℓ
Nitrate + nitrite	Water	28 days	Polyethylene or glass bottle	Adjust pH to <2.0 with H_2SO_4	125 mℓ
Phosphorus, total	Water	28 days	Polyethylene or glass bottle	Adjust pH to <2.0 with H_2SO_4	125 mℓ
Sulfate	Water	28 days	Polyethylene or glass bottle	4°C	125 mℓ
Sulfide	Water	7 days	Polyethylene or glass bottle	Adjust pH to >9.0 with zinc acetate plus NaOH, 4°C	500 mℓ
Surfactants	Water	48 hours	Polyethylene or glass bottle	4°C	1,000 mℓ
Radiological tests: alpha, beta, radium	Water	6 months	Polyethylene or glass bottle	Adjust pH to [2]<2.0	
Total organic carbon	Soil	28 days	Polyethylene or glass bottle	Adjust pH to <2.0 4°C	10 g
Total organic halogens	Water	28 days	Glass with Teflon™-lined cap	Adjust pH to <2.0 4°C	40 mℓ

[1] Additional sample must be collected for matrix spike or matrix spike duplicate samples.
[2] Must be preserved in the field at time of collection.

Notes: mℓ = milliliter.
HCl = hydrochloric acid.
°C = degrees Celsius
g = gram.
ℓ = liter.
HNO_3 = nitric acid.
$Na_2S_2O_3$ = sodium thiosulfate.
NaOH = sodium hydroxide.
H_2SO_4 = sulfuric acid.
TSS = total suspended solids.
VSS = visible suspended solids.
TDS = total dissolved solids.

To assure that analytical results reflect the actual concentrations present at sampling locations, chemical sampling and field analytical equipment must be properly decontaminated prior to the field effort, during the sampling program (i.e., between sampling points), and at the conclusion of the sampling program.

This section addresses the decontamination procedures for chemical sampling and field analytical equipment as well as for drilling equipment. These cleaning procedures are based on USEPA Region IV Standard Operating Procedures (SOPs) (USEPA, 1996). To clarify the decontamination procedures, the following definitions have been used.

Detergent will be a standard brand of phosphate-free laboratory detergent such as Alconox 41™ or Liquinox™.

Acid solution will be made from reagent-grade nitric acid and deionized water.

Tap or potable water will be treated water from any municipal water supply system.

Analyte-free (deionized) water will be tap water that has been treated by passing through a standard deionizing resin column to remove cations and anions. At a minimum, finished water should contain no detectable heavy metals or other inorganics.

Organic analyte-free water will be tap water that has been treated with activated carbon and deionizing units. It should contain no detectable pesticides, herbicides, extractable organic compounds, and less than 5 micrograms per liter ($\mu g/\ell$) of purgeable organic compounds as measured by a low-level gas chromatograph/mass spectrometer (GC/MS) scan. It should also meet the definition of analyte-free water. This organic analyte-free water will be used for blank preparation and for final rinse in decontamination (where applicable). The consultant may use an onsite-generated source of organic analyte-free water.

Solvent will be pesticide-grade isopropanol. Other solvents may be used on a case-by-case basis.

4.3.1 In-House Cleaning Procedures Prior to transport to the field, sampling equipment will be decontaminated using the procedures described below. To the extent feasible, enough sampling equipment will be made available to conduct a sampling episode without field decontamination. All decontamination procedures conducted in-house will be documented in an equipment room logbook.

The following subsections describe cleaning procedures for sampling, pumping, and measurement equipment that will be conducted "in-house" prior to transport of the equipment to the field.

4.3.1.1 Teflon™ or Glass Sampling Equipment (Trace Organics and/or Metal Analyses) In-house decontamination procedures for Teflon™ or glass sampling equipment used to collect samples for trace organic and/or metal analysis are listed below.

1. Wash and scrub equipment thoroughly with laboratory detergent and hot water.

2. Rinse thoroughly with hot tap water.

3. Rinse with at least a 10 percent nitric acid solution.

4. Rinse thoroughly with analyte-free (deionized) water.

5. Rinse thoroughly with solvent (pesticide-grade isopropanol).

6. Air dry for at least 24 hours.

7. Wrap equipment in aluminum foil. Roll the edges into a "tab" to allow easy removal. Seal the foil-wrapped equipment in plastic and date.

8. After use in the field, rinse the equipment thoroughly with tap water as soon as possible if full field decontamination procedures are not used.

4.3.1.2 Stainless-Steel or Metal Sampling Equipment (Organic and/or Metal Analyses) In-house decontamination procedures for stainless-steel or metal sampling equipment used to collect samples for trace organic and/or metal analysis are listed below.

1. Wash and scrub equipment thoroughly with laboratory detergent and hot water.

2. Rinse thoroughly with hot tap water.

3. Rinse with analyte-free (deionized) water.

4. Rinse thoroughly with solvent (pesticide-grade isopropanol).

5. Air dry for at least 24 hours.

6. Wrap equipment in aluminum foil. Roll the edges into a "tab" to allow easy removal. Seal the foil-wrapped equipment in plastic and date.

7. After use in the field, rinse the equipment thoroughly with tap water as soon as possible if full field decontamination procedures are not used.

4.3.1.3 Submersible Pumps and Hoses In-house decontamination procedures for submersible pumps and hoses used for purging monitoring wells are listed below.

1. Pump a sufficient amount of soapy water through the hose to flush out any residual purge water.

2. Using a brush, scrub the exterior of the contaminated hose and pump with hot soapy water. Rinse the soap from the outside of the hose with tap water. Next, rinse the hose with deionized water and recoil onto the spool.

3. Pump a sufficient amount of tap water through the hose to flush out soapy water.

4. Pump a sufficient amount of analyte-free (deionized) water through the hose to flush out the tap water.

5. Rinse the outside of the pump housing and hose with deionized water (approximately 1/4 gallon).

6. Equipment will be placed in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transit.

4.3.1.4 **Sampling and/or Filtering Tubing** In-house decontamination procedures for Teflon™, PVC, stainless-steel, and glass tubing used for groundwater sampling and/or filtering are listed below. In-line disposable filter cartridges should be rinsed with tap water and disposed of.

4.3.1.5 **Teflon™ Tubing** Use only new, food-grade Teflon™ tubing. This tubing is not precleaned, but should be stored and transported in its original container or wrapped in polyethylene to prevent contamination. Tubing should be flushed in the field with the sample medium before sample collection to remove any residues. Tubing will not be reused.

4.3.1.6 **PVC Tubing** Use only new PVC tubing. PVC is not to be used for samples being submitted for organics analyses. This tubing is not precleaned, but should be stored and transported in its original container or wrapped in polyethylene to prevent contamination. Tubing should be flushed in the field with the sample medium before collection to remove any manufacturing residues.

4.3.1.7 **Stainless-Steel Sampling Tubing** Preclean tubing as follows.

1. Wash and scrub equipment thoroughly with laboratory detergent and hot water.

2. Rinse thoroughly with hot tap water.

3. Rinse with analyte-free (deionized) water.

4. Rinse thoroughly with solvent (pesticide-grade isopropanol).

5. Air dry for at least 24 hours.

6. Wrap tubing and cap ends with aluminum foil and seal in plastic to prevent contamination during storage and transport.

4.3.1.8 **Glass Tubing** Use only new glass tubing, precleaned as follows.

1. Rinse equipment thoroughly with solvent and allow to air dry at least 24 hours.

2. Wrap tubing and cap ends in aluminum foil and seal in plastic to prevent contamination during storage and transport.

4.3.1.9 **Well Sounders and Groundwater Measurement Tapes** In-house decontamination procedures for Teflon™, PVC, stainless-steel, and glass tubing used for groundwater sampling are listed below.

1. Wash with laboratory detergent and tap water.

2. Rinse with tap water.

3. Rinse with analyte-free (deionized) water.

4. Wrap equipment in aluminum foil. Roll the edges into a "tab" to allow easy removal. Seal the foil-wrapped equipment in plastic and date.

4.3.1.10 **Ice Chests and Shipping Containers** In-house decontamination procedures for ice chests and shipping containers are listed below. Noticeably contaminated containers should be thoroughly cleaned and properly disposed of.

1. Wash inside and out with laboratory detergent and tap water.

2. Rinse with tap water.

3. Air dry.

4.3.1.11 **Field Parameter Measurement Probes** Field parameter measurement probes, (e.g., pH or specific ion electrodes, geophysical probes, or thermometers) that come in direct contact with the sample will be decontaminated using the procedures listed below, unless manufacturer's instructions indicate otherwise. Probes that make no direct contact (e.g., OVA equipment) will be wiped with clean paper towels.

1. Rinse with tap water.

2. Rinse with analyte-free (deionized) water.

3. Solvent rinse if obvious contamination remains after rinsing and if solvent will not damage probe.

4. Rinse with analyte-free (deionized) water.

4.3.2 **Organic-Free Water Containers** New containers that will be used to store and transport organic-free water will be cleaned as follows.

1. Wash containers thoroughly with hot tap water and laboratory detergent, using a bottle brush to remove particulate matter and surface film.

2. Rinse containers thoroughly with hot tap water.

3. Rinse containers with at least 10 percent nitric acid solution.

4. Rinse containers thoroughly with tap water.

5. Rinse containers thoroughly with deionized, analyte-free water.

6. Rinse twice with solvent and allow to air dry for at least 24 hours.

7. Cap with aluminum foil or Teflon™ film.

8. After using, rinse with tap water in the field, seal with aluminum foil to keep the interior of the container wet and return to the laboratory.

Used containers will be capped with aluminum foil immediately after being used in the field. The exterior of the containers will be washed with laboratory detergent and rinsed with deionized water, if necessary. The interior of the container will be rinsed twice with solvent. The interior of the container will be thoroughly rinsed with organic-free or Milli-Q™ water. The container will be filled with organic-free or Milli-Q™ water and capped with aluminum foil for storage.

<u>**4.3.3 Field Decontamination Procedures**</u> When practical, sufficient equipment should be staged in the field so that the entire study can be conducted without the need for field cleaning. However, when this is not possible, the following USEPA Region IV field decontamination procedures will be followed (USEPA, 1996).

4.3.3.1 Sampling Equipment for Classic Water Quality Parameters Sampling equipment for classic water quality parameters (dissolved oxygen [DO], biological oxygen demand, TOC, etc.) including, but not limited to, Kemmerers, buckets, DO dunkers, and dredges, will be cleaned in the field prior to use and between sampling locations as follows.

1. Rinse and scrub with water to be sampled or tap water.

2. If tap water is used, rinse with water to be sampled prior to sampling.

4.3.3.2 Sampling Equipment for Organic and Metal Analysis Teflon™, stainless-steel, glass, or metal sampling equipment used to collect samples for organic and metal analysis will be cleaned between sample locations as listed below.

1. Wash and scrub equipment thoroughly with laboratory detergent and tap water.

2. Rinse thoroughly with tap water.

3. Rinse thoroughly with deionized, analyte-free water.

4. Rinse with solvent (pesticide-grade isopropanol). Note: Do not rinse PVC or plastic materials with solvent.

5. Rinse with organic-free water and allow to air dry as long as possible.

6. If organic-free water is not available, allow equipment to air dry as long as possible. Do not rinse again with deionized or distilled water.

<u>**4.3.4 Large Equipment Decontamination**</u> Large equipment (e.g., drill rigs, backhoes, augers, drill pipe, casing, and screen) will be cleaned prior to use and between sample locations in accordance with USEPA Region IV SOPs as outlined below.

4.3.4.1 Cleaning Procedures Prior to Initiation of Field Work All equipment to be used on site will be in good working order and free of leaks. Any part of the drill rig or backhoe that will be over the borehole or sampling location (e.g., kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) will be decontaminated prior to arriving at the site as described below.

1. Steam clean and wire brush to remove soil and rust.

2. Inspect to assure that seals and gaskets are intact and that there are no residual oils, grease, or hydraulic fluids that could drip into the sample location.

3. If necessary, use Teflon™ string to tighten drill stem.

4. Steam clean the drill rig prior to drilling each borehole.

4.3.4.2 **Cleaning Procedures for Downhole Equipment** Drilling, sampling, and associated equipment that will come in contact with the downhole sampling medium will be cleaned as outlined below.

1. Wash and scrub with tap water and detergent, if necessary, to remove particulates.

2. Steam clean and/or high pressure wash, if necessary, to remove soils. The steam cleaner or high pressure washer should be capable of generating a pressure of at least 2,500 pounds per square inch and producing hot water and/or steam (200°F and above). If it is necessary to steam clean PVC well materials, care must be taken to control steam temperature so as to maintain the integrity of the PVC.

3. Rinse thoroughly with tap water.

4. Rinse thoroughly with deionized, analyte-free water.

5. Rinse thoroughly with solvent (pesticide-grade isopropanol). Note: do not rinse PVC materials with solvent.

6. Rinse thoroughly with organic-free water and allow to air dry. Do not rinse again with analyte-free (deionized) or distilled water.

7. If organic-free water is not available, allow equipment to air dry.

8. Where appropriate, wrap with aluminum foil to prevent contamination during storage. Augers, drill stems, casings, and other large items can be wrapped in clean plastic, if necessary.

9. If caked mud, rust, and/or paint is present that can not be removed by steam or high pressure wash, the downhole equipment will be sandblasted prior to step number 1 above and prior to arrival onsite.

10. Printing and/or writing on well casing, screens, tremie tubing, etc., will be removed with emery cloth or sand paper prior to arrival onsite. Where possible, materials without printing or writing will be ordered.

4.3.4.3 **Decontamination Staging Area and Fluid Disposal** Cleaning and decontamination of all equipment will occur at a designated area at each POI or study area that is downgradient and downwind (prevailing wind direction) of the clean equipment drying and storage area. The cleaning and decontamination area will contain an excavated pit, lined with heavy duty plastic sheeting, for containment of washwater and waste. Alternatively, a ground-level pad may be set up. The pad will consist of a frame and impermeable liner such that fluids will be contained and easily transferred to containers. The decontamination area will be designed such that washwater will drain into the pit or be easily collected. Solvent rinsates will be collected in separate containers. Large portable equipment (drill rods, auger flights, well casing and screen, etc.) will be cleaned on saw horses or other supports constructed above the plastic sheeting.

The water will be pumped or poured into 55-gallon drums and the sediment will be collected in separate drums. The plastic sheeting will be washed and the washwater will be containerized as contaminated washwater. The plastic sheeting will then be properly disposed of. The pit will be backfilled with the originally excavated material.

The drums containing waste will be properly labeled, sealed, and staged for storage until laboratory analytical results are received. Drum labels will include the contents (medium), the POI or study area of origin, the investigation location identification, and the date of generation. The contaminated material will be treated as discussed in Section 4.10.

4.4 FIELD INVESTIGATION TECHNIQUES AND PROCEDURES.

4.4.1 **Mobilization** To streamline field tasks and minimize project delays at commencement of field activities, the following mobilization tasks will be implemented prior to initiating field investigative activities.

1. A central office facility (e.g., trailer or permanent structure) will be established to function as headquarters for field program activities. The field office will, at a minimum, have electrical power, sanitary sewage, public water, and telephone communication. Additionally, based on the size of the field program, the field office may contain a two-way radio base station, portable computer, and copy machine. The office will also serve as the location for field project files and field equipment storage.

2. Subcontractor drilling and excavation equipment and supplies are to be staged in a designated location during mobilization, prior to the initiation of subsurface exploration activities. The equipment will be decontaminated prior to arrival onsite as prescribed in Section 4.3.

3. A temporary, centrally located decontamination pad will be constructed during drilling and excavation equipment mobilization and prior to the initiation of field activities (see Section 4.3).

4. All sampling and health and safety equipment and materials will be staged in the field office.

5. Team meetings will comprise the final phase of mobilization. Meetings will focus on project health and safety requirements, installation policies and procedures to be followed (e.g., utility clearances), field sampling procedures, site preparation and access requirements, and drilling requirements (e.g., decontamination, waste handling, and well installation).

6. During field programs, morning health and safety meetings will be held prior to commencement of the day's field activities.

4.4.2 UXO Clearance Survey UXO clearance surveys will be conducted by a qualified UXO consultant or Navy explosive ordnance disposal (EOD) personnel to determine the location of UXO located both within the surface and subsurface of a POI. Clearance surveys will be conducted, prior to any field exploration activities, at POIs that have been designated as potential UXO sites. The clearance survey consists of conducting records review, visual sweeps, and geophysical survey sweeps of designated areas. Results of the survey will be used to assess the need of removing UXO from any exploration location, including borehole clearance during drilling.

4.4.2.1 **Records Review** The UXO consultant will initially collect all pertinent data available including (1) review of base records and (2) conductance of interviews with appropriate base personnel. The information will be evaluated and combined with the actual onsite clearance data to evaluate the levels, types, and boundaries of potential UXO within designated POIs.

4.4.2.2 **Visual Sweep Survey** A surface, visual sweep team, consisting of a minimum of two EOD trained specialists, will conduct a visual search and clearance of the designated areas. Hazardous UXO items visually located by the sweep team will be marked with stakes. Removal of hazardous UXO items will be conducted by either the UXO consultant or EOD installation personnel. Hazardous UXO items that can be safely moved will be collected and placed at a designated ordnance holding area.

4.4.2.3 **Geophysical Sweep Survey** Following the visual sweep survey, the UXO consultant will perform a geophysical sweep survey of designated areas. Using marking stakes and lines, as necessary, the UXO specialist will mark the outer perimeter of each survey site. The geophysical survey team will conduct a subsurface electromagnetic search of the survey area using a military-approved ordnance locator. This hand-held unit is the most recent military-approved locator currently in use for detecting subsurface ordnance items by the U.S. Military EOD forces. An ordnance locator uses two fluxgate magnetometers that are aligned and mounted a fixed distance apart to detect changes in the earth's ambient magnetic field caused by ferrous metal or disturbances caused by soil conditions.

The EOD specialist will use the ordnance locator and move along each line of the survey grid. When a subsurface anomaly is detected, the specialist will check the ground with his hand to determine if the contact is on, or just below, the surface. If the contact is buried, the UXO consultant will mark the spot and continue until the fade out zone is established for each contact.

Any excavation deemed necessary will be completed by hand, or with hand tools, in accordance with EOD procedures. Items located by the UXO team will be marked, and subsurface diagnosis will be performed by an EOD team with nonsparking tools. An EOD technician will be present to ensure safety and to verify all excavations. The items will then be recorded on the survey grid data sheets.

4.4.2.4 **Borehole Clearance** Prior to any drilling activities in UXO designated areas, the EOD specialist will surface sweep the access to the boring sites. The sweep will encompass a minimum access way of 25 feet and a drilling site area of approximately 70 feet in diameter and 10 feet deep at designated boring locations. Both ferrous and nonferrous locators will be used to achieve a high effectiveness of the surface sweep. At designated sites, boreholes may be cleared at the surface and every 5 feet thereafter by removing the augers and inserting the probe of the ordnance locator to the bottom of the borehole. This procedure will be followed to a minimum depth of 10 feet.

4.4.3 Surface Geophysical Survey Geophysical surveys can be used to identify buried objects or features such as utility lines or pipes, former disposal trenches or pits, buried drums, and/or waste material. Geophysical techniques commonly used as part of field investigations include GPR, magnetometry, time domain metal detection (TDMD), and TC. Using more than one individual survey technique in a given area provides for correlation of anomalous features and a more comprehensive interpretation.

4.4.3.1 **Magnetometry** Magnetometers can be used to locate buried steel containers, define boundaries of pits or trenches filled with ferrous debris, and locate ferrous underground utility pipes and electrical conduits. Magnetometers measure the intensity of the earth's magnetic field. Buried ferrous objects can cause variations in the magnetic field, which, in turn, can be detected by the magnetometer.

Measurements can be collected at individual stations located on a grid or continuously along traverse lines. Presentation of the data is typically limited to profile lines or contour maps showing the location of the magnetic anomaly.

The magnetic gradiometer consists of a pair of total field magnetic sensors mounted on a survey pole. The sensors are designed to measure magnetic field strength. Simultaneous readings from each sensor with the survey pole held vertically provides the gradient value by calculating the difference in total field strength between each sensor. The magnetometer thus provides both total field and magnetic gradient values at the same time. The unit is equipped with a portable data logging device to record individual gradient and total field strength readings. The particular advantage of this surveying technique is that it is fully portable and self contained. Access limitations associated with some geophysical surveying methods (e.g., cables and the need for field support vehicles) need not be considered with this form of geophysical survey.

Data will usually be collected at preestablished grid nodes within a survey area. The grid nodes will be marked in the field with flagged stakes for collecting data and locating interpreted magnetic anomalies later. Data stored in the portable data logger is downloaded to a personal computer for processing. Processing includes establishing a uniform grid data set over the area surveyed and contouring the results. At the completion of the survey, interpretation of the contoured gradient and total field data will be conducted and anomalies marked in the field with labeled flagged stakes. Surveying limitations may occur in areas where interference from fences, railroad tracks, power lines, and surficial ferrous metal debris exist. These areas will be avoided, where possible, during the survey.

The magnetometry method requires a two person crew consisting of one instrument operator to collect data at the designated survey nodes and an assistant to maintain field mapping notes on observed landmarks and surficial features that may affect magnetic readings. Field maps will be used as an integral part of the interpretation of magnetic anomalies. A magnetic base station will be established and total magnetic field data collected periodically to monitor diurnal variations in the earth's magnetic field so that corrections to the total field data from the survey can be made, if necessary.

4.4.3.2 **GPR** GPR uses electromagnetic waves in the frequency range of 80 to 1,000 megahertz to define subsurface stratigraphy. With the GPR technique, electromagnetic energy is radiated downward into the subsurface from an antenna that is pulled slowly across the ground at speeds varying from about 0.25 to 5 miles per hour, depending on the amount of detail desired and the nature of the target. The radio wave energy is reflected from surfaces where there is a contrast in the electrical properties of subsurface materials. These surfaces may be naturally occurring geologic horizons (e.g., soil layers, changes in moisture content, voids, and fractures in bedrock) or manmade (e.g., buried utilities, tanks, drums, or dunnage). The reflected energy is processed and displayed as a continuous strip chart recording of distance versus time, where time can be thought of as approximately proportional to depth. The depth of penetration of a GPR system is highly site-specific and generally depends on the soil types at the site (clean sands are best), moisture conditions (dry is best), and the frequency of the antenna (the lower the frequency, the deeper the penetration and the less the resolution).

The GPR unit will generally be operated from a utility vehicle with the remote transmitter and receiver antenna towed either manually or behind the vehicle. Reflected radar signals, transferred to a graphic strip chart recorder on the GPR unit, will be interpreted directly in the field. Interpreted reflectors will be marked at the surface with flagging or spray paint during the survey.

Several factors may adversely affect the quality, and the ability to collect interpretable data. They include physical access limitations for both the utility vehicle and towed antenna, contrasts in electrical properties between soil and subsurface targets (clay pipe and concrete tanks are more difficult to locate than metallic objects because of the lower contrast), the size and depth of subsurface objects (deeper and smaller objects are more difficult to locate), and the clay content and degree of water saturation of soils. Wet, clay-rich soils can significantly attenuate the radar signal making interpretation difficult and sometimes impossible.

Proposed survey lines will be concentrated in areas where the targets are likely to exist for better resolution. Because of the inherent flexibility in data collection, actual GPR survey lines can be easily modified in the field based on preliminary interpretations. Survey line spacings will be increased or decreased in response to success of data collection efforts at the time of the survey. The survey will generally be conducted by a two person crew.

4.4.3.3 **TC** TC surveys have traditionally been used in mineral exploration for tracing conductive ore bodies (i.e., massive sulfides). More recently, TC surveys have been widely used not only for tracing conductive contaminant plumes in groundwater, but for mapping landfill boundaries and zones with high concentrations of metal, as would occur in a drum repository, and conductive soil.

Because the instrument never comes in contact with the ground, data acquisition is quite rapid. However, quantification of conductivity data to yield a layered-earth solution as is commonly done with earth resistivity techniques yields only simple solutions that should be regarded as approximate.

This instrument consists of a transmitter and receiver. When a measurement is made, the transmitter is energized by an alternating current that produces a primary magnetic field. This artificial magnetic field induces small electric currents to flow in the earth, which, in turn, produce a secondary magnetic field made up of two components: the quadrature-phase and in-phase. The secondary magnetic field is related to the transmitter and receiver separation and to the operating frequency of the transmitter, both of which are selected by the operator. The ratio of the quadrature phase of the secondary field to the primary field is linearly proportional to the TC. This ratio is measured by the receiver and converted into conductivity values in units of millimhos per meter.

Field measurements may be recorded on a digital data logger, which is capable of recording simultaneously both the quadrature-phase and in-phase components of the induced magnetic field. The quadrature-phase component gives the ground conductivity value in millimhos per meter. The in-phase component is significantly more sensitive to metallic objects and may be useful for rough screening for buried metal objects. Data from the in-phase component may be thought of as being equivalent to a metal detector survey. Data will be logged continuously along survey lines yielding conductivity profiles, or at selected grid nodes. In either case, data will be downloaded from the data logger and processed into a map to provide for a comprehensive interpretation of conductivity anomalies.

Physical access is generally not a problem because of the inherent portability of TC equipment. Surficial features, such as chain-link fences, automobiles, buildings, and railroad tracks can, however, cause significant interference in TC data. Areas possessing these types of features will be avoided, to the extent practical, during surveying.

The survey method is commonly conducted by a two person crew. One person operates the TC unit and data logger; the other logs surface landmarks and reference points on a hand-drawn map. The map is used in conjunction with processed TC data to provide a more accurate interpretation of anomalies. The map will also be used to assist in flagging areas in the field where TC anomalies have been identified.

4.4.3.4 **Seismic Refraction Profiling** Seismic refraction profiling is an indirect means of determining the thickness and velocity values of the various seismic layers underlying a site. There is often a direct correlation between geologic strata and the layers defined during a seismic refraction investigation.

The basis for the interpretation of data is the amount of time required for elastic waves, generated at a point source, to travel to a series of sensitive listening devices called geophones, or seismometers. Geophones are placed at known intervals along a straight line on the ground surface and connected by special multiconductor cables to the seismograph. The cables are known as seismic spread cables, and the array of geophones and cables is called a seismic spread. The seismograph is the device that records the elastic wave arrivals from the energy source along the seismic spread, acquiring separate data for each geophone position.

The seismic waves detected in a seismic refraction survey and used for depth calculations and the identification of materials are "P" (compressional) waves. This wave travels through earth materials as a series of compressions and rarefactions. Just as sunlight bends when it passes through a glass prism (refraction), so sound waves bend as they travel deeper into the earth through the various layers of soil and rock. Because they are bent they eventually return to the surface as refracted seismic waves. Careful measurement of the transit times between the energy source and each geophone enables interpretation of subsurface structure. The thickness and velocity values of various soil and rock layers can be computed. In the same manner, seismologists have learned about the interior of the earth by carefully measuring the arrival of seismic waves generated by distant earthquakes.

<u>Field Procedure for Data Acquisition</u>. Seismic spread cables, which have premeasured shotpoint and geophone locations, are positioned along the lines of investigation. Geophones, which have a spiked base to provide good ground contact, are positioned at measured locations along the seismic spread cables. Either a weight impact (sledge hammer) or small buried charges of explosives provide the seismic energy source. If explosives are necessary, shotholes are usually prepared with a driven rod (not excavated) to ensure good ground coupling. The blaster tamps the explosives tightly and notes the depth and amount of explosives in each shothole.

Seismograms are obtained using a portable signal enhancement seismograph. This instrument records the wave arrivals from the energy source along the seismic spread, acquiring separate data for each geophone position. Timing lines across the entire recording allow direct reading of wave arrivals to an accuracy of 1 millisecond. The signal enhancement capability refers to the ability of the instrument to record the seismic waves from several impacts (or explosions), add them electronically, and retain these data in its internal digital memory for later processing and interpretation. The enhanced signal improves data quality and greatly simplifies interpretation.

Generally, the field party will obtain several recordings (seismograms) along each seismic spread. Seismograms are generated with the energy source at each end, and others may be obtained by energy generation in the middle, and at other positions along an individual seismic spread as necessary.

Continuous profiling is accomplished by having an end shotpoint of one seismic spread coincident with an end or intermediate position shotpoint of the succeeding spread. The length of each spread is determined by the required depth of penetration. Seismic spreads of varying lengths can be used in a study; the deeper the required penetration, the longer the spread must be.

<u>Interpretation</u>. The data are interpreted by first accurately measuring the individual transit times at each geophone position, then constructing a graph of these times versus their distance from the energy source. The geophysicist then determines by inspection of the time-distance graphs the number of subsurface

seismic layers present. Straight line segments of best fit are drawn onto the graphs with each layer represented by a line of different slope. The inverse of the slope of each line is the (apparent) velocity value for each layer. The distance, *x*, from the energy source to the "crossover point" between two layers is proportional to the thickness, *D*, of the overlying layer.

Depth calculations are made using standard critical distance formulae of the form

$$D_n = \frac{x_{n+1}}{2}\sqrt{\frac{V_{n+1}-V_n}{V_{n+1}+V_n}} + D_1\frac{V_{n+1}\sqrt{V_n^2-V_1^2} - V_n\sqrt{V_{n+1}^2-V_1^2}}{V_1\sqrt{V_{n+1}^2-V_n^2}} + \ldots \qquad (3)$$

$$+ \ldots + D_{n-1}\frac{V_{n+1}\sqrt{V_n^2-V_{n-1}^2} - V_n\sqrt{V_{n+1}^2-V_{n-1}}}{V_{n-1}\sqrt{V_{n+1}^2-V_n^2}}$$

where D_n is the thickness of the *n*th layer, x_{n+1}, and is the critical distance for the deepest refractor, designated as the *n+1* layer of seismic velocity value V_{n+1}.

There are several limitations, discussed below, of seismic refraction exploration that should be restated whenever such a study is planned so that expectations are reasonable.

Accuracy. The accuracy of any measurement or calculation (depth, velocity, or critical distance) is generally limited to within plus or minus 10 to 15 percent of its "true" value. For example, if a depth to a refractor (bedrock) is calculated from refraction measurements to be 50 feet, then one might reasonably expect that if one were to confirm the depth to rock through drilling, that bedrock would be encountered at a depth of 50 plus or minus 5 to 7.5 feet, or 42.5 to 57.5 feet bls.

Layer Thickness and Velocity Relationships. To be detected by seismic refraction, a target refractor must have sufficient thickness and velocity contrast with overlying layers. A general guideline that can be used is that a target refractor should have a seismic velocity value of at least 1.2 to 1.5 times the velocity of the overlying layer and a thickness of from 0.5 to 1.0 times the combined thickness of the overlying layers. The greater the contrast in velocity between the target refractor and the overlying layer, and the greater its thickness, the more accurately it can be mapped. Conversely, the smaller the contrast in velocity and the thinner the target refractor, the less likely that it will be mapped accurately. In fact, as the velocity contrast or thickness approaches smaller and smaller values, there is a point at which the layer will no longer be detected by seismic refraction.

Seismic Velocity Increases with Depth. Interpretation and data processing of all seismic refraction data make the assumption that the velocity value at which sound waves travel through subsurface materials will increase with depth. Generally, this assumption is both reasonable and valid, although there are notable exceptions. When seismic refraction measurements are made on asphalt or concrete surfaces, the asphalt or concrete "layer" is always of higher velocity than the underlying fill or soil materials. These data must be used with caution and with the knowledge that sometimes such data will not be useable. Refraction surveys in karst terrain with limestone deposits underlain by shale or weathered bedrock would also fall into this category.

Uneven Terrain and Crooked Traverses. There are many pitfalls to the successful interpretation of seismic data that are not controllable, but two common pitfalls that are controllable are avoiding uneven terrain and avoiding unnecessary bends along seismic traverses. Uneven terrain along a traverse causes otherwise flat-lying layers to behave as if they were dipping alternately in one direction, then in the other, depending on which side of a slope the observer is. If traverses can be positioned generally parallel to topographic contours, interpretation will generally be more reliable.

For crooked seismic traverses, the measured distance between geophones and the energy source will be different (shorter) from that of a straight traverse. This will shorten the arrival times between the energy source and each geophones. Traverses with significant bends will need to be time-corrected in accordance with the geometric relationships between the energy source and each geophone.

Low Velocity Effects from Organic Surface Materials. Care must be taken to position individual geophones (generally fitted with a spiked base) such that root matter and peat zones are avoided. Each foot of low velocity surface material through which seismic waves travel is equivalent to perhaps 5 to 10 times an equivalent thickness of saturated overburden materials. Not accounting properly for these time delays can lead to erroneous interpretation. The identification of various materials can be made with a knowledge of seismic velocity values based on other engineering studies, and on correlations with various test borings taken near seismic lines.

4.4.3.5 **TDMD** The TDMD method falls into the category of electromagnetic induction geophysical methods. The method is suitable for sites with potential surface interferences.

The basic principle of this method involves generation of an alternating electromagnetic field. The electromagnetic field causes induced electrical currents to flow in the subsurface. The induced currents generate a secondary electromagnetic field that is measured at the ground surface by a receiver coil. Components of the secondary field are measured and compared, which allows determination of subsurface conductivity.

4.4.4 **Test Pits** Test pits may be excavated to collect subsurface soil samples and characterize shallow subsurface soil conditions. The following discussion outlines test pit excavation procedures: collection of test pit soil samples is outlined in Paragraph 4.5.1.2. Test pit excavation will be directed by the field geologist.

To expedite the sampling and record keeping efforts and to minimize periods of potential exposure during the excavation of test pits, the sampling crew will have sufficient tools and equipment to sample each pit prior to requiring decontamination. The backhoe, bucket, and boom will be decontaminated before each new test pit in accordance with procedures outlined in Subsection 4.3.4.

The actual layout of each test pit, temporary staging area, and spoils pile will depend on site conditions and wind direction at the time the test pit is made.

During excavation, sampling, and logging of each test pit, the backhoe operator and all site personnel will remain upwind or crosswind of the test pit and spoils pile. Wind direction will be monitored by means of a wind sock or other banner located in a prominent position visible to all personnel.

Preselection and the use of hand and horn signals is important during completion of test pits due to noise levels around the machine. The sampling crew and backhoe operator will rehearse appropriate signals ahead of time and be thoroughly familiar with their meaning.

Test pits will be logged by the field geologist as they are excavated. Records of each test pit will be made on prepared forms or in a field book (Figure 4-1). If the log is made in a field book, it will be transcribed to prepared forms. These records include plan and profile sketches of the test pit showing all materials encountered and their depth and distribution in the test pit and sample locations. These records will also include safety and sample screening information. This format provides a cross check with COC records and sample label counts. Photographic logs will be recorded in the field logbooks.

The actual depth of samples obtained from each test pit will be selected at the time the test pit is excavated. Additional samples of each residue phase and any fluids encountered in each test pit may also be collected.

Before the test pit is excavated, the backhoe and backhoe bucket will be decontaminated as discussed in Subsection 4.3.4. Test pits will be excavated in the following manner.

1. The sampler and subcontractor (including the backhoe operator) will plan the excavation.

2. After the area to be excavated has been cleared, the backhoe operator will excavate the test pit proceeding in increments as planned by the sampler and subcontractor.

3. After each increment, the operator will wait while the sampler inspects the test pit to decide if conditions are appropriate for sampling.

4. If conditions are suitable for sampling, discrete samples from appropriate intervals may be collected from the bottom or sides of the test pit with the backhoe bucket. Normally, test pits are not entered by any personnel for sampling. Test pits must never be entered unless the excavation conforms to OSHA requirements (see Volume II, Appendix J). Note proper depths and locations of sample collection in the field log.

5. The backhoe operator, who will have the best view of the test pit, will immediately cease digging if

   - any fluid phase or groundwater seepage is encountered in the test pit,
   - any drums or other potential waste containers are encountered,
   - distinct changes of material are encountered, or

TEST PIT RECORD

Point of Interest: ______________________________

Well/Boring ______________ Date ______________ Time ______________ End ______

Coordinates ______________________________ Grid Element ______________

SKETCH MAP OF TEST PIT SITE

N

WIND

SCALE 1" = ____________ FT.

NOTES: ______________________________

Crew Members:

1.

2.

3.

4.

5.

6.

Monitor Equipment:

PI Meter	Y	N
Explosive Gas	Y	N
Avail. Oxygen	Y	N
OVA	Y	N
Other ______________		

Photographs, Roll ______________

Exposure ______________

FIGURE 4-1

EXAMPLE TEST PIT RECORD

PROJECT OPERATIONS PLAN

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

NAVAL TRAINING CENTER ORLANDO, FLORIDA

TEST PIT RECORD

Profile Along Test Pit: ______________________________

Point of Interest: ______________________________

SKETCH MAP OF TEST PIT PROFILE

SCALE 1" = __________ FT.
DEPTH (FT). __________

NOTES: ______________________________

no.	Int. Ser. No.	Depth (Ft.)	HD. SP. VOA PPM
S-1			
S-2			
S-3			
S-4			
S-5			
S-6			
S-7			
S-8			

REFERENCE: FIELD BOOK, Pg. ______

ATTACHMENTS ______

SIGNATURE: ______________

FIGURE 4-1 (Cont.)

EXAMPLE TEST PIT RECORD (Cont.)

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

- the field geologist directs the operator to cease digging.

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. For instance, should any fluids or seepage be encountered, they could, after suitable screening and monitoring, be sampled.

Waste and sludge deposits could likewise be sampled before proceeding. Should uncollapsed drums be encountered, the test pit will be terminated, backfilled carefully to avoid damage from rocks, etc., flagged to identify the location of the buried drums, and redug at an adjacent location. Under no circumstances will any personnel open and/or sample any buried drums. The field investigation task leader will immediately notify the project manager (PM) and other personnel, as appropriate, so that a course of action, including health and safety considerations, may be initiated.

Test pits will be secured, when open, during the day and backfilled at the end of each day. Cleanup procedures at the conclusion of a test pit exploration include proper disposal of cuttings, decontamination of the backhoe and sampling equipment, removal of plastic sheeting, and completion of the field logbook and/or data sheets.

4.4.5 TerraProbe℠ Surveys The TerraProbe℠ system can be used to conduct soil vapor, soil, and groundwater surveys. These surveys provide screening information that can be used to optimize the location of soil borings and monitoring well installations and to assess VOC contamination in the vadose zone.

The TerraProbe℠ system consists of a hydraulic ram unit with the capability of driving 3/4-inch diameter rods and stainless-steel sampling probes into the subsurface for sample collection. The entire system is mounted in, and operates out of, a standard cargo van. The system is unfolded from the rear of the van, and the steel probe assembly is advanced to the desired depth. The closed probe point is then released using internal rods, allowing the point to recede into the probe when it is advanced farther.

4.4.5.1 Sampling To obtain a soil sample, the probe is then advanced another 12 inches, collecting a sample inside the tube. Water samples are collected by allowing formation water to flow into a slotted probe tip. Water within the probe is then purged and sampled using a low-flow rate sampling pump or a bailer. The collection of groundwater samples via the TerraProbe℠ method is dependent on sufficient saturated thickness of overburden soils and an adequate rate of inflow through the probe tip. For soil vapor, a vacuum is applied to the drive rods and a sample is collected in a syringe.

Soil gas surveys are performed by driving a probe into unsaturated soil to a designated depth (i.e., 5 feet). Probe depth depends on site-specific factors such as type of soils, depth to groundwater, location of underground utilities, and potential source and type of contamination anticipated. After the probe is in place, a soil gas sample is extracted and analyzed using an FID or PID and an electron capture detector (ECD).

As an alternative to sampling gaseous soil organic vapors, soil samples may be obtained from discrete depths in the vadose zone and GC screened. An extraction will be performed on the soil samples in the field laboratory and each sample GC screened using purge-and-trap techniques (see Section 4.6). The purge-and-trap soil screening will improve data quality while assessing the distribution of VOC contamination in the vadose zone.

Groundwater and soil samples may be field analyzed according to the field laboratory analyses outlined in Section 4.6 (see Paragraph 4.5.1.3 for additional details of TerraProbe℠ sampling procedures).

4.4.5.2 **Microwell Installation** The TerraProbe℠ system may be utilized to install small-diameter wells (microwells) in locations where permanent, larger diameter wells are unnecessary or impractical.

When constructing microwells, ABB-ES utilizes GeoProbe® geowells, which are 1/2-inch inside diameter (ID), Schedule 80 PVC. The screen section is 1-1/2-inch outside diameter (OD) and 3 feet in length and is constructed of 1/2-inch ID Schedule 80 PVC material with 0.010-inch slot mill cuts. Screened sections may be threaded together to increase screen length. The entire exterior of the screen section is encased or prepacked with a 20/40 grade filter sand held into place with a stainless-steel wire mesh of 0.011-inch pore size. Per FDEP requirements, microwells installed to intercept the water table will use 9-feet-long screened intervals.

Microwells are installed utilizing 2-inch steel casing that has an expandable point affixed to the bottom rod. The rod is then driven 4 inches below the target screen area. The microwell is then connected to the expendable point. Upon verification of a proper and secure connection between the expendable point and the bottom of the microwell, the steel casing is retracted the necessary distance so that the bottom of the steel casing is 0.5 foot above the top of the screen interval. The borehole is then checked for natural formation collapse with a measuring device lowered from the ground surface. Standard temporary monitoring well completion protocol is followed for the remainder of the installation of the microwell, including the addition of filter sand buffer above the screen interval, bentonite, grout, and a well-head manhole at the surface. Additional information on the microwell construction and installation is included in Appendix B.

4.4.6 **Exploratory Drilling** Soil borings will most often be drilled using hollow-stem auger (HSA) drilling and split-spoon sampling techniques where confirmatory soil and groundwater sampling is needed and where exploration depths exceed 5 feet. If conditions are encountered where the HSA method cannot be used (i.e., caving or running sands), or another method becomes advantageous, other investigative techniques, such as mud or air rotary or cased borehole methods may be used. Split-spoon samples will be collected either continuously (i.e., the zero- to 1-foot interval, then every 2 feet thereafter to the water table) or at 5-foot intervals, depending on site-specific data needs.

A qualified drilling subcontractor will supply the necessary type and number of drilling rigs capable of performing the drilling technique appropriate for the existing subsurface conditions. Prior to implementing the proposed drilling plan, the drilling subcontractor will perform the duties listed below.

- Secure and comply with any required boring or well drilling permits.
- Arrange drill sites (e.g., the drilling subcontractor will have containment materials on hand) to minimize the potential for the

possibility of spills and leaks from the drilling operation entering the borehole.

- Clean drilling equipment prior to movement to the site (see Section 4.3).

- Store well drilling equipment and well installation supplies in the staging area. At each drill location, clean equipment and supplies will be temporarily stored on sheets of disposable polyethylene sheeting to eliminate contamination from the native soils at the well location.

Soil borings will be used to obtain characterization and confirmatory samples for laboratory analyses. A geologist will be present during the drilling of borings and installation of monitoring wells. The geologist will maintain drilling logs, collect appropriate samples, and be equipped as required to perform this task appropriately. Subsurface split-spoon soil samples will be collected and logged using the Unified Soil Classification System (USCS). Typically, soil samples will be collected in accordance with Level III or IV DQOs, depending on the requirements of the task. In general, samples collected for laboratory analyses will be selected based on previous field screening results, field monitoring results (i.e., elevated PID, FID, or GC readings), visual examination, and/or at predesignated depth intervals. Most soil boring locations will correspond with monitoring well installations. Soil borings not used for monitoring well installations will be abandoned and grouted to ground surface.

Drilling of shallow borings will be conducted using 6.25-inch ID HSAs. If the site geologist determines that due to geologic conditions, augers cannot be used, borings will be advanced using an alternative method. If a boring is to be completed as a bedrock monitoring well, a surface casing will be placed through the overburden to the bedrock surface, followed by mud rotary drilling until the desired depth has been attained.

- Potable water for drilling and decontamination will be obtained from a source that has been approved by the Navy (Section 4.3).

- Drilling will be conducted by an approved drilling consultant.

- Drilling tools and rigs will be steam-cleaned prior to being delivered on site. Drilling rigs and tools will be decontaminated in accordance with procedures outlined in Subsection 4.3.4 prior to beginning any borings and between borings and well installations.

- Well screen and riser will be cleaned prior to installation. Well materials will be cleaned at the decontamination area in accordance with Section 4.3 and wrapped in plastic sheeting prior to transport to the drill site. All surfaces coming into contact with decontaminated well materials will be covered with plastic sheeting.

Drill cuttings and drilling fluids will be inspected visually for discoloration or other indications of contamination and screened with a PID or FID every 5 feet drilled or at every split spoon collected, whichever is more frequent. Drilling fluids or cuttings will be contained and disposed of as described in Section 4.10.

The boring methods employed at a given site are selected on the basis of subsurface conditions. The consultant will prepare detailed drilling specifications that govern the drilling subcontractor's effort. These specifications will be modified on a site-specific basis to reflect the needs of each project.

4.4.6.1 **Auger Borings** With this technique, HSAs are advanced into the soil. Drill cuttings are compressed laterally and carried upwards on the auger flights. The bottom opening in the hollow stem of the auger is blocked with a plug while the auger is advanced. When the desired sampling depth is reached, the plug is removed and a sample is obtained from below the bottom of the auger. The advantages of the HSA technique include

- simplicity of procedure,
- low risk of personnel exposure,
- can be used to obtain soil samples from a wide range of subsurface conditions,
- drilling fluids are generally not required, and
- availability of equipment.

The disadvantages of the HSA technique are listed below.

- Difficulty in penetrating excessively cobbled or bouldered soils.
- Difficulty in sampling granular soils below the water table because, without drill fluids, there are no practical means to maintain hydrostatic equilibrium in the borehole. When the plug is withdrawn, water and sediment from outside the augers may enter the borehole, potentially causing contamination and difficulty in sampling undisturbed soil below the bottom of the augers.

4.4.6.2 **Water Rotary** Drilling fluid is pumped down the drill rods and through a bit that is attached to the lower end of the drill rods. The fluid circulates back to the surface by moving up the annular space between the drill rods and the wall of the borehole. At the surface, the fluid discharges through a pipe and enters into a segregated or baffled sedimentation tank. The settling tank overflows into a suction tank where a pump recirculates the fluid back through the drill rods. The advantages of this drilling technique are

- simplicity of procedure,
- low risk of personnel exposure,
- ability to obtain soil samples from a wide range of subsurface conditions,
- ability to obtain samples from depths greater than 100 feet, and
- availability of equipment.

The disadvantages arise from the need to use a drilling fluid. The drilling fluid used will be from an approved water source. Drilling additives will not be used unless soil pore pressures or other downhole conditions require a heavier drilling fluid. The drilling fluids and cuttings removed from the borehole will require collection, containerization, and transportation to a suitable onsite disposal or staging site.

In sediments such as limestone, loss of drilling fluid circulation may occur, necessitating other rotary drilling techniques, such as air rotary. This procedure is essentially identical to water rotary, except pressurized air is pumped through the drill rods and drill bit, forcing formation water and drill cuttings up the annulus to land surface.

4.4.6.3 **Rotasonic™ Method** Sonic drilling methods use a sonic drill head to create a series of high-frequency wave vibrations in the drill casing. This creates a cutting action at the bit face, displacing formation as it advances. Several variations of the sonic method have been adapted from other applications for use in environmental applications, including a combined rotary rig and sonic head.

The advantages to this method are that it

- requires no circulating medium (air, mud, or water),
- minimizes IDW generation,
- is applicable to any formation,
- is fast, and
- allows collection of continuous core samples.

The disadvantages to this method are that it

- is more expensive than HSA methods;
- may generate more core than footage drilled; and
- uses no circulating (cooling) medium; therefore, it may heat up the formation during drilling.

4.4.6.4 **Cable Tool Method** This drilling method uses a drill bit attached to the bottom of a weighted drill stem that is raised and dropped in the borehole to crush formation material.

This method is particularly well-suited to drilling in saturated, unconsolidated sand and gravel. It also allows for identification of individual water-bearing horizons if coupled with a good casing program.

4.4.6.5 **Mud Rotary Method** Mud rotary drilling may be used at NTC, Orlando, primarily to install surface casings of large diameter. Surface casings have been installed (1) to provide a permanent seal to prevent contaminant migration from the shallow aquifer during installation of intermediate and deep monitoring wells and (2) to provide a temporary seal of the upper portion of the shallow aquifer during direct-push technology (DPT) investigations at intermediate depths to allow use of telescope casings through dense layers within the surficial aquifer.

Mud rotary is particularly useful for installing large-diameter casings and for use in unconsolidated materials. Extraction wells also often achieve higher efficiencies when installed using cable tool because there is less smearing of the formation. Permanent steel casings are grouted in place using a bentonite-cement grout. Temporary PVC casings are also grouted in place, and the casings and borehole are abandoned, also using a bentonite-cement grout, after sampling activities are completed.

4.4.6.6 **Monitoring Well Installation** Monitoring wells may be installed by several methods, depending on their intended use. Monitoring wells will be constructed of materials in accordance with SOUTHNAVFACENGCOM *Interim Final Monitoring Well Design, Installation, Construction, and Development Guidelines* (Appendix A), and installed in accordance with USEPA Region IV EISOPQAM (USEPA, 1996) guidelines. In the event of a conflict, the USEPA specifications will be followed with the exception of the use of well materials. Care will be used in steam cleaning well materials to ensure integrity is maintained. The following is a description of the most common well installation methods.

Standard Well Installation. Standard monitoring wells consist of 2-inch or 4-inch-diameter wells. A geologist will be present during monitoring well installation to record details of the well installation. Monitoring wells will be installed in borings unless the lithology requires abandoning the boring. Abandoned borings will be grouted in the presence of the site geologist.

For purposes of well abandonment or monitoring well installation, grout will initially be mixed to consist of 20 parts Portland Type II or V cement to one part bentonite by weight, with a maximum of 8 gallons of approved water per 94-pound bag of cement; however, these proportions may be modified to meet field conditions, with Navy approval. This grout mixture will also be used as necessary for backfilling soil borings not completed as wells. All grout materials will be combined in an aboveground rigid container or mixer and mechanically, not manually, blended on site to produce a thick, lump-free mixture throughout the mixing vessel. The mixed grout will be recirculated through the grout pump prior to placement. Grout will be placed using a grout pump and tremie pipe. The grout pump for recirculation and placement will be a commercially available product specifically manufactured to pump cement grouts. The tremie pipe will be of rigid, not flexible, construction. Drill rods, rigid PVC, or metal pipes are acceptable tremies. Hoses and flexible PVC are unacceptable. Grout placement, via gravity and the grout head, using an elevated grout tank is expressly prohibited.

All well installations will begin immediately after boring completion. Once begun, they will continue uninterrupted, to the extent possible, until completion. In all cases, the well screen and casing will be cleaned in accordance with procedures described in Subsection 4.3.4. All well screens will have a bottom plug.

The following materials will be used in monitoring well construction.

- Two-inch ID, Schedule 40, threaded, flush-jointed, PVC screen-and-riser pipe will be used. No PVC solvent will be used. The well screen will be factory-slotted, with a slot width of 0.010 inch. A loose-fitting PVC cap will be used to cover the top of the well riser and to allow equilibration of the well water level with atmospheric pressure. Water table well screen lengths will typically be 10 to 15 feet in length. Monitoring well depths and screened intervals will depend on POI-specific data objectives. Whenever possible, shallow wells will be installed so that the screen will intersect the water table during all seasons. Stainless-steel well materials may also be used in locations where chlorinated solvents are the primary contaminants.

- Clean silica sand used in the filter envelope around the well screen will be selected to be compatible with both the screen slot size and aquifer materials. The sandpack will extend a maximum of 2 feet below the bottom of the well screen to 2 feet above the top of the screen.

- A minimum of 2 feet of bentonite pellets or slurry will be used in the seal and will be a commercially available product designed for well sealing purposes. The bentonite or slurry seal will be allowed to hydrate for the manufacturer's recommended hydration time. As an alternative, fine-grained sand may be used in place of hydrated bentonite for monitoring wells that straddle the water table. The decision to use bentonite or fine-grained sand will be made on a case-by-case basis.

- For wells screened at depths greater than 20 feet bls (top of screen interval), a fine sand (30/65) layer will be installed on top of the hydrated bentonite seal. This layer should be at least 2 feet thick. The purpose of the sand cap is to prevent intrusion of the overlying grout seal into the screened formation.

- A cement-bentonite grout will be placed in the annular space above the seal layer. The cement-bentonite grout seal will extend from the top of the bentonite seal to ground surface. Grouting will be completed as a continuous operation in the presence of the field geologist. The grout will be pumped into the annular space under pressure using a tremie pipe placed at the top of the bentonite seal to ensure a continuous grout seal. The protective casing will be sealed in the grout.

- At least one sample each, 0.5 pint in volume, of the granular backfill, bentonite, mud, or other material used as part of a well installation will be taken from each shipment of materials and stored with the soil samples.

- Monitoring wells will either be flush mounted with protective steel casing at ground surface or will have aboveground protective casings to protect the well riser. Aboveground wells in high traffic areas will be surrounded by four protective steel posts. Protective steel casings will be equipped with locking covers. The same key will be used for all padlocks that will be placed on new monitoring wells at NTC, Orlando. A concrete seal and concrete pad will be placed from the top of the grout to the ground surface around each protective casing to secure the casing, prevent surface runoff from entering the borehole, and to direct runoff away from the casing. The concrete pad shall measure 3 feet by 4 feet by 6 inches. The aboveground parts of both the well riser and protective casing will be vented. The protective casing will have two weep holes near ground level to allow water to drain from inside the casing. A reference mark will be placed on each PVC monitoring well riser pipe for water-level measurements. Wells will be permanently and properly identified as specified in SOUTHNAVFACENGCOM guidance (Appendix A) and USEPA EISOPQAM guidance (USEPA, 1996).

- A sketch of the well installation will be included with the boring log. It will show, by depth, the bottom of the boring, screen location, granular backfill, seals, grout, water level, cave-in, and height of riser above ground surface. The actual composition of the grout, seals, and granular backfill will be recorded on each sketch. Figures 4-2A, -2B, and -2C illustrate typical well installation diagrams.

- Well sketches will include the protective casing detail.

Modifications to monitoring well installation requirements may be necessary if the depth to groundwater is shallow. The bentonite seal and sand-pack extension may be reduced, though it is preferred that the bentonite seal be not less than 2 feet. Modifications to installation requirements will only be implemented with prior approval from the Navy.

Drive Point Wells. Drive point wells may be used in locations where standard well installation techniques are impractical or unnecessary (e.g., directly in surface water bodies or in marshy surface areas). These wells are useful for measuring depth to groundwater, or for collecting groundwater samples in shallow water table conditions.

Drive point wells are constructed from 1.25-inch ID stainless-steel casing. Casings are threaded together (5-foot sections), as needed, and attached to a 1-foot section of 0.010-inch slotted screen. A stainless-steel point is attached to the screened section. These wells are installed to the desired depth using a slide hammer and a protective cap applied to the top of the casing.

Drive point wells have no external filter pack or surface seal, although they may have an internal geo-fabric filter installed in the screened interval. Well development is accomplished by using small-diameter Teflon™ tubing and a peristaltic pump. The tubing is also used to surge the well.

Microwells. Microwells are small-diameter monitoring wells installed at shallow or intermediate depths, often using DPT. Installation of these wells is discussed in Paragraph 4.4.5.2. Additional details are included in the GeoProbe® material in Appendix B.

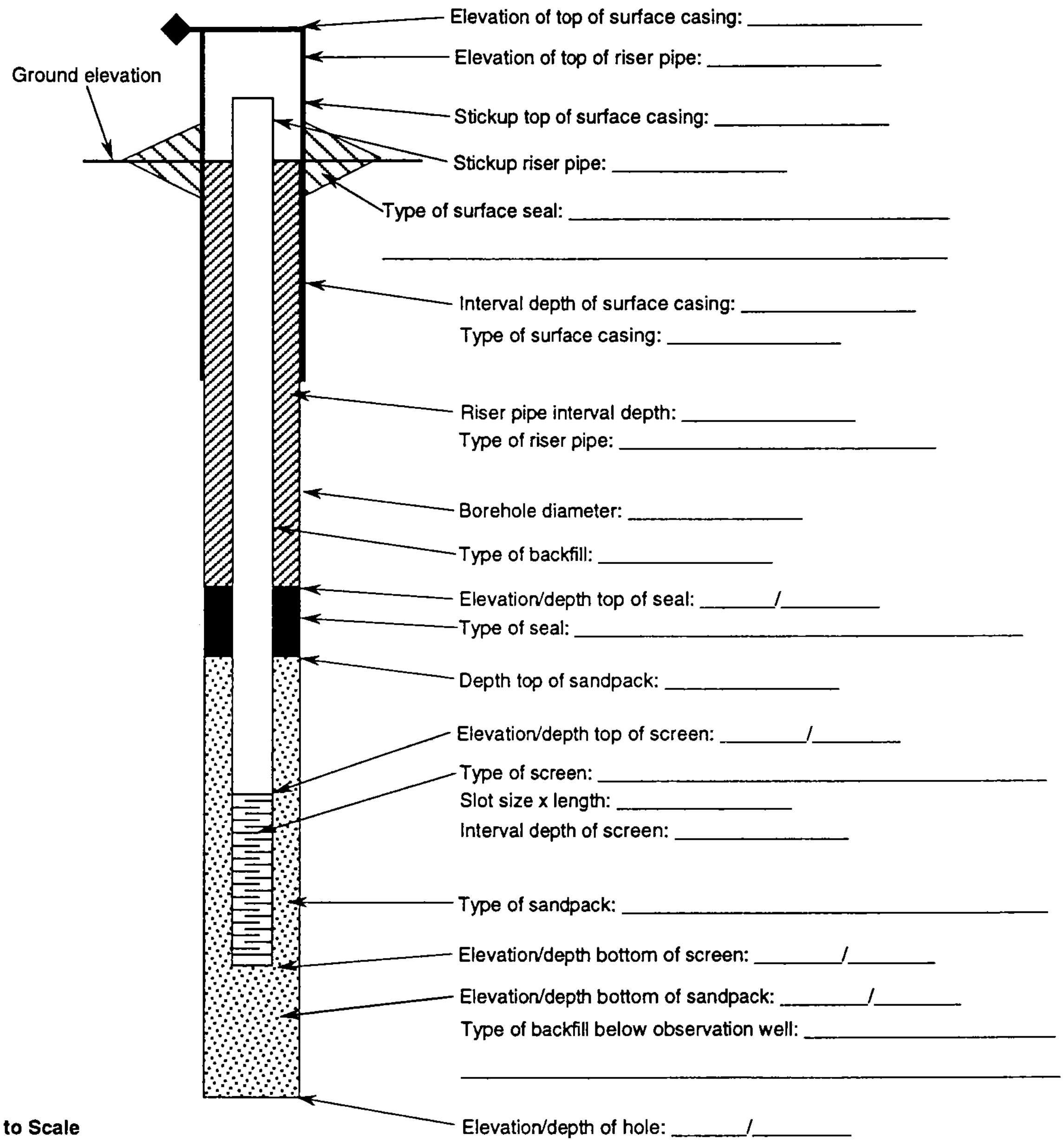
Temporary Wells. Temporary wells may be used to enable sampling of the upper portion of the saturated zone. They may be installed in a borehole created by hand augering or by conventional drilling. These wells are used primarily during site-screening investigations because they are quickly installed, cost-effective, provide acceptable groundwater samples, and minimize the number of permanent monitoring wells onsite that will ultimately require abandonment.

Generally, wells are constructed of 2-inch-diameter, Schedule 40 PVC with a 5-foot-long, 0.010-inch slotted screen section threaded to riser pipe. A filter sand pack may be installed to fill the annular space around the screened section.

Overburden Monitoring Well Sheet

Boring Number: ____________

Project ____________	Location ____________	Driller ____________
Project Number ____________	Boring ____________	Drilling Method ____________
Elevation ____________	Date ____________	Development Method ____________
Field Geologist ____________		____________



Not to Scale

FIGURE 4-2A

WELL CONSTRUCTION SUMMARY - OVERBURDEN

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8545-14 FIG 4-2A 081197MAW

Confining Layer Monitoring Well Sheet

Boring Number: ___________

Project ____________________ Location ____________________

Project Number ____________________ Boring ____________________

Elevation ____________________ Date ____________________

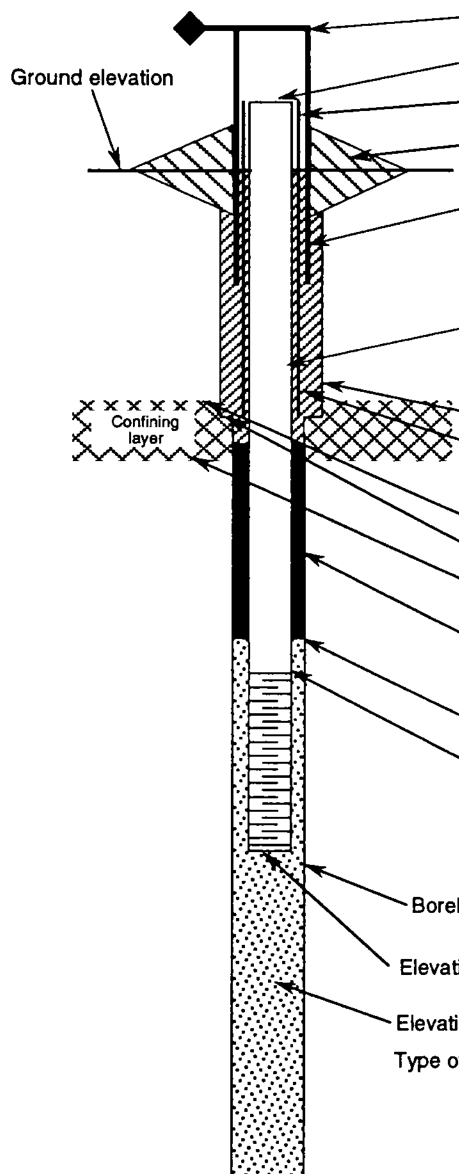
Field Geologist ____________________

Driller ____________________

Drilling Method ____________________

Development Method ____________________

____



Elevation of top of surface casing: ____________________

Elevation of top of riser pipe: ____________________

Elevation top of permanent casing: ____________________

Type of surface seal: ____________________

Interval depth of surface casing: ____________________

Type of surface casing: ____________________

Riser pipe interval depth: ____________________

Type of riser pipe: ____________________

Borehole diameter: ____________________

Permanent casing interval depth: ____________________

Type of casing and backfill: ____________________

Elevation/depth top confining layer: ________/________

Elevation/depth bottom of casing: ________/________

Elevation/depth bottom confining layer: ________/________

Elevation/depth top of seal: ________/________

Type of seal: ____________________

Depth top of sandpack: ____________________

Elevation/depth top of screen: ________/________

Type of screen: ____________________

Type of sandpack: ____________________

Borehole diameter below casing: ____________________

Elevation/depth bottom of screen: ________/________

Elevation/depth bottom of sandpack: ________/________

Type of backfill below observation well: ____________________

Elevation/depth of hole: ________/________

Not to Scale

FIGURE 4-2B

WELL CONSTRUCTION SUMMARY - CONFINING LAYER

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER ORLANDO, FLORIDA

8545-14 FIG 4-2B 081197MAW

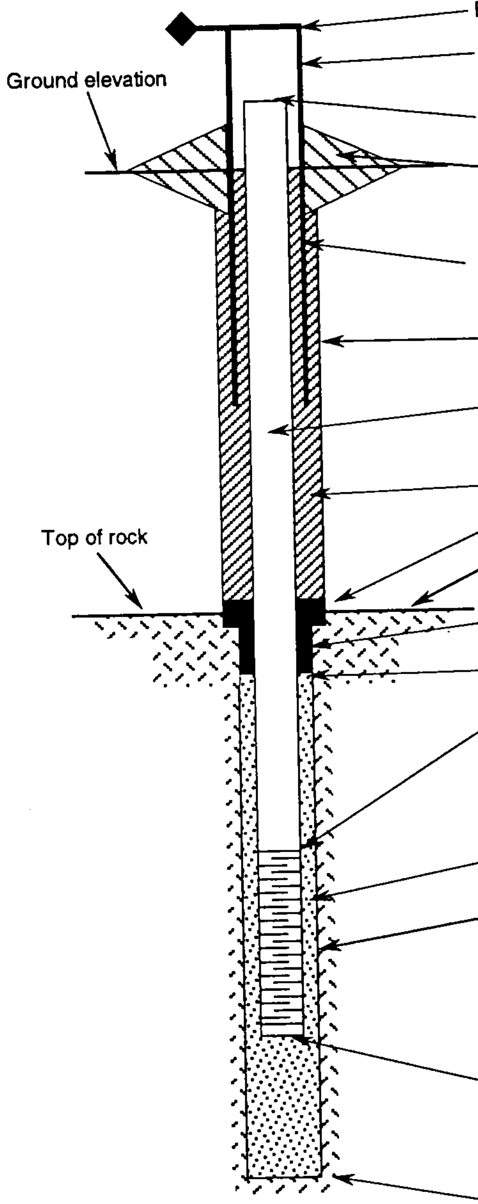
Bedrock Monitoring Well Sheet - Well Installed in Bedrock

Boring Number: ______

Project ______
Project Number ______
Elevation ______
Field Geologist ______

Location ______
Boring ______
Date ______

Driller ______
Drilling Method ______
Development Method______
______



Elevation of top of surface casing: ______
Stickup of casing above ground surface : ______
Elevation top of riser: ______
Type of surface seal: ______
Interval depth of surface casing: ______
Diameter of hole: ______
Riser pipe interval depth: ______
Type of riser pipe: ______
Type of backfill: ______
Elevation/depth top of seal: ______/______
Elevation/depth top of bedrock: ______/______
Type of seal: ______
Elevation/depth top of sand: ______
Elevation/depth top of screen: ______/______
Type of screen: ______
Slot size x length: ______
Interval depth screen: ______
Type of sandpack: ______
Diameter of hole in bedrock: ______
Core/ream: ______
Elevation/depth bottom of screen: ______/______
Elevation/depth bottom of hole: ______/______

Not to Scale

FIGURE 4-2C

WELL CONSTRUCTION SUMMARY - BEDROCK

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8545-14 FIG 4-2c 081197MAW

The wells may be purged and sampled immediately, or allowed to equilibrate overnight. Purging is accomplished using an adjustable flow-rate peristaltic pump. Because elevated turbidity is the primary drawback to temporary well use, purging is primarily designed to reduce turbidity prior to sampling. By using a flow rate at or below the drawdown rate in the well, and by gradually raising the pump tubing from the bottom to the top of the screened interval, relatively low turbidity is achievable.

Groundwater sampling may then be conducted using the low-flow technique summarized in Paragraph 4.5.2.2. If groundwater samples are being collected for total metals analysis, a sample should also be collected for TSS to aid in data interpretation. Following groundwater sampling, the well may be removed from the borehole and disposed of, and the borehole backfilled to the ground surface.

4.4.6.7 **Monitoring Well Development** The development will be performed as soon as practical after well installation, but not sooner than 24 hours after grout set time and optimally after the protective casing installation. Other development methods may be employed for temporary wells. The following data will be recorded during well development:

- well designation;
- date and time well installation completed;
- date and time of development;
- static water level before and after development, including depth to water and depth to well bottom;
- quantity of drilling fluid lost during drilling;
- quantity of standing water in well and filter pack (30-percent porosity assumed for calculation) prior to development;
- specific conductivity, temperature, turbidity, and pH measurements taken and recorded during development after removal of each well volume (calibration standards will be run prior to and after each day's operation in the field);
- screen length;
- depth from top of well casing to top of sediment inside well, before and after development;
- physical character of removed water, including changes during development in clarity, color, particulates, and odor;
- type, size, and capacity of pump and/or bailer used;
- height of well casing above ground surface; and
- quantity of water removed and time for removal.

This information will be documented on a Well Development Record (Figure 4-3) and/or in the field logbook. Well development will be performed using a bailer, hand pump, air-activated surge pump, or electric-powered submersible pump. Bailers will be used to develop wells only where the recharge rate of the well is so slow that other development methods are clearly inappropriate. The pump will be periodically raised and water in the piping allowed to drain back into the hole in order to induce flow out through the well screen. A surge block may be used, in instances where field personnel expect that development may be improved by its use. Generally, neither water nor air will be added to the well to aid in development. However, if deemed appropriate, water jetting and simultaneous pumping may be used if the water source is known to be free from contamination. All well development equipment will be decontaminated prior to use in the next monitoring well (see Section 4.3). Development fluids will be containerized and handled as described in Section 4.10.

A well is considered to be fully developed when all the following criteria are met:

- the well water is visually clear to the unaided eye and/or field parameters of pH, specific conductance, and temperature have stabilized to within 10 percent and

- the total volume of water removed from the well equals five times the standing water volume in the well (including the well screen and casing plus saturated annulus, assuming 30 percent porosity) plus the volume of any drilling fluid lost.

The well may be allowed to stabilize a minimum of 24 hours after well development before groundwater sampling.

4.4.6.8 **Monitoring Well Identification** All monitoring wells at NTC, Orlando are given a unique identifier, in accordance with SOUTHNAVFACENGCOM guidance (1997; Appendix A). Each well designation includes the Study Area or OU number, the standard Navy designation "OLD" for NTC, Orlando, a sequential well number, and if part of a well cluster, a relative depth code. The depth codes and their corresponding depths are

- "A" for shallow wells,
- "B" for intermediate wells, and
- "C" for deep wells.

For example, the well identifier shown in bold would convey the following information: **OLD-32-6C**

- "OLD" indicates that the well is located at NTC, Orlando;

- "32" indicates that the well is located within Study Area 32;

- "6" indicates that it is monitoring well designation 6 within the area; and

- "C" indicates that it is screened at the greatest depth in a well cluster.

WELL DEVELOPMENT RECORD

Project:	Well Installation Date and Time:		Project No.
Client:	Well Development Date and Time:	Logged by:	Checked by:
Well/Site I.D.:	Weather:	Start Date:	Finish Date:
Volume of Drilling Fluid Lost (gal.)	Volume of Water in Well and Filter Pack (gal.)	Start Time:	Finish Time:

Installed Depth From Top of Well Casing to Bottom of Well:

Initial Depth to Water (ft):	Initial Depth to Well Bottom:

Water Level during Initial Pumping/Purging (ft):

Depth to Water at Termination of Pumping/Purging (ft):	Depth to Well Bottom at Termination of Pumping/Purging (ft):

BEGINNING OF WELL DEVELOPMENT

Time	Temperature	pH	Conductivity	Turbidity	Other	Approximate Pumping Rate (gal/min.)

END OF WELL DEVELOPMENT

Notes: (Include Physical character of removed water, type and size of pump, volume of water removed.)

Well Developer's Signature ______________________________

FIGURE 4-3

EXAMPLE WELL DEVELOPMENT RECORD

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8519-03 940321WEM

4.4.7 **CPT System** This technology may be used to perform CPT and discrete-depth groundwater sampling. A DPT rig is a box truck equipped with a hydraulic press for pushing instruments into the subsurface. Onboard computer systems are linked to a piezocone attached to the tip of the leading push rod, and real-time soil responses are recorded on logs as a function of depth. Tip resistance, pore pressure, and sleeve friction values, and ratios thereof, are used to classify the soil type. The CPT logs show the depths at which any of these changes occur. The CPT logs may be correlated with the soil boring logs of existing monitoring wells or empirically derived measurements. The CPT data from multiple probe locations may be used to produce a fence diagram, which shows the stratigraphy of the surficial aquifer in two dimensions. The CPT data may also be used to select discrete depth intervals at permeable layers to sample groundwater for analysis.

To collect groundwater samples, a discrete sampler is attached to the tip of the leading push rod, which has a shielded screened section that becomes exposed to the groundwater when the push rods are retracted about 2 feet. The groundwater passes though the screen and then enters into either a stainless-steel chamber that is retrieved and decanted, or the center of the push rods themselves, and is collected with a small-diameter bailer. Probe holes are abandoned by pumping bentonite grout through uninstrumented push rods.

4.4.8 Soil Gas Surveys Soil gas analysis can be performed using different methodologies, each with unique DQOs. The methods to be used will be soil headspace analysis, active soil gas collection, and passive soil gas collection. The TerraProbe℠ or other push-probe technology may be used for obtaining soil gas samples at discrete intervals. Where the target soil horizon is greater than 20 feet below ground surface, a passive soil gas collection technique will be used.

Soil gas surveys can be targeted to identify the areal extent of waste deposition and to define areas for sample collection. Soil headspace samples and soil gas samples may be collected and analyzed using an onsite GC. All soil gas analyses will be performed in accordance with field screening DQOs. Soil gas sampling points should be selected based on information about historical practices at a site and any other information that suggests where subsurface contamination might be expected.

Other methods for manually collecting soil gas samples include creating a 0.5-inch diameter hole using a manual slidehammer sampler or other impact hammer. The hole will be opened to a predetermined depth generally between 2 and 5 feet below ground surface. Samples are collected using a hollow 0.25-inch diameter stainless-steel probe with perforations in the bottom 0.5 foot. The probe is placed in the hole and is pushed or driven until the end of the probe is embedded approximately 0.5 foot into undisturbed soil at the bottom of the hole. Soil gas is extracted using a portable PID or FID through a Teflon™ transfer tube attached to the sampling probe. As soil gas is extracted from the hole, total VOC concentrations are monitored on the PID or FID. When readings are observed to stabilize (i.e., measurements fluctuate by $<\pm 2$ ppm), the PID or FID measurement is recorded and soil gas is collected through a septum in the transfer line, using a glass gas syringe. The sample is transferred immediately to an onsite GC for analysis.

Passive soil gas techniques involve placement of a gas collector at a prescribed depth. After a period of time (1 to 2 weeks), the collectors are retrieved and analyzed for the presence of volatiles. Several types of collectors are available. One type uses one or more adsorbents to collect VOCs. This method relies on thermal or chemical desorption of VOCs in the laboratory, followed by analysis of the desorbed vapor. A second type of collector uses a permeable membrane surrounding a glass sampling container. VOCs pass through the membrane by gaseous diffusion. Upon retrieval, the vial contents are analyzed by gas chromatography.

Sampling probes used for active soil gas collection will be decontaminated before use at each sampling point by washing with approved decontamination water. Care will be taken to ensure that the perforations are clear of residual soil particles.

4.4.9 Ecological Surveys To identify potential receptors and exposure pathways, ecological communities at and in the vicinity of the POIs will be identified through literature review, consultation with known experts in the field (i.e., U.S. Fish and Wildlife Service, FGFWFC, Florida Natural Heritage Program, local government, and nonprofit environmental organization sources), and review of relevant information sources, including maps and historical records. Information previously gathered regarding ecological receptors at NTC, Orlando will be supplemented with additional data from the information source review and from consultation with local, State, and Federal aquatic, wetlands, and terrestrial authorities. Existing information sources related to flora, fauna, and ecological communities at the installation will be reviewed, and standard taxonomic sources and references will be identified.

Following the information review, a qualitative field reconnaissance program will be initiated to characterize aquatic, wetland, and terrestrial habitats at and in the vicinity of selected POIs at NTC, Orlando. This qualitative field program will involve a site walkover by a two person team consisting of a terrestrial biologist and wetland-aquatic specialist. Ecological receptors in the vicinity of the POIs that could potentially be exposed to contaminated environmental media will be identified. Any possible site-specific exposure pathways through which ecological receptors could be exposed to contaminated media will be evaluated, and possible signs and symptoms of stress on biological receptors at the site will be observed.

If necessary, a qualitative aquatic survey will be conducted to examine the macroinvertebrate communities associated with aquatic and wetland systems at selected POIs to determine whether or not environmental contamination from the installation is resulting in any gross community-level impacts. Depending on the habitats present at the site, macroinvertebrate fauna will be collected with a benthic dredge, surber sampler, aquatic dip net, and/or seine net upstream, within, and downstream of identified sites (see Subsection 4.5.4).

A terrestrial survey will identify and verify major vegetative cover types and dominant taxa at the various areas of concern at the installation. This will include a qualitative walkover survey to confirm ecological habitat types, flora, and fauna at and in the vicinity of each selected POI. Belt and/or line transect surveys of community types in the upland and wetland communities associated with the selected POIs will be conducted. Evidence of ecological stress in plant species (e.g., yellowing, wilting, or insect infestations) and animal species (e.g., disease, parasitism, death, and reduced diversity or abundance) will be noted. Any federally- or State-listed rare and endangered plants encountered at the installation will be documented.

When appropriate, habitat types present at the site, including wetlands, will be field mapped onto existing base maps (not surveyed to scale); however, no flagging of wetlands or jurisdictional determinations regarding wetlands will be made, unless specifically required by the Navy (see Subsection 4.4.10). When appropriate, lists of flora and fauna encountered or expected at the site will be generated. Observations of plants, fish, invertebrates, amphibians, reptiles, birds, and mammals, and their sign will be noted for each habitat present and mapped.

If necessary, quantitative ecological programs (i.e., macroinvertebrate survey, biomonitoring studies, small mammal trapping) will be conducted at NTC, Orlando. Separate workplans will be prepared for any required quantitative ecological programs. Information collected in the ecological survey will be used in risk or threat evaluations at NTC, Orlando.

4.4.10 Public Health Surveys A public health survey will consist of site reconnaissance, interviews, and records search to evaluate regional land use at and in the vicinity of NTC, Orlando. Selected POIs will be studied to evaluate current and foreseeable future land uses. During the public health survey, populations that may come into contact with contamination and exposure pathways through which human receptor exposure could occur will be identified. If necessary, contacts will be made with local authorities (i.e., board of health) and relevant files of local authorities will be reviewed. Information collected in the public health survey will be used in risk or threat evaluations at NTC, Orlando.

4.4.11 Wetlands Delineation If required by the Navy, wetlands will be delineated at selected POIs at NTC, Orlando. The primary objective of this task will be to identify and delineate wetlands in the known contaminated regions at selected POIs. Wetlands at these selected POIs will be identified and delineated in accordance with applicable Federal and State guidelines, rules, and regulations.

The Florida wetlands boundary will be defined according to Chapter 17-301, Florida Administrative Code and the FDEP (formerly Florida Department of Environmental Regulation) regulations on surface waters of the State. These regulations state the following:

> *"The line demarcating the landward extent of surface waters, as defined by Section 403.031, F.S., shall be established for any water body, pursuant to Section 403.817, F.S., by dominant plant species. Dominance shall be determined in a plant stratum (canopy, sub-canopy, or ground cover). The canopy is composed of all woody plants with a trunk 4 inches or greater in diameter at breast height (DBH). DBH is measured at 4.5 feet above the ground. The subcanopy is composed of all woody plants with a trunk or stem and between 1 and 4 inches and a height greater than 3 feet. The ground cover includes all other plants..."*

If required, the Federal wetlands boundary will be determined using criteria for hydric soils, hydrophytic vegetation, and wetland hydrology as provided in the 1987 U.S. Army Corps of Engineers Wetlands Delineation Manual (U.S. Army Corps of Engineers Environmental Laboratory, 1987). This manual presents technical guidance for identifying wetlands and for distinguishing wetlands from aquatic habitats and other nonwetlands.

When required, wetland and upland boundary stations will be flagged with orange surveyor's flagging or staked with surveyor's pin flags.

<u>4.5 SAMPLING TECHNIQUES</u>. The procedures described in the following subsections of Section 4.5 will govern the collection of samples. Additional detail regarding sample collection methods is described in the CompQAP (ABB-ES, 1993) and USEPA Region IV EISOPQAM (USEPA, 1996).

<u>4.5.1 General Soil Sampling Methodology</u> The soil sampling program at NTC, Orlando has been developed to define the location, nature, and concentration of contaminants in surface and subsurface soils at the site. Development of a soil sampling plan to evaluate the distribution and magnitude of contamination at a specific site requires at a minimum

- an assessment of the site conditions, including site topography and surface drainage;
- evaluation of site waste disposal practices;
- consideration of site soil types, geology, and hydrogeology;
- evaluation of the methodology and results of any previous sampling and analysis programs that may have been completed at the site; and
- definition of the scope and objectives of the project.

A number of techniques have been developed to obtain samples from various depths below the ground surface. The techniques described herein have been selected to provide a practical and efficient means of obtaining samples in a manner consistent with safety protocols and QA/QC requirements. Additionally, they employ equipment that is normally available for use.

The selection of sampling techniques to be employed at a given site is based upon the depth from which samples must be obtained, the types of exploration, and/or the nature of the soils to be sampled. The sampling techniques are categorized by the depths or the types of explorations from which they are obtained:

- shallow soil samples, from depths of less than approximately 5 feet, usually less than 2 feet (surface soil is defined as samples from the zero- to 1-foot interval);
- test pit samples from depths up to approximately 15 feet;
- subsurface soil samples from test borings and TerraProbe℠ explorations at variable depths; and
- sediment samples from depths of less than 6 inches.

Maintaining proper records is an important aspect of sample collection. All soil samples collected will be logged in the field at the time of sampling by the field geologist. Soils will be classified in accordance with the USCS. Soil samples will be described fully on the appropriate sampling logs. The descriptions for intact samples (e.g., undisturbed split spoons or test pit walls) will include the following parameters:

- general description;
- USCS symbol;
- secondary components and estimated percentages;
- color;
- plasticity;
- consistency and density;
- relative moisture content;
- texture, fabric, and bedding;
- grain angularity; and
- depositional environment or formation (unit) name, if appropriate.

If disturbed samples must be described (e.g., auger flight samples, wash samples, or backhoe bucket samples), the parameters outlined above will be used to the extent practical. In general, a substantially reduced level of detail will be appropriate for disturbed samples.

If required, soil pH will be measured in the field and will be recorded on the Sample Data Sheet. A minimum of approximately 25 grams of soil will be placed in a clean glass jar or beaker. An approximately equal volume of organic-free water will be added to the soil. The mixture will be vigorously stirred or shaken and then allowed to stand for approximately 1 minute before measurement. Soil pH will be measured with a calibrated pH meter or with pH paper. Measurements will be made within 24 hours after sample collection and as soon after collection as practical.

4.5.1.1 **Surface Soil Sampling** Soil samples will be collected to determine the nature and extent of near-surface contamination. For the NTC, Orlando program, surface soil is defined as soil from the zero- to 1-foot interval. Where appropriate, surface soil samples will be based on a sampling grid established in the field. A grid system will be laid out within the POI. Grid systems will be established by staking the corners of each individual grid block and labeling the stake with the appropriate distance from the origin. Right-angle prisms may be used to facilitate grid setup. Origin points for grids will be determined in the field and recorded in the field notebook. A compass and 200-foot cloth tape will be used in the grid setup to ensure that stakes are located along straight lines and that the lines are perpendicular. The 200-foot cloth tape will be used to locate the stakes at the proper distances from one another. The stakes will be appropriately marked and flagged.

Surface soil samples will be collected using a decontaminated stainless-steel trowel, hand auger, tulip bulb planter, or stainless-steel spoon. Stones and vegetation will be carefully removed from the sampling location surface; these materials will also be removed from the sample prior to laboratory analysis. The soil will be mixed prior to filling sample containers, with the exception of containers for volatiles. These containers will be filled first, prior to blending, to minimize loss of volatile constituents. The soil samples will be placed in prelabeled sample jars and sent for laboratory analysis. Appropriate sample containers are described in Section 4.2. Information regarding sample location, depth, and character will be recorded on a Surface Soil Sample Record (Figure 4-4) and/or the bound field logbook. Further data and some of the preliminary COC information will be recorded on the Surface Soil Sample Field Data Record (Figure 4-5) and/or the bound field logbook.

Surface soil samples from any ditches, swales, or trenches will typically be collected from the center line of the ditch and in sequence from the least to the most contaminated point. Surface soil samples collected from any spill or release areas will typically be collected from the outer extremities of the stained area towards the heavily contaminated area.

In the event that it is necessary to remove asphalt to collect the sample, a pickaxe or jackhammer may be used. All sampling and asphalt-removal equipment will be decontaminated between sample collections as described in Section 4.3.

4.5.1.2 **Test Pit Sampling** To sample the test pit from the ground surface, two methods may be used. The method will be selected in the field at the time the test pit is sampled.

- Samples can be obtained from the backhoe bucket. The sampler or work site geologist will direct the backhoe operator to remove material from the selected depth or location within the test pit. The bucket will be brought to the surface and moved away from the pit. The sampler will approach the bucket and monitor its contents with the FID or PID and record the reading in the log. If granular or loose soils and/or uniform materials are encountered, the sample will be obtained directly from the bucket. The sample will be collected from the center of the bucket and placed in sample jars using a clean trowel or spatula. Appropriate sample containers will be used as described in Section 4.2.

  If cohesive soils or multiphase conditions are encountered (e.g., the bucket contains a mixture of soil and sludge) so that obtaining a sample from the bucket is not practical, the sampler may direct the backhoe operator to empty the bucket onto the ground. The sampler will then obtain the sample from the interior of soil clods or lumps of sludge using a clean trowel or spatula.

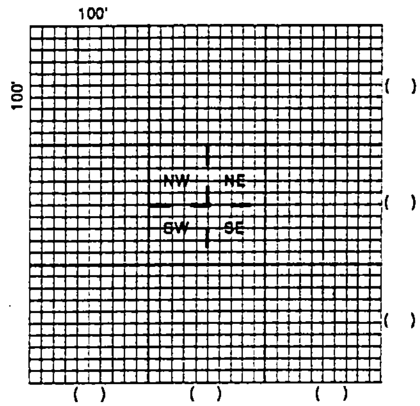
- Samples can be obtained directly from the test pit. This is necessary when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., caving or excessive mixing of soils or wastes within the test pit) or when samples from relatively small discrete zones within the test pit are required. In these circumstances, samples will be obtained by means of extendable handle tools: scrapers, trowels, spoons, or cups. The face of the test pit will be scraped to remove the smeared zone that has contacted the backhoe bucket. The material to be sampled, if a solid, will then be removed from the test pit wall by means of long handled scoops or trowels.

SURFACE SOIL SAMPLING RECORD

Point of Interest ____________________

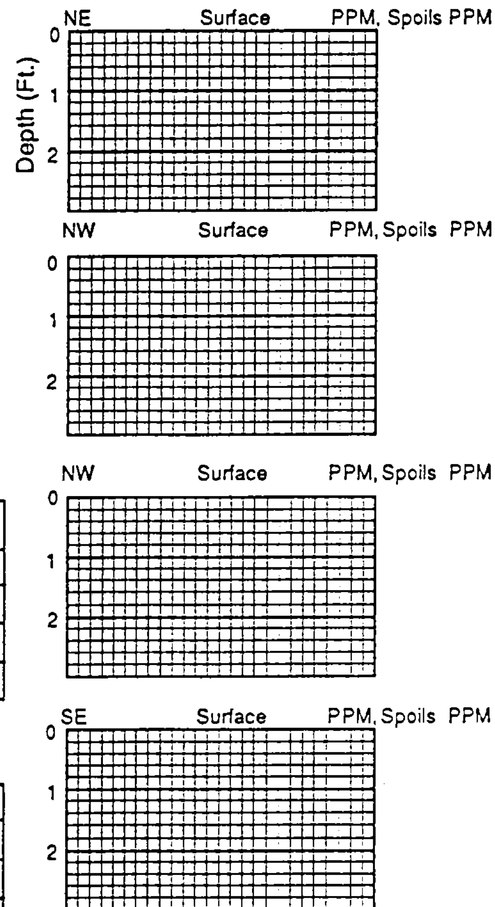
Grid Element; ________ Date; ________ Time: ________ St., ________ End. ________

Sketch Map of Grid Element



Sample Component Loss

-Description- -Monitoring- -PPM-



Samples Obtained

Composite Samples

Depth (Ft)	Quadrants	Init. Ser No.	Hd. Sp. PPM
S	NE NW SE SW		
1'	NE NW SE SW		
1.5'	NE NW SE SW		
2'	NE NW SE SW		

Grab Samples

	NE NW SE SW		
	NE NW SE SW		
	NE NW SE SW		
	NE NW SE SW		

Notes: ____________________

Photographers Roll: ____________________

Exposures: ____________________

____________________ Reference: Field Book, Page ________

Attachments, No. ________

Signed ________

FIGURE 4-4

EXAMPLE SURFACE SOIL SAMPLE RECORD

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SURFACE SOIL SAMPLE FIELD DATA RECORD

Project: ______________________________ Site: ______________________________

Project Number: ______________________________ Date: ______________________________

Sample Location ID: ______________________________

Time: Start: ____________ End: ____________ Signature of Sampler: ______________

SOIL SAMPLE

DEPTH OF SAMPLE ____________

EQUIPMENT USED FOR COLLECTION:
[ ] HAND AUGER
[ ] S.S. SPLIT SPOON
[ ] SHOVEL
[ ] HAND SPOON
[ ] ALUMINUM PANS
[ ] SS BUCKET
[ ] ____________

TYPE OF SAMPLE COLLECTED:
[ ] DISCRETE
[ ] COMPOSITE

SAMPLE OBSERVATIONS:
[ ] ODOR ____________
[ ] COLOR ____________
[ ] ____________

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] HNO_3 SOLUTION
[ ] POTABLE WATER
[ ] NONE

SOIL TYPE:
[ ] CLAY
[ ] SAND
[ ] ORGANIC
[ ] GRAVEL

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID ____________

SAMPLE LOCATION SKETCH:
[ ] YES
[ ] NO

SAMPLES COLLECTED

✓ IF REQUIRED AT THIS LOCATION	MATRIX: SURFACE WATER	MATRIX: SEDIMENT	✓ IF PRESERVED WITH ACID-BASE	VOLUME REQUIRED	✓ IF SAMPLE COLLECTED	SAMPLE BOTTLE IDS
[ ]	[ ]	[ ]	[ ]	______	[ ]	____/____/____/____
[ ]	[ ]	[ ]	[ ]	______	[ ]	____/____/____/____
[ ]	[ ]	[ ]	[ ]	______	[ ]	____/____/____/____
[ ]	[ ]	[ ]	[ ]	______	[ ]	____/____/____/____
[ ]	[ ]	[ ]	[ ]	______	[ ]	____/____/____/____
[ ]	[ ]	[ ]	[ ]	______	[ ]	____/____/____/____
[ ]	[ ]	[ ]	[ ]	______	[ ]	____/____/____/____

NOTES/SKETCH

FIGURE 4-5

EXAMPLE SURFACE SOIL SAMPLE FIELD DATA RECORD

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4.5.1.3 **Subsurface Soil Sampling** Sampling procedures for obtaining subsurface soil samples for the different drilling techniques are presented in the following subsections.

Soil Test Borings. The field geologist will collect soil samples for physical and analytical testing and geologic classification at predetermined boring locations. The soil samples will be collected from predetermined sampling intervals or whenever subsurface conditions warrant. The latter condition will be determined by the field geologist.

The samples for laboratory analysis will generally be collected using a 3-inch OD by 24-inch-long split spoon that is driven with a 300-pound hammer. If necessary, a thin-walled tube sampler or solid wall sampler in conjunction with DPT will be used for sample collection.

Samples collected for geologic classification will be collected in accordance with American Standards and Test Methods (ASTM) D-1586 Standard Penetration Testing (ASTM, 1967) using a 2-inch OD by 24-inch long split-spoon sampler driven with a 140- pound hammer. The collection of the samples will be in accordance with the following procedures.

- The appropriate number and type of laboratory-cleaned samples bottles will be available for use at the boring location. Refer to Section 4.2 for a summary of bottle requirements.

- Sample labels will be placed on the sample bottles prior to, or at the time of sample collection. The sample labels will be filled out using waterproof, permanent ink and will include sample identification, location, date and time, as well as the initials of the sampler and the analysis to be performed. Clear plastic tape will be placed around the sample label to ensure its integrity.

- The split spoon will be advanced ahead of the auger at the appropriate depth using the 140-pound hammer. Blow counts will be recorded by the inspecting geologist for every 6 inches the split spoon is advanced.

- The driller will remove the split spoon from the borehole and unscrew the ends, slowly and carefully opening the split spoon as the inspecting geologist monitors the sample with an ambient air monitoring device. The geologist will quickly collect and place the sample in the appropriate jars using a clean stainless-steel spatula. During this process, the geologist will note lithologic changes observed in the sample. The boring lithology will be recorded on a Soil Boring Log (Figure 4-6) and/or the bound field logbook. Soil boring logs will be transmitted to the Navy upon completion of the written report.

- The split spoons and stainless-steel sampling trowels will be decontaminated between samples using procedures outlined in Section 4.3.

Hand Auger. Hand augering is used to manually collect subsurface samples from depths generally less than 15 feet. A 3-inch auger bucket with cutting heads is pushed and twisted into the ground and removed as buckets are filled. Extension rods may be added as necessary to achieve the required sampling depth. If composite vertical sampling is used, the same auger bucket may be used to advance

SOIL BORING LOG				Point of Interest:
				Boring No.:
Client:		Project No.		Protection:
Contractor:	Date Started:			Completed:
Method:	Casing Size:			PI Meter:
Ground Elev.:	Soil Drilled:			Total Depth:
Logged by:	Checked by:			▽ Below Ground:
Screen: (ft.)	Riser: (ft.)	Diam: (ID)	Material:	Page of:

DEPTH (FT)	SAMPLE NUMBER	SAMPLE DEPTH	CLP/SCREENING	RECOVERY	PID (ppm)	SOIL/ROCK DESCRIPTION	SOIL CLASS	BLOWS/6-IN.	WELL DATA	LITHOLOGY	ELEVATION (FT.)

PROPORTIONS	(-) AMOUNT (+)	ABBREVIATIONS		
Trace (tr)	0-10%	f = fine	gr = gray	MS = Split Spoon
Little (li)	10-20%	m = medium	bn = brown	BW = Screened Auger
Some (so)	20-35%	c = coarse	blk = black	HP = Hydropunch
and	35-50%			

FIGURE 4-6

EXAMPLE SOIL BORING LOG

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the hole and collect the sample. If a discrete sample is required, a clean bucket auger should be used to collect the sample after the hole has been advanced to the required depth.

The top several inches should be removed from the bucket to minimize cross contamination from sloughed material fallen into the bucket. The order of sample collection and decontamination methods are the same as for other subsurface sampling methods.

TerraProbe℠ or CPT Sampling. The TerraProbe℠ or CPT sampling system will be used to obtain discrete soil, groundwater, or soil gas samples that can be screened with an FID or PID, onsite field GC, and/or submitted for laboratory analysis to determine the presence or absence of contaminants in unsaturated soils. The TerraProbe℠ system is described in Subsection 4.4.5 and the CPT system is described in Subsection 4.4.7. Samples will be collected and documented, employing the procedure outlined below.

- Following removal of the assembly from the hole, the sample will be extracted and placed within the appropriate sample bottles.
- The appropriate number and type of laboratory-cleaned sample bottles will be available for use at the boring location. Refer to Section 4.2 for a summary of the bottle requirements.
- If additional soil volume is required, then the procedure will be repeated at a depth immediately beneath the previous sample.
- Sample labels will be placed on the sample bottles prior to, or at the time of sample collection. The sample labels will be filled out using waterproof, permanent ink and will include sample identification, location, date and time, initials of the sampler, and analysis to be performed. Clear plastic tape will be placed around the sample to ensure its integrity.

Immediately after the TerraProbe℠ samples are collected, all labeled vials and jars will be checked for completeness and COC procedures will be initiated. TerraProbe℠ explorations will be documented on the field data record (Figure 4-7) and/or in the bound field logbook. Field laboratory analyses are described in Section 4.6.

Shelby Tube Sampling. Collecting and transporting soil samples in a nearly "undisturbed" state is required for certain treatability, hydraulic, and geotechnical tests. It is recognized that this cannot be done without some degree of sample disturbance, but care will be taken to minimize disturbance.

Shelby tube sampling is a common method of "undisturbed sampling." As applied herein, Shelby tube sampler refers to any open-drive sampler consisting of thin-walled seamless steel tubing with a sharp and drawn-in cutting edge that can be connected to a sampler head or adaptor containing a check valve and vents for escape of air and water. (Thin-walled refers to a wall thickness typically less than 2.5 percent of the diameter of the sampler.) Shelby tubes are disposable samplers that are used for sample collection and transportation and typically for testing as well.

FIELD INVESTIGATION DATA RECORD TERRAPROBE SOIL/WATER SYSTEM INFORMATION

Project ______________________________

Point of Interest ______________________________

Sample ID	Matrix	Date	Time	Depth	Collection Method
	❑ Water ❑ Soil ❑ Sediment			❑ Inches ❑ Feet	❑ Soil Probe ❑ Surface Soil ❑ Bail for Water

Observations (Texture, Color, Odor, Etc.)

Sample Collected for:
❑ Laboratory Analysis
❑ Field Analysis

Sample ID	Matrix	Date	Time	Depth	Collection Method
	❑ Water ❑ Soil ❑ Sediment			❑ Inches ❑ Feet	❑ Soil Probe ❑ Surface Soil ❑ Bail for Water

Observations (Texture, Color, Odor, Etc.)

Sample Collected for:
❑ Laboratory Analysis
❑ Field Analysis

Sample ID	Matrix	Date	Time	Depth	Collection Method
	❑ Water ❑ Soil ❑ Sediment			❑ Inches ❑ Feet	❑ Soil Probe ❑ Surface Soil ❑ Bail for Water

Observations (Texture, Color, Odor, Etc.)

Sample Collected for:
❑ Laboratory Analysis
❑ Field Analysis

Sample ID	Matrix	Date	Time	Depth	Collection Method
	❑ Water ❑ Soil ❑ Sediment			❑ Inches ❑ Feet	❑ Soil Probe ❑ Surface Soil ❑ Bail for Water

Observations (Texture, Color, Odor, Etc.)

Sample Collected for:
❑ Laboratory Analysis
❑ Field Analysis

Signature ____________________ Date ____/____/____

FIGURE 4-7

EXAMPLE TERRAPROBE FIELD DATA RECORD

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Whenever possible, the Shelby tube will be forced into the soil by rapid, uninterrupted pushing. A heavy drop hammer will be used where pushing provides insufficient penetration. In both cases, care will be taken to minimize interruptions during sampler penetration and to eliminate rotation of the sampler. Total penetration should not exceed the net length of the sampler (i.e., the sampler should not be underdriven or overdriven).

To allow full development of adhesion and friction between the sample and the sample tube, it is helpful to wait 10 to 20 minutes before beginning sample withdrawal. The drill rods should be rotated through two or three full revolutions to separate the sample from the subsoil, immediately after which the sampler should be withdrawn slowly and smoothly.

The Shelby tube will be marked with the sample identification and date and with an indication of which end of the tube is the stratigraphic top. Aluminum foil will be placed against the soil at both ends of the tube; bubblewrap or other suitable cushioning material will be inserted between the foil and the end of the tube (if the sample does not entirely fill the tube), and plastic caps will be secured by tape over both ends of the tube. Wax seals may be used only if provisions are made to prevent contact between the wax and the soil. The samples will be kept upright at all times.

Shelby tube samples will be stored and transported in a framework that supports them in an upright position and cushions them from vibrations.

4.5.1.4 **Geotechnical Testing** Samples will be obtained from selected borings for geotechnical laboratory testing. The purpose of geotechnical testing will be to verify field soil classifications and to support the characterization of geologic units encountered during the field investigation. Specific tests may include Atterberg limits, particle size analysis, and visual-manual description of soils. This subsection describes sample collection and standard geotechnical testing to be performed.

The test methods to be used do not require "undisturbed" samples; therefore, special drilling procedures to limit sample disturbance will not be necessary. The primary method for obtaining geotechnical test samples will be with split spoons driven in accordance with the Standard Penetration Test procedure (see Paragraph 4.5.1.3). Shallow test pit sampling and/or other sampling techniques may also be employed. Immediately after opening the split spoon, an FID or PID reading will be obtained from the sample and recorded on the boring log. Following field identification and logging of the sample, a representative portion will be selected and placed in a clean, standard 12-ounce reference jar. A minimum sample size of 8 ounces will be obtained for all three types of geotechnical tests to be performed. A label will be fixed to the side of each jar that shows plainly, the project number, the boring and sample numbers, the depth of the sample below ground surface and the number of blows for each 6 inches of penetration or fraction thereof. FID or PID readings shall be obtained within the sample jar (head space), 1 to 2 hours after placement in the jar and recorded on the jar label and the boring log.

Soil jars will be tightly closed to minimize moisture loss and to protect from freezing. No other sample preservation requirements will be necessary. The samples will be shipped to the geotechnical laboratory with appropriate packing to prevent damage during shipment. Field boring logs will be sent to the laboratory along with the instructions for testing for each sample. Upon completion of the testing, the geotechnical laboratory will ship back to the consultant the unused or residual portions of the samples. The consultant will dispose of the residual material within one drill cutting drum used during the field investigation.

All geotechnical testing will be performed in accordance with ASTM standard procedures. Atterberg limit tests (ASTM D4318) will generally be performed on soils exhibiting some degree of plasticity (i.e., clays and silts). Particle size analyses (ASTM D422) will generally be performed on granular soils or soils with appreciable amounts of sand and gravel material. Visual soil classification will be performed on selected samples of cohesive and granular soils. The classifications will be performed in accordance with ASTM D2488, *Standard Practice for Description and Identification of Soils, Visual Manual Procedure* (ASTM, 1984). The determination of samples to be tested will be made in the field by the field geologist.

4.5.2 General Water Sampling Methodology The water sampling program at NTC, Orlando has been developed to define the location, nature, and concentration of contaminants in site surface water and groundwater. The location and distribution of contaminants at a given site are governed by many factors, including

- site operation or waste disposal practices,
- site design,
- site closure,
- waste characteristics,
- site topography and surface drainage,
- flow rate,
- climate, and
- site hydrogeology.

Development of a water sampling plan that will effectively reveal the distribution and magnitude of contamination at a specific site requires

- an assessment of the factors listed above,
- an evaluation of the methodology and results of any previous sampling and analysis program completed at the site, and
- a definition of the scope and objectives of the project.

4.5.2.1 Surface Water Sampling Surface water is defined as water that flows over or rests on land and is open to the atmosphere. Surface water samples may be collected from streams, ponds, lakes, and ditches at NTC, Orlando to determine the extent of contaminant migration via surface water and runoff. Sampling will begin at the location farthest downstream and proceed upstream.

Each surface water sample will be collected in the following manner.

1. The sampler will collect the sample from the surface water body by immersing a sample collection device, or sample bottle, below the surface of the water to avoid collecting floating debris. If the surface water sample is collected from a moving water body, the inverted collection container will be turned upright and pointed upstream. The sampling equipment and the individual collecting the sample should always be positioned downstream of the sampling location. For surface-water sampling from specific depths in the water column, samples will be collected using a Teflon™ bailer; a submersible pump and tubing; a specialized sampling device such as a Van Dorn, Kemmerer, or Nansen bottle; or other suitable device. Reusable samplers will be decontaminated with approved decontamination water before each successive sample is collected. The sample will be collected from a location in the water body that is, in the judgment of the sampler, well mixed and, therefore, representative of the water body. Water samples to be analyzed for dissolved inorganic compounds will be pumped through a 0.45-micron, high capacity, inline disposable filter.

2. The appropriate sample containers, as outlined in Section 4.2, will be directly filled from the sampling device if needed. Prepreserved containers will not be used as surface-water collection containers. If samples must be preserved, the preservative will be added to the container after the sample is collected. For VOC samples, free air bubbles adhering to the sides of the sample container will be removed prior to capping. If possible, VOC samples will be capped under water.

3. The sampler will measure the following parameters, if possible, in the water body, not the sample:

    - PID or FID reading, above the water;
    - temperature;
    - pH;
    - specific conductance; and
    - any other site-specific field measurements required.

    If direct measurement is not possible, the sampler will measure these parameters from water remaining in the sampling device or another sample bottle. This information will be recorded on the sample data record, sample labels will be completed, and COC procedures will be initiated.

4. The sampler will complete a Surface Water and Sediment Sample Field Data Record (Figure 4-8) or record the information in the bound field logbook.

At surface-water sampling locations where surface water may not be present at the time of sampling, sumps may be dug for collecting samples of shallow groundwater. Sumps will be dug by hand to below the water table, and the sumps will be left

SURFACE WATER AND SEDIMENT SAMPLE FIELD DATA RECORD

Project: ______________________ Site: ______________________

Project Number: ______________________ Date: ______________________

Sample Location ID: ______________________

Time: Start: __________ End: __________ Signature of Sampler: ______________________

SURFACE WATER INFORMATION

TYPE OF SURFACE WATER:
[ ] STREAM [ ] RIVER
[ ] POND/LAKE [ ] SEEP

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] HNO_3 SOLUTION
[ ] POTABLE WATER
[ ] NONE

WATER DEPTH AND SAMPLE LOCATION __________ (ft)

DEPTH OF SAMPLE FROM TOP OF WATER __________ (ft)

EQUIPMENT USED FOR COLLECTION:
[ ] NONE, GRAB INTO BOTTLE
[ ] BOMB SAMPLER
[ ] PUMP __________

VELOCITY MEASUREMENTS OBTAINED? [ ] YES, SEE FLOW MEASUREMENT DATA RECORD

TEMPERATURE __________ Deg. C. SPEC. COND. __________ μmhos/cm pH __________ Units DISS. O_2 __________ ppm

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID __________

SAMPLE LOCATION SKETCH:
[ ] YES
[ ] NO

METHOD USED:
[ ] WINKLER
[ ] PROBE

SEDIMENT INFORMATION

DEPTH OF SEDIMENT SAMPLE __________ (ft)

EQUIPMENT USED FOR COLLECTION:
[ ] GRAVITY CORER
[ ] S.S. SPLIT SPOON
[ ] DREDGE
[ ] HAND SPOON
[ ] ALUMINUM PANS
[ ] SS BUCKET
[ ] __________

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] HNO_3 SOLUTION
[ ] POTABLE WATER
[ ] NONE

TYPE OF SAMPLE COLLECTED:
[ ] DISCRETE
[ ] COMPOSITE

SEDIMENT TYPE:
[ ] CLAY
[ ] SAND
[ ] ORGANIC
[ ] GRAVEL

SAMPLE OBSERVATIONS:
[ ] ODOR __________
[ ] COLOR __________
[ ] __________

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID __________

SAMPLES COLLECTED

✓ IF REQUIRED AT THIS LOCATION	MATRIX: SURFACE WATER	MATRIX: SEDIMENT	✓ IF PRESERVED WITH ACID-BASE	VOLUME REQUIRED	✓ IF SAMPLE COLLECTED	SAMPLE BOTTLE IDS
[ ]	[ ]	[ ]	[ ]	______	[ ]	___/___/___/___
[ ]	[ ]	[ ]	[ ]	______	[ ]	___/___/___/___
[ ]	[ ]	[ ]	[ ]	______	[ ]	___/___/___/___
[ ]	[ ]	[ ]	[ ]	______	[ ]	___/___/___/___
[ ]	[ ]	[ ]	[ ]	______	[ ]	___/___/___/___
[ ]	[ ]	[ ]	[ ]	______	[ ]	___/___/___/___
[ ]	[ ]	[ ]	[ ]	______	[ ]	___/___/___/___

NOTES/SKETCH

FIGURE 4-8

EXAMPLE SURFACE WATER AND SEDIMENT SAMPLE FIELD DATA RECORD

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to stabilize for at least 24 hours before sample collection. During the period before sampling, the sumps will be covered to minimize the introduction of surface soil and debris. Samples will be collected by direct immersion of sample containers. If the sump is too deep for direct immersion, stainless-steel or Teflon™ sampling equipment may be used to collect and transfer the water to the sample containers. Digging tools and sampling equipment will be decontaminated prior to each use, as described in Section 4.3.

4.5.2.2 **Groundwater Sampling** The groundwater sampling of all monitoring wells (or, under special circumstances, well points) will be conducted to delineate the distribution of chemicals and to quantify, to the extent possible, the chemicals in the aquifer(s) underlying the POIs. The products of monitoring well sampling are as follows:

- groundwater samples from each well;
- measurements of specific conductance, temperature, turbidity, and pH; and
- depth to static water level at each new, and designated existing, well.

The purging-and-sampling techniques outlined below help to ensure the collection of representative groundwater samples.

Sampling Preparation Activities. Groundwater sampling equipment will be decontaminated prior to use in accordance with the procedures outlined in Section 4.3. Calibration of the sampling equipment will be in accordance with the manufacturers' suggested procedures and will be completed prior to each day's sampling activities. Daily instrument calibration data will be recorded on a Field Instrumentation Quality Assurance Record (Figure 4-9) or in the bound field logbook.

Groundwater samples will be collected from each monitoring well using one of the procedures described in the following paragraphs. Data generated during groundwater sampling will be recorded on the Groundwater Sample Field Data Record (Figure 4-10) or in the bound field logbook. Groundwater Sample Data Records will be submitted to the Navy upon completion of the written report.

Sampling of groundwater wells will proceed from the upgradient (background) wells to the downgradient (contaminated) wells as best as can be determined, based on existing data.

Prepurging Activities. The following activities will be performed immediately prior to purging each well. These activities will be conducted regardless of the sampling method used.

1. Check the well for proper identification and location.
2. Measure and record the height of protective casing.
3. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using the FID or PID. If the ambient air quality at breathing level reaches 5 ppm, the sampler will use the appropriate safety equipment as described in the HASP.

FIELD INSTRUMENTATION & MATERIAL QUALITY ASSURANCE RECORD

Project ______________ Site ____

Project No. ____________ Sampler Signature ______________________________________

Date ______________

Field Instrumentation Calibration Data

Equipment Type/I.D.	Battery Condition	Calibration Information
______________________	________	pH 4 ____ pH 7 ____ pH 10____
______________________	________	pH 4 ____ pH 7 ____ pH 10____
______________________	________	pH 4 ____ pH 7 ____ pH 10____
______________________	________	Cond. Std. _____/_____ Cond. Std. _____/_____
______________________	________	Cond. Std. _____/_____ Cond. Std. _____/_____
______________________	________	Cond. Std. _____/_____ Cond. Std. _____/_____
Dissolved Oxygen		
____________________	_______	Avg. Winkler Value_____ ppm Meter Value_____ppm
Redox		
____________________	_______	Zobell Sol. Value _____ Meter Value____
Photoionization Meter		
____________________	_______	Zero/Zero Air? ☐Yes ☐No Span Gas Value___ ppm Equiv. Meter Value ___ ppm Equiv.
____________________	_______	Zero/Zero Air? ☐Yes ☐No Span Gas Value___ ppm Equiv. Meter Value ___ ppm Equiv.
Other		
____________________	_____	____

Fluids/Materials Record

Deionized Water Source: ____ ABB Staging Portable System Other

Trip Blank Water Source: ____ ABB Lab; Lot No.________

____ Other; Type____________________ ID________

Decontamination Fluids: ___ Methyl Hydrate; Lot No.____________

___ Other; Type____________________ ID________

HNO_3/DI Rinse Solution: ___ ABB Staging; Lot No.______________

Filtration Paper ID: (In Line) Manuf/Type ____________________ Lot No. _________ / _________

(Vacuum) Manuf/Type ____________________ Lot No. _________ / _________

Chemicals Used: HNO_3 Lot No. __________________ ZnAOC Lot No.__________________

H_2SO_4 Lot No. __________________ Other Lot No.__________________

HCL Lot No. __________________ Other Lot No.__________________

NaOH Lot No. __________________

FIGURE 4-9

EXAMPLE FIELD INSTRUMENTATION AND MATERIAL QUALITY RECORD

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GROUNDWATER SAMPLE FIELD DATA

Project:______________________ Point of Interest:______________________
Project Number:______________________ Date:______________________
Sample Location ID:______________________
Time: Start: ____________ End: ____________ Signature of Sampler:______________________

Water Level/Well Data

Well Depth ______ Ft. ___ Measured ___ Historical ___ Top of Well ___ Top of Protective Casing ___ ______

Well Riser Stick-up ______ Ft. (from ground)

Protective ______ Ft. Casing/Well Difference

Protective ______ Ft. Casing

Depth to Water ______ Ft.

Well Material: ___ PVC ___ SS ______

Well Locked?: ___ Yes ___ No

Well Dia. ___ 2 inch ___ 4 inch ___ 6 inch ___ ______

Water Level Equip. Used: ___ Elect. Cond. Probe ___ Float Activated ___ Press. Transducer ___ ______

Height of Water Column ______ Ft. X ___ .16 Gal/Ft. (2 in.) ___ .65 Gal/Ft. (4 in.) ___ 1.5 Gal/Ft. (6 in.) ___ ___ Gal/Ft. (__ in.) = [______ Gal/Vol ______ Total Gal Purged]

Well Integrity:	Yes	No
Prot. Casing Secure	___	___
Concrete Collar Intact	___	___
Other ______	___	___

Equipment Documentation

Purging/Sampling Equipment Used:

(✓ If Used For)

Purging	Sampling		Equipment ID
___	___	Peristaltic Pump	______
___	___	Submersible Pump	______
___	___	Bailer	______
___	___	PVC/Silicon Tubing	______
___	___	Teflon/Silicon Tubing	______
___	___	Airlift	______
___	___	Hand Pump	______
___	___	In-line Filter	______
___	___	Press/Vac Filter	______
___	___		______

Decontamination Fluids Used:

(✓ All That Apply at Location)

- ___ Methanol (100%)
- ___ 25% Methanol/75% ASTM Type II water
- ___ Deionized Water
- ___ Liquinox Solution
- ___ Hexane
- ___ HNO_3/D.I. Water Solution
- ___ Potable Water
- ___ None
- ___ ______
- ___ ______

Field Analysis Data

Ambient Air VOC ______ ppm Well Mouth ______ ppm Field Data Collected ___ In-line ___ In Container

Sample Observations: ___ Turbid ___ Colored ___ Clear ___ Odor ___ Cloudy

Purge Data	@ ______ Gal.	@ ______ Gal.	@ ______ Gal.	@ ______ Gal.	@ ______ Gal.
Temperature, Deg. C					
pH, units					
Specific Conductivity (umhos/cm. @ 25 Deg. C)					
Oxidation - Reduction, +/- mv					
Dissolved Oxygen, ppm					

Sample Collection Requirements
(✓ If Required at this Location)

Analytical Parameter	✓ If Field Filtered	Preservation Method	Volume Required	✓ If Sample Collected	Sample Bottle IDs
VOA	___	HCL	______	___	___/___/___/___
SVOA	___	4OC	______	___	___/___/___/___
Pest/PCB	___	4OC	______	___	___/___/___/___
Inorganics	___	HNO_3	______	___	___/___/___/___
Explosives	___	4°C	______	___	___/___/___/___
TPH	___	H_2SO_4	______	___	___/___/___/___
TOC	___	H_2SO_4	______	___	___/___/___/___
Nitrate	___	H_2SO_4	______	___	

Notes: ______________________

FIGURE 4-10

EXAMPLE GROUNDWATER SAMPLE FIELD DATA RECORD

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4. Measure and record the distance between the top of the well casing and the top of the protective casing.

5. Using the electronic water-level meter, measure and record the static water level from the reference point to an accuracy of 0.01 foot. Upon removing the water-level wire, rinse it with water from an approved water source.

6. Inspect the well head for any signs of forced entry, which could invalidate the sampling data.

Groundwater purging and sampling may be completed using one of several methods. Two methods, referred to herein as the standard method and the low-flow method, are described below. The standard method has been widely used and accepted for many years. The low-flow method has developed out of a decade of research supported by USEPA and others (e.g., Puls and Powell, 1992), which indicates that excess disturbance of formation water during well purging and sampling potentially compromises data quality. Use of a low-flow purge and sample method is becoming increasingly commonplace and has been adopted as a standard procedure by some regulatory agencies (e.g., USEPA, 1994). Both sampling and purging methods are described below. Selection of a groundwater sampling method will be made on a case-by-case basis and specified in the appropriate workplans.

Purging and Sample Collection, Standard Method. Wells will be purged prior to sampling of groundwater to remove stagnant water so that a representative sample can be collected. The following steps outline the purging and sample collection activities using pumps and bailers.

1. The sampler will calculate the volume to be purged, assuming a total of 3 to 5 well volumes. Well volume includes the volume of standing water in the well, plus the volume of water in the filter pack (assume 30 percent porosity).

2. In all shallow water table wells, the sampler will lower a submersible pump intake to just below the top of the water column and begin purging 3 to 5 well volumes. The pump intake will not be lowered below the top of the well screen. If the well screen is dewatered, air may enter the formation, altering the chemistry of the aquifer.

3. In all deep aquifer wells, the sampler will place the pump intake at the static water level and begin purging 3 to 5 well volumes. The pump intake will not be lowered below the top of the well screen. In both water table and deep aquifer wells, low permeability formations may require the pumping rate to be reduced to allow continuous pumping. In this situation, the pumping rate will be reduced to allow the 5-volume purge without depressing the water level drastically. If the pumped flow rate drops below 1 gallon per minute, modifications to the standard purging procedures may be necessary.

4. Purging is considered complete when 3 to 5 well volumes have been purged and when the *in situ* parameters (pH, specific conductance, turbidity, and temperature) vary by less than approximately 10 percent. For wells in low permeability locations (i.e., less than 1 gallon per minute recharge), the well will be purged of 1 volume and then sampled.

Purging of less than 5 volumes, and sampling before stabilization of *in situ* parameters, will only be done with prior approval of the ABB-ES onsite geologist or if the well purges dry.

5. The sampler will record the *in situ* parameters (pH, specific conductance, turbidity, and temperature), once for every volume purged, on a Groundwater Sample Field Data Record (Figure 4-10) or in the bound field logbook. Redox potential may be monitored and recorded at the completion of purging activities.

6. After purging and pump removal, the sampler will lower a Teflon™, stainless-steel, or polypropylene bailer to the middle of the screened interval or midpoint of the static water level.

7. The sampler will collect the sample(s) in appropriate containers as listed in Section 4.2. Samples will be placed directly from the bailer into the appropriate containers. VOC sample containers will be filled with as little agitation as possible. Water samples to be analyzed for dissolved inorganic compounds will be pumped through a 0.45-micron, high capacity, inline disposable filter. Sample preservation methods are discussed in Section 4.2.

8. The pump assembly and bailer will be removed from the well.

9. Using the electronic water-level meter, measure and record the static water level from the reference point and the depth of the well to an accuracy of 0.01 foot. Rinse the water-level wire with water from an approved source.

10. The sampler will record sampling data on a Groundwater Sample Field Data Record (Figure 4-10) or the bound field logbook.

11. The well cap and lock will be secured.

12. Pumps and discharge lines used to purge the monitoring wells will be decontaminated between wells, as described in Section 4.3.

Purging and Sample Collection, Low-Flow Method. Collection of groundwater samples from monitoring wells is required to characterize the nature and extent of contamination. Because of concerns about turbidity in the wells and the effects on metals sampling results, the low-flow purge and sample method may be used. This method is required for purging temporary monitoring wells.

The low-flow method creates less disturbance and agitation in the formation; therefore, excess turbidity is not generated during the purging and sampling process. The result is a more rapid stabilization of turbidity and other parameters (pH, temperature, specific conductivity, DO, and Eh) and a sample more representative of conditions in the formation is collected. This method is considered most appropriate for wells with moderate to high recharge rates.

The low-flow purge and sample method consists using a submersible or peristaltic pump to purge the well at a very low flow rate (less than 1 liter per minute [ℓ/min]). The pump intake is set approximately in the middle of the well screen, with a stagnant water column over the top of the pump. The well is purged at the low-flow rate until the field parameters (temperature, pH, specific conductance, turbidity, DO, and Eh) have stabilized. The sample is then collected using the peristaltic pump/vacuum jug technique (USEPA, 1996). The following steps outline the purging and sampling activities. Refer to Paragraph 4.4.6.6 for purging and sampling methods for temporary wells.

1. The sampler will attach and secure the 0.25-inch OD Teflon™-lined polyethylene tubing to the adjustable flow-rate submersible or peristaltic pump. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties placed approximately 5 feet apart, as necessary.

2. The pump should be set at approximately the middle of the screen. Be careful not to place the pump intake less than 2 feet above the bottom of the well because this may cause mobilization of any sediment present in the bottom of the well. Start pumping the well at less than 1 ℓ/min. If purging a temporary well, begin pumping with the tubing set at the bottom of the well and slowly raise through the water column.

3. The water level in the well should be monitored during pumping and, ideally, the pump rate should equal the well recharge rate with little or no water-level drawdown in the well (the water level should stabilize for the pumping rate). There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken or entrainment of air in the sample. Record the pumping rate adjustments and depth(s) to water in the logbook. If the recharge rate of the well is very low and the well is purged dry, then wait until the well has recharged to a sufficient level and collect the appropriate volume of sample with the pump, or use standard purge-and-sample techniques.

4. The well should be purged at a low-flow rate (ideally, less than 1 ℓ/min). During purging, monitor the field parameters (temperature, pH, turbidity, specific conductance, DO, and Eh) approximately every 3 to 5 minutes (or as often as practical) until the parameters have stabilized to within 10 percent (plus or minus 5 percent) over a minimum of three readings. Turbidity and DO are typically the last parameters to stabilize. Note: once turbidity readings get below 7 nephelometric turbidity units (NTUs), then the stabilization range can be amended to 20 percent (plus or minus 10 percent) over a minimum of three readings.

5. The sampler will record the *in situ* parameters (pH, temperature, specific conductance, turbidity, DO, and Eh), along with the corresponding volume purged, on a Groundwater Sample Field Data Record (Figure 4-10) or in a bound field logbook.

6. Once the field parameters have stabilized, the sampler will collect the samples using the peristaltic pump/vacuum jug technique (USEPA, 1996). Sampling protocols for some natural attenuation parameters (e.g., hydrogen) require the use of a bladder pump in place of the peristaltic. Refer to site-specific workplans for appropriate equipment. The bottles should be preserved and filled according to the procedures specified in Section 4.2. All sample bottles should be filled by allowing the water to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled. Volatiles and analytes that degrade by aeration must be

collected first. Volatile samples will be collected by shutting off the pump, disconnecting the tubing, holding a thumb over the end of the tubing, and withdrawing the tubing from the well. The sample containers will be filled by removing the thumb and allowing groundwater to flow, by gravity, into the containers containing preservatives.

The vacuum jug assembly allows for sample collection without the sample coming into contact with the pump tubing. The vacuum assembly is created by using a new, standard-cleaned 2.5-liter or 1-gallon amber glass bottle fitted with a rubber stopper. The rubber stopper (number 5 size for a 2.5-liter bottle) is wrapped in a Teflon™ swatch and placed in the bottle mouth. Two 0.25-inch OD Teflon™ tubing lengths are fitted into holes in the stopper. One length of tubing is connected to the peristaltic pump, and the other to the monitoring well, set at the screen midpoint. When the pump is turned on, a vacuum is created in the jug, and groundwater is slowly drawn in. When the jug is full, or sufficient volume is collected to fill all sample containers, the pump is turned off. Remove the stopper assembly from the jug, and decant the water directly into sample containers as necessary. Reassemble the jug if additional sample is needed. A new jug should be used for each well to be sampled.

7. Filtered samples should be collected for approximately 10 percent of the wells sampled using the low-flow method for which metals analyses will be conducted. The remaining wells will only have unfiltered metals samples analyzed. Samples for TSS analysis are also recommended, especially for temporary wells. The filtered metals samples will be collected by pumping the sample through a high-capacity, 0.45 micron, inline filter installed between the jug and the well and collecting the filtrate in the jug. Document all field procedures used and any pertinent field observations.

8. Samples will be preserved, labeled, and placed immediately into a cooler and maintained at 4 degrees Celsius (°C) throughout the sampling and transportation period. Samples should be labeled, recorded on the COC, and shipped according to the procedures specified elsewhere in Chapter 4.0.

9. The pump assembly should be carefully removed from the well. The Teflon™-lined polyethylene tubing will be dedicated to each well, wherever possible. The tubing should be returned to the well casing following each sampling event. The pump and discharge lines will be decontaminated between wells as described in Section 4.3.

10. The sampler will measure and record the static water level from the reference point and the total depth of the well, using an electronic water level meter. Rinse the water-level wire with water from an approved source.

11. The sampler will record all sampling information on a Groundwater Sampling Record (Figure 4-10) or in a bound field logbook.

12. The sampler will secure the well cap and lock.

__4.5.3 General Sediment Sampling Methodology__ Sediment samples will generally be collected in conjunction with surface water samples to help define partitioning of chemicals between the sediment and water. The shape, flow pattern, bathymetry, and water circulation patterns must all be considered when selecting sediment sampling sites. Sediment samples will be preferentially collected from depositional areas, rather than areas with net erosional losses. In areas with moving water, sediments will be collected from downstream locations prior to upstream locations.

All sediment sample locations will be noted on a base plan or aerial photograph and marked in the field with flagging and a 4-foot wooden stake or temporary buoy. The stake will be labeled with an identification number.

When both water and sediment samples are to be collected at a given sampling location, the water samples will be collected prior to the sediment sample. The sediment samples will be collected in the following manner.

1. The sampler will select the sample location, identify it on a site map or aerial photograph, and set the wooden stake, as close as practicable, onshore. For offshore sampling locations, temporary buoys may be set. Sample locations will also be recorded using GPS. Sediment samples will be collected from depositional areas.

2. Sampling devices include scoop samplers, core samplers, gravity corers, and dredge samplers. A gravity corer, stainless-steel spoon, or dredge will generally be used to collect river, lake, and pond samples. If the water is shallow enough, the gravity corer will be pushed directly into the substrate until approximately 1 inch (2.5 centimeters) or less of the core is above the sediment-water interface. If the substrate is hard or coarse, the corer will be gently rotated while it is pushed to facilitate greater penetration, and reduce core compaction. The corer or spoon will be gently removed from the sediment to avoid losing the sample, and raised to the surface so the sample may be retrieved. Dredges will generally be used when samples cannot be obtained with coring devices. Three major types of dredges may be used at NTC, Orlando: Peterson, Ekman, and Ponar dredges.

3. Alternatively, sediment samples under shallow water may be collected as follows. If the location is accessible by foot, samples may be collected using a 2-inch ID polyethylene terephthalate-sleeved stainless-steel sediment corer. The corer may be manually pushed or hammer-driven to the appropriate sampling depth. The corer is then retrieved, and the polyethylene terephthalate sleeve is removed, capped on both ends, and labeled.

4. For collection of sediment samples beneath deep water and/or where recovery of sediment and substrate is intended, a vibratory coring system may be employed from a boat or floating platform. The system will use a high frequency vibratory drive. Sediment-substrate core will be collected in a core tube with a butyrate, acrylic, or polyethylene liner. The sediment core and liner will be removed from the core tube and will be logged by a geologist on a Sediment Core Log (Figure 4-11) or the bound field logbook.

5. For water depths less than 6 feet, a 3-inch-diameter, stainless-steel sleeve sampler may also be used. The sampler is attached to extendable stainless-steel rods and lowered from a boat to the sediment surface.

SEDIMENT CORE LOG

Client:	No.	Point of Interest:
		Site ID:
		Protection:
Contractor:	Date Started:	Completed:
Method:	Core Tube Size:	PI Meter:
Logged by:	Checked by:	Total Depth:
		Page of:

DEPTH (FT)	REFERENCE SAMPLE NUMBER	SAMPLE DEPTH	RECOVERY	PID (ppm)	SEDIMENT DESCRIPTION	SOIL CLASS

FIGURE 4-11

EXAMPLE SEDIMENT CORE LOG

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A slidehammer is used to drive the sampler to the appropriate depth. Following withdrawal of the sampler, the sleeve is removed, capped, and labeled.

For waters greater than 6 feet deep, the 3-inch sampler is unwieldy, so a 1.5-inch-diameter, sleeved sampler may be substituted. The remainder of the procedure is the same as above.

6. Sediment sampling information will be recorded on a Surface Water and Sediment Field Data Record and COC procedures will be initiated (Figure 4-9).

A minimum of 500 grams of sediment will be collected at each location for chemical analysis. Sediment samples will be collected from the saturated zone using a stainless-steel spoon or auger. Digging tools and sampling equipment will be decontaminated prior to each use, as described in Subsection 4.3.3.

4.5.4 Aquatic Macroinvertebrate Sampling Sampling of aquatic macroinvertebrates is conducted to determine the presence or absence, population density, and taxonomic diversity of macroinvertebrate fauna; to perform statistical community analysis; to evaluate bioaccumulation and bioconcentration of contaminants; and to correlate macroinvertebrate community characteristics with concentrations of contaminants found in sediments.

To meaningfully evaluate biological conditions, sampling stations will be selected in comparable habitats (similar water depth and movement, substrate composition, and canopy coverage). Otherwise, community differences resulting from dissimilar physical habitats may be incorrectly attributed to biological degradation from chemical impact.

Typically, at each sampling station, sample(s) will be collected from vegetation (phytomacrofauna) and from sediment (benthic infauna). Samples will be collected in standardized unit areas that are clearly marked immediately prior to the commencement of sampling.

Many methods are available to obtain macroinvertebrate samples. Sampling devices include hand-held corers, dip-nets, grab samplers, dredges, and artificial substrates. Phytomacrofauna will typically be collected from the water column and from submerged macrophytes with D-frame aquatic dip nets (~600 microns) by sweeping the entire marked water column both vertically and horizontally. The contents of the dip net will be washed into a number 30 USGS brass sieve. Plant matter and other debris will be discarded after removing any attached invertebrates. Material not passing through the sieve will be placed in labeled jars containing approximately 70 percent ethanol.

Benthic organisms will typically be collected, using an Eckman dredge or similar sampling device, from sampling stations with silt, muck, or sludge substrates. The dredge contents will be washed through a number 30 USGS brass sieve.

Macroinvertebrates and smaller debris not passing through the sieve will be placed in labeled jars containing approximately 70 percent ethanol. If necessary, the 70 percent ethanol preservative will be replaced with fresh preservative to avoid dilution.

For each sampling station, the physical attributes of the aquatic habitat (including nature of the substrate and vegetative characteristics) and water quality parameters (DO, temperature, pH, and conductivity) will be recorded. When appropriate, voucher macroinvertebrates specimens will be retained for taxonomic analysis.

4.5.5 Fish Sampling Fish sampling is conducted for ecological community analysis and for pathological analysis. Fish and fish-tissue sampling is also conducted to analyze whole fish and fish fillets for specified contaminants, as a basis for determining potential ecological and human health risks. Because fish are mobile organisms and contaminants in surface water bodies usually are nonpoint source, fish-sampling locations should represent regions or areas, rather than fixed points. Sampling can be conducted during the day and/or at night. Target species will be selected based on the nature of the water body and the following criteria: human fishery utilization, abundance, size, ecological importance, position in food chain, metabolism, and the ability to collect sufficient, duplicate, replicate, and/or laboratory QC samples.

It is often useful to use a variety of active and passive fishing techniques to minimize sample gear bias. Available techniques include electrofishing, seining, and trawling (active techniques), and gill netting and trap netting (passive techniques). The objective of electrofishing is to stun and immobilize the fish for collection. Electrofishing consists of sweeping sampling areas with a boat-mounted electroshocking unit (e.g., Coffelt VVP-15), using moderate current densities (amperes per square centimeter) that maximize the extent of the "stun" field while minimizing the "kill" and "escape" fields. Seine nets vary considerably in length and depth. Smaller seines are typically used for biological sampling in shallow waters, whereas larger seines are often used in ponds and lakes. Entire reaches of streams and shallows of ponds and lakes can be sampled with seine nets. Trawls are bag- or funnel-shaped nets that are towed through the water by one or more boats for straining fish from the water. They vary in size and can be designed for bottom, midwater, or surface sampling. Experimental gill nets are stationary, flat nets, suspended vertically in the water, with variable meshes that entangle passing fish as they try to withdraw. Trap nets are stationary, long, tapering mesh tubes or funnels, with mesh wings that channel and direct fish into the tube. Fish that reach the end of the tube are unable to turn around and swim out.

When appropriate, after collection, the fish will be identified to species, weighed to the nearest gram, and measured to the nearest millimeter. Fish will be checked for external pathological gross abnormalities (e.g., tumors, lesions, structural or bone defects) through an evaluation of the conditions of the lips, jaws, barbels (if and as applicable), eyes, right gill, fins, urogenital cavity, anus, body form, and body surfaces. Field processing will be minimized to avoid contamination (e.g., skinning, filleting, etc. will be performed as necessary in the laboratory).

When fish are collected for tissue analysis, after field classification and examination, fish will be placed in sealed bags, labeled, and shipped on ice to the laboratory via overnight courier. If necessary, separate workplans will be developed for fish sampling at NTC, Orlando.

4.6 FIELD LABORATORY ANALYSES. To develop screening information to aid in the placement and selection of boring, monitoring well, and sample locations, selected soil, sediment, soil vapor, and aqueous samples will be analyzed in the field to evaluate the extent of contamination. Field analyses will be conducted in accordance with the procedures and USEPA methods for field screening shown in Appendix B. The analytical method references are shown in Chapter 7.0, Analytical Procedures. Field screening analytical procedures will always be supported by sampling for laboratory analyses. An onsite field laboratory will be set up and used, as appropriate, for the analysis of VOCs, TPHs, PCBs, and inorganic analytes. VOCs from the headspace of soil and water samples will be measured in the field using a portable GC equipped with an ECD and or a PID. The GC target compounds at NTC, Orlando will be benzene; toluene; ethylbenzene; meta-, para-, and ortho-xylene; PCE; and TCE. The target list of VOCs may be modified according to compounds of interest at the individual POIs. Infrared spectroscopy will be used to measure TPH concentrations in soil and water samples using a modified version of USEPA Method 418.1. PCBs will be measured in soil according to the Draft USEPA Method 4020. The method is based on the use of immunoassay test kits. X-ray fluorescence will be used to measure concentrations of selected inorganics in soil and water samples.

Results of soil and sediment field analyses will be reported in micrograms per kilogram dry weight. Liquid results will be reported in $\mu g/\ell$.

Chemical Standards. Chemical standards will be purchased from Supelco, Inc.; Chem Service, Inc.; or an equivalent supplier. All chemical standard preparation records will be logged and coded in a project GC run logbook.

Standards Preparation. All standards will be prepared from neat solutions or prepared mixes. Stock standards will be made by diluting neat standards or prepared mixes with an appropriate solvent. For standards made from neat solutions, the compound density will be used to determine the quantity of neat compound to add to the solvent.

All calibration standards will be made by serial dilution from stock standards. The calibration standard concentrations will be determined by the expected range of contaminant concentrations.

4.6.1 Calibration Prior to analyzing samples, instrument operation conditions will be established and recorded in the instrument logbook or on an operation conditions record sheet. Standard calibration techniques will be used; a detailed description of external standard calibration is found in USEPA Method 8000 (USEPA, 1986).

Initial Calibration. At the initiation of each field program, a minimum three-point initial calibration curve will be prepared covering the desired concentration range of analyses for the site.

Quantitation of volatile organics may be calculated from a point to point calibration curve as described in USEPA Method 8000 (USEPA, 1986), but is not required. If the relative standard deviation of response factors is less than 30 percent for a given target analyte, linear regression may be used for determining the concentration detected in samples.

Continuing Calibration. Prior to sample analysis, a continuing calibration check standard will be analyzed at or near the mid-level each day. The target analytes must have percent differences (%D) of less than 30 percent when compared to the initial calibration.

Samples may be run only if no more than one compound per detector, or a total of 10 percent of the target compounds, exceed the %D criteria of 30 percent. If the above criteria are not met, a second standard will be analyzed. If the second standard is unacceptable, a new calibration curve will be prepared. Following analysis of an acceptable continuing calibration standard, samples can be analyzed for a period of 24 hours from the time of standard injection. Sample identifications for the continuing calibration standard will be entered into the instrument logbook.

Additional details and procedures concerning instrument calibration can be found in the SOPs and USEPA methods for field screening found in Appendix B.

Method Blanks. A method blank will be analyzed before samples are analyzed. Blanks will be analyzed using the same procedures as field samples. Method blanks will be deemed acceptable if no target compounds are present above the detection limits established for the instrument. Samples will not be analyzed until an acceptable method blank is run, demonstrating that the instrument is free of contamination.

Cleaning Blank. Blanks will be analyzed after any high-level sample, to ensure that carryover is not occurring. A high-level sample is defined as being five times higher than the highest calibration point. Blanks may be run more often based on the judgment of the field analyst.

4.6.2 Sample Preparation Sample preparation techniques have been adapted from protocols outlined in USEPA methods and are specified in the methods found in Appendix B. Methods have been modified for the purpose of field application where appropriate. Samples will be analyzed after instrument calibration and method blank analysis has been completed.

Soil Samples. Soil samples include subsurface soils, surface soils, or sediment samples. Concentrations in soil samples will be calculated based on the dry weight. Percent moisture adjustments will be made to the raw data results. An automatic moisture balance may be used to determine percent solid as per the manufacturers' instruction.

4.6.3 Target Compound Concentrations Calculations The concentration of target compounds detected in samples will be calculated using either point-to-point comparison to the initial calibration curve, or by linear regression (if the response factor is less than 30 percent).

4.6.4 Field Documentation Procedures A log of all GC analyses will be recorded in a bound notebook with sequentially numbered pages. A separate logbook will be maintained for each GC instrument used in the field. The logbook will record the concentrations for all calibration standards injected, sample run number, sample identification, date, standard preparation code, sample volume and /or weight, and any additional information particular to the injection.

After conclusion of the field effort, data will be storaged by the Consultant. Raw data include chromatograms and calibration records from all standard, blank, and sample analyses used in the field program.

4.6.5 Quality Control Procedures In addition to instrument calibration and continuing calibration checks, duplicates and matrix spike/matrix spike duplicate (MS/MSD) samples may be analyzed by field screening methods. The number and/or frequency of QA/QC samples will be determined and established on a POI-specific basis dependent on the DQOs required for that particular field measurement. A minimum of 5 percent of samples collected for DQO Level II analysis (field screening) will be split for Level IV DQO confirmation.

The following procedures will be implemented by the field chemist to ensure standardization of the operating procedures.

1. All appropriate standards will be preserved by storing them in a refrigerator or cooler.

2. If a continuing calibration standard does not meet requirements, then a second standard will be analyzed. If the second standard does not meet requirements, a new initial calibration will be required.

3. The field chemist will review each sample analysis chromatogram before analyzing the next sample. Target compound retention times will be compared to calibration standards and carryover potential will be evaluated.

4. Carryover target and nontarget analytes: cleaning blanks will be analyzed after samples containing high concentrations of target or non-target compounds until, in the judgment of the field analyst, carryover will not impact subsequent analytical runs.

Data from all sample analyses and relevant calibration and blank analyses will be documented in the project instrument run logbook.

4.7 SURFACE WATER HYDROLOGIC MEASUREMENTS. The following subsections describe the procedures used to obtain streamflow estimates and surface water elevation measurements.

4.7.1 Streamflow Estimates The flow of a stream or river may be calculated by measuring the water velocity and the stream channel cross-sectional area. This information is useful in evaluating sitewide surface water characteristics, and potentially, the relation of surface water hydrology to groundwater hydrology at the site. The transects used to generate velocity profiles will be selected such that no surface flow influx features or impediments (i.e., running outfalls, side channels, or bridge abutments) are located directly upstream of the profile line. The procedure for measuring streamflow and cross-sectional area follows standard USGS methods (Corbett, 1945) and is outlined briefly below.

1. Field personnel will select an appropriate stream reach, preferably straight-channeled, with no bars or upstream impediments or surface flow sources. The field personnel will identify marker points on

opposing stream banks that can be used for an elevation and location survey.

2. A tape will be stretched across the stream width and marked into 15 to 30 equal segments that will define the subsections. Segments will be numbered consecutively, starting with 1 at the left bank. Total channel width will also be measured and recorded.

3. Channel depth will be measured at the midpoint of each section. The midpoint verticals will be the point from which velocity measurements for each subsection will be made. Total depth times 0.6 will be the depth at which velocity measurements will be taken. (Controlled field studies have shown that 0.6 times total depth is the point at which the average stream velocity occurs.) It is assumed that the velocity sample at each vertical represents the mean velocity in a rectangular subsection. The subsection area extends laterally from half the distance from the preceding observation vertical to half the distance to the next, and vertically from the water surface to the measured depth. Measurements will be recorded to the nearest 0.01 foot on data sheets. A sample streamflow measurement data sheet is presented as Figure 4-12.

4. A mechanical current meter will be lowered to the measured depth and the meter will be left in place for 60 seconds. Meter counts will be recorded on the data sheet. Flow velocity will be interpreted using the calibration curve supplied by the manufacturer and recorded on the data sheet. At least two, preferably three, flow measurements will be collected at each transect.

5. Discharge (Q=VDW) will be calculated for each channel section using channel subsection area and mean flow velocity normal to each subsection. Total discharge for the profile is the sum of all subsections.

$$Q = \Sigma_{i=1}^{m} q_i \qquad (4)$$

where
Q = discharge (cubic feet per minute),
m = total number of segments, and
i = segment number.

The discharge for any subsection at vertical *i* is given by the equation:

$$qi = vi\left[\frac{b_{(i+1)} - b_{(i-1)}}{2}\right] di \qquad (5)$$

where
qi = discharge through subsection *i*,
vi = measured mean velocity at vertical *i*,
b(*i*-1) = distance from initial point to preceding vertical,
bi(*i*+1) = distance from initial point to next vertical, and
di = depth of water at vertical.

Stream Flow Measurements

TOTAL CHANNEL WIDTH (ft.):
TOTAL NO. SEGMENTS (M):
WIDTH/SEGMENT (w) (ft.):

DATE:
TIME IN:
TIME OUT:
TRANSECT LOCATION:
(Refer to site plan)

STATION (m)	DEPTH d (ft)	0.6d (ft)	TIME (sec)	CTS (sec)	MEAN VEL (v) (ft/s)	DISCH q = wdv	STATION (m)

SKETCH OF CHANNEL SECTION:
m=0 (left bank facing upstream)

PG _____ of _____

FIGURE 4-12

EXAMPLE STREAM FLOW MEASUREMENT DATA SHEET

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Direct flow measurements can also be obtained using V-notch weir plates and rectangular weir plates.

4.7.2 Surface Water Elevation Measurements Surface water elevation measurements will be taken at selected locations to augment groundwater elevation data generated during water-level measurement rounds. Because no permanent elevation monuments or staff gages will be erected, the following method will be used.

1. The surveyor will select a suitable surface water measurement location (i.e., near a sampling point, easily accessible, and quiet water).

2. A reference point onshore (e.g., tree, fencepost, or large boulder) will be marked and labeled by the surveying team for inclusion in the elevation survey. The reference point will be selected such that it, along with the water's edge, are readily visible from the surveyor's station.

3. The relative elevation of the reference point will be surveyed to the nearest 0.01 foot. The reference point elevation will be referenced to the National Geodetic Vertical Datum (NGVD).

4. The surface water elevation and the reference point will be shot from the same station.

4.8 AQUIFER CHARACTERIZATION. Aquifer testing will be conducted to characterize groundwater flow patterns and to assess aquifer characteristics.

4.8.1 Water Levels The depth to groundwater will be measured from a surveyor's mark on the well riser or, in the absence of such mark, from the highest point on the rim of the well casing or riser. Water-level measurements at the various wells will be obtained using an electronic water-level meter. The water level will be measured to the nearest 0.01 foot. The measured value will be checked by raising the probe 1 to 2 feet and remeasuring the water level to obtain a precise and accurate measurement. The probe end of the water-level meter will be properly decontaminated between monitoring wells.

The water-level elevations will be used to construct groundwater elevation contour maps, from which groundwater flow directions will be interpreted. Vertical hydraulic gradients can be calculated from water-level data at well pairs.

4.8.2 Hydraulic Conductivity Testing Permeability testing will be conducted in (1) all new monitoring wells representative of each sampling interval and (2) specific existing wells, as requested by the Navy. Permeability tests (or slug tests) are useful for calculating estimated groundwater flow parameters, for evaluating the heterogeneity of the aquifer, for identifying high permeability zones, and for determining the viability of various remedial options. Tests will be conducted using the following procedures. A PVC slug or compressed air will be used to displace water in the well for testing. Compressed air will be used only in wells screened below the water table, and care will be taken not to lower the water table to the depth of the screen.

Slug tests can be categorized into falling head and rising head tests. Falling head tests are typically performed by introducing a solid "slug" below the water level and measuring the rate of water-level decrease per time until equilibrium conditions are reached (i.e., the rate of recovery). Rising head tests are performed by withdrawing a solid "slug" and measuring the rate of recovery. The change in water level with time is measured manually with a water-level tape or electronically with an *In Situ* Hermit™ 1000B or 2000 Datalogger™ with 10- or 20-pound-per-square-inch transducers, or equivalent. Only rising head tests will be performed on water table wells (wells with screened zones extending above the water table). Rising and/or falling head tests will be performed on wells that are screened below the water table; however, rising head tests will be preferred.

By observing the behavior of the recovery as a function of time, an estimate of the hydraulic conductivity of aquifer materials surrounding the well can be calculated using the Hvorslev (1951) or Bouwer and Rice (1976) technique. The slug test data can also be analyzed using a method by Cooper, Bredehoeft, and Papadopulus (1967).

An Aquifer Test Completion Checklist (Figure 4-13) will be completed for each test conducted. In addition, a Field Permeability Test Data Sheet (Figure 4-14) will be completed for each test.

Should field conditions render hydraulic conductivity tests using slugs ineffective, the following alternate method will be used. A submersible pump will be used to remove water from the well. The discharge rate will be measured and recorded. Two to three separate discharge rates will be selected to adequately stress the aquifer. Changes in water levels will be measured as a function of time during both pumping and recovery. By observing the behavior of the drawdown, discharge, and recovery as a function of time, an estimate of the hydraulic conductivity of the aquifer will be made.

<u>4.8.3 Groundwater Pumping Tests</u> Pumping tests are employed to measure hydraulic characteristics (transmissivity and storativity) over a large aquifer volume. They also can determine the area of influence of a pumping well and the location of hydraulic boundaries. The test typically consists of pumping water from one well at a constant rate while measuring drawdown versus time in that well and in observation wells located at various distances from the pumping well. Measurements are made both during pumping and after pumping (to observe water-level recovery). Interpretations of the time-drawdown plots will be the basis for determining the specific aquifer characteristics.

Each planned pumping test will be designed to address the specific objectives of the test and to reflect anticipated site conditions. A detailed design will be included in each task-specific workplan.

<u>4.9 LOCATION AND ELEVATION SURVEY</u>. All final elevation and location surveys will be conducted by a Florida-registered professional land surveyor. Interim surveys may be conducted by ABB-ES personnel, provided existing survey points are used as benchmarks. Elevations will be referenced to the NGVD of 1929 and will be measured to an accuracy of 0.01 foot for monitoring well casings and 0.1 foot for ground surfaces. Horizontal locations will be recorded as State Planar coordinates to the nearest 0.1 foot.

AQUIFER TEST COMPLETION CHECKLIST

AQUIFER TEST NO. ______

SETUP	DATE	BY WHOM
MONITORING WELL ID		
DATE OF TEST		
TYPE OF TEST		
HERMIT TYPE/SERIAL#		
TEST #		
DATA COLLECTION RATE		
TRANSDUCER		
SERIAL #		
PSIG		
SCALE FACTOR		
OFFSET		
INPUT CHANNEL		
TEST DATA		
INPUT MODE (TOC/SUR)		
STATIC WATER LEVEL (FT./TOC)		
WELL DEPTH (FT./TOC)		
XD DEPTH (FT.TOC)		
INITIAL XD REFERENCE		
SLUG DEPTH (FT./TOC)		
TIME OF SLUG PLACEMENT		
TIME OF WL EQUILIBRATION		
NEW XD REFERENCE		
START TIME OF TEST		
END TIME OF TEST		
NOTES:		

FIGURE 4-13

EXAMPLE AQUIFER TEST COMPLETION CHECKLIST

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Field Permeability Test Data Sheet

Project No.	Project Name:	Well No.:
Performed by:	Date:	Type of Test:
Borehole Dia. (in.):	Well dia. I.D. (in.):	Total Test Time:
Depth to static water level (ft.):		Page ___ of ___

All Measurements Taken from Top of Riser

Time	Elapsed Time	Depth to Water	ΔH	Comments

FIGURE 4-14

FIELD PERMEABILITY TEST DATA SHEET

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The actual surveying techniques and the required equipment to be employed, and the required accuracy and precision, are dependant upon the field conditions and the nature of the sampling stations and/or techniques to be employed. Traditional level and rod techniques, global positioning system techniques, or fathometers may be used, as appropriate. All survey observations and measurements will be properly recorded by the designated member of the survey crew in bound field books, in accordance with the requirements of these guidelines.

Any calibrations performed upon surveying equipment in connection with this work will be properly documented with regard to personnel, date, instrument number, calibration readings, procedures and standards employed, adjustments made, comments and/or observations, etc.

All analyses employed in the reduction of field data, calculations, production of maps, etc., will follow commonly accepted professional survey practices that are appropriate for the task at hand, including all appropriate procedures for QC to check and review the work. Where a computer is used to reduce data, the program employed will have first been certified to yield repeatable results within the required limits of accuracy. All office calculations, data reduction, map making, etc., will be performed in a neat, sequential, and logical order to facilitate future review.

The installed locations of all benchmarks, baselines, and monuments will be appropriately documented on a base map to indicate their relative locations. Benchmarks will be described with respect to their construction and location, on map, in addition to their grid coordinates.

If required, final maps will be submitted as an original or Mylar™, in the specified map size. If one sheet is not sufficient, the mapped area may be divided into sections, one per sheet, and appropriate references and match lines provided. Maps will be of a suitable scale to show appropriate detail clearly. Although this varies with the size of the site mapped, appropriate map scales generally range from 1 inch equals 50 feet to 1 inch equals 200 feet. The scale used will be clearly shown on the map both graphically (e.g., bar scale) and numerically (e.g., 1 inch = 50 feet). Each map will also indicate a true north meridian, preferably oriented toward the top of the page, and will be provided with appropriate borders, legends, title boxes, notes, data references, and means of identifying author, checkers, etc.

The following paragraphs summarize specific surveying requirements appropriate to various sampling locales.

4.9.1 Borings and Test Pits Horizontal locations and ground surface elevations for borings and test pits are indicated on boring and test pit logs and may be used to construct geologic sections or profiles. Horizontal locations will be staked to the nearest foot, and ground surface elevations measured to 0.1 foot. The surveyors may stake the location in advance, indicating the boring number, grid coordinates and ground-surface elevation on the stake. They will also have one or more tall witness stakes with colored flagging around the staked location to make it more readily visible. In paved areas, it is usually more convenient to spray paint the location and other information directly on the paving. A greater degree of layout accuracy may be required in confined areas, where the drilling or excavation must be performed carefully to avoid disturbance of underground facilities (i.e., utilities, tunnels, foundations, etc.).

<u>4.9.2 Monitoring and Pumping Wells and Piezometers</u> In general, horizontal location, well riser elevation, and ground surface elevation criteria for wells and piezometers are similar to those of test pits or borings. However, the surveyor will measure and mark the elevation of the top of the riser to 0.01 foot because this point will be used as a reference to measure precise groundwater elevations. The riser elevation will be noted, and also permanently recorded directly on the outer protective casing, if possible. The well location and ground surface elevation may be surveyed either before or after well installation, but the riser (i.e., top of casing) and outer protective casing (optional) elevations must always be surveyed afterward. For monitoring wells, pumping wells, and piezometers, a permanent mark will be made on the riser, protective casing, or other point of reference both for surveying purposes and to enable reproducible depth-to-water measurements.

<u>4.9.3 Surface Water and Sediment Sampling</u> When grab samples are obtained from the edges of surface water bodies, the samplers will install a location stake at the shoreline marked with the station number and coordinates, if appropriate. This stake may also be used as a reference point for measuring the water surface elevation (to an accuracy of the nearest 0.01 foot). In certain cases, this may not be required, because the sampler can estimate and mark the appropriate location and elevation directly on a site topographic map. Such locations do not require great locational accuracy (within several feet), because they are usually only indicated graphically on the site map.

When samples are to be taken within the surface water body away from the shoreline, better horizontal control is usually required. Sampling locations will be determined by the sampler using onshore baselines or ranges.

<u>4.9.4 Surface Soil and Waste Sampling</u> Measurement and layout requirements for obtaining a single grab sample of soil or waste are comparable to those for obtaining surface water grab samples from the shoreline. Where a composited sample is to be collected from a sampling grid, the surveyors will stake out the grid and indicate the station number(s), coordinates or orientation of the grid, and ground elevation(s) on the stakes. Generally, a precision of no better than the nearest foot for location, and 0.1 foot for elevation will suffice from grab or grid surface sampling.

<u>4.10 CONTROL AND DISPOSAL OF IDW</u>. As part of the field activities, a certain amount of IDW material will be generated in association with personal protection, sample handling, multimedia sampling, soil boring, well installation, well development, well purging, and decontamination. Every effort will be made to minimize the IDW generated and to dispose of the material in the most appropriate, cost-effective manner. The majority of material generated by investigation activities will be uncontaminated or below applicable disposal limits; however, some material will come in contact with, or be composed of contaminated media, which may require pretreatment or off-site disposal.

The IDW will be segregated by medium (i.e., solids or liquids) and by location (i.e., boring, well, study area) into storage containers (generally, Department of Transportation [DOT]-approved 55-gallon drums). Labels will be attached to the storage containers that describe the content of the specific container, the POI or Study Area of origin, the specific exploration location, and the date of generation. The storage containers will be segregated by POI or Study Area of origin. The storage container pallets will be arranged so as to allow access between them for inspection. A logbook will be maintained with the preceding information recorded in it, as well as a sketch map of the storage areas. The IDW storage area will be designated by the Navy. To avoid transporting IDW on public roads, each discrete NTC, Orlando facility will have one or more designated storage areas. Quarterly inspections of the IDW storage areas will be conducted to confirm that all requirements are being met and that the integrity of all storage containers remains uncompromised.

Liquid IDW will come from three sources: (1) groundwater generated from sampling and purging of new and existing monitoring wells, (2) water generated during equipment and personnel decontamination procedures, and (3) drilling fluids. Laboratory analysis of groundwater samples from the representative monitoring wells will be used to determine if the liquid IDW is acceptable to the City of Orlando for disposal to the onsite sewer systems. If representative groundwater samples have been collected and submitted for laboratory analysis of site-specific compounds, those results will be submitted to determine disposal options. If no representative groundwater samples are available, or if the IDW source is decontamination fluid, a sample from each drum will be analyzed for VOCs using the onsite GC.

Analytical results, either from the contract laboratory (Level III or IV data) or from the field GC (Level II data), will be submitted to the City of Orlando for approval, on a drum-by-drum basis, to dispose of the IDW in the onsite sewer system. Once approval for disposal via the sewers is received, the City and Public Works Center (PWC) Orlando are notified of the date, location, and approximate amount of liquid to be disposed of. A designated drain at each separate facility at NTC, Orlando has been designated for IDW disposal to minimize the handling and transportation of the containers. If the City of Orlando rejects a specific container or group of containers, a determination will be made whether some pretreatment (e.g., carbon stripping) will render the material suitable for on-site disposal or whether off-site disposal will be necessary.

Solid IDW will be generated from three sources: (1) soil from the advancement of soil borings, (2) the drilling of monitoring wells, and (3) personal protective equipment (PPE) and other disposable items (e.g., plastic sheeting, paper towels). All solid IDW generated from drilling or soil boring activities will be containerized as described above. PPE or other disposable materials may be double-bagged in plastic trash bags and disposed of in onsite dumpsters. If heavily soiled, the PPE or disposable equipment may be rinsed first, with the rinsate collected and treated as liquid IDW, as described above. The rinsed items can then be bagged and disposed of in a dumpster.

Other solid IDW (i.e., soil and drill spoils) will be managed as follows. Solid IDW will be collected at the site of generation and containerized by location. If soils are known to be contaminated, based on previous investigation results, or by physical evidence, every attempt will be made to segregate them from uncharacterized or potentially clean material. Soils from more than one exploration location within a POI or Study Area may be combined in a container to minimize the number of containers generated. Under no circumstances will IDW from different areas be combined prior to characterization. As described in Subsection 4.4.6, as soil borings are advanced, split-spoon samples may be collected and submitted for laboratory analysis (Level III or IV data) of specific contaminants of concern. For boreholes that extend below the water table, groundwater samples may also be collected and submitted for analysis. These analytical results may be used to determine the classification of the IDW generated from that boring. For subsurface exploration locations where soil samples are not collected for laboratory analysis, the IDW will be containerized and then a composite sample will be collected to represent all IDW from a single location (the composite may be from several locations within one drum or include soils from several drums). The composite sample will be submitted for appropriate analyses, based on contaminants of concern at the area of investigation to determine disposal methods, as outlined below.

All solid IDW will be stored at the designated storage areas. After receipt of laboratory analytical results, the IDW storage containers will be labeled as non-hazardous, solid waste, or hazardous waste, using the criteria as outlined below. The results of the analyses from the solid samples will be used to determine the appropriate IDW disposal option. If the analytical results are less than NTC, Orlando background values (refer to Background Sampling Report, ABB-ES, 1995d) and less than TCLP threshold values, the corresponding IDW will be labeled as "non-hazardous." Nonhazardous solid IDW will be considered appropriate for disposal at the point of origin or transported elsewhere onbase for use as clean fill. If analytical results are greater than appropriate background values but less than TCLP threshold values, the IDW containers will be labeled as solid waste and the containers will be turned over to NTC Public Works personnel for disposal at a Subtitle D landfill or held for remediation with other contaminated soils from the same POI or Study Area. If the analytical results from the IDW exceed TCLP threshold values, the IDW containers will be labeled as hazardous waste, and the material turned over to NTC Public Works personnel for disposal at an approved hazardous waste facility.

A copy of all analytical results related to IDW will be kept on file at the ABB-ES Orlando office so that comparisons of the results and IDW classification may be made. Monthly summaries of the analytical results, comparisons to background, TCLP, or WWTP limit values, IDW classification and (proposed) disposal methods, and location maps will be provided to PWC Orlando for distribution to interested parties (e.g., City of Orlando), as necessary.

5.0 SAMPLE HANDLING AND CUSTODY PROCEDURES

This chapter describes a program of sample tracking and COC that is followed during sample handling activities in both field and laboratory operations. This program, which is compatible with USEPA Region IV EISOPQAM (USEPA, 1996) COC requirements, is designed to assure that each sample is accounted for at all times. To maintain this level of sample monitoring, sample container labels, shipping seal manifests, and COC forms are employed as necessary. Field data sheets and COC records are also completed by the appropriate sampling and laboratory personnel for each sample.

The objective of the sample custody identification and control system is to ensure that

- samples are uniquely identified;
- samples are collected for all scheduled analyses;
- the correct samples are analyzed for requested analyses and are traceable to their records;
- descriptions of important sample characteristics and field observations are recorded;
- samples are protected from loss and identified if damaged;
- alteration of samples (e.g., filtration and preservation) is documented;
- a forensic record of sample custody is established;
- sample security is maintained; and
- relevant field information is recorded including location, sample number, date and time, identification of field samples, and individuals collecting the samples.

5.1 FIELD CUSTODY. The field COC record is used to record the custody of all samples or other physical evidence collected and maintained by field personnel. The COC protocol followed by the sampling crews involves the following steps:

- documenting procedures used and reagents added to samples during sample preparation and preservation;
- recording sample locations, sample site identification, field sample number, and specific sample collection procedures on the appropriate forms;
- using sample labels that contain all information necessary for effective sample tracking; and

- completing standard field data record forms and/or maintaining a bound field logbook to establish sample custody in the field before sample shipment (see Chapter 4.0).

Prior to sampling, labels are developed for each sample to be collected. Each label is numbered to correspond with the appropriate sample(s) to be collected. Samples will be identified using an 8-digit sample identifier as described in Section 4.1. A summary of the labels prepared, with space for sample tracking and notations, will also be printed. This sample manifest assists sample control in the field and will eventually be retained as part of the project file. An example of a sample label and an example of a sample tracking form is shown on Figure 5-1. Additional information regarding sample tracking can be found in Section 8.5.

The COC record is used to document sample-handling information (i.e., sample location, sample identification, and number of containers corresponding to each sample number). The following information is recorded on the COC record:

- project reference;
- the site name, sample identification number, date of collection, time of collection, preservation, and sample type, number of containers, and sample matrix;
- the names of the sampler(s) and the person shipping the samples;
- serial number of custody seals and shipping cases;
- the date and time that the samples were delivered for shipping;
- analyses required; and
- the names of those responsible for receiving the samples at the laboratory.

An example of a COC is shown on Figure 5-2. Field sample data records, which also include pertinent data relative to COC procedures were presented in Chapter 4.0 (see Figures 4-5, 4-8, and 4-10). The COC is completed in triplicate. One copy accompanies the samples to the laboratory, another is kept by the sample crew chief and transferred to the Laboratory Quality Assurance Coordinator (QAC), and the last copy is maintained in the project file.

5.2 SAMPLE PACKING AND SHIPPING. Sample packaging and shipping procedures should protect the integrity of the samples and prevent detrimental effects from leakage or breakage. Regulations for packaging, marking, labeling, and shipping hazardous materials and wastes are promulgated by DOT and described in the CFR Parts 171 through 177; in particular Part 172.402h, Packages Containing Samples. In general, these regulations were not intended to hamper shipment of samples collected at controlled or uncontrolled hazardous waste sites or samples collected during emergency responses. However, the USEPA has agreed through a memorandum of agreement to package, mark, label, and ship samples observing DOT procedures. The information presented here is for general guidance.

SAMPLE ID.____________	COMMENTS
PROJECT No.____________	
DATE/TIME____________	
SAMPLE MATRIX____________	
SAMPLE SITE____________	
PRESERVATIVE____________	
FILTERED (Y/N)____________	
ANALYSIS____________	
SAMPLER____________	
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FIGURE 5-1

EXAMPLE SAMPLE LABEL

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CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME					NO. OF CON-TAINERS	SAMPLE TYPE											REMARKS INDICATE SOIL/WATER/AIR SEDIMENT/SLUDGE
SAMPLERS (SIGNATURE)																		
STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION													

RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)
RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)
RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED FOR DISPOSAL BY: (SIGNATURE)	DATE/TIME	REMARKS	

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FIGURE 5-2

EXAMPLE CHAIN OF CUSTODY RECORD

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Correct packaging, storing, and shipping of environmental samples are necessary to

- ensure samples remain sealed in original containers,
- prevent breakage,
- prevent cross-contamination of individual samples,
- ensure sample characteristics are preserved,
- prevent contamination to receiving personnel, and
- ensure samples are protected against tampering when not in sampler's possession.

Sample containers are generally packed in metal or hard plastic, insulated coolers for shipment. Bottles are packed tightly so that no motion is possible. Styrofoam, and "bubble pack" are used to protect bottles from breaking. Ziploc® bags containing ice are added to the cooler along with all paperwork. The paperwork (i.e., COC forms) is sealed in a separate Ziploc® bag. The cooler top is then taped shut and all openings are sealed with evidence tape.

The standard procedure followed for shipping environmental samples to the analytical laboratory is detailed below.

- Shipping of environmental samples collected by field personnel is done daily through Federal Express or equivalent overnight delivery service. Receipts are retained as a part of the COC documentation. When samples are relinquished to a shipping company for transport, the tracking number from the shipping bill or receipt will be recorded on the COC.

- Prior to leaving for the field, the Consultant's Field Operations Leader (FOL) will notify the Laboratory/Data Management Leader of the number, type, and approximate collection and shipment dates for the samples. If the number, type, or date of shipment changes due to program changes, the FOL must notify the Project TOM and Laboratory and Data Management Leader of the changes. This notification from the field also needs to occur when sample shipments will arrive on Saturdays. The FOL will coordinate sample pickup with the laboratory.

- If prompt shipping and laboratory receipt of the samples cannot be guaranteed (e.g., Sunday arrival), the samplers will be responsible for proper storage and custody of the samples until transportation or shipment arrangements can be made.

- The FOL will notify the appropriate laboratory when samples collected by field sampling teams are going to be shipped to the laboratory.

The Laboratory and Data Management Leader keeps the laboratory and the PM informed of all field sampling activities. This communication is critical to allow the laboratory enough time to prepare for the sample shipment arrival and to keep the PM current on the status of the sampling program.

During sampling, field samples will be brought to a central sample collection location. The COC will be initiated upon receipt of the samples and sample data records at the collection point. Once the COC form is initiated, when transferring possession of the samples, each transferee will sign and record the date and time on the COC record. Custody transfers, if made to a sample custodian in the field, will account for each individual sample, although samples are transferred as a group. Every person who takes custody will fill in the appropriate section of the COC record. To prevent undue proliferation of custody records, the number of custodians in the COC will be kept as small as possible.

5.3 LABORATORY CUSTODY. COC procedures are also necessary in the laboratory from the time of sample receipt to the time the sample is discarded. The field samples collected by the sampling team will be submitted to a NEESA-approved laboratory. The sample custody procedure will be detailed in the laboratory's Quality Assurance Project Plan (QAPP).

6.0 EQUIPMENT CALIBRATION AND PREVENTIVE MAINTENANCE

This chapter describes calibration protocols for laboratory services and field instruments that may be used at NTC, Orlando during field activities.

6.1 CALIBRATION PROCEDURES FOR LABORATORY EQUIPMENT. The procedures used for calibration of laboratory equipment are described in the analytical methods. The laboratory will keep records on the source of all standards used, and standards will be traceable to original sources. Check standards from a second source will be used to verify the accuracy of calibration standards.

6.2 CALIBRATION PROCEDURES AND FREQUENCY FOR FIELD INSTRUMENTS. Each piece of field sampling equipment requiring calibration will be calibrated prior to each day's use or as specified in the procedures included in Appendix B. As previously discussed in Chapter 4.0, data are recorded on a form shown as Figure 4-9. The procedures described in the following subsections apply to the specific instrument noted.

6.2.1 Salinity, Conductivity, and Temperature Meters A salinity, conductivity, and temperature meter consists of a temperature probe and a specific conductance meter.

Temperature Probe:

1. Using a thermometer whose calibration can be traced to a National Bureau of Standards-approved thermometer, immerse both probes into a beaker of water and note any differences for the field probe.

2. Recalibrate as necessary.

Specific Conductance Meter:

1. Calibrate meter and probe using the calibration control and the red-line on the meter dial.

2. Turn the function switch to read conductivity times 10 and then depress the cell test button, noting the deflection. If the needle falls more than 2 percent of the reading, clean the probe and retest.

3. Using at least two solutions of different ionic strength that will most likely bracket the expected values for conductivity, note accuracy of the probe and clean probe, if necessary.

6.2.2 Specific Ion Meter The Specific Ion Meter consists of an ion-specific electrode.

1. Place electrodes and buffer solutions in a water bath at the temperature of the water to be sampled. After temperature equilibrium, measure temperature and adjust the temperature compensation knob for this temperature.

2. If using refillable probes, remove electrode cap and check that filling solution is above the filling mark.

3. Immerse the probe in the pH 7 buffer solution and adjust the calibration control to read the appropriate pH. Check the pH buffer solution for correct pH value at the equilibrated temperature.

4. Remove the probe, rinse with distilled water, and immerse in either the pH 4 or pH 10 buffer solution, depending on the expected pH of the sample.

5. If the meter does not register the correct pH for that buffer solution, adjust the calibration knob on the back of the instrument to obtain the pH of the buffer.

6. After rinsing, insert the pH probe into the flow cell and allow the probe to come to equilibrium with the sample water.

7. Store the pH probe either in ambient air or a buffer solution overnight, according to the manufacturer's specifications.

6.2.3 Tripar Analyzer The Tripar Analyzer consists of a temperature sensor, a specific conductance sensor, and a pH sensor.

Temperature Calibration:

1. Temperature Zero Adjustment. Connect the temperature sensor and select temperature as the display parameter. Remove the rear access cover exposing the sensor calibration potentiometers.

   Prepare an ice water slurry and place the temperature sensor in the solution. Allow the temperature sensor to stabilize for approximately 1 minute while stirring the sensor in the solution vigorously. Using the adjustment tool provided in the rear cover, adjust the temperature "zero" potentiometer for a reading of 0.00°C on the system display.

2. Temperature Span Adjustment. Prepare a test solution to be used for temperature calibration. A beaker of water at room temperature works well as it will not be changing rapidly in temperature. Place the Tripar temperature sensor in the test solution and allow to stabilize for approximately 1 minute. Using a precision laboratory thermometer, measure the temperature of the test solution. At the Tripar rear panel, adjust the temperature "CAL" potentiometer until the Tripar display reads the value of the calibration solution.

   Best results will be obtained if the temperature "ZERO" and "SPAN" calibration procedures are repeated.

Conductivity Calibration:

From time to time, the Tripar conductivity circuit will require calibration. A simple two-point calibration procedure is used by first adjusting the conductivity zero and then the span.

1. Conductivity Zero Adjustment. With the conductivity sensor clean, dry, and in air, adjust the conductivity "zero" potentiometer for a reading of 0000 on the Tripar display.

2. Conductivity Span Adjustment. Totally immerse the Tripar conductivity sensor in calibration solution of known conductance. Note that the reading displayed on the Tripar is a temperature corrected value to 25°C. Therefore, the value of the standard solution must be calculated to 25°C. Also, the value of the calibration solution should fall in the upper 50 percent of the ranges to be calibrated (i.e., adjustment of the 1,000 micromhos range should be accomplished with a 500 to 1,000 micromhos standard). Once the sensor has stabilized in the solution for approximately 1 minute, adjust the conductivity "CAL" potentiometer at the Tripar rear panel for a reading on the display equal to the temperature corrected value of the standard solution.

   Best results will be obtained if the conductivity ZERO and SPAN procedures are repeated.

pH Calibration:

1. pH Standardization. The pH sensor should be standardized before each use after long storage. First, moisten the electrode body with tap water and carefully remove the plastic storage cap covering the tip of the electrode. Care should be taken not to bend the body of the electrode as this can result in damage to the internal element.

   For first-time use after long storage, immerse the lower end of the electrode in tap water for 30 minutes. This hydrates the pH bulb and prepares the ceramic wick for contact with test solutions. If air bubbles are present in the pH bulb, shake the electrode downward to fill the bulb with solution.

   Prepare a small sample of pH 7 buffer solution and measure the temperature of the buffer. Rinse the pH electrode with distilled water and immerse the pH bulb in the reference buffer. Set the compensation dial in the Tripar front panel to the temperature of the buffer, allow several minutes for the sensor to reach equilibrium, and stir the sensor slightly to dislodge any possible air bubbles from the electrode tip. Using the "Standardize" potentiometer, adjust for a reading of pH 7.00 on the Tripar display.

2. pH Slope Adjustment. Very infrequently, the pH slope adjustment may require recalibration. This adjustment is available at the Tripar readout rear panel. To accomplish this adjustment, prepare a test solution of pH 4 or 10. Measure the temperature of the solution and make the appropriate setting at the pH "Compensation" dial. Rinse the pH electrode in distilled water and immerse in the buffer solution. Allow several minutes for the sensor to equilibrate and stir the electrode slightly. Using the pH "Slope" potentiometer available at the rear panel, adjust the Tripar readout module for a reading equal to the value of the buffer solution. For best results, the pH "Standardize" and "Slope" adjustments should be repeated at least once.

Note that some interference may be seen on the pH reading if the Tripar conductivity sensor is present in the same test solution as the pH sensor.

6.2.4 Photoionization Meters A number of PID meters are available for field use, as described below.

HNu™. With the probe attached to the instrument, turn the function switch to the battery check position. The needle on the meter should read within or above the green battery area on the scale plate. If the needle is in the lower position of the battery arc, the instrument should be recharged prior to any calibration. If the red LED comes "on," the battery should be recharged. Next, turn the function switch to the "on" position. In this position, the ultraviolet light source should be on.

To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection, while counterclockwise rotation yields a downscale deflection. If the span adjustment setting is changed after zero is set, the zero should be rechecked and adjusted if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero. The instrument is now ready for calibration by switching the function switch to the proper measurement range.

Using nontoxic analyzed isobutylene gas available from the manufacturer in pressurized containers, connect the cylinder with the analyzed gas mixture to the end of the probe with a piece of tubing. Open the valve of the pressurized container until a slight flow is indicated and the instrument draws in the volume of sample required for detection. Adjust the span potentiometer so that the instrument is reading the stated value of the calibration gas.

If the instrument span setting is changed, the instrument should be turned back to the standby position and the electronic zero should be readjusted, if necessary. If the instrument does not calibrate, it may be necessary to clean the probe or the lamp connection.

Photovac™ Total Ionizables Present (TIP). The name of this instrument is derived from the fact that it measures TIP. Turn power switch on by first pulling knob out and then up. Allow the TIP to warm up for 5 minutes prior to use. Turn span knob to max (9) and zero knob to "ZERO." Attach "zero air" cylinder to TIP inlet using PVC tubing. Zero instrument using zero knob only. (TIP is very sensitive so stable reading of absolute zero is difficult and not necessary to achieve.) Next, attach isobutylene cylinder to TIP inlet. Use the span knob to adjust TIP reading to the concentration number on the isobutylene cylinder (usually 60 ppm). Remove cylinder. TIP is now calibrated and ready for use. (Calibration should be checked often because TIP has tendency to drift.) When finished, turn power off by pulling switch out and down. Recharge instrument overnight. (Battery charger must be pushed into place and then screwed into bottom of TIP.)

MicroTIP™ IS-3000. Calibration of the instrument will follow procedures in the manufacturer's operation manual. First, zero the instrument. Usually clean ambient air will be suitable as zero air. If there is any doubt, use a commercial source of zero grade air. Isobutylene at 100 ppm in air is the span gas for calibration. To calibrate the instrument, use the calibration kit as follows.

1. Connect the supplied regulator to the span gas cylinder. Hand tighten the fittings. Observe proper handling techniques for all gases.

2. Open the valve on the gas bag by turning the valve stem fully counter-clockwise.

3. Attach the nut to the regulator. Hand tighten the fittings.

4. Turn the regulator knob counterclockwise about half a turn to start the flow of gas.

5. Fill the gas bag about half full and then close the regulator fully clockwise to turn off the flow of gas.

6. Disconnect the bag from the adaptor and empty it. Flush the bag a few times with the span gas and then fill it.

7. Close the gas bag by turning the valve clockwise.

8. Press SETUP and select the desired "CAL" memory with the arrow keys and press ENTER. Press EXIT to return to the normal display.

   Note: MicroTIP™ has 10 "CAL" memories and can be calibrated with 10 different span gases or response factors if desired. Only one cal memory can be used at a time. Each memory stores a different response factor, zero point, and sensitivity. (See instruction manual for information on programming the "CAL" memories).

9. Press "CAL" and enter the desired response factor. (Use Table 2, on page 21 of the instruction manual, to find the correct response factor for the compound of interest). If you are not looking specifically for one compound, then enter 1.00.

   Note: The concentration detected by MicroTIP™ will be multiplied by the response factor before it is displayed and logged.

10. Expose MicroTIP™ to zero air. Press ENTER and MicroTIP™ sets its zero point.

11. The MicroTIP™ is then ready for the span gas concentration to be entered. Enter the known span gas concentration and then connect the span gas bag adaptor to the inlet.

12. Press ENTER to set the MicroTIP™ sensitivity.

13. When MicroTIP™ display reverts to normal, the MicroTIP™ is calibrated and ready for use. Remove the span gas bag from the unit.

Organic Vapor Meter (OVM). An OVM is another variety of PID that will be used during this investigation. The calibration procedure for the Thermo Electron

Instruments, Inc., Model 580B OVM is as follows. Refer to the instrument operating manual for additional details.

1. Hit ON/OFF toggle once.
2. Wait until lamp lights (screen will display "PPM = ___").
3. Hit MODE toggle.
4. Hit -/CRSR toggle until "RESET" to CALIBRATE comes up.
5. Hit RESET toggle to enter calibration mode. (Screen will display "ZERO GAS RESET WHEN READY".)
6. Hit -/CRSR toggle.
7. Connect zero gas canister via tube and gauge supplied with OVM. Open valve on gauge.
8. Hit RESET toggle. Screen will display "Model 580 Zeroing."
9. When zeroing is complete, screen will display "SPAN/PPM = 0000".
10. Span gas concentration (Isobutylene 100 ppm) is entered by hitting RESET and +/INC toggles simultaneously to increment digit above cursor or RESET and -/CRSR simultaneously to move the cursor.
11. When correct value has been entered, hit +/INC toggle. (Screen will display "SPAN GAS RESET WHEN READY.")
12. Connect span gas canister via tubing and gauge. Open valve on gauge.
13. Hit RESET toggle. Screen will display "Model 580 Calibrating."
14. When calibration is complete, the screen display will return to "RESET" to CALIBRATE. If calibration is acceptable, hit MODE toggle to return screen to run mode.

<u>6.2.5 Yellow Springs Instrument Oxidation-Reduction Potential Electrode Assembly (Model 4540)</u> The oxidation-reduction potential (ORP) device consists of an electrode assembly and cable designed for use with the YSI 3560 Water Quality Monitor System and similar ORP measuring systems.

1. Place the shorting cap on the pH input jack. Rinse the ORP electrode and a temperature sensor with deionized or distilled water and connect them to the meter. Pat dry with a laboratory tissue. Follow with a rinse of a small amount of reconstituted YSI 3682 Zobell solution.
2. Pour 3682 Zobell Solution into a sample cup (such as one from the YSI 3565 Sample Cup Pack) and immerse the ORP electrode and temperature sensor in the solution.
3. Turn on the instrument and allow the sensors to equilibrate in the solution.

4. Set the function switch to the millivolt (mV) mode. Read the temperature and calculate the correction to 25°C by adding 1.3 mV for each degree below 25°C, or by subtracting 1.3 mV for each degree above 25°C; or determine the correction by use of the table provided in the Zobell Solution instrument sheet. A corrected reading within 25 mV of the value indicated assures correct electrode function.

6.2.6 FIDs A number of FIDs are available for field use, as described below.

Century Model OVA 128 Organic Vapor Analyzer.

1. Set calibrate switch to X10 and gas select control to 300.
2. Adjust meter reading to zero with the calibrate adjust knob.
3. Introduce a methane calibration gas of 95 ppm and adjust trimpot R-32 so the meter reading is 95 ppm.
4. Turn off hydrogen supply valve to put out flame.
5. Leave calibration switch on X10 position and use calibrate adjust knob to adjust meter reading to 4 ppm.
6. Place calibrate switch in X1 position and using trimpot R-31 adjust meter reading to 4 ppm.
7. Move calibrate switch to X10 position again. Use calibrate adjust (zero) knob to adjust meter to a reading of 40 ppm.
8. Move calibrate switch to X100 position and use trimpot R-33 to adjust meter reading to 400 ppm.
9. Move calibrate adjust (zero) knob to adjust meter reading to zero.
10. Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.
11. Note: Carbon filters are used to distinguish between methane and VOCs.
12. Note: background corrections are made for measured responses for soil borings or split-spoon samples analyzed in ambient air.

Heath PortaFID™ II OVA-FID. Calibration of the instrument will follow procedures outlined in the manufacturer's operation manual. To set up the calibration procedure, ignite and run the instrument for approximately 1 hour to stabilize. Set the instrument on a flat horizontal surface (the instrument must remain in this position throughout the calibration procedure). Now proceed as follows.

1. The meter needle should be set to zero by adjusting the zero control knob.
2. Depress the 500 ppm range switch.

3. There should be no significant drift or movement of the meter needle. The needle should remain relatively stable on zero.

   Note: calibration must be conducted in a hydrocarbon-free atmosphere (clean air).

4. Attach calibration kit regulator assembly to calibration cylinder, turn calibration cylinder valve knob counterclockwise (one half to one turn). Do NOT force the knob all the way counterclockwise (open).

5. Attach calibration kit outlet connector to the hand-held unit by pushing the connector firmly into the sample inlet quick disconnect on the housing.

6. Within 30 seconds the meter needle should start moving upscale.

7. Allow the unit to run at least 30 seconds before checking the meter.

8. The meter needle should register within one division of 10 on the instrument meter scale.

9. If an adjustment is necessary to bring the meter to within one division of 10 on the 500 ppm scale, an adjusting control is supplied with the hand-held unit located inside the bottom rear of the instrument.

10. Adjust control to the proper level. Calibration is complete.

11. Repeat steps 1 through 8 to verify calibration.

6.2.7 Turbidimeter A turbidimeter (nephelometer) is used to characterize the turbidity of a liquid by viewing light through it and determining how much light is blocked by the liquid. Turbidity measurements are reported in NTUs. Models frequently used are the LaMotte Portable and the Hach 2100P. Calibration of either model is as follows.

1. Turn the unit "ON," as necessary.

2. Rinse the sample cell three times with deionized water.

3. Fill the cell to the mark, as indicated, with deionized water, and then cap.

4. Use nonabrasive, lint-free paper (e.g., lens paper) to wipe off outside of cell.

5. Open cover, insert the cell, as indicated, and replace cover.

6. Press "READ" and wait for light bulb icon to go off, or wait until digital display settles. Record the reading.

7. Using standards provided, repeat steps 4 through 6, and record results.

7.0 ANALYTICAL PROCEDURES

Sample analyses conducted during field investigation activities at NTC, Orlando range from onsite analytical field screening analyses to CLP laboratory analyses. This section addresses the field screening and laboratory analytical methods and associated DQOs levels for the media to be sampled during the NTC, Orlando project. The analytical method references are outlined in Table 7-1.

Field Screening Analytical Data. Field screening data provide real-time qualitative data and quantitative data conforming to Level II analyses. Screening methods will be employed to attempt to define high concentration areas and to gain information concerning the horizontal and vertical extent of contamination. These analytical results will be evaluated to determine optimal locations for the collection of confirmatory soil, groundwater, surface water, and sediment samples. A minimum of 5 percent of samples collected for field screening analyses will be analyzed at Level IV for confirmation.

Laboratory Analytical Data. Laboratory analytical data will be used for confirmatory sampling. These data will provide qualitative and quantitative data concerning type, concentration, and distribution of contaminants. In any level of QC and for any POI where volatiles and semivolatiles are analyzed by GC/MS, the current CLP methods will be used, unless a regulatory detection limit can only be met using a non-CLP method.

7.1 SELECTION OF PARAMETERS. Based on a review of the NTC, Orlando operational history and previous investigation, samples will be analyzed for a list of analytical parameters selected for this investigation. The lists of analytes are found in Table 7-1. Additional parameters may need to be added to the list as required on a POI-specific basis.

7.2 LABORATORY AND METHOD CERTIFICATION. Analyses will be performed by an FDEP- and NEESA-approved CLP laboratory. CLP methods are available for the analyses of VOCs, SVOCs, PCBs, and pesticides and inorganics. In the event that additional methods are needed where no CLP methods exist or are not appropriate, USEPA-approved methods will be used whenever possible.

In addition, soil samples will be collected for geotechnical evaluation. Physical soil testing will be conducted on the soil samples using the procedures and equipment in compliance with current ASTM standards. The tests to be performed include Atterberg Limits, sieve grain size distribution, and assignment of USCS symbols equivalent to ASTM D-2.487-69. All samples will be sent, following proper COC procedures, to a geotechnical testing laboratory.

7.3 LABORATORY QC PROGRAM. The laboratory subcontractor is responsible for generation of a detailed Laboratory QA Plan. This plan will also be approved during the NEESA and FDEP certification program.

The laboratory will submit QC reports as specified in the laboratory QA program. The Consultant will review the control charts periodically to ensure that the subcontract laboratory is performing analyses in compliance with CLP criteria.

Table 7-1
Laboratory Analytical Program

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Media	Analytes	Method	Reference	Analytical Level
Soils	TCL volatiles	Purge-and-trap GC/MS	CLP	III or IV
	TCL semivolatiles	GC/MS	CLP	III or IV
	TAL inorganics	AA/ICP	CLP or SW846	III or IV
	TCL pesticide and PCBs	GC/ECD	CLP or SW846 (8080)	III or IV
	TCL herbicides	GC/ECD	CLP or SW846 (8150)	III or IV
	TPH		SW846 (418.1)	III or IV
	Total organic carbon	Combustion	SW846(9060)	II
	Grain-size distribution	Sieve analysis	ASTM D 422	II
	Selected screening volatile	GC/ECD/PID	SW846-M	II
	Selected screening semivolatile	GC/ECD/PID	SW846-M	II
	Selected screening PCBs	Immunoassay Test Kit	SW846-M (4020)	II
	Selected screening inorganics	X-ray fluorescence	SW846-M	II
Groundwater	TCL volatiles	Purge-and-trap GC/MS	CLP (low level)	III or IV
	TCL semivolatiles[1]	GC/MS	CLP	III or IV
	TAL inorganics	AA/ICP	CLP or SW846	III or IV
	TCL pesticides and PCBs	GC/ECD	CLP or SW846 (8080)	III or IV
	TCL herbicides	GC/ECD	CLP or SW846 (8150)	III or IV
	TPH		SW846 (418.1)	III or IV
	Selected screening volatile	GC/ECD/PID	SW846-M	II
	Selected screening semivolatile	GC/ECD/PID	SW846-M	II
	Selected screening pesticides and PCBs	GC/ECD/PID	SW846-M	II
	Selected screening inorganics	X-ray fluorescence	SW846-M	II
	Selected radionuclides-gamma scan	Scintillation counter	(101.1)	III
	Selected radionuclides-alpha or beta scan	Scintillation counter	(8310)	III
Sediments	TCL volatiles	Purge-and-trap GC/MS	CLP	III or IV
	TCL semivolatiles	GC/MS	CLP	III or IV
	TAL inorganics	AA/ICP	CLP or SW846	III or IV
	TCL pesticides and PCBs	GC/ECD	CLP or SW846 (8080)	III or IV
	Total organic carbon	Combustion	SW846(9060)	II
Surface water	TCL volatiles	Purge-and-trap GC/MS	CLP	III or IV
	TCL semivolatiles	GC/MS	CLP	III or IV
	TAL inorganics	AA/ICP	CLP or SW846 (8080)	III or IV
	TCL pesticides and PCBs	GC/ECD	CLP or SW846	III or IV

[1] To achieve Florida maximum contaminant levels (MCLs) for all parameters, selective ion monitoring will be used in conjunction with standard CLP methods for detection of pentachlorophenol, hexachlorobenzene, and bis(2-ethylhexyl)-phthalate. SW846 Method 8310, a high performance liquid chromatography method, will be used to detect benzo(a)pyrene at MCLs.

Notes: TCL = target compound list.
GC/MS = gas chromatograph/mass spectrometry.
CLP = Contract Laboratory program (USEPA, 1991a; 1991b).
TAL = target analyte list.
AA/ICP = atomic absorption/inductively coupled plasma.
PCBs = polychlorinated biphenyls.
GC/ECD/PID = gas chromatography/electron capture detection/photoionization detector.
ASTM = American Society for Testing and Materials.
M = method for field screening.
SW846 = Test Methods for Evaluating Solid Waste.
TPH = total petroleum hydrocarbons.

7.4 HOLDING TIMES. Analyses to be performed for this investigation will be initiated within specified time limits (i.e., sample holding times) to avoid degradation of the parameters being analyzed. When required, samples will be preserved in the field prior to shipment to the laboratory. Sample preservation and holding time requirements were presented in Section 4.2 (see Table 4-1).

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

Reliable analytical field measurements of environmental samples require continuous monitoring and evaluation of the analytical processes involved. Depending on what is required of the analysis, how the results will be used, and what the expected results may be, QC requirements necessary to accomplish the objectives can and do vary substantially.

Data collected from investigative activities include survey data, field screening data, and laboratory analytical data. To represent data generated from field investigative activities in a usable form, a number of steps are required. Raw data are "reduced" for final reporting, formatting, and interpretation; "validated" when data are reviewed for accuracy; and reported when all parameters and requirements have been met.

8.1 DATA REDUCTION. Data reduction is the process of converting measurement system outputs to an expression of the parameter that is consistent with the comparability objective. Analytical results collected from both field and laboratory analytical instruments will be reduced to the concentration units specified in the analytical procedures using the equations provided in the analytical references in Chapter 7.0. Data reduction of laboratory data is conducted by the analytical laboratory. Reduction of data collected from field analytical instruments will be performed on site by the analyst. All analysts will be trained in the required data reduction procedures required for the measurement.

Reduction of data for field measurements made by the OVA with an FID or PID will be performed according to the following formula to determine the OVA reading in ppm:

Correct OVA Reading = *(Direct Instrument Reading of Sample)* - *(Direct Instrument Reading of Sample Using An Activated Charcoal Filter)* (6)

The list below identifies the field measurements read directly from the instrument in which data reduction is required.

- direct-read instruments include pH meter, Model EP/pH;
- specific conductivity meter (PI Dsph-1pH); and
- water-level indicator (ORS Interface Probe).

Analyses in the field will be performed by trained field engineers or scientists. They are responsible for properly documenting and performing calculations of results that require data reduction.

Field activities and data calculations will be documented in hard-bound log books that indicate conversions of raw data to qualitative and quantitative results. Entries are made describing what samples will be taken and analyzed, the locations, raw data, and calculations. The activities will be performed by environmental scientists, field technicians, geologists, and engineers.

8.2 VALIDATION. Validation of measurements is a systematic process of reviewing a body of data to provide assurance that the data are adequate for their intended use and includes a review of PARCC parameters. Sample results are validated through comparison to QA/QC data to assure that analytical results fall within acceptable accuracy and precision confidence limits and to eliminate, correct, or flag matrix and other interference effects.

Laboratory Data. All data for IR-related investigations received from contract laboratories are validated and verified. Data for screening purposes may be validated. Data validation is performed as soon as the laboratory data are received. Data validation will be conducted in accordance with NEESA document *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program)* (1988). Other applicable guidance documents include the USEPA *Functional Guidelines for Evaluating Organic Analyses* (USEPA, 1988b) and the USEPA *Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, 1988a). Validation includes a rigorous review of sample custody, holding times, sample extraction and preparation, GC/MS Spectrometry tuning, initial and daily calibration, surrogate performance, MS/MSD performance, method calibration, method, field and trip blank contamination, detection limits and detection limit standards, analytical sequences, interferences, laboratory and field duplicates, serial dilutions, laboratory control samples, postdigestion spike results, and method of standard addition results.

If data validation is performed by a subcontractor, then 10 percent of all validated data will be reviewed for accuracy, completeness, and for conformance with validation guidance documents.

During validation, the COC is reviewed for completeness and the field documentation is checked to determine at what point in the sampling sequence the equipment rinsate blank was collected, the origin of the field blank water and decontamination solvent, the source of the sample bottles, and whether or not the correct number of samples and blanks were collected in accordance with the workplan. During the data validation process, the data are reviewed for the presence of any obvious anomalous values.

Validated data will be prepared in the following formats representing

- laboratory data package as received from the laboratory, tabulated by media and analytical fraction and
- annotated data resulting from the review process, tabulated in a similar format.

Field Screening Data. Field screening data provide real-time qualitative data and Level II quantitative data. This information is useful for determining strategic sampling locations. Greater variability may be expected from field screening methods and, due to time constraints, the field analytical data will not be formally validated in the same manner as laboratory data; however, the data will be carefully screened and evaluated.

Before field results are reported, they are subject to review. The field analyst has the initial responsibility for proper instrument condition and calibration, for the data meeting all acceptance criteria, and for the accuracy of all calculations. The analyst has the responsibility to correct all deficiencies at the time that they are discovered. An independent review is then conducted by a peer analyst, geologist, or site lead who was not involved in the original analysis. A review is made of all the raw data, calibration information, logbook documentation, analytical and field blanks, transcriptions, and calculated results. The ultimate responsibility for the analytical field results lies with the field lead. Analytical data collected in the field are checked by a chemist or technical representative of the project team who was not originally involved in the sampling or data gathering process. Records of field QA/QC data will be maintained, out-of-control conditions will be noted, and, where appropriate, the data will be rejected or annotated. The field data collection and validation process is outlined in Figure 8-1.

8.3 DATA REPORTING. Data reporting of field measurement activities occurs after the site field activities have been approved by the field leader or scientist.

The data provided by approved contract laboratories must be formatted into summary tables that are easily read and can be included in final reports submitted to clients. The reporting format for laboratory data is described above in Section 8.2.

8.4 DATA STORAGE. All field records, laboratory data, and reports pertaining to a given project are kept as hard copies in central project files according to a unique project number. Each project remains in the central file until the end of the year in which the project comes to its completion. At the end of the year, the file is removed and archived in a temperature controlled office file room, where it is stored for 3 years or for a contract-specified time period. Archived project files are indexed and can be accessed according to project numbers.

8.5 DATA MANAGEMENT. Three broad categories make up data management: (1) laboratory data management, (2) sample data management, and (3) field data management. Laboratory data management consists of storing, retrieving, editing, validating, and reporting the results of the laboratory chemical analyses. Sample data management consists of tracking the origin, location, and status of a set of chemical data obtained from the analysis of an environmental sample. Field data management consists of storing, retrieving, and reporting the results of measurements made from the field.

Laboratory data management begins with receipt of unvalidated data (one hard copy and one electronic copy) from the laboratory. The laboratory data manager later receives the validated data from the data validator. One hard copy of all of the chemical data is kept in house in a locked file cabinet to allow access to the raw data. A second hard copy of the unvalidated data is stored off site. Upon receipt of the validated data, the laboratory data manager uploads the electronic copy into a secure database. Data in the database are backed-up daily and the back-ups are stored for 2 weeks in a firesafe vault. At the conclusion of the project, the laboratory data manager archives the electronic data, and moves the in-house copy of the unvalidated data to a storage site separate from the first storage site. This minimizes the risk of catastrophic data loss.

Sample management begins upon creation of the sample. The sample data manager tracks the life cycle of each sample, and uses milestones in the life cycle as

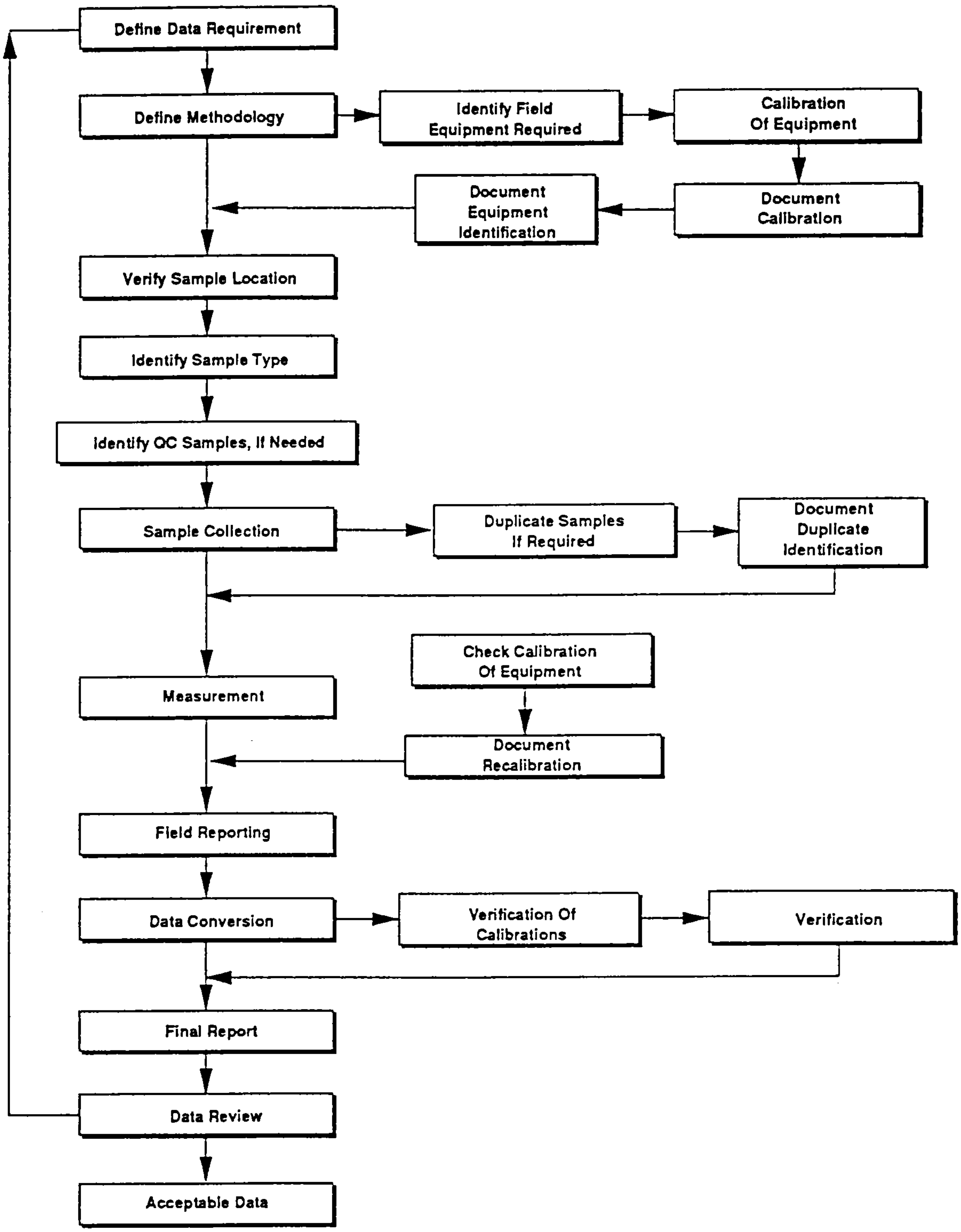

FIGURE 8-1

FIELD DATA COLLECTION AND VALIDATION

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8519-03 940321WEM

reference points to judge the status of individual samples. Milestones include sample collection, sample receipt by the laboratory, unvalidated sample data receipt, and validated sample receipt, as well as various steps in the process needed to ensure the quality of the electronic data. As each milestone is achieved, the sample data manager records the achievement in the sample data management database (FRED [Fast Retrieval of Environmental Data]). This database is a secure database backed-up daily on a 14-day cycle. The back-up is stored in a fire-safe vault for 2 weeks. At the conclusion of the project, the sample data manager archives the database and makes two copies to store in separate storage facilities. An example data tracking report form is presented on Figure 8-2.

Field data management procedures vary depending on the type of data collected. In all cases, two hard copies of the data exist. One copy resides in the field office, and one copy resides in the home office. Where appropriate, electronic field data also exist. The main objectives of the field data manager are to store the field data and to ensure the integrity of any reproductions of the field data. When the project is completed, the data manager ensures that two correct copies of all field data exist. The field data manager stores each copy in a separate storage facility.

Data Tracking Report

Project: ______________________ SDG No: ______________________

Laboratory: ______________________ Week Ending: ______________________

ABB-ES Site ID	LAB Sample ID	Lot Code	Date Sample Recv'd	Parameter to be Analyzed (by method)	Due Date for Extraction/ Preparation	Actual Date of Extraction/ Preparation	Due Date for Analysis	Actual Date of Analysis	Due Date for ABB-ES	Actual Date Data Sent ABB-ES

FIGURE 8-2

EXAMPLE DATA TRACKING FORM

PROJECT OPERATIONS PLAN

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CHAPTER 9.0

9.0 INTERNAL QC

QC procedures have been established for both field activities and laboratory activities. The number and types of QC samples collected for each POI will be specified in the task specific workplans. A brief description of the types of field and laboratory QC samples and frequency of collection is presented below.

9.1 FIELD QC ACTIVITIES. Field QC activities include the use of calibration standards and blanks for pH, specific conductance, temperature, and photoionization and flame ionization measurements. Field QC samples to be submitted to the laboratory include trip blanks, equipment rinsate blanks, field water blanks, and field duplicates. The frequency of field QC samples is summarized in Table 9-1. Field QC samples are analyzed in the laboratory as samples, and their purpose is to assess transport, decontamination procedures, and sampling procedures as possible sources of sample contamination and to document overall sampling and analytical precision. Field staff may add blanks or duplicates if field circumstances are such that they consider normal procedures insufficient to prevent or control sample contamination, or at the direction of the Consultant's project TOM. A brief description of field QC samples for NTC, Orlando and the frequency of collection is shown below.

Table 9-1
Frequency Requirements for Field Quality Control Samples

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Type	Frequency
Trip Blank (volatiles only)	One per cooler containing volatile organic compound samples.
Equipment Rinsate Blank	
Precleaned Equipment Blank	Minimum of one, then at 5 percent of equipment sets for all parameters measured.
Field Cleaned Equipment Blank	One per day per sampling event for all parameters measured.
Field Water Blank	Two per source for all parameters measured (one at the beginning of the project and one at end).
Field Duplicates	Ten percent per sample matrix for all parameters measured.
Background Samples	To be specified in the task specific workplans.

9.1.1 Trip Blanks Trip blanks are required for assessing the potential for contaminating samples with VOCs during sampling, transit, and storage. The trip blank consists of a volatile organic analytes (VOA) sample container which is filled with analyte free water at the laboratory and shipped to the site with the other VOA sample containers. Preservatives or additives are added to the trip blanks during preparation, if required for that parameter group. The trip blanks are kept with the investigative samples throughout the sampling event and are packaged and shipped with the investigative samples. A trip blank is included with each cooler of water or soil samples scheduled for VOC analysis and will be stored and analyzed with the corresponding VOC samples.

9.1.2 Equipment Rinsate Blanks An equipment rinsate is a sample of organic-free water that has been used to rinse the sampling equipment. This blank is useful in documenting adequate decontamination of sampling equipment. Two types of equipment blanks will be collected during NTC, Orlando field activities: a precleaned equipment rinsate and a field cleaned equipment rinsate.

A precleaned equipment blank is defined as an organic-free water blank of equipment rinsate performed on site before sampling begins. Contaminants present within the sampling equipment are assessed by collecting a sample of organic-free water passed through the clean sampling apparatus. In addition, field cleaned equipment blanks are collected if equipment is cleaned in the field. A field cleaned equipment blank is defined as an organic-free water blank of equipment rinsate performed on site after equipment has been cleaned in the field (i.e., between sampling points). Contaminants present within or on soil sampling apparatus where intimate contact with the sample occurs (i.e., split spoon, trowel, and Shelby tubes) are assessed by rinsing the sampling apparatus with organic-free water following decontamination. These equipment rinsate blanks are water samples collected directly into the appropriate bottle for each parameter. Preservatives or additives must be added to the equipment rinsate, where appropriate, for the parameter group.

Equipment rinsate blanks are prepared for each parameter group sampled when a particular piece of sampling equipment is employed for sample collection and subsequently decontaminated in the field for use in additional sampling. These blanks must be collected and analyzed for all matrices involved in the sampling event. Equipment rinsate blanks will not be collected during sampling activities using dedicated equipment.

9.1.3 Field Water Blanks Field water blanks include a complete set of samples collected from each water source used in the investigation. One set of samples will be collected from each water source used at the beginning of the project and one set at the completion of the project. These blanks should account for potential artifacts that could be introduced through decontamination procedures.

9.1.4 Field Duplicates Field duplicates are designed to assess the precision of the overall sampling and analytical techniques and the homogeneity of the sampling media. These samples will be submitted for analysis of all parameters specified for the media sampled. Field duplicate samples will be collected at a frequency of 10 percent per matrix. The identity of the duplicate samples will not be revealed to the laboratory.

9.1.5 Background Samples Background samples are collected from areas upgradient and away from known or suspected contaminated areas. Several background (also called upgradient) samples have been collected from each matrix. The estimated number and location of these samples at each POI will be presented in the task-specific workplans. Background samples allow identification of possible upgradient sources and/or confirm upgradient contamination. In addition, background inorganic analyses allow the estimation of concentrations for naturally occurring compounds.

Sitewide soil sampling representative locations at all four geographic areas was completed in 1994. The resulting background data sets for each area are reported in the *Background Sampling Report, Naval Training Center, Orlando* (ABB-ES, 1995d).

9.2 LABORATORY QC ACTIVITIES. Laboratory QCs are addressed in detail in the Laboratory QA Plan submitted as part of the laboratory approval process. The laboratory QC for chemical analyses is based on criteria developed in the CLP and in the specific analytical methods. The analysis of control samples (e.g., surrogates and method blanks) is routinely done to monitor the performance of each analytical method.

9.2.1 MS and MSD Samples An important element of the NTC, Orlando effort will be the collection and analysis of samples to evaluate matrix effects on target compound response. MS/MSD samples will be prepared in the laboratory by adding a known amount of pure compounds to an environmental sample to simulate background and interference found in actual samples. For Level IV analyses, the current CLP requirements are specified. For methods not defined in the CLP, MS/MSDs will be performed for every 20 samples of similar matrix. A similar matrix is defined as soil or water from the same NTC, Orlando Facility (i.e., the Main Base, McCoy Annex, Herndon Annex, and Area C). For metals analysis, a laboratory duplicate and a matrix spike are required for every 20 samples of a similar matrix. For Level III analyses, MS/MSDs are required for volatiles, semivolatiles, and all GC analyses for every 20 samples of a similar matrix. For metals analyses at Level III a laboratory duplicate and matrix spike are required for every 20 samples of a similar matrix.

10.0 QUALITY ASSURANCE ACTIVITIES

Audits are performed to ensure and document that QC measures are being utilized to provide data of acceptable quality, and that subsequent calculations, interpretation, and other project outputs are checked and validated. Both scheduled and unscheduled audits are provided for in the QA program.

System and performance audits may be conducted by the QAM. The QAM may also conduct project audits of calculations, interpretations, and reports which are based on the measurement system outputs. Audits of field work and reviews of the project assessment elements may also be conducted by the QA Manger. The Laboratory QAC will perform systems, methods, and performance audits in accordance with the Laboratory QA Plan. A minimum of one internal audit will be scheduled by the QAM in coordination with the TOM during the SS/SI/RI activities. Internal audits will be performed as outlined in Section 10.3. All audit records, including audit plans, reports, written responses and corrective action forms (CAFs), will be maintained with the project files. Sections 10.1 through 10.5 describe the varieties and associated requirements of audits.

In addition to routine audits, project and deliverable review systems will be implemented to assess scope compliance and overall technical quality of the contracted services.

10.1 SYSTEMS AUDIT. A systems audit is a review of a specific SOP or program. It is performed to evaluate the conformance of each activity with requirements. A systems audit may be conducted to determine that proper procedures, checks, and documentation are being completed. Systems audits may address field, office, or laboratory procedures.

The types of system audits to be performed are described in this section.

Facilities and Equipment. The audit will address whether field equipment and analytical instruments are selected and used to meet requirements specified by the project objectives stated in the POP or the task-specific workplan. Equipment and facilities provided for personnel health and safety may also be evaluated. Calibration and documentation procedures for instruments used in the field will also be reviewed.

Analytical Laboratories. Only FDEP- and NEESA-approved and CLP-certified laboratories will be contracted to provide services for NTC, Orlando. Systems audits may be performed of each laboratory

Sampling and Sample Handling Procedure. An audit of scheduled samples versus samples collected versus samples received for analysis may be performed. Field documentation may be reviewed. If deemed necessary, a site visit to NTC, Orlando will be made to ensure that designated control procedures are practiced during sampling activities.

Data Handling. During a systems audit, the QAM will review data handling procedures with the TOM. Accuracy, consistency, documentation, and appropriate selection of methodologies will be discussed.

For each field or systems audit, a checklist, described in Section 10.3, will be prepared and submitted to the Consultant's TOM.

10.2 PERFORMANCE AUDIT. These audits are intended primarily for the analytical data generation systems. The contracted analytical laboratories are CLP qualified and are pre-approved as part of the FDEP and NEESA laboratory certification programs. Periodic field performance audits are conducted to determine that instrument calibrations, QC checks, and continuing calibration verifications are being performed as specified by the appropriate SOPs. Project-specific field activities are also compared to the workplan.

The QAM is responsible for ensuring that routine performance audits are carried out as appropriate. Performance audits consist of reviews of logged calibration or standardization results and execution of measurement calibration operations, and may also consist of analysis of measurements or introduced standards or samples of known result.

10.3 AUDIT COMPONENTS.

Scheduling. Audits will be scheduled by the QAM in coordination with the TOM or other responsible manager of the activity to be audited. The necessity and frequency of audits will be determined during the workplan development.

Planning.

1. The auditor will complete an audit plan that includes a checklist with the following items:

   Date of Audit: Projected date and actual date.
   Reason for Audit: Scheduled, Requested by, etc.
   Applicable Documents: Workplan, SAP, QAPP, POP, SOPs, etc.
   Scope: Activities to be monitored.
   List: List of items to be checked compiled from applicable documents.

   The list will address such issues as:

   - organization and responsibilities,
   - documentation procedures,
   - sampling procedure, and
   - applicable standard operating procedures.

2. The auditor will notify the TOM or Line Manager regarding the date and scope of the audit. It is the responsibility of the TOM or Line Manager to notify all affected personnel.

3. The auditor will determine if technical specialists are desirable to assist in performing the audit.

Performance.

1. The auditor(s) will meet with the TOM, or Line Manager, to explain the purpose and scope of the audit.

2. The auditor(s) will complete the audit checklist by reviewing documentation, observing activities, and interviewing field or office personnel. A draft audit report consisting of a list of findings and observations will be compiled by the auditor(s) prior to the post-audit meeting and will be submitted in writing to the leader of the activity audited. It will address these items that require corrective action.

3. At the completion of the audit, the auditor(s) will hold a post-audit meeting with the TOM and other responsible personnel to discuss the results of the audit.

   The purpose of the post audit meeting is to ensure that all parties understand the draft audit observations. Any discrepancies that cannot be resolved will be noted on the draft paper.

4. Any discrepancy or observation that requires correction will be addressed either through a CAF or, if the integrity of the program is threatened, through a Stop Work Notice.

Reporting.

1. The final audit report will be prepared by the audit team and will be reviewed and approved by the QAM.

2. A copy of the approved final audit report will be submitted to personnel as designated by the TOM:

The PM or designee will complete and submit CAF(s) to document that the problem has been addressed. The Comprehensive Long-Term Environmental Action, Navy (CLEAN) TOM has final responsibility for resolving any disagreements between the auditor and project personnel. All audit records, including audit plans, checklist reports, written responses, and CAFs, will be maintained with the project files.

10.4 PROJECT REVIEWS. Project reviews are scheduled and conducted by the Consultant's TOM. The intent of a project review is to assess scope compliance and overall technical quality of the contracted services. A project review is appropriate at instances such as (1) sampling design plan finalization, (2) end of field program; and (3) determination of conclusion and recommendations. Documentation of the project review, especially identified action items and their follow-up, is essential to maximizing the utility of these reviews.

10.5 QUALITY ASSURANCE AUDIT REPORT. QA audits are conducted at the request of management or clients and occur less frequently than project reviews. A written report of a QA project audit will include the following:

- an assessment of project team status in each major project area,
- clear statements of areas requiring improvement or problems to be corrected,

- recommendations and assistance regarding proposed corrective actions or system improvements (if no action is required, the report will state that the QA audit was satisfactorily completed), and

- a timetable for any corrective action required.

Distribution of the report will be as determined by the TOM. This form will cover any field or laboratory audit checklist (internal) or external audit performed. The QAM is responsible for the coordination of such audits, the disposition of the audit records, and the monitoring of corrective actions.

10.6 QUALITY REVIEW OF STUDIES AND REPORT PREPARATION. The purpose of quality review through the course of studies, designs, and reports is to ensure that the service, designs, and documents meet currently accepted professional standards and project requirements. QA reviews will be scheduled on a routine basis for the NTC, Orlando project. The Project Review Committee will be an integral part of this process.

QA during the preparation of studies and reports relies on documentation of data utilized and peer review of conclusions drawn from the assembled data base. This allows all data base components to be traced to the primary generator and forces a review of data quality as the database is developed. Project personnel are responsible for utilization and monitoring of this process; compliance is audited by the QAM. Upon completion of the data base, data interpretation, evaluation, and report preparation commence. Data evaluation incorporates peer review to provide broad-based insight to data correlations and interactions.

To enhance the professional quality of the company's studies and reports, the Project TOM will also (1) require that reports refer to and are consistent in scope with the project proposal and contract, and (2) require that report language and contents be chosen to foster client understanding of risks and uncertainties by distinguishing fact from opinion and identifying risks and limitations in a clear and informative manner.

Implementation of QA for reports involves the use of a review routing and sign-off form. Figure 10-1 illustrates a Deliverable Review Tracking Form. The Project TOM provides final review and release for all deliverables.

DELIVERABLE REVIEW TRACKING AND DOCUMENTATION RECORD

Document Full Title and Facility Name: ______________________________

Authors: ______________ ______________ ______________

Task Order Manager: ______________________ Project No.: ______________

Approved for Technical Review: ______________________ Date: ______________

Task Order Manager Review	Lead Senior Technical Review	Supplementary Technical Review
Name: ____________ Date: ____________ Meets Statement of Work Approval: _______ Date: _______ Overall Comments: Additional Comments Attached: Yes ____ No _____	Name: ____________ Date: ____________ Meets ALL Technical Requirements Approval: _______ Date: _______ Overall Comments: Additional Comments Attached: Yes ____ No _____	Name: ____________ Date: ____________ Components Rev'd: ____________ Approval: ____________ Name: ____________ Date: ____________ Components Rev'd: ____________ Approval: ____________ Comments Attached: Yes ____ No _____
Contracts/Purchasing Review	**Copy Editor**	**Word Processing/Drawings Release**
Name: ____________ Date: ____________ Meets Contract Requirements Approval: _______ Date: _______ Comments Attached: Yes ____ No _____	Name: ____________ Date: ____________ Meets Program Editorial Standards Approval: _______ Date: _______ Comments Attached: Yes ____ No _____	Name: ____________ Date: ____________ Meets Navy/Applicable Format Approval: _______ Date: _______ Comments Attached: Yes ____ No _____

PROGRAM MANAGEMENT RELEASE

DOCUMENT APPROVED FOR RELEASE

______________________ ______________________ ____________

Program Task Order Manager Signature Date

Comments Attached: Yes ____ No _____

FIGURE 10-1

DELIVERABLE REVIEW TRACKING AND DOCUMENTATION RECORD

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER ORLANDO, FLORIDA

8519-03 940308WEM

11.0 PROBLEM PREVENTION

Problem prevention procedures attempt to control problems before they occur and before they have an adverse impact on the project. Program management and project personnel are required to plan and implement projects utilizing readiness review, project technical reviews, audits, and corrective action measures to anticipate, identify, and correct problems.

Program management and project personnel will identify events or other signals that could indicate development of problems and take early action to implement corrective measures. Proper project planning includes the development of technical workplans, field SAPs, HASPs, and QA/QC project plans.

At the initiation of a project a review will be conducted to verify proper planning for the project. A list of potential topics for review include project organization and staff availability, project funding, subcontracts, schedules, mobilization plans, and equipment and supplies.

11.1 ANALYTICAL INSTRUMENTATION. The contracted analytical laboratories follow a well-defined program to prevent the failure of laboratory equipment or instrumentation during use. Preventive maintenance of analytical instrumentation and equipment for the contract laboratories will be performed in accordance with the CLP requirements and the individual laboratory QA/QC program.

11.2 FIELD SAMPLING INSTRUMENTS. Preventive maintenance of field sampling equipment and instrumentation, which is performed by analysts, field personnel, and sample program staging area staff, routinely precedes each sampling event; more extensive maintenance is performed by manufacturers on the basis of hours in use. Sampling crews report on the performance of the equipment after each sampling event. Critical spare parts are kept in stock. At times, it is necessary to perform routine maintenance in the field; therefore, each field instrument is provided with an operating manual.

For field analytical instrumentation, preventative maintenance will be performed by the analysts according to the procedures delineated in the manufacturer's instrument manual. For example, GC injection liners and injector septa are cleaned or replaced on a regular basis. Maintenance is performed routinely as specified or when instrument performance begins to decline as evidenced by the decrease in peak resolution, shift in calibration curves, decreased sensitivity, or failure to meet the QC criteria.

Instrument logbooks will be maintained in the field laboratories. They contain records of usage, calibration, maintenance and repairs. Adequate supplies of spare parts for field analytical instruments such as GC columns, syringes, and septa are maintained in the laboratories so that they are available when needed.

12.0 DATA ASSESSMENT

The following items are evaluated prior to assessing POI conditions:

- quality of laboratory data
  - acceptable
  - provisional
  - unacceptable

- method limitations
  - dynamic range
  - accuracy
  - method detection limit
  - practical quantitation level
  - precision

- sampling/analysis scope and results
  - number of replicates at one location
  - number of samples for each site/media
  - background/downgradient distribution
  - consistency/trends of chemical assay data collected at site
  - agreement with existing site information

- use of data
  - chemical distribution and transport at the site (generally, order-of-magnitude comparisons)
  - compliance with standards, regulations, response objectives
  - presence or absence of chemical
  - treatability
  - disposal method for media containing chemicals
  - risk assessment

12.1 PARCC PARAMETERS. The purpose of data quality assessment is to ensure that data generated under the NTC, Orlando project are accurate and consistent with project DQOs. The data assessment will be based on precision, accuracy, consistency, and completeness. Data quality assessment will be conducted in three phases:

Phase 1. Prior to data collection, sampling and analysis procedures are evaluated with regard to their ability to generate the appropriate, technically acceptable information required to achieve project objectives. The POP meets this requirement by establishing project objectives defined in terms of parameters, analytical methods, and required sampling protocols.

Phase 2. During data collection, results will be assessed to ensure that the selected procedures are efficient and effective and that the data generated provide sufficient information to achieve project objectives. The appropriateness of the precision and accuracy of selected measurement systems will also be evaluated. In general, evaluation of data will be based on performance audits, results of spiked laboratory sample analyses, and review of completeness objectives.

Phase 3. Following completion of data collection activities, an assessment of the adequacy of the data base generated with regard to completing project objectives will be undertaken by the Project TOM and QAM. Recommendations for improved QC will be developed, if appropriate. In the event that data gaps are identified, the QAM may recommend the collection of additional raw data to fully support the project's findings and recommendations.

Each phase of the assessment will be conducted in conjunction with appropriate project staff.

PARCC parameters will be assessed via review of multiple analyses (precision) and surrogate and/or spike recovery (accuracy), both in standard water and soil matrices. Accuracy is expressed as percent recovery. Precision is expressed as the difference between recoveries for data pairs. Documentation of substandard accuracy and precision, and corrective action if necessary, is a laboratory responsibility. A review of accuracy in the sample matrix must recognize the impact of matrix interferences. Precision must be assessed for each sample matrix because distribution of contaminants may be nonhomogeneous, especially in non-water matrices. Precision in samples must also be reviewed with knowledge of the matrix and level of analyte present.

Each certified method provides QC requirements and acceptance criteria. The QC criteria and required QC samples are specified for each analytical method and are components of the laboratory QA plan. General QA objectives applicable to investigations conducted in accordance with the POP are presented in Tables 3-1, 3-2, and 3-3.

Another important component of Phase 3 Data Assessment is identification of laboratory contamination. Methyl ethyl ketone, acetone, toluene, phthalates, and methylene chloride are all common laboratory contaminants. Samples associated with data in which the laboratory blanks contain similar concentrations of these common laboratory contaminants will not be corrected. Data will only be corrected during validation according to procedures outlined in the USEPA Functional Guidelines for Data Review. Documentation of all data correction for nonsite-related contaminants will be provided in the project report.

12.2 CALCULATION OF DATA QUALITY INDICATORS. The equations used to calculate precision and accuracy are shown in Section 3.3.

12.3 EVALUATION OF DATA GAPS. All data will be continually assessed and POIs will be evaluated to determine: (1) if contamination is present, (2) if it presents a threat, (3) if it has been delineated, and (4) what further action is needed (i.e., delineation, interim or early remedial action, or evaluation of remedial alternatives). The goal is to eliminate lengthy interim report development and review times by allowing continual data assessment and rapid decision making.

13.0 CORRECTIVE ACTION

Corrective or preventive action is required when potential or existing conditions are identified that may adversely impact data quantity or quality. Corrective action could be immediate or long term. In general, members of the program staff who identify a condition adversely affecting quality can initiate corrective action by notifying his/her supervisor and the QAM in writing. The written communication will identify the condition and explain how it may affect data quality or quantity.

Refer to Table 13-1 for corrective action of field measurements. Inspections, tests and operating status checks may be necessary to control the use or installation of faulty, substandard, and/or nonconforming items. Controlled items may include, but are not limited to field construction and installation items, equipment, instruments, and software. The Nonconformance Report (NCR), Figure 13-1, provides a mechanism for avoiding the use of items or services that do not meet required specifications. These reports can be used to identify and correct and item, material, service, or activity that dose not comply with contract, regulatory, or other project requirements. In general, NCRs are filed for hardware or equipment problems.

Table 13-1
Summary of Corrective Action for Field Measurements

Project Operations Plan for Site Investigations
and Remedial Investigations
Naval Training Center
Orlando, Florida

Analysis	Control item	Acceptance Criteria	Corrective Action
Specific conductivity at 25°C	Check standard 0.00702 N potassium chloride	±5 percent 1000 μmhos/cm	Recalibrate with fresh potassium chloride.
pH	pH buffer 4, 7, and 10	±.2 pH	Recalibrate, adjust temperature, and check standard expiration date.
Temperature	±0.1°C	([1])	Calibrate against NIST thermometer.

[1] Precision and accuracy for this method have not been determined.

Notes: °C = degrees Celsius.
μmhos/cm = micromhos per centimeter.
NIST = National Institute of Standards and Technology.

Any person within the organization may initiate an NCR. The nonconforming item or action should be brought to the attention of the activity supervisor and the TOM. The TOM will determine if a stop work order is needed. If materials, instrumentation, or other items are determined to be out of conformance, they will be clearly labelled and, if possible, removed from the site. The TOM will consult with the QAM to determine what action is necessary to correct the nonconformance. If items are not within specification, and the deviation may impair the quality of the project, the items will be rejected and returned to the supplier or disposed of. If use of the item will not impair the quality of the project, the item may be used, if justification is documented.

NONCONFORMANCE REPORT (NCR)

NCR No.: ______________ Manufacturer/Vendor: ______________________
Date: ______________ Lot No./Other ID: ______________________
Originator: ____
Project: ____

Specified Requirement: ____
____
____

Nonconforming Condition: ____
____
____

Recommended Disposition

Use-as-Is ________ Repair ________
Rework ________ Reject/Scrap ________

Justification (use as is and repair): ____
____
____
____

Disposition Approvals:

Project Manager: ______________________________ Date: __________
QA Specialist: ______________________________ Date: __________
Technical Representative: ______________________________ Date: __________

Corrective Action to Prevent Recurrence Yes ___ No ___
see CAF No.
Potential Impact to Other Projects: ____
____

Affected Project Documents to be Modified: ____
____

Disposition Completion By: ______________________________ Date: __________
Disposition Verification: By (QAM): ______________________________ Date: __________

FIGURE 13-1

EXAMPLE NON-CONFORMANCE REPORT

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER ORLANDO, FLORIDA

Actions, procedures, or services that are not in conformance may also be controlled through a corrective action notice, a stop work order, or a notice to the file. Documentation of the action or justification for non-action will be attached to the NCR. If the nonconformance could impact other projects, the PM or the QAM will notify responsible managers.

13.1 IMMEDIATE CORRECTIVE ACTION. Immediate corrective action is usually applied to spontaneous, nonrecurring problems (e.g., instrument malfunction). The individual who detects or suspects nonconformance to previously established criteria or protocol in equipment, instruments, data, or methods, will fix the malfunction and reperform the activity. If the measurement system will not go back into control, the individual will immediately notify his/her supervisor. The supervisor and the QAM will then investigate the extent of the problem and take the necessary corrective steps. If a large quantity of data is affected, the supervisor must prepare a CAF (Figure 13-2), an NCR, or a memorandum to the Project TOM and QAM. These individuals will collectively decide how to proceed. If the problem is limited in scope, the individual will decide on the corrective action measure and document the solution in the appropriate workbook or log and notify the TOM and the QAM in a memorandum. If data loss occurs as a result of the malfunction, the extent of loss will be assessed by the responsible manager, and approved by the QAM and the Florida Operations Manager or CLEAN Technical Services Manager. All other affected PMs will be informed in writing.

13.2 LONG-TERM CORRECTIVE ACTION. Long-term corrective action procedures are devised and implemented to prevent the recurrence of a potentially serious problem. The QAM will be notified of the problem and will conduct an investigation to determine the severity and extent of the problem. The QAM will then file a CAF with the Project TOM, Florida Operations Manager or CLEAN Technical Services Manager.

Corrective actions may also be initiated as a result of other activities, including (1) performance audits, (2) system audits, (3) laboratory and field comparison studies, and (4) ongoing project audits.

The QAM will be responsible for documenting all notifications, recommendations, and final decisions. The Project TOM and the QAM will be jointly responsible for notifying program staff and implementing the agreed-upon course of action. The QAM will be responsible for verifying the efficacy of the implemented actions. The development and implementation of preventive and corrective actions will be timed, to the extent possible, so as to not adversely impact either project schedules or subsequent data generation and processing activities. The QAM will also be responsible for developing and implementing FDEP and/or NEESA recommended corrective actions resulting from performance audits, system audits, validation, and data review. Finally, the QAM will also be responsible for developing and implementing routine program controls to minimize the need for corrective action.

Examples of long-term types of actions include

- staff training in technical skills or in implementing the QA program,
- rescheduling of laboratory routine to ensure analysis within allowed holding times,

CORRECTIVE ACTION FORM

Project: ______________________________ Date: __________

Project No.: ______________________________ Page ____ of ____

Problem Description: ______________________________
____
____
____

Cause: ______________________________
____
____
____

Proposed Corrective Action(s): ______________________________
____
____
____
____

Project Manager: ______________________________ Date: __________

QA: ______________________________ Date: __________

Affected Organization: ______________________________ Date: __________

Proposed Organization: ______________________________

FIGURE 13-2

EXAMPLE CORRECTIVE ACTION FORM

PROJECT OPERATIONS PLAN

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8519-03 940321WEM

CORRECTIVE ACTION FORM (Continued)

Verification Corrective Actions: ______________________________

____

____

____

____

Comments and Recommendations: ______________________________

____

____

____

____

____

____

____

Close out Signature: ______________________________

Date: ______________________________

FIGURE 13-2 (Cont.) **EXAMPLE CORRECTIVE ACTION FORM**	**PROJECT OPERATIONS PLAN** **NAVAL TRAINING CENTER** **ORLANDO, FLORIDA**

8519-03 940321WEM

- identifying vendors to supply reagents of sufficient purity, and
- revision of Consultant QA system or replacement of personnel.

For either immediate or long-term corrective actions, steps comprising a closed-loop corrective action system are as follows:

- define the problem,
- assign responsibility for investigating the problem,
- investigate and determine the cause of the problem,
- determine a corrective action to eliminate the problem,
- assign and accept responsibility for implementing the corrective action,
- establish effectiveness of the corrective action and implement the correction, and
- verify that the corrective action has eliminated the problem.

Depending on the nature of the problem, the corrective action employed may be formal or informal. In either case, occurrence of the problem, corrective action employed, and verification that the problem has been eliminated will be documented.

14.0 REPORTS

14.1 QA AND QC REPORTS. As noted in previous chapters, reports of a variety of QA and QC activities are provided to managers at appropriate levels of the project organization. All QA and QC reports are available to SOUTHNAVFACENGCOM and FDEP.

14.2 PROJECT DELIVERABLES. Preparation of each NTC, Orlando report will begin following completion of the CA. The Draft Report will be submitted to the BRAC Cleanup team (BCT) for review. The Consultant will respond to review comments through the preparation of a Comment Response Package. Following agreement on comments, a Draft Final Report will be prepared and resubmitted to the BCT.

Preparation of the Final Report will begin when comments on the Draft Final Report are received. Comments received from the BCT on the Draft Final Report (if any) will be addressed in the Final Report. The Consultant's Task Leader will be responsible for developing the Final Report, with oversight by the TOM and the Internal Review Committee.

Report development will involve drafting of text, and compilation of data, tables, and figures for geologic, hydrogeologic, chemical, and risk assessment. Draft and Draft Final Reports will be prepared under the direction of the TOM, with review by the Internal Review Committee.

14.3 PROJECT RECORDKEEPING. Task Order-specific files will be maintained by the Consultant for the duration of the project and then turned over to SOUTHNAVFACENGCOM for long-term maintenance. Specific logs, notebooks, and forms for each element of project activity have been described as a component of the procedures in Chapter 4.0.

Summary audit reports may be prepared coincident to the completion of each task to inform task staff and management of QA status. The reports will include the following:

- 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, any incidents requiring corrective action will be fully documented. Procedurally, the QAM will prepare the reports to management. These reports will be addressed to the TOM and the Internal Review Committee. The summary of findings will be factual, concise, and complete. Any required supporting information will be appended to the report.

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