

REVISED FINAL

PHASE II RCRA FACILITY INVESTIGATION  
REPORT FOR 16 SOLID WASTE MANAGEMENT UNITS

AT

FORT STEWART, GEORGIA  
VOLUME I OF III

REGULATORY AUTHORITY  
RESOURCE CONSERVATION AND RECOVERY ACT  
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The undersigned certifies that I am a qualified groundwater scientist who has received a baccalaureate or postgraduate 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, to 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 a subordinate working under my direction.

  
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## ACRONYMS

ADA	Air Defense Artillery
ADD	average daily dose
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
Army	U.S. Army
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
AT123D	Analytical Transient 1-, 2-, 3-Dimensional
AUF	area use factor
AWQC	Ambient Water Quality Criteria
BAF	bioaccumulation factor
BCF	bioconcentration factor
bgs	below ground surface
BHC	benzene hexachloride
BN	battalion
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Corrective Action Plan
CB	chemical/biological
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMCOC	contaminant migration chemical of concern
CMCOPC	contaminant migration constituent of potential concern
COC	contaminant of concern
COPC	contaminant of potential concern
CSM	Conceptual Site Model
DAF	dilution attenuation factor
DEH	Directorate of Engineering and Housing
DF	dilution factor
DO	dissolved oxygen
DOL	Directorate of Logistics
DPT	direct-push technology
DPW	Directorate of Public Works
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Organization
ECOPC	ecological contaminant of potential concern
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
EPRE	ecological preliminary risk evaluation
EP Tox	Extraction Procedure Toxicity
ERA	Ecological Risk Assessment
ESV	ecological screening value
FR	<u>Federal Register</u>
FSMR	Fort Stewart Military Reservation
GAF	gastrointestinal absorption factor
GEPD	Georgia Environmental Protection Division
GSSL	generic soil screening level
HAZWRAP	Hazardous Waste Remedial Actions Program
HELP	Hydrologic Evaluation of Landfill Performance

## ACRONYMS (continued)

HHCOC	human health chemical of concern
HHCOPC	human health contaminant of potential concern
HHPRE	human health preliminary risk evaluation
HI	hazard index
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	hazard quotient
IDW	investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	incremental lifetime cancer risk
IRA	Interim Removal Action
IWTP	Industrial Wastewater Treatment Plant
LAS	Land Application System
LOAEL	lowest observed adverse effect level
MCL	maximum contaminant level
MOGAS	motor gasoline
NFA	no further action
NGTC	National Guard Training Center
NGVD	National Geodetic Vertical Datum
NOAEL	no observed adverse effect level
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
OB	open burn
OD	open detonation
ODAST	One-dimensional Analytical Solute Transport
OWS	oil/water separator
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PETN	pentaerythrite tetranitrate
PID	photoionization detector
POL	petroleum, oil, and lubricants
POTW	publicly owned treatment works
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QCSR	Quality Control Summary Report
RBC	risk-based concentration
RBCA	Risk-based Corrective Action
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
Redox	oxidation-reduction
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SESOIL	Seasonal Soil Compartment Model
SMCL	secondary maximum contaminant level

## ACRONYMS (continued)

SPT BN	Support Battalion
SRC	site-related contaminant
SSL	soil screening level
SQB	sediment quality benchmark
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TAC	Tactical Air Command
TC	toxicity characteristic
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TEF	toxicity equivalence factor
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
TRV	toxicity reference value
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UST	underground storage tank
UXO	unexploded ordnance
VOC	volatile organic compound
WQS	water quality standard

## EXECUTIVE SUMMARY

This report summarizes the results of the Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for the 16 Solid Waste Management Units (SWMUs) at Fort Stewart, Georgia. The 16 SWMUs include: Camp Oliver Landfill, SWMU 2; TAC-X Landfill, SWMU 3; Inactive EOD Area in Red Cloud Range, Hotel Area, SWMU 9; Inactive EOD Area North of Garrison Area, SWMU 10; Inactive EOD Area Located Approximately Three Miles Northeast of Garrison Area, SWMU 11; Active EOD Containing Open Detonation Unit and Open Burn Unit, SWMU 12A; Old Fire Training Area, SWMU 14; DRMO Hazardous Waste Storage Area, SWMU 17; Industrial Wastewater Treatment Plant, SWMU 18; Old Sludge Drying Beds, SWMU 19; Old Radiator Shop/Paint Booth, SWMU 24B; Motorpools, SWMUs 27A through 27V; Evans Army Helicopter POL Storage Facility, SWMU 29; DEH Asphalt Tanks, SWMU 31; Supply Diesel Tank, SWMU 32; DEH Equipment Wash Rack, SWMU 34; and NGTC Equalization Basin, SWMU 37. Four of the 16 sites—Old Sludge Drying Beds, SWMU 19; Old Radiator Shop/Paint Booth, SWMU 24B; Motorpools, SWMUs 27A through 27V; and NGTC Equalization Basin, SWMU 37—had not been investigated previously and were investigated as Phase I RFIs. This report has been prepared by Science Applications International Corporation (SAIC) for the U.S. Army Corps of Engineers (USACE), Savannah District, under Contract DACA21-95-D-0022, Delivery Order No. 0009. The RFI was conducted in accordance with USACE Guidance EM 200-1-3 and the Georgia Environmental Protection Division (GEPD)-approved Sampling and Analysis Plan (SAP) (SAIC 1997).

The 16 SWMUs investigation consisted of 38 SWMU sites (including 22 motorpool sites) as designated under Hazardous Waste Permit HW-045. The sites were divided into 45 distinct geographic areas for investigation. Seven (SWMUs 2, 3, 9, 10, 11, 12A, and 29) of the 38 SWMUs are located outside the garrison area. The remaining 31 (SWMUs 14, 17, 18, 19, 24B, 27A through 27V, 31, 32, 34, and 37) are located within the garrison area.

### OBJECTIVES AND SCOPE OF THE INVESTIGATION

The specific objectives of the Phase I and Phase II RFIs for the 16 SWMUs at Fort Stewart, Georgia, as defined in the Phase II RFI SAP (SAIC 1997) (approved by the GEPD in October 1997) are listed below.

#### *Phase I RFI*

- Determine if contamination of the environment has occurred.
- Determine whether contaminants, if present, constitute a threat to human health or the environment.
- Determine the need for future action and/or no further action (NFA).

#### *Phase II RFI*

- Determine the horizontal and vertical extent of contamination.
- Determine whether contaminants present a threat to human health or the environment.

- Determine the need for future action and/or NFA.
- Gather data necessary to support a Corrective Action Plan (CAP), if warranted.

The information provided in this report is based upon data collected previously during the Phase I RFI (if available) and data collected as part of the Phase II field sampling and analysis. At some of the sites, the Phase II sampling program incorporated an observational approach to sampling, as defined in the Phase II RFI SAP (SAIC 1997). This observational approach used field screening techniques to determine the horizontal and vertical extent of contamination at the SWMU and to identify suitable locations for installation of permanent monitoring wells. The scope of the fieldwork for the Phase I and Phase II sites included the activities listed below.

### ***Phase I Sites***

- Collection of direct-push soil samples using a push probe.
- Collection of direct-push groundwater samples using a push probe.
- Installation of permanent groundwater monitoring points or monitoring wells to confirm the nature of potential contamination at a specific push-probe location.
- Collection of surface water and sediment samples at SWMUs at which surface water and sediment were available.
- Surveying of the positions of all sample locations.

### ***Phase II Sites***

- Collection of direct-push soil samples using a push probe.
- Collection of direct-push groundwater samples using a push probe, including vertical-profile probes.
- Installation of permanent groundwater monitoring wells both upgradient and downgradient of the site.
- Groundwater sampling at existing monitoring wells (if available) and sampling of newly installed wells around the SWMUs.
- Collection of surface water and sediment samples at SWMUs at which surface water and sediment were available.
- Surveying of the positions of all sample locations.

### **Nature and Extent of Contamination**

Site-related contaminants (SRCs) were identified for each site by comparing the analytical results obtained from soil, groundwater, surface water, and sediment against the reference background criteria. Contaminants with concentrations above the reference background criteria were identified as SRCs. The results of the chemical analyses on surface soil, subsurface soil, and groundwater were screened against the reference

background criteria for the Fort Stewart Military Reservation. Surface water and sediment were screened against site-specific background criteria.

In general, reference background samples were collected from each medium at locations upgradient or upstream of each site so as to be representative of naturally occurring conditions at sites under investigation. Upgradient or upstream samples were not collected at sites under a Phase I RFI (i.e., SWMUs 19, 24B, 27A through 27V and 37). The reference background concentrations for surface soil, subsurface soil, and groundwater were calculated as two times the average concentration of all of the locations selected to be in the background data set. If a chemical was not detected at a site, then one-half the detection limit was used as the concentration when calculating the reference mean background concentration. Surface water and sediment background samples were collected during the Phase II RFI and applied to the SWMUs on a site-specific basis.

Inorganics were considered to be SRCs if their concentrations were above the reference background concentrations, while organics were considered SRCs if they were simply detected because organic constituents are considered to potentially be man-made. SRCs from the nature and extent of contamination evaluation were further evaluated as potential concerns based upon fate and transport characteristics and upon their potential risk to human health and ecological receptors. A summary of SRCs by medium for each SWMU is presented in Table ES-1.

### **Fate and Transport Analysis**

Fate and transport analysis was performed on each SWMU. This analysis included developing a site-specific Conceptual Site Model (CSM) identifying potential contaminant release and migration pathways and determining the potential for SRCs in surface soil, subsurface soil, and/or sediment to migrate to groundwater.

The maximum concentrations of the SRCs determined from nature and extent analysis were compared to U.S. Environmental Protection Agency (EPA) Generic Soil Screening Levels (GSSLs). Generally, if contaminant concentrations in soil fall below the GSSLs and there are no significant ecological receptors of concern, then no further study or action is warranted. SRCs were identified as contaminant migration constituents of potential concern (CMCOPCs) if they were detected at concentrations that exceeded their respective GSSLs. To evaluate leaching of CMCOPCs from soil to groundwater at the 16 SWMUs, groundwater concentrations of CMCOPCs were compared to maximum contaminant levels (MCLs). If an MCL for a chemical was not available, the groundwater concentration was compared to the risk-based concentration, as established by EPA Region III (EPA 1999b). A summary of the results of the fate and transport analysis (CMCOPCs) is presented in Table ES-2.

A weight-of-evidence approach was used to evaluate each CMCOPC identified based on leaching to groundwater. In some instances, the potential impact of CMCOPCs to groundwater, and possibly to surface water, was evaluated (modeled concentrations were compared to risk-based criteria) in a human health baseline risk assessment. CMCOPCs that indicated a potential risk to human health (i.e., that exceeded risk-based screening criteria) from modeling were identified as contaminant migration chemicals of concern, and remedial levels were developed based on protection of groundwater. SWMUs for which a human health baseline risk assessment was performed are identified in Table ES-2.

### **Human Health Preliminary Risk Evaluation**

A human health preliminary risk evaluation (HHPRE) using a Step i risk evaluation approach based on guidance from GEPA was performed for each SWMU to determine the potential human health risks associated with the maximum concentrations of identified SRCs. The Step i risk evaluation involves the components listed below.

- For inorganics, compare detected concentrations to naturally occurring background levels to determine if detected inorganics are naturally occurring or are associated with past activities at the site.
- Identify potential migration and exposure pathways associated with the site and identify potential exposure scenarios to determine appropriate action levels.
- Identify available risk-based action levels for each contaminant detected above background levels or develop levels if they do not exist.
- Compare sample concentrations to action levels to determine if site conditions warrant further evaluation.

Chemicals that exceeded action levels were identified as human health contaminants of potential concern (HHCOPCs). A summary of the HHPRE results (HHCOPCs) is presented in Table ES-2.

A weight-of-evidence approach was used to evaluate each HHCOPC identified in the preliminary risk assessment. In some instances, HHCOPCs were evaluated further in a human health baseline risk assessment. HHCOPCs and/or CMCOPCs (see previous section) that either had hazard indices of 0.1 or incremental lifetime cancer risks of  $1 \times 10^{-6}$  were identified as human health contaminants of concern. Remedial levels were developed that were protective of the most sensitive receptor population, based on a minimum risk level of 3.0 for the total hazard index and  $1 \times 10^{-4}$  for the total incremental lifetime cancer risk. SWMUs for which a human health baseline risk assessment was performed are identified in Table ES-2.

### Ecological Preliminary Risk Evaluation

An ecological preliminary risk evaluation (EPRE) based on guidance from GEPD was performed to determine the potential risk to ecological receptors associated with the maximum concentrations of the identified SRCs. The EPRE compared measured concentrations of detected substances to conservative ecological screening values to identify substances detected at the facility that pose a potential hazard to ecological receptors and that are identified as ecological contaminants of potential concern (ECOPCs). A summary of the results of the EPRE (ECOPCs) is presented in Table ES-2.

A weight-of-evidence approach was used to evaluate each ECOPC identified in the preliminary risk evaluation. In some instances, ECOPCs were evaluated further in a supplemental preliminary risk evaluation (SPRE). The SPRE presented a comparison of more realistic exposure estimates to toxicity reference values based on the lowest observed adverse effects levels. The exposure estimates were calculated using measured concentrations and more realistic exposure assumptions such as diets, absorption efficiencies, and area use factors. SWMUs for which an SPRE was performed are identified in Table ES-2.

### Conclusions and Recommendations

A weight-of-evidence approach was used with the results from the fate and transport evaluation, HHPRE, human health baseline risk assessment (if performed), EPRE, and SPRE (if performed) to determine the recommendation for each SWMU. The recommendations fell into the following three categories:

- **No Further Action:** NFA was recommended for a SWMU if: (1) the contaminant levels in soil, groundwater, surface water, and sediment were below the reference background criteria, fate and transport values (GSSLs), and/or human health or ecological screening criteria or (2) significant uncertainty was evident, indicating minimal potential risk of migration to groundwater and/or a surface water body and/or to human health and ecological receptors.

- **Additional Investigation (Phase II RFI or additional monitoring):** A Phase II RFI or additional monitoring was recommended if the nature and extent of potential contaminants had not been determined, and further investigation or additional monitoring was required to evaluate extent or potential migration in the future.
- **Corrective Action Plan:** A CAP was recommended if the nature and extent of contamination at a SWMU was determined by the Phase II RFI, there was a potential risk of migration of contaminants to groundwater and/or surface water bodies or a potential risk to human health and ecological receptors, or institutional controls need to be applied to protect the health and safety of humans coming in contact with the site (i.e., inactive EOD areas). Such a site requires a CAP to evaluate appropriate remedial actions to eliminate or minimize these potential risks.

The recommendations for each SWMU are presented in Table ES-3.

Table ES-1. Summary of Site-related Contaminants

SWMU	Type of Investigation	Site-related Contaminants				
		Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
2	Phase II	2 VOCs, 14 pest., 1 SVOC, and 6 metals	1 VOC, 3 pest., 1 SVOC, and 3 metals	3 VOCs and 3 metals	None	alpha-Chlordane
3	Phase II	4 pest., BEHP, As, Cr, and Pb	2 VOCs, BEHP, 3 pest., Cr, and Cd	3 VOCs, 3 pest., Ba, Cd, Cr, Pb, and Hg	1 SVOC, As, Ba, Cr, and Pb	6 VOCs, As, Ba, Cr, Pb, Hg, and Se
9	Phase I <sup>c</sup>	As, Cr, and Ag	NC	NC	NP	NP
10	Phase II	As, Ba, Cr, and Pb	NC <sup>b</sup>	None	Cd, Cr, and Hg	As, Ba, and Pb
11	Phase II	As, Ba, Cr, Pb, and Ag	NC <sup>b</sup>	None	NP	NP
12A	Phase II	3 SVOCs, 4 exp., and 16 metals	Al, As, Ba, Cr, Fe, Pb, and V	BEHP, 1 exp., and 8 metals	RDX, Pb, Mn, and Hg	1 SVOC, 1 exp., and 9 metals
14	Phase I	2 VOCs, BEHP, and Hg	5 VOCs, Cr, and Hg	1 VOC, Pb, and Hg	NP	NP
17	Phase II	1 VOC	3 VOCs	3 VOCs and Pb	None	None
18	Phase II	1 VOC, Pb, and Hg	5 VOCs, 2 SVOCs, Ba, Cr, Pb, and Hg	9 VOCs, Ba, Cd, and Pb	1 SVOC and Ba	(6 VOCs, 4 SVOCs, As, Ba, Cd, Cr, Pb, Hg, Se, and Ag) <sup>f</sup>
19	Phase I	4 VOCs, 7 pest., and 5 metals	6 VOCs, 9 pest., and 5 metals	BEHP, 7 pest., and 3 metals	NP	NP
24B	Phase I	1 VOC, 10 SVOCs, and 6 metals	2 VOCs	1 VOC, 11 SVOCs, and Hg	NP	NP
27A (Bldg. 1339A)	Phase I	None	2 VOCs and 3 SVOCs	2 VOCs and BEHP	NP	NP
27A (Bldg. 1339B)	Phase I	BEHP and Pb	2 VOCs	1 VOC	NP	NP
27A (Bldg. 1322)	Phase I	3 VOCs and Pb	3 VOCs	Acetone	NP	NP
27B	Phase I	None	1 VOC	ND	NP	NP
27C	Phase I	1 VOC	2 VOCs and 1 SVOC	4 VOCs	NP	NP
27D	Phase I	3 VOCs	1 VOC	None	NP	NP
27E (Bldg. 1628)	Phase I	None	1 VOC	None	NP	NP

Note: Footnotes appear on page ES-8.

Table ES-2. Summary of CMCOPCs, HHCOPCs, and ECOPCs

SWMU	CMCOPCs			HHCOPCs					ECOPCs				HHBRA or SPRE Performed?
	Soil	Sediment	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment	Surface Soil	Groundwater	Surface Water	Sediment		
2	2 pest., Ar, Ca, and Hg	None	As and Cr	None	None	None	None	4,4'-DDE, Cd, Cr, and Pb	1 VOC, Pb, and Hg	None	None	HHBRA and SPRE	
3	None	As	As	None	1 pest. and Hg	1 SVOC, As, Cr, and Pb	As	Pb and Cr	2 pest., Ba, Cd, Pb, and Hg	1 SVOC, Ba, and Pb	2 VOCs, As, Ba, and Se	HHBRA and SPRE	
9 <sup>a</sup>	NA <sup>a</sup>	NA <sup>a</sup>	NA <sup>a</sup>	NC <sup>a</sup>	NC <sup>a</sup>	NP	NP	NA <sup>a</sup>	NC <sup>a</sup>	NP	NP		
10	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	NC	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>		
11	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	NC	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>	NP	NP		
12A	Ar, Cd, Cr, Pb, Ag, 1 SVOC, and 2 exp.	None	As and Pb	As	BEHP	Hg	None	1 SVOC, Cd, Cr, and Pb	BEHP	Pb and Hg	Ba	HHBRA and SPRE	
14	1 VOC	NA	None	None	None	NP	NP	None	Pb, Hg, and 1 VOC	NP	NP		
17	None	None	None	None	1 VOC	None	None	None	1 VOC and Pb	None	None	HHBRA	
18	Cr and Hg	(1 VOC, 1 SVOC, Ar, Ba, Cd, Cr, Hg, and Se) <sup>c</sup>	None	None	3 VOCs and Pb	1 SVOC	As	Pb	4 VOCs, Ba, and Pb	Ba and BEHP	None	HHBRA and SPRE	
19	2 pest.	NA	None	None	BEHP, 2 pest., and As	NP	NP	Cd, Pb, and 1 pest.	BEHP, 5 pest., Ba, and Hg	NP	NP	HHBRA and SPRE	
24B	1 VOC, 3 SVOCs, and Pb	NA	4 SVOCs, As, and Pb	None	1 VOC, 9 SVOCs, and Hg	NP	NP	NP	Hg and 9 SVOCs	NP	NP		
27A (Bldg. 1339A)	None	NA	None	None	BEHP	NP	NP	None	1 VOC and BEHP	NP	NP		
27A (Bldg. 1339B)	None	NA	None	None	Benzene	NP	NP	Pb	Xylenes	NP	NP		
27A (Bldg. 1322)	None	NA	None	None	Acetone	NA	NA	Pb	None	NP	NP	HHBRA	

Note: Footnotes appear on page ES-11.

Table ES-3. SWMU-specific Recommendations

SWMU	Recommendation
2	CAP
3	CAP
9	CAP
10	CAP
11	CAP
12A	Long-term compliance monitoring and CAP
14	NFA
17	NFA
18	Long-term monitoring and CAP
19	NFA
24B	Phase II RFI
27A (Building 1339A)	NFA
27A (Building 1339B)	NFA
27A (Building 1322)	NFA
27B	NFA
27C	NFA
27D	NFA
27E (Building 1628)	NFA
27E (Building 1720)	NFA
27F (NW Building 1340)	Phase II RFI
27F (NE Building 1340)	NFA
27G	NFA
27H (Building 1071)	Phase II RFI

SWMU	Recommendation
27H (Building 1056)	Phase II RFI
27I (Block 9900)	NFA
27I (Block 10300)	NFA
27J (Building 10535)	NFA
27J (Building 10531)	Phase II RFI
27K	NFA
27L (Block 10200)	Phase II RFI
27M (Block 10100)	NFA
27N (Block 9800)	NFA
27O (Block 9700)	NFA
27P (Block 9500)	NFA
27Q (Block 9400)	NFA
27R	NFA
27S	NFA
27T	Phase II RFI
27U	NFA
27V	NFA
29	CAP
31	NFA
34	NFA
32	NFA
37	NFA

## **10.5 SWMU 11: INACTIVE EOD AREA LOCATED THREE MILES NORTH OF THE GARRISON AREA**

### **10.5.1 History and Description of SWMU 11, Inactive EOD Area Located Three Miles North of the Garrison Area**

SWMU 11 is located 3 miles northeast of the garrison area, about 2 miles south of State Road 144, and 1 mile northeast of Wright Army Airfield. This EOD area is located in an area designated as A-16 on the Fort Stewart Installation Map. The EOD area operated from 1953 to 1975, with open detonation of UXO taking place. Numerous blast craters are spread out over nearly 1 acre. This site is difficult to distinguish from the surrounding forest because it has become overgrown with trees and bushes. There are no surface water features located at this site. A site reconnaissance in November 1993 observed spent ammunition near the trenches/blast craters. Another site reconnaissance in September 1996 indicated evidence of previous EOD activities; however, no evidence of recent activities was observed.

The waste disposed of included excess artillery powder bags, small arms rounds, artillery and mortar rounds, illuminating projectiles, pyrotechnics, bulk explosives, rockets, propellant, and regular smoke grenades. There are no records or information indicating any disposal of CB agents, acids, solvents, or other hazardous or toxic substances (Environmental Science and Engineering 1982). Previous investigations at the site are summarized below in sequential order.

#### **10.5.1.1 1987 RCRA Facility Assessment**

In 1987, as part of the initial RFA for the Installation, 10 surface soil samples were collected at 40-foot intervals along a transect that was oriented so as to intersect as many blast craters as possible. Samples were collected from 0 foot to 1 foot bgs and analyzed for metals and EP Tox.

**Surface Soil.** The analysis for metals showed the existence of various levels of arsenic, barium, mercury, and lead in all the samples. These metals were also found in the background samples at approximately the same concentrations. Selenium, chromium, and cadmium were also detected in some of the samples. None of the metals were leachable as defined by EP Tox.

#### **10.5.1.2 1993 Phase I RCRA Facility Investigation**

In 1993, as part of the Phase I RFI, six surface soil samples were collected from various locations within each blast crater at depths of 1 foot to 1.5 feet bgs and analyzed for VOCs, total RCRA metals, and explosives residue. Analytical results for the Phase I RFI are presented in Table 10.5-1.

#### ***Surface Soil***

**VOCs.** Concentrations of VOCs were not reported above the detection limits in surface soil.

**RCRA Metals.** Arsenic, barium, chromium, lead, mercury, and silver were detected in surface soil. Arsenic was detected at levels above the reference background criterion in four of six samples at concentrations ranging from 2.81 mg/kg at SS3 to 13.7 mg/kg at SS2. Barium was detected at concentrations that exceeded the reference background criterion in three of six samples at concentrations ranging from 15.7 mg/kg at SS2 to 19.6 mg/kg at SS1. Silver was detected in SS5 and SS6 at concentrations of 2.6 mg/kg and 15.8 mg/kg, respectively, both of which exceeded the reference background criterion (0.15 mg/kg). Lead was detected at SS2 and SS3 at concentrations of 45.7 mg/kg and 9.29 mg/kg, respectively, both of which exceeded the reference background criterion (8.81 mg/kg). Chromium was detected at a concentration of 7.3 mg/kg at SS6.

The remaining metal, mercury, was detected below the respective reference background criterion at all sampling locations. Arsenic, barium, silver, chromium, and lead are considered to be SRCs in surface soil from the Phase I RFI.

**Explosives.** No explosives residue concentrations were detected in the surface soil samples.

### **10.5.2 Summary of Phase II RCRA Facility Investigation Activities**

Initial screening consisted of using DPT techniques to collect groundwater samples from Geoprobe borings for explosives analysis. Eight Geoprobes were installed around the perimeter of the EOD area, as indicated in Figure 10.5-1. The results of the Geoprobe screening were used to determine the extent of potential contamination and to select a location for a vertical-profile boring. Because no explosives or contamination was observed in the Geoprobe borings, a vertical-profile boring was not installed at the site. In addition, no monitoring wells were installed at the site during the Phase II RFI activities (as approved by GEPD).

Three surface soil samples were collected from within the SWMU's boundary and analyzed for explosives and RCRA metals. Phase II RFI sampling locations are presented in Figure 10.5-1.

No surface water bodies are located in close proximity to the site; therefore, no surface water or sediment samples were collected.

### **10.5.3 Physical Characteristics of the Site**

#### **10.5.3.1 Topography**

There are approximately 14 feet of relief across the site. The elevation of the site is approximately 43 feet amsl along the western boundary and slopes gently downward to approximately 29 feet amsl at the southeastern corner.

#### **10.5.3.2 Surface drainage**

There are no surface water bodies near the site. Based on topography, the overland surface water flow direction is to the south.

#### **10.5.3.3 Soils**

Site-specific subsurface soil characterization was not performed at this site. There were no soil cuttings associated with the Geoprobe installation for classification. However, the soils present at the site are expected to be similar to those at other sites at Fort Stewart, which consist of silty and clayey sands.

#### **10.5.3.4 Hydrogeology**

Groundwater was encountered from approximately 17.2 feet bgs or 23.9 feet amsl along the northern boundary of the site to approximately 14.5 feet bgs or 19.3 feet amsl along the southern boundary. The shallow groundwater flow direction across the site is estimated to be toward the south.

#### **10.5.3.5 Ecology**

As stated in Section 8.2, this site is classified as "unmanaged grasslands." The SWMU is approximately 1 acre in size, with pine-oak forest bordering it. To the east lies a large food plot that is managed for wild game and

that contains native and planted grasses. No surface hydrology is present; however, runoff drains toward the south.

#### **10.5.4 Nature and Extent of Contamination**

##### **10.5.4.1 Surface soil**

Surface soil samples were collected from three locations within the boundary of the EOD area and were analyzed for explosives and RCRA metals. The results of the surface soil analyses are presented in Table 10.5-2 and Figure 10.5-2.

**Explosives.** No explosives were detected in the surface soil samples.

**RCRA Metals.** Arsenic, barium, cadmium, chromium, and lead were detected in surface soil samples. Arsenic and barium were detected above the reference background criteria. Arsenic was detected above the reference background criterion at one location (SS8) at a concentration of 2.2 mg/kg. Barium was detected at all three locations at concentrations ranging from 28 mg/kg at SS7 to 40.4 mg/kg at SS8. Arsenic and barium are considered to be SRCs in surface soil from the Phase II RFI.

##### **10.5.4.2 Subsurface soil**

In accordance with the approved Work Plan (SAIC 1997), no subsurface soil samples were collected. Approval is required from the Department of the Army before subsurface drilling can be implemented at a former EOD site. In addition, potential contamination would primarily be associated with the surface soil at a former EOD site.

##### **10.5.4.3 Groundwater**

Groundwater samples were collected from eight Geoprobe locations and were screened for explosives. No explosives were detected in any of the groundwater samples. The horizontal and vertical extent of contamination was determined from the Geoprobe groundwater data; therefore, in accordance with the GEPD-approved Work Plan and with GEPD concurrence, the proposed vertical-profile boring and three monitoring wells were not installed. No additional sampling or analysis was performed on groundwater.

##### **10.5.4.4 Surface water**

No surface water bodies are located near the site; therefore, no surface water samples were collected.

##### **10.5.4.5 Sediment**

No surface water bodies are located near the site; therefore, no sediment samples were collected.

##### **10.5.4.6 Site-related contaminant summary**

SRCs from the Phase I and Phase II RFIs and the corresponding maximum concentrations are presented in Table 10.5-3.

## 10.5.5 Conclusions and Risk Management and Site Recommendations for SWMU 11

### 10.5.5.1 Conclusions

#### *Nature and Extent of Contamination*

- No explosives were detected in groundwater or surface soil.
- Arsenic, barium, chromium, lead, and silver were detected above reference background criteria and are SRCs in surface soil.
- The maximum concentrations of arsenic, barium, chromium, lead, and silver in surface soil were above the respective reference background criteria; therefore, these metals are considered to be SRCs in surface soils. However, with the exception of silver, the maximum detected concentrations of metals are within the range established by the USGS for element concentrations in soils in the eastern United States (USGS 1984). The maximum concentration of arsenic (13.7 mg/kg) is within the range of arsenic soil concentrations less than 0.1 mg/kg to 73 mg/kg (USGS 1984). Chromium concentrations, with only one detection that was slightly above background (7.3 mg/kg as compared to a reference value of 6.21 mg/kg), are within the background range for the eastern United States (1 mg/kg to 1,000 mg/kg) (USGS 1984). Similarly, the maximum concentrations of barium and lead (40.4 mg/kg and 45.7 mg/kg, respectively) are within their respective ranges of 10 mg/kg to 1,500 mg/kg and less than 10 mg/kg to 300 mg/kg (USGS 1984). Silver was detected in only two samples, and with the exception of the maximum concentration, all of the silver concentrations were within the USGS range (below detection to 3.0 mg/kg). Given that the concentrations of these metals are within the range for naturally occurring concentrations, the potential impacts to human health and the environment are likely to be minimal, and further investigation and/or evaluation is not warranted.

### 10.5.5.2 Site recommendations

- Based on the information presented in this section and the potential health and safety risks associated with the site (i.e., a former EOD area), an NFA status is recommended for SWMU 11 regarding further investigation of the site. With the concurrence of GEPD, Fort Stewart recommends a CAP evaluating institutional controls be prepared for this site and SWMUs 8, 9, 10, and 12A that will provide/establish institutional controls to ensure the protection of human health and the continued safety of all personnel using the FSMR, specifically the former EOD areas. Institutional controls that are protective of human health against potential UXO risks will also be protective against risks from the potential SRCs identified for SWMU 11; therefore, further investigation and/or remediation of the identified SRCs is not warranted. It is anticipated that the CAP will be submitted to GEPD in the fourth fiscal quarter (July through September) of 2000.

Table 10.5-1. Summary of Phase I RFI Results, SWMU 11

SURFACE SOIL							
Depth (feet)	Reference Background Criteria	Sample Location					
		0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Analyte		SS1 <sup>a</sup>	SS2	SS3	SS4	SS5	SS6
<i>Metals (mg/kg)</i>							
Arsenic	2.10	<2.5	<b>13.7</b>	<b>2.81</b>	<b>4.22</b>	<2.5	<b>2.93</b>
Barium	14.70	<b>19.6</b>	<b>15.7</b>	<b>15.9</b>	11.74	3.0	11.0
Chromium	6.21	<2.5	4.74	5.3	6.17	<2.5	<b>7.3</b>
Lead	8.81	4.52	<b>45.7</b>	<b>9.29</b>	5.33	<2.5	4.18
Mercury	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Silver	0.15	<2.5	<2.5	<2.5	<2.5	<b>2.6</b>	<b>15.8</b>
<i>Explosives (mg/kg)</i>							
Explosives	NA	ND	ND	ND	ND	ND	ND

<sup>a</sup>Site-specific background location.

NA = Not available.

ND = Not detected.

**Bold** indicates concentrations above reference background criteria.

Table 10.5-2. Summary of Analytes Detected in Phase II RFI Surface Soil, SWMU 11

Station	Reference Background Criteria	11-SS7	11-SS8	11-SS9
Sample ID		117711	117811	117911
Date		02/01/98	02/01/98	02/01/98
Depth (feet)		0 to 1	0 to 1	0 to 1
Sample Type		Grab	Grab	Grab
<i>Metals (mg/kg)</i>				
Arsenic	2.10	<b>1.1</b>	<b>2.2</b>	1.5
Barium	14.70	<b>28</b>	<b>40.4</b>	<b>39.7</b>
Cadmium	0.18	0.08	0.12	0.1
Chromium	6.21	3.8	5.8	5.5
Lead	8.81	5.3	5.3	6.3

**Bold** indicates concentrations above reference background criteria.

Table 10.5-3. Summary of Site-related Contaminants, SWMU 11

Analyte	Maximum Concentration (mg/kg)			Maximum Concentration (µg/L)	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
<i>Metals</i>					
Arsenic	13.7 <sup>a</sup>	NC	NP	NA	NP
Barium	40.4	NC	NP	NA	NP
Chromium	7.3 <sup>a</sup>	NC	NP	NA	NP
Lead	45.7 <sup>a</sup>	NC	NP	NA	NP
Silver	15.8 <sup>a</sup>	NC	NP	NA	NP

<sup>a</sup>Phase I RFI data.

NA = Not analyzed.

NC = Not collected.

NP = No pathway exists.