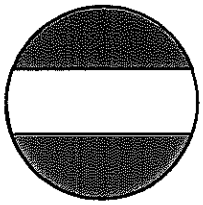

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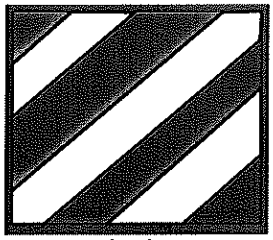


3D Inf Div (Mech)

REVISED FINAL RCRA FACILITY INVESTIGATION REPORT OLD PROPERTY DISPOSAL (PDO) YARD

at

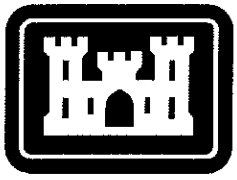
HUNTER ARMY AIRFIELD, GEORGIA

under

Contract No. DACA21-93-D-0049
Delivery Order No. 0020

SEPTEMBER 1999

Submitted to:



U.S. Army Corps
of Engineers
SAVANNAH DISTRICT

Prepared by:

METCALF & EDDY, INC.
NORCROSS, GEORGIA

DOCUMENT 8

Report Certification

I, David Wilderman, certify that I am a qualified groundwater scientist who has received a baccalaureate or post-graduate degree in the natural sciences or engineering, and have sufficient training and experience in groundwater hydrology and related fields, as demonstrated by state registration and completion of accredited university courses, that enable me to make sound professional judgments regarding groundwater monitoring and contaminant fate and transport. I further certify that this report was prepared by myself or by a subordinate working under my direction.

RCRA Facility Investigation Report for the Old Property Disposal (PDO) Yard
Hunter Army Airfield, Georgia

Georgia Registered Professional Geologist No. 978

Signature

Date

David M. Wilderman
METCALF & EDDY, INC.
2 Sun Court at Technology Park
Suite 200
Norcross, Georgia 30092

This Revised Final RCRA Facility Investigation (RFI) Report is subject to release under the Freedom of Information Act (FOIA). Requests for the document must be referred to Commander, U.S. Army Corps of Engineers, PM-H, P. O. Box 889, Savannah, GA 31402-0889.

This Revised Final RFI Report was prepared in accordance with the Statement of Work (SOW) prepared by the United States Army Corps of Engineers (USACE) for the investigation of the Old Property Disposal (PDO) Yard and Building 1310 at Hunter Army Airfield. This document was prepared under the supervision of David Wilderman, P.G., Project Manager.

This document was reviewed and approved by:

David M. Wilderman, P.G.

Project Manager — 9.2.99

Title — Date

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APPENDICES (continued)

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LIST OF ACRONYMS

ADD	-	Average Daily Dose
AOC	-	Area of Concern
ARARs	-	Applicable or Relevant and Appropriate Requirements
AST	-	Aboveground Storage Tank
AT&E	-	Atlanta Testing & Engineering
AWQC	-	Ambient Water Quality Criteria
BAF	-	Bioaccumulation Factor
BCF	-	Bioconcentration Factor
bls	-	below land surface
BRA	-	Baseline Risk Assessment
BTEX	-	Benzene, Toluene, Ethylbenzene and Xylene
BW	-	Body Weight
CAP	-	Corrective Action Plan
CDAP	-	Chemical Data Acquisition Plan
CDI	-	Chronic Daily Intake
CO	-	Consent Order
COC	-	Contaminant of Concern
COPC	-	Contaminants of Potential Concern
CSR	-	Compliance Status Report
CW	-	Chemical Concentration in Water
DAACG	-	Departure and Arrival Control Group
DAF	-	Dilution Attenuation Factor
DNR	-	Department of Natural Resources
DQOs	-	Data Quality Objectives
DQSR	-	Data Quality Summary Report
DRO	-	Diesel Range Organics
ECOPC	-	Ecological Contaminant of Potential Concern
ECOC	-	Ecological Contaminant of Concern
ED	-	Exposure Duration
EF	-	Exposure Frequency
EPA	-	Environmental Protection Agency
EPD	-	Environmental Protection Division
ERA	-	Ecological Risk Assessment
ESV	-	Ecological Screening Value
ET	-	Earth Tech, Inc.
FSWSV	-	Freshwater Surface Water Screening Value
fpd	-	feet per day
feet/sec	-	feet per second
ft/ft	-	feet per feet
GHWMA	-	Georgia's Hazardous Waste Management Act
GRO	-	Gasoline Range Organics
HA	-	Hand Auger

LIST OF ACRONYMS (Continued)

HAAF	-	Hunter Army Air Field
HEAST	-	Health Effects Assessment Summary Tables
HHCOPC	-	Human Health Contaminant of Potential Concern
HI	-	Hazard Index
HP-II	-	Hydropunch II
HQ	-	Hazard Quotient
HSI	-	Hazardous Sites Inventory
HSRA	-	Hazardous Sites Response Act
HW	-	Hazardous Waste
ILCR	-	Increased Lifetime Cancer Risk
IR	-	Interim Removal
IRIS	-	Integrated Risk Information System
IWQS	-	In-stream Water Quality Standards
JP	-	Jet Propulsion
K	-	hydraulic conductivity
K_d	-	partitioning coefficient
K_{oc}	-	organic carbon partitioning coefficient
K_{ow}	-	octanol/water partitioning coefficient
LOAEL	-	Lowest Observable Adverse Effects Level
LT	-	Lifetime
LQL	-	Laboratory Quantitation Limit
MCL	-	Maximum Contaminant Level
M&E	-	Metcalf & Eddy, Inc.
mg/kg	-	milligram per kilogram
msl	-	mean sea level
MW	-	Monitoring Well
NOAEL	-	No Observed Adverse Effect Level
NTU	-	Nephelometric Turbidity Units
OVA	-	Organic Vapor Analyzer
PAH	-	Polynuclear Aromatic Hydrocarbons
PCB	-	Polychlorinated Biphenyl
PCE	-	Tetrachloroethene
PDO	-	Old Property Disposal Yard
PRE	-	Preliminary Risk Evaluation
PRG	-	Preliminary Remediation Goal
PRS	-	Potential Receptor Survey
QAPP	-	Quality Assurance Project Plan
QA/QC	-	Quality Assurance/ Quality Control
RAGS	-	Risk Assessment Guidance for Superfund
RBC	-	Risk-Based Concentration
RCRA	-	Resource Conservation and Recovery Act
RESVS	-	Recommended Ecological Screening Values for Soil

LIST OF ACRONYMS (Continued)

RfD	-	Reference Dose
RFI	-	RCRA Facility Investigation
RL	-	Remedial Level
RME	-	Reasonable Maximum Exposure
RRS	-	Risk Reduction Standards
SAIC	-	Science Applications International Corporation
SAV	-	Savannah District
SB	-	Soil Boring
SDWA	-	Safe Drinking Water Act
SF	-	Slope Factor
SOW	-	Scope of Work
SRC	-	Site Related Contaminant
SSL	-	Soil Screening Level
SSV	-	Sediment Screening Value
SVOC	-	Semivolatile organic compound
TPH		Total petroleum hydrocarbons
TRV	-	Toxicity Reference Value
µg/L	-	micrograms/liter
UCL	-	Upper Confidence Limit
USACE	-	United States Army Corps of Engineers
USAEHA	-	United States Army Environmental Hygiene Agency
USDA	-	United States Department of Agriculture
USGS	-	United States Geological Survey
VOC	-	Volatile Organic Compound
WDES	-	Waste Disposal Engineering Study
	-	

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EXECUTIVE SUMMARY

Metcalf & Eddy, Incorporated (M&E) conducted a Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) at the old Property Disposal (PDO) Yard at Hunter Army Airfield (HAAF), Georgia under a contract with the United States Army Corps of Engineers (USACE), Savannah District (SAV). HAAF is a subinstallation of nearby Fort Stewart which is located approximately 30 miles southwest of Savannah. The RFI was conducted to respond to a Consent Order (CO) issued to Fort Stewart for deficiencies observed at the PDO Yard and several other HAAF locations. Three new above-ground storage tanks (ASTs) located inside a concrete containment structure, a 90-day hazardous waste storage area, and several paved open storage bays are located within the PDO Yard.

M&E performed the site investigation at the PDO Yard in two phases. M&E's Phase I investigation was summarized in a Final RFI Report that was submitted to the Georgia Department of Natural Resources (DNR), Environmental Protection Division (EPD), Hazardous Waste Management Branch (hereafter referred to as GA EPD) in April 1998. The GA EPD summarized their comments on the Final RFI Report in a letter to Lieutenant Colonel Cary W. Brown dated May 21, 1998. Recommendations in the letter included conducting additional subsurface investigation to define the extent of contamination at the PDO Yard and to complete interim removal measures (i.e., AST removal, over excavation, and AST replacement) as outlined in the recommendations section of the April 1998 Final RFI Report. The GA EPD also recommended that data from these activities be incorporated into a Revised Final RFI report.

M&E completed the additional investigation activities (Phase II) in August 1998 and reported findings of the study in the December 1998 Revised Final RFI. The GA EPD reviewed the document and summarized their comments on the Revised Final RFI Report in a letter to Colonel Ovidio E. Perez dated April 2, 1999. The majority of GA EPD comments centered on elements of the human health and ecological risk assessment presented in the report. The GA EPD also recommended collecting an additional surface water and sediment sample from Lamar canal directly down-gradient of MW06. These samples were collected by Science Applications International Corporation (SAIC) personnel as part of Phase II field activities.

This Revised Final RFI Report (report title not changed from previous submittal) addresses all GA EPD comments outlined in the April 2, 1999 (Khaleghi to Perez) document review letter. Data collected by M&E from both the initial (Phase I) and subsequent (Phase II) field activities conducted at the PDO Yard are presented herein. Phase I activities include those actions performed during the original scope of work that were summarized in the December 1998 Revised Final RFI Report with the exception of soil data from HA05, HA07, HA08, HA09, and HA10. These locations were within the excavation area of the Interim Removal (IR) activities conducted at the former above-ground storage tank (AST) in July 1998. Data from these locations were deleted from the risk assessment at the request of the GA EPD because they are no longer representative of conditions in that area of the PDO Yard. Confirmatory soil sample

results from samples collected by the Installation's removal contractor (Earth Tech, Inc.) following excavation activities (PDO-1 through PDO-8) were added to the risk assessment at the request of the GA EPD. Phase II activities include those performed in response to both the May 1998 GA EPD Final RFI review recommendations and the April 1999 GA EPD Revised Final RFI review comments. Most Phase II field activities were conducted between June and August of 1998. Some additional activities, namely surface water and sediment sampling conducted in response to the April 1999 GA EPD Revised Final RFI review comments, were conducted in April 1999.

Summary of Site Investigation Activities

The Phase I PDO Yard soil and groundwater sample results identified limited contamination in groundwater above screening criteria. Although five parameters in groundwater exceeded screening criteria, no current groundwater exposure pathway exists. The complete horizontal and vertical extent of the two most prominent organic contaminants in groundwater, benzene and tetrachloroethene (or perchloroethene- PCE), was not completely defined. However, the maximum concentration of both benzene and PCE in groundwater samples was within one order of magnitude of their respective maximum contaminant level (MCLs).

IR activities commenced at the PDO Yard in July 1998. The ASTs were removed from the facility, cleaned, and taken off-site for recycling. The soil around the former AST locations, including the berms, was excavated to a depth of about 3 feet below land surface (bls) with the exception of the northeast corner where the excavation was taken down to a depth of 4.2 feet bls. The excavation pit was approximately 50 feet x 75 feet and produced about 450 cubic yards of soil. The excavated soil was placed in the bioremediation cell near the HAAF golf course. Eight confirmatory soil samples were collected from the excavation prior to backfilling for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and RCRA metals. No elevated concentrations of target compounds were present in the soil samples. Analytical results of the confirmatory soil samples (PDO-1 through PDO-8) are considered in the risk assessment section of this Revised Final RFI Report. Fill material was obtained from a borrow pit at HAAF and the excavation area was backfilled, compacted using the weight of a loader, and covered with #57 stone.

The Installation completed the construction of a new concrete containment facility in August 1998 and installed three new state-of-the-art ASTs within it. The new facility is located on the north side of the PDO yard.

Four new shallow (MW05, MW06, MW07, and MW08) and three deep monitoring wells (MW09, MW10, and MW11 [a double cased well]) were installed from July 21 to August 1, 1998 in response to the GA EPD's comments to delineate the groundwater contaminant plume at the PDO Yard. Two soil samples were collected for laboratory analyses at each drilling location. Groundwater samples were collected from the eleven existing and the seven new PDO Yard monitoring wells from August 10 to 13, 1998. Low flow peristaltic pumps were used to purge

the wells and avoid turbidity in the samples. Samples (soil and groundwater) were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and RCRA metals. Analytical results indicate that benzene and PCE exceeded screening criteria in groundwater samples. Three surface water and sediment samples were collected from Lamar canal on August 13, 1998. Zinc concentrations exceeded surface water screening criteria and barium was present in all sediment samples. All other compounds identified in Phase II soil, groundwater, surface water, or sediment samples were either attributed to laboratory contamination/ isolated occurrences or were below screening criteria. Two additional surface water and sediment samples were collected by SAIC on April 16, 1999 at the request of the GA EPD. The samples were collected directly down-gradient of MW06; the area most likely to receive discharge of contaminated groundwater from the shallow aquifer. Analytical results of these samples indicate that no volatile or semi-volatile organic compounds are present in surface water. Trace concentrations of lead marginally exceeding the Georgia Instream Water Quality Standard (IWQS) of 1.3 micrograms per liter (µg/L) were identified.

Human Health Risk Assessment

The baseline risk assessment (BRA) conducted in the April 1998 Final RFI Report was updated with information collected during the Phase II field investigation. The BRA evaluates potential human health risks associated with the contamination at the PDO Yard. The data collected in the Phase I and Phase II investigations are sufficient to complete the BRA.

The human health assessment consisted of a comparison of soil, sediment, surface water, and groundwater data to screening values. Soil samples from both phases of the RFI were evaluated during the human health risk assessment. Four human health contaminants of potential concern (HHCOPCs); arsenic, cadmium, chromium, and benzo(a)pyrene, exceeded screening criteria in Phase I soil samples. Arsenic was identified in 2 of 73 sampling locations at concentrations (26 milligrams per kilogram [mg/kg] and 28 mg/kg) which marginally exceeded the residential risk-based concentration (RBC) of 23 mg/kg. However, each of these samples were collected from 2 feet below land surface (bls) and both arsenic concentrations were well below the industrial RBC of 610 mg/kg. Concentrations of cadmium and chromium in surface soil were all below the residential RBC but exceeded the U.S. Environmental Protection Agency (EPA) Region 4 Soil Screening Level (SSL) based on a dilution attenuation factor (DAF) of 1 (i.e., no dilution in the soil column). Similarly, all cadmium and chromium concentrations in subsurface soil were below both residential and industrial RBCs but many exceeded the conservative SSL.

The laboratory quantitation limit (LQL) for benzo(a)pyrene was greater than the residential RBC of 0.088 mg/kg for all soil samples. The LQL was used as screening criteria for this compound because the laboratory is incapable of accurately quantifying concentrations at the residential RBC level. Benzo(a)pyrene was confirmed in 2 of 73 locations (PDO-SB01, 1.6 mg/kg and PDO-HA06, 0.59 mg/kg) at a concentration greater than the LQL. Only the sample from PDO-SB01 exceeded the residential RBC of 0.78 mg/kg. All sample results for benzo(a)pyrene were below the EPA SSL based on a DAF of 20. The generic SSLs, based on default values and standardized equations for groundwater protection, were used as additional evaluation criteria. The human health exposure pathway for contamination in soil was not considered complete under current or

anticipated future use scenarios. However, arsenic and benzo(a)pyrene were retained as potential soil HHCOPCs in the human health risk assessment process. Risk calculations for both residential and on-site worker exposure scenarios indicated risks were well within the criteria accepted by both EPA and EPD. Therefore, development of soil remedial levels was not warranted and additional soil remediation is not required.

The human health assessment considered sediment screening values although the exposure assessment determined the exposure pathway was incomplete. No sediment exposure pathway is currently known or suspected under future site use. No sediment parameters exceeded any human health screening criteria (industrial or residential RBCs) in any Phase II sample collected by M&E. The arsenic concentration in both Phase II locations sampled by SAIC marginally exceeded the residential RBC but was below the SSL based on a DAF of 1. Arsenic was eliminated as a HHCOPC in sediment based on its detection near the limits of analytical precision and concentrations less than two times the screening criteria.

Surface water was also evaluated in the human health assessment although wading does not occur in Lamar canal and no exposure pathway exists under current or anticipated future site use. Although arsenic was identified above EPA Region 3 RBC tap water standard of 0.045 µg/L in 2 of 5 Phase II surface water samples, concentrations were well below the MCL of 50 µg/L. Therefore, arsenic was eliminated as a HHCOPC for surface water based on its detection near the limits of analytical precision and the unlikelihood of actual surface water exposure.

All HHCOPCs identified in groundwater samples were evaluated with respect to the September 1996 US Environmental Protection Agency (EPA) residential Risk-Based Concentrations (RBCs) previously cited in the December 1998 Revised Final RFI. The GA EPD agreed with Fort Stewart's recommendation to use the 1996 version of the RBC table in this document to maintain consistency with previous versions of the PDO Yard RFI reports. No current groundwater exposure pathway exists and no future groundwater exposure pathway is anticipated. However, an evaluation of risk for potential future use was conducted using a residential exposure scenario in response to GA EPD comments. Only analyses from Phase II groundwater samples were considered in the risk assessment because they were collected after purging wells with low-flow rate pumps to decrease sample turbidity. The samples collected from the wells following this purge method are considered more representative of actual groundwater conditions. Benzene and PCE were retained as HHCOPCs in groundwater for further risk characterization because concentrations of these compounds exceeded residential RBCs.

Published default values were used in the baseline human health risk assessment. The residential exposure scenario used in the risk assessment is extremely unlikely given regional confining units between the shallow aquifer where contamination was identified and the deep aquifer (i.e., the Floridan); tapped as a source of drinking water in the Savannah area. The calculated carcinogenic and noncarcinogenic risks for HHCOPCs identified in groundwater samples were below the recommended threshold defined by Georgia EPD and EPA. No risk-based remediation levels were derived because no exposure is known or expected and potential risk was within acceptable

levels. However, the Installation is aware that the GA EPD will not accept risk calculations for constituents which exceed their respective MCLs. Therefore, remedial levels (RLs) proposed for benzene and PCE are their respective MCLs of 5 µg/L.

Ecological Risk Assessment

The ecological risk evaluation was initiated by conducting a preliminary risk evaluation (PRE) which compared surface water and sediment detections to ecological screening values published by EPA Region 4. An adequate number of samples were collected at potential receptor locations to evaluate potential ecological risks during the PRE.

Lead and zinc were the only constituents detected in surface water samples exceeding ecological screening criteria. All lead concentrations were below the EPA Region 4 Acute Freshwater Surface Water Screening Value (FSWSV) but they exceeded the chronic FSWSV of 1.32 µg/L. The most elevated lead concentration (13.4J µg/L) was detected in the up-gradient surface water sample PDO-SWE01. Elevated lead concentrations were not considered to be associated with the PDO Yard and were eliminated from further consideration in the PRE. Zinc concentrations in samples ranged from 12.1 µg/L in sample SAIC-PD1600 to 110 µg/L in the up-gradient (PDO-SWE01) sample. Zinc was similarly eliminated as an ecological contaminant of concern (ECOC) in the PRE because its presence cannot be attributed to the PDO Yard. The only organic compound identified in surface water samples at concentrations exceeding ecological screening criteria (chronic freshwater surface water screening value-FSWSV) was bis(2-ethylhexyl)phthalate, a common laboratory contaminant. The presence of bis(2-ethylhexyl)phthalate was attributed to laboratory contamination or sampling anomaly and was subsequently eliminated from risk characterization. No ecological contaminant of potential concern (ECOPC) was retained as an ECOC based on calculations performed in the PRE. Development of RLs for surface water is not required.

Analytical results of Phase I sediment samples were close to screening values but were not considered significant due to low frequency of occurrence, overall magnitude, and the conservative basis of screening values. Lead and barium, detected in Phase II sediment samples, were evaluated as ECOPCs in the PRE. Lead was the only ECOPC to marginally exceed the EPA SSV in Phase II sediment samples. The background sediment sample PDO-SWE01 contained the most elevated lead concentration which only marginally exceeded its conservative ecological screening value (ESV). In addition, the concentrations of lead found in sediment samples is well within the range published by the United States Geological Survey (USGS) for soils in this region. Therefore, the lead concentrations in sediment are most likely attributed to natural occurrence or up-gradient source and lead is not considered an ECOPC for sediment at this site. Barium, present in all Phase II samples, has no published ESV and was retained as an ECOPC by default. Preliminary risk calculations presented indicate the hazard quotient (HQ) associated with barium is well below the target level of an HQ equal to 0.1. Therefore, barium was not retained as an ECOC.

Groundwater contaminants (benzene and PCE) were evaluated with respect to ESVs. All benzene concentrations were lower than the Acute FSWSV while two locations exceeded the

Chronic FSWSV. However, the benzene concentrations are below the Chronic FSWSV of 53 µg/L in the down-gradient reaches of the benzene groundwater plume where exposure, if any, would take place. Benzene is therefore not considered to pose a threat to potential receptors in Lamar canal and was eliminated from further quantitation in the PRE. The most elevated concentrations of PCE at the PDO Yard were below ESVs. No ECOCs were retained in the groundwater media.

Conclusions and Recommendations

Conclusions

The following conclusions and recommendations have been made based on the results of the Phase I and Phase II RFI for the PDO Yard:

- The horizontal and vertical extent of contamination has been adequately delineated by activities conducted during the Phase I and Phase II RFI.
- There are no HHCOPCs in surface water or sediment.
- Arsenic and benzo(a)pyrene were evaluated as HHCOPCs in soil and were found to be present at concentrations within acceptable risk levels for both present industrial conditions and potential future residential use; therefore additional human health risk assessment is not required.
- Benzene and PCE were identified as HHCOPCs in groundwater and concentrations of both constituents exceeded their respective RBCs and MCLs. Risk calculations indicate neither constituent exceeds acceptable levels of risk under a future residential use scenario. However, the MCLs for benzene and PCE were selected as RLs.
- There are no identified ECOPCs in surface soil, surface water, sediment, or groundwater at concentrations that exceed acceptable levels of risk. Therefore, an ERA is not required for the PDO Yard.

Recommendations

- Risk calculations for benzene and PCE indicated the calculated carcinogenic and noncarcinogenic human health risks are below the recommended threshold values as defined by Georgia EPD and the EPA. Therefore, further human health risk assessment is not required for the PDO Yard.
- A Corrective Action Plan (CAP) will be required to evaluate measures to mitigate the effects of benzene and PCE because concentrations of these HHCOPCs exceed their respective MCLs. The CAP will evaluate the effectiveness of "hot-spot" treatment and monitored natural attenuation in remediating these organic compounds. Fate and transport modeling will be used in evaluating effects associated with both treatment and natural attenuation remedial options. In addition, the CAP will also evaluate the implementation/continuance of institutional controls for the site.

The Installation recently completed a one year period of quarterly monitoring at the PDO Yard. A groundwater sample was collected from each of the monitoring wells on-site using low-flow peristaltic pumps on a quarterly basis. In addition, surface water and sediment samples were collected. All samples were analyzed for VOCs, SVOCs, and RCRA metals. The Installation submitted the quarterly groundwater, surface water, and sediment data for the annual monitoring period to Georgia EPD in correspondence dated June 1999 (Perez to Khaleghi). Data from the first quarter of the monitoring period (August 1998) was used as the basis for this Revised Final RFI. The August 1998 data was summarized the First Quarterly Monitoring Progress Report dated October 1998. Data from subsequent quarterly monitoring visits conducted in November 1998 and February 1999 were also summarized reports submitted to GA EPD. The final progress report for the annual monitoring period summarizing May 1999 data will be submitted to GA EPD once it is completed. All data collected from the quarterly monitoring period will be utilized in preparation of the CAP.

SECTION 1.0

INTRODUCTION

Metcalf & Eddy, Incorporated conducted a RCRA Facility Investigation (RFI) at the PDO Yard at Hunter Army Airfield in response to a Consent Order issued to Fort Stewart for deficiencies observed at the PDO Yard and at several other HAAF locations. Hunter Army Airfield is a subinstallation of nearby Fort Stewart which is located approximately 30 miles southwest of Savannah. The RFI was performed under USACE, Savannah District Contract DACA21-93-D-0049, Delivery Order No. 20. The PDO Yard is located near the northwestern boundary of HAAF. A location map showing the HAAF facility and the PDO Yard is shown in **Figure 1.**

The investigation was summarized in a Final RFI report that was submitted to the GA EPD in April 1998. The GA EPD summarized their comments on the Final RFI Report in a letter to Lieutenant Colonel Cary W. Brown dated May 21, 1998. Recommendations in the letter included conducting additional subsurface investigation to define the extent of contamination at the PDO Yard and to complete Interim Measures (i.e., AST removal, over excavation, and AST replacement) outlined in the recommendations section of the Final RFI Report. The GA EPD also recommended that data from these activities be incorporated into a Revised Final RFI Report.

This Revised Final RFI Report (report title not changed from previous submittal) addresses all GA EPD comments outlined in the April 2, 1999 (Khaleghi to Perez) document review letter (see the response to comment table enclosed within the inside front cover pocket of this binder). Data collected by M&E from both the initial (Phase I) and subsequent (Phase II) field activities conducted at the PDO Yard are presented herein. Phase I activities include those actions performed during the original scope of work that were summarized in the December 1998 Revised Final RFI Report with the exception of soil data from HA05, HA07, HA08, HA09, and HA10. These locations were within the excavation area of the Interim Removal (IR) activities conducted at the former above-ground storage tank (AST) in July 1998. Data from these locations were deleted from the risk assessment at the request of the GA EPD because they are no longer representative of conditions in that area of the PDO Yard. Confirmatory soil sample results from samples collected by the Installation's removal contractor (Earth Tech, Inc.) following excavation activities (PDO-1 through PDO-8) were added to the risk assessment at the request of the GA EPD. Phase II activities include those performed in response to both the May 1998 GA EPD Final RFI review comments and the April 1999 GA EPD Revised Final RFI review comments. Most of the Phase II field activities were conducted between June and August of 1998. Some additional activities, namely surface water and sediment sampling conducted in response to the April 1999 GA EPD Revised Final RFI review comments, were conducted in April 1999.

Interim removal activities commenced at the PDO Yard in July 1998 as part of Phase II activities. The ASTs were removed from the facility, cleaned, and taken off-site for recycling. The soil around the former AST locations, including the berms, was excavated to a depth of

about 3 feet bls with the exception of the northeast corner where the excavation was taken down to a depth of 4.2 feet bls. The excavation pit was approximately 50 feet x 75 feet and produced about 450 cubic yards of soil. The excavated soil was placed in the bioremediation cell near the HAAF golf course. Fill material was obtained from a borrow pit at HAAF and the excavation area was backfilled, compacted using the weight of a loader, and covered with #57 stone.

The three original ASTs located near the southeastern corner of the PDO Yard were cleaned, rendered unusable, and disposed of in accordance with API protocols. Manifests documenting the proper disposal of the tanks were provided in the tank closure report prepared by HAZWRAP/ Earth Tech, Inc. The report was submitted to the EPD in November 1998. Three new state-of-the-art ASTs were installed in a newly constructed concrete lined tank area on the north side of the PDO Yard in July 1998. An illustration of the current PDO Yard layout showing the new AST containment area is provided in **Figure 2**. The three new ASTs, a 90-day hazardous waste storage area, and several paved open storage bays are located within the PDO Yard.

Four new shallow wells (MW05, MW06, MW07, and MW08) and three deep monitoring wells (MW09, MW10, and MW11 [double cased]) were installed from July 21 to August 1, 1998. These wells were installed as part of Phase II activities in response to the EPD's comments on the April 1998 Final RFI Report. The well locations were selected to delineate the vertical and horizontal extent of the groundwater contaminant plume at the PDO Yard. M&E returned to the PDO Yard on August 10, 1998 to collect groundwater samples from eleven existing and seven new monitoring wells. Low flow peristaltic pumps were used to purge groundwater from the wells and avoid turbidity in the samples. Samples for inorganic parameters were collected directly from the teflon discharge tubing of the low-flow peristaltic pump. Samples for organic parameters were then collected at each location with teflon bailers. All samples were packed on ice and were shipped to a laboratory for analysis of VOCs, SVOCs, and RCRA metals. M&E collected three surface water and sediment samples were collected from Lamar canal on August 13, 1998. Two additional surface water and sediment samples were collected by SAIC on April 16, 1999 at the request of the GA EPD. The SAIC samples were collected directly down-gradient of MW06; the area most likely to receive discharge of contaminated groundwater from the shallow aquifer. Analytical results are discussed in Section 4 of this Revised Final RFI Report.

The RFI was conducted in accordance with federal, state, and USACE regulations and rules as stated in the scope of work (SOW). This Revised Final RFI Report was prepared in accordance with the US Environmental Protection Agency (EPA), OSWER Directive 9902.3-2A guidance dated May 1994 and *Georgia EPD Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units.*

1.1 Objectives

The purpose of this Revised Final RFI Report is to respond to CO GA4210022733 that was issued to Fort Stewart for deficiencies observed at the PDO Yard. The CO was a result of a HAAF inspection by the Georgia DNR, EPD to evaluate compliance with Georgia's Hazardous Waste Management Act (GHWMA) and Rules. Several sites at HAAF received violations, including the PDO Yard. Violations cited during the inspection at the PDO Yard included:

1.	40 CFR 262.11:	Hazardous Waste Determination
2.	40 CFR 262.34(a)(2):	Date of Accumulation Marked
3.	40 CFR 262.34 (a)(3):	Label During Accumulation Time
4.	40 CFR 265.15(a) & (c):	General Inspection Requirements

The CO required that an investigation be conducted to determine if the environment had been impacted as a result of the PDO Yard's use. Sample analytical results from initial investigations performed by the United States Army Environmental Hygiene Agency (USAEHA) indicated contaminants of potential concern (COPCs) were present in soil and groundwater.

The PDO Yard RFI project objectives were to:

I. Determine the horizontal and vertical extents of contamination (soil and groundwater).
II. Determine whether contaminants present constitute a threat to human health or the environment.
III. Determine the need for further actions and/or no further action and gather necessary data to support development of a corrective action plan, if warranted.

Metcalf & Eddy focused on the six categories listed below during this RFI to meet the USACE SOW objectives.

Data Evaluation - All acquired data were evaluated for completeness and for meeting the requirements of the project Data Quality Objectives (DQOs).

Fate and Transport - A qualitative assessment of the fate and transport for detected contaminants was performed.

Site Characterization - The nature and extent of COPCs found on-site were evaluated and conclusions drawn from the analytical data were supported by contaminant distribution maps and related figures and tables.

Health and Environmental Assessments - An evaluation of potential health and environmental impacts from site use and potential future use was performed. Sections 6.0 and 7.0 of this Revised Final RFI Report includes a discussion of the COPCs identified at the PDO Yard, an exposure assessment, toxicity assessment, and an assessment of potential risk in accordance with Georgia EPD guidance for selecting remediation levels at solid waste management units.

Identification of screening criteria and remedial levels - Screening criteria were selected for all identified contaminants of concern (COCs) and clean-up standards and/or points of compliance required for remediation activities were evaluated.

Conclusions and Recommendations - Conclusions and recommendations were made based on an overall analysis of the data, site characteristics, and probable impacts.

1.2 Site Background

1.2.1 Site Description

Hunter Army Airfield is located within the Coastal Plain physiographic province in the City of Savannah, Chatham County, Georgia. The airfield covers approximately 5,400 acres, and it is bounded on the north by lightly populated areas, on the east and south by residential and light commercial areas, and on the west by the Little Ogeechee River. HAAF is a subinstallation to the Fort Stewart Military Installation, which is located approximately 30 miles southwest.

HAAF is located near the coast toward the north end of the Barrier Island Sequence physiographic province of Georgia. Area topography consists of step-like terraces with decreasing altitudes toward the Atlantic Ocean (Clark and Zisa, 1976). Topographic relief base-wide ranges from approximately 2 to 42 feet above mean sea level (msl).

The PDO Yard is located near the northwestern boundary of HAAF, and it consists of a parcel containing approximately 0.955 acres. The PDO Yard is part of a larger parent parcel designated as tract Number I-900 conveyed by Warranty Deed dated 29 September 1950 from the Mayor and Aldermen of the City of Savannah to the United States of America (recorded in Deed Book 52-J Office of the Clerk of Superior Court, Chatham County, Georgia). A legal description is provided in **Appendix A**.

The site, which is fenced, is approximately 136 feet by 300 feet. Much of the site is paved with the remainder covered in crushed stone. The PDO Yard contains three newly installed ASTs which serve as an accumulation point for used oil and off-specification JP-4, and a 90-day hazardous waste (HW) storage area. A coal stockpile area was located outside the fenced area, toward the north (**Figure 2**). Although no longer in use, the coal pile area was used to stockpile coal reserves for 20 to 30 years.

1.2.2 Site History

From the early days of aviation, the area now known as Hunter Army Airfield was used by practice flyers, barnstormers, and aerial circuses. In 1928, the city of Savannah took possession of the field for use as a municipal airport. In the spring of 1940, the property was designated as a military airfield. Except for a short period when military activities were moved to Travis Field west of the city, the Army Air Corps (and later the separately-organized Air Force) made extensive use of the base for approximately two decades. Users included the U.S. Air Force Strategic Air Command and the Military Air Transport Command.

The Air Force ceased using the base in the early 1960's, and deactivation efforts were undertaken. However, the Army acquired the facility in 1967 to support the increased need for helicopter pilot training during the Vietnam conflict. Advanced helicopter training for Vietnamese Air Force

flight students was conducted at HAAF from 1970 to 1972. In 1975, the airfield became an important component of nearby Fort Stewart when the 24th Infantry Division (reflagged the 3'rd Infantry Division- Mechanized, in May 1996) was reactivated and stationed at the Fort Stewart/Hunter Army Airfield complex.

1.2.3 Previous Investigations

The U.S. Army Environmental Hygiene Agency (USAEHA) conducted Waste Disposal Engineering Study (WDES) No. 37-24-J2KZ-94 at the old PDO Yard site from November of 1993 to January of 1994. Samples were collected from soil borings and hydropunch locations. The bermed area contained two 20,000-gallon tanks for waste oil and one 18,000-gallon tank for off-specification JP-8. Surface soil samples collected during WDES No. 37-26-J2KZ-94 from within the bermed area exceeded the screening criteria for total petroleum hydrocarbons (TPH) and BTEX (the sum of benzene, toluene, ethylbenzene, and xylene) established by the Georgia DNR EPD Underground Storage Tank Management Program. The average concentration of TPH in composite surface soil samples collected within the berm was 12,000 mg/kg. The average TPH concentration dropped to 1,900 mg/kg in the 6 to 18 inch below land surface (bls) composite samples. Arsenic, while not statistically exceeding background, exhibited a mean concentration of 7.50 mg/kg which exceeded the screening criteria of 1.6 mg/kg used during the USAEHA investigation. All other inorganics identified in soil samples were below their respective screening criteria. PCE and metals were also identified in groundwater samples. The USAEHA concluded that soil and groundwater contamination at the PDO Yard required further assessment.

Based on the results of the site assessment, the USAEHA conducted a WDES, No. 38-26-K2KZ-94 for groundwater assessment at the PDO Yard in April 1994. Seven monitoring wells were installed during this investigation. **Figure 2** shows the locations where samples were collected during the USAEHA studies. The USAEHA confirmed that PCE was present in a groundwater sample collected from monitoring well 1-23 at a concentration of 145 µg/L, which is above the Maximum Contaminant Level (MCL) of 5 µg/L. Metals (antimony, iron, manganese, nickel, lead, and thallium) exceeded their corresponding MCL or Secondary Drinking Water Standard but may be naturally occurring as they were detected up-gradient from the PDO Yard. Additional information on the findings of the two USAEHA studies is provided in Section 3.4 of this Revised Final RFI Report.

Several organic and inorganic constituents were identified in groundwater and soil samples from the PDO Yard. Based on these studies, however, the PDO Yard was not identified as the source of elevated nickel, lead, thallium, iron, and manganese in groundwater. Further investigation into an antimony anomaly was recommended in WDES No. 38-26-K2KZ-94. The groundwater was found to be contaminated with PCE above the drinking water MCL.

M&E was previously retained by the USACE to perform a site investigation at the PDO Yard in response to the site becoming listed on hazardous sites inventory (HSI). A Compliance Status Report (CSR) was prepared by M&E for the PDO Yard and was submitted (by Fort Stewart) to the EPD in accordance with Georgia Rule, Chapter 391-3-19-.06 (3). The CSR was submitted in response to the EPD's determination that a release exceeding reportable quantities had occurred at the PDO Yard based on sample analytical results provided in United States Army Environmental Hygiene Agency (USAEHA) reports. The purpose of the CSR was to document the current status of the PDO Yard with regard to the Risk Reduction Standards (RRS) of Rule 391-3-19-.07 for all regulated substances associated with the release at the PDO Yard. The CSR provided documentation on the horizontal and vertical extents of soil and groundwater contamination. In addition, background concentrations for each COPC were identified. However, the Hazardous Site Response Program delegated oversight for the corrective action at the PDO Yard to the Facilities Compliance Program of the GA EPD in correspondence dated March 10, 1998 (Cash to Brown).

SECTION 2.0

SITE DESCRIPTION AND LOCATION

2.1 Demography, Surface Features And Land Use

The total population of Chatham County, taken from the 1990 census, is 216,935. This translates to an approximate population density of 336 persons per square mile. There are 8,111 houses with approximately 12.5 houses per square mile. The area surrounding the Airfield is largely commercial, with the majority of facilities located along Abercorn Extension. Residential areas exist north, south, and west (beyond the rail line) of HAAF. Few surface features delineate the PDO Yard. Elevation is relatively flat except for a manmade hill (from a nearby lake excavation) located to the southeast and southwest. Trees are scattered along this hill. A railroad track runs along the northwest side of the PDO Yard. Further to the north lies the Lamar canal which flows towards the west. The PDO Yard has been used as a storage facility for used oil and off-specification JP-4, scrap metal storage, and a temporary storage site for hazardous waste as discussed in Section 1.2.1.

2.2 Soils

The PDO Yard is underlain primarily by the Chipley-Leon-Ellabelle soil association. The Chipley-Leon-Ellabelle soil association consists of moderately well drained and poorly drained, sandy soils on broad, low ridges and very poorly drained soils that have loamy underlying layers in depressions and drainage ways. Slopes range from about 0 to 2 percent. This association is comprised of about 30 percent Chipley soils, 25 percent Leon soils, 2 percent Ellabelle soils, and 25 percent minor soils (Olustee, Ocilla, Pelham soils) (USDA, 1974).

According to the United States Department of Agriculture (USDA) report, the texture of the Chipley soils is a fine sand to a depth of 6 feet or more. A seasonal high water table is 15 to 36 inches bls. In some places within the investigation area, the soil profile has been altered by cutting, filling, grading, and landscaping. In this urban land, the identification of soils is impractical due to the presence of urban facilities. A generalized description of the near-surface soils can be found in **Table 1**.

2.3 Local Geology

Soil borings performed by M&E as part of environmental investigation activities at HAAF have documented local geological conditions from the surface to approximately 40 feet bls. The lithology of the soil samples is described and recorded on boring logs presented in the following: Final Corrective Action Plan - Part A for former Building 728, M&E, 1996; Final Corrective Action Plan - Part B for the Departure Arrival/Airfield Control Group (DAACG) Facility, M&E,

1996; Final Completion Report - Former Building 133, M&E, 1995a; the Final Completion Report - Former Building 710, M&E, 1995b; and **Appendix B** of this Revised Final RFI Report.

Lithology beneath these sites consists predominantly of brown and tan fine to very fine sand with a little silt (silty sand). Layers of clayey sand and silt were also present at some locations. The lithology beneath the PDO Yard consists of brown and gray, fine to medium sand, silty in places (20-25%). Layers of sandy clay were also present around 3 to 5 feet bls. The near-surface lithology beneath the PDO Yard is consistent with undifferentiated alluvial deposits identified in previous M&E investigations.

2.4 Groundwater

The previously described shallow lithologic units form the surficial aquifer at the PDO Yard. Although aquifer parameter tests were not performed on soils or wells at the PDO Yard, three shelby tube samples were collected and eight slug tests (slug-out) were performed during the CAP-Part B investigation at former Building 728 which has the same general lithology. The former Building 728 site is located approximately 1400 feet northeast of the PDO Yard. The shelby tube samples were analyzed for grain size, effective porosity and moisture content. The slug tests were conducted on six shallow monitoring wells and two deep monitoring wells.

Shelby tube samples were collected from 2 to 4 feet, 6 to 8 feet and 10 to 12 feet bls during the former Building 728 investigation. The laboratory analyses indicate the hydraulic conductivities (K) of the samples range from 2.30×10^{-7} feet per second (feet/sec) to 1.74×10^{-4} feet/sec. The average K of the two shelby tubes collected within the saturated zone (below 6 feet bls) was 1.15×10^{-4} feet/sec, which is typical of medium-grained sand. Slug tests were also conducted on six shallow monitoring wells and two deep monitoring wells during the former Building 728 investigation. The Hvorslev slug test method was used to calculate the formation hydraulic conductivity. The average hydraulic conductivity calculated for the shallow monitoring wells is 5.48×10^{-4} feet/sec and the average hydraulic conductivity calculated for the deep monitoring wells is 7.55×10^{-4} feet/sec.

Results of sieve analyses from the eleven new monitoring wells at the PDO Yard indicated the site was underlain by fine-grained sands. An average groundwater seepage velocity of 0.72 feet per day (fpd) for the movement of groundwater across the site was calculated using a hydraulic gradient of 1.3×10^{-2} feet per feet (at the PDO Yard) and the average hydraulic conductivity and effective porosity values of 1.15×10^{-4} feet/sec and 0.18, respectively, from the nearby Building 728 investigation.

All newly-installed and existing wells were surveyed to obtain accurate top of casing elevations. This elevation was then used to measure the depth to groundwater at each well. Groundwater was encountered at the PDO Yard at 5 to 7 feet bls. Soil boring samples were wet at

approximately 3 to 5 feet bls. Initial measurements from monitoring wells estimated the groundwater level to be 6 feet bls. Based on the site potentiometric map, **Figure 3**, groundwater flow is north to northwest toward Lamar canal. Topographic survey information is provided in **Appendix C.**

2.5 Surface Water Hydrology

Surface water samples were taken in Lamar canal as described in Section 4. Water depth in the canal averaged about 6 inches to 1 foot during sampling, but it is higher during periods of heavy rains. The water was clear with large amounts of aquatic plants growing along the banks. Flow was consistent with a low velocity.

2.6 Site Conceptual Model

The conceptual site model is a simplified illustration of potential contaminant sources, receptors, and migration pathways. A detailed explanation of the site conceptual model developed for the PDO Yard was provided in the Work Plan. Additional discussion of the site conceptual model is provided in the Risk-Based Corrective Action Implementation Plan, **Appendix D**. A schematic illustration of potential contamination sources at the PDO Yard is provided in the appendix. A flow diagram which shows the possible exposure pathways by which the contaminants could migrate to receptors is also provided. Possible contaminants include volatile and semi-volatile organic compounds, metals, gross alpha and beta radiation particles (from coal natural radiation), and petroleum hydrocarbons.

The areas of concern (AOCs) at the site are covered by concrete, asphalt, and grass. The potential for human exposure to subsurface contamination beneath paved areas is minimal. Moreover, recent IR activities at the former AST area have successfully removed soil containing contaminants above screening criteria. However, land disturbing activities in other areas of the site could result in the following exposures: dermal contact with contaminated soils and waters, inhalation of volatile organic vapors, inhalation of contaminated dusts, and inadvertent ingestion of contaminated dusts. Access to the PDO Yard is currently controlled by a locked gate and fence encircling the facility.

Four water supply wells were identified within a 1-mile radius of the PDO Yard. One of these wells provide water for the City of Savannah, two wells supply water to Hunter Army Airfield, and the remaining well services the Seaboard Coast Line rail road yard. Two of these wells (Hunter 1 and the Seaboard Coast Line well) are located within 0.5 miles of the site. No private potable wells were identified within a 0.5 mile radius of the PDO Yard. Although the PDO Yard is located in the high or average groundwater pollution susceptibility area, all public wells in use within the 1-mile radius are screened at a minimum depth of 259 feet bls. These wells are hydraulically separated from the surficial aquifer by several interbedded clay layers at depth. The closest public well (Hunter 1) is located approximately 1,700 feet east (up-gradient) of the PDO Yard and is cased to a depth of 259 feet bls. Information on the location of all potable wells

identified within a 1-mile radius of the PDO Yard during M&E's well survey is provided in **Table 2**.

Documented reports of investigations conducted throughout the coastal plain area on groundwater resources indicate three major aquifers exist in the study area: the surficial aquifer, Brunswick aquifer, and the upper and lower Floridan aquifers (Clarke et al, 1990). Separating the surficial aquifer from the deeper aquifers are two confining units. The upper confining unit, Miocene unit A, ranges in thickness from about 20 feet to 90 feet with a vertical hydraulic conductivity of 5.3×10^{-3} to 1.3×10^{-4} feet/day (Clarke et al, 1990). The Miocene A unit is encountered approximately 60 feet bls and is roughly 20 feet thick in the Savannah area. The lower confining unit, Miocene unit B, ranges in thickness from about 10 feet to 50 feet with a vertical hydraulic conductivity of 6.7×10^{-5} feet/day to 1.3×10^{-2} feet/day (Clarke et al, 1990). This unit lies directly beneath the Miocene A unit and is approximately 20 feet thick in the Savannah area. The two confining units that exist between the shallow aquifer and deeper aquifers (Upper Floridan) limit the vertical migration of contaminants toward the potable wells' production zone. There are no private residential areas located within a 0.5 mile radius of the PDO Yard. As such, no private potable wells are present within a 0.5 mile radius of the site. The depths of the in-use wells identified range from 300 to 1000 feet and are completed in the Floridan Aquifer.

SECTION 3.0

SITE ACTIVITIES

M&E's sampling activities for the RFI at the PDO Yard were designed to determine if contamination exists above regulatory screening criteria, quantify concentrations, assess the horizontal and vertical extents of contamination, and determine whether contaminants constitute a potential threat to human health or the environment. This section summarizes the quantity and type of samples collected and their locations. A detailed discussion of sampling procedures was provided in the Chemical Data Acquisition Plan (CDAP); a subsection of the Workplan. Boring logs prepared during drilling activities are provided in **Appendix B**. Topographic survey data are presented in **Appendix C**. A copy of the field logbook which provides documentation of daily activity is furnished in **Appendix E.** Monitoring well construction diagrams are presented in **Appendix F**. Well development and sampling records are provided in **Appendix G**. Analytical results and data quality summary reports (DQSRs) are provided in **Appendix H**. A thorough discussion of soil, groundwater, and surface water quality is provided in Section 4.0 of this Revised Final RFI Report.

3.1 Phase I Investigation Summary

Soil Investigation:

Twenty-five soil borings (ten hand auger and fifteen power auger locations) were advanced at the PDO Yard between August 14 and September 16, 1996 as part of Phase I field activities. Two soil samples were collected at each of these locations. One sample was collected from a depth of 0 to 2.0 feet bls and the other sample was obtained from the interval with the highest organic vapor analyzer (OVA) reading. In the absence of any OVA readings or visual contamination, the second sample was collected from the interval closest to the soil/groundwater table interface. Two soil samples were also collected from each Phase I monitoring well boring based on the two highest OVA readings. In the absence of any OVA readings or visual contamination, one sample was collected near the surface (0 to 4.0 feet bls) and the second sample was collected from the interval closest to the soil/groundwater table interface.

Groundwater Investigation:

Ten groundwater samples were collected using the Hydropunch II (HP-II) technology between August 15 and 18, 1996 as part of Phase I field activities at the PDO Yard. These samples were collected to define the outer boundaries of the contaminant plume. Four new groundwater monitoring wells were installed during Phase I activities based on chemical analyses of HP-II samples to define the horizontal extent of groundwater contamination. Seven existing wells were also sampled. Data collected from the wells provided groundwater quality, groundwater flow direction, and potential contaminant migration information.

3.2 Phase II Investigation Summary

Groundwater and Soil Investigation:

M&E installed four new shallow and three deep monitoring wells during Phase II activities between July 21 and August 1, 1998. The well locations were selected to delineate the vertical and horizontal extent of the contaminant plume identified during the Phase I RFI. Two soil samples were also collected from each Phase II monitoring well boring based on the two highest OVA readings. A detailed discussion of soil sampling activities is provided in Section 4. Confirmatory soil samples were also collected by the Installation's removal contractor (Earth Tech, Inc.) following excavation activities associated with the IR in July 1998.

M&E returned to the PDO Yard on August 10, 1998 to collect groundwater samples from all PDO Yard monitoring wells. Low flow peristaltic pumps were used to purge groundwater from the wells to avoid turbidity in the samples. Samples for inorganic parameters were collected directly from the pump's teflon discharge tubing then additional samples for organic parameters were collected with teflon bailers. All samples were packed and shipped to a laboratory for analysis of VOCs, SVOCs, and RCRA metals. Analytical results are discussed in Section 4.4 of this Revised Final RFI Report.

Surface Water and Sediment Investigation:

Two sediment (up-gradient and down-gradient) and three surface water (up-gradient, down-gradient and cross-gradient) were collected on August 13, 1998 from the drainage canal (Lamar canal) located north of the PDO Yard. Surface water and sediment sampling locations are provided in Section 4. Additional surface water and sediment sampling conducted in response to the April 1999 GA EPD Revised Final RFI review comments, was conducted by SAIC in April 1999. Analytical results from these samples, discussed in Section 4.5, are used to evaluate surface water and sediment quality in proximity to the PDO Yard.

3.3 Contaminant Source Investigation

A site inspection trip by the Georgia Department of Natural Resources on April 21, 1993, identified several areas within the fenced PDO Yard used for storage of non-hazardous and hazardous wastes. A consent order issued by the State initiated two assessments from the U.S. Army Environmental Hygiene Agency. No spill was ever reported at the PDO Yard. However, the DNR trip report dated May 18, 1993 noted that containers of freon, liquid petroleum gas, industrial debris, and waste solvent existed within the PDO yard. Containers of antifreeze, paint, acetone, electrolyte (potassium hydroxide), polychlorinated biphenyl (PCB) waste, jet propulsion (JP) pads and filters were present in the 90 day HW storage area. Six transformers were also being stored in the hazardous waste area. Areas within the PDO yard that were used for the temporary storage of chemicals/hazardous waste were well defined in the project record.

M&E conducted a review of available records and performed interviews with HAAF personnel in early 1996 to obtain information about the potential source of contamination at the PDO Yard. According to Installation personnel, no records were available at that time regarding the types of waste stored at the PDO Yard, their quantities, or any documentation of leak/spill history. More recent conversations with Installation and Fort Stewart personnel indicate records of waste inventories are now maintained by the Department of Public Works at HAAF. These records do not identify any source areas for contaminants identified in this investigation.

The WDES No. 37-26-J2KZ-94 and No. 38-26-K2KZ-94 conducted by the USAEHA investigated soil and groundwater quality at the PDO Yard and possible sources of contamination. Conclusions from the studies were presented in Section 1.2.3. M&E observed apparent oil staining of surface soil within the AST berm area during sampling activities in August 1996. No other area within the PDO Yard appeared to be impacted (i.e. visually stained soil, stressed vegetation, etc.) from past and/or present waste storage practices. The entire berm area was excavated to a depth of three feet bls during the July 1998 IR and was replaced with clean, compacted fill material to grade.

SECTION 4.0

DATA EVALUATION AND EXTENT OF CONTAMINATION

The Phase I field investigation at the PDO Yard was conducted to assess the potential nature and extent of soil and groundwater contamination. Phase II field activities were undertaken to address GA EPD comments from their review of the April 1998 Final RFI Report and December 1998 Revised Final RFI Report. The PDO Yard falls under the Resource Conservation and Recovery Act (RCRA) Division of the Georgia EPD because of the CO, although HAAF does not have a RCRA permit.

Soil, sediment, surface water, and groundwater data were generated during both Phase I and Phase II field activities. All data from the Phase I investigation was presented in the Final RFI Report submitted to the GA EPD for review in April 1998. The data presentation in this Revised Final RFI Report includes a summary of previous analytical results and risk assessment findings from the original (April 1998) Final RFI Report. This is especially the case for soil data where sampling at particular drilling locations was not duplicated between the Phase I and Phase II field activities. However, where updated data exists, as is the case for surface water, sediment, and groundwater data, emphasis will be placed on the most recently acquired (July/August 1998 and April 1999) analytical results. Therefore, soil data from both phases of the RFI will be presented in tables and figures in this Revised Final RFI Report. All surface water, sediment, and groundwater data presented herein will be from the Phase II (most recent) sampling activities.

For data quality, the Quality Assurance Program Plan (QAPP-- a subsection of the Workplan) contains details of the number and types of quality assurance/ quality control (QA/QC) samples. In general, duplicate samples were taken at a rate of 10 percent of the total number of samples, equipment rinsate samples were taken at a rate of 5 percent, and trip blanks were taken at a rate of one per cooler for groundwater samples designated for volatile organic analysis. In addition, QA split samples were collected for the USACE-Savannah District laboratory analysis during performance of sampling activities at a rate of 10 percent.

Rationale for selecting the appropriate RCRA screening criteria are provided in the following sections. These sections also summarize the quantity and type of samples collected at the PDO Yard and their respective locations.

4.1 Soil, Sediment, Groundwater, and Surface Water Evaluation Criteria

M&E evaluated applicable screening criteria for this site following applicable federal and state regulations and guidance documents. Screening criteria developed for this investigation are presented on **Table 3** for soil and sediment and **Table 4** for groundwater and surface water. These

criteria are intended to be protective of both human health and the environment. Federal maximum contaminant levels (MCLs) established for drinking water, secondary drinking water criteria, Georgia In-stream Water Quality Standards, EPA Region 3 RBCs (R.L. Smith, September 1996), EPA Region 4 Freshwater Surface Water Screening Values (FSWSV), EPA Soil Screening Levels (SSLs), EPA Region 4 Recommended Ecological Screening Values for Soil (RESVSs) and EPA Region 4 Sediment Screening Values (SSVs) were used as screening criteria to assess data at the PDO Yard. The GA EPD agreed with a Fort Stewart recommendation to use the 1996 version of the RBC table in this document (e-mail correspondence between Little and Kahleghi dated June 12, 1999) to maintain consistency with previous versions of the PDO Yard RFI reports. Results that exceed screening criteria and are not excluded based on further evaluations were selected as COPCs. Each COPC was further evaluated following Georgia EPD risk guidance.

The human health BRA and preliminary risk evaluation (PRE, conducted for ecological receptors) evaluate potential risks posed by COPCs. The risk assessment followed guidance provided in **Appendix D.** Surface soil (from 0 to 2 feet below land surface- bls), subsurface soil (below 2 feet bls), sediment, surface water, and groundwater data are evaluated separately. A detailed discussion of potential human health risks is presented in Section 6.0, Human Health Risk Assessment. The results of the preliminary risk evaluation (PRE) are provided in Section 7.0, Ecological Risk Assessment.

Analytical methods for Phase I soil, groundwater, surface water and sediment sample analyses included VOCs by Environmental Protection Agency (EPA) method 8260, SVOCs by EPA method 8720, TPH by EPA methods 8100M and 8015M (Diesel Range Organics - DRO, and Gasoline Range Organics - GRO, respectively), and priority pollutant metals by EPA methods 6000/7000. Gross alpha and beta radiation by EPA method 900.0/9310 were also analyzed in Phase I soil and sediment samples. The radiological parameter samples were collected to assess any possible effect of past coal storage in the PDO Yard area. Phase II samples were analyzed using the same methods with the exception of the collection and sample extraction method for VOCs in soil and sediment. The Encore ™ sampling device was used for sample collection and analysis was performed following extraction by EPA Method 5035. No radiological analyses were required in Phase II soil or sediment samples based on previous Phase I analytical results.

4.2 Background Samples

A background monitoring well (PDO-MW04) was installed to obtain a representative groundwater sample hydraulically up-gradient of the PDO Yard. This background sample was used for data comparison to other samples to assess the potential degree of site impact. Similarly, up-gradient background soil samples were collected to establish background soil quality conditions. Two soil samples (PDO-MWB0401 and PDO-MWB0402) were collected from the MW04 boring. These samples were used to establish site specific background soil conditions. Results of soil samples collected at MW04 identified only trace concentrations of metals; all below the screening criteria. The LQL for arsenic (<1 mg/kg) at PDO-MW0401 exceeded the residential RBC (based on arsenic as a carcinogen) of 0.43 mg/kg. The standard method detection limit (i.e., LQL) was used

as screening criteria under these circumstances because the laboratory is incapable of accurately quantifying concentrations at residential RBC levels. Phase II analytical results of groundwater samples collected from the background well, MW04, indicated that no contaminants were identified above LQLs or MCLs.

Background surface water/sediment samples were collected during Phase II activities from PDO-SW/SE01, an up-gradient location in Lamar canal (**Figure 3**). Analytical results of background surface water and sediment samples indicate all organic parameters were below screening criteria. Concentrations of zinc in surface water (110 µg/L) exceeded ecological screening criteria of 60 µg/L (IWQS) and 58.91 µg/L (chronic FSWSV). This moderately elevated level of zinc in surface water, being less that two times the screening criteria, is not considered significant. Zinc did not exceed the sediment screening criteria at any sample location. The LQL of 10 µg/L for bis(2-ethylhexyl)phthalate in background surface water sample PDO-SWE01 was higher than the screening criteria of 0.3 µg/L (chronic FSWSV) and 5.92 µg/L (IWQS). The LQL (i.e., the standard method detection limit) was used as the screening criterion for this compound because the laboratory is incapable of accurately quantifying concentrations at published chronic FSWSV and IWQS levels.

4.3 Soil Quality

Surface and subsurface soil samples were collected from a number of locations at the PDO Yard during the RFI. All soil samples collected during Phase I and Phase II drilling activities were analyzed for VOCs, SVOCs, TPH-GRO, TPH-DRO, priority pollutant metals, and gross alpha and beta radiation (Phase I samples only) using methods described in Section 4.1. **Tables 5A, 5B,** and **5C** highlight COPCs detected in surface soil samples. **Tables 5D, 5E, 5F, 5G,** and **5H** list COPCs detected in subsurface soil samples collected at the PDO Yard. Analytical results for specific components that exceed the soil screening criteria are emphasized on the tables. Confirmatory soil samples collected by HAZWRAP/ Earth Tech, Inc. during the IR (removal of 450 cubic yards of soil and the former ASTs) are summarized in **Table 5E**.

Soil sample results were compared to EPA Region 3 residential RBCs (for surface soil less than 2 feet below land surface- bls), industrial RBCs (for soil greater than 2 feet bls), and EPA Region 4 RESVSs (for ecological evaluation only). The GA EPD allowed Fort Stewart (in e-mail correspondence between Mr. Brent Rabon (GA EPD) and Ms. Melanie Little (Fort Stewart) dated June 12, 1999) to use the same version of the EPA Region 3 RBC table as was referenced in the December 1998 Revised Final RFI for the PDO Yard. In addition to RBCs, EPA SSLs are listed in Table 3. SSLs are soil values derived for the protection of groundwater. At the request of the GA EPD, SSLs values used in this report are based on a DAF of 20 for organics and a DAF of 1 for inorganic parameters. EPA guidance (1996a) states that a DAF of 20 should be protective for sources up to 0.5 acres in size and may be protective of larger sources as well. Using a DAF of 1 for inorganics assumes that no dilution, absorption, or retardation occurs in the soil column. EPA SSLs are used in conjunction with the RBC values but are not considered justification alone to exclude a chemical from the baseline risk assessment. Likewise, exceeding an SSL (especially the

SSL based on a DAF of 1) will not necessarily require that a HHCOPC be carried through the baseline risk assessment. This is especially the case for inorganic parameters where confirmatory groundwater results are available. SSLs are used in this RFI report as additional information when the concentration of a HHCOPC is considered marginal for consideration in the baseline risk assessment.

Soil sample analytical results from the Phase I and Phase II (including the IR samples) were reviewed against screening criteria to assess potential risks. A discussion of samples that exceed screening criteria is provided in the following paragraphs. A complete evaluation of potential human health and ecological risks is provided in Sections 6 and 7, respectively.

Surface soil:

Twenty three shallow soil samples were collected during Phase I and Phase II field activities at the PDO Yard. Again, surface soil samples are those collected between 0 and 2 feet bls. Analytical summaries of COPCs identified in surface soil samples are provided in **Tables 5A, 5B** and **5C**. Complete laboratory reports are provided in **Appendix H**. Hand augered soil samples can be identified by the "HA" incorporated into the sample ID (i.e., PDO-HA01). Split-barrel samplers were used to collect soil samples from monitoring well and power auger soil boring locations. Soil samples collected at monitoring well locations include an "MW" and the sample ID (i.e., PDO-MW01). Soil samples from soil borings are identified using an "SB" in the sample identification (i.e., PDO-SB01).

Several metals were detected in surface soil samples at concentrations that exceed screening criteria. Arsenic, cadmium, and chromium concentrations exceeded screening criteria in a number of soil samples. In many cases, the LQL was greater than the screening criteria. The standard method detection limit (i.e., LQL) was used as screening criteria under these circumstances because the laboratory is incapable of accurately quantifying concentrations at residential RBC levels. Concentrations of cadmium and chromium were all below residential RBCs. However, several samples exceeded the EPA SSL based on a DAF of 1. The LQL for arsenic exceeded the residential RBC of 0.43 mg/kg at all locations. The lowest LQL for arsenic was <1.1 mg/kg. For comparison purposes, arsenic concentrations were evaluated with respect to the industrial RBC of 3.8 mg/kg. The industrial RBC was exceeded at 10 of 23 sampling locations. Arsenic concentrations in surface soil are illustrated on **Figure 5**. No other inorganic COPCs were identified at concentrations above screening criteria.

Benzo(a)pyrene was the only organic compound identified in the 23 surface soil samples at a concentration exceeding screening criteria. The LQL for benzo(a)pyrene was greater than the residential RBC of 0.088 mg/kg for all soil samples. The LQL was used as screening criteria for this compound because the laboratory is incapable of accurately quantifying concentrations at residential RBC levels. Concentrations of benzo(a)pyrene exceeded the industrial RBC of 0.78

mg/kg in only 1 of 23 locations. Benzo(a)pyrene was detected at SB01 (1.6 mg/kg) slightly exceeding the industrial RBC of 0.78 mg/kg but was below the SSL of 8 mg/kg.

All soil samples collected during the Phase I investigation were also analyzed for gross alpha and beta radiation. No soil criteria exist for gross alpha and gross beta parameters. However, within the accuracy of the analytical method (considering +/- qualifiers), the results were fairly close to quantitation limits.

Subsurface soil:

Subsurface soil samples were collected during Phase I and Phase II investigations at the PDO Yard. These soil samples were collected from depths greater than 2 feet bls. Analytical summaries of COPCs identified in subsurface soil samples are provided in **Tables 5D, 5E, 5F, 5G,** and **5H**. Complete laboratory reports are provided in **Appendix H**. Hand augered soil samples can be identified by the "HA" incorporated into the sample ID (i.e., PDO-HA01). Soil samples collected at monitoring well locations include an "MW" and the sample ID (i.e., PDO-MW01) and samples from soil borings are identified using an "SB" in the sample identification (i.e.,PDO-SB01). Confirmatory soil samples collected by Earth Tech (under a HAZWRAP contract with Fort Stewart) as part of the July 1998 interim removal project are identified by the prefix "ET" in the sample identification.

No organic parameters were identified in any subsurface soil sample collected by M&E at concentrations above the EPA Region 3 Industrial RBCs. The only metal that exceeded the industrial RBC was arsenic. Arsenic was identified in 4 of 50 locations at concentrations exceeding the industrial RBC of 3.8 mg/kg. Arsenic concentrations in subsurface soil are illustrated on **Figure 6**. The LQL for both cadmium and chromium exceeded the SSL based on a DAF of 1 at several locations. However, no concentration of cadmium of chromium exceeded the industrial RBC.

Confirmatory soil samples were collected as part of the Phase II IR action. The ASTs were removed and the soil around the former AST locations, including the berms, was excavated to a depth of about 3 feet bls with the exception of the northeast corner where the excavation was taken down to a depth of 4.2 feet bls. Analytical data from Phase I soil sampling locations within the area excavated during the IR (e.g., HA05, HA07, HA08, HA09, HA10) has been excluded from this Revised Final RFI Report in accordance with GA EPD. The excavation pit was approximately 50 feet x 75 feet and produced about 450 cubic yards of soil. Eight soil samples were collected by Earth Tech, a HAZWRAP subcontractor, to document the source material removal (see **Figure 2** for sampling locations and **Table 5H** for analytical results). Soil samples collected during the IR were analyzed for VOCs, SVOCs, and priority pollutant metals. No target analytes were identified in any of the confirmatory soil samples above screening criteria.

4.4 Groundwater Quality

Groundwater samples were collected during Phase I of the RFI using direct-push (hydropunch, HP-II) methods and from permanent groundwater monitoring wells. The only contaminant identified in hydropunch samples was benzene (at a concentration of 2 µg/L) in one of ten sampling locations. Each HP-II sample was collected from within the upper five feet of the watertable. These HP-II analytical results were used as field screening data to select locations for permanent Phase I groundwater monitoring well installation. As a result of comments received by the GA EPD on the April 1998 Final RFI Report, all permanent groundwater monitoring wells were resampled in August 1998 as part of Phase II field activities. Groundwater samples were collected from eleven existing and seven new monitoring wells after purging each well with a low-flow peristaltic pump. A low-flow purging technique was used to avoid creating the turbidity observed in the Phase I samples. Samples for inorganic parameters were collected directly from the low flow pump's teflon discharge tubing. The organic parameter samples were collected with teflon bailers. All samples were packed on ice and were shipped to a laboratory for VOC, SVOC, and RCRA metals analyses. **Table 6** lists the contaminants identified in groundwater samples collected during the Phase II sampling effort. Only the Phase II groundwater data is evaluated in this Revised Final RFI Report because these samples, containing very low turbidity as a result of low-flow rate purging, more accurately reflect actual groundwater conditions. Complete laboratory reports are provided in **Appendix H.** These Phase II groundwater results are compared to EPA Region 3 RBCs for tap water and MCLs in this report. Constituents detected at or above groundwater screening criteria included benzene, PCE, and bis(2-ethylhexyl)phthalate.

Organics in the Shallow Aquifer:

Benzene was detected in the following monitoring well samples; PDOMW01 (64 µg/L), PDOMW02 (4 µg/L), PDOMW06 (36 µg/L), PDOMW1-23 (13 µg/L), and PDOMW1-25 (29 µg/L). Benzene concentrations in groundwater are illustrated on **Figure 7.** The concentration of benzene in PDOMW01 increased slightly when compared to Phase I sample results; however, benzene in all other wells decreased slightly since the Phase I investigation. Contaminated soil in the former AST area were removed during the IR activities and were the suspected source of benzene identified in groundwater. The EPA Region 3 RBC for benzene is 0.36 µg/L while the Federal MCL is 5.0 µg/L. The quantitation limit for benzene was 2.0 µg/L thereby presenting difficulty in interpreting the significance of results listed as <2 µg/L in **Table 6.** The benzene MCL was exceeded at 4 of 18 groundwater monitoring wells. **Figure 6** indicates the suspected source of benzene is near the waste oil/JP-4 bermed area.

PCE was detected in groundwater samples from PDOMW02 (16 µg/L), PDOMW05 (47 µg/L), PDOMW1-22 (11 µg/L), and PDOMW1-24 (15 µg/L). Groundwater screening criteria for PCE include the EPA Region 3 RBC of 1.1 µg/L and the Federal MCL of 5 µg/L. PCE concentrations presented in **Figure 7** seem to be localized between the railroad tracks and the storage bays outside the fenced area.

Organics in the Deeper Portion (25 to 35 feet BLS) of the Shallow Aquifer:

M&E installed three deep wells, PDOMW09, PDOMW10, and PDOMW11, during the Phase II field activities. Bis(2-ethylhexyl)phthalate was detected in the August 1998 PDOMW10 groundwater sample at 14 µg/L, which exceeds the RBC of 4.8 µg/L. The source of this compound in this down-gradient deep groundwater monitoring well is unknown. Subsequent quarterly groundwater sample results from this well fail to confirm the presence of bis(2-ethylhexyl)phthalate. Quarterly reports detailing the results of groundwater samples collected in August 1998 (also covered in this RFI report), November 1998, and February 1999 were submitted to the GA EPD (Perez to Khaleghi) in correspondence dated June 1999. The single occurrence of this contaminant is most probably associated with laboratory contamination or an anomaly and is therefore not considered to be significant. Neither benzene or PCE was detected in any deep monitoring well.

Inorganics in the Shallow Aquifer:

Several inorganics were identified in Phase I groundwater samples at concentrations that exceeded screening criteria. The suspected source of inorganics in these samples was suspended sediment (i.e., turbidity). Phase II groundwater samples were collected following purging with low flow peristaltic pumps until turbidity measurements were below 10 nephelometric units (NTU) or until the well had been purged for 12 hours. Only PDOMW11 (15.01 NTU) and PDOMW1-19 (28 NTU) failed to reach the 10 NTU criteria. Analytical results indicate that the only inorganic present in groundwater samples above the LQL was barium. All barium concentrations were several orders of magnitude lower than screening criteria. Turbidity in samples was apparently responsible for the false-positive detections or elevated concentrations of metals identified in Phase I groundwater samples.

Inorganics in the Deeper Portion (25 to 35 feet BLS) of the Shallow Aquifer:

Inorganics were not detected above their respective LQLs in the groundwater samples collected from the deep wells.

4.5 Surface Water Quality

The State of Georgia DNR EPD has promulgated IWQS under Chapter 391-3-6. In addition, EPA Region 4 has established FSWSVs with both acute and chronic screening values for the protection of ecological receptors. These standards are, in some cases, more stringent than the federal MCLs. The State IWQS and FSWSVs are the criteria used to evaluate any risks associated with surface water contact in the nearby drainage ditch. M&E personnel collected surface water samples from three locations in Lamar canal in August 1998. In April 1999, SAIC returned to the PDO Yard in response to GA EPD comments to collect two additional surface water samples. The locations of surface water sampling sites are provided on **Figure 7.** Analytical results of surface water samples are presented in **Tables 7** and **8** and in **Appendix H.** Bis(2-ethylhexyl)phthalate was identified in surface water sample PDOSWE02 at 16 µg/L in August

1998; well below the acute FSWSV of 1,110 µg/L but above both the IWQS (5.92 µg/L) and the chronic FSWSV (<0.3 µg/L) screening criteria. This compound was present near the LQL of 10 µg/L and, like the single detection in the groundwater sample from PDOMW10, is likely associated with laboratory contamination or an anomaly. Additionally, bis(2-ethylhexyl)phthalate was not identified in any Phase I (August 1996) or quarterly (November 1998, February 1999, or May 1999) surface water sample. Zinc was identified in all three Phase II samples above ecological screening criteria. Zinc concentrations ranged from 70 µg/L in the down-gradient sample (PDO-SWE03) to 110 µg/L in the up-gradient (PDO-SWE01) sample. Zinc has been present in varying concentrations in surface water samples collected during the quarterly monitoring program. Results over the monitoring period have ranged from 40 µg/L to 200 µg/L and may be heavily dependent on sediment load in the canal.

4.6 Sediment Quality

Sediment results were compared to soil screening values and available sediment criteria derived for ecological evaluations. Sediment samples were collected by M&E personnel from three locations in Lamar canal in August 1998. In April 1999, SAIC returned to the PDO Yard in response to GA EPD comments to collect two additional sediment samples. The locations of sediment sampling sites are provided on **Figures 4** and **5**. Analytical results of sediment samples are presented in **Tables 9** and **10** and in **Appendix H**. Total chromium results exceeded the SSL for hexavalent chromium based on a DAF of 1 in the August 1998 samples but all other COPCs were below their respective screening criteria. The LQL for phenanthrene marginally exceeded the EPA Region 4 ecological sediment screening value (SSV) in 1 of the SAIC samples and the LQL was utilized as the screening criterion by default at this location. Arsenic concentrations in both SAIC samples exceeded the residential RBC. Cadmium and chromium were identified at concentrations above the SSL based on a DAF of 1, however, no concentration exceeded any human health or ecological screening criteria. Lead concentrations in SAIC sample PD2500 (135 mg/kg) exceeded the SSV of 30.2 mg/kg although the lead value in PD1500, located approximately 25 feet down stream of PD2500, contained only 8.8 mg/kg of lead. These analytical results demonstrate the high degree of variability in inorganic COPC concentrations over a relatively short lateral distance.

SECTION 5.0

CONTAMINANT FATE AND TRANSPORT

The fate and transport of metals and organic compounds are functions of both site characteristics and the physical and chemical interactions between the contaminants and the site media. The physical and chemical properties of the contaminants that influence these interactions include, but are not limited to, solubility in water, tendency to transform or degrade (usually described by an environmental half-life in a given medium), and chemical affinity for solids or organic matter (usually described as partitioning coefficient "K_d" , organic carbon partitioning coefficient "K_{oc}" , or octanol/water partitioning coefficient "K_{ow}"). These properties and how they affect the behavior of detected analytes at the PDO yard are described below.

5.1 Physical and Chemical Properties of Inorganic COPCs

Inorganic analytes detected at the PDO yard, when associated with the aqueous phase in a soil, are subject to movement with soil water. Aqueous transport mechanisms may result in metal migration through the vadose zone to groundwater. Metals, unlike organic compounds, are not degraded. However, some metals, such as arsenic (identified in soil samples at concentrations above screening criteria), can be transformed to other oxidation states in soil, reducing their mobility and toxicity. Metals may also react with soil particles or other solid surfaces by ion exchange, adsorption, precipitation, or complexation. Such reactions are affected by pH, oxidation-reduction conditions, and the type and amount of organic matter, clay, and hydrous oxides present. In general, these reactions cause an element's mobility to be retarded. The retardation factor is largely derived from the partitioning coefficient (K_d) but is affected by the soil bulk density and soil moisture content. The dissolved/aqueous fraction and its equilibrium fraction are of primary importance when considering the migration potential of metals associated with soils. The filterable inorganics represent the dissolved fraction, which is the more mobile and bioavailable fraction. Soluble compounds are transported in aqueous forms that are subject to retardation. Insoluble compounds remain as precipitates and limit the overall dissolution of a metal.

5.2 Physical and Chemical Properties of Organic COPCs

The organic constituents detected at the PDO Yard include VOCs and SVOCs. Volatile organics are nonmethane organic compounds characterized by high vapor pressures and Henry's Law constants, moderate to low K_{ow} , and low K_{oc}. As a result, these chemicals tend to be mobile in the environment. These contaminants may be degraded in the environment by various processes including hydrolysis, oxidation/reduction, photolysis, or biodegradation. Environmental half-lives of organic compounds in various media can vary from minutes to years, depending on the chemical and on environmental conditions. Degradation usually reduces the toxicity but may not eliminate the threat to human health and the environment completely. The mobility of an organic compound is affected by its volatility, its partitioning behavior between solids and water, water solubility, and concentration. Water solubility and the tendency to adsorb to particles or organic matter can

correlate with retardation in groundwater transport. The organic carbon partition coefficient (K_{oc}) indicates the tendency of an organic chemical to be adsorbed to organic material in soil.

A low K_{oc} value indicates that a chemical can easily be leached from soil to water. A high K_{oc} value indicates that a chemical has a strong affinity to bind to organic material in soil. The octanol/water partition coefficient (K_{ow}) represents the distribution of a chemical between octanol and water phases under equilibrium conditions. These values are normally reported in logarithmic form and represent the tendency of a chemical to move between organic material, such as soil, and non-organic phases such as water. Values less than 1.0 tend to remain dissolved in water rather than adsorb onto organic material. Values greater than 4.0 are more likely to remain adsorbed to organic material rather than migrate to water.

Vapor pressure and Henry's Law constant are two measures of chemical volatility. Vapor pressure is a measure of the volatility of a chemical from its pure state at a specific temperature. A higher vapor pressure, > 1mm Hg, indicates a greater tendency for movement of a chemical from water or soil into air. Henry's Law constant considers the interaction between water solubility and vapor pressure and is an important predictor of a chemical's volatilization from water to air. A large Henry's Law constant, > $1x10^{-3}$ atm-m^3/mole, indicates a tendency for a chemical to readily move from water into air.

Chemicals with relatively high water solubilities and low adsorption coefficients (e.g., acetone, methyl ethyl ketone, methylene chloride, etc.) are expected to remain primarily as dissolved phases and be transported at the same rate as the groundwater flow. Chemicals with lower water solubilities and higher adsorption coefficients (e.g., polynuclear aromatic hydrocarbons—PAHs) are expected to remain primarily adsorbed to the surface of the soils and their transportation with the groundwater would be more limited and occur at a much slower rate.

In groundwater, biodegradation or decay of organic compounds is controlled by a variety of factors including: the chemical structure of the compound and its susceptibility to biological breakdown, the presence and population size of microorganisms capable of metabolizing the chemical, nutrient availability (e.g., oxygen, water, mineral ions) and the presence or absence of inhibitory substances. The decay or breakdown rates are described by the substance's half-life. Contaminants with long half-lives have a greater potential for contaminating groundwater than do those with shorter half-lives.

At the PDO yard, benzene and PCE were the only organic compounds consistently identified at concentrations above the screening criteria. The presence of bis(2-ethylhexyl)phthalate in one groundwater sample is most likely associated with laboratory contamination or an anomaly and is not discussed further in this section. Benzene is a volatile aromatic hydrocarbon with a low K_{ow} and moderate K_{oc} causing it to migrate readily through the soil column toward groundwater. Degradation of benzene by hydrolysis is minimal in the subsurface. Benzene is less dense than

water and when it comes in contact with groundwater tends to float on top of the water column. PCE, a chlorinated aliphatic hydrocarbon, has a tendency to leach rapidly to groundwater rather than to adsorb to soil particles due to a moderate K_{oc} and high water solubility. Once in groundwater, PCE is very mobile because of its moderate K_{oc} and low K_{ow}. A major mechanism for removal of these chemicals from groundwater is volatilization, as indicated by high Henry's Law constants. Being denser than water, PCE may migrate vertically through a saturated medium as a separate phase. **Table 10** shows the physical and chemical properties of benzene and PCE; organic compounds consistently identified in the groundwater above screening criteria.

SECTION 6.0

HUMAN HEALTH RISK ASSESSMENT

The State of Georgia requires that all RCRA facilities choosing to set remediation levels based on an assessment of risk to human health and the environment prepare risk assessment documentation and propose remediation levels according to the *Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units* (Georgia EPD 1996). Georgia EPD (1996) guidance is based on the guidance contained in EPA Region 4 Bulletin, *Supplemental Guidance to RAGS, Human Health Risk Assessment* (EPA 1996a). Where there are differences with EPA guidance, the Georgia EPD 1996 guidance document takes precedence. The PDO Yard human health risk assessment discussed in the following sections was conducted in accordance with the Georgia EPD guidance and procedures outlined in the Risk-based Corrective Action Plan provided in Appendix D.

6.1 Evaluation of Potential Receptors

M&E conducted a Potential Receptor Survey (PRS) during the RFI. The conceptual site model, discussed in **Appendix D**, was used as a basis to investigate surrounding land use, groundwater use, and potential receptors (both human and ecological) with respect to the PDO Yard. This section identifies those populations that may be exposed to site related contaminants (SRCs). The receptor populations are identified under both current and future conditions. Potential changes in land-use are evaluated to determine whether they may result in the presence of more sensitive receptor populations in the future.

Projecting future land-use scenarios and associated receptors involves considerable uncertainty. The following sections present conservative estimates of potential receptor populations in the future; an approach intended to prevent premature elimination of human health COPCs from the screening process. Following suggestions of the GA EPD, the future use evaluation was performed using a residential exposure scenario. This evaluation results in the most conservative approach to assessing risk to potential future receptor populations.

All of the four public and commercial water supply wells identified within a 1-mile radius of the PDO Yard develop water from the Floridan Aquifer. Two confining units exist between the shallow aquifer and deeper aquifers (Upper Floridan) thereby limiting the vertical migration of contaminants toward the wells' production zone. Therefore, human exposure to contaminants identified in the shallow groundwater at the PDO Yard through these public/commercial supply wells is unlikely.

Article C of the Savannah City Code, Section 5-1053, prohibits the use of any surface well within city limits where city water mains are accessible unless an exception to the Code is granted by petition. Hunter Army Airfield is located just south of the Savannah city limits. Similarly, areas

northwest and west of the PDO Yard (Lamarville on **Figure 1**) are not within the city limits. A windshield survey of the Lamarville area indicated that numerous residential wells are used for potable water supply. The closest private potable well identified during the October 1997 windshield survey is approximately 2800 feet west northwest of the PDO Yard. Well construction details for the Lamarville area could not be obtained during the windshield survey. However, an informal interview with a property owner suggested that wells produce water from the shallow aquifer (a reference was made to "hand dug wells"). The groundwater use investigation conducted as part of the PRS indicated that no shallow groundwater is used for potable water supply within 0.5 miles of the site. In addition, Lamar canal is located between the PDO Yard and the Lamarville residential area. M&E anticipates that the canal is in hydraulic contact with the shallow aquifer based on the sandy, unconfined lithology of the area and a hydraulic head drop of approximately three feet between MW1-22 and the SWE02 location (Figure 3). This sharp increase in the hydraulic gradient near the canal bank indicates that groundwater seepage into the ditch is ongoing. Therefore, the canal acts as a hydraulic barrier for westward contaminant migration in the shallow aquifer. Human consumption of shallow groundwater down-gradient of the study area is therefore not considered to be a completed exposure pathway. However, the potential exposure pathway for on-site residential ingestion is considered in response to GA EPD's April 1999 comments on the December 1998 Revised Final RFI.

The PRS indicated that a potential exists for exposure to HHCOPCs in the open drainage ditch (Lamar canal) located north of the PDO Yard. This man-made surface water drainage feature eventually empties into Springfield canal which flows southwest and joins the Little Ogeechee River more than 3 miles downstream of the site. However, interviews with HAAF personnel indicate that the open drainage ditch is not used by HAAF personnel for any recreational purposes. The sides of the ditch, being heavily vegetated and steep, are not conducive to casual human contact. Therefore, the potential for human exposure to water or sediment in the ditch is remote.

A visual survey of the site and adjacent areas indicate that no buildings exist within the documented contamination plume, thereby eliminating the potential for human exposure to volatile compounds by vapor migration.

Receptor populations are typically divided into on-site and off-site receptors. On-site receptors are those individuals who may be present within the site boundaries and come into direct contact with contaminants present. The "site" in this case consists of the entire investigation area covered under the PDO Yard investigation. The exposure to off-site receptors occurs when a migration pathway transports a contaminant off-site to a point of exposure for the potential receptor. Only on-site receptors are considered in this risk assessment since the entire vertical and horizontal extent of contamination in soil, groundwater, surface water, and sediment has been delineated within the boundaries of the PDO Yard investigation area.

Human health risks associated with contaminated soil are considered in this Revised Final RFI at the request of the GA EPD. Surface soil, according to the GA EPD, is soil within 2 feet of land surface. Any soil sample collected from depths greater than 2 feet bls is considered a subsurface soil sample. Soil analytical results (tables, figures, etc.) presented in this Revised Final RFI are separated into surface and subsurface groups based on the depth the sample was collected. Specific screening criteria are used for each of the soil sample categories as recommended by GA EPD.

6.2 Screening for Human Health Chemicals of Potential Concern (HHCOPCs)

In accordance with *Georgia EPD Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units* (November 1996), risk-based corrective action was evaluated. The approach compared site data to minimum screening criteria and identified chemicals exceeding screening values as HHCOPCs. For soil and sediment, the minimum screening criteria for human health risk evaluation consisted of EPA Region 3 residential RBCs (for surface soil), industrial RBCs (for subsurface soil) and EPA Region 4 SSLs based on a DAF of 20 for organic HHCOPCs and a DAF of 1 for inorganic HHCOPCs. The DAF of 1 was selected for inorganic HHCOPCs following the advice of GA EPD personnel (in a telephone conversation between Michelle Burgess and David Wilderman on June 21, 1999) and represents a highly conservative "no dilution" approach to evaluating potential impacts to groundwater. EPA SSLs were used in conjunction with the RBC values but were not considered justification alone to exclude a chemical from the baseline risk assessment. The SSL was used as additional information when a value is considered marginal for consideration for the baseline risk assessment.

EPA Region 3 tap water RBCs were used as minimum criteria for HHCOPCs in groundwater and surface water. The GA EPD agreed with a Fort Stewart recommendation to use the 1996 version of the RBC table in this document to maintain consistency with previous versions of the PDO Yard RFI reports. Both carcinogenic risk and noncarcinogenic hazards were calculated in the human health evaluation. Calculated values are based on potential exposure pathways, consideration of current and future site use, and published toxicity data.

6.3 Baseline Risk Assessment

Risk evaluation under this BRA compares the maximum value detected in each medium with its respective screening value. Exceeding the screening value means that a potential risk may exist and that those chemicals exceeding their respective screening values should be evaluated more carefully. Contaminants identified as HHCOPCs may be evaluated further if not excluded by other elements in the data review and risk assessment process.

The identification of SRCs for each environmental medium (surface soil, subsurface soil, groundwater, sediment, and surface water) was addressed in Section 4 of this RFI report. The HHCOPC selection process involves two steps. The initial step is the comparison of SRC concentrations to the appropriate screening values. Given the conservative nature of the

screening values, a weight-of-evidence analysis is presented for those chemicals that exceed their respective screening values to determine whether a baseline risk assessment is required.

The weight-of-evidence screening includes an evaluation of the constituent's frequency of detection, detected concentration relative to detection limits, frequency of detection above background (for inorganic COPCs), and the frequency in which results exceed screening criteria. The Risk Assessment Guidance for Superfund (RAGS) (EPA 1989) presents a weight-of-evidence threshold criterion of greater than a 5 percent frequency of detection before a constituent should be considered site-related. This criterion is used in the evaluation presented below.

6.3.1 Exposure Assessment

Risk associated with on-site exposure to COPCs in groundwater, soil, sediment, and surface water is quantified following Georgia EPD guidance in this section. Two confining units exist between the shallow aquifer and deep water-supply aquifer; the Floridan. In addition, local ordinances prohibit the installation of drinking water wells in the shallow aquifer. Given the limited migration potential and restrictions for shallow groundwater consumption, no groundwater exposure exists based on current conditions. However, the potential exposure pathway for future on-site residential ingestion is considered in response to GA EPD comments on the December 1998 Revised Final RFI. No other groundwater pathway is considered to be potentially complete. The potential for current exposure to COPCs in soil, sediment, and surface water is remote because of access restrictions to the area and the type of activities conducted at the PDO Yard. However, these pathways are also considered in the BRA.

Groundwater:

The Phase II analytical results from the August 1998 groundwater samples confirmed the presence of benzene, PCE, and bis(2-ethylhexyl)phthalate in concentrations at or above groundwater screening criteria. Only concentrations of benzene and PCE exceeded their respective MCLs. **Table 6** lists analytical results and LQLs for chemicals analyzed in groundwater samples and the associated risk-based screening levels. For all groundwater parameters, the LQL was lower than the federal MCL which also is risk-based. The "<" sign in the results column of the tables indicates a parameter was not detected at a concentration above the LQL (i.e., undetected). Analytical results provided in the tables that exceed screening criteria are emphasized for ease of use.

The LQLs for benzene, PCE, and bis(2-ethylhexyl)phthalate were higher than the tap water RBCs at all groundwater sampling locations. Bis(2-ethylhexyl)phthalate was identified in one location (deep well PDOMW10) at a concentration marginally exceeding the LQL and RBC. This compound is a common laboratory contaminant and this single occurrence is not considered significant. Additional groundwater sampling data collected as part of a quarterly groundwater monitoring program ongoing at the PDO Yard failed to identify bis(2-ethylhexyl)phthalate in any well. The Installation submitted results of data available from the quarterly monitoring program

to the GA EPD (Perez to Khaleghi, June 1999) for review. Consequently, bis(2-ethylhexyl)phthalate is not considered a HHCOPC in groundwater. No other organic or inorganic HHCOPC was present in groundwater samples above screening criteria.

Since shallow groundwater is not used for drinking water purposes now or under anticipated future conditions, comparison to tap water RBC values is very conservative. Benzene and PCE exceed the tap water criteria and are retained as HHCOPCs in groundwater for quantitative risk evaluation. As a further conservative step, risk characterization assumes a residential scenario for groundwater exposure which, given the current and anticipated future use of HAAF and the PDO Yard, is unlikely. All analytical results from the Phase II groundwater samples are considered in this risk assessment.

Soil:

Soil samples were collected from hand auger, power soil auger, and groundwater monitoring well locations during the Phase I assessment at the PDO Yard. Additional soil samples were collected during the IR activity (confirmatory samples) conducted as part of the Phase II assessment and during Phase II groundwater monitoring well installation. Based on the human health screening, only benzo(a)pyrene and arsenic were identified as a HHCOPCs. **Tables 5A** through **5H** list analytical results and LQLs for chemicals analyzed in samples and the associated risk-based screening levels. The "<" sign in the results column of the tables indicates a parameter was not detected at a concentration above the LQL (i.e., undetected). Analytical results provided in the tables that exceed screening criteria are emphasized for ease of review.

The LQL for benzo(a)pyrene was greater than the residential RBC at all Phase I and Phase II soil sampling locations. The LQL was used as screening criteria for this compound because the laboratory is incapable of accurately quantifying concentrations at residential RBC levels. Benzo(a)pyrene was detected above the LQL at 2 of 23 surface soil sample locations. Benzo(a)pyrene concentrations of 1.6 mg/kg (PDO-SB01) and 0.59 mg/kg (PDO-HA06) exceed the residential RBC of 0.087 mg/kg. The compound was not identified in any of the 50 subsurface soil samples above screening criteria. Both detections were below the 8 mg/kg SSL based on a DAF of 20 for migration to groundwater. Additionally, the compound was not present in any groundwater sample. The two detections of benzo(a)pyrene are not located adjacent to each other and therefore are not indicative of a specific source area. Both of the sampling locations are within the locked compound of the PDO Yard where access is strictly controlled. Additionally, concentrations of benzo(a)pyrene at both locations was within one order of magnitude of the LQL and well below the EPA SSL. The presence of benzo(a)pyrene in 2 of 73 soil samples at the reported concentrations is not considered significant given current and anticipated future use of the site. However, benzo(a)pyrene is retained as a HHCOPC in soil because concentrations at the two sampling locations exceeded screening criteria and the LQL is elevated with respect to the residential RBC.

The LQL for arsenic exceeded the residential RBC of 0.43 mg/kg (based on a 1 in 1,000,000 cancer risk) at all locations. The lowest LQL for arsenic was <1.1 mg/kg. Arsenic was identified at PDO-MW01 (28 mg/kg) and PDO-SB14 (26 mg/kg). These concentrations exceed all human health screening criteria under this investigation. These two sample locations are not situated adjacent to each other and therefore are not indicative of a specific source area. However, arsenic is retained as a HHCOPC in soil because concentrations at the two sampling locations exceeded screening criteria.

The results of confirmatory soil samples collected following the July 1998 IR (discussed previously and presented in **Table 5H**) indicate that all HHCOPCs were below screening criteria. Therefore, the IR successfully removed all impacted soil from the former AST area and mitigated the risk associated with surface and near surface soil contamination identified during the Phase I assessment.

In accordance with EPA Soil Screening Guidance (EPA, 1996), contamination in subsurface soil was also evaluated relative to protection of groundwater from soil leaching. Concentrations of cadmium and chromium in several samples exceeded the EPA SSL based on a DAF of 1 but were below their respective RBCs. A review of groundwater analytical results indicate that no inorganic parameter exceeds any tap water RBC thereby indicating cadmium and chromium do not present a threat to groundwater quality through leaching. Therefore, cadmium and chromium are not retained in the BRA based solely on exceeding the SSL based on a DAF of 1.

Sediment:

No sediment data exceeded any human health screening criteria (industrial or residential RBCs). Concentrations of chromium exceeded the SSLs based on a DAF of 1 at all locations. The SSL used for this site was developed by EPA based on the hexavalent (Cr+6) chromium state (not the more common trivalent, Cr+3, state). Hexavalent chromium in the environment rapidly oxidizes to the trivalent state and would represent only a small fraction of the total exposure to chromium. However, the hexavalent chromium SSL is used as a screening criterion because it is more mobile and more toxic than the trivalent state. Chromium was not detected in any surface water sample. Therefore, chromium was not retained as a HHCOPC based solely on exceeding the SSL based on a DAF of 1. Cadmium also exceeded the SSL at 1 of 5 sediment locations but was excluded from further consideration in the BRA because it was not detected in any surface water sample. Arsenic was identified in the two sediment samples collected by SAIC at concentrations of 0.64 and 0.9 mg/kg. These concentrations marginally exceed the residential RBC of 0.43 mg/kg and are below the SSL based on a DAF of 1 (1 mg/kg). No arsenic was present in surface water samples. Based on this marginal exceedence of the residential RBC and remote potential for contact, arsenic was not retained as an HHCOPCs in sediment. Development of RLs for sediment is unnecessary since no HHCOPCs were retained. The sediment medium was therefore eliminated from the BRA.

Surface Water:

Bis(2-ethylhexyl)phthalate was the only constituent detected in a surface water sample which exceeded human health screening criteria. Bis(2-ethylhexyl)phthalate was detected at PDOSWE02 (16 µg/L); exceeding the tap water RBC of 4.8 µg/L. This compound was present near the LQL of 10 µg/L and, like the single detection in the groundwater sample from PDOMW10, is likely associated with laboratory or an anomaly. Additionally, bis(2-ethylhexyl)phthalate was not identified in any Phase I (August 1996) or quarterly (November 1998, February 1999, or May 1999) surface water sample. Wading does not occur in the stream and therefore no exposure pathway exists under current or anticipated future site use. Therefore, bis(2-ethylhexyl)phthalate is not considered an HHCOPC and development of RLs for surface water is not warranted. The surface water medium was therefore eliminated from the BRA based on the analytical data.

6.3.2 Toxicity Assessment

In quantifying risk, compounds are classified as carcinogenic or noncarcinogenic. The carcinogenic toxicity assessment considers a weight-of-evidence classification and a slope factor. The weight-of-evidence is a measure of the likelihood that a compound is a human carcinogen. The weight-of-evidence for the HHCOPCs are given in **Table 14**. Classifications for HHCOPCs are A, B2, C and D; where group A compounds are human carcinogens, B2 compounds are probable human carcinogens (sufficient evidence has been demonstrated in animals, but inadequate or no evidence exists for humans), C compounds are possible human carcinogens, and D compounds that are not classifiable as to human carcinogenicity. The slope factor (SF) is an estimate of the dose-response relationship. The slope factor is usually an upper-bound lifetime probability and is a measure of risk per unit dose. Health criteria for noncarcinogens are based upon the reference dose (RfD) which is an estimate of an exposure level unlikely to result in adverse human health effects during a lifetime. Toxicity data obtained from the EPA Integrated Risk Information System (IRIS) are also summarized in **Table 12**. A risk assessment issue paper for PCE is also referenced since a SF for PCE is not available on IRIS or the EPA Health Assessment Summary Table (HEAST).

6.3.3 Risk Characterization

Groundwater:

Calculating risk associated with groundwater contaminants identified at the PDO Yard is based on the following steps.

1. Identify average background concentrations (inorganics only).
2. Perform weight of evidence screen.
3. Compare to risk-based screening criteria any constituent identified at least once over background. Retain organic constituents as COPCs if they exceed screening criteria and are valid with respect to the weight of evidence screen. Retain inorganic contaminants as COPCs if they exceed twice the average background concentration.

4. Calculate intake rates for COPCs.
5. Calculate increased lifetime cancer risk (ILCR or risk) and noncarcinogenic Hazard Quotient (HQ) for COPCs.
6. Calculate total risk ($ILCR_{total}$) and Hazard Index (HI) for simultaneous exposure to COPCs.
7. Conduct an uncertainty analysis to validate risk-based calculations.
8. Retain any COPC as a COC if it exceeds an acceptable level of risk (1×10^{-6} for carcinogens or a HQ>1 for noncarcinogens).
9. Consider cumulative effects of COPCs and COCs by evaluating $ILCR_{total}$ and the HI. Determine if $ILCR_{total}$ and the HI exceed acceptable risk levels (1×10^{-6} to 1×10^{-4} for carcinogens or a HI>1 for noncarcinogens).
10. Develop remedial levels for COCs

HHCOPCs retained from the exposure assessment are considered to be either a human carcinogen (benzene) or a probable human carcinogen (PCE). Baseline risk for benzene and PCE are evaluated in this section. The expression for groundwater ingestion is given by equation 6.1 below.

$$CDI = (CW \times IR \times EF \times ED)/(365 \times BW \times LT) \quad \text{(Equation 6.1)}$$

where:
CDI = Chronic daily intake (mg/kg-day)
CW = Chemical concentration in water (mg/L)
IR = Ingestion rate (L/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
LT = Lifetime (years)

The exposure factors used for a residential exposure scenario and the corresponding references are summarized in **Table 13**. The residential exposure scenario, however unlikely at this site, is used at the request of the GA EPD and represents the most conservative approach to estimating risk at the PDO Yard. No current exposure to groundwater exists and no likely future use of shallow groundwater will occur at the site. All HHCOPC risk calculations are provided in **Appendix D** with a description of the risk assessment process.

The arithmetic average concentration (based on the contaminated portion of the plume) was calculated for each HHCOPC identified in groundwater. Values above the residential RBC were used in calculating the arithmetic average. As summarized in **Table 13**, the EPA Region 4, EPA RAGS values and Georgia EPD default values used for ingestion rate, exposure frequency, and exposure duration were the same.

In accordance with EPA Region 4 guidance, risk can be quantified for parameters which have published toxicity data. Consequently, the potential carcinogenic effects of benzene and PCE are

estimated. Potential increased lifetime cancer risk (ILCR), or risk, is based on the relationship ILCR = CDI x SF, and potential noncarcinogenic effects are calculated based on the relationship Hazard Quotient (HQ) = CDI/RfD. The ILCR $_{total}$ and Hazard Index (HI) are the summation of ILCRs and HQs for individual compounds. A spreadsheet showing calculations for each HHCOPC is provided in **Appendix D, Attachment 2.**

Using the input data and equations given above, the following estimates were derived:

Increased lifetime cancer risk (ILCR)

Benzene: $Risk_B = 9.94 \times 10^{-6}$
PCE: $Risk_P = 1.36 \times 10^{-5}$

Summation: $ILCR_{total} = 2.36 \times 10^{-5}$

Chemicals are not considered as significant contributors to risk and therefore are not included as HHCOCs if their individual carcinogenic risk contribution is less than 1 in 1,000,000 (10^{-6}) and their noncarcinogenic HQ is less than 0.1 (EPA, 1996a). Trigger levels used by Georgia EPD to evaluate potential health effects are 1×10^{-6} for carcinogenic risk and a noncarcinogenic hazard index of 0.1. Both benzene and PCE exceed the carcinogenic risk threshold of 10^{-6} for groundwater ingestion. Benzene and PCE are carried through the quantitative risk assessment as HHCOCs . None of the noncarcinogenic hazard index values exceed their respective trigger levels so they are not retained as HHCOCs in the BRA. Remediation levels should not exceed a 1×10^{-4} risk level for carcinogens or a hazard quotient of 3 for noncarcinogens. Although benzene and PCE exceeded a 1×10^{-6} trigger level based on carcinogenic effects, they are well within the acceptable risk range of 1×10^{-6} to 1×10^{-4} defined by EPA and the Georgia EPD.

The calculated risk level is extremely conservative because no groundwater consumption presently occurs and none is anticipated in the future. Additionally, the residential exposure scenario considers drinking 2 liters of groundwater per day, 350 days per year for 30 years, which is highly improbable. The exposure concentration used in calculating risk was the arithmetic average in the most highly contaminated part of the plume. Given anticipated future site use as a 90-day HW storage facility, a well would not be located within the worst plume area evaluated.

The Installation is aware that the GA EPD will not accept risk calculations for constituents which exceed their respective MCLs regardless of risk assessment calculations. For this reason, proposed RLs for benzene and PCE are equal to their respective MCLs of 5 µg/L.

Soil:

Human health risk associated with HHCOPCs in soil was also evaluated. The selection of COPCs in soil (see Tables 5A through 5H) was performed by comparing maximum detected concentrations in samples to risk-based screening values. Benzo(a)pyrene and arsenic were

identified as HHCOPCs in surface soil. Arsenic was the only HHCOPC identified in subsurface soil.

Benzo(a)pyrene was positively identified in only 2 of 23 surface soil samples at concentrations above the residential RBC of 0.088 mg/kg. Only one sample location exceeded the industrial RBC of 0.78 mg/kg, which, given current and anticipated site use, is more applicable at this site. Benzo(a)pyrene was detected at this location (SB01, 1.6 mg/kg) at approximately twice the industrial RBC but significantly below the SSL of 8 mg/kg. Additionally, the sample was collected at 2 feet bls; a depth considered by EPA as a subsurface soil horizon (EPA, 1996a). Benzo(a)pyrene was not detected above the industrial RBC in any of the 50 subsurface soil samples collected at the PDO Yard or in any groundwater sample.

Arsenic was present in both surface and subsurface soil samples at concentrations exceeding the screening criteria. The LQL for arsenic exceeded the residential RBC of 0.43 mg/kg at all locations. The lowest LQL for arsenic was <1.1 mg/kg. For comparison purposes, arsenic concentrations in surface soil (0 to 2 feet bls) were evaluated with respect to the industrial RBC of 3.8 mg/kg. The industrial RBC was exceeded at 10 of 23 surface soil sampling locations. Arsenic was identified in 4 of 50 subsurface soil sampling locations at concentrations exceeding the industrial RBC of 3.8 mg/kg. The average concentration of arsenic in subsurface soil is 1.71 mg/kg. The average includes all positive detections of arsenic and one half the value of the LQL at locations where arsenic was not detected. This average concentration in subsurface soil is well below the industrial RBC. Therefore, risks associated with arsenic in subsurface soil is not considered in the BRA. Risk associated with arsenic exposure in surface soil is characterized in this section.

Exposure scenarios were developed for each potential receptor population. These scenarios address where a receptor is likely to come into contact with soil and identify the appropriate exposure pathways (ingestion, dermal contact, etc.) for that receptor. A detailed discussion of the potential exposure pathways at the PDO Yard is provided in Appendix D. Two potential receptor populations, the on-site worker and on-site resident, are evaluated in the BRA for exposure to HHCOPCs in soil. No digging below 2 feet bls is anticipated at the site under current or potential future use scenarios. In addition, risks associated with HHCOPCs in subsurface soil that were initially retained for characterization in the BRA were eliminated based on rationale discussed above. The concentrations of HHCOPCs in soil are assumed to remain constant over the exposure period and are based on monitoring data. Data collection from the PDO Yard investigation is essentially random in nature and the average HHCOPC concentration and 95% upper confidence limit (UCL) on the mean concentration is used for conservative evaluation of adverse health effects.

On-Site Worker. Under current and future conditions, an on-site worker could be exposed to HHCOPCs in surface soil at the site as a result of direct contact and incidental ingestion of particulates. Total cancer risks associated with benzo(a)pyrene and arsenic in soil to this population are 8.68×10^{-6} and 3.09×10^{-5}, respectively. All risk calculations are provided in **Appendix D, Attachment 3.** The $ILCR_{total}$ for all risks is 3.96×10^{-5}. The ILCR for arsenic

marginally exceeds the trigger level of 1×10^{-6}. The conservative exposure assumptions used in the risk characterization would lead to an overstatement of risk to the on-site worker. Considering that the $ILCR_{total}$ is well within the acceptable range of 1×10^{-4} to 1×10^{-6} accepted by the EPD, the conservative assumptions, and the unlikelihood of actual exposure to contaminants at the PDO Yard, remedial actions to protect the worker exposed to soil are not warranted.

On-Site Resident. Although not a likely receptor for the PDO Yard, the on-site resident is included as a worst-case scenario for exposure to HHCOPCs in soil. This scenario assumes that a family lives on the site. Since both benzo(a)pyrene and arsenic are classified as potential human carcinogens, the adult exposure scenario is considered the more conservative scenario for estimating potential cancer risks. This is based on the longer exposure duration for the adult as compared with the child. The child scenario is typically used to evaluate potential risks associated with systemic exposures, given the child's lower body weight and relatively higher water ingestion rate per unit body weight.

Total cancer risks associated with benzo(a)pyrene and arsenic in soil to this population are 3.72×10^{-6} and 1.32×10^{-5}, respectively (see **Appendix D, Attachment 4**). The $ILCR_{total}$ for all risks is 1.70×10^{-5}. The ILCR for arsenic marginally exceeds the trigger level of 1×10^{-6}. The conservative exposure assumptions used in the risk characterization would lead to an overstatement of risk to the on-site worker. Considering that the $ILCR_{total}$ is well within the acceptable range of 1×10^{-4} to 1×10^{-6} accepted by the EPD, the conservative assumptions, and the unlikelihood of residential development at the PDO Yard, surface soil remedial actions to protect this hypothetical population exposed to surface soil are not warranted.

6.4 Uncertainty

There are uncertainties associated with all phases of the BRA, including collection and laboratory analysis of the samples, exposure assessment, toxicity assessment, and risk characterization. These uncertainties are considered to be inherent in the risk assessment process and are typically addressed by applying conservative and often overly conservative assumptions to increase protection to potentially affected populations.

Uncertainties associated with the collection and laboratory analysis of the sampling data may impact the results of the HHCOPC selection process. These uncertainties result from the potential for contamination of samples during collection, preparation, or analysis and from normal error in the analytical techniques. These uncertainties are minimized by the laboratory validation process and by performing analyses consistent with current EPA guidance.

Uncertainty is also associated with the criteria used for the selection of COPCs. Uncertainties are also inherent in development of screening values. The use of conservative assumptions when selecting the screening values coupled with the use of low toxicity assessment endpoints (i.e., the use of an HI of 0.1 and an ILCR of 1 in 1,000,000) ensures that those constituents most likely to contribute significantly to potential risks are evaluated.

The most conservative land-use scenario (residential) was evaluated in the BRA in addition to the on-site worker scenario. The probability that the PDO Yard would be used for residential purposes or that the shallow aquifer underlying the site would be used for drinking water is extremely low. Physiological values (e.g., body weight, inhalation rates) and behavioral values (e.g., average time spent in one place and amount of groundwater ingested) used to model the reasonable maximum exposure (RME) are a combination of average and upper-bound levels taken from reliable sources. The use of upper-bound estimates will tend to overestimate exposure for RME. Therefore, the range of potential risks is likely to be greater than the actual risks. This approach provides conservative, health-protective values for the risk assessment.

The toxicological parameters used to quantify potential risk to a receptor include CSFs and RfDs. These values are often derived from laboratory animal studies. Uncertainties associated with the use of laboratory animal studies arise during the extrapolation of: (1) the toxic effects observed at the high doses in the animal studies to much lower, environmentally relevant doses, and (2) the toxic effects differences between animals and man. The EPA has derived CSFs using a weight-of-evidence approach from studies in the scientific literature. The CSFs represent the upper 95 percent confidence limits on the slope of the dose response curve for carcinogenic responses. Because CSFs represent the near upper limits of the slope of the line, the use of the CSF is more likely to overestimate the actual risk than underestimate it. The RfDs used to characterize noncarcinogenic effects are derived using studies in humans or animals by identifying the lowest-observed-adverse-effect level (LOAEL) or no-observed-adverse-effect level (NOAEL). An uncertainty factor, a product of as many as five separate factors, is utilized in the determination of the LOAEL and NOAEL to account for uncertainty in determining individual values.

The risk characterization evaluates the potential risks associated with exposure to numerous chemicals via multiple pathways. There is uncertainty associated with exposure to chemical mixtures because chemicals may have synergistic or antagonistic effects on other chemicals. For the purposes of this risk assessment, it was assumed that all chemicals have additive toxicity and that the potential health effects would be equal to the sum of each of the individual chemical actions. This approach may result in the overestimation or underestimation of certain risks.

In general, sources of uncertainty may be categorized into site-specific factors (e.g., variability in analytical data and exposure parameter assumptions) and toxicity factors. The use of conservative assumptions in the risk assessment is believed to result in an overestimation of risk. Actual site risks are likely to be lower than the estimates presented in this RFI report.

6.5 Human Health Risk Assessment Summary

The human health risk assessment consisted of a comparison of soil, sediment, groundwater, and surface water data to risk-based screening values. Based on the results of the risk assessment, the following can be concluded:

- HHCOPCs in soil are not present at concentrations that require remediation for the protection of on-site workers under current use or potential residents under a future use scenario.
- There are no HHCOPCs in surface water or sediment.
- Benzene and PCE were identified as HHCOPCs in groundwater and concentrations of both constituents exceeded their respective RBCs and MCLs.
- Risk calculations for benzene and PCE indicated the calculated carcinogenic and noncarcinogenic human health risks are below the recommended threshold values as defined by Georgia EPD and the EPA. Therefore, further human health risk assessment is not required for the PDO Yard.
- Proposed RLs for benzene and PCE are their respective MCLs of 5 μg/L.

No current groundwater exposure exists. Evaluating shallow groundwater use for future drinking water (i.e. comparison to the MCLs/RBCs) is very conservative. Additionally, the residential exposure scenarios for groundwater use are extremely unlikely given regional confining units exist between the shallow aquifer where contamination was identified and deep aquifer where drinking water wells are located. Only conservative default assumptions were used in the assessment. All noncarcinogenic effects were below target threshold levels for all media. All constituents contributing to carcinogenic risk were within the acceptable range defined by EPA and EPD (1×10^{-6} to 1×10^{-4}). Based on the rationale provided above, remediation levels for groundwater equal to the MCL for benzene and PCE are selected for the site. No RLs were derived for HHCOPCs identified in soil.

SECTION 7

ECOLOGICAL RISK ASSESSMENT

The State of Georgia requires that all RCRA facilities choosing to set remediation levels based on an assessment of risk to human health and the environment prepare risk assessment documentation and propose remediation levels according to the *Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units*. This guidance is based on the guidance contained in EPA Region 4 Bulletins, *Supplemental Guidance to RAGS, Ecological Risk Assessment* (EPA 1996b) and *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA 1997). Where there are differences with EPA guidance (EPA 1996b, 1997), the Georgia EPD 1996 guidance document takes precedence. The PDO Yard ecological risk assessment discussed in the following sections was conducted in accordance with the Georgia EPD guidance and procedures outlined in the Risk-based Corrective Action Plan provided in Appendix D.

Risk is the likelihood of experiencing adverse effects. Ecological risk assessments identify and evaluate the risk to biota exposed to chemical contaminants and physical and biological hazards. The ecological risk assessment for the PDO Yard focuses on evaluating the potential for harmful effects on ecological receptors as a result of exposure to chemicals.

The assessment of risk for ecological receptors at the PDO Yard is being conducted in a phased approach according to Georgia EPD guidance (Georgia EPD 1996). As shown in the flowchart of the Georgia EPD ecological risk assessment process (see Appendix D), the two phases are:

- Preliminary Risk Evaluation (PRE) and
- Ecological Risk Assessment (ERA).

The PRE compares measured concentrations of site-related contaminants to conservative ecological screening values for one or more ecological receptors. Only those facility-related contaminants that are indicated to be potential hazards in the PRE are evaluated as ecological ECOPCs in an ERA. The basic approach to the ERA is similar to that of the PRE but site-specific data are used to quantify exposure and evaluate effects in the ERA (Georgia EPD 1996). Appropriate site-specific data include concentrations of contaminants in animals and plants (tissue residues) and toxicity tests (EPA 1996b). Remediation levels for protection of ecological resources are developed and proposed only for those ECOPCs identified as ecological contaminants of concern (ECOCs) in the ERA, if one is required.

7.1 Preliminary Risk Evaluation

The purpose of the PRE is to identify substances detected at the PDO Yard that pose a potential hazard to ecological receptors. Ecological COPCs are those substances that are detected at the

PDO Yard at concentrations exceeding ecological screening values provided they are not eliminated in subsequent steps of the PRE.

According to GEPD (1996), the PRE consists of five steps:

i. Ecological screening value comparison,

ii. Preliminary problem formulation,

iii. Preliminary ecological effects evaluation,

iv. Preliminary exposure estimate, and

v. Preliminary risk calculation.

The laboratory quantitation limits for chemicals analyzed were sufficiently low to allow comparison to risk-based screening levels. **Tables 5** through **10** list analytical results and LQLs for chemicals analyzed and the associated risk-based screening levels. For most ECOPCs, the LQLs were less than or equal to the risk-based screening values making a direct comparison to screening criteria possible. For some ECOPCs, the LQLs were higher than the risk-based screening levels. The LQL was used as screening criteria for these compounds because the laboratory is incapable of accurately quantifying concentrations at residential RBC levels. The "<" sign in the tables indicates the analyte was not detected at a concentration above the LQL.

As shown in the flowchart of the GEPD ecological risk assessment process (**Appendix D**), all substances detected are screened as ECOPCs by comparing the maximum detected concentration to the ecological screening values (ESVs). This approach assumes that the most sensitive receptors are those that live in direct contact with the medium and are exposed by multiple pathways to contaminants. If no ECOPCs are identified based on the screening (Step i), then no further evaluation is required. If ECOPCs are identified based on the screening, then ECOPCs are evaluated further (Steps ii through v).

7.1.1 Ecological Screening Value Comparison (Step i)

EPA Region 4 has developed ESVs for surface water and sediment which are used in preliminary screening. Ecological screening values were not intended as remediation levels since they are based on conservative endpoints and sensitive ecological effects data. Exceedences of the ecological screening values may indicate the need for further evaluation of the potential ecological risks. The frequency, magnitude, and pattern of exceedences are all considered. The EPA Region 4 ecological surface water screening criteria are intended to protect 95% of the species, 95% of the time. Sediment values are derived from toxicity observations and statistical procedures. Currently there are no peer-reviewed, ecologically based screening levels for soil. The US EPA issued a memorandum entitled; *Ecological Risk*

Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders, which provides ecological screening values for surface soil (EPA 1998). Draft Recommended Ecological Screening Values (RESVSs) will form the basis for evaluating ECOPCs in surface soil at the PDO Yard. These RESVSs were obtained from EPA Region 4 (via e-mail correspondence between Sharon Thoms and David Wilderman). The RESVSs selected as screening criteria are based on US Fish and Wildlife Service values for moderate soil contamination which require additional study.

The ESVs used to identify ECOPCs at the PDO Yard are EPA Region 4 Freshwater Surface Water Screening Values (FSWSV), EPA Region 4 Sediment Screening Values (SSVs), and Draft RESVSs for soil. The surface water ESVs are also used to evaluate potential impact to groundwater receptors. Although there are no receptors anticipated to come in direct contact with groundwater, some mixing of groundwater and surface water media takes place in seeps on the bank of Lamar canal. For analytes without Region 4 ESVs, screening values are proposed based on other methods and data obtained from published toxicological data bases including the Hazardous Substances Data Bank, Integrated Risk Information System (IRIS), Ambient Water Quality Criteria (AWQC), and Georgia IWQS. These additional ESVs are risk-based criteria designed for the conservation of fish, wildlife, and other beneficial aquatic life. Ecological screening values are conservative to prevent elimination of any contaminant that may pose ecological risk (EPA 1997).

7.1.1.1 Evaluation of ECOPCs in Surface Water

Three surface water samples were collected during the Phase I investigation from Lamar canal; located north of the PDO Yard. Lamar canal is a man-made ditch which flows into Springfield canal; a tributary of Little Ogeechee River. The canal is marshy, has a fairly low flow rate, and the water level is generally less than one foot except during periods of heavy rainfall. The Phase I surface water and sediment analytical results (from September 18, 1996) were verified during the Phase II RI investigation by collecting samples from the same locations. M&E collected three surface water samples; PDO-SWE01, PDO-SWE02, and PDO-SWE03 on August 13, 1998. Results of Phase II samples, collected specifically for ecological risk evaluation, were compared to ESVs in the ecological screening value comparison presented in the December 1998 Revised Final RFI report. GA EPD comments on the report mandated that additional surface water and sediment samples be collected in close proximity to the most contaminated groundwater monitoring well (MW06). These additional surface water samples (PD1600 and PD 2600) were collected by SAIC on April 16, 1999. Analytical results of all Phase II surface water samples are summarized in the following section and are quantitatively evaluated in this Revised Final RFI Report. Sampling locations are illustrated on Figure 7.

Bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was detected in the PDO-SWE02 surface water sample at 16 µg/L; above the chronic FSWSV. The concentration was, however, two orders of magnitude lower than the 1,110 µg/L acute FSWSV. Since bis(2-ethylhexyl)phthalate was only identified in one Phase II groundwater sample (deep well PDOMW10) a correlation cannot be made between the PDO Yard as a source and its presence in

surface water. Additionally, bis(2-ethylhexyl)phthalate was not identified in any Phase I (September 1996) or quarterly (November 1998, February 1999, or May 1999) groundwater or surface water sample. This compound is likely a result of laboratory contamination or an anomaly and was not retained as an ECOPC in the ecological risk assessment. A summary of surface water analytical results and screening criteria are provided in Table 7 and Table 8.

Zinc was also detected in surface water samples at concentrations exceeding both chronic (58.91 µg/L) and acute (65.04 µg/L) EPA Region 4 FSWSVs. The most elevated zinc concentration, 110 µg/L, was identified in the up-gradient sample location PDO-SWE01 (August 1998). Zinc concentrations in the April 1999 SAIC surface water samples PD1600 and PD2600 were significantly lower than screening criteria (12.1 µg/L and 19.5 µg/L, respectively). These samples were collected from locations exhibiting the highest probability for adverse effects from the PDO Yard. Zinc detections were also compared to Ambient Water Quality Criteria (AWQC) for freshwater fish and aquatic life. The acute and chronic AWQC are 120 and 110 µg/L, respectively, based on a hardness of 100 mg/L CaCO3. The levels of zinc in surface water are all below the acute and chronic AWQC and decrease to the FSWSV levels at sampling locations down-gradient of the PDO Yard. All zinc values in proximity of the PDO Yard were below concentrations identified in the background (up-gradient) sample. This indicates that the PDO Yard is not a source of zinc contamination and that ecological receptors in the drainage ditch are not at risk from marginally elevated zinc concentrations in surface water. Zinc was not retained as an ECOPC for further evaluation in the PRE based on surface water sample results.

Lead was present in all surface water samples above the IWQS (1.3 µg/L) and chronic FSWSV (1.32 µg/L). No lead concentrations in August 1998 surface water samples exceeded the acute FSWSV of 33.78 µg/L. Lead concentrations ranged from 2.9 µg/L to 13.4 µg/L with an arithmetic average concentration of 9.34 µg/L. As was the case for zinc above, the highest concentration of lead was detected in the up-gradient sample SWE01 at 13.4 µg/L. Lead concentrations in SAIC surface water samples PD1600 and PD2600, collected from locations exhibiting the highest probability for adverse effects from the PDO Yard, were the lowest concentrations identified in surface water samples (each 2.9 µg/L). Additionally, lead concentrations in all surface water samples from the November 1998 and February 1999 quarterly sampling program were below the 5 µg/L detection limit. Lead was once again present in the May 1999 up-gradient surface water sample SWE01 at 56 µg/L. This indicates that the PDO Yard is not the source of elevated lead observed in surface water samples. However, ecological receptors in the drainage ditch may be at risk from elevated lead concentrations in surface water. Lead was not retained as an ECOPC for further evaluation in the PRE because the development of RLs for lead and subsequent remedial measures would not be initiated in association with the PDO Yard area. Further evaluation of the source of lead in Lamar canal and potential risks to ecological receptors could be performed if the present concentrations suggest an unacceptable level of risk exists. No other inorganic or organic ECOPC was identified in surface water during Step i of the PRE.

7.1.1.2 Evaluation of ECOPCs in Sediment

Sediment samples were also collected from all surface water sampling locations during the Phase II investigation (i.e., collocated). M&E collected three sediment PDO-SWE01, PDO-SWE02, and PDO-SWE03 on August 13, 1998. SAIC personnel collected two additional sediment samples, PD1500 and PD2500, on April 16, 1999 (also collocated with surface water sample locations PD1600 and PD2600). The two SAIC samples were collected in close proximity to the most contaminated groundwater monitoring well (MW06) to assess risks most likely attributed to the PDO Yard. Analytical results of all Phase II sediment samples were compared to ESVs in the ecological screening value comparison.

Lead was identified in Phase II sediment samples at concentrations above EPA Region 4 ecological SSV. A summary of ECOPCs in sediment and their accompanying SSVs is provided in **Table 9** and **Table 10**. Background (up-gradient) sediment sample results from PDOSWE-01 indicated that only lead exceeded its SSV of 30.2 mg/kg. Of all the sediment samples collected by M&E, the up-gradient sample (PDOSWE01) contained the most elevated lead concentration (50 mg/kg). See **Figure 9** for sediment sample locations and analytical results. The most down-gradient sample (PDOSWE03) contained 36 mg/kg compared with a SSV of 30.2 mg/kg. The PDOSWE03 duplicate contained 24 mg/kg, thus averaging the two values results in a lead concentration of 30 mg/kg. Only 16 mg/kg lead was identified in PDOSWE02; located directly down-gradient of the PDO Yard, which is below its respective ecological screening value. Lead was detected above the SSV in only one of the three sediment samples collected during the November 1998 quarterly sampling and in none of the February 1999 or May 1999 quarterly samples. The lead concentration in the November SWE03 sample (the most down-gradient location) was 71 mg/kg compared with its February result of 2.6 mg/kg indicating a high degree of variability in analytical results. No lead concentrations exceeded the SSV when evaluated using average lead concentrations at each sampling location over the quarterly monitoring program.

Lead was also detected in samples PD1500 (8.8 mg/kg) and PD2500 (135 mg/kg), collected by SAIC. Lead concentration in the two samples exhibit a high degree of variability considering they were collected adjacent (within 25 feet) to each other.

Lead is most likely attributed to natural occurrence or a source located up-gradient of the PDO Yard based on the distribution of lead in sediment samples. Analytical results also indicate that lead concentrations vary significantly at the same locations over time. Lead concentrations were not consistently confirmed above SSVs at individual sampling locations. Moreover, considering that the home range of potential ecological receptors covers an extended length of Lamar canal, isolated periodic exceedence of the SSV at low concentrations is not considered significant. Lead is therefore not retained as an ECOPC in sediment for this site.

Barium was present in all samples but no published SSV exists. Therefore, barium is retained as an ECOPC by default. Barium concentrations ranged from 16 mg/kg in the sample directly down-gradient of the PDO Yard (PDOSWE02) to 76 mg/kg at the furthest down-gradient (PDOSWE03) sample location. The up-gradient sample, PDOSWE01, contained 42 mg/kg of barium.

7.1.1.3 Evaluation of ECOPCs in Surface Soil

Currently there are no peer-reviewed, ecologically based screening levels for surface soil. The US EPA issued a memorandum entitled; *Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders*, which provides ecological screening values for surface soil (EPA 1998). Draft RESVSs form the basis for evaluating ECOPCs in surface soil at the PDO Yard and are provided on Table 3. The RESVSs selected as screening criteria are based on US Fish and Wildlife Service values for moderate soil contamination which require additional study.

Benzo(a)pyrene was the only organic compound identified in the 23 surface soil samples at a concentration exceeding its RESVS. Benzo(a)pyrene was detected in 1 of 23 locations (SB01, 1.6 mg/kg) marginally exceeding the RESVS of 1 mg/kg. Because of the low frequency of detection and the SB01 sample concentration being less than twice the RESVS, benzo(a)pyrene is not retained as a ECOPC in surface soil. No inorganic elements exceeded the RESVSs. Analytical results from subsurface soil samples were also compared to RESVSs. No analyte in subsurface soil exceeded RESVSs.

7.1.1.4 Evaluation of ECOPCs in Groundwater

Groundwater is evaluated in the PRE for the PDO Yard although the groundwater table exists approximately six feet bls and potential ecological receptors (specifically burrowing vertebrates) are not likely to exist beyond 3 to 4 feet bls. The groundwater table exists slightly above the elevation of surface water in Lamar canal so hydraulic communication most likely takes place at the groundwater/ surface water interface. For this reason, toxicity to aquatic biota is evaluated for ECOPCs that exist in groundwater at the PDO Yard. The highest concentrations of benzene (illustrated on **Figure 7**) is lower than the Acute FSWSV listed on **Table 4** but marginally exceeds the Chronic FSWSV of 53 µg/L. In response to GA EPD's April 1999 comments, two surface water samples (PD1600 and PD2600) were collected by SAIC directly down-gradient of PDO-MW06 where anticipated mixing (seeping) of benzene-contaminated groundwater would occur. Benzene was not detected in either of the two samples. No adverse biological effects are anticipated from benzene in identified in groundwater samples near Lamar canal considering the surface water analytical results. In addition, benzene concentrations decrease from 64 µg/L at PDO-MW10 (located 140 feet from the canal) to 36J µg/L at PDO-MW06 (approximately 20 feet from the canal). Benzene is not retained as an ECOC in the groundwater media.

The most elevated concentration of PCE, 47 µg/L, was detected at PDOMW05. This concentration is well below both the Acute and Chronic FSWSVs for PCE (528 µg/L and 84 µg/L, respectively) listed in **Table 4.** PCE was not identified in any surface water sample collected from Lamar canal. Therefore, PCE is not retained as an ECOC in groundwater. No other ECOPC identified in groundwater exceeded published FSWSVs.

7.1.2 Preliminary Problem Formulation (Step ii)

The preliminary problem formulation (Step ii) qualitatively identifies categories of potential ecological receptors that occur at the PDO Yard and contaminants that may pose a risk to those receptors in the environment. Preliminary assessment endpoints, ecological receptors, and surrogate species representative of potential ecological receptors are selected for evaluation in the preliminary risk calculation. Ecological ECOPCs identified in the PRE Step i for surface water, sediment, surface soil, and groundwater are considered. The ecological screening value comparison conducted above retained one ECOPC, barium, in the sediment medium. No ECOPCs were retained from Step i in the surface water, soil, or groundwater media.

7.1.2.1 Environmental Setting

A detailed investigation of ecological receptors was not performed as part of the field investigation. However, a general description of the PDO Yard and the surrounding area is provided in this section. Surface topography at the site is essentially flat with a slight rise in elevation on the southern boarder of the study area. The principal surface water body receiving drainage from the PDO Yard is Lamar canal. The canal is located approximately 175 feet north of the northeast corner of the PDO Yard's fenced enclosure. Surface soil in the area is composed primarily of fine to medium-grain size sand with minor percentages of silt and clay. Soil is well drained and, where not paved or graded, covered in scrub grasses. Visual inspection of Lamar canal hydraulically down-gradient of the PDO Yard indicates that it is capable of supporting shallow freshwater plants and aquatic life typically encountered in the Savannah area. Abundant vegetation was observed in the shallow water of the drainage feature. Small fish, turtles, small mammals, and coastal water fowl are likely to inhabit the area. The raccoon (*Procyon lotor*) was selected as the surrogate species to evaluate potential adverse effects associated with ECOPCs in sediment.

7.1.3 Preliminary Effects Evaluation (Step iii)

The preliminary ecological effects evaluation (Step iii) focuses on determining toxicity reference values (TRVs) for ECOPCs as well as determining the complete exposure pathways that exist at the site. These data are then used in the preliminary risk calculation. Only barium was identified as an ECOPC in the ecological screening value comparison (Step i). Therefore, TRVs are derived directly from the no observed adverse effect level (NOAEL) for barium of 45 mg/kg-day. The NOAEL value for barium, expressed in units of milligrams of contaminant/ kilogram body weight/

day (mg/kg-day), is derived from a subchronic rat laboratory toxicity study. This test specie is closely related to the raccoon and is acceptable for TRV development. Further derivation of TRVs using the duration conversion factor (value = 1) or the endpoint conversion factor (value = 1) was unnecessary because the factors had no effect on the unadjusted NOAEL value.

The published NOAEL for test specie is used to derive a NOAEL for the surrogate species selected for the PDO Yard PRE. The surrogate specie NOAEL is adjusted for the difference in body weight between a test species of the same taxonomic class (in this case a rat) and the surrogate specie; a raccoon. The NOAEL for surrogate specie, based on average daily dose (mg/kg-day) is developed according to the following equation:

Raccoon NOAEL = rat NOAEL x $(bw_{rat}/bw_{raccoon})^z$,

where:

rat NOAEL = 45 mg/kg-day
bw_{rat} = body weight (kg) of the test specie, (0.435 kg),
$bw_{raccoon}$ = body weight (kg) of the surrogate specie, (4.31 kg), and
z = 0.25 for mammals

Substituting the values in the equation above produces a raccoon NOAEL of 25.36 mg/kg-day. The calculated NOAEL for the surrogate specie is the TRV used in the PRE.

7.1.4 Preliminary Exposure Estimate (Step iv)

The preliminary exposure estimate (Step iv) involves the selection of exposure parameters for use in calculating a daily exposure dose for the selected receptor species. Potential pathways of exposure appropriate to the preliminary assessment endpoints and ecological receptors at the PDO Yard are evaluated. Exposure factors are selected for receptors likely exposed to barium in sediment by two trophic transfer and by incidental ingestion.

The exposures of the surrogate specie for the PDO Yard are estimated using conservative assumptions. The surrogate specie at the PDO Yard is assumed to spend its entire life and obtain 100% of its diet or drinking water from that area, i.e., the area use factor (AUF) equals 1. The raccoon is selected to represent species potentially at risk and is assumed to eat only sediment and surface water-dwelling vertebrates and invertebrates that may bioaccumulate contaminants from these media. Contaminants are assumed to bioaccumulate in the surface water and sediment-dwelling prey of ecological receptors at levels equal to published bioaccumulation factors (BAFs) for worms and fish (HAZWRAP 1994). The exposure parameters for a raccoon exposed to barium is presented in **Table 15**.

A raccoon may be exposed to barium indirectly by ingestion of biota which concentrate barium in tissue. The maximum detected concentration of barium in sediment samples is used as the exposure point concentrations to calculate the maximum average daily doses (ADDs). Incidental ingestion of soil is also considered in the ADD. The ADD to raccoons is calculated as the product of the maximum detected sediment barium concentration, the unitless soil-to-invertebrate bioaccumulation factor (BAF_i), and the daily specific food ingestion rate (IR) of the receptor. The direct exposure to barium by incidental ingestion of sediment is then added to the ADD at a rate of 9 % of the raccoon's total food ingestion rate. Calculation of the ADD is provided in **Appendix D, Attachment 4**.

The concentration of barium to which endpoint receptors at Lamar canal are directly or indirectly exposed are estimated by the maximum detected concentration in sediment samples.

7.1.5 Preliminary Risk Calculation (Step v)

The preliminary risk calculation (Step v) uses the hazard quotient (HQ) method as an indicator of the risks posed to the surrogate ecological receptor from exposure to site-related ECOPCs. The HQs of ECOPCs are added to produce a hazard index (HI). An HI greater than 1 for a category of ECOPCs is a useful indicator of potential risk when no individual ECOPC in that category has an HQ greater than 1. However, based on data provided herein, only barium is considered an ECOPC at the PDO Yard and calculation of an HI is therefore not required.

A NOAEL-based HQ or HI less than one indicates an exposure level at which adverse ecological effects are unlikely to occur, due to the conservative assumptions which were made during the PRE. NOAEL assumptions therefore minimize the probability of falsely concluding that there is no risk when, in actuality, risk exists. Therefore, ECOPCs with HQs and HIs less than 1.0 indicate little to no likelihood of risk to the ecological receptors. To minimize the probability of falsely concluding there is risk when there is none, an ERA for those ECOPCs with calculated HQs or HIs exceeding 1 is performed using site-specific data (GEPD 1996).

Risk calculations performed to quantify the potential exposure to ECOPCs in sediment are summarized in **Appendix D, Attachment 5**. This attachment provides estimates of specie-specific average daily dose (ADD), TRV, intake rate (IR), incidental ingestion rate (IIR) and BAFs. Risks to potential receptors from exposure to ECOPCs in surface soil, surface water, sediment, and groundwater were evaluated in Step i of this PRE. Barium in sediment was the only ECOPC retained for additional evaluation based on Steps ii through iv of the PRE. Results of preliminary risk calculations for surrogate species exposed to barium are summarized in this section.

Barium, present in all Phase II sediment samples, has no published SSV and was retained as an ECOPC in the ecological screening value comparison by default. Preliminary risk calculations presented in **Appendix D, Attachment 5** indicate the HQ associated with barium for the raccoon

is 1.47×10^{-3}; well below the target level of an HQ equal to 1. Barium was the only ECOPC identified in sediment and, as such, no HI is calculated. Based on calculations, barium is not retained as an ECOC for sediment at the PDO Yard.

Groundwater COPCs were also evaluated with respect to ESVs. All ECOPC concentrations were lower than their respective ESVs in the monitoring wells located down-gradient of the PDO Yard. COPCs previously identified in groundwater are therefore not considered to pose a threat to potential receptors in Lamar canal.

7.2 Summary of Ecological Risks

The ecological assessment consisted of conducting a PRE which compared surface soil, surface water, sediment, and groundwater detections to ecological screening values published by EPA Region 4. The following summarizes the findings of the PRE:

- There are no identified ECOPCs in surface soil, surface water, or groundwater.
- Barium concentrations in sediment do not pose a risk to potential receptors near the PDO Yard.
- An ERA is not required for the PDO Yard based on the data evaluation conducted in the PRE.

SECTION 8.0

SUMMARY AND CONCLUSIONS

The soil, surface water, sediment, and groundwater sampling activities conducted at the PDO Yard and background locations provided data on the types and extent of constituents present at these locations. These data were used to evaluate potential human health and environmental risks associated with exposure to contamination at the waste unit.

8.1 Summary of Source

Areas within the PDO yard that were used for the temporary storage of chemicals/hazardous waste were well defined in the project record. Although there was no physical evidence of source material present during the Phase I and Phase II investigations, constituent levels were elevated around the former bermed areas (in Phase I soil samples) and outside the fenced area (monitoring wells). Interim removal activities at the PDO Yard effectively removed contaminated soil in proximity of the bermed area and former ASTs. No elevated concentrations of target compounds were present in the soil samples collected following the IR.

Benzene and PCE concentrations in groundwater are above the human health screening criteria. A likely source of benzene is the former AST bermed area. PCE is confined to a cluster of wells outside the fenced area near the railroad tracks. The low flow purging technique employed during Phase II groundwater sampling confirmed that turbidity in groundwater samples was responsible for the elevated concentrations of inorganics detected during the Phase I groundwater investigation. No inorganics were present in Phase II groundwater samples above screening criteria.

8.2 Summary of Exposure Pathways

All media were considered in the exposure pathway evaluation. The contaminated soil within the bermed area was removed during the July 1998 IR thereby eliminating potential for exposure to contaminated surface and subsurface soils. In addition, access to the PDO Yard is restricted by a fence and locked gate. Construction activities in the PDO Yard area that intersect the groundwater table could cause site worker exposure if performed without adequate protection; however, this is a short term health and safety matter. Groundwater HHCOCs, namely benzene and PCE, migrating toward Lamar canal are unlikely to adversely affect surface water quality because the most elevated concentrations in the down-gradient reaches of the plumes are below IWQS and other ESVs. Lamar canal also forms a natural barrier (constant head boundary) for shallow groundwater contaminants migrating down-gradient thereby limiting the potential for drinking water impact in the Lamarville residential area (located approximately 3000 feet west of the PDO Yard). Currently, there is no completed pathway (human or ecological) for exposure to groundwater.

Human health risk associated with groundwater exposure was considered for a future residential use scenario, although the likelihood of shallow groundwater being used for potable purposes is extremely remote. Local ordinances prohibit the installation/use of drinking water wells in the shallow aquifer within the Savannah city limit. In addition, several confining units separate the shallow aquifer, where contamination was identified, from the deep aquifer used for potable water supply. Calculated risks associated with exposure to the two carcinogenic HHCOPCs identified in groundwater, benzene and PCE, under a residential use scenario were within the acceptable risk range observed by both EPA and the EPD. Similarly, calculated risks associated with HHCOPCs in soil, namely benzo(a)pyrene and arsenic, were within acceptable risk ranges. Surface water and sediment pathways were considered in the human health risk assessment but were determined to be incomplete and were therefore eliminated.

Pathways for ecological risk are complete for species in contact with surface soil, surface water, and sediment. In accordance with EPD guidance, quantitative evaluation of risk to potential receptors was performed. Risk associated with exposure to the only ECOPC identified in the PRE, barium, was well within the acceptable range observed by both EPA and EPD.

8.3 Conclusions

This investigation has provided an expanded understanding of the nature and extent of contamination and the potential impacts to human health and the environment. PDO Yard soil and groundwater sample results indicate limited contamination above minimum screening criteria. The horizontal and vertical extent of PCE in groundwater has been defined although plume closure down-gradient of MW05 was inferred. No PCE was identified in any surface water sample collected from Lamar canal. The benzene plume has been defined to well below the IWQS both horizontally and vertically. Benzene plume contours indicate that benzene contaminated groundwater is reaching the ditch at concentrations below the IWQS. No benzene was identified in any surface water sample collected by M&E. Additionally, no benzene was present in confirmation surface water samples collected by SAIC directly down-gradient of MW06.

The maximum concentration of both benzene and PCE identified in groundwater samples was within one order of magnitude of their respective MCLs. Risk calculations indicate that even under the highly unlikely future residential exposure scenario, the levels of contamination are within acceptable risk ranges determined by the EPA and Georgia EPD. The calculated levels were based on the highest contaminant concentrations detected at the PDO Yard and very conservative assumptions resulting in a risk estimation strongly biased toward the protection of human health. However, the Installation is aware that the GA EPD will not accept risk calculations for constituents which exceed their respective MCLs. Therefore, the remedial levels proposed for both benzene and PCE are their respective MCLs of 5 µg/L.

The following conclusions have been made based on the results of the Phase I and Phase II RFI for the PDO Yard:

- The horizontal and vertical extent of contamination has been fully delineated by activities conducted during the Phase II RFI.
- The IR conducted in July 1998 eliminated risks associated with direct exposure to COPCs (identified during Phase I) in contaminated AST berm area soil.
- Although HHCOPCs were identified in the screening value comparison for surface and subsurface soil, none were retained as HHCOCs following further quantitative evaluation. No HHCOPCs were identified in surface water or sediment.
- Benzene and PCE were identified as HHCOPCs in groundwater and concentrations of both constituents exceeded their respective RBCs and MCLs. Remedial action for both benzene and PCE will be required. No other HHCOPC evaluated in the BRA requires remediation.
- Human health risk calculations indicate that the level of risk to potential receptors associated with both carcinogens and non-carcinogens in groundwater was well within risk ranges accepted by EPA and the EPD.
- There are no identified ECOPCs in soil, surface water, or groundwater. Barium concentrations in sediment pose no ecological threat to potential receptors in Lamar canal. Therefore, an ERA is not required for the PDO Yard.

8.4 Recommendations

Recommendations based on the RFI include:

- Risk calculations for benzene and PCE identified in the shallow aquifer indicated the calculated carcinogenic and noncarcinogenic human health risks are below the recommended threshold values as defined by Georgia EPD and the EPA. Therefore, further human health risk assessment is not required for the PDO Yard.
- Benzene and PCE concentrations exceed their respective MCLs. A Corrective Action Plan (CAP) is required to evaluate measures to mitigate the effects of these contaminants. The CAP will evaluate the effectiveness of monitored natural attenuation in remediating these organics using fate and transport modeling. In addition, the CAP will also evaluate the implementation/continuance of institutional controls for the site.

The Installation recently completed a one year period of quarterly monitoring at the PDO Yard. A groundwater sample was collected from each of the monitoring wells on-site using low-flow peristaltic pumps on a quarterly basis. In addition, surface water and sediment samples were collected. All samples were analyzed for VOCs, SVOCs, and RCRA metals. The Installation submitted the quarterly groundwater, surface water, and sediment data for the annual monitoring period to Georgia EPD in correspondence dated June 1999 (Perez to Khaleghi). Data from the first quarter of the monitoring period (August 1998) was used as the

basis for this Revised Final RFI. The August 1998 data was summarized the First Quarterly Monitoring Progress Report dated October 1998. Data from subsequent quarterly monitoring visits conducted in November 1998 and February 1999 were also summarized reports submitted to GA EPD. The final progress report for the annual monitoring period summarizing May 1999 data will be submitted to GA EPD once it is completed. All data collected from the quarterly monitoring period will be utilized in preparation of the CAP.

TABLES

TABLE 1
NEAR-SURFACE SOIL PROFILE (CHIPLEY-URBAN LAND COMPLEX)

		Percentage Passing Sieve Number			
Depth (in.)	Soil Description	#4 % Passing	#40 % Passing	#200 % Passing	Permeability (in/hr)
0-65	Fine sand	100	95-100	5-15	6.3-10.0

Source - USDA, 1974.

TABLE 2
WATER SUPPLY WELLS WITHIN A 1-MILE RADIUS OF PDO YARD

Well I.D.	Quad.	Owner	Total Depth	Casing Depth	Use
112	36Q	SCL RR, Shops	508	275	Commercial
285	36Q	U.S. Army, Hunter 1	504	259	Public
286	36Q	U.S. Army, Hunter 2	555	260	Institution
302	36Q	City of Savannah 25	540	287	Public

Quad: Georgia Grid System. The full well name as in Bulletin 113 is "36O017" but only "017" is listed on the map for brevity..

Sources:
Hunter AAF in AT&E, 1993.
Hunter AAF, Pers. Comm., October 1997
GA Geologic Survey, Bulletin 113, 1990.
U.S.G.S. Well Listing, 1996.
City of Savannah Well Listing, 1996.
GA Geologic Survey, Information Circular 62, 1984

TABLE 3

SCREENING CRITERIA FOR THE EVALUATION OF SOIL AND SEDIMENT AT THE PDO YARD

CONTAMINANT	EPA Region 3 (1)		EPA Soil Screening Levels for Migration to Groundwater (organics use a DAF of 20) (inorganics use a DAF of 1) (2)	Background Concentrations		Ecological EPA Region 4 Sediment Screening Values (3)	EPA Region 4 Recommended Ecological Screening Value for Soil (4)
	Industrial Risk-Based Concentration	Residential Risk-Based Concentration		Soil (PDO-MW04 avr.)	Sediment PDO-SE01		
UNITS	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
INORGANICS							
ARSENIC (as a carcingen)	3.8	0.43	1	<1.1	<1.1	7.24	30
BARIUM	14,000	550	82	-	-	-	400
CADMIUM	100	3.9	0.40	<0.58	<0.71	1	5
CHROMIUM (VI) *	613.2	23.5	2	3.35	3.6	52.3	250
COPPER	8,200	310	-	<2.8	<3.6	18.7	100
LEAD	400**	400**	-	4.2	16	30.2	150
MERCURY (inorganic)	61	2.3	0.1	0.028	0.079	0.13	2
NICKEL	4,100	156	7	-	-	15.9	100
SELENIUM	1,000	39	0.3	-	-	-	-
SILVER	1,000	39	2	<0.12	<1.4	2	-
ZINC	61,000	2,300	620	3.6	100	124	500
VOLATILE ORGANICS							
ACETONE	20,000	780	16	<0.056	<0.071	-	-
CARBON DISULFIDE	20,000	780	32	-	-	-	-
ETHYLBENZENE	20,000	780	13	-	-	-	-
METHYLENE CHLORIDE	780	85	0.02	<0.0056	-	-	-
TETRACHLOROETHYLENE	110	12	0.06	-	-	-	-
TOLUENE	41,000	1,600	12	-	<0.0071	-	-
TOTAL XYLENES	100,000	16,000	190	-	-	-	-
TRICHLOROFLUOROMETHANE	61,000	2,300	-	-	-	-	-
SEMIVOLATILE ORGANICS							
BENZO(a)ANTHRACENE	7.8	0.88	2	-	-	0.33	-
BENZO(a)PYRENE	0.78	0.088	8	-	-	0.33	1
BENZO(b)FLUORANTHENE	7.8	0.88	5	-	-	-	-
BENZO(g,h,i)PERYLENE	-	-	-	-	-	-	-
BENZO(k)FLUORANTHENE	78	8.8	49	-	-	-	-
BIS(2-ETHYLHEXYL)PHTHALATE	410	46	3,600	-	-	0.182	-
CHRYSENE	780	88	160	-	-	-	-
FLUORANTHENE	8,200	310	4,300	-	<0.47	0.33	10
INDENO(1,2,3-c,d)PYRENE	7.8	0.88	14	-	-	0.33	-
2-METHYL NAPHTHALENE***	4,088	156.4	84	<0.37	-	0.33	5
NAPHTHALENE	4,088	156.4	84	-	-	0.33	5
PHENANTHRENE	-	-	-	-	-	0.33	5
PYRENE	6,100	230	4,200	-	<0.47	0.33	10

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

(-) - No level is listed

* RBCs for Chromium VI are used as screening criteria although only total Chromium analyses were performed on soil and sediment samples.

** From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead

*** Screening criteria for naphthalene is used for 2-methyl naphthalene based on similar structure/ activity relationship.

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) EPA OSWER Soil Screening Guidance, EPA 540/R-95/041, July 1996. SSLs for organics are based on a DAF of 20, noncancer hazard quotient of 1 and cancer risk of 1 in 1,000,000. SSLs for inorganics are based on a DAF of 1, noncancer hazard quotient of 1 and cancer risk of 1 in 1,000,000. Generic SSLs used where available.

(3) EPA Region 4 Office of Technical Services, Supplemental Guidance to RAGS, Table 3 (Draft)

(4) US EPA Memorandum from Ted W. Smith, 12-22-98, Ecological Risk Assessment at Military Bases. Based on US Fish and Wildlife Service values for moderate soil contamination which requires additional study.

TABLE 4

CRITERIA FOR EVALUATION OF CONTAMINANTS IN GROUNDWATER AND SURFACE WATER SAMPLES

CONTAMINANT	Human Health EPA Region 3 Risk-based Concentrations (tap water) (1)	Federal Drinking Water MCL	Background (Groundwater) PDO-MW04	GA EPD IWQS (2)	Ecological EPA Region 4 Freshwater Surface Water Screening Values (3)		Background (Surface water) PDO-SE01
UNITS	ug/L	ug/L	ug/L	ug/L	Acute (ug/L)	Chronic (ug/L)	ug/L
INORGANICS							
ARSENIC	0.045	50	<30	0.14	360	90	<10
BARIUM	260	2000	30	-	-	-	30
BERYLLIUM	7.3	4	<4	-	16	0.53	<4
CADMIUM	1.8	5	<5	0.7	1.79	0.66	<10
CHROMIUM (VI)*	10.9	100	<10	120	16	11	<10
COPPER	150	1,300	<26	12	9.22	6.54	<26
LEAD	n/a	15	<15	1.3	33.78	1.32	<5
NICKEL	73	100	<40	88	789	87.71	<40
SELENIUM	-	50	<40	5	20	5	<40
ZINC	1,100	5,000 (a)	<20	60	65.04	58.91	110
VOLATILE ORGANICS							
ACETONE	61	-	<100	-	-	-	<25
BENZENE	0.36	5	<2	71.28	530	53	<1
2-BUTANONE (MEK)	190	-	<100	4.42	-	-	<10
CARBON DISULFIDE	100	-	<10	98.6	-	-	<1
ETHYL BENZENE	130	700	<2	28,718	4,530	453	<1
METHYL ISOBUTYL KETONE (MIBK)	14	-	<10	41.99	-	-	<10
METHYLENE CHLORIDE	4.1	5	<5	-	19,300	1,930	<5
P-ISOPROPYLTOLUENE	-	-	<10	-	-	-	ND
1,2,4-TRIMETHYLBENZENE	30	-	<10	-	-	-	ND
TETRACHLOROETHENE	1.1	5	<2	8.85	528	84	<1
TOLUENE	75	1,000	<2	200,000	1,750	175	<1
TOTAL XYLENES	1,200	10,000	<5	-	-	-	<1
TRICHLOROETHENE	1.6	5	<2	80.7	-	-	1.3
SEMIVOLATILE ORGANICS							
BIS(2-ETHYLHEXYL)PHTHALATE	4.8	6	<10	5.92	1110	0.3	<10
NAPHTHALENE	73	-	<10	-	230	62	<10
2-METHYL NAPHTHALENE**	73	-	<10	-	230	62	<10

* Screening criteria for Chromium VI are used although total Chromium analyses were performed on water samples.

** Screening criteria for naphthalene is used for 2-methyl naphthalene based on similar structure/ activity relationship.

(1) EPA Region 3 Risk-Based Concentrations (4-12-99). All values are based on a noncancer hazard quotient of 0.1 and a cancer risk of 1 in 1,000,000.

(2) GA EPD IWQS - Georgia DNR, EPD, Water Quallity Control, Instream Water Quality Standards, Chapter 391-3-6.03, sec 5(d)(ii)&(iii), 5/29/94.
IWQS values for chromium, copper, lead, nickle, and zinc are based on a hardness (CaCO3) of <100 mg/L in freshwater.

(a) Secondary Drinking Water criteria based on aesthetics.

(3) EPA Region 4 Management Division Freshwater Surface Water Screening Values for Hazardous Waste Sites, Table 1.

Note: Background GW sample PDO-MW04, Laboratory Quantiation Limits(LQL) obtained from analysis performed 8/98 except beryllium, copper, nickel and zinc LQLs are from 9/96. These analytes were not part of the analysis in 8/98.

(-) Not Listed ND- Not Detected

Note: Tap water RBC values for chromium (VI) and naphthalene were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5A
SURFACE SOIL SAMPLE ANALYSES
Phase I Hand Auger Locations

CONSTITUENT:	EPA REGION 3 (1) RESIDENTIAL RBC	EPA SSL (2)	SITE:	PDO-HA01			PDO-HA02			PDO-HA03			PDO-HA04			PDO-HA04			PDO-HA06		
			SAMPLE ID:	PDO-HA0101			PDO-HA0201			PDO-HA0301			PDO-HA0401			PDO-HA0402			PDO-HA0601		
			DATE:	8/29/1996			8/29/1996			8/29/1996			9/16/1996			9/16/1996			9/16/1996		
			DEPTH (ft):	1.0			1.0			1.0			1.0			2.0			1.0		
(Units in mg/kg)			RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?
Ethyl benzene	780	13		< 0.0058		No	< 0.0052		No	< 0.0056		No	< 0.0056		No	< 0.0058		No	< 0.0056		No
Tetrachloroethene	12	0.06		< 0.0058		No	< 0.0052		No	< 0.0056		No	< 0.0056		No	< 0.0058		No	< 0.0056		No
Toluene	1,600	12		< 0.0058		No	< 0.0052		No	< 0.0056		No	< 0.0056		No	< 0.0058	J	No	< 0.0056		No
m&p-Xylene	16,000	190		< 0.0058		No	< 0.0052		No	< 0.0056		No	< 0.0056		No	< 0.0058		No	< 0.0056		No
o-Xylene	16,000	190		< 0.0058		No	< 0.0052		No	< 0.0056		No	< 0.0056		No	< 0.0058		No	< 0.0056		No
Benzo(a)pyrene*	0.088	8		< 0.38		Yes	< 0.34		Yes	< 0.36		Yes	< 0.36		Yes	< 0.38		Yes	0.59		Yes
Fluoranthene	310	4,300		< 0.38		No	< 0.34		No	< 0.36		No	< 0.36		No	< 0.38		No	1		No
Naphthalene	156	84		< 0.38		No	< 0.34		No	< 0.36		No	< 0.36		No	< 0.38		No	< 0.38		No
Pyrene	230	4,200		< 0.38		No	< 0.34		No	< 0.36		No	< 0.36		No	< 0.38		No	0.93		No
2-Methylnaphthalene	156.4	84		< 0.38		No	< 0.34		No	< 0.36		No	< 0.36		No	< 0.38		No	< 0.38		No
GRO	-	-		< 0.21	J	No	< 0.18	J	No	< 0.2	J	No	< 0.2	J	No	< 0.2		No	< 0.2		No
DRO	-	-		16	J	No	16	J	No	28	J	No	26		No	< 11		No	92		No
Arsenic*	0.43	1		1.3		Yes	1.1		Yes	8.1		Yes	1.3		Yes	< 1.1		Yes	3.1		Yes
Cadmium	3.9	0.4		< 0.58		Yes	< 0.52		Yes	< 0.56		Yes	< 0.56		Yes	< 0.58		Yes	< 0.56		Yes
Chromium (VI)	23.5	2		3.8	J	Yes	6.9	J	Yes	3.1	J	Yes	4.4		Yes	1.6		No	5.8		Yes
Copper	310	-		4.3		No	9.1		No	8.5		No	8.4		No	< 2.8		No	6.3		No
Lead	400**	-		27	J	No	110	J	No	24	J	No	120		No	17		No	45		No
Mercury	2.3	0.1		0.033		No	0.044		No	0.024		No	0.062		No	0.027		No	0.027		No
Nickel	156	7		< 4.8		No	< 4.2		No	< 4.4		No	< 4.4		No	< 4.6		No	< 4.6		No
Zinc	2,300	620		12		No	24		No	16		No	20		No	< 2.2		No	23		No

(1) EPA Region 3 RBC - Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) - The Laboratory Quantitation Limit (LQL) was greater than the residential RBC for all soil samples. The LQL was used as the screening criteria for this compound because the laboratory was incapable of accurately quantifying concentrations at the Residential RBC.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

Note: RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5B
SURFACE SOIL SAMPLE ANALYSES
Phase I Soil Boring Locations

CONSTITUENT:	EPA REGION 3 RBC (1)	EPA SSL (2)	SITE: / SAMPLE ID: / DATE: / DEPTH (ft):	PDO-SB01 PDO-SB0101 8/14/1996 2.0			PDO-SB02 PDO-SB0201 8/15/1996 2.0			PDO-SB03 PDO-SB0301 8/15/1996 2.0			PDO-SB04 PDO-SB0401 8/15/1996 2.0			PDO-SB05 PDO-SB0502 8/15/1996 2.0			PDO-SB06 PDO-SB0601 8/16/1996 2.0		
(Units in mg/kg)			RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?
Acetone	780	16		< 0.058	J	No	< 0.057		No	< 0.057		No	0.11		No	0.11		No	< 0.056		No
Benzo(a)pyrene *	0.088	8		1.6		Yes	< 0.38		Yes	< 0.38		Yes	< 0.36		Yes	< 0.39	J	Yes	< 0.38		Yes
Benzo(g,h,i)perylene	-	-		1.3		No	< 0.38		No	< 0.38		No	< 0.36		No	< 0.39	J	No	< 0.38		No
Fluoranthene	310	4,300		0.88		No	< 0.38		No	< 0.38		No	< 0.36		No	< 0.39	J	No	< 0.38		No
Naphthalene	156	84		< 0.38		No	< 0.38		No	< 0.38		No	< 0.36		No	< 0.39	J	No	< 0.38		No
Pyrene	230	4,200		1.9		No	< 0.38		No	< 0.38		No	< 0.36		No	< 0.39	J	No	0.46		No
2-Methylnaphthalene	156	84		< 0.38		No	< 0.38		No	< 0.38		No	< 0.36		No	< 0.39	J	No	< 0.38		No
DRO	-	-		26		No	< 11		No	< 11		No	31		No	< 12		No	240	J	No
Arsenic*	0.43	1		1.4	J	Yes	1.3	J	Yes	< 1.1	R	Yes	3.8	J	Yes	1.3	J	Yes	4.3		Yes
Cadmium	3.9	0.40		0.59		Yes	< 0.58		Yes	< 0.58		Yes	< 0.56		Yes	< 0.6		Yes	< 0.56		Yes
Chromium (VI)	24	2		12		Yes	6.3		Yes	2.8		Yes	2.7		Yes	5.7		Yes	4.1		Yes
Copper	310	-		10		No	< 2.8		No	< 2.8		No	3.5		No	< 3		No	9.5		No
Lead	400**	-		67	J	No	7.6	J	No	6.5	J	No	20	J	No	3.3	J	No	17	J	No
Mercury	2.3	0.1		0.022		No	0.026		No	0.012		No	0.03		No	0.016		No	0.024		No
Nickel	156	7		4.9		No	< 4.6		No	< 4.6		No	< 4.4		No	< 4.8		No	< 4.6		No
Zinc	2,300	620		46		No	< 2.2		No	2.5		No	3.2		No	< 2.3		No	22		No

(1) EPA Region 3 RBC - Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) - The Laboratory Quantitation Limit (LQL) was greater than the residential RBC for all soil samples. The LQL was used as the screening criteria for this compound because the laboratory was incapable of accurately quantifying concentrations at the Residential RBC.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

Note: RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(-) - No level listed. J = Result is estimated R = Result is rejected

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5B
SURFACE SOIL SAMPLE ANALYSES
Phase I Soil Boring Locations

CONSTITUENT:	EPA REGION 3 RBC (1)	EPA SSL (2)	SITE:	PDO-SB07		PDO-SB09		PDO-SB10		PDO-SB11		PDO-SB12	
			SAMPLE ID:	PDO-SB0701		PDO-SB0901		PDO-SB1001		PDO-SB1101		PDO-SB1201	
			DATE:	8/16/1996		8/16/1996		8/17/1996		8/17/1996		8/17/1996	
			DEPTH (ft):	2.0		2.0		2.0		2.0		2.0	
(Units in mg/kg)			RESULT TYPE:	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?
Acetone	780	16		< 0.056	No	< 0.058	No	< 0.056	No	< 7	No	1 J	No
Benzo(a)pyrene *	0.088	8		< 0.38	Yes	< 0.38	Yes	< 0.38	Yes	< 0.37	Yes	< 0.38	Yes
Benzo(g,h,i)perylene	-	-		< 0.38	No	< 0.38	No	< 0.38	No	< 0.37	No	< 0.38	No
Fluoranthene	310	4,300		< 0.38	No	< 0.38	No	< 0.38	No	< 0.37	No	< 0.38	No
Naphthalene	156	84		< 0.38	No	< 0.38	No	< 0.38	No	< 0.37	No	0.62	No
Pyrene	230	4,200		< 0.38	No	< 0.38	No	< 0.38	No	< 0.37	No	0.45	No
2-Methylnaphthalene	156	84		< 0.38	No	< 0.38	No	< 0.38	No	< 0.37	No	1.3	No
DRO	-	-		18 J	No	< 12 R	No	13	No	< 11	No	260	No
Arsenic*	0.43	1		1.4	Yes	< 1.1	Yes	1.6	Yes	14	Yes	13	Yes
Cadmium	3.9	0.40		< 0.56	Yes	< 0.58	Yes	< 0.56	Yes	< 0.56	Yes	< 0.58	Yes
Chromium (VI)	24	2		1.6	No	7.3	Yes	1.8	No	1.1	No	5.3	Yes
Copper	310	-		5.5	No	< 3	No	< 2.8 J	No	< 2.8 J	No	7.1 J	No
Lead	400**	-		2.8 J	No	3.5 J	No	6.1	No	3.3	No	18	No
Mercury	2.3	0.1		0.024	No	0.019	No	< 0.011	No	0.012	No	0.092	No
Nickel	156	7		< 4.6	No	< 4.6	No	< 4.6	No	< 4.4	No	< 4.8	No
Zinc	2,300	620		2.6	No	4.3	No	2.3	No	< 2.2	No	10	No

(1) EPA Region 3 RBC - Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) - The Laboratory Quantitation Limit (LQL) was greater than the residential RBC for all soil samples. The LQL was used as the screening criteria for this compoun because the laboratory was incapable of accurately quantifying concentrations at the Residential RBC.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

Note: RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(-) - No level listed. J = Result is estimated R = Result is rejected

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5B
SURFACE SOIL SAMPLE ANALYSES
Phase I Soil Boring Locations

CONSTITUENT:	EPA REGION 3 RBC (1)	EPA SSL (2)	SITE:	PDO-SB13			PDO-SB13			PDO-SB14			PDO-SB15		
			SAMPLE ID:	PDO-SB1301			PDO-SB13			PDO-SB1401			PDO-SB1501		
			DATE:	8/17/1996			8/17/1996			8/17/1996			8/17/1996		
			DEPTH (ft):	2.0			2.0			2.0			2.0		
(Units in mg/kg)			RESULT TYPE:	Primary		Exceeds criteria?	Duplicate		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?
Acetone	780	16		< 6.8	J	No	0.18		No	< 0.056		No	< 0.056		No
Benzo(a)pyrene *	0.088	8		< 0.36		Yes	< 0.36		Yes	< 0.37		Yes	< 0.36		Yes
Benzo(g,h,i)perylene	-	-		< 0.36		No	< 0.36		No	< 0.37		No	< 0.36		No
Fluoranthene	310	4,300		< 0.36		No	< 0.36		No	< 0.37		No	< 0.36		No
Naphthalene	156	84		< 0.36		No	< 0.36		No	< 0.37		No	< 0.36		No
Pyrene	230	4,200		< 0.36		No	< 0.36		No	< 0.37		No	< 0.36		No
2-Methylnaphthalene	156	84		< 0.36		No	< 0.36		No	< 0.37		No	< 0.36		No
DRO	-	-		< 10		No	< 11		No	39		No	20		No
Arsenic*	0.43	1		11		Yes	7		Yes	26		Yes	5		Yes
Cadmium	3.9	0.40		< 0.54		Yes	< 0.56		Yes	< 0.56		Yes	< 0.56		Yes
Chromium (VI)	24	2		3.8		Yes	4.4		Yes	3		Yes	3.7		Yes
Copper	310	-		< 2.8	J	No	7.8	J	No	< 2.8	J	No	4.2	J	No
Lead	400**	-		12		No	6.7		No	6.6		No	7.8		No
Mercury	2.3	0.1		< 0.01		No	0.016		No	< 0.011		No	0.018		No
Nickel	156	7		< 4.3		No	< 4.4		No	< 4.4		No	< 4.4		No
Zinc	2,300	620		< 2.1		No	2.6		No	< 2.2		No	6.8		No

(1) EPA Region 3 RBC - Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) - The Laboratory Quantitation Limit (LQL) was greater than the residential RBC for all soil samples. The LQL was used as the screening criteria for this compoun because the laboratory was incapable of accurately quantifying concentrations at the Residential RBC.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

Note: RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(-) - No level listed. J = Result is estimated R = Result is rejected

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5C
SURFACE SOIL SAMPLE ANALYSES
Phase I Monitoring Well Soil Borings

CONSTITUENT: (Units in mg/kg)	RESIDENTIAL RBC (1)	EPA SSL (2)	SITE: / SAMPLE ID: / DATE: / DEPTH (ft): / RESULT TYPE:	PDO-MW01 PDO-MWB0101 8/26/1996 2.0 Primary	Exceeds criteria?	PDO-MW03 PDO-MWB0301 8/26/1996 2.0 Primary	Exceeds criteria?	PDO-MW04 PDO-MWB0401 8/27/1996 2.0 Primary	Exceeds criteria?
Acetone	780	16		< 0.054	No	< 0.054	No	< 0.052	No
Methylene chloride	85	0.02		< 0.0054	No	< 0.0053	No	< 0.0052	No
2-Methylnaphthalene	156.4	84		< 0.36	No	< 0.54	No	< 0.34	No
DRO	-	-		18 J	No	44 J	No	< 10 R	No
Arsenic *	0.43	1		28	Yes	< 3.3	Yes	< 1	Yes
Chromium (VI)*	23.5	2		2.5	Yes	3.4	Yes	2	No
Copper	310	-		3.6	No	< 7.8	No	< 2.6	No
Lead	400**	-		13	No	12	No	4.8	No
Mercury	2.3	0.1		0.041	No	0.031	No	0.012	No
Zinc	2,300	620		3.8	No	6.2	No	3.8	No

(1) EPA Region 3 RBC - Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) - The Laboratory Quantitation Limit (LQL) was greater than the residential RBC for all soil samples. The LQL was used as the screening criteria for this compound because the laboratory was incapable of accurately quantifying concentrations at the Residential RBC.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

Note: RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5D
SUBSURFACE SOIL SAMPLE ANALYSES
Phase I Hand Auger Locations

CONSTITUENT:	INDUSTRIAL RBC (1)	EPA SSL (2)	SITE:	PDO-HA01			PDO-HA02			PDO-HA03			PDO-HA06			PDO-HA07		
			SAMPLE ID:	PDO-HA0102			PDO-HA0202			PDO-HA0302			PDO-HA0602			PDO-HA0702		
			DATE:	8/29/1996			8/29/1996			8/29/1996			9/16/1996			9/16/1996		
			DEPTH (ft):	5.0			4.0			5.0			5.0			5.0		
(Units in mg/kg)			RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?
Ethyl benzene	20,000	13		< 0.006		No	< 0.006		No	< 0.0058		No	< 0.006		No	< 0.006		No
Tetrachloroethane	110	0.06		< 0.006		No	< 0.006		No	< 0.0058		No	< 0.006		No	< 0.006		No
Toluene	41,000	12		< 0.006		No	< 0.006		No	< 0.0058		No	< 0.006		No	< 0.006		No
m&p-Xylene	100,000	190		< 0.006		No	< 0.006		No	< 0.0058		No	< 0.006		No	< 0.006		No
o-Xylene	100,000	190		< 0.006		No	< 0.006		No	< 0.0058		No	< 0.006		No	< 0.006		No
Benzo(a)pyrene	0.78	8		< 0.4		No	< 0.39		No	< 0.38		No	< 0.4		No	< 0.39		No
Fluoranthene	8,200	4,300		< 0.4		No	< 0.39		No	< 0.38		No	< 0.4		No	< 0.39		No
Naphthalene	4,088	84		< 0.4		No	< 0.39		No	< 0.38		No	< 0.4		No	< 0.39		No
Pyrene	6,100	4,200		< 0.4		No	< 0.39		No	< 0.38		No	< 0.4		No	< 0.39		No
2-Methylnaphthalene	4088	84		< 0.4		No	< 0.39		No	< 0.38		No	< 0.4		No	< 0.39		No
GRO	-	-		< 0.21	J	No	< 0.21	J	No	< 0.2	J	No	< 0.21		No	< 0.21		No
DRO	-	-		< 12	R	No	16	J	No	< 12	R	No	< 12		No	< 12		No
Arsenic	3.8	1		< 1.2		Yes	< 1.1		Yes	< 1.1		Yes	< 1.2		Yes	< 1.1		Yes
Cadmium	100	0.40		< 0.6		Yes	< 0.6		Yes	< 0.58		Yes	< 0.6		Yes	< 0.6		Yes
Chromium (VI) *	613.2	2		7.8	J	Yes	< 1.1		No	3.2	J	Yes	6.4		Yes	5.2		Yes
Copper	8,200	-		< 3		No	< 3		No	< 3		No	< 3		No	< 3		No
Lead	400**	-		8.6	J	No	4.1	J	No	4.5	J	No	6.3		No	6.4		No
Mercury	61	0.1		0.075		No	0.035		No	0.018		No	0.018		No	0.023		No
Nickel	4100	7		< 4.8		No	< 4.8		No	< 4.6		No	< 4.8		No	< 4.8		No
Zinc	61,000	620		< 2.4		No	< 2.3		No	< 2.3		No	< 2.4		No	< 2.3		No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5D
SUBSURFACE SOIL SAMPLE ANALYSES
Phase I Hand Auger Locations

CONSTITUENT:	INDUSTRIAL RBC (1)	EPA SSL (2)	SITE:	PDO-HA08		PDO-HA09		PDO-HA10		PDO-HA10	
			SAMPLE ID:	PDO-HA0802		PDO-HA0902		PDO-HA1002		PDO-HA12	
			DATE:	9/16/1996		9/16/1996		9/16/1996		9/16/1996	
			DEPTH (ft):	5.0		3.0		3.0		3.0	
(Units in mg/kg)			RESULT TYPE:	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Duplicate	Exceeds criteria?
Ethyl benzene	20,000	13		< 0.0058	No	< 0.0058	No	< 0.0061	No	< 0.006	No
Tetrachloroethene	110	0.06		< 0.0058	No	< 0.0058	No	< 0.0061	No	< 0.006	No
Toluene	41,000	12		< 0.0058	No	< 0.0058	No	< 0.0061	No	< 0.006	No
m&p-Xylene	100,000	190		< 0.0058	No	< 0.0058	No	< 0.0061	No	< 0.006	No
o-Xylene	100,000	190		< 0.0058	No	< 0.0058	No	< 0.0061	No	< 0.006	No
Benzo(a)pyrene	0.78	8		< 0.38	No	< 0.38	No	< 0.4	No	< 0.4	No
Fluoranthene	8,200	4,300		< 0.38	No	< 0.38	No	< 0.4	No	< 0.4	No
Naphthalene	4,088	84		< 0.38	No	< 0.38	No	< 0.4	No	< 0.4	No
Pyrene	6,100	4,200		< 0.38	No	< 0.38	No	< 0.4	No	< 0.4	No
2-Methylnaphthalene	4088	84		< 0.38	No	< 0.38	No	< 0.4	No	< 0.4	No
GRO	-	-		< 0.21	No	< 0.2	No	< 0.22	No	< 0.21	No
DRO	-	-		< 12	No	< 12	No	< 12	No	< 12	No
Arsenic	3.8	1		< 1.1	Yes	1.5	Yes	< 1.2	Yes	< 1.2	Yes
Cadmium	100	0.40		< 0.58	Yes	< 0.58	Yes	< 0.61	Yes	< 0.6	Yes
Chromium (VI) *	613.2	2		6.5	Yes	4.1	Yes	1.9	No	2.9	Yes
Copper	8,200	-		< 3	No	< 3	No	< 3	No	7.8	No
Lead	400**	-		< 29	No	140	No	9.4	No	6.7	No
Mercury	61	0.1		0.027	No	0.03	No	0.068	No	0.073	No
Nickel	4100	7		< 4.8	No	< 4.6	No	< 5	No	< 4.8	No
Zinc	61,000	620		< 2.3	No	< 2.3	No	11	No	51	No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5E
SUBSURFACE SOIL SAMPLE ANALYSES
Phase I Soil Boring Locations

CONSTITUENT:	INDUSTRIAL RBC (1)	EPA SSL (2)	SITE:	PDO-SB01			PDO-SB02			PDO-SB03			PDO-SB04			PDO-SB04		
			SAMPLE ID:	PDO-SB0102			PDO-SB0202			PDO-SB0302			PDO-SB0402			PDO-SB16		
			DATE:	8/14/1996			8/15/1996			8/15/1996			8/15/1996			8/15/1996		
			DEPTH (ft):	4.0			4.0			4.0			4.0			4.0		
(Units in mg/kg)			RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Duplicate		Exceeds criteria?
Acetone	20,000	16		0.21		No	< 0.06		No	< 0.06		No	0.13		No	0.18		No
Benzo(a)pyrene	0.78	8		< 0.39		No	< 0.39		No	< 0.4		No	< 0.4		No	< 0.4		No
Benzo(ghi)perylene	-	-		< 0.39		No	< 0.39		No	< 0.4		No	< 0.4		No	< 0.4		No
Fluoranthene	8,200	4,300		< 0.39		No	< 0.39		No	< 0.4		No	< 0.4		No	< 0.4		No
Naphthalene	4,088	84		< 0.39		No	< 0.39		No	< 0.4		No	< 0.4		No	< 0.4		No
Pyrene	6,100	4,200		< 0.39		No	< 0.39		No	< 0.4		No	< 0.4		No	< 0.4		No
2-Methylnaphthalene	4,088	84		< 0.39		No	< 0.39		No	< 0.4		No	< 0.4		No	< 0.4		No
DRO	-	-		< 12		No	< 12		No	< 12		No	< 12		No	12		No
Arsenic	3.8	1		< 1.1	R	Yes	< 1.1	R	Yes	9.9	J	Yes	< 1.2	R	Yes	< 1.2	R	Yes
Cadmium	100	0.40		< 0.6		Yes	< 0.6		Yes	< 0.6		Yes	< 0.6		Yes	< 0.6		Yes
Chromium*	613	2		6.1		Yes	6.6		Yes	11		Yes	4.2		Yes	4.8		Yes
Copper	8,200	-		< 3		No	< 3		No	< 3		No	< 3		No	< 3		No
Lead	400**	-		2.1	J	No	2.7	J	No	2.5	J	No	2.4	J	No	2.6	J	No
Mercury	61	0.10		0.022		No	0.024		No	0.014		No	0.031		No	0.062		No
Nickel	4,100	7		< 4.8		No	< 4.8		No	< 4.8		No	< 4.8		No	< 4.8		No
Zinc	61,000	620		< 2.3		No	< 2.3		No	< 2.4		No	< 2.4		No	2.5		No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5E
SUBSURFACE SOIL SAMPLE ANALYSES
Phase I Soil Boring Locations

CONSTITUENT:	INDUSTRIAL RBC (1)	EPA SSL (2)	SITE:	PDO-SB05			POO-SB06			PDO-SB07			PDO-SB08			PDO-SB08		
			SAMPLE ID:	PDO-SB0501			PDO-SB0602			PDO-SB0702			PDO-SB0801			PDO-SB17		
			DATE:	8/15/1996			8/16/1996			8/16/1996			8/16/1996			8/16/1996		
			DEPTH (ft):	4.0			4.0			4.0			4.0			4.0		
(Units in mg/kg)			RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Duplicate		Exceeds criteria?
Acetone	20,000	16		< 0.056		No	< 0.06		No	< 0.06		No	< 0.06		No	0.14		No
Benzo(a)pyrene	0.78	8		< 0.38		No	< 0.39		No	< 0.39		No	< 0.4		No	< 0.39		No
Benzo(ghi)perylene	-	-		< 0.38		No	< 0.39		No	< 0.39		No	< 0.4		No	< 0.39		No
Fluoranthene	8,200	4,300		< 0.38		No	< 0.39		No	< 0.39		No	< 0.4		No	< 0.39		No
Naphthalene	4,088	84		< 0.38		No	< 0.39		No	< 0.39		No	< 0.4		No	< 0.39		No
Pyrene	6,100	4,200		< 0.38		No	< 0.39		No	< 0.39		No	< 0.4		No	< 0.39		No
2-Methylnaphthalene	4,088	84		< 0.38		No	< 0.39		No	< 0.39		No	< 0.4		No	< 0.39		No
DRO	-	-		22		No	< 12	R	No	< 12	R	No	< 12	R	No	< 12	R	No
Arsenic	3.8	1		2.3	J	Yes	< 1.1		Yes	< 1.1		Yes	< 1.2		Yes	< 1.1		Yes
Cadmium	100	0.40		< 0.56		Yes	< 0.6		Yes	< 0.6		Yes	< 0.6		Yes	< 0.6		Yes
Chromium*	613	2		2		No	1.4		No	5		Yes	8.1		Yes	7.6		Yes
Copper	8,200	-		< 2.8		No	5.8		No	< 3		No	< 3		No	< 3		No
Lead	400**	-		33	J	No	< 0.6	J	No	2.6	J	No	2.4	J	No	2.3	J	No
Mercury	61	0.10		0.026		No	< 0.011		No	0.028		No	0.035		No	0.045		No
Nickel	4,100	7		< 4.6		No	< 4.8		No	< 4.8		No	< 4.8		No	< 4.8		No
Zinc	61,000	620		4.8		No	< 2.3		No	4.4		No	5.4		No	5.2		No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999

TABLE 5E
SUBSURFACE SOIL SAMPLE ANALYSES
Phase I Soil Boring Locations

CONSTITUENT:	INDUSTRIAL RBC (1)	EPA SSL (2)	SITE:	PDO-SB09			PDO-SB10			PDO-SB11			PDO-SB12			PDO-SB13		
			SAMPLE ID:	PDO-SB0902			PDO-SB1002			PDO-SB1102			PDO-SB1202			PDO-SB1302		
			DATE:	8/16/1996			8/17/1996			8/17/1996			8/17/1996			8/17/1996		
			DEPTH (ft):	4.0			4.0			4.0			4.0			4.0		
(Units in mg/kg)			RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?
Acetone	20,000	16		< 7.5	J	No	< 0.06		No	< 0.06		No	< 0.058		No	0.17		No
Benzo(a)pyrene	0.78	8		< 0.4		No	< 0.39		No	< 0.39		No	< 0.38		No	< 0.38		No
Benzo(ghi)perylene	-	-		< 0.4		No	< 0.39		No	< 0.39		No	< 0.38		No	< 0.38		No
Fluoranthene	8,200	4,300		< 0.4		No	< 0.39		No	< 0.39		No	< 0.38		No	< 0.38		No
Naphthalene	4,088	84		< 0.4		No	< 0.39		No	< 0.39		No	< 0.38		No	< 0.38		No
Pyrene	6,100	4,200		< 0.4		No	< 0.39		No	< 0.39		No	< 0.38		No	< 0.38		No
2-Methylnaphthalene	4,088	84		< 0.4		No	< 0.39		No	< 0.39		No	< 0.38		No	< 0.38		No
DRO	-	-		< 12	R	No	< 12		No	< 12		No	< 12		No	< 11		No
Arsenic	3.8	1		< 1.2		Yes	2.9		Yes	4		Yes	< 1.1		Yes	< 1.1		Yes
Cadmium	100	0.40		< 0.6		Yes	< 0.6		Yes	< 0.6		Yes	< 0.58		Yes	< 0.58		Yes
Chromium*	613	2		7.4		Yes	2.6		Yes	3.4		Yes	6.4		Yes	2.7		Yes
Copper	8,200	-		3.3		No	< 3	J	No	< 3	J	No	11	J	No	< 2.8	J	No
Lead	400**	-		3.2	J	No	2.7		No	2.2		No	2.2		No	1.6		No
Mercury	61	0.10		0.044		No	< 0.011		No	< 0.011		No	0.032		No	< 0.011		No
Nickel	4,100	7		< 4.8		No	< 4.8		No	< 4.8		No	< 4.8		No	< 4.6		No
Zinc	61,000	620		3		No	< 2.3		No	< 2.3		No	10		No	< 2.2		No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999

TABLE 5E
SUBSURFACE SOIL SAMPLE ANALYSES
Phase I Soil Boring Locations

CONSTITUENT: (Units in mg/kg)	INDUSTRIAL RBC (1)	EPA SSL (2)	SITE:	PDO-SB14			PDO-SB15		
			SAMPLE ID:	PDO-SB1402			PDO-SB1502		
			DATE:	8/17/1996			8/17/1996		
			DEPTH (ft):	4.0			4.0		
			RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?
Acetone	20,000	16		0.096		No	< 0.06		No
Benzo(a)pyrene	0.78	8		< 0.39		No	< 0.4		No
Benzo(ghi)perylene	-	-		< 0.39		No	< 0.4		No
Fluoranthene	8,200	4,300		< 0.39		No	< 0.4		No
Naphthalene	4,088	84		< 0.39		No	< 0.4		No
Pyrene	6,100	4,200		< 0.39		No	< 0.4		No
2-Methylnaphthalene	4,088	84		< 0.39		No	< 0.4		No
DRO	-	-		< 12		No	< 12		No
Arsenic	3.8	1		2.1		Yes	< 1.2		Yes
Cadmium	100	0.40		< 0.6		Yes	< 0.6		Yes
Chromium*	613	2		4		Yes	8		Yes
Copper	8,200	-		< 3	J	No	< 3	J	No
Lead	400**	-		3.2		No	1.8		No
Mercury	61	0.10		< 0.011		No	0.035		No
Nickel	4,100	7		< 4.8		No	< 4.8		No
Zinc	61,000	620		3.4		No	3.1		No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999

TABLE 5F
SUBSURFACE SOIL SAMPLE ANALYSES
Phase I Monitoring Well Boring Locations

CONSTITUENT: (Units in mg/kg)	INDUSTRIAL R8C (1)	EPA SSL (2)	SITE: / SAMPLE ID: / DATE: / DEPTH (ft): / RESULT TYPE:	PDO-MW01 PDO-MW80102 8/26/1996 4.0 Primary	Exceeds criteria?	PDO-MW02 PDO-MWB0201 8/26/1996 4.0 Primary	Exceeds criteria?	PDO-MW02 POO-MWB0202 8/26/1996 6.0 Primary	Exceeds criteria?	PDO-MW02 PDO-MWB05 8/26/1996 6.0 Duplicate	Exceeds criteria?	PDO-MW03 PDO-MWB0302 8/26/1996 4.0 Primary	Exceeds criteria?	PDO-MW04 PDO-MWB0402 8/27/1996 4.0 Primary	Exceeds criteria?
Acetone	20,000	16		< 0.057	No	0.084	No	< 0.058	No	0.11	No	0.074	No	< 0.06	No
Methylene chloride	760	0.02		< 0.0058	No	< 0.006	No	< 0.0058	No	0.036	Yes	< 0.0058	No	< 0.006	No
2-Methylnaphthalen	4088	84		< 0.38	No	< 0.4	No	< 0.38	No	< 0.38	No	< 0.38	No	< 0.4	No
DRO	-	-		12 J	No	20 J	No	29 J	No	23 J	No	20 J	No	14 J	No
Arsenic	3.8	1		1.6	Yes	< 1.2	Yes	< 1.1	Yes	< 1.1	Yes	< 1.1	Yes	< 1.2	Yes
Chromium *	613.2	2		4.6	Yes	2	No	2	No	1.6	No	1.8	No	4.7	Yes
Copper	8,200	-		< 2.8	No	< 3	No	< 3	No	< 3	No	< 2.8	No	< 3	No
Lead	400**	-		5.8	No	6.1	No	4.4	No	5	No	2.7	No	3.5	No
Mercury	61	0.1		0.018	No	0.026	No	0.021	No	0.015	No	0.023	No	0.043	No
Zinc	61,000	620		< 2.2	No	3.8	No	2.5	No	< 2.3	No	< 2.2	No	3.4	No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) R8Cs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5G
SUBSURFACE SOIL SAMPLE ANALYSES
Phase II Monitoring Well Boring Locations

CONSTITUENT:	INDUSTRIAL RBC (1)	EPA SSL (2)	SITE:	PDOMW05		PDOMW05		PDOMW06		PDOMW06		PDOMW06	
			SAMPLE ID:	PDO-SB0501		PDO-SB0502		PDO-SB0601		PDO-SB0602		PDO-SB5001	
			DATE:	7/21/1998		7/21/1998		7/21/1998		7/22/1998		7/22/1998	
			DEPTH (ft):	6		16		6		16		16	
(Units in mg/kg)			RESULT TYPE:	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Duplicate 1	Exceeds criteria?
Carbon disulfide	20000	32		< 0.011	No	0.028	No	< 0.012	No	0.014	No	< 0.013	No
Toluene	41000	12		< 0.0054	No	< 0.0063	No	< 0.0058	No	< 0.0063	No	0.0083	No
Trichlorofluoromethane	61,000	-		< 0.011	No	< 0.013	No	< 0.012	No	< 0.013	No	< 0.013	No
Arsenic	3.8	1		< 3 J	Yes	< 3	Yes	< 3	Yes	< 3.8	Yes	< 3.8	Yes
Barium	14,000	82		17	No	9.9	No	31	No	9.4	No	9.7	No
Chromium *	613.2	2		1.4	No	2.3	Yes	5	Yes	3.8	Yes	3.7	Yes
Lead	400**	-		7.4	No	< 3.1	No	4.7	No	< 3.1	No	< 3.1	No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5G
SUBSURFACE SOIL SAMPLE ANALYSES
Phase II Monitoring Well Boring Locations

CONSTITUENT:	INDUSTRIAL RBC (1)	EPA SSL (2)	SITE: / SAMPLE ID: / DATE: / DEPTH (ft): / RESULT TYPE:	PDOMW07 PDO-SB0701 7/23/1998 6 Primary	Exceeds criteria?	PDOMW07 PDO-SB0702 7/23/1998 14 Primary	Exceeds criteria?	PDOMW08 PDO-SB0801 7/28/1998 6 Primary	Exceeds criteria?	PDOMW08 PDO-SB0802 7/28/1998 14 Primary	Exceeds criteria?	PDOMW09 PDO-SB0901 7/29/1998 8 Primary	Exceeds criteria?
(Units in mg/kg)													
Carbon disulfide	20000	32		< 0.011	No	< 0.012	No	< 0.012	No	< 0.012	No	< 0.012	No
Toluene	41000	12		< 0.0057	No	< 0.0062	No	< 0.0059	No	< 0.0062	No	< 0.0061	No
Trichlorofluoromethane	61,000	-		< 0.011	No	< 0.012	No	< 0.012	No	< 0.012	No	< 0.012	No
Arsenic	3.8	1		< 3	Yes	< 3	Yes	< 3.5	Yes	12	Yes	< 3.7	Yes
Barium	14,000	82		50	No	18	No	27	No	13	No	45	No
Chromium *	613.2	2		6.9	Yes	4.2	Yes	4.8	Yes	4.4	Yes	3.1	Yes
Lead	400**	-		34	No	3.2	No	3.2	No	< 3.1	No	3.1	No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5G
SUBSURFACE SOIL SAMPLE ANALYSES
Phase II Monitoring Well Boring Locations

CONSTITUENT:	INDUSTRIAL RBC (1)	EPA SSL (2)	SITE:	PDOMW09		PDOMW10		PDOMW10		PDOMW11		PDOMW11	
			SAMPLE ID:	PDO-SB0902		PDO-SB1001		PDO-SB1002		PDO-SB1101		PDO-SB1102	
			DATE:	7/29/1998		7/22/1998		7/22/1998		7/23/1998		7/23/1998	
			DEPTH (ft):	22		6		20		4		22	
(Units in mg/kg)			RESULT TYPE:	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?
Carbon disulfide	20000	32		< 0.013	No	< 0.012 J	No	< 0.013	No	< 0.012	No	< 0.013	No
Toluene	41000	12		< 0.0067	No	< 0.006 J	No	0.0071	No	< 0.0059	No	< 0.0063	No
Trichlorofluoromethane	61,000	-		< 0.013	No	< 0.012 J	No	0.016	No	< 0.012	No	< 0.013	No
Arsenic	3.8	1		< 4	Yes	< 3.8	Yes	< 3.8	Yes	< 3	Yes	< 3	Yes
Barium	14,000	82		10	No	11	No	8.5	No	13	No	9	No
Chromium *	613.2	2		4.4	Yes	1.7	No	2.8	Yes	1.2	No	3.8	Yes
Lead	400**	-		< 3.3	No	6	No	< 3.1	No	5.6	No	< 3.2	No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**) - From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead.

(-) - No level listed. J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5H
HUNTER ARMY AIRFIELD
CONSTITUENTS DETECTED IN PHASE II INTERIM REMOVAL CONFIRMATORY
SOIL SAMPLES (COLLECTED BY HAZWRAP)

			FIELD SAMPLE ID:	ET-PDO-1		ET-PDO-2		ET-PDO-3		ET-PDO-4	
			DATE:	7/23/1999		7/23/1999		7/23/1999		7/23/1999	
			DEPTH (Ft)	3		3		3		3	
			UNITS	mg/kg		mg/kg		mg/kg		mg/kg	
CONSTITUENTS (METHOD)	INDUSTRIAL RBC (1) (units in mg/kg)	EPA SSL (2) (units in mg/kg)			Exceeds criteria?		Exceeds criteria?		Exceeds criteria?		Exceeds criteria?
VOLATILES (8260B)											
Methylene chloride	760	0.02		0.005 J	No	0.006 J	No	0.005 U	No	0.005 U	No
Naphthalene	4,088	84		0.006 U	No	0.006 U	No	0.005 U	No	0.078	No
SEMIVOLATILE ORGANICS (8270C)											
Fluoranthene	8,200	4,300		0.36 U	No	0.38 U	No	0.36 U	No	0.35 U	No
Pyrene	6,100	4,200		0.36 U	No	0.38 U	No	0.36 U	No	0.35 U	No
Benzo(a)anthracene	7.8	2		0.36 U	No	0.38 U	No	0.36 U	No	0.35 U	No
Chrysene	780	160		0.36 U	No	0.38 U	No	0.36 U	No	0.35 U	No
Benzo(b)fluoranthene	7.8	5		0.36 U	No	0.38 U	No	0.36 U	No	0.35 U	No
Benzo(k)fluoranthene	78	49		0.36 U	No	0.38 U	No	0.36 U	No	0.35 U	No
Benzo(a)pyrene	0.78	8		0.36 U	No	0.38 U	No	0.36 U	No	0.35 U	No
Indeno(1,2,3-cd)pyrene	7.8	14		0.36 U	No	0.38 U	No	0.36 U	No	0.35 U	No
bis(2-ethylhexyl)phthalate	410	3,600		0.36 U	No	0.38 U	No	0.36 U	No	0.082 JB	No
RCRA METALS											
Arsenic	3.8	1		0.73 B	No	0.79 B	No	1 B	No	1.2 B	Yes
Barium	14,000	82		11.4 *	No	17.6 *	No	9.1 *	No	9 *	No
Cadmium	100	0.4		0.03 U	No	0.44 B	Yes	0.55 B	Yes	0.21 B	No
Chromium (VI) *	613	2		6.1	Yes	6.4	Yes	2.4	Yes	1.9	No
Lead	400**	-		6.2 BN*	No	93.4 N*	No	88.4 N*	No	45.5 N*	No
Mercury	61	0.1		0.08	No	0.05	No	0.1	No	0.11	Yes
Selenium	1,000	0.3		0.43 U	Yes	0.45 U	Yes	0.42 U	Yes	0.67 B	Yes
Silver	1,000	2		0.13 U	No	0.13 U	No	0.12 U	No	0.13 U	No

ORGANICS QUALIFIER FLAGS

U - Indicates compound was analyzed for but not detected.

J - Indicates an estimated value.

B - This flag is used when the analyte is found in the associated blank as well as the sample.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.

INORGANICS CLP QUALIFIER FLAGS

U - Indicates compound was analyzed for but not detected.

J - Indicates an estimated value.

B - The reported values are less than the CRDL but > or = the IDL; the analyte is flagged with a "U" if analyzed but not detected

N - Spike sample recovery not within control limits.

* - Duplicate analysis not within control limits.

(1) EPA Region 3 RBC - Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL -Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**)-EPA Office of Solid Waste, Directive on Risk Assessment & Cleanup of Residential Soil Lead.

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

TABLE 5H
HUNTER ARMY AIRFIELD
CONSTITUENTS DETECTED IN PHASE II INTERIM REMOVAL CONFIRMATORY
SOIL SAMPLES (COLLECTED BY HAZWRAP)

			FIELD SAMPLE ID:	ET-PDO-5		ET-PDO-6		ET-PDO-7		ET-PDO-8	
			DATE:	7/23/1999		7/23/1999		7/23/1999		7/23/1999	
			DEPTH (Ft)	3		3		3		3	
			UNITS	mg/kg		mg/kg		mg/kg		mg/kg	
CONSTITUENTS (METHOD)	INDUSTRIAL RBC (1) (units in mg/kg)	EPA SSL (2) (units in mg/kg)			Exceeds criteria?		Exceeds criteria?		Exceeds criteria?		Exceeds criteria?
VOLATILES (8260B)											
Methylene chloride	760	0.02		0.004 J	No	0.006 U	No	0.005 U	No	0.005 U	No
Naphthalene	4,088	84		0.005 U	No	0.006 U	No	0.005 U	No	0.005 U	No
SEMIVOLATILE ORGANICS (8270C)											
Fluoranthene	8,200	4,300		0.35 U	No	0.071 J	No	0.36 U	No	0.35 U	No
Pyrene	6,100	4,200		0.35 U	No	0.086 J	No	0.36 U	No	0.35 U	No
Benzo(a)anthracone	7.8	2		0.35 U	No	0.071 J	No	0.36 U	No	0.35 U	No
Chrysene	780	160		0.35 U	No	0.076 J	No	0.36 U	No	0.35 U	No
Benzo(b)fluoranthene	7.8	5		0.35 U	No	0.084 J	No	0.36 U	No	0.35 U	No
Benzo(k)fluoranthene	78	49		0.35 U	No	0.12 J	No	0.36 U	No	0.35 U	No
Benzo(a)pyrene	0.78	8		0.35 U	No	0.096 J	No	0.36 U	No	0.35 U	No
Indeno(1,2,3-cd)pyrene	7.8	14		0.35 U	No	0.042 J	No	0.36 U	No	0.35 U	No
bis(2-ethylhexyl)phthalate	410	3,600		0.35 U	No	0.052 JB	No	0.36 U	No	0.043 JB	No
RCRA METALS											
Arsenic	3.8	1		1.7 B	Yes	9.6 B	Yes	1.6 B	Yes	0.44 B	No
Barium	14,000	82		13.7 *	No	22.4 *	No	16.9 *	No	16.3 *	No
Cadmium	100	0.4		0.17 B	No	0.43 B	Yes	0.33 B	No	0.03 U	No
Chromium (VI) *	613	2		5.2	Yes	15.8	Yes	4	Yes	5.8	Yes
Lead	400**	-		33.6 N*	No	34.8 N*	No	54.6 N*	No	6.7 BN*	No
Mercury	61	0.1		0.08	No	0.05	No	0.06	No	0.06	No
Selenium	1,000	0.3		0.42 U	Yes	1 B	Yes	0.43 U	Yes	0.41 U	Yes
Silver	1,000	2		0.13 B	No	0.19 B	No	0.19 B	No	0.12 U	No

ORGANICS QUALIFIER FLAGS

U - Indicates compound was analyzed for but not detected.

J - Indicates an estimated value.

B - This flag is used when the analyte is found in the associated blank as well as the sample.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.

(1) EPA Region 3 RBC - Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk

(2) - EPA SSL -Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.

(*) RBCs for Chromium VI are used as screening criteria although only Total Chromium analyses were performed on soil and sediment samples.

(**)-EPA Office of Solid Waste, Directive on Risk Assessment & Cleanup of Residential Soil Le

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

INORGANICS CLP QUALIFIER FLAGS

U - Indicates compound was analyzed for but not detected.

J - Indicates an estimated value.

B - The reported values are less than the CRDL but > or = the IDL; the analyte is flagged with a "U" if analyzed but not detected

N - Spike sample recovery not within control limits.

* - Duplicate analysis not within control limits.

TABLE 6
GROUNDWATER
CONSTITUENTS DETECTED IN PHASE II
GROUNDWATER SAMPLES

CONSTITUENT: (Units in ug/l)	EPA Region 3 Risk-Based Concentrations[1]	Federal Drinking Water MCL[2]	SITE: / SAMPLE ID: / DATE: / RESULT TYPE:	PDOMW01 PDO-GW0102 8/11/1998 Primary	Exceeds criteria?	PDOMW02 PDO-GW0202 8/11/1998 Primary	Exceeds criteria?	PDOMW03 PDO-GW0302 8/11/1998 Primary	Exceeds criteria?	PDOMW03 PDO-GW5002 8/11/1998 Duplicate 1	Exceeds criteria?	PDOMW04 PDO-GW0401 8/10/1998 Primary	Exceeds criteria?
Benzene	0.36	5		64	Yes	4	Yes	< 2	Yes	< 2	Yes	< 2	Yes
Ethyl benzene	130	700		16	No	< 2	No	< 2	No	< 2	No	< 2	No
p-Isopropyltoluene	-	-		< 10	No	< 10	No	< 10	No	< 10	No	< 10	No
Naphthalene	73	-		< 10	No	< 10	No	< 10	No	< 10	No	< 10	No
Tetrachloroethene	1.1	5		< 2	Yes	16	Yes	< 2	Yes	< 2	Yes	< 2	Yes
Toluene	75	1,000		7	No	< 2	No	< 2	No	< 2	No	< 2	No
1,2,4-Trimethylbenzene	30	-		17	No	< 10	No	< 10	No	< 10	No	< 10	No
o-Xylene	1,200	10,000		25	No	< 5	No	< 5	No	< 5	No	< 5	No
Bis(2-ethylhexyl)phthalate	4.8	6		< 10	Yes	< 10	Yes	< 10	Yes	< 10	Yes	< 10	Yes
2-Methylnaphthalene	73	-		< 10	No	< 10	No	< 10	No	< 10	No	< 10	No
Barium	260	2,000		80	No	70	No	30	No	30	No	30	No
Cadmium	1.8	5		< 5 J	Yes	< 5 J	Yes	< 5 J	Yes	< 5 J	Yes	< 5 J	Yes
Lead	n/a	15		< 15 J	No	< 15 J	No	< 15 J	No	< 15 J	No	< 15 J	No

(1) EPA Region 3 Risk-Based Concentrations (4-12-99). All values are based on a non-cancer hazard quotient of 0.1 and cancer risk of 1 in 1,000,000.

(2) MCL - Maximum Contaminant Level, as listed in EPA Drinking Water Regulations and Health Advisories.

J = RESULT IS ESTIMATED R = RESULT IS REJECTED

(-) Not Listed

Note: Tap water RBC values for chromium (VI) and naphthalene were provided by GA EPD in April 1999.

TABLE 6
GROUNDWATER
CONSTITUENTS DETECTED IN PHASE II
GROUNDWATER SAMPLES

CONSTITUENT: (Units in ug/l)	EPA Region 3 Risk-Based Concentrations[1]	Federal Drinking Water MCL[2]	SITE: SAMPLE ID: DATE: RESULT TYPE:	PDOMW05 PDO-GW0501 8/12/1998 Primary	Exceeds criteria?	PDOMW06 PDO-GW0601 8/12/1998 Primary	Exceeds criteria?	PDOMW07 PDO-GW0701 8/12/1998 Primary	Exceeds criteria?	PDOMW08 PDO-GW0801 8/12/1998 Primary	Exceeds criteria?	PDOMW09 PDO-GW0901 8/12/1998 Primary	Exceeds criteria?
Benzene	0.36	5		< 2 J	Yes	36 J	Yes	< 2 J	Yes	< 2 J	Yes	< 2 J	Yes
Ethyl benzene	130	700		< 2 J	No	5 J	No	< 2 J	No	< 2 J	No	< 2 J	No
p-Isopropyltoluene	-	-		< 10 J	No	97 J	No	< 10 J	No	< 10 J	No	< 10 J	No
Naphthalene	73	-		< 10	No	< 10	No	< 10	No	< 10 J	No	< 10	No
Tetrachloroethene	1.1	5		47 J	Yes	< 2 J	Yes	< 2 J	Yes	< 2 J	Yes	< 2 J	Yes
Toluene	75	1,000		< 2 J	No	< 2 J	No	< 2 J	No	< 2 J	No	< 2 J	No
1,2,4-Trimethylbenzene	30	-		< 10 J	No	< 10 J	No	< 10 J	No	< 10 J	No	< 10 J	No
o-Xylene	1,200	10,000		< 5 J	No	8 J	No	< 5 J	No	< 5 J	No	< 5 J	No
Bis(2-ethylhexyl)phthalate	4.8	6		< 10	Yes	< 10	Yes	< 10	Yes	< 10 J	Yes	< 10	Yes
2-Methylnaphthalene	73	-		< 10	No	< 10	No	< 10	No	< 10	No	< 10	No
Barium	260	2,000		90	No	40	No	60	No	100	No	10	No
Cadmium	1.8	5		< 5 J	Yes	< 5 J	Yes	< 5 J	Yes	2.7 J	Yes	< 5 J	Yes
Lead	n/a	15		< 15 J	No	< 15 J	No	< 15 J	No	< 15 J	No	< 15 J	No

(1) EPA Region 3 Risk-Based Concentrations (4-12-99). All values are based on a non-cancer hazard quotient of 0.1 and cancer risk of 1 in 1,000,000.
(2) MCL - Maximum Contaminant Level, as listed in EPA Drinking Water Regulations and Health Advisories.
J = RESULT IS ESTIMATED R = RESULT IS REJECTED
(-) Not Listed
Note: Tap water RBC values for chromium (VI) and naphthalene were provided by GA EPD in April 1999.

TABLE 6
GROUNDWATER
CONSTITUENTS DETECTED IN PHASE II
GROUNDWATER SAMPLES

CONSTITUENT: (Units in ug/l)	EPA Region 3 Risk-Based Concentrations[1]	Federal Drinking Water MCL[2]	SITE: / SAMPLE ID: / DATE: / RESULT TYPE:	PDOMW1-19 PDO-GW1-1902 8/11/1998 Primary	Exceeds criteria?	PDOMW1-20 PDO-GW1-2002 8/12/1998 Primary	Exceeds criteria?	PDOMW1-21 PDO-GW1-2102 8/12/1998 Primary	Exceeds criteria?	PDOMW1-22 PDO-GW1-2202 8/12/1998 Primary	Exceeds criteria?	PDOMW1-23 PDO-GW1-2301 8/11/1998 Primary	Exceeds criteria?
Benzene	0.36	5		< 2	Yes	< 2 J	Yes	< 2 J	Yes	< 2 J	Yes	13	Yes
Ethyl benzene	130	700		< 2	No	< 2 J	No	< 2 J	No	< 2 J	No	8	No
p-Isopropyltoluene	-	-		< 10	No	< 10 J	No	< 10 J	No	< 10 J	No	< 10	No
Naphthalene	73	-		< 10	No	< 10	No	< 10	No	< 10	No	19	No
Tetrachloroethene	1.1	5		< 2	Yes	< 2 J	Yes	< 2 J	Yes	11 J	Yes	< 2	Yes
Toluene	75	1,000		< 2	No	< 2 J	No	< 2 J	No	< 2 J	No	< 2	No
1,2,4-Trimethylbenzene	30	-		< 10	No	< 10 J	No	< 10 J	No	< 10 J	No	27	No
o-Xylene	1,200	10,000		< 5	No	< 5 J	No	< 5 J	No	< 5 J	No	< 5	No
Bis(2-ethylhexyl)phthalate	4.8	6		< 10	Yes	< 10	Yes	< 10	Yes	< 10	Yes	< 10	Yes
2-Methylnaphthalene	73	-		< 10	No	< 10	No	< 10	No	< 10	No	18	No
Barium	260	2,000		60	No	40	No	40	No	100	No	70	No
Cadmium	1.8	5		< 5 J	Yes	< 5 J	Yes	< 5 J	Yes	< 5 J	Yes	< 5 J	Yes
Lead	n/a	15		15.8 J	No	< 15 J	No	< 15 J	No	< 15 J	No	< 15 J	No

(1) EPA Region 3 Risk-Based Concentrations (4-12-99). All values are based on a non-cancer hazard quotient of 0.1 and cancer risk of 1 in 1,000,000.
(2) MCL - Maximum Contaminant Level, as listed in EPA Drinking Water Regulations and Health Advisories.
J=RESULT IS ESTIMATED R=RESULT IS REJECTED
(-) Not Listed
Note: Tap water RBC values for chromium (VI) and naphthalene were provided by GA EPD in April 1999.

TABLE 6
GROUNDWATER
CONSTITUENTS DETECTED IN PHASE II
GROUNDWATER SAMPLES

CONSTITUENT: (Units in ug/l)	EPA Region 3 Risk-Based Concentrations[1]	Federal Drinking Water MCL[2]	SITE: / SAMPLE ID: / DATE: / RESULT TYPE:	PDOMW1-24 PDO-GW1-2401 8/11/1998 Primary	Exceeds criteria?	PDOMW1-25 PDO-GW1-2502 8/12/1998 Primary	Exceeds criteria?	PDOMW10 PDO-GW1001 8/12/1998 Primary	Exceeds criteria?	PDOMW11 PDO-GW1101 8/13/1998 Primary	Exceeds criteria?
Benzene	0.36	5		< 2	Yes	29 J	Yes	< 2 J	Yes	< 2 J	Yes
Ethyl benzene	130	700		< 2	No	4 J	No	< 2 J	No	< 2 J	No
p-Isopropyltoluene	-	-		< 10	No	< 10 J	No	< 10 J	No	< 10 J	No
Naphthalene	73	-		< 10	No	< 10	No	< 10	No	< 10	No
Tetrachloroethene	1.1	5		15	Yes	< 2 J	Yes	< 2 J	Yes	< 2 J	Yes
Toluene	75	1,000		< 2	No	< 2 J	No	< 2 J	No	< 2 J	No
1,2,4-Trimethylbenzene	30	-		< 10	No	< 10 J	No	< 10 J	No	< 10 J	No
o-Xylene	1,200	10,000		< 5	No	< 5 J	No	< 5 J	No	< 5 J	No
Bis(2-ethylhexyl)phthalate	4.8	6		< 10	Yes	< 10	Yes	14	Yes	< 10	Yes
2-Methylnaphthalene	73	-		< 10	No	< 10	No	< 10	No	< 10	No
Barium	260	2,000		40	No	30	No	< 10	No	20	No
Cadmium	1.8	5		< 5 J	Yes	< 5 J	Yes	< 5 J	Yes	< 5 J	Yes
Lead	n/a	15		< 15 J	No	< 15 J	No	< 15 J	No	< 15 J	No

(1) EPA Region 3 Risk-Based Concentrations (4-12-99). All values are based on a non-cancer hazard quotient of 0.1 and cancer risk of 1 in 1,000,000.
(2) MCL - Maximum Contaminant Level, as listed in EPA Drinking Water Regulations and Health Advisories.
J = RESULT IS ESTIMATED R = RESULT IS REJECTED
(-) Not Listed
Note: Tap water RBC values for chromium (VI) and naphthalene were provided by GA EPD in April 1999.

TABLE 7
SURFACE WATER
CONSTITUENTS DETECTED IN PHASE II SURFACE WATER SAMPLES (M&E)

CONSTITUENT:	GEORGIA EPD INSTREAM WQ STANDARDS (1)	EPA Region 4 Freshwater Surface Water Screening Values (2)		SITE:	PDO-SWE01		PDO-SWE02		PDO-SWE03		PDO-SWE03	
				SAMPLE ID:	PDO-SW0102		PDO-SW0202		PDO-SW0302		PDO-SW0202	
				DATE:	8/13/1998		8/13/1998		8/13/1998		8/13/1998	
(Units in ug/l)		Acute	Chronic	RESULT TYPE:	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Primary	Exceeds criteria?	Duplicate	Exceeds criteria?
Naphthalene	-	230	62		< 10	No	23	No	< 10	No	< 10	No
Bis(2-ethylhexyl)phthalat	5.92	1110	0.3		< 10	Yes	16	Yes	< 10	Yes	< 10	Yes
2-Methylnaphthalene	-	230	62		< 10	No	12	No	< 10	No	< 10	No
Barium	-	-	-		30	No	20	No	30	No	30	No
Lead	1.3	33.78	1.32		13.4	J Yes	3	J Yes	13.2	J Yes	11.3	J Yes
Zinc	60	65.04	58.91		110	Yes	90	Yes	70	Yes	60	Yes

1) - GA EPD IWQS - Georgia DNR, EPD, Water Quality Control, Instream Water Quality Standards, Chapter 391-3-6.03, section 5(d)(ii)&(iii), 5/29/94.
2) - EPA Region 4 Management Division Freshwater Surface Water Screening Values for Hazardous Waste Sites, Table 1.
(a) - Secondary Drinking Water Standard based on aesthetics.
(-) - Not Listed.
J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

* pH dependant.
** Based on Hardness raised to e(1.72(enH)-6.52)
(b) Based on Hardness (CaCO3) < 100 mg/L in freshwater.

TABLE 8
SURFACE WATER
CONSTITUENTS DETECTED IN PHASE II SURFACE WATER SAMPLES (SAIC)

CONSTITUENT:	GEORGIA EPD INSTREAM WQ STANDARDS	Ecological EPA Region 4 Freshwater Surface Water Screening Values (2)		SITE: SAMPLE ID: DATE:	SAIC-PDO PD1600 4/16/1999			SAIC-PDO PD2600 4/16/1999		
(Units in ug/L)		Acute	Chronic	RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?
Arsenic	0.14	360	90		< 2.9		Yes	3.4	J	Yes
Barium	-	-	-		20.8	J	No	21.9	J	No
Cadmium	0.7	1.79	0.66		0.211	J	No	0.234	J	No
Chromium	120	16	11		1.25	J	No	1.36	J	No
Lead	1.3	33.78	1.32		2.9	J	Yes	2.9	J	Yes
Selenium	5	20	5		< 1.4		No	1.61	J	No
Zinc	60	65.04	58.91		12.1	J	No	19.5	J	No

1) - GA EPD IWQS - Georgia DNR, EPD, Water Quality Control, Instream Water Quality Standards, Chapter 391-3-6.03, section 5(d)(ii)&(iii), 5/29/94.
IWQS values for chromium, copper, lead, nickle, and zinc are based on a hardness (CaCO3) of <100 mg/L in freshwater.

2) - EPA Region 4 Management Division Freshwater Surface Water Screening Values for Hazardous Waste Sites, Table 1.

(a) - Secondary Drinking Water Standard based on aesthetics.

(-) - Not Listed.

J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

TABLE 9
SEDIMENT
CONSTITUENTS DETECTED IN PHASE II SEDIMENT SAMPLES (M&E)

CONSTITUENT:	EPA Region 3 (1) Industrial RBC	EPA Region 3 (1) Residential RBC	EPA SSL (2)	Ecological EPA Region IV Sediment Screening Values (3)	SITE:	PDO-SWE01			PDO-SWE02			PDO-SWE03			PDO-SWE03		
					SAMPLE ID:	PDO-SE0102			PDO-SE0202			PDO-SE0302			PDO-SE2002		
					DATE:	8/13/1998			8/13/1998			8/13/1998			8/13/1998		
					DEPTH (ft):	0			0			0			0		
(Units in mg/kg)					RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Primary		Exceeds criteria?	Duplicate		Exceeds criteria?
Toluene	41,000	1,600	12	-		< 0.01	J	No	< 0.0077	J	No	< 0.011	J	No	0.052	J	No
Barium	14,000	550	82	-		42		No	16		No	76		No	42		No
Chromium *	613	24	2	52.3		9.7		Yes	4		Yes	7		Yes	6.1		Yes
Lead	400**	400**	-	30.2		50		Yes	16		No	36		Yes	24		No
Zinc	61,000	2,300	620	124		100		No	34		No	92		No	60		No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk
(2) - EPA Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.
(3) EPA Region 4 Office of Technical Services, Supplemental Guidance to RAGS, Table 3 (Draft)
* RBCs for Chromium VI are used as screening criteria although only total Chromium analyses were performed on soil and sediment samples.
** From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead
(-) - Not Listed.
J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

TABLE 10
SEDIMENTS
CONSTITUENTS DETECTED IN PHASE II SEDIMENT SAMPLES (SAIC)

CONSTITUENT:	EPA Region 3 (1) Industrial Risk-Based Concentration	EPA Region 3 (1) Residential Risk-Based Concentration	EPA SSL (2)	Ecological EPA Region IV Sediment Screening Values (3)	SITE:	SAIC-PDO			SAIC-PDO		
					SAMPLE ID:	PD1500			PD2500		
					DATE:	4/16/1999			4/16/1999		
					DEPTH (ft):	0			0		
(Units in mg/kg)					RESULT TYPE:	Primary		Exceeds criteria?	Primary		Exceeds criteria?
Acetone	20,000	780	16	-		0.019	UJ	No	0.014	UJ	No
Toluene	41,000	1,600	12	-		< 0.010		No	< 0.007		No
Xylenes, total	100,000	16,000	190	-		0.001	J	No	< 0.007		No
Benzo(a)anthracene	7.8	0.88	2	0.33		0.028	J	No	0.025	J	No
Benzo(a)pyrene	0.78	0.088	8	0.33		0.030	J	No	0.032	J	No
Benzo(b)fluoranthene	7.8	0.88	5	-		0.054	J	No	0.030	J	No
Benzo(g,h,i)perylene	-	-	-	-		0.026	J	No	0.023	J	No
Benzo(k)fluoranthene	78	8.8	49	-		0.041	J	No	0.031	J	No
Chrysene	780	88	160	-		0.050	J	No	0.038	J	No
Fluoranthene	8,200	310	4,300	0.33		0.066	J	No	0.032	J	No
Indeno(1,2,3-cd)pyrene	7.8	0.88	14	0.33		0.153	J	No	0.145	J	No
Phenanthrene	-	-	-	0.33		0.036	J	No	< 0.450		Yes
Pyrene	6,100	230	4,200	0.33		0.073	J	No	0.030	J	No
GRO	-	-	-	-		-		No	-		No
DRO	-	-	-	-		-		No	-		No
Arsenic	3.8	0.43	1	7.24		0.9		Yes	0.64		Yes
Cadmium	100	3.9	0.4	1		0.74		Yes	0.33		No
Chromium (total) *	613.2	23.5	2	52.3		2.4	J	Yes	26.3	J	Yes
Copper	8,200	310	-	18.7		-		Yes	-		Yes
Lead	400**	400**	-	30.2		8.8	J	No	135	J	Yes
Mercury	61	2.3	0.1	0.13		< 0.02		No	0.04	J	No
Silver	1,000	39	2	2		0.28		No	0.41	J	No
Zinc	61,000	2,300	620	124		20.9		No	24		No

(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk
(2) - EPA SSL - Soil Screening Levels for Migration to Groundwater with a DAF of 20 for organics and a DAF of 1 for inorganics.
(3) - EPA Region 4 Office of Technical Services, Supplemental Guidance to RAGS, Table 3 (Draft)
* RBCs for Chromium VI are used as screening criteria although only total Chromium analyses were performed on soil and sediment samples.
** From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead
(-) - Not Listed. NA - Not Analyzed
J = RESULT IS ESTIMATED. R = RESULT IS REJECTED.

Table 11 Physical and Chemical Properties of Organic COPCs in Groundwater

Constituents	Molecular Weight (grams/mol)	Solubility S_w (mg/L)	Henry's Constants (atm.m^3/mol)	K_{oc} (ml/g)	Biodeg. half-life (day)	Log (K_{ow})
Benzene	78.1	1.78E+03	5.55E-03	6.20E+01	720	2.13
Tetrachloroethene (PCE)	165.8	1.50E+02	2.87E-02	3.17E+02	1653	2.53

Table 12. Selection of HHCOPCs in Soil

Analyte	Results > LQL	LQL > Screening Criteria	LQL Range	Range of Detected Concentrations	EPA Region 3 Residential RBC	HHCOPC? (Yes or No)	Justification
SURFACE SOIL (mg/kg)							
Benzo(a)pyrene	2/23	18/23	0.36-0.39J	0.59-1.6	0.088	Yes	RBC exceeded*
Arsenic	18/23	23/23	<1.1 -<3.3	1.1-28	0.43	Yes	RBC exceeded*
SUBSURFACE SOIL (mg/kg)							
Benzo(a)pyrene	0/50	0/50	0.096J-0.4	N/A	0.78	No	RBC not exceeded
Arsenic	16/50	34/50	<1.1 -<4	0.73B - 12	3.8	Yes	RBC exceeded*

* The LQL for this parameter exceeded the RBC.

Table 13

Summary of Analytes Detected in Groundwater

COPC	Screening Criteria (µg/L)		Groundwater Concentration (µg/L)							
	MCL (µg/L)	Region 3 RBC (µg/L)	MW01	MW02	MW05	MW06	MW1-22	MW1-23	MW1-24	MW1-25
Benzene	5	0.36	64	4	<2	36	<2	13	<2	29
PCE	5	1.1	<2	16	47	<2	11	<2	15	<2

Table 14

Toxicity Data for COPCs

Compound	Weight of Evidence (WOE)	SF $(mg/kg\text{-}day)^{-1}$	RfD (mg/kg-day)
Benzene	A	$2.9E^{-2}$ (1)	-
PCE	C- B2	$5.2E^{-2}$ (2)	$1E^{-2}$ (1)

- Indicates value is under review and unavailable on IRIS.

(1) EPA Integrated Risk Information System (IRIS)

(2) Superfund Technical Support Center, Risk Assessment Issue Paper for: Carcinogenicity Information for Tetrachloroethene (PCE) (CASRN 127-18-4)

A - Compounds that are human carcinogens

B2 - Compounds that are probable human carcinogens

C - compounds are possible human carcinogens.

Table 15

Residential Exposure Factors

Exposure Variable	Value Used	Reference
Concentration in Water	Benzene 18.5 µg/L PCE 10.9 µg/L	Arithmetic average of concentrations > RBC EPA Region 4 (1)
Ingestion Rate	2 L/day	EPA Region 4 default value (1) and EPD default value (3)
Exposure Frequency	350 days/year	EPA Region 4 default value (1) and EPD default value (3)
Exposure Duration	30 years	EPA Region 4 default value (1) and EPD default value (3)
Body Weight	70 kg	EPD default value (3) and EPA RAGS (2)
Lifetime	70 years	EPD default value (3) and EPA RAGS (2)

(1) EPA Region 4, *Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment (Interim)*, Waste Management Division, November, 1995.

(2) EPA, *Risk Assessment Guidance for Superfund, Volume I Human Health Evaluation Manual (Part A)*, USEPA (EPA/540/1-89/002), December, 1989.

(3) Georgia EPD, Chapter 391-1-9 Hazardous Site Response Act, Table 3.

Table 16

Exposure Parameters for Surrogate Species Exposed to ECOPCs in Sediment PDO Yard, HAAF

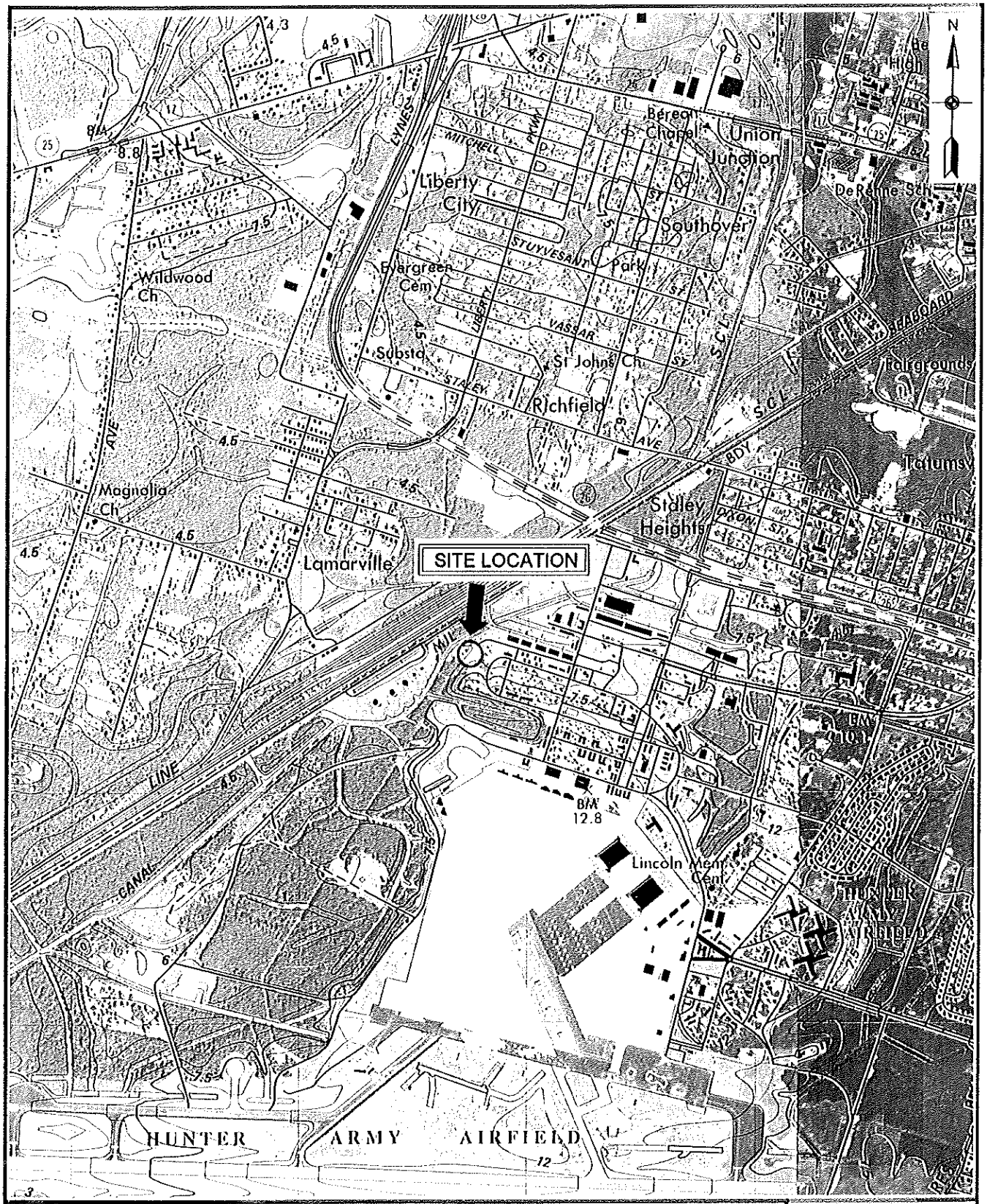
Parameter	Surrogate Species Raccoon
Body Weight (WT) in kg	4.31*
Food Ingestion Rate (IR) in kg/d	0.23**
Sediment Incidental Ingestion Rate (IIR) in kg/d as a percentage of IR	0.02
Food Ingestion Rate normalized for body weight (FI_n) in kg/kg/d	0.06
AUF	1
Relative Bioavailability	1
Diet (estimated)*	50% insect 50% crustacea/ annelida
Source Medium	Sediment

* Wildlife Exposure Factors Handbook

** $IR = 0.0687 * WT^{0.822}$

$FI_n = (IR + IIR)/WT$

FIGURES



US.ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

PDO YARD LOCATION MAP

Hunter Army Airfield — **Savannah, Georgia**

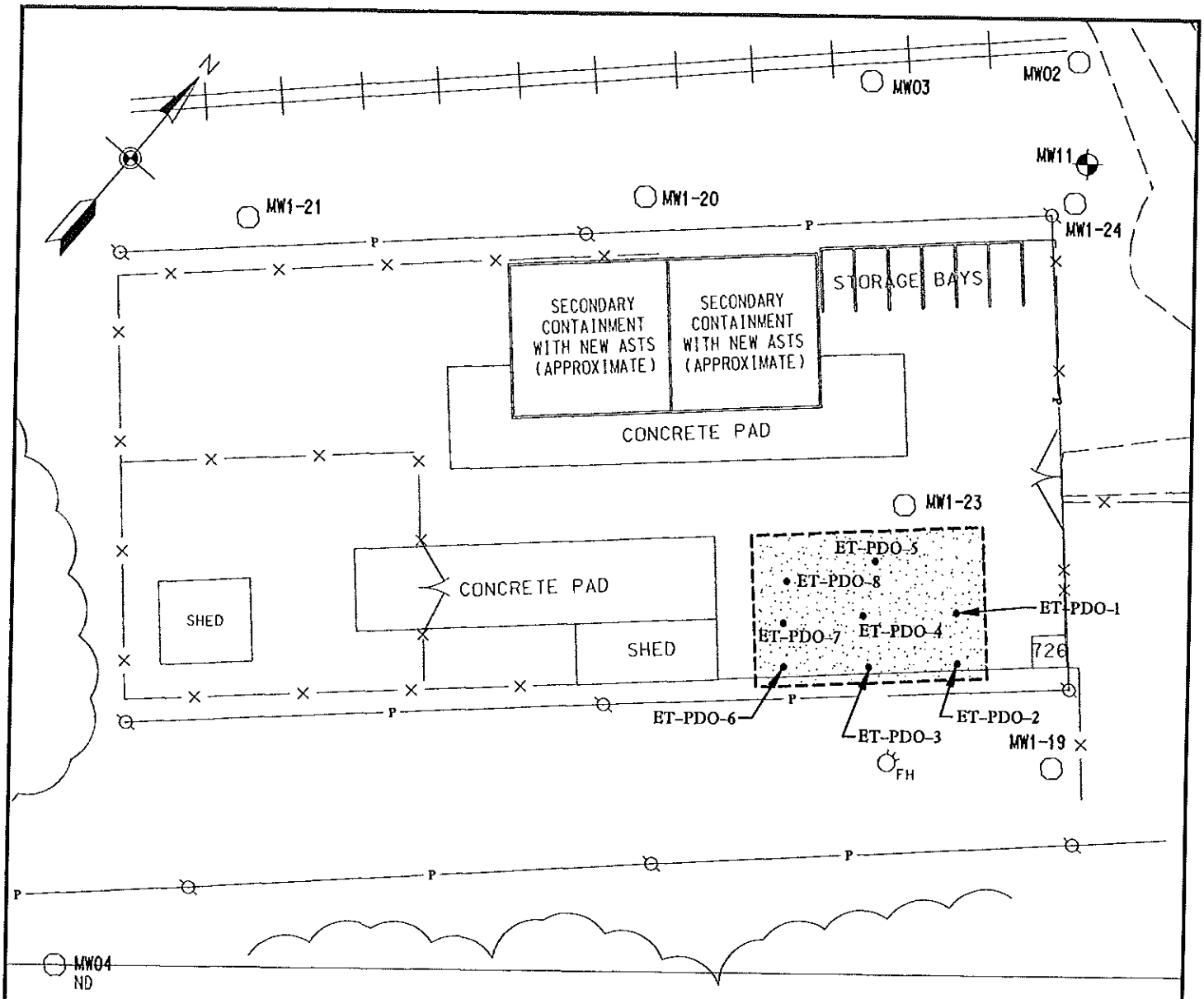
SCALE: 1"=2000' (0 — Feet — 2000)

DATE:

APPROVED:

FIGURE 1

Metcalf & Eddy



LEGEND

- DEEP MONITORING WELL
- EARTH TECH CONFIRMATION SOIL SAMPLE LOCATION
- MW01 MONITORING WELL
- APPROXIMATE EXTENT OF INTERIM REMOVAL ACTIVITIES (I.E., REMOVAL OF TANKS AND SOIL)
- POWER POLE/LINE
- FIRE HYDRANT
- RAILROAD TRACKS

U.S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

PDO YARD LAYOUT

HUNTER army AIRFIELD SAVANNAH, GEORGIA

FIGURE 2

M&E
AQUA ALLIANCE

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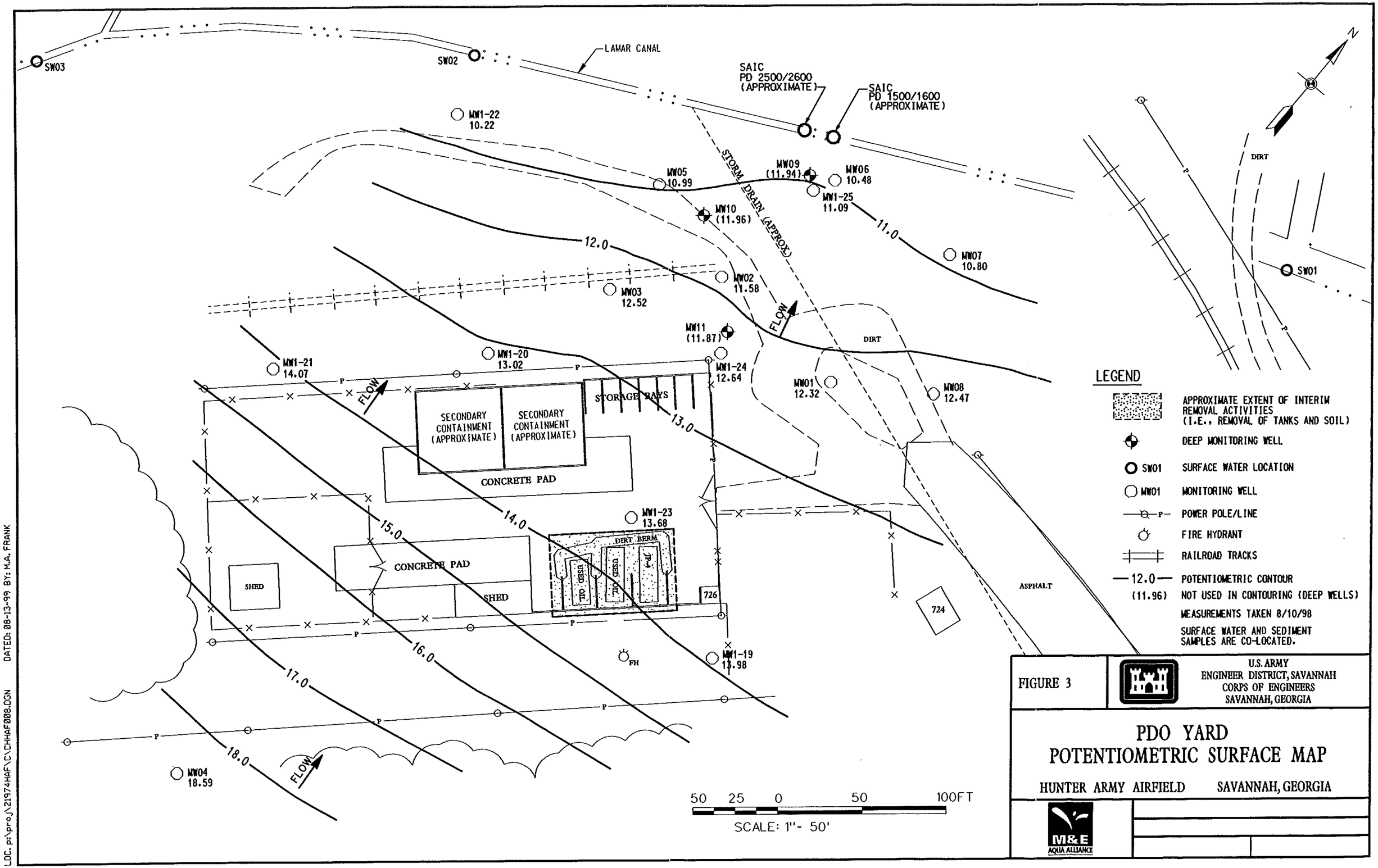

FIGURE 3

U.S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

PDO YARD
POTENTIOMETRIC SURFACE MAP

HUNTER ARMY AIRFIELD SAVANNAH, GEORGIA

M&E
AQUA ALLIANCE

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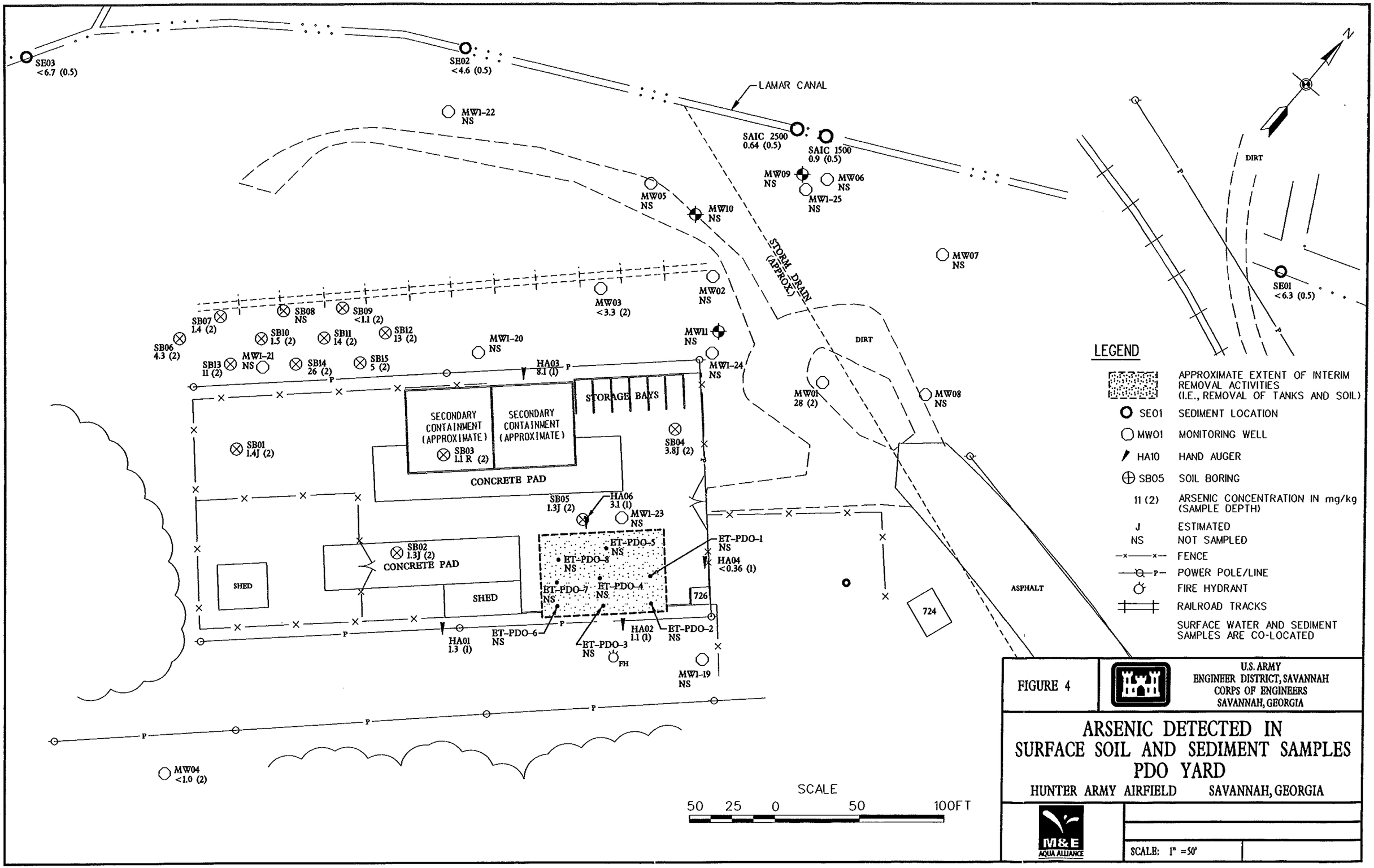

FIGURE 4

U.S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

ARSENIC DETECTED IN SURFACE SOIL AND SEDIMENT SAMPLES PDO YARD

HUNTER army AIRFIELD SAVANNAH, GEORGIA

M&E
AQUA ALLIANCE

SCALE: 1" = 50'

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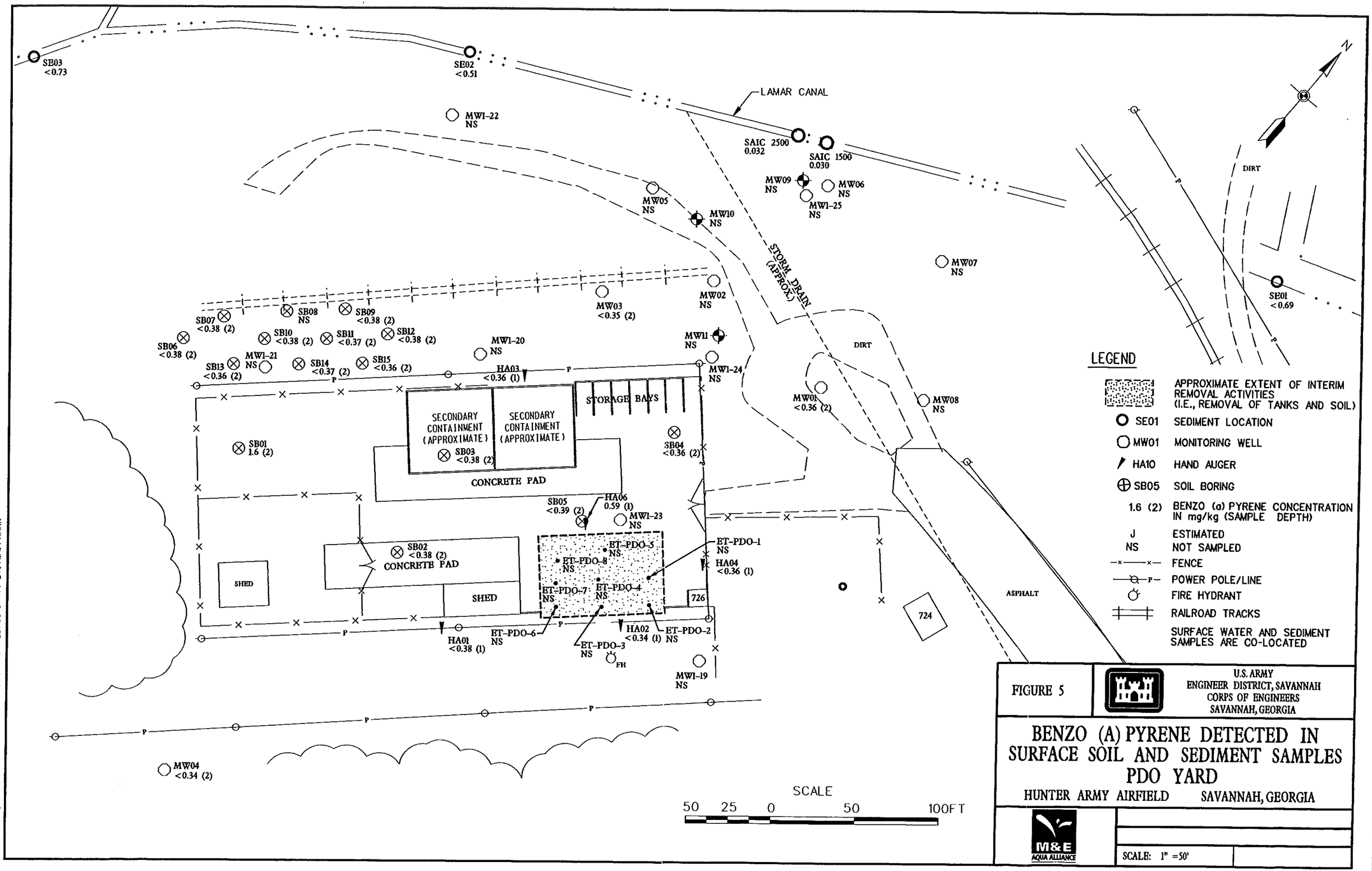

LEGEND

- APPROXIMATE EXTENT OF INTERIM REMOVAL ACTIVITIES (I.E., REMOVAL OF TANKS AND SOIL)
- SE01 SEDIMENT LOCATION
- MW01 MONITORING WELL
- HA10 HAND AUGER
- SB05 SOIL BORING
- 1.6 (2) BENZO (a) PYRENE CONCENTRATION IN mg/kg (SAMPLE DEPTH)
- J ESTIMATED
- NS NOT SAMPLED
- FENCE
- POWER POLE/LINE
- FIRE HYDRANT
- RAILROAD TRACKS
- SURFACE WATER AND SEDIMENT SAMPLES ARE CO-LOCATED

FIGURE 5

U.S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

BENZO (A) PYRENE DETECTED IN SURFACE SOIL AND SEDIMENT SAMPLES PDO YARD

HUNTER army AIRFIELD SAVANNAH, GEORGIA

M&E
AQUA ALLIANCE

SCALE: 1" =50'

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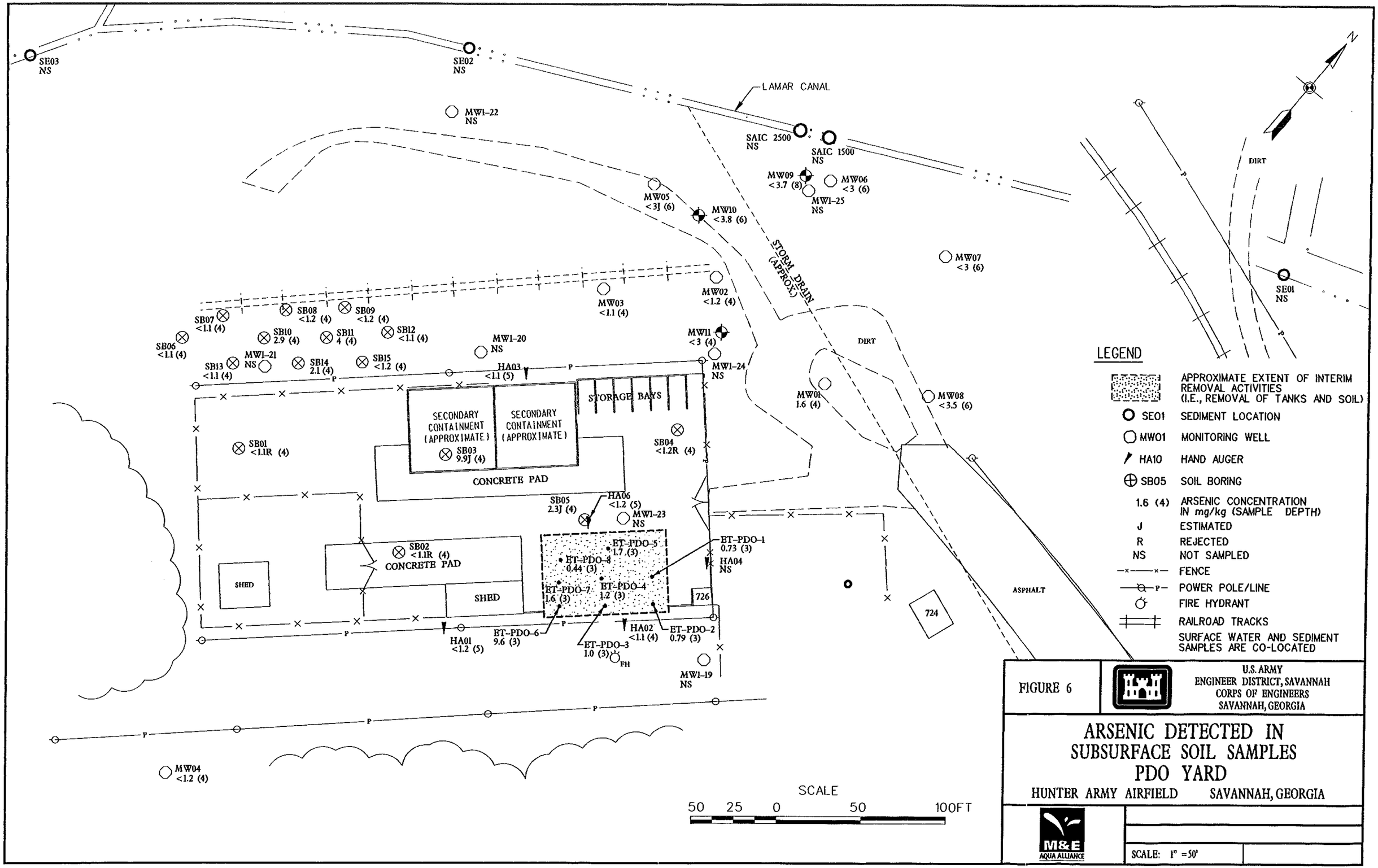

FIGURE 6

U.S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

ARSENIC DETECTED IN SUBSURFACE SOIL SAMPLES PDO YARD

HUNTER ARMY AIRFIELD SAVANNAH, GEORGIA

M&E AQUA ALLIANCE

SCALE: 1" = 50'

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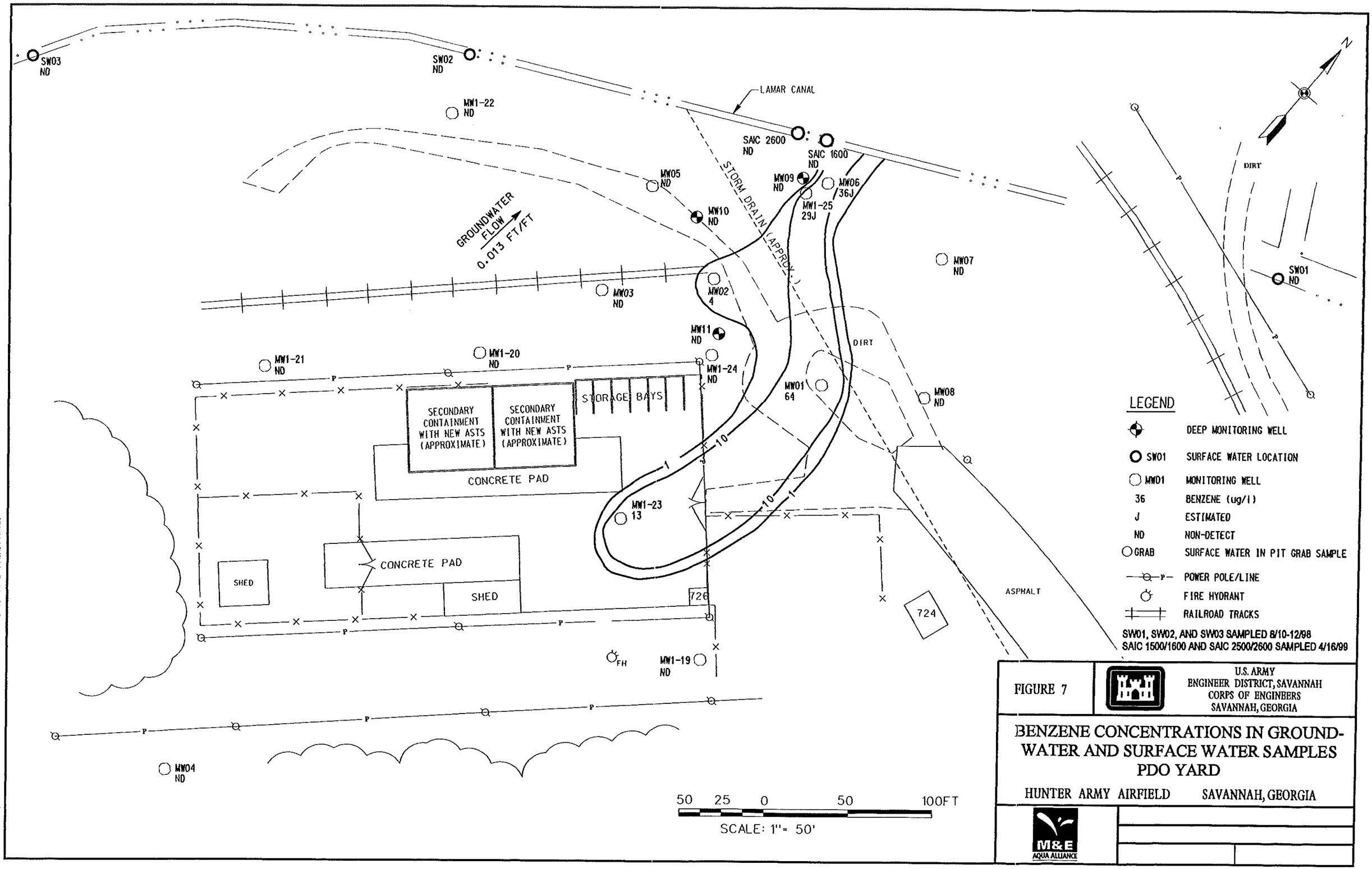

FIGURE 7

U.S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

BENZENE CONCENTRATIONS IN GROUND-WATER AND SURFACE WATER SAMPLES PDO YARD

HUNTER army AIRFIELD SAVANNAH, GEORGIA

M&E AQUA ALLIANCE

LOC: p:\proj\21974haf\c\chhaf01l.dgn DATED: 08-13-99 BY: M.A. FRANK

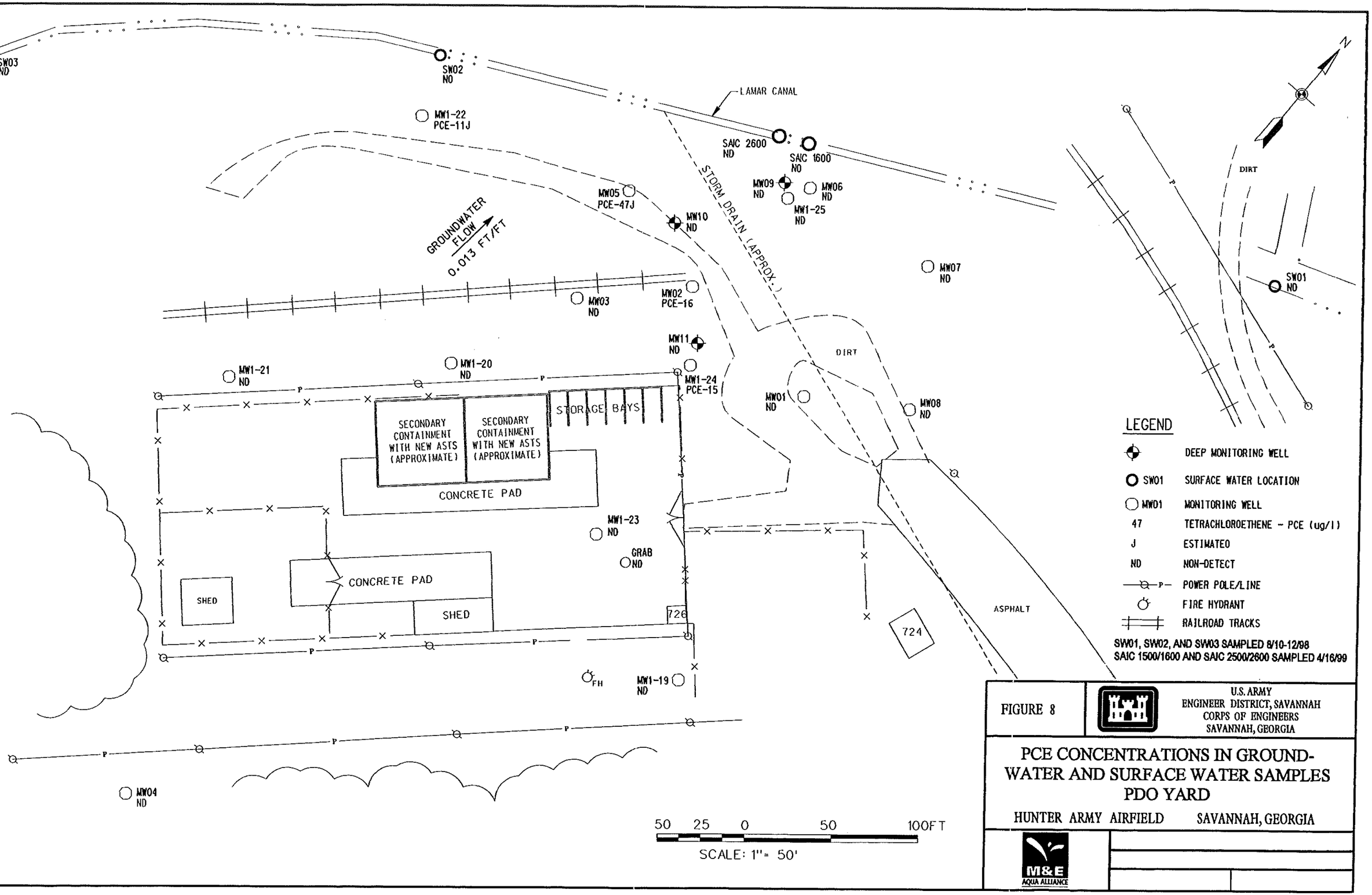

FIGURE 8

U.S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

PCE CONCENTRATIONS IN GROUND-WATER AND SURFACE WATER SAMPLES PDO YARD

HUNTER army AIRFIELD SAVANNAH, GEORGIA

M&E AQUA ALLIANCE

LOC: p:\proj\21974haf\c\chhaf012.dgn DATED: 08-13-99 BY: M.A. FRANK

SW03
ND

SURFACE WATER
LEAD - 13.2J ug/L
ZINC - 70 ug/L
SEDIMENT
BARIUM - 76 mg/kg
LEAD - 36 mg/kg

SURFACE WATER
BIS (2-ETHYLHEXYL) PHTHALATE - 16 ug/L
LEAD - 3 ug/L
ZINC - 90 ug/L
SEDIMENT
BARIUM - 16 mg/kg
LEAD - 16 mg/kg

SW02
ND

LAMAR CANAL

MW1-22
PCE-11J

SURFACE WATER (PD2600)
ARSENIC - 3.4J ug/L
LEAD - 2.9J ug/L
ZINC - 19.5J ug/L
SEDIMENT (PD2500)
PHENANTHRENE - <0.45
LEAD - 135 mg/kg

SAIC 2600
SAIC 2500
SAIC 1600
SAIC 1500

MW09
ND
MW06
ND
MW1-25
ND

MW05
PCE-47J

MW10
ND

STORM DRAIN (APPROX.)

GROUNDWATER FLOW
0.013 FT/FT

SURFACE WATER (PD1600)
ARSENIC - <2.9 ug/L
LEAD - 2.9J ug/L
ZINC - 12.1J ug/L
SEDIMENT (PD1500)
LEAD - 8.8 mg/kg

MW07
NO

MW03
ND

MW02
PCE-16

MW11
NO

MW1-21
ND

MW1-20
ND

MW1-24
PCE-15

SECONDARY CONTAINMENT WITH NEW ASTS (APPROXIMATE)

SECONDARY CONTAINMENT WITH NEW ASTS (APPROXIMATE)

STORAGE BAYS

CONCRETE PAD

DIRT

MW01
ND

MW08
NO

SURFACE WATER
LEAD - 13.4J ug/L
ZINC - 110 ug/L
SEDIMENT
BARIUM - 42 mg/kg
LEAD - 50 mg/kg

SW01
ND

MW1-23
NO

CONCRETE PAD

SHED

SHED

726

724

ASPHALT

FH

MW1-19
ND

MW04
ND

50 25 0 50 100FT
SCALE: 1"= 50'

LEGEND

- DEEP MONITORING WELL
- SW01 SURFACE WATER LOCATION
- MW01 MONITORING WELL
- 47 TETRACHLOROETHENE - PCE (ug/l)
- J ESTIMATED
- ND NON-DETECT
- P POWER POLE/LINE
- FIRE HYDRANT
- RAILROAD TRACKS

SW01, SW02, AND SW03 SAMPLED 8/10-12/98
SAIC 1500/1600 AND SAIC 2500/2600 SAMPLED 4/16/99

FIGURE 9

U.S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

CONSTITUENTS EXCEEDING ECOLOGICAL CRITERIA IN SURFACE WATER AND SEDIMENT SAMPLES PDO YARD

HUNTER army AIRFIELD SAVANNAH, GEORGIA

M&E
AQUA ALLIANCE

LOC: p:\proj\21974HAF\C\CHHAF033.DGN DATED: 08-13-99 BY: M.A. FRANK

APPENDIX A

LEGAL DESCRIPTION

AFFIDAVIT

State of Georgia
County of Chatham

Personally before the undersigned officer authorized to administer oaths appeared Thomas D. Houston, REP, who being duly sworn, does state on oath the following:

This affidavit is given on the basis that the following described tract of land belonging to the United States of America and located at Hunter Army Airfield, Chatham County, Georgia, has been listed as site number 10105 on the Hazardous Site Inventory list prepared by the Environmental Protection Division, Department of Natural Resources, State of Georgia:

LEGAL DESCRIPTION OF THE HAZARDOUS SITE

The hazardous site consists of a parcel or tract containing 0.9552 acres more or less which is a part of a larger parent parcel or tract designated as Tract Number I-900 conveyed by Warranty Deed dated 29 September 1950 from the Mayor and Aldermen of the City of Savannah to the United States of America as recorded in Deed Book 52-J Office of the Clerk of Superior Court, Chatham County, Georgia. The hazardous site is more particularly described as follows:

Beginning at a point which is the Northwest corner at Longitude 81°:08':24.32" West 32°:01':50.30" North, thence S 46°:00':00"W 300.58 feet to a corner at Longitude 81°:08':26.84" West 32°:01':48.25" North which is the Southwest corner, thence S 40°:00':00"E 134.90 feet to a corner at Longitude 81°:08':25.84" West 32°:01:47.22" North which is the Southeast corner, thence N 47°:00'00"W 311.08 feet to a corner at Longitude 81°:08':23.20" West 32°:01°:49.33" North which is the Northeast corner thence N44°:00':00"W 137.56 feet to the point of beginning. The said parcel being locally designated as the Old PDO yard being enclosed by a Chain Link Fence located on Hunter Army Airfield, Chatham County, Georgia.

"This property has been listed on the state's hazardous site inventory and has been designated as needing corrective action due to the presence of hazardous waste, hazardous constituents, or hazardous substances regulated under state law. Contact the property owner or the Georgia Environmental Protection Division for further information concerning this property. This notice is provided in compliance with the Georgia Hazardous Site Response Act." Georgia Rules for Hazardous Site Response, Chapter 391-3-19.08(1).

Signature Thomas D. Houston REP

Title: Chief, Environmental &
Natural Resources Div
Directorate of Public Works
Fort Stewart, Georgia

Sworn to and subscribed before
me this 26 day of AUGUST, 1994.

Gwendolyn L. Myers
Notary Public

GWENDOLYN L. MYERS
Notary Public, Liberty County, Georgia
My Commission Expires Nov. 24, 1995

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APPENDIX B
BORING LOGS

Hole No. PDO-HA01

DRILLING LOG	DIVISION SAV.	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT	HAAF PDO/1310
2. LOCATION (Coordinates or Station)	PDO
3. DRILLING AGENCY	M&E
4. HOLE NO. (As shown on drawing title and file number)	PDO-HA01
5. NAME OF DRILLER	D. Humphris / G. Rowell
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	5.0'
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	5.0'
10. SIZE AND TYPE OF BIT	3" Hand auger
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	—
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	—
16. DATE HOLE	STARTED 8/29/96 COMPLETED 8/29/96
17. ELEVATION TOP OF HOLE	20.4
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	D. Humphris

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0					OVA, ppm
	1		SAND: med-fine; Yell Br 10YR 5/6, silty-20%, well sorted, dry (SM)	—	1	0 Lab
	2		: as above, w/ Yell-Red 5YR 5/6 mottling (SM)	—	2	0
	3		CLAY: Lt Br Gy 10YR 6/2, sandy 35% dry, low-med plastic, (CL)	—	3	0
	4		SAND: med-fine, clayey 30%, Yell Br + Yell Red mottling. well sorted (SC)	—	4	0
	5		as above, Lt. Br. Gy 10YR 6/2, tr. glauconite + micas. clayey 30% (SC)	—	5	0 Lab
			E.O.B. @ 5.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-HA02

DRILLING LOG	DIVISION: SAV	INSTALLATION: HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: HAAF PDO/1310
2. LOCATION (Coordinates or Station): PDO, SAV 6A
3. DRILLING AGENCY: MKE
4. HOLE NO. (As shown on drawing title and file number): PDO-HA02
5. NAME OF DRILLER: D. Humphris / G. Rowell
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 4.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 4.0'
10. SIZE AND TYPE OF BIT: 3" Hand Auger
11. DATUM FOR ELEVATION SHOWN (USM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: —
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 8/29/96; COMPLETED 8/29/96
17. ELEVATION TOP OF HOLE: 20.3
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphris

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		SAND: med-fine; dk GyBr 10YR 4/2 well sorted, silty 20%, dry (SM)	—	1	OVA, ppm 0 Lab
	1		: as above, Gy 10YR 5/1, silty 5-10%, well sorted, dry (SW)	—	2	0
	2		: as above	—	3	0
	3		: dk Br 7.5YR 3/2, silty 10-15% moist-wet. (SW/SM)	—	4	0 Lab
	4		G.O.B. @ 4.0' bgs	—	—	
	5					
	6					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG. FORM ... PROJECT ... HOLE NO.

Hole No. PDO-HA03

DRILLING LOG	DIVISION SAV.	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT	HAAF PDO/1310
2. LOCATION (Coordinates or Station)	SAV, GA
3. DRILLING AGENCY	M&E
4. HOLE NO. (As shown on drawing title and file number)	PDO-HA03
5. NAME OF DRILLER	D. Humphris / G. Rowell
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	5.0'
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	5.0'
10. SIZE AND TYPE OF BIT	3" Hand Auger
11. DATUM FOR ELEVATION SHOWN (~~TBM or MSL~~)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	—
16. DATE HOLE	STARTED 8/29/96 COMPLETED 8/29/96
17. ELEVATION TOP OF HOLE	17.7'
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	D. Humphris

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		SAND: med-fine: Black/U.dk.Gy 2.5Y 2.5/1, dry, well sorted, silty 20% (SM)	—	1	OVA, ppm 0 Lab
	1		dk Yell Br. 10YR 5/4, silty 20% (SM)	—	2	0
	2		10YR 6/2 Lt Br Gy + Yell-Br 5/6 mottling, moist, clayey 10%, well sorted tr. glauconite (SC)	—	3	0
	3		mostly Lt Br Gy 10YR 6/2, clayey 20-40%, well sorted, tr. glauconite + thick. moist (SC)	—	4	0
	4		as above, wet (SC)	—	5	0 Lab
	5		E.O.B. @ 5.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-HA04

DRILLING LOG	DIVISION SAV.	INSTALLATION NAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: PDO/1310 (PDO)
2. LOCATION (Coordinates or Station): SAV. GA.
3. DRILLING AGENCY: NA
4. HOLE NO. (As shown on drawing title and file number): PDO-HA04
5. NAME OF DRILLER: NA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 2.0'
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 2.0'
10. SIZE AND TYPE OF BIT: 3" SS HAND AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: NA
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: -
16. DATE HOLE: STARTED 9-16-96; COMPLETED 9-16-96
17. ELEVATION TOP OF HOLE: 18.2'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Sand; fine-med, black to brown. 10YR 2/1 to 5/3 Silty - 30-35% well sorted dry	-	1	OVA, ppm: 0 Lab
	1.0		As above. wet.		2	0 Lab.
	2.0		E.O.B. = 2.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-HA05

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: PDO/1310 (PDO)
2. LOCATION (Coordinates or Station): SAV, GA.
3. DRILLING AGENCY: NA
4. HOLE NO. (As shown on drawing title and file number): PDO-HA05
5. NAME OF DRILLER: NA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 2.0'
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 2.0'
10. SIZE AND TYPE OF BIT: 3" SS HAND AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: NA
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 9-16-96; COMPLETED 9-16-96
17. ELEVATION TOP OF HOLE: 18.7'
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1.0		Sand: fine-med; Gray to black 10YR 6/1 to 2/1 Well sorted dry to wet (6") Silty - 25%-30%		1	OVA, PPm 140 Lab
	2.0		As above: black 10YR 2/1 wet to saturated.		2	>1000 Lab
	3.0		E.O.B. = 2.0'			
	4.0					
	5.0					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-HA06

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS
1. PROJECT PDO/1310 (PDO)		10. SIZE AND TYPE OF BIT 3" SS HAND AUGER	
2. LOCATION (Coordinates or Station) SAV. GA-		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY NA		12. MANUFACTURER'S DESIGNATION OF DRILL NA	
4. HOLE NO. (As shown on drawing title and file number)	PDO-HA06	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5	UNDISTURBED 0
5. NAME OF DRILLER NA		14. TOTAL NUMBER CORE BOXES —	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER —	
7. THICKNESS OF OVERBURDEN 5.0'		16. DATE HOLE STARTED 9-16-96	COMPLETED 9-16-96
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE 18.0' ±	
9. TOTAL DEPTH OF HOLE 5.0'		18. TOTAL CORE RECOVERY FOR BORING — %	
		19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1.0		Sand: Reddish yellow to strong Brown to Black 7.5YR 6/6 - 4/6 to 2.5/1 fine to med well sorted dry silty - 25%		1	OVA, ppm 2.5 Lab
	2.0		1.5' - clay: Lt gray - Yellow - gray 10YR 7/1 - 7/8 - 5/1 Low - med plasticity increasing sand 15% to 30% with depth dry		2	1.5
	3.0				3	ϕ
	4.0		As above moist		4	ϕ
	5.0		Sand: white - very pale brown - light gray 10YR 8/1.8/3 7/1 Fine to med well sorted wet silty. 20%		5	~~OVA-PPM~~ ϕ/10 LAB.
			E.O.B - 5.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-HA07

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT	PDO/1310 (PDO)
2. LOCATION (Coordinates or Station)	SAV, GA
3. DRILLING AGENCY	NA
4. HOLE NO. (As shown on drawing title and file number)	PDO-HA07
5. NAME OF DRILLER	NA
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	5.0'
8. DEPTH DRILLED INTO ROCK	NA
9. TOTAL DEPTH OF HOLE	5.0'
10. SIZE AND TYPE OF BIT	3" SS HAND AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	NA
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	—
16. DATE HOLE	STARTED 9-16-96 / COMPLETED 9-16-96
17. ELEVATION TOP OF HOLE	18.3'
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1.0		Sand: Reddish Yellow to Stg Br to Blk. 7.5YR 6/6-4/6-2.5/1 fine to med well sorted dry silty - 15-20%		1	OVA, PPm 0 Lab
			As Above		2	.5
	2.0		Clay: Lt. gray - Yellow - gray 10YR 7/1-7/8-5/1 Low-Med plasticity increasing sand 15%-30% with depth		3	1.5
	3.0		dry			
	4.0		As Above		4	5.5
	5.0		Sand: white - very pale br - lt. gray 10YR 8/1-8/3-7/1 Fine to med - well sorted wet silty - 15-20%		5	7.0 Lab
			E.O.B - 5.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT HOLE NO.

Hole No. PDO-HA08

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT	PDO/1310 (PDO)
2. LOCATION (Coordinates or Station)	SAV. GA.
3. DRILLING AGENCY	NA
4. HOLE NO. (As shown on drawing title and file number)	PDO-HA08
5. NAME OF DRILLER	NA
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	5.0'
8. DEPTH DRILLED INTO ROCK	NA
9. TOTAL DEPTH OF HOLE	5.0'
10. SIZE AND TYPE OF BIT	3" SS HAND AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	NA
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	—
16. DATE HOLE	STARTED 9.16.96 / COMPLETED 9-16-96
17. ELEVATION TOP OF HOLE	19.1'
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Sand: Reddish Yellow- to Blk 7.5YR 6/L-2.5/1 Fine-med well sorted dry silty. 20%		1	OVA, PPM 0 Lab
	1.0		As Above		2	0
	2.0		Clay: Ltgray-Yellow-gray 10YR 7/1-7/2.5/1 Low-Mod Plasticity increasing sand with depth 15%-30% dry		3	0
	3.0		As above		4	.5
	4.0		As above moist		5	1.5 Lab
	5.0		Sand: white-very pale brown. lt. gray 10YR 8/1-8/3 7/1 Fine-Med. Well sorted silty 15% wet			
			E.O.B. 5.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG FORM ... PROJECT HOLE NO.

Hole No. PDO-HA08

DRILLING LOG	DIVISION SAV.	INSTALLATION WAAF	SHEET 1 OF 1 SHEETS

1. PROJECT	PDO/1310 (PDO)
2. LOCATION (Coordinates or Station)	SAV. 6A.
3. DRILLING AGENCY	NA
4. HOLE NO. (As shown on drawing title and file number)	PDO-HA08
5. NAME OF DRILLER	NA
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	3.0'
8. DEPTH DRILLED INTO ROCK	—
9. TOTAL DEPTH OF HOLE	3.0'
10. SIZE AND TYPE OF BIT	3" HAND AUGER SS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	NA
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 3 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	—
16. DATE HOLE	STARTED 9-16-96 / COMPLETED 9-16-96
17. ELEVATION TOP OF HOLE	19.4'
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		Sand; Lt gray-Black 10YR 7/1-2/1 Fine-Med well sorted dry silty (10%)		1	OVA, PPM 0 Lab
	1.0		As Above Moist		2	0
	2.0		Sand; ~~Black~~ Black 10YR-2/1 Fine Med well sorted Clayey (15%) wet.		3	0 Lab
	3.0		E.O.B. 3.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT HOLE NO.

Hole No. PDO-HA10

DRILLING LOG	DIVISION SAV	INSTALLATION WAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: PDO/1310 (PDO)
2. LOCATION (Coordinates or Station): SAV. 6A
3. DRILLING AGENCY: NA
4. HOLE NO. (As shown on drawing title and file number): PDO-HA05
5. NAME OF DRILLER: NA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 3.0'
8. DEPTH DRILLED INTO ROCK: -
9. TOTAL DEPTH OF HOLE: 3.0'
10. SIZE AND TYPE OF BIT: 3" SS HAND AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: NA
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 9-16-96; COMPLETED 9-16-96
17. ELEVATION TOP OF HOLE: 19.1'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: Thomas Deal

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1.0		Sand: Black 10YR 2/1 Fine-Med, sub'rd Well Sorted dry Silt-15%		1	OVA, PPM ϕ Lab
	2.0		As above moist		2	ϕ
	3.0		As Above wet		3	ϕ Lab
	4.0					
	5.0					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

FILE FORM | PROJECT | HOLE NO.

Hole No. PDO-SB1

DRILLING LOG	DIVISION SAV.	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: PDO/1310 PDO
2. LOCATION (Coordinates or Station): SAV 6A
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB1
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 15.0'
8. DEPTH DRILLED INTO ROCK: Ø
9. TOTAL DEPTH OF HOLE: 15.0'
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5; UNDISTURBED Ø
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 8/14/96; COMPLETED 8/14/96
17. ELEVATION TOP OF HOLE: 16.8'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphris

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		GRAVEL & SAND: fine-med. silty 25%, Gray 7.5YR 5/1 Poorsorting. damp. ← Gray 5Y 5/1, firm, sand (GP) (SM)	Post Hole +0.5'	1	Blows 3" Spoons 1535 Lab 14/6 OVA 1 ppm HS: 25 BZ=0
	2		SAND: fine-med; Gray 5Y 6/1; silty 25%, wellsorted, moist-wet, loose-firm tr. glauconite (SM)	79	2	8-11-12-14 ISAE Lab ✱ undisturbed sample HS=25 BZ=0
	4		as above, clay 10% - 2mm balls. loose. wet (SM)	58	3	2" Spoons 6-7-9-7 HS=NA BZ=0
	6		Cuttings as above	—	—	Auger
	8		SAND: med-fine, Reddish 7.5YR 6/6 silty 30%, wellsorted. v-loose. wet (SM)	50	4	4-6-6-6 BZ=0
	10		Cuttings as above - runny sands	—	—	Auger
	12		: dk gray 5Y 4/1, silty 30% as above (SM)	75	5	5-7-7-5
	14		E.O.B. @ 15.0'			
	16					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG FORM ... PROJECT ... HOLE NO.

Hole No. PDO-SB02

DRILLING LOG	DIVISION: SAV	INSTALLATION: HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: PDO/1310 PDO
2. LOCATION (Coordinates or Station): SAV 6A
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB02
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBUROEN: 15.0'
8. DEPTH DRILLED INTO ROCK: Ø
9. TOTAL DEPTH OF HOLE: 15.0'
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5; UNDISTURBED Ø
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 8/15/96; COMPLETED 8/15/96
17. ELEVATION TOP OF HOLE: 18.1'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphus

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	OVA ppm
	0					BLOWS	
			Gravel + Sand: Lt. Yel Brn 10YR 6/4, silty-clayey 30%, loose-firm, dry, poor sorting (GC/GM)	67	1	5-16-9-6 0814 Lab 3" spoons	HS-1.5 BZ-0
	2		SAND: med-fine, v. Pale Br 10YR 7/3, silty/clayey 25%, firm-v. firm, moist-wet at bottom, well sorted. (SC) (SM) tr. mica + glauconite	71	2	12-17-20-22 0830 Lab x initial wet sample	HS-22 BZ-0
	4		: as above, less silty 10% (SM)	71	3	5-7-7-6 2" spoons	BZ-0
	6		Cuttings as above	—	—	Auger	
	8		: Yell 10YR 7/6, silty 10%, tr. mica, tr. glauconite, well sorted, wet, v. base-loose (SW)	71	4	4-7-10-8	BZ-0
	10		Cuttings as above, runny sands	—	—	Auger	
	12		Same as above (SW)	50	5	4-7-6-4	BZ-0
	14		E.O.B. @ 15.0'				
	16						

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

END DRILL | PROJECT | HOLE NO

Hole No. PDO-SB03

DRILLING LOG	DIVISION: SAV	INSTALLATION: HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT	HAAF PDO/1310
2. LOCATION (Coordinates or Station)	SAV 6A
3. DRILLING AGENCY	PSI
4. HOLE NO. (As shown on drawing title and file number)	PDO-SB03
5. NAME OF DRILLER	K. Durham
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	15.0'
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	15.0'
10. SIZE AND TYPE OF BIT	4¼" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 5 / UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 8/15/96 / COMPLETED 8/15/96
17. ELEVATION TOP OF HOLE	17.0'
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	D. Humphus

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	OVA, ppm
	0		Concrete: 6"				
			SAND: med-fine; 5YR 7/6, silty, 10%, well sorted, damp, loose-firm, tr. glauconite + mica (SW)	77	1	13 blows 3" spoons 1000 lab Drive 18" 7-12-12	HS = 0 BZ = 0
	2		: Pink to 7.5YR 6/1 to LtBr by 4Br mottling, clay 20%, loose (SW)	75	2	6-8-8-8 1015 lab = initial wet sample	HS = 60 BZ = 0
	4		CLAY - sandy 35%, dry, plastic, firm (CL)				
			as above	75	3	2" spoons 3-6-9-16	HS = NA BZ = 0
	6		SAND: med-fine, Yell 2.5Y 8/6, silty 5% well sorted, tr. glauc. + mica (SW)				
			cuttings as above	—	—	↑ Auger ↓	
	8		CLAY: 10YR 5/6 Yell Br, plastic, sandy 20% (CL) stiff.	83	4	9-12-9-8	BZ = 0
			SAND: med-fine, white 10YR 8/1, well sorted, silty 5%, tr. glauconite + mica (SW)				
	10		cuttings mix of clay + sand	—	—	↑ Auger ↓	
	12		as above 2" clay layer - Gray 2.5Y 5/1	50	5	8-11-8-7	BZ = 0
	14		E.O.B. @ 15.0'				
	16						

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG FORM | PROJECT | HOLE NO

Hole No. PDO-SB04

DRILLING LOG	DIVISION: SAV	INSTALLATION: HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: HAAF 1310/PDO
2. LOCATION (Coordinates or Station): PDO SAN GA
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB04
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 10'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 10.0'
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 8/15/96; COMPLETED 8/15/96
17. ELEVATION TOP OF HOLE: 17.2'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphus

ELEVATION a	DEPTH b	LEGEND	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		GRAVEL + SAND: Black 10YR 2/1, poorsorting, damp. (GC) firm-v.firm.	75	1	Blows 1125 / OVA, ppm 3" spoons / HS 1.5 17-22-19-17 / BZ=0
	2		SAND: med-fine, Yell-Br 10YR 5/4 to dk Gy - 4/1 wellsorted, damp, silty 20%. (SM)			
	4		: Gy Br 10YR 5/2, silt 10% wet wellsorted, v.loose (SW)	58	2	3" spoon / ∇ initial wetsample 1140 3-3-3-5 / HS: 2.5 BZ=0
			clay - Woodpieces, Gy Br, sandy 40% plastic, soft, moist (CL)			
	6		Rootroot SAND · clayey 35%, med-fine, wellsorted wet. Gy Br 10YR 5/2 (SC)	80	3	2" spoons 7-9-9-5 / BZ=0
			As above	—	—	↑ Auger ↓
	8		: as above, clayey 30% (SC)			5-4-7-8 / BZ=0
	10		clayey clay 5%, Lt. Gy 10YR 7/2, wellsorted wet, loose, fine sand + mica. (SW)	80	4	
			E.O.B. @ 10.0'			
	12			—	—	
	14				5	NA
	16					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-SB05

DRILLING LOG	DIVISION	INSTALLATION	SHEET / OF / SHEETS
	SAV	HAAF	

1. PROJECT: PDO / 1310
2. LOCATION (Coordinates or Station): SAV 6A
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB05
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 10.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 10.0
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 8/15/96; COMPLETED 8/15/96
17. ELEVATION TOP OF HOLE: 17.7'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphries

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	2		SAND: med-fine; v. dk gy Br 10YR 4/2, tr. gravel, silty 20%, poor sorting, damp, v. loose-firm. (SM)	79	1	Blows / 3" spoons / 6-11-16-13 — 1415 — OVA, ppm: HS: 8, BZ: 0
	4		dk yell Br 10YR 4/4, gy 5/1 mottling, silty 35%, dry, wet at bottom, (SM)	79	2	1426 — HS: 22, BZ: 0 — 6-11-12-13
	6		SAND: med-fine; Lt Br Gy 10YR 6/2, clayey 10-30%, wet, loose, well sorted, tr. glauconite + mica, massive. (SC/SM)	58	3	2" spoons / 6-6-5-6 — Initial wet sample — BZ: 0
	8		Cuttings as above	—	—	↑ Auger ↓
	10		SAND: med-fine, Lt Gy 10YR 7/2, well sorted uniform, tr. glauconite, silty 5%, v. loose-loose. wet. (SW)	50	4	3-5-7-4 — BZ: 0
	12		E.O.B. @ 10.0' bgs	—	—	
	14				5	NA
	16					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-SB06

DRILLING LOG

DIVISION: SAV
INSTALLATION: HAAF
SHEET 1 OF 1 SHEETS

1. PROJECT: PDO/1310 PDO
2. LOCATION (Coordinates or Station): SAV 6A
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB06
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBUROEN: 10.0'
8. DEPTH DRILLED INTO ROCK: Ø
9. TOTAL DEPTH OF HOLE: 10.0'
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVERBUROEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 8/16/96; COMPLETED 8/16/96
17. ELEVATION TOP OF HOLE: 16.1'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphris

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	2		SAND: med-fine, v.dk Gy 10YR 3/1, dk yel Br - 4/6 mottling, coal pieces, silty 20% fr. gravel, poor sorting, loose-firm, dry (SM/SP)	100	1	BLOWS 3" spoons 8-11-15-13 12.58 lb OVA, ppm HS = 3 BZ = 0
	4		Lt. Gy 10YR 7/1, well sorting, wet, fr. glauconite + mica, silty 5% loose-firm, massive. (SW)	63	2	9-18-18-19 13:05 Lab ▽ water level wet sample HS = 5 BZ = 0
	6		as above, Gy 10YR 5/1, silty 15% (SM)	88	3	2" spoons 8-12-13-12
	8		runny sands	—	—	↑ Auger ↓
	10		as above. silt 5-10% (SW)	25	4	5-7-15-17 BZ=0
			E.O.B. @ 10.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT HOLE NO.

Hole No. PDO-SB07

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT	PDO / 1310 PDO
2. LOCATION (Coordinates or Station)	SAV. 6A
3. DRILLING AGENCY	PSI
4. HOLE NO. (As shown on drawing title and file number)	PDO-SB07
5. NAME OF DRILLER	K. Durham
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	10.0'
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	—
16. DATE HOLE	STARTED 8/16/96 / COMPLETED 8/16/96
17. ELEVATION TOP OF HOLE	16.1'
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	D. Humphus

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	2		SAND: med-fine, yellBr 10YR 5/6 to v.dk. GyBr 3/2 well sorted, silty 10-25%, damp, firm. (SM)	75	1	Blows 1365 Lab OVA, HNU 3" spoons HS=0 12-13-14-15 BZ=0
	4		as above. Gy 10YR 6/1, silty clayey 20%-30%, well sorted. wet at bottom loose-firm (SM/SC)	75	2	5-10-11-12 1400 Lab HS=18 BZ=0
	6		: Lt YellBr -6/4 + Gy -6/1 mottling v.loose-loose (SM/SC) CLAY: Gray 5Y5/1, plastic, sandy 20% (CL)	50	3	2" spoons ∇ initial wet sample 5-5-3-4
	8		as above, sand/clay mix	—	—	Auger
	10		CLAY: Gy 5Y5/1, plastic, sandy 20%, (Fat) (CL) SAND: Gray, clayey 10-30% wet (SC)	90	4	3-5-5-7 BZ=0
			E.O.B. @ 10.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-SB08

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: PDO 11310 PDO
2. LOCATION (Coordinates or Station): SAV 6A
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB08
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 10.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 10.0'
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 8/16/96; COMPLETED 8/16/96
17. ELEVATION TOP OF HOLE: 16.2'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphries

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		SAND: dk Br 10YR 3/3; wet-fine - silty 20% (SM)	83	1	BLOWS 3" spoons 1510 OVA ppm 8-15-17-20 HS - NA BZ = 0
	2		COAL: dry, sand in it. No Sample taken			
	4		SAND: wet-fine, GyBr 5YR 5/2, silty 20% well sorted, loose-firm. wet at bottom (SM)	67	2	5-7-11-11 1525 HS = 4.5 BZ = 0 x mixture wet sample
	6		: as above. Lt Br/Gy 10YR 6/2. tr. glauconite. v. loose-firm. wet massive. (SM)	75	3	2" spoons 4-9-7-11 BZ = 0
	8		Cuttings as above	—	—	
	10		: Gray 5Y 5/1, well sorted, as above (SM) CLAY: fat, plastic, sandy 10% (CL)	83	4	3-11-3 BZ = 0
	12		E.O.B. @ 10.0' bgs			
	14					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG FORM ... PROJECT HOLE NO.

Hole No. PDO - SB09

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT	PDO/1310
2. LOCATION (Coordinates or Station)	SAV 6A
3. DRILLING AGENCY	PSI
4. HOLE NO. (As shown on drawing title and file number)	PDO - SB09
5. NAME OF DRILLER	K. Durham
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	10.0'
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	—
16. DATE HOLE	STARTED 8/16/96 / COMPLETED 8/16/96
17. ELEVATION TOP OF HOLE	16.5'
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	D. Humphris

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0					RCOWS / OVA, ppm
			SAND: med-fine, tr gravel, black 10YR 2/1 to yellow-7/6 to 5/1 brown, dry, loose-firm (SP) silty 20%	88	1	3" spoons 1600 HS= 14 10-11-10-7 BZ=0
	2		: as above.			
				58	2	5-6-6-9 1615 HS= 100 BZ=0
			SAND: Gray 10YR 5/1, wet, well sorted (SW) silty 10%.			
	4		: as above			2" Spoons
				25	3	5-6-7-5 BZ=0
	6		Cuttings as above	—	—	Auger
	8		as above, clay at 20%			3-6-6-8 BZ=0
			(SC)	75	4	
	10		E.O.B. @ 10.0' bgs			
	12					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

END FORM PROJECT HOLE NO.

Hole No. PDO-SB10

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: PDO/1310
2. LOCATION (Coordinates or Station): SAV 6A
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB10
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 10.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 10.0'
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 8/12/96; COMPLETED 8/12/96
17. ELEVATION TOP OF HOLE: 16.2'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphus

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		SAND: med-fine; V.dk. 6/1Br 10YR 3/2, silty 20% well sorted, dry. (SM)	92	1	BLOWS / 3" spoons / 23-16-22-22; 0735 Lab; OVA, ppm; HS- 3.5; BZ- 0
			gravel + coal			
	2		SAND: Lt.Gy - 7/2, well sorted, silty 5% dry (SW) v.firm			
			: as above, wet, loose-firm. tr. glauconite, tr. mica. (SW)	67	2	0740 Lab; 6-12-14-12; HS- 5.0; BZ- 0
	4		: Lt.Olive Gy 5Y 6/2, clayey 25%, roots (SC)	90	3	2" spoons; 3-4-5-3; BZ- 0
			v.thin beds clay, sandy 40% (CL)			initial wet sample
	6		V. Soft drilling, clayey sand mix	—	—	Auger
			v.clayey			
	8		CLAY: interbedded sand thinbeds top 1/2 plastic, firm-stiff, Lt-med Br 10YR 6/4 to Gy 5Y 5/1. CL	100	4	8-11-8-9; BZ=0
	10		E.O.B. @ 10.0' bgs			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT | HOLE NO.

Hole No. PDO-SB11

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: PDO/1310
2. LOCATION (Coordinates or Station): SAV GA
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB11
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 10.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 10.0'
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4 | UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 8/17/96 | COMPLETED 8/17/96
17. ELEVATION TOP OF HOLE: 16.5'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphries

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–2		SAND: dk olive Br 2.5Y 3/3 to Pale Yell -7/3. med-fine, 10% gravel, 10% clay. sand is well sorted, dry, firm-v firm, tr. glauconite. (SP)	90	1	BLOWS 3" spoons 0810 Lab; 17-21-18-20; OVA, ppm: HS - 9.0, BZ - 0
	2–4		: med-fine; Lt. Yell Br 2.5Y 6/3, well sorted, silty 5-10%, tr. glauconite + mica, wet. (SW)	63	2 ▽ initial wet sample	5-13-16-15 0820 Lab; HS - 31, BZ - 0
	4–6		: as above, v. loose-loose (SW); 4" clay layer, sandy 40%, low plastic (SW)	71	3	2" spoons 3-9-9-10; BZ - 0
	6–8		Cuttings sand w/clay mix	—	—	Auger
	8–10		SAND: med-fine, Br-Yell 10YR 6/8, well sorted, silt 10%, tr. glauconite + mica, wet, v. loose; ← Gray - 6/1. (SW)	75	4	3-4-3-4; BZ - 0

E.O.B @ 10.0' bgs

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO - SB12

DRILLING LOG	DIVISION	INSTALLATION	SHEET / OF / SHEETS
	SAV	HAAF	

1. PROJECT: PDO / 1310
2. LOCATION (Coordinates or Station): SAV 6A
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB12
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 10.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 10.0'
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 8/17/96; COMPLETED 8/17/96
17. ELEVATION TOP OF HOLE: 17.1'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humple

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		SAND: med-fine, v.dk gy br 10YR 3/2, well sorted dry, silty 10% (SW)	63	1	Bcows 3"spoons 0913 Lab; OVA, ppm HS-3.5 BZ-0; 3-26-9-9
	2		Coal & Gravel			
			CLAY: Gy 10YR 5/1 Sandy 40%, plastic (CL) as above			
	4		SAND: med-fine, v.pale Br 10YR 7/3, well sorted, wet at bottom, silty 20-10%, tr. glauconite firm. (SM)	63	2	3-9-11-11 0920 Lab; HS-22 BZ-0; * Initial wet sample
			as above, silty 5-10%, v.loose-loose (SW)	71	3	4-5-4-5 BZ-0
	6		-clayey 30-50% (SC)			
	8		Cuttings mix of sand + clay	—	—	↑ Auger ↓
			SAND: mostly Yell 10YR 7/6, med-fine, well sorted, wet, v.loose-loose, silty 5-10%, tr. glauconite + mica. (SW)	83	4	0-4-7-6 BZ-0
	10					
			E.O.B. @ 10.0' bgs			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT HOLE NO.

Hole No. PDO-SB13

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT	PDO/1310
2. LOCATION (Coordinates or Station)	SAV 6A
3. DRILLING AGENCY	PSI
4. HOLE NO. (As shown on drawing title and file number)	PDO-SB13
5. NAME OF DRILLER	K Durham
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	10.0'
8. DEPTH DRILLED INTO ROCK	Ø
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	—
16. DATE HOLE	STARTED 8/17/96 / COMPLETED 8/17/96
17. ELEVATION TOP OF HOLE	16.1'
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	D. Humphris

ELEVATION a	DEPTH b (ft)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		COAL + Br. sand, grass			Blows 955 lab / OVA, ppm
	2		SAND: med-fine, YrgBr 10YR 5/6 to Gy-bl, clayey 25%, dry, loose-firm, well sorted (SC)	88	1	3"spoons 6-14-20-14 / HS- 3 / B2-0
	4		: Gy-bl, clayey 20-40%, wet sorted loose-firm, wet., tr. glauconite + mica (SC)	75	2	1005 6-11-11-8 lab / HS- 55 / B2-6
	6		: Lt Gy 10YR 7/2, well sorted, silty 5-10%, fr. glauconite + mica. Yellow 10YR 7/6 (SW)	75	3	initial wet sample 2"spoons 0-4-5-6 / B2= 0
	8		Cuttings as above	—	—	Auger
	10		as above Gy 10YR 5/1. (SW)	71	4	4-4-4-5 / B2= 0
			E.O.B. @ 10.0' bgs			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO - SB14

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: PDO/130
2. LOCATION (Coordinates or Station): SAV 6A
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-SB14
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 10.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 10.0'
10. SIZE AND TYPE OF BIT: 4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED 3
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: —
16. DATE HOLE: STARTED 8/17/96; COMPLETED 8/17/96
17. ELEVATION TOP OF HOLE: 16.5'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphrey

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		SAND: med-fine: v.dk gy br 10YR 3/2, silty 20% dry, firm-v.firm	75	1	Blows Lab OVA ppm 3" spoons HS-3 13-17-17-25 BZ-0
			Coal + gravel			
	2		SAND: med-fine; Yell Br 10YR 5/8, well sorted, silty 25 (SM)			
			: as above, clayey 20% at top, wet	80	2	initial sample 1250 Lab HS=26 7-15-20-12 BZ-0
	4		- clayey 5%, well sorted, loose - firm. (SW)			
			CLAY: GY 10YR 6/1, sandy 30%, plastic. (CL)	92	3	2" spoons 2-4-6-9 BZ=0
	6		SAND: GY, med-fine, well sorted, loose, silty 10% (SW)			
			Cuttings mixed sand/clay	—	—	↑ Auger ↓
	8		SAND: med-fine, Br-yel 10YR 6/6, tr. banding w/thin clay laminae, clay 5-20%, well sorted, wet, v.loose-loose. (SW/SC)	50	4	4-4-8-8 OZ=0
	10		E.O.B. @ 10.0' bgs			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG FORM _____ PROJECT _____ HOLE NO. _____

Hole No. PDO-SB15

DRILLING LOG	DIVISION	INSTALLATION	SHEET / OF / SHEETS
	SAV	HAAF	

1. PROJECT	PDO/1310
2. LOCATION (Coordinates or Station)	SAV GA
3. DRILLING AGENCY	PSI
4. HOLE NO. (As shown on drawing title and file number)	PDO-SB15
5. NAME OF DRILLER	K. Durham
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	10.0'
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	4 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	—
15. ELEVATION GROUND WATER	—
16. DATE HOLE	STARTED 8/17/96 / COMPLETED 8/17/96
17. ELEVATION TOP OF HOLE	17.1'
18. TOTAL CORE RECOVERY FOR BORING	— %
19. SIGNATURE OF INSPECTOR	D. Humphrey

ELEVATION a	DEPTH b (ft)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			SAND: med-fine, v. dk gy/dk yellowish br 10YR 3/2, well sorted, silty 20% (SM)	75	1	Blows 1320 OVA/PPM 3" spoons Lab HS = 1.5 12-17-10-6 BZ = 0
	2		Coal, Gravel, wood Sand as above CLAY: Gray 10YR 5/1, low plastic, sandy 30% (CL)			
			: as above, moist, tr. glauconite tr. mica. (CL)	58	2	Lab HS = 5 2-4-4-9 BZ = 0
	4		: as above. v. soft-firm. (CL) - 2" sand - wet	92	3	2" spoons Initial wet sample 2-6-4-3 BZ = 0
	6		SAND - Gray - 5Y 5/1, clayey 40%, wet. (SC)			
			Cuttings clay/sand mix	—	—	↑ Augor ↓
	8		CLAY + SAND - gy 10YR 5/1 SAND: med-fine, Pale Yell 2.5Y 7/3, well sorted, silty 10%, tr. glauconite + mica, wet, v. loose - loose (SW)	100	4	4-4-6-5 BZ = 0
	10		E.O.B. @ 10.0' bgs			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG FORM _____ PROJECT _____ HOLE NO. _____

Hole No. PDO-MW01

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT 1310/PDO PDO	10. SIZE AND TYPE OF BIT 6 1/4" ID HSA
2. LOCATION (Coordinates or Station) SAV. GA	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY PSI	12. MANUFACTURER'S DESIGNATION OF DRILL CME 75
4. HOLE NO. (As shown on drawing title and file number) PDO-MW01	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED 0
5. NAME OF DRILLER K. Durham	14. TOTAL NUMBER CORE BOXES —
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN 13.0'	16. DATE HOLE: STARTED 8/26/96; COMPLETED 8/26/96
8. DEPTH DRILLED INTO ROCK 0	17. ELEVATION TOP OF HOLE 17.7'
9. TOTAL DEPTH OF HOLE 13.0'	18. TOTAL CORE RECOVERY FOR BORING — %
	19. SIGNATURE OF INSPECTOR D. Hunnicutt

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0					BLOWS / OVA, ppm
			SAND: med-fine, black 10YR 2/1 to YellBr 5/8 tr. gravel, silty 10-20%, well sorted dry, firm-v.firm. tr. glauconite+mica. (SM)	71	1	3" spoons 1ft: 13-22-17-15 / HS - 0.5, BZ - 0
	2					
			as above, clayey 10-20%, v. loose - loose. wet (SC)	63	2	3-9-9-6 1ft / HS - 2.0, BZ - 0
	4					☒ initial wet sample
			; as above: clayier 25-30% less clay 10-20% (SC)	75	3	2" spoons 1ft: 4-9-11-10 / ☒ in well at install / HS - NA, BZ - 0
	6					
			Cuttings as above	—	—	Auger
	8					
			; Lt. Gy 10YR 7/1, thin clay laminae. clay matrix 5-10%, well sorted. loose, wet. SW/SC	71	4	6-9-8-5 Geotech / BZ - 0
	10					
			Cuttings as above. runny sands	—	—	Auger
	12					BZ = 0
			E.O.B. @ 13.0' bgs			
	14					
	16					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-MW02

DRILLING LOG	DIVISION SAN	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS
1. PROJECT 1310/PDO PDO		10. SIZE AND TYPE OF BIT 6 1/4" ID HSA	
2. LOCATION (Coordinates or Station) SAN 6A		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY PSI		12. MANUFACTURER'S DESIGNATION OF DRILL CME 75	
4. HOLE NO. (As shown on drawing title and file number) PDO-MW02		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4	UNDISTURBED 0
5. NAME OF DRILLER K. Durham		14. TOTAL NUMBER CORE BOXES —	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN 14.0'		16. DATE HOLE STARTED 8/26/96	COMPLETED 8/26/96
8. DEPTH DRILLED INTO ROCK 0		17. ELEVATION TOP OF HOLE 17.8'	
9. TOTAL DEPTH OF HOLE 14.0'		18. TOTAL CORE RECOVERY FOR BORING — %	
		19. SIGNATURE OF INSPECTOR D. Humphus	

ELEVATION a	DEPTH (Ft blg)	LEGEND (Ft elg)	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		SAND: mud-fine; v.dk gy 10YR 3/1 to Blk 2/1, dry, loose-v. firm, tr. gravel, poor sorted, silty 20% + tr. coal (SP/SM)	75	1	BLOWS/3" SPOONS 7-30-26-19 OVA, ppm HS - 1.5 BZ - 0
	2		: Lt. Br Gy-6/2 to Blk-2/1, well sorted silty 10%, v. loose - loose (SW) Blk - silty - 20%, damp. (SM)	63	2	3-4-6-6 1ft HS - 50 BZ - 0
	4		: blk 2/1 - silty 10%, damp, v. loose-firm, well sorted, - Lt. Br Gy - 6/2, well sorted, silty 5% tr. glauconite, mica. (SW/SM)	63	3	3-4-7-11 1ft HS - 56 BZ - 0 ∓ initial wet sample
	6		Cuttings as above	—	—	Auger ∓ in well at install
	8		- Gy 10YR 5/1, well sorted, silty 5-10% wet, tr. glauconite mica. (SW)	25	4	2' spoon 9-9-10-9 Bedrock BZ - 0
	10		Cuttings as above, runny sands	—	—	Auger
	12					
	14		E.O.B. @ 14.0' bgs			
	16					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG FORM _____ PROJECT _____ HOLE NO. _____

Hole No. PDO - MW03

DRILLING LOG	DIVISION SAV.	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT 1310/PDO
2. LOCATION (Coordinates or Station) SAV 6A
3. DRILLING AGENCY PSI
4. HOLE NO. (As shown on drawing title and file number) PDO - MW03
5. NAME OF DRILLER K. Durham
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN 13'
8. DEPTH DRILLED INTO ROCK 0
9. TOTAL DEPTH OF HOLE 13'
10. SIZE AND TYPE OF BIT 6 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES —
15. ELEVATION GROUND WATER
16. DATE HOLE: STARTED 8/26/96; COMPLETED 8/26/96
17. ELEVATION TOP OF HOLE 17.5'
18. TOTAL CORE RECOVERY FOR BORING — %
19. SIGNATURE OF INSPECTOR D. Humphus

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0					BLOWS / OVA, ppm
	2		SAND: med-fine; mostly v dk gy Br 10YR 3/2 tr. gravel+rock, silty 10-25%, dry, firm-dense, poor sorting (SM/SP)	71	1	3" spoons 11-28-38-28 16b; HS - 2.0 BZ - 0
	4		: med-fine; dk gy to v.dk.gy 10YR 4/1-3/1 moist; well sorted; loose-v.loose, silty 5-15% (SM/SW)	63	2	5-5-5-3 Lab; HS - 0.5 BZ - 0
	6		: dk gy - 4/1; wet, tr. roots. clay 5-15%, v. loose. (SW/SC)	67	3	▽ initial wet sample 2-2-2-5; HS - 0 BZ - 0
	8		Cuttings as above	—	—	▽ in well at install ↑ Auger ↓
	10		: Lt. Olive Gy 5Y 6/2, clayey 10-30% v.loose-loose. (SC) - lesser clayey 5% - well sorted tr. thin laminae, tr. glauconite (SW)	63	4	2" spoon 2-5-5-4 Grotech; BZ - 0
	12		Cuttings as above.	—	—	↑ Auger ↓ BZ = 0
	14		E.O.B @ 13.0'			
	16					
	18					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. PDO-MW04

DRILLING LOG	DIVISION SAV.	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: 1310 / PDO PDO
2. LOCATION (Coordinates or Station): SAV 6A
3. DRILLING AGENCY: PSI
4. HOLE NO. (As shown on drawing title and file number): PDO-MW04
5. NAME OF DRILLER: K. Durham
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 19.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 19.0'
10. SIZE AND TYPE OF BIT: 6 1/4" ID HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 8/27/96; COMPLETED 8/27/96
17. ELEVATION TOP OF HOLE: 26.0'
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphus

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	2		SAND: med-fine. Br 10YR 4/3 to Lt Gy 7/2 well sorted, dry, v.loose-loose. silty 5% tr. glauconite. (SW)	75	1	BLOWS 3" spoons Lab 3-6-9-9 OVA, ppm HS - 0.1 BZ - 0
	4		: as above; Lt Gy 7/2, v.loose-firm. wet. (SW) – clayey 10%-20% (SC)	75	2	3-6-9-17 Lab & similar wet sample perched? HS - 7.5 BZ - 0
	6		: Yel Br 10YR 5/4 + Lt Gy mottling, clayey 25-30%, well sorted, loose, mica (SC) CLAY - sandy 35%, Lt-Br Gy 10YR 6/2, plast: moist. (CL)	79	3	2" spoons 10-9-7-10 HS - NA BZ - 0
	8		Cuttings mix of clay + sand	—	—	↑ Auger ↓ & in augers @ TD 17' (7.2' bgs)
	10		CLAY as above, moist (CL)	42	4	4-5-6-7 BZ = 0
	12		Cuttings mix of clay + sand	—	—	↑ Auger ↓
	14		SAND: Yel Br 10YR 5/6, clayey 15%, wet well sorted, loose, tr. glauconite – clayey 35% (SC)	58	5	5-9-8-5 & wet sample BZ=0
	16		as above.	75	6	2-1-2-1
	18		Cuttings as above.	—	—	↑ Auger ↓ BZ=0
	20		E.O.B. @ 19.0' bgs			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

END DEPTH | PROJECT | HOLE NO.

Hole No. MW-5

DRILLING LOG | DIVISION SAV. | INSTALLATION HAAF | SHEET 1 OF 1 SHEETS

1. PROJECT: Hunter CTM
2. LOCATION (Coordinates or Station): PDO
3. DRILLING AGENCY: Piedmont
4. HOLE NO. (As shown on drawing title and file number): MW05
5. NAME OF DRILLER: Don Young
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 16.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 16.0'
10. SIZE AND TYPE OF BIT: 6 1/4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: Acker AD II
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 8 | UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 7/21/98 | COMPLETED 7/21/98
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphrey

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	PD	CONC-			Blows / OVA, ppm
	2		SAND- fine-med, br 7.5YR 4/2, silt 10% (SM) clayey (SC) 30% black 7.5YR 2.5/1 dry.	100	Hand auger	NA / BZ- 0, HS- 5
	4		SAND: fine-med, ol.gn to black silty 20%. dry (SM)	100	Hand auger	NA / HS-6 1100
	6		: as above, mostly black 7.5YR 2.5/1 v. loose. (SM)	100	3	3-3-4-3 / HS-6 1120
	8		: as above Pink 6y 7.5YR 6/2 to gy-5Y1. micaceous, tr. glauconite, silty - wet 20% v.loose - v firm. (SM)	100	4	2-18-25-2 Lab ↑ ± in wet of install ± in tube wet sample. / HS-6 BZ=0 1140
	10		: as above: Ltgy 10YR 7/2 to gy yr -5Y2. wet, silty 10-20%, tr. glauconite, v loose firm. (SM)	13/24 54	5	3-8-11-10 Geotech / HS-3 1155
	12		: as above, br. 10YR 5/3. v. loose loose, mica, tr. glauconite. (SM)	100	6	4-7-9-10 / HS-4 1203 BZ=0
	14		: fine-med, dkgy 5Y4/1, silty 3 clayey 3" 10%. clayey 10% wet v. loose-dense (SC/SM)	48	7	3-10-13-21 / HS-2 1224
	16		: as above, v. loose-loose silty 10% (SM)	100	8	2-2-3-7 Lab / HS-5 1227
			E.O.B. @ 16.0'			
	18					
	20					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT | HOLE NO.

Hole No. MW06

DRILLING LOG | DIVISION SAV. | INSTALLATION HAAF | SHEET 1 OF 1 SHEETS

1. PROJECT: Hunter CTM
2. LOCATION (Coordinates or Station): PDO
3. DRILLING AGENCY: Piedmont
4. HOLE NO. (As shown on drawing title and file number): MW06
5. NAME OF DRILLER: D. Young
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 16.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 16.0'
10. SIZE AND TYPE OF BIT: 6 1/4" ID / 2 3/4" ID pilot hole
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: Acker AD II
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 8 | UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 7/21/98 | COMPLETED 7/22/98
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: 0 %
19. SIGNATURE OF INSPECTOR: D. Humphrey

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
	2		SAND: fine-med, tr. gravel, dk 6yBr 10YR 4/2, silty 25%, dry, tr. coal (SM)	hand auger	1	BLOWS: NA	OVA, ppm: HS-3, B2-0, 1650
	4		: as above: Gy 10YR 5/1 & yell. br 5/4 mottling, silty 30%, tr. gravel (SM)	hand auger	2	N/A	HS-2, 1655
	6		SAND: fine-med-v. dk Gy 10YR 3/1, dry, v. loose, silty 25% (SM)	100	3	3-3-3-4 Lab	HS-4, 1713
	8		: as above, clayey 40%, dk 6yBr. -4/2. v. loose-loose. ← wet (SC)	51	4	3-5-5-8 ⊻ at install; ⊻ initial wet sample 7/22/98	HS-2, B2-0, 1720
	10		: as above Gy 2.5Y 6/1, mica, clayey 25%, v. loose-loose. wet thin clay laminae. tr. glauconite (SC)	54	5	2-5-5-4	HS-4, B2-0, 715
	12		: as above, no laminae silty 20% clayey 1" (SM)	75	6	2-3-4-5 Geotech	HS-4, 725
	14		: as above, tr. organic roots (SM)	54	7	2-3-3-6	HS-100, 740, w/filter-100
	16		: as above. clayey 10-20% thin laminae. loose-firm, wet. (SC)	58	8	6-7-11-15 Lab	HS-100, 755, w/filter-100
	18		E.O.B. @ 16.0'				
	20						

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT | HOLE NO.

Hole No. MW07

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 1 SHEETS

1. PROJECT: Hunter LTM
2. LOCATION (Coordinates or Station): PDO
3. DRILLING AGENCY: Piedmont
4. HOLE NO. (As shown on drawing title and file number): MW07
5. NAME OF DRILLER: D. Young
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 14.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 14.0'
10. SIZE AND TYPE OF BIT: 2 1/4" pilot 6 1/4" ID well
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: Acker AD11
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 7; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 7/23/98; COMPLETED 7/23/98
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: 0 %
19. SIGNATURE OF INSPECTOR: D. Humphs

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	2		SAND: fine-med- dk gy 10YR 4/1 to dk. brgy-6/2, tr gravel, silty 20% - clayey 30% v dk gy 6ley 3/N SP	hand auger	1	BG 0-2.5 NA OVA, ppm HS: 3,2 BZ=0
	4		as above, tr roots, fine-med clayey 10-30% (SC)	hand auger	2	NA HS-2 1528
	6		: fine-med- black 5Y 2.5/1, well sorted, silty 10-30%, tr. mica v. loose. (SM)	67	3	4-2-3-3 Lab 1528 HS-9,9
	8		: as above v.loose-loose. - GY 5Y5/1, tr glauconite (SM)	71	4	1-2-10-9 ☒ initial wet sample and well install. HS=2 BZ=0
	10		: as above, well sorted, silty 10-20% tr. glauconite + mica. fine-med v. loose-loose (SM)	71	5	7-7-3-3 HS-0
	12		: DK gy -6/1, tr wood, tr thin clay laminae. v. loose. (SM)	58	6	2-2-4-3 Geotech HS-3
	14		: as above, (SM)	100	7	3-3-3-5 Lab HS-11,2
			E.O.B. @ 14.0'			

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT HOLE NO.

Hole No. MW08

DRILLING LOG | DIVISION SAV. | INSTALLATION HAAF | SHEET 1 OF 1 SHEETS

1. PROJECT: Hunter LTM
2. LOCATION (Coordinates or Station): PDO
3. DRILLING AGENCY: Piedmont
4. HOLE NO. (As shown on drawing title and file number): MW08
5. NAME OF DRILLER: B. Lynch
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 14.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 14.0'
10. SIZE AND TYPE OF BIT: 2 1/4 ID pibt / 6 1/4 ID well
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: Acker AD II
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 7 | UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 7/28/98 | COMPLETED 7/28/98
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Hemplo

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
	0-2		SAND: fine-med 1 dk yell Br 10YR3/6, silty 20%, uniform, dry (SM)	hand auger	1	BLOWS: NA	OVA, ppm: HS=0, BZ=0
	2-4		as above - lt. Br 6Y 10YR 6/2, tr glauconite, dry (SM)	hand auger	2	NA	HS=0
	4-6		: as above, tr. mica, v. loose-loose well sorted, silty 10-20% tr glauconite moist (SM)	71	3	5-4-6-7 Lab; ▽ 1 hr well @ 12 hr	HS-0
	6-8		: as above, wet - 6Y 10YR 5/1 v. loose, loose clayey 10-20%, silty 10% (SM/SC)	88	4	4-7-5-8 ▽ initial wet sample	HS-0, BZ=0
	8-10		as above, tr-thin clay laminae silty 20%, v. loose-loose - clayey 30% - lt gy 10YR 4/1 (SM)	79	5	3-3-3-6 Geotech	HS-0
	10-12		Bluish Gy Gley 5/1, tr. roots silty 20%, v. lose-lose, well sorted, tr mica + glauconite. (SM)	58	6	2-3-6-9	HS-0
	12-14		: as above, (SM)	38	7	3-4-10-10 Lab	HS-1
	14		E.O.B. @ 14.0'.				
	16						
	18						
	20						

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT | HOLE NO.

Hole No. MW09

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 2 SHEETS
1. PROJECT Hunter LTM		10. SIZE AND TYPE OF BIT 7-1/4 ID pilot / 6-1/4 ID well	
2. LOCATION (Coordinates or Station) PDO -		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY Piedmont		12. MANUFACTURER'S DESIGNATION OF DRILL Acker AD II	
4. HOLE NO. (As shown on drawing title and file number) MW09		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED	UNDISTURBED 0
5. NAME OF DRILLER B. Lynch		14. TOTAL NUMBER CORE BOXES —	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN 35.0'		16. DATE HOLE STARTED 7/24/98	COMPLETED 7/29/98
8. DEPTH DRILLED INTO ROCK 0		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 35.0'		18. TOTAL CORE RECOVERY FOR BORING — %	
		19. SIGNATURE OF INSPECTOR D. Humphris	

ELEVATION a	DEPTH (Ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
	0		SAND: fine-med, v.dk gy 10YR 3/1, gravelly silty 25%, moist (SM)	hand auger	1	Blows / NA	OVA, ppm / HS: 0 BZ=0
	2		CLAY, sandy 30% (CL)				
			SAND: as above, no gravel black 10YR 2/1 (SM)	hand auger	2	NA	HS - 0
	4		No Recovery - drive spoon 3 times	0	3	3-3-3-4	HS - NA
	6		CLAY: dk yel brn 4/4, sandy 35%, plastic, v.soft-firm, to gy br 5/2 (CL)	54	4	1-2-7-8 Initial wet sample — Lab	HS - 1
	8		SAND: mod-fine, ltgy 10YR 7/1, silty 20% wet (SM)				
			as above, v.loose-loose tr. glauconite, well sorted, wet silty 10-20% (SM)	50	5	3-3-5-5	HS - 45, 22 BZ=0
	10		: as above, v.pale Br-8/2 to gy 5/1 (SM)	58	6	3-3-2-5	HS - 20, 25
	12		: buby Clay 5/10Y, tr. thinclay/laminae, wet, tr. glauconite + mica, well sorted, v.loose-loose. (SM)	67	7	3-5-7-8	HS - 200 1/100 BZ=0
	14		: as above (SM)	71	8	2-3-6-9	HS - 40, 80
	16		: as above: no clay laminae, mostly med. sand (SM)	52	9	6-4-8-4	HS - 15, 10
	18		: as above, (SM)	67	10	10-5-2-4	HS - 30, 22
	20		: as above (SM)	100	11	1-1-1-1 — Lab	HS - 3, 2 BZ=0
	22		CLAY - sandy - 30%, med plastic thin sand laminae, moist (CL)				
			SAND: as above	100	12	1-1-6-13	HS - NA
	24		CLAY - v. plastic, wet, sand 10% v. loose-firm				
			SAND - med-coarse, (SC)				
			CLAY - SAND - CLAY - SAND - Mt. clays/sands 3-4' as above thinbedding (SC CL)	83	13	6-10-15-20 — Geotech	HS - NA
	26						

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | **Hole No.** MW09

PROJECT: Hunter LTM | INSTALLATION: HAAF | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH 26 b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
						BLOWS	OVA, ppm
	28		SAND - mostly med, tr. coarse & fines, silty 10-20%, clay 5/1 gy, well sorted, wet, loose-v.firm. tr glauconite (SM)	71	14	8-14-23-28	HS - NA BZ=0
	30		: as above: loose-firm uniform (SM)	100	15	18-8-10-13	HS - NA
	32		No sample recovered (running sands)	0	16	20-30-50/4	HS - NA
	34		SAND: as above, loose-firm (SM)	50	17	10-8-12-14	
	36		E.O.B. @ 35.0'			Augr	
	38						
	40						

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

Hole No. MW10

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 2 SHEETS

1. PROJECT: Hunter LTM
2. LOCATION (Coordinates or Station): PDO -
3. DRILLING AGENCY: Piedmont
4. HOLE NO. (As shown on drawing title and file number): MW10
5. NAME OF DRILLER: D. Young
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 34.0'
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 34.0'
10. SIZE AND TYPE OF BIT: 2 1/4" ID HSA pilot; 6 1/4 ID well
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: Acker AD II
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 17; UNDISTURBED 9
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 7/22/98; COMPLETED 7/22/98
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphries

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0					BLOWS / OVA 1ppm
	2		SAND: fine-med- black 10YR 2/1, coal gravel silty 20%, dk gy 7.5YR 4/2. (SM)	hand auger	1	NA / 1242 HS-2 BZ-0
	4		: pinkish gy 7.5YR 6/2 to black 2.5/1, as above. (SM)	hand auger	2	NA / 1300 HS=7
	6		: as above black 2.5/1 to dk gy 4/1, silty 20%, v. loose, tr. wood (fill material) (SM)	75	3	2-2-2-3 / Lab / HS-9 1310
	8		: Lt. Br Gy 10YR 6/2, well sorted, silty 10%, tr. glauconite, loose-firm (SM)	63	4	9-9-12-9 ≡ at install ∑ in field wet sample / HS-3 1320 BZ=0
	10		: Gy - 6/1, tr. gley laminae thru, at bottom, silty 10%, v. loose-loose, wet, tr. mica. (SM)	67	5	2-1-1-5 / HS=3 1330
	12		as above, v. loose-firm. Gy 2.5Y 5/1 (SM)	63	6	4-9-15-14 / HS=1 1335
	14		: Gy as above, v. loose- v. firm. (SM)	67	7	4-7-10-21 / w/filter 5 / HS=7 BZ=0 1340
	16		: as above, v. loose-loose. - clayey 2" (SM)	83	8	4-2-5-7 / w/filter 20 / HS=20 1350
	18		: fine-med; Gy 2.5Y 5/1, well sorted, silty 20%-10%, tr. glauconite mica, v. loose-loose. (SM)	71	9	3-4-4-8 / 1400 / HS=32 BZ=0
	20		: fine-coarse, as above (SM)	100	10	3-5-2-7 / Lab / HS=20 1405
	22		CLAY: sandy 20-40%, Gy 2.5Y 5/1 med-plastic, v. soft. (CL)	88	11	1-1-1-2 / Geotech / HS=8 1417
	24		: as above, v. soft-stiff SAND: fine-coarse, clayey thinlaminae, 30-40% (SC)	50	12	1-1-4-9 / HS=4 1427 BZ=0
	26		: DK Gy 4/N Gley, fine-med silty 10-20%, v loose-firm. wet tr. mica + glauconite. (SM)	50	13	4-11-14-17 / HS=5 1440

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | **Hole No.** MW10

PROJECT: Hunter LTM | INSTALLATION: HAAF | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	26		SAND: as above, v. loose-firm fine-med, silty 10-20% V. lt gy Gley 3/N (SM)	30	14	BLOWS 3-2-3-12 1450 OVA, ppm HS- 9 w/filter BZ=0 also
	28		: fine-mostly coarse, silty 10-20%, Gn Gy Gley 5/1	79	15	10-18-17-23 HS- 7
	30		: as above, tr. gebble	50	16	0-3-17-24 HS- 20
	32		as above	75	17	4-10-19-23 HS- 7 BZ=0
	34		E.O.B. @ 34.0'			
	36					
	38					
	40					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

PROJECT | HOLE NO.

Hole No. MW11

DRILLING LOG	DIVISION SAV	INSTALLATION HAAF	SHEET 1 OF 2 SHEETS

1. PROJECT: Hunter CTM
2. LOCATION (Coordinates or Station): PDO
3. DRILLING AGENCY: Piedmont
4. HOLE NO. (As shown on drawing title and file number): MW 11
5. NAME OF DRILLER: D. Young
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 35.6
8. DEPTH DRILLED INTO ROCK: Ø
9. TOTAL DEPTH OF HOLE: 35.0'
10. SIZE AND TYPE OF BIT: 2½ ID split / 6¼ ID for well
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: Acker AD11
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13 | UNDISTURBED Ø
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 7/23/98 | COMPLETED 7/31/98
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: D. Humphries

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	2		SAND; fine-med; black 10YR 2/1, coal 30% silty 10-30% - LtBr by - 6/2 - well sorted, tr glauconite dry (SM)	hand auger	1	BLOWS NA 1014 OVA: ppm HS-6, 4 BZ-0
	4		Mix of above - coal gone - black 10YR 2/1, well sorted, silty 10-30% dry (SM)	hand auger	2	NA Lab 1020 HS-9, 8
	6		as above, v. loose-loose. silty 10-30% black, dry SM	38	3	3-4-5-6 1001 HS-1
	8		as above, tr. gravel, v. loose, dry SM	33	4	3-3-4-4 ▽ in well at install HS-1 1052 BZ-0
	10		: fine-med, 6yBr 10YR 5/2, well sorted silty 10-30%, tr mica + glauconite wet, v. loose-loose SM	30	5	5-5-4-5 ▽ in fluid wet sample HS-1 1057
	12		: as above, tr wood, wet, v. loose. (SM) tr. glauconite 6y-5/1 - clayey 20-30% (SC)	50	6	4-3-3-4 HS-2 1104
	14		: as above, 6y-5/1, well sorted silty 10%, uniform, tr mica + glauconite, loose, wet (SM)	42	7	5-10-5-9 1120 HS-7,7
	16		: as above, v. loose-loose - loose-med, tr. pebble (SM)	71	8	3-5-7-9 1127 HS-8,7 BZ-0
	18		: fine-med; GY-5/1, silty 10-20% v. loose-loose. wet (SM)	100	9	3-5-10-9 1137 HS-7,7
	20		: as above, well sorted, silty 10-20% fine-med. 6y-5/1. uniform SM	100	10	3-6-2-2 1148 HS-2
	22		: as above (SM) CLAY: med plastic, sandy 30-40% (CL)	100	11	1-2-2-3 Lab HS-1
	24		SAND as Above 6y 10YR 5/1 (SM) CLAY - Sandy 30-40, 6y-5/1 (CL)	100	12	1-1-2-2 HS-NA BZ-0
	26		: as above. (CL) SAND - fine-med, 6y-5/1, well sorted silty 10% v. loose-loose (SM) tr MICA + glauconite.	100	13	2-9-14-15 geotech 6" Casing Set to 25'

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG. FORM ... | PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | **Hole No.** MW 11

PROJECT: Hunter LTM | INSTALLATION: HAAF | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH 26 b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	28		SAND: med-coarse, dk by Gley 4/N, tr thin clay laminae, firm, wet, silty 10% well sorted. (SM)	88	14	Blows begin 7/31/98 OVA, ppm 13-13-16-16 mud rotary BZ=0 6" bit
	30		as above, tr. clay thin bed, poor sorting clay 40% tr pebble loose-firm. (SC) (SM)	90	15	6-5-9-16
	32		SAND: coarse-med, tr. pebbles, dk by Gley 4/1, well sorted, silty 10%, wet, loose v. firm. (to SW SM)	63	16	6-11-20-22 BZ=0
	34		as above, tr gravel, loose-dense 3" 3" clay layers (SP)	83	17	6-13-32-43
				—	—	mud drill
	36		E.O.B. @ 35.0'			
	38					
	40					

Split-spoon samples for lithologic definition and/or chemical analysis were collected from 3 to 5 feet below ground surface (BGS) and every 5 feet or lithologic change thereafter (unless otherwise noted).

ENG FORM | PROJECT | HOLE NO.

APPENDIX C
TOPOGRAPHIC SURVEY

HUNTER ARMY AIRFIELD
SUBSURFACE ASSESSMENT
PDO YARD
SAVANNAH, GEORGIA

MONITOR WELL	N-COORD	E-COORD	TOC	BOC	GROUND
MW01	740077.60	818195.51	20.44	17.7	17.7
MW02	740083.69	818106.43	20.76	17.9	17.8
MW03	740036.02	818060.24	20.25	17.5	17.3
MW04	739656.52	818044.86	29.09	26.2	26.0
*MW05	740101.60	818043.25	20.21	17.5	17.5
*MW06	740169.63	818121.30	21.22	18.5	18.3
*MW07	740179.57	818201.73	21.27	18.5	18.4
*MW08	740111.13	818246.68	21.32	18.4	18.3
*MW09	740162.43	818107.97	20.93	18.2	18.1
*MW10	740104.70	818075.26	20.39	17.7	17.6
*MW11	740061.20	818129.53	20.78	18.0	17.9
MW1-19	739909.68	818245.52	21.03	19.6	19.6
MW1-20	739961.14	818028.96	21.67	19.3	18.1
MW1-21	739874.25	817937.44	17.73	16.2	16.2
MW1-22	740057.60	817925.36	19.20	NA	16.6
MW1-23	739941.87	818155.72	20.06	17.7	17.7
MW1-24	740049.24	818134.68	19.61	17.4	17.4
MW1-25	740156.84	818115.23	20.33	NA	18.1

SOIL BORING	N-COORD	E-COORD	GROUND
SB01	739828.02	817956.16	16.8
SB02	739842.18	818067.52	18.1
SB03	739903.16	818051.54	17.0
SB04	740001.58	818146.58	17.2
SB05	739926.64	818138.74	17.7
SB06	739855.90	817889.05	16.1
SB07	739881.06	817899.41	16.1
SB08	739907.32	817925.75	16.2
SB09	739930.51	817951.03	16.5
SB10	739886.56	817926.24	16.2
SB11	739910.28	817954.10	16.5
SB12	739935.46	817979.70	17.1
SB13	739863.60	817921.71	16.1
SB14	739888.33	817951.24	16.5
SB15	739912.70	817979.33	17.1

HUNTER ARMY AIRFIELD
SUBSURFACE ASSESSMENT
PDO YARD
SAVANNAH, GEORGIA

HAND AUGER	N-COORD	E-COORD	GROUND
HA01	739822.93	818118.58	20.4
HA02	739892.65	818198.53	20.3
HA03	739966.60	818059.55	17.7
HA04	739951.08	818212.45	18.2
HA05	739939.00	818176.52	18.7
HA06	739923.98	818143.75	18.0
HA07	739913.26	818138.43	18.3
HA08	739877.62	818159.63	19.1
HA09	739891.63	818174.53	19.4
HA10	739917.86	818201.68	19.1

HYDRO PUNCH	N-COORD	E-COORD	GROUND
HP01	739891.01	818104.13	17.9
HP02	739852.79	818017.32	17.3
HP03	739996.56	818214.85	18.8
HP04	740075.63	818200.45	17.7
HP05	740137.18	818182.09	17.9
HP06	740141.83	818072.94	18.1
HP07	740087.65	818130.66	17.8
HP08	740062.64	818053.35	17.9
HP09	740011.18	818084.88	17.9
HP10	739859.55	818176.47	20.9

SURFACE WATER SAMPLE	N-COORD	E-COORD	GROUND
SE/SW01	740299.94	818360.76	8.0
SE/SW02	740090.65	817910.94	7.6
SE/SW3	739924.57	817714.86	7.7□

APPENDIX D

RISK BASED CORRECTIVE ACTION IMPLEMENTATION PLAN

RISK-BASED CORRECTIVE ACTION IMPLEMENTATION PLAN
FOR THE
RCRA FACILITY INVESTIGATION
AT THE
OLD PDO YARD

HUNTER ARMY AIRFIELD, GEORGIA

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1.0 INTRODUCTION

This Risk-Based Corrective Action (RBCA) Implementation Plan has been developed to outline risk assessment activities for the old PDO Yard at Hunter Army Airfield (HAAF), Savannah, Georgia. The airfield is a subinstallation of nearby Fort Stewart which maintains a RCRA Part B permit issued under the Georgia Hazardous Waste Management Act. The risk assessment activities are designed to evaluate the need for corrective actions necessary to manage actual or potential releases from the PDO Yard. Risk assessment activities for the RFI will be performed at The PDO Yard using recent guidance from the State of Georgia, *Georgia Environmental Protection Division Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units* (Georgia EPD 1996), which was developed to implement on a state level the concepts of risk- based corrective action proposed by EPA in RCRA Subpart S *(55, Federal Register,* 30798; 61, *Federal Register, 19432).*

1.1 SCOPE AND OBJECTIVES OF THE RBCA IMPLEMENTATION PLAN

This plan defines the procedures for assessing the risk to human health and the environment, and identifies methods for calculating site-specific remediation levels under RCRA for the PDO Yard. Methods and milestones for both human health and ecological assessment are outlined.

1.2 SCOPE AND OBJECTIVES OF THE PDO YARD RFI RISK ASSESSMENT

An assessment of potential human and ecological risk will be performed at the PDO Yard during the RFI field activities. Field data will be used to identify the chemicals and areas of concern (COPCs) at the site. A baseline risk assessment (BRA) for human receptors and preliminary risk evaluation (PRE) for ecological receptors will be performed to identify the need for corrective action or further assessment.

The scope of a human health risk assessment at the PDO Yard is to identify and evaluate all potentially complete exposure pathways of concern and evaluate any completed source→pathway→receptor scenario. This involves identifying COPCs, pathways of concern , exposure scenario type (industrial, residential), and location of actual and potential human receptors that may be exposed. The human health risk assessment will be performed under the general State guidance (Georgia EPD, 1996), EPA guidance (EPA 1989a, 1989b, and 1992), and supplemental guidance provided by EPA Region 4 (1996a).

The scope of the ecological risk assessment (ERA) at the PDO Yard is to characterize the risk to ecological receptors, focusing primarily on animals in terrestrial and aquatic environments, resulting from potential chemical exposure. The ERA will be performed according to Georgia EPD guidance (Georgia EPD 1996) and EPA guidance (EPA 1996b and 1997c). The ERA will evaluate potential ecological effects by conducting a Preliminary Risk Evaluation (PRE). Additional investigation into the types of ecological receptors including threatened or endangered

species protected under the Endangered Species Act (DOI 1973) will be performed if the PRE indicates an unacceptable level of risk exists.

2.0 DATA ANALYSIS AND BACKGROUND SCREENING

As part of a field investigation, only data that are collected, verified, and validated according to the Quality Assurance Program Plan (QAPP), will be used for this assessment. Data are reviewed and screened to identify site-related chemicals. The following sections present the process through which the data are reviewed and compared to background concentrations.

2.1 INITIAL DATA REDUCTION

The data set used in the risk assessment will consist of sample results verified and validated using methodology described in the QAPP. Data qualified during the validation as rejected data ("R") will be evaluated for their usability. Data determined to be unusable will be clearly identified and excluded from the data set.

Detection limits achieved during sample analysis will be reviewed to ensure that required detection limits have been met. Typically, detection limit requirements are established to ensure that characterization has occurred to levels that are low enough to determine if chemicals are present at hazardous levels. These levels are chemical-specific and related to each chemical's toxicity. Required detection limits are presented in the QAPP. In some cases recommended detection limits cannot be achieved by a laboratory, e.g., if matrix or chemical interference requires that a sample be diluted. Elevated detection limits that exceed 10 times the required detection limit may be excluded from the risk assessment data set.

2.2 BACKGROUND CHARACTERIZATION

A major step in assessing data is to distinguish between chemicals that are likely related to past waste storage practices and those that may be naturally occurring or "background" level. Data collected up-gradient of expected contamination will be used to define background levels for the risk assessment.

2.3 BACKGROUND COMPARISON

Background surface soil, surface water, sediment, and groundwater quality will be assessed during the RFI. Background samples will enable M&E to distinguish between naturally occurring and site-related inorganic elements. Where possible, background sampling locations have been selected in areas which are located hydraulically up-gradient of the PDO Yard. The background soil and groundwater sampling locations are within close proximity to the PDO Yard and therefore should be representative of natural conditions. Although the background surface water and sediment locations are up-gradient of the PDO, upstream activities at the Installation may affect surface water and sediment quality.

Each background soil, groundwater, surface water, and sediment sample collected during the RFI will be analyzed for volatile organic compounds by Environmental Protection Agency (EPA) method 8260, semi-volatile organic compounds (SVOC) by EPA method 8720, TPH by EPA methods 8100M and 8015M (Diesel Range Organics - DRO, and Gasoline Range Organics - GRO, respectively), and priority pollutant metals by EPA methods 6000/7000. Gross alpha and beta radiation by EPA method 900.0/9310 will also analyzed in soil and sediment samples (Phase I samples only). The radiological parameter samples will be collected to assess any possible effect of past coal storage in the PDO Yard area on soil quality.

Results will be compared to the chemical-specific background location concentrations. Inorganic analytes with no detection greater than two times the background concentration will be considered naturally occurring and not related to past waste disposal activities at the site.

2.4 WEIGHT-OF-EVIDENCE SCREENS

Because of inherent problems in applying a single background criterion to data sets that have different characteristics, an additional screening step will be applied to the data after they have been subjected to the background screen. This screening step is referred to as a weight-of-evidence screen; that is, multiple types of evidence are considered to determine whether a chemical is site-related or naturally occurring. This screen will be applied to chemicals that, based upon review of the sampling results, should be more carefully scrutinized because of site-specific issues that need to be addressed. For example, naturally occurring metals may be present in concentrations near the analytical detection limits, making it difficult to evaluate, or a chemical may not have site-related background concentrations, therefore, other data may be used to evaluate if the concentrations are within normal background ranges. The weight-of-evidence screens that will be used to further evaluate the data are described below.

Site-related chemicals may not be screened out during comparison to background because some metals occur naturally in the environment at levels that are near analytical detection limits. This situation will need to be evaluated if and when it occurs. Because the single background location is not comprised of a statistically-based mean concentration, it is possible to observe occasional detections above the criteria that are still within the range of background. A review of the analytes with a low frequency of detection above the background criteria will be performed. If a single detection is greater than the background concentration or the chemical is detected at levels that are only slightly above the background screening value, the chemical will be evaluated as to whether it is significantly above background or within the expected range of variation of the data set. In this case, the standard of twice the background concentration will be applied to evaluate the significance of the detected concentration.

3.0 HUMAN HEALTH ASSESSMENT

The methods for assessing human health concerns for the PDO Yard RFI is derived primarily from recent Georgia EPD guidance (Georgia EPD 1996) and the *Supplemental Guidance to RAGS: Region 4 Bulletin Human Health Risk Assessment* (EPA 1996a).

Figure D-1 summarizes the general process for assessing risk and selecting remedial levels for human receptors, as illustrated in the Georgia EPD guidance (1996). This process is similar to earlier EPA methods for assessing risks at Comprehensive Environmental Response, Conservation, and Liability Act (CERCLA) sites. The process is divided into three primary phases:

- Step 1 - Compare analytical data to screening values and determine if there are COPCs at a site.
- Step 2 - Evaluate baseline risk for COPCs.
- Step 3 - If target risk/hazard levels are exceeded in the baseline risk assessment, select chemicals of concern (COCs) and derive remedial levels based on complete and potential future pathways.

The following sections summarize the risk assessment work to be performed at the PDO Yard.

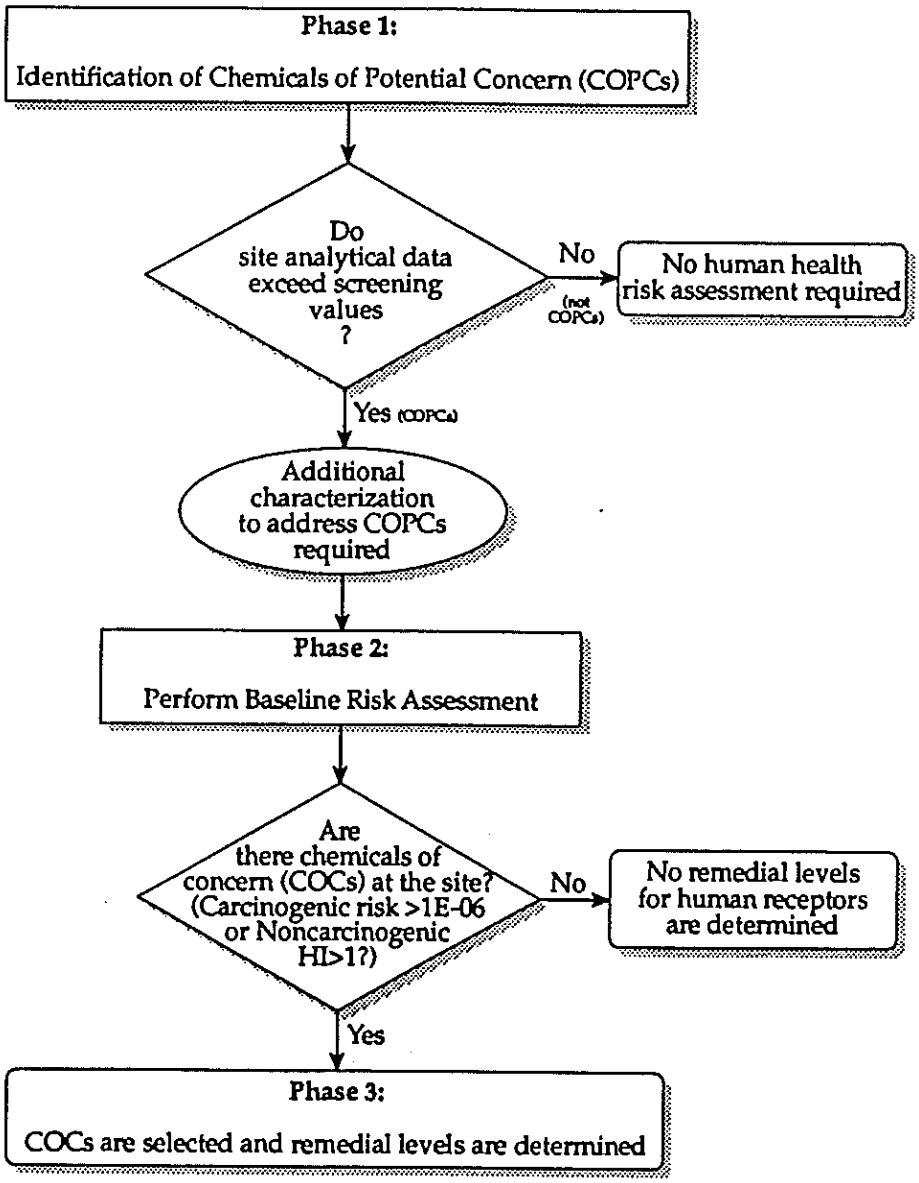
3.1 STEP 1: SCREENING FOR CHEMICALS OF POTENTIAL CONCERN

The purpose of risk evaluation screening is to identify the COPCs and areas of concern (AOCs) at a site, and possibly identify sites for which no further action is needed. The first step in the risk process uses screening levels that are easily obtainable and, due to their conservative nature, can be used with a high degree of confidence to indicate sites for which no further action is required.

The screening process is similar to the ASTM (ASTM 1995) Tier 1-type risk screen. The screen involves the following stages:

- For inorganics, identify chemicals that are present at concentrations greater than two times the average background levels (see Section 2.2). All confirmed organic COPCs are evaluated with respect to screening criteria.
- Identify potential migration and exposure pathways associated with the site and identify potential exposures scenarios.
- Identify risk-based screening levels for each contaminant detected at least once above background levels at each site.
- Compare site-related concentrations to screening levels to determine if any COPCs exist at the site.

Georgia EPA Guidance for Identifying Human Health Risks



*Adapted from Georgia EPD guidance for selecting media remediation levels at RCRA SWMUs

FIGURE D-1

3.1.1 Screening Levels

Table 1 and **Table 2** provide screening levels for soil, sediment, groundwater and surface water that will be used during the PDO Yard for evaluating COPCs. These levels have been taken from the following sources:

- Soil screening levels developed by EPA (EPA , 1994);
- Soil and groundwater risk-based concentrations developed by EPA Region 3 (EPA Region 3, 1996);
- Federal drinking water MCLs for groundwater;
- Georgia EPD Instream water quality standards for surface water; and
- EPA Region 4 Waste Management screening values for surface water and sediment (EPA Region 4, 1995b).

The EPA Soil Screening Guidance (EPA, 1994) provides two options for selecting soil values that address protection of groundwater. One value assumes no contaminant dilution or attenuation would occur between the soil and groundwater; a second value assumes a 20 fold dilution-attenuation factor (DAF). For COPC screens at the PDO Yard, a DAF of 20 will be selected for organic constituents and a DAF of 1 will be used for inorganic parameters consistent with EPA and EPD guidance. The more conservative DAF will be used because of the relatively shallow depth to groundwater and permeable soil type at the site. Soil screening levels based on ingestion of surface soil are also considered.

The screening levels for the PDO Yard RFI risk assessment reflect a residential land use scenario. The exposure scenarios used in the residential-based levels are: incidental ingestion and dermal contact. Applying a residential exposure scenario typically results in an overstatement of the risk to receptors because of the conservative assumptions used to develop residential screening criteria. This, along with the use of conservative screening criteria, should maximize protection to current and potential future populations.

The absence of risk-based concentration levels is generally a result of (1) the chemical not being considered to be toxic except perhaps at extremely high concentrations (e.g., aluminum, sodium, etc.), (2) no dose-response data indicate a toxic effect; or (3) the EPA is currently reviewing toxicity information and no reference dose or cancer slope factor currently is available; as is the case for lead.

TABLE 1

SCREENING CRITERIA FOR THE EVALUATION OF SOIL AND SEDIMENT AT THE PDO YARD

CONTAMINANT	EPA Region 3 (1)		EPA Soil Screening Levels for Migration to Groundwater (organics use a DAF of 20) (inorganics use a DAF of 1) (2)	Background Concentrations		Ecological EPA Region 4 Sediment Screening Values (3)	EPA Region 4 Recommended Ecological Screening Value for Soil (4)
UNITS	Industrial Risk-Based Concentration (mg/kg)	Residential Risk-Based Concentration (mg/kg)	(mg/kg)	Soil (PDO-MW04 avr.) (mg/kg)	Sediment PDO-SE01 (mg/kg)	(mg/kg)	(mg/kg)
INORGANICS							
ARSENIC (as a carcingen)	3.8	0.43	1	<1.1	<1.1	7.24	30
BARIUM	14,000	550	82	-	-	-	400
CADMIUM	100	3.9	0.40	<0.58	<0.71	1	5
CHROMIUM (VI) *	613.2	23.5	2	3.35	3.6	52.3	250
COPPER	8,200	310	-	<2.8	<3.6	18.7	100
LEAD	400**	400**	-	4.2	16	30.2	150
MERCURY (inorganic)	61	2.3	0.1	0.028	0.079	0.13	2
NICKEL	4,100	156	7	-	-	15.9	100
SELENIUM	1,000	39	0.3	-	-	-	-
SILVER	1,000	39	2	<0.12	<1.4	2	-
ZINC	61,000	2,300	620	3.6	100	124	500
VOLATILE ORGANICS							
ACETONE	20,000	780	16	<0.056	<0.071	-	-
CARBON DISULFIDE	20,000	780	32	-	-	-	-
ETHYLBENZENE	20,000	780	13	-	-	-	-
METHYLENE CHLORIDE	760	85	0.02	<0.0056	-	-	-
TETRACHLOROETHYLENE	110	12	0.06	-	-	-	-
TOLUENE	41,000	1,600	12	-	<0.0071	-	-
TOTAL XYLENES	100,000	16,000	190	-	-	-	-
TRICHLOROFLUOROMETHANE	61,000	2,300	-	-	-	-	-
SEMIVOLATILE ORGANICS							
BENZO(a)ANTHRACENE	7.8	0.88	2	-	-	0.33	-
BENZO(a)PYRENE	0.78	0.088	8	-	-	0.33	1
BENZO(b)FLUORANTHENE	7.8	0.88	5	-	-	-	-
BENZO(g,h,i)PERYLENE	-	-	-	-	-	-	-
BENZO(k)FLUORANTHENE	78	8.8	49	-	-	-	-
BIS(2-ETHYLHEXYL)PHTHALATE	410	46	3,600	-	-	0.182	-
CHRYSENE	780	88	160	-	-	-	-
FLUORANTHENE	8,200	310	4,300	-	<0.47	0.33	10
INDENO(1,2,3-c,d)PYRENE	7.8	0.88	14	-	-	0.33	-
2-METHYL NAPHTHALENE***	4,088	156.4	84	<0.37	-	0.33	5
NAPHTHALENE	4,088	156.4	84	-	-	0.33	5
PHENANTHRENE	-	-	-	-	-	0.33	5
PYRENE	6,100	230	4,200	-	<0.47	0.33	10

Note: Residential and Industrial RBC values for chromium (VI), naphthalene, and nickel were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.
(-) - No level is listed
* RBCs for Chromium VI are used as screening criteria although only total Chromium analyses were performed on soil and sediment samples.
** From EPA Office of Solid Waste, Directive on Risk Assessment and Cleanup of Residential Soil Lead
*** Screening criteria for naphthalene is used for 2-methyl naphthalene based on similar structure/ activity relationship.
(1) EPA Region 3 Risk-Based Concentrations (R.L. Smith, September 1996) based on a HQ = 0.1 and a 1 in 1,000,000 cancer risk
(2) EPA OSWER Soil Screening Guidance, EPA 540/R-95/041, July 1996. SSLs for organics are based on a DAF of 20, noncancer hazard quotient of 1 and cancer risk of 1 in 1,000,000. SSLs for inorganics are based on a DAF of 1, noncancer hazard quotient of 1 and cancer risk of 1 in 1,000,000. Generic SSLs used where available.
(3) EPA Region 4 Office of Technical Services, Supplemental Guidance to RAGS, Table 3 (Draft)
(4) US EPA Memorandum from Ted W. Smith, 12-22-98, Ecological Risk Assessment at Military Bases. Based on US Fish and Wildlife Service values for moderate soil contamination which requires additional study.

TABLE 2

CRITERIA FOR EVALUATION OF CONTAMINANTS IN GROUNDWATER AND SURFACE WATER SAMPLES

CONTAMINANT UNITS	Human Health EPA Region 3 Risk-based Concentrations (tap water) (1) ug/L	Federal Drinking Water MCL ug/L	Background (Groundwater) PDO-MW04 ug/L	GA EPD IWQS (2) ug/L	Ecological EPA Region 4 Freshwater Surface Water Screening Values (3) Acute (ug/L)	 Chronic (ug/L)	Background (Surface water) PDO-SE01 ug/L
INORGANICS							
ARSENIC	0.045	50	<30	0.14	360	90	<10
BARIUM	260	2000	30	-	-	-	30
BERYLLIUM	7.3	4	<4	-	16	0.53	<4
CADMIUM	1.8	5	<5	0.7	1.79	0.66	<10
CHROMIUM (VI)*	10.9	100	<10	120	16	11	<10
COPPER	150	1,300	<26	12	9.22	6.54	<26
LEAD	n/a	15	<15	1.3	33.78	1.32	<5
NICKEL	73	100	<40	88	789	87.71	<40
SELENIUM	-	50	<40	5	20	5	<40
ZINC	1,100	5,000 (a)	<20	60	65.04	58.91	110
VOLATILE ORGANICS							
ACETONE	61	-	<100	-	-	-	<25
BENZENE	0.36	5	<2	71.28	530	53	<1
2-BUTANONE (MEK)	190	-	<100	4.42	-	-	<10
CARBON DISULFIDE	100	-	<10	98.6	-	-	<1
ETHYL BENZENE	130	700	<2	28,718	4,530	453	<1
METHYL ISOBUTYL KETONE (MIBK)	14	-	<10	41.99	-	-	<10
METHYLENE CHLORIDE	4.1	5	<5	-	19,300	1,930	<5
P-ISOPROPYLTOLUENE	-	-	<10	-	-	-	ND
1,2,4-TRIMETHYLBENZENE	30	-	<10	-	-	-	ND
TETRACHLOROETHENE	1.1	5	<2	8.85	528	84	<1
TOLUENE	75	1,000	<2	200,000	1,750	175	<1
TOTAL XYLENES	1,200	10,000	<5	-	-	-	<1
TRICHLOROETHENE	1.6	5	<2	80.7	-	-	1.3
SEMIVOLATILE ORGANICS							
BIS(2-ETHYLHEXYL)PHTHALATE	4.8	6	<10	5.92	1110	0.3	<10
NAPHTHALENE	73	-	<10	-	230	62	<10
2-METHYL NAPHTHALENE**	73	-	<10	-	230	62	<10

* Screening criteria for Chromium VI are used although total Chromium analyses were performed on water samples.

** Screening criteria for naphthalene is used for 2-methyl naphthalene based on similar structure/ activity relationship.

(1) EPA Region 3 Risk-Based Concentrations (4-12-99). All values are based on a noncancer hazard quotient of 0.1 and a cancer risk of 1 in 1,000,000.

(2) GA EPD IWQS - Georgia DNR, EPD, Water Quality Control, Instream Water Quality Standards, Chapter 391-3-6.03, sec 5(d)(ii)&(iii), 5/29/94. IWQS values for chromium, copper, lead, nickle, and zinc are based on a hardness (CaCO3) of <100 mg/L in freshwater.

(a) Secondary Drinking Water criteria based on aesthetics.

(3) EPA Region 4 Management Division Freshwater Surface Water Screening Values for Hazardous Waste Sites, Table 1.

Note: Background GW sample PDO-MW04, Laboratory Quantiation Limits(LQL) obtained from analysis performed 8/98 except beryllium, copper, nickel and zinc LQLs are from 9/96. These analytes were not part of the analysis in 8/98.

(-) Not Listed ND- Not Detected

Note: Tap water RBC values for chromium (VI) and naphthalene were provided by GA EPD in Revised Final RFI comments #9 and #10, April 1999.

3.1.2 Screening Method

The risk screening process is a systematic screening of field sample results to determine potential site-related COPCs. The following process will be used to screen chemicals detected in soils:

- essential elements and inorganics detected within the range of background are not considered to be COPCs;
- chemicals considered not site-related based on weight-of-evidence screens are not considered COPCs (determined on a case-by-case basis);
- chemicals below soil screening levels are not considered COPCs; and
- All remaining chemicals will be considered COPCs for soil.

Chemicals detected in groundwater will be screened from further consideration using the following criteria:

- chemicals detected within the range of background are not considered COPCs;
- chemicals considered not site-related based on weight-of-evidence screens are not considered COPCs,
- chemicals detected below risk-based screening levels are not considered COPCs; and
- all remaining chemicals will be considered COPCs for groundwater.

3.2 STEP 2: BASELINE RISK ASSESSMENT

3.2.1 General Method

A BRA will be performed for COPCs identified in the risk evaluation in accordance with methods presented in the *Georgia Environmental Protection Division Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units* (Georgia EPD 1996) and the *Supplemental Guidance to RAGS: Region 4 Human Health Risk Assessment* (EPA 1996a). Additional methodology may be taken from:

- *Risk Assessment for Superfund, Volume I: Human Health Evaluation Manual, (Part A)* (EPA 1989b),
- *Dermal Exposure Assessment: Principals and Applications* (EPA 1992);

- *U.S. EPA Integrated Risk Information System (IRIS); and*
- *Health Effects Assessment Summary Tables (HEAST)* (EPA, 1997b).

3.2.1.1 Exposure Assessment

The exposure assessment will be performed in two steps. The first step will be to identify any potentially complete pathways between the contaminant source and potential receptors. This involves identifying potential current and future receptors, release mechanisms through which contamination may come in contact with the receptors, and the routes of exposure through which the receptors may be exposed. **Figure D-2** presents a conceptual site model which illustrates potentially complete pathways for contaminant sources at the PDO Yard. **Figure D-3** provides a conceptual model flow diagram between contaminant sources and potential receptors.

The second step will be to quantify the exposure for each receptor resulting from contact with contaminated media. In order to quantify exposure for each receptor, chronic daily intake (CDI), or exposure per unit body weight per unit time averaged over the exposure period, will be estimated. Receptors may be exposed to chemicals by contact with site media or as the result of chemical migration away from the source into other media. The expression for groundwater ingestion is given equation 3.1 below.

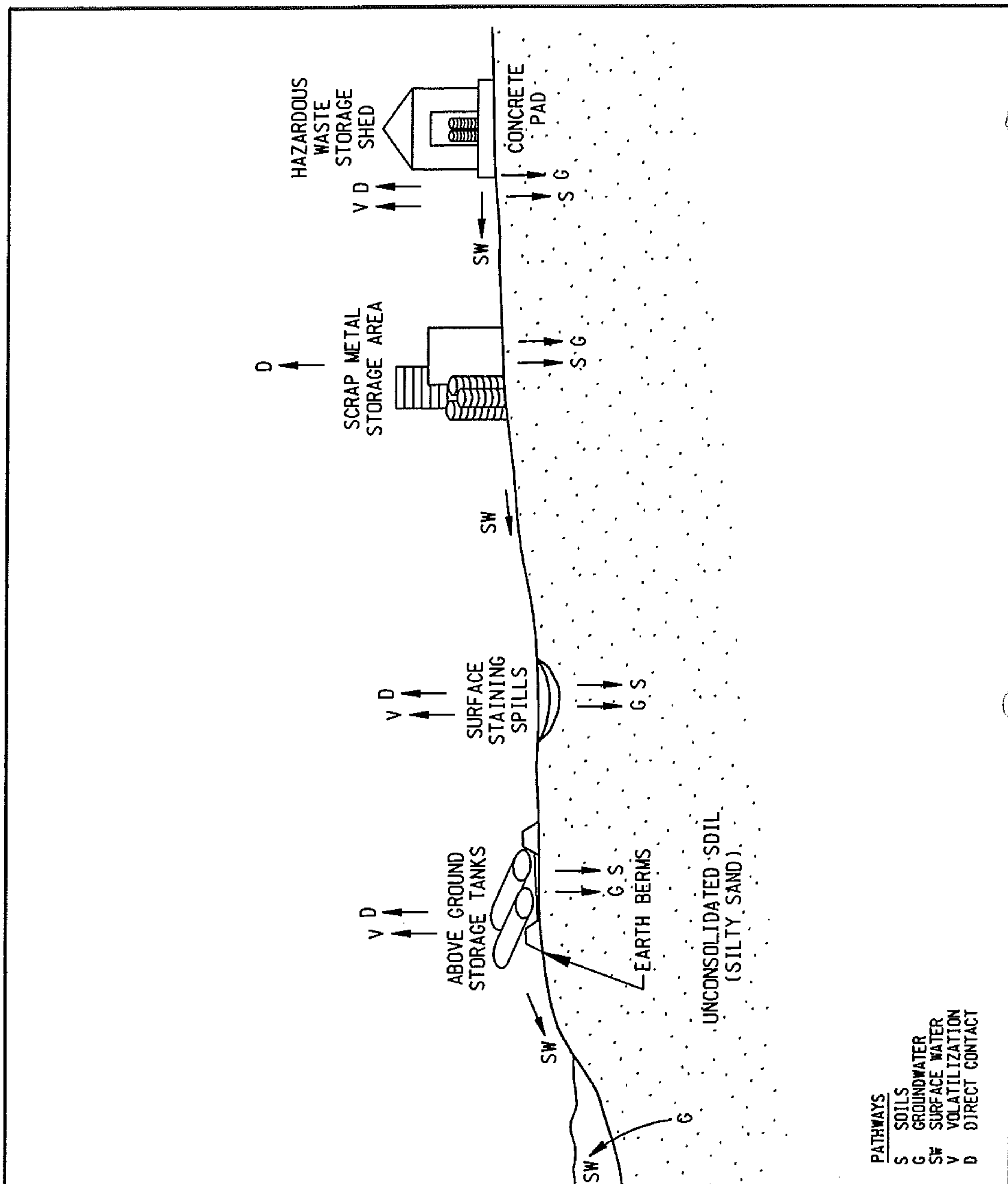
$$CDI = (CW \times IR \times EF \times ED)/(365 \times BW \times LT) \quad \text{(Equation 3.1)}$$

where:

CDI	=	Chronic daily intake (mg/kg-day)
CW	=	Chemical concentration in water (mg/L)
IR	=	Ingestion rate (L/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
LT	=	Lifetime (years)

Exposure from a *direct contact pathway* represents exposure via direct contact with the source media. For direct contact pathways, the exposure point is represented by data collected at the site. Direct contact exposure, if applicable, will be estimated using standard exposure equations and standard parameter values identified for various exposure conditions (EPA 1996a, 1992b, 1989). Where available, site-specific parameter values will be used.

LOC. p:\proj\16602haf\c\cxhaf00LDGN DATED: 04-19-96 BY: M.A. FRANK



U.S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

CONCEPTUAL SITE MODEL
PDO YARD

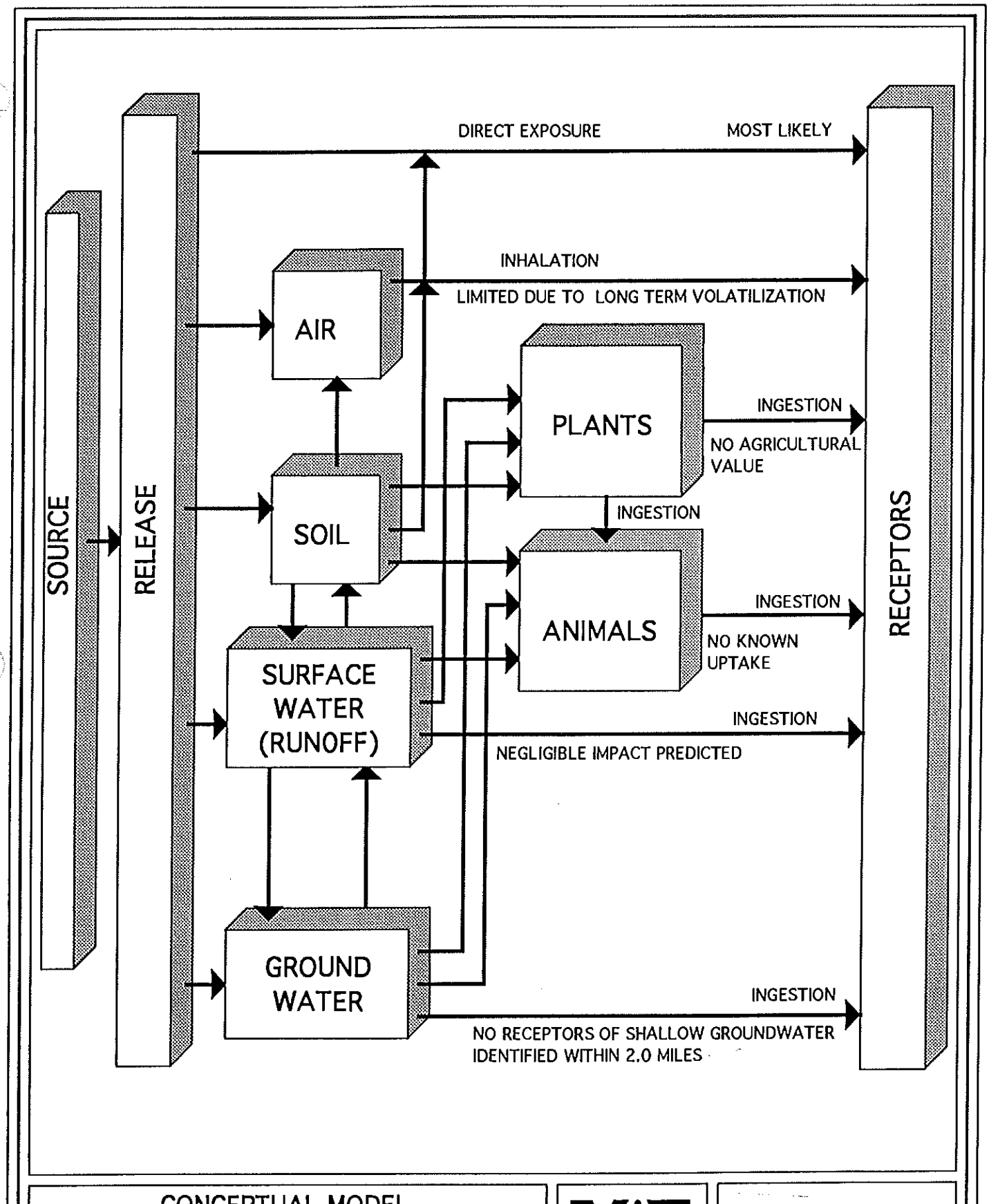
HUNTER ARMY AIRFIELD

SAVANNAH, GEORGIA

FIGURE D-2

METCALF & EDDY

SCALE: N.T.S. | DATE: | APPROVED:



CONCEPTUAL MODEL
FLOW DIAGRAM
HUNTER army AIRFIELD

Metcalf & Eddy

FIGURE D-3

Exposure pathways that incorporate chemical migration to a secondary media (groundwater, surface water, sediments, air, and biota) or to an off-site receptor are referred to as *indirect contact pathways.* The CDI concentrations for the secondary media will be determined using mathematical models that take into consideration chemical-specific and media-specific properties to estimate the chemical concentration in the secondary exposure media.

Migration to and through groundwater to a receptor often is a primary pathway in defining baseline risks and in calculating site-specific remediation levels. An important aspect of quantifying this pathway is defining the hydrogeologic conceptual model. This model is essential for establishing quantitative estimates of chemical migration. The outputs of the modeling effort verify chemical-specific DAFs, which are subsequently used both in the BRA and to develop remediation levels for off-site exposure to groundwater. DAFs incorporate physical, chemical, and biological characteristics of the subsurface into one predictor of chemical migration through the subsurface environment. The two primary considerations in developing the DAFs are:

1. dilution, or mixing, of the chemical in groundwater in various directions; and

2. attenuation, including chemical binding (absorption) of the chemical to the subsurface soil particles, and biological degradation (applicable only for organic compounds).

3.2.1.2 Toxicity Assessment

This section briefly summarizes the effects of chemicals on exposed populations. All toxicity values will be derived from published data provided in Integrated Risk Information System (IRIS) (EPA 1997a). If toxicity data are not available on IRIS, the Health Effects Assessment Summary Tables (HEAST) (EPA , 1997) will be consulted.

The cancer slope factor (SF) is defined as a plausible upper-bound estimate of the probability developing cancer as a result of lifetime exposure to a particular concentration of a potential carcinogen (EPA 1989b). Slope factors are specific for each contaminant and route of exposure. The potential for noncarcinogenic health effects is assessed by comparing an exposure estimate (intake or dose) to a reference dose (RfD). The chronic RfD is defined as an estimate of daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime (EPA 1989b). An RfD is also specific to a chemical and route of exposure.

3.2.1.3 Risk Characterization

A risk characterization estimates the likelihood that receptors can develop adverse effects as a result of exposure to COPCs (EPA 1991). Risks will be calculated from toxicity information and the results of the exposure assessment. For radionuclides and carcinogens, incremental lifetime cancer risks (ILCRs), or the increased lifetime probability of cancer, will be calculated. This ILCR represents the increase chance above the background of contracting cancer. In the United States, the background chance is approximately 3 chances in 10, or 3×10^{-1} (American Cancer

Society 1990). The resulting ILCRs are compared to the range specified in the National Contingency Plan (EPA 1990) of 10^{-6} to 10^{-4}, or 1 in 1 million to 1 in 10,000 persons developing cancer. ILCRs below 10^{-6} are considered acceptable risks, while ILCRs above 10^{-4} are considered unacceptable risks. Risks between 10^{-6} and 10^{-4} should consider uncertainty in the risk estimates. The risk of developing cancer will be determined as follows (EPA 1989b):

$$ICLR = CDI \times SF$$

where:

ILCR = Incremental Lifetime Cancer Risk (unitless probability),
CDI = chronic daily intake or dermally absorbed dose from exposure assessment (mg/kg-day),
SF = Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$

For a given pathway, with simultaneous exposure of a receptor to several carcinogens, the total risk to a receptor is the sum of the ILCRs for each carcinogen encountered in all sources and each pathway. The equation that will be used to calculate the total ILCR is :

$$ILCR_{total} = \sum ILCR_i$$

where:

$ILCR_{total}$ = Total chance of cancer incidence,
$ILCR_i$ = ILCR for the i^{th} contaminant.

Noncarcinogenic or toxic effects from exposures to hazardous substances will also be considered. Possible adverse effects associated with toxic chemicals are evaluated by comparing an intake, or CDI, to an RfD. The RfD is the threshold level below which no toxic effects are expected to occur (in a normal population, including sensitive subpopulations). The ratio of intake over the chemical specific RfD is termed the hazard quotient (HQ) (EPA 1989b) and is defined as:

$$HQ = \frac{I}{RfD},$$

where:

HQ = Hazard Quotient (unitless ratio),
CDI = daily intake of a contaminant (mg/kg-day),
RfD = Reference Dose (mg/kg-day).

The HQs for each contaminant are summed to obtain a hazard index (HI). An HI greater than 1 has been defined as the level of concern for potential adverse noncarcinogenic health effects (EPA 1989b). This threshold approach is different from the probabilistic approach used to evaluate carcinogens. A HQ of 0.1 indicates that the estimated intake is 100 times less than the threshold level at which adverse health effects may occur. In the simultaneous exposure of a receptor to

several chemicals, a HI is calculated as the sum of the individual HQs for all noncarcinogens encountered in all sources for each pathway as follows:

$$HI = \sum HQ_i ,$$

where:

HI = Hazard Index for toxic effects,
HQ_i = Hazard Quotient for the i^{th} contaminant.

A total ILCR and a total HI associated with each media for each receptor will be estimated by summing the pathway-specific values.

3.2.1.4 Uncertainty Analysis

There is uncertainty associated with every risk assessment. Assumptions built into a risk assessment tend to be conservative and overestimate rather than underestimate potential risks, but occasionally can result in underestimating risk. For example, it is assumed that the toxic and carcinogenic effects of the chemicals of concern are additive with respect to pathway and media. This assumption can result in an underestimation of risks due to synergistic toxic effects, or an overestimation of risks due to antagonistic toxic effects. In addition, the risk parameters typically used reflect an upper bound for the population. These upperbound assumptions compounded for each parameter may result in an overestimation of risks to the typical population. As part of the risk evaluation for the PDO Yard, uncertainties will be identified and addressed wherever possible in order to qualify the risk results.

3.2.1.5 Identification of Chemicals of Concern

Chemicals of potential concern will be identified as those contaminants that exceed acceptable screening criteria for each receptor and pathway and are not eliminated based on the weight of evidence evaluation. The COCs will be identified as compounds exceeding recommended risk levels and will be specific to media and receptor. These chemicals represent the main contributors to human health risks at the site that will need to be addressed during remedial action.

3.3 STEP 3: REMEDIAL LEVELS IDENTIFIED FOR PROTECTION OF HUMAN HEALTH

The BRA identifies actual chemicals and pathways of concern. Site-specific remediation levels may be developed for chemicals and pathways of concern for presentation in the Final RFI Report. Georgia EPD recommends developing risk-based remediation levels using a risk goal at least 1×10^{-6} and not to exceed 1×10^{-4} for remaining carcinogens, and an HQ of no more than 3 for noncarcinogens (Georgia EPD 1996). The Georgia EPD preference for target remediation goal is a 10^{-6} cancer risk and a target HQ of 0.1.

Prior to developing final site-specific remediation levels, issues such as receptor location (point of compliance) for each media and the method for handling any modeling uncertainties identified in the BRA must approved by applicable USACE, Fort Stewart and regulatory personnel.

4.0 ECOLOGICAL RISK ASSESSMENT

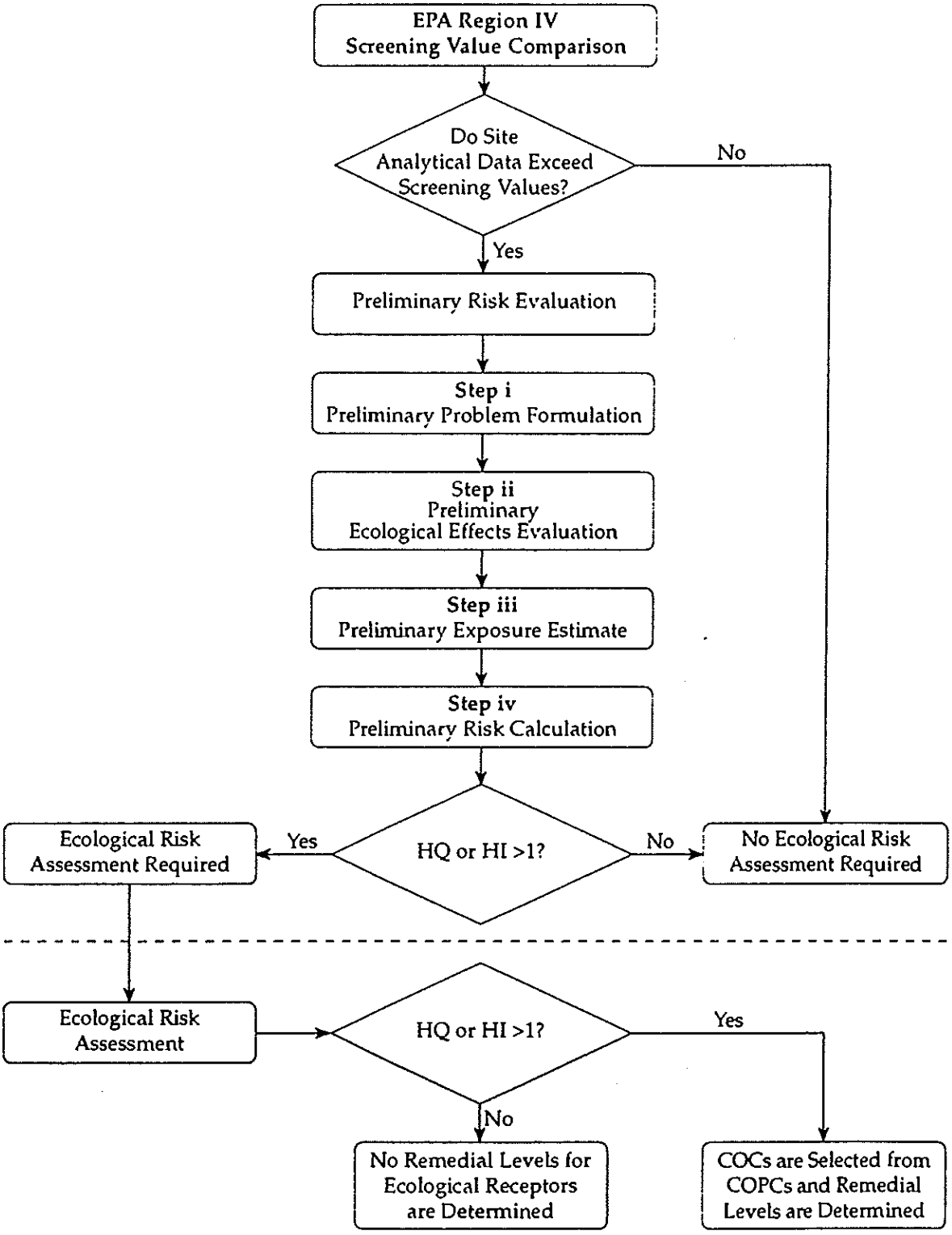
The State of Georgia requires that all RCRA facilities choosing to set remediation levels based on an assessment of risk to human health and the environment prepare risk assessment documentation and proposed remediation levels according to the Georgia EPD's *Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units* (Georgia EPD 1996). Additional guidance is contained in EPA Region 4 Bulletin, *Supplemental Guidance to RAGS, Ecological Risk Assessment* (EPA , 1996b).

The assessment of risk for ecological receptors at the PDO Yard will be conducted in a phased approach according to Georgia EPD guidance (Georgia EPD 1996). As shown in the flowchart of the Georgia EPD ecological risk assessment process (**Figure D-4**), the two phases are:

- Preliminary Risk Evaluation (PRE), and
- Ecological Risk Assessment (ERA).

The PRE will be conducted using analytical results from samples of soil, sediment, surface water, and groundwater collected in accordance with the RFI Work Plan (see Section 3). Concentrations detected will be compared to ecological screening values (ESVs). Remediation levels for protection of ecological resources will be developed and proposed in the ERA only for those contaminants that are identified as ecological contaminants of concern in the PRE.

Georgia EPA Guidance for Identifying Ecological Risks



*Adapted from Georgia EPD guidance for selecting media remediation levels at RCRA SWMUs

FIGURE D-4

ATTACHMENT 1

CALCULATION OF ARITHMETIC AVERAGES

Benzene: Arithmetic average= 29.2 ug/l

Sampling Location	Concentration > RBC (ug/l)
PDO-MW01	64
PDO-MW02	4
PDO-MW06	36J
MW1-23	13
MW1-25	29

Tetrachloroethene: Arithmetic average= 22.3 ug/l

Sampling Location	Concentration > RBC (ug/l)
PDO-MW02	16
PDO-MW05	47
MW1-22	11J
MW1-24	15

RISK CALCULATION SPREADSHEET

Process for evaluating COPCs:

1. Identify average background concentrations (inorganics only).
2. Perform weight of evidence screen.
3. Compare to risk-based screening criteria any constituent identified at least once over background.
   Retain organic constituents as COPCs if they exceed screening criteria and are valid with respect to the weight of evidence screen
   Retain inorganic contaminants as COPCs if they exceed twice the average background concentration.
4. Calculate intake rates for COPCs.
5. Calculate Increased lifetime cancer risk (ILCR or risk) and noncarcinogenic Hazard Quotient (HQ) for COPCs.
6. Calculate total risk (ILCRtotal) and Hazard Index (HI) for simultaneous exposure to COPCs.
7. Conduct an uncertainty analysis to validate risk-based calculations.
8. Retain any COPC as a COC if it exceeds an acceptable level of risk (1 x 10-6 for carcinogens or a HQ>1 for noncarcinogens).
9. Consider cumulative effects of COPCs and COCs by evaluating ILCRtotal and the HI.
   Determine if ILCRtotal and the HI exceed acceptable risk levels (1 x 10-6 to 1 x 10-4 for carcinogens or a HI>1 for noncarcinogens).
10. Develop remedial levels for COCs

Contaminant	Media	Background conc.	Freq. of Detection	Range of Detection limits (ppm)	Range of Detected conc. (ppm)	Basis for Elimination	Contaminant conc.* (in ppm)	Lowest RBC (ppm)	RBC source
Benzene	water	<0.002	5/18	<0.002	0.004 - 0.064	no	0.0292	0.00036	EPA Reg. 3
PCE	water	<0.002	4/18	<0.002	0.011- 0.047	no	0.0223	0.0011	EPA Reg. 3

WOE- Weight of Evidenco

* Contaminant concentration is the arithmetic average of all samples that exceeded the laboratory quantitation limit (LQL).

FORMULAE:

Chronic daily intake =(H19*K19*M19*N19)/(365*O19*P19)

ILCR=S19*Q19

ILCR(total)=SUM(V22:V24)

Contaminant	Ingestion rate (liters/day)	WOE	WOE Source	Exposure freq. (days/year)	Exposure Duration (years)	Body Weight (kg)	Lifetime (years)	Chronic Daily Intake (mg/kg -day)	Carcinogenic or Noncarcinogenic	Oral Slope Factor	Reference Dose	ILCR
Benzene	2	A	IRIS	350	30	70	70	3.43E-04	Carcinogenic	0.029	n/a	9.94E-06
PCE	2	B	HEAST	350	30	70	70	2.62E-04	Carcinogenic	0.052	n/a	1.36E-05
											ILCR(total)=	2.36E-05

WOE- Weight of Evidence

* Contaminant concentrati

Carcinogenic Risks
On-site Worker Exposure Scenario

Chemical	Ingestion ILCR	Dermal ILCR	Subtotal ILCR
Benzo(a)pyrene*	1.57E-06	7.11E-06	8.68E-06
Arsenic**	1.26E-05	1.83E-05	3.09E-05
		Total ILCR =	3.96E-05

ILCR- Increased lifetime cancer risk
* Note: The arithmetic average concentration of 1.1 mg/kg was used because positive detections above LQL were confirmed in only 2 of 23 samples
** 95% UCL of the mean arsenic concentration was used for calculation.

For incidental ingestion of soil:

Intake (mg/kg-day)= (CS * IR * CF * FI * EF * ED)/ (BW * AT)

where:

CS = Concentration in soil (mg/kg)
IR = Ingestion rate, 100 mg/day (adult)
CF = Conversion factor, 10^{-6} kg/mg
FI = Fraction ingested from contaminant source (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (30 years * 250 days/year)

Ingestion input data:	Benzo(a)pyrene	Arsenic
CS =	1.1	8.84
IR =	100	100
CF =	1.00E-06	1.00E-06
FI =	1	1
EF =	250	250
ED =	30	30
BW =	70	70
AT =	7500	7500

For dermal contact with soil:

AD (mg/kg-day)= (CS * CF * SA * AF * ABS * EF * ED)/ (BW * AT)

where:

AD = Absorbed dose (mg/kg-day)
C_s = Concentration in soil (mg/kg)
CF = Conversion factor (10^{-6} kg/mg)
SA = skin surface area available for contact (cm^2)
AF = Adhearance factor of soil to skin (mg/cm^2)
ABS = Absorption factor (1.0% for organics, 0.1% for inorganics)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (30 years * 250 days/year)

Dermal input data:	Benzo(a)pyrene	Arsenic
C_s =	1.1	8.84
CF =	1.00E-06	1.00E-06
SA =	3120	3120
AF =	1.45	1.45
ABS =	0.1	0.032
EF =	250	250
ED =	30	30
BW =	70	70
AT =	7500	7500

Carcinogenic Risks
On-site Resident (Adult) Exposure Scenario

Chemical	Ingestion ILCR	Dermal ILCR	Subtotal ILCR
Benzo(a)pyrene*	6.73E-07	3.05E-06	3.72E-06
Arsenic**	5.41E-06	7.84E-06	1.32E-05
		Total ILCR =	1.70E-05

ILCR- Increased lifetime cancer risk
* Note: The arithmetic average concentration of 1.1 mg/kg was used because positive detections above LQL were confirmed in only 2 of 23 samples
** 95% UCL of the mean arsenic concentration was used for calculation.

For incidental ingestion of soil:

Intake (mg/kg-day)= (CS * IR * CF * FI * EF * ED)/ (BW * AT)

where:

CS = Concentration in soil (mg/kg)
IR = Ingestion rate, 100 mg/day (adult)
CF = Conversion factor, 10^{-6} kg/mg
FI = Fraction ingested from contaminant source (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (70 years * 365 days/year)

Ingestion input data:	Benzo(a)pyrene	Arsenic
CS =	1.1	8.84
IR =	100	100
CF =	1.00E-06	1.00E-06
FI =	1	1
EF =	365	365
ED =	30	30
BW =	70	70
AT =	25550	25550

For dermal contact with soil:

AD (mg/kg-day)= (CS * CF * SA * AF * ABS * EF * ED)/ (BW * AT)

where:

AD = Absorbed dose (mg/kg-day)
C_s = Concentration in soil (mg/kg)
CF = Conversion factor (10^{-6} kg/mg)
SA = skin surface area available for contact (cm^2)
AF = Adhearance factor of soil to skin (mg/cm^2)
ABS = Absorption factor (1.0% for organics, 0.1% for inorganics)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (70 years * 365 days/year)

Dermal input data:	Benzo(a)pyrene	Arsenic
C_s =	1.1	8.84
CF =	1.00E-06	1.00E-06
SA =	3120	3120
AF =	1.45	1.45
ABS =	0.1	0.032
EF =	365	365
ED =	30	30
BW =	70	70
AT =	25550	25550

Ecological Risk Characterization

Formulae:	IR (kg/kg/day)= 0.0687 $WT^{0.822}$
	IIR (kg/kg/day)= IR X 0.09
	FI_n (in kg/kg/d)= IR + IIR / WT, for all mammals
	ADD = (Max Conc. x BAF) x (IR+ IIR)
	HQ - ADD/TRV

Sediment

Surrogate Species	ECOPC	Max Conc. in mg/kg	BAF[1]	IR in kg/kg/day	IIR in kg/kg/day	ADD	TRV	HQ
Racoon	Barium	76	7.50E-03	0.06	0.0054	3.73E-02	2.54E+01	1.47E-03

Definitions:

ADD- Average daily dose in mg/kg/d
BAF[1]- Bioconcentration factor for earthworms (racoon), (HAZWRAP 1994)
ECOPC - Contaminant of potential concern
HQ - Hazard quotient
IR - Ingestion rate (from Table 16)
IIR - Sediment Incidental Ingestion rate (9% of the IR)
FI_n - Normalized Food Intake
TRV - Toxicity reference value, based on the NOAEL in mg/kg/d for barium.

APPENDIX E

FIELD LOGBOOK

WED. 8/19/96 PC, warm, humid

0640 At 1310 - gate locked - call # - not a good # apparently.
- Go to MP station thy make call. 260th QM.

0730 Gate unlocked -
W.L. @ MW3 ≈ 2.2 bgs.
- Resume drilling to 13±' OVA 1u BZ=0.
Sofwell MW03 see schematic for yesterday.

815 Hydrate Bentonite
Clean up site

845 Move to PDO Yard.
Unload drums from 1310
- Construct Decon Pad

0945 Greg Rowell offsite to Lab.

1000 COE onsite
Wes Smith - Wes says 1310 wells good asis.
Franz F.
Kathleen Miles

1115 COE offsite

(Wed) Kathleen Miles items:
1. 833 drums to go offsite need relabeling writing washing off

1130 } Lunch
1220 }

1230 Take Eq Blank PDO 2" spoon

1300 PSI onsite - mob to 1310 to do pals.

1330 COE onsite
Tom Neal onsite - give HASP briefing.

1409 COE offsite

1500 At PDO Yard - setup on SB1 - Not Yet
Decon augers
Setup SB1

1610 Heavy Rain - all offsite to - Met to Lab.

D. Klemp

PM - PC, hot, humid
THURS 8/15/96 - AM - clear, warm, humid
G. Powell, D. Humphs, Tom Neal, PSI (3)
0705 Onsite - wait @ DPW for Doug Swanson for keys to PDO.

0715 in PDO - clean up @ SB01. Grout - 2 bags
0800 Setup on PDO - SB02 (Drum 6)
0900 Grout PDO SB02 2 bag grout.
0906 Decon -

0955 Setup on PDO - SB03 (Drum 7)
1058 cleanup
- Call W. Liberman - progress report - Also, Borings depth to 10' not 15'.

1110 Move to PDO - SB04 (Drum 8) 1/2
1210 Grout SB04
1230 } Lunch PSI Gasses up rig.
1330 } - Stop by 1310 to let folks know we'll be on tomorrow - don't park trucles in the way.
- PSI decons augers
1410 Setup on SB05 Use Drum 8

1450 Setup on PDO - HP01

(Thurs)
Auger to 4', push HP to 7' (drum 8)
W.L ≈ 3-4'
Take VOA sample 8010/8020
retrieve sample w/ bailer
1540 Setup on HP-02 - Auger to 4
push HP to 7' bgs (drum 8)
1630 Decon - use (D3) @ PDO
Pack sample
1740 To lab -

(D) & Samples

FRI 8/16/96 AM- mostly sunny, hot, humid

0700 Onsite - @ 1310

0720 Setup on HP01 (bg) 1" concrete
Drum 9
Auger to 3', hammer HP 18" refusal
Sample -

0805 Setup on 1310 HP02 4" concrete
Smelly hole - OVA in BZ - 0-10
fluctuating. Auger to 3', hammer
18" - refusal.
- let HP sit

0900 sample

0905 Move to HP03 (downgradient.)
Auger to 4' Concrete 9"
drive spoon HP to 5'
sample

1000 Move to HP04 by tanks
auger to 4', push HP to 7'
Sample + split + MS/MSD

1020 Call SAIC - they will be there for STAT delivery

(FRI Cont'd)

1100 Move to PDO Yard
Decon

1115 } Lunch
1215 }

1245 Setup on PDO-SB06 Coal Ash
TD 10' Drum 10

1340 Setup on PDO-SB07 Drum 10

1425 - PSI Decons + Kenny to get ice.
Sample 2-4 / 0-2 Coal. No Sample

1600 Move on PDO-SB08 + then SB09
- Wes Smith visits - says D.I. / Drum sand dec was going OK.

1630 Clean up site.
PSI Decons
M+E sample pack.

1730 To Lab

1800 Off

D. Humphrey

SAT 8/17/96, Mostly sunny, hot, humid

0705 Onsite - Prep to drill

0720 Setup PDO-SB10

0800 Setup PDO-SB11

0845 Decon

0910 Setup on PDO-SB12 (start Drum 11)

0945 Setup on PDO-SB13

1035 Clean up

1040 Decon - unload drums off tractor
Fix trailer flat tire
Use D5 drum PDO yard.

1115 } Lunch
1215 }

1230 Setup on PDO-SB14

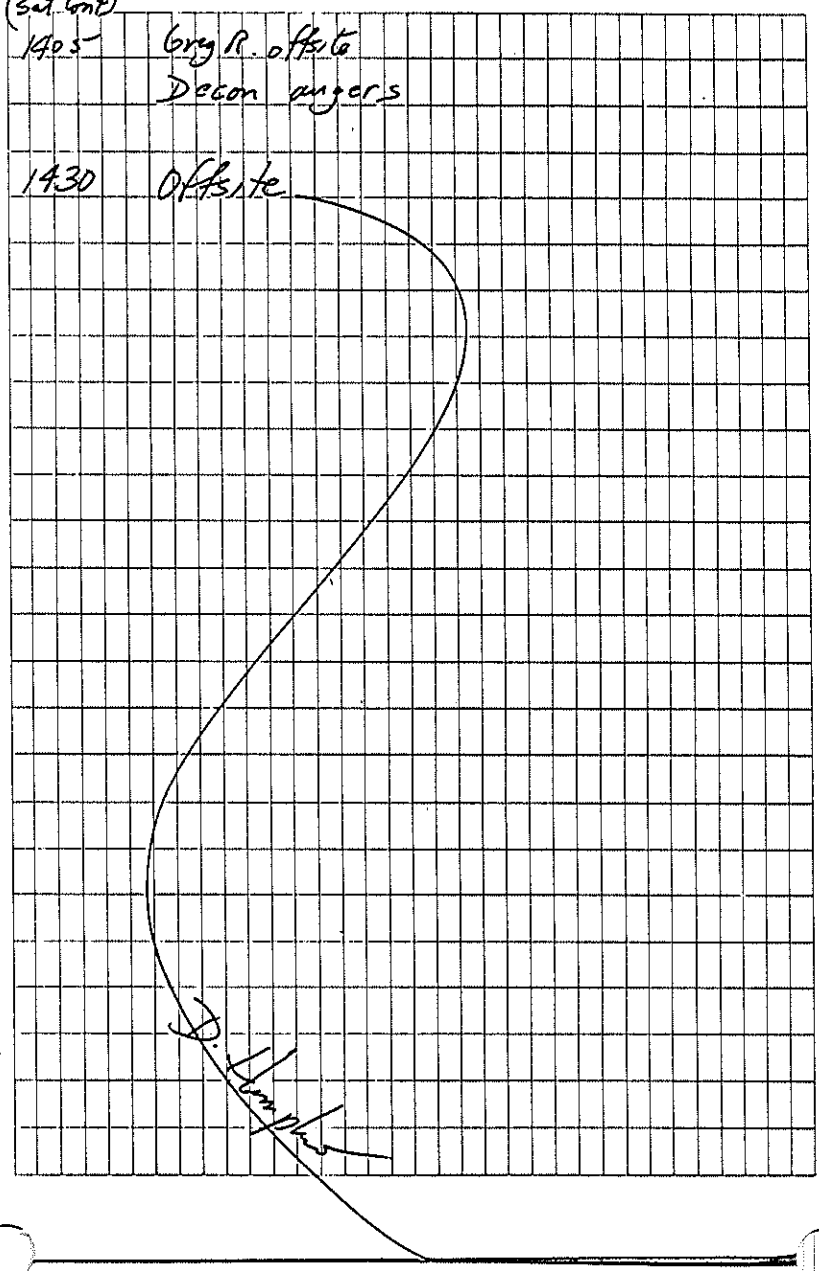
1315 Setup on PDO-SB15

Grout up holes

(Sat Cont)

1405 Greg R. offsite
Decon augers

1430 Offsite



Sun 8/18/96 PC, hot, humid

0650 Onsite

0700 PSJ onsite

0720 Setup on 1310 HP05 (Cont drum 9)
HA to 3', push to 6'.

0745 Sample 8010/8020

0800 Setup on 1310-HP06
0820 Sample 8010/8020
+ Trip Blank

— PDO YARD —

0840 Setup on PDO-HP03
Auger to 5', Push HP to 7'.
DRY - let sit open hole / HA to 9'
1010 - Sample 8010/8020

0915 PDO-HP04
Auger to 7', Push to 9'. +split
0930 Sample 8010/8020.

1015 Move to PDO-HP05
Auger to 7', Push HR to 9'
1030 Sample 8010/8020

(Sun Cont)

1053 Setup on PDO-HP06
Auger to 8', Hammer to 10'
1115 - Sample 8010/8020

1135 Clean up
1140 } - Lunch.
1255 }
Re-ice samples

W.L in HP06 ≈ 7' bgs
(in well 1-25- ≈ 7' bgs)

1330 Setup on PDO-HP07
Auger to 9', hammer push to 11'.
1350 Sample 8010/8020

1400 Setup on PDO-HP08
Auger to 9', hammer push to 11'.
1415 Sample 8010/8020
- Decon
1435 Move to PDO-HP09 (Drum 11)
Auger to 6', hammer to 8'
1450 Sample + Dup -

D. Humphrey

8/18/96
(Sun Cont'd)

1510 Setup on PDO-HP10 (background)
Handauger due to utilities to 4'
Auger to 8', drive HP to 10'
Sample 1540 8010/8020

1555 Decon
Use D6 Drum

1620 All offsite

D. Humphries

Mon 8/19/96
0700 Onsite - repack samples
Cal OVA, Hydac
0800 PSI onsite. Prep to Develop.
0815 At 1310. MW01
W.L. = 2.27' TOC ± 2.5' bgs
1 vol = 15.2 gal
5 vol = 76
+35 gal (5x7 gal added)
TOTAL = 111
Construct Surge block & decon pump.
0910 D. Wilderman calls -
says do not develop - we'll need the
day next week between wells.
- Pack up
1015 PSI offsite
- Conduct a windshield survey of
area about 1310.
- Take Samples to Lab + FedEx
1215 Drive to ATL.

D. Humphries

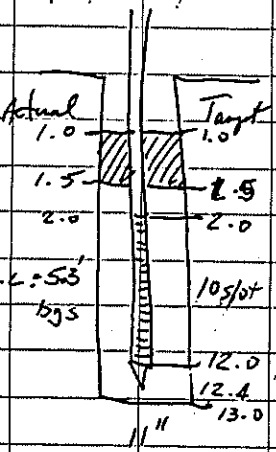
MON 8/26/96 PC, low, humid, sl breeze

0700 Onsite - get water, unload drums

0800 Setup on PDO-MW01

Drum 12

rc dpt 11 w/ plug - add 7 gal water



Drums 12, F

Sand - 30 lbs - 4½

Bent - ¼ bag

Grout - 5 gallon

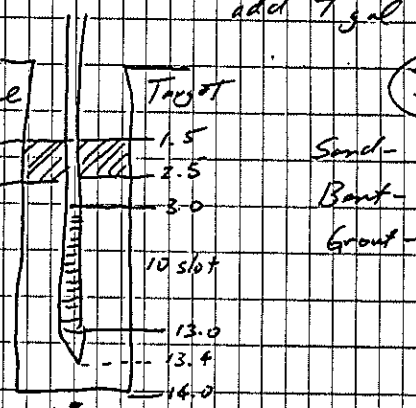
0930 Hydrate bentonite w/ 3 gal potable water

(Mon Cont)

1000 Setup on PDO-MW02

add 7 gal water

Drum 13



Sand - 5 bag

Bent - ½ bag

Grout - 5 gallon

1100 Hydrate w/ 3 gal pot. water

Cleanup site

- 45 drums from DAG - soil emptied

empty drums stored upside down

1130 - Cass D. Wilderman about drums ↑ he says Doug Swanson was supposed to take care of the drums

- Decon - use Drum 17

1200 > Lunch

1300 <

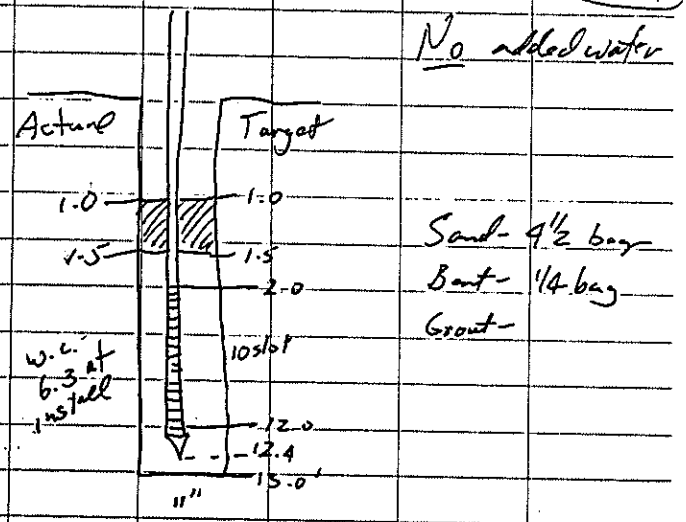
(Mon Cont)

1310 PSI on site. PDO

Setup on MW03

Drum 14, 15 1/4

No added water



Sand- 4½ bags

Bent- 1/4 bag

Grout-

1420 Hydrate w/ 3 gal pot. water

Clean up site

- Doug Swanson visits - ask about drums.

1505 Grout MW01 - 5 gal

Cut Pro covers to fit

(Mon Cont)

1600 Set Pro cover on MW02

1800 Set Pro cover on MW03

1710 Offsite

Dr Humphrey

TUES 8/27/96 PC, hot, humid

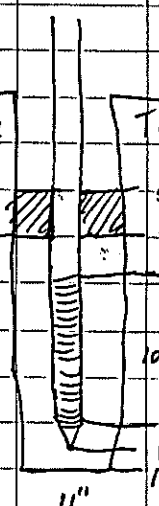
0700 Change out sock @ B. 133
Measure product in 728 MW8 tank,
8" water 17½" product

0715 At PDO yard - PSI unloads drums.

0745 Setup on PDO - MW04 (background)
Cont Drum 15
Drum 16

Charge Augers 10 gals

Sand - 6 bag
Bent - ¾" bag
Grout - 2 bag



9.95
2.2
1.15

(Tues Cont)

0912 Call Wes Smith - (D. Wilderman not in)
discuss clay @ MW4 + where to set well - we decide on screen 8-18', 1' sand, 2' bentonite 7-5' to seal well in clay. Will still probably have a submerged screen

0925 Set well

0945 Hydrate w/ 3 gals pot. water
clean up site

1015 At decon - PSI pickup has flat

1040 PSI to Home Depot + mechanic
Mike to Lab

1100 } Lunch
1215 }

1230 PSI onsite - unload drums @ PDO.
Got material to make pads

1255 Grout PDO - MW04

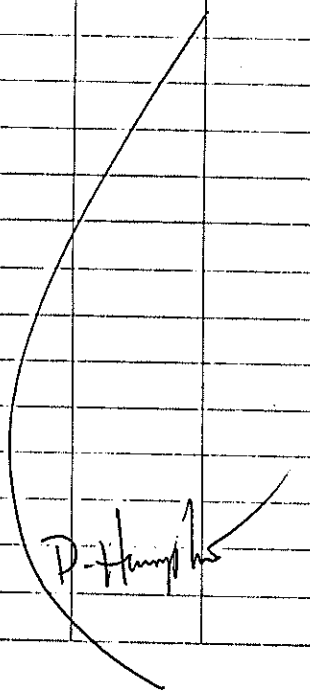
1315 At 1310 - No decon water on whole Pump Hose - Kenny goes to get.

1410 Develop 1310 - MW01
110 gal - photo - clear
v. slt. milky
but can read thru bottle

(Tues Cont)

1600 Survey 130

1700 PSI offsite
M+E offsite



WED 8/28/96 PC, hot, humid PM rains

0630 Calibrate OVA + Hydacs

0700 Onsite, prep to develop

0705 PSI onsite
Work on surge block

0750 At PDO-MW01 - prep to develop
W.L. 8.05 - 2.8 stickup - 5.3 bgs

Drum 21, 23

1010 End - clear / photo
Decon

1050 W.L PDO-MW03 8.90' TOC
- 2.7' stickup
5.7' bgs

1 vol = 10.1 gal 5 vol = 50.5 gal

Drum 25

- dry 0.9' and every 3-4 gal thereafter
after 3-4 min recharge period.

1220 End
PSI to lunch

1320 } Lunch

1320 - Onsite, PSI pointing boreholes
+ pad on PDO MW04
M+E downs pumps

(Wed Cont)

1340 Move to PDO-MW04

9.76' TOC - 34" stick = 6.9' bgs

.16 gal/ft x 10 ft = 16 gal = 1 vol + .2 gal

1 Vol = 16.2 gal

5 vol = 81 + 50 gal remov

= 131 gal to be removed.

Drums 27, 29, 30.

1430 PSI to decon augers

1450 Rain

-

1725 Offsite - Rain

Stopped PDO-MW04 @ 100 gal

Leaking 30 gal.

D. Humphrey

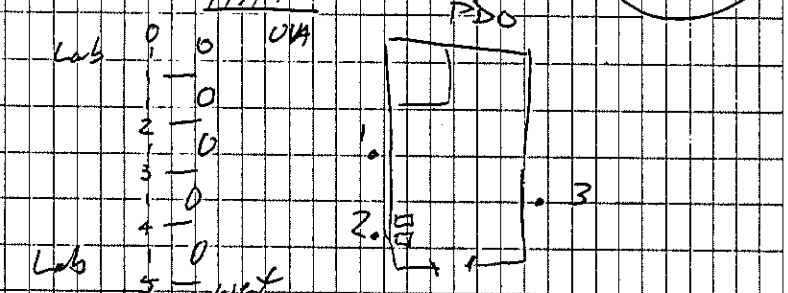
THURS 8/29/96

0650 Onsite, 1751 onsite, resume development @ PDO-MW04

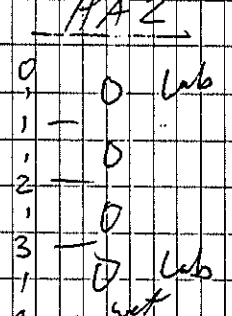
0810 Set up for HAs, PSI loading drums into PDO.

Drum 31

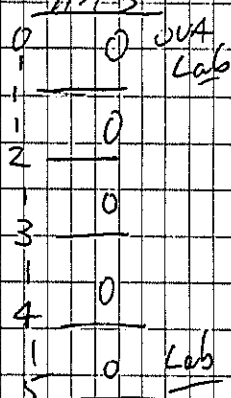
HA1



HA2



HA3



(Thurs Cont'd)

1100 Offsite - to hotel.
1225 AT Lab - drop off samples
1235 To ATL

D. Humphries

8-13-96

2

Tues. HAAF

1615 - Set up on 1310-MW803

Time	Sample	OVA	Lab #
1635	0-2'	30	
1645	2'-4'	>1000	1310-MW80301 *
1655	4'-6'	360	1310-MW80302

* Dup - 1310-MW806 collected at 1310-MW80301 location.

8-14-96

3

HAAF - SAV. GA. Wed.

Arrive: 0640

1245: Collected equip blank at PDO-SB01 location. PDO-ER01.

~~1453~~ 1515 - Set up on PDO-SB01

Time	Sample	OVA	Lab #
1530	0-2'	25	PDO-SB0101
1540	2'-4'	25	PDO-SB0102 *

* Collected core lab split

4

8-15-96

Thurs. HAAP, SAV. GA

Arrive: 0700

0800 - Set up on PDO-SB02

Time	Sample	OVA	Lab #
* 0815	0-2'	1.5	PDO-SB0201
0830	2'-4'	25	PDO-SB0202

* PDO-SB0201 is MS/MSD

0950

~~1000~~ - Set up on PDO-SB03

Time	Sample	OVA	Lab #
1000	0-2'	0	PDO-SB0301
1015	2-4'	60	PDO-SB0302

1115 - Set up on PDO-SB04

Time	Depth	OVA	Lab #
1125	0-2	1.5	PDO-SB0401
* 1140	2-4		PDO-SB0402

* PDO-SB0402 taken as dup PDO-SB16

1400 - Set up on PDO-SB05

Time	Sample	OVA	Lab #
1415	0-2'	8	PDO-SB0501
* 1425	2-4'	22	PDO-SB0502

* Core lab split sample

5

1515 - Set up on PDO-HPW01

1520 - Collected PDO-HPW01 sample

1500 - " " " " Trip Blank

1550 - Set up on PDO-HPW02

1600 - Collected PDO-HPW02 sample.

8-16-96 HAAF

Fri. SAV. GA

0650 - Arrive.

0715 - Set up on 1310 - HPW01

0745 - Collected 1310 - HPW01

0800 - Set up on 1310 - HPW02

0825 - Collected 1310 - HPW02 ~~+ MS/MSD~~ GR

0900 - Set up on 1310 - HPW03

0930 - Collected 1310 - HPW03 + split

1000 - Set up on 1310 - HPW04

1030 - Collected 1310 - HPW04

" " 1310 - HPW07 (Dup)

" " MS/MSD

1240 - Set up on PDO - SB06

Time	Sample	OVA	Lab #
1300	0-2	3	PDO-SB0601
1305	2-4	5	PDO-SB0602

1330 - Set up on PDO - SB07

Time	Sample	OVA	Lab #
1340	0-2	0	PDO-SB0701
1350	2-4	18	PDO-SB0702

1455 - Set up on PDO - SB08

Time	Sample	OVA	Lab #
~~1505~~ GR	0-2	—	~~PDO-SB0801~~ GR
* 1520	2-4	4.5	PDO-SB0801

* Collected dup at PDO-SB0801 (PDO-SB17)

1550 - Set up on PDO - SB09

Time	Sample	OVA	Lab #
1600	0-2	14	PDO-SB0901
1610	2-4	100	PDO-SB0902

P-17-96

8

SAT. HAAF Sev. Gf

0655 - Arrive

0720 - Set up on PDO-SB10

Time	Sample	OVA	Lab #
* 0725	0-2	4.5	PDO-SB1001
0740	2-4	5	PDO-SB1002

* Collected split at PDO-SB1001

0800 - Set up on PDO-SB11

Time	Sample	OVA	Lab #
0810	0-2	9	PDO-SB1101
0815	2-4	31	PDO-SB1102

0855 - Set up on PDO-SB12

Time	Sample	OVA	Lab #
0905	0-2	3.5	PDO-SB1201
* 0915	2-4	22	PDO-SB1202

* MS/MSD

0940 - Set up on PDO-SB13

Time	Sample	OVA	Lab #
* 0950	0-2	3	PDO-SB1301
1000	2-4	55	PDO-SB1302

* Dup PDO-SB18 at PDO-SB1301

9

1230 - Set up on PDO-SB14

Time	Sample	OVA	Lab #
1235	0-2	3	PDO-SB1401
1245	2-4	26	PDO-SB1402

1310 - Set up on PDO-SB15

Time	Sample	OVA	Lab #
1315	0-2	1.5	PDO-SB1501
1325	2-4	5	PDO-SB1502

P. Mundy

8-26-96

10 Hunter HAAF SAW. GA

Arrive: 0700

0800 - Set up on PDO-MW301

Time	Sample	OVA	Lab #
0835	0-2	.5	PDO-MW30101
*0845	2-4	2	PDO-MW30102

* Corps Lab split taken PDO-MW30102

1000 - Set up on PDO-MW302

Time	Sample	OVA	Lab #
1010	0-2	1.5	
1015	2-4	50	PDO-MW30201
*1025	4-6	56	PDO-MW30202
* Dup	PDO-MW305		

1320 - Set up on PDO-MW303

Time	Sample	OVA	Lab #
*1330	0-2	2	PDO-MW30301
1340	2-4	2	PDO-MW30302

⊗ MS/MSD

8-27-96

11 Hunter AAF, SAW. GA Tues

Arrive: 0650

0745 Set up on PDO-MW304

Time	Sample	OVA	Lab #
0755	0-2	1	PDO-MW30401
0805	2-4	7	PDO-MW30402
	4-6 ok		

8-27-96

12

Well | Hunter AAF | SAV. GA

Arrive: 0700

0745 - Set upon 1310-mw03 for development.

0910 - Completed development

1020 - Set up on PDO-mw02

1200 - Completed development

9-16-96

13

Hunter AAF — SAV. GA — Mon

1300 - Arrive at PDO yard.

1410 - Commence PDO-HA04

Time	Depth	OVA	Lab #
1415	0-1	Ø	PDO-HA04 01
* 1425	1-2	Ø	PDO-HA04 02

* Collected split @ PDO HA04 02

1450 - Set up on PDO HA05

Time	Depth	OVA	Lab ID
1455	0-1	140	PDO-HA05 01
* 1505	1-2	> 1000	PDO-HA05 02

* Collected Dup PDO-HA11

1525 - Set up on PDO-HA06

Time	Depth	OVA	Lab #
1530	0-1	2.5	PDO-HA06 01
1535	1-2	.5	
1545	2-3	Ø	
1555	3-4	Ø	
1605	4-5	10	PDO-HA06 02

1630 - Set up on PDO-HA07

Time	Depth	OVA	Lab #
1635	0-1	0	PDO-HA07 01
1640	1-2	.5	
1650	2-3	1.5	
1655	3-4	5.5	
1700	4-5	7	

PDO-HA07 02

8-28-96

12 Wed | Hunter AAF | SAV GA

Arrive: 0700

0745 - Set up on 1310-MW03 for development.

0910 - Completed development

1020 - Set up on PDO-MW02

1200 - Completed development

J Rowell

9-16-96

13 Mon | Hunter AAF | SAV GA

1300 - Arrive at PDO yard.

1410 - Commence PDO-HA04

Time	Depth	OVA	Lab #
1415	0-1	Ø	PDO-HA040[illegible]
* 1425	1-2	Ø	PDO-HA0402

* Collected spl. @ PDO-HA0402

1450 - Set up on PDO-HA05

Time	Depth	OVA	Lab ID
1455	0-1	140	PDO-HA050[illegible]
* 1505	1-2	> 1000	PDO-HA0502

* Collected Dup PDO-HA11

1525 - Set up on PDO-HA06

Time	Depth	OVA	Lab #
1530	0-1	2.5	PDO-HA0600[illegible]
1535	1-2	.5	
1545	2-3	Ø	
1555	3-4	Ø	
1605	4-5	10	PDO-HA0602

1630 - Set up on PDO-HA07

Time	Depth	OVA	Lab #
1635	0-1	0	PDO-HA0701
1640	1-2	.5	
1650	2-3	1.5	
1655	3-4	5.5	
1700	4-5	7	PDO-HA0702

9-16-86

14 Mon Hunter AAF

1725 - Set up on PDO-HA08

Time	Depth	OVA	Lab #
1730	0-1	Ø	PDO-HA0801
1735	1-2	Ø	
1740	2-3	Ø	
1745	3-4	.5	
1750	4-5	1.5	PDO-HA0802

1810 - Set up on PDO-HA09

Time	Depth	OVA	Lab #
1815	0-1	0	PDOHA0901
1820	1-2	0	
*1825	2-3	0	PDO-HA0902
OK	3-4		
OK	4-5		

*Collected Split Sample

1855 - Set up on PDOHA10

Time	Depth	OVA	LAB #
1900	0-1	Ø	PDO-HA1001
1905	1-2	Ø	
*1910	2-3	Ø	PDO-HA1002

*Collected Dup - PDO-HA12

S. Powell

9-17-86

15 Hunter AAF Tues.

0800 - Arrive.

0835 - Commence gauging MW's @ B.1310.

MW	DTW	OVA
1310-MW01	2.28	70
1310-MW02	1.10	420
1310-MW03	2.10	460

0930 - Set up on 1310-MW01

1050 - Collected 1310-MW01 sample

0930 - Set up on 1310-MW02

1100 - Collected 1310-MW02 sample

0945 - Set up on 1310-MW03

1120 - Collected 1310-MW03 sample

1040 - Collected 1310-EB02

1130 - " 1310-TB03

1430 - Commence gauging MW's @ PDO yard

MW	DTW (ft ground)	OVA
1-19	6.54	30 PID
1-20	8.65	25
1-21	3.85	40
1-22	8.40	36
1-23	6.15	76
1-24	6.91	55
1-25	9.46	100
PDO-MW01	9.80/5.59	83
PDO-MW02	9.84/7.14	70
PDO-MW03	6.34/5.89	88
PDO-MW04	9-43/7.08	20

9-17-96

16

Tues. Sw. GA

1550 - Set up on 1-19
1715 - Collected 1-19 sample
1610 - Set up on 1-23
1730 - Collected 1-23 sample + Dup PDO-6005
1625 - Set up on 1-24
1745 - Collected 1-24 sample + split
1650 - Set up on 1-25
1805 - Collected 1-25 sample + MS/MSD
1550 - Collected PDO-ER02

D. Rowell

9-18-96

17

Wed

Hunter AAF

0700 - Arrive
0745 - Set up on 1-21
0940 - Sampled well # 1-21
0810 - Set up on 1-20
0950 - Sampled well # 1-20
0825 - Set up on # 1-22
1005 - Sampled well # 1-22
0845 - Set up on PDO-mw04
1015 - Sampled " "
0855 - Set up on PDO-mw01
1025 - Sampled " "
0905 - Set up on PDO-mw02
1035 - Sampled " "
0915 - Set up on PDO-mw03
1045 - Sampled " "
1330 - Set up @ PDO-sw/SE03 + Dup sw/SE04
1340 - Sampled PDO- " "
1400 - Set up on PDO-sw02
1415 - Sampled PDO - " "
1430 - Set up on PDO-sw/SE01
1440 - Sampled " "
1520 - Gauged prod. rec. Tank @ B. ~~823~~ 728
Water = 1" Total Vol = 29.5"
1530 - Changed sock in PK1 @ B. 133

D. Rowell

1-23-97

Hunter A.A.F, Sav. GA

1115 - Arrive onsite

1130 - Chatham Const. onsite to empty IDW drums. 28 drums H2O into tank truck and spread 12 drums soil on ground.

1330 - Commence emptying tank truck into SS.

PH was measured @ 6.8.

1430 - Re-labeled surbent sock drum.

1445 - Gauged tank at B.728

Product = 5"

water = 2.5"

1500 - Changed sock at FTA-MW07

1515 - " " " B.133 - PX01

1520 - Stacked pallets at PD yard + check labels on pumphouse drums.

1600 - Depart

1-24-97.

Hunter A.A.F, Sav. GA

0800 - Arrive.

0810 - Fortjen Recycling onsite to remove empty drums as scrap metal

0830 - Fortjen departs w/ 40 empty drums

1020 - Laid law arrives to remove 5 drums (4 non Haz, 1 Haz)

1110 - DPW signs manifests, Laidlaw departs.

1200 - Depart site

Mon 7/20/98

Onsite late afternoon
change absorbant socks at
728 - 2 wells 59, 61
FTA - #7
133 - PX1, PX1R
PH2 - MW27

Tues 7/21/98
Piedmont drilling onsite,
construct decon pad, drum shipment
arrives.
- Drill + install MW05 (shallow)
drill MW06 shallow to water - stop for
today.
Very hot + humid, using new Encore
10A soil samplers - hard to get cap
on sampler and sampler does not work
well in clayey/tight soils.

Wed 7/22/98 PC HOT, humid

- finished drilling & install MW06 (shallow) lots of bridging sand problems.
- drilled and installed MW10 (deep) 1 bag grout in today, will finish tomorrow.

Continue having problems with the Encore samplers - caps won't seat well.

Thurs 7/23/98 PC HOT humid

- Grout up MW10 (deep)
- Lithology & sample MW11 to 25 ft
- drill & install MW07 (shallow)

Fri 7/29/98

No work
Driller D. Young sick
- Demob for weekend

Mon - No work - no driller

Tues 7/28/98
- Mob to site
- drill + install MW 08 (shallow)
- using new/modified Encore soil sampler - works much better than previous model

Wed 7/29/98

- Drilled and installed MW09.
  Had to redrill it twice, lots of sand flowing and bridging problems.
- Could not install MW11 casing since storm last night wet grout.
- developed 3 wells
  2 shallow - MW05, 08
  1 deep - MW10

Thurs 7/30/98

- Set casing at MW11
- Develop MW09, grout MW09
  Half-developed MW06 - v. slow recharger
- Moved drums into PDO Yard.

Fri 7/31/98

- drilled 2nd stage of MW11 and set well
- developed MW11 (deep) and MW07 (shallow)
- moved all drums into PDO yard
- poured all pads/posts except MW11.

SAT 8/1/98

- Attached nameplates, checked locks, clean up
- Make pad at MW11, paint all posts, top off settled concrete in posts,
- Tear down decon pad
- Demob offsite

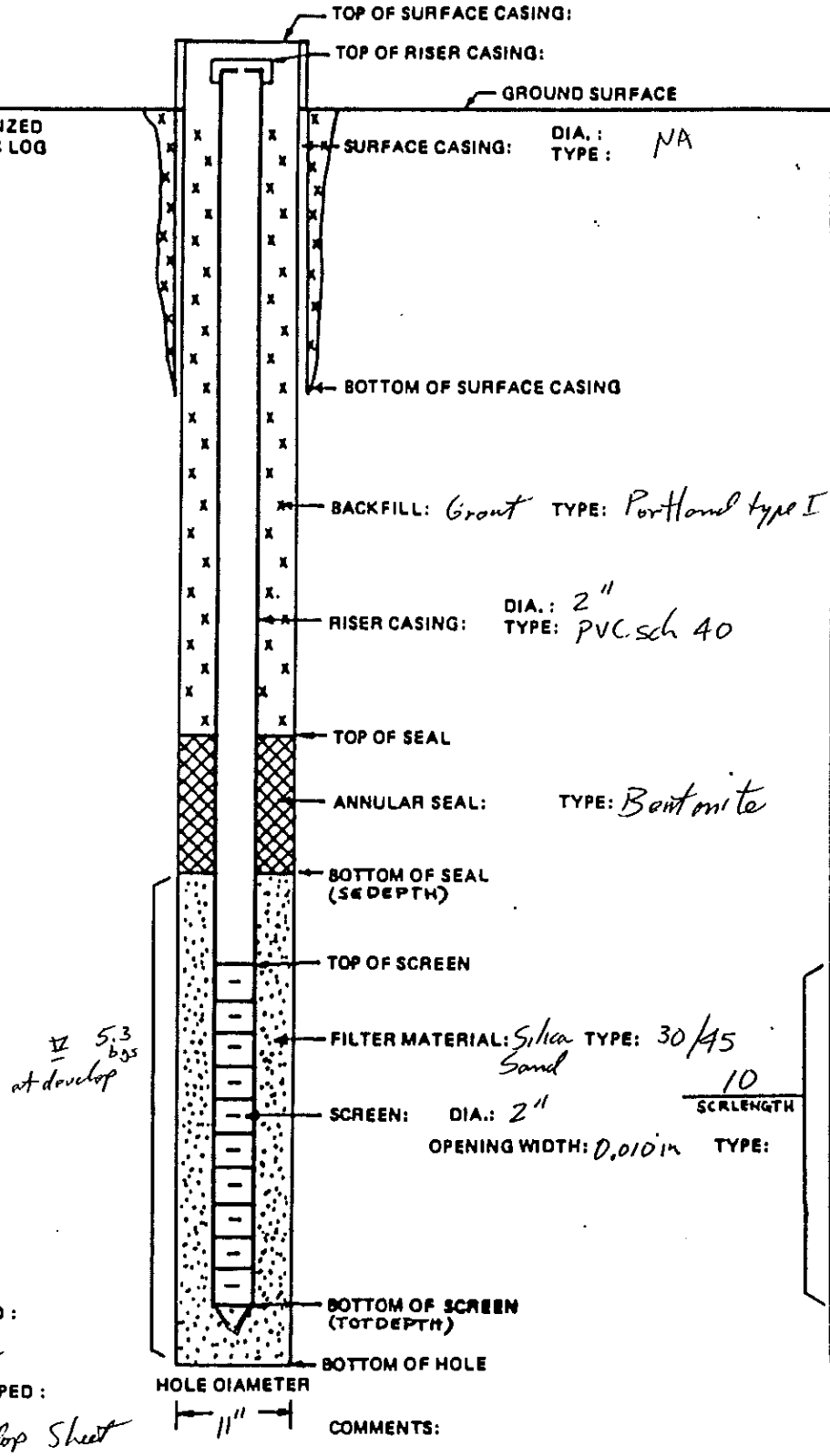
APPENDIX F

MONITORING WELL CONSTRUCTION DIAGRAMS

GROUND WATER INSTALLATION

PROJECT: PDO Yard	JOB NO. 017830	WELL NO. PDO - MW01	
DRILLING CONTRACTOR: PSI	COORDINATES:		
BEGUN: 8/26/96 FINISHED: 8/26/96	SUPERVISOR: D. Humphris DRILLER: K. Durham	WELL SITE:	WATER LEVEL. DEPTH/ELEV 5.3' bgs

REFERENCE POINT & ELEVATION:



DEPTH IN FT.	ELEV. IN
0	17.7
NA	
1.0	16.7
1.5	16.2
2.0	15.7
NA	
12.0	5.7
13.0	4.7

METHOD DRILLED: 6¼" ID HSA

METHOD DEVELOPED: See Develop Sheet

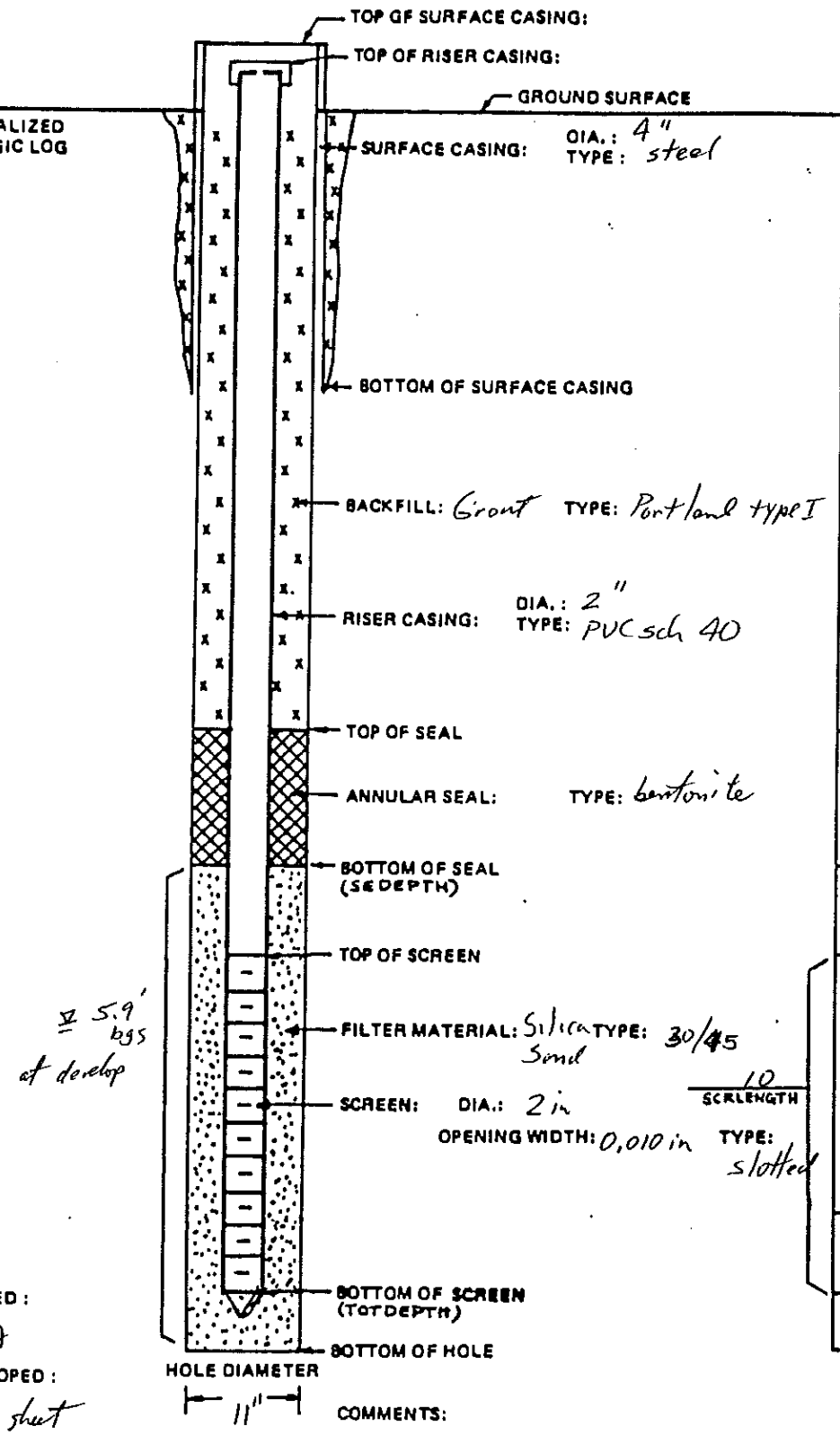
TIME DEVELOPED:

COMMENTS:

Metcalf & Eddy

GROUND WATER INSTALLATION	PROJECT: PDO/1310	JOB NO. 017830	WELL NO. PDO-MW02
DRILLING CONTRACTOR: PSI	COORDINATES:		
BEGUN: 8/26/96 FINISHED: 8/26/96	SUPERVISOR: D. Humphris DRILLER: K. Durham	WELL SITE:	WATER LEVEL. DEPTH/ELEV 5.9' bgs

REFERENCE POINT & ELEVATION:



	DEPTH IN FT	ELEV. IN MSL
	0	17.8
	1.0	16.8
	1.0	16.8
	2.0	15.8
	3.0	14.8
	NA	
	13.0	4.8
	14.0	3.8

METHOD DRILLED: 6¼" ID HSA

METHOD DEVELOPED: See Develop sheet

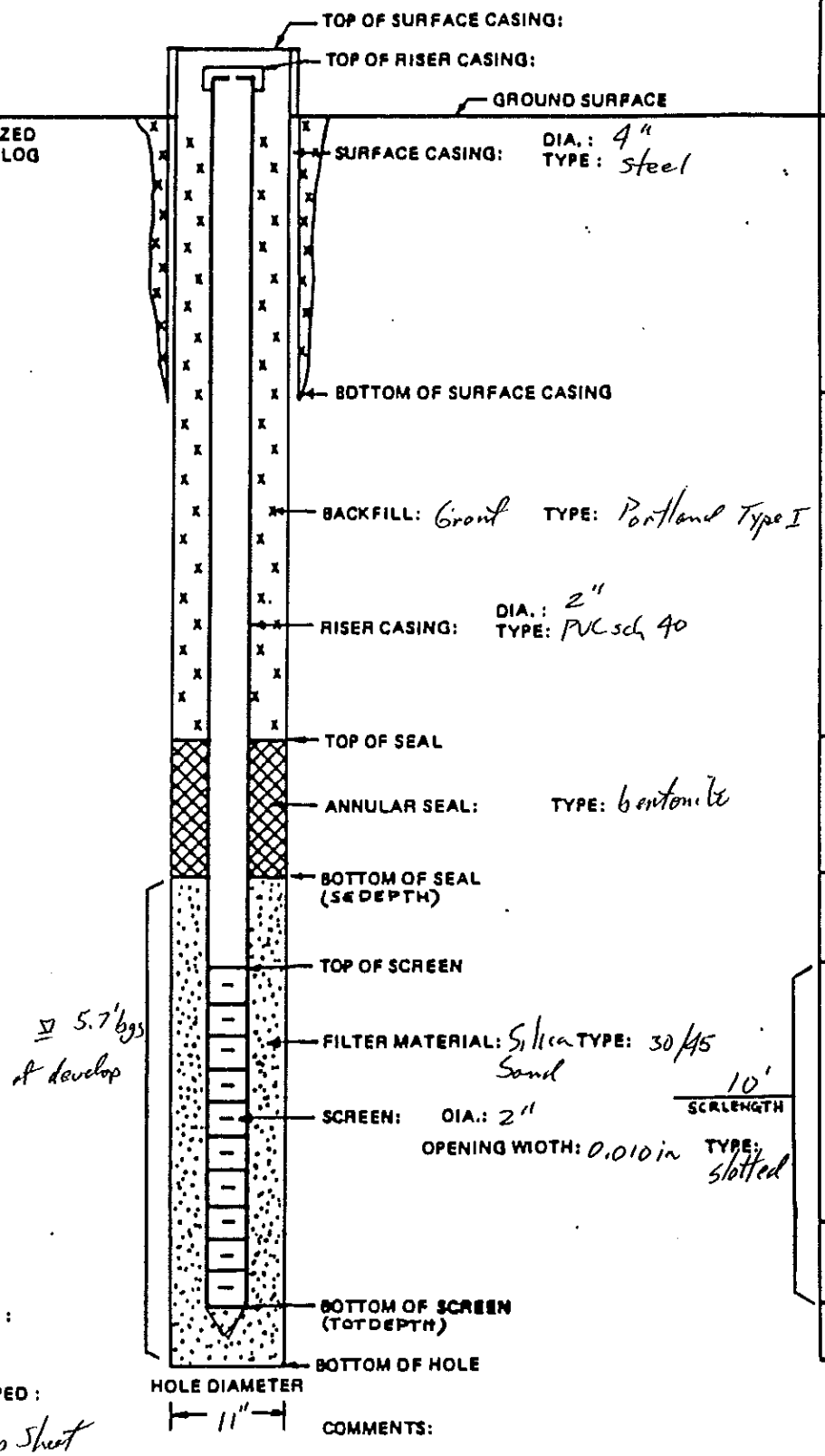
TIME DEVELOPED:

COMMENTS:

Metcalf & Eddy

GROUND WATER INSTALLATION	PROJECT: PDO/1310	JOB NO. 017830	WELL NO. PDO-MW03
DRILLING CONTRACTOR: PSI	COORDINATES:		
BEGUN: 8/26/96 FINISHED: 8/26/96	SUPERVISOR: D. Humphris DRILLER: K. Durham	WELL SITE:	WATER LEVEL. DEPTH/ELEV 5.7' bgs

REFERENCE POINT & ELEVATION:



	DEPTH IN FT	ELEV. IN MSL
TOP OF SURFACE CASING:		
TOP OF RISER CASING:		
GROUND SURFACE	0	17.3'
BOTTOM OF SURFACE CASING	1.0	16.3
	1.0	16.3
TOP OF SEAL		
ANNULAR SEAL		
	1.5	15.8
BOTTOM OF SEAL (SE DEPTH)	2.0	15.3
TOP OF SCREEN		
	NA	
BOTTOM OF SCREEN (TOT DEPTH)	12.0	5.3
BOTTOM OF HOLE	13.0	4.3

METHOD DRILLED: 6 1/4" ID HSA

METHOD DEVELOPED: See Develop Sheet

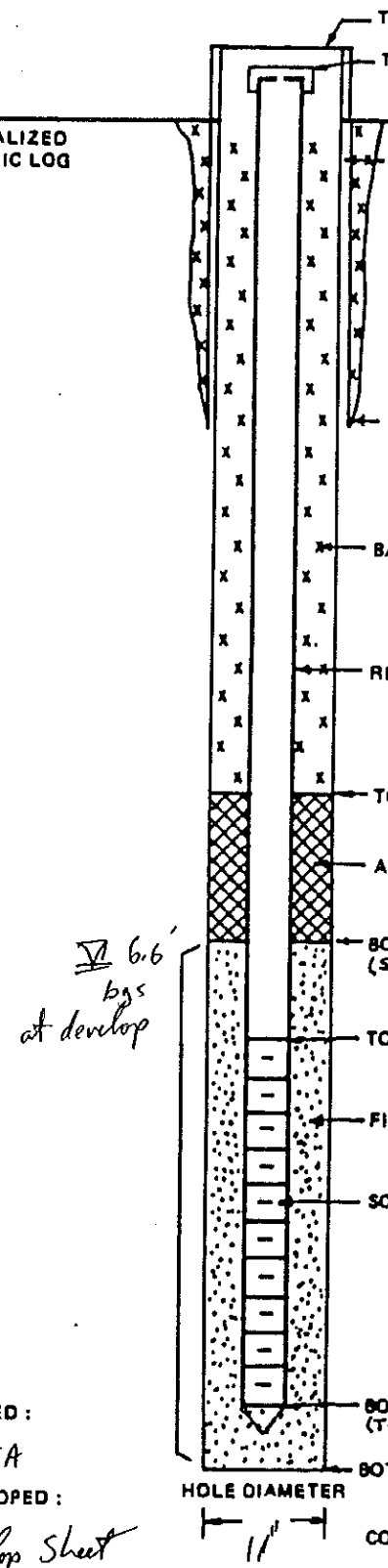
TIME DEVELOPED:

COMMENTS:

Metcalf & Eddy

GROUND WATER INSTALLATION	PROJECT: PDO/1310	JOB NO. 017830	WELL NO. PDO-MW04
DRILLING CONTRACTOR: PSI	COORDINATES:		
BEGUN: 8/21 FINISHED:	SUPERVISOR: D. Humphries DRILLER: K. Durham	WELL SITE:	WATER LEVEL. DEPTH/ELEV 6.6' bgs

REFERENCE POINT & ELEVATION:



DEPTH IN FT.	ELEV. IN MSL
0	26.0'
2.0	24.0'
5.0	21.0'
6.6	19.4'
8.0	14.0'
NA	
18.0	4.0'
19.0	3.0'

▽ 6.6' bgs at develop

METHOD DRILLED: 6¼" ID HSA

METHOD DEVELOPED: See Develop Sheet

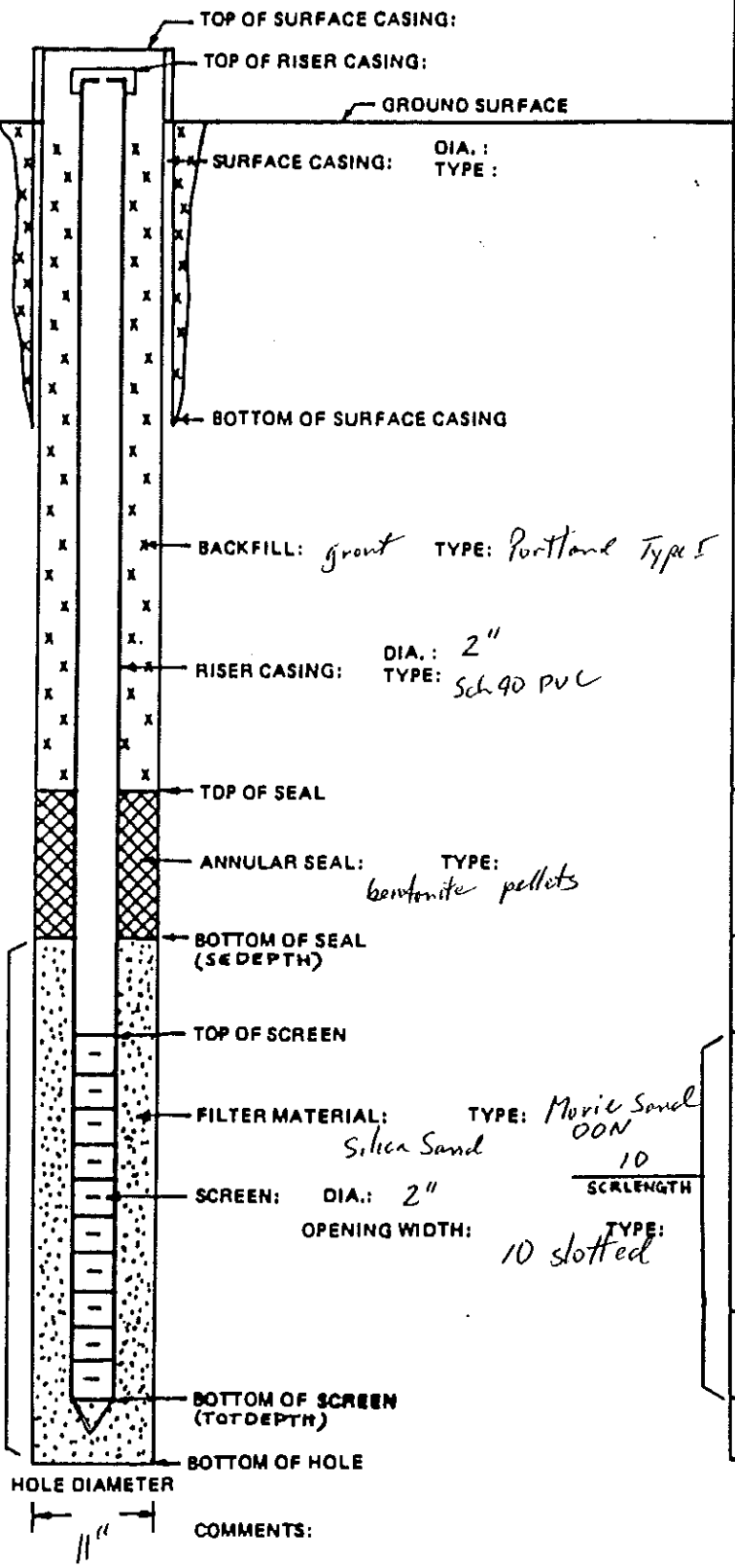
TIME DEVELOPED:

COMMENTS:

Metcalf & Eddy

GROUND WATER INSTALLATION	PROJECT: HAAP PDO	JOB NO. 021974	WELL NO. MW05
DRILLING CONTRACTOR: Piedmont	COORDINATES:		
BEGUN: 7/21/98 FINISHED: 7/21/98	SUPERVISOR: D. Humphris DRILLER: Dan Young	WELL SITE:	WATER LEVEL. DEPTH/ELEV

REFERENCE POINT & ELEVATION:



DEPTH IN	ELEV. IN
NA	
1.5	
3.5	
6.0	
NA	
16.0	
16.5	

METHOD DRILLED: 6 1/4" HSA

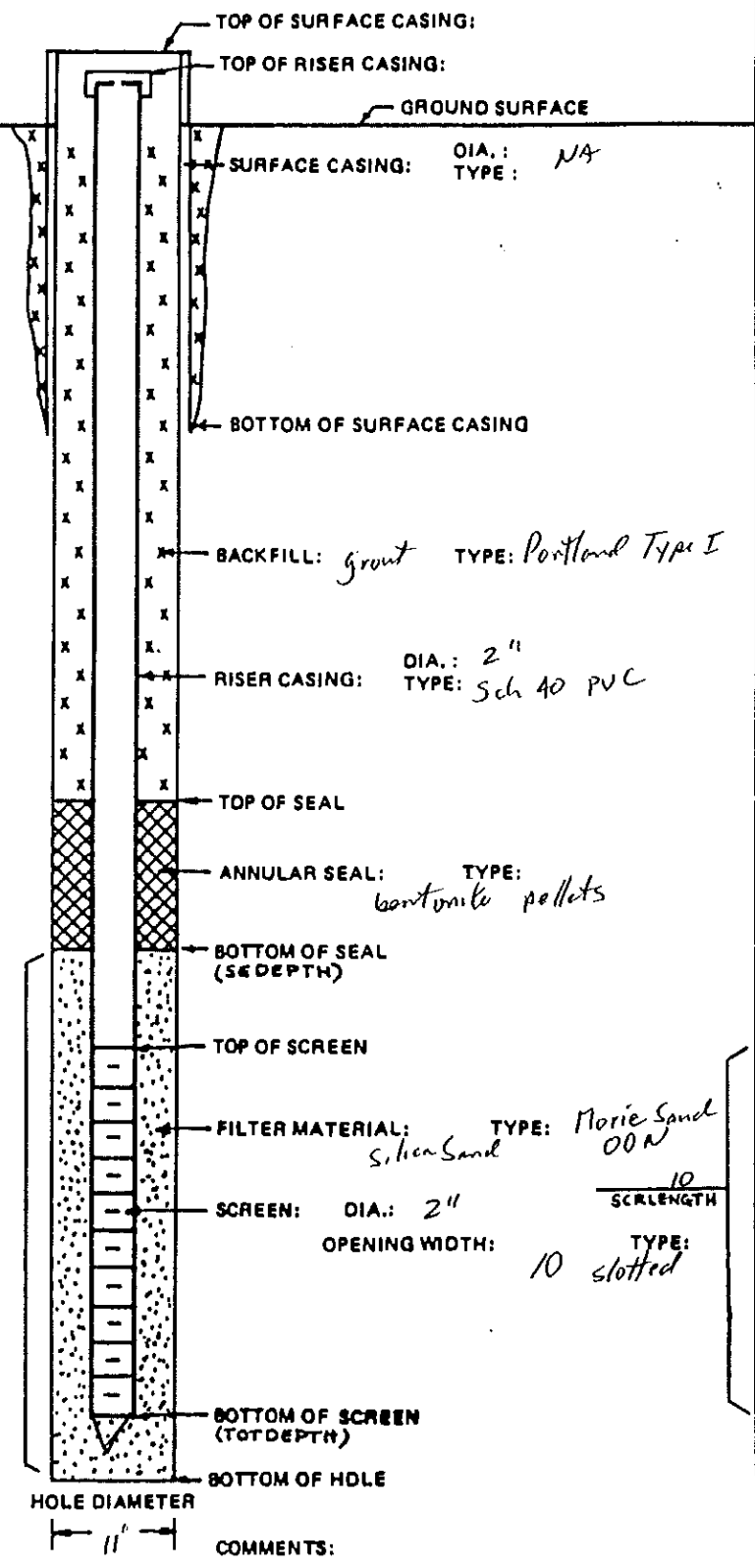
METHOD DEVELOPED:

TIME DEVELOPED:

Metcalf & Eddy

GROUND WATER INSTALLATION	PROJECT: HAAF PDO	JOB NO. 021974	WELL NO. MW06
DRILLING CONTRACTOR: Piedmont	COORDINATES:		
BEGUN: 7/22/98 FINISHED: 7/22/98	SUPERVISOR: D. Humphries DRILLER: D. Young	WELL SITE:	WATER LEVEL. DEPTH/ELEV

REFERENCE POINT & ELEVATION:



DEPTH IN	ELEV. IN
NA	
1.5	
3.5	
5.5	
—	
15.5	
16.0	

METHOD DRILLED :
6 1/4" ID HSA

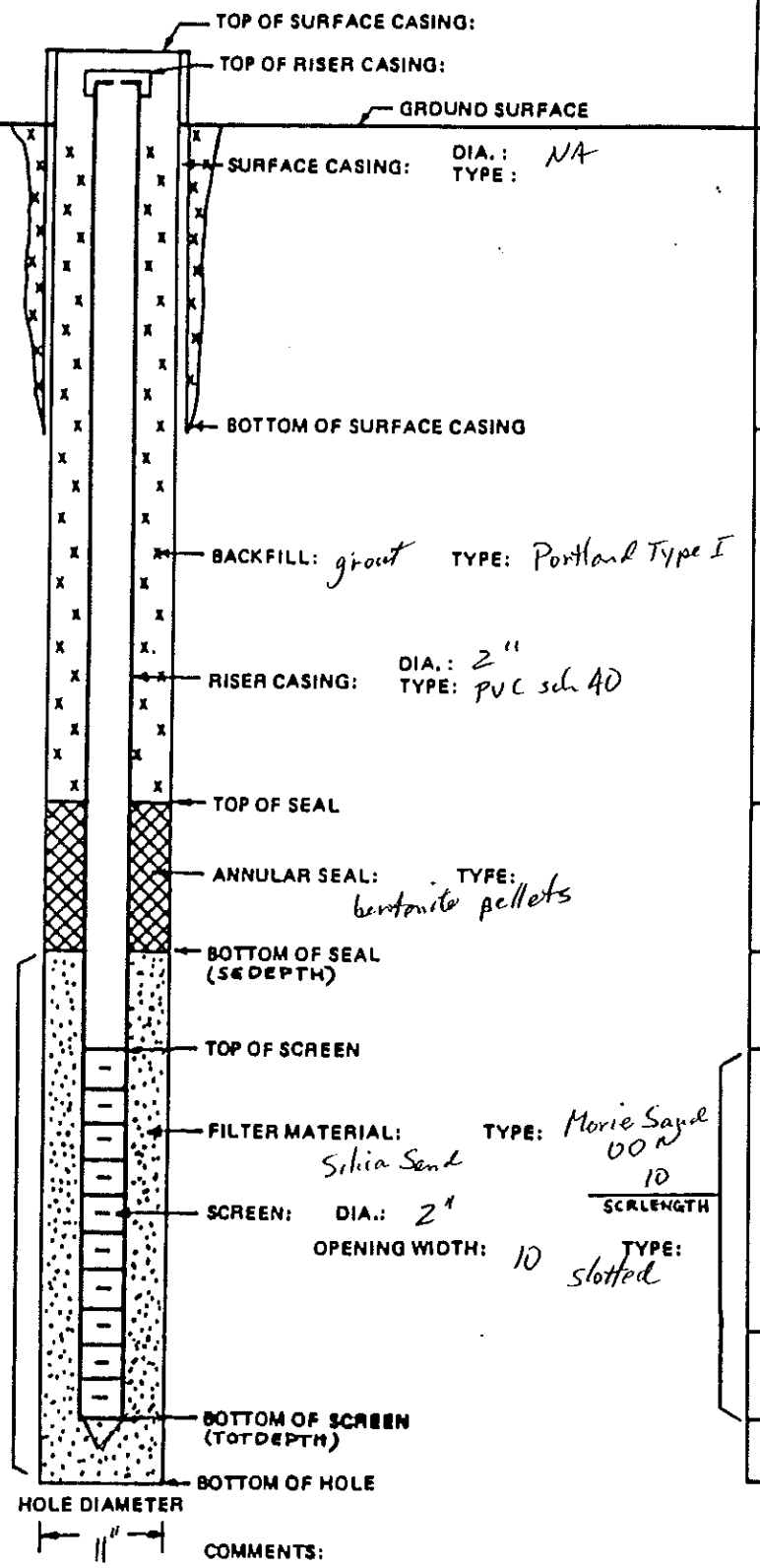
METHOD DEVELOPED :

TIME DEVELOPED :

Metcalf & Eddy

GROUND WATER INSTALLATION	PROJECT: HAAP PDO LTM	JOB NO. 021974	WELL NO. MW07
DRILLING CONTRACTOR: Piedmont	COORDINATES:		
BEGUN: 7/23/98 FINISHED: 7/23/98	SUPERVISOR: D. Humphris DRILLER: D. Young	WELL SITE:	WATER LEVEL. DEPTH/ELEV

REFERENCE POINT & ELEVATION:



DEPTH IN	ELEV. IN
NA	
1.0	
2.0	
4.0	
—	
14.0	
14.0	

METHOD DRILLED :
6 1/4" ID HSA

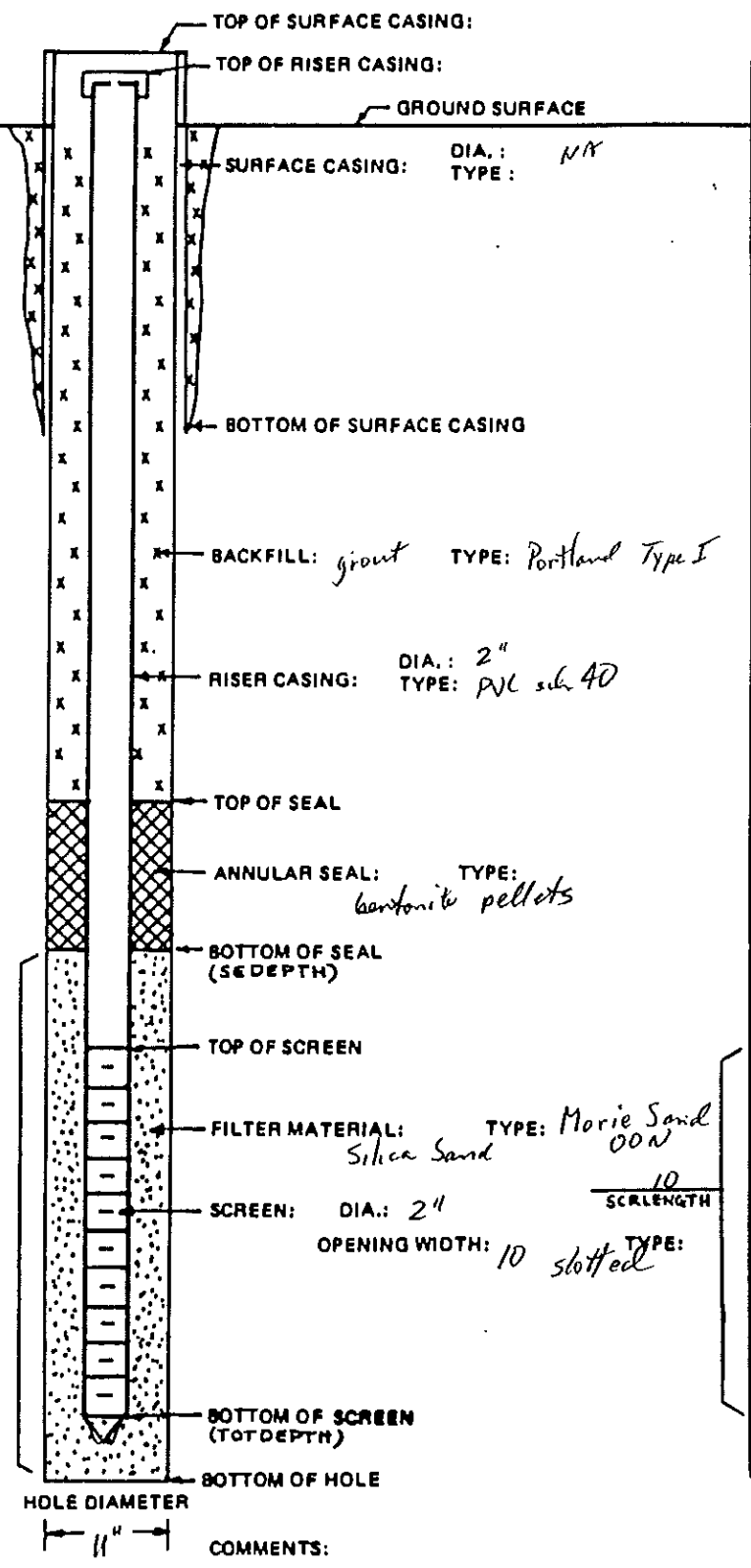
METHOD DEVELOPED :

TIME DEVELOPED :

Metcalf & Eddy

GROUND WATER INSTALLATION	PROJECT: Hunter LTM	JOB NO. 021974	WELL NO. MW08
DRILLING CONTRACTOR: Piedmont	COORDINATES:		
BEGUN: 7/28/98 FINISHED: 7/28/98	SUPERVISOR: D. Humphris DRILLER: B. Lynch	WELL SITE:	WATER LEVEL. DEPTH/ELEV

REFERENCE POINT & ELEVATION:



	DEPTH IN	ELEV. IN
	NA	
	1.0	
	2.0	
	3.0	
	—	
	13.0	
	14.0	

METHOD DRILLED: 6 1/4" ID HSA

METHOD DEVELOPED:

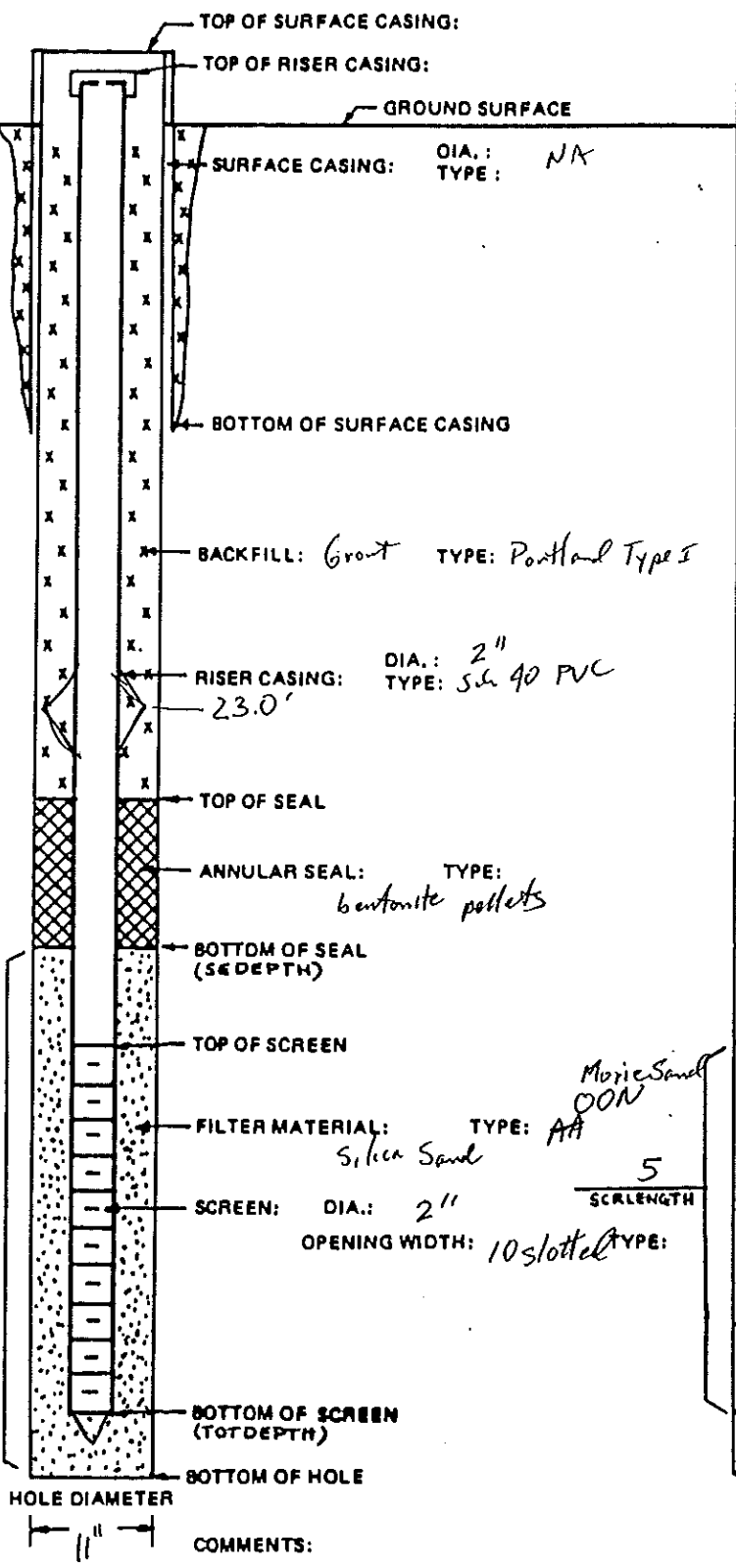
TIME DEVELOPED:

Metcalf & Eddy

GROUND WATER INSTALLATION	PROJECT: Hunter LTM	JOB NO. 021974	WELL NO. MW09
DRILLING CONTRACTOR: Piedmont	COORDINATES:		
BEGUN: / FINISHED:	SUPERVISOR: D. Humphrie / DRILLER:	WELL SITE:	WATER LEVEL. DEPTH/ELEV

REFERENCE POINT & ELEVATION:

DEPTH IN	ELEV. IN



DEPTH IN	ELEV. IN
NA	
21.0	
21.0	
29.1	
Morie Sand 00N	
5 SCRLENGTH	
34.1	
35.0	

METHOD DRILLED : 6 1/4 HSA

METHOD DEVELOPED :

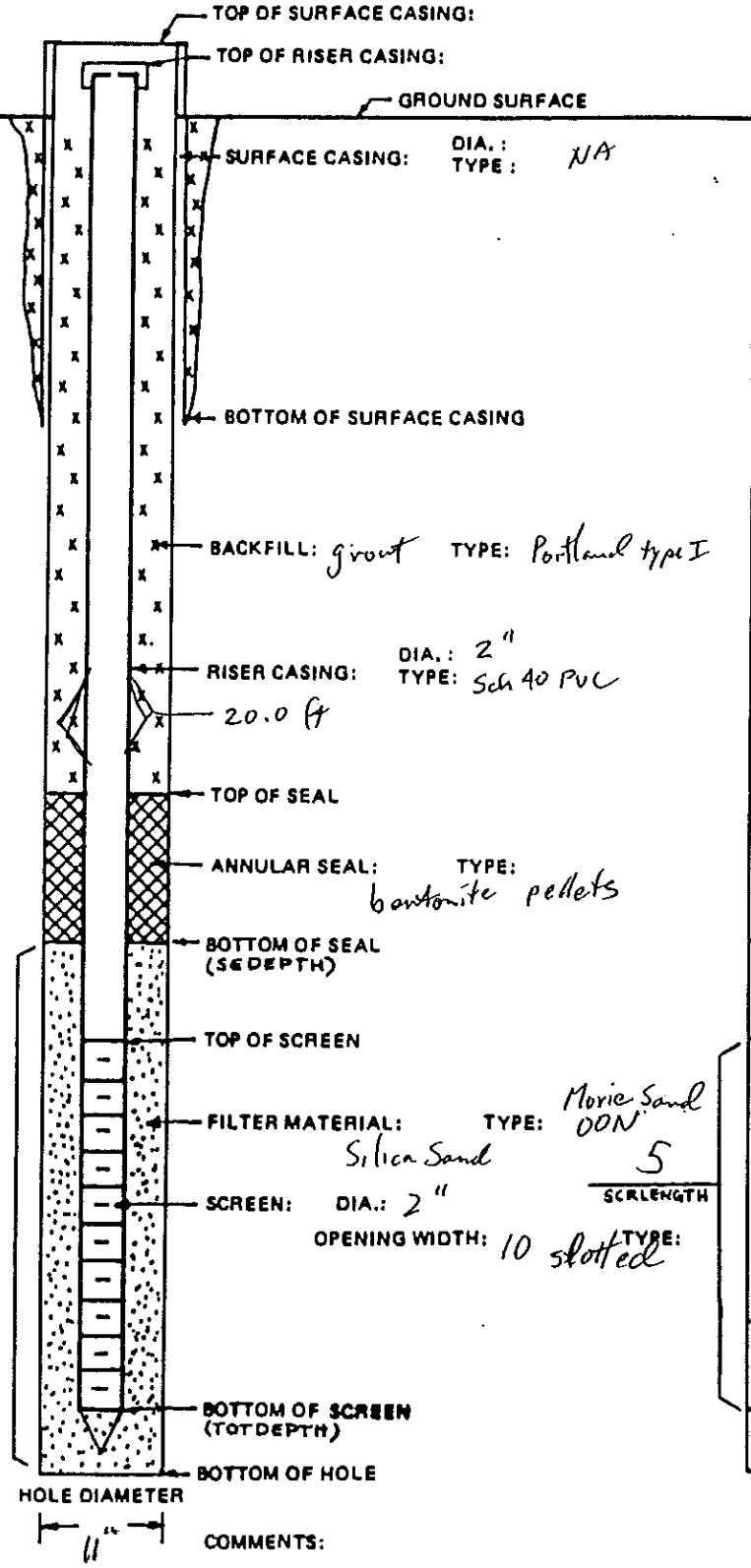
TIME DEVELOPED :

Metcalf & Eddy

GROUND WATER INSTALLATION	PROJECT: Hunter LTM	JOB NO. 021974	WELL NO. MW10
DRILLING CONTRACTOR: Piedmont	COORDINATES:		
BEGUN: 7/22/98 FINISHED: 7/22/98	SUPERVISOR: D. Humphries DRILLER: D. Young	WELL SITE:	WATER LEVEL. DEPTH/ELEV

REFERENCE POINT & ELEVATION:

DEPTH IN	ELEV. IN



DEPTH IN	ELEV. IN
NA	
20.9	
23.9	
26.0	
—	
31.0	
32.0	

METHOD DRILLED: 6 1/4" ID HSA

METHOD DEVELOPED:

TIME DEVELOPED:

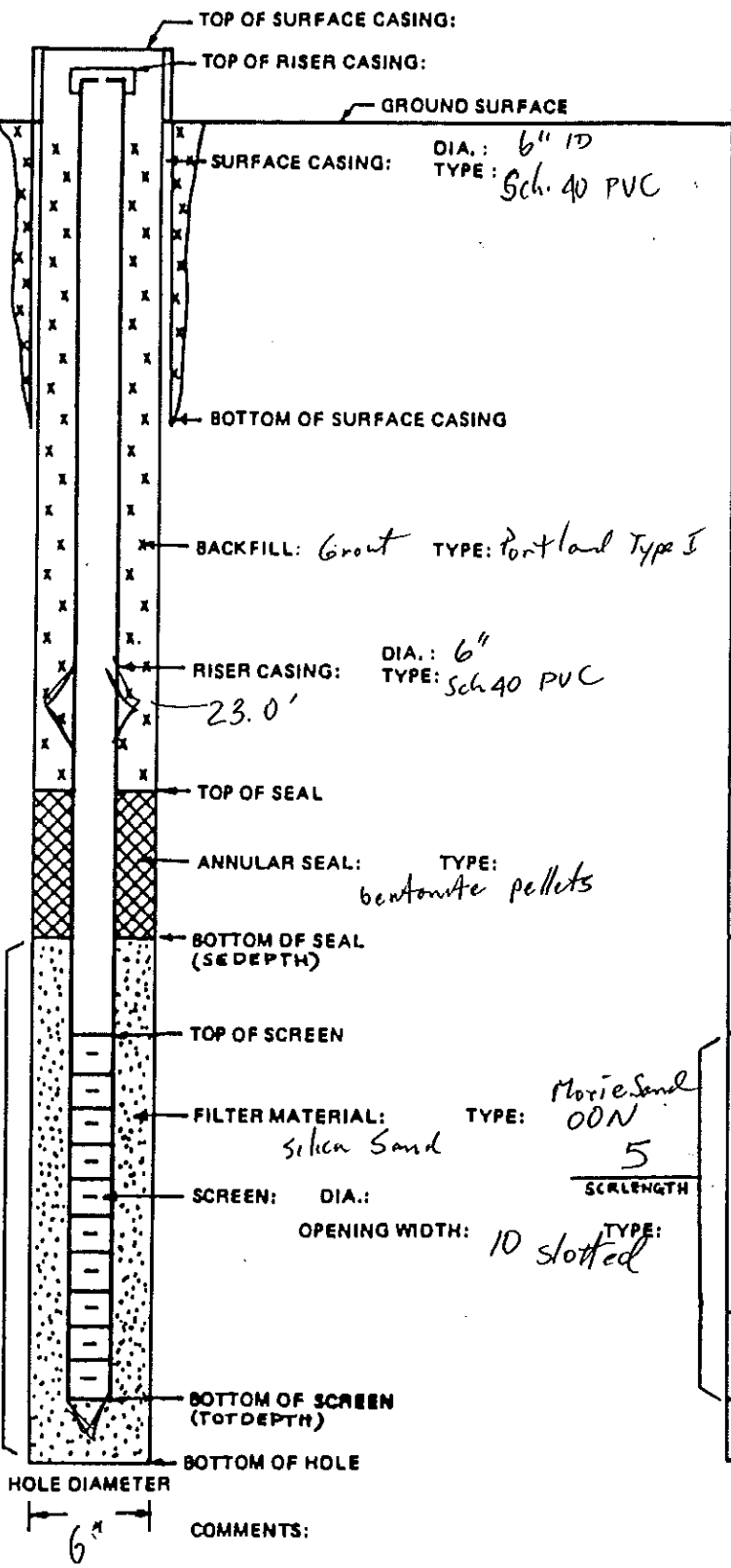
COMMENTS:

Metcalf & Eddy

GROUND WATER INSTALLATION

PROJECT: Hunter LTM JOB NO. 021974		WELL NO. MW11
DRILLING CONTRACTOR: Piedmont	COORDINATES:	
BEGUN: / FINISHED:	SUPERVISOR: D. Humphris / DRILLER: T. Young / B. Lynch	WELL SITE:
WATER LEVEL. DEPTH/ELEV		

REFERENCE POINT & ELEVATION:



DEPTH IN	ELEV. IN
25.0	
24.5	
26.8	
29.0	
—	
34.0	
35.0	

METHOD DRILLED:
8¼" ID HSA for 25'
6" Mud Rotary to 35'

METHOD DEVELOPED:

TIME DEVELOPED:

Metcalf & Eddy

APPENDIX G

WELL DEVELOPMENT AND SAMPLING RECORDS

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: PDO-MW01

METHOD OF DEVELOPMENT: 12V DC Whale Pump

DATE: 8/28/96

STATIC WATER LEVEL: 5.3' bgs

LOGGED BY: D. Humphris

TD = 12.0' 1 Vol = 10.7 gal

5 vol = 55 gal + 35 = 90 gal

SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
1	0831	81.5	5.10	431		2.2	2		Surge @ 0, 2, 5
2	0844	82.0	5.11	268			10		Surge @ 10, 15
3	0859	81.8	4.16	417			20		Surge @ 20, 25
4	0913	82.2	4.27	434			30		Surge @ 30, 35
5	0930	81.6	4.04	384			40		clearing
6	0937	81.1	4.17	282		1-2	50		clear, sulfur odor
7	0945	80.8	4.04	403			60		clear
8	0959	80.8	4.19	268			70		"
9	1008	81.8	4.17	395			80		"
10	1016	80.7	4.22	366			90	Y	-

TOTAL DEVELOPMENT TIME: 1:45

TOTAL VOLUME PURGED: 90 GAL

COMMENTS: clear, sulfur odor

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: PDO-MW02

DATE: 8-28-96

LOGGED BY: G. Rowell

METHOD OF DEVELOPMENT: 2" Grundfos Redi-Flo

STATIC WATER LEVEL: 5.85 ~~TOC~~ BGS

1 vol = 11.4 GAL

5 vol = 57.2 GAL + 35 GAL = 92.2 GAL

SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
1	1035	79.6	4.97	133			5		surge @ 0 GAL
2	1040	79.5	4.99	129			10		" 5 "
3	1045	79.2	5.03	129			15		" 10 "
4	1050	78.4	5.19	128			20		" 15 "
5	1100	78.2	5.09	127			25		" 20 "
6	1105	78.5	5.07	127			30		" 25 "
7	1115	79.2	5.05	124			40		" 30 "
8	1125	79.1	4.96	121			50		clearing
9	1140	80.4	4.88	124			70		clear
10	1200	80.7	4.90	124			90	Y	clear
							95 end		

TOTAL DEVELOPMENT TIME: 1hr : 25 min

TOTAL VOLUME PURGED: 95 GAL

COMMENTS _____

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: PDO - MW03

METHOD OF DEVELOPMENT: 12V DC Whale Pump

DATE: 8/28/96

STATIC WATER LEVEL: 8.40' TOC / 5.7' bgs

LOGGED BY: D. Humphris

1 vol = 10.1 gal
6.3' water in well
5 vol = 50.5 gal

SAMPLE NO.	TIME 1105	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
1	1109	80.4	4.70	122		≈2.2	2		Surge @ 0, 2, 5 - Dry @ 9
2	1123	79.5	4.69	139			10		Surge @ 10, 15
3	1133	79.6	4.60	155		1-2	15		
4	1141	80.0	4.66	185			20		Surge @ 20, dry @ 3-4 gals.
5	1202	79.2	4.42	158			30		clearing
6	1208	79.7	4.37	167			40		clear
7	1217	79.7	4.34	162			50		"
8	END						51	Y	clear, sl. sulfur odor

TOTAL DEVELOPMENT TIME: 1:12

TOTAL VOLUME PURGED: 51 GAL

COMMENTS: Clear, sl. sulfur odor

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: PDO - MW04

METHOD OF DEVELOPMENT: 2" Grundfos Red. Flo

DATE: 8-28-96

STATIC WATER LEVEL: 9.7' TOC

LOGGED BY: G. Rowell

1 vol = 16.2 GAL

5 vol = 81 GAL + 50 GAL = 131 GAL

SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
1	1400	82.7	5.76	120		≈1.5	5		surge @ 0 GALS 1350
2	1410	82.3	6.22	112			10		" 5 "
3	1425	79.7	5.45	106			15		" 10 "
4	1435	80.6	5.49	92.0			20		" 15 "
5	1445	80.8	5.50	89.5			25		" 20 "
6	1455	80.2	5.62	80.1			30		" 25 "
7	1505	78.3	5.77	73.2		≈1.0	35		" 30 "
8	1525	80.6	5.26	68.5			~~40~~ 45		" 35 "
9	1535	79.2	5.32	66.6			50		clear
10	1615	78.1	5.19	66.1			70		
11	1655	77.5	5.23	62.8			90		
8/29/96 12	0715	74.9	5.15	83.1			110		Emp 8/28/96 @ 100 gal - Rain
13	0745	75.9	5.12	76.5			130	Y	

TOTAL DEVELOPMENT TIME: 3hr : 40min

TOTAL VOLUME PURGED: 132 GAL.

COMMENTS

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: MW 05

METHOD OF DEVELOPMENT: Surge Block/Whale Pump

DATE: 7-27-98

STATIC WATER LEVEL: 7.36

LOGGED BY: DLW

SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
	9:08								Surged 10X
	9:12					1.25	5		Gray fine sand (Turbid)
	9:18								Surged 10X
	9:21					1.~~25~~	10		Same
	9:26								Surged 10X
	9:29					1.66	15		Same
	9:32								Surged 10X
	9:35					1.66	20		Same
	9:38								Surged 10X
	9:41					1.66	25		Slightly cleaner
	9:44								Surged 10X
	9:48					1.25	30		Same
	9:51								Surged 10X
	9:54					1.44	35		Slightly clearer
	9:57								Surged 10X
	9:59					2.50	40		light grey
	10:03					1.25	45		Cloudy
	10:06					1.66	50		Cloudy
	10:09					1.66	55		"
	10:12					1.66	60		"
	1025					1.53	80		Clear

TOTAL DEVELOPMENT TIME: ~~730 - 1030 = 3 hours~~ 77 min

TOTAL VOLUME PURGED: 80

COMMENTS

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: MW06

DATE: 7-30-98 / 7-31-98

LOGGED BY: DLW

METHOD OF DEVELOPMENT: Surge block / Whale Pump

STATIC WATER LEVEL: 8.08'

+35 gal

SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
	1204								Surged 10X
	1205					1.5	1.5		Dark gray - Dry (wait 10 min)
	1216					1.5	3		Same - Dry: Wait 9 min
	1226					1.0	4		Same - Dry: Wait 9 min
	1231					1.0	5		Same - Dry: Wait 9 min
	1248								Surged 10X
	1430						14		Very Slow Recharge
	1435								Surged 10X
	1437					1.0	16		Same: Dry
	1448								Surged 10X
	1447					1.0	18		Same: Dry
	1452								Recharge ~ 4 gal/min
	1456								Surged 10X
	1458					~1	20		Same: Dry
	1604								Surged 10X
	1508					~1	22		Same: Dry
	1514								Surged 10X
	1516					~1	24		slightly Clearer: Dry
	1525								Surged 10X
	1542					~1	30		Cloudy: Dry: Wait 10 min
	1605					~0.5	35		Same: Dry
	1625					0.25	40		Clearer
*1	1750					~0.5	57		Almost Clear: Stop for Dry
7-31-98	0740					~1.25	59		Almost Clear: Dry
	0840					~1.25	75	Yes	Clear, no sediment

TOTAL DEVELOPMENT TIME: 406 min

TOTAL VOLUME PURGED: 75

COMMENTS *1: Sample set overnight with small amount of sand settling out - still slightly cloudy

Whale Pump

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: MW07

METHOD OF DEVELOPMENT: Surge block/

DATE: 7-30-98/7-31-98

STATIC WATER LEVEL: 7.77

LOGGED BY: DLW

+ 15 gal

SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
	1734					~0.5	2		Surge 10 X, Pumped Dry
	1741					~0.5	4		" " "
7-31-98	0853					~1.0	5.5		" " " Dark gray
	0856					~1.0	6.5		" " " "
	0908					~1.0	7.5		" " " "
	0914					~1.0	9.0		" " " "
	0919					~1.0	10.5		" " " "
	0926					~1.0	14		" " " Slightly clearer
	0938					~1.0	17		" " " "
	0949					~1.0	22		" " Not Dry "
	0951					~1.0	24		Dry
	1054					0.59	55		Cloudy
	1200					~0.5	90		Almost Clear, sediment free
									Stop Pump for ~1.5 hrs
	1430						125	Y	clear, no sediment

TOTAL DEVELOPMENT TIME: _____

TOTAL VOLUME PURGED: _____

COMMENTS _____

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: MW08

METHOD OF DEVELOPMENT: Surge block/Whale Pump

DATE: 7-29-98

STATIC WATER LEVEL: 7.01

LOGGED BY: DLW

+35 gal

SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
	1131								Surged 10X
	1156					1	5		Dark gray fine sand
	1138								Surged 10X
	1141					0.66	7		Same - Dry: Stop 30 min
	1216					0.75	10		Same
	1219								Surge 10X
	1227					0.63	15		Slightly Clearer - Going Dry
	1230								Surge 10X
	1238					0.63	20		Slightly Clearer
	1241								Surge 10X
	1248					0.72	25		Cloudy
	1251								Surge 10X
	1300					0.56	30		Clearer
	1303								Surge 10X
	1306					0.33	31		Dry: Stop 10 min
	1319					1.25	35		Dry - Cloudy: Wait 5 min
	1328								Surge 10X
	1331					0.75	38		Dry - Cloudy: wait 10 min
	1342					2	40		Cloudy
1353	[illegible]						45		Cloudy
	1441					0.5	55		Cloudy
	1504					0.4	65		slightly cloudy/almost clear
	1530					0.4	75	Yes	clear

TOTAL DEVELOPMENT TIME: 2hr 30min

TOTAL VOLUME PURGED: 75 gal

COMMENTS

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: MW09

DATE: 7-30-98

LOGGED BY: DLW

METHOD OF DEVELOPMENT: Surge block/Whale Pump

~~STATIC~~ WATER LEVEL: 4.56 and Dropping

SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
	0830								Surge 10X
	0833					1.66	5		Dark gray fine sand
	0837								Surged 10X
	0840					1.66	10		Same
	0845								Surged 10X
	0848					1.66	15		Same
	0852								Surged 10X
	0855					1.66	20		Same
	0858								Surged 10X
	0901					1.66	25		Slightly Clearer
	0907								Surged 10X
0910	~~0907~~					1.66	30		Same
	0914								Surged 10X
	0917					1.66	35		Same
	0921								Surged 10X
	0924					1.66	40		Same
	0948					1.66	80		Slightly Cloudy
	0956					1.25	90		~~Same~~ Almost Clear
	1057					0.33	110		Same: Stop 15 min
	1237					0.20	130		Same: No Sediment @ 10 min
	1317					1.0	170	Yes	Clear

TOTAL DEVELOPMENT TIME: 287 min

TOTAL VOLUME PURGED: 170 gallons

COMMENTS

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: MW10

METHOD OF DEVELOPMENT: Surgeblock/Whale Pump

DATE: 7-29-98

STATIC WATER LEVEL: 5.62

LOGGED BY: DCW

SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
	1500								Surge 10X
	1503					1.66	5		Dark Gray fine sand
	1508								Surge 10X
	1511					1.66	10		Same
	1516								Surge 10X
	1519					1.66	15		Same
	1524								Surge 10X
	1527					1.66	20		Slightly Clearer
	1532								Surge 10X
	1535					1.66	25		Same
	1538								Surge 10X
	1541					1.66	30		Same
	1546								Surge 10X
	1549					1.66	35		Same
	1553								Surge 10X
	1556					1.66	40		Cloudy
	1559					1.64	45		Slightly Cloudy
	1608					1.64	60		Almost Clear
	1614					1.66	70		~~Same~~ Clearer
	1623					1.46	85		Same
	1629					1.44	95		Same
	1633					1.50	100		Same
	1707					1.50	151		Clear
	1718					1.50	165	Yes	Clear

TOTAL DEVELOPMENT TIME: 138 min

TOTAL VOLUME PURGED: 165

COMMENTS

MONITORING WELL DEVELOPMENT

Metcalf & Eddy

WELL I.D. NO.: MW11

DATE: 7-31-98

LOGGED BY: DLW

METHOD OF DEVELOPMENT: Surge Block/Whale Pump

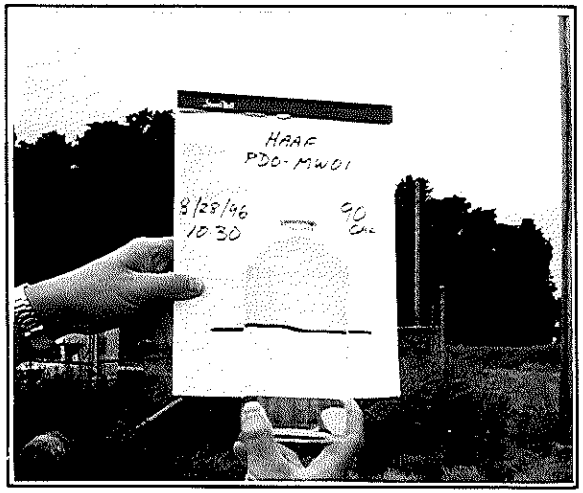
STATIC WATER LEVEL: ~6

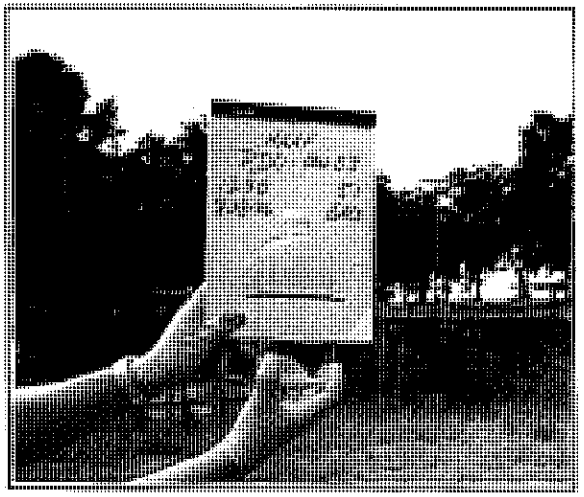
SAMPLE NO.	TIME	PARAMETERS				PUMPING RATE (gpm)	VOLUME PUMPED (gal)	PHOTO TAKEN	OBSERVATIONS
		TEMP (°F)	pH	COND'Y (umhos)	TURBIDITY (NTU)				
	1405					~1.0	5		Surged 10X, Pump: Grey
	1413					~1.0	10		Surged 10X, Pump: Same
	1421					~1.0	15		Surged 10X, Pump: Slightly clearer
	1431					~1.0	20		" , Pump: Grey then ~1 gallon cloudy
	1439					~1.0	25		" " "
	1448					~1.0	30		" " "
	1456					~1.0	35		" " "
	1505					~1.0	40		" " Clearer
	1513					~1.0	45		" " "
	1525					1.25	60		Slightly Cloudy
	1541					1.25	80		Almost Clear
	1605					1.25	110		Clear
1	1617					1.25	125	Yes	Clear

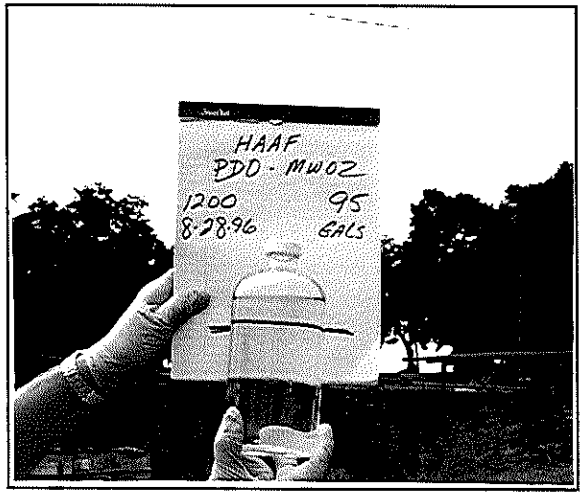
TOTAL DEVELOPMENT TIME: 125

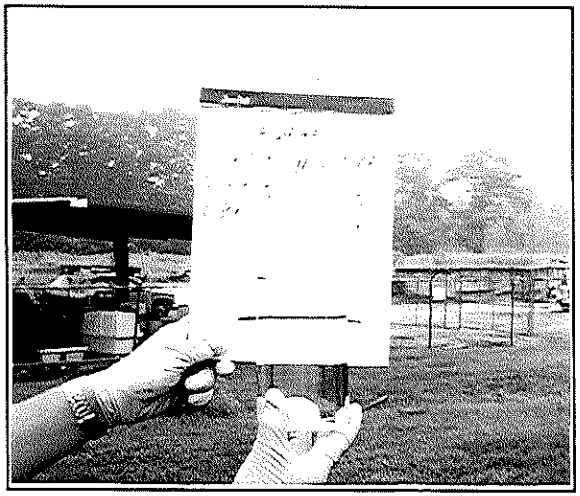
TOTAL VOLUME PURGED: 125

COMMENTS

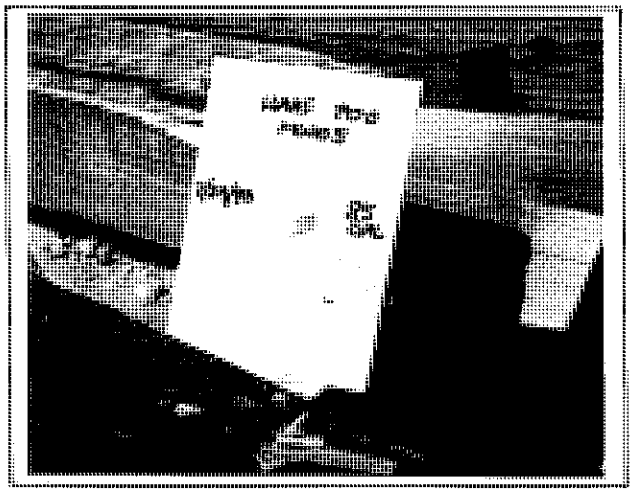


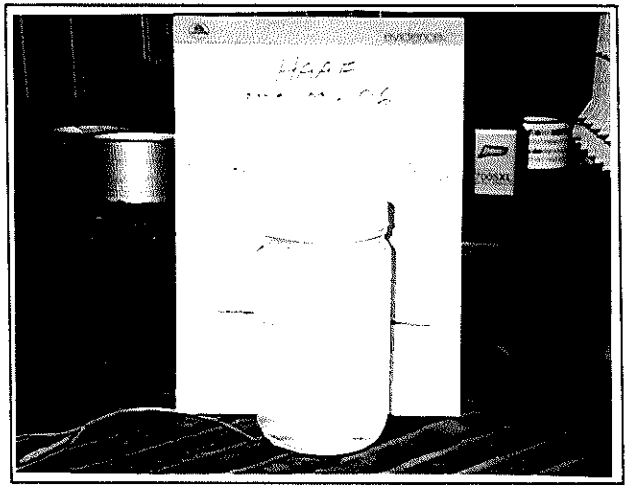


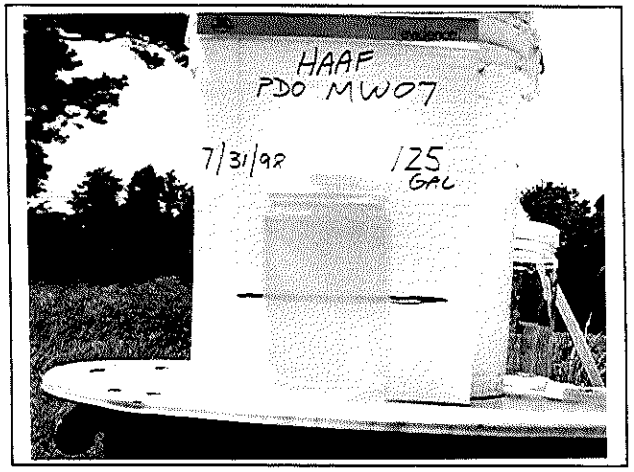


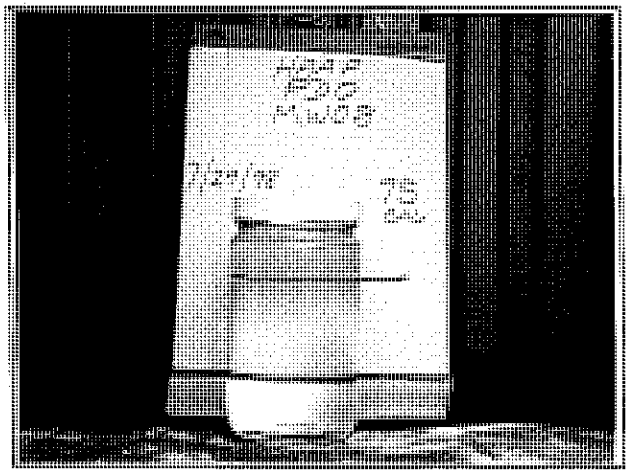


MONITORING WELL DEVELOPMENT PHOTOGRAPHS

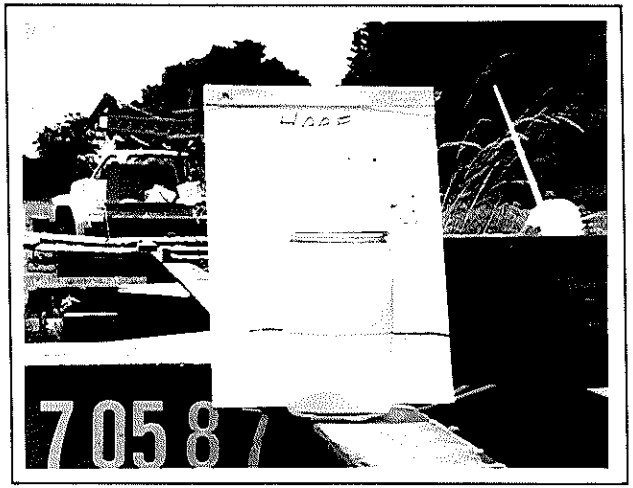


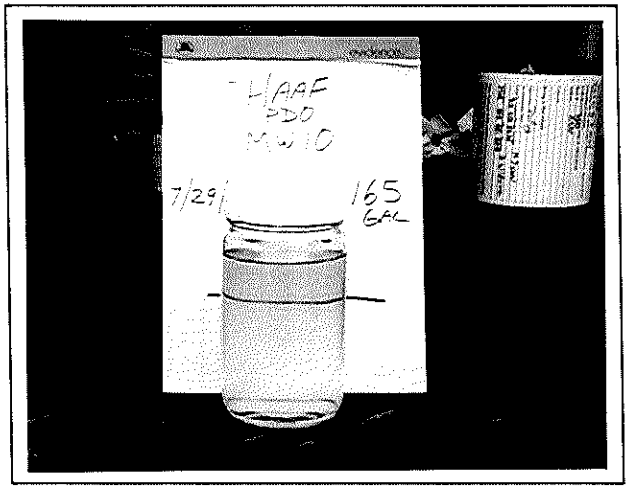


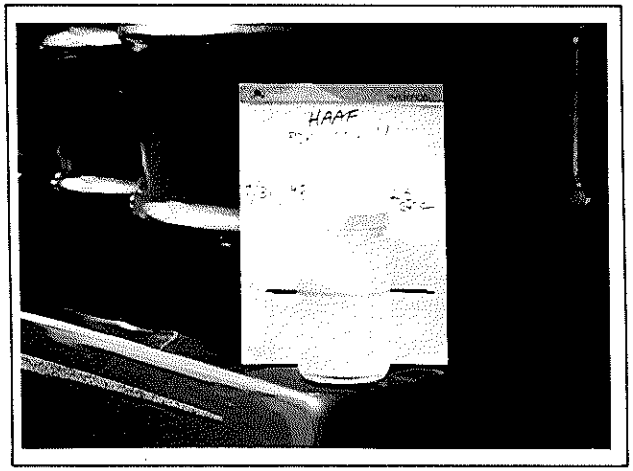




MONITORING WELL DEVELOPMENT PHOTOGRAPHS







MONITORING WELL DEVELOPMENT PHOTOGRAPHS

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - MW01

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8/11/98 Time start 1100 End 1140

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 8.12 ft

3. Depth of well from T.O.C. 14.25 ft

4. Feet of standing water (h) 6.13 ft

1. Standing water (gal.) = 1.0

2. X 3 well volumes

3. = 3.0 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 + 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 + 4] (6.13 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 = 1.0 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1.Well volume = 1.0	gal.	3.9	323	27.5
2.Well volume = 2.0	gal.	4.2	209	27.3
3.Well volume = 3.0	gal.	4.3	187	26.7
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-o-C

Sample Description

Odor:

Color: Metal samples : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 1.3 / ② 0.61 / ③ 0.38

Flow rate = 300 ml/min

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Prowell / D. Howard

WELL ID: PDO - MW02

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-11-98 Time start 1310 End 1400

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 9.18 ft

3. Depth of well from T.O.C. 15.30 ft

4. Feet of standing water (h) 6.12 ft

1. Standing water (gal.) = 1.0

2. X 3 well volumes

3. = 3.0 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 + 4](h)$

$= 3.14[(0.17\text{ ft.})^2 + 4](6.12\text{ ft.}) \times 7.48\text{ gal/ft.}^3 = 1.0\text{ gal}$

		pH	Conductivity	Temperature, (F)
1.Well volume = 1.0	gal.	5.0	100.8	27.3
2.Well volume = 2.0	gal.	5.1	84.0	26.6
3.Well volume = 3.0	gal.	5.1	84.8	25.6
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color:

Appearance: Metals sample : clear

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 0.47 / ② 0.33 / 0.65

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Powell / D. Howard

WELL ID: PDO - mw03

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-11-98 Time start 1425 End 1505

Well secured upon arrival? (Y)/ N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 7.73 ft

3. Depth of well from T.O.C. 14.25 ft

4. Feet of standing water (h) 6.52 ft

1. Standing water (gal.) = 1.1

2. X 3 well volumes

3. = 3.3 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 \div 4] (6.52 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 = 1.1 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1.Well volume = 1.1	gal.	3.9	296	27.8
2.Well volume = 2.2	gal.	3.9	289	27.2
3.Well volume = 3.3	gal.	3.8	291	26.8
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 1.0 / ② 0.96 / ③ 1.2

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Powell / D. Howard

WELL ID: PDO - mw04

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-10-98 Time start 1530 End 1830

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 10.50 ft

3. Depth of well from T.O.C. 20.35 ft

4. Feet of standing water (h) 9.85 ft

1. Standing water (gal.) = 1.7

2. X 3 well volumes

3. = 5.1 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14[(0.17 \text{ ft.})^2 \div 4](9.85 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 = 1.7 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1. Well volume =	1.7 gal.		40.4	25.3
2. Well volume =	3.4 gal.		40.5	26.1
3. Well volume =	5.1 gal.		41.2	27.
4. Well volume =	gal.			
5. Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals sample: clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 2.53 / ② 1.10 / ③ 0.89

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO-MW05

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-12-98 Time start 1505 End 1655

Well secured upon arrival? (Y) / N

1. Casing Diameter (d) 2 inches ÷ 12 = 0.17 ft

2. Depth of water from T.O.C. 9.27 ft

3. Depth of well from T.O.C. 19.10 ft

4. Feet of standing water (h) 9.88 ft

1. Standing water (gal.) = 1.7

2. X 3 well volumes

3. = 5.1 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14[(0.17 \text{ ft.})^2 \div 4](9.88 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 = 1.7 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1. Well volume = 1.7	gal.	4.8	93.1	23.8
2. Well volume = 3.4	gal.	5.4	93.3	24.0
3. Well volume = 5.1	gal.	5.2	94.1	23.9
4. Well volume =	gal.			
5. Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals Sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 0.30 / ② 0.11 / ③ 0.11

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - mw06

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-12-98 Time start 1320 End 1430

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches ÷ 12 = 0.17 ft

2. Depth of water from T.O.C. 10.74 ft

3. Depth of well from T.O.C. 18.7 ft

4. Feet of standing water (h) 7.96 ft

1. Standing water (gal.) = 1.4

2. X 3 well volumes

3. = 4.2 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 \div 4] (7.96 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 =$ 1.4 gal

		pH	Conductivity	Temperature, (F)
1.Well volume =	1.4 gal.	5.8	189.7	27.0
2.Well volume =	2.8 gal.	5.8	174	26.3
3.Well volume =	4.2 gal.	5.8	169	25.4
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: Ø ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 5.76 / ② 13.10 / ③ 8.97

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - mw07

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-12-98 Time start 1320 End 1415

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 10.47 ft

3. Depth of well from T.O.C. 17.2 ft

4. Feet of standing water (h) 6.73 ft

1. Standing water (gal.) = 1.1

2. X 3 well volumes

3. = 3.3 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 + 4](h)$

$= 3.14[(0.17 \text{ ft.})^2 + 4](6.73 \text{ ft.}) \times 7.48 \text{ gal/ft.}^3 = 1.1 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1.Well volume = 1.1	gal.	6.2	457	26.0
2.Well volume = 2.2	gal.	6.3	398	26.0
3.Well volume = 3.3	gal.	6.2	376	25.5
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - see C-O-C

Sample Description

Odor:

Color: Metals sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 9.30 / ② 7.2 / ③ 5.6

pumping rate = 300 ml/min

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard WELL ID: PDO - mw08

PROJECT NAME: HAAF 1st Qtr Sampling LOCATION: PDO Yard

Date sampled: 8-12-98 Time start 1500 End 1615 Well secured upon arrival? (Y)/ N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft
2. Depth of water from T.O.C. 8.85 ft
3. Depth of well from T.O.C. 16.4 ft
4. Feet of standing water (h) 7.55 ft

1. Standing water (gal.) = 1.3
2. X 3 well volumes
3. = 3.9 gallons to purge
4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 + 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 + 4] (7.55 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 = 1.3 \text{ gal}$

		pH (DH)	Conductivity	Temperature, (F)
1.Well volume = 1.3	gal.	4.95	160.0	26.9
2.Well volume = 2.6	gal.	4.95	163.1	26.8
3.Well volume = 3.9	gal.	5.10	163.5	26.9
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer Field preservation - See C-o-C

Sample Description

Odor:

Color: Metals sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU (1) 1.9 / (2) 0.71 / (3) 0.52

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - MW09

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8/12-98 Time start 1315 End 1550

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 8.99 ft

3. Depth of well from T.O.C. 37.3 ft

4. Feet of standing water (h) 28.31 ft

1. Standing water (gal.) = 4.8

2. X 3 well volumes

3. = 14.4 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 + 4](h)$

$= 3.14[(0.17\text{ ft.})^2 + 4](28.31\text{ ft.}) \times 7.48\text{ gal/ft.}^3 = 4.8$ gal

		pH	Conductivity	Temperature, (F)
1.Well volume =	4.8 gal.	6.8	241	25.9
2.Well volume =	9.6 gal.	6.8	232	23.7
3.Well volume =	14.4 gal.	6.7	226	23.7
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals Sample: clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 13.76 / ② 1.21 / ③ 0.83

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Havard

WELL ID: PDO - MW 10

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-12-98 Time start 1610 End 1915

Well secured upon arrival? (Y) / N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 8.43 ft

3. Depth of well from T.O.C. 34.2 ft

4. Feet of standing water (h) 25.77 ft

1. Standing water (gal.) = 4.4

2. X 3 well volumes

3. = 13.2 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 + 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 + 4] (25.77 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 =$ _____ gal

		pH	Conductivity	Temperature, (F)
1.Well volume = 4.4	gal.	6.7	235	23.7
2.Well volume = 8.8	gal.	6.74	205	24.9
3.Well volume = 13.2	gal.	6.8	186	24.2
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals Sample: clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 23.9 / ② 4.13 / ③ 1.56

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - MW 11

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-12-98 Time start 1650 (8-12-98) End 1630 (8-13-98)

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 8.91 ft

3. Depth of well from T.O.C. 37.2 ft

4. Feet of standing water (h) 28.29 ft

1. Standing water (gal.) = 4.8

2. X 3 well volumes

3. = 14.4 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 + 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 + 4] (28.29 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 = 4.8 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1.Well volume = 4.8	gal.	7.3	277	25.4
2.Well volume = 9.6	gal.	7.4	239	24.6
3.Well volume = 14.4	gal.	7.4	240.0	24.0
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals sample: clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 494 / ② 76.3 / ③ 36.6

1745 end of day. Recommence in A.M. w/ turbidity readings only. 0700 - 29.7 / 1040 - 18.9 1600: 15.01

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard WELL ID: PDO - 1.19

PROJECT NAME: HAAF 1st Qtr Sampling LOCATION: PDO Yard

Date sampled: 8/9/98 Time start 1520 (0740) End 1830 (1700) Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches ÷ 12 = 0.17 ft
2. Depth of water from T.O.C. 7.05 ft
3. Depth of well from T.O.C. 15.12 ft
4. Feet of standing water (h) 8.07 ft

1. Standing water (gal.) = 1.4
2. X 3 well volumes
3. = 4.2 gallons to purge
4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14[(0.17 \text{ ft.})^2 \div 4](8.07 \text{ ft.}) \times 7.48 \text{ gal/ft.}^3 = 1.4 \text{ gal}$

		pH	Conductivity	Temperature, (F)	(ml) Pump Rate
1. Well volume =	1.4 gal.		81.2	26.3	240
2. Well volume =	2.8 gal.		105.2	25.5	440
3. Well volume =	4.2 gal.		139.0 (134)	25.8 ~~26.6~~	"
4. Well volume =	5.6 gal.		DH ~~140.0~~	~~25.9~~ 26.7	160
5. Well volume =	7.0 gal.		136.8	27.0	"
Ground water sample	8.4		140.2 (143.3)	25.7 (26.0)	" 140

Sampling method - Disposable Teflon Bailer Field preservation - See C.O.C

Sample Description

Odor:

Color: Metals sample: H. brown

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: Ø ppm

In Well: ppm @

COMMENTS: Turbidity = 330 NTU | 1.4 gal | 64.3 @ 7.0 | 1153 : 40

260 | 2.8 | 62.5 @ 8.4 | 1300 : 41

240 | 4.2 | 48.2 @ 9.8 | 1430 : 32

DH 93 ~~97~~ | 5.6 | Time (8/11/98) 0830 97, 0935 62 | 1700 : 28

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard WELL ID: PDO-1-20

PROJECT NAME: HAAF 1st Qtr Sampling LOCATION: PDO Yard

Date sampled: 8-12-98 Time start 0810 End 0920 Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches ÷ 12 = 0.17 ft
2. Depth of water from T.O.C. 8.65 ft
3. Depth of well from T.O.C. 21.68 ft
4. Feet of standing water (h) 13.03 ft

1. Standing water (gal.) = 2.2
2. X 3 well volumes
3. = 6.6 gallons to purge
4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14[(0.17\text{ ft.})^2 \div 4](13.03\text{ ft.}) \times 7.48\text{ gal/ft.}^3 = 2.2\text{ gal}$

		pH	Conductivity	Temperature, (F)
1.Well volume = 2.2	gal.	4.2	80.5	24.6
2.Well volume = 4.4	gal.	4.3	70.0	24.9
3.Well volume = 6.6	gal.	4.3	66.4	24.9
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals Sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 0.08 / ② 0.04 / ③ 0.12

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - 1-21

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-12-98 Time start 0825 End 0845

Well secured upon arrival? (Y) / N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 3.66 ft

3. Depth of well from T.O.C. 18.93 ft

4. Feet of standing water (h) 15.27 ft

1. Standing water (gal.) = 2.6

2. X 3 well volumes

3. = 7.8 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14[(0.17 \text{ ft.})^2 \div 4](15.27 \text{ ft.}) \times 7.48 \text{ gal/ft.}^3 = 2.6 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1.Well volume =	2.6 gal.	3.9	153.1	25.2
2.Well volume =	5.2 gal.	4.0	145.2	25.1
3.Well volume =	7.8 gal.	4.1	148.8	25.1
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals Sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 0.09 / ② 0.22 / ③ 0.32

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - 1-22

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 9-12-98 Time start 1000 End 1110

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches ÷ 12 = 0.17 ft

2. Depth of water from T.O.C. 8.98 ft

3. Depth of well from T.O.C. 21.50 ft

4. Feet of standing water (h) 12.52 ft

1. Standing water (gal.) = 2.1

2. X 3 well volumes

3. = 6.3 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 \div 4] (12.52 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 = 2.1 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1.Well volume = 2.1	gal.	4.25	88.3	24.4
2.Well volume = 4.2	gal.	4.35	84.8	24.4
3.Well volume = 6.3	gal.	4.4	84.4	24.0
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals Sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 0.14 / ② 0.02 / ③ 0.62

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - 1-23

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-11-98 Time start 0755 End 0955

Well secured upon arrival? (Y) / N

1. Casing Diameter (d) 2 inches ÷ 12 = 0.17 ft

2. Depth of water from T.O.C. 6.38 ft

3. Depth of well from T.O.C. 20.60 ft

4. Feet of standing water (h) 14.22 ft

1. Standing water (gal.) = 2.4

2. X 3 well volumes

3. = 7.2 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:

Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 \div 4] (14.22 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 = 2.4 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1. Well volume =	2.4 gal.		112.0	26.0
2. Well volume =	4.8 gal.		111.9	26.3
3. Well volume =	7.2 gal.		112.6	26.4
4. Well volume =	gal.			
5. Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metals sample: clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: 0 ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 0.36 / ② 0.28 / ③ 0.65

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - 1-24

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-11-98 Time start 1535 End 1645

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches + 12 = 0.17 ft

2. Depth of water from T.O.C. 6.97 ft

3. Depth of well from T.O.C. 21.45 ft

4. Feet of standing water (h) 14.48 ft

1. Standing water (gal.) = 2.5

2. X 3 well volumes

3. = 7.5 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 + 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 + 4] (14.48 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 = 2.5 \text{ gal}$

		pH	Conductivity	Temperature, (F)
1.Well volume = 2.5	gal.	5.1	83.9	26.1
2.Well volume = 5.0	gal.	5.1	79.7	24.9
3.Well volume = 7.5	gal.	5.1	78.9	24.6
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metal sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: Ø ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① 0.75 / ② 0.48 / ③ 0.19

FIELD LOG BOOK SAMPLING DATA:
GROUNDWATER MONITORING WELL WORK SHEET

SAMPLED BY: G. Rowell / D. Howard

WELL ID: PDO - 1-25

PROJECT NAME: HAAF 1st Qtr Sampling

LOCATION: PDO Yard

Date sampled: 8-12-98 Time start 1010 End 1125

Well secured upon arrival? (Y)/N

1. Casing Diameter (d) 2 inches ÷ 12 = 0.17 ft

2. Depth of water from T.O.C. 9.24 ft

3. Depth of well from T.O.C. 21.29 ft

4. Feet of standing water (h) 12.05 ft

1. Standing water (gal.) = 2.0

2. X 3 well volumes

3. = 6.0 gallons to purge

4. Purging Method Peristaltic Pump

CALCULATION:
Standing water volume $= \pi[(d)^2 \div 4](h)$

$= 3.14 [(0.17 \text{ ft.})^2 \div 4] (12.05 \text{ ft.}) \times 7.48 \text{ gal / ft.}^3 =$ 2.0 gal

		pH	Conductivity	Temperature, (F)
1.Well volume =	2.0 gal.	5.5	103.4	23.7
2.Well volume =	4.0 gal.	5.9	102.1	23.5
3.Well volume =	6.0 gal.	5.5	102.4	23.7
4.Well volume =	gal.			
5.Well volume =	gal.			
Ground water sample				

Sampling method - Disposable Teflon Bailer

Field preservation - See C-O-C

Sample Description

Odor:

Color: Metal Sample : clear

Appearance:

Weather Conditions:

Air Monitoring Equipment used: OVA

Reading: Breathing zone: Ø ppm

In Well: ppm

COMMENTS: Turbidity = NTU ① DF 2.73 / ② 1.76 / ③ 1.51