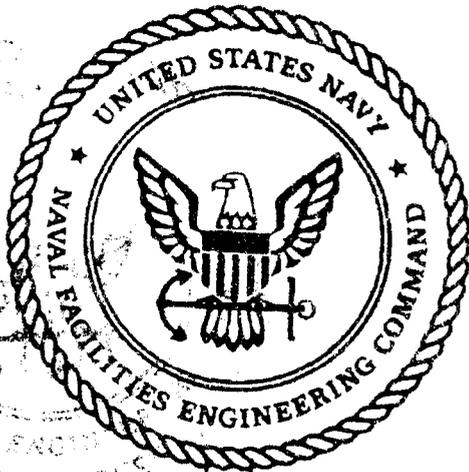


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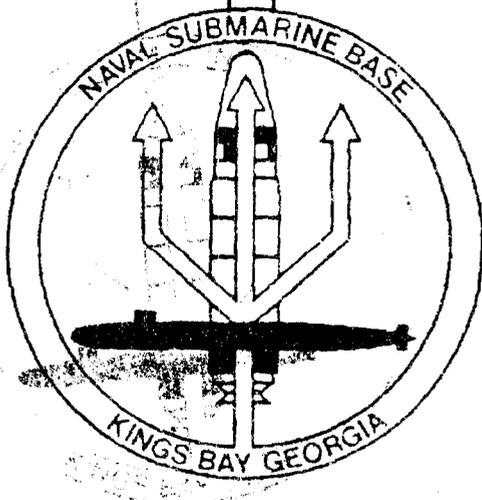
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VOLUME I - SECTIONS 1 THROUGH 9

NAVAL INSTALLATION RESTORATION PROGRAM  
NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA

CONTRACT NO. N62467-89-D-0317

DECEMBER 1993



SOUTHERN DIVISION  
NAVAL FACILITIES ENGINEERING COMMAND  
NORTH CHARLESTON, SOUTH CAROLINA  
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The geologic work and professional opinions rendered in the RFI Interim Report for Site 11, Naval Submarine Base, Kings Bay, Georgia, were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice.



Eric G. Nelson

Professional Geologist No. 539  
Expires December 31, 1995

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NSB Kings Bay, GA	15

**RFI INTERIM REPORT FOR SITE 11**

**CONTRACT TASK ORDER NO. 041  
MODIFICATION NO. 3  
NAVY CLEAN - DISTRICT 1  
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**VOLUME I - SECTIONS 1 THROUGH 9**

**NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA**

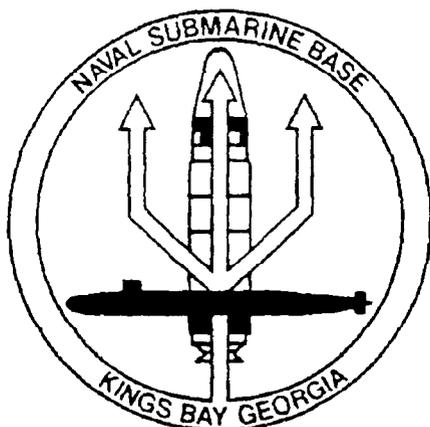
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**December 1993**



## FOREWORD

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the 1986 Superfund Amendments and Reauthorization Act (SARA), the 1976 Resource Conservation and Recovery Act (RCRA) as augmented by the 1984 Hazardous and Solid Waste Amendments (HSWA), and as directed in Executive Order 12580 of January 1987, the Department of Defense (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 (NACIP) program was developed by the Navy to implement the IR Program for all Naval and Marine Corps facilities. The NACIP program was originally conducted in three phases: (1) Phase I, Initial Assessment Study, (2) Phase II, Confirmation Study (including a Verification Step and a Characterization Step), and (3) Phase III, Planning and Implementation of Remedial Measures. The three-phase IR Program was modified and updated to be congruent with the CERCLA/SARA and RCRA/HSWA-driven DOD IR Program.

The updated nomenclature for the RCRA/SARA process is as follows:

- Preliminary Assessment and Site Inspection
- Remedial Investigation
- Feasibility Study
- Planning and Implementation of Remedial Design

This report discusses the findings and results of three phases of an RFI in progress at Site 11. This investigation included characterization of the nature and extent of volatile organic compounds in groundwater associated with Site 11, Old Camden County Landfill, at Naval Submarine Base, Kings Bay, Georgia. Groundwater analytical data were used to perform a human health screening risk evaluation.

Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) has the responsibility for implementation of the Navy and Marine Corps IR Program in the southeastern and midwestern United States. Questions regarding this report should be addressed to the Public Affairs Office, Naval Submarine Base, Kings Bay, Georgia, at (912) 673-4714.

## EXECUTIVE SUMMARY

Under contract to the U.S. Department of the Navy (Navy) Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), this Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Interim Report was prepared for Site 11, the Old Camden County Landfill, located on the Naval Submarine Base (NSB) in Kings Bay, Georgia. This report was prepared under the Navy's Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62467-89-D-0317, Contract Task Order No. 041.

This report provides a comprehensive presentation of information obtained from Site 11 during three phases of investigation conducted at the site. The three phases include the RFI field program and associated bimonthly groundwater sampling program, the Phase I Interim Investigation, and the Interim Corrective Measure Screening (ICMS) Investigation. The ICMS Investigation was conducted during October and November 1992, with limited follow-on work conducted during January and March 1993. The work conducted in January and March 1993 is reported herein as an addendum and included as Section 9.0. Investigation of environmental media at Site 11 began in January 1992 and continues today. Most work at the site has been directed towards assessment of volatile organic compounds (VOCs) in groundwater.

This report addresses information requirements of an RFI as presented in the RCRA Corrective Action Program Planning Document (USEPA, 1988). The extent to which these information requirements are met is established by the status of the RFI, which is not complete, and the applicability or appropriateness of certain suggested requirements. Because investigations conducted at the site have been concerned with VOCs in groundwater, information is lacking in several other areas, including source/waste, characterization, soil contamination characteristics, and potential Appendix IX constituents in groundwater other than VOCs.

The presence of groundwater contamination at Site 11 was indicated by the presence of VOCs, primarily vinyl chloride, in groundwater samples from downgradient monitoring well KBA-11-2. Site 11 is located on the western part of the base, just east of the NSB property line. Groundwater flow at the landfill is towards the west-northwest, which indicated that VOCs may have migrated off NSB property toward a residential area. The Phase I Investigation was performed to assess whether VOCs had migrated off NSB property. The results of the Phase I Interim Investigation confirmed that 18 VOCs had migrated off NSB property as far as the western right-of-way of Spur 40, which is adjacent to the residential area. The ICMS Investigation was performed to evaluate the nature and extent of VOCs in groundwater and to support a human health screening risk evaluation. The ICMS Investigation confirmed VOC contaminants were present in groundwater beneath the residential area. VOC contaminants are present in groundwater to depths of approximately 60 feet below ground surface downgradient and west of the landfill. In March 1993 groundwater samples collected from within the landfill indicated the depth of the plume to be approximated 85 feet bgs. VOCs detected include chlorinated and nonchlorinated solvents and fuel-related VOCs.

Based on results of the human health screening risk evaluation, no adverse health effects are expected due to exposure to groundwater. An Interim Measure (IM) for remedial action has been planned and will include a groundwater extraction and treatment system. The RFI activities will continue in support of the IM, Corrective Measures Study, and Baseline Risk Assessment.

## ACKNOWLEDGEMENTS

In preparing this report, the personnel at ABB Environmental Services, Inc. commend the support, assistance, and cooperation provided by the personnel at NSB Kings Bay, Georgia, and SOUTHNAVFACENGCOM.

RFI Interim Report for Site 11  
 Volume I  
 Naval Installation Restoration Program  
 Naval Submarine Base  
 Kings Bay, Georgia

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## GLOSSARY OF ACRONYMS

ABB-ES	ABB Environmental Services, Inc.
ACL	Alternative Concentration Limit
ARARs	Applicable or Relevant and Appropriate Requirements
ADD	Requirements
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
B&K	Bruel & Kjaer
C	celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS	Corrective Measure Study
CLEAN	Comprehensive Long-Term Environmental Action, Navy
CLP	USEPA Contract Laboratory Program
CRQL	Contract Required Quantitation Limit
DOD	Department of Defense
DQO	Data Quality Objective
EP	Extraction Procedure
F	Fahrenheit
ft/min	feet per minute
ft/yr	feet per year
GA DNR	Georgia Department of Natural Resources
GC	gas chromatograph(y)
GPR	ground-penetrating radar
HRS	Hazard Ranking Score
HSWA	Hazardous and Solid Waste Amendments
ICMS	Interim Corrective Measure Screening
in/yr	inches per year
IR	Installation Restoration
K <sub>ow</sub>	octanol-water partition coefficient
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDL	Method Detection Limit
mg/kg	micrograms per kilogram
mg/l	milligrams per liter
MLW	mean low water
MOTKI	Military Ocean Terminal, Kings Bay
MS/MSD	Matrix Spike/Matrix Spike Duplicate
µg/l	micrograms per liter
µg/kg	micrograms per kilogram
µmhos/cm	micro-mhos per centimeter

GLOSSARY OF ACRONYMS (continued)

NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NPL	National Priorities List
NSB	Naval Submarine Base
PARCC	precision, accuracy, representativeness, comparability, and completeness
PCB	polychlorinated biphenyl
PCOC	Potential Contaminants of Concern
PID	Photoionization Detector
PIW	private irrigation well
POA	Plan of Action
ppm	parts per million
PQLs	Practical Quantitation Limits
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RfDs	Reference Doses
RFI	RCRA Facility Investigation
RPD	Relative Percentage Difference
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SI	Site Inspection
SOUTHNAVFACENGCOM	Southern Division, Naval Facilities Engineering Command
SRE	Screening Risk Evaluation
s.u.	standard unit
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TBC	to be considered
TCL	Target Compound List
TDS	total dissolved solids
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds

## 1.0 INTRODUCTION

Under contract to the U.S. Department of the Navy (Navy) Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), this Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Interim Report was prepared for Site 11, the Old Camden County Landfill, located on the Naval Submarine Base (NSB) in Kings Bay, Georgia. This report was prepared under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62467-89-D-0317, Contract Task Order No. 041. The following subsections describe the regulatory setting, purpose of the report, the objectives of the RFI, and previous investigations.

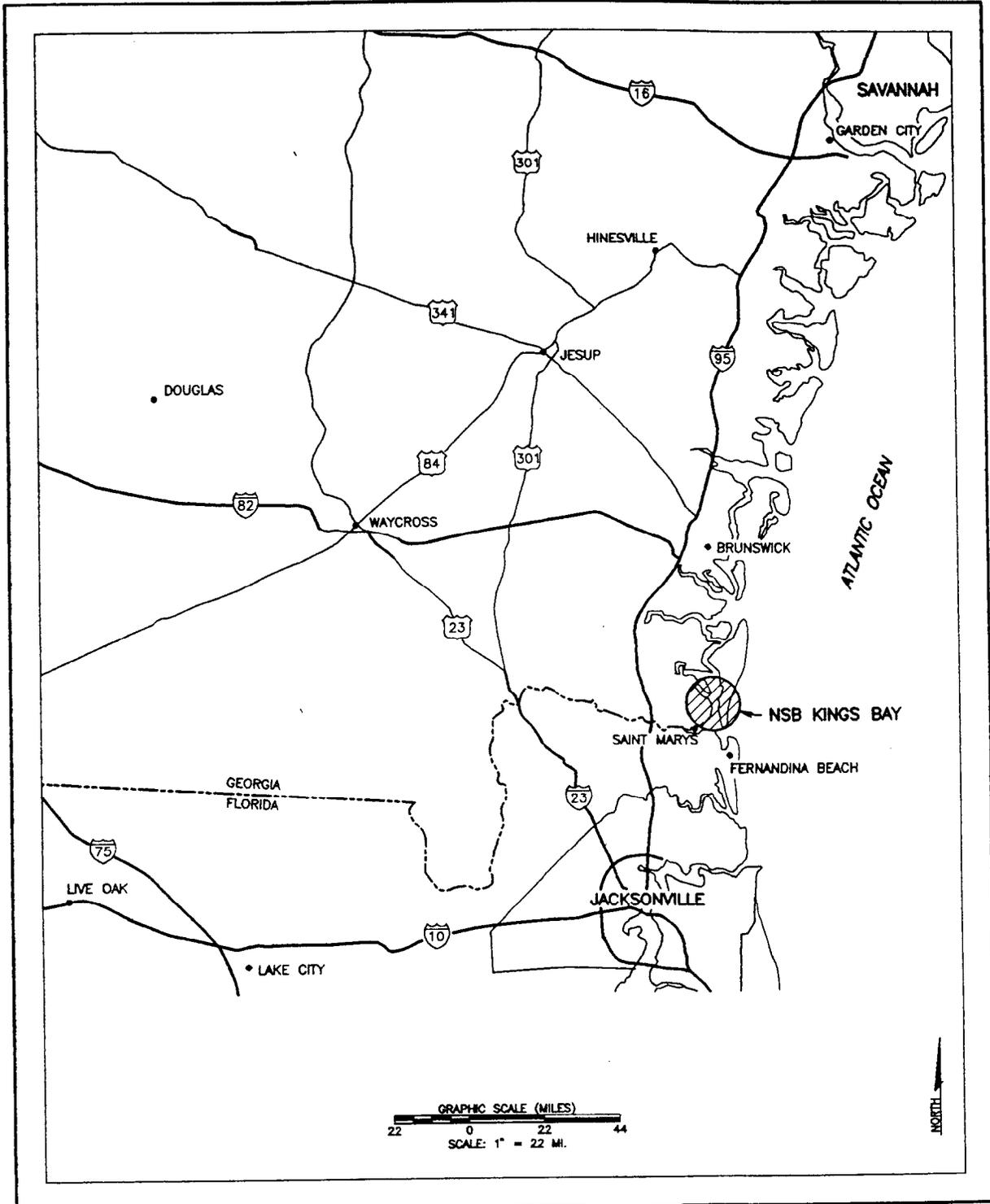
1.1 FACILITY BACKGROUND. The NSB Kings Bay is located in the southeast corner of Georgia, approximately 8 miles north of the Georgia-Florida border (Figure 1-1). The area of the NSB is included on the Harriett's Bluff topographic quadrangle (Figure 1-2). The NSB covers approximately 16,168 acres and is located in Camden County. The history of the facility is summarized in the following paragraphs of this subsection.

The U.S. Army began operations at NSB Kings Bay in the early 1950s. The property originally was developed as a military ocean terminal. From its inception until June 30, 1965, the terminal was known as the Kings Bay Army Terminal. The Kings Bay Army Terminal was constructed to meet the Department of the Army's requirements for East Coast port facilities capable of transporting ammunition and other explosives in the event of a national emergency. During this time, the Kings Bay Army Terminal was used for training purposes by the U.S. Army Reserves.

On April 1, 1965, as a result of a major reorganization, the terminal was placed under the jurisdiction of the newly organized Military Traffic Management and Terminal Service. On July 1, 1965, the terminal became known as the U.S. Army Military Ocean Terminal, Kings Bay (MOTKI). MOTKI was designed to store ammunition or explosives for about three months, and was directly subordinate to the Military Ocean Terminal, Southport, North Carolina. Facilities constructed at MOTKI included a 2,000-foot wharf, administration buildings, work shops, utility buildings, and 47 miles of railroad track for transporting explosives. MOTKI had no assigned military personnel and was maintained and operated by 19 U.S. Government Civil Service employees for reserve training operations and contingency purposes from 1965 to 1978. The mission of MOTKI was to plan programs, make military repairs, and provide fire prevention and protection functions for the terminal. Because there was no immediate operational need for this installation, it was placed on inactive status from 1965 until July 1, 1978.

In 1978, the Department of the Navy selected MOTKI as the East Coast location for its Fleet Ballistic Missile submarine support facility. On July 1, 1978, the site was established under a developmental status and was named the Naval Submarine Support Base. Construction of a refit facility for one submarine Squadron (T-1) began in 1978 in anticipation of 10 Poseidon submarines. In 1979, the Navy moved Squadron 16 from Spain to Kings Bay, and the site's official name became the Naval Submarine Base, Kings Bay.

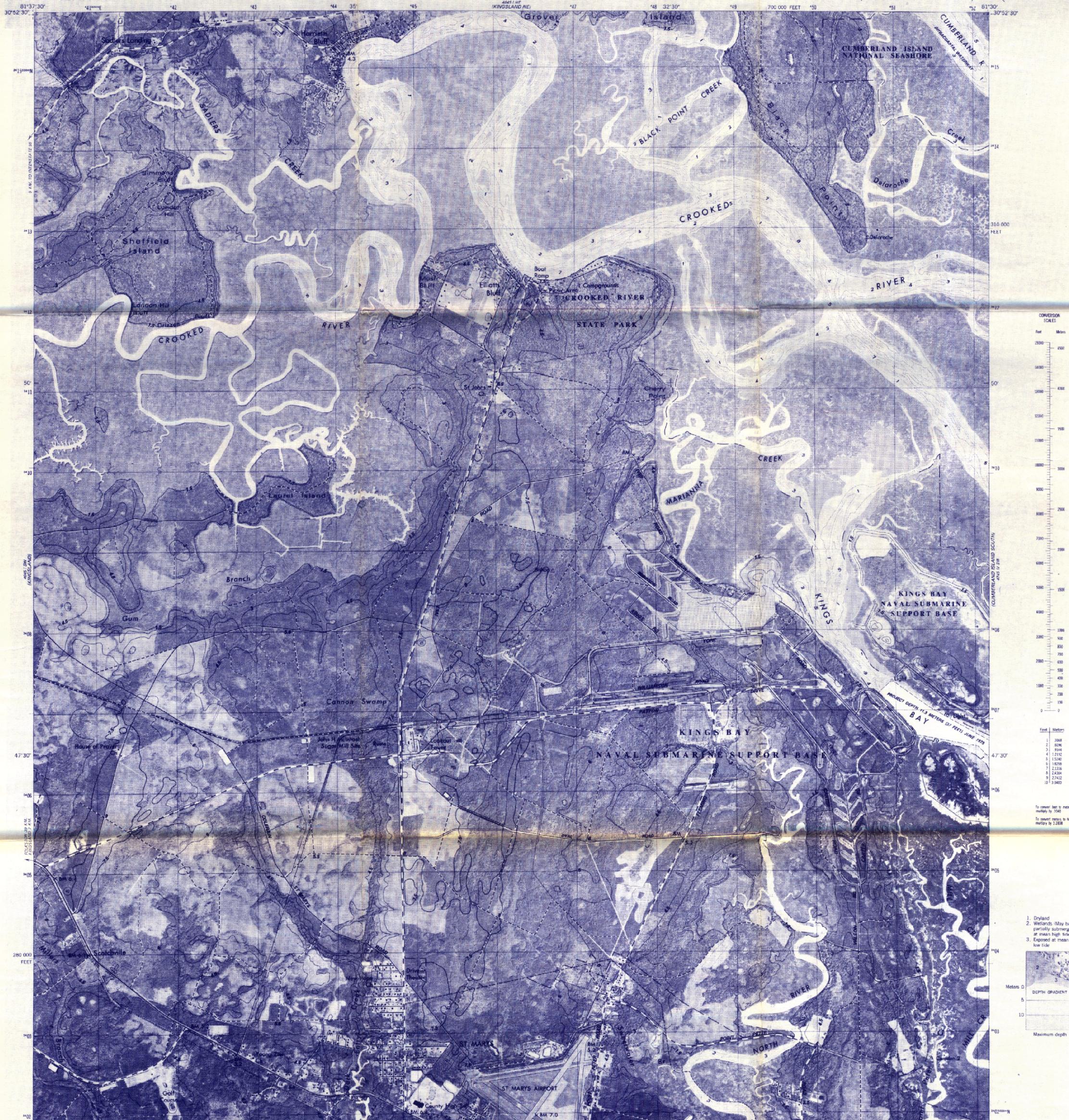
Currently, NSB Kings Bay supports TRIDENT submarines. New facilities completed in the early 1990s are for crew training, weapons handling and storage, submarine maintenance and repair, personnel support, and housing.



DWN: DMF	DES: DMF	PROJECT NO.: 7553-09	TITLE: REGIONAL LOCATION MAP
CHKD: KMH	APPD.: LBH	FIGURE NO.: 1-1	
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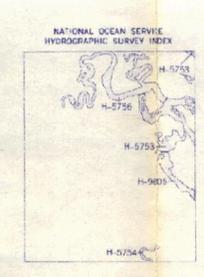
Produced by the United States Geological Survey and the National Ocean Service  
Control by USGS, NOS/NOAA, and USCE  
Orthophotomaps prepared by the Geological Survey from aerial photographs taken April 19, 1974. Topography by photostereoscopic surveys 1958, revised from aerial photographs taken 1974. Field checked 1975. Map edited 1980.  
Route survey compiled by the National Ocean Service from tide-coordinated hydrographic surveys.  
Soundings compiled from NOS 11503 and 11504.  
This information is not intended for navigational purposes.  
Mean lower low water (dotted) line and mean high water (solid) line compiled by NOS from tide-coordinated aerial photographs. Apparent shoreline (outer edge of vegetation) shown by photostereography.  
Projection and 10,000 foot grid ticks: Georgia coordinate system, east zone (Transverse Mercator).  
1000 meter Universal Transverse Mercator grid, zone 17 1927 North American Datum.  
To place on the predicted North American Datum 1983, move the projection lines 21 meters south and 17 meters west as shown by dashed corner ticks.  
There may be private inholdings within the boundaries of the National or State reservations shown on this map.

CONTOURS AND ELEVATIONS IN METERS  
UTM GRID AND 1983 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Survey Number	Survey Date	Survey Scale	Survey Line Spacing (Neat, Meters)
H-5754	1958	1:10,000	02.50
H-5754	1954-55	1:10,000	02.50
H-5756	1955	1:10,000	02.50
H-5853	1979	1:2,500	01.10

SCALE 1:24,000  
CONTOUR INTERVAL 1.5 METERS  
NATIONAL GEODETIC VERTICAL DATUM OF 1929  
BATHYMETRIC CONTOUR INTERVAL 1 METER WITH SUPPLEMENTARY 0.5 METER CONTOURS - SOUNDINGS IN METERS  
DATUM IS MEAN LOWER LOW WATER  
THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE

BASE MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS  
BATHYMETRIC SURVEY DATA COMPLIES WITH INTERNATIONAL HYDROGRAPHIC ORGANIZATION (IHO) SPECIAL PUBLICATION 44 ACCURACY STANDARDS AND/OR STANDARDS USED AT THE DATE OF THE SURVEY  
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092  
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST



ROAD CLASSIFICATION  
Primary highway: hard surface  
Secondary highway: hard surface  
Light-duty road, hard or improved surface  
Unimproved road  
Trails  
Interstate Route, U. S. Route, State Route

HARRIETTS BLUFF, GA.  
30081-G5-OM-024  
1980  
PHOTOREVISED 1988  
DMA 4645 I SE-SERIES V9450

Revisions shown in purple compiled in cooperation with State of Georgia agencies from aerial photographs taken 1983 and

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**1.2 REGULATORY SETTING.** In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986, the Department of Defense (DOD) conducts an Installation Restoration (IR) Program for evaluation and remediation of problems related to the release and disposal of hazardous materials at DOD facilities. The IR Program provides the mechanism for funding and management of investigations conducted at Site 11 at NSB Kings Bay.

Because NSB Kings Bay is operating under a current RCRA permit, the facility is obligated to follow RCRA regulations. The RCRA Corrective Action Program uses a four-phase approach to evaluate the condition of SWMUs and direct corrective action, if necessary, at these sites. The first step, a RCRA Facility Assessment (RFA), was not formally conducted at NSB Kings Bay by representatives of state and federal regulatory agencies. However, the Georgia Department of Natural Resources (GA DNR) issued an HSWA Permit to the NSB on September 29, 1989. The HSWA permit identified four SWMUs (Figure 1-3) suspected to be sources of current or past releases of hazardous substances to the environment:

- Site 5 - Army Reserve Disposal Area, Towhee Trail;
- Site 11 - Old Camden County Landfill;
- Site 12 - Army Reserve Disposal Area, Future Dry Dock; and
- Site 16 - Army Reserve Disposal Area, Motor Missile Magazines.

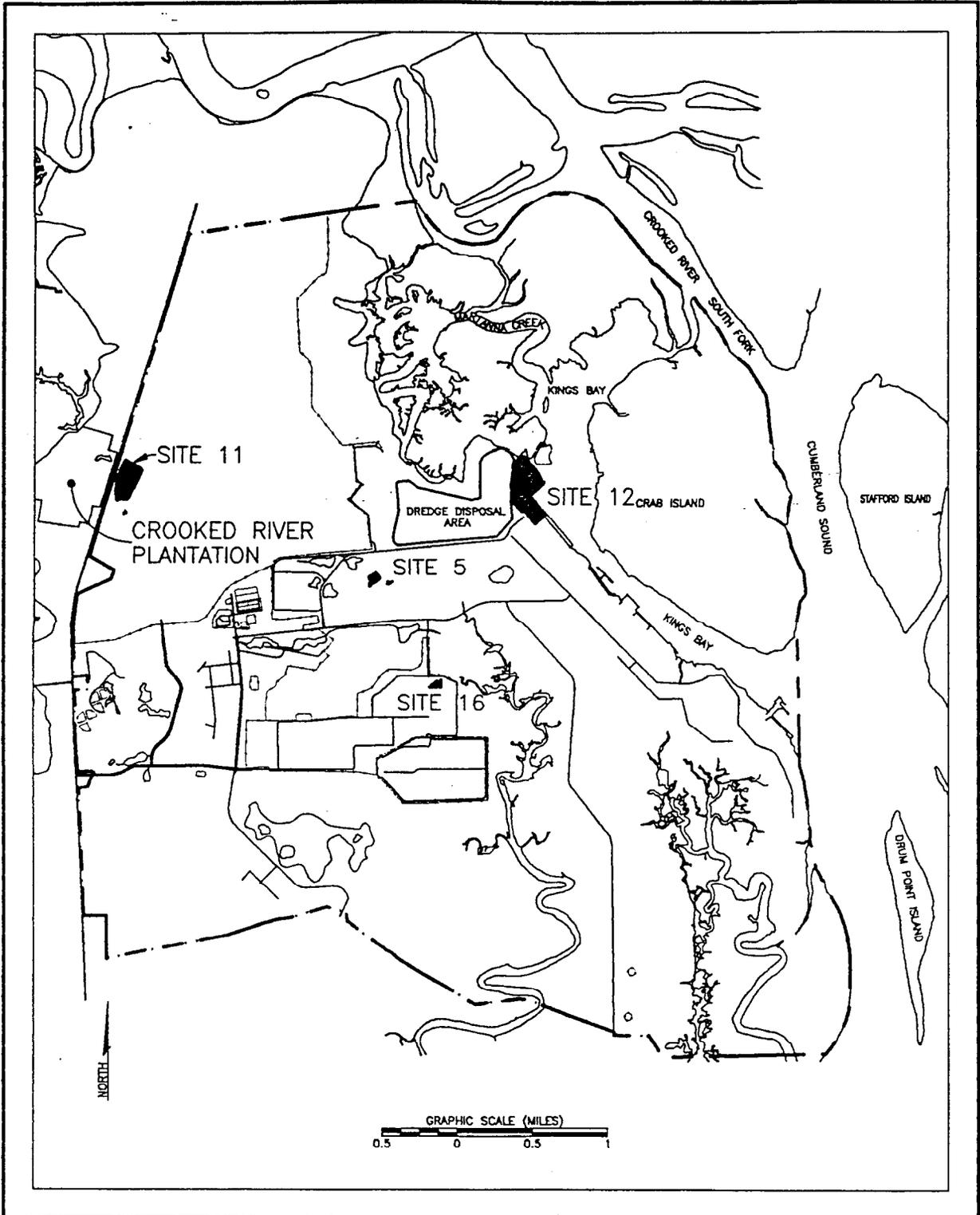
Site 12 is included in the RFI but no sampling or analysis will be conducted because it was reportedly remediated during construction of a dry dock. NSB Kings Bay will conduct a records search and information review to be reported in the comprehensive RFI report.

The second step of corrective action includes developing an RFI Work Plan and conducting an RFI to determine the presence or absence of toxic or hazardous substances and obtain information on the nature and extent of the contamination. Information collected during the RFI stage will be used to establish whether there is a need to implement additional phases of the Corrective Action Program. The third step, interim corrective measures, would involve controlling the further migration of contaminants and/or controlling potential sources of release. The fourth step, Corrective Measure Study (CMS), would evaluate and recommends specific technical methodologies for achieving long-term remedial action goals.

Several steps of the RCRA Corrective Action Program are currently being conducted at Site 11. Planning for the Interim Corrective Measure and CMS Programs has begun and a supplemental RFI program is also being developed to support both the Interim Corrective Measures and CMS, as well as to address the information requirements outlined in the RCRA Corrective Action Program Planning Document (Interim Final) (USEPA, 1988).

**1.3 PURPOSE OF REPORT.** Three RFI investigative phases have been conducted at Site 11 over the past year. Table 1-2 summarizes these investigations. Each of the phases has been reported separately, as follows:

- RFI Technical Memoranda Nos. 1 through 5 present the results of the original RFI program, including six bimonthly groundwater monitoring events.



DWN: DMF	DES: DMF	PROJECT NO.:	TITLE:  SITE LOCATION MAP	
CHKD: KMH	APPD.: LBH	7553-09		
DATE: 3-19-93	REV.:	FIGURE NO.:		
		1-3		<small>           NPT INTERIM REPORT FOR SITE 11            NAVAL SUBMARINE BASE, KINGS BAY, GEORGIA         </small>

Table 1-1 Investigation Chronology and Source Documents

Investigation	Dates Conducted	Activities	Source Document
RFI Field Program	January/February 1992	Soil Borings Geophysical Surveys Subsurface Soil Sampling Monitoring Well Installation Slug Tests Groundwater Sampling Event No. 1	Technical Memorandum No. 1 <sup>1</sup>  Potential Source of Contamination Investigation/Site Investigation Solid Waste Management Unit RCRA Facility Investigation Work Plan <sup>2</sup>
RFI Field Program	May 1992	Groundwater Sampling Event No. 2	Technical Memorandum No. 2 <sup>3</sup>
RFI Field Program	July 1992	Groundwater Sampling No. 3	Technical Memorandum No. 3 <sup>4</sup>
Phase I Interim Investigation	August 1992	Piezocone Penetrations Groundwater Sampling	Phase I Interim Investigation Memorandum <sup>5</sup>
RFI Field Program	September 1992	Groundwater Sampling Event No. 4	Technical Memorandum No. 4 <sup>6</sup>
Interim Corrective Measure Screening Investigation	October/November 1992	Records Search Piezocone Penetrations Air Screening Survey Groundwater Sampling Soil Vapor Sampling Sediment Sampling Surface Water Sampling Private Irrigation Well Sampling Screening Risk Evaluation	Interim Corrective Measure Screening Investigation Report <sup>7</sup>  Technical Work Plan Interim Corrective Measure Screening Investigation <sup>8</sup>
RFI Field Program	November 1992	Groundwater Sampling Event No. 5	Technical Memorandum No. 5 <sup>9</sup>
RFI Field Program	January 1993	Groundwater Sampling Event No. 6	RFI Interim Report for Site 11

**Notes:**

- <sup>1</sup>ABB-ES 1992a
- <sup>2</sup>ABB-ES 1991
- <sup>3</sup>ABB-ES 1992c
- <sup>4</sup>ABB-ES 1992e
- <sup>5</sup>ABB-ES 1992d
- <sup>6</sup>ABB-ES 1992g
- <sup>7</sup>ABB-ES 1993a
- <sup>8</sup>ABB-ES 1992f
- <sup>9</sup>ABB-ES 1993b

- Phase I Interim Investigation Memorandum, Site 11 discusses the results of a preliminary investigation of VOCs in groundwater at Site 11.
- Interim Corrective Measure Screening (ICMS) Investigation Report, Site 11 presents the results of an extensive VOC groundwater contamination assessment.

The objective of this report is to present a comprehensive overview of the information obtained to date from previous investigative phases at the Old Camden County Landfill. To the extent possible, this report addresses the information requirements of an RFI as presented in the RCRA Facility Investigation Guidance, (Interim Final) Vol.1 (USEPA, 1989a) and the RCRA Corrective Action Program Planning Document (Interim Final) (USEPA, 1988). The extent to which these requirements will be met will be established by the status of the RFI process, which is still incomplete, and the applicability or appropriateness of certain suggested requirements presented in the guidance documents.

1.4 OBJECTIVES OF RFI. The objectives of the RFI are to provide the necessary information to:

- verify whether a release has occurred from the Old Camden County Landfill
- characterize the release, if any, with respect to the type, concentration, and distribution of contaminants; and the rate, direction, and distance of contaminant migration
- establish the need for interim corrective measures based on information collected during the RFI
- establish the need for a CMS if a release is characterized as either immediately or potentially threatening to human health or the environment
- gather information in support of the CMS

The overall objectives of the RFI are being fulfilled through phased investigations, with each successive phase being built upon the findings and conclusions of previous phases. Investigations conducted to date include the RFI field program conducted in January and February of 1992, the Phase I Interim Investigation conducted in August 1992, and the ICMS Investigation conducted in October and November of 1992, and January and March of 1993.

1.5 PREVIOUS INVESTIGATIONS. Site 11, the Old Camden County Landfill, was first investigated in 1985 when an Initial Assessment Study was performed at NSB Kings Bay under the IR Program (C.C. Johnson, 1985). The Initial Assessment Study consisted of records searches and interviews. Sixteen sites were evaluated and none were recommended for further investigation. However, four sites, including the Old Camden County Landfill, required further action under the facility HSWA permit issued to NSB Kings Bay by the GA DNR. An RFI Work Plan was prepared in response to the HSWA permit requirements (ABB-ES, 1991).

The RFI Work Plan was implemented in January 1992. The RFI included geophysical surveys, subsurface soil sampling, and the installation of nine groundwater

monitoring wells along the perimeter of the landfill. Part of the RFI included six bimonthly groundwater monitoring events. The sixth monitoring event was completed in January 1993. During the first three groundwater monitoring events at Site 11 concentrations of vinyl chloride ranging from 18 to 150 micrograms per liter ( $\mu\text{g}/\text{l}$ ) were detected in samples from monitoring well KBA-11-2, located on the western edge of the landfill. In August 1992, a Phase I Interim Investigation was conducted to begin characterization of VOCs in groundwater. Results of this investigation are presented in the Phase I Interim Investigation Memorandum (ABB-ES, 1992d) and are summarized in the following paragraphs.

The Phase I Interim Investigation was implemented in August 1992, and included collection of 36 groundwater samples. These groundwater samples were collected from 25 locations downgradient of the landfill. The groundwater samples were analyzed in an on-site laboratory for VOCs, including vinyl chloride, chloroethane, trans-1,2-dichloroethene, trichloroethene, and tetrachloroethene. Duplicate groundwater samples were also sent to an off-site analytical laboratory for confirmation.

The results of this investigation confirmed that at least 17 VOCs had migrated, via the groundwater, beyond the boundary of the landfill and as far as the western right-of-way of Spur 40. These chemicals included solvent-related VOCs such as the dichloroethene and vinyl chloride as well as fuel-related VOCs such as benzene, ethylbenzene, toluene, and xylenes. This information led to the development of an ICMS Investigation Work Plan (ABB-ES, 1992f).

The ICMS Investigation was implemented in October and November 1992 and included an ambient air screening survey, collection of groundwater samples within the surficial aquifer, and collection of soil vapor, sediment, surface water, and private irrigation well (PIW) samples. An air screening survey conducted for vinyl chloride did not indicate the presence of "hot spots" within the Crooked River Plantation Subdivision, a residential development located west of the landfill. Results of the groundwater investigation indicated the contaminant plume extends approximately 600 feet west of the NSB Kings Bay property line. VOCs were detected in groundwater at depths ranging from 11 to 57 feet below ground surface (bgs), and included chlorinated solvents, such as vinyl chloride, dichloroethene, trichloroethene, and tetrachloroethene, and fuel-related VOCs, such as benzene, toluene, ethylbenzene, and xylenes. No VOC or semivolatile organic compound (SVOC) contaminants were identified in the sediment or surface water samples collected from Porcupine Lake. SVOCs detected in groundwater samples collected from locations near the landfill included naphthalene and phenolic compounds. Five of 51 PIW samples contained VOCs that are common to the plume, including vinyl chloride, cis-1,2-dichloroethene, and ethylbenzene. Of the 27 samples submitted for off-site analysis, acetone and carbon disulfide were found in 4 and 9 samples, respectively. These compounds are not considered to be related to the plume. The results of this investigation are presented in the ICMS Investigation Report (ABB-ES, 1993a).

During January and March 1993, follow-on activities to the initial ICMS Investigation were conducted. These activities included collection of groundwater samples from 11 PIWs (January) and from within the surficial aquifer to the north of and within the landfill (March). Results of this follow-on work are reported in an addendum to the ICMS Report, included as Section 9.0 of this report. None of the PIW samples contained VOCs related to the plume. Analysis of the groundwater samples from the landfill indicated that the concentrations of VOCs beneath the landfill are generally less than those detected from

locations along the western margin of the landfill and extending to the western right of Spur 40. This may indicate the source of the VOCs is near the western margin of the landfill or that the source is depleted and the majority of VOCs have migrated away from the source.

The interpretations and conclusions presented in Sections 2.0 through 5.0 of this report are based on the results of the RFI field program, the Phase I Interim Investigation, and the ICMS Investigation.

**1.6 REPORT ORGANIZATION.** This report presents both conclusions and a strategy for corrective action based on the analysis and evaluation of data collected during the investigations at Site 11 and includes the following:

- Introduction - including the facility background, regulatory setting, purpose of the report, objectives of the RFI, previous investigations, and report organization.
- Environmental Setting - discusses regional and site-specific hydrogeology, soils, topography, surface water and drainage, and climate.
- Source Characterization - discusses the disposal area and waste characteristics.
- Contamination Characteristics - discusses groundwater, soil, surface water, sediment, and air contamination, as well as subsurface gas accumulation.
- Investigation Analyses - summarizes data quality for the various analytical programs associated with investigations conducted at the site.
- Potential Receptors - discusses human populations and ecological systems potentially susceptible to contaminant exposure.
- Protection Standards - discusses groundwater and other relevant protection standards.
- Strategy for Corrective Action - summarizes follow-on activities planned at the site.
- ICMS Investigation Addendum - describes the field program, analytical program, and results of additional activities conducted as part of the ICMS Investigation.

## 2.0 ENVIRONMENTAL SETTING

The environmental setting for Site 11 includes information regarding the hydrogeology, soils topography, surface water and drainage, and climate. This information is provided in the sections below.

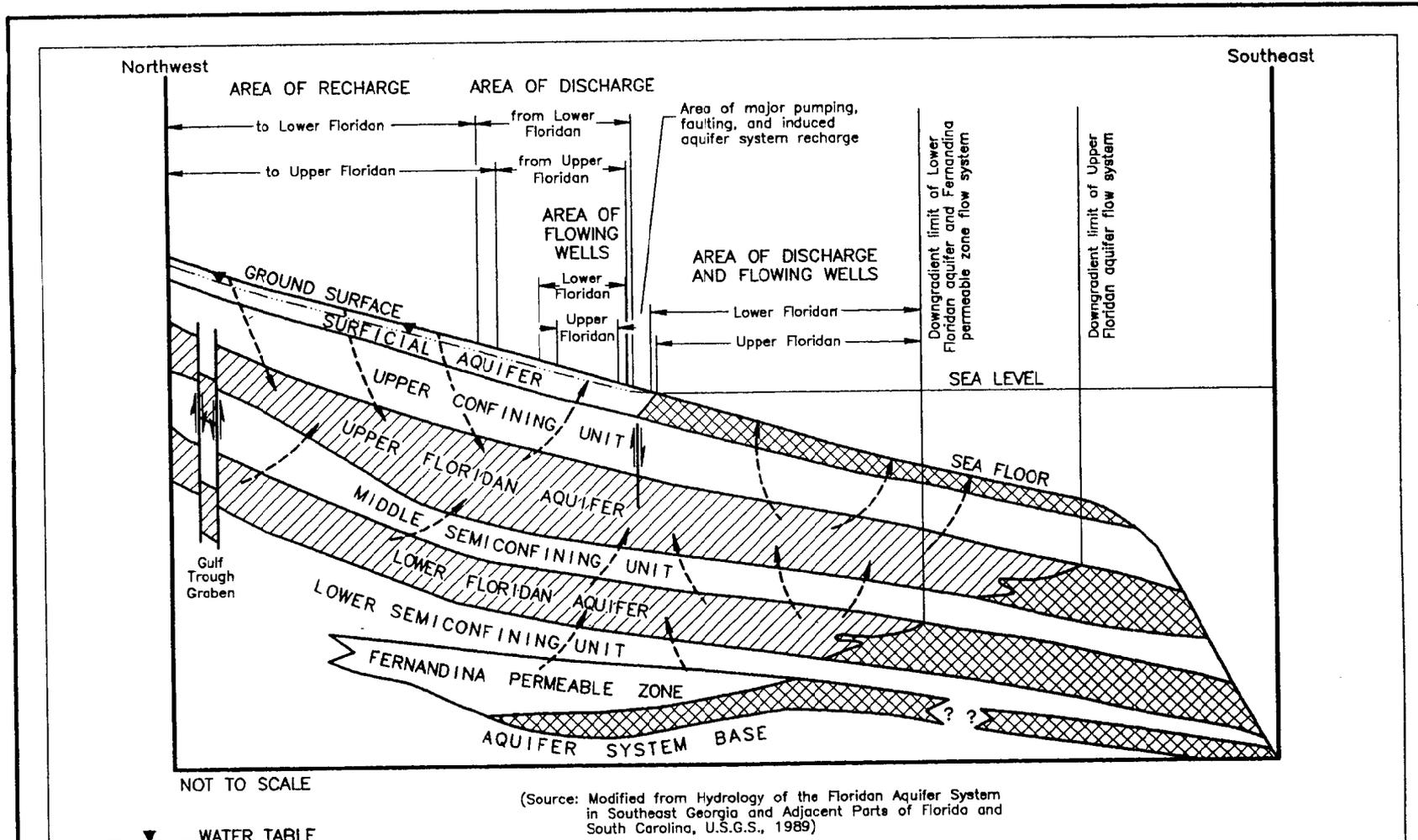
2.1 HYDROGEOLOGY. The hydrogeology for Site 11 is described on a regional scale and a site-specific scale. This information is provided in the following subsections.

2.1.1 Regional Hydrogeology The Kings Bay region is located within the Coastal Plain physiographic province along the Georgia coast line. Seven different depositional shorelines have been discovered around Kings Bay as a result of sea level fluctuations during the Quaternary period. The shoreline complexes have not been accurately dated, but are of approximate Pleistocene and Holocene age (C.C. Johnson, 1985).

A principal source for the hydrogeologic information discussed below is the Hydrogeology of the Floridan Aquifer System in Southeast Georgia and Adjacent Parts of Florida and South Carolina, Professional Paper 1403-D (USGS, 1989). The uppermost aquifer in the Kings Bay area is the unconfined water table (surficial) aquifer. Below the surficial aquifer lies the upper confining unit. The primary artesian aquifer, or the Floridan aquifer system, lies below the upper confining unit (Figure 2-1). Figure 2-1 shows the conceptual model of the Floridan aquifer system from the Gulf Trough in the northwest to the offshore area in the southeast. Figure 2-2 provides a generalized correlation of these units with respect to stratigraphy, lithology, and hydrologic properties. Analysis of geophysical logs obtained from the U.S. Geological Survey (USGS) of area wells confirms a structural downdip to the southwest of approximately 2 feet per mile in the above units.

The surficial aquifer ranges in thickness from approximately 6 to 90 feet bgs and consists of post-Miocene age unconsolidated fine to very coarse, well-sorted sand. Layers of poorly sorted sand, clayey silty sand, and, at depth, argillaceous limestone are interbedded with these well-sorted sand beds. The primary source of recharge to the surficial aquifer is infiltration from precipitation. Water movement is laterally downgradient with discharge to streams, ponds, and other surface water bodies. Evaporation and transpiration, as well as downward migration to lower aquifers, account for some water loss. Water levels in the surficial aquifer respond rapidly to rainfall. Seasonal variations correspond to variations in rainfall and evapotranspiration. Water levels may fluctuate seasonally by 15 to 20 feet in areas of high topographic relief and high permeability aquifer material. In flat-lying areas where low-permeability material is present, seasonal fluctuations are commonly less than 10 feet. The surficial aquifer functions as a source of recharge for the Floridan aquifer system by downward leakage through the secondary aquifer in areas where the water table in the surficial aquifer is above the potentiometric surface in the Floridan. Where the head gradient between the surficial aquifer and the Floridan is in the opposite direction, the surficial aquifer receives recharge from the Floridan aquifer system.

The upper confining unit, beginning at approximately 90 feet bgs, ranges from 380 to 530 feet thick. This confining unit separates the water table aquifer from



NOT TO SCALE

(Source: Modified from Hydrology of the Floridan Aquifer System in Southeast Georgia and Adjacent Parts of Florida and South Carolina, U.S.G.S., 1989)

- ▼ WATER TABLE
- GROUNDWATER CIRCULATION
- ▨ FRESHWATER
- ▩ SALTWATER

DWN: DMF	DES: DMF	PROJECT NO.: 7553-09	TITLE:
CHKD: KMH	APPD.: LBH	FIGURE NO.:	CONCEPTUAL MODEL OF THE FLORIDAN AQUIFER SYSTEM
DATE: 3-10-93	REV.:	2-1	



RPT INTERIM REPORT FOR SITE 11  
NAVAL SUBMARINE BASE, KINGS BAY, GEORGIA

System	Series	Gulf Coast Stage	NORTHEAST FLORIDA AND EXTREME SOUTHEAST GEORGIA		
			Stratigraphic Unit	Lithology	Hydrostratigraphic Unit Hydrologic Properties
Quaternary	Holocene and Pleistocene		Alluvium and terrace deposits	Chiefly sand, gravel, clay, shells, limestone, and marl	Surficial Aquifer - Low to moderate yields
Tertiary	Pliocene		Charlton Formation	Shells, sand, and marl	Surficial Aquifer - Low to moderate yields
	Miocene		Hawthorn Formation	Chiefly interbedded sand, clay, and dolomite, and sandy phosphatic dolomite and marl	Upper Confining Unit - Low to moderate amounts of artesian and nonartesian water. Most of the Hawthorn forms the upper confining unit for the underlying artesian water, but in places, the lower part may be hydraulically connected to the Upper Floridan aquifer
	Oligocene	Chickasawhayan	Suwannee Limestone	Limestone ranging from soft, chalky, and fossiliferous to dense, calcified, saccharoidal, and unfossiliferous, containing many solution cavities in recharge area	Upper Floridan - Yields moderate to large amounts of water, but generally less than underlying Eocene formations. Uppermost unit of the Floridan aquifer system
	Upper Eocene	Jacksonian	Ocala Limestone	White to gray, fossiliferous, recrystallized, porous limestone containing large solution cavities and caves in recharge area as well as at depth down-gradient	Upper Floridan Prolific aquifer; yields as much as 7,500 gal/min from two distinct water-bearing zones near the top and base of the formation
	Middle Eocene	Claibornian	Avon Park Formation	Cream-colored to brown, chalky to well indurated, pelletal to micritic limestone interbedded with cream-colored to dark-brown, fine to medium crystalline, slightly vuggy dolomite	Middle Confining Unit/Lower Floridan Not a significant contributor to the Floridan aquifer system in southeast Georgia. Yields moderate to large amounts of water in northeast Florida where the dolomite contains secondary permeability solution cavities
	Lower Eocene	Sabinian	Oldsmar Formation	Off-white to light/gray micritic limestone, interbedded with gray to light-brown, fine to medium crystalline, commonly vuggy dolomite. In places, contains pore-filling gypsum and thin beds of anhydrite	Lower Floridan Upper part acts as a semiconfining bed to basal part, which yields large amounts of water
	Paleocene	Midwayan	Cedar Keys Formation	Gray and cream-colored, dolomitized limestone containing gypsum and anhydrite stringers, to finely crystalline dolomite and anhydrite	Fernandina Zone Extremely low permeability. Acts as the lower confining unit of the Floridan aquifer system except where permeable in the Brunswick, Ga., area, where it is part of the Lower Floridan aquifer. Contains mineralized water there
Cretaceous	Upper	Navarroan	Lawson Limestone	Light-tan to orange, recrystallized, sandy, porous dolostone and calcarenite	Fernandina Zone Low permeability. Extremely high permeability locally in the Brunswick, Ga., area where it is part of the Lower Floridan aquifer. Contains highly mineralized water there
		Tayloran	Undifferentiated	White to cream-colored, argillaceous, soft, chalky limestone to hard, gray, shaly marl	Low permeability. Locally acts as the lower confining unit of the Floridan aquifer system in the Brunswick, Ga., area

Source: Modified USGS, 1989

DWN: DMF	DES: LGT	PROJECT NO.: 7553-09	TITLE: GENERALIZED CORRELATION OF COSTAL PLAINS STRATIGRAPHIC UNITS, LITHOLOGY, AND HYDROLOGIC PROPERTIES
CHKD: LBH	APPD.: LBH	FIGURE NO.: 2-2	
DATE: 5-17-93	REV.:		



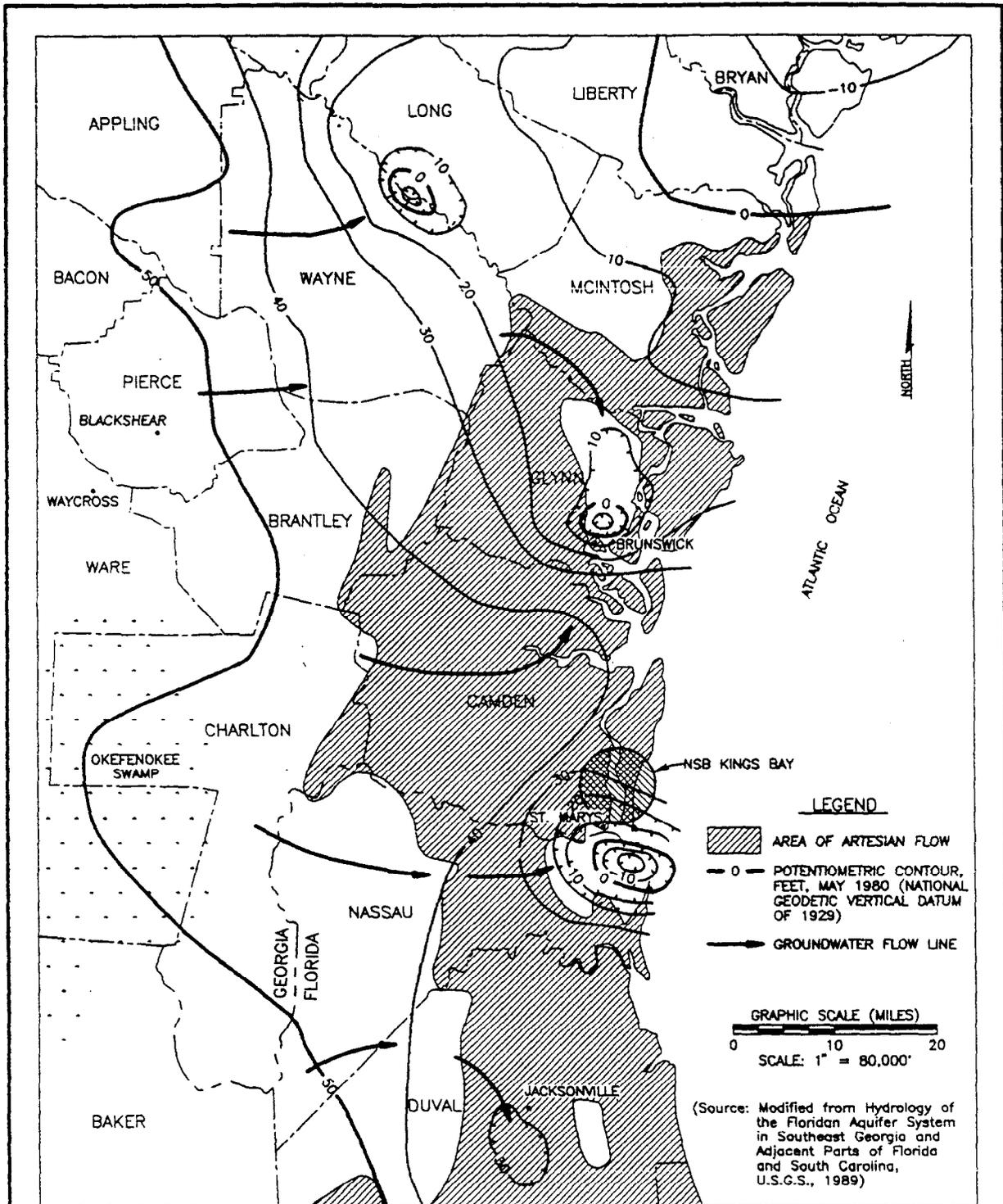
FLORIDA DEPARTMENT OF NATURAL RESOURCES  
WWW.FLORIDADNR.COM

the Floridan aquifer system and includes not only extremely low-permeability clay, but also moderately permeable sand beds. The confining unit is a regional formation, the Hawthorn Formation of late and middle Miocene age, present from north Florida to South Carolina. Over most of the region, the unit consists of middle Miocene age, interbedded sand, silt, clay, and low-permeability sandy clay beds. Groundwater yields in the confining unit are highly variable, and it is not considered a principal source of water (USGS, 1989).

The Floridan aquifer system is composed of upper and lower permeable zones, termed the Upper Floridan and the Lower Floridan aquifers, respectively. This unit is used for drinking water, as it is of good quality and provides sufficient yield. In southeast Georgia and northeast Florida, the aquifer system contains cavities, cavernous zones, and solution channels tens of feet in the vertical and horizontal dimensions. Primarily, these zones are found in the Upper Floridan, but the Lower Floridan contains some of the largest in its Fernandina zone. Most of these zones are oriented horizontally, enhancing lateral permeabilities. However, some solution channels have formed along probable zones of weakness caused by high-angle, nearly vertical fractures and faults. In extreme southeast Georgia and northeast Florida, permeable zones within the entire Floridan aquifer system are locally connected by these nearly vertical conduits. Faults are believed to be present in the Floridan aquifer system along the coast in extreme southeast Georgia and northeast Florida; however, none were indicated on regional structure maps (USGS, 1989).

The Upper Floridan aquifer consists primarily of late Eocene Ocala limestone and equivalents. The Ocala is a very fossiliferous limestone having high effective porosity and permeability, especially the upper portion. Migration of groundwater along bedding planes, joints, fractures, and other zones of weakness have developed secondary permeability that makes the Ocala extremely permeable. The Upper Floridan is composed of two permeable zones in the area of southeast Georgia. These units are designated the upper and lower water-bearing zones. The upper water-bearing zone ranges in thickness from 75 to 150 feet and consists of late Eocene age limestone that is very fossiliferous and permeable. The lower water-bearing zone ranges in thickness from 15 to 110 feet and consists of middle to late Eocene age dolomitic limestone that is recrystallized and less permeable than the upper water-bearing zone. Hydraulic characteristics of the Floridan aquifer system are primarily known for the Upper Floridan aquifer. Regional groundwater flow in the upper Floridan is primarily easterly with southeasterly and northeasterly components (Figure 2-3). Because of the aquifer's heterogeneity, transmissivity ranges from nearly zero near the aquifer's updip extent (east-central Georgia and southern South Carolina) to approximately 1 million feet squared per day in the thick carbonate sequence in southern Georgia. Because the Upper Floridan is so prolific, water supply wells in southeast Georgia generally do not tap other water-bearing units beneath the Upper Floridan (USGS, 1989).

The Lower Floridan aquifer consists primarily of middle to lower Eocene carbonate rocks that are less fossiliferous and more dolomitic than the Upper Floridan aquifer. The permeability of the unit is primarily secondary, developed along bedding planes and other zones of weakness. In the southeastern Georgia area, the Lower Floridan aquifer includes a water-bearing zone designated the Fernandina permeable zone. The zone consists of Paleocene and late Cretaceous age recrystallized limestone and dolomite that is extremely permeable. The



DWN: DMF	DES: DMF	PROJECT NO.: 7553-09	TITLE: REGIONAL POTENTIOMETRIC SURFACE MAP FOR THE UPPER FLORIDAN AQUIFER
CHKD: KMH	APPD.: LBH	FIGURE NO.: 2-3	
DATE:	REV.:		



AN INTERIM REPORT FOR SITE 11  
NASSAU SUPERFICIAL BASIN, NASSAU COUNTY, GEORGIA

middle semi-confining unit, which lies between the Upper and Lower Floridan aquifers, consists of middle Eocene dense limestone and dolomite that is recrystallized and of low permeability.

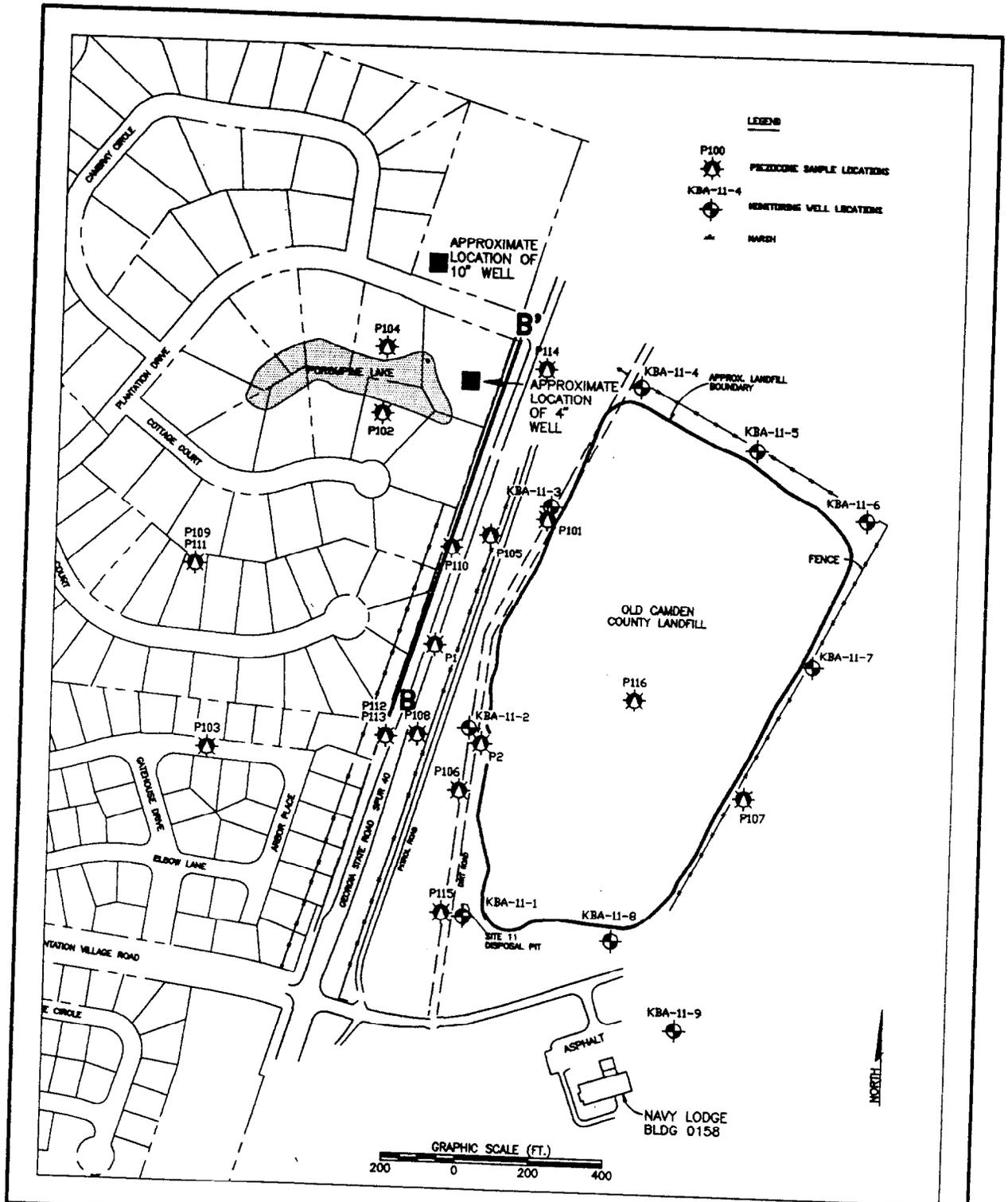
**2.1.2 Site-Specific Hydrogeology** A conceptual model of the hydrogeologic setting at the landfill is discussed below. This model describes the generalized physical conditions of the site that affect contaminant migration. Geologic and hydrogeologic information have been obtained from the following activities during three phases of investigation: magnetometer and terrain conductivity surveys, collection of subsurface soil samples, installation of groundwater monitoring wells, collection of groundwater samples, and piezocone penetrations. Estimates of hydraulic conductivity have been obtained from slug tests and groundwater sampling using a hydrocone groundwater sampler. Field investigation methods and results are discussed in Section 4.0. The hydrogeologic conceptual model will be confirmed and/or refined during the Supplemental RFI.

The water table aquifer consists mainly of layers of fine sands interbedded with silty and/or clayey fine sands and some medium sands (Figure 2-4). The stratigraphic cross-section shown in Figure 2-4 is based on piezocone data. Locations of piezocones are shown in Figure 2-5. The aquifer thickness is approximately 90 feet in the vicinity of the landfill. The density of the layers, as interpreted from piezocone data, is generally medium dense and dense. No strata have been identified that would act as a confining layer or barrier to contaminant migration. Piezocone and boring logs indicate that the lithologic units present in the area have been undisturbed by faulting. Four stratigraphic units are identified in Figure 2-4 as layers A, B, C, and D. These units were differentiated based on grain size variations. Layers A and C are deposits of fines representing cyclic fluctuations in sea level. These graded fine sands are separated by a homogenous layer of sorted fine sand. This fine sand unit (layer B) represents a period of stability in the sedimentary environment. Layer D was identified as a separate stratigraphic unit because it is neither homogenous (layer B) or cyclic (layers C and A). The top of layer D is marked by a dense fine sand layer recorded as a cemented unit during piezocone penetrations.

A groundwater potentiometric surface map was prepared from groundwater elevations measured on January 14, 1993, during the sixth monitoring event (Figure 2-6). Potentiometric surface maps for groundwater sampling rounds one through five are provided in Appendix A. The overall hydraulic gradient in the vicinity of the landfill slopes gently toward the west-northwest. Groundwater flows laterally in this direction and is interpreted to ultimately discharge to surface water. Some localized variations in groundwater flow exist. Localized mounding in the area of monitoring well KBA-11-8 was present during the first five monitoring events. Groundwater levels at the site were also measured over a 24-hour period to evaluate potential tidal influence in the aquifer. Based on the collected data, there is no significant tidal influence on the aquifer at the landfill. Based on the regional hydrogeologic information, the upper confining unit lies below the surficial aquifer, separating this unit from the primary potable source aquifer in the vicinity of the landfill, the Upper Floridan.

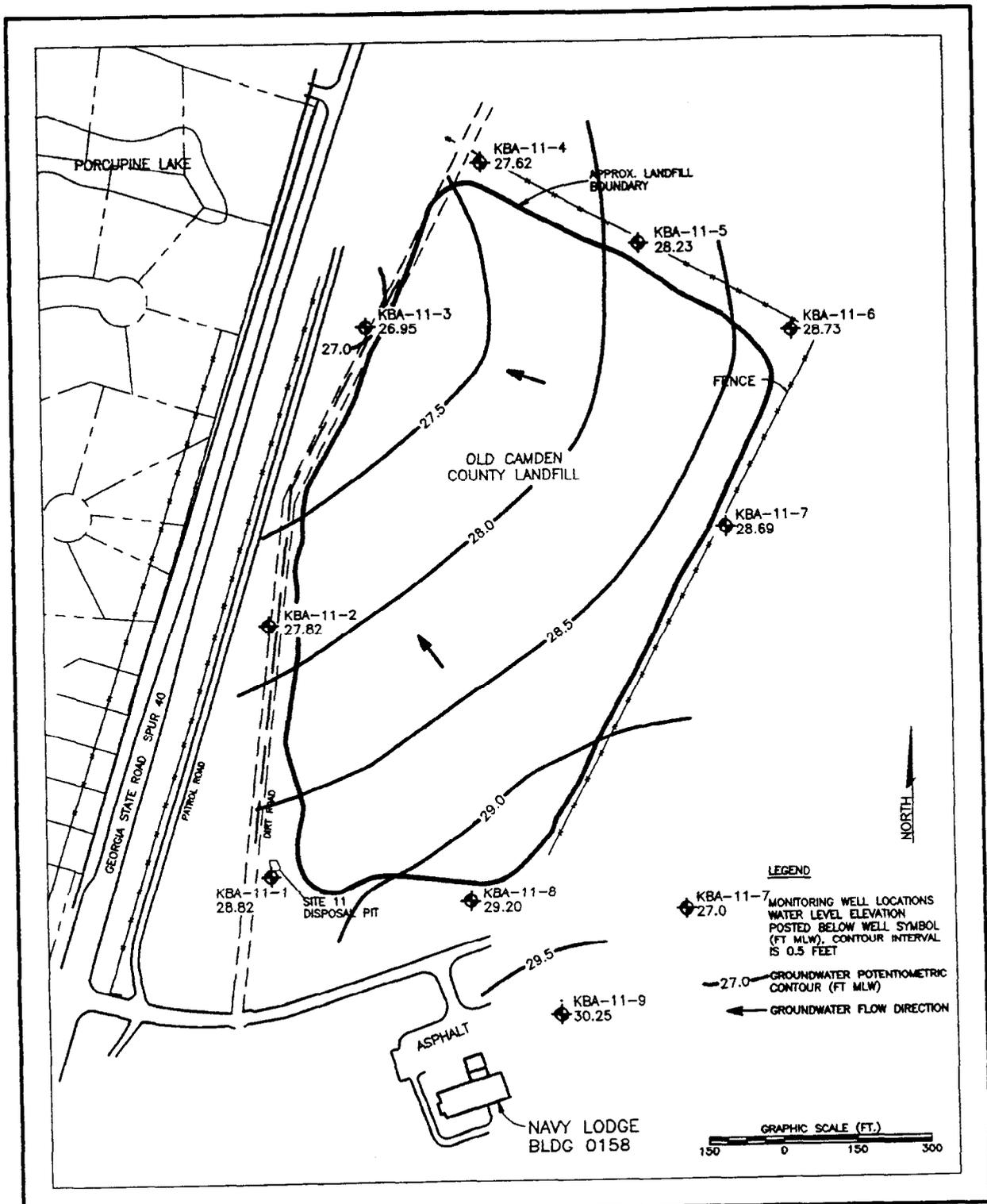
Hydraulic conductivity values were calculated for slug test data from four monitoring wells (KBA-11-1, KBA-11-3, KBA-11-5, and KBA-11-7) using AQTESOLV™ software and methods of analysis developed by Bouwer and Rice (1976). Values of hydraulic conductivity calculated from the slug tests range from  $4.8 \times 10^{-3}$  ft/min to  $7.9 \times 10^{-3}$  ft/min. Hydraulic conductivity values were calculated from





DWN: DMF	DES: LGT	PROJECT NO.: 7553-09	TITLE: PIEZOCONE LOCATIONS
CHKD: LBH	APPD.: LBH	FIGURE NO.: 2-5	
DATE: 3-31-93	REV.:		





DWN: DMF	DES: NW	PROJECT NO.: 7553	TITLE: GROUNDWATER POTENTIOMETRIC SURFACE MAP JANUARY 14, 1993
CHKD: KMH	APPD.: LBH	FIGURE NO.: 2-6	
DATE: 7-26-93	REV.:		



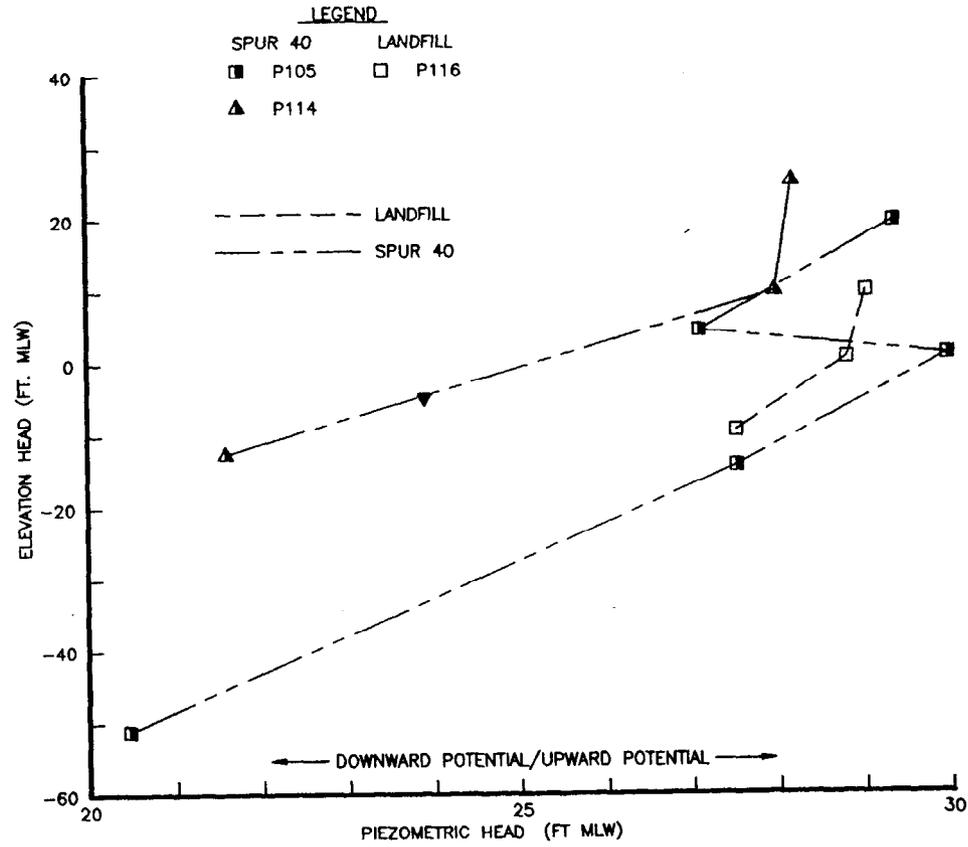
hydrocone data based on rate of filling of the sample chamber using methods of analysis developed by Hvorslev (1951) as presented by Cedergren (1989). Hydraulic conductivity values based on the hydrocone data range from  $2.2 \times 10^{-5}$  ft/min to  $1.0 \times 10^{-2}$  ft/min (101 measurements).

The methods used to calculate the hydraulic conductivity estimates for the slug tests data and hydrocone data are both based on time lag. The difference between methods of Bouwer and Rice (1976) and Hvorslev (Cedergren, 1989) is in the graphical representation of the data, with mathematical differences resulting therefrom. Both methods use the same data and both log transform the head displacement data. Hvorslev's method plots head ratios, whereas Bouwer and Rice's method plots straight head data. The hydraulic conductivities resulting from either method of analysis should show little variation, being of similar magnitude. The observed variation between the range of hydraulic conductivities calculated from slug tests and those calculated using hydrocone data are attributable to differences in effective length (10 feet vs. 1 foot) and differences in interval tested (i.e., depth in the aquifer).

Seepage velocities were calculated using hydraulic conductivity values from slug tests data and hydrocone data from the area of the landfill and an average hydraulic gradient of 0.003 feet per foot. This hydraulic gradient is based on water level measurements obtained at the existing monitoring wells. Assuming Darcian flow and an effective porosity of 30 percent, seepage velocities range from 7.3 feet per year (ft/yr) to 49 ft/yr. This results in an estimated maximum distance of contaminant migration (due to advection) of 880 feet based on a maximum seepage velocity of 49 ft/yr over an 18-year period from 1974 to late 1992. This value best reflects the observed distance of migration based on the distribution of contaminants.

Head potential graphs were developed to represent the vertical potential within the surficial aquifer (Figures 2-7 and 2-8). Pore pressure measurements were collected at various depths during eight of 15 piezocone penetrations. Appendix A contains a head potential graph for each of the eight piezocone locations and one showing all eight combined. Figure 2-7 represents vertical head potential data from locations in the area of the landfill and on the western right-of-way of Spur 40. Figure 2-8 represents head potential data from locations in the subdivision. Piezometric head measurements from within a piezocone borehole are plotted along the x-axis and the corresponding elevation head along the y-axis. The elevation head is the depth at which the measurement was collected relative to feet MLW. The piezometric head is an expression of the hydraulic pressure in feet MLW. A negative slope (a shift of data to the right) graphically represents an upward head potential. A positive slope (a shift of data to the left) graphically represents a downward head potential.

The overall head potential for the study area is downward. The stratigraphic layers (A through D) shown on Figure 2-4 are indicated on the head potential graphs in Appendix A for individual piezocone locations. Zones of upward head potential are present in the uppermost stratigraphic unit (layer A), but shifts to downward head potential in Layer B, a fine sand layer. The top of the fine sand layer is approximately 30 feet BLS and its base is approximately 50 feet BLS. The majority of VOC contaminants are present within this stratigraphic layer (30 to 50 feet BLS).

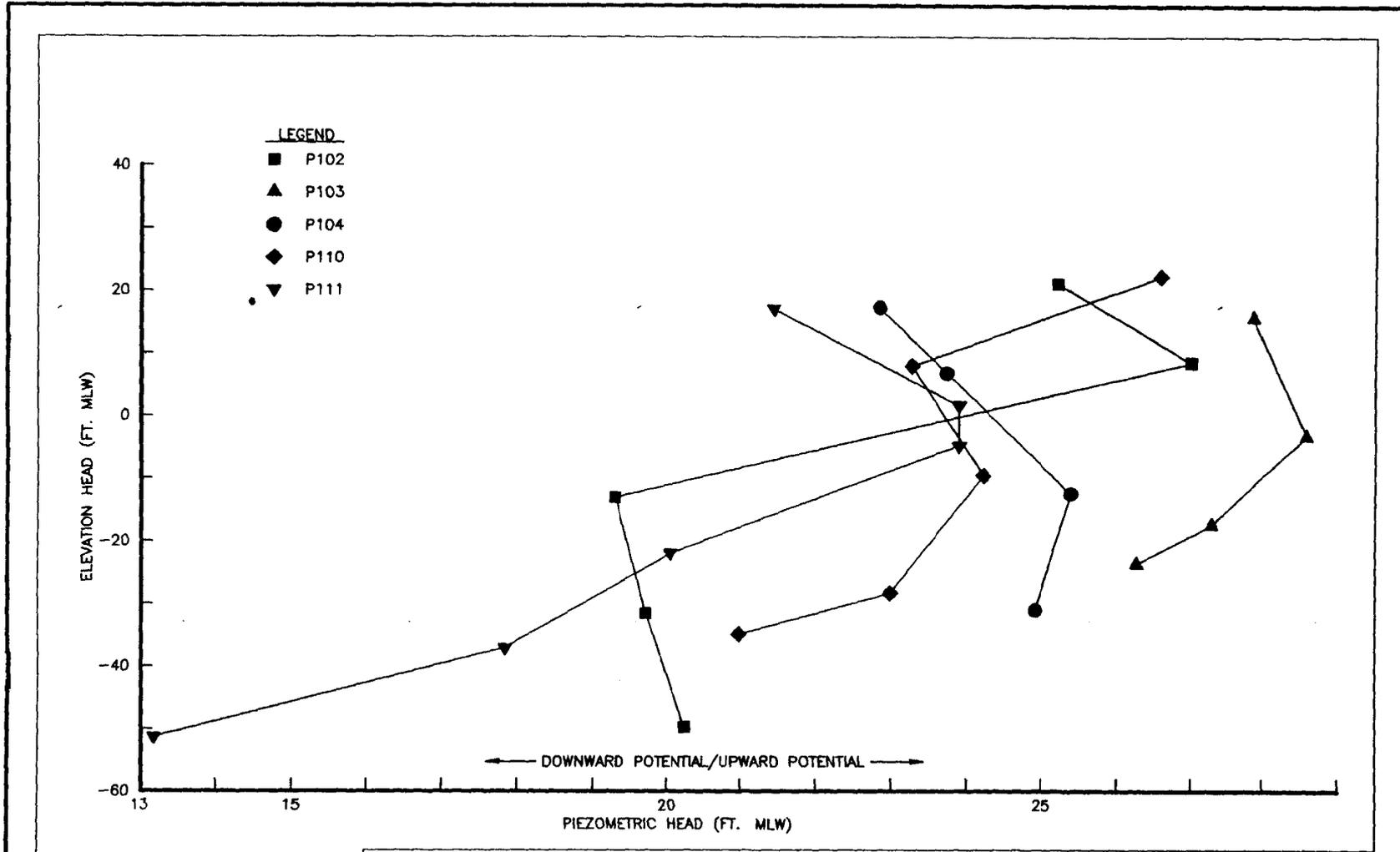


DWN: DMF	DES: DMF	PROJECT NO.: 7553-09
CHKD: LBH	APPD.: LBH	FIGURE NO.: 2-7
DATE: 4-13-93	REV.:	

TITLE:  
HYDRAULIC HEAD POTENTIAL  
GRAPH - LANDFILL AND  
SPUR 40 AREA



RF11 INTERIM REPORT FOR SITE 11  
NAVAL SUBMARINE BASE, KINGS BAY, GEORGIA



DWN: DMF	DES: DMF	PROJECT NO.:	TITLE:
CHKD: LBH	APPD.: LBH	7553-09	
DATE: 4-13-93	REV.:	FIGURE NO.:	HYDRAULIC HEAD POTENTIAL GRAPH - SUBDIVISION AREA
		2-8	



Comparison of hydraulic conductivity estimates obtained in various stratigraphic layers does not suggest that the fine sand unit (layer B) is more permeable than units above and below it. The hydraulic conductivity values for the graded fine sands comprising layer A range from  $4.6 \times 10^{-4}$  ft/min to  $1.0 \times 10^{-2}$  ft/min. Hydraulic conductivity values for layer B, the fine sand unit, range from  $5.5 \times 10^{-4}$  ft/min to  $3.0 \times 10^{-3}$  ft/min. Hydraulic conductivity measurements from layers C and D are similar to layer B, ranging from  $2.2 \times 10^{-5}$  ft/min to  $2.6 \times 10^{-3}$  ft/min.

Contaminant migration is affected by dispersive movement, advective transport due to actual hydraulic gradient - which may vary horizontally and vertically within the aquifer - and the influence of PIW use.

**2.2 SOILS.** Four soil map units are associated with the NSB Kings Bay area, the Mandarin-Rutledge, Pottsburg-Cainhoy, Fripp-Duckston-Beaches, and the Bohicket-Capers soils (Soil Conservation Service, 1980). The Mandarin-Rutledge and Pottsburg-Cainhoy soils are associated with nearly level or gently sloping soils on ridges and flats and in depressions and drainageways. The Fripp-Duckston-Beaches soils are associated with level to rolling soils on dunes and flats and in depressions, and nearly level beaches. The Bohicket-Capers soils are associated with level soils in tidal marshes (Figure 2-9).

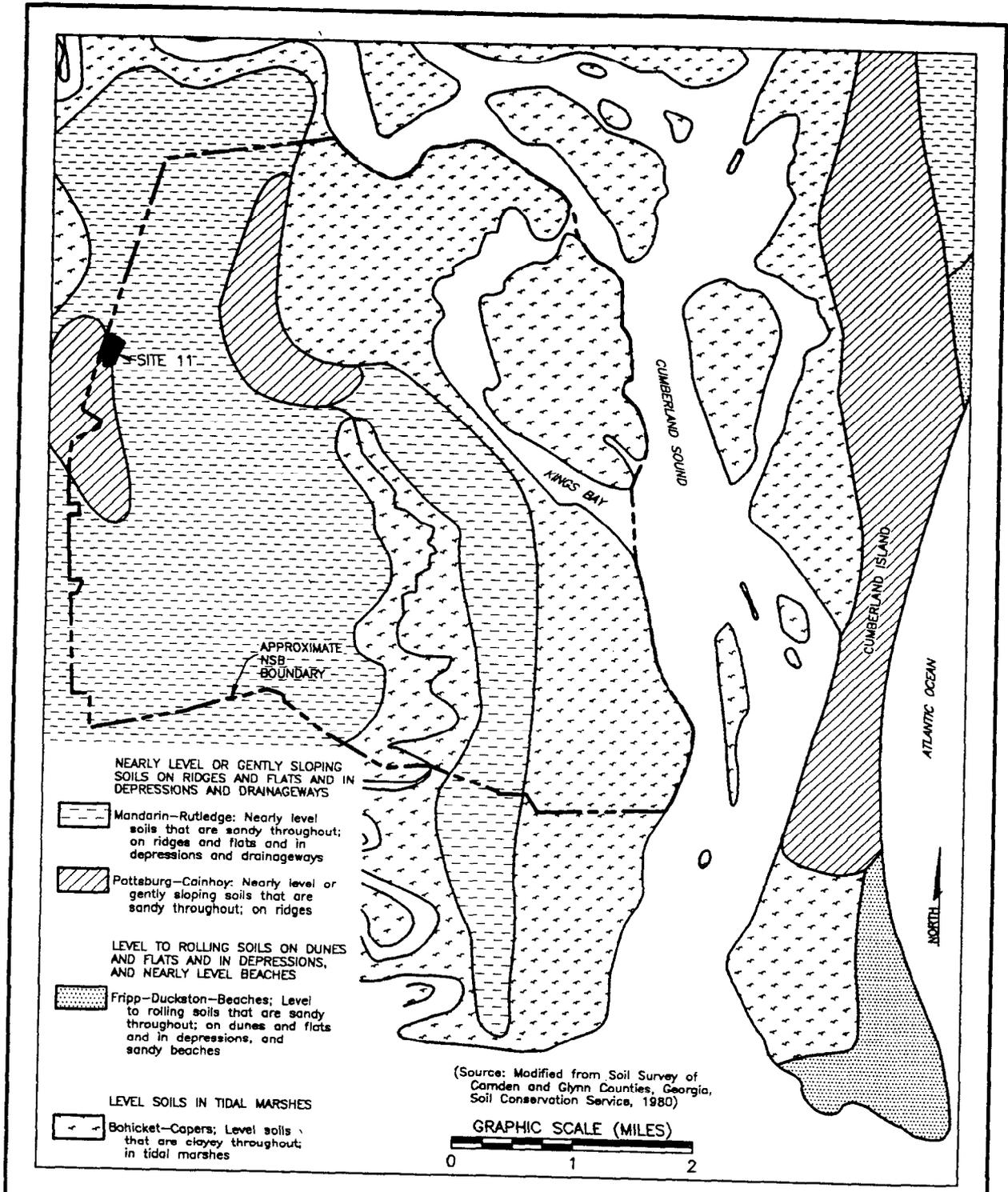
Mandarin-Rutledge - The Mandarin soils are typically fine sand, somewhat poorly drained, and found on ridges and flats. A very dark gray surface layer approximately 3 inches thick is underlain by a predominantly light gray layer extending to a depth of 19 inches. A weakly cemented organic hardpan extends below this to approximately 34 inches. The hardpan color is dark brown in the lower section, very dark brown in the middle section, and black in the upper section. Light gray, white, and grayish brown layers lie beneath the hardpan to a depth of 62 inches. A second weakly cemented black organic hardpan underlies these layers to a depth of 80 inches or more.

Rutledge soils are typically fine sand, very poorly drained, and found in depressions and drainageways. A black surface layer approximately 15 inches thick is underlain by a layer that is light gray mottled with brownish gray in the upper section, light brownish gray in the middle section, and grayish brown mottled with very dark grayish brown in the lower section. This layer extends to a depth of 70 inches or more.

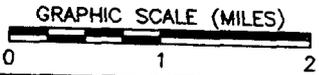
This unit has a slope of mainly less than 1 percent and lies in the east-central and extreme western part of Camden County and on the coastal islands. Because of the wetness of the soils, it has poor potential for most uses except woodlands.

Pottsburg-Cainhoy - The Pottsburg soils are typically sand, somewhat poorly drained, and nearly level. A gray surface layer approximately 4 inches thick is underlain by a layer that is light gray with brownish yellow and brown mottles in the upper section and white with brownish yellow and dark grayish brown mottles in the lower section. This layer extends to a depth of 63 inches and is underlain by a weakly cemented dark brown organic hardpan which extends to a depth of 80 inches or more.

Cainhoy soils are typically fine sand, somewhat excessively drained, and nearly level and gently sloping. A dark gray surface layer approximately 5 inches thick is underlain by a layer that is brownish yellow and extends to a depth of 23 inches. A very pale brown layer extends to a depth of 50 inches. Below this



(Source: Modified from Soil Survey of Camden and Glynn Counties, Georgia, Soil Conservation Service, 1980)



DWN: DMF	DES: DMF	PROJECT NO.: 7553-09	TITLE:  GENERAL SOIL MAP
CHKD: KMH	APPD.: LBH	FIGURE NO.: 2-9	
DATE: 3-22-93	REV.:		



NATIONAL WETLANDS INVENTORY REPORT FOR SITE 11  
WWW.EPA.GOV/NWIS/BCE/SPCS

layer are light gray and white layers to a depth of 101 inches. Next, a black and dark reddish brown layer extends to a depth of 120 inches.

This unit has a slope of 5 percent or less and lies on Cumberland Island and in the extreme western part of Camden County. Community development and recreation are the main uses for this unit. Due to the wetness of the soils on the lower landscapes, they have poor potential for urban uses. However, soils on the higher landscapes have good potential for most urban uses. The wetness of the lower landscape soils and the low available water capacity of the higher landscape soils are the main concerns for use and management of this map unit.

Fripp-Duckston-Beaches - The Fripp soils are typically fine sand, excessively drained, and found on undulating and rolling dunes. A grayish brown surface layer approximately 6 inches thick is underlain by a layer that is pale brown in the upper section and white in the lower section. This layer extends to a depth of 80 inches.

Duckston soils are typically sand, poorly drained, and found in shallow depressions and on flats. A surface layer approximately 17 inches thick is grayish brown in the upper section and light brownish gray in the lower section. Below this surface layer is a predominantly light gray layer, greenish gray in the lower section, extending to a depth of 80 inches.

Beaches soils are found adjacent to the ocean and are typically fine sand, sand, coarse sand, and varying amounts of small shell fragments. These soils are covered twice daily by the tide.

This unit has a slope ranging from 0 to 20 percent and lies on Cumberland Island. Soils in some areas have been developed for dwellings and recreation. Soils are too sandy for many wildlife and recreational uses. Because of flooding and wetness, potential is poor for most other uses.

Bohicket-Capers - The Bohicket soils are typically very poorly drained soils that border the ocean and are flooded twice daily by the tides. A dark silty clay loam approximately 8 inches thick is underlain by a dark greenish gray silty clay and clay to a depth of 65 inches or more. Grass fibrous roots are found throughout the soil.

Capers soils are typically very poorly drained, extend inland along creeks and rivers, and are flooded frequently by the tide. A surface layer of very dark gray silty clay approximately 8 inches thick is underlain by a very dark gray and dark gray clay to a depth of approximately 42 inches. Next is a greenish gray clay to a depth of 60 inches or more. Fine grass roots are found throughout the soils.

This unit has a slope of less than 1 percent and is found mainly along the Cumberland Sound and the Satilla River. Soils in some areas have been developed for farming. However, due to flooding, wetness, and natural sulfur content, they are primarily used by wetland wildlife.

2.3 TOPOGRAPHY, SURFACE WATER, AND DRAINAGE. Elevations at NSB Kings Bay are measured relative to MLW, rather than mean sea level. The elevations at NSB Kings Bay range from 0 feet MLW at the shoreline to 35 feet MLW in the western part of the base. The area around the base is generally flat and marshy, and traversed by slow meandering streams.

Elevations at the Old Camden County Landfill are higher than most surrounding areas, being approximately 35 feet MLW. The landfill surface is characterized by relatively flat to gently sloping surface topography. Drainage features provide topographic relief and, in the vicinity of the landfill, variations in elevations are approximately 10 feet.

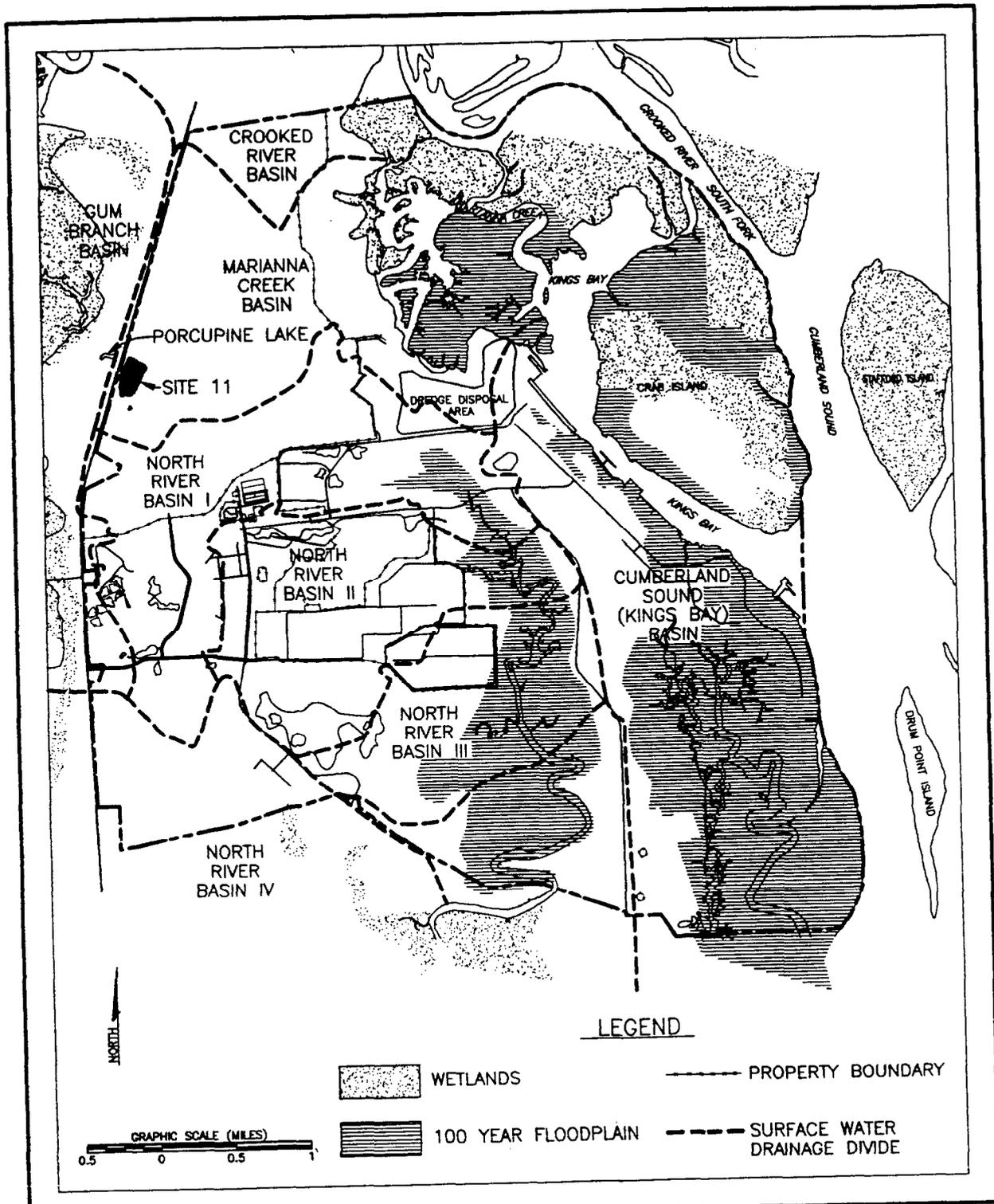
NSB Kings Bay is drained by three major drainage networks, Marianna Creek, North River, and Cumberland Sound Basins, as shown in Figure 2-10. Because the NSB is relatively flat, roads and disturbed areas form artificial drainage patterns and dividing lines between drainage basins. Surface runoff at NSB Kings Bay is rivers and intermittent creeks and rivers via storm drainage ditches. Infiltration of precipitation to groundwater is promoted by the flat topography and permeable sands. Most surface water runoff is stored in the upland swamps and marshes and is diverted off base through long shallow ditches and intermittent creeks and rivers. Water may eventually migrate through the surficial aquifer and discharge into streams, rivers, and springs, including the North River, Crooked River, and Marianna Creek. These streams and rivers eventually flow into Kings Bay and the Cumberland Sound.

The NSB Kings Bay drainage network covers an area of approximately 11,000 acres within the boundaries of the activity. Approximately 30 percent of this area is salt marsh, and the remainder consists of upland swamps and marshes. The major drainage outlet is the North River, draining approximately 49 percent of the area to the south. To the north, the Crooked River drains approximately 5 percent of the NSB, Marianna Creek drains 17 percent, and the remaining 29 percent of the base drains eastward into the Cumberland Sound.

Porcupine Lake, a man-made lake supported by groundwater discharge, is located approximately 400 feet northwest of the Old Camden County Landfill, Site 11. This lake is the nearest surface water body to the landfill, and, because, it is hydraulically downgradient of the landfill, could potentially be affected by releases from the landfill. The depth of the lake ranges from approximately 6 feet in the west end to 5 feet in the east end of the lake. The water in the lake is clear and supports abundant flora and fauna. Measurements of pH indicate the water is neutral, ranging from 6.61 to 7.10 standard units (s.u.). Specific conductance measurements ranged from 254 to 272 micro-mhos per centimeter ( $\mu\text{mhos/cm}$ ). Temperature of the lake water ranged from 22.8° Celsius (C) to 24.1° C. These measurements were taken in late October during the Interim Corrective Measure Screening Investigation.

Water quality in freshwater bodies in and near the NSB is typical of that for freshwater bodies within the region. Water quality is affected by concentrations of mercury, possibly from mercury-based fungicides, and low levels of dissolved oxygen. Water quality within Kings Bay and Cumberland Sound are affected by dredging activities, spoils disposal effluent discharge, sewage effluent discharge, construction, runoff from pine plantations and small agricultural areas, and waterfront industrial operations. The North River is classified for industrial use. The freshwater bodies described above are used principally for non-contact recreation including boating, fishing, and navigation.

The elevations of the 10-, 100-, and 500-year floodplains in the region are 6.8, 12.4, and 16.5 feet above mean sea level, respectively. Approximately one-half of the facility lies within the 100-year floodplain. In general, land



DWN: DMF	DES: DMF	PROJECT NO.: 7553-09	TITLE: SURFACE WATER DRAINAGE BASINS, WETLANDS, AND 100 YEAR FLOOD PLAIN MAP	
CHKD: KMH	APPD.: LBH	FIGURE NO.: 2-10		
DATE: 3-19-93	REV.:			

surrounding the low marshy areas near Marianna Creek and the North River lies within the 100-year floodplain.

2.4 CLIMATE. NSB Kings Bay is located in an area characterized by a humid subtropical climate, with hot wet summers and cool, dry winters. A summary of climatological data for the Kings Bay area is provided in Table 2-1. The normal annual temperature is approximately 70° Fahrenheit (F). Because of the moderating effect of the ocean, temperatures rarely rise above 100° F. Normal annual precipitation is estimated to be 53 inches (Thibodeaux, 1979). Precipitation occurs mainly in the form of rain during summer months. Evapotranspiration rates range from 35 to 36 inches per year (in/yr). The average annual runoff for the southeastern Georgia area is estimated at less than 10 in/yr (USGS, 1989). Based on the above estimates for annual precipitation, evapotranspiration, and surface water runoff, the annual infiltration to the surficial aquifer is estimated to be 7 inches. Relative humidity varies widely throughout the year, with an annual average of 87 percent in the morning and 55 percent in the afternoon. The highest relative humidity is generally encountered during June through October. The relative humidity is generally lowest during March through May (Thibodeaux, 1979).

Prevailing winds are westerly, with strong northerly components in winter and southerly components in summer. Figure 2-11 is a wind rose diagram for data obtained from the National Climatic Data Center for the period of record 1973 through 1982 from Jacksonville, Florida. Wind rose diagrams for each month of the year, over the period of record, are provided in Appendix B. Prevailing wind speeds are highest (9 to 10 miles per hour) in late winter and early spring, and lowest during the summer. The seasonal and annual wind pattern is influenced by the land and water temperatures along the coast. Thunderstorms occur most frequently in summer months, and tornadoes commonly occur during March through May. Generally, tropical cyclones and hurricanes have occurred during the months of August and September.

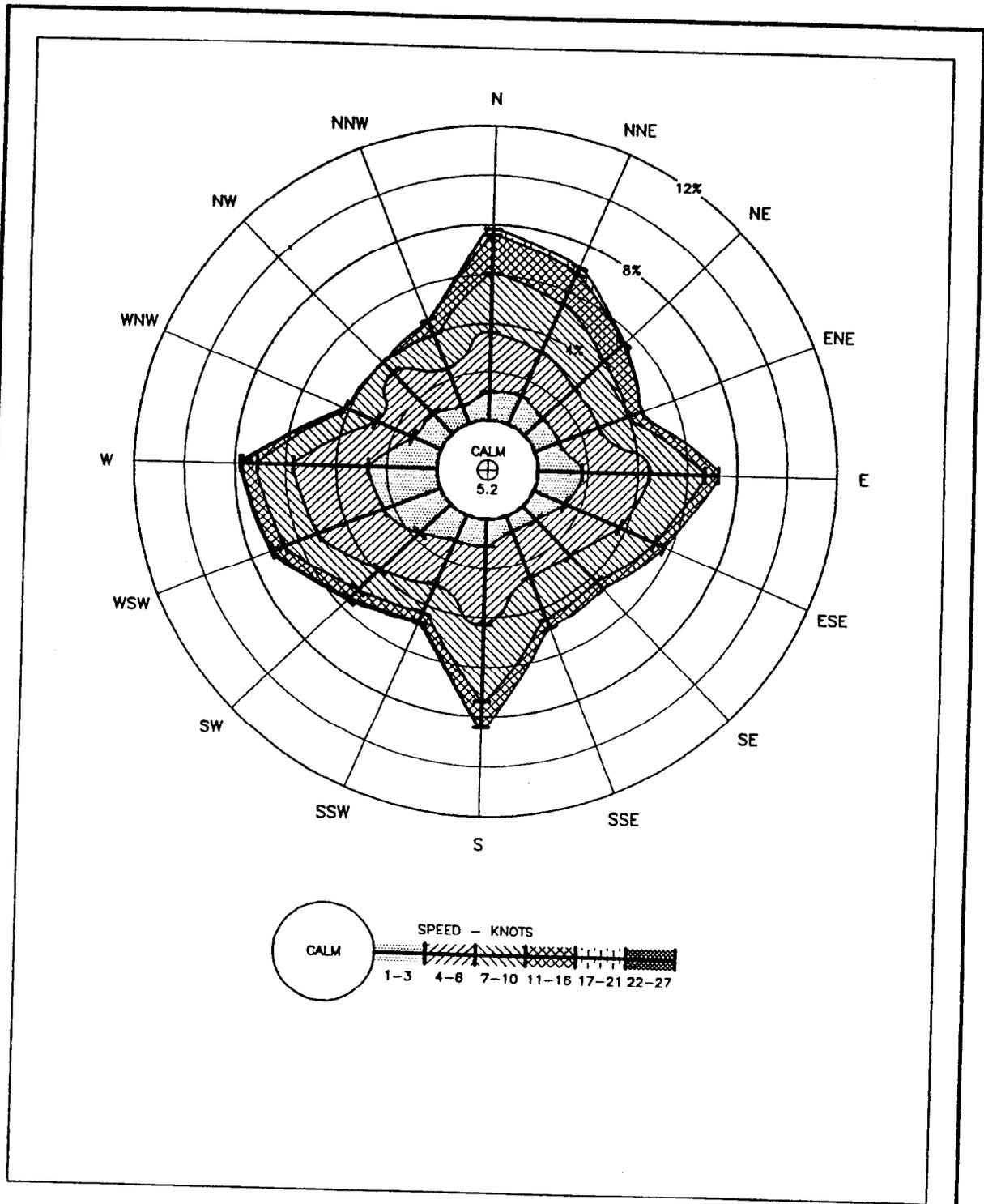
Table 2-1 Summary of Climatological Data<sup>1</sup>

	(yr) Length of Record	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Average Relative Humidity (%)	35	87/57 <sup>2</sup>	85/52	85/49	85/47	83/48	86/55	87/58	90/59	91/62	90/58	88/55	87/57	87/55
Normal Monthly/ Annual Precip. (inches)	NR	2.45	2.91	3.49	3.55	3.47	6.33	7.68	6.85	7.56	5.16	1.69	2.22	53.36
Normal Monthly/ Annual Average Temp (°F)	NR	55.9	57.5	62.2	68.7	75.8	80.8	82.6	82.3	79.4	71.0	61.7	56.1	69.5
Average Wind Speed (mi/hr)	22	8.7	9.8	9.8	9.5	9.1	8.7	7.9	7.7	8.8	9.0	8.6	8.4	8.8

**Notes:**<sup>1</sup> Information reported for Jacksonville, Florida Station<sup>2</sup> 87/57 = Average relative humidity for 7:00 am/1:00 pm

NR = Not Reported

Source: Thibodeaux, 1979.



DWN: DMF	DES: DMF	PROJECT NO.: 7553-09	TITLE: WIND ROSE JACKSONVILLE, FL., 1973-1982 ALL MONTHS	
CHKD: KMH	APPD.: LBH	FIGURE NO.: 2-11		
DATE: 3-19-93	REV.:			

### 3.0 SOURCE CHARACTERIZATION

Characteristics of the disposal area and the waste are described in the following sections.

3.1 DISPOSAL AREA CHARACTERISTICS. The Old Camden County Landfill is situated along the northwest boundary of the NSB (see Figure 1-2). The width of the landfill ranges from approximately 140 feet at the southern end to approximately 760 feet at the northern end. The landfill is approximately 1,400 feet at its maximum length.

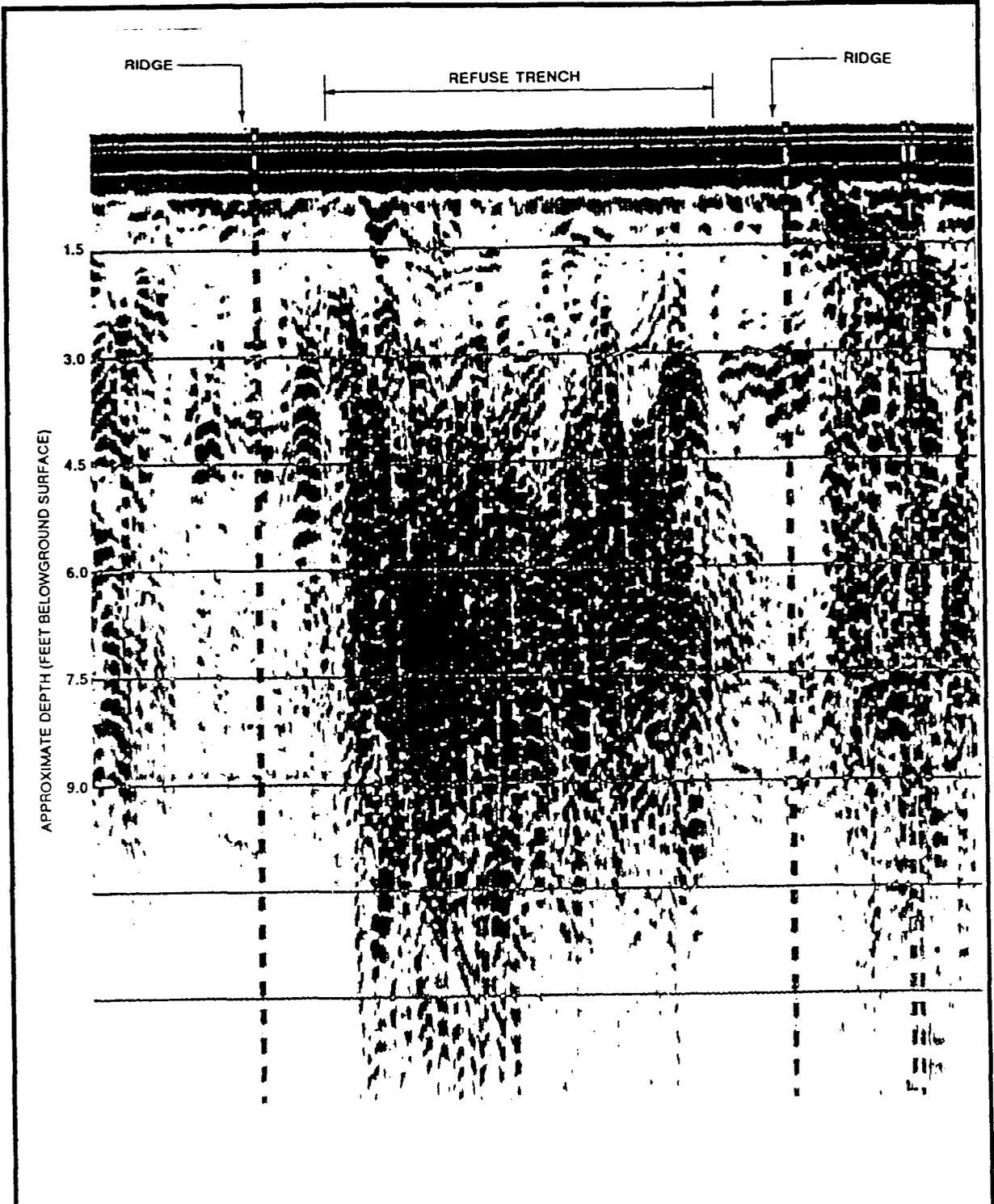
The landfill operated as a trench and fill operation with trenches oriented in a southeast to northwest direction. Based on magnetic and ground-penetrating radar (GPR) surveys performed during previous investigations, the trenches range from 575 to 775 feet in length and 35 to 50 feet in width. The GPR signature of the trenches is characterized by chaotic reflections and diffractions (Figure 3-1). GPR data also suggested that the spacing between trenches ranged between 3 and 5 feet and the depth to refuse ranged from 2 to 3 feet bgs. The areas between the trenches are interpreted to represent areas of the landfill that do not have substantial amounts of refuse beneath them.

The landfill was operated by Camden County from 1974 to 1981. On the average, approximately 12 truck loads per day of wastes were disposed of at Site 11. Burning of wastes was allowed during the early years of landfill activity. This practice was prohibited in 1975. At the end of each day, the wastes (and ash) were compacted and covered with at least 6 inches of soil cover. The landfill ceased operations in October 1981 and was covered with 2 feet of fill. The landfill surface is currently vegetated with grasses, weeds, and pine saplings (ABB-ES, 1993a).

3.2 WASTE CHARACTERISTICS. Approximately 500,000 cubic yards of waste were disposed of at the landfill between 1974 and 1981. This reportedly consisted of general household waste, office waste, scrap paper and wood, and waste sludge and grit from the NSB sewage treatment plant. The landfill reportedly received no hazardous waste. A September 1981 letter from Captain R.A. Currier, Navy Commanding Officer, requested permission to dispose of approximately 100 cubic yards of fire-fighting pit sludges from a proposed dredge spoils disposal area. This waste did not exceed Extraction Procedure (EP) Toxicity as described in 40 Code of Federal Regulations (CFR), Part 251.24 under Section 3001 of the RCRA. EP Toxicity tests were applicable for waste characterization in 1981. Approval from the Camden County Health Department for the disposal of burnt oils and gasoline from fire-fighting residues was granted in a December 1981 letter. No record of the actual disposal was found; however, it is assumed that disposal occurred.

Domestic waste sources and their estimated contributions are as follows:

<u>Source</u>	<u>Percentage of Total Waste</u>
Camden County	60 percent
NSB Kings Bay	20 to 30 percent
Blue Star Shipping Co.	5 to 10 percent
Gilman Paper Co.	5 to 10 percent



OWN: SFC	DES.: SFC	PROJECT NO.: 7553	TITLE:  GROUND-PENETRATING RADAR PROFILE	
CHKD: KMH	APPO: LBH	FIGURE NO.: 3-1		
DATE: 3/08/93	REV.:			

RFI INTERIM REPORT FOR SITE 11  
NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA

Knowledge of the chemical characteristics of the waste are based on the results of the RFI activities completed to date. Chlorinated and non-chlorinated solvents and fuel-related VOCs have been identified as constituents of the waste at Site 11. Little SVOC data currently exists. SVOCs detected during the first two bimonthly sampling events were limited to phthalates that could be attributed to laboratory or sampling artifacts.

Table 3-1 summarizes physical data for 23 organic chemicals detected in groundwater samples from the site. Chemical data and field observations indicate that contaminants are present as solute in groundwater. Concentrations of contaminants are generally less than 1 milligram per liter (mg/l), except for vinyl chloride (screening data only) and cis-1,2-dichloroethene that have been detected at concentrations that exceed 1 mg/l. These concentrations would not pose an explosion hazard or cause contaminated groundwater to be ignitable. Migration of contaminants is attributed to advection and dispersion of solutes.

Contaminants identified in the plume can be classified as chlorinated and non-chlorinated aliphatics, monocyclic aromatics, and polycyclic aromatics. Physical properties having a significant effect on transformation and migration are discussed in the following paragraphs.

Contaminants that are chlorinated aliphatics include tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethane, and 1,2-dichloropropane. These compounds are relatively soluble, having octanol-water partition coefficient ( $K_{ow}$ ) values that are generally less than 1,000 (Tetra Tech, 1989). Solubility of tetrachloroethene is somewhat less as indicated by its higher  $K_{ow}$  of 2510.

The chlorinated aliphatic compounds present in the plume, except for 1,2-dichloropropane, could be attributed to transformation of parent compounds, tetrachloroethene and/or trichloroethene, through biodegradation processes. Because the disposal area has not been characterized, all of the chlorinated aliphatics found in the plume cannot be attributed to the transformation of parent compounds. For example, 1,1-dichloroethane is used as an antiknock agent in gasoline, as a paint and varnish remover, and as a degreaser. This compound can also form during biodegradation of tetrachloroethene. Vinyl chloride is not commonly used for practical applications and its prevalence in the plume is attributed to biodegradation of other chlorinated aliphatic compounds. The chlorinated aliphatics are volatile compounds. However, volatilization does not appear to be an important transformation process at the site, as evidenced by the ubiquitous occurrence of vinyl chloride, a highly volatile compound. Photolysis is not considered to be a significant factor because this transformation process is prohibited by absence of light. Chlorinated aliphatics are susceptible to hydrolysis, but this transformation process is considered insignificant compared to biotransformation.

Contaminants that are monocyclic aromatics include benzene, toluene, ethylbenzene, xylenes, chlorobenzene, 1,4-dichlorobenzene, 2-methylphenol, 4-methylphenol, and 2,4-dimethylphenol. These compounds are relatively soluble, having  $K_{ow}$  values ranging from 89 (4-methylphenol) to 1,600 (m-xylene) (Mackay, 1991; Tetra Tech, 1989). Six of these compounds are typically associated with gasoline, including benzene, toluene, ethylbenzene, xylenes, chlorobenzene, and 1,4-dichlorobenzene. 1,4-Dichlorobenzene is also widely used as a deodorant and disinfectant and xylenes are common solvents, particularly in paints.

Table 3-1 Physical and Chemical Characteristics of VOCs and SVOCs Detected in Groundwater

Chemical	Physical Form	Chemical Class	Molecular Weight	Specific Density	Boiling Point (°F)	<sup>1</sup> Solubility in Water	Vapor Pressure	Flash Point (°F)
acetone	Liquid	Solvent	58.1	0.7899 @ 20/4°C	133	Miscible	180 mm	0
benzene	Liquid	Solvent	78.11	0.8765 @ 20/4°C	176	1,000 mg/l	76 mm	12
2-Butanone (Methol Ethyl Ketone)	Liquid	Solvent	72.1	0.8054 @ 20/4°C	175	25.5 % wt.	71 mm	16
chlorobenzene	Liquid	Solvent	112.6	1.1058 @ 20/4°C	270	503 mg/l	12 mm	85
carbon disulfide	Liquid	Solvent	76.1	1.2632 @ 20/4°C	116	0.1185 % wt.	297 mm	-22
1,4-Dichlorobenzene	Liquid	Solvent	147.0	1.3048 @ 20/4°C	357	137 mg/l	1 mm	151
1,1-Dichloroethane	Liquid	Solvent	99.0	1.1757 @ 20/4°C	135	5,060 mg/l	230 mm	22
1,2-Dichloroethane	Liquid	Solvent	99.0	1.2351 @ 20/4°C	182	8,300 mg/l	64 mm	63
cis-1,2-Dichloroethene	Liquid	Solvent	96.9	1.257 @ 20/4°C	140	NA	NA	36
trans-1,2-Dichloroethene	Liquid	Solvent	96.9	1.257 @ 20/4°C	118	6,300 mg/l	265	36
1,2-Dichloropropane	Liquid	Solvent	113.0	1.560 @ 20/4°C	206	2,800 mg/l	42 mm	60
ethylbenzene	Liquid	Solvent	106.2	0.8670 @ 20/4°C	277	206 mg/l	10 mm	55
2-Hexanone (methyl butyl ketone)	Liquid	Solvent	100.2	0.8113 @ 20/4°C	262	35,000 mg/l	4 mm	77
4-Methyl-2-pentanone (methyl isobutyl ketone)	Liquid	Solvent	100.2	0.7978 @ 20/4°C	242	17,000 mg/l	15 mm	64
Naphthalene	Solid	Base	128.2	1.162 @ 20/4°C	424	30 mg/l	0.054	174
2,4-Dimethylphenol	Solid	Acid	122.2	0.965 @ 20/4°C	410	7,868 mg/l	0.062 mm	7,230
2-Methylphenol	Solid/ Liquid	Acid	108.1	1.047 @ 20/4°C	376	25,000 mg/l	0.24 mm	178
4-Methylphenol	Solid	Acid	108.1	1.018 @ 20/4°C	395	23,000 mg/l	0.04 mm	187
tetrachloroethylene	Liquid	Solvent	165.8	1.6227 @ 20/4°C	250	150 mg/l	14 mm	NA
toluene	Liquid	Solvent	92.1	0.8669 @ 20/4°C	232	524 mg/l	22 mm	40
trichloroethene	Liquid	solvent	131.4	1.4642 @ 20/4°C	189	1,100 mg/l	58 mm	90
xylene (total)	Liquid	Solvent	106.2	0.8802 @ 20/4°C	269-292	152 mg/l	9 mm	64
vinyl chloride	Gas	Solvent	62.5	0.9106 @ 20/4°C	7	1,100 mg/l	>1 atm	N/A

## Notes:

<sup>1</sup> Solubility in fresh water at 25°C<sup>2</sup> Vapor pressure at 20°C to 25°C

atm = atmosphere

°C = degrees celsius

°F = degrees fahrenheit

mg/l = milligram per liter

mm = millimeter

NA = not available

wt. = weight

Sources: Montgomery, 1991.

Montgomery and Welkon, 1989.

Niosh, 1990.

Chlorobenzene, 1,4-dichlorobenzene, and the phenols probably represent related transformation products. All these compounds are susceptible to biotransformation. Transformations of any type generally affect functional groups and not the ring structure of the molecules, and typically result in formation of alcohols, acids, or aldehydes. Abiotic hydrolysis is not likely because of the structure of this group of compounds. Under suitable conditions, photolysis would occur.

One polycyclic aromatic compound, naphthalene, has been detected in a groundwater sample from the plume. This compound is typically associated with incomplete combustion of fuel, but could also be the natural byproduct of incomplete combustion of plant material. Polycyclic aromatic compounds are characterized by low solubilities, having  $K_{ow}$  values ranging from 2,000 (naphthalene) to over 1 million for the larger, more complex molecules (Tetra Tech, 1989; Mackay, 1991). These compounds tend to adsorb to organic particulates that coat soil particles. Biotransformation is possible, but slower than for other organic compounds discussed in the preceding paragraphs. Abiotic hydrolysis is unlikely for naphthalene because it has no functional groups in its structure. Under suitable conditions, polycyclic aromatics readily undergo photolysis transformations.

Currently, information regarding waste characteristics is limited. During future RFI activities, installation of monitoring wells into the plume and test pits in the landfill will allow collection of data for evaluation of other potential contaminants.

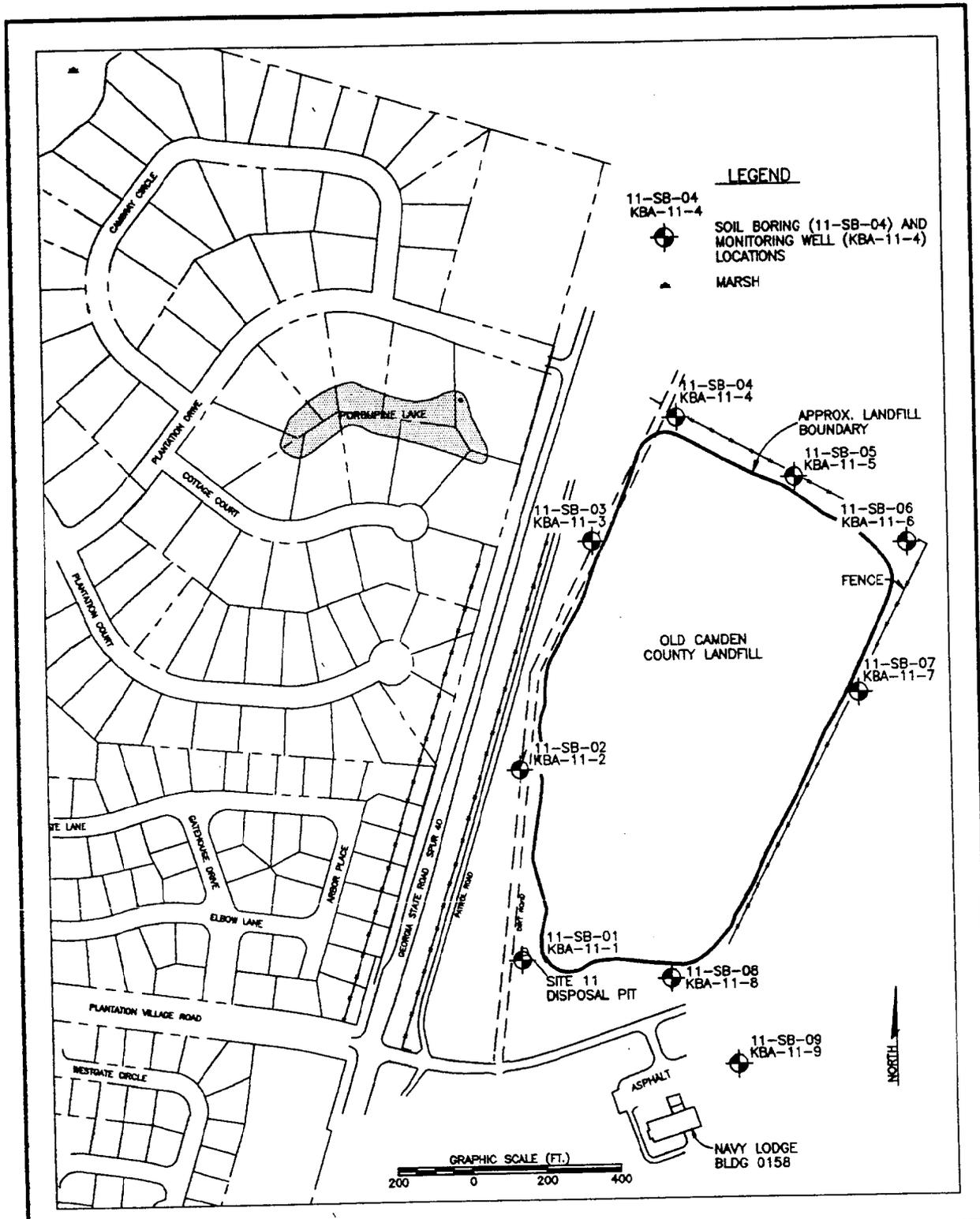
## 4.0 CONTAMINATION CHARACTERISTICS

A limited evaluation of contamination characteristic of groundwater, soil, surface water, sediment, air, and subsurface soil gas has been conducted from investigations at Site 11. The results and methodology of these investigations are described in the following subsections.

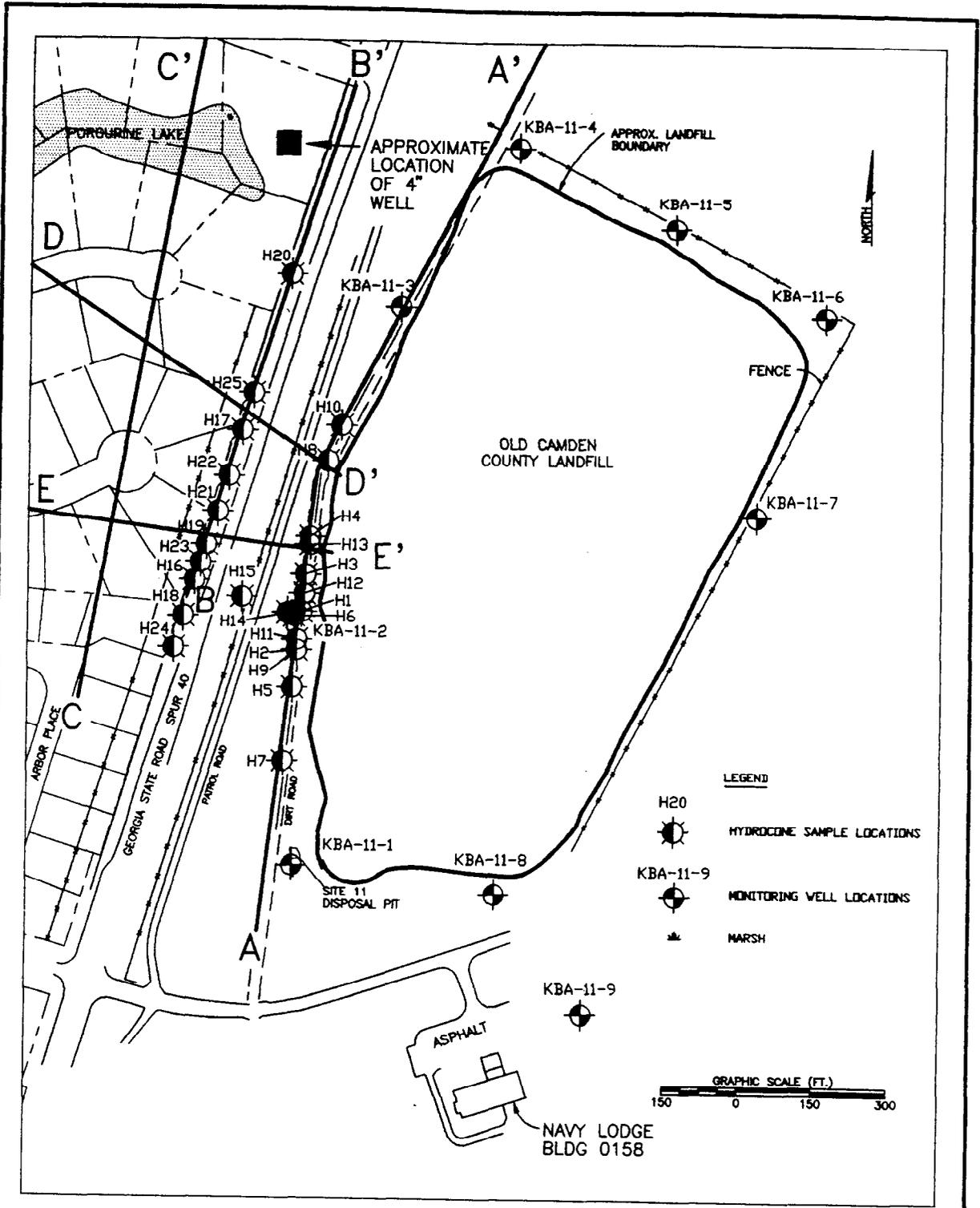
4.1 GROUNDWATER CONTAMINATION. Investigation activities to characterize the nature and extent of groundwater contamination associated with Site 11 include the groundwater monitoring program and collection of groundwater samples from locations within and around the landfill, on the western right-of-way of Spur 40, and in the Crooked River Plantation. Figures 4-1 through 4-3 show the locations of these sampling activities. The remainder of this section discussed the nature of the groundwater investigations that have been conducted and summarizes the obtained results.

4.1.1 Investigative Approach A groundwater monitoring program consisting of six bimonthly sampling events began in February 1992. The results of the first five sampling rounds are provided in Technical Memoranda Nos 1. through 5 (ABB-ES 1992a, 1992c, 1992e, 1992g, and 1993b). The results of the sixth sampling round are included in this report. Nine groundwater monitoring wells, KBA-11-1 through KBA-11-9, were included in the monitoring program (Figure 4-1). These monitoring wells are approximately 13 feet bgs and have 10-foot well screens that intercept the water table surface. Samples from the first two sampling events were analyzed for Appendix IX VOCs, SVOCs, organochlorine pesticides, and polychlorinated biphenyls (PCBs), dioxins and furans, herbicides, organophosphorus pesticides, and inorganics (including cyanide and sulfide). The analytical program was reduced after the second sampling event to include Appendix IX volatiles, inorganics (including cyanide and sulfide), total dissolved solids (TDS), and total suspended solids (TSS). Beginning with the third sampling event, both filtered and non-filtered samples were collected for inorganic analysis. Groundwater samples and Quality Control (QC) samples were collected and submitted for analysis at the off-site laboratory. Validated data tables for the six groundwater sampling events are provided in Appendix C. Summary tables for each of the six groundwater sampling rounds are provided in Appendix D. The sampling methods used during the groundwater monitoring program are described below.

Upon opening each monitoring well, the headspace was screened for VOCs using a flame ionization detector or photoionization detector (PID). Prior to sample collection, each well was purged of at least three well volumes. Samples were collected within 24 hours following purging. Decontaminated Teflon bailers or a peristaltic pump with polyethylene tubing was used to purge the monitoring wells. Decontaminated Teflon bailers were used to collect samples. For non-filtered samples, groundwater was transferred from the bailer directly into labeled sample containers. For inorganic samples requiring filtration, groundwater was pumped from the bailer through a 0.45-micron filter using a peristaltic pump with polyethylene tubing and then collected in a labeled sample container. Appropriate preservatives were added to the empty sample containers by the laboratory before delivery of the containers to the project. Following sample collection, sampling personnel checked pH values of aliquot of all preserved samples except VOC samples. Samples for cyanide analysis were also checked for sulfide and chloride interference by testing an aliquot of the sample

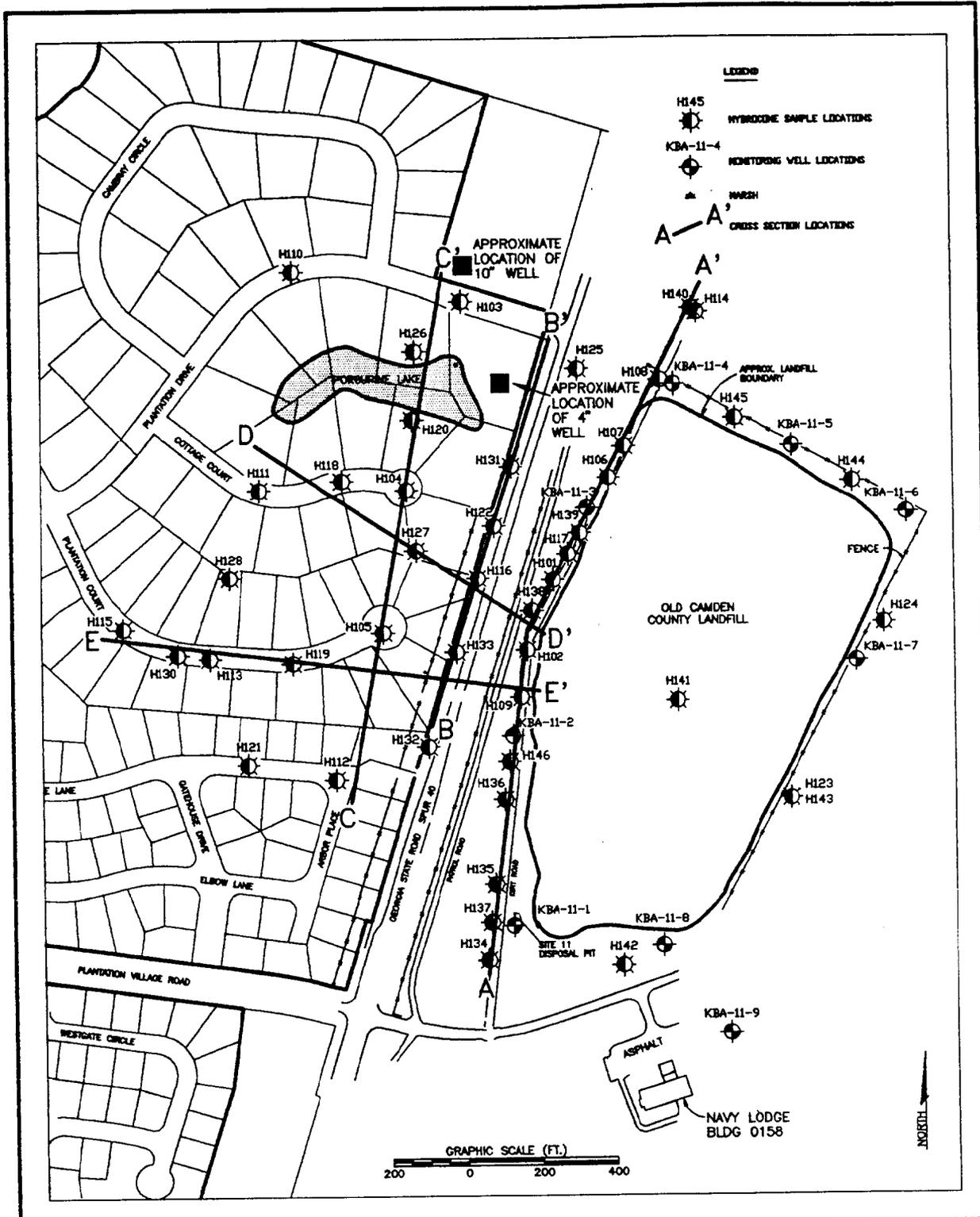


DWN: DMF	DES: LGT	PROJECT NO.: 7553-09	TITLE: MONITORING WELL AND SOIL BORING LOCATION MAP	
CHKD: LBH	APPD.: LBH	FIGURE NO.: 4-1		
DATE: 4-13-93	REV.:			



DWN: DMF	DES: LGT	PROJECT NO.: 7553-09	TITLE: HYDROCONE SAMPLE LOCATIONS AUGUST 1992
CHKD: LBH	APPD.: LBH	FIGURE NO.: 4-2	
DATE: 3-31-93	REV.:		





DWN: DMF	DES: LGT	PROJECT NO.: 7553-09	TITLE: HYDROCONE SAMPLE LOCATIONS OCTOBER AND NOVEMBER 1992
CHKD: LBH	APPD.: LBH	FIGURE NO.:	
DATE: 3-31-93	REV.:	4-3	



with lead acetate and potassium iodide test paper. Investigative team personnel placed the filled containers on ice in ice chests immediately after collection. Chain-of-custody was initiated in the field at the time of sample collection. Samples were shipped via overnight courier service to the laboratory on the date of collection. Field parameters for groundwater samples included pH, conductivity, and temperature. These parameters are summarized for each of the six sampling rounds and are provided in Appendix E.

During the Phase I Interim and ICMS investigations, direct push methods were used for collection of stratigraphic information and collection of groundwater samples. Direct push technology (also known as cone penetrometer testing) uses hydraulic pressure to advance a series of rods fitted with either a groundwater sampling device or piezocone. The piezocone is used to record stratigraphic information and to record pore pressure at the cone tip. Piezocone logs are included in Appendix F. The hydrocone groundwater sampler consists of a telescoping assembly containing a 1-foot length of stainless steel well screen fitted with a cone tip. When the screen was exposed by retracting the outer casing of the sample device, natural hydrostatic pressure forced groundwater to flow into the sample collection chamber.

The amount of groundwater entering the collection chamber was monitored by transducers and resulting data stored in the computer for later analysis. Argon back-pressure prevented volatilization of the sample during retrieval. The sample was held in the chamber for retrieval using argon gas back-pressure to impinge a small ball into its check-valve at the bottom of the sample collection chamber. The sample collection chamber and screen assemblage were lifted to the surface to recover the sample. To collect water from multiple intervals, the hole was reentered with a clean sample collection chamber and screen assemblage and the hydrocone was advanced to the desired depth. Cross-contamination was prevented by using O-rings to form watertight seals above and below the sample chamber. The pressure transducer and computer monitored the sample chamber for infiltration of water.

During sample collection, the rate of filling the 6.5-foot-long cylinder was recorded. These data were plotted with the computer to estimate permeability at specific intervals within the aquifer. The analysis was performed in the field, using Hvorslev's Basic Time Lag Method (Hvorslev, 1951).

During the Phase I Interim Investigation in August 1992, 33 groundwater samples, including three duplicates, were collected for field analysis of target VOCs including chloromethane, vinyl chloride, trans-1,2-dichloroethene, trichloroethene, and tetrachloroethene. These samples were collected from sample locations H1 through H25 as shown in Figure 4-2. Six replicate groundwater samples, including a duplicate, were sent to the contract laboratory for confirmatory analysis using SW846 Methods 8010 and 8020. Hydraulic conductivity data recorded during the collection of samples using the hydrocone are provided in Appendix G.

During the ICMS Investigation in October and November 1992, groundwater samples were collected from 46 locations in and around the landfill, on the western right-of-way of Spur 40, and in the Crooked River Plantation Subdivision (see Figure 4-3). A total of 144 groundwater samples were collected from sample locations H101 through H146 at depths ranging from 5 to 72 feet bgs. All groundwater samples collected with the hydrocone were analyzed in the on-site

laboratory for target VOCs which included vinyl chloride, trans-1,2-dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, benzene, toluene, ethylbenzene, m/p-xylene, and o-xylene. Seventeen hydrocone groundwater samples were submitted to an off-site laboratory for confirmatory analysis. Off-site analysis included Target Compound List (TCL) VOCs using Contract Laboratory Program (CLP) methods. CLP analytical methods were selected because of the anticipated HRS II score and to enable Level D data validation to be performed.

**4.1.2 VOCs in Groundwater** The VOC results of six bimonthly sampling programs are summarized in Table 4-1. Tables 4-2 through 4-5 summarize on-site and off-site laboratory data for the Phase I Interim and ICMS Investigations. Samples from five of nine groundwater monitoring wells contained detectable levels of VOCs. Samples from KBA-11-2 contained the greatest number and concentration of VOCs.

Eleven chlorinated and nonchlorinated solvents and fuel-related VOCs were detected in groundwater samples from monitoring well KBA-11-2, with concentrations ranging from 1 J to 160  $\mu\text{g}/\text{l}$ . In the remaining four wells containing detectable VOCs, one to four VOCs were detected with concentrations ranging from 1 J to 28  $\mu\text{g}/\text{l}$ .

The results of the Phase I Interim and ICMS investigations were used to create Figures 4-4 through 4-11. The profile locations for Figures 4-7 through 4-11 are shown on Figures 4-2 and 4-3. These figures represented the total target VOC results. Data for the landfill itself was collected in March 1993 and is included as an addendum in Section 9.0 of this report. The interpreted plume plan view for total target VOCs is shown at 20 to 10 feet MLW, 5 to -5 feet MLW, and -10 to -20 feet MLW (Figures 4-4 through 4-6). Comparison of Figures 4-4 through 4-6 indicates that most groundwater VOC contamination is approximately 30 feet bgs, or near 0 feet MLW. The interpreted plume appears to have two lobes extending to the west-southwest and to the north-northwest. Groundwater sampling results indicate that the VOC contamination is present below the site and the Crooked River Plantation Subdivision. Based on the interpreted plume plan views shown in Figures 4-4 through 4-6, the plume extends a maximum distance of approximately 740 feet from the NSB Kings Bay property line (see 5 to -5 feet MLW interval). The highest concentrations of total target VOCs are found in the 20 to 10 feet MLW interval (Figure 4-6). Figures 4-7 through 4-11 show cross-sections of the plume. Based on these figures, the plume is interpreted to reach a maximum depth of approximately 65 feet bgs downgradient of the site, but is deeper in the area underlying the landfill (see Section 9.0). The highest concentrations appear to be in the area of KBA-11-2 and generally along the western perimeter of the landfill. VOC contaminants were detected in groundwater samples from locations along the right-of-way to Spur 40 at depths ranging from 11 to 58 feet bgs. Based on the plume contours shown in Figure 4-8, the maximum depth of contamination on the right-of-way is approximately 60 feet bgs. In the subdivision, where VOCs were detected in groundwater samples from depths ranging from 14 to 51 feet bgs, Figure 4-9 indicates the base of the plume to be approximately 50 to 60 feet bgs. Along Plantation Court, the top of the plume is approximately 30 feet bgs. To the north of Plantation Court, the top of the plume is approximately 10 feet bgs, based on the chemical contours in Figure 4-9. Comparison of Figures 4-10 and 4-11 indicates that the magnitude and extent of groundwater contamination is greater in the area of Cottage Court than Plantation Court.

Table 4-1 Summary of VOC Analytical Data for RFI Groundwater Monitoring Program at Site 11

Monitoring Well I.D.	VOCs Detected	Concentration Range (µg/l)	Associated Sample Events
KBA-11-1	None		
KBA-11-2	vinyl chloride	18 -160	1,2,3,4,5,6
	1,2-dichloroethene	4.8 -22	1,2,3,4,5,6
	ethylbenzene	1 J	5
	toluene	1 J - 3 J	2,4,5,6
	xylene (total)	2 J - 4 J	2,3,5,6
	1,4-dichlorobenzene	1 J	5
	chloroethane	3 J - 5 J	3,5
	chloromethane	3.3	4
	trichloroethene	1 J	2
	tetrachloroethene	1 J	2
	chloroform	4 J	1
	KBA-11-3	chlorobenzene	3 J - 6
1,4-dichlorobenzene		15 - 28	1,2,4,5,6
1,3-dichlorobenzene		15	2,3
KBA-11-4	None		
KBA-11-5	xylene (total)	2	1
	1,4-dichlorobenzene	1 J - 2 J	1,2,3,4
KBA-11-6	xylene (total)	2	1
	1,4-dichlorobenzene	1 J - 2 J	1,2,3,4,6
KBA-11-7	None		
KBA-11-8	vinyl chloride	2 J	1
	ethylbenzene	1 J	1
	xylene (total)	5	1
	chloroethane	2 J	2
KBA-11-9	xylene	3 J	1

Notes: µg/l = micrograms per liter Sources: ABB-ES, 1992a. ABB-ES, 1992e.  
 J = estimated concentration ABB-ES, 1992c. ABB-ES, 1992g.  
 ABB-ES, 1993b.

Table 4-2 Phase I Interim Investigation Field Laboratory Results for Groundwater ( $\mu\text{g}/\text{l}$ )

Parameter	Sample I.D. and Depth (ft bgs)							
	MCL	KBA-11-2 <sup>1</sup> 3-13	H1 11-12	H2 10.5-11.5	H3 11-12	H3Dup 11-12	H4 11-12	H5 11-12
Chloroethane	N/A	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene	100/70 <sup>2</sup>	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Vinyl Chloride <sup>3</sup>	2	93 J	4.2	2.2	2 U	2 U	2 U	2 U

Parameter	Sample I.D. and Depth (ft bgs)									
	MCL	H6A 7-8	H6B 9.5-10.5	H6C 12.5-13.5	H6D 15.5-16.5	H7 16-17	H8 16-17	H9 15.5-16.5	H10 14-15	H11 14-15
Chloroethane	N/A	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene	100/70	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Vinyl Chloride	2	2 U	40	700 J	1400 J	2 U	40	2.5	4.3	9.0

Parameter	Sample I.D. and Depth (ft bgs)									
	MCL	H12 16-17	H12Dup 16-17	H13 16-17	H14 19-20	H15A 16-17	H15B 24-25	H15C 49-50	H15D 77-78	H16 12-13
Chloroethane	N/A	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene	100/70 <sup>2</sup>	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	6.2
Vinyl Chloride <sup>2</sup>	2	3.2	2.7	5.7	60 J	400 J	11	2 U	2 U	120 J

See notes at end of table.

Table 4-2 (continued) Phase I Interim Investigation Field Laboratory Results for Groundwater ( $\mu\text{g}/\text{l}$ )

Parameter	Sample I.D. and Depth (ft bgs)								
	H17 19-20	H18 16-17	H19 13-14	H20 15-16	H21 15-16	H22 16-17	H23 12.5-13.5	H24 13-14	H25 13-14
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	4.6	2 U	3.2	2 U	2 U	2 U	2 U	2 U	6.4
Vinyl Chloride <sup>2</sup>	4.8	6.2	2 U	2 U	3.0	2.8	45 J	3.2	54 J

**Notes:**

<sup>1</sup> Monitoring Well

<sup>2</sup> trans-1,2-dichloroethene/cis-1,2-dichloroethene

<sup>3</sup> Values flagged J as estimated because concentrations exceeded the linear range of the GC

Dup Duplicate

ft bgs = feet below ground surface

J = estimated concentration

$\mu\text{g}/\text{l}$  = micrograms per liter

U = Compound analyzed but not detected above or below the indicated practical quantitation limit.

MCL = Maximum Contaminant Level, USEPA Office of Water, December of 1992: The Bureau of National Affairs, Inc., July 1992.

N/A = none applicable

Table 4-3 Phase I Interim Investigation Off-site Analytical Data for Hydrocone Groundwater Samples ( $\mu\text{g/l}$ )

Parameter	MCL	Sample I.D. and Depth (ft bgs)					
		H2 10.5-11.5	H3 11-12	H10 14-15	H15B 24-25	H23 12.5-13.5	H23D 12.5-13.5
Chloroethane	N/A	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5	1.0 U	1.0 U	1.0 U	1.0 U	4.9	4.7
Tetrachloroethene	5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride <sup>1</sup>	2	2.0	1.0 U	1.4	11 J	32 J	35 J
Benzene	5	1.0 U	1.0 U	1.0 U	1.7	1.0 U	1.0 U
Bromomethane	N/A	1.0 U	1.0 U	1.0 U	1.0 U	1.5	1.1
Chlorobenzene	N/A	1.0 U	1.0 U	2.3	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	60	1.0 U	1.0 U	6.4	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	1.0 U	1.8	4.6	1.0 U	1.0 U	1.0 U
Dichlorodifluoromethane	N/A	1.0 U	1.0 U	1.0 U	5.3	1.0 U	1.0 U
1,1-Dichloroethane	N/A	1.0 U	1.0 U	1.0 U	100	1.0 U	1.0 U
1,1-Dichloroethene	7	1.0 U	1.0 U	1.0 U	3.9	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	1.0 U	1.0 U	1.0 U	200	29	28
Ethylbenzene	700	1.0 U	1.0 U	1.0 U	10	1.0 U	1.0 U
Methylene Chloride	5	1.0 U	1.0 U	1.0 U	15	1.0 U	1.0 U
Toluene	1,000	1.0 U	1.0 U	1.0 U	230	1.0 U	1.0 U
m- and p-Xylene	10,000	2.0 U	2.0 U	2.0 U	17	2.0 U	2.0 U
o-Xylene	10,000	1.0 U	1.0 U	1.0 U	15	1.0 U	1.0 U
Total Xylenes	10,000	1.0 U	1.0 U	1.0 U	31	1.0 U	1.0 U

**Notes:**

<sup>1</sup> Values flagged J as estimated because the continuing calibration standard exceeded QC limits.

ft bgs = feet below ground surface

J = estimated concentration

MCL = Maximum Contaminant Level, USEPA Office of Water, December of 1992: The Bureau of National Affairs, Inc., July 1992.

N/A = none applicable

$\mu\text{g/l}$  = micrograms per liter

U = Compound analyzed but not detected

Table 4-4 ICMS On-site Analytical Data for Hydrocone Groundwater Samples

Compound	Sample ID Numbers ( $\mu\text{g/l}$ )										
	MCL	H10109	H10116	H10121	H10210	H10216	H10225	H10220	H10320D	H10330	H10342
Vinyl chloride	2	2 U	2 U	220 J	2 U	2 U	7.8	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	100	5 U	5 U	6.4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	5 U	64 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	51 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	700	5 U	5 U	200 J	5 U	18	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	94 J	10 U	10 U	10 U				
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	49	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Compound	Sample ID Numbers ( $\mu\text{g/l}$ )										
	MCL	H10407	H10414	H10422	H10430	H10505	H10507	H10530	H10545	H10559	H10559D
Vinyl chloride	2	2 U	2.5	2 U	19	2 U	2 U	2 U	20 U	2 U	2 U
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	5 U	5 U	98 J	5 U	5 U	5 U	50 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5.1	5 U	5 U	5 U	50 U	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	12	5 U	5 U	5 U	50 U	5 U	5 U
Ethylbenzene	700	5 U	5 U	5 U	8.2	5 U	5 U	5 U	50 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	14	10 U	10 U	10 U	110	10 U	10 U
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	6.9	5 U	5 U	5 U	50 U	5 U	5 U

See notes at end of table.

Table 4-4 (continued) ICMS On-site Analytical Data for Hydrocone Groundwater Samples

Compound	Sample ID Numbers (µg/L)													
	MCL	H10622	H10632	H10642	H10647	H10726	H10728	H10728D	H10736	H10756	H10822	H10832	H10832D	H10841
Vinyl chloride	2	12	26	32	15	15	13	14	36	2 U	2.7	10	10	31
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	5 U	22	9.8	6.2	12	12	5 U	5 U	5 U	5 U	5 U	7.9
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5.1	5.0	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	22	10	5 U	5 U	5 U	52 J	5 U	5 U	5 U	5 U	30
Ethylbenzene	700	26	18	5 U	5 U	5 U	18	19	5 U	5 U	5 U	5 U	5 U	13
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	10 U	10 U	10 U						
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Compound	Sample ID Numbers (µg/L)										
	MCL	H10923	H10923D	H10937	H10949	H10949D	H11014	H11024	H11026	H11039	H11050
Vinyl chloride	2	4.1	3.2	90 J	17	18	2 U	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	5 U	5 U	12	10	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	7.8	8.3	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	6.9	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	190 J	24	22	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	700	8.1	8.0	52 J	7.4	6.5	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	100 J	10	10 U	10 U	10 U	10 U	10 U	10 U
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	55 J	5 U	5.6	5 U	5 U	5 U	5 U	5 U

See notes at end of table.

Table 4-4 (continued) ICMS On-site Analytical Data for Hydrocone Groundwater Samples

Compound	MCL	Sample ID Numbers ( $\mu\text{g}/\text{L}$ )							
		H11117	H11134	H11160	H11215	H11232	H11241	H11325	H11311
Vinyl chloride	2	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 UJ
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ
cis-1,2-Dichloroethene	70	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ
Toluene	1,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ
Ethylbenzene	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ

Compound	MCL	Sample ID Numbers ( $\mu\text{g}/\text{L}$ )									
		H11346	H11346D	H11415	H11442	H11549	H11559	H11625	H11635	H11644	H11726
Vinyl chloride	2	2.0	2.8	2 U	2 UJ	2 U	2 U	300 J	16	22	31 J
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	15	5 UJ
cis-1,2-Dichloroethene	70	5 U	5 U	5 U	5 UJ	5 U	5 U	250 J	37	10 U	5 UJ
Trichloroethene	5	5 U	5 U	5 U	5 UJ	5 U	5 U	45	5 U	10 U	5 UJ
Tetrachloroethene	5	5 U	5 U	5 U	5 UJ	5 U	5 U	5.6	5 U	10 U	5 U
Benzene	5	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5.0	5 UJ
Toluene	1,000	5 U	5 U	5 U	5 UJ	5 U	5 U	21 J	430 J	140 J	5 UJ
Ethylbenzene	700	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	38	12	50 J
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	57	22	10 UJ
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	30	14	5 UJ

See notes at end of table.

Table 4-4 (continued) ICMS On-site Analytical Data for Hydrocone Groundwater Samples

Compound	MCL	Sample ID Numbers ( $\mu\text{g/L}$ )								
		H11744	H11756	H11768	H11816	H11816D	H11826	H11835	H11845	H11855
Vinyl chloride	2	17 J	13 J	2 UJ	NEG	NEG	POS	NEG	POS	NEG
trans-1,2-Dichloroethene	100	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ
Trichloroethene	5	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 UJ	26 J	5 UJ	5 U	5 U	5 U	78 J	5 U	5 U
Ethylbenzene	700	16 J	5 UJ	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 UJ	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U
o-Xylene	<sup>1</sup> 10,000	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U

Compound	MCL	Sample ID Numbers ( $\mu\text{g/L}$ )										
		H11940	H11950	H12015	H12035	H12045	H12045D	H12055	H12072	H12126	H12144	H12153
Vinyl chloride	2	POS	POS	POS	POS	POS	POS	NEG	POS	NEG	2 UJ	2 UJ
trans-1,2-Dichloroethene	100	5 U	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	21 J	16 J	5 UJ	8.6 J	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U
Trichloroethene	5	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U
Benzene	5	5 U	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	140 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	700	5 U	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 U
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U

See notes at end of table.

Table 4-4 (continued) ICMS On-site Analytical Data for Hydrocone Groundwater Samples

Compound	Sample ID Numbers ( $\mu\text{g/L}$ )										
	MCL	H12211	H12236	H12236D	H12243	H12253	H12261	H12271	H12309	H123226	H12430
Vinyl chloride	2	2 UJ	15 J	15 J	3.7 J	4.3 J	2 UJ	2 UJ	2 UJ	2 UJ	2 UJ
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	6.3	6.5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	6.2	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	700	5.2	20	20	16	5.3	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Compound	Sample ID Numbers ( $\mu\text{g/L}$ )									
	MCL	H12445	H12453	H12523	H12535	H12535D	H12553	H12612	H12634	H12650
Vinyl chloride	2	2 UJ	2 UJ	2 U	9.6 J	7.0 J	2 U	2 UJ	2.6 J	2 UJ
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	5 U	5 U	5 UJ	5 UJ	5 U	5 UJ	5 UJ	5 UJ
Trichloroethene	5	5 U	5 U	5 U	5 UJ	5 UJ	5 U	5 UJ	5 UJ	5 UJ
Tetrachloroethene	5	5 U	5 U	5 U	5 UJ	5 UJ	5 U	5 UJ	5 UJ	5 UJ
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	12	12	5 U	5 U	5 U	5 U
Ethylbenzene	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	10 U				
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

See notes at end of table.

Table 4-4 (continued) ICMS On-site Analytical Data for Hydrocone Groundwater Samples

Compound	MCL	Sample ID Numbers ( $\mu\text{g}/\text{l}$ )									
		H12716	H12716D	H12729	H12740	H12747	H12748	H12762	H12811	H12837	H12853
Vinyl chloride	2	14 J	16 J	27 J	15 J	7.2 J	8.8 J	2 UJ	2 UJ	2 UJ	2 UJ
trans-1,2-Dichloroethene	100	5 U	5 U	13	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	64 J	57 J	120 J	9.9 J	41 J	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	250 J	48 J	40 J	5 U	5 U	5 U	5 U
Ethylbenzene	700	5 U	5 U	5 U	23	5.8	5.7	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	45	10 U					
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Compound	MCL	Sample ID Numbers ( $\mu\text{g}/\text{l}$ )									
		H12925	H12935	H12947	H12955	H13038	H13049	H13124	H13135	H13135D	H13147
Vinyl chloride	2	2.1	2 UJ	8.6 J	12 J	6.6 J	19 J				
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	5 U	5 U	5 U	5 U	5 U	5 U	6.1	6.6	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	28	28	18
Ethylbenzene	700	5 U	5 U	5 U	5 U	5 U	5 U	6.3	8.0	7.8	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

See notes at end of table.

Table 4-4 (continued) ICMS On-site Analytical Data for Hydrocone Groundwater Samples

Compound	Sample ID Numbers ( $\mu\text{g/l}$ )												
	MCL	H13157	H13166	H13220	H13322	H13331	H13340	H13356	H13435	H13555	H13628	H13642	H13642D
Vinyl chloride	2	3.6 J	2 UJ	34 J	28 J	23 J	17 J	2 U	2 UJ	2 UJ	23	10	13
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	6.6	5 U	5 U	5 UJ	5 UJ	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	5 U	38 J	5.2	5.3	8.7	5 U	5 U	5 U	9.6	22	32 J
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	21	31 J
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	16	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	5 U	20	5 U	5 U	5 U	5 U	270 J	31 J	33 J
Ethylbenzene	700	5 U	5 U	5 U	5.9	5 U	40	5 U	5 U	5 U	22	6.2	6.4
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	43	10 U	10 U	10 U	10 U	52 J	10 UJ	10 UJ
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	19	5 U	5 U	5 U	5 U	30	6	6.3

Compound	Sample ID Numbers ( $\mu\text{g/l}$ )											
	MCL	H13646	H13726	H13827	H13842	H13863	H13935	H13940	H13940D	H14030	H14035	H14052
Vinyl chloride	2	2 U	2 U	190 J	25	2 U	5.5	2 U	2 U	2 UJ	2 UJ	2 UJ
trans-1,2-Dichloroethene	100	5 U	5 U	5.0	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	5 U	140 J	21	5 U	5 U	9.6	9.1	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	5 UJ	5 UJ
Toluene	1,000	6.8	5 U	140 J	32 J	5 U	5 U	5 U	5 U	5 UJ	5 UJ	5 UJ
Ethylbenzene	700	5 U	5 U	30	42 J	5 U	5 U	5 U	5 U	5 UJ	5 UJ	5 UJ
m/p-Xylene	<sup>1</sup> 10,000	10 UJ	10 U	53	63 J	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	32 J	28	5 U	5 U	5 U	5 U	5 UJ	5 UJ	5 UJ

See notes at end of table.

Table 4-4 (continued) ICMS On-site Analytical Data for Hydrocone Groundwater Samples

Compound	MCL	Sample ID Numbers ( $\mu\text{g}/\text{l}$ )									
		H14134	H14138	H14220	H14229	H14245	H14333	H14342	H14342D	H14430	H14446
Vinyl chloride	2	16 J	15	2 U	2 U	2 U	2 U	2 U	2 U	45 J	6.2
trans-1,2-Dichloroethene	100	5 U	21 J	5 U	5 UJ	5 UJ	5 U	5 U	5 U	5 U	13 J
cis-1,2-Dichloroethene	70	17	5 UJ	5 U	5 UJ	5 UJ	5 U	5 U	5 U	15	5 UJ
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 UJ	5 U	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 U
Benzene	5	6.2 J	5 UJ	5 U	5 UJ	5 UJ	5 U	5 U	5 U	8.7	5 UJ
Toluene	1,000	5 UJ	200 J	5 U	5 UJ	5 UJ	5 U	5 U	5 U	5 U	18 J
Ethylbenzene	700	10 J	5 UJ	5 U	5 UJ	5 UJ	5 U	5 U	5 U	18	5 UJ
m/p-Xylene	<sup>1</sup> 10,000	10 UJ	10 UJ	10 U	10 UJ	10 UJ	10 U	10 U	10 U	18	10 UJ
o-Xylene	<sup>1</sup> 10,000	5 UJ	9.6 J	5 U	5 UJ	5 UJ	5 U	5 U	5 U	14	5 UJ

Compound	MCL	Sample ID Numbers ( $\mu\text{g}/\text{l}$ )			
		H14547	H14547D	H14621	H14631
Vinyl chloride	2	31 J	33 J	54 J	120 J
trans-1,2-Dichloroethene	100	5 U	5 U	5 UJ	10 J
cis-1,2-Dichloroethene	70	5 U	5 U	28 J	140 J
Trichloroethene	5	5 U	5 U	5 U	27
Tetrachloroethene	5	5 UJ	5 UJ	5 U	5 U
Benzene	5	5 U	5 U	5 UJ	5 U
Toluene	1,000	5 U	5 U	23 J	560 J
Ethylbenzene	700	5 U	5 U	40 J	10
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	41 J	23
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	28 J	12

**Notes:**<sup>1</sup> total xylenes

GC = gas chromatograph(y)

J = Sample result is considered estimated because continuing calibration exceeded QC limits or because concentration exceeded the linear range of the GC.

MCL = Maximum Contaminant Level, USEPA Office of Water, December 1992; The Bureau of National Affairs, Inc., July 1992.

NEG = Compound was not detected but a quantitation limit could not be calculated.

 $\mu\text{g}/\text{l}$  = micrograms per liter

POS = Compound was detected but the concentration could not be quantified.

U = Compound was not detected at the stated concentration.

UJ = Quantitation level was estimated because QC criteria were not met.

Table 4-5 ICMS Off-site Laboratory Analytical Data for Hydrocone Groundwater Samples

Compound	Hydrocone Sampling Locations (µg/l)								
	MCL	H10116	H10342	H10632	H111134	H11346	H11625	H11625D	H11835
Acetone <sup>1</sup>	NA	170	170	14 U	58	28	10 U	10 U	330 J
2-Butanone	NA	5 U	5 U	5 U	5 U	5 U	10 U	10 U	580
2-Hexanone	NA	5 U	5 U	5 U	5 U	5 U	10 U	10 U	18
4-Methyl-2-pentanone	NA	5 U	5 U	5 U	5 U	5 U	10 U	10 U	78
Carbon disulfide	NA	1	1 U	39 U	1 U	1 U	2 U	2 U	2 U
1,1-Dichloroethane	NA	1 U	1 U	1 U	1 U	1 U	2 U	2 U	3
1,2-Dichloroethane	5	1 U	1 U	1 U	1 U	1 U	9	9	1 U
1,2-Dichloropropane	5	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1
Vinyl chloride	2	1 U	1 U	1 U	1 U	1 U	310	280	1 U
Trichloroethene	5	1 U	1 U	1 U	1 U	1 U	28	26	1 U
Tetrachloroethene	5	1 U	1 U	1 U	1 U	1 U	3	3	1 U
cis-1,2-Dichloroethene	70	1 U	1 U	16	1 U	1 U	3,600	3,400	45
trans-1,2-Dichloroethene	100	1 U	1 U	1 U	1 U	1 U	23	23	1 U
Benzene	5	1 U	1 U	5	1 U	1 U	2	3	4
Ethylbenzene	700	2	1 U	17	1 U	1 U	2 U	2 U	2
Chlorobenzene	100	10	1 U	1 U	1 U	1 U	2 U	2 U	2 U
1,4-Dichlorobenzene	75	12	1 U	1 U	1 U	1 U	2 U	2 U	2 U
Toluene	1,000	1 U	1 U	1 U	1 U	1 U	20	19	120
Xylenes (total)	10,000	1 U	1 U	1	1 U	1 U	2 U	2 U	4
<b>Semivolatile Organic Compounds</b>									
2,4-Dimethylphenol	NA	---	---	---	---	---	---	---	---
2-Methylphenol	NA	---	---	---	---	---	---	---	---
4-Methylphenol	NA	---	---	---	---	---	---	---	---
Diethylphthalate	NA	---	---	---	---	---	---	---	---
Naphthalene	NA	---	---	---	---	---	---	---	---

See notes at end of table.

Table 4-5 (continued) ICMS Off-site Laboratory Analytical Data for Hydrocone Groundwater Samples

Compound	Hydrocone Sampling Locations ( $\mu\text{g/l}$ )									
	MCL	H11950	H12015	H12045	H12716	H12740	H12748	H12748D	H12811	H13642
Acetone <sup>1</sup>	NA	38 U	40 U	54 U	13 U	93	160	170	8 U	100 J
2-Butanone	NA	5 U	5 U	24	5 U	150	360	350	5 U	130
2-Hexanone	NA	5 U	5 U	5 U	5 U	70	19	16	5 U	1 U
4-Methyl-2-pentanone	NA	12	5 U	55	5 U	34	110	110	5 U	36
Carbon disulfide	NA	1 U	5 U	1 U	1 U	7	5	13	1 U	1 U
1,1-Dichloroethane	NA	1 U	2	1 U	1 U	24	5	5	1 U	12
1,2-Dichloroethane	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5	1 U	1 U	1 U	1 U	6	1 U	1 U	1 U	1 U
Vinyl chloride	2	1 U	1 U	1 U	12	1 U	1 U	1 U	1 U	2
Trichloroethene	5	1 U	1 U	1 U	1 U	4	1 U	1 U	1 U	45
Tetrachloroethene	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	70	21	1	1 U	82	18	1 U	1 U	1 U	50
trans-1,2-Dichloroethene	100	1 U	1 U	1 U	1	1 U	1 U	1 U	1 U	1 U
Benzene	5	1 U	2	1 U	1 U	3	1 U	1 U	1 U	1 U
Ethylbenzene	700	1 U	1 U	1 U	1 U	41	7	6	1 U	9
Chlorobenzene	100	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	75	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1,000	1 U	1 U	4 U	1 U	580	68	65	1 U	61
Xylenes (total)	10,000	1 U	1 U	1 U	1 U	120	13	12	1 U	25
<b>Semivolatile Organic Compounds</b>										
2,4-Dimethylphenol	NA	---	---	---	---	---	---	---	---	---
2-Methylphenol <sup>2</sup>	NA	---	---	---	---	---	---	---	---	---
4-Methylphenol	NA	---	---	---	---	---	---	---	---	---
Diethylphthalate	NA	---	---	---	---	---	---	---	---	---
Naphthalene	NA	---	---	---	---	---	---	---	---	---

See notes at end of table.

Table 4-5 (continued) ICMS Off-site Laboratory Analytical Data for Hydrocone Groundwater Samples

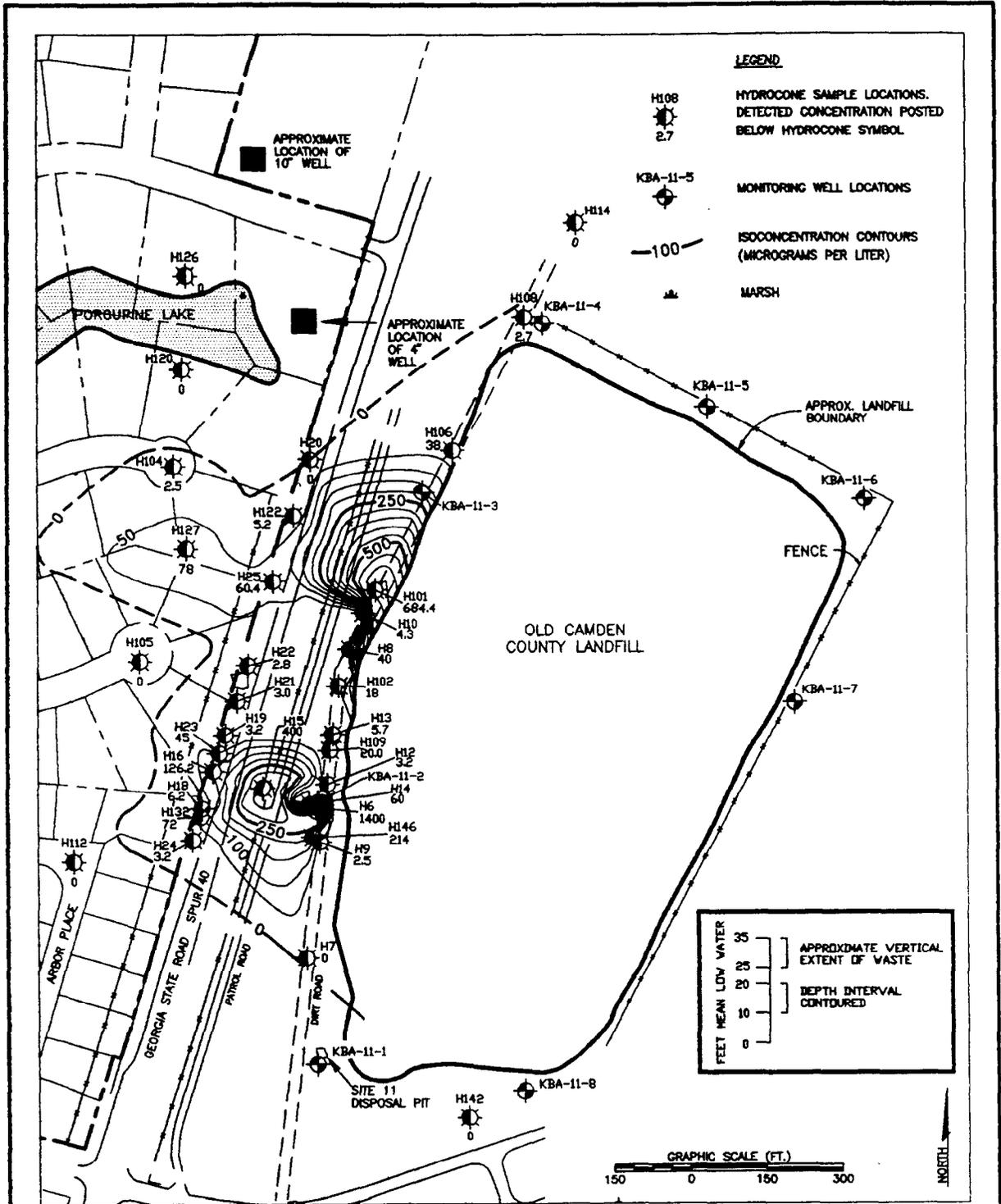
Compound	Hydrocone Sampling Locations (µg/L)					
	MCL	H13646	H14229	H138272	H146214	H14621D
Acetone <sup>1</sup>	NA	24 U	6	---	---	---
2-Butanone	NA	5 U	1 U	---	---	---
2-Hexanone	NA	5 U	1 U	---	---	---
4-Methyl-2-pentanone	NA	5 U	1 U	---	---	---
Carbon disulfide	NA	2 U	1 U	---	---	---
1,1-Dichloroethane	NA	1 U	1 U	---	---	---
1,2-Dichloroethane	5	1 U	1 U	---	---	---
1,2-Dichloropropane	5	1 U	1 U	---	---	---
Vinyl chloride	2	1 U	1 U	---	---	---
Trichloroethene	5	1 U	1 U	---	---	---
Tetrachloroethene	5	1 U	1 U	---	---	---
cis-1,2-Dichloroethene	70	1 U	1 U	---	---	---
trans-1,2-Dichloroethene	100	1 U	1 U	---	---	---
Benzene	5	1 U	1 U	---	---	---
Ethylbenzene	700	1 U	1 U	---	---	---
Chlorobenzene	100	1 U	1 U	---	---	---
1,4-Dichlorobenzene	75	1 U	1 U	---	---	---
Toluene	1,000	1 U	1 U	---	---	---
Xylenes (total)	10,000	1 U	1 U	---	---	---
<b>Semivolatile Organic Compounds</b>						
2,4-Dimethylphenol	NA	---	---	280	10 U	10 U
2-Methylphenol	NA	---	---	7 J	10 U	10 U
4-Methylphenol	NA	---	---	120	10 U	10 U
Diethylphthalate	NA	---	---	50	2 J	2 J
Naphthalene	NA	---	---	10 U	19	20

**Notes:**

--- = analysis was not requested or performed  
MCL = Maximum Contaminant Level, USEPA Office of Water, December 1992;  
The Bureau of National Affairs, Inc., July 1992.  
J = estimated concentration

NA = none applicable  
µg/l = micrograms per liter  
U = compound was not detected at the stated concentration

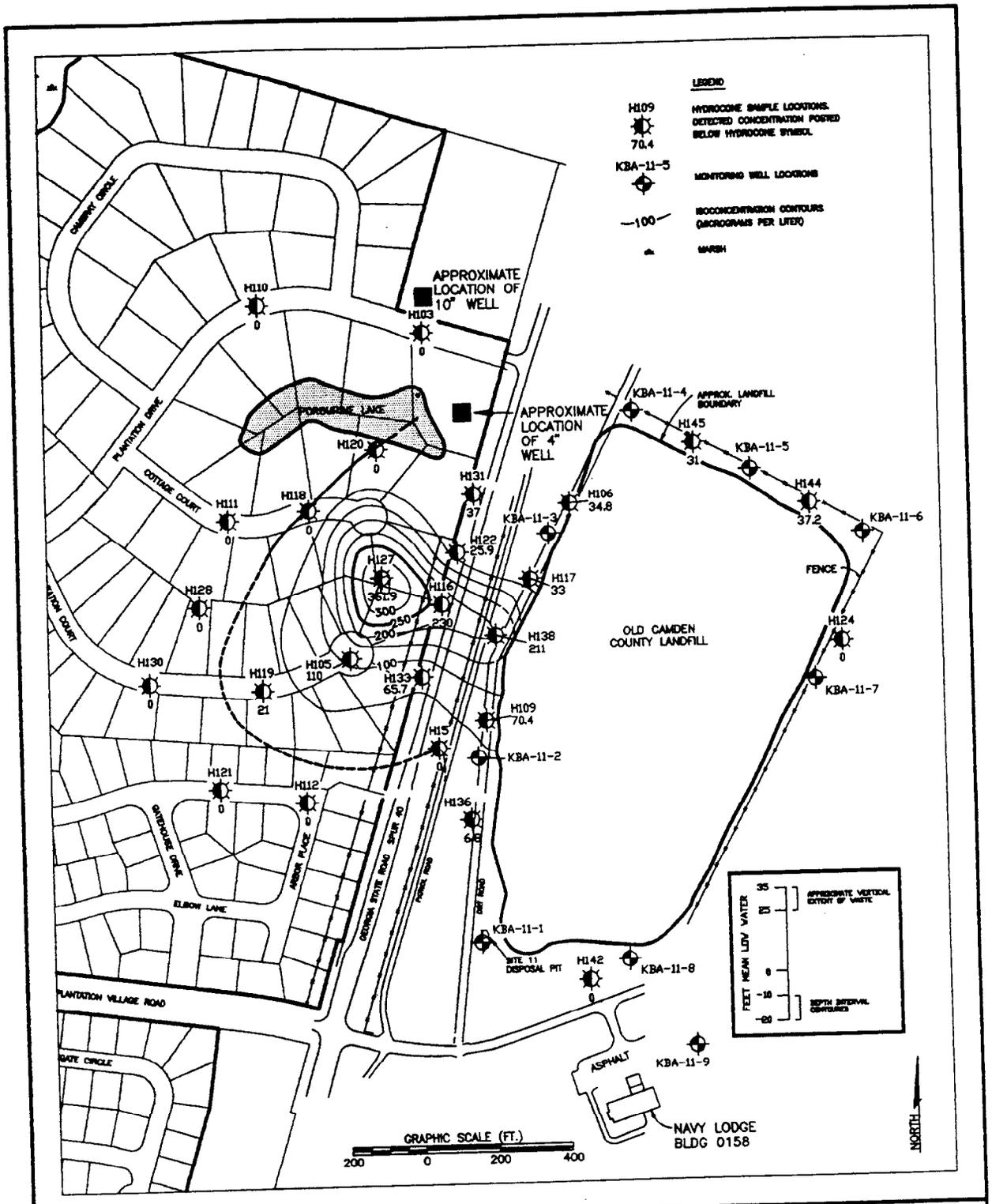
<sup>1</sup> Sample result is considered estimated and flagged with a J qualifier because an associated continuing calibration standard exceeded QC limits.  
<sup>2</sup> Sample results are considered estimated and flagged with a J qualifier because concentrations are less than the Sample Quantitation Limit.



DWN: dmf	DES: LGT	PROJECT NO.: 7553-09	TITLE: INTERPRETED PLUME PLAN VIEW 20 TO 10 FT. MEAN LOW WATER TOTAL TARGET VOCs
CHKD: LBH	APPD.: LBH	FIGURE NO.: 4-4	
DATE: 3-31-93	REV.:		

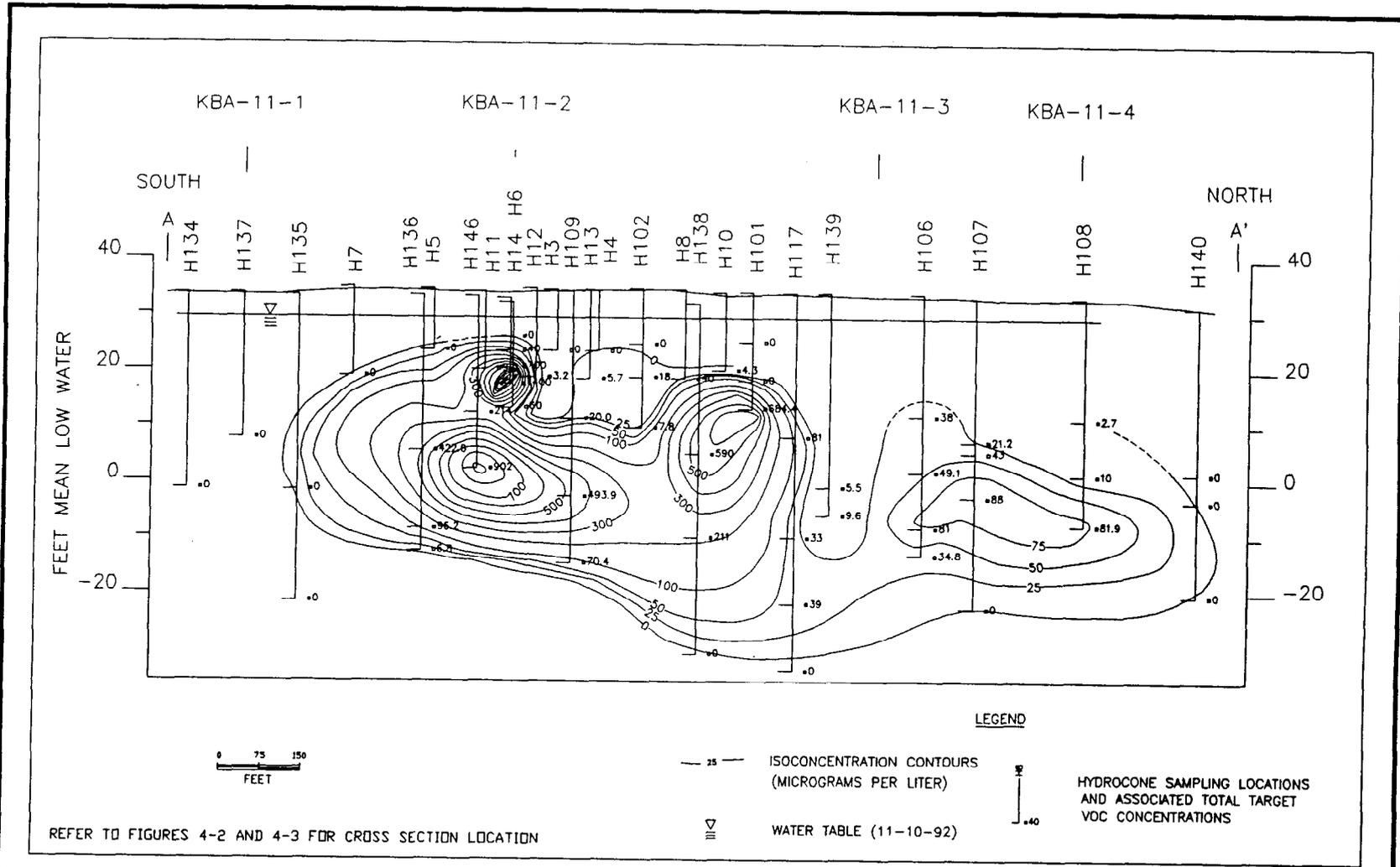




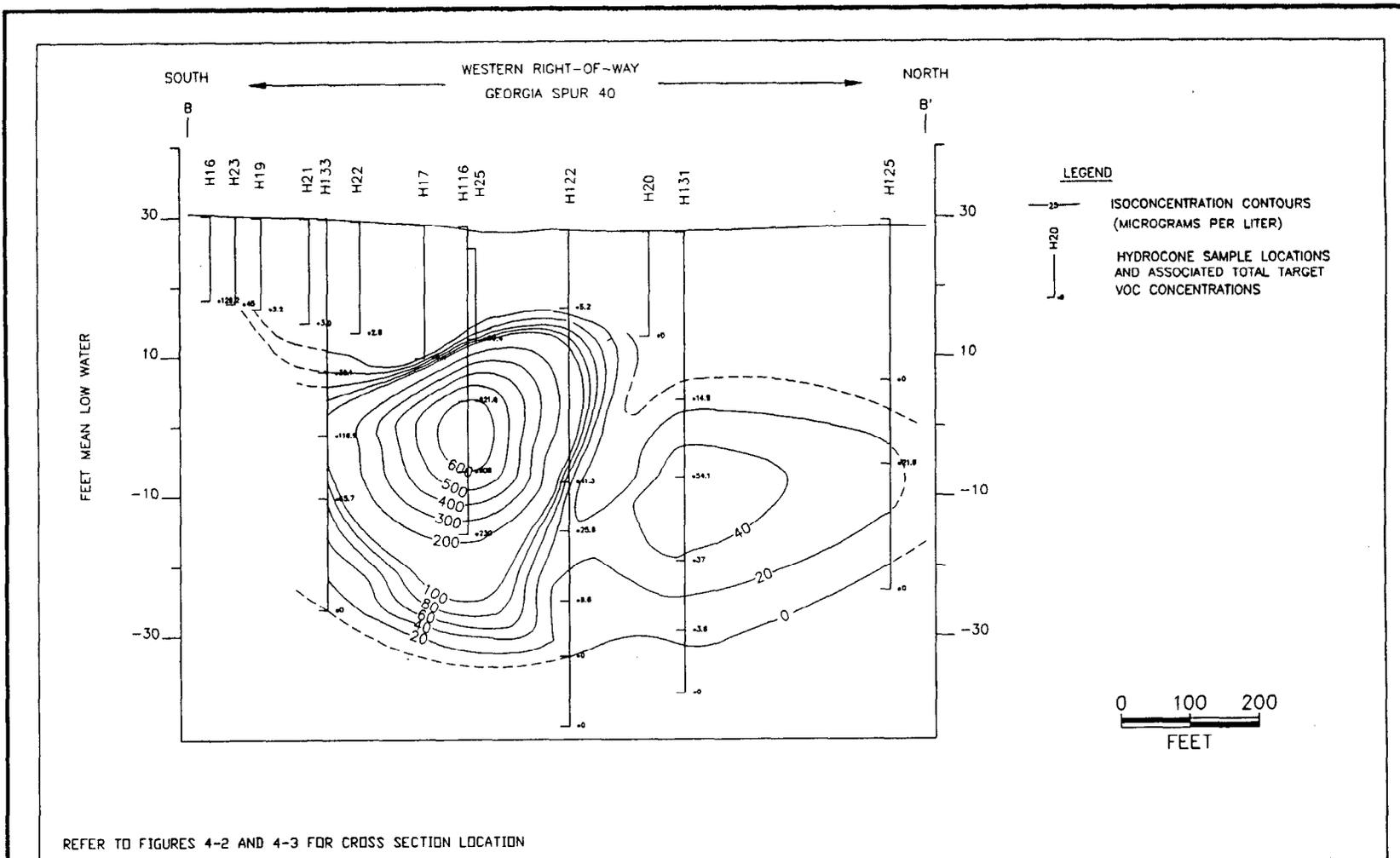


DWN: DMF	DES: LGT	PROJECT NO.: 7553-09	TITLE: INTERPRETED PLUME PLAN VIEW -10 TO -20 FT. MEAN LOW WATER TOTAL TARGET VOCs
CHKD: LBH	APPD.: LBH	FIGURE NO.: 4-6	
DATE: 3-31-93	REV.:		

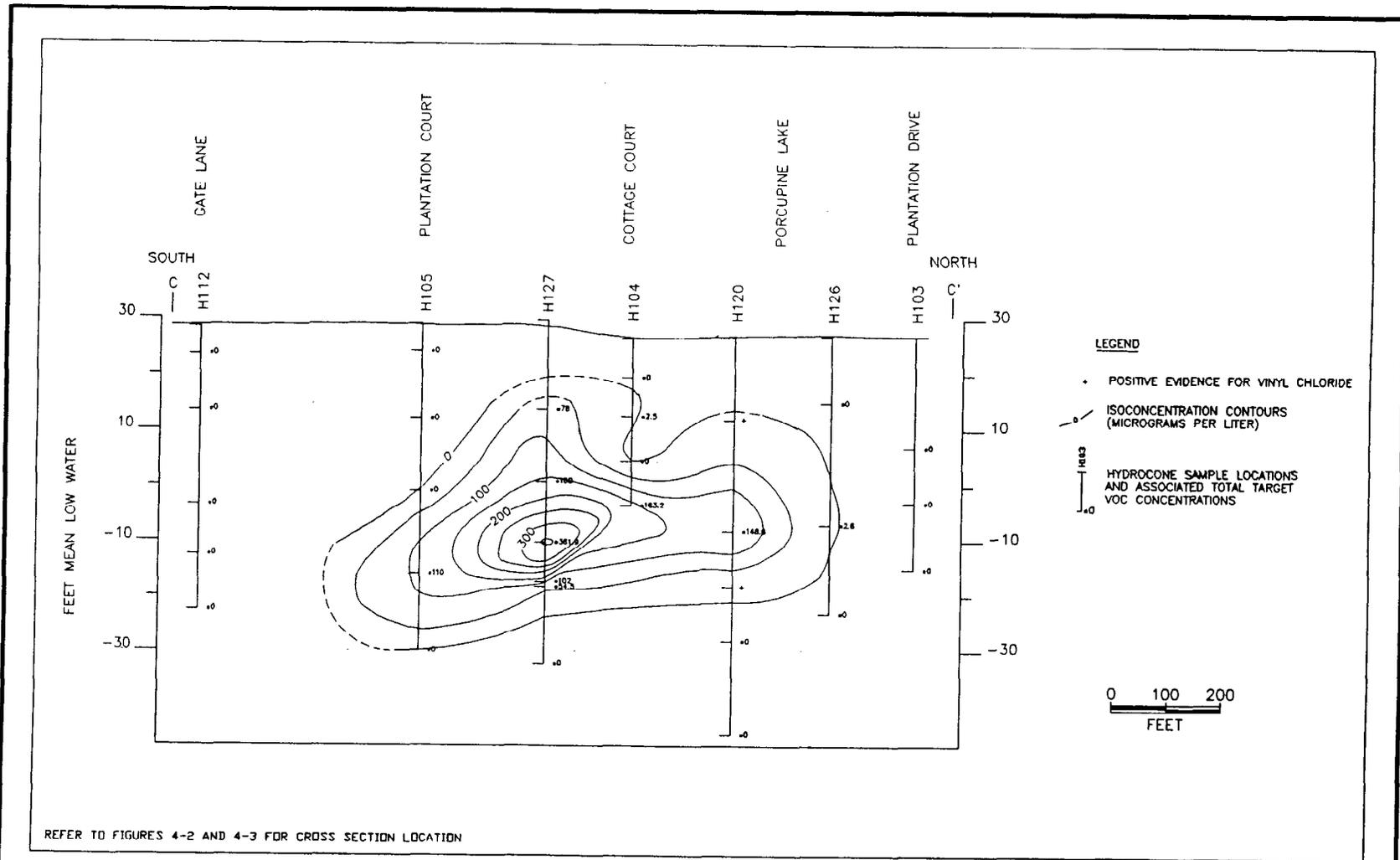




KINGSBAY\CHDN\MAPS\RFI14-7.dwg			
DWN: LGT	DES.: LGT	PROJECT NO.: 7553	TITLE:
CHKD: LBH	APPD.: LBH	FIGURE NO.: 4-7	<p align="center"><b>CROSS SECTION A-A'</b> TOTAL TARGET VOCs ON-SITE ANALYTICAL DATA</p>
DATE: 2/17/93	REV.:		
			<p>RFI INTERIM REPORT FOR SITE 11</p> <p>NAVAL SUBMARINE BASE KINGS BAY, GEORGIA</p>

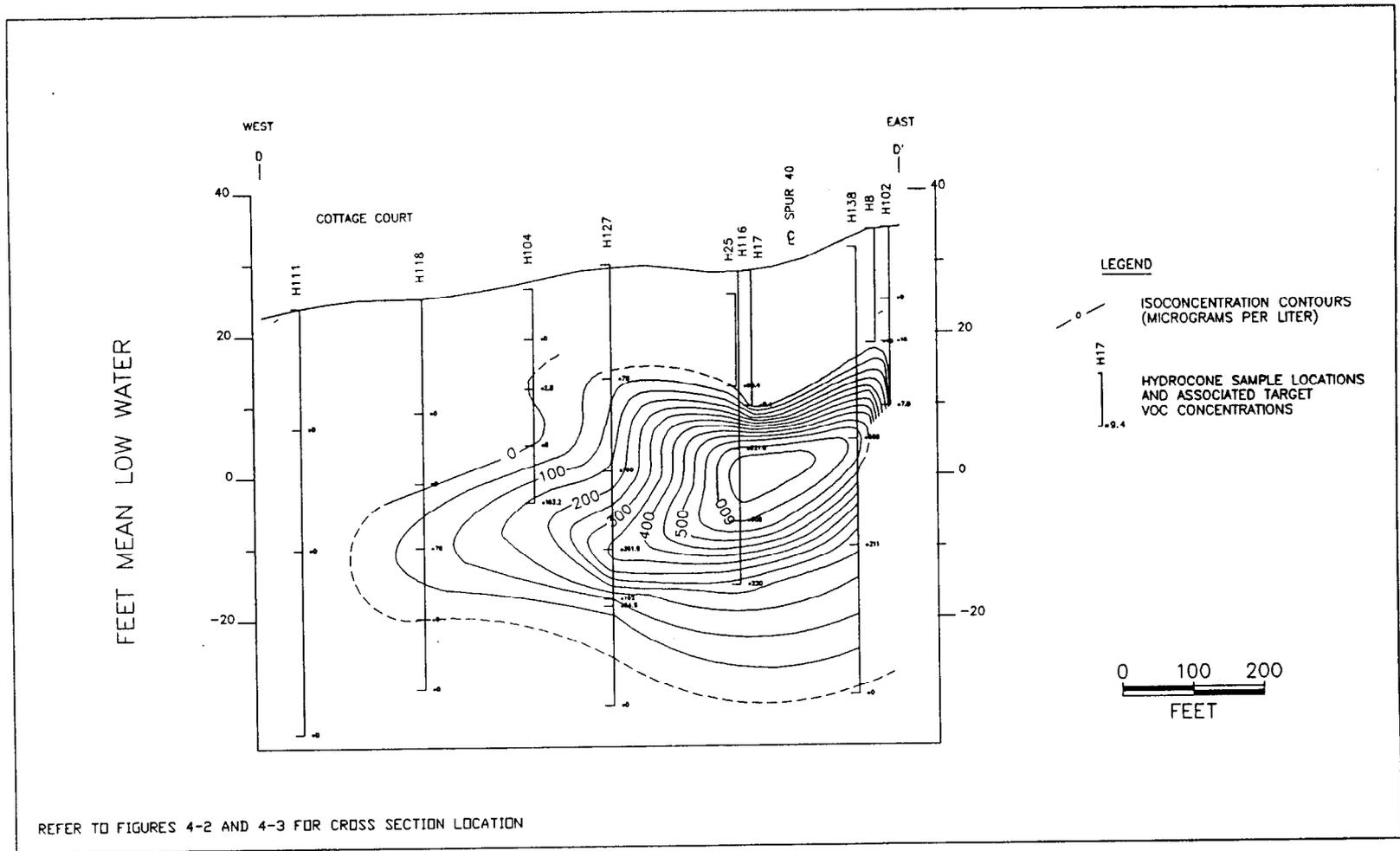


KINGSBAY\CHEM\MAPS\RF114-8.dwg				PROJECT NO.:		TITLE:	
DWN: LGT	DES.: LGT	7553		CROSS SECTION B-B' TOTAL TARGET VOCs ON-SITE ANALYTICAL DATA			
CHKD: LBH	APPD: LBH	FIGURE NO.:					
DATE: 2/18/93	REV.:	4-8					
						RFI INTERIM REPORT FOR SITE 11	
						NAVAL SUBMARINE BASE KINGS BAY, GEORGIA	



KINGSBAY\CHEM\MAPS\RFI\4-9.dwg		PROJECT NO.:		TITLE:	 RFI INTERIM REPORT FOR SITE 11 NAVAL SUBMARINE BASE KINGS BAY, GEORGIA
DWN:	DES.:	7553			
CHKD:	APPD:				
DATE:	REV.:	FIGURE NO.:			
2/17/93		4-9			

CROSS SECTION C-C'  
TOTAL TARGET VOCs  
ON-SITE ANALYTICAL DATA



REFER TO FIGURES 4-2 AND 4-3 FOR CROSS SECTION LOCATION

KINGSBAY\CHEN\MAPS\RFI14-10.dwg

DWN:	DES:
LGT	LGT
CHKD:	APPD:
LBH	LBH
DATE:	REV.:
2/18/93	

PROJECT NO.:
7553
FIGURE NO.:
4-10

TITLE:

CROSS SECTION D-D'  
TOTAL TARGET VOCs  
ON-SITE ANALYTICAL DATA



RFI INTERIM REPORT  
FOR SITE 11

NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA



The configuration of the interpreted plume will be used to establish the location and screened interval of the permanent monitoring wells to be installed during the Supplemental RFI.

4.1.3 SVOCs in Groundwater During the first two bimonthly groundwater sampling events, SVOCs were included in the analytical program. SVOCs detected in groundwater samples during the first two bimonthly sampling events included 1,4-dichlorobenzene and phthalate compounds. 1,4-Dichlorobenzene is included as a VOC and an SVOC in Appendix IX analyses. This compound was detected as an SVOC in groundwater samples from monitoring well KBA-11-3 at concentrations ranging from 4 J to 13  $\mu\text{g}/\text{l}$ . Two phthalate compounds, diethylphthalate and bis(2-ethylhexyl)phthalate, were detected in groundwater samples. Diethylphthalate was detected at 9 J  $\mu\text{g}/\text{l}$  in one sample from monitoring well KBA-11-8 during the first sample event. This compound was not detected in the associated method blank, but was detected in other method blanks associated with other RFI samples. Bis(2-ethylhexyl)phthalate was detected in groundwater samples from four monitoring wells at concentrations ranging from 4 J to 94  $\mu\text{g}/\text{l}$ . Because of their pervasive presence as sampling and laboratory artifacts, it is unlikely that future evaluations of phthalates in environmental media at the site would provide conclusive data regarding their source. A recommendation was made to delete SVOCs from the analytical program for the bimonthly groundwater sampling after the second sampling event based on the information discussed in this paragraph. SVOCs will be investigated during the supplemental RFI as potential constituents in waste and in the groundwater plume.

4.1.4 Inorganics in Groundwater Appendix H presents inorganic data for groundwater samples collected at Site 11 during the six sampling events. Data is presented in bar chart form for 11 of the 12 inorganic constituents regulated under the Safe Drinking Water Act. Antimony could not be accurately compared to the corresponding primary Maximum Contaminant Level (MCL) because the MCL is less than the method detection limit for antimony.

A statistical comparison was performed on data collected during the groundwater monitoring program at Site 11. Four monitoring wells are located upgradient of the site and five monitoring wells are located downgradient of the site. Both filtered and unfiltered groundwater samples were obtained from each well and analyzed separately. All sampling rounds for each well were combined for the statistical analysis.

Probability plots were generated for the sample data to ascertain if the normal or the lognormal distribution better describes the data. In a probability plot, data plotted along a straight line indicate that the data can be explained by the normal distribution (for a normal probability plot). Log-transformed data were also plotted on a normal probability plot. Probability plots indicated that the data were better described by a lognormal distribution. Normal probability plots of the log-transformed data are provided in Appendix I.

Because the data are better described by the lognormal distribution, the data were log-transformed before statistical analyses were performed. The procedure used to compare the upgradient versus downgradient data was the t-Test for Unpaired Data at the 95 percent confidence level. Bartlett's Test for Homogeneity of Variances was performed to establish the validity of the comparison. In all cases, the test results showed that there were no significant differences in sample variances. Table 4-6 shows the results of the analyses for the filtered data set and Table 4-7 the results for the unfiltered data set.

Table 4-6 Statistical Results from Comparison of Filtered Inorganic Groundwater Data

Analyte	Upgradient Mean Concentration ( $\mu\text{g}/\text{l}$ )	Downgradient Mean Concentration ( $\mu\text{g}/\text{l}$ )	t-Statistic Probability	<sup>1</sup> Significant Difference
Antimony	6.48	6.51	0.952	No
Arsenic	1.46	1.69	0.888	No
Barium	18.60	19.90	0.489	No
Beryllium	0.29	0.34	0.759	No
Cadmium	1.76	1.83	0.464	No
Chromium	8.95	18.72	0.570	No
Cobalt	1.83	1.64	0.450	No
Copper	10.68	16.26	0.887	No
Cyanide	2.98	8.34	0.633	No
Lead	2.54	4.26	0.570	No
Mercury	0.11	0.34	0.387	No
Nickel	6.93	9.91	0.960	No
Selenium	1.09	1.12	0.995	No
Silver	1.64	1.45	0.850	No
Sulfide	79.17	156.25	0.097	No
Total Dissolved Solids	<sup>2</sup> 369.50	<sup>2</sup> 319.50	0.684	No
Thallium	0.95	0.95	0.970	No
Tin	7.51	7.70	0.938	No
Total Suspended Solids	<sup>2</sup> 352.00	<sup>2</sup> 922.25	0.039	Yes
Vanadium	8.75	12.03	0.474	No
Zinc	17.93	42.18	0.837	No

Notes:

<sup>1</sup> At the 95 percent confidence level

<sup>2</sup> milligrams per liter

$\mu\text{g}/\text{l}$  = micrograms per liter

Table 4-7 Statistical Results from Comparison of Unfiltered Inorganic Groundwater Data

Analyte	Upgradient Mean Concentration ( $\mu\text{g/l}$ )	Downgradient Mean Concentration ( $\mu\text{g/l}$ )	t-Statistic Probability	<sup>1</sup> Significant Difference
Antimony	6.15	6.46	0.411	No
Arsenic	2.67	4.08	0.591	No
Barium	56.56	73.76	0.649	No
Beryllium	1.17	1.46	0.716	No
Cadmium	1.64	1.37	0.282	No
Chromium	59.99	69.64	0.561	No
Cobalt	2.35	3.00	0.668	No
Copper	32.55	36.22	0.210	No
Cyanide	10.05	25.43	0.743	No
Lead	10.13	12.47	0.772	No
Mercury	0.26	0.31	0.957	No
Nickel	15.63	19.02	0.578	No
Selenium	5.12	3.41	0.599	No
Silver	0.96	1.08	0.577	No
Sulfide	487.50	420.31	0.633	No
Total Dissolved Solids	<sup>2</sup> 299.44	<sup>2</sup> 583.73	0.067	No
Thallium	0.84	0.88	0.624	No
Tin	24.28	23.95	0.893	No
Total Suspended Solids	<sup>2</sup> 391.67	<sup>2</sup> 463.33	0.336	No
Vanadium	28.16	39.99	0.951	No
Zinc	41.51	60.54	0.647	No

Notes:

$\mu\text{g/l}$  = micrograms per liter

<sup>1</sup> At the 95 percent confidence level

<sup>2</sup> milligrams per liter

"Upgradient Mean Concentration" is the average concentration for the specified analyte of the sample data taken from the upgradient wells. "Downgradient Mean Concentration" is the average concentration for the specified analyte of the sample data taken from the downgradient wells. The column titled "t-Statistic Probability" is the approximate probability level that the sample mean concentrations are not different. A probability value below 0.05 would indicate that there is significant evidence to reject the hypothesis that the sample means are equal. As can be seen from the tables, only TSS data in the Filtered data set show a significant difference in mean concentration. Therefore, for the remaining inorganic analytes in both sets, there is not sufficient evidence to indicate that there is a difference between mean concentrations. The inorganic data from the existing shallow monitoring wells do not suggest that inorganic contaminants are present in groundwater. However, additional data are needed from within the plume to confirm that inorganic contaminants are not present.

4.1.5 Pesticides, Herbicides, PCBs, Dioxins, and Furans in Groundwater No pesticides, herbicides, PCBs, dioxins, or furans were detected in groundwater samples during the first two bimonthly sampling events. These compounds were subsequently deleted from the groundwater monitoring program. Samples collected during other investigations at the site were not analyzed for these parameters because adequate sample volumes were not obtainable.

4.1.6 Data Gaps Knowledge of the contaminant plume reveals that the existing monitoring wells are generally too shallow to adequately characterize landfill derived constituents. Although these monitoring wells are needed to monitor the upper portion of the surficial aquifer, additional wells are needed to penetrate the plume. Deeper monitoring wells will be installed during the Supplemental RFI. Groundwater samples will be collected from these deeper monitoring wells to characterize potential constituents released from the waste. Also, test trenches will be dug in the landfill during the Supplemental RFI to allow visual examination and possible sampling of the waste material.

4.2 SOIL CONTAMINATION. Ten subsurface soil samples, including one duplicate sample, were collected from nine soil borings drilled during the RFI field program conducted in January and February of 1992. These borings were installed for construction of groundwater monitoring wells KBA-11-1 through KBA-11-9 (see Figure 4-1).

4.2.1 Investigative Approach Borings were advanced using 8-inch outside diameter hollow-stem augers. Split-spoon samples were collected continually at 2-foot intervals in each borehole. Each split-spoon sample was screened for VOCs with a PID. VOC screening data were recorded on field boring logs. Data recorded in the field were used to create the boring logs contained in Appendix G. Split-spoon samples were logged at each drilling location by a geologist. The split-spoon sample from the interval above the groundwater table was collected, placed in sample jars, and submitted to the laboratory for analysis of Appendix IX parameters.

One sample per boring was analyzed by the laboratory. QC samples included duplicates, matrix spike, and matrix spike duplicates. Validated data tables are provided in Appendix C.

4.2.2 VOCs in Soil Table 4-8 provides a summary of the subsurface soil sample results for VOC analysis. VOCs detected in the soil samples included acetone and xylene. Acetone was detected in seven soil samples at concentrations ranging

Table 4-8 Summary of Laboratory Analysis of Subsurface Soil Samples<sup>1</sup>

Compounds Detected	CRQL	11-SB-01 4-6'	11-SB-02 4-6'	11-SB-03 4-6'	11-SB-03D 4-6'	11-SB-04 4-6'	11-SB-05 4-6'	11-SB-06 4-6'	11-SB-07 4-6'	11-SB-08 4-6'	11-SB-09 2-4'
<b>APPENDIX IX VOCs (<math>\mu\text{g}/\text{kg}</math>)</b>											
Acetone	10	48 U	470	96	210	470	190	150	100	48 U	29 U
Xylene (total) <sup>2</sup>	5	6 U	6 U	6 U	6 U	6 U	2 J	6 U	6 U	6 U	5
<b>APPENDIX IX SVOCs (<math>\mu\text{g}/\text{kg}</math>)</b>											
Di-n-Butylphthalate <sup>2,3</sup>	330	460 J	94 J	64 J	46 J	45 J	65 J	50 J	68 J	380 U	450 U
bis(2-Ethylhexyl)Phthalate <sup>2</sup>	330	200 J	400 U	420 U	420 U	410 U	410 U	410 U	400 U	340	230 J
<b>APPENDIX IX Inorganics (mg/kg)</b>											
Arsenic <sup>2</sup>	2	0.24 J	0.17 U	0.18 U	0.17 U	0.28 U	0.17 U	0.17 U	0.17 U	0.23 J	0.18 U
Barium <sup>2</sup>	40	1.1 J	4.5 J	3.0 J	2.7 J	4.7 J	1.5 J	1.8 J	2.4 J	3.1 J	0.78 U
Beryllium <sup>2</sup>	1	0.05 U	0.05 U	0.05 U	0.05 U	0.08 U	0.05 U	0.05 U	0.05 J	0.05 J	0.05 U
Cadmium <sup>2</sup>	1	0.74 U	0.72 U	0.81 J	0.73 U	1.2 U	0.73 U	0.72 U	0.72 U	0.67 U	0.76 U
Chromium	2	1.4 U	3.2	2.9 U	2.6 U	4.0	2.0 U	2.5 U	4.2	2.0 U	1.9 U
Lead	0.6	1.6 U	2.3	1.8	0.88	3.6	1.1	0.46 J	0.96	2.2	2.0
Nickel <sup>2</sup>	8	1.0 J	2.0 U	2.2 U	1.1 U	1.6 U	0.94 U	2.4 U	1.5 U	2.7 J	1.3 J
Selenium <sup>2</sup>	1	0.32 U	0.31 U	0.33 U	0.32 U	0.51 U	0.46 J	0.32 U	0.31 U	0.29 U	0.33 U
Silver <sup>2</sup>	2	0.43 U	0.42 U	0.44 U	0.43 U	0.69 U	0.43 U	0.42 U	0.47 J	0.39 U	0.54 U
Vanadium <sup>2</sup>	10	0.68 U	1.4 J	1.7 J	1.6 J	2.7 J	1.0 J	1.4 J	1.3 J	1.6 U	1.2 U
Zinc	4	1.8 U	1.9 U	3.8 U	1.5 U	4.0 U	0.90 U	2.4 U	2.5 U	6.8	5.3

**Notes:**

CRQL = Contract Required Quantitation Limit

J = estimated concentration

mg/kg = micrograms per kilograms

 $\mu\text{g}/\text{kg}$  = micrograms per kilograms

U = not detected above or below CRQL

<sup>1</sup> No Appendix IX pesticides, PCBs, herbicides, or dioxins/furans were detected in groundwater samples.<sup>2</sup> Value(s) flagged J as estimated because concentrations are less than the CRQL.<sup>3</sup> Value flagged J as estimated because the continuing calibration standard exceeded QC limits.

from 96 to 470 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ). Xylene was detected in two soil samples at concentrations of 2 J  $\mu\text{g}/\text{kg}$  and 5  $\mu\text{g}/\text{kg}$ . Although the concentrations of acetone in soil samples from Site 11 cannot be attributed to method blank contamination based on USEPA data validation guidelines, acetone was found in method blanks associated with soil samples collected from other sites during the RFI field program at concentrations ranging from 2 J  $\mu\text{g}/\text{kg}$  to 770  $\mu\text{g}/\text{kg}$ . This indicates that it may be a laboratory artifact chemical. Acetone, which is very soluble in water, was not found in groundwater samples and it is unlikely to be in soil and not in groundwater adjacent to the soil. Acetone in subsurface soil samples from Site 11 is not considered related to the site because of the absence of acetone in groundwater samples from associated monitoring wells and the concentrations found in method blanks associated with the overall RFI field program. Xylene in soil samples was considered to be representative of site conditions.

4.2.3 SVOCs in Soil The results of the SVOC analyses of subsurface soil samples are provided in Table 4-8. SVOCs detected in the soil samples include di-n-butylphthalate and bis(2-ethylhexyl)phthalate. Di-n-butylphthalate was detected in nine of 10 samples, but was qualified as undetected in one sample because of method blank contamination. Concentrations ranged from 45 J  $\mu\text{g}/\text{kg}$  to 460  $\mu\text{g}/\text{kg}$ .

Bis(2-ethylhexyl)phthalate was detected in three soil samples at concentrations ranging from 200 J  $\mu\text{g}/\text{kg}$  to 340  $\mu\text{g}/\text{kg}$ . Due to their pervasive presence in the environment and as sampling and laboratory artifacts, it may be unlikely that future evaluations of phthalates in environmental media at the site would provide conclusive data regarding their source.

4.2.4 Inorganics in Soil Appendix IX inorganic compounds in soil were evaluated by comparing site-specific data to reported naturally occurring ranges and by comparing background (upgradient) data to data from borings downgradient of the landfill. These data are summarized in Table 4-9. Background or upgradient soil samples include 11-SB-01, 11-SB-07, 11-SB-08, and 11-SB-09. The remaining soil samples are from locations downgradient and adjacent to the landfill. Table 4-8 provides a summary of the subsurface soil sample results for inorganic analyses.

Inorganic compounds detected in the 10 subsurface soil samples include arsenic, barium, beryllium, cadmium, chromium, lead, nickel, selenium, silver, vanadium, and zinc. The concentrations of inorganics detected in these samples were compared to naturally occurring concentrations for soils as reported by Kabata-Pendias and Pendias (1984). When comparing the background (upgradient) inorganic concentrations to naturally occurring ranges, the concentrations of inorganics found in the upgradient soil samples were all less than the naturally occurring concentration ranges, except for of nickel and silver, which were within the reported natural ranges. Inorganic concentrations in downgradient soil samples were compared to reported naturally occurring ranges. Except for the cadmium concentration in one soil sample, 11-SB-03, none of the concentrations of inorganics detected in the subsurface soil samples exceeded reported natural ranges. Sample 11-SB-03 contained cadmium at a concentration of 0.81 J milligrams per kilogram ( $\text{mg}/\text{kg}$ ), which is just above the Practical Quantitation Limit and below the Contract Required Quantitation Limit (CRQL) of 1  $\text{mg}/\text{kg}$  for cadmium. This concentration is only slightly higher than the reported natural range for cadmium. The duplicate of this sample, 11-SB-03D, did not contain detectable cadmium.

Table 4-9 Summary of Inorganic Concentrations in Soil

Compound	CRQL	Naturally Occurring <sup>1</sup>		Site Specific	
		Range <sup>2</sup> (mg/kg)	Arithmetic Mean (mg/kg)	Upgradient Range (mg/kg)	Downgradient Range (mg/kg)
Arsenic	2	1.5 - 21	7.8	0.17 U - 0.24 J	0.17 U - 0.28 U
Barium	40	150 - 1500	520	0.78 U - 3.1 J	1.5 J - 4.7 J
Beryllium	1	1 - 2	1.6	0.05 U - 0.05 J	0.05 U - 0.08 U
Cadmium	1	0.41 - 0.57 <sup>3</sup>	NR	0.67 U - 0.76 U	0.72 U - 0.81 J
Chromium	2	5 - 150	50	1.4 U - 4.2	2.0 U - 4.0
Lead	0.6	10 - 50	22	1.6 U - 2.2	0.46 J - 3.6
Nickel	8	<5 - 70	18	1.5 U - 2.7 J	0.94 U - 2.4 U
Selenium	1	0.1 - 1.4	0.19	0.29 U - 0.33 U	0.31 U - 0.46 J
Silver	2	0.3 - 8 <sup>3</sup>	NR	0.39 U - 0.47 J	0.42 U - 0.69 U
Vanadium	10	10 - 150	72	0.68 U - 1.3 J	1.0 J - 2.7 J
Zinc	4	10 - 106	50	1.8 U - 6.8	0.94 U - 4.0 U

**Notes:**

CRQL = Contract Required Quantitation Limit

mg/kg = milligrams per kilograms

NR = not reported

U = not detected above or below the CRQL

J = estimated because concentrations are less than the CRQL

<sup>1</sup> Source: Kabata-Pendias and Pendias, 1984.<sup>2</sup> For soils over limestone and calcareous rocks<sup>3</sup> As reported for various soil types

Concentrations of inorganics in downgradient soil samples were compared to background (upgradient) concentrations. Barium, cadmium, lead, selenium, and vanadium were detected in downgradient soil samples at concentrations exceeding the site background concentration ranges. Cadmium and selenium were not detected in the upgradient soil borings and concentrations in downgradient soil samples were below the CRQL of 1 mg/kg for these compounds. The majority of inorganic concentrations above background were associated with samples from borings 11-SB-02 and 11-SB-04. Concentrations of barium and lead in downgradient soil samples were less than two times the concentration in background soil samples and most likely reflect natural variation rather than releases from disposed waste. Vanadium was detected in downgradient soil samples at concentrations ranging from 1.0 J to 2.7 J mg/kg, which are less than the CRQL of 10 mg/kg, but greater than site background concentrations. Vanadium concentrations were less than two times the maximum concentration of 1.3 J mg/kg in background soil samples.

Concentrations of inorganics in soil samples collected from the site do not indicate that releases from the landfill have caused adjacent shallow soils to be contaminated with inorganic compounds. Additional soil samples will be collected from locations within the plume and where waste is in contact with soil to further evaluate potential inorganic contamination of soil.

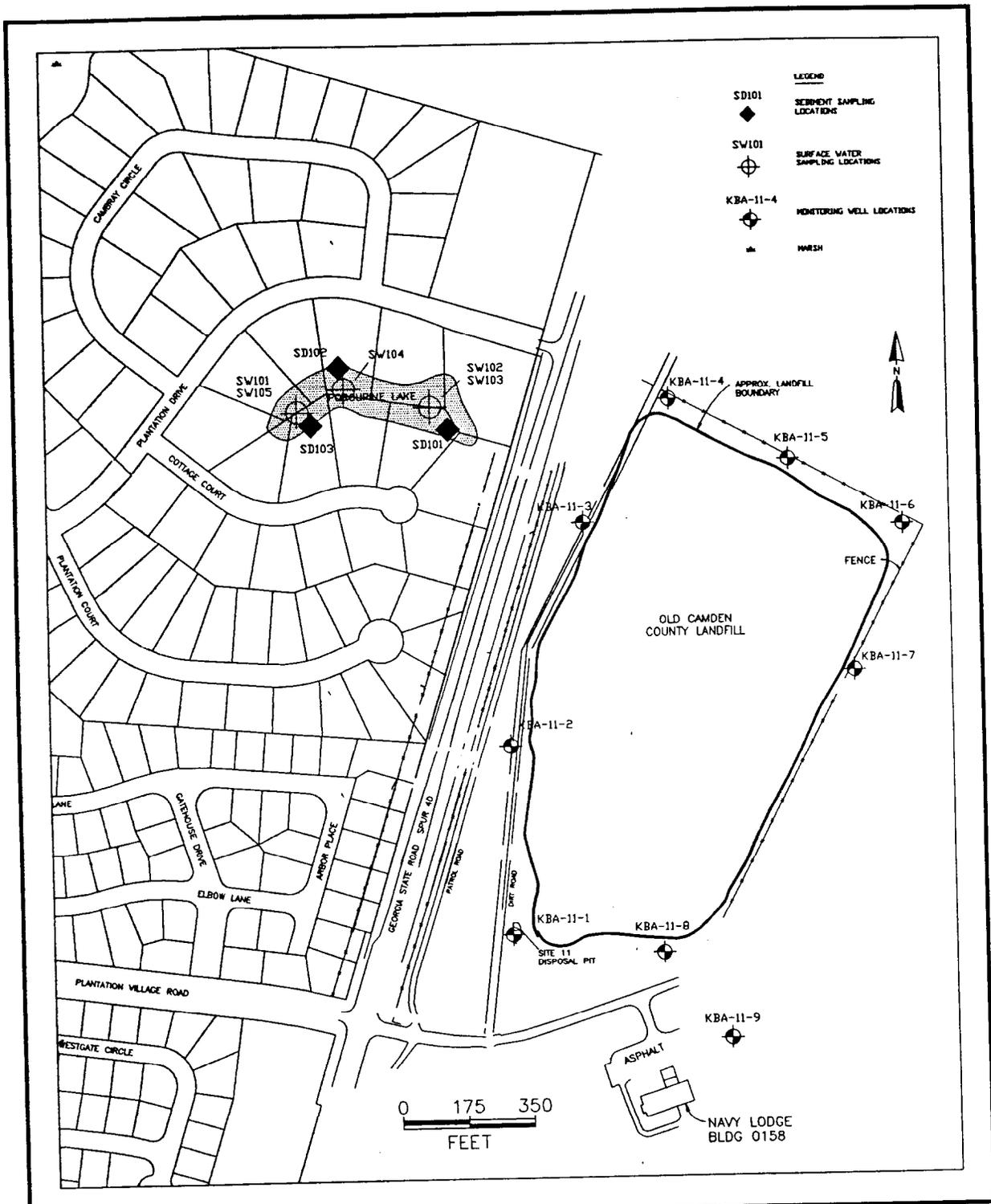
**4.2.5 Pesticides, Herbicides, PCBs, Dioxins, and Furans in Soil** Ten subsurface soil samples were collected and analyzed for Appendix IX pesticides, herbicides, PCBs, dioxins, and furans. None of these compounds were detected in the subsurface soil samples. Additional soil sampling is planned to evaluate the presence or absence of these compounds in soil in contact with waste and contaminated groundwater.

**4.2.6 Data Gaps** Information is lacking at this time for soil properties, such as cation exchange and organic carbon content, that affect contaminant migration. Also, contaminated soils may be present where releases originated and where soils are in contact with waste material and contaminated groundwater. Potential soil contamination within the groundwater contaminant plume has not been evaluated. These properties and conditions will be evaluated during Supplemental RFI activities.

The permeability of the soil is assumed to be similar to that of the surficial aquifer (see Subsection 2.1.2). The shallow water table and burial of waste in groundwater basically eliminate the unsaturated soil as a migration pathway.

**4.3 SURFACE WATER AND SEDIMENT CONTAMINATION**. During the ICMS Investigation, potential VOC and SVOC contamination of surface water and sediment in Porcupine Lake was evaluated. Other surface water bodies have not been identified as potentially affected by releases from the landfill.

**4.3.1 Investigative Approach** Two preliminary surface water samples were collected from Porcupine Lake and analyzed in the on-site laboratory to assist the air screening survey. Four additional surface water samples and four sediment samples were collected from Porcupine Lake for analysis of VOCs and SVOCs in the off-site laboratory. The surface water and sediment sampling locations are shown in Figure 4-12. The sediment and surface water samples include a duplicate sample of each media. The surface water samples were collected using a small boat and a Grab Sampler III. The samples were collected from depths ranging from 6 inches to 1 foot above the bottom of the lake. Water depth, pH, specific conductance, and temperature measurements were also made

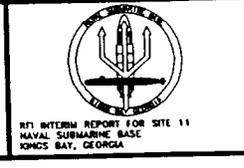


KINGSBAY\CHEN\MAPS\RFI114-12.dwg

OWN: LGT	DES.: LGT
CHKD: LBH	APPD: LBH
DATE: 3/11/93	REV.:

PROJECT NO.: <b>7553</b>
FIGURE NO.: <b>4-12</b>

TITLE:  
**SEDIMENT AND SURFACE WATER SAMPLING LOCATIONS**



during collection of the surface water samples. Sediment samples were collected from the edge of the lake using a hand auger. Water depth at the sediment sample locations was approximately 3 feet. Surface water and sediment samples were analyzed for target VOCs in the on-site laboratory and submitted to the off-site laboratory for analysis of TCL VOCs and TCL SVOCs using CLP methods. Validated data tables are provided in Appendix C.

**4.3.2 VOCs in Surface Water and Sediment** Tables 4-10 and 4-11 provide a summary of the on-site and off-site laboratory analysis of surface water and sediment samples. VOCs were not detected during on-site VOC analysis of the sediment and surface water samples collected from Porcupine Lake. VOCs detected during off-site laboratory analysis of surface water and sediment samples were 2-butanone and acetone in one surface water sample, 11SW103, and carbon disulfide in all three sediment samples. Acetone and 2-butanone were detected at concentrations of 4 and 2 J  $\mu\text{g}/\text{l}$ , respectively. Acetone was not detected in laboratory or field quality assurance/quality control (QA/QC) samples associated with surface water sample 11SW103. However, acetone was detected at a concentration of 4 J  $\mu\text{g}/\text{kg}$  in the method blank associated with the sediment samples from Porcupine Lake. Other QA/QC samples, such as rinsates, field blanks, and trip blanks contained acetone at concentrations ranging from 3 J to 22  $\mu\text{g}/\text{l}$ . Although acetone concentration in surface water sample 11SW103 cannot be discounted according to data validation guidelines, there is evidence that its presence in the surface water sample is not representative of the media. 2-Butanone was not detected in any QC samples associated with this investigation, but it is a chemical commonly found in laboratory samples and results from many man-made and natural processes. 2-Butanone was also detected in some groundwater samples from the plume. Additional data collected in future RFI activities may clarify the status of ketone compounds, such as 2-butanone, as site contaminants.

**4.3.3 SVOCs in Surface Water and Sediment** No SVOCs were detected in surface water samples from Porcupine Lake. Two phthalate compounds, bis(2-ethylhexyl)phthalate and di-n-butylphthalate, were detected in sediment samples from the lake. One sediment sample contained bis(2-ethylhexyl)phthalate at a concentration of 47 J  $\mu\text{g}/\text{kg}$ . Di-n-butylphthalate was found in all samples at concentrations ranging from 120 to 400 J  $\mu\text{g}/\text{kg}$ . QC blanks associated with the sediment samples did not contain concentrations of these phthalate compounds, but they are commonly laboratory and/or sampling artifact chemicals. Bis(2-ethylhexyl)phthalate was detected in method blanks associated with other samples from the investigation at concentrations ranging from 1 J  $\mu\text{g}/\text{l}$  to 35  $\mu\text{g}/\text{l}$ . This suggests that the concentrations of bis(2-ethylhexyl)phthalate may be wholly or partly attributed to laboratory artifacts. Because phthalates have low water solubility and tend to adsorb to particulates, it is unlikely that phthalates would migrate from the landfill in groundwater to be discharged into Porcupine Lake.

**4.3.4 Data Gaps** Inorganics, pesticides, herbicides, PCBs, dioxins, and furans have not been evaluated in surface water or sediment from Porcupine Lake. Currently, there is no evidence that compounds of this nature have been released from the site. The need to evaluate these compounds in Porcupine Lake will be based on evaluation of groundwater and soil data collected during the Supplemental RFI.

**4.4 AIR CONTAMINATION.** During the ICMS Investigation, an air screening survey was conducted over a four-day period in the Crooked River Plantation Subdivision and at the landfill to evaluate the potential emission of vinyl chloride from

Table 4-10 Summary of On-site Laboratory Analysis of Surface Water and Sediment Samples

Compound	Surface Water Sampling Locations ( $\mu\text{g}/\text{l}$ )					
	SW101	SW102	SW103	SW104	SW104D	SW105
Vinyl chloride	2 U	2 U	2 UJ	2 UJ	2 UJ	2 UJ
trans-1,2-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	5 U	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	10 U	10 U	10 U	10 U	10 U	10 U
o-Xylene	5 U	5 U	5 U	5 U	5 U	5 U

Compound	Sediment Sampling Locations ( $\mu\text{g}/\text{kg}$ )			
	SD101	SD102	SD102D	SD103
Vinyl chloride	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	5 UJ	5 UJ	5 UJ	5 UJ
cis-1,2-Dichloroethene	5 U	5 U	5 U	5 U
Trichloroethene	5 U	5 U	5 U	5 U
Tetrachloroethene	5 U	5 U	5 U	5 U
Benzene	5 U	5 U	5 U	5 U
Toluene	5 U	5 U	5 U	5 U
Ethylbenzene	5 U	5 U	5 U	5 U
m/p-Xylene	10 U	10 U	10 U	10 U
o-Xylene	5 U	5 U	5 U	5 U

Notes:

U = compound was not detected at the stated concentration  
 J = quantitation limit is considered estimated because a continuing calibration standard exceeded QC limits  
 $\mu\text{g}/\text{l}$  = micrograms per liter  
 $\mu\text{g}/\text{kg}$  = micrograms per kilogram

Table 4-11 Summary of Off-Site Laboratory Analysis of Surface Water and Sediment Samples

Compounds Detected	Surface Water Sampling Locations ( $\mu\text{g}/\text{l}$ )				Sediment Sampling Locations ( $\mu\text{g}/\text{kg}$ )			
	11SW103	11SW104	11SW104D	11SW105	11SD101	11SD102	11SD102D	11SD103
<b>Volatile Organic Compounds</b>								
2-Butanone <sup>1,2</sup>	2 J	5 U	5 U	5 U	13 U	14 U	13 U	14 U
Acetone <sup>2</sup>	4 J	5 U	5 U	5 U	13 U	14 U	13 U	14 U
Carbon Disulfide <sup>1</sup>	1 U	1 U	1 U	1 U	13 U	4 J	2 J	27
<b>Semivolatile Organic Compounds</b>								
bis(2-Ethylhexyl)phthalate <sup>2</sup>	10 U	10 U	10 U	10 U	420 U	47 J	420 U	460 U
Di-n-butylphthalate <sup>2</sup>	10 U	10 U	10 U	10 U	120 J	400 J	330 J	290 J

**Notes:**

J = sample result is considered estimated because the concentration is less than the Sample Quantitation Limit

U = compound was not detected at the stated concentration

$\mu\text{g}/\text{l}$  = micrograms per liter

$\mu\text{g}/\text{kg}$  = micrograms per kilogram

SW = surface water sample

SD = sediment sample

<sup>1</sup> Sample result is considered estimated and flagged with a J qualifier because an associated continuing calibration standard exceeded QC limits.

<sup>2</sup> Sample results are considered estimated and flagged with a J qualifier because concentrations are less than the Sample Quantitation Limit.

soil. The best available screening technology for measurement of vinyl chloride in the air was direct reading instrumentation using photoacoustic infrared spectroscopy and calibrated for vinyl chloride.

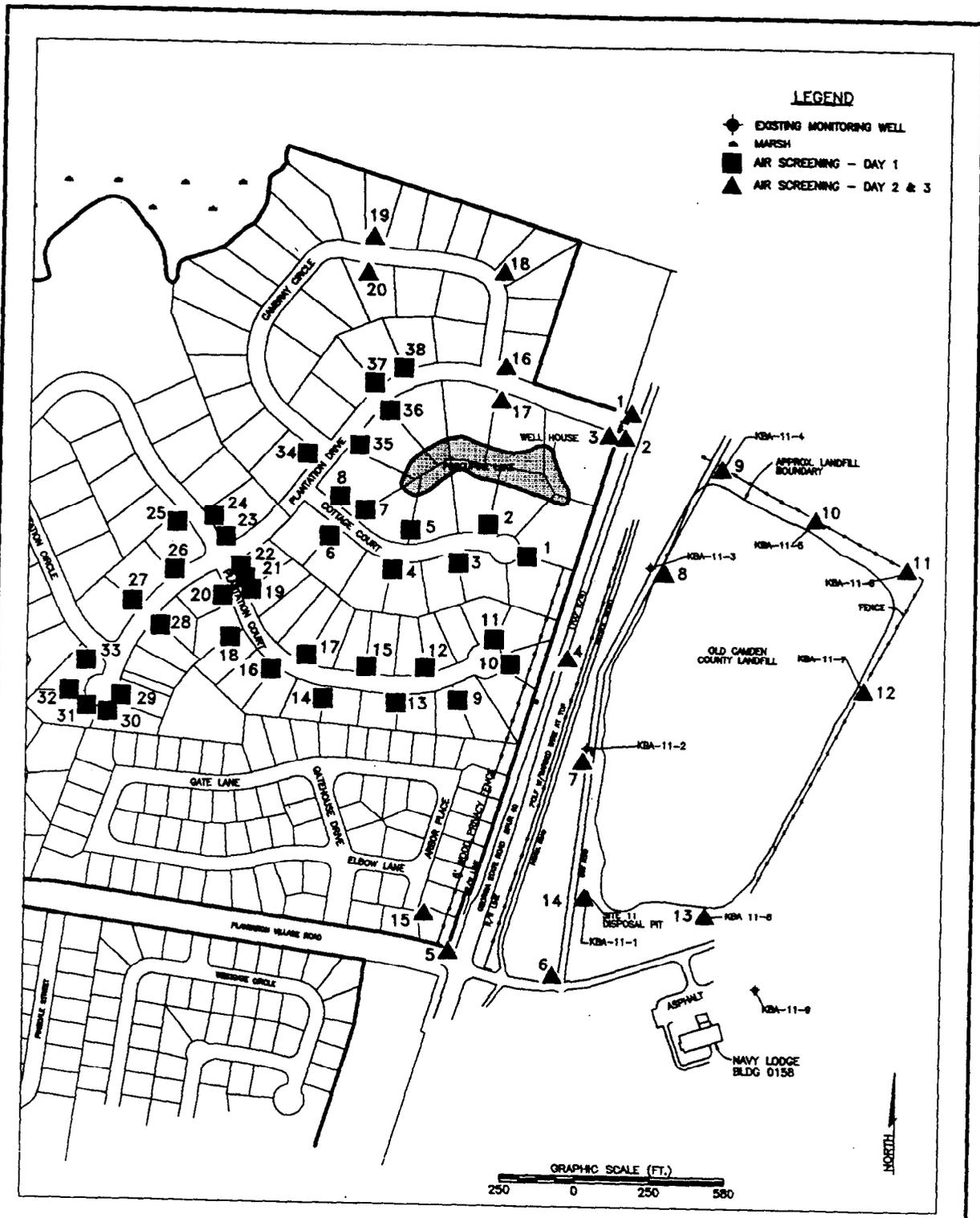
**4.4.1 Investigative Approach** The locations used in the air screening survey are shown in Figure 4-13. Replicate measurements were collected in accessible low-lying areas or depressions. Wind speed and direction, temperature, barometric pressure, relative humidity, precipitation, and general weather conditions were monitored and recorded during the survey. Multiple background air screening measurements were made each day during the air screening survey. Background readings were collected at two locations. One location was approximately 1,000 feet east of the landfill at the intersection of James Madison Road and Pine Loop Road. The other readings were made at an indoor location approximately 3.5 miles south-southwest of the landfill. During the first two days, the survey was performed with a Bruel & Kjaer (B&K) Type 1302 Multi-gas Monitor. The B&K had a detection limit of 0.2 parts per million (ppm). The B&K developed mechanical problems and was replaced with the only other available instrument, a Foxboro Miran 1B2 Infrared Analyzer. The Miran was used to measure vinyl chloride concentrations during the last two days of the survey. The detection limit for the Miran was 0.8 ppm.

**4.4.2 Vinyl Chloride in Air** None of the air survey screening measurements taken from locations in the Crooked River Plantation Subdivision were above the range of background readings. Background concentrations of vinyl chloride ranged from 0.20 to 2.20 ppm. These readings reflect the total concentration of all compounds present having similar wavelengths to vinyl chloride. The headspace of monitoring well KBA-11-2 contained vinyl chloride at a concentration of 5.86 ppm, which exceeds the range of background concentrations. This reading could also be influenced by the presence of other compounds having a similar wavelength to vinyl chloride when measured by infrared spectroscopy. Air survey screening data are provided in Appendix J.

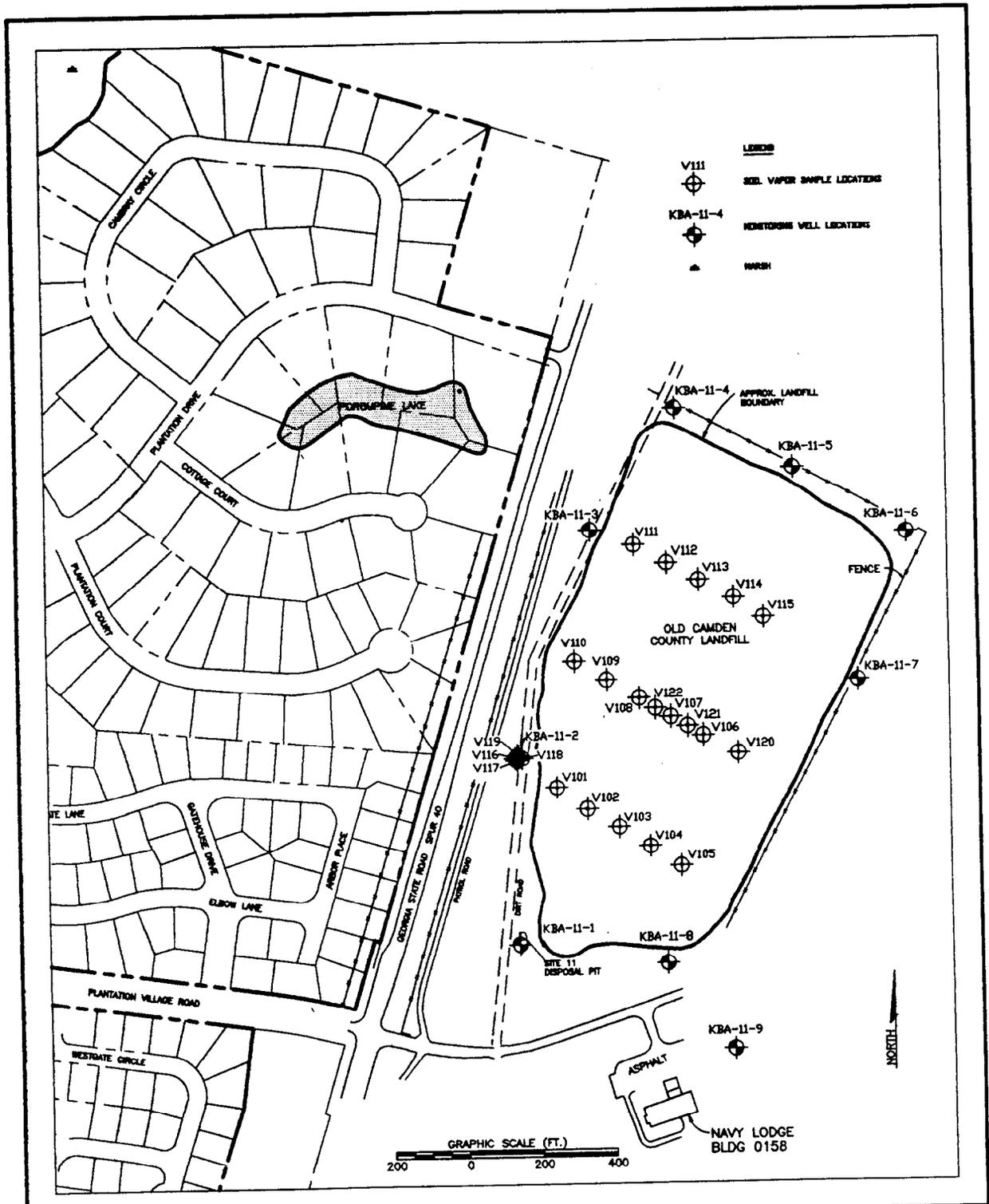
**4.4.3 Data Gaps** Interpretation of the air screening survey data is limited by the direct reading instrumentations detection limits. "Hot spots" were not identified during the survey and the data fulfilled the intended use. A confirmatory air monitoring program will be developed for the Supplemental RFI to evaluate the potential for emissions of vinyl chloride and other VOCs from soil. This program will likely include air flux sampling at upwind and downwind locations, followed by off-site laboratory analysis.

**4.5 SUBSURFACE GAS ACCUMULATION.** A soil vapor survey was performed during the ICMS Investigation to evaluate the potential for migration of VOCs from groundwater into the soil.

**4.5.1 Investigative Approach** Soil vapor samples were collected from an approximate depth of 3.5 feet bgs, approximately 6 inches above the water table, in the unsaturated zone. Samples were collected using a vapor cone sampler. Locations of the soil vapor samples are shown in Figure 4-14. The sampler was pushed to an approximate depth of 3.5 feet bgs using hydraulic pressure, then the outer casing was retracted, exposing the sampler tip. Soil vapors entered ports in the sampler tip and were conveyed to Tedlar bags through tygon tubing. An AeroVironment Pulse Pump III was used to draw the required volume of sample. The pump was purged with argon gas between samples. New tygon tubing and decontaminated vapor cones were used to collect each sample. Tedlar bags were



DWN: DMF	DES: LGT	PROJECT NO.:	TITLE:	
CHKD: LBH	APPD.: LBH	7553-09	LOCATIONS OF AIR SCREENING SURVEY	
DATE: 3-31-93	REV.:	FIGURE NO.:		
		4-13		



DWN: DMF	DES: LGT	PROJECT NO.: 7553-09	TITLE: VAPOR CONE SAMPLE LOCATIONS
CHKD: LBH	APPD.: LBH	FIGURE NO.: 4-14	
DATE: 3-31-93	REV.:		



reused after being purged with three volumes of argon gas; analyses of blank samples indicated the bags did not contain detectable concentrations of target VOCs.

Soil vapor samples were collected from 22 locations and submitted for analysis of 10 target VOCs in the on-site laboratory; targets included vinyl chloride, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, tetrachloroethene, benzene, toluene, ethylbenzene, m/p-xylene, and o-xylene.

**4.5.2 VOCs in Soil Vapor** Soil vapor samples were collected from 18 locations within the landfill boundaries, and four locations around monitoring well KBA-11-2. Table 4-12 summarizes the on-site laboratory analysis of vapor cone samples. Of the 22 samples collected and analyzed, two contained detectable concentrations of target VOCs. One sample contained 5.9 µg/l of vinyl chloride. The second sample contained ethylbenzene at a concentration of 5.6 µg/l and xylenes (total) at a concentration of 12.8 µg/l. Both samples were in the east-central area of the landfill. Three additional samples were collected to assess the extent of VOCs in soil vapor where these samples were collected. No target VOCs were detected in the additional soil vapor samples. The presence of VOCs in the two soil vapor samples indicates that there is a potential for VOCs to partition from the liquid phase to the gaseous phase. These samples were collected from locations within the landfill and, therefore, near a potential source of VOCs.

**4.5.3 Data Gaps** Results of the soil vapor survey conducted during the ICMS Investigation indicate that there is a potential for VOCs in soil vapor within the source area. The absence of detectable concentrations of VOCs in soil vapor samples collected adjacent to monitoring well KBA-11-2, where relatively high concentrations of VOCs are present in groundwater, indicates that there is little or no potential for accumulation of VOCs in soil within the unsaturated zone in areas outside the landfill boundaries and overlying the groundwater contaminant plume. No significant data gaps have been identified relative to subsurface accumulation of contaminants in the vadose zone.

Table 4-12 Summary of On-site Laboratory Analysis of Vapor Cone Samples

Compound	Vapor Cone Sampling Locations ( $\mu\text{g/l}$ )											
	VC101	VC102	VC103	VC104	VC105	VC106	VC107	VC108	VC109	VC110	VC111	VC112
Vinyl chloride	2 UJ	2 U	2 UJ	2 U	2 UJ	5.9	2 UJ	2 U	2 UJ	2 U	2 UJ	2 U
trans-1,2-Dichloroethene	5 U	5 UJ	5 U	5 UJ	5 U	5 UJ	5 U	5 UJ	5 U	5 UJ	5 U	5 UJ
cis-1,2-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	5 U	5 U	5 U	5 U	5 U	5 U	5.6	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	10 UJ	10 U	10 UJ	10 U	10 UJ	10 U	5.8 J	10 U	10 UJ	10 U	10 UJ	10 U
o-Xylene	5 U	5 U	5 U	5 U	5 U	5 U	7.0	5 U	5 U	5 U	5 U	5 U

Compound	Vapor Cone Sampling Locations ( $\mu\text{g/l}$ )											
	VC113	VC114	VC115	VC116	VC117	VC118	VC119	VC120	VC120D	VC121	VC122	VC122D
Vinyl chloride	2 UJ	2 UJ	2 UJ	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethene	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	10 UJ	10 U	10 UJ	10 U	10 U	10 U	10 U					
o-Xylene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

## Notes:

J = Quantitation limit is considered estimated because a continuing calibration standard exceeded QC limits.  
 U = Compound was not detected at the stated concentration.  
 $\mu\text{g/l}$  = micrograms per liter

## 5.0 INVESTIGATION ANALYSES

Analytical programs for on-site and off-site analyses of various media sampled during field activities associated with three investigations conducted at Site 11 are summarized in this section. These investigations include the RFI field program and bimonthly groundwater sampling events, the Phase I Interim Investigation, and the ICMS Investigation. In addition, it summarizes the data quality and useability assessments that were performed for the three investigations.

5.1 RFI FIELD PROGRAM AND BIMONTHLY GROUNDWATER SAMPLING EVENTS. RFI field activities at Site 11 included the collection of 10 subsurface soil samples (including one duplicate), the installation of nine groundwater monitoring wells, and the collection of six sets of 10 groundwater samples (including one duplicate). All samples were collected in accordance with procedures outlined in the Quality Assurance Project Plan, Appendix A of the NSB Kings Bay RFI Work Plan (ABB-ES, 1991). Subsurface soil samples were collected in February 1992 and groundwater samples were collected during six bimonthly sampling events as shown below.

<u>Sampling Event No.</u>	<u>Month Sampled</u>
1	February 1992
2	May 1992
3	July 1992
4	September 1992
5	November 1992
6	January 1993

5.1.1 Chemical Analysis Subsurface soil samples and groundwater samples were submitted to the contract laboratory for chemical analyses. Soil samples and groundwater samples collected during sampling events Nos. 1 and 2 were analyzed in accordance with USEPA SW-846 methods (USEPA, 1986) and Naval Energy and Environmental Support Activity (NEESA) Level C documentation for Appendix IX VOCs, SVOCs, polychlorinated dibenzo-dioxins and furans, organochlorine and organophosphorus pesticides, PCBs, herbicides, and inorganic analytes (including total cyanide and sulfide). Table 5-1 lists Appendix IX compounds, corresponding USEPA analytical method numbers, and PQLs.

Based on analytical results for the RFI field program and first two groundwater sampling events indicating that no SVOCs, pesticides, herbicides, dioxins or furans were present in groundwater at the landfill, these Appendix IX parameters were deleted from the groundwater monitoring program at Site 11. As a result, groundwater samples collected during the last four sampling events were analyzed for Appendix IX inorganics and a select list of Appendix IX VOCs. In addition, both filtered and unfiltered groundwater samples were collected during the last four sampling events to evaluate the contribution of aquifer solids in groundwater to the total concentration of inorganic constituents in groundwater. Two analytical parameters, TDS and TSS, were added to the monitoring program after sampling event No. 2 to establish what percentage of the total solids in groundwater represents suspended particulates. Table 5-2 lists the compounds and analytical methods included in the analytical program for sampling events Nos. 3 through 6. Groundwater samples were analyzed for VOCs and inorganic analytes in accordance with the same USEPA SW-846 methods used during the first two sampling events (see Table 5-1) and NEESA Level C (USEPA Level III)

Table 5-1 Appendix IX Compound List and Practical Quantitation Limits for Corresponding SW-846 Methods

	PQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{l}$ )
<b>Appendix IX Volatile Organic Compounds</b>		
<b>Method: USEPA SW-846 Method 8240</b>		
Chloromethane	10	10
Bromomethane	10	10
Vinyl chloride	10	10
Chloroethane	10	10
Methylene chloride	5	5
Acetone	10	10
Carbon disulfide	5	5
Trichlorofluoromethane	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone (Methyl ethyl ketone)	10	10
1,1,1-Trichloroethane	5	5
Carbon tetrachloride	5	5
Vinyl acetate	10	10
Bromodichloromethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
trans-1,3-Dichloropropene	5	5
2-Chloroethylvinylether	10	10
Bromoform	5	5
2-Hexanone	10	10
4-Methyl-2-pentanone	10	10
Tetrachloroethene	5	5
1,1,2,2-Tetrachloroethane	5	5
Toluene	5	5
Chlorobenzene	5	5
Ethylbenzene	5	5
Styrene	5	5
Xylene (total)	5	5

See notes at end of table.

Table 5-1 (continued) Appendix IX Compound List and Practical Quantitation Limits for Corresponding SW-846 Methods

	PQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{l}$ )
<b>Appendix IX Volatile Organic Compounds (cont.)</b>		
1,3-Dichlorobenzene	5	5
1,4-Dichlorobenzene	5	5
1,2-Dichlorobenzene	5	5
Acrolein	100	100
Iodomethane	10	10
Acrylonitrile	100	100
Dibromomethane	5	5
Ethyl methacrylate	5	5
1,2,3-Trichloropropane	5	5
trans-1,4-Dichloro-2-butene	5	5
Acetonitrile	100	100
3-Chloropropene	5	5
Propionitrile	100	100
Methacrylonitrile	5	5
1,4-Dioxane	200	200
Methyl methacrylate	10	10
1,2-Dibromoethane	5	5
1,1,1,2-Tetrachloroethane	5	5
1,2-Dibromo-3-chloropropane	10	10
Pentachloroethane	10	10
Isobutyl alcohol	200	200
Chloroprene	200	200
<b>Appendix IX Semivolatile Organic Compounds</b>		
<b>Method: USEPA SW-846 Method 8270</b>		
N-Nitrosodimethylamine	330	10
Phenol	330	10
Aniline	330	10
bis(2-Chloroethyl)ether	330	10
2-Chlorophenol	330	10
1,3-Dichlorobenzene	330	10
1,4-Dichlorobenzene	330	10
Benzyl alcohol	330	10
1,2-Dichlorobenzene	330	10
2-Methylphenol	330	10
bis(2-Chloroisopropyl)ether	330	10

See notes at end of table.

Table 5-1 (continued) Appendix IX Compound List and Practical Quantitation Limits for Corresponding SW-846 Methods

	PQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{l}$ )
<b>Appendix IX Semivolatile Organic Compounds (cont.)</b>		
N-Nitrosodi-n-propylamine	330	10
Hexachloroethane	330	10
Nitrobenzene	330	10
Isophorone	330	10
2-Nitrophenol	330	10
2,4-Dimethylphenol	330	10
Benzoic acid	1,600	50
bis(2-Chloroethoxy)methane	330	10
2,4-Dichlorophenol	330	10
1,2,4-Trichlorobenzene	330	10
Naphthalene	330	10
4-Chloroaniline	330	10
Hexachlorobutadiene	330	10
4-Chloro-3-methylphenol	330	10
2-Methylnaphthalene	330	10
Hexachlorocyclopentadiene	330	10
2,4,6-Trichlorophenol	330	10
2,4,5-Trichlorophenol	1,600	50
2-Chloronaphthalene	330	10
2-Nitroaniline	1,600	50
Dimethylphthalate	330	10
Acenaphthylene	330	10
2,6-Dinitrotoluene	330	10
3-Nitroaniline	1,600	50
Acenaphthene	330	10
2,4-Dinitrophenol	1,600	50
4-Nitrophenol	1,600	50
Dibenzofuran	330	10
2,4-Dinitrotoluene	330	10
Diethylphthalate	330	10
4-Chlorophenyl-phenylether	330	10
Fluorene	330	10
4-Nitroaniline	1,600	50
4,6-Dinitro-2-methylphenol	1,600	50
N-Nitrosodiphenylamine	330	10
Diphenylamine	330	10
1,2-Diphenylhydrazine	330	10

See notes at end of table.

Table 5-1 (continued) Appendix IX Compound List and Practical Quantitation Limits for Corresponding SW-846 Methods

	PQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{L}$ )
<b>Appendix IX Semivolatile Organic Compounds (cont.)</b>		
4-Bromophenyl-phenylether	330	10
Hexachlorobenzene	330	10
Pentachlorophenol	1,600	50
Phenanthrene	330	10
Anthracene	330	10
Di-n-butylphthalate	330	10
Fluoranthene	330	10
Pyrene	330	10
Butylbenzylphthalate	330	10
3,3'-Dichlorobenzidine	660	20
Benzo(a)anthracene	330	10
Chrysene	330	10
bis(2-Ethylhexyl)phthalate	330	10
Di-n-octyl phthalate	330	10
Benzo(b)fluoranthene	330	10
Benzo(k)fluoranthene	330	10
Benzo(a)pyrene	330	10
Indeno(1,2,3-cd)pyrene	330	10
Dibenz(a,h)anthracene	330	10
Benzo(g,h,i)perylene	330	10
2-Picoline	1,600	50
Methyl methanesulfonate	330	10
Ethyl methanesulfonate	330	10
Acetophenone	330	10
N-Nitrosopiperidine	330	10
Phenyl-tert-butylamine	1,600	50
2,6-Dichlorophenol	330	10
N-Nitrosodi-n-butylamine	330	10
N-Nitrosodiethylamine	330	10
N-Nitrosopyrrolidine	330	10
Benzidine	1,600	50
1,2,4,5-Tetrachlorobenzene	1,600	50
Pentachlorobenzene	1,600	50
1-Naphthylamine	1,600	50
2-Naphthylamine	1,600	50
2,3,4,6-Tetrachlorophenol	330	10
Phenacetin	330	10

See notes at end of table.

Table 5-1 (continued) Appendix IX Compound List and Practical Quantitation Limits for Corresponding SW-846 Methods

	PQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{l}$ )
<b>Appendix IX Semivolatile Organic Compounds (cont.)</b>		
4-Aminobiphenyl	1,600	50
Pentachloronitrobenzene	1,600	50
Pronamide	330	10
p-Dimethylaminoazobenzene	330	10
7,12-Dimethylbenz(a)anthracene	330	10
3-Methylcholanthrene	330	10
Pyridine	1,600	50
N-Nitrosomethylethylamine	330	10
N-Nitrosomorpholine	330	10
o-Toluidne	330	10
3-Methylphenol	330	20
4-Methylphenol	330	20
Hexachloropropene	1,600	50
p-Phenylenediamine	1,600	50
Safrole	1,600	50
Isosafrole	1,600	50
1,4-Naphthoquinone	1,600	50
1,3-Dinitrobenzene	330	10
5-Nitro-o-toluidine	330	10
1,3,5-Trinitrobenzene	330	10
4-Nitroquinoline-1-oxide	330	10
Methapyrilene	1,600	50
Aramite	1,600	50
3,3'-Dimethylbenzidine	330	10
2-Acetamidofluorene	330	10
Hexachlorophene	1,600	50
<b>Parameter: Polychlorinated Dibenzo- Furans/Dioxins</b>		
<b>Method: USEPA SW-846 Method 8280</b>		
Tetrachlorodibenzo-p-dioxins (TCDDs)	0.50	0.01
2,3,7,8-TCDD	0.50	0.005
Pentachlorodibenzo-p-dioxins (PeCDDs)	1.0	0.01
Hexachlorodibenzo-p-dioxins (HxCDDs)	1.0	0.01
Tetrachlorodibenzofurans (TCDFs)	0.50	0.01
Pentachlorodibenzofurans (PeCDFs)	0.50	0.01
Hexachlorodibenzofurans (HxCDFs)	0.50	0.01

See notes at end of table.

Table 5-1 (continued) Appendix IX Compound List and Practical Quantitation Limits for Corresponding SW-846 Methods

	PQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{l}$ )
<b>Parameter: Organochlorine Pesticides and PCBs<sup>1</sup></b>		
<b>Method: USEPA SW-846 Method 8080</b>		
alpha-BHC	0.4	0.05
beta-BHC	0.8	0.05
delta-BHC	0.4	0.05
gamma-BHC (Lindane)	0.4	0.05
Heptachlor	0.4	0.05
Aldrin	0.4	0.05
Heptachlor epoxide	0.4	0.05
Endosulfan I	0.8	0.10
Dieldrin	0.8	0.10
4,4'-DDE	0.8	0.10
Endrin	0.8	0.10
Endosulfan II	0.8	0.10
4,4'-DDD	0.8	0.10
Endrin Aldehyde	0.8	0.10
Endosulfan sulfate	0.8	0.10
4,4'-DDT	0.8	0.10
Methoxychlor	1.6	0.50
Endrin ketone	0.8	0.10
Chlordane	4.0	0.50
Toxaphene	20	1.0
Aroclor-1016	32	0.8
Aroclor-1221	80	2.0
Aroclor-1232	80	2.0
Aroclor-1242	32	0.8
Aroclor-1248	16	0.5
Aroclor-1254	8	1.0
Aroclor-1260	8	1.0
Chlorobenzilate	20	0.50
Diallate	40	1.0
Isodrin	0.8	0.02
Kepone <sup>2</sup>	--	1.0
<b>Parameter: Herbicides</b>		
<b>Method: USEPA SW-846 Method 8150</b>		
2,4-D	100	2.5
2,4,5-T	20	0.5

See notes at end of table.

Table 5-1 (continued) Appendix IX Compound List and Practical Quantitation Limits for Corresponding SW-846 Methods

	PQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{l}$ )
<b>Parameter: Herbicides (continued)</b>		
Dinoseb <sup>2</sup>	--	2.5
Silvex	20	0.5
<b>Parameter: Organophosphorus Pesticides</b>		
<b>Method: USEPA SW-846 Method 8140</b>		
Triethylphosphorothioate	50	1.0
Thionazin	50	1.0
Sulfotepp	50	1.0
Phorate	50	1.0
Dimethoate <sup>2</sup>	--	5.0
Disulfoton	50	1.0
Methyl Parathion	50	1.0
Ethyl Parathion	50	1.0
Famphur	50	1.0
<b>Parameter: Inorganic Analytes</b>		
	<b>mg/kg</b>	
<b>Method : Various SW-846 Methods</b>		
Antimony (Method 6010)	12	60
Arsenic (Method 7060)	2	10
Barium (Method 6010)	40	200
Beryllium (Method 6010)	1	5
Cadmium (Method 6010)	1	5
Chromium (Method 6010)	2	10
Cobalt (Method 6010)	10	50
Copper (Method 6010)	5	25
Lead (Method 7421)	1.0	3
Mercury (Method 7470)	0.1	0.2
Nickel (Method 6010)	8	40
Selenium (Method 7740)	1	5
Silver (Method 6010)	2	10
Thallium (Method 7841)	2	10
Vanadium (Method 6010)	10	50
Zinc (Method 6010)	4	20
Cyanide (Method 9010)	1.0	10

See notes at end of table.

Table 5-1 (continued) Appendix IX Compound List and Practical Quantitation Limits for Corresponding SW-846 Methods

	PQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{l}$ )
<b>Parameter: Inorganic Analytes (continued)</b>		
Tin (Method 6010)	40	200
Sulfide (Method 9030)	4,000	100

**Notes:**

<sup>1</sup> Lower PQLs for pesticides and PCBs were achieved for aqueous samples during the first sampling event. Values listed above are the highest PQL value for all sampling events.

<sup>2</sup> Compound was not analyzed for in soil samples due to poor spiking studies performed at the laboratory.

mg/kg = milligrams per kilogram

PQL = Practical Quantitation Limit

$\mu\text{g}/\text{l}$  = micrograms per liter

$\mu\text{g}/\text{kg}$  = micrograms per kilogram

Source: USEPA, 1986.

Table 5-2 Compound List for Groundwater Sampling Event Nos. 3 through 6

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<b>Parameter:</b>	<b>Volatile Organic Compounds</b>	
<b>Method:</b>	<b>SW-846 Method 8240</b>	
Chloromethane		cis-1,3-Dichloropropene
Bromomethane		Trichloroethene
Vinyl chloride		Dibromochloromethane
Chloroethane		1,1,2-Trichloroethane
Methylene chloride		Benzene
Acetone		trans-1,3-Dichloropropene
Carbon disulfide		Bromoform
Trichlorofluoromethane		2-Hexanone
1,1-Dichloroethene		4-Methyl-2-pentanone
1,1-Dichloroethane		Tetrachloroethene
1,2-Dichloroethene (total)		1,1,2,2-Tetrachloroethane
Chloroform		Toluene
1,2-Dichloroethane		Chlorobenzene
2-Butanone		Ethylbenzene
1,1,1-Trichloroethane		Styrene
Carbon tetrachloride		Xylene (total)
Vinyl acetate		1,3-Dichlorobenzene
Bromodichloromethane		1,4-Dichlorobenzene
1,2-Dichloropropane		1,2-Dichlorobenzene

<b>Parameter:</b>	<b>Appendix IX Inorganic Analytes</b>	
<b>Method:</b>	<b>SW-846 Methods (listed in parentheses)</b>	

Antimony (6010)	Copper (6010)	Thallium (7841)
Arsenic (7060)	Lead (7421)	Vanadium (6010)
Barium (6010)	Mercury (7470)	Zinc (6010)
Beryllium (6010)	Nickel (6010)	Tin (6010)
Cadmium (6010)	Selenium (7740)	Cyanide (9010)
Chromium (6010)	Silver (6010)	Sulfide (9030)
	Cobalt (6010)	

<b>Parameter:</b>	<b>Total Dissolved Solids (TDS)/ Total Suspended Solids (TSS)</b>	
<b>Method:</b>	<b>Standard Methods-- Methods 2540C and 2540D</b>	

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Sources: USEPA, 1986.  
 APHA-AWWA-WPCF, 1989.

documentation. The analytical methods on Table 5-2 correspond to methods on Table 5-1 and have the same PQLs for corresponding compounds.

During the fourth groundwater sampling event, additional samples were collected from four monitoring wells at Site 11, KBA-11-1, KBA-11-2, KBA-11-3, and KBA-11-8, and analyzed for VOCs using SW-846 Methods 8010 and 8020. The purpose of using the two additional VOC analytical methods was to achieve lower compound detection limits at these four monitoring wells to establish whether site-related VOCs, especially vinyl chloride, were present at concentrations below the normal detection limits of 5 and 10  $\mu\text{g}/\text{l}$  for Method 8240. Table 5-3 lists the VOCs analyzed by Methods 8010 and 8020 and corresponding PQLs.

5.1.2 Data Quality Assessment Summary Analytical results for environmental samples collected during the RFI field program and bimonthly sampling events were evaluated and validated according to NEESA Level C (USEPA Level III) QC criteria to establish data quality and useability. NEESA Level C (USEPA Level III) documentation and validation requirements are described in the June 1988 NEESA "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program" (NEESA, 1988) (Document 20.2-047B). Data review and NEESA Level C (USEPA Level III) validation were performed under subcontract. Appendix K of this document provides a detailed assessment of the analytical performance and quality of data generated during the six sampling events.

Data quality indicators of precision, accuracy, representativeness, comparability and completeness (PARCC) were evaluated for all data generated during this investigation. Appendix L of this report contains data tables summarizing analytical results for matrix spike/matrix spike duplicate (MS/MSD) samples, initial and continuing calibration standards, and compounds detected in field duplicate samples (Heartland Environmental Services, Inc., 1993). These data were used during each field event to evaluate the precision and accuracy of analytical methods and sampling techniques.

Field duplicate samples were collected during RFI field activities to assess sampling precision. Duplicate groundwater samples and soil samples were collected in accordance with NEESA Level C (USEPA Level III) guidelines at a minimum frequency of 10 percent (NEESA, 1988). All samples were collected in accordance with procedures outlined in the Quality Assurance Project Plan, Appendix A of the NSB Kings Bay RFI Work Plan (ABB-ES, 1991). Tables 1.1 through 1.1.8 in Appendix L summarize compounds detected in duplicate soil samples and groundwater samples collected from Site 11 as well as duplicate samples collected from Site 5, Army Reserve Disposal Area, Towhee Trail, and Site 16, Army Reserve Disposal Area, Motor Missile Magazines at NSB Kings Bay. As shown in these tables, compounds detected in water and soil matrices that did not meet the relative percentage difference (RPD) criteria were largely due to low sample values at or below the quantitation limit. Low precision values for inorganic analytes in groundwater may also be attributable to the variation in the amount of suspended solids in each sample and the nature of the inorganic constituents sorbed to those suspended solids.

Tables 1.2 through 1.2.6 in Appendix L summarize percentage recoveries and RPDs for MS/MSD samples that did not fall within QC advisory limits. The precision of each analytical method is evaluated based on RPD results for MS/MSD analyses and the accuracy of each analytical method is evaluated based on percentage recoveries for MS/MSD samples. An evaluation of organic and inorganic MS/MSD

Table 5-3 Target Compound List and Practical Quantitation Limits for SW-846 Methods 8010 and 8020

PQL for Aqueous Samples ( $\mu\text{g/l}$ )	
<b>Method: USEPA SW-846 Method 8010 - Halogenated Volatile Organic Compounds</b>	
Bromodichloromethane	1.0
Bromoform	1.0
Bromomethane	1.0
Carbon tetrachloride	1.0
Chloroethane	1.0
2-Chloroethyl vinyl ether	1.0
Chloroform	1.0
Chloromethane	1.0
Dibromochloromethane	1.0
Dichlorofluoromethane	1.0
1,1-Dichloroethane	1.0
1,2-Dichloroethane	1.0
1,1-Dichloroethene	1.0
cis-1,2-Dichloroethene	1.0
trans-1,2-Dichloroethene	1.0
1,2-Dichloropropane	1.0
cis-1,3-Dichloropropene	1.0
trans-1,3-Dichloropropene	1.0
Methyl tert butyl ether	1.0
Methylene chloride (Dichloromethane)	1.0
1,1,2,2-Tetrachloroethane	1.0
Tetrachloroethene	1.0
1,1,1-Trichloroethane	1.0
1,1,2-Trichloroethane	1.0
Trichloroethene	1.0
Trichlorofluoromethane	1.0
Vinyl chloride	1.0
<b>Method: USEPA SW-846 Method 8020 - Aromatic Volatile Organic Compounds</b>	
Benzene	1.0
Chlorobenzene	1.0
1,2-Chlorobenzene	1.0
1,3-Chlorobenzene	1.0
1,4-Chlorobenzene	1.0
Ethylbenzene	1.0
Toluene	1.0
Xylenes (total)	1.0

Notes:  $\mu\text{g/l}$  = micrograms per liter  
PQL = Practical Quantitation Limit

analyses indicate that at least 92 percent of all RPD results and at least 89 percent of all recoveries were within QC limits.

Representativeness is the degree to which the data obtained from a sample collection activity accurately reflect the contamination at a site. Factors such as the proper selection of analytical methodology and sampling strategies establish the degree of representativeness achieved. Measures used during the chemical analyses of environmental samples to confirm analytical representativeness include the analysis of analytical method blanks. Measures used during the field sampling to confirm sampling representativeness include collection of source water blanks, equipment rinsate blanks, and trip blanks. In accordance with NEESA Level C (USEPA Level III) guidance, one equipment rinsate blank was collected each day for each type of sampling equipment used that day, one source water blank was collected during each sampling event for each water source, and one trip blank was included in each cooler containing samples for volatile analysis. Rinsate blanks and source water blanks were analyzed for the same chemical parameters as associated environmental samples. Trip blanks were analyzed for VOCs only. Included in Appendix K of this document is a detailed assessment of compounds detected in analytical method blanks and field blanks collected during RFI field program and bimonthly sampling events and the subsequent impact on data quality and useability.

Comparability is the confidence with which one data set can be compared with another and the degree to which the data are found to be equivalent. Comparability cannot be accurately measured for data collected during RFI and bimonthly groundwater sampling events because two separate analytical laboratories were not used to analyze duplicate samples. However, the comparison of data collected during each groundwater sampling event suggests that the analytical methods employed during each event successfully confirmed the presence or absence of certain organic and inorganic constituents.

Analytical completeness is the percentage of useable data reported and validated compared with the total number of samples submitted for analysis. The goal for analytical completeness for the RFI is 95 percent useable data. Unusable analytical data are those results reported by the laboratory but rejected during the validation process. The following table illustrates by matrix and analytical parameter those results judged useable expressed as a percentage of total fractions.

<u>Parameter</u>	<u>Soil</u>	<u>Groundwater</u>	<u>QC Samples</u>
VOC	100.0	100.0	100.0
SVOC	98.0	99.1	98.8
Pesticide/PCB	100.0	100.0	100.0
Herbicide	100.0	100.0	100.0
Dioxin/Furan	100.0	100.0	100.0
Inorganics	100.0	100.0	100.0

As shown, the completeness goal of 95 percent was met for all matrices and all parameters. Overall, the data generated meet NEESA Level C (USEPA Level III) data quality objectives (DQOs) established for the RFI and are acceptable for use in site characterization and evaluation.

**5.2 PHASE I INTERIM INVESTIGATION.** Field activities during the Phase I investigation included the collection and chemical analysis of hydrocone groundwater samples. All samples were collected in accordance with procedures

outlined in the Quality Assurance Project Plan, Appendix A of the NSB Kings Bay RFI Work Plan (ABB-ES, 1991).

**5.2.1 On-Site Chemical Analysis** Samples collected for on-site analysis were analyzed for target halogenated VOCs using a gas chromatographic (GC) field laboratory. The five target VOCs and corresponding PQLs are listed below.

<u>Compound</u>	<u>Practical Quantitation Limit</u>
Chloroethane	10 µg/l
Vinyl chloride	2 µg/l
trans-1,2-Dichloroethene	2 µg/l
Trichloroethene	5 µg/l
Tetrachloroethene	2 µg/l

The analytical method used was a modification of the USEPA SW-846 8010 purge-and-trap GC method. A detailed summary of the modifications to the USEPA SW-846 8010 method and the performance criteria for the modified method is presented in Subsections 3.1.1.1 and 3.1.1.2 of the ICMS Investigation Report (ABB-ES, 1993a) and Appendix K of this report. A total of 33 groundwater samples were collected, including three duplicate samples, for on-site analysis.

**5.2.2 On-Site Data Quality Assessment Summary** Data generated by the on-site laboratory were reviewed against applicable performance criteria to assess data quality and useability. No qualification of data was required based on precision and accuracy criteria. The only on-site data requiring qualification were vinyl chloride results for eight groundwater samples because sample concentrations exceeded the linear range of the GC. Overall, data generated by the on-site analytical laboratory met USEPA Level II criteria for field screening and were suitable for use in site characterization and evaluation.

**5.2.3 Off-Site Chemical Analysis** During the Phase I Interim Investigation, six groundwater samples, including one duplicate, were collected for off-site analysis. Samples were submitted to the contract laboratory for analysis of halogenated and aromatic VOCs. Samples for VOC analysis were analyzed in accordance with USEPA SW-846 Methods 8010 and 8020 (USEPA, 1986) and NEESA Level E (USEPA Level V) documentation (NEESA, 1988). NEESA Level E (USEPA Level V) documentation requirements are described in the June 1988 NEESA "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program" (NEESA, 1988) (Document 20.2-047B). Table 5-3 lists the VOCs analyzed in samples and corresponding PQLs.

**5.2.4 On-Site Data Quality Assessment Summary** Analytical results for environmental samples collected during the investigation were reviewed against method performance criteria to assess data quality and useability. Except for one continuing calibration standard, no qualification of data was required based on precision and accuracy criteria. Results for vinyl chloride in three groundwater samples were qualified as estimated because an associated continuing calibration standard contained vinyl chloride with a percentage difference greater than the QC limit of 20. No other off-site data collected during the Phase I investigation required qualification.

Overall, the quality of the off-site sampling data generated during the field program met the established field QC criteria and was traceable to sample location. The data generated meet NEESA Level E (USEPA Level V) DQOs and were acceptable for use in site characterization and evaluation.

#### 5.2.5 Comparison of On-Site Laboratory Results and Off-Site Laboratory Results

Table 5-4 summarizes compounds detected in the six groundwater samples that were analyzed by both the on-site and off-site laboratories. Except for vinyl chloride in three samples, review of the replicate groundwater samples exhibited good agreement with groundwater samples. During replicate comparisons, where an analyte was not detected in the on-site sample, it was also not detected in the off-site sample above the PQL established for the on-site laboratory. For three groundwater samples (H10, H23, and H23D), vinyl chloride was detected in both the on-site and off-site samples; however, the concentration of vinyl chloride in the off-site sample was more than 30 percent lower than the concentration in the on-site sample. The difference in vinyl chloride concentrations in replicates is most likely due to the physical characteristics of vinyl chloride (i.e., low boiling point and high volatility). Vinyl chloride is an extremely volatile compound and can easily be lost to the atmosphere from a groundwater sample during all stages of environmental sampling, sample shipment, and chemical analysis. Concentrations of vinyl chloride in the two off-site duplicate samples (H23 and H23D) were in agreement, which indicates that the decrease in concentration of vinyl chloride in the off-site samples was not due to the precision of the analytical method. The decrease in concentration of vinyl chloride in the off-site samples most likely occurred during sample shipment via air transport.

5.3 ICMS INVESTIGATION. Field activities during the screening investigation included the collection and chemical analysis of groundwater and PIW samples, surface water samples, sediment samples, and vapor cone samples. All samples were collected in accordance with procedures outlined in the Quality Assurance Project Plan, Appendix A of the NSB Kings Bay RFI Work Plan (ABB-ES, 1991).

5.3.1 On-Site Chemical Analysis Samples collected for on-site analysis were analyzed for target VOCs using a GC field laboratory. The analytical method used was a modification of the USEPA SW-846 8010/8020 purge-and-trap GC method as described in the ICMS Investigation Work Plan (ABB-ES, 1992f). A detailed summary of the modifications to the USEPA SW-846 8010/8020 method is presented in Subsection 3.1.1.1 of the ICMS Investigation Report (ABB-ES, 1993a). Table 5-5 summarizes the sampling and analysis program for samples collected for on-site laboratory analysis. Table 5-6 provides a list of the 10 target compounds and corresponding reporting limits.

5.3.2 On-Site Data Quality Assessment Summary Data generated by the on-site laboratory were reviewed against applicable performance criteria and PARCC parameters were evaluated for the on-site data. A detailed discussion of the PARCC parameters is presented in Subsection 3.2.1.1 of the ICMS Investigation Report (ABB-ES, 1993a).

Overall, data generated by the on-site analytical laboratory met USEPA Level II criteria for field screening. Except for certain vinyl chloride data, all data were suitable for use in site characterization and evaluation.

5.3.3 Off-Site Chemical Analysis In accordance with the ICMS Investigation Work Plan (ABB-ES, 1992f), a minimum of 10 percent of all samples collected for on-site VOC analysis and all samples collected for SVOC analysis were submitted to the contract laboratory for chemical analysis. Table 5-7 summarizes the sampling and analysis program for samples collected for off-site analysis. Samples for VOC and SVOC analyses were analyzed according to the USEPA CLP

Table 5-4 Summary of Compounds Detected in On-site and Off-site Replicate Groundwater Samples

Sample ID	Compound Detected	On-site Result ( $\mu\text{g/l}$ )	Off-site Result ( $\mu\text{g/l}$ )
H2	Vinyl chloride	2.2	2.0
H3	(no target VOCs detected by either analysis)		
H10	Vinyl chloride	4.3	1.4
H15B	Vinyl chloride	11	11
H23	Trichloroethene	5 U	4.9
	Vinyl chloride	45 J	32 J
H23D	Trichloroethene	--	4.7
	Vinyl chloride	--	35 J

**Notes:**

-- = analysis not performed  
 J = estimated value  
 $\mu\text{g/l}$  = micrograms per liter  
 U = compound not detected as the stated quantitation limit  
 VOC = volatile organic compound

Table 5-5 Summary of Sampling and Analysis Program for Samples Collected for On-site Analysis during the ICMS Investigation

Type of Sampling	Number of VOC Analyses
Groundwater	142
Private Irrigation Wells	51
Surface Water	3
Sediment	3
Soil Vapor	22
Quality Control Samples	
Field Duplicates	25
MS/MSD	11
Equipment Rinsate Blanks	14
Method Blanks	41

**Notes:**

VOC = Volatile Organic Compound  
MS/MSD = Matrix spike/Matrix Spike Duplicate

Table 5-6 Target Compounds and Reporting Limits for On-site Analysis

Compound Name	Reporting Limit ( $\mu\text{g}/\text{l}$ )
Vinyl Chloride	2.0
trans-1,2-Dichloroethene	5.0
cis-1,2-Dichloroethene	5.0
Trichloroethene	5.0
Tetrachloroethene	5.0
Benzene	5.0
Toluene	5.0
Ethylbenzene	5.0
m/p-Xylene	10
o-Xylene	5.0

**Note:**

$\mu\text{g}/\text{l}$  = micrograms per liter

Table 5-7 Summary of Sampling and Analysis Program for Samples Collected for Off-site Analysis during the ICMS Investigation

Type of Sampling	Laboratory Analysis	
	VOC	SVOC
Groundwater	17	2
Private Irrigation Wells	24	0
Surface Water	3	3
Sediment	3	3
Field Duplicates		
Groundwater	2	1
Private Irrigation Wells	3	0
Surface Water	1	1
Sediment	1	1
Quality Control Samples		
Trip Blanks	15	0
Equipment Rinsate Blanks	11	2
Source Water Blanks	9	0

**Notes:**

VOC = Volatile Organic Compound  
SVOC = Semivolatile Organic Compound

Statement of Work for multimedia samples (USEPA, 1991a). NEESA Level D (USEPA Level IV) documentation (NEESA, 1988) was used for VOC and SVOC analyses. Table 5-8 lists the TCL SVOCs analyzed in samples and corresponding CRQLs.

Because many of the target VOCs currently have federal Primary Drinking Water MCLs below their respective CLP CRQLs, it was necessary to achieve lower reporting limits for VOCs. Based on VOC Method Detection Limit (MDL) studies performed and submitted by the contract laboratory, lower reporting limits for VOCs were achieved. Table 5-9 lists the TCL VOCs, their corresponding MDLs, and the reporting limits used during this investigation. All reporting limits listed in Table 5-9 are lower than corresponding federal Primary Drinking Water MCLs. Appendix D of the ICMS Investigation Progress Report (ABB-ES 1993a) contains data supporting the MDL study.

5.3.4 Off-Site Data Quality Assessment Summary Analytical results for environmental samples collected during the investigation were evaluated and validated according to NEESA Level D (USEPA Level IV) QC criteria to establish data quality and useability. NEESA Level D (USEPA Level IV) documentation and validation requirements are equivalent to USEPA Level IV requirements and are described in the June 1988 NEESA "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program" (NEESA, 1988) (Document 20.2-047B). Data review and NEESA Level D (USEPA Level IV) validation were performed under subcontract. Subsection 3.2.2 of the ICMS Investigation Report (ABB-ES, 1993a) provides a detailed assessment of the analytical performance and quality of data generated during the screening investigation. Appendix D of the report contains the PARCC report submitted for all data collected for off-site analysis during the screening investigation (Heartland Environmental Services, Inc., 1993).

Overall, the quality of the off-site sampling data generated during the field program met the established field QC criteria and was traceable to sample location. The data generated meet NEESA Level D (USEPA Level IV) DQOs established for the ICMS Investigation and are acceptable for use in site characterization and evaluation. The widespread occurrence of acetone and the unknown origin of carbon disulfide in rinsate blanks render data for acetone and carbon disulfide suspect for groundwater and PIW samples containing these compounds at concentrations that could not be directly attributed to contamination. The source of acetone and carbon disulfide in rinsate samples will be further investigated during future field programs at NSB Kings Bay.

5.3.5 Comparison of On-site Laboratory Results and Off-Site Laboratory Results A statistical analysis of groundwater contamination data was performed on the analytical results from on-site analysis and results from off-site laboratory analysis. Results are presented in Subsection 3.2.3 of the ICMS Investigation Progress Report (ABB-ES, 1993a). In summary, except for vinyl chloride and cis-1,2-dichloroethene, the results from on-site and off-site analyses were not statistically different. Based on the measured precision and accuracy of the on-site and off-site results, and a statistical test for comparability of results, the on-site data can be used to augment the off-site data for site characterization.

Table 5-8 Target Compound List and Contract Required Quantitation Limits for Off-site Laboratory Analysis

	CRQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{l}$ )
<b>Semivolatle Organic Compounds (64 total)</b>		
<b>Method: Contract Laboratory Program Statement of Work for Organic Analysis, Multi-media, Multi-concentration, USEPA Document No. OLM01.0, 1991.</b>		
Phenol	330	10
Acenaphthene	330	10
bis(2-Chloroethyl)Ether	330	10
2,4-Dinitrophenol	800	25
2-Chlorophenol	330	10
4-Nitrophenol	800	25
1,3-Dichlorobenzene	330	10
Dibenzofuran	330	10
1,4-Dichlorobenzene	330	10
2,4-Dinitrotoluene	330	10
1,2-Dichlorobenzene	330	10
Diethylphthalate	330	10
2-Methylphenol	330	10
4-Chlorophenyl-phenylether	330	10
2,2'-Oxybis(1-Chloropropane)	330	10
Fluorene	330	10
4-Methylphenol	330	10
4-Nitroaniline	800	25
N-Nitroso-Di-n-Propylamine	330	10
4,6-Dinitro-2-methylphenol	800	25
Hexachloroethane	330	10
N-Nitrosodiphenylamine	330	10
Nitrobenzene	330	10
4-Bromophenyl-phenylether	330	10
Isophorone	330	10
Hexachlorobenzene	330	10
2-Nitrophenol	330	10
Pentachlorophenol	800	25
2,4-Dimethylphenol	330	10
Phenanthrene	330	10
bis(2-chloroethoxy)Methane	330	10
Anthracene	330	10
2,4-Dichlorophenol	330	10
Carbazole	330	10
1,2,4-Trichlorobenzene	330	10

See notes at end of table.

Table 5-8 (continued) Target Compound List and Contract Required Quantitation Limits for Off-site Laboratory Analysis

	CRQL	
	Soil ( $\mu\text{g}/\text{kg}$ )	Water ( $\mu\text{g}/\text{l}$ )
<b>Semivolatile Organic Compounds (continued)</b>		
Di-n-Butylphthalate	330	10
Naphthalene	330	10
Fluoranthene	330	10
4-Chloroaniline	330	10
Pyrene	330	10
Hexachlorobutadiene	330	10
Butylbenzylphthalate	330	10
4-Chloro-3-methylphenol	330	10
3,3'-Dichlorobenzidine	330	10
2-Methylnaphthalene	330	10
Hexachlorocyclopentadiene	330	10
2,4,6-Trichlorophenol	330	10
2,4,5-Trichlorophenol	800	25
2-Chloronaphthalene	330	10
2-Nitroaniline	800	25
Dimethylphthalate	330	10
Acenaphthalene	330	10
2,6-Dinitrotoluene	330	10
3-Nitroaniline	800	25
Benzo(a)anthracene	330	10
Chrysene	330	10
bis(2-Ethylhexyl)phthalate	330	10
Di-n-octylphthalate	330	10
Benzo(b)fluoranthene	330	10
Benzo(k)fluoranthene	330	10
Benzo(a)pyrene	330	10
Ideno(1,2,3-cd)pyrene	330	10
Dibenz(a,h)anthracene	330	10
Benzo(g,h,i)perylene	330	10

**Notes:**

CRQL = Contract Required Quantitation Limit

$\mu\text{g}/\text{kg}$  = micrograms per kilograms

$\mu\text{g}/\text{l}$  = micrograms per liter

Table 5-9 Method Detection Limits and Reporting Limits for Volatile Organic Compounds

	MDL ( $\mu\text{g}/\text{l}$ )	Reporting Limit ( $\mu\text{g}/\text{l}$ )
<b>Volatile Organic Compounds (37 total)</b>		
<b>Method: Contract Laboratory Program Statement of Work for Organic Analysis, Multi-media, Multi-concentration, USEPA Document No. OLM01.0, 1991.</b>		
Chloromethane	0.203	1
cis-1,3-Dichloropropene	0.274	1
Bromomethane	0.396	1
Trichloroethene	0.185	1
Vinyl Chloride	0.165	1
Dibromochloromethane	0.190	1
Chloroethane	0.147	1
1,1,2-Trichloroethane	0.268	1
Methylene Chloride	9.712	10
Benzene	0.235	1
Acetone	3.491	5
trans-1,3-Dichloropropene	0.097	1
Carbon Disulfide	0.114	1
Bromoform	0.230	1
1,1-Dichloroethene	0.175	1
2-Hexanone	0.465	5
1,1-Dichloroethane	0.205	1
4-Methyl-2-Pentanone	0.746	5
cis-1,2-Dichloroethene	0.215	1
Tetrachloroethene	0.340	1
trans-1,2-Dichloroethene	0.254	1
1,1,2,2-Tetrachloroethane	0.391	1
Chloroform	0.285	1
Toluene	0.167	1
1,2-Dichloroethane	0.160	1
Chlorobenzene	0.238	1
2-Butanone	0.709	5
Ethylbenzene	0.195	1
1,1,1-Trichloroethane	0.221	1
Styrene	0.240	1
Carbon Tetrachloride	0.354	1
Xylenes (total)	0.141	1
Bromodichloromethane	0.144	1
1,3-Dichlorobenzene	0.126	1
1,2-Dichloropropane	0.236	1
1,4-Dichlorobenzene	0.164	1
1,2-Dichlorobenzene	0.222	1

**Notes:**

$\mu\text{g}/\text{l}$  = micrograms per liter  
MDL = Method Detection Limit

## 6.0 POTENTIAL RECEPTORS

6.1 SITE ACCESS. The area of the base near the site is used for recreational purposes and hunting. Housing for base employees, a day-care center, and Navy lodge, are also present in the area. Access to the site is limited to the extent that entry to the base is restricted. There are no controls to restrict access to the site within the base. Human activities near the site observed by ABB-ES field crews include jogging, bicycle riding, walking, and hunting.

6.2 GROUNDWATER USE. The Crooked River Plantation Subdivision is a residential development of 630 homes located west of the landfill. The subdivision was built on 260 acres west of Spur 40 during the 1980s. A marsh fronts the north and west perimeter of the subdivision. More than 90 homes in the subdivision have PIWs that draw groundwater from the surficial aquifer. Based on the residential survey of the Crooked River Plantation Subdivision residents and the fact that the subdivision is supplied by the city water system, the PIWs are not used as drinking water.

The USGS, GA DNR, and the Camden County Health Department were contacted for information relating to locations of public and/or private water supply wells. Table 6-1 summarizes information obtained. Approximate locations of the wells are shown on Figure 6-1.

Groundwater in the surficial aquifer is used primarily for irrigation. The public water supply for the NSB Kings Bay and surrounding towns and urban areas comes from the Floridan aquifer system. In Camden County, water treatment facilities for St. Marys and Kingsland are adequate for present demands. Currently, the City of St. Marys is served by two water supply wells. One well is located on Jefferson Road near the NSB Kings Bay boundary (No. 48 on Figure 6-1), approximately 3 miles south of Site 11. The other well is located adjacent to the southern boundary of the St. Marys Airport (No. 49 of Figure 6-1), approximately 4 miles south-southeast of Site 11. Two other wells are available on a standby basis. One is located near Mission Trace Drive in Mission Trace (No. 50 on Figure 6-1), approximately 2.2 miles southwest of Site 11. The other is located on Ready Street near City Hall (No. 51 on Figure 6-1), approximately 5 miles south-southeast of Site 11. The city of Kingsland is served by two water supply wells located off South Grove Boulevard near Colony Pines (not within the Harriett's Bluff Quadrangle). These wells are approximately 6 miles west-southwest of Site 11.

Private wells supply water for most of the individual homes within the unincorporated areas of Camden County. NSB Kings Bay obtains its potable water from three groundwater wells within its property boundaries. Relative to Site 11, these three wells are approximately 1 mile to the south, 2 miles to the east, and 3.2 miles to the east-southeast. These wells are approximately 900 feet deep and 18 inches in diameter.

Table 6-1 Summary of Water Supply Well Data

USGS Grid No. <sup>1</sup>	Map No. <sup>2</sup>	Latitude	Longitude	Bottom of Casing (ft bgs)	Well Depth (ft bgs)	Station Name <sup>3</sup>	Well Use
33E002	1	30° 46' 27"	81° 37' 12"	80	474	Rayonier, Inc.	Unused
33E003	2	30° 47' 51"	81° 32' 01"	302	--	NSB Refill Station	Unused
33E004	3	30° 49' 10"	81° 32' 38"	186	516	NSB Etowah	Recreational
33E005	4	30° 52' 08"	81° 35' 03"	--	650	W. Bailey	--
33E006	5	30° 46' 08"	81° 34' 52"	--	750	Finn & Neighbor	--
33E007	6	30° 45' 10"	81° 34' 38"	525	770	G. H. Davis	Domestic
33E008	7	30° 50' 37"	81° 33' 23"	261	470	Crooked River State Park	Unused
33E009	8	30° 50' 45"	81° 33' 46"	250	565	American Legion	--
33E018	9	30° 48' 00"	81° 31' 05"	145	486	NSB Club	Unused
33E023	10	30° 50' 31"	81° 34' 27"	450	650	R. Norieka	Domestic
33E027	11	30° 47' 56"	81° 31' 11"	555	990	NSB TW1	Observational
33E032	12	30° 47' 39"	81° 34' 31"	585	894	NSB 1	Commercial
33E033	13	30° 47' 43"	81° 33' 42"	585	813	NSB 2	Fire Fighting
33E034	14	30° 47' 52"	81° 31' 12"	500	810	NSB 4	Commercial
33E035	15	30° 47' 59"	81° 31' 19"	500	800	NSB 3	Commercial
33E037	16	30° 49' 13"	81° 35' 31"	--	575	C. Drury, Laurel Island	Unused
33E038	17	30° 51' 57"	81° 31' 56"	66	340	Brunswick Pulp and Paper	Unused
33E039	18	30° 47' 49"	81° 33' 53"	100/560/950	1150	NSB Observ. No. 1	Observational
33E040	19	30° 47' 49"	81° 33' 53"	100	750	NSB Observ. No. 2	Observational
33E046	20	30° 49' 16"	81° 36' 07"	245	650	Joiner/Greene/Crocker/Oneil	Domestic
33E047	21	30° 45' 15"	81° 36' 57"	87	111	Osprey Cove Golf Course	Institutional
33E048	22	30° 45' 15"	81° 36' 57"	334	502	Osprey Cove Golf Course	Institutional
NA	23	30° 49' 42"	81° 34' 12"	--	45	Private Residence	Domestic
NA	24	30° 49' 45"	81° 34' 06"	--	45	Private Residence	Domestic
NA	25	30° 52' 13"	81° 36' 57"	--	200 (Avg)	Sadler Cove (39)	--

See notes at end of table.

Table 6-1 (continued) Summary of Water Supply Well Data

USGS Grid No. <sup>1</sup>	Map No. <sup>2</sup>	Latitude	Longitude	Bottom of Casing (ft bgs)	Well Depth (ft bgs)	Station Name <sup>3</sup>	Well Use
NA	26	30° 52' 06"	81° 37' 04"	--	200 (Avg)	Mallard Pointe (112)	--
NA	27	30° 52' 27"	81° 36' 49"	--	200 (Avg)	Sadler Creek (112)	--
NA	28	30° 50' 29"	81° 36' 29"	--	200 (Avg)	London Hill (16)	--
NA	29	30° 52' 16"	81° 35' 04"	--	200 (Avg)	Harriett's Bluff (6)	--
NA	30	30° 50' 35"	81° 34' 17"	--	125 (Avg)	Timber Ridge (5)	--
NA	31	30° 50' 22"	81° 34' 31"	--	125 (Avg)	Elliott's Plantation	--
NA	32	30° 50' 30"	81° 34' 22"	--	125 (Avg)	Riverbend (3)	--
NA	33	30° 50' 39"	81° 34' 19"	--	125 (Avg)	Marsh Point	--
NA	34	30° 50' 23"	81° 34' 09"	--	125 (Avg)	Foxwood (40)	--
NA	35	30° 45' 36"	81° 34' 43"	--	60 (Avg)	Gaines Davis (7)	--
NA	36	30° 45' 57"	81° 34' 48"	--	60 (Avg)	New Hope Baptist Church	--
NA	37	30° 45' 39"	81° 36' 06"	--	60 (Avg)	Woodsville	--
NA	38	30° 45' 02"	81° 34' 25"	--	60 (Avg)	Bank South	--
NA	39	30° 45' 10"	81° 35' 10"	--	60 (Avg)	Shadowlawn (4)	--
NA	40	30° 45' 29"	81° 31' 26"	--	85 (Avg)	N. River Oaks (9)	--
NA	41	30° 45' 25"	81° 31' 21"	--	85 (Avg)	Highland Oaks (23)	--
NA	42	30° 45' 22"	81° 31' 31"	--	--	River Oaks (24)	--
NA	43	30° 45' 13"	81° 31' 35"	--	85 (Avg)	Chaney's MHP (2)	--
NA	44	30° 45' 10"	81° 31' 22"	--	85 (Avg)	Pagan Street	--
NA	45	30° 44' 50"	81° 31' 25"	--	85 (Avg)	Marchi Drive	--
NA	46	30° 44' 39"	81° 31' 28"	--	85 (Avg)	Lonsome Pine Rd.	--
NA	47	30° 45' 21"	81° 31' 20"	--	85 (Avg)	Palmetto Street	--
NA	48	30° 47' 14"	81° 35' 17"	--	--	City of St. Marys	Public Supply
NA	49	30° 45' 01"	81° 33' 45"	--	--	City of St. Marys	Public Supply
NA	50	30° 45' 52"	81° 34' 25"	--	--	City of St. Marys	Public Supply (Standby)

See notes at end of table.

Table 6-1 (continued) Summary of Water Supply Well Data

USGS Grid No. <sup>1</sup>	Map No. <sup>2</sup>	Latitude	Longitude	Bottom of Casing (ft bgs)	Well Depth (ft bgs)	Station Name <sup>3</sup>	Well Use
NA	51	30° 44' 24"	81° 33' 02"	--	--	City of St. Marys	Public Supply (Standby)
NA	52	30° 45' 00"	81° 31' 24"	--	--	Point Peter	--
NA	53	30° 50' 07"	81° 34' 18"	--	--	Unnamed	--
NA	54	30° 47' 58"	81° 32' 45"	--	--	NSB 6	Raw Water Supply

**Notes:**

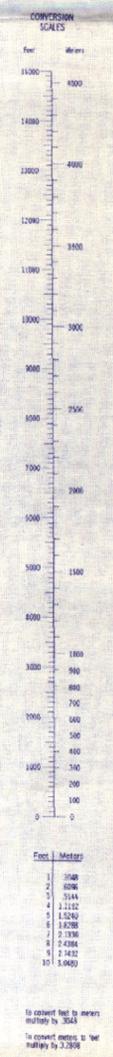
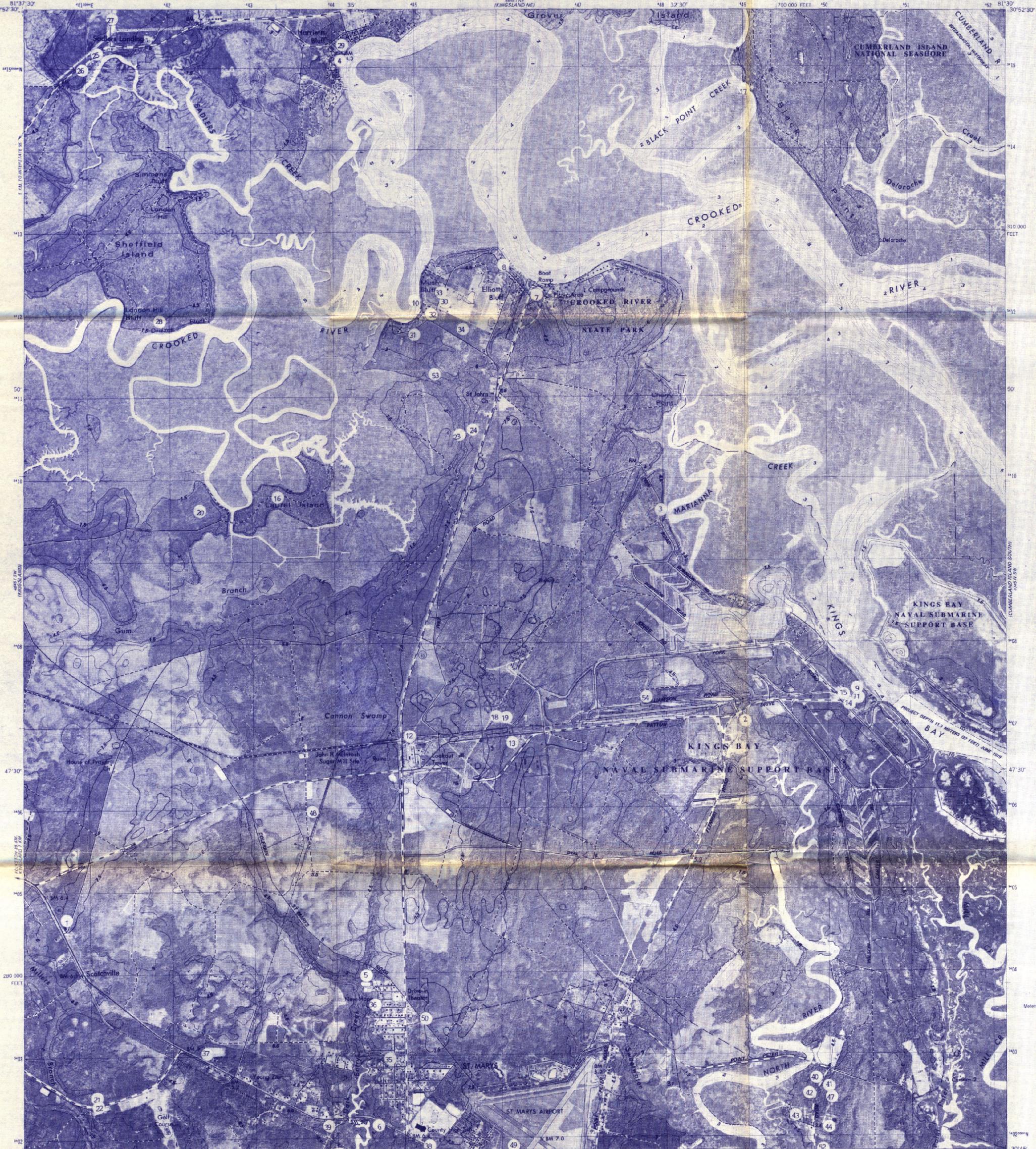
-- = no data  
 Avg = average  
 ft bgs = feet below ground surface  
 NA = Not Applicable

<sup>1</sup> Grid No. is based on USGS designation for a well location.

<sup>2</sup> Map No. corresponds to location identification on Figure 6-1 of this report.

<sup>3</sup> Number in parentheses indicates total number of supply wells in the area of the station.

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Produced by the United States Geological Survey and the National Ocean Service  
Control by USGS, NOS/NOAA, and USCE  
Orthophotomaf prepared by the Geological Survey from aerial photographs taken April 19, 1974. Topography by plane-table surveys, 1958; revised from aerial photographs taken, 1974. Field checked, 1975. Map edited, 1980.  
Bathymetry compiled by the National Ocean Service from tide-coordinated hydrographic surveys.  
Soundings compiled from NOS 11503 and 11504.  
This information is not intended for navigational purposes.  
Mean lower low water (MLLW) line and mean high water (MHW) line compiled by NOS from tide-coordinated aerial photographs; apparent shoreline (outer edge of vegetation) shown by photography.  
Projection and 10,000-foot grid ticks: Georgia coordinate system, east zone (transverse Mercator).  
1000-meter Universal Transverse Mercator grid, zone 17 1997 North American Datum.  
To place on the projected North American Datum 1983, move the projection lines 21 meters south and 17 meters west as shown by dashed corner ticks.  
There may be private holdings within the boundaries of the National or State reservations shown on this map.

UTM GRID AND 1983 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

CONTOURS AND ELEVATIONS IN METERS

Survey Number	Survey Date	Survey Scale	Survey Unit Spacing (Approx. Meters)
H-5753	1925	1:10,000	0.5-1.2
H-5754	1934-35	1:10,000	0.5-0.8
H-5756	1935	1:10,000	0.5-1.0
H-5805	1979	1:2,000	0.1-0.2

SCALE 1:24,000

CONTOUR INTERVAL 1.5 METERS  
NATIONAL GEODETIC VERTICAL DATUM OF 1929  
BATHYMETRIC CONTOUR INTERVAL 1 METERS WITH SUPPLEMENTARY 0.5 METER CONTOURS—SOUNDINGS IN METERS  
DATUM IS MEAN LOWER LOW WATER  
THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE

BASE MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS  
BATHYMETRIC SURVEY DATA COMPLIES WITH INTERNATIONAL HYDROGRAPHIC ORGANIZATION (IHO) SPECIAL PUBLICATION 44 ACCURACY STANDARDS AND NATIONAL STANDARDS USED AT THE DATE OF THE SURVEY

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092  
AND NATIONAL OCEAN SERVICE, ROCKVILLE, MARYLAND 20852  
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST



ROAD CLASSIFICATION

Primary highway, hard surface  
Secondary highway, hard surface  
Trails  
Interstate Route  
U. S. Route  
State Route  
Light-duty road, hard or improved surface  
Unimproved road

HARRIETTS BLUFF, GA.  
30081 G5-OM-024  
1980  
PHOTO-REVISED 1988  
DMA 4645 1.9E-SERIES V8460

Approximate Location of Water Supply Well

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During a residential survey, 94 PIWs were identified in the Crooked River Plantation Subdivision (Figure 6-2). Appendix M contains copies of completed survey forms. A summary table is provided at the beginning of Appendix M. This summary table includes sample and analysis information. Survey forms indicated that the groundwater from the private irrigation wells is used for a variety of non-potable purposes including irrigation, washing cars and yard items, and for filling swimming pools, children's wading pools and for other water-using play devices. Two residents indicated groundwater was used as drinking water for pets (Appendix M).

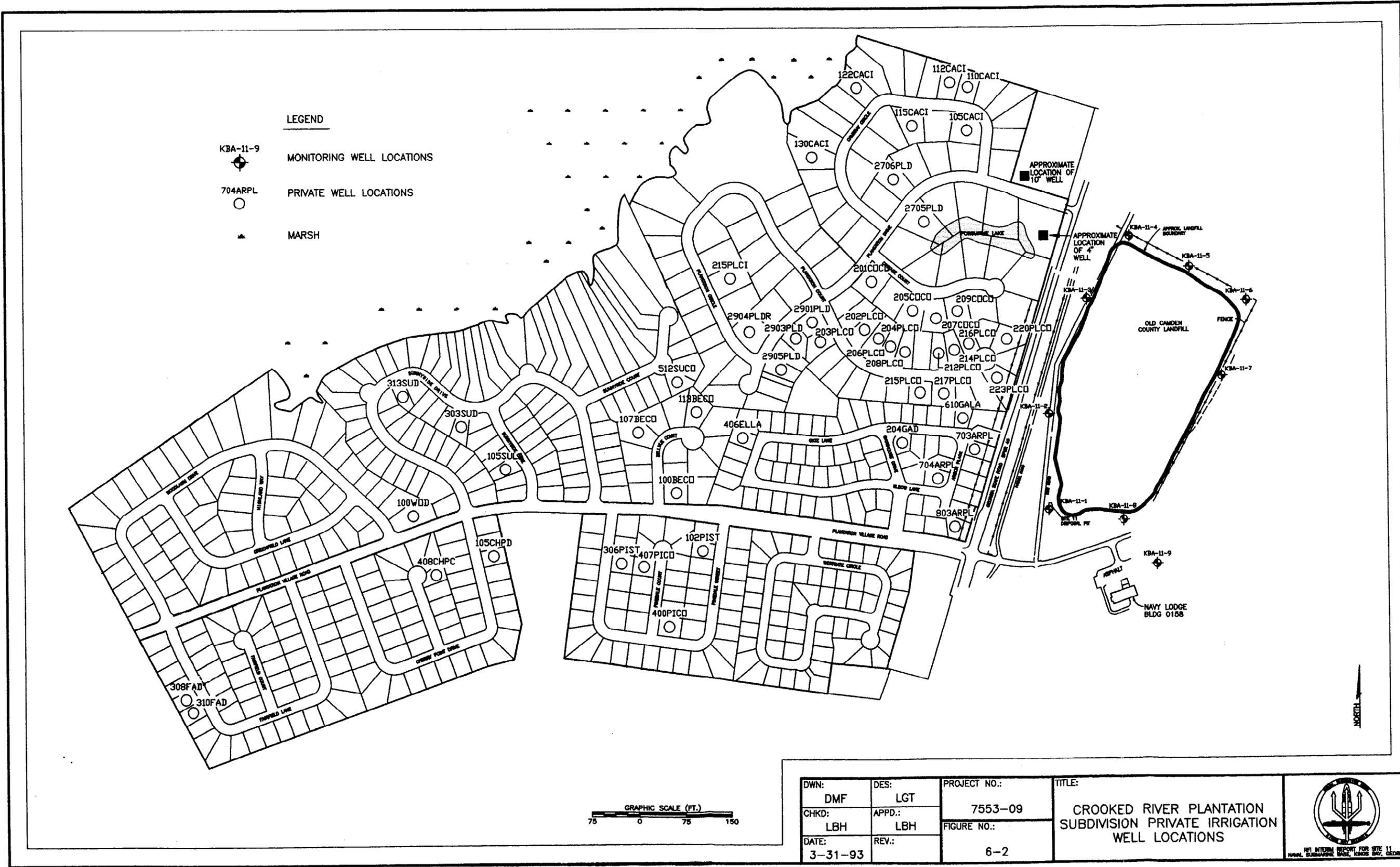
Groundwater samples were collected from 51 PIWs in the Crooked River Plantation Subdivision. All 51 PIW samples and five duplicate samples were analyzed at the on-site laboratory for the 10 target VOCs (see Subsection 4.1). Twenty-four PIW samples and three duplicate samples were submitted to the off-site laboratory for confirmatory analysis according to CLP procedures. Table 6-2 summarizes analytical data from on-site analysis of PIW samples. Table 6-3 summarizes analytical data from off-site analysis of PIW samples. Validated data tables are provided in Appendix C.

Measurements of pH, specific conductance, temperature, and flow rates were collected during PIW sampling (Appendix N). Field analytical data indicate that five of the PIW samples contained VOCs potentially related to the plume, including vinyl chloride, cis-1,2-dichloroethene, and ethylbenzene. Three PIW samples contained VOCs potentially related to the plume based on off-site analytical results. For a detailed discussion of the PIW sample results, see the ICMS Investigation Progress Report (ABB-ES, 1993a). Residents have been asked to curtail contact with groundwater and not to provide groundwater for pet drinking water.

Two deep wells are present in the vicinity of the lake (see Figure 6-2). No boring logs were available for either well. A 10-inch well, located north of Porcupine Lake near the intersection of Plantation Drive and Spur 40, is reported to extend to a depth of approximately 320 to 380 feet bgs. This well was originally planned for potable water supply, but was never completed as such. The well was abandoned by capping the steel casing. Sometime later, a paving contractor tapped the steel casing with a 2-inch hand valve and installed a 2-inch polyvinyl chloride pipe connecting the well to the lake. It was reported that this well was artesian and would be used to sustain the lake during droughts. During the ICMS Investigation, the valve was opened but no water flow from the well was observed. A 4-inch well is located in the yard of Lot No. 1 on Plantation Drive at the intersection of Plantation Drive and Spur 40. The well is reported to be artesian. It was also intended to sustain Porcupine Lake during droughts. The depth of this well is estimated to range from 600 to 700 feet bgs. There is no indication that either of these wells has been used.

The potential for future groundwater development of the Floridan aquifer system in the southeastern Georgia area ranges from 0 to 10 million gallons per day (USGS, 1989). Local variables include problems with water quality and excessive declines in groundwater levels.

**6.3 SURFACE WATER USE.** There are no surface water bodies that drain the area of the landfill. Abundant vegetation allows little runoff from the landfill. Porcupine Lake is located approximately 400 feet northwest of the Old Camden



DWN: DMF	DES: LGT	PROJECT NO.: 7553-09	TITLE: CROOKED RIVER PLANTATION SUBDIVISION PRIVATE IRRIGATION WELL LOCATIONS
CHKD: LBH	APPD.: LBH	FIGURE NO.: 6-2	
DATE: 3-31-93	REV.:		



FPI INTERIM REPORT FOR SITE 11  
N.W. 11 SUBDIVISION, BAY, KING'S BAY, GEORGIA

0512A04Z

Table 6-2 Summary of On-site Laboratory Analysis of Private Irrigation Well Samples

Compound ( $\mu\text{g/l}$ )	Sampling Locations (CRP-)													
	MCL	PW-1	PW-2	PW-3	PW-3D	PW-4	PW-5	PW-6	PW-7	PW-8	PW-9	PW-10	PW-11	PW-12
Vinyl chloride	2	NEG	NEG	NEG	NEG	NEG	NEG	POS	POS	NEG	NEG	NEG	NEG	NEG
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 UJ												
Trichloroethene	5	5 UJ												
Tetrachloroethene	5	5 UJ												
Benzene	5	5 UJ												
Toluene	1,000	5 UJ												
Ethylbenzene	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	10,000	10 UJ												
o-Xylene	10,000	5 UJ												

Compound ( $\mu\text{g/l}$ )	Sampling Locations (CRP-)											
	MCL	PW-13	PW-14	PW-15	PW-16	PW-17	PW-18	PW-18D	PW-19	PW-20	PW-21	PW-22
Vinyl chloride	2	NEG	NEG	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG	POS
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 UJ	5 UJ	5 UJ	5 UJ	12 J						
Trichloroethene	5	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ						
Tetrachloroethene	5	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ					
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	10 U						
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

See notes at end of table.

Table 6-2 (continued) Summary of On-site Laboratory Analysis of Private Irrigation Well Samples

Compound ( $\mu\text{g/l}$ )	Sampling Locations (CRP-)												
	MCL	PW-23	PW-24	PW-25	PW-26	PW-27	PW-28	PW-29	PW-29D	PW-30	PW-31	PW-32	PW-33
Vinyl chloride	2	NEG	2 UJ	2 U	2 U	2 U	2 U	2 UJ	2 U				
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U
Trichloroethene	5	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U
Tetrachloroethene	5	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	10 U							
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Compound ( $\mu\text{g/l}$ )	Sampling Locations (CRP-)												
	MCL	PW-34	PW-35	PW-36	PW-37	PW-38	PW-38D	PW-39	PW-40	PW-41	PW-42	PW-43	PW-44
Vinyl chloride	2	2 U	2 U	2 U	2 U	2 U	2 U	2 UJ					
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ				
Trichloroethene	5	5 U	5 U	20	5 U	5 U	5 U	5 U	5 UJ				
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ				
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	10 U	10 U	10 U					
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

See notes at end of table.

Table 6-2 (continued) Summary of On-site Laboratory Analysis of Private Irrigation Well Samples

Compound ( $\mu\text{g/l}$ )	Sampling Locations (CRP-)								
	MCL	PW-45	PW-46	PW-47	PW-47D	PW-48	PW-49	PW-50	PW-51
Vinyl chloride	2	2 U	2 U	5.2	5.2	4.1	2 U	2 U	2 U
trans-1,2-Dichloroethene	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	70	5 UJ	5 U	5 U	5 U	5.4	5 U	5 U	5 U
Trichloroethene	5	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethyl benzene	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
m/p-Xylene	<sup>1</sup> 10,000	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
o-Xylene	<sup>1</sup> 10,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

**Notes:**

U = compound was not detected at the stated concentration

J = Quantitation limit is considered estimated because a continuing calibration standard exceeded QC limits.

UJ = Quantitation level was estimated because QC criteria were not met.

NEG = Compound was not detected.

POS = Compound was detected but the concentration could not be quantified.

$\mu\text{g/l}$  = micrograms per liter

MCL = Maximum Contaminant Level, USEPA Office of Water, December 1992; The Bureau of National Affairs, Inc., July 1992.

<sup>1</sup> Total xylenes.

Table 6-3 Summary of Off-site Laboratory Analysis of Private Well Samples

Compound ( $\mu\text{g}/\text{l}$ )	Private Well Locations (CRP-)														
	MCL	PW1	PW2	PW3	PW3D	PW4	PW5	PW6	PW9	PW17	PW21	PW22	PW26	PW29	PW29D
Acetone	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	7 U	19 U	14 U	5 U	5 U
Carbon disulfide	NA	1 U	1 U	1	1 U	1 U	1 U	1	1 U	1 U	20	1 U	5	1 U	1 U
Ethylbenzene	700	1 U	1 U	1 U	1 U	1 U	1 U	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	2	1 U	1 U	1 U	1 U	1 U	1 U	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	70	1 U	1 U	1 U	1 U	1 U	1 U	5	1 U	1 U	1 U	13	1 U	1 U	1 U

Compound ( $\mu\text{g}/\text{l}$ )	Private Well Locations (CRP-)													
	MCL	PW32	PW33	PW39	PW41	PW42	PW43	PW45	PW46	PW47	PW48	PW50	PW51	PW51D
Acetone <sup>1</sup>	NA	5 U	6	5 U	5 U	5 U	5	5 U	5	5 U	5 U	5 U	5 U	4 J
Carbon disulfide	NA	1 U	1 U	1 U	1 U	1 U	28	1 U	1 U	1 U	2	1	2	2
Ethylbenzene	700	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	70	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	8	1 U	1 U	1 U

**Notes:**

MCL = Maximum Contaminant Level, USEPA Office of Water, December 1992; The Bureau of National Affairs, Inc., July 1992.

NA = none applicable

$\mu\text{g}/\text{l}$  = micrograms per liter

U = Compound was not detected at the stated concentration.

<sup>1</sup> Sample result is considered estimated and flagged with a J qualifier because concentration is less than the Sample Quantitation Limit.

County Landfill, Site 11. The lake is supported by groundwater discharge. The water in the lake is clear and supports abundant flora and fauna. The depth of the lake varies from approximately 6 feet in the west end to approximately 5 feet in the east end.

The environmental and economic utilization of surface waters provides the basis for classification in the State of Georgia. The specific classifications are included in Chapter 3, Rule 6, Water Quality Control, of the Rules and Regulations of the State of Georgia, Title 391 (BNA, 1991). Surface waters not specified in the Rule are classified as best utilized for fishing. Rule 6 specifically classifies littoral waters of the North River on the oceanside of Cumberland Island as best suited for recreational use. No other classifications were specifically listed for surface water bodies in the area of NSB Kings Bay.

**6.4 ENDANGERED, THREATENED, OR RARE SPECIES.** Several endangered, threatened, and unusual flora and fauna have been listed as possibly occurring in the general area of NSB Kings Bay by the U.S. Fish and Wildlife Service and the GA DNR (Table 6-4) (ABB-ES 1991). Unusual species in the State of Georgia have been designated to include any resident species that exhibit special or unique features and, therefore, deserve special consideration for continued survival in the state (ABB-ES, 1991).

An ecological survey is planned as part of the Baseline Risk Assessment to identify species potentially affected by contaminants associated with the landfill. The ecological risk assessment will evaluate potential exposure routes and exposure pathways, and, if necessary, evaluate associated risks.

**6.5 HUMAN HEALTH SCREENING RISK EVALUATION.** A Screening Risk Evaluation (SRE) was performed as part of the ICMS Investigation to evaluate whether exposure to VOC contaminants released into the groundwater from Site 11 pose an unacceptable threat to humans living in the Crooked River Plantation Subdivision. Groundwater was the only exposure route identified in the SRE. Two risk scenarios were evaluated, one representing a maximum possible exposure scenario and one representing a maximum likely exposure scenario.

The SRE was conducted according to standard USEPA guidelines found in the following documents: Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A) (USEPA, 1989b), RCRA Facility Investigation (RFI) Guidance (USEPA, 1989a), Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities, Proposed Rule (USEPA, 1990b), Exposure Factor Handbook (USEPA, 1990c), Supplemental Region IV Risk Assessment Guidance (USEPA, 1991b), and Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (USEPA, 1991c).

The SRE differs from the Baseline Risk Assessment in four general areas. One area is the media considered. The SRE considered exposure to contaminants in groundwater and air, whereas the Baseline Risk Assessment will evaluate exposure to all media (groundwater, air, soil, sediment, and surface water). A second difference is the population considered. The SRE limited the population potentially exposed to residents of Crooked River Subdivision, whereas the Baseline Risk Assessment will evaluate populations potentially exposed in the subdivision and at the landfill, which includes personnel living and/or working at the NSB. A third difference is that the Baseline Risk Assessment will evaluate present and future land use, as opposed to the SRE, which only evaluated

Table 6-4 Endangered, Threatened, and Unusual Flora and Fauna Occurring or Possibly Occurring in the Vicinity of Kings Bay

Common Name	Scientific Name	GA DNR	USFWS
<b>Flora</b>			
Buckthorn	<i>Bumelia thornei</i>	E	
Indian-plantain	<i>Cacalia diversifolia</i>	T	
Spider-lily	<i>Hymenocallis coronaria</i>	E	
Loosestrife	<i>Lythrum curtissii</i>	E	
Cow-bane	<i>Oxypolis canbyi</i>	T	
Panic grass	<i>Panicum hirstii</i>	E	
Trumpet leaf	<i>Sarracenia flava</i>	T	
White trumpet	<i>Sarracenia leucophylla</i>	T	
Hooded pitcher plant	<i>Sarracenia minor</i>	T	
Parrot pitcher plant	<i>Sarracenia psittacina</i>	T	
<b>Amphibians</b>			
Georgia blind cave salamander	<i>Haiedotriton wallacei</i>	U	
<b>Reptiles</b>			
American alligator	<i>Alligator mississippiensis</i>		E
Eastern indigo snake	<i>Drymarchon corais</i>	T	T
<b>Birds</b>			
Ivory-billed woodpecker	<i>Campephilus principalis</i>	E	E
American peregrine falcon	<i>Falco peregrinus anatum</i>	E	T
Arctic peregrine falcon	<i>Falco peregrinus tundrius</i>	E	T
Bald eagle	<i>Haliaeetus leucocephalus</i>	E	E
Wood stork	<i>Mycteria americana</i>		E
Red-cockaded woodpecker	<i>Picoides borealis</i>	E	E
Bachman's warbler	<i>Vermivora bachmanni</i>	E	E

**Notes:**

GA DNR = Georgia Department of Natural Resources  
 USFWS = United States Fish and Wildlife Service  
 E = Endangered  
 T = Threatened  
 U = Unusual

Source: ABB-ES, 1991.

potential exposures based on present land use. Lastly, the SRE only considered potential exposure to VOC contaminants. The Baseline Risk Assessment will evaluate potential risks associated with exposure to all PCOCs, which could include compounds that are included in other chemical groups such as SVOCs or inorganic constituents.

The information presented in this section is taken from the ICMS Investigation Report (ABB-ES, 1993a). An effort has been made to summarize pertinent information explained in detail in the report.

Table 6-5 summarizes groundwater analytical data used in the SRE, and calculated exposure point concentrations. Data used for the SRE include NEESA Level D (USEPA Level IV) TCL VOC data for groundwater samples collected during the ICMS Investigation using the hydrocone sampler and from PIWs. All but two of the contaminants detected in the groundwater were selected as potential contaminants of concern (PCOCs). Acetone and carbon disulfide were rejected because they were both detected in several rinsate blanks at comparable levels to those found in the environmental samples and they may be artifacts of sampling. In addition, carbon disulfide was rejected as a PCOC because it is believed to be a natural background chemical.

The only identified route for human exposure to the PCOCs in the groundwater is through the use of the PIWs in the Crooked River Plantation Subdivision. The exposure pathways examined in the SRE are all linked to known or possible uses of the groundwater. Human receptors could be exposed to the PCOCs in the groundwater through the following exposure pathways:

- inhalation of the VOCs released during irrigation;
- dermal contact with the water during irrigation, washing activities, and swimming; and
- incidental ingestion of the groundwater during irrigation, washing activities, and swimming.

Table 6-6 summarizes assumptions used to calculate Lifetime Adjusted Daily Doses for carcinogenic risks and Adjusted Daily Doses (ADDs) for non-carcinogenic risks. The differences between the maximum possible exposure scenario and the maximum likely exposure scenario are generally reflected in Table 6-6. Tables 6-7 and 6-8 summarize carcinogenic and noncarcinogenic risks, respectively, for both exposure scenarios evaluated in the SRE.

**6.5.1 Carcinogenic Risks for the Maximum Possible Exposure Scenario** The total carcinogenic risk for the 3-year child resident was  $4 \times 10^{-4}$ , which exceeds the upper end of the  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  acceptable risk range. Almost 98 percent of this risk is due to vinyl chloride via the dermal exposure and incidental ingestion routes of exposure. No other dermal or incidental ingestion risks were greater than  $1 \times 10^{-6}$ . No risks due to inhalation exposure to any PCOC, including vinyl chloride, were greater than  $3 \times 10^{-8}$  indicating that the inhalation pathway may not be a significant exposure pathway for PCOCs released from the groundwater.

Similar results were found for the 6-year child exposure. The total carcinogenic risk was  $8 \times 10^{-4}$  with over 98 percent of the risk coming from vinyl chloride. Over 35 percent of the vinyl chloride risk was due to dermal contact with the

Table 6-5 The Chemicals Detected, Range of Detections, and Exposure Point Concentrations for the Potential Chemicals of Concern in the Groundwater Plume at the Crooked River Plantation Subdivision

Chemical	<sup>1</sup> Number of Detections/Number of Samples	<sup>2</sup> Range of Detections (µg/l)	<sup>3</sup> 95% UCL (µg/l)	EPC (µg/l)
Benzene	5/41	2 - 5	8	5
2-Butanone (methyl ethyl ketone)	6/41	2 - 580	1,741,483	580
Chlorobenzene	1/41	10	NC	10
1,4-Dichlorobenzene	1/41	12	NC	12
1,1-Dichloroethane	5/41	2 - 24	8,521	24
1,2-Dichloroethane	1/41	9	NC	9
cis-1,2-Dichloroethene	11/41	1 - 3,600	6,257	3,600
trans-1,2-Dichloroethene	2/41	1 - 23	NC	23
1,2-Dichloropropane	2/41	1 - 6	NC	6
Ethyl benzene	8/41	2 - 41	42	41
2-Hexanone (methyl butyl ketone)	4/41	11 - 70	1,179	70
4-Methyl-2-pentanone (methyl isobutyl ketone)	6/41	12 - 110	205	110
Tetrachloroethene	1/41	3	NC	3
Toluene	6/41	4 - 580	43,708	580
Trichloroethene	3/41	4 - 45	NC	28
Xylenes (total)	5/41	1 - 120	1.2x10 <sup>11</sup>	120
Vinyl chloride	4/41	2 - 310	4.7x10 <sup>12</sup>	310

**Notes:**

µg/l = micrograms per liter  
 95% UCL = 95 percent Upper Confidence Limit  
 EPC = Exposure Point Concentration  
 NC = cannot be calculated with less than 4 data points

- <sup>1</sup> Duplicates count as one sample for determining number of samples collected.
- <sup>2</sup> The highest concentration detected, even duplicates, used for concentration range.
- <sup>3</sup> The average concentration of duplicate sample was used for calculation of 95% UCL.

Table 6-6 The Exposure Factors Used To Calculate Doses for Each Exposure Route and Exposure Scenario

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**Daily Intake via Ingestion of Spray Water (Maximum Possible Exposure):**

C <sub>w</sub>	Chemical concentration in water	Chemical-specific, mg/l; 100% of EPC for each chemical
IR	Hourly water ingestion	0.05 l/hr
EF	Exposure frequency, spray	350 days/year
ED	Exposure duration	3 years for adults and children 6 years for children 30 years for adults
ET	Exposure time, spray	2 hours/day
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects

**Intake via Ingestion of Pool Water During Swimming (Maximum Possible Exposure):**

C <sub>w</sub>	Chemical concentration in water	Chemical-specific, mg/l; 100% of EPC for each chemical
IR	Hourly water ingestion	0.05 l/hr
EF	Exposure frequency	88 days/year
ED	Exposure duration	3 years for adults and children 6 years for children 30 years for adults
ET	Exposure time	4 hours/day
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects

**Daily Intake via Ingestion of Spray Water (Maximum Likely Exposure):**

C <sub>w</sub>	Chemical concentration in water	Chemical-specific, mg/l; 10% of EPC for each chemical
IR	Hourly water ingestion	0.05 l/hr
EF	Exposure frequency	350 days/year
ED	Exposure duration	3 years for adults and children 6 years for children 30 years for adults
ET	Exposure time	0.167 hours/day
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects

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See notes at end of table.

Table 6-6 (Continued) The Exposure Factors Used To Calculate Doses for Each Exposure Route and Exposure Scenario

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**Daily Intake via Ingestion of Pool Water During Swimming (Maximum Likely Exposure):**

C <sub>w</sub>	Chemical concentration in water	Chemical-specific, mg/l adults: 10 percent EPC except vinyl chloride zero (0) percent children: 100 percent EPC except vinyl chloride 50 percent
IR	Hourly water ingestion	0.05 l/hr
EF	Exposure frequency	88 days/year
ED	Exposure duration	3 years for adults and children 6 years for children 30 years for adults
ET	Exposure time	4 hours/day
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects

**Daily Intake via Inhalation of Vapors from Spray Water (Maximum Possible Exposure Scenario):**

C <sub>a</sub>	Chemical concentration in air	Chemical-specific, mg/l; 100 percent volatilization of EPC concentration from groundwater into air
IR	Inhalation rate	0.833 m <sup>3</sup> /hour
EF	Exposure frequency	350 days/year
ED	Exposure duration	3 years for adults and children 6 years for children 30 years for adults
ET	Exposure time	24 hours/day
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects

**Daily Intake via Inhalation of Vapors from Spray Water (Maximum Likely Exposure Scenario):**

C <sub>a</sub>	Chemical concentration in air	Chemical-specific, mg/l; 90 percent volatilization of EPC concentration from groundwater into air
IR	Inhalation rate	0.833 m <sup>3</sup> /hour
EF	Exposure frequency	350 days/year
ED	Exposure duration	3 years for adults and children 6 years for children 30 years for adults
ET	Exposure time	24 hours/day
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects

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See notes at end of table.

Table 6-6 (Continued) The Exposure Factors Used To Calculate Doses for Each Exposure Route and Exposure Scenario

Absorbed Dose via Dermal Contact with Spray Water (Maximum Possible Exposure):		
SA	Exposed surface area	1,990 cm <sup>2</sup> for children 5,300 cm <sup>2</sup> for adults
PC	Permeability constant	Chemical-specific, cm/hour;
	Benzene	1.1x10 <sup>-1</sup>
	2-Butanone	5.0x10 <sup>-3</sup>
	Chlorobenzene	4.1x10 <sup>-2</sup>
	1,4-Dichlorobenzene	6.2x10 <sup>-2</sup>
	1,1-Dichloroethane	8.9x10 <sup>-3</sup>
	1,2-Dichloroethane	5.3x10 <sup>-3</sup>
	cis-1,2-Dichloroethene	1.0x10 <sup>-2</sup>
	trans-1,2-Dichloroethene	1.0x10 <sup>-2</sup>
	1,2-Dichloropropane	1.0x10 <sup>-2</sup>
	Ethylbenzene	1.0
	2-Hexanone (MBK)	9.5x10 <sup>-2</sup>
	4-Methyl-2-pentanone (MIBK)	8.3x10 <sup>-2</sup>
	Tetrachloroethene	3.7x10 <sup>-1</sup>
	Toluene	1.0
	Trichloroethene	2.3x10 <sup>-1</sup>
	Xylenes (total)	8.0x10 <sup>-2</sup>
	Vinyl chloride	7.3x10 <sup>-3</sup>
C <sub>w</sub>	Chemical concentration in water	Chemical-specific, mg/l; 100 percent of EPC for each chemical
ET	Exposure time	2 hours/day
EF	Exposure frequency	350 days/year
ED	Exposure duration (years)	3 years for adults and children 6 years for children 30 years for adults
CF	Correction factor	0.001 l/cm <sup>3</sup>
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects
Absorbed Dose via Dermal Contact with Spray Water (Maximum Likely Exposure):		
SA <sub>s</sub>	Exposed surface area, spray	1,990 cm <sup>2</sup> for children 5,300 cm <sup>2</sup> for adults
PC	Permeability constant	Chemical-specific, cm/hour; See above
C <sub>w</sub>	Chemical concentration in water	Chemical-specific, mg/l; 10 percent of EPC of each chemical
ET	Exposure time	0.167 hours/day
EF	Exposure frequency	350 days/year
ED	Exposure duration	3 years for adults and children 6 years for children 30 years for adults
CF	Correction factor	0.001 L/cm <sup>3</sup>
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects

See notes at end of table.

Table 6-6 (Continued) The Exposure Factors Used To Calculate Doses for Each Exposure Route and Exposure Scenario

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**Absorbed Dose via Dermal Contact While Swimming (Maximum Possible Exposure):**

SA <sub>p</sub>	Exposed surface area, pool	7,280 cm <sup>2</sup> for children 19,400 cm <sup>2</sup> for adults
PC	Permeability constant	Chemical-specific, cm/hour; See above
ED	Exposure duration	3 years for adults and children 6 years for children 30 years for adults
C <sub>w</sub>	Chemical concentration in water	Chemical-specific, mg/l; 100 percent of EPC for each chemical
EF	Exposure Frequency	88 days/year
ET	Exposure time	4 hours/day
CF	Correction factor	0.001 l/cm <sup>3</sup>
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects

**Absorbed Dose via Dermal Contact While Swimming (Maximum Likely Exposure):**

SA <sub>p</sub>	Exposed surface area, pool	7,280 cm <sup>2</sup> for children 19,400 cm <sup>2</sup> for adults
PC	Permeability constant	Chemical-specific, cm/hour; See above
ED	Exposure duration	3 years for adults and children 6 years for children 30 years for adults
C <sub>w</sub>	Chemical concentration in water	Chemical-specific, mg/l; adults: 10 percent EPC except vinyl chloride zero (0) percent; children: 100 percent EPC except vinyl chloride 50 percent
EF	Exposure Frequency	88 days/year
ET	Exposure time	4 hours/day
CF	Correction factor	0.001 l/cm <sup>3</sup>
BW	Body weight	15 kg for children 70 kg for adults
AT	Averaging time	25,550 days for cancer effects ED x 365 days/year for non-cancer effects

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**Notes:**

cm = centimeter  
cm<sup>2</sup> = square centimeters  
cm/hour = centimeters per hour  
days/year = days per year  
EPC = Exposure Point Concentration  
hours/day = hours per day  
kg = kilogram  
l/hr = liters per hour  
m<sup>3</sup>/l = cubic meters per liter  
mg/l = milligrams per liter

Table 6-7 Summary of Lifetime Total Maximum Upper-Bound Carcinogenic Risks by Exposure Route Associated with the Maximum Possible and Maximum Likely Exposures to the PCOCs Identified in the Groundwater at Crooked River Plantation Subdivision

Human Receptor	3 Year			6 Year			30 Year		
	Inhal	Dermal	Ingest	Inhal	Dermal	Ingest	Inhal	Dermal	Ingest
Child Resident ("Worst Case" Exposure)	3x10 <sup>-8</sup>	1x10 <sup>-4</sup>	2x10 <sup>-4</sup>	6x10 <sup>-8</sup>	3x10 <sup>-4</sup>	5x10 <sup>-4</sup>	-	-	-
Adult Resident ("Worst Case" Exposure)	6x10 <sup>-9</sup>	8x10 <sup>-5</sup>	5x10 <sup>-5</sup>	-	-	-	6x10 <sup>-8</sup>	8x10 <sup>-4</sup>	5x10 <sup>-4</sup>
Child Resident (More Probable Exposure)	2.8x10 <sup>-8</sup>	4.8x10 <sup>-5</sup>	4.2x10 <sup>-5</sup>	5.5x10 <sup>-8</sup>	9.5x10 <sup>-5</sup>	8.3x10 <sup>-5</sup>	-	-	-
Adult Resident (More Probable Exposure)	5.9x10 <sup>-9</sup>	2.5x10 <sup>-7</sup>	6.9x10 <sup>-9</sup>	-	-	-	5.9x10 <sup>-8</sup>	2.5x10 <sup>-6</sup>	6.9x10 <sup>-8</sup>

**Notes:**

- = not calculated
- Inhal = Inhalation Exposure
- Dermal = Dermal Absorption
- Ingest = Incidental Ingestion
- PCOC = Potential Contaminants of Concern

Table 6-8 Total Hazard Quotient by Exposure Route Associated with Exposure to the Contaminants Identified in the Groundwater at Crooked River Plantation Subdivision

Human Receptor	3 Year			6 Year			30 Year		
	Inhal	Dermal	Ingest	Inhal	Dermal	Ingest	Inhal	Dermal	Ingest
Child Resident ("Worst Case" Exposure)	0.0002	6.2	3.8	0.0002	6.2	3.8	-	-	-
Adult Resident ("Worst Case" Exposure)	0.00004	3.5	0.87	-	-	-	0.00004	3.5	0.87
Child Resident (More Probable Exposure)	0.0002	4.0	1.28	0.0002	4.0	1.3			
Adult Resident (More Probable Exposure)	0.00004	2.3	0.27	-	-	-	0.00004	2.3	0.27

**Notes:**

- = not calculated
- Inhal = Inhalation Exposure
- Dermal = Dermal Absorption
- Ingest = Incidental Ingestion

other 64 percent due to incidental ingestion. No inhalation risks were greater than  $1 \times 10^{-6}$ .

The 3-year adult exposure, total risk of  $1 \times 10^{-4}$ , also had carcinogenic risks at the upper bound of the acceptable range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  (Table 6-7). Again this was almost completely due to vinyl chloride by the dermal and incidental ingestion routes of exposure (Table 6-7).

The greatest total carcinogenic risk in all of the SRE exposure scenarios was  $1 \times 10^{-3}$  for the 30-year adult exposure (Table 6-7). This risk was almost 98 percent due to vinyl chloride exposure (Table 6-7). Dermal absorption accounted for 60 percent of the vinyl chloride risk with incidental ingestion accounting for another 30 percent of the risk. Incidental ingestion did not show risks above  $1 \times 10^{-6}$ .

**6.5.2 Non-Carcinogenic Risks for the Maximum Possible Exposure Scenario** Table 6-8 provides the total HIs resulting from exposure to the PCOCs at the site for both adults and children. The HIs are broken down by exposure pathway in Table 6-8.

The total HI for the maximum possible exposure to the groundwater for the 3- and 6-year old child exposure indicates that there is concern for the potential for non-carcinogenic health effects to occur if the groundwater were to be used for the purposes described in the exposure assessment (Table 6-8).

The total HQ for these exposure scenarios were 9.9 with 60 percent of this effect due to cis-1,2-dichloroethene and 30 percent due to toluene (Table 6-7). The cis-1,2-dichloroethene HI was almost 60 percent due to incidental ingestion with the remaining 43 percent due to dermal absorption. Toluene also showed an HI above 1.0 with 99 percent of this value due to dermal absorption. The potential for non-carcinogenic effects due to inhalation exposure does not appear to be of concern since the HI for this route of exposure is less than 1.0.

If non-carcinogenic effects were to occur, the organ systems that might be affected include the nervous system, the liver (hepatic), kidney, and the hematopoietic (blood) system. Possible non-carcinogenic toxic effects on the immunological system, the skin and eyes (dermal/ocular), and lungs (respiratory) might also occur. It should be noted that the risk estimates presented in this exposure scenario were used as an initial screen to determine if any significant risks were present at the site regardless of the practicality of the exposure scenario. However, as shown above, the carcinogenic risks are above the acceptable risk range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$  whereas the HIs, using the chronic RfDs rather than the subchronic RfDs for children, indicate a potential for non-carcinogenic health effects. Therefore, the risks associated with a more reasonable maximum likely exposure scenario were also calculated to determine if unacceptable risks were present under a more realistic exposure scenario.

**6.5.3 Carcinogenic Risks for the Maximum Likely Exposure Scenario** In contrast to the maximum possible exposure scenario, the carcinogenic risks associated with the maximum likely exposure scenario were much lower (Table 6-7). The total carcinogenic risk of the 3-year child exposure was within the acceptable range at  $9 \times 10^{-5}$  with over 95 percent of the risk due to vinyl chloride exposure. The vinyl chloride risks were equally split between incidental ingestion and dermal absorption. No other risks were above  $1 \times 10^{-6}$ .

The carcinogenic risk in the 6-year child exposure was slightly above the upper end of the acceptable risk range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  with a total risk of  $2 \times 10^{-4}$ . Again, over 96 percent of the risk was due to vinyl chloride exposure (Table 6-7). The vinyl chloride risk was split evenly between ingestion and dermal absorption.

The carcinogenic risks of the 30-year adult exposure were within the acceptable risk range with a total risk of  $2 \times 10^{-6}$ . No one PCOC showed a risk greater than  $1 \times 10^{-6}$  by any route of exposure.

**6.5.4 Non-Carcinogenic Risks for the Maximum Likely Exposure Scenario** These results indicate that non-carcinogenic toxic effects on several organ system may occur. However, if the standard USEPA risk assessment guidance to use subchronic RfDs in a subchronic exposure situation were to be followed, then none of the HQs or HIs would be above 1.0.

None of the HIs or HQs calculated for the adult residents were greater than 1.0. This indicates that no non-carcinogenic effects are for adults expected due to exposure to the groundwater (Table 6-8).

The total HI, using the chronic RfD rather than the subchronic RfD, for the maximum likely exposure to the groundwater for the 3- and 6-year old child exposure suggests concern for the potential for non-carcinogenic health effects could occur if the groundwater were to be used in children's wading pools or for other water play devices. The total HI for these exposure scenarios was 5.3 with 53 percent of the risk due to cis-1,2-dichloroethene and 26 percent due to toluene (Table 6-8). The risks from cis-1,2-dichloroethene were evenly distributed between dermal absorption and incidental ingestion. The toluene risk was over 99 percent due to dermal absorption.

Based upon the HQs in this exposure scenario, the potentiation interaction between 2-hexanone (methyl butyl ketone) and 2-butanone (methyl ethyl ketone) is not believed likely to occur. The sum of the HQs for these two contaminants multiplied by a factor of 10 to account for possible potentiation was less than 1.0.

If non-carcinogenic effects were to occur, the possible affected organ systems include the nervous system, the liver (hepatic), the kidney, and the hematopoietic (blood) system. Other possible target organ include the immunological system, the skin and eyes (dermal/ocular), and lungs (respiratory).

The potentiation interaction between 2-hexanone (methyl butyl ketone) and 2-butanone (methyl ethyl ketone) was also a toxic effect considered in this analysis. However, the sum of the HQs of these two PCOCs, with a multiplicative factor of 10, indicates that there was no evidence that this interaction would occur in the present exposure scenarios.

There are several uncertainties in this analysis that may lead to overly conservative estimates of non-carcinogenic risks. The exposure scenarios for the swimming pool exposures are different between the child resident and the adult resident. Thus, the difference between the HQs calculated for the children and the adults can be attributed to the differences in the PCOC concentrations in the water used to calculate the HIs and HQs for incidental ingestion and dermal absorption during swimming activity.

6.5.5 Uncertainty Analysis The risk estimates presented in this document are based upon the standard USEPA methodology developed for analyzing both carcinogenic and non-carcinogenic risks at hazardous waste sites (USEPA, 1989a; 1990c; 1991d). This methodology relies upon a number of conservative assumptions, each with its own level of uncertainty. Those uncertainties can be grouped into five broad categories:

- the assumptions concerning the exposure scenarios,
- the population of human receptors exposed to the contaminants,
- the toxicity assessment of the contaminants,
- the air modeling used to calculate the air concentrations, and
- the PCOC concentrations used in the risk analysis.

The assumptions used in the exposure scenarios may not be indicative of the actual exposure conditions at the site. This is especially true for the maximum possible exposure scenario but may also be true for the maximum likely exposure scenario as well. The assumption that the irrigation systems are used 350 days a year is probably an overestimate. The assumption that people will be exposed to the spray 350 days per year is certainly an excessive overestimate because factors such as inclement weather and cold weather will tend to discourage people from coming into contact with the spray from the irrigation systems. Also it is unlikely that persons would be exposed to the spray from the irrigation systems for 2 hours per day for 350 days per year. Therefore, the assumptions used in the exposure scenarios will overestimate the actual risks at the site. The assumptions for the maximum possible exposure scenario probably grossly overestimate the actual risks at the site.

The maximum possible exposure scenario certainly grossly overestimates the actual conditions at the site. The maximum likely exposure scenario also overestimates the actual human health risks at the site. However, uncertainties such as the inadequacy of the toxicity factors to describe all possible PCOC-receptor interactions and individual differences in the human population such as lifestyle, age, genetic predisposition, or underlying disease processes may need to be considered when using the results of this analysis for risk management decisions.

## 7.0 PROTECTION STANDARDS

The regulatory setting under which NSB Kings Bay is operating is discussed in Subsection 1.2. The facility currently has a RCRA permit and is required to comply with RCRA regulations. Because of the facility's anticipated HRS II ranking, activities and data associated with characterizing and mitigating contamination at Site 11 may be evaluated against CERCLA criteria in the future.

One significant difference between response actions conducted under RCRA and those governed by CERCLA is the establishment of cleanup levels. Under RCRA, cleanup levels (media protection standards) are established by regulatory agencies with program authority based on their assessment of actions necessary to protect human health and the environment. Under CERCLA, Section 121(d), remedial actions must comply with Applicable and Relevant or Appropriate Requirements (ARARs) of federal laws and more stringent, promulgated state laws, which are also protective of human health and the environment. In selecting cleanup levels under both CERCLA and RCRA, available remedial technologies must be considered to determine whether a particular cleanup level for a given contaminant can be achieved. As stated in Subsection 1.2, to the extent possible, activities at Site 11 have been designed to be consistent with CERCLA feasibility study guidance and address criteria outlined in the National Contingency Plan (NCP) and SARA.

This section discusses ARARs for groundwater and air, because these media are the primary exposure pathways. Other media, such as soil and sediment, may need to be addressed for the CMS. Development of ARARs for other media will be similar to the processes discussed herein for groundwater and air.

7.1 DEFINITION OF ARARs. To properly consider ARARs and to clarify their function in this RFI/SI, ARARs have been defined following two components presented in the NCP: (1) applicable requirements, and (2) relevant and appropriate requirements.

Applicable requirements are federal and state requirements that specifically address substances or contaminants and actions. An example of an applicable requirement is the use of MCLs for a site where groundwater contamination enters a public water supply.

Relevant and appropriate requirements are federal and state requirements that, while not legally applicable, can be applied if site circumstances are sufficiently similar to those covered by jurisdiction, and if use of the requirement is appropriate. For example, MCLs would be relevant and appropriate requirements at a site where groundwater contamination could affect a potential (rather than actual) drinking water source.

Applicable requirements and relevant and appropriate requirements are considered equivalent compliance standards for CERCLA site cleanups.

SARA also identifies a "to be considered" (TBC) category, which includes federal and state non-regulatory requirements such as criteria, advisories, and guidance documents. TBCs do not have the same status as ARARs; however, if no ARAR exists for a chemical or particular situation, TBCs can be used to confirm that a remedy is protective of human health and the environment.

ARARs or risk-based, regulator-determined cleanup levels must be attained for hazardous substances remaining on site at the completion of the remedial action. Remedial action implementation should also comply with ARARs (and TBCs, as appropriate) to protect public health and the environment. Generally, ARARs pertain to either contaminant levels or to performance or design standards to confirm protection at all points of potential exposure. ARARs are divided into three general categories: chemical-specific, location-specific, and action-specific.

Chemical-specific requirements establish the remedial action objectives because they set health- or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances, pollutants, and contaminants. They govern the extent of site remediation by providing either actual cleanup levels or a basis for calculating such levels. If a chemical has more than one requirement that is an ARAR, the most stringent generally should be attained. If no ARAR exists, or if the ARAR for a substance is established as not sufficiently protective, the federal or state TBC should be used in conjunction with the risk assessment to set the appropriate cleanup level.

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because of a site's particular characteristic or location. Site features governed by location-specific ARARs may include natural features such as wetlands, floodplains, and sensitive ecosystems. These ARARs provide a basis for assessing existing site conditions, which subsequently aid in assessing potential remedies. Location-specific ARARs will be addressed in the CMS.

Action-specific ARARs are usually technology- or activity-based limitations controlling actions conducted at hazardous waste sites. These requirements are triggered by the activities associated with the components selected to develop proposed corrective measures. Action-specific requirements do not in themselves establish the corrective measure; rather, they indicate how a selected corrective measure must be achieved. As remedial alternatives are developed, action-specific ARARs also provide a basis for assessing feasibility and effectiveness. During the CMS detailed analysis of remedial alternatives, each alternative will be evaluated for compliance with the applicable, or relevant and appropriate, standards of each ARAR. This analysis will not be presented in this report.

Only chemical-specific ARARs will be discussed in this report because no actions have been identified. Therefore, location- and action-specific ARARs cannot be addressed at this time.

**7.2 CHEMICAL-SPECIFIC ARARs.** Chemical-specific ARARs for NSB Kings Bay, identified in Table 7-1, are described below. The State of Georgia does not classify groundwater aquifers. Therefore, assuming all groundwater may be a potential drinking water supply, the Safe Drinking Water Act (SDWA), MCLs, and Maximum Contaminant Level Goals (MCLGs), which are applicable to public water systems, are relevant and appropriate requirements. MCLs are legally enforceable federal drinking water standards, based on advisories and health effects of a contaminant, and reflect the technical and economic feasibility of removing the contaminants from water supplies. SDWA MCLGs are non-enforceable health goals established by the USEPA and set at levels that would result in no known or anticipated adverse health effects with an adequate margin of safety. CERCLA Section 121 (d) states that remedial actions shall attain MCLGs where they are

Table 7-1 Chemical Specific ARARs

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS
<u>FEDERAL</u>		
RCRA Subpart F - Groundwater Protection Standards (40 CFR 254.94)	Applicable	Subpart F outlines three possible standards for setting cleanup levels for remediation of groundwater contamination attributable to a RCRA facility. These standards include: (1) Maximum Contaminant Levels (MCLs), (2) background concentrations, and (3) Alternative Concentration Limits.
Safe Drinking Water Act (SDWA) - MCLs (40 CFR 141.11 - 141.16)	Relevant and Appropriate	MCLs have been promulgated for a number of common organic and inorganic contaminants. These are legally enforceable levels that regulate the concentration of contaminants in public drinking water supplies and are considered for groundwater aquifers used for drinking water or potential sources of drinking water. Groundwater contaminant concentrations are compared to MCLs during the evaluation of risks to human health due to consumption of groundwater.
SDWA - Maximum Contaminant Level Goals (MCLGs) (40 CFR 141.50 - 141.51)	Relevant and Appropriate	MCLGs are health-based criteria for a number of organic and inorganic contaminants in drinking water sources. MCLGs are used in cases in which multiple contaminants or pathways of exposure present extraordinary risks to human health. As promulgated under SARA, MCLGs should be considered relevant and appropriate for groundwater remediation of actual and potential drinking water supplies.
Federal Ambient Water Quality Criteria (AWQC)	Applicable	Federal AWQC include (1) health-based criteria for 95 carcinogenic and noncarcinogenic compounds and (2) water quality parameters. AWQC, established for the protection of human health, are set at levels considered safe for consumption of drinking water as well as consuming fish. Remedial actions involving contaminated surface water or groundwater must consider the uses of the water and the circumstances of the release or threatened release. These factors will determine whether AWQC are relevant and appropriate.
Clean Air Act, Title I, Air Quality and Emission Limitations Title III, Hazardous Air Pollutants	Relevant and Appropriate	Title I establishes air quality standards and emission limitations, including requirements for ozone protection and national emissions standards for hazardous air pollutants. Title III lists numerous chemicals identified as hazardous air pollutants and provides for USEPA promulgation of regulations establishing emission standards for categories and subcategories of sources. The list of chemicals includes: benzene, chlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,1-dichloroethane, 2-butanone, toluene, and vinyl chloride.
USEPA Regulations on National Ambient Air Quality Standards (NAAQS) (40 CFR 50)	Relevant and Appropriate	These regulations set forth national primary and secondary air quality standards for protection of public health and welfare. A level of 0.12 ppm has been established as a primary and secondary air quality standard for ozone. VOCs are precursors of ozone formation. No source of VOC emissions may cause or contribute to a violation of the ozone NAAQS.
USEPA Regulation National Emission Standard for Hazardous Air Pollutants (NESHAP) (40 CFR 61)	Relevant and Appropriate	These regulations establish emission standards for various types of sources of emissions of air pollutants designated as hazardous or having serious health effects from ambient exposure to the substance. Benzene and vinyl chloride have been designated hazardous air pollutants. Substances causing serious health effects include chlorinated benzenes, tetrachloroethene, and toluene.

See notes at end of table.

Table 7-1 (continued) Chemical Specific ARARs

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS
<u>FEDERAL (TO BE CONSIDERED)</u>		
USEPA Reference Doses (RfDs)	Relevant and Appropriate	RfDs are dose levels developed by the USEPA for noncarcinogenic effects for lifetime exposure.
USEPA Cancer Assessment Group Slope Factors (CSFs)	Relevant and Appropriate	CSFs are developed by the USEPA from Health Effects Assessment (HEA) or evaluation by the Carcinogenic Assessment Group.
Acceptable Intake - Chronic (AIC) and Subchronic (AIS) - USEPA Health Assessment Documents	Relevant and Appropriate	AIC and AIS values are developed from RfDs and HEAs for noncarcinogenic compounds.
American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Values (TLVs), Time Weighted Averages (TWAs), and Short Term Exposure Limits (STELs)	Relevant and Appropriate	TLV-TWAs and TLV-STELs are issued as consensus standards for controlling air quality in workplace environments.
<u>STATE OF GEORGIA</u>		
Georgia Rules for Safe Drinking Water (Georgia Department of Natural Resources (DNR), July 1992)	Applicable	Georgia MCLs for drinking water have been promulgated for a number of common organic and inorganic contaminants. These are legally enforceable levels that regulate the concentration of contaminants in public drinking water supplies and are considered for groundwater aquifers used for drinking water or potential sources of drinking water. Groundwater contaminant concentrations are compared to MCLs during the evaluation of risks to human health due to consumption of groundwater.
Georgia Water Quality Control Regulations and Standards	Applicable	Standards established for instream concentrations of the chemical constituents listed by the USEPA as toxic priority pollutants (Section 307(a)(1)) of the federal CWA.
<u>GEORGIA (TO BE CONSIDERED)</u>		
Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions (Georgia DNR, July 1984)	Relevant and Appropriate	These guidelines are used in the review of all air quality applications for construction and operating permits for sources of toxic air pollutants. Acceptable ambient pollutant concentrations are discussed.

**Notes:**

ARARs = Applicable or Relevant and Appropriate Requirements  
ppm = parts per million  
RCRA = Resource Conservation and Recovery Act  
USEPA = U.S. Environmental Protection Agency  
VOCs = volatile organic compounds

relevant and appropriate based on the circumstances of release. Ambient Water Quality Criteria (AWQC) are also potentially relevant and appropriate standards under CERCLA Section 121. RCRA concentration limits (40 CFR 264.94) are applicable to active RCRA facilities and establish three categories of groundwater protection standards: background concentrations, MCLs, and Alternative Concentration Limits (ACLs).

RCRA MCLs are equal to SDWA MCLs. A background level or health-based (assuming human exposure) ACL may be developed on a case-by-case basis as a groundwater protection standard. ACLs are developed in accordance with 40 CFR 264.94 and are based on the concentration at which the contaminant will adversely affect groundwater quality and hydraulically connected surface water. The ACL takes into consideration factors such as physical and chemical characteristics of the waste, hydrogeological characteristics of the site, the quantity and direction of groundwater flow, current and future uses of groundwater, existing quality of the area groundwater, and the persistence and permanence of adverse effects. Additional factors are listed in 40 CFR 264.94.

The Georgia Hazardous Waste Management Rules are applicable when developing appropriate clean up standards at a site. Georgia Hazardous Waste Management Rules are consistent with the regulatory requirements of 40 CFR Parts 260 through 270; therefore, RCRA groundwater protection standards are also applicable to Site 11 under Georgia regulations. In addition, Georgia Drinking Water Standards or MCLs (GA DNR, July 1992) are applicable when developing appropriate cleanup levels. Georgia groundwater quality standards, MCLs, MCLGs, AWQC, background levels, and ACLs will be assessed and used during the evaluation of an interim corrective measure at Site 11 to develop appropriate cleanup levels. A preliminary list of chemicals of potential concern and the associated chemical specific ARARs are presented in Table 7-2.

Federal non-regulatory criteria to be considered when ARARs are not available for specific contaminants or that may be used in conjunction with the risk assessment include USEPA Risk Reference Doses and USEPA Carcinogenic Assessment Group Cancer Slope Factors (USEPA, 1989b).

Table 7-2 Chemical Specific Values

Chemical µg/l	Federal MCL µg/l	MCLG µg/l	Federal <sup>1</sup> AWQC µg/l	Georgia Drinking <sup>2</sup> Water Standards µg/l	Georgia Surface <sup>3</sup> Water Criteria µg/l
Acetone	-----	-----	-----	-----	-----
Ethylbenzene	700	700	1,400	700	28,718
Chlorobenzene	100	100	488	100	20
1,1-Dichloroethane	-----	-----	-----	-----	-----
trans-1,2-Dichloroethene	100	100	-----	100	136,319
Methylene Chloride	5	0	-----	-----	1,578
2-Butanone	-----	-----	-----	-----	-----
Tetrachloroethene	5	0	0.8	5	8.85
Carbon Disulfide	-----	-----	-----	-----	-----
Trichloroethene	5	0	2.7	5	81
Vinyl Chloride	2	0	2.0	2	525
Toluene	1,000	1,000	14,300	1,000	301,941
Bromomethane	-----	-----	-----	-----	470.8
1,1-Dichloroethene	7	7	0.033	7	3.2
cis-1,2-Dichloroethene	70	70	-----	70	-----
Benzene	5	0	0.66	5	71.28
1,2-Dichlorobenzene	600	600	-----	600	2,600
1,4-Dichlorobenzene	75	75	-----	75	2,600
Dichlorodifluoromethane	-----	-----	-----	-----	-----
m/p-Xylene	*	*	-----	-----	-----
o-Xylene	*	*	-----	-----	-----
xylenes (Total)	10,000	10,000	-----	10,000	-----
1,2-Dichloroethane	5	0	-----	-----	-----
1,2-Dichloropropane	5	0	-----	-----	-----
2-Hexanone	-----	-----	-----	-----	-----
4-Methyl-2-pentanone	-----	-----	-----	-----	-----

Notes:

- \* = See xylenes (total)
- = none reported
- MCL = Maximum Contaminant Level, USEPA Office of Water, December 1992; The Bureau of National Affairs, Inc., July 1992.
- MCLG = Maximum Contaminant Level Goal, USEPA Office of Water, April 1992; The Bureau of National Affairs, July 1992.
- Federal AWQC = Federal Ambient Water Quality Criteria
- µg/l = micrograms per liter

<sup>1</sup> Water Quality Criteria Summary Concentrations, Published Criteria (Water and Organisms) USEPA Office of Science and Technology Health and Ecological Criteria Division, May 1991.  
<sup>2</sup> Georgia Drinking Water Standards, Rules for Safe Drinking Water, Chapter 391-3-5, Revised July 1992, Rules of Georgia Department of Natural Resources Environmental Protection Division.  
<sup>3</sup> Georgia Surface Water Criteria, Georgia Water Quality Control Specifications and Standards, The Bureau of National Affairs, Inc., August 1991.

## 8.0 STRATEGY FOR CORRECTIVE ACTION

The overall plan for corrective action at Site 11 addresses three areas. One area is planning and implementation of an Interim Measure to begin abatement of VOC contamination of groundwater. A second area is performing a CMS. The CMS will present evaluations and recommendations of remedial alternatives for contaminated media and the source. The third area is continuation of the RFI to support the Interim Measure, CMS, and a Baseline Risk Assessment.

**8.1 INTERIM MEASURE.** Activities associated with planning the Interim Measure have begun. In general, the Interim Measure includes development of a work plan, installation and pilot scale activities, and engineering evaluation of the recovery and treatment system.

The Interim Measure work plan will address how the VOC contaminants in groundwater will be abated and how the Interim Measure will be integrated with the long-term Corrective Measure for Site 11. The Interim Measure work plan will include discussions of the technical approach, installation, coordination of utilities for system power and discharge needs, preliminary pilot scale activities, data management, operations and maintenance, and testing and engineering evaluation of a pilot-scale system.

Installation and pilot scale activities include drilling and well installation/development, groundwater sampling and analysis, mobile treatment (air stripper) unit and conveyance piping setup, coordination of utilities for system power and discharge needs, well performance testing, bioreactor testing, and initial groundwater recovery/treatment system operation. Permitting for short-term air and water discharges will be coordinated with the State of Georgia.

The engineering evaluation includes evaluation of hydraulic and chemical data collected during installation and pilot scale activities, and evaluation of the overall effectiveness of the pilot-scale groundwater extraction and treatment system. The evaluation will be limited to the integral systems that comprise the pilot-scale system including: the groundwater extraction system, conveyance system, mobile treatment unit, and discharge permit. These systems will be assessed for ease of implementation, ability to meet remediation objectives, cost effectiveness, and ability to meet scheduling objectives.

**8.2 CORRECTIVE MEASURE STUDY.** The CMS evaluates and selects methods for achieving long-term remedial action goals for all media requiring remediation. Groundwater is currently the only environmental media known to require remediation. For the most part, the CMS will be conducted following interpretation of information obtained during the RFI. However, information requirements for the CMS that must be addressed during the RFI will be identified in a pre-investigation evaluation of corrective measures technologies. The March 1993 Plan of Action includes performing the pre-investigation evaluation of corrective measures technologies.

Part of the CMS includes development of a report that identifies potential corrective measure technologies that may be used on site and off site for the containment, treatment, remediation, and/or disposal of contaminated media. The report will identify data needs to be addressed in the RFI to facilitate the evaluation and selection of the final corrective measures. This information will

include compatibility of wastes and construction materials, information to evaluate effectiveness of corrective measures, and potential treatability of contamination at the site.

**8.3 RCRA FACILITY INVESTIGATION.** RFI activities will address collection of information regarding environmental setting, source characteristics, contamination characteristics, potential receptors, and media protection standards. Some activities overlap one or more of these general areas.

Planning documents for the continuation of the RFI will be based on existing documents under which RFI activities have been conducted. Planning documents will include a work plan, field sampling plan, quality assurance project plan, and health and safety plan. Components of the existing plans that are applicable to future RFI work will be used, with any necessary revisions or modifications considered beneficial based on current knowledge of conditions at Site 11.

The present conceptual model of the environmental setting is discussed in Section 2.0 of this document. Knowledge of the environmental setting is primarily based on literature and screening activities, such as geophysical surveys and use of direct push instrumentation. Future activities intended to supplement current knowledge are anticipated to include borehole geophysics, soil boring and subsurface soil sampling, and aquifer tests. Borehole geophysical logging of one or both of the deep wells in Crooked River Plantation Subdivision (see Section 6.2 and Figure 6-2) could be used to supplement information obtained from literature regarding the nature and configuration of the Upper Floridan aquifer and the overlying confining unit. Soil borings and subsurface soil sampling will be done in conjunction with monitoring well installation. Visual inspection and physical analyses will be performed to verify and augment stratigraphic information about the surficial aquifer obtained from shallow soil borings and piezocone penetrations conducted previously. Aquifer testing will be performed on selected monitoring wells to evaluate variation in hydraulic conductivity with location and depth.

Currently, information regarding the source area and nature of wastes is based on information obtained during the Initial Assessment Study, results of geophysical surveys conducted at the landfill, and interpretation of the nature of wastes based on contaminants detected in groundwater. Test trenches in the landfill will be included in upcoming RFI activities to allow visual inspection and, if appropriate, sampling of waste.

Much of the upcoming RFI program will be concerned with contamination characteristics of environmental media. Surface soil and subsurface soil samples will be collected for chemical analysis to evaluate the presence or absence of site-related contaminants in these media. Monitoring wells will be installed to monitor groundwater at various depths in the surficial aquifer at locations around the landfill and in the Crooked River Plantation Subdivision. Locations will be selected based on current knowledge of the distribution of VOC contaminants in groundwater. An air monitoring program will be implemented to assess the potential for VOC contaminants in air and to confirm the air screening survey results of the ICMS Investigation. The RFI air monitoring program will include collection of samples for laboratory analysis. The need for surface water and sediment sampling will be evaluated based on information requirements of the human health and ecological risk assessments. Further characterization of contaminants in groundwater could cause additional surface water and sediment sampling to be warranted. Currently the only surface water body identified as

potentially impacted by releases from the site is Porcupine Lake. VOC and SVOC analyses have been conducted on sediment and surface water samples from this surface water body.

The ICMS Investigation included a screening human health risk evaluation for exposure to VOC contaminants in groundwater. The only potential receptors considered in the screening risk evaluation were residents of Crooked River Plantation Subdivision. Other potential receptors include humans that work or live at the NSB, flora, and fauna. A demographic/human health survey and ecological survey will be included in the RFI. The ecological survey will potentially include sampling and analysis of flora and fauna tissue samples. The information obtained from these surveys will be integral to performing the Baseline Risk Assessment. Results of the Baseline Risk Assessment will be used in evaluating and/or recommending media protection standards and remedial action goals in conjunction with federal or state requirements, which are discussed in Section 7.0 of this document.

## 9.0 INTERIM CORRECTIVE MEASURE SCREENING INVESTIGATION ADDENDUM

This section includes the Interim Corrective Measure Screening Investigation Addendum. The addendum discusses the field program, analytical program, and results of activities conducted during January and March 1993. These activities included collection of groundwater samples from 11 PIWs (January) and from locations within and to the north of the landfill (March).

**INTERIM CORRECTIVE MEASURE SCREENING  
INVESTIGATION ADDENDUM**

**CONTRACT TASK ORDER NO. 041  
MODIFICATION NO. 3  
NAVY CLEAN - DISTRICT 1  
CONTRACT NO. N62467-89-D-0317**

**NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA**

*Prepared for:*

**Southern Division  
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**December 1993**



## FOREWORD

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the 1986 Superfund Amendments and Reauthorization Act (SARA), the 1976 Resource Conservation and Recovery Act (RCRA), as augmented by the 1984 Hazardous and Solid Waste Amendments (HSWA), and as directed in Executive Order 12580 of January 1987, the Department of Defense (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 (NACIP) program was developed by the Navy to implement the IR Program for all Naval and Marine Corps facilities. The NACIP program was originally conducted in three phases: (1) Phase I, Initial Assessment Study, (2) Phase II, Confirmation Study (including a Verification Step and a Characterization Step), and (3) Phase III, Planning and Implementation of Remedial Measures. The three-phase IR Program was modified and updated to be congruent with the CERCLA/SARA and RCRA/HSWA-driven DOD IR program.

The updated nomenclature for the RCRA/SARA process is as follows:

- Preliminary Assessment/Site Inspection (PA/SI)
- Remedial Investigation/Feasibility Study (RI/FS)
- Remedial Design/Remedial Action (RD/RA)
- Site Closeout (SC)

Four sites at the Naval Submarine Base (NSB), in Kings Bay, Georgia, were identified for investigation under the IR Program. A work plan for conducting a RCRA Facility Investigation (RFI) at each of the four sites has been completed and implemented. No sampling or analyses will be conducted at the fourth site. The Public Works Department at the NSB will gather information for the fourth site to include in the RFI Report.

Because of the detection of volatile organic compounds in groundwater samples downgradient and off site, an Interim Corrective Measure Screening Investigation (ICMSI) was implemented at Site 11, the Old Camden County Landfill. This addendum presents an evaluation of data collected during a March 1993 field program conducted as part of the initial ICMSI program (reported separately).

Questions regarding this report should be addressed to the NSB Public Affairs office at (912) 673-4714.

## EXECUTIVE SUMMARY

This addendum to the Interim Corrective Measure Screening Investigation (ICMSI) Progress Report was prepared as a result of follow-on activities conducted as part of the ICMSI at Site 11, Old Camden County Landfill, at the Naval Submarine Base in Kings Bay, Georgia. The follow-on activities were conducted in January and March of 1993 and included collection of groundwater samples from private irrigation wells (PIWs) in Crooked River Plantation Subdivision and from locations within and north of the landfill. The following paragraphs summarize the interpretations and evaluations of analytical data obtained from this field effort. The information presented herein does not reiterate, but is in addition to that provided in the ICMSI Progress Report.

Fifty-four groundwater samples, including four duplicate samples, were collected from various depths at 16 locations within and north of the landfill. Samples were analyzed in an on-site laboratory for 10 target volatile organic compounds (VOCs) using gas chromatographic (GC) methods. Target VOCs included vinyl chloride, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, tetrachloroethane, benzene, toluene, ethylbenzene, m-xylene, and o/p-xylene. Six groundwater samples, including one duplicate sample, were submitted to an off-site contract laboratory for analysis of Target Compound List VOCs.

The data obtained during March 1993 indicate that beneath the landfill the plume is similar in composition to the downgradient portion investigated during the initial ICMSI. The same five VOCs were detected in groundwater samples from within the landfill at concentrations above Federal Maximum Contaminant Levels, including vinyl chloride, tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, and benzene. The concentrations of total VOCs beneath most of the landfill area are lower than those detected along and downgradient of the western margin of the landfill, in the direction of groundwater flow. Contaminants were detected in samples from depths ranging from 15 to 85 feet below ground surface (bgs), which is deeper than the 60 feet bgs estimated for off-site contamination.

The occurrence of VOCs in the 11 PIW samples collected during January 1993 was sporadic. Two of the PIWs sampled were at locations known to overlie the plume. Acetone was detected in one of the two PIW samples and no other VOCs were detected. VOCs detected in one or more of the remaining PIW samples, from locations outside the plume, include VOCs that are commonly observed artifacts of laboratory or sampling procedures (acetone and 2-butanone); trihalomethanes that are commonly formed in water chlorinated for drinking supply (bromoform, bromodichloromethane, and dibromochloromethane); and solvents (trichloroethene, toluene, and styrene).

#### ACKNOWLEDGEMENTS

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LIST OF ACRONYMS

bgs	below ground surface
CLP	USEPA Contract Laboratory Program
GC	gas chromatographic
GPR	ground penetrating radar
ICMSI	Interim Corrective Measure Screening Investigation
MCL	Maximum Contamination Limit
MDL	Minimum Detection Limit
ml	milliliter
$\mu\text{g}/\ell$	micrograms per liter
MS	matrix spike
MSD	matrix spike duplicate
NEESA	Naval Energy and Environment Support Activity
NSB	Naval Submarine Base
%R	percent recovery
PARCC	precision, accuracy, representativeness, completeness, and comparability
PIW	private irrigation well
QC	quality control
RFI	RCRA Facility Investigation
RPD	relative percentage difference
SOW	Statement of Work
TCL	Target Compound List
USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds

## 1.0 INTRODUCTION

Under contract to the U.S. Department of the Navy (Navy) Southern Division, Naval Facilities Engineering Command, this addendum to the Interim Corrective Measure Screening Investigation (ICMSI) Progress Report was prepared for Site 11, the Old Camden County Landfill, located on the Naval Submarine Base (NSB) in Kings Bay, Georgia. This report was prepared under the Navy's Comprehensive Long-term Environmental Action, Navy Contract No. N62467-89-D-0317, Contract Task Order No. 041. This report concludes the activities required for the ICMSI.

The ICMSI was initiated as part of the overall Resource Conservation and Recovery Act Facility Investigation (RFI) field program at NSB Kings Bay to establish whether the volatile organic compounds (VOCs) detected in groundwater downgradient of Site 11 have migrated into the Crooked River Plantation Subdivision. The ICMSI was planned to establish whether an immediate threat to human health exists within the subdivision. The ICMSI Progress Report (Progress Report) documents the findings of the original investigation, including a human health screening risk evaluation. The Progress Report also provides a detailed site description and regulatory information that are not repeated here.

### 1.1 OBJECTIVES OF THE INTERIM CORRECTIVE MEASURE SCREENING INVESTIGATION

ADDENDUM. This addendum documents the findings related to groundwater samples collected from locations within and north of the landfill and from private irrigation wells (PIWs) located within the Crooked River Plantation Subdivision. This sampling was conducted in January and March of 1993. The objectives of collecting these additional samples were to provide sufficient information to evaluate the following:

- the horizontal and vertical extent of groundwater VOC contamination within the landfill boundaries,
- VOC contaminants of potential concern, if any, in the PIW water samples collected within the Crooked River Plantation Subdivision.

The information presented in this addendum does not reiterate, but is in addition to that provided in the ICMSI Progress Report.

### 1.2 REPORT ORGANIZATION

This addendum presents an interpretation and evaluation of data collected during the January and March 1993 sampling event as part of the ICMSI conducted at the Old Camden County Landfill and includes the following:

- Introduction includes the objectives for the additional activities of the investigation and report organization;
- Site Investigation Program discusses the site-specific field program and activities;
- Quality Assurance Program and Data Quality Assessment discusses the analytical program, and data quality and use;
- Results of the Investigation discusses the chemical and hydrogeologic data in relation to interpreting the site's physical conditions;

- Summary and Recommendations summarizes the results of the additional ICMSI site activities in support of recommendations for a Corrective Measures Study.

## 2.0 SITE INVESTIGATION PROGRAM

The following subsections describe the scope and components of the follow-on investigation to the ICMSI field program at the Old Camden County Landfill. Included are discussions of methods used to select hydropunch locations through use of ground-penetrating radar (GPR) and to collect samples of groundwater using hydropunch equipment and from PIWs.

2.1 SAMPLE IDENTIFICATION. During March 1993 activities, sample location identifiers for samples collected from landfill locations were consecutive beginning with location 147. Locations 101 through 146 were used during the initial ICMSI activities.

Sample identification for groundwater samples collected using the hydropunch includes location and depth information as described below:

G      147    25  
G = hydropunch  
147 = location identifier  
25 = upper limit of a 1-foot sample interval in feet below ground surface (bgs)

PIW samples collected in January 1993 were labeled consecutively starting with location 52, preceded by CRP-PW, which signifies a PIW in the Crooked River Plantation Subdivision. Locations 1 through 51 were used during the initial ICMSI activities. The sample labels are cross-referenced with location codes identifying the PIW's corresponding street name and number on Table 2-1.

The location codes are needed for the geographical information system database to manage data from multiple sample events at a single location.

The analytical program for the investigation included on-site laboratory analyses of all groundwater samples collected from the landfill using the hydropunch for 10 target VOCs:

vinyl chloride  
cis-1,2-dichloroethene  
trans-1,2-dichloroethene  
trichloroethene  
tetrachloroethene  
benzene  
toluene  
m/p-xylene  
o-xylene  
ethylbenzene

The hydropunch samples were analyzed in an on-site laboratory with a minimum of 10 percent of the samples submitted to an off-site contract laboratory for analysis of VOCs using U.S. Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) methods. All the PIW samples were submitted to the contract laboratory for analysis.

Table 2-1 PIW Location Codes and Corresponding Sample Identification

Sample Identification	PIW Location Code <sup>1</sup>
PW52	204COCO
PW53	114CACI
PW54	213PLCO
PW55 <sup>2</sup>	204PLCO
PW56	106CHPDR
PW57 <sup>3</sup>	310FADR
PW58	301CHPDR
PW59	314SUDR
PW60	300FADRR
PW61	309WODR
PW62	206SUDR

<sup>1</sup> Location codes include numeric prefix and alphabetical suffix. Numeric prefix is the house number in the address. The alphabetical suffix is an abbreviation of the street name. An example follows:

Location Code	Address
FADR	Fairfield Lane
CHPDR	Cherry Point Drive
WODR	Woodlawn Drive
SUDR	Sunnyside Drive
PLCO	Plantation Court
COCO	Cottage Court
CACI	Cambray Circle

<sup>2</sup> Same location as PW7, sampled during the initial ICMSI field program.

<sup>3</sup> Same location as PW36, sampled during the initial ICMSI field program.

**2.2 SUBSURFACE EXPLORATION.** Previous investigations revealed the presence of trenches of waste materials within the Site 11 landfill. These trenches range from approximately 575 to 775 feet in length and 35 to 50 feet in width. Depth of the trenches is reportedly 8 to 12 feet bgs. Spacing between the trenches ranges between 3 and 5 feet. Based on results of the GPR survey conducted in March 1993, discussed in the following paragraphs, the depth to refuse ranges from 2 to 3 feet bgs. The areas between the trenches are interpreted to represent areas of the landfill that do not have substantial amounts of refuse beneath them.

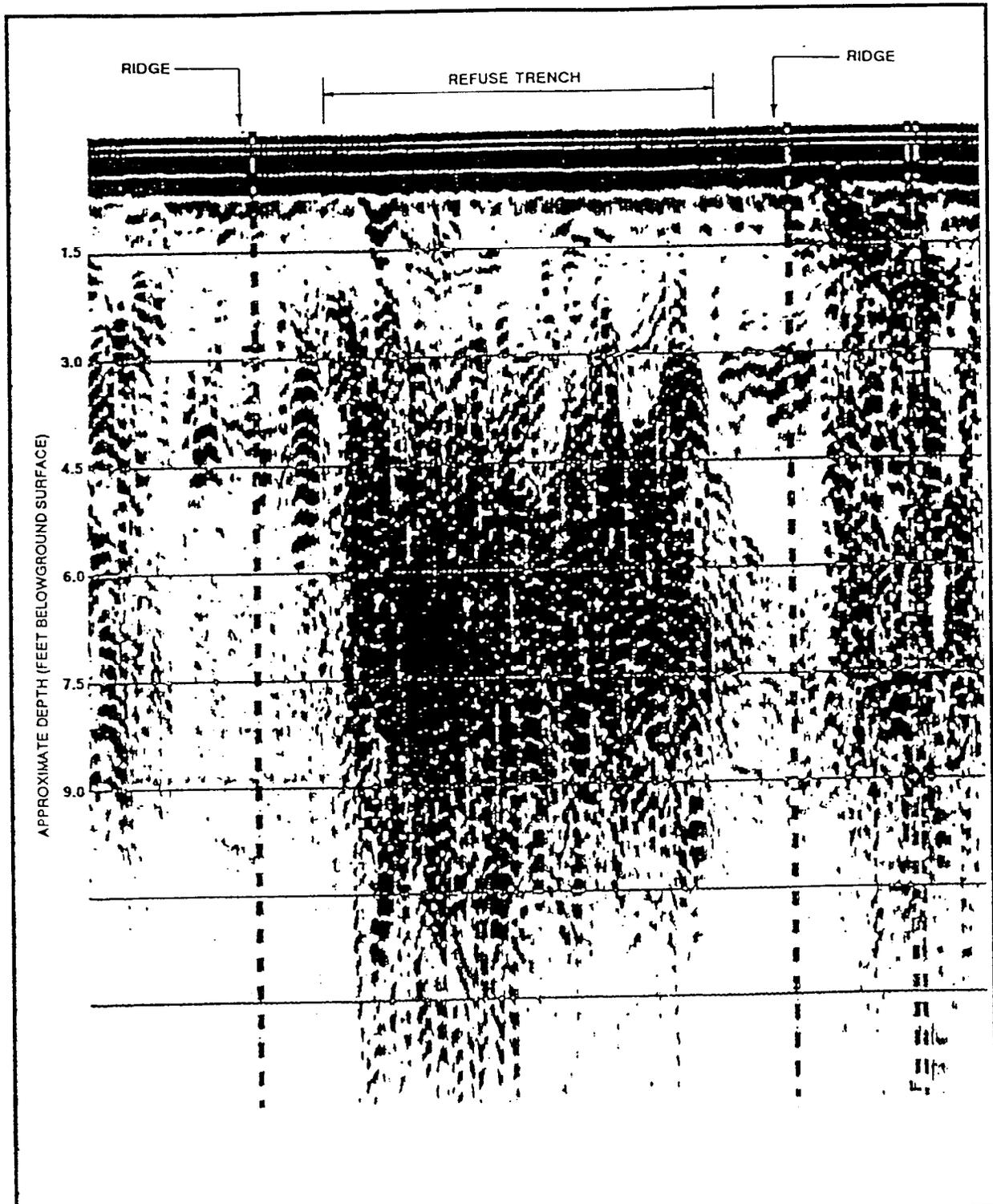
A GPR survey was conducted at Site 11 to assist in the selection of hydropunch locations within the landfill that would not encounter substantial amounts of refuse. The GPR technique uses high frequency radio waves to establish the presence of subsurface objects and structures.

Thirty-two proposed hydropunch locations were staked within the landfill boundary, based on the results of GPR data. Proposed locations were surveyed using GPR to verify they were clear of substantial amounts of refuse. The GPR survey was conducted with a GSSI System III GPR unit equipped with a 500-megahertz antenna.

Figure 2-1 shows the reflection signature of a portion of the GPR profiles conducted at the landfill. The GPR signature of the trenches compared to areas that did not receive waste is evident, as shown in Figure 2-1. Trenches are characterized by chaotic reflections and diffractions. Trenches most likely display this signature because of the nature of landfilled materials and the fact that refuse tends to retain moisture in the unsaturated zone. Areas not appearing to have received waste are typified by reflection-free signatures with some diffractions. These radar signatures are indicative of thickly bedded sands. These types of sedimentary deposits were observed during the cone-penetrator survey conducted in October and November of 1992.

**2.3 HYDROPUNCH GROUNDWATER SAMPLING.** The hydropunch groundwater sampling device consists of a stainless steel telescoping assembly containing an airtight and watertight sealed intake screen and sample chamber that is isolated from the surrounding environment. The tool attaches to a standard drill rod and is advanced through the hollow-stem augers by driving the drill rod with a 140-pound hammer. The hydropunch sampler is advanced a distance of 5 feet beyond the augers. When the desired depth for collection is reached, the hydropunch is opened by pulling back on the drill rod. Soil friction holds the drive cone in place as the body of the hydropunch moves back. Once the O-ring seal between the drive cone and the body of the tool is broken, groundwater flows from the surrounding formation into the sample chamber. As the sample is collected, the drive cone and sample chamber are tightly sealed against the borehole walls. This "packer" effect isolates the intake from groundwater above and below and results in a discrete 11-inch sample interval.

Once open, the hydropunch sample chamber fills from the bottom with no aeration and minimal agitation of the sample. As the tool is pulled upward, increased hydrostatic head within the tool closes lower and upper check valves that retain the sample within the body of the hydropunch. Once at the surface, the hydropunch is inverted and the sample is decanted through a top discharge valve and tubing.



OWN: SFC	DES.: SFC	PROJECT NO.: 7553	TITLE: GROUND-PENETRATING RADAR PROFILE	
CHKD: NLW	APPD: LBH	FIGURE NO.:		
DATE: 6/23/93	REV.: 1.0	2-1		

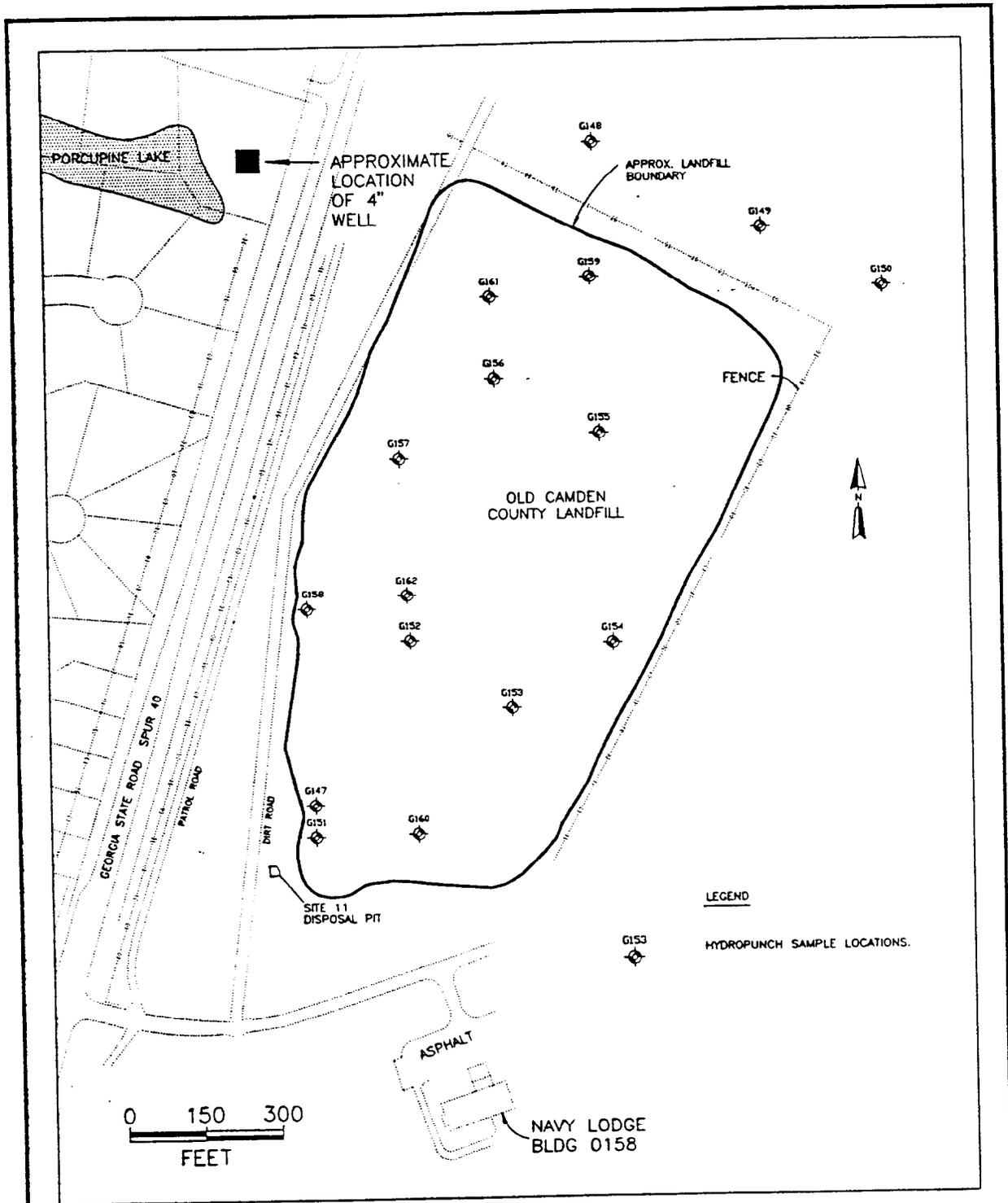
To collect water samples from multiple intervals, the existing borehole is advanced by hollow-stem auger drilling and a clean hydropunch sampler is advanced for sample collection.

During a 9-day period from March 15 to March 24, 1993, groundwater samples were collected from 16 locations within and to the north of the landfill. Figure 2-2 shows the locations where the hydropunch samples were collected. Sample depths ranged from 12 to 90 feet bgs. Sample locations and depth intervals were chosen based on analytical information provided by the on-site laboratory. Thus, the location and depth interval of successive samples were selected based on analytical information from preceding samples. Sampling objectives included evaluating the horizontal and vertical extent of VOC contamination and characterizing concentrations of VOCs in the plume.

Fifty-four groundwater samples, including four duplicate samples, were collected for analysis of target VOCs in the on-site laboratory. Six groundwater samples, including one duplicate sample, were submitted for off-site analysis at the contract laboratory. A sample from G152 (G15230) and a duplicate from this location were submitted for off-site analysis. This sample was not analyzed onsite. Off-site analysis included Target Compound List (TCL) VOCs using the USEPA CLP Statement of Work (SOW) for multi-media samples (USEPA, 1991a). Section 3.0 provides more detailed information about the analytical program for this investigation. The results of this sampling effort are discussed in Section 4.0.

On March 24, 1993, a monitoring well was installed at hydropunch location G162 (see Figure 2-2). The monitoring well was installed following completion of hydropunch sampling, which extended to a depth of 18 feet bgs. The boring was extended to 20 feet bgs and the monitoring well constructed inside the hollow-stem augers. Well construction inside hollow-stem augers involves gradually removing the augers from the borehole as the filter pack and bentonite seal are placed. Figure 2-3 is a construction diagram and boring log for the new monitoring well (KBA-11-10). Well construction materials included Schedule 40, flush threaded polyvinyl chloride well screen and riser pipe. The well screen is 10 feet long and has 0.01-inch machined slots. The filter pack is made up of 20-30 mesh silica sand and extends 2 feet above the top of the screen. A 1-foot-thick bentonite pellet seal was placed on top of the filter pack. The remainder of the annulus was grouted using Type I Portland cement. Well development consisted of pumping 270 gallons of water from the well. Approximately 100 gallons of potable water was used during placement of the sand pack to manage problems associated with bridging of sand within the augers. Groundwater was initial brown and silty but cleared during development. No samples have been collected from this new monitoring well.

**2.4 PRIVATE IRRIGATION WELL SAMPLING.** On two occasions, residents of the Crooked River Plantation Subdivision were provided questionnaires requesting information about PIWs. Ninety-four PIWs were identified. The second questionnaire requested permission to collect groundwater samples from PIWs and asked property owners for physical information about their PIWs and specifics of use. The initial ICMSI field program included sampling of 51 PIWs. Nine additional PIWs were sampled on January 12 and 13, 1993. Two previously sampled PIWs were also resampled. Figure 2-4 shows the locations of the PIWs sampled in January 1993. All samples were analyzed for TCL VOCs in the off-site contract laboratory using the USEPA CLP SOW for multimedia samples (USEPA, 1991a). Copies



KINGSBAY\CHEM\MAPS\GLDCS.dwg

DWN: NLW	DES.: NLW	PROJECT NO.: 7553	TITLE: HYDROPUNCH SAMPLING LOCATIONS MARCH 1993
CHKD: VAR	APPD: LBH	FIGURE NO.: 2-2	
DATE: 6/23/93	REV.: 1.1		

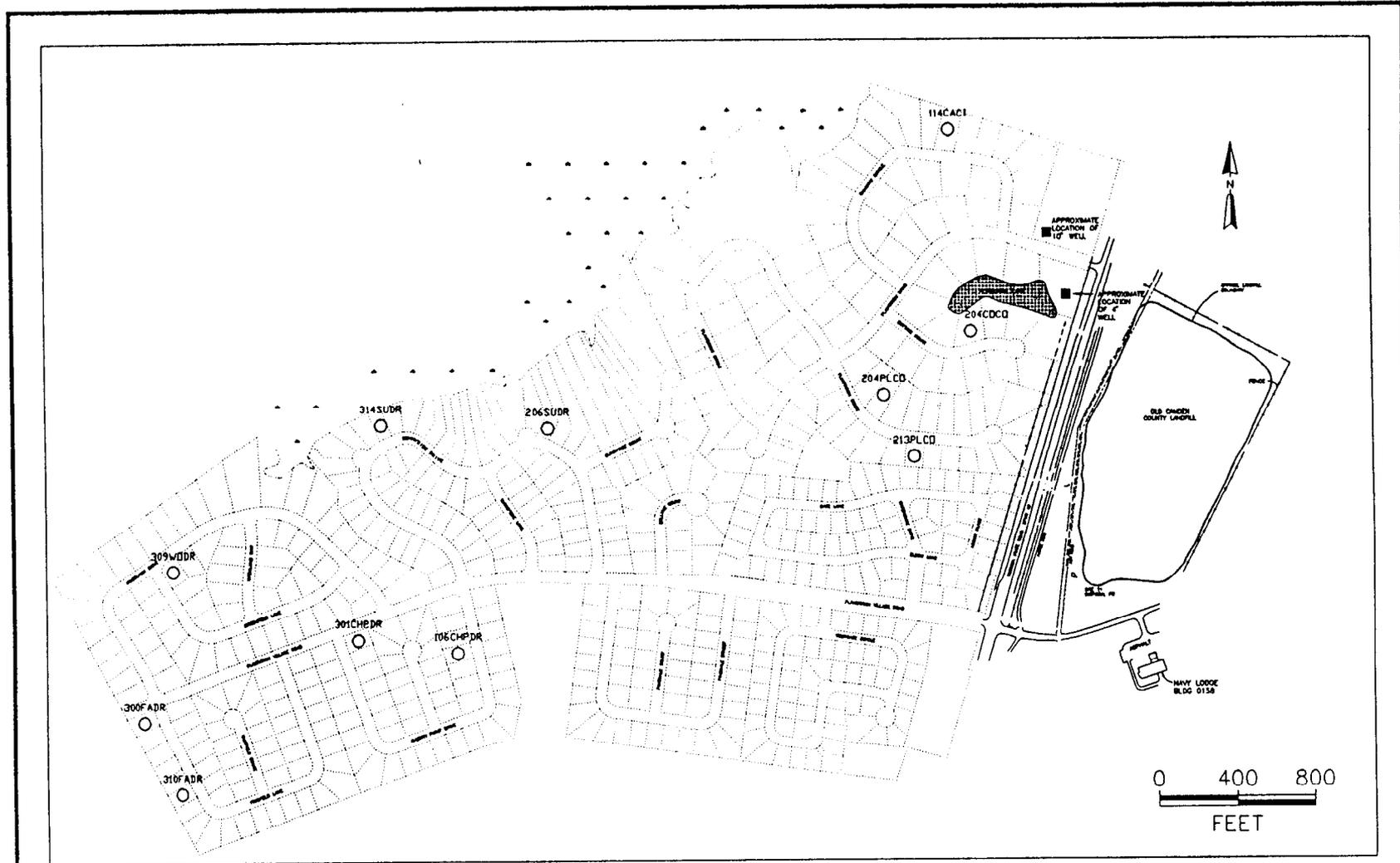


ICMS/ ADDENDUM  
NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA

TITLE: NSB KINGS BAY		LOG of WELL: KBA-11-10		BORING NO.					
CLIENT: U.S. NAVY, SOUTHNAVFACENCON			PROJECT NO: 7553-33						
CONTRACTOR: Ground Water Protection		DATE STARTED: 3/24/93		COMPLTD: 3/24/93					
METHOD: HSA	CASE SIZE: 2"	BORING DIA: 8.25"	PROTECTION LEVEL: 0						
TOC ELEV.: FT.	MONITOR INST.: PORTA FID	TOT DPTH: 20FT.	DPTH TO $\nabla$ FT.						
LOGGED BY: L. W. Smith		WELL DEVELOPMENT DATE: 3/24/93		SITE: 11					
DEPTH FT.	LABORATORY SAMPLE ID	SAMPLE	RECOVERY	HEADSPACE (open)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
					Topsail, light grey to light tan		SC		
					Silty sand, dark brown, medium to fine				
5									
10									
15									
20					boring terminated at 20 ft.				
25					NOTE: log estimated from cuttings				

PAGE 1 of KB-11-10

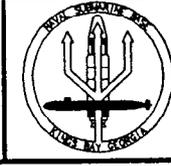
OWN: TLK	DES.: TLK	PROJECT NO.: 7553	TITLE: BORING LOG AND WELL CONSTRUCTION DIAGRAM FOR KBA-11-10	 ICMSI ADDENDUM NAVAL SUBMARINE BASE KINGS BAY, GEORGIA
CHKD: LBH	APPD: LBH	FIGURE NO.: 2-3		
DATE: 6/24/93	REV.: 1.0			



KINGSBAY\CHEM\MAPS\PIW-1-93.dwg

DWN: NLW	DES.: NLW	PROJECT NO.: 7553
CHKD: VAR	APPD: LBH	FIGURE NO.: 2-4
DATE: 6/23/93	REV.: 1.1	

TITLE:  
CROOKED RIVER PLANTATION SUBDIVISION  
PRIVATE IRRIGATION WELL LOCATIONS  
JANUARY 1993



ICMSI ADDENDUM  
  
NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA

of completed questionnaires and consent forms for the additional PIWs sampled are provided in Appendix A.

Samples were placed in 40 milliliter (ml) vials directly from spigots or sprinkler heads. When samples were collected from sprinkler heads, the heads were removed so that samples could be collected from a steady flow with minimum aeration. Before sample collection, each well was purged for 15 minutes, during which time flow rates were measured by measuring the time required to fill a 5-gallon bucket. Flow rates were not measured for PIWs that were purged and sampled through sprinkler heads. Flow rate data for the PIWs are provided in Table 2-2. The chemical results of this sampling effort are discussed in Section 4.0 of this report.

2.5 DECONTAMINATION PROCEDURES. Hydropunch sampling equipment that came in contact with sample material was cleaned as follows:

1. Steam-cleaned with potable water.
2. Washed with Alconox™ and distilled water.
3. Rinsed with distilled water.
4. Rinsed with pesticide-grade isopropanol.
5. Rinsed with deionized, organic-free water.
6. Air dried.
7. Wrapped in aluminum foil.

Isopropanol used in decontamination was collected in a plastic bucket and allowed to evaporate. Periodically, unused portions of groundwater samples from on-site analyses were returned to the site. The groundwater and decontamination fluids, other than isopropanol, were disposed of within the area of contamination (within the landfill boundaries) in accordance with USEPA guidance for management of investigation-derived waste (USEPA, 1991b).

Table 2-2 PIW Flow Rates

Sample Identification	Flow Rate (gpm)
PW52	NA
PW53	7.3
PW54	6.4
PW55	5.5
PW56	5.5
PW57	5.0
PW58	12.0
PW59	7.5
PW60	NA
PW61	4.8
PW62	7.5

NA Flow rates out of sprinkler heads were not measured  
gpm = gallons per minute

### 3.0 QUALITY ASSURANCE PROGRAM AND DATA QUALITY ASSESSMENT

This section summarizes the analytical program for on-site and off-site analyses of groundwater samples and PIW samples collected during the 1993 follow-on ICMSI field activities at Site 11. In addition, it assesses on-site and off-site data quality and useability and compares on-site and off-site analytical results.

**3.1 ANALYTICAL PROGRAM.** Field activities during the screening investigation included the collection of groundwater samples from the landfill using hydropunch equipment and from PIWs. All samples were collected in accordance with procedures outlined in the Quality Assurance Project Plan, Appendix A, of the NSB Kings Bay RFI/Site Investigation Work Plan (ABB-ES, 1991). Groundwater samples from the landfill were analyzed in an on-site laboratory with a minimum of 10 percent of the samples submitted for confirmatory off-site analysis. PIW groundwater samples were submitted to the off-site laboratory and were not analyzed in the on-site laboratory. Table 3-1 summarizes the sampling and analysis program for samples collected for on-site and off-site laboratory analysis.

**3.1.1 On-Site Chemical Analysis** Hydropunch groundwater samples collected for on-site analysis were analyzed for target VOCs using a gas chromatographic (GC) field laboratory. The analytical method was a modification of the USEPA 8010/8020 purge-and-trap GC method as described in the ICMSI Work Plan (ABB-ES, 1992).

**3.1.1.1 On-Site Analytical Method Modifications to the USEPA 8010/8020 Method** are summarized in this subsection. Samples were analyzed using an LSC-2000 purge-and trap unit connected to a Hewlett-Packard™ 5890 GC. A DB-624 75-meter megabore column was used for compound separation. The on-site GC was equipped with a purge-and-trap unit and two detectors, a photometric ionization detector and an electrolytic conductivity (Hall) detector. A standard sample volume of 25 milliliters was used for each analysis. The following run conditions were established:

- LSC-2000 purge time = 6 minutes
- LSC-2000 desorb time = 3 minutes
- LSC-2000 bake time = 5 minutes
- HP 5890 injection port temperature = 225 °C
- HP 5890 detector port temperature = 275 °C
- HP 5890 initial oven temperature = 35 °C
- HP 5890 oven temperature ramp = 6 °C per minute
- helium carrier flow = 10 ml per minute
- helium make-up flow = 20 ml per minute
- hydrogen make-up flow = 75 ml per minute

**3.1.1.2 Performance Criteria** The quality control (QC) criteria for the on-site analytical method were established to monitor method performance. An initial three-point calibration for quantitation (low, mid-range, and high concentrations) was performed for each instrument. Target compounds and reporting limits are presented on Table 3-2. Instrument stabilities were monitored every 24 hours with a calibration standard at the mid-range concentration. The quantitation performance criterion for operation was agreement of the check standard with the three-point calibration curve to within 30 percent.

Table 3-1 Summary of Sampling and Analysis Program for Samples Collected for On-site and Off-site Analysis

Type of Sampling	Number of VOC Analyses	
	On-site	Off-site
Groundwater	50	5
Private Irrigation Wells	0	11
Field Duplicates		
Groundwater	4	1
Private Irrigation Wells	0	3
Quality Control Samples		
Trip Blanks	0	4
Equipment Rinsate Blanks	9	3
Source Water Blanks	2	2
MS/MSDs	3	2
Method Blanks	10	8

Notes:

VOC = Volatile Organic Compound

MS/MSD = Matrix Spike/Matrix Spike Duplicate

Table 3-2 Target Compounds and Reporting Limits for On-site Analysis

Compound Name	Reporting Limit ( $\mu\text{g}/\text{l}$ )
Vinyl Chloride	1.0
trans-1,2-Dichloroethene	1.0
cis-1,2-Dichloroethene	1.0
Trichloroethene	1.0
Tetrachloroethene	1.0
Benzene	1.0
Toluene	1.0
Ethylbenzene	1.0
m/p-Xylene	2.0
o-Xylene	1.0

Note:  $\mu\text{g}/\text{l}$  = micrograms per liter

The identities of the target compounds were based on comparison with the retention times for the standards. Retention time windows of plus or minus 3 percent were established, based on the most recent calibration curve. Every 24 hours, a method blank of deionized water was analyzed to confirm that no target compounds were introduced by sample handling and analysis. The method blank criterion was met if no target compounds were present above the reporting limit for the instrument. A surrogate solution containing 100 micrograms per liter ( $\mu\text{g/l}$ ) of bromofluorobromine was injected into each sample to establish percentage recoveries. The recovery range of 30 to 170 percent was established as one of the operating criteria for on-site analyses.

**3.1.2 Off-Site Analysis** In accordance with the ICMSI Work Plan (ABB-ES, 1992), a minimum of 10 percent of all groundwater samples collected for on-site VOC analysis and all PIW samples were submitted to a contract laboratory for chemical analysis. Table 3-1 summarizes the sampling and analysis program for samples collected for off-site analysis. Samples for VOC analysis were analyzed according to the USEPA CLP SOW for multi-media samples (USEPA, 1991a). Naval Energy and Environmental Support Activity (NEESA) Level D documentation (NEESA, 1988) was used for VOC analyses. Appendix B contains validated Level D Data.

Because many target VOCs currently have Federal Primary Drinking Water Maximum Contaminant Levels (MCLs) below their respective CLP Contract Required Quantitation Limits, it was necessary to achieve lower reporting limits for VOCs. Based on VOC Method Detection Limit (MDL) studies performed and submitted by the contract laboratory, lower reporting limits for VOCs were achieved. Table 3-3 lists the TCL VOCs, their corresponding MDLs, and the reporting limits used during this investigation. All reporting limits listed in Table 3-3 are lower than corresponding Federal Primary Drinking Water MCLs. Appendix B contains data supporting the MDL study.

**3.2 DATA QUALITY ASSESSMENT.** Data generated by the on-site and off-site laboratories were reviewed against applicable performance criteria. In addition, data quality indicators of precision, accuracy, representativeness, comparability, and completeness (PARCC) were evaluated and established for both on-site and off-site data, as discussed below.

**3.2.1 On-Site Data Quality and Use** All samples collected for on-site analysis during the screening investigation were properly preserved, placed in coolers, and packed with ice immediately after collection. All samples remained in the custody of an investigation team member until delivery to the on-site laboratory. Except for one groundwater sample (G15230), all groundwater samples collected during the investigation were analyzed by the on-site laboratory. Groundwater sample G15230 could not be analyzed on site because of insufficient sample volume; however, this sample was analyzed by the off-site laboratory.

**3.2.1.1 Analytical Performance** Review of analytical data indicated the on-site laboratory generally met applicable analytical QC criteria for VOC analyses. All tuning criteria, extraction and analysis holding times, initial and continuing calibration standard criteria, and internal standard/surrogate recoveries were met. Overall, no qualification of environmental data was required based on precision and accuracy criteria. However, qualifications were required because several analytical method blanks contained target compounds at concentrations ranging from below the reporting limit of  $1.0 \mu\text{g/l}$  to  $2.7 \mu\text{g/l}$ . Table 3-4 summarizes compounds detected in on-site analytical method blanks. In accordance

Table 3-3 Method Detection Limits (MDLs) and Reporting Limits for Volatile Organic Compounds

	MDL ( $\mu\text{g/l}$ )	Reporting Limit ( $\mu\text{g/l}$ )
<b>Volatile Organic Compounds (37 total)</b>		
<b>Method: Contract Laboratory Program Statement of Work for Organic Analysis, Multi-media, Multi-concentration, USEPA Document No. OLN01.0, 1991.</b>		
Chloromethane	0.203	1
cis-1,3-Dichloropropene	0.274	1
Bromomethane	0.396	1
Trichloroethene	0.185	1
Vinyl Chloride	0.165	1
Dibromochloromethane	0.190	1
Chloroethane	0.147	1
1,1,2-Trichloroethane	0.268	1
Methylene Chloride	9.712	10
Benzene	0.235	1
Acetone	3.491	5
trans-1,3-Dichloropropene	0.097	1
Carbon Disulfide	0.114	1
Bromoform	0.230	1
1,1-Dichloroethene	0.175	1
2-Hexanone	0.465	5
1,1-Dichloroethane	0.205	1
4-Methyl-2-Pentanone	0.746	5
cis-1,2-Dichloroethene	0.215	1
Tetrachloroethene	0.340	1
trans-1,2-Dichloroethene	0.254	1
1,1,2,2-Tetrachloroethane	0.391	1
Chloroform	0.285	1
Toluene	0.167	1
1,2-Dichloroethane	0.160	1
Chlorobenzene	0.238	1
2-Butanone	0.709	5
Ethylbenzene	0.195	1
1,1,1-Trichloroethane	0.221	1
Styrene	0.240	1
Carbon Tetrachloride	0.354	1
Xylenes (total)	0.141	1
Bromodichloromethane	0.144	1
1,3-Dichlorobenzene	0.126	1
1,2-Dichloropropane	0.236	1
1,4-Dichlorobenzene	0.164	1
1,2-Dichlorobenzene	0.222	1

Note:  $\mu\text{g/l}$  = micrograms per liter

Table 3-4 Summary of Compounds Detected in On-site Analytical Method Blanks

Compound	Reporting Limit	Blank ID Numbers ( $\mu\text{g/l}$ )				
		GC002	GC011	GC020	GC032	GC053
Vinyl chloride	1	1 U	1 U	1 U	1 U	0.41 J
trans-1,2-Dichloroethene	1	1 U	1 U	0.98 J	1.0	1 U
cis-1,2-Dichloroethene	1	0.74 J	0.63 J	0.93 J	0.97 J	0.65 J
Trichloroethene	1	2.7	1 U	1 U	1 U	1 U
Tetrachloroethene	1	0.28 J	0.63 J	0.82 J	0.89 J	0.74 J
Benzene	1	0.66 J	1 U	0.71 J	0.77 J	1 U
Toluene	1	0.29 J	1.4	0.50 J	0.52 J	0.34 J
Ethylbenzene	1	0.30 J	1.8	0.72 J	0.71 J	0.62 J
m/p-Xylene	2	0.35 J	2 U	2 U	2 U	2 U
o-Xylene	1	0.60 J	1 U	0.34 J	0.35 J	1 U

Compound	Reporting Limit	Blank ID Numbers ( $\mu\text{g/l}$ )				
		GC059	GC069	GC088	GC108	GC122
Vinyl chloride	1	1 U	1 U	1 U	0.79 J	1 U
trans-1,2-Dichloroethene	1	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1	0.62 J	0.79 J	0.56 J	1.1	0.47 J
Trichloroethene	1	1 U	1 U	1 U	1.1	1 U
Tetrachloroethene	1	0.76 J	0.59 J	0.54 J	1.0	0.48 J
Benzene	1	0.57 J	0.57 J	0.57 J	0.68 J	1 U
Toluene	1	1.6	1.1	0.78 J	0.85 J	0.43 J
Ethylbenzene	1	0.83 J	0.82 J	0.84 J	1.2	0.62 J
m/p-Xylene	2	2 U	2 U	2 U	2 U	2 U
o-Xylene	1	0.74 J	0.47 J	0.50 J	0.63 J	1 U

Notes: U = compound not detected at the stated quantitation limit  
 J = sample result is considered estimated because it is less than the reporting limit  
 $\mu\text{g/l}$  = micrograms per liter

with NEESA Level C guidelines (NEESA, 1988), all positive sample results associated with method blank contamination were qualified as undetected if the sample concentration was less than five times the blank concentration. Sample concentrations greater than five times associated method blank concentrations did not require qualification.

**3.2.1.2 On-Site Data Use** Performance criteria for the on-site analytical method, described in Subsection 3.1.1.2, were used to assess the quality of data generated by the field laboratory. PARCC parameters were established based on the extent of conformance to these performance criteria.

The accuracy and precision of the on-site analytical method were established. Accuracy was calculated based on the range of matrix spike percentage recoveries (%R) for matrix spike/matrix spike duplicate (MS/MSD) samples and precision was calculated based on the relative percentage difference (RPD) between spike results for MS/MSD samples. Calculation of %R and RPD are as follows:

$$\%R = (\text{spike sample result} / \text{concentration of spike added}) \times 100 \quad (1)$$

and

$$RPD = \frac{|\text{MS result} - \text{MSD result}|}{(\text{MS result} + \text{MSD result}) / 2} \times 100 \quad (2)$$

Three sets of MS/MSD samples were analyzed on site during field activities and the precision and accuracy results for the target compounds are shown in Table 3-5. The accuracy range was 73 to 210 and the precision range was 0 to 18 percent. Overall, no qualification of environmental data was required based on accuracy criteria.

Representativeness is a qualitative parameter that expresses how well the sampling represents the environmental conditions of the sampled media. Field duplicate samples, equipment rinsate samples, and source water blanks were collected to give an indication of representativeness and to monitor method reproducibility. A total of four duplicate samples were collected and analyzed on site. Analytical results for duplicate samples are presented in Table 4-1 in Section 4.0 of this document. In general, results for field duplicates show good agreement with RPD values ranging from 0 to 35 percent. Nine equipment rinsate samples and two source water blanks were collected and analyzed by the on-site laboratory. None of the rinsate samples or source water blanks contained target compounds.

The completeness of the on-site data set was measured by establishing what percentage of the data set was considered valid after data review. Valid results are defined as those results from analyses meeting the performance criteria defined by calibration checks and surrogate recoveries. The completeness for all analytes was established to be 100 percent.

Comparability is discussed in Subsection 3.2.3 of this document.

Overall, data generated by the on-site analytical laboratory met USEPA Level II criteria for field screening and are suitable for use in site characterization, engineering design, and evaluation of remedial alternatives.

Table 3-5 Summary of Precision and Accuracy for On-site MS/MSD Analysis

Compound	MS/MSD Recovery Range (Accuracy)	RPD Range (Precision)
Vinyl Chloride	76-100	3-9
trans-1,2-Dichloroethene	110-210	0-2
cis-1,2-Dichloroethene	120-180	0-13
Trichloroethene	89-150	9-14
Tetrachloroethene	100-170	7-14
Benzene	90-120	2-10
Toluene	73-110	9-16
Ethylbenzene	92-120	0-8
m/p-Xylene	90-120	9-10
o-Xylene	91-120	0-18
USEPA Method 8010/8020	75-120	2-28

Notes:

RPD = Relative Percentage Difference

MS/MSD = Matrix Spike/Matrix Spike Duplicate

**3.2.2 Off-Site Data Quality and Use** All samples collected for off-site analysis were properly preserved, placed in coolers, and packed with ice immediately after collection. All samples remained in the custody of an investigation team member until delivery to the courier service providing overnight shipment to the laboratory. All samples requiring off-site analysis were shipped, complete with chain-of-custody forms, to the contract laboratory within 24 hours for analysis. Upon arrival at the laboratory, the chain-of-custody and preservation of the samples were checked with the contents of each cooler. After verification, the chain-of-custody form was signed and the samples accepted for analysis.

Review of the field notebook and chain-of-custody forms did not indicate any non-conformance relative to field instrument calibration or sample handling. Except for one sample delivery, all required field QC samples were collected in conformance with the requirements of the USEPA, NEESA, and ABB-ES Quality Assurance Plans and the June 1988 NEESA "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program" (NEESA, 1988) (Document 20.2-047B). These field QC samples included field duplicates, equipment rinsate blanks, source water blanks, and VOC trip blanks for each VOC sample shipment.

Analytical results for environmental samples collected during the investigation were evaluated and validated according to NEESA Level D QC criteria to establish data quality and useability. NEESA Level D documentation and validation requirements are equivalent to USEPA Level IV requirements. The data tables included in Appendix B reflect validation according to Level D criteria, which are described in Subsection 7.3.1 of NEESA Document 20.2-047B. The following subsections discuss analytical performance and the evaluation of field and laboratory QC samples.

**3.2.2.1 Analytical Performance** Data review and NEESA Level D validation were performed under subcontract. Review of analytical data indicated the laboratory generally met applicable analytical QC criteria for all chemical analyses. Appendix C of this report contains a detailed evaluation of each PARCC parameter and data tables summarizing analytical results for MS/MSD samples, initial and continuing calibration standards, field duplicate samples, and compounds detected in method blanks, trip blanks, rinsate blanks, and source water blanks (Appendix C). The following subsections summarize evaluations of each PARCC parameter.

For VOC analyses, all analytical holding times, tuning criteria, internal standard/surrogate recoveries, and MS/MSD criteria were met. Except for one equipment rinsate sample, BS126ER, no qualifications were required based on precision or accuracy criteria. The positive sample result for acetone in BS126ER was qualified as estimated and flagged with a J qualifier because an associated continuing calibration standard exceeded QC limits for acetone.

Field duplicate samples, analytical method blanks, trip blanks, equipment rinsate samples, and source water blanks were collected to give an indication of representativeness and to monitor method reproducibility. A total of four duplicate samples were collected and analyzed off site. Analytical results for duplicate samples are presented in Tables 4-2 and 4-3 in Section 4.0 of this document. In general, results for field duplicates show good agreement. However, one set of PIW replicate samples, PW-55/PW-55D, showed disagreement in results for one common laboratory contaminant, acetone (see Table 4-3 in Section 4.0). Acetone was detected in replicate samples PW-55 and PW-55D at 19 and 32

µg/l, respectively; however, the result for PW-55D was qualified as undetected due to method blank contamination. The poor replication of acetone in duplicate samples and the prevalence of acetone in several method blanks associated with this investigation and previous investigations at Site 11 indicate that the concentrations of acetone detected in PIW samples are most likely laboratory artifacts.

Four trip blanks, three equipment rinsate blanks, and two source water blanks were submitted for off-site VOC analysis. The equipment rinsate samples were collected during decontamination procedures involving hydropunch equipment. The source water blanks represented organic-free, deionized water used as a final rinse during equipment decontamination procedures (BS113FB) and potable water used to steam-clean hydropunch equipment (BS114FB). Trip blanks accompanied each VOC sample shipment to monitor contamination introduced during sample collection, shipment, and storage. However, one sample shipment including PIW samples PW-60, PW-61, PW-61D, PW-62, and PW-55D did not contain a trip blank. One common laboratory contaminant, 2-butanone, was detected in one sample associated with the shipment (PW-61D) but was not detected in the replicate sample (PW-61). The presence of 2-butanone in PW-61D is considered suspect and may be due to laboratory or sampling contamination.

Appendix B provides tables summarizing compounds detected in analytical method blanks, trip blanks, rinsate blanks, and source water blanks and an evaluation of the impact of contamination on data useability. In summary, the representativeness of the data was only affected by the prevalence of acetone, methylene chloride, and carbon disulfide in analytical method blanks and the prevalence of acetone in rinsate samples. The occurrence of acetone, methylene chloride, and carbon disulfide in method blanks and field blanks render data for these compounds suspect for groundwater and PIW samples containing these compounds at concentrations that could not be directly attributed to contamination.

Comparability could not be accurately measured for data collected during this investigation because environmental samples were not submitted to two different contract laboratories; however, the results of the on-site analyses were compared to those of the off-site results and are discussed in Subsection 3.2.3 of this document.

The completeness goal for laboratory analysis for this investigation was 95 percent useable data. Unusable data are those results reported by the laboratory but rejected during the validation process. For all samples collected during this investigation, the analytical completeness was established to be 100 percent.

**3.2.2.2 Off-Site Data Use** Overall, the data generated during this investigation meet Level D data quality objectives established for the ICMSI and are acceptable for use in site characterization and evaluation. Blank qualifications for VOCs resulted in elevated detection limits for the chemicals discussed earlier. The widespread occurrence of acetone, and methylene chloride and the unknown origin of carbon disulfide in method blanks and field blanks render data for these compounds suspect for groundwater and PIW samples containing these compounds at concentrations that could not be directly attributed to contamination. The source of these contaminants will be further investigated during future field programs at NSB Kings Bay.

### 3.2.3 Comparison of On-Site Laboratory Results and Off-Site Laboratory Results

Four groundwater samples that were analyzed on site were also analyzed by the off-site laboratory. A summary of analytical results for the 10 target VOCs analyzed by both laboratories, in units of  $\mu\text{g/l}$ , are as follows:

<u>Sample</u>	<u>Compound</u>	<u>On-site</u>	<u>Off-site</u>
G15030	(no target VOCs detected by either analysis)		
G15885	vinyl chloride	1.5	1 U
	cis-1,2-dichloroethene	7.0	1 U
	toluene	4.0	2
G15940/G15940D	vinyl chloride	4.6/4.3	1 U
	cis-1,2-dichloroethene	18/20	6
	ethylbenzene	16/22	15
	m/p-xylene	2 U/2 U	12 (total)
	o-xylene	4.6/1 U	12 (total)
G16035	vinyl chloride	6.9	1 U
	cis-1,2-dichloroethene	64 J	22
	trichloroethene	1 U	3
	benzene	12	5
	toluene	20	11
	ethyl benzene	8.4	6
	m/p-xylene	6.4	14 (total)
	o-xylene	8.6	14 (total)

Except for vinyl chloride and cis-1,2-dichloroethene, on-site laboratory results correlated well with off-site results when target compounds were detected in both on-site and off-site samples at concentrations greater than five times the quantitation limit. Comparison of vinyl chloride and cis-1,2-dichloroethene results for on-site and off-site samples indicated that the off-site laboratory may have experienced a loss of sensitivity for these compounds. The loss of sensitivity most likely occurred during shipment to the laboratory via air transport or during sample preparation at the analytical laboratory.

Based on the comparison of the on-site and off-site results, the on-site data can be used to augment the off-site data for site characterization.

## 4.0 RESULTS OF INVESTIGATIONS

4.1 ON-SITE GROUNDWATER CONTAMINATION. Analytical data from on-site analyses are presented in Table 4-1. Table 4-2 summarizes validated analytical data for the off-site analysis of groundwater samples collected using the hydropunch. Hydropunch sample locations are shown in Figure 2-2.

Figures 4-1 through 4-3 show the approximate horizontal extent of VOC contamination at various depth intervals. Figure 4-4 shows locations of cross-sections D-D' (Figure 4-5), E-E' (Figure 4-6), and F-F' (Figure 4-7). The interpreted plan views (Figures 4-1 through 4-3) and the cross-sections (Figures 4-5 through 4-7) are based on on-site laboratory GC data associated with the Phase I Interim Investigation, the initial ICMSI data, and the additional data provided in this addendum. The initial ICMSI provided data on off-site target VOC concentrations. This additional investigation provided information about the concentration of target VOCs beneath the landfill. Therefore, the western extent of the plume that was defined in the initial ICMSI Progress Report did not change as a result of this investigation.

The isoconcentration contours portrayed in Figures 4-1 through 4-3 and 4-5 through 4-7 are computer generated using GIS/KEY™ in combination with QUICKSURF™. The area representing the plume is approximated from data associated with actual sample locations. The actual presence of plume constituents at locations within the contoured areas and between sample locations can only be verified by actual sampling and analysis of groundwater at those locations.

Data collected during the March 1993 hydropunch groundwater sampling indicate that vinyl chloride and dichloroethene are the primary halogenated VOCs present, which is consistent with data from off-site locations collected during the initial ICMSI field program. The same five VOCs detected above Federal MCLs in the initial ICMSI were also the only five target VOCs to be detected above MCLs during this additional sampling effort. The five VOCs are vinyl chloride, trichloroethene, cis-1,2-dichloroethene, tetrachloroethene, and benzene. MCLs are included on analytical data tables for on-site and off-site analyses. Of these five VOCs, vinyl chloride concentrations were above its MCL of 2 µg/l more frequently than any other target VOC, just as was found in the initial ICMSI. Vinyl chloride was detected at concentrations above its MCL at 11 of 15 locations sampled, and in 27 out of 49 samples. Vinyl chloride was present at 85 feet bgs at location G158, and at 15 feet bgs at G158, G153, and G152.

The data indicate that the concentrations of target VOCs detected in samples collected from within the landfill are generally less than concentrations detected from locations along and downgradient of the western margin of the landfill (Figures 4-1 through 4-3 and 4-5 through 4-7). With the exception of data associated with sample G158 (50 feet bgs), concentrations of total target VOCs detected during March 1993 on-site analyses ranged from 1 µg/l at location G161 (17 feet bgs) on the north side of the landfill to 188 µg/l at location G158 (70 feet bgs) on the west side of the landfill (see Figure 2-2 and Table 4-1). One sample from location G158 (50 feet bgs) contained 1,537 µg/l total target VOCs. A sample from G152 (30 feet bgs) at the center of the landfill that was analyzed off site for TCL VOCs contained 2,153 µg/l total VOCs, 931 µg/l attributed to the 10 target VOCs analyzed in the on-site laboratory.

Table 4-1 On-site Analytical Data for Hydropunch Groundwater Samples

Compound	Sample ID Numbers (µg/L)										
	MCL	G14730	G14745	G14830	G14845	G14845D	G14930	G14945	G15030	G15045	G15125
Vinyl chloride	2	31	1.4 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-dichloroethene	100	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-dichloroethene	70	8.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	5	1.3 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1,000	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	700	15	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
m/p-Xylene	<sup>1</sup> 10,000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
o-Xylene	<sup>1</sup> 10,000	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Compound	Sample ID Numbers (µg/L)										
	MCL	G15145	G15215	G15245	G15260	G15275	G15290	G15290D	G15315	G15330	G15350
Vinyl chloride	2	1 U	56 J	14	4.7	2.6	10	11	2.0	1 U	10
trans-1,2-Dichloroethene	100	1 U	1 U	1.3 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	70	1 U	3.0 U	24	2.9 U	3.7 U	11	12	3.8 U	11	9.5
Trichloroethene	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	5	1 U	2.7 U	6.4	1 U	1 U	1 U	1.2 U	2.1 U	3.0 U	5.9
Toluene	1,000	1 U	1.3 U	38 J	27	6.0	23	24	1 U	1 U	5.6
Ethylbenzene	700	1 U	26	17	1.2 U	1.1 U	3.1	3.2	1 U	2.7	1 U
m/p-Xylene	<sup>1</sup> 10,000	2 U	19	18	2 U	2 U	2.8	3.0	2 U	2 U	2 U
o-Xylene	<sup>1</sup> 10,000	1 U	11	5	1 U	1 U	2.1	2.2	1 U	1 U	1 U

See notes at end of table.

Table 4-1 (continued) On-site Analytical Data for Hydropunch Groundwater Samples

Compound	MCL	Sample ID Numbers ( $\mu\text{g}/\text{L}$ )									
		G15365	G15383	G15425	G15440	G15460	G15535	G15565	G15625	G15625D	G15645
Vinyl chloride	2	1 U	1.1	6.9	14	1.9	5.7	1 U	10.0	8.3	27
trans-1,2-dichloroethene	100	1 U	1 U	1.8 U	1.4 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-dichloroethene	70	2.1 U	1.4 U	35 J	76 J	63 J	23	2.0 U	40 J	28	100
Trichloroethene	5	1 U	1 U	1 U	5.9	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	5	1 U	1.8 U	1 U	5.1	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	5	1 U	1 U	2.8 U	7.4	2.3 U	6.2	1 U	28	24	16
Toluene	1,000	1 U	1.1 U	1 U	13	16	1.1 U	1 U	1 U	1 U	1.5 U
Ethylbenzene	700	1 U	1 U	7.9	18	7.0	20	1.6 U	9.9	7.6	33
m/p-Xylene	<sup>1</sup> 10,000	2 U	2 U	2 U	7.0	2.1	2 U	2 U	2 U	2 U	7.6
o-Xylene	<sup>1</sup> 10,000	1 U	1 U	1 U	8.2	2.8 U	1 U	1 U	1.4 U	1 U	2.8

Compound	MCL	Sample ID Numbers ( $\mu\text{g}/\text{L}$ )									
		G15660	G15720	G15735	G15755	G15770	G15815	G15830	G15850	G15870	G15885
Vinyl chloride	2	1.9	8.2	15	7.8	1 U	1.5	1.8	30	14	1.5
trans-1,2-Dichloroethene	100	1 U	1 U	1 U	1 U	1 U	1 U	1 U	12	1 U	1 U
cis-1,2-Dichloroethene	70	4.6	1 U	2.1	2.6	1 U	1.4	1.3	1100 J	140	7.0
Trichloroethene	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	5	2.0 U	1 U	1 U	1 U	1 U	1 U	1 U	24	1 U	1 U
Benzene	5	1.6 U	2.3 U	4.0	1.4 U	1 U	1.1 U	1.3 U	12	2.1	1.2 U
Toluene	1,000	1 U	1.2 U	2.9 U	1.9 U	1 U	1 U	1 U	150 J	34	4.0
Ethylbenzene	700	6.8	2.8	56 J	5.3	1 U	1 U	2.8	61	1 U	1.6 U
m/p-Xylene	<sup>1</sup> 10,000	4.7	2 U	8.4	2 U	2 U	2 U	2 U	73	2 U	2 U
o-Xylene	<sup>1</sup> 10,000	2.1	1 U	4.5	1.1 U	1 U	3.2	1 U	75	1 U	1.6 U

See notes at end of table.

Table 4-1 (continued) On-site Analytical Data for Hydropunch Groundwater Samples

Compound	MCL	Sample ID Numbers ( $\mu\text{g/l}$ )									
		G15915	G15940	G15940D	G15955	G16016	G16035	G16050	G16117	G16135	G16145
Vinyl chloride	2	1 U	4.6	4.3	1 U	1.1 U	6.9	1 U	1 U	13	1 U
trans-1,2-dichloroethene	100	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-dichloroethene	70	3.1 U	18	20	1 U	2.1 U	64 J	1 U	1 U	89 J	32 J
Trichloroethene	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	5	1 U	1 U	3.4	1 U	1 U	12	1 U	1.0	7.1	9.0
Toluene	1,000	1 U	1 U	1 U	1 U	1 U	20	1 U	1 U	1 U	28
Ethylbenzene	700	1 U	16	22	1 U	6.5	8.4	1 U	1 U	1 U	2.9
m/p-Xylene	<sup>1</sup> 10,000	2 U	2 U	2 U	2 U	2 U	6.4	2 U	2 U	10	2 U
o-Xylene	<sup>1</sup> 10,000	1 U	4.6	1 U	1 U	1 U	8.6	1 U	1 U	1 U	2.4

Compound	MCL	Sample ID Numbers ( $\mu\text{g/l}$ )			
		G16155	G16165	KBA-11-10 (12')	KBA-11-12 (18')
Vinyl chloride	2	1 U	1 U	1.4	1 U
trans-1,2-Dichloroethene	100	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	70	1.2 U	1 U	1 U	8.1
Trichloroethene	5	1 U	1 U	1 U	1 U
Tetrachloroethene	5	1 U	1 U	1 U	1 U
Benzene	5	1 U	1 U	1.3	1 U
Toluene	1,000	1.4 U	1 U	1 U	1 U
Ethylbenzene	700	1 U	1 U	1 U	1 U
m/p-Xylene	<sup>1</sup> 10,000	2 U	2 U	2 U	2 U
o-Xylene	<sup>1</sup> 10,000	1 U	1 U	1 U	1 U

Notes: <sup>1</sup> = total xylenes

J = sample result is considered estimated because concentration exceeded the linear range of the instrument

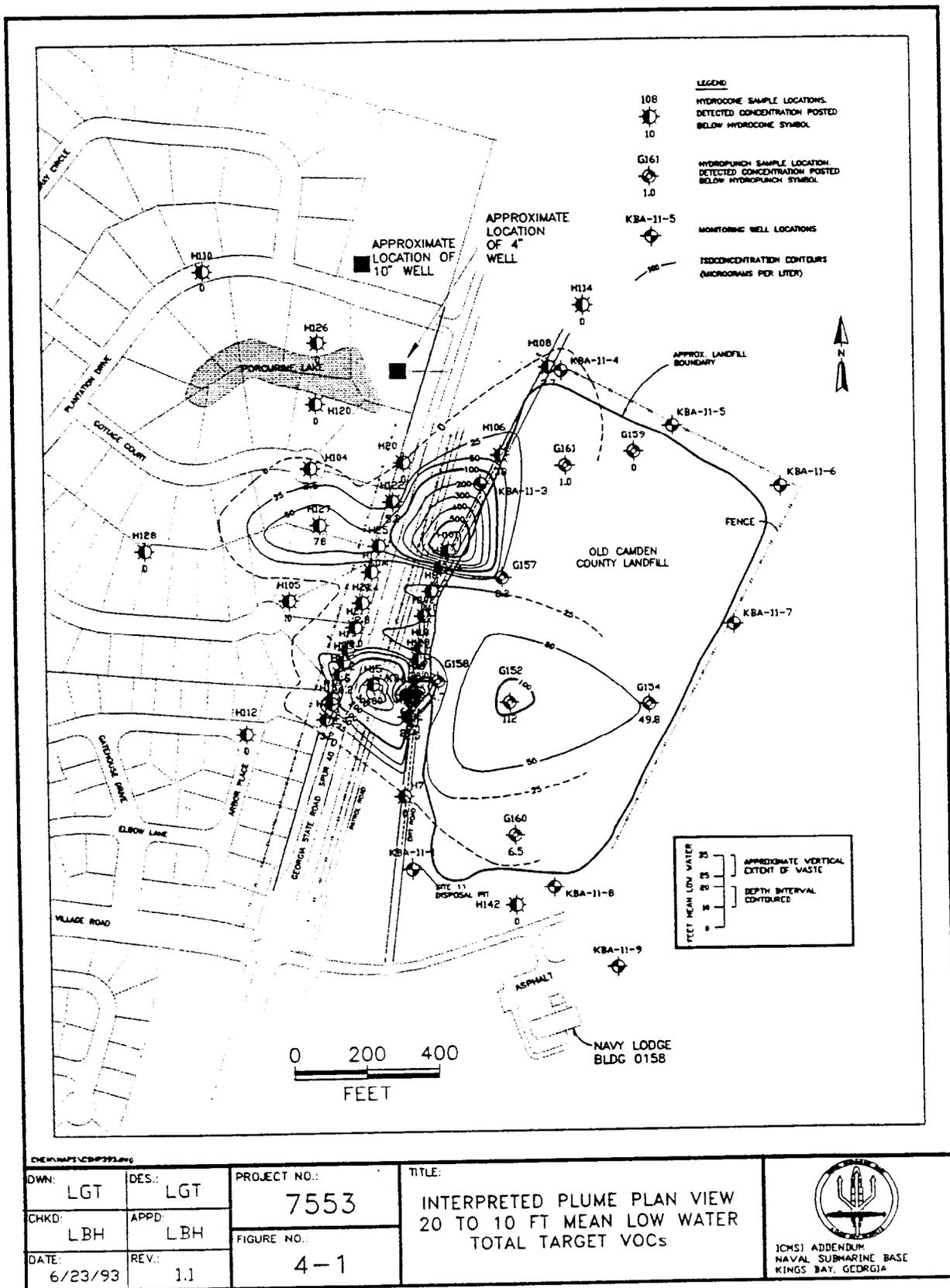
U = compounds not detected at the stated quantitation limit

MCL = Maximum Contaminant Level, USEPA Office of Water, December 1992; The Bureau of National Affairs, Inc., July 1992.

Table 4-2 Summary of Off-site Laboratory Analysis of Hydropunch Samples

Compound	Hydropunch Sampling Locations (µg/L)						
	MCL	G15030	G15230	G15230D	G15885	G15940	G16035
Methylene chloride	NA	2 U	37	41	2 U	2 U	3
Acetone	NA	5 U	280	310	800	5 U	24 U
2-Butanone	NA	5 U	440	480	5 U	5 U	5 U
2-Hexanone	NA	5 U	19	17	5 U	5 U	5 U
4-Methyl-2-pentanone	NA	5 U	100	110	5 U	5 U	5 U
Carbon disulfide	NA	3	200	250	1 U	1 U	3
Chloroform	100	1 U	1 U	1 U	3	1 U	1 U
1,1-Dichloroethane	NA	1 U	12	14	1 U	1 U	17
Trichloroethene	5	1 U	3	3	1 U	1 U	3
cis-1,2-dichloroethene	70	1 U	2	2	1 U	6	22
Benzene	5	1 U	1	1	1 U	1 U	5
Toluene	1,000	1 U	720	840	2	1 U	11
1,4-Dichlorobenzene	75	1 U	1 U	1 U	1 U	3	1 U
Ethyl benzene	70	1 U	16	18	1 U	15	6
Xylenes (total)	10,000	1 U	62	67	1 U	12	14

Notes: U = compound was not detected at the stated concentration  
 NA = none applicable  
 MCL = Maximum Contaminant Level, USEPA Office of Water, December 1992; The Bureau of National Affairs, Inc., July 1992.

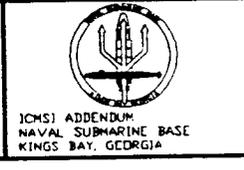


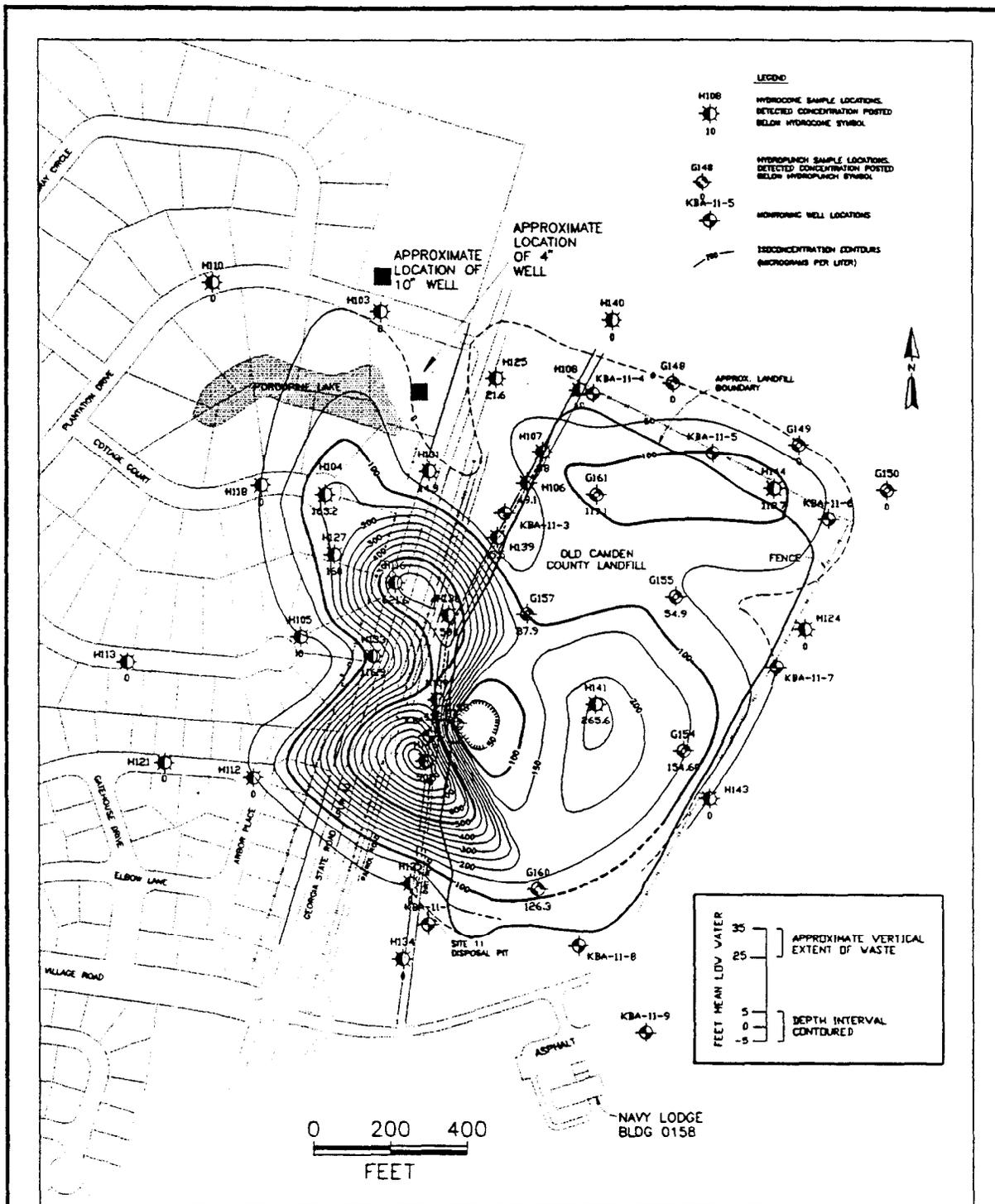
CHK:KMP:CSH993.00

DWN: LGT	DES: LGT
CHKD: LBH	APPD: LBH
DATE: 6/23/93	REV: 1.1

PROJECT NO: 7553
FIGURE NO: 4-1

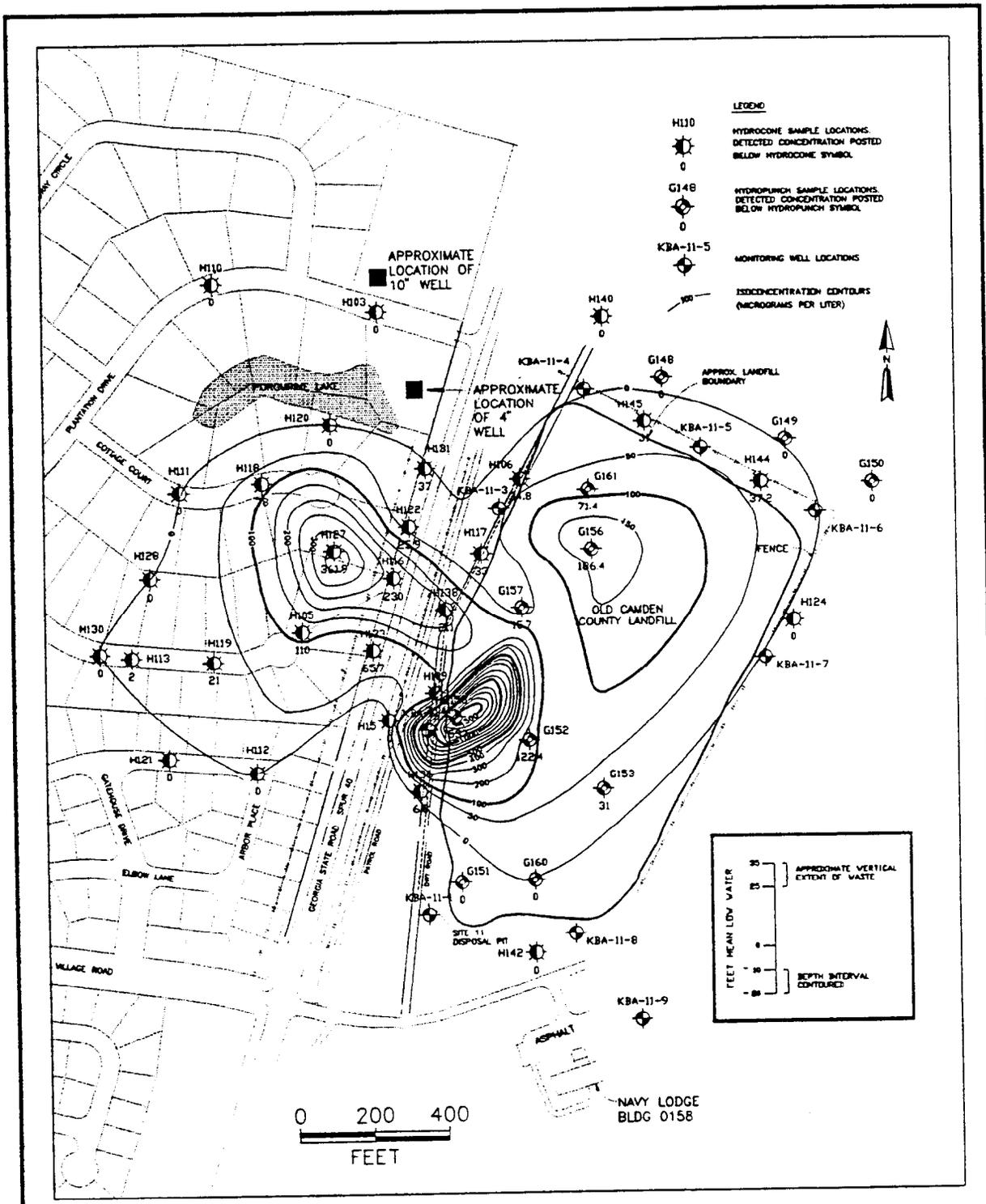
TITLE:  
INTERPRETED PLUME PLAN VIEW  
20 TO 10 FT MEAN LOW WATER  
TOTAL TARGET VOCs



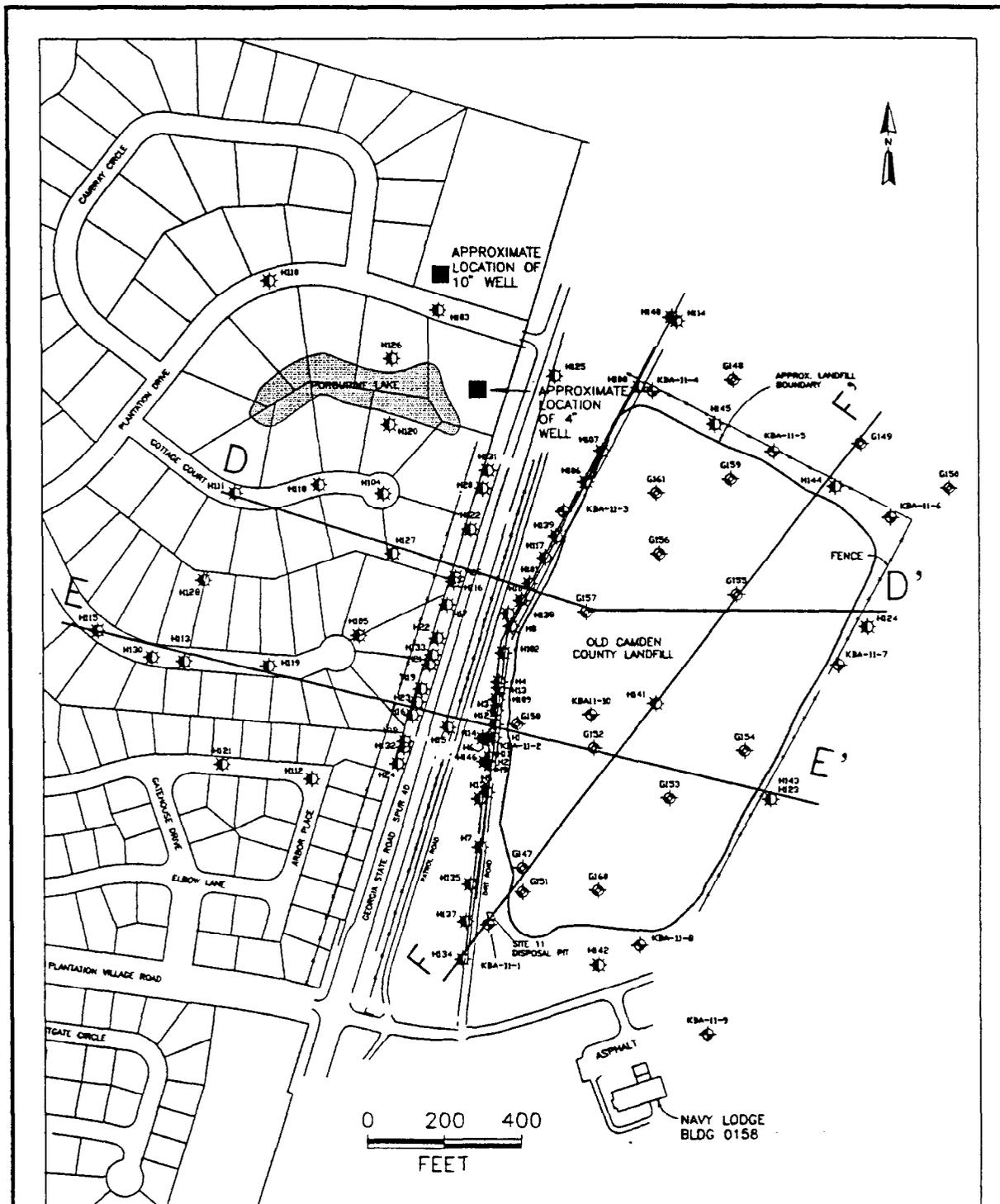


CHKMPLS\CHKMPLS93.dwg

DWN: LGT	DES.: LGT	PROJECT NO.: 7553	TITLE: INTERPRETED PLUME PLAN VIEW 5 TO -5 FT MEAN LOW WATER TOTAL TARGET VOCs	 ICMSI ADDENDUM NAVAL SUBMARINE BASE KINGS BAY, GEORGIA
CHKD: LBH	APPD: LBH	FIGURE NO.: 4-2		
DATE: 6/23/93	REV.: 1.1			

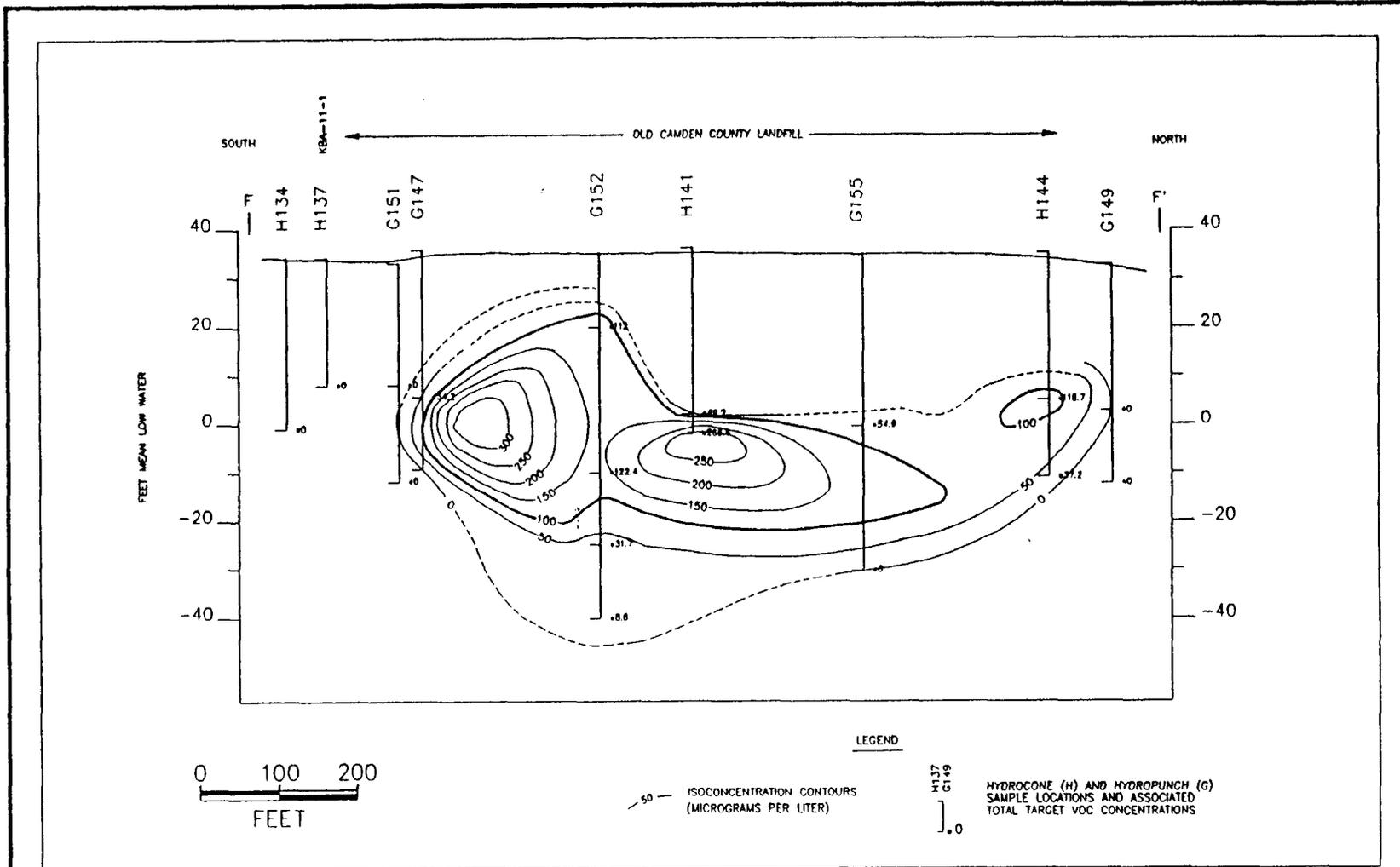


DWN: LGT		DES.: LGT	PROJECT NO.: 7553	TITLE: INTERPRETED PLUME PLAN VIEW -10 TO -20 FT MEAN LOW WATER TOTAL TARGET VOCs	 ICMSI ADDENDUM NAVAL SUBMARINE BASE KINGS BAY, GEORGIA
CHKD: LBH	APPD: LBH	FIGURE NO.: 4-3			
DATE: 6/23/93	REV.: 1.1				



KINGSBAY\CHEM\MAPS\PROFILE.MXD

OWN: LGT	DES.: LGT	PROJECT NO.: 7553	TITLE: PROFILE LINE LOCATIONS
CHKD: LBH	APPD: LBH	FIGURE NO.: 4-4	 ICMSI ADDENDUM NAVAL SUBMARINE BASE KINGS BAY, GEORGIA
DATE: 6/23/93	REV.: 1.1		



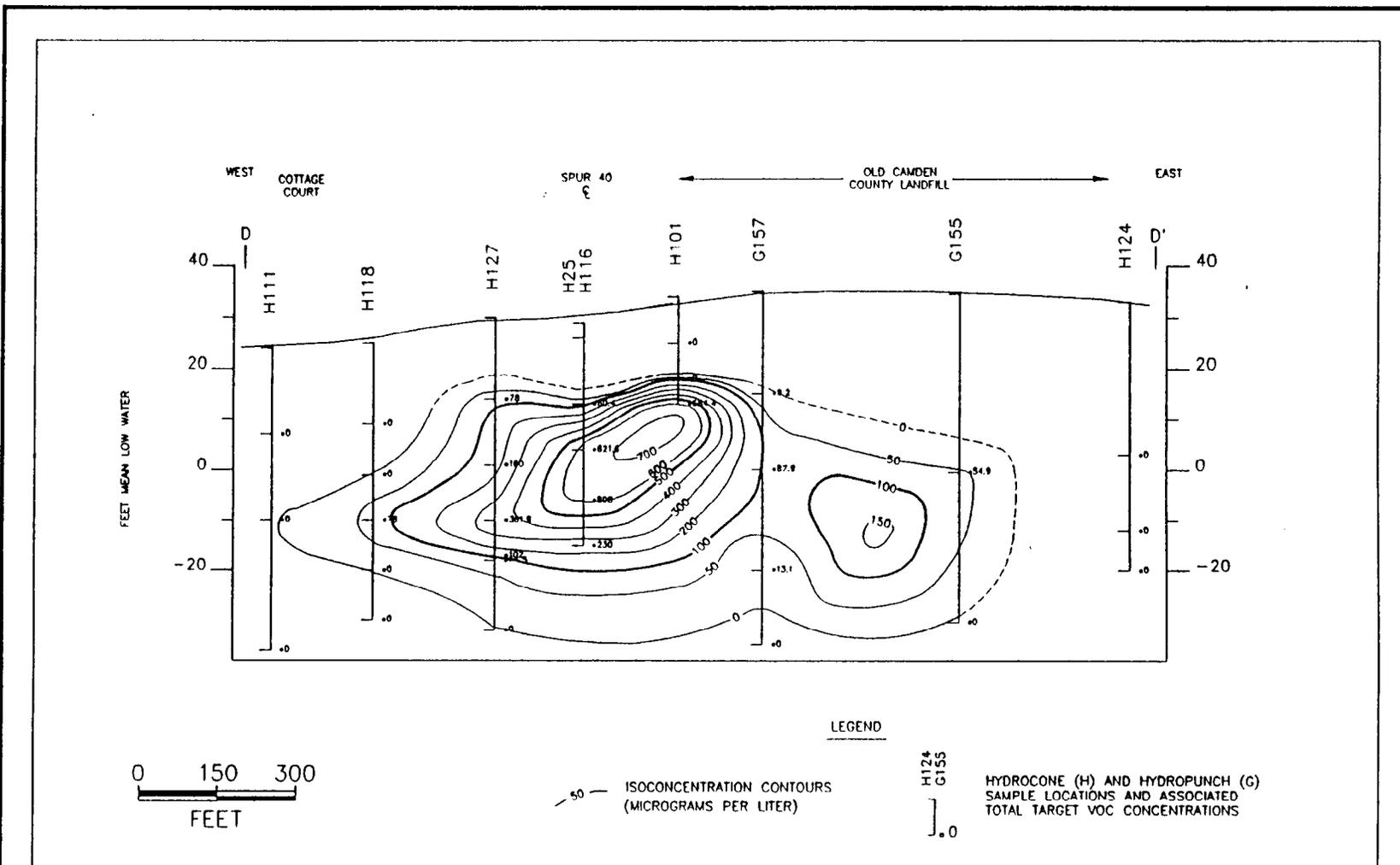
KINGSBAY\CHEM\MAPS\107 SEC 93.0.d

OWN: LGT	DES: LGT	PROJECT NO.: 7553	TITLE:
CHKD: LBH	APPD: LBH	FIGURE NO.:	CROSS SECTION F-F' TOTAL TARGET VOCs ON-SITE ANALYTICAL DATA
DATE: 6/23/93	REV.: 1.1	4-5	



ICMSI ADDENDUM

NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA

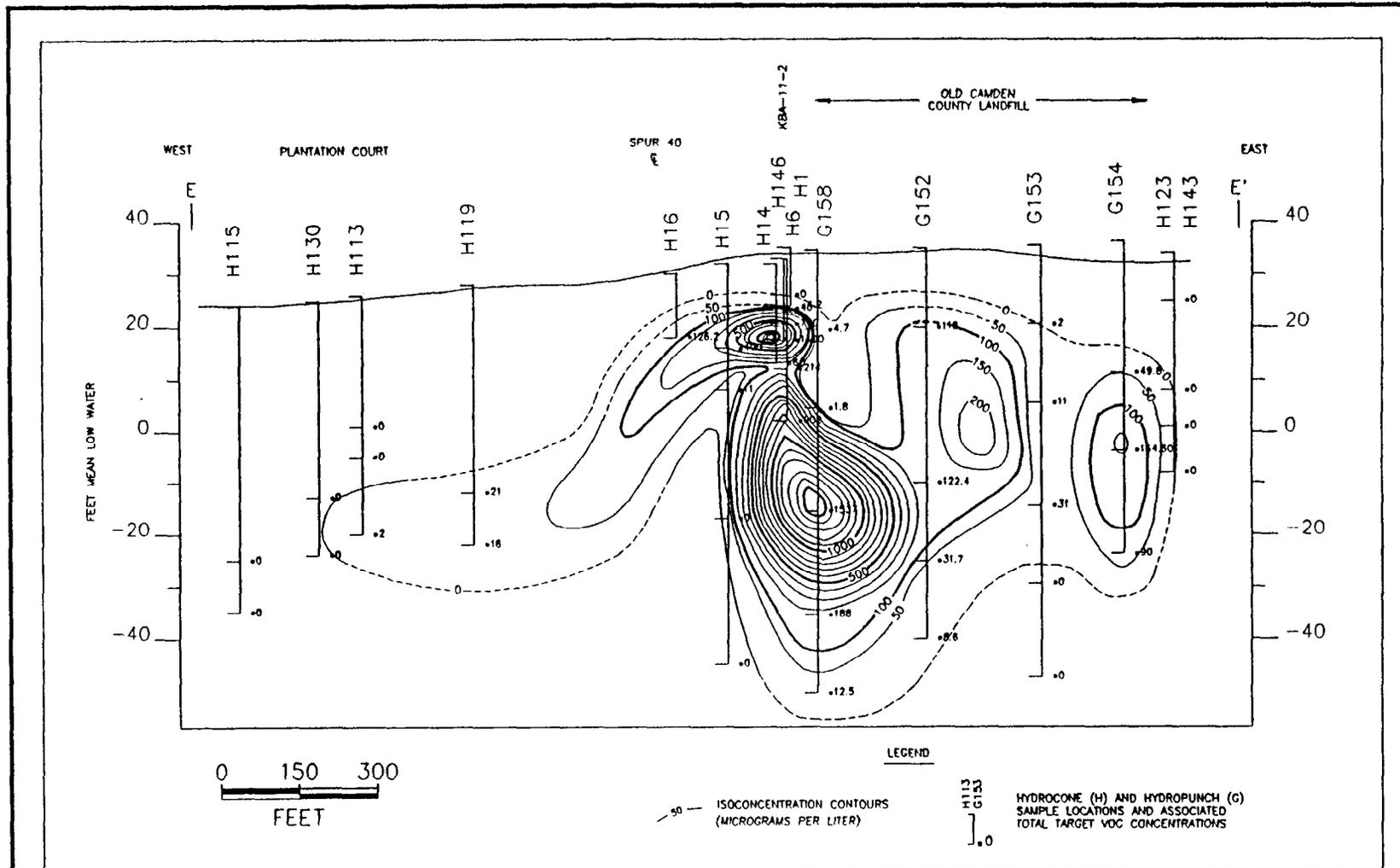


KINGSBAY\DH\MAPS\CDSEC393.dwg

OWN: LGT	DES.: LGT	PROJECT NO.: <b>7553</b>
CHKD: LBH	APPD.: LBH	
DATE: 6/23/93	REV.: 1.1	FIGURE NO.: <b>4-6</b>

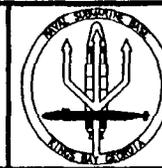
TITLE:  
**CROSS SECTION D-D'  
TOTAL TARGET VOCs  
ON-SITE ANALYTICAL DATA**

ICMSI ADDENDUM  
NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA



KINGSBAY\CHEM\MAPS\CESEC093.dwg

DWN: LGT	DES.: LGT	PROJECT NO.: 7553	TITLE:
CHKD: LBH	APPD: LBH	FIGURE NO.:	CROSS SECTION E-E' TOTAL TARGET VOCs ON-SITE ANALYTICAL DATA
DATE: 6/23/93	REV.: 1.1	4-7	



ICMSI ADDENDUM

NAVAL SUBMARINE BASE  
KINGS BAY, GEORGIA

One sample from location G152 that was collected from 90 feet bgs contained 52.2  $\mu\text{g}/\text{l}$  total target VOCs. However, these concentrations are highly suspect because the hydropunch sampler met refusal after being advanced only 2 feet beyond the augers (advancement of 5 feet is typical). Therefore, once the sample collection chamber was opened (an 11-inch extension), the top of the chamber was only 13 inches below the augers, which is not far enough to isolate the chamber from the conduit formed by the auger. The chamber was not advanced far enough into the undisturbed formation to prevent cross-contamination from areas of higher concentration. This theory is supported by the data available from other elevations at G152. The most concentrated elevation detected at G152 was 122.4  $\mu\text{g}/\text{l}$  at 45 feet bgs. The samples from 60 and 75 feet, like samples from other locations, show a decrease in concentrations with increasing depth below 45 feet bgs. The target VOC concentration detected at 90 feet bgs shows an increase in concentration that is not consistent with this trend. The data for the lowermost sample from location G152 (90 feet bgs) was not used in preparing the plume plan views and cross-sections presented in Figures 4-1 through 4-3 and 4-5 through 4-7.

**4.2 PRIVATE IRRIGATION WELL RESULTS.** Groundwater samples were collected from 11 PIWs in the Crooked River Plantation Subdivision (see Figure 2-3) including two PIWs that were also sampled in the initial ICMSI. All PIW samples, and three duplicate samples, were analyzed at an off-site laboratory. Table 4-3 summarizes the analytical data for the PIW samples, providing the concentrations of all constituents that were detected.

The two PIWs that were resampled in January 1993, PW-54 and PW-55, are in locations underlain by the plume (see Figure 2-2). Sample PW-54 did not contain detectable concentrations of VOCs (see Table 4-3). Sample PW-55 contained a detectable concentration of acetone, which is discussed in the following paragraph. VOCs detected in other PIW samples include compounds suspected of being artifacts of laboratory or sampling procedures, compounds common in water treated for public drinking water supply, and solvents.

Two VOCs, acetone and 2-butanone, are common laboratory solvents that are frequently observed artifacts of laboratory procedures, and can be artifacts of sampling procedures when solvents are used in decontamination of sampling equipment. However, no decontamination was performed during sampling of PIWs because samples were collected directly from PIW plumbing fixtures. Acetone was detected in six PIW samples, PW-52, PW-53, PW-55, PW-56, PW-57, and PW-58 (see Table 4-3) at concentrations ranging from an estimated 3 J to 19  $\mu\text{g}/\text{l}$ , which could not be qualified based on validation criteria. The occurrence of acetone in these PIWs is sporadic over the area investigated and no correlation to the area of the plume is evident. Therefore, the reported concentrations are either artifacts of laboratory procedures or have a source other than Site 11. 2-Butanone, also a common laboratory solvent, was detected in one PIW sample, PW-61D (see Table 4-3) at a concentration of 5  $\mu\text{g}/\text{l}$ . However, because the analysis of replicate sample PW-61 did not contain detectable concentrations of 2-butanone, the concentration reported for duplicate sample PW-61D is suspected as being an artifact of laboratory procedures.

VOCs commonly found in chlorinated public water supplies include bromodichloromethane, dibromochloromethane, and bromoform. These compounds are generally classified as trihalomethanes and are formed in water as a result of chlorination. It is suspected that the occurrence of these VOCs in PIW samples

Table 4-3 Summary of Analytical Data for Private Irrigation Well Samples

Compound	Well ID Numbers ( $\mu\text{g/L}$ )										
	MCL	PW-52	PW-53	PW-54	PW-55	PW-55D	PW-56	PW-57	PW-58	PW-59	PW-59D
Acetone	NA	3 J	4 J	5 U	19	32 U	9	4 J	4 J	5 U	5 U
Carbon Disulfide	NA	130	1 U	1 U	1 U	1 U	4	1 U	1 U	1 U	1 U
2-Butanone	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromodichloromethane	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	16	16
Trichloroethene	5	1 U	1 U	1 U	1 U	1 U	1 U	60	1 U	1 U	1 U
Dibromochloromethane	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	14	14
Bromoform	100	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3	2
Toluene	1,000	1 U	1 U	1 U	1 U	1 U	1 U	1	1 U	1 U	1 U
Styrene	100	1 U	1 U	1 U	1 U	1 U	1 U	8	1 U	1 U	1 U

Compound	Sample ID Numbers ( $\mu\text{g/L}$ )				
	MCL	PW-60	PW-61	PW-61D	PW-62
Acetone	NA	21 U	14 U	16 U	5 U
Carbon Disulfide	NA	150	1 U	1 U	3
2- Butanone	NA	5 U	5 U	5	5 U
Bromodichloromethane	NA	1 U	1 U	1 U	1 U
Trichloroethene	5	1 U	1 U	1 U	1 U
Dibromochloromethane	NA	1 U	1 U	1 U	1 U
Bromoform	100	1 U	1 U	1 U	1 U
Toluene	1,000	1 U	1 U	1 U	1 U
Styrene	100	1 U	1 U	1 U	1 U

Notes: J = sample result is considered estimated because concentration exceeded the linear range of the instrument  
 U = compounds not detected at the stated quantitation limit  
 MCL = Maximum Contaminant Level, USEPA Office of Water, December 1992; The Bureau of National Affairs, Inc., July 1992.

is related to land application of city water in the area of the PIW samples. The occurrence of these compounds in PIW samples is also sporadic and does not appear to be related to Site 11.

Sample PW-57 contained trichloroethene, styrene, and toluene, which are solvents. Sample PW-57 is from a PIW that was also sampled in the initial ICMSI (previously CRP-PW-36) when trichloroethene was also found at this location (toluene and styrene were not). However, this PIW is located approximately 1,600 feet southwest of the site and is not likely to be influenced by the plume from the landfill. The presence of trichloroethene at this location is not attributed to the site.

One other VOC was detected in PIW samples collected during the January 1993 sampling event. Carbon disulfide was detected in four PIW samples at concentrations ranging from 3 to 150  $\mu\text{g}/\text{l}$ . The marsh deposits common to the Kings Bay area are a natural source of sulfur compounds that can be a food source for bacteria. The presence of carbon disulfide in groundwater is considered to be a by-product of the metabolism of sulfur compounds by indigenous bacteria (Verschueren, 1983).

## 5.0 SUMMARY

The follow-on ICMSI field activities reported in this addendum were conducted to evaluate groundwater VOC contamination beneath the Old Camden County Landfill. Additionally, 11 PIWs were sampled, including two PIWs previously sampled, to evaluate VOCs in irrigation water that are potentially related to groundwater contamination associated with releases from the landfill. The results of these follow-on investigations are summarized in the paragraphs below.

Data from on-site analysis of 10 target VOCs in groundwater samples collected from the landfill using hydropunch equipment indicate that the plume is similar in composition over its entire area. Vinyl chloride and cis-1,2-dichloroethene are the primary halogenated VOCs present, and benzene, toluene, ethylbenzene, and xylenes are characteristic fuel-related VOCs in the plume. The same five VOCs detected above Federal MCLs in the samples collected during the ICMSI were also detected in groundwater samples collected during follow-on sampling activities in the landfill. The five VOCs are vinyl chloride, trichloroethene, cis-1,2-dichloroethene, tetrachloroethene, and benzene. The MCLs for these compounds are 2, 70, 5, 5, and 5 µg/l, respectively.

The on-site laboratory data were compiled into the database developed from data collected during the initial ICMSI, which focused on VOC contamination in groundwater along and downgradient of the western margin of the landfill in the direction of groundwater flow. The plume plan views and cross-sections presented in Figures 4-1 through 4-3 and 4-5 through 4-7 were developed using data from the Phase I Interim Investigation (August 1992), the initial ICMSI (October and November 1992), and the data presented in this addendum. The isoconcentration contours in the plume plan views and cross-sections represent concentrations of total target VOCs. As can be seen in these figures, the concentrations of VOCs beneath the landfill are generally less than those detected from locations along the western margin of the landfill and extending to the western right of Spur 40. This may indicate the source of the VOCs is near the western margin of the landfill or that the source is depleted and the majority of VOCs have migrated away from the source.

One or more of the 11 PIW samples collected in January 1993 contained detectable concentrations of VOCs that are attributed to incidental contamination during laboratory procedures (acetone and 2-butanone), trihalomethanes that commonly result from the chlorination of drinking water supplies (bromoform, bromodichloromethane, and dibromochloromethane), and solvents (trichloroethene, toluene, and styrene). The occurrence of VOCs in the 11 PIW samples was sporadic, and with the exception of acetone detected in sample PW-55, none of these VOCs were detected in samples from locations known to be underlain by the plume. One sample also contained carbon disulfide, which is suspected of being naturally occurring. The analytical data indicates that plume contaminants were not present in the PIW samples.

## REFERENCES

- ABB Environmental Services, Inc. (ABB-ES), 1991. Potential Source of Contamination (PSC) Site Investigation/Solid Waste Management Unit (SI/SWMU) RCRA Facility Investigation (RFI) Work Plan Naval Submarine Base, Kings Bay, Georgia. Contract Task Order No. 030 Navy CLEAN - District 1, Contract No. N62467-89-D-0317. October.
- ABB Environmental Services, Inc. (ABB-ES), 1992. Technical Work Plan Interim Corrective Measure Screening Investigation - Site 11 RCRA Facility Investigation NSB, Kings Bay, Georgia. Contract Task Order No. 041 Navy CLEAN-District 1, Contract No. N62467-89-D-0317. October.
- Naval Energy and Environmental Support Activity (NEESA), 1988. Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, Naval Energy and Environment Support Activity. NEESA 20.2-047B. Port Hueneme, California.
- U.S. Environmental Protection Agency (USEPA), 1991a. Contract Laboratory Program - Statement of Work for Organic Analysis. USEPA Document No. OLM01.0.
- U.S. Environmental Protection Agency (USEPA), 1991b. Management of Investigation Derived Waste During Site Inspection. Office of Research and Development. Washington D.C. May, 1991.
- Verschueren, Karel, 1983. Handbook of Environmental Data on Organic Chemicals, 2nd Edition, van Nostrand Reinhold.

# **Appendix A**

## **Private Irrigation Well Survey Forms**

**PRIVATE WELL SURVEY**

Thank you for participating in this brief survey. Your input will help identify potential problems associated with the use of groundwater in the area. Your responses will be held in confidence, only to be used by the project team working on the groundwater investigation. (See other side when complete)

1. How long have you lived in your current home? 4 YRS  
 Do you own the house or rent it? OWN  
 If rented, who owns the house?  
 Their mailing address?
  
2. Do you have a private well? Yes  
 (Any water source other than a metered, public water supply).
  
3. What kind of well is it? BACK YARD, 20 FEET, 1/2 HP  
 Please describe it as best you can. (Location in yard, depth, type of pump).
  
4. Do you know who installed your well? ME  
 When? 1990
  
5. Please use the chart below to indicate how you have used your well water, how often and when. Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input type="checkbox"/> Filling Swimming Pool		
<input type="checkbox"/> Garden Watering		
<input checked="" type="checkbox"/> Lawn Watering	<u>4-6</u>	<u>1700 - 1900</u>
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input type="checkbox"/> Washing Cars and Yard Items		
<input type="checkbox"/> Other, please specify: <hr/> <hr/> <hr/>		

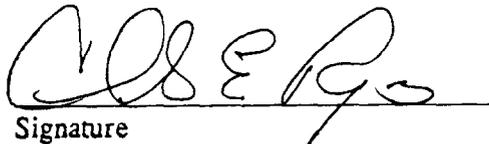
6. Do you use a hose with your private well water? yes  
 For what kind of activities? WASH PATIO
  
7. Do you have a sprinkler system? Yes How many sprinkler heads? 12  
 What type and number of spigots do you have on each system? PVC 3 VALVES  
 What are their positions in the yard? BACK YARD / ALONG SIDE PUMP.

## WELL TEST CONSENT FORM

To gather information on the location and concentration of the plume, we are asking your permission to sample your private well. This sampling process will be conducted at no expense to you and the data will provide a better understanding of groundwater quality in your area. The process is as follows:

1. Upon receipt of this completed Consent Form, you will be contacted to establish a date and time for the sampling. (The sampling needs to take place by early November.)
2. An ABB Environmental Services, Inc. (ABB-ES) staff member will meet you at the agreed date and time to take 3-9 samples from your well. The sampling will require up to 2 hours time.
3. Results from your well test will be made available to you, through the U.S. Navy, after laboratory analysis and validation. This process can take several weeks.

With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.

  
Signature

213 PLANTATION COURT  
Address

882-4015  
Phone

work 673-3810

Please return this form at the public meeting or mail it to Public Affairs Office, Subase King's Bay, GA 31547-5015 on or by October 15, 1992. Please keep one copy of this completed form for your records.

### Property Owner Advisement

Federal law gives you the right to obtain a portion of any water or soil sample that the Navy may draw from your property. This is what is normally referred to as a "split sample." Should you request a split sample, you will be responsible for providing a container(s) for the split sample(s) and will be responsible for all costs associated with analyzing your portion of the sample(s). The Navy will be responsible for its portion of the sample(s) and will bear all costs associated with analyzing its portion. Federal law also gives you the right to obtain a copy of the results of the Navy's analysis of any samples it draws from your property. Unless you indicate to us that you do not desire to receive a copy of the results, a copy will be provided to you without charge.

Statutory Authority Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code Sec. 9604(4)(B).

## PRIVATE WELL SURVEY

Thank you for participating in this brief survey. Your input will help identify potential problems associated with the use of groundwater in the area. Your responses will be held in confidence, only to be used by the project team working on the groundwater investigation. (See other side when complete)

1. How long have you lived in your current home? 4 1/2 yrs  
 Do you own the house or rent it? own  
 If rented, who owns the house?  
 Their mailing address?

2. Do you have a private well? yes  
 (Any water source other than a metered, public water supply).

3. What kind of well is it? shallow well  
 Please describe it as best you can. (Location in yard, depth, type of pump).  
close to house. one pump 20' deep.

4. Do you know who installed your well? self  
 When? 2 yrs ago.

5. Please use the chart below to indicate how you have used your well water, how often and when. Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input checked="" type="checkbox"/> Filling Swimming Pool	<u>2 to 3</u>	<u>AM and PM</u>
<input checked="" type="checkbox"/> Garden Watering	<u>2</u>	<u>Evening</u>
<input checked="" type="checkbox"/> Lawn Watering	<u>same</u>	<u>same</u>
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input checked="" type="checkbox"/> Washing Cars and Yard Items	<u>1</u>	<u>afternoons</u>
<input type="checkbox"/> Other, please specify: _____ _____ _____		

6. Do you use a hose with your private well water? yes

For what kind of activities?

7. Do you have a sprinkler system? no How many sprinkler heads? \_\_\_\_\_  
 What type and number of spigots do you have on each system? \_\_\_\_\_  
 What are their positions in the yard?

## WELL TEST CONSENT FORM

To gather information on the location and concentration of the plume, we are asking your permission to sample your private well. This sampling process will be conducted at no expense to you and the data will provide a better understanding of groundwater quality in your area. The process is as follows:

1. Upon receipt of this completed Consent Form, you will be contacted to establish a date and time for the sampling. (The sampling needs to take place by early November.)
2. An ABB Environmental Services, Inc. (ABB-ES) staff member will meet you at the agreed date and time to take 3-9 samples from your well. The sampling will require up to 2 hours time.
3. Results from your well test will be made available to you, through the U.S. Navy, after laboratory analysis and validation. This process can take several weeks.

With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.

Samuel C Rodshauer  
Signature

106 Cherry Point Dr.  
Address

882-6658  
Phone

Please return this form at the public meeting or mail it to Public Affairs Office, Subase King's Bay, GA 31547-5015 on or by October 15, 1992. Please keep one copy of this completed form for your records.

### Property Owner Advisement

Federal law gives you the right to obtain a portion of any water or soil sample that the Navy may draw from your property. This is what is normally referred to as a "split sample." Should you request a split sample, you will be responsible for providing a container(s) for the split sample(s) and will be responsible for all costs associated with analyzing your portion of the sample(s). The Navy will be responsible for its portion of the sample(s) and will bear all costs associated with analyzing its portion. Federal law also gives you the right to obtain a copy of the results of the Navy's analysis of any samples it draws from your property. Unless you indicate to us that you do not desire to receive a copy of the results, a copy will be provided to you without charge.

Statutory Authority Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code Sec. 9604(4)(B).

## PRIVATE WELL SURVEY

Thank you for participating in this brief survey. Your input will help identify potential problems associated with the use of groundwater in the area. Your responses will be held in confidence, only to be used by the project team working on the groundwater investigation. (See other side when complete)

1. How long have you lived in your current home? 1.5 yr  
 Do you own the house or rent it?  
 If rented, who owns the house?  
 Their mailing address? NA
  
2. Do you have a private well? Yes  
 (Any water source other than a metered, public water supply).
  
3. What kind of well is it? NA  
 Please describe it as best you can. (Location in yard, depth, type of pump).
  
4. Do you know who installed your well?  
 When? NA
  
5. Please use the chart below to indicate how you have used your well water, how often and when.  
 Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input type="checkbox"/> Filling Swimming Pool		
<input type="checkbox"/> Garden Watering	3	
<input checked="" type="checkbox"/> Lawn Watering	3	<u>evening</u>
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input checked="" type="checkbox"/> Washing Cars and Yard Items	1	
<input type="checkbox"/> Other, please specify: _____ _____ _____		

6. Do you use a hose with your private well water? Yes  
 For what kind of activities? Cow
  
7. Do you have a sprinkler system? Yes How many sprinkler heads? 5  
 What type and number of spigots do you have on each system? 1  
 What are their positions in the yard? each corner of back yard  
none for front

## WELL TEST CONSENT FORM

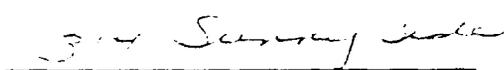
To gather information on the location and concentration of the plume, we are asking your permission to sample your private well. This sampling process will be conducted at no expense to you and the data will provide a better understanding of groundwater quality in your area. The process is as follows:

1. Upon receipt of this completed Consent Form, you will be contacted to establish a date and time for the sampling. (The sampling needs to take place by early November.)
2. An ABB Environmental Services, Inc. (ABB-ES) staff member will meet you at the agreed date and time to take 3-9 samples from your well. The sampling will require up to 2 hours time.
3. Results from your well test will be made available to you, through the U.S. Navy, after laboratory analysis and validation. This process can take several weeks.

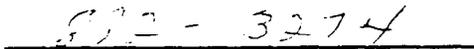
With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.



Signature



Address



Phone

Please return this form at the public meeting or mail it to Public Affairs Office, Subase King's Bay, GA 31547-5015 on or by October 15, 1992. Please keep one copy of this completed form for your records.

### Property Owner Advisement

Federal law gives you the right to obtain a portion of any water or soil sample that the Navy may draw from your property. This is what is normally referred to as a "split sample." Should you request a split sample, you will be responsible for providing a container(s) for the split sample(s) and will be responsible for all costs associated with analyzing your portion of the sample(s). The Navy will be responsible for its portion of the sample(s) and will bear all costs associated with analyzing its portion. Federal law also gives you the right to obtain a copy of the results of the Navy's analysis of any samples it draws from your property. Unless you indicate to us that you do not desire to receive a copy of the results, a copy will be provided to you without charge.

Statutory Authority Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code Sec. 9604(4)(B).

## PRIVATE WELL SURVEY

Thank you for participating in this brief survey. Your input will help identify potential problems associated with the use of groundwater in the area. Your responses will be held in confidence, only to be used by the project team working on the groundwater investigation. (See other side when complete)

1. How long have you lived in your current home? ≈ 1.5 years  
 Do you own the house or rent it? OWN  
 If rented, who owns the house?  
 Their mailing address?
  
2. Do you have a private well? yes  
 (Any water source other than a metered, public water supply).
  
3. What kind of well is it? Sho  
 Please describe it as best you can. (Location in yard, depth, type of pump).
  
4. Do you know who installed your well? former owner  
 When?
  
5. Please use the chart below to indicate how you have used your well water, how often and when. Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input type="checkbox"/> Filling Swimming Pool		
<input type="checkbox"/> Garden Watering		
<input checked="" type="checkbox"/> Lawn Watering	<u>once / twice a week</u>	<u>Evening</u>
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input type="checkbox"/> Washing Cars and Yard Items		
<input type="checkbox"/> Other, please specify: _____ _____ _____		

6. Do you use a hose with your private well water? No  
 For what kind of activities?
  
7. Do you have a sprinkler system? yes How many sprinkler heads? 215  
 What type and number of spigots do you have on each system? Rainbird  
 What are their positions in the yard?

WELL TEST CONSENT FORM

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- 2. An ABB Environmental Services, Inc. (ABB-ES) staff member will meet you at the agreed date and time to take 3-9 samples from your well. The sampling will require up to 2 hours time.
- 3. Results from your well test will be made available to you, through the U.S. Navy, after laboratory analysis and validation. This process can take several weeks.

With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.

*Jerry W Keeling*  
Signature

*300 Fairfield Drive*  
Address

*673-7173*  
Phone

Please return this form at the public meeting or mail it to Public Affairs Office, Subase King's Bay, GA 31547-5015 on or by October 15, 1992. Please keep one copy of this completed form for your records.

**Property Owner Advisement**

Federal law gives you the right to obtain a portion of any water or soil sample that the Navy may draw from your property. This is what is normally referred to as a "split sample." Should you request a split sample, you will be responsible for providing a container(s) for the split sample(s) and will be responsible for all costs associated with analyzing your portion of the sample(s). The Navy will be responsible for its portion of the sample(s) and will bear all costs associated with analyzing its portion. Federal law also gives you the right to obtain a copy of the results of the Navy's analysis of any samples it draws from your property. Unless you indicate to us that you do not desire to receive a copy of the results, a copy will be provided to you without charge.

Statutory Authority Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code Sec. 9604(4)(B).

## PRIVATE WELL SURVEY

Thank you for participating in this brief survey. Your input will help identify potential problems associated with the use of groundwater in the area. Your responses will be held in confidence, only to be used by the project team working on the groundwater investigation. (See other side when complete)

1. How long have you lived in your current home? 4 years  
 Do you own the house or rent it? own  
 If rented, who owns the house?  
 Their mailing address?
  
2. Do you have a private well? yes  
 (Any water source other than a metered, public water supply).
  
3. What kind of well is it? SHALLOW SPRINKLER, REAR OF YARD, 25' DEEP  
 Please describe it as best you can. (Location in yard, depth, type of pump).
  
4. Do you know who installed your well? Self  
 When? 1989
  
5. Please use the chart below to indicate how you have used your well water, how often and when. Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input type="checkbox"/> Filling Swimming Pool		
<input checked="" type="checkbox"/> Garden Watering	<u>5</u>	<u>AM + PM</u>
<input checked="" type="checkbox"/> Lawn Watering	<u>2</u>	<u>AM</u>
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input type="checkbox"/> Washing Cars and Yard Items		
<input type="checkbox"/> Other, please specify: _____ _____ _____		

6. Do you use a hose with your private well water? NO  
 For what kind of activities?
  
7. Do you have a sprinkler system? Yes How many sprinkler heads? 12  
 What type and number of spigots do you have on each system? \_\_\_\_\_  
 What are their positions in the yard?

## WELL TEST CONSENT FORM

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3. Results from your well test will be made available to you, through the U.S. Navy, after laboratory analysis and validation. This process can take several weeks.

With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.

Rodney J. Gibbons  
Signature

301 CHERRY PT  
Address

882 3149  
Phone

Please return this form at the public meeting or mail it to Public Affairs Office, Subase King's Bay, GA 31547-5015 on or by October 15, 1992. Please keep one copy of this completed form for your records.

### Property Owner Advisement

Federal law gives you the right to obtain a portion of any water or soil sample that the Navy may draw from your property. This is what is normally referred to as a "split sample." Should you request a split sample, you will be responsible for providing a container(s) for the split sample(s) and will be responsible for all costs associated with analyzing your portion of the sample(s). The Navy will be responsible for its portion of the sample(s) and will bear all costs associated with analyzing its portion. Federal law also gives you the right to obtain a copy of the results of the Navy's analysis of any samples it draws from your property. Unless you indicate to us that you do not desire to receive a copy of the results, a copy will be provided to you without charge.

Statutory Authority Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code Sec. 9604(4)(B).

## PRIVATE WELL SURVEY

Thank you for participating in this brief survey. Your input will help identify potential problems associated with the use of groundwater in the area. Your responses will be held in confidence, only to be used by the project team working on the groundwater investigation. (See other side when complete)

1. How long have you lived in your current home? 2 yrs.  
 Do you own the house or rent it? Own  
 If rented, who owns the house?  
 Their mailing address?
  
2. Do you have a private well? Yes  
 (Any water source other than a metered, public water supply).
  
3. What kind of well is it? Shallow, west side of house, 30', 1/2 horse pump  
 Please describe it as best you can. (Location in yard, depth, type of pump).
  
4. Do you know who installed your well? Yes  
 When? Oct 1990
  
5. Please use the chart below to indicate how you have used your well water, how often and when. Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input type="checkbox"/> Filling Swimming Pool		
<input type="checkbox"/> Garden Watering		
<input checked="" type="checkbox"/> Lawn Watering	<u>3-4</u>	<u>morning &amp; evening</u>
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input type="checkbox"/> Washing Cars and Yard Items		
<input type="checkbox"/> Other, please specify: _____ _____ _____		

6. Do you use a hose with your private well water? No  
 For what kind of activities?
  
7. Do you have a sprinkler system? Yes How many sprinkler heads? 21  
 What type and number of spigots do you have on each system? None  
 What are their positions in the yard?

## WELL TEST CONSENT FORM

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3. Results from your well test will be made available to you, through the U.S. Navy, after laboratory analysis and validation. This process can take several weeks.

With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.

Joseph M. Drury  
Signature

204 Cottage Ct., St Marys, Ga. 31558  
Address

882-4741  
Phone

Please return this form at the public meeting or mail it to Public Affairs Office, Subase King's Bay, GA 31547-5015 on or by October 15, 1992. Please keep one copy of this completed form for your records.

### Property Owner Advisement

Federal law gives you the right to obtain a portion of any water or soil sample that the Navy may draw from your property. This is what is normally referred to as a "split sample." Should you request a split sample, you will be responsible for providing a container(s) for the split sample(s) and will be responsible for all costs associated with analyzing your portion of the sample(s). The Navy will be responsible for its portion of the sample(s) and will bear all costs associated with analyzing its portion. Federal law also gives you the right to obtain a copy of the results of the Navy's analysis of any samples it draws from your property. Unless you indicate to us that you do not desire to receive a copy of the results, a copy will be provided to you without charge.

**Statutory Authority** Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code Sec. 9604(4)(B).

## PRIVATE WELL SURVEY

Thank you for participating in this brief survey. Your input will help identify potential problems associated with the use of groundwater in the area. Your responses will be held in confidence, only to be used by the project team working on the groundwater investigation. (See other side when complete)

1. How long have you lived in your current home? 3 years  
 Do you own the house or rent it? own  
 If rented, who owns the house?  
 Their mailing address?
  
2. Do you have a private well? yes  
 (Any water source other than a metered, public water supply).
  
3. What kind of well is it? Shallow  
 Please describe it as best you can. (Location in yard, depth, type of pump).  
outside of house in front of house small depth
  
4. Do you know who installed your well? yes  
 When? June 91
  
5. Please use the chart below to indicate how you have used your well water, how often and when. Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input type="checkbox"/> Filling Swimming Pool		
<input checked="" type="checkbox"/> Garden Watering		
<input checked="" type="checkbox"/> Lawn Watering		
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input type="checkbox"/> Washing Cars and Yard Items		
<input type="checkbox"/> Other, please specify: _____ _____ _____		

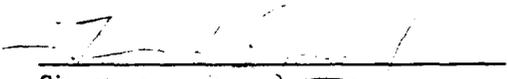
6. Do you use a hose with your private well water? yes  
 For what kind of activities? watering yard & garden
  
7. Do you have a sprinkler system? NO How many sprinkler heads? \_\_\_\_\_  
 What type and number of spigots do you have on each system? \_\_\_\_\_  
 What are their positions in the yard?

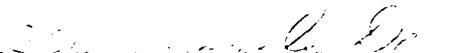
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With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.

  
\_\_\_\_\_  
Signature

  
\_\_\_\_\_  
Address

  
\_\_\_\_\_  
Phone

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## PRIVATE WELL SURVEY

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1. How long have you lived in your current home? 2  
 Do you own the house or rent it? OWN  
 If rented, who owns the house?  
 Their mailing address?
  
2. Do you have a private well? YES  
 (Any water source other than a metered, public water supply).
  
3. What kind of well is it? SHALLOW WELL  
 Please describe it as best you can. (Location in yard, depth, type of pump).
  
4. Do you know who installed your well?  
 When? I INSTALLED, 1989
  
5. Please use the chart below to indicate how you have used your well water, how often and when. Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input type="checkbox"/> Filling Swimming Pool		
<input checked="" type="checkbox"/> Garden Watering	<u>4 TO 5</u>	<u>EARLY MORNING</u>
<input checked="" type="checkbox"/> Lawn Watering	<u>4 TO 5</u>	<u>" "</u>
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input type="checkbox"/> Washing Cars and Yard Items		
<input type="checkbox"/> Other, please specify: <hr style="border: none; border-top: 1px solid black; margin: 2px 0;"/> <hr style="border: none; border-top: 1px solid black; margin: 2px 0;"/> <hr style="border: none; border-top: 1px solid black; margin: 2px 0;"/>		

6. Do you use a hose with your private well water? NO  
 For what kind of activities?
  
7. Do you have a sprinkler system? YES How many sprinkler heads? 27  
 What type and number of spigots do you have on each system?  
 What are their positions in the yard? COMPLETE BACK YARD COVERAGE, PARTIAL SIDE/FRONT

## WELL TEST CONSENT FORM

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With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.

Larry W Wallace  
Signature

204 PLANTATION CT.  
Address

882-7887  
Phone

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### Property Owner Advisement

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## PRIVATE WELL SURVEY

Thank you for participating in this brief survey. Your input will help identify potential problems associated with the use of groundwater in the area. Your responses will be held in confidence, only to be used by the project team working on the groundwater investigation. (See other side when complete)

1. How long have you lived in your current home? 4 yrs  
 Do you own the house or rent it?  
 If rented, who owns the house?  
 Their mailing address?
  
2. Do you have a private well? yes  
 (Any water source other than a metered, public water supply).
  
3. What kind of well is it? Shallow well | 25 feet | 1 HP Pump  
 Please describe it as best you can. (Location in yard, depth, type of pump).  
on North side of house
  
4. Do you know who installed your well? Self  
 When? 3 yrs
  
5. Please use the chart below to indicate how you have used your well water, how often and when.  
 Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input type="checkbox"/> Filling Swimming Pool		
<input type="checkbox"/> Garden Watering		
<input checked="" type="checkbox"/> Lawn Watering	<u>2</u>	<u>late afternoon</u>
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input type="checkbox"/> Washing Cars and Yard Items		
<input type="checkbox"/> Other, please specify: <hr style="border: none; border-top: 1px solid black; margin: 2px 0;"/> <hr style="border: none; border-top: 1px solid black; margin: 2px 0;"/> <hr style="border: none; border-top: 1px solid black; margin: 2px 0;"/>		

6. Do you use a hose with your private well water? yes  
 For what kind of activities? sprinkler to water lawn
  
7. Do you have a sprinkler system? No How many sprinkler heads? \_\_\_\_\_  
 What type and number of spigots do you have on each system? \_\_\_\_\_  
 What are their positions in the yard?

## WELL TEST CONSENT FORM

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3. Results from your well test will be made available to you, through the U.S. Navy, after laboratory analysis and validation. This process can take several weeks.

With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.

Hilda Yegorov  
Signature

310 Fairchild Drive  
Address St Marys Ga 31558

882-4173  
Phone

Please return this form at the public meeting or mail it to Public Affairs Office, Subbase King's Bay, GA 31547-5015 on or by October 15, 1992. Please keep one copy of this completed form for your records.

### Property Owner Advisement

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Statutory Authority Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code Sec. 9604(4)(B).

## **Appendix B**

### **Validated Analytical Data Tables**

## DEFINITION OF DATA QUALIFIERS

### Organic Data Qualifiers

- J - Indicates an estimated concentration because results are either below the concentration required detection level (CRQL) or quality control criteria were not met.
- U - Indicates that compound was analyzed but not detected.
- UJ - Indicates that quantitation level was estimated because QC criteria were not met.
- NJ - Presumptive evidence for the presence of a compound at an estimated value.
- E - Indicates that the analyte concentration exceeded the calibration range of the GC/MS and re-analysis of diluted sample within calibration range.
- D - Indicates that sample concentration was obtained by dilution to bring result within calibration range.
- X - Total concentration of two indistinguishable isomers (i.e., 3-Methylphenol and 4-Methylphenol).
- UR - Indicates that the reported detection limit is unusable because QA criteria were not met.

### Inorganic Data Qualifiers

- J - Indicates an estimated concentration because results are either below the concentration required detection level (CRQL) or quality control criteria were not met.
- U - Indicates that compound was analyzed but not detected.
- UJ - Indicates that quantitation level was estimated because QC criteria were not met.
- E - The reported concentration is estimated because of the presence of an interference.
- UR - Indicates that the reported detection limit is unusable because QC criteria were not met.

**Hydropunch Groundwater Samples  
March 1993**

PROJECT: NSB KINGSBAY, GEORGIA

VOLATILE AQUEOUS ANALYSES (ug/l)

VALIDATION SUMMARY TABLE

SAMPLE NUMBER:	11G15030	11G15230	11G15230D	11G15885	11G15940	11G16035
LAB NUMBER:	35388001	35388006	35388007	35433003	35442002	35442003
DATE SAMPLED:	03/17/93	03/17/93	03/17/93	03/22/93	03/23/93	03/23/93
DATE ANALYZED:	03/24/93	03/23/93	03/24/93	03/29/93	03/30/93	03/30/93
DILUTION FACTOR:	1	1	1	1	1	1

Compound	CRQL						
Chloromethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	1	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	2	2 U	37	41	2 U	2 U	3
Acetone	5	5 U	280	310	800	5 U	24 U
Carbon disulfide	1	3	200	250	1 U	1 U	3
1,1-Dichloroethene	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1	1 U	12	14	1 U	1 U	17
cis-1,2-Dichloroethene	1	1 U	2	2	1 U	6	22
trans-1,2-Dichloroethene	1	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1	1 U	1 U	1 U	3	1 U	1 U
1,2-Dichloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	5	5 U	440	480	5 U	5 U	5 U
1,1,1-Trichloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1	1 U	3	3	1 U	1 U	3
Dibromochloromethane	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	1	1 U	1	1	1 U	1 U	5
trans-1,3-Dichloropropene	1	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1	1 U	1 U	1 U	1 U	1 U	1 U
2-Hexanone	5	5 U	19	17	5 U	5 U	5 U
4-Methyl-2-Pentanone	5	5 U	100	110	5 U	5 U	5 U
Tetrachloroethene	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1	1 U	720	840	2	1 U	11
Chlorobenzene	1	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	1	1 U	16	18	1 U	15	6
Styrene	1	1 U	1 U	1 U	1 U	1 U	1 U
Xylene (total)	1	1 U	62	67	1 U	12	14
1,3-Dichlorobenzene	1	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	1	1 U	1 U	1 U	1 U	3	1 U
1,2-Dichlorobenzene	1	1 U	1 U	1 U	1 U	1 U	1 U

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**Private Irrigation Well Samples  
January 1993**

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858001	CRPPW52	01/12/93	Chloromethane	1 U
34858001	CRPPW52	01/12/93	Bromomethane	1 U
34858001	CRPPW52	01/12/93	Vinyl chloride	1 U
34858001	CRPPW52	01/12/93	Chloroethane	1 U
34858001	CRPPW52	01/12/93	Methylene chloride	2 U
34858001	CRPPW52	01/12/93	Acetone	3 J
34858001	CRPPW52	01/12/93	Carbon disulfide	130
34858001	CRPPW52	01/12/93	1,1-Dichloroethene	1 U
34858001	CRPPW52	01/12/93	1,1-Dichloroethane	1 U
34858001	CRPPW52	01/12/93	cis-1,2-Dichloroethene	1 U
34858001	CRPPW52	01/12/93	trans-1,2-Dichloroethene	1 U
34858001	CRPPW52	01/12/93	Chloroform	1 U
34858001	CRPPW52	01/12/93	1,2-Dichloroethane	1 U
34858001	CRPPW52	01/12/93	2-Butanone	5 U
34858001	CRPPW52	01/12/93	1,1,1-Trichloroethane	1 U
34858001	CRPPW52	01/12/93	Carbon tetrachloride	1 U
34858001	CRPPW52	01/12/93	Bromodichloromethane	1 U
34858001	CRPPW52	01/12/93	1,2-Dichloropropane	1 U
34858001	CRPPW52	01/12/93	cis-1,3-Dichloropropane	1 U
34858001	CRPPW52	01/12/93	Trichloroethene	1 U
34858001	CRPPW52	01/12/93	Dibromochloromethane	1 U
34858001	CRPPW52	01/12/93	1,1,2-Trichloroethane	1 U
34858001	CRPPW52	01/12/93	Benzene	1 U
34858001	CRPPW52	01/12/93	trans-1,3-Dichloropropene	1 U
34858001	CRPPW52	01/12/93	Bromoform	1 U
34858001	CRPPW52	01/12/93	2-Hexanone	5 U
34858001	CRPPW52	01/12/93	4-Methyl-2-pentanone	5 U
34858001	CRPPW52	01/12/93	Tetrachloroethene	1 U
34858001	CRPPW52	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858001	CRPPW52	01/12/93	Toluene	1 U
34858001	CRPPW52	01/12/93	Chlorobenzene	1 U
34858001	CRPPW52	01/12/93	Ethylbenzene	1 U
34858001	CRPPW52	01/12/93	Styrene	1 U
34858001	CRPPW52	01/12/93	Xylenes (total)	1 U
34858001	CRPPW52	01/12/93	1,3-Dichlorobenzene	1 U
34858001	CRPPW52	01/12/93	1,4-Dichlorobenzene	1 U
34858001	CRPPW52	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/15/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858002	CRPPW53	01/12/93	Chloromethane	1 U
34858002	CRPPW53	01/12/93	Bromomethane	1 U
34858002	CRPPW53	01/12/93	Vinyl chloride	1 U
34858002	CRPPW53	01/12/93	Chloroethane	1 U
34858002	CRPPW53	01/12/93	Methylene chloride	2 U
34858002	CRPPW53	01/12/93	Acetone	4 J
34858002	CRPPW53	01/12/93	Carbon disulfide	1 U
34858002	CRPPW53	01/12/93	1,1-Dichloroethene	1 U
34858002	CRPPW53	01/12/93	1,1-Dichloroethane	1 U
34858002	CRPPW53	01/12/93	cis-1,2-Dichloroethene	1 U
34858002	CRPPW53	01/12/93	trans-1,2-Dichloroethene	1 U
34858002	CRPPW53	01/12/93	Chloroform	1 U
34858002	CRPPW53	01/12/93	1,2-Dichloroethane	1 U
34858002	CRPPW53	01/12/93	2-Butanone	5 U
34858002	CRPPW53	01/12/93	1,1,1-Trichloroethane	1 U
34858002	CRPPW53	01/12/93	Carbon tetrachloride	1 U
34858002	CRPPW53	01/12/93	Bromodichloromethane	1 U
34858002	CRPPW53	01/12/93	1,2-Dichloropropane	1 U
34858002	CRPPW53	01/12/93	cis-1,3-Dichloropropane	1 U
34858002	CRPPW53	01/12/93	Trichloroethene	1 U
34858002	CRPPW53	01/12/93	Dibromochloromethane	1 U
34858002	CRPPW53	01/12/93	1,1,2-Trichloroethane	1 U
34858002	CRPPW53	01/12/93	Benzene	1 U
34858002	CRPPW53	01/12/93	trans-1,3-Dichloropropene	1 U
34858002	CRPPW53	01/12/93	Bromoform	1 U
34858002	CRPPW53	01/12/93	2-Hexanone	5 U
34858002	CRPPW53	01/12/93	4-Methyl-2-pentanone	5 U
34858002	CRPPW53	01/12/93	Tetrachloroethene	1 U
34858002	CRPPW53	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858002	CRPPW53	01/12/93	Toluene	1 U
34858002	CRPPW53	01/12/93	Chlorobenzene	1 U
34858002	CRPPW53	01/12/93	Ethylbenzene	1 U
34858002	CRPPW53	01/12/93	Styrene	1 U
34858002	CRPPW53	01/12/93	Xylenes (total)	1 U
34858002	CRPPW53	01/12/93	1,3-Dichlorobenzene	1 U
34858002	CRPPW53	01/12/93	1,4-Dichlorobenzene	1 U
34858002	CRPPW53	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/14/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858003	CRPPW54	01/12/93	Chloromethane	1 U
34858003	CRPPW54	01/12/93	Bromomethane	1 U
34858003	CRPPW54	01/12/93	Vinyl chloride	1 U
34858003	CRPPW54	01/12/93	Chloroethane	1 U
34858003	CRPPW54	01/12/93	Methylene chloride	2 U
34858003	CRPPW54	01/12/93	Acetone	5 U
34858003	CRPPW54	01/12/93	Carbon disulfide	1 U
34858003	CRPPW54	01/12/93	1,1-Dichloroethene	1 U
34858003	CRPPW54	01/12/93	1,1-Dichloroethane	1 U
34858003	CRPPW54	01/12/93	cis-1,2-Dichloroethene	1 U
34858003	CRPPW54	01/12/93	trans-1,2-Dichloroethene	1 U
34858003	CRPPW54	01/12/93	Chloroform	1 U
34858003	CRPPW54	01/12/93	1,2-Dichloroethane	1 U
34858003	CRPPW54	01/12/93	2-Butanone	5 U
34858003	CRPPW54	01/12/93	1,1,1-Trichloroethane	1 U
34858003	CRPPW54	01/12/93	Carbon tetrachloride	1 U
34858003	CRPPW54	01/12/93	Bromodichloromethane	1 U
34858003	CRPPW54	01/12/93	1,2-Dichloropropane	1 U
34858003	CRPPW54	01/12/93	cis-1,3-Dichloropropane	1 U
34858003	CRPPW54	01/12/93	Trichloroethene	1 U
34858003	CRPPW54	01/12/93	Dibromochloromethane	1 U
34858003	CRPPW54	01/12/93	1,1,2-Trichloroethane	1 U
34858003	CRPPW54	01/12/93	Benzene	1 U
34858003	CRPPW54	01/12/93	trans-1,3-Dichloropropene	1 U
34858003	CRPPW54	01/12/93	Bromoform	1 U
34858003	CRPPW54	01/12/93	2-Hexanone	5 U
34858003	CRPPW54	01/12/93	4-Methyl-2-pentanone	5 U
34858003	CRPPW54	01/12/93	Tetrachloroethene	1 U
34858003	CRPPW54	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858003	CRPPW54	01/12/93	Toluene	1 U
34858003	CRPPW54	01/12/93	Chlorobenzene	1 U
34858003	CRPPW54	01/12/93	Ethylbenzene	1 U
34858003	CRPPW54	01/12/93	Styrene	1 U
34858003	CRPPW54	01/12/93	Xylenes (total)	1 U
34858003	CRPPW54	01/12/93	1,3-Dichlorobenzene	1 U
34858003	CRPPW54	01/12/93	1,4-Dichlorobenzene	1 U
34858003	CRPPW54	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/15/93  
Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858004	CRPPW55	01/12/93	Chloromethane	1 U
34858004	CRPPW55	01/12/93	Bromomethane	1 U
34858004	CRPPW55	01/12/93	Vinyl chloride	1 U
34858004	CRPPW55	01/12/93	Chloroethane	1 U
34858004	CRPPW55	01/12/93	Methylene chloride	2 U
34858004	CRPPW55	01/12/93	Acetone	19
34858004	CRPPW55	01/12/93	Carbon disulfide	1 U
34858004	CRPPW55	01/12/93	1,1-Dichloroethene	1 U
34858004	CRPPW55	01/12/93	1,1-Dichloroethane	1 U
34858004	CRPPW55	01/12/93	cis-1,2-Dichloroethene	1 U
34858004	CRPPW55	01/12/93	trans-1,2-Dichloroethene	1 U
34858004	CRPPW55	01/12/93	Chloroform	1 U
34858004	CRPPW55	01/12/93	1,2-Dichloroethane	1 U
34858004	CRPPW55	01/12/93	2-Butanone	5 U
34858004	CRPPW55	01/12/93	1,1,1-Trichloroethane	1 U
34858004	CRPPW55	01/12/93	Carbon tetrachloride	1 U
34858004	CRPPW55	01/12/93	Bromodichloromethane	1 U
34858004	CRPPW55	01/12/93	1,2-Dichloropropane	1 U
34858004	CRPPW55	01/12/93	cis-1,3-Dichloropropane	1 U
34858004	CRPPW55	01/12/93	Trichloroethene	1 U
34858004	CRPPW55	01/12/93	Dibromochloromethane	1 U
34858004	CRPPW55	01/12/93	1,1,2-Trichloroethane	1 U
34858004	CRPPW55	01/12/93	Benzene	1 U
34858004	CRPPW55	01/12/93	trans-1,3-Dichloropropene	1 U
34858004	CRPPW55	01/12/93	Bromoform	1 U
34858004	CRPPW55	01/12/93	2-Hexanone	5 U
34858004	CRPPW55	01/12/93	4-Methyl-2-pentanone	5 U
34858004	CRPPW55	01/12/93	Tetrachloroethene	1 U
34858004	CRPPW55	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858004	CRPPW55	01/12/93	Toluene	1 U
34858004	CRPPW55	01/12/93	Chlorobenzene	1 U
34858004	CRPPW55	01/12/93	Ethylbenzene	1 U
34858004	CRPPW55	01/12/93	Styrene	1 U
34858004	CRPPW55	01/12/93	Xylenes (total)	1 U
34858004	CRPPW55	01/12/93	1,3-Dichlorobenzene	1 U
34858004	CRPPW55	01/12/93	1,4-Dichlorobenzene	1 U
34858004	CRPPW55	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/15/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858005	CRPPW56	01/12/93	Chloromethane	1 U
34858005	CRPPW56	01/12/93	Bromomethane	1 U
34858005	CRPPW56	01/12/93	Vinyl chloride	1 U
34858005	CRPPW56	01/12/93	Chloroethane	1 U
34858005	CRPPW56	01/12/93	Methylene chloride	2 U
34858005	CRPPW56	01/12/93	Acetone	9
34858005	CRPPW56	01/12/93	Carbon disulfide	4
34858005	CRPPW56	01/12/93	1,1-Dichloroethene	1 U
34858005	CRPPW56	01/12/93	1,1-Dichloroethane	1 U
34858005	CRPPW56	01/12/93	cis-1,2-Dichloroethene	1 U
34858005	CRPPW56	01/12/93	trans-1,2-Dichloroethene	1 U
34858005	CRPPW56	01/12/93	Chloroform	1 U
34858005	CRPPW56	01/12/93	1,2-Dichloroethane	1 U
34858005	CRPPW56	01/12/93	2-Butanone	5 U
34858005	CRPPW56	01/12/93	1,1,1-Trichloroethane	1 U
34858005	CRPPW56	01/12/93	Carbon tetrachloride	1 U
34858005	CRPPW56	01/12/93	Bromodichloromethane	1 U
34858005	CRPPW56	01/12/93	1,2-Dichloropropane	1 U
34858005	CRPPW56	01/12/93	cis-1,3-Dichloropropane	1 U
34858005	CRPPW56	01/12/93	Trichloroethene	1 U
34858005	CRPPW56	01/12/93	Dibromochloromethane	1 U
34858005	CRPPW56	01/12/93	1,1,2-Trichloroethane	1 U
34858005	CRPPW56	01/12/93	Benzene	1 U
34858005	CRPPW56	01/12/93	trans-1,3-Dichloropropene	1 U
34858005	CRPPW56	01/12/93	Bromoform	1 U
34858005	CRPPW56	01/12/93	2-Hexanone	5 U
34858005	CRPPW56	01/12/93	4-Methyl-2-pentanone	5 U
34858005	CRPPW56	01/12/93	Tetrachloroethene	1 U
34858005	CRPPW56	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858005	CRPPW56	01/12/93	Toluene	1 U
34858005	CRPPW56	01/12/93	Chlorobenzene	1 U
34858005	CRPPW56	01/12/93	Ethylbenzene	1 U
34858005	CRPPW56	01/12/93	Styrene	1 U
34858005	CRPPW56	01/12/93	Xylenes (total)	1 U
34858005	CRPPW56	01/12/93	1,3-Dichlorobenzene	1 U
34858005	CRPPW56	01/12/93	1,4-Dichlorobenzene	1 U
34858005	CRPPW56	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/15/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858006	CRPPW57	01/12/93	Chloromethane	1 U
34858006	CRPPW57	01/12/93	Bromomethane	1 U
34858006	CRPPW57	01/12/93	Vinyl chloride	1 U
34858006	CRPPW57	01/12/93	Chloroethane	1 U
34858006	CRPPW57	01/12/93	Methylene chloride	2 U
34858006	CRPPW57	01/12/93	Acetone	4 J
34858006	CRPPW57	01/12/93	Carbon disulfide	1 U
34858006	CRPPW57	01/12/93	1,1-Dichloroethene	1 U
34858006	CRPPW57	01/12/93	1,1-Dichloroethane	1 U
34858006	CRPPW57	01/12/93	cis-1,2-Dichloroethene	1 U
34858006	CRPPW57	01/12/93	trans-1,2-Dichloroethene	1 U
34858006	CRPPW57	01/12/93	Chloroform	1 U
34858006	CRPPW57	01/12/93	1,2-Dichloroethane	1 U
34858006	CRPPW57	01/12/93	2-Butanone	5 U
34858006	CRPPW57	01/12/93	1,1,1-Trichloroethane	1 U
34858006	CRPPW57	01/12/93	Carbon tetrachloride	1 U
34858006	CRPPW57	01/12/93	Bromodichloromethane	1 U
34858006	CRPPW57	01/12/93	1,2-Dichloropropane	1 U
34858006	CRPPW57	01/12/93	cis-1,3-Dichloropropane	1 U
34858006	CRPPW57	01/12/93	Trichloroethene	60
34858006	CRPPW57	01/12/93	Dibromochloromethane	1 U
34858006	CRPPW57	01/12/93	1,1,2-Trichloroethane	1 U
34858006	CRPPW57	01/12/93	Benzene	1 U
34858006	CRPPW57	01/12/93	trans-1,3-Dichloropropene	1 U
34858006	CRPPW57	01/12/93	Bromoform	1 U
34858006	CRPPW57	01/12/93	2-Hexanone	5 U
34858006	CRPPW57	01/12/93	4-Methyl-2-pentanone	5 U
34858006	CRPPW57	01/12/93	Tetrachloroethene	1 U
34858006	CRPPW57	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858006	CRPPW57	01/12/93	Toluene	1
34858006	CRPPW57	01/12/93	Chlorobenzene	1 U
34858006	CRPPW57	01/12/93	Ethylbenzene	1 U
34858006	CRPPW57	01/12/93	Styrene	8
34858006	CRPPW57	01/12/93	Xylenes (total)	1 U
34858006	CRPPW57	01/12/93	1,3-Dichlorobenzene	1 U
34858006	CRPPW57	01/12/93	1,4-Dichlorobenzene	1 U
34858006	CRPPW57	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/15/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858007	CRPPW58	01/12/93	Chloromethane	1 U
34858007	CRPPW58	01/12/93	Bromomethane	1 U
34858007	CRPPW58	01/12/93	Vinyl chloride	1 U
34858007	CRPPW58	01/12/93	Chloroethane	1 U
34858007	CRPPW58	01/12/93	Methylene chloride	2 U
34858007	CRPPW58	01/12/93	Acetone	4 J
34858007	CRPPW58	01/12/93	Carbon disulfide	1 U
34858007	CRPPW58	01/12/93	1,1-Dichloroethene	1 U
34858007	CRPPW58	01/12/93	1,1-Dichloroethane	1 U
34858007	CRPPW58	01/12/93	cis-1,2-Dichloroethene	1 U
34858007	CRPPW58	01/12/93	trans-1,2-Dichloroethene	1 U
34858007	CRPPW58	01/12/93	Chloroform	1 U
34858007	CRPPW58	01/12/93	1,2-Dichloroethane	1 U
34858007	CRPPW58	01/12/93	2-Butanone	5 U
34858007	CRPPW58	01/12/93	1,1,1-Trichloroethane	1 U
34858007	CRPPW58	01/12/93	Carbon tetrachloride	1 U
34858007	CRPPW58	01/12/93	Bromodichloromethane	1 U
34858007	CRPPW58	01/12/93	1,2-Dichloropropane	1 U
34858007	CRPPW58	01/12/93	cis-1,3-Dichloropropane	1 U
34858007	CRPPW58	01/12/93	Trichloroethene	1 U
34858007	CRPPW58	01/12/93	Dibromochloromethane	1 U
34858007	CRPPW58	01/12/93	1,1,2-Trichloroethane	1 U
34858007	CRPPW58	01/12/93	Benzene	1 U
34858007	CRPPW58	01/12/93	trans-1,3-Dichloropropene	1 U
34858007	CRPPW58	01/12/93	Bromoform	1 U
34858007	CRPPW58	01/12/93	2-Hexanone	5 U
34858007	CRPPW58	01/12/93	4-Methyl-2-pentanone	5 U
34858007	CRPPW58	01/12/93	Tetrachloroethene	1 U
34858007	CRPPW58	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858007	CRPPW58	01/12/93	Toluene	1 U
34858007	CRPPW58	01/12/93	Chlorobenzene	1 U
34858007	CRPPW58	01/12/93	Ethylbenzene	1 U
34858007	CRPPW58	01/12/93	Styrene	1 U
34858007	CRPPW58	01/12/93	Xylenes (total)	1 U
34858007	CRPPW58	01/12/93	1,3-Dichlorobenzene	1 U
34858007	CRPPW58	01/12/93	1,4-Dichlorobenzene	1 U
34858007	CRPPW58	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/15/93  
Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858008	CRPPW59	01/12/93	Chloromethane	1 U
34858008	CRPPW59	01/12/93	Bromomethane	1 U
34858008	CRPPW59	01/12/93	Vinyl chloride	1 U
34858008	CRPPW59	01/12/93	Chloroethane	1 U
34858008	CRPPW59	01/12/93	Methylene chloride	2 U
34858008	CRPPW59	01/12/93	Acetone	5 U
34858008	CRPPW59	01/12/93	Carbon disulfide	1 U
34858008	CRPPW59	01/12/93	1,1-Dichloroethene	1 U
34858008	CRPPW59	01/12/93	1,1-Dichloroethane	1 U
34858008	CRPPW59	01/12/93	cis-1,2-Dichloroethene	1 U
34858008	CRPPW59	01/12/93	trans-1,2-Dichloroethene	1 U
34858008	CRPPW59	01/12/93	Chloroform	11 U
34858008	CRPPW59	01/12/93	1,2-Dichloroethane	1 U
34858008	CRPPW59	01/12/93	2-Butanone	5 U
34858008	CRPPW59	01/12/93	1,1,1-Trichloroethane	1 U
34858008	CRPPW59	01/12/93	Carbon tetrachloride	1 U
34858008	CRPPW59	01/12/93	Bromodichloromethane	16
34858008	CRPPW59	01/12/93	1,2-Dichloropropane	1 U
34858008	CRPPW59	01/12/93	cis-1,3-Dichloropropane	1 U
34858008	CRPPW59	01/12/93	Trichloroethene	1 U
34858008	CRPPW59	01/12/93	Dibromochloromethane	14
34858008	CRPPW59	01/12/93	1,1,2-Trichloroethane	1 U
34858008	CRPPW59	01/12/93	Benzene	1 U
34858008	CRPPW59	01/12/93	trans-1,3-Dichloropropene	1 U
34858008	CRPPW59	01/12/93	Bromoform	3
34858008	CRPPW59	01/12/93	2-Hexanone	5 U
34858008	CRPPW59	01/12/93	4-Methyl-2-pentanone	5 U
34858008	CRPPW59	01/12/93	Tetrachloroethene	1 U
34858008	CRPPW59	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858008	CRPPW59	01/12/93	Toluene	1 U
34858008	CRPPW59	01/12/93	Chlorobenzene	1 U
34858008	CRPPW59	01/12/93	Ethylbenzene	1 U
34858008	CRPPW59	01/12/93	Styrene	1 U
34858008	CRPPW59	01/12/93	Xylenes (total)	1 U
34858008	CRPPW59	01/12/93	1,3-Dichlorobenzene	1 U
34858008	CRPPW59	01/12/93	1,4-Dichlorobenzene	1 U
34858008	CRPPW59	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/15/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858009	CRPPW59D	01/12/93	Chloromethane	1 U
34858009	CRPPW59D	01/12/93	Bromomethane	1 U
34858009	CRPPW59D	01/12/93	Vinyl chloride	1 U
34858009	CRPPW59D	01/12/93	Chloroethane	1 U
34858009	CRPPW59D	01/12/93	Methylene chloride	2 U
34858009	CRPPW59D	01/12/93	Acetone	5 U
34858009	CRPPW59D	01/12/93	Carbon disulfide	1 U
34858009	CRPPW59D	01/12/93	1,1-Dichloroethene	1 U
34858009	CRPPW59D	01/12/93	1,1-Dichloroethane	1 U
34858009	CRPPW59D	01/12/93	cis-1,2-Dichloroethene	1 U
34858009	CRPPW59D	01/12/93	trans-1,2-Dichloroethene	1 U
34858009	CRPPW59D	01/12/93	Chloroform	12 U
34858009	CRPPW59D	01/12/93	1,2-Dichloroethane	1 U
34858009	CRPPW59D	01/12/93	2-Butanone	5 U
34858009	CRPPW59D	01/12/93	1,1,1-Trichloroethane	1 U
34858009	CRPPW59D	01/12/93	Carbon tetrachloride	1 U
34858009	CRPPW59D	01/12/93	Bromodichloromethane	16
34858009	CRPPW59D	01/12/93	1,2-Dichloropropane	1 U
34858009	CRPPW59D	01/12/93	cis-1,3-Dichloropropane	1 U
34858009	CRPPW59D	01/12/93	Trichloroethene	1 U
34858009	CRPPW59D	01/12/93	Dibromochloromethane	14
34858009	CRPPW59D	01/12/93	1,1,2-Trichloroethane	1 U
34858009	CRPPW59D	01/12/93	Benzene	1 U
34858009	CRPPW59D	01/12/93	trans-1,3-Dichloropropene	1 U
34858009	CRPPW59D	01/12/93	Bromoform	2
34858009	CRPPW59D	01/12/93	2-Hexanone	5 U
34858009	CRPPW59D	01/12/93	4-Methyl-2-pentanone	5 U
34858009	CRPPW59D	01/12/93	Tetrachloroethene	1 U
34858009	CRPPW59D	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858009	CRPPW59D	01/12/93	Toluene	1 U
34858009	CRPPW59D	01/12/93	Chlorobenzene	1 U
34858009	CRPPW59D	01/12/93	Ethylbenzene	1 U
34858009	CRPPW59D	01/12/93	Styrene	1 U
34858009	CRPPW59D	01/12/93	Xylenes (total)	1 U
34858009	CRPPW59D	01/12/93	1,3-Dichlorobenzene	1 U
34858009	CRPPW59D	01/12/93	1,4-Dichlorobenzene	1 U
34858009	CRPPW59D	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/15/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34874001	CRPPW60	01/13/93	Chloromethane	1 U
34874001	CRPPW60	01/13/93	Bromomethane	1 U
34874001	CRPPW60	01/13/93	Vinyl chloride	1 U
34874001	CRPPW60	01/13/93	Chloroethane	1 U
34874001	CRPPW60	01/13/93	Methylene chloride	2 U
34874001	CRPPW60	01/13/93	Acetone	21 U
34874001	CRPPW60	01/13/93	Carbon disulfide	150
34874001	CRPPW60	01/13/93	1,1-Dichloroethene	1 U
34874001	CRPPW60	01/13/93	1,1-Dichloroethane	1 U
34874001	CRPPW60	01/13/93	cis-1,2-Dichloroethene	1 U
34874001	CRPPW60	01/13/93	trans-1,2-Dichloroethene	1 U
34874001	CRPPW60	01/13/93	Chloroform	1 U
34874001	CRPPW60	01/13/93	1,2-Dichloroethane	1 U
34874001	CRPPW60	01/13/93	2-Butanone	5 U
34874001	CRPPW60	01/13/93	1,1,1-Trichloroethane	1 U
34874001	CRPPW60	01/13/93	Carbon tetrachloride	1 U
34874001	CRPPW60	01/13/93	Bromodichloromethane	1 U
34874001	CRPPW60	01/13/93	1,2-Dichloropropane	1 U
34874001	CRPPW60	01/13/93	cis-1,3-Dichloropropane	1 U
34874001	CRPPW60	01/13/93	Trichloroethene	1 U
34874001	CRPPW60	01/13/93	Dibromochloromethane	1 U
34874001	CRPPW60	01/13/93	1,1,2-Trichloroethane	1 U
34874001	CRPPW60	01/13/93	Benzene	1 U
34874001	CRPPW60	01/13/93	trans-1,3-Dichloropropene	1 U
34874001	CRPPW60	01/13/93	Bromoform	1 U
34874001	CRPPW60	01/13/93	2-Hexanone	5 U
34874001	CRPPW60	01/13/93	4-Methyl-2-pentanone	5 U
34874001	CRPPW60	01/13/93	Tetrachloroethene	1 U
34874001	CRPPW60	01/13/93	1,1,2,2-Tetrachloroethane	1 U
34874001	CRPPW60	01/13/93	Toluene	1 U
34874001	CRPPW60	01/13/93	Chlorobenzene	1 U
34874001	CRPPW60	01/13/93	Ethylbenzene	1 U
34874001	CRPPW60	01/13/93	Styrene	1 U
34874001	CRPPW60	01/13/93	Xylenes (total)	1 U
34874001	CRPPW60	01/13/93	1,3-Dichlorobenzene	1 U
34874001	CRPPW60	01/13/93	1,4-Dichlorobenzene	1 U
34874001	CRPPW60	01/13/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/25/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34874002	CRPPW55D	01/13/93	Chloromethane	1 U
34874002	CRPPW55D	01/13/93	Bromomethane	1 U
34874002	CRPPW55D	01/13/93	Vinyl chloride	1 U
34874002	CRPPW55D	01/13/93	Chloroethane	1 U
34874002	CRPPW55D	01/13/93	Methylene chloride	2 U
34874002	CRPPW55D	01/13/93	Acetone	32 U
34874002	CRPPW55D	01/13/93	Carbon disulfide	1 U
34874002	CRPPW55D	01/13/93	1,1-Dichloroethene	1 U
34874002	CRPPW55D	01/13/93	1,1-Dichloroethane	1 U
34874002	CRPPW55D	01/13/93	cis-1,2-Dichloroethene	1 U
34874002	CRPPW55D	01/13/93	trans-1,2-Dichloroethene	1 U
34874002	CRPPW55D	01/13/93	Chloroform	1 U
34874002	CRPPW55D	01/13/93	1,2-Dichloroethane	1 U
34874002	CRPPW55D	01/13/93	2-Butanone	5 U
34874002	CRPPW55D	01/13/93	1,1,1-Trichloroethane	1 U
34874002	CRPPW55D	01/13/93	Carbon tetrachloride	1 U
34874002	CRPPW55D	01/13/93	Bromodichloromethane	1 U
34874002	CRPPW55D	01/13/93	1,2-Dichloropropane	1 U
34874002	CRPPW55D	01/13/93	cis-1,3-Dichloropropane	1 U
34874002	CRPPW55D	01/13/93	Trichloroethene	1 U
34874002	CRPPW55D	01/13/93	Dibromochloromethane	1 U
34874002	CRPPW55D	01/13/93	1,1,2-Trichloroethane	1 U
34874002	CRPPW55D	01/13/93	Benzene	1 U
34874002	CRPPW55D	01/13/93	trans-1,3-Dichloropropene	1 U
34874002	CRPPW55D	01/13/93	Bromoform	1 U
34874002	CRPPW55D	01/13/93	2-Hexanone	5 U
34874002	CRPPW55D	01/13/93	4-Methyl-2-pentanone	5 U
34874002	CRPPW55D	01/13/93	Tetrachloroethene	1 U
34874002	CRPPW55D	01/13/93	1,1,2,2-Tetrachloroethane	1 U
34874002	CRPPW55D	01/13/93	Toluene	1 U
34874002	CRPPW55D	01/13/93	Chlorobenzene	1 U
34874002	CRPPW55D	01/13/93	Ethylbenzene	1 U
34874002	CRPPW55D	01/13/93	Styrene	1 U
34874002	CRPPW55D	01/13/93	Xylenes (total)	1 U
34874002	CRPPW55D	01/13/93	1,3-Dichlorobenzene	1 U
34874002	CRPPW55D	01/13/93	1,4-Dichlorobenzene	1 U
34874002	CRPPW55D	01/13/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/25/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34874003	CRPPW61	01/13/93	Chloromethane	1 U
34874003	CRPPW61	01/13/93	Bromomethane	1 U
34874003	CRPPW61	01/13/93	Vinyl chloride	1 U
34874003	CRPPW61	01/13/93	Chloroethane	1 U
34874003	CRPPW61	01/13/93	Methylene chloride	2 U
34874003	CRPPW61	01/13/93	Acetone	14 U
34874003	CRPPW61	01/13/93	Carbon disulfide	1 U
34874003	CRPPW61	01/13/93	1,1-Dichloroethene	1 U
34874003	CRPPW61	01/13/93	1,1-Dichloroethane	1 U
34874003	CRPPW61	01/13/93	cis-1,2-Dichloroethene	1 U
34874003	CRPPW61	01/13/93	trans-1,2-Dichloroethene	1 U
34874003	CRPPW61	01/13/93	Chloroform	1 U
34874003	CRPPW61	01/13/93	1,2-Dichloroethane	1 U
34874003	CRPPW61	01/13/93	2-Butanone	5 U
34874003	CRPPW61	01/13/93	1,1,1-Trichloroethane	1 U
34874003	CRPPW61	01/13/93	Carbon tetrachloride	1 U
34874003	CRPPW61	01/13/93	Bromodichloromethane	1 U
34874003	CRPPW61	01/13/93	1,2-Dichloropropane	1 U
34874003	CRPPW61	01/13/93	cis-1,3-Dichloropropane	1 U
34874003	CRPPW61	01/13/93	Trichloroethene	1 U
34874003	CRPPW61	01/13/93	Dibromochloromethane	1 U
34874003	CRPPW61	01/13/93	1,1,2-Trichloroethane	1 U
34874003	CRPPW61	01/13/93	Benzene	1 U
34874003	CRPPW61	01/13/93	trans-1,3-Dichloropropene	1 U
34874003	CRPPW61	01/13/93	Bromoform	1 U
34874003	CRPPW61	01/13/93	2-Hexanone	5 U
34874003	CRPPW61	01/13/93	4-Methyl-2-pentanone	5 U
34874003	CRPPW61	01/13/93	Tetrachloroethene	1 U
34874003	CRPPW61	01/13/93	1,1,2,2-Tetrachloroethane	1 U
34874003	CRPPW61	01/13/93	Toluene	1 U
34874003	CRPPW61	01/13/93	Chlorobenzene	1 U
34874003	CRPPW61	01/13/93	Ethylbenzene	1 U
34874003	CRPPW61	01/13/93	Styrene	1 U
34874003	CRPPW61	01/13/93	Xylenes (total)	1 U
34874003	CRPPW61	01/13/93	1,3-Dichlorobenzene	1 U
34874003	CRPPW61	01/13/93	1,4-Dichlorobenzene	1 U
34874003	CRPPW61	01/13/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/25/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34874004	CRPPW61D	01/13/93	Chloromethane	1 U
34874004	CRPPW61D	01/13/93	Bromomethane	1 U
34874004	CRPPW61D	01/13/93	Vinyl chloride	1 U
34874004	CRPPW61D	01/13/93	Chloroethane	1 U
34874004	CRPPW61D	01/13/93	Methylene chloride	2 U
34874004	CRPPW61D	01/13/93	Acetone	16 U
34874004	CRPPW61D	01/13/93	Carbon disulfide	1 U
34874004	CRPPW61D	01/13/93	1,1-Dichloroethene	1 U
34874004	CRPPW61D	01/13/93	1,1-Dichloroethane	1 U
34874004	CRPPW61D	01/13/93	cis-1,2-Dichloroethene	1 U
34874004	CRPPW61D	01/13/93	trans-1,2-Dichloroethene	1 U
34874004	CRPPW61D	01/13/93	Chloroform	1 U
34874004	CRPPW61D	01/13/93	1,2-Dichloroethane	1 U
34874004	CRPPW61D	01/13/93	2-Butanone	5
34874004	CRPPW61D	01/13/93	1,1,1-Trichloroethane	1 U
34874004	CRPPW61D	01/13/93	Carbon tetrachloride	1 U
34874004	CRPPW61D	01/13/93	Bromodichloromethane	1 U
34874004	CRPPW61D	01/13/93	1,2-Dichloropropane	1 U
34874004	CRPPW61D	01/13/93	cis-1,3-Dichloropropane	1 U
34874004	CRPPW61D	01/13/93	Trichloroethene	1 U
34874004	CRPPW61D	01/13/93	Dibromochloromethane	1 U
34874004	CRPPW61D	01/13/93	1,1,2-Trichloroethane	1 U
34874004	CRPPW61D	01/13/93	Benzene	1 U
34874004	CRPPW61D	01/13/93	trans-1,3-Dichloropropene	1 U
34874004	CRPPW61D	01/13/93	Bromoform	1 U
34874004	CRPPW61D	01/13/93	2-Hexanone	5 U
34874004	CRPPW61D	01/13/93	4-Methyl-2-pentanone	5 U
34874004	CRPPW61D	01/13/93	Tetrachloroethene	1 U
34874004	CRPPW61D	01/13/93	1,1,2,2-Tetrachloroethane	1 U
34874004	CRPPW61D	01/13/93	Toluene	1 U
34874004	CRPPW61D	01/13/93	Chlorobenzene	1 U
34874004	CRPPW61D	01/13/93	Ethylbenzene	1 U
34874004	CRPPW61D	01/13/93	Styrene	1 U
34874004	CRPPW61D	01/13/93	Xylenes (total)	1 U
34874004	CRPPW61D	01/13/93	1,3-Dichlorobenzene	1 U
34874004	CRPPW61D	01/13/93	1,4-Dichlorobenzene	1 U
34874004	CRPPW61D	01/13/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/25/93

Dilution Factor: 1.0

VALIDATED DATA FOR OFF-SITE PRIVATE IRRIGATION WELL SAMPLES

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34874005	CRPPW62	01/13/93	Chloromethane	1 U
34874005	CRPPW62	01/13/93	Bromomethane	1 U
34874005	CRPPW62	01/13/93	Vinyl chloride	1 U
34874005	CRPPW62	01/13/93	Chloroethane	1 U
34874005	CRPPW62	01/13/93	Methylene chloride	2 U
34874005	CRPPW62	01/13/93	Acetone	5 U
34874005	CRPPW62	01/13/93	Carbon disulfide	3
34874005	CRPPW62	01/13/93	1,1-Dichloroethene	1 U
34874005	CRPPW62	01/13/93	1,1-Dichloroethane	1 U
34874005	CRPPW62	01/13/93	cis-1,2-Dichloroethene	1 U
34874005	CRPPW62	01/13/93	trans-1,2-Dichloroethene	1 U
34874005	CRPPW62	01/13/93	Chloroform	1 U
34874005	CRPPW62	01/13/93	1,2-Dichloroethane	1 U
34874005	CRPPW62	01/13/93	2-Butanone	5 U
34874005	CRPPW62	01/13/93	1,1,1-Trichloroethane	1 U
34874005	CRPPW62	01/13/93	Carbon tetrachloride	1 U
34874005	CRPPW62	01/13/93	Bromodichloromethane	1 U
34874005	CRPPW62	01/13/93	1,2-Dichloropropane	1 U
34874005	CRPPW62	01/13/93	cis-1,3-Dichloropropane	1 U
34874005	CRPPW62	01/13/93	Trichloroethene	1 U
34874005	CRPPW62	01/13/93	Dibromochloromethane	1 U
34874005	CRPPW62	01/13/93	1,1,2-Trichloroethane	1 U
34874005	CRPPW62	01/13/93	Benzene	1 U
34874005	CRPPW62	01/13/93	trans-1,3-Dichloropropene	1 U
34874005	CRPPW62	01/13/93	Bromoform	1 U
34874005	CRPPW62	01/13/93	2-Hexanone	5 U
34874005	CRPPW62	01/13/93	4-Methyl-2-pentanone	5 U
34874005	CRPPW62	01/13/93	Tetrachloroethene	1 U
34874005	CRPPW62	01/13/93	1,1,2,2-Tetrachloroethane	1 U
34874005	CRPPW62	01/13/93	Toluene	1 U
34874005	CRPPW62	01/13/93	Chlorobenzene	1 U
34874005	CRPPW62	01/13/93	Ethylbenzene	1 U
34874005	CRPPW62	01/13/93	Styrene	1 U
34874005	CRPPW62	01/13/93	Xylenes (total)	1 U
34874005	CRPPW62	01/13/93	1,3-Dichlorobenzene	1 U
34874005	CRPPW62	01/13/93	1,4-Dichlorobenzene	1 U
34874005	CRPPW62	01/13/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/26/93

Dilution Factor: 1.0

**Trip Blanks  
Rinsate Blanks  
Source Water Blanks  
March 1993**

PROJECT: NSB KINGSBAY, GEORGIA  
 PARAMETER: VOLATILE AQUEOUS ANALYSES (ug/l)

VALIDATION SUMMARY TABLE

SAMPLE NUMBER:	BT118FB	BT119FB	BT120FB	BS126ER	BS130ER	BS131ER
LAB NUMBER:	35388K05	35433K01	35442K01	35388002	35433K02	35442K04
DATE SAMPLED:	03/17/93	03/22/93	03/23/93	03/17/93	03/22/93	03/23/93
DATE ANALYZED:	03/23/93	03/29/93	03/30/93	03/23/93	03/29/93	03/30/93
DILUTION FACTOR:	1	1	1	1	1	1

Compound	CRQL	BT118FB	BT119FB	BT120FB	BS126ER	BS130ER	BS131ER
Chloromethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	1	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	2	2 U	2 U	2 U	2 U	2 U	2 U
Acetone	5	5 U	5 U	5 U	33 J	5 U	13
Carbon disulfide	1	1 U	1 U	1 U	2 U	1 U	1 U
1,1-Dichloroethene	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	5	5 U	5 U	5 U	5 U	5 U	5 U
1,1,1-Trichloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	1	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1	1 U	1 U	1 U	1 U	1 U	1 U
2-Hexanone	5	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-Pentanone	5	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1	1 U	1 U	1 U	1 U	1	1 U
Ethylbenzene	1	1 U	1 U	1 U	1 U	1 U	1 U
Styrene	1	1 U	1 U	1 U	1 U	1 U	1 U
Xylene (total)	1	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	1	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	1	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1	1 U	1 U	1 U	1 U	1 U	1 U

PROJECT: NSB KINGSBAY, GEORGIA  
 PARAMETER: VOLATILE AQUEOUS ANALYSES (ug/l)

VALIDATION SUMMARY TABLE

SAMPLE NUMBER:	BS113FB	BS114FB
LAB NUMBER:	35388003	35388004
DATE SAMPLED:	03/17/93	03/17/93
DATE ANALYZED:	03/23/93	03/23/93
DILUTION FACTOR:	1	1

Compound	CRQL		
Chloromethane	1	1 U	1 U
Bromomethane	1	1 U	1 U
Vinyl chloride	1	1 U	1 U
Chloroethane	1	1 U	1 U
Methylene chloride	2	2 U	2 U
Acetone	5	5 U	5 U
Carbon disulfide	1	1 U	1 U
1,1-Dichloroethene	1	1 U	1 U
1,1-Dichloroethane	1	1 U	1 U
cis-1,2-Dichloroethene	1	1 U	1 U
trans-1,2-Dichloroethene	1	1 U	1 U
Chloroform	1	1 U	34
1,2-Dichloroethane	1	1 U	1 U
2-Butanone	5	5 U	5 U
1,1,1-Trichloroethane	1	1 U	1 U
Carbon Tetrachloride	1	1 U	1 U
Bromodichloromethane	1	1 U	26
1,2-Dichloropropane	1	1 U	1 U
cis-1,3-Dichloropropene	1	1 U	1 U
Trichloroethene	1	1 U	1 U
Dibromochloromethane	1	1 U	15
1,1,2-Trichloroethane	1	1 U	1 U
Benzene	1	1 U	1 U
trans-1,3-Dichloropropene	1	1 U	1 U
Bromoform	1	1 U	2
2-Hexanone	5	5 U	5 U
4-Methyl-2-Pentanone	5	5 U	5 U
Tetrachloroethene	1	1 U	1 U
1,1,2,2-Tetrachloroethane	1	1 U	1 U
Toluene	1	1 U	1 U
Chlorobenzene	1	1 U	1 U
Ethylbenzene	1	1 U	1 U
Styrene	1	1 U	1 U
Xylene (total)	1	1 U	1 U
1,3-Dichlorobenzene	1	1 U	1 U
1,4-Dichlorobenzene	1	1 U	1 U
1,2-Dichlorobenzene	1	1 U	1 U

B-17

**Trip Blank**  
**January 1993**

VALIDATED DATA FOR OFF-SITE TRIP BLANK SAMPLE

Lab Number	Location	Date Collected	Parameter	Concentration (ug/l)
34858K10	TRIP BLANK	01/12/93	Chloromethane	1 U
34858K10	TRIP BLANK	01/12/93	Bromomethane	1 U
34858K10	TRIP BLANK	01/12/93	Vinyl chloride	1 U
34858K10	TRIP BLANK	01/12/93	Chloroethane	1 U
34858K10	TRIP BLANK	01/12/93	Methylene chloride	2 U
34858K10	TRIP BLANK	01/12/93	Acetone	5 U
34858K10	TRIP BLANK	01/12/93	Carbon disulfide	1 U
34858K10	TRIP BLANK	01/12/93	1,1-Dichloroethene	1 U
34858K10	TRIP BLANK	01/12/93	1,1-Dichloroethane	1 U
34858K10	TRIP BLANK	01/12/93	cis-1,2-Dichloroethene	1 U
34858K10	TRIP BLANK	01/12/93	trans-1,2-Dichloroethene	1 U
34858K10	TRIP BLANK	01/12/93	Chloroform	22
34858K10	TRIP BLANK	01/12/93	1,2-Dichloroethane	1 U
34858K10	TRIP BLANK	01/12/93	2-Butanone	5 U
34858K10	TRIP BLANK	01/12/93	1,1,1-Trichloroethane	1 U
34858K10	TRIP BLANK	01/12/93	Carbon tetrachloride	1 U
34858K10	TRIP BLANK	01/12/93	Bromodichloromethane	1 U
34858K10	TRIP BLANK	01/12/93	1,2-Dichloropropane	1 U
34858K10	TRIP BLANK	01/12/93	cis-1,3-Dichloropropane	1 U
34858K10	TRIP BLANK	01/12/93	Trichloroethene	1 U
34858K10	TRIP BLANK	01/12/93	Dibromochloromethane	1 U
34858K10	TRIP BLANK	01/12/93	1,1,2-Trichloroethane	1 U
34858K10	TRIP BLANK	01/12/93	Benzene	1 U
34858K10	TRIP BLANK	01/12/93	trans-1,3-Dichloropropene	1 U
34858K10	TRIP BLANK	01/12/93	Bromoform	1 U
34858K10	TRIP BLANK	01/12/93	2-Hexanone	5 U
34858K10	TRIP BLANK	01/12/93	4-Methyl-2-pentanone	5 U
34858K10	TRIP BLANK	01/12/93	Tetrachloroethene	1 U
34858K10	TRIP BLANK	01/12/93	1,1,2,2-Tetrachloroethane	1 U
34858K10	TRIP BLANK	01/12/93	Toluene	1 U
34858K10	TRIP BLANK	01/12/93	Chlorobenzene	1 U
34858K10	TRIP BLANK	01/12/93	Ethylbenzene	1 U
34858K10	TRIP BLANK	01/12/93	Styrene	1 U
34858K10	TRIP BLANK	01/12/93	Xylenes (total)	1 U
34858K10	TRIP BLANK	01/12/93	1,3-Dichlorobenzene	1 U
34858K10	TRIP BLANK	01/12/93	1,4-Dichlorobenzene	1 U
34858K10	TRIP BLANK	01/12/93	1,2-Dichlorobenzene	1 U

Date Analyzed: 01/14/93

Dilution Factor: 1.0

## **Appendix C**

### **Precision, Accuracy, Representativeness, Comparability, and Completeness (PARCC) Report for Off-site Analytical Data**



**HEARTLAND ENVIRONMENTAL SERVICES, INC.**

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**PRECISION, ACCURACY, REPRESENTATIVENESS**

**COMPARABILITY, AND COMPLETENESS**

**NSB KINGSBAY**

SDG 34858  
34874

Draft  
Revision 1.1  
February 4, 1993

## **I. Analytical Precision**

Duplicate samples should be evaluated for precision only when contaminants are detected in both the sample and the sample duplicate. However, due to the low Contract Required Quantitation Limits (CRQLs) required in the Scope of Work and the low levels of contamination found at the site, duplicates may not exhibit positive results for all compounds found at or below the SOW CRQL. Those duplicates with Relative Percent Differences (RPDs) within control limits indicate good sampling and analytical precision. Duplicates with RPDs outside the control limits may result from inappropriate sampling procedures, matrix interferences, or non-homogeneity of the sample matrix. In addition, poor precision can be attributed to deviations in the methodology or to poor reproducibility of target analyte concentrations at or near the detection limit (CRQL or IDL).

The acceptance criteria for field duplicates is 20% RPD for water matrices and 35% RPD for soil matrices. The results for the field duplicate precision and duplicate frequency are given in Table 1.1. As shown in this table, all compounds found at concentrations greater than 10X the CRQL (1  $\mu\text{g/L}$ ), are within the RPD limits. The two (2) RPDs that do not meet the RPD limit are at or below the SOW CRQL (5  $\mu\text{g/L}$ ), but above the contractual CRQL for NBS Kingsbay. The RPDs for all compounds found at or below the SOW CRQL are considered to be in control because of the very low concentration of the compounds found in the samples and associated duplicates. No action is required for duplicate precision.

The results of the matrix spike and matrix spike duplicate analysis for volatiles, found in Table 1.2, indicate that all of the RPDs are within QA/QC limits. The acceptable RPDs represent good method performance and little or no matrix interference.

## **II. Analytical Accuracy**

The volatile recovery results for the matrix spike and matrix spike duplicates were all within the QA/QC limits. The accuracy of the results indicate that the method performance was acceptable and the matrix did not interfere with the analysis.

The calibration results for the volatile analyses were in control throughout the duration of the project. As expected, criteria and non criteria calibration compounds did not meet the 30% RSD and 25% D criteria in the calibrations. The volatile calibrations exhibited a loss in sensitivity for two (2) of the ketones. For the compounds in the volatile analysis that did not meet calibration criteria, qualifications were only required for positive results. All positive results that are qualified as estimated (J) due to calibration deficiencies are considered to be useable.

The analytical blanks associated with the volatile analysis contained detectable concentrations of methylene chloride, which are summarized in Table 1.4. Methylene chloride and acetone are common laboratory solvents and are frequently found in laboratory method blanks. Method blank contamination that is observed in the samples is evaluated per the criteria found in the Blank Summary following this narrative. The laboratory contamination noted in the method blanks and the samples is common and does not result in rejection of data.

The one (1) trip blank contained a detectable concentration of one (1) of the trihalomethanes (THMs), chloroform, and a compound that was attributed to method blank contamination. Trihalomethanes are products of the water treatment process and are usually only found in treated water, i.e. treated drinking water. The one (1) trip blank resulted in sample qualification (See Table 1.5). All data qualified for trip blank contamination is considered to be useable. In addition, due to the sample medium and sampling techniques, rinseate blanks and field blanks were not required for this sampling event.

### **III. Analytical Representativeness**

For the volatile analysis, all analysis holding times, tuning criteria, internal standard EICP areas and surrogate recoveries met the QA/QC criteria.

The volatile analyses indicated possible laboratory and/or field contamination for acetone in field samples whose associated method blank was devoid of contamination. Due to the history of the NSB Kingsbay site and the expected contaminants, acetone may or may not be a compound of concern. The acetone results found in the field samples are of low concentration (all less than 23  $\mu\text{g/L}$ ) and may be due to laboratory and/or field contamination. Two (2) samples, CRP-PW59 and CRP-PW59D exhibited positive results for three (3) of the THMs. The THMs can be attributed to the water treatment process. All samples analyzed during this sampling event, except as noted above, are considered to be useable without bias qualifications, either negative or positive.

**IV. Comparability**

ABB Environmental Services did not contract two (2) or more laboratories for this project. Although certain methodologies contain different aspects that can be compared, i.e. TIC results for volatiles with TCL results for semivolatiles, the data generated for this project cannot be compared due to the analysis requested.

**V. Completeness**

Completeness is the quantitative measure of the amount of data obtained from a measurement process compared with the amount expected to be obtained under the conditions of measurement.

The completeness goal for laboratory analysis for this project was 95% useable data. Unusable analytical data are those results reported by the laboratory but rejected during the data validation process. For the private monitoring wells, the analytical completeness was determined to be 100%.

SAMPLE EVENT DATA VALIDATION SUMMARY TABLE					
SDG	PRECISION	ACCURACY	REPRESENT- ATIVENESS	COMPLETENESS	COMPARIBILITY
34858	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	NOT APPLICABLE
34874	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	NOT APPLICABLE

# **PRECISION AND ACCUARCY**

## **FIELD DUPLICATE RESULTS**

**AND**

## **MS/MSD RESULTS**

### **TABLES:**

- 1.1
- 1.2

**FIELD DUPLICATE PRECISION - TABLE 1.1  
VOLATILES**

SDG	SAMPLE ID	MATRIX	NO. ASSC. SAMPLES	COMPOUND	SAMPLE CONC.	DUP CONC	MAX RPD	RPD	RPD OUT
34858	CRP-PW59	WATER	8	BROMODICHLOROMETHANE	16	16	20%	0.0%	0
				DIBROMOCHLOROMETHANE	14	14	20%	0.0%	0
				BROMOFORM	3	2	20%	40.0%	1
34874	CRP-PW61	WATER	4	2-BUTANONE	0	5	20%	200.0%	1

% OF DUPLICATES COLLECTED	RPD IN	RPD OUT	% WITHIN RPD LIMIT
16.7%	2	2	50.0%

**MATRIX SPIKE/MATRIX SPIKE DUPLICATE - TABLE 1.2**  
**VOLATILE SUMMARY TABLE**

MS = MATRIX SPIKE <i>SAMPLE CRP-PW59</i>		SDG 34858					
MSD = MATRIX SPIKE DUPLICATE		MS			MSD		
RPD = RELATIVE PERCENT DIFFERENCE		UNSPIKED	SPIKED	%R	SPIKED	%R	%RPD
<b>VOA COMPOUNDS</b>	<b>UNITS</b>						
1,1-DICHLOROETHENE	ug/L	U	44.90	90	43.40	87	3
TRICHLOROETHENE	ug/L	U	51.90	104	49.30	99	5
BENZENE	ug/L	U	52.40	105	50.10	100	5
TOLUENE	ug/L	U	54.90	110	51.20	102	8
CHLOROBENZENE	ug/L	U	53.90	108	51.80	104	4

\* DENOTES VALUE NOT WITHIN QA/QC ADVISORY LIMITS

**CORRESPONDING SDG'S WITH ASSOCIATED SAMPLES**

34858: CRP-PW52, CRP-PW53, CRP-PW54, CRP-PW55, CRP-PW56,  
 CRP-PW57, CRP-PW58, CRP-PW59, CRP-WP59D,  
 CRP-PW59MS, CRP-PW59MSD

34874: CRP-PW60, CRP-PW55-D, CRP-PW61, CRP-PW61-D, CRP-PW62

COMPOUND	ADVISORY LIMITS		RPD	
	WATER	SOIL	WATER	SOIL
1,1-DICHLOROETHENE	61%-145%	59%-172%	14	22
TRICHLOROETHENE	71%-120%	62%-137%	14	24
BENZENE	76%-127%	66%-142%	11	21
TOLUENE	76%-125%	59%-139%	13	21
CHLOROBENZENE	75%-130%	60%-133%	13	21

# **CALIBRATION SUMMARY**

**INITIAL CALIBRATION RESULTS**

**AND**

**CONTINUING CALIBRATION RESULTS**

## **TABLES:**

**1.3**

## VOLATILE ORGANIC COMPOUNDS - TABLE 1.3

### INITIAL AND CONTINUING CALIBRATION - %RSD AND %D

<i>ICAL = INITIAL CALIBRATION = %RSD</i> <i>CCAL = CONTINUING CALIBRATION = %D</i>	SDG 34858		
	<b>ICAL</b>	<b>CCAL1</b>	<b>CCAL2</b>
DATE	010493	011593	011593
INSTRUMENT ID	5100	5100	5100
ACETONE	31.1		33.5
2-HEXANONE		25.9	34.0

#### SDG 34858

CCAL1 011593: VBLKW1, CRP-PW52, CRP-PW53, CRP-PW54, CRP-PW55,  
CRP-PW56, CRP-PW57, CRP-PW58, CRP-PW59

CCAL2 011593: VBLKW2, TRIP BLANK, CRP-PW59D, CRP-PW59MS,  
CRP-PW59MSD

<i>ICAL = INITIAL CALIBRATION = %RSD</i> <i>CCAL = CONTINUING CALIBRATION = %D</i>	SDG 34874		
	<b>ICAL</b>	<b>CCAL1</b>	<b>CCAL2</b>
DATE	012493	012593	012693
INSTRUMENT ID	5100	5100	5100
ACETONE	80.9		38.8
2-HEXANONE		-31.9	28.9
2-BUTANONE		-43.3	
4-METHYL-2-PENTANONE			28.6

#### SDG 34874

CCAL1 012593: VBLKW1, CRP-PW60, CRP-PW55-D, CRP-PW61,  
CRP-PW61D

CCAL2 012693: VBLKW2, CRP-PW62

# **BLANK SUMMARY**

**METHOD BLANK RESULTS**

**TRIP BLANK RESULTS**

**RINSEATE BLANK RESULTS**

**AND**

**FIELD BLANK RESULTS**

## **TABLES:**

1.4

1.5

## BLANK VALIDATION QUALIFICATIONS CODES

- CRQL** = The related environmental sample result for the blank contaminant is less than the related environmental sample CRQL and is less than 10X the blank value. The related environmental sample result for the contaminant is rejected and the related environmental sample result for that compound is reported at the CRQL as non detect (U). The non detect value at the CRQL will take into account sample weights, volumes, and/or dilutions.
- U** = The related environmental sample result for the blank contaminant is greater than the related environmental sample CRQL and is less than 10X the blank value. The related environmental sample result for the contaminant is qualified as non detect (U) at the compound value reported. The non detect value will take into account sample weights, volumes, and/or dilutions.
- NA (No Action)** = The related environmental sample result for the blank contaminant is greater than the related environmental sample CRQL and is greater than 10X the blank value. The related environmental sample result for the contaminant is considered to be "real", unless otherwise noted in the PARCCs report or associated data validation narrative. qualified as non detect (U) at the compound value reported. The reported value will take into account sample weights, volumes, and/or dilutions.

## VOLATILE METHOD BLANK SUMMARY - TABLE 1.4

SDG NUMBER	BLANK ID	RELATED ENVIRONMENTAL SAMPLES	CONTAMINANT	MB CONC.	UNITS	VALIDATION QUALIFIER
34858	VBLKW1	CRP-PW52, CRP-PW53, CRP-PW54, CRP-PW55, CRP-PW57, CRP-PW58, CRP-PW59	METHYLENE CHLORIDE	2	ug/L	U
	VBLKW1	CRP-PW56	METHYLENE CHLORIDE	2	ug/L	CRQL
	VBLKW2	CRP-PW59D, CRP-PW59MS, CRP-PW59MSD, TRIP BLANK	METHYLENE CHLORIDE	2	ug/L	U
34874	VBLKW1	CRP-PW60, CRP-PW55-D, CRP-PW61, CRP-PW61-D	METHYLENE CHLORIDE	1	ug/L	CRQL
	VBLKW1	CRP-PW60, CRP-PW55-D, CRP-PW61, CRP-PW61-D	ACETONE	3	ug/L	U
	VBLKW2	CRP-PW62	METHYLENE CHLORIDE	1	ug/L	



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**PRECISION, ACCURACY, REPRESENTATIVENESS**

**COMPARABILITY, AND COMPLETENESS**

**NSB KINGSBAY**

Draft  
Revision 1.0  
April 15, 1993  
HESI PARCCs Release Number: 3  
Prepared by: Heartland ESI

## **I. Analytical Precision**

Duplicate samples should be evaluated for precision only when contaminants are detected in both the sample and the sample duplicate. However, due to the low Contract Required Quantitation Limits (CRQLs) required in the Scope of Work and the low levels of contamination found at the site, duplicates may not exhibit positive results for all compounds found at or below the SOW CRQL. Those duplicates with Relative Percent Differences (RPDs) within control limits indicate good sampling and analytical precision. Duplicates with RPDs outside the control limits may result from inappropriate sampling procedures, matrix interferences, or non-homogeneity of the sample matrix. In addition, poor precision can be attributed to deviations in the methodology or to poor reproducibility of target analyte concentrations at or near the detection limit (CRQL or IDL).

The acceptance criteria for field duplicates is 20% RPD for water matrices and 35% RPD for soil matrices. The results for the field duplicate precision and duplicate frequency are given in Table 1.1.0.0. As shown in this table, one (1) of the compounds, carbon disulfide, found at a concentration greater than 10X the CRQL (1  $\mu\text{g/L}$ ) is not within RPD control limits. The slightly high RPD (22.2%) can be attributed to the required dilution of the sample, 11G15230 and its duplicate, 11G15230D. The carbon disulfide results in the original undiluted analyses produced a RPD of 9.1%; whereas, the diluted analyses yielded the RPD result of 22.2%. Therefore, the variation in the carbon disulfide results in the diluted samples is most likely due to limited laboratory contamination (as noted in the associated method blanks). No action is required for duplicate precision.

The results of the matrix spike and matrix spike duplicate analysis for volatiles, found in Table 1.2.0.0, indicate that all of the RPDs are within QA/QC limits. The acceptable RPDs represent good method performance and little or no matrix interference.

## **II. Analytical Accuracy**

The volatile recovery results for the matrix spike and matrix spike duplicates were all within the QA/QC limits. The accuracy of the results indicate that the method performance was acceptable and the matrix did not interfere with the analysis.

The calibration results for the volatile analyses were in control throughout the duration of the project. As expected, criteria and non criteria calibration compounds did not meet the 25% D criteria in the calibrations. The volatile calibrations exhibited a loss in sensitivity for three (3) of the ketones. For the compounds in the volatile analysis that did not meet calibration criteria, all positive results that are qualified as estimated (J) due to calibration deficiencies. All results qualified for calibration deficiencies are considered to be useable.

The two (2) of the four (4) analytical blanks associated with the volatile analysis contained detectable concentrations of methylene chloride and carbon disulfide, which are summarized in Table 1.4.0. Methylene chloride and carbon disulfide are common laboratory solvents and are frequently found in laboratory method blanks. Method blank contamination that is observed in the samples is evaluated per the criteria found in the Blank Summary following this narrative. The laboratory contamination noted in the method blanks and the samples is common and does not result in rejection of data.

The three (3) trip blanks did not contain detectable concentrations of TCLs other than compounds that were attributed to method blank contamination. No qualifications were required for trip blank contamination.

The three (3) rinseate blanks contained detectable concentrations of acetone or toluene. Two (2) of the rinseate blanks resulted in sample qualification (see Table 1.6.0). All data qualified for rinseate blank contamination is considered to be usable.

One (1) of the two (2) field blanks contained a detectable concentrations of all four (4) of the trihalomethanes (THMs). Trihalomethanes are products of the water treatment process and are usually only found in treated water, i.e. treated drinking water. The one (1) field blank that contained the THMs did not result in sample qualification. All data is considered to be useable.

### **III. Analytical Representativeness**

For the volatile analysis, all analysis holding times, tuning criteria, internal standard EICP areas and surrogate recoveries met the QA/QC criteria.

The volatile analyses indicated possible laboratory and/or field contamination for carbon disulfide in field samples whose associated method blank was devoid of contamination. Due to the history of the NSB Kingsbay site and the expected contaminants, carbon disulfide may or may not be a compound of concern. The carbon disulfide results found in the three (3) of the field samples, 11G15030, 11G15030MS, and 11G15030MSD, are of low concentration (all 3  $\mu\text{g/L}$ ) and may be due to laboratory and/or field contamination. In addition, one (1) sample, 11G15885 exhibited positive results for chloroform and toluene at low concentration levels, 2  $\mu\text{g/L}$  and 3  $\mu\text{g/L}$  respectively. Chloroform is a THM and is byproduct of the water treatment process; whereas, toluene is a common laboratory contaminant. All samples analyzed during this sampling event, except as noted above, are considered to be useable without bias qualifications, either negative or positive.

#### **IV. Comparability**

ABB Environmental Services did not contract two (2) or more laboratories for this project. Although certain methodologies contain different aspects that can be compared, i.e. TIC results for volatiles with TCL results for semivolatiles, the data generated for this project cannot be compared due to the analysis requested.

#### **V. Completeness**

Completeness is the quantitative measure of the amount of data obtained from a measurement process compared with the amount expected to be obtained under the conditions of measurement.

The completeness goal for laboratory analysis for this project was 95% useable data. Unusable analytical data are those results reported by the laboratory but rejected during the data validation process. For the groundwater monitoring wells, the analytical completeness was determined to be 100%.

<b>SAMPLE EVENT DATA VALIDATION SUMMARY TABLE NSB KINGSBAY</b>					
<b>SDG</b>	<b>PRECISION</b>	<b>ACCURACY</b>	<b>REPRESENT- ATIVENESS</b>	<b>COMPLETENESS</b>	<b>COMPARABILITY</b>
35388	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE
35433	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE
35442	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE

# **PRECISION AND ACCUARCY**

## **FIELD DUPLICATE RESULTS**

**AND**

## **MS/MSD RESULTS**

### **TABLES:**

1.1.0.0

1.2.0.0

# WATER FIELD DUPLICATE PRECISION - TABLE 1.1.0.0

## VOLATILE

SDG	SAMPLE ID	MATRIX	NO. ASSC. SAMPLES	COMPOUND	SAMPLE CONC.	DUP CONC	MAX RPD	RPD
35388	11G15230	WATER	2	METHYLENE CHLORIDE	37	41	20%	10.3%
				ACETONE	280	310	20%	10.2%
				CARBON DISULFIDE	200	250	20%	22.2%
				1,1-DICHLOROETHANE	12	14	20%	15.4%
				cis-1,2-DICHLOROETHENE	2	2	20%	0.0%
				2-BUTANONE	440	480	20%	8.7%
				TRICHLOROETHENE	3	3	20%	0.0%
				BENZENE	1	1	20%	0.0%
				2-HEXANONE	19	17	20%	11.1%
				4-METHYL-2-PENTANONE	100	110	20%	9.5%
				TOLUENE	720	840	20%	15.4%
				ETHYLBENZENE	16	18	20%	11.8%
				XYLENES (TOTAL)	62	67	20%	7.8%
35433		WATER	1					
35442		WATER	2					

% OF DUPLICATES COLLECTED	RPD IN	RPD OUT	% WITHIN RPD LIMIT
20.0%	12	1	92.3%

**WATER MATRIX SPIKE/MATRIX SPIKE DUPLICATE - TABLE 1.2.0.0  
VOLATILE SUMMARY TABLE**

MS = MATRIX SPIKE <i>SAMPLE 11G15030</i>		SDG 35388		
MSD = MATRIX SPIKE DUPLICATE		MS	MSD	
RPD = RELATIVE PERCENT DIFFERENCE		%R	%R	%RPD
<b>VOA COMPOUNDS</b>	<b>UNITS</b>			
1,1-DICHLOROETHENE	ug/L	90	85	6%
TRICHLOROETHENE	ug/L	108	104	4%
BENZENE	ug/L	95	92	3%
TOLUENE	ug/L	88	87	1%
CHLOROBENZENE	ug/L	94	91	3%

\* DENOTES VALUE NOT WITHIN QA/QC ADVISORY LIMITS

**CORRESPONDING SDG'S WITH ASSOCIATED SAMPLES**

SDG 35388: 11G15030, BS126ER, BS113FB, BS114FB, BT118FB, 11G15230,  
11G15230DL, 11G15230D, 11G15230DDL

SDG 35433: BT119FB, BS130ER, 11G15885, 11G15885DL

SDG 35442: BT120FB, 11G15940, 11G16035, BS1313ER

	WATER		WATER
1,1-DICHLOROETHENE	61%-145%		14
TRICHLOROETHENE	71%-120%		14
BENZENE	76%-127%		11
TOLUENE	76%-125%		13
CHLOROBENZENE	75%-130%		13

**CALIBRATION SUMMARY**

**INITIAL CALIBRATION RESULTS**

**AND**

**CONTINUING CALIBRATION RESULTS**

**TABLES:**

1.3.0

## VOLATILE ORGANIC COMPOUNDS - TABLE 1.3.0

INITIAL AND CONTINUING CALIBRATION - %RSD, %D, AND RRF

<i>ICAL = INITIAL CALIBRATION = %RSD</i>	SDG 35388	SDG 35442
<i>CCAL = CONTINUING CALIBRATION = %D</i>	CCAL1	CCAL1
DATE	3/23/93	03/29/93
INSTRUMENT ID	5100	5100
CALIBRATION CRITERIA	%D	%D
ACETONE	37.2	
CHLOROETHANE	-28.2	
BROMOFORM		-28.7
TETRACHLOROETHENE		-33.3
2-BUTANONE		39.0
2-HEXANONE		27.7

### SDGS, STANDARDS, AND ASSOCIATED SAMPLES

**SDG 35388**

CCAL1: BS126ER, BS113FB, BS114FB, BT118FB, 11G15230, 11G15230D

**SDG 35442**

CCAL1: BT120FB, BS131ER, 11G15940, 11G16035

# **BLANK SUMMARY**

**METHOD BLANK RESULTS**

**TRIP BLANK RESULTS**

**RINSEATE BLANK RESULTS**

**AND**

**FIELD BLANK RESULTS**

## **TABLES:**

**1.4.0**

**1.5.0**

**1.6.0**

**1.7.0**

## BLANK VALIDATION QUALIFICATIONS CODES

- CRQL** = The related environmental sample result for the blank contaminant is less than the related environmental sample CRQL and is less than 10X the blank value. The related environmental sample result for the contaminant is rejected and the related environmental sample result for that compound is reported at the CRQL as non detect (U). The non detect value at the CRQL will take into account sample weights, volumes, and/or dilutions.
- U** = The related environmental sample result for the blank contaminant is greater than the related environmental sample CRQL and is less than 10X the blank value. The related environmental sample result for the contaminant is qualified as non detect (U) at the compound value reported. The non detect value will take into account sample weights, volumes, and/or dilutions.
- NA (No Action)** = The related environmental sample result for the blank contaminant is greater than the related environmental sample CRQL and is greater than 10X the blank value. The related environmental sample result for the contaminant is considered to be "real", unless otherwise noted in the PARCCs report or associated data validation narrative. qualified as non detect (U) at the compound value reported. The reported value will take into account sample weights, volumes, and/or dilutions.

**VOLATILE METHOD BLANK SUMMARY - TABLE 1.4.0**

SDG NUMBER	BLANK ID	RELATED ENVIRONMENTAL SAMPLES	CONTAMINANT	MB CONC.	UNITS	VALIDATION QUALIFIER
35388	VBLKW1	BS113FB, BS114FB, BT118FB	METHYLENE CHLORIDE	1	ug/L	CRQL
		11G15230, 11G15230D	METHYLENE CHLORIDE	1	ug/L	NA
		BS126ER	CARBON DISULFIDE	2	ug/L	U
		11G15230, 11G15230D	CARBON DISULFIDE	2	ug/L	NA
	VBLKW2	11G15030, 11G15030MS, 11G15030MSD, 11G15230DL, 11G15230DDL	NO CONTAMINATION FOUND			
35433	VBLKW1	11G15885, 11G15885DL, BS130ER, BT119FB	NO CONTAMINATION FOUND			
35442	VBLKW1	11G15940, 11G16035, BS131ER, BT120FB	NO CONTAMINATION FOUND			

**VOLATILE TRIP BLANK SUMMARY - TABLE 1.5.0**

<b>SDG NUMBER</b>	<b>BLANK ID</b>	<b>RELATED ENVIRONMENTAL SAMPLES</b>	<b>CONTAMINANT</b>	<b>TB CONC.</b>	<b>UNITS</b>	<b>VALIDATION QUALIFIER</b>
35388	BT118FB	11G15030, 11G15030MS 11G15030MSD, 11G15230, 11G15230D	NO CONTAMINATION FOUND			
35433	BT119FB	11G15885	NO CONTAMINATION FOUND			
35442	BT120FB	11G15940, 11G16035,	NO CONTAMINATION FOUND			

**VOLATILE RINSEATE BLANK SUMMARY - TABLE 1.6.0**

SDG NUMBER	BLANK ID	RELATED ENVIRONMENTAL SAMPLES	CONTAMINANT	RB CONC.	UNITS	VALIDATION QUALIFIER
35388	BS126ER	11G15230, 11G15230D, 11G15230DL, 11D15230DDL	ACETONE	33	ug/L	NA (NO ACTION)
35433	BS130ER	11G15885	CHLOROBENZENE	1		
35442	BS131ER	11G15940 11G16035	ACETONE ACETONE	13 13	ug/L ug/L	CRQL U

**VOLATILE FIELD BLANK SUMMARY - TABLE 1.7.0**

SDG NUMBER	BLANK ID	RELATED ENVIRONMENTAL SAMPLES	CONTAMINANT	FB CONC.	UNITS	VALIDATION QUALIFIER
35388	BS113FB	11G15030, 11G15030MS, 11G15030MSD, 11G15230, 11G15230D	NO CONTAMINATION FOUND			
	BS114FB	11G15030, 11G15030MS, 11G15030MSD, 11G15230, 11G15230D	CHLOROFORM BROMODICHLOROMETHANE CHLORODIBROMOMETHANE BROMOFORM	34 26 15 2	ug/L	

### VOLATILE TRIP BLANK SUMMARY - TABLE 1.5

SDG NUMBER	BLANK ID	RELATED ENVIRONMENTAL SAMPLES	CONTAMINANT	TB CONC.	UNITS	VALIDATION QUALIFIER
34858	TRIP BLANK	CRP-PW59, CRP-PW59D	CHLOROFORM	22	ug/L	U

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