Decision Documents for FST-008

GA EPD letter for SWMU #10 received dated	October 2, 2001
Transmittal letter to GA EPD for SWMU #10 dated	July 30, 2001
Corrective Action Plan for SWMU #10 dated	July 2001
EPD letter received dated	October 5, 2001
Transmittal letter sent to GA EPD dated	July 30, 2001
Corrective Action Plan for SWMUs #8-11 dated	May 2001
EPD letter received dated	December 8, 2000
RCRA Facility Investigation dated	April 2000

Georgia Departr nt of Natural Resources
205 Butler Street, S.E., Suite 1162, Atlanta, Georgia 30334
Lonice C. Barrett, Commissioner
Environmental Protection Division
Harold F. Reheis, Director
404/656-2833

October 2, 2001

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
7001 0360 0001 4967 8174

Gregory V. Stanley, Colonel, U.S. Army
Director, Public Works
Headquarters, 3D Infantry Division (Mechanized) and Fort Stewart
Directorate of Public Works, Building 1137
Environmental Branch (ATTN: Melanie Little)
1550 Frank Cochran Drive
Fort Stewart, GA 31314-4927

RE: Corrective Action Plan for the Inactive EOD Area North of Garrison Area [Solid Waste Management Unit (SWMU) 10] dated July 2001; Fort Stewart; EPA ID No. GA9 210 020 872.

Dear Colonel Stanley:

The Hazardous Waste Management Branch of the Georgia Environmental Protection Division (GA EPD) is in receipt of the above-referenced document. Based upon our review, GA EPD (1) has generated no comments and (2) tentatively approves the Corrective Action Plan for SWMU 10 dated July 2001.

Please note that a final decision concerning the Corrective Action Plan for SWMU 10 dated July 2001 will be made by GA EPD, after completion of a forty-five (45) day public comment period, by our issuance of a Notice of Decision documenting the next modification of your Hazardous Waste Facility Permit #HW-045(S&T). Should you have any questions concerning this correspondence, please contact Brent Rabon of my staff at (404)656-2833.

Sincerely,

Bruce Khaleghi

Bruce Khaleghi, Unit Coordinator
Hazardous Waste Management Branch

c: Mr. Larry Rogers, GA EPD-Southeast Regional Office
File: Fort Stewart(R)
R:\BRENTR\STEWART\SWMUs8THRU12\SWMU10CAPTENTAPPROVAL

File copy -

DEPARTMENT OF THE ARMY
HEADQUARTERS, 3D INFANTRY DIVISION (MECHANIZED), FORT STEWART
DIRECTORATE OF PUBLIC WORKS
1550 FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-4927

REPLY TO
ATTENTION OF

JUL 30 2001

Office of the Directorate

EXPRESS MAIL

Georgia Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30303

Dear Mr. Khaleghi:

Fort Stewart is pleased to submit two copies of the Final Corrective Action Plan for the Inactive EOD Area North of Garrison Area (SWMU 10) at Fort Stewart, Georgia, dated July 2001, EPA ID No. GA9 210 020 872, for your review and comments.

In accordance with the Federal Code of Regulations, Section 270.11(d), the following certification is provided by the Installation:

> I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Please contact Ms. Melanie Little or Ms. Tressa Rutland, (918) 296-9490 or (912) 767-2010, respectively, should questions arise regarding the enclosed documents.

Sincerely,

for Thomas C. Fry
Gregory V. Stanley
Colonel, U.S. Army
Director, Public Works

Enclosures

FINAL

FORSCOM

CORRECTIVE ACTION PLAN

for the

3d Inf Div (Mech)

Inactive EOD Area North of Garrison Area (SWMU 10) at Fort Stewart, Georgia

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract No. DACA21-95-D-0022
Delivery Order 0037

July 2001

00-275(PPT)/071001

5.0 CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN

This section presents a conceptual design and plan for implementation of the selected corrective action alternative for SWMU 10 based on the level and type of soil contamination and the fact that the OE survey conducted in May 2001 indicated that no UXO or OE–related items were located at the larger portion of SWMU 10. The OE survey also indicated that no UXO was located at the surface of the smaller area of SWMU 10; however, the smaller area of SWMU 10 contained OE–related items at the surface and unidentified OE–related items in the near subsurface. A cost-effective corrective action was selected that would adequately protect human health and safety. The technology evaluation presented in Chapter 4.0 compares three different corrective action alternatives for SWMU 10 based on their effectiveness at protecting human health and safety, life-cycle costs, and technical factors. The selected alternative and justification for the given selection are presented in Table 5-1.

Table 5-1. Selected Alternative Summary Table, SWMU 10

Site	Selected Alternative	Summary of Justification
SWMU 10	Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Fence Barrier and Fence-mounted Warning Signs around the Smaller Area of SWMU 10 only, Implementation of O&M Plan	High level of protection

5.1 SELECTED CORRECTIVE ACTION

The selected corrective action alternative for SWMU 10 involves a multi-layered approach to restricting human activity within the boundaries of SWMU 10 geared to the potential hazards at the individual areas making up SWMU 10. The selected set of institutional controls comprising this alternative will provide a combination of land use restrictions and prohibitions and physical barriers. Land use restrictions will be documented and/or enforced through deed recordation, the BMP, zoning restrictions, and signage. Six-foot-high chain-link fencing topped with three strands of barbed wire will be provided as a physical barrier to access by humans around the smaller area of SWMU 10, at which OE–related items at the surface may potentially represent a physical safety hazard to FSMR personnel or trespassers.

Justification of Selection

Alternative 2 has been selected because it will provide effective protection of human health and safety. Although the posting of warning signs without fencing would be less expensive, the additional degree of protection provided by the fencing is necessary around the smaller area of SWMU 10 to ensure human safety. The protection that the fence will provide against inadvertent access to the exploded surface debris at the site and unauthorized excavation below the ground surface justifies the moderately greater expense of implementing Alternative 2 rather than Alternative 1. Institutional controls described for Alternative 2 will provide a sufficient level of protection for human health and safety and an adequate degree of long-term reliability and effectiveness as well as short-term effectiveness. The institutional controls under Alternative 2 can be easily and affordably implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

Effectiveness. Chain-link, barbed-wire fencing; warning signs; and documented land use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to contaminants or exploded ordnance debris within the boundaries of the smaller portions of SWMU 10. The use of chain-link, barbed-wire fencing provides a high degree of both short-term and long-term reliability for the prevention of site access by humans. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land use controls during ownership by DoD. In addition, all construction will be prohibited under the BMP. These land use controls will remain in effect after transfer from DoD ownership by restrictions imposed through deed recordation.

An annual O&M program will be administered to replace or repair warning signs and fencing, which may deteriorate over time (see Appendix B). Implementation of the O&M Plan will ensure the effectiveness of this program. The O&M program for this CAP will involve inspection as well as potential replacement and/or repair of warning signs and fencing.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried exploded ordnance and debris within the boundaries of SWMU 10. Posting of warning signs together with existing access restrictions will be most effective over the short term. The site is remote and not being used, so access is already limited.

Implementability. Very few factors limit implementability of the institutional controls under evaluation. On-site personnel or contractors can readily perform fence installation and posting of signs. O&M inspections require few resources with respect to inspection personnel and materials for repair. Establishment of an adequate combination of land use management tools will require additional time and effort for development, preparation, and processing of necessary paperwork. However, the time and resources are available to administer and acquire necessary land use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to facilitate incorporation of land use controls into the BMP and to facilitate deed recordation.

Cost. The estimated total life-cycle cost of installation of fencing and warning signs, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $186,839. Although Alternative 1 is less expensive ($155,320), Alternative 2 provides a significantly higher level of protection with respect to preventing access by humans to the smaller area that actually represents a safety hazard.

5.2 CONCEPTUAL DESIGNS

During the period of DoD's ownership, institutional controls will be recorded in the BMP to ensure implementation. Notification of transfer will be made to regulatory authorities upon transfer of the property. Land use restrictions and institutional control requirements that are expected to be enforced subsequent to property transfer include the following: deed recordation; the purchase agreement or lease; zoning controls; applicable state land use control management systems in effect at the time the property is transferred; community, transferee, or governmental notice (if needed); and self-certification (if feasible). To reduce potential exposure to human health and safety hazards associated with the smaller area of SWMU 10, 6-foot-high chain-link fencing topped with three strands of barbed wire will be installed around the boundary of the smaller area of the site. Warning signs stating restrictions on human activity within SWMU 10 will be mounted on the fencing (see Figure 4-2). No warning signs will be installed around the larger area of SWMU 10.

All activities within the boundaries of SWMU 10 that would involve disturbance of the subsurface will be prohibited in accordance with all land use control mechanisms. Activities that will be prohibited include

hunting, recreational activities, and construction. However, the following activities, conducted in a manner that would minimize disturbance of the subsurface, will be permitted: use for military training exercises/training, performance of wildlife studies, and provision and maintenance of feed lots for deer.

Establishment of Institutional Controls

Prior to installation of fencing and posting of warning signs around the smaller area of SWMU 10, land use and "zoning-like" requirements for the entire area of SWMU 10 will be incorporated into the BMP, which will include all restrictions and provisions documented in Appendix C of this report. The BMP will include a description of institutional controls as provided in this CAP. The appropriate implementing document(s) will include land use prohibitions and restrictions, including those related to activities that disturb the subsurface and to construction of new buildings. The appropriate implementing document(s) will also provide allowances for those activities that do not impact the subsurface, as described above. Reference to documents relevant to the corrective actions performed at SWMU 10 will also be included in the BMP.

Deed recordation and the purchase agreement or lease agreement upon property transfer will also incorporate land use controls. Deed recordation provisions and requirements are described in Appendix C. The deed recordation will, in perpetuity, notify any potential purchaser of the property that SWMU 10 has been used as an EOD area. The purchase agreement(s) and deed recordation or lease agreements will reference this CAP and other environmental documents that contain the rationale for the restrictions. As required by the DoD policy "Responsibility for Additional Environmental Cleanup after Transfer of Property," the property disposal agent will ensure that the transfer documents for real property reflect the land use controls. The legal office of USACE and its telephone number will be included as a point of contact in the purchase agreement and deed in case a problem arises with a use control, additional contamination is found, or the transferee wishes to revise or terminate a land use control. All applicable and appropriate state land use control management systems in effect at the time of transfer will also be implemented. Additional land use control mechanisms related to property transfer (e.g., notices, media use restrictions, self-certification) will be evaluated and implemented as necessary and appropriate.

A survey plat has been prepared by a professional land surveyor certified in the state of Georgia (Appendix D). The plat will be included in the BMP. The survey plat indicates the location and dimensions of SWMU 10 with respect to permanently surveyed benchmarks. The plat contains a prominently displayed note that states Fort Stewart's obligation to prohibit disturbance of SWMU 10 in accordance with this CAP.

A 6-foot-high, industrial chain-link fence constructed of 6-gauge galvanized steel topped with three strands of barbed wire will be installed around the perimeter of the smaller portion of SWMU 10 (473 linear feet). Fencing will include 2-inch-diameter galvanized posts set a minimum of 2 feet bgs in concrete on 10-foot centers. Four-inch-diameter galvanized posts will be installed at each corner and as the supports at each swing gate. One 20-foot-wide (total), double-swing gate will be installed along one side of the fenced area of SWMU 10 (see Figure 4-2). A strip of fluorescent orange reflective tape (2 inches wide) will be placed on the outside surface and along the aboveground length of each galvanized post to increase the visibility of the fence to military personnel. Two strips will be placed on the 4-inch corner posts. The minimum specifications for the chain-link fencing and gates are presented Figure 5-1.

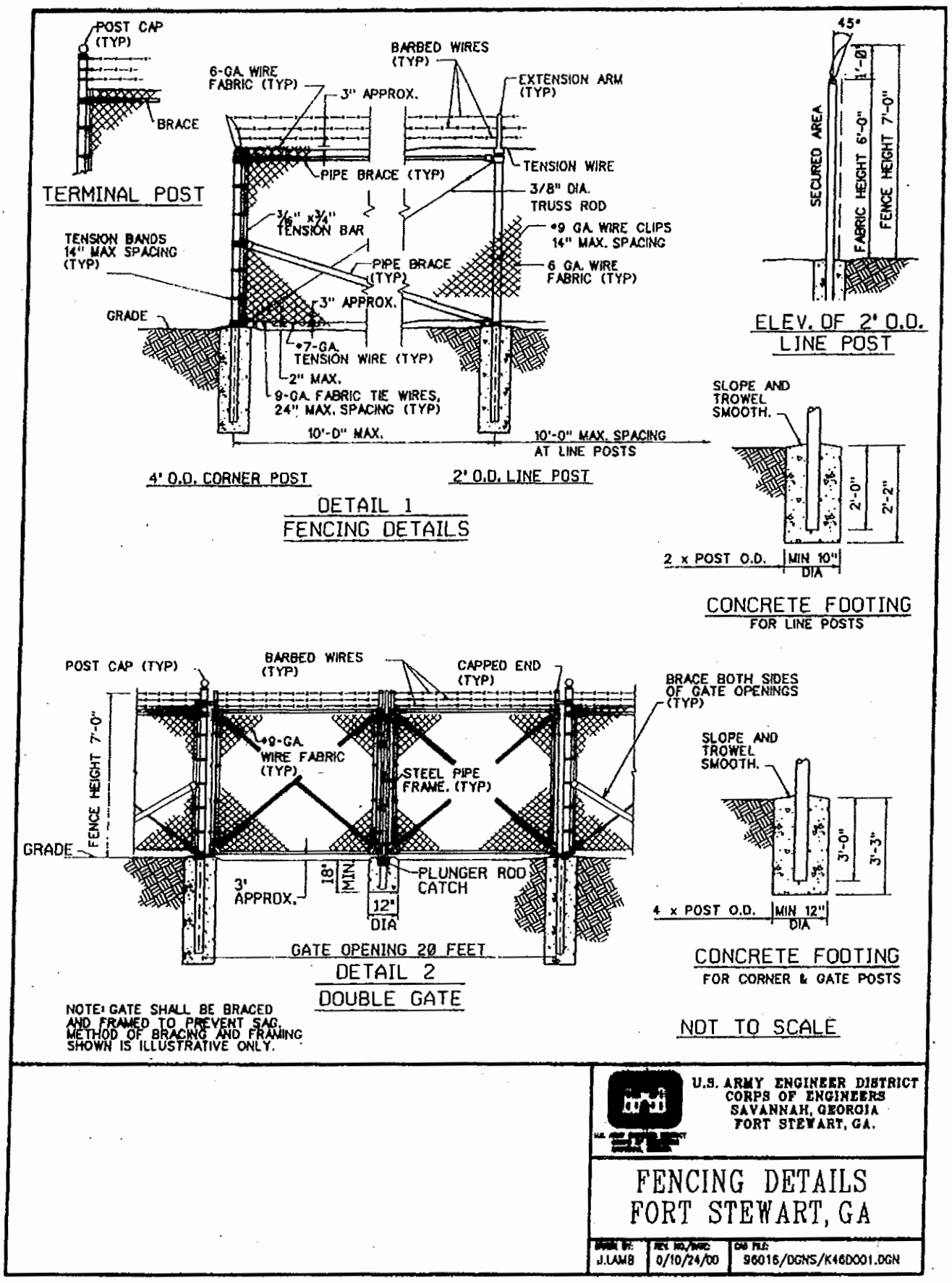

Figure 5-1. Specifications for Chain-link Fencing and Gates, SWMU 10

Four fence-mounted warning signs will be posted on each side of fencing surrounding the smaller area, as shown in Figure 4-2. These signs will be worded as follows:

CAUTION:
FORMER EXPLOSIVE ORDNANCE DISPOSAL AREA
NO TRESPASSING
CONTACT DPW
REGARDING USE RESTRICTIONS
767-2010

Each sign will have the dimensions of 24 inches by 24 inches. Warning signs will be metal plates with reflective painting and weather-resistant construction. The signs will have a brown background and white lettering.

Signs will be permanently mounted to chain-link fencing. All signs will be permanently labeled (for identification purposes) on the back with a numerical identification number as shown on Figure 4-2.

The warning signs and fencing at SWMU 10 will be inspected annually in accordance with the O&M Plan. Damaged fencing will be repaired as needed. Damaged signs will also be repaired or replaced as needed. Repair or replacement of signs or fencing will occur within 1 month of inspection. Should damage be observed between inspections, repair or replacement will occur within 1 month of observation.

5.3 COST ESTIMATES

Detailed cost estimates are provided in Appendix E for implementation of institutional controls at SWMU 10. The life-cycle cost estimates for the selected institutional controls alternatives for SWMU 10 are provided in Table 5-2.

Capital costs include materials and labor associated with installation of fencing and/or mounting or posting of 24-inch by 24-inch aluminum signage according to the quantities provided in Table 5-3.

Table 5-2. Estimated Cost for Selected Alternative, SWMU 10

Site	Capital Costs	O&M	Other[a]	Total
SWMU 10	$27,863	$92,678	$66,297	$186,839

[a]Includes engineering management, contingency, health and safety, and contractor profit.

Table 5-3. Summary of Primary Physical Components of the Selected Alternative, SWMU 10

Site	Fencing (feet)	Number of 20-Foot Gates	Number of Signs
SWMU 10	473	1	4

Four signs for the smaller area at SWMU 10 are included in the cost for SWMU 10. The cost of a single 20-foot-wide, double-swing gate is included for the fenced area. Costs that would be associated with the deed recordation are also included.

O&M costs include the prices of annual inspections and fence and sign repair/replacement every 5 years for 30 years. The cost for sign repair/replacement every 5 years was assumed to be equivalent to 25 percent of the cost of initial installation. In addition, the cost for fence repair/replacement every 5 years was assumed to be equivalent to 10 percent of the cost of initial installation.

5.4 IMPLEMENTATION SCHEDULE

Implementation of the corrective action will begin at SWMU 10 once approval of this CAP is received from GEPD. The schedule presented in Table 5-4 has been established for implementation of institutional controls at this site.

Table 5-4. Corrective Action Implementation Schedule, SWMU 10

Task	Frequency of Action or Time from GEPD Approval of CAP (days)
Procure fencing, signs, and materials	90
Record institutional controls in BMP and any other approved implementing document	120
Install fence and post signs around smaller area of SWMU 10	120
Perform inspections (implement O&M Plan)	Annually[a]
Repair/replace signage and repair fencing	As needed
Notify GEPD of property transfer	Prior to property transfer
Establish appropriate legal land use controls for property transfer (e.g., deed recordation, lease or purchase agreements)	Prior to property transfer

[a]The first O&M report will be submitted to GEPD 455 days after the installation of the fencing and signs, with subsequent reports submitted annually thereafter.

6.0 REFERENCES

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Georgia Department of Natural Resources
205 Butler Street, S.E., Suite 1162, Atlanta, Georgia 30334
Lonice C. Barrett, Commissioner
Environmental Protection Division
Harold F. Reheis, Director
404/656-2833

October 5, 2001

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Gregory V. Stanley, Colonel, U.S. Army
Director, Public Works
Headquarters, 3D Infantry Division (Mechanized) and Fort Stewart
Directorate of Public Works, Building 1137
Environmental Branch (ATTN: Melanie Little)
1550 Frank Cochran Drive
Fort Stewart, GA 31314-4927

RE: Corrective Action Plan for the Inactive EOD Area located approximately nine (9) miles Northeast of Garrison Area, Inactive EOD Area in Red Cloud Range (Hotel Area), and Inactive EOD Area located approximately three (3) miles Northeast of Garrison Area [Solid Waste Management Units (SWMUs) 8, 9 & 11, respectively] dated May 2001; Fort Stewart; EPA ID No. GA9 210 020 872.

Dear Colonel Stanley:

The Hazardous Waste Management Branch of the Georgia Environmental Protection Division (GA EPD) is in receipt of the above-referenced document. Based upon our review, GA EPD (1) has generated no comments and (2) tentatively approves the Corrective Action Plan for SWMUs 8, 9 & 11 dated May 2001.

Please note that a final decision concerning the Corrective Action Plan for SWMUs 8, 9 & 11 dated May 2001 will be made by GA EPD, after completion of a forty-five (45) day public comment period, by our issuance of a Notice of Decision documenting the next modification of your Hazardous Waste Facility Permit #HW-045(S&T). Should you have any questions concerning this correspondence, please contact Brent Rabon of my staff at (404)656-2833.

Sincerely,

for

Bruce Khaleghi, Unit Coordinator
Hazardous Waste Management Branch

c: Mr. Larry Rogers, GA EPD-Southeast Regional Office
File: Fort Stewart(R)
R:\BRENTR\STEWART\SWMUs8THRU12\SWMU8911CAPTENTAPPROVAL

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DEPARTMENT OF THE ARMY
HEADQUARTERS, 3D INFANTRY DIVISION (MECHANIZED), FORT STEWART
DIRECTORATE OF PUBLIC WORKS
1550 FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-4927

REPLY TO
ATTENTION OF

JUL 30 2001

Office of the Directorate

EXPRESS MAIL

Georgia Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30303

Dear Mr. Khaleghi:

Fort Stewart is pleased to submit two copies of the Final Corrective Action Plan for the Inactive EOD Area Located Approximately Nine Miles Northeast of Garrison Area (SWMU 8); Inactive EOD Area in Red Cloud Range, Hotel Area (SWMU 9); and Inactive EOD Area Located Approximately Three Miles Northeast of Garrison Area (SWMU 11) at Fort Stewart, Georgia, dated May 2001, EPA ID No. GA9 210 020 872, for your review and comments.

In accordance with the Federal Code of Regulations, Section 270.11(d), the following certification is provided by the Installation:

> I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Please contact Ms. Melanie Little or Ms. Tressa Rutland, (918) 296-9490 or (912) 767-2010, respectively, should questions arise regarding the enclosed documents.

Sincerely,

Thomas C. Fry
for Gregory V. Stanley
Colonel, U.S. Army
Director, Public Works

Enclosures

FINAL

FORSCOM

CORRECTIVE ACTION PLAN

for the

3d Inf Div (Mech)

Inactive EOD Area Located Approximately Nine Miles Northeast of Garrison Area (SWMU 8); Inactive EOD Area in Red Cloud Range, Hotel Area (SWMU 9); and Inactive EOD Area Located Approximately Three Miles Northeast of Garrison Area (SWMU 11) at Fort Stewart, Georgia

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract No. DACA21-95-D-0022
Delivery Order 0037

May 2001

SAIC

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FINAL

CORRECTIVE ACTION PLAN FOR THE INACTIVE EOD AREA LOCATED APPROXIMATELY NINE MILES NORTHEAST OF GARRISON AREA (SWMU 8); INACTIVE EOD AREA IN RED CLOUD RANGE, HOTEL AREA (SWMU 9); AND INACTIVE EOD AREA LOCATED APPROXIMATELY THREE MILES NORTHEAST OF GARRISON AREA (SWMU 11) AT FORT STEWART MILITARY RESERVATION FORT STEWART, GEORGIA

REGULATORY AUTHORITY
Resource Conservation and Recovery Act
40 CFR 264, Title II, Subpart C, Section 3004;
42 USC 6901 et seq.

Prepared for
U.S. Army Corps of Engineers
Savannah District
Under Contract DACA21-95-D-0022
Delivery Order Number 0037

Prepared by
Science Applications International Corporation
800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37831

May 2001

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 that I 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 by a subordinate working under my direction.

GEORGIA REGISTERED 2285 PROFESSIONAL ENGINEER

4/24/01

Patricia Stoll, P.E.
Technical Manager
Science Applications International Corporation

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CONTENTS

FIGURES v
TABLES v
ACRONYMS vi

1.0 INTRODUCTION 1-1
1.1 SCOPE 1-1
1.2 SITE BACKGROUND 1-1
1.2.1 SWMU 8 1-2
1.2.2 SWMU 9 1-2
1.2.3 SWMU 11 1-2
1.3 REGULATORY BACKGROUND 1-3
1.4 REPORT ORGANIZATION 1-4

2.0 SITE CHARACTERIZATION AND REMEDIAL INVESTIGATION RESULTS 2-1
2.1 SITE LOCATION AND HISTORY 2-1
2.1.1 SWMU 8 2-1
2.1.2 SWMU 9 2-1
2.1.3 SWMU 11 2-2
2.2 TOPOGRAPHY/PHYSIOGRAPHY/CLIMATE 2-2
2.2.1 SWMU 8 2-2
2.2.2 SWMU 9 2-2
2.2.3 SWMU 11 2-9
2.3 SITE GEOLOGY 2-9
2.4 SITE HYDROLOGY 2-9
2.4.1 SWMU 8 2-9
2.4.2 SWMU 9 2-9
2.4.3 SWMU 11 2-10
2.5 HYDROGEOLOGY 2-10
2.5.1 SWMU 8 2-10
2.5.2 SWMU 9 2-10
2.5.3 SWMU 11 2-11
2.6 SITE ECOLOGY 2-11
2.6.1 SWMU 8 2-12
2.6.2 SWMU 9 2-12
2.6.3 SWMU 11 2-12
2.7 NATURE AND EXTENT OF CONTAMINATION 2-12
2.7.1 SWMU 8 2-13
2.7.2 SWMU 9 2-13
2.7.3 SWMU 11 2-14

3.0 JUSTIFICATION/PURPOSE OF CORRECTIVE ACTION 3-1
3.1 PURPOSE 3-1
3.2 REMEDIAL RESPONSE OBJECTIVE 3-1
3.3 IDENTIFICATION OF REMEDIAL LEVELS 3-1

4.0 SCREENING OF CORRECTIVE ACTIONS 4-1
4.1 SCREENING CRITERIA 4-1
4.1.1 Effectiveness 4-1

4.1.2 Implementability 4-1
4.1.3 Cost 4-1
4.2 EVALUATION OF CORRECTIVE ACTION TECHNOLOGIES 4-2
4.3 CORRECTIVE ACTION ALTERNATIVES 4-2
4.3.1 Evaluation Factors 4-4
4.3.2 Site-specific Evaluation of Corrective Action Alternatives 4-4

5.0 CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN 5-1
5.1 SELECTED CORRECTIVE ACTION 5-1
5.1.1 SWMU 8 5-1
5.1.2 SWMU 9 5-2
5.1.3 SWMU 11 5-3
5.2 CONCEPTUAL DESIGNS 5-4
5.2.1 SWMU 8 5-4
5.2.2 SWMU 9 5-7
5.2.3 SWMU 11 5-8
5.3 COST ESTIMATES 5-10
5.4 IMPLEMENTATION SCHEDULE 5-11

6.0 REFERENCES 6-1

APPENDICES

A OPERATIONS AND MAINTENANCE PLANS A-1
B BASE MASTER PLAN AND DEED RECORDATION REQUIREMENTS B-1
C SITE DESCRIPTIONS, DIRECTIONS TO SITES, AND SURVEY PLATs C-1
D COST ESTIMATES D-1

FIGURES

2-1 Regional Location Map for Fort Stewart Military Reservation, Georgia 2-3
2-2 Location Map for Fort Stewart Military Reservation, Georgia 2-4
2-3 Location of SWMUs 8, 9, and 11, Fort Stewart, Georgia 2-5
2-4 Site Features of SWMU 8, Fort Stewart, Georgia 2-6
2-5 Site Features of SWMU 9, Fort Stewart, Georgia 2-7
2-6 Site Features of SWMU 11, Fort Stewart, Georgia 2-8
4-1 Alternative 1: Institutional Controls with Post-mounted Warning Signs, SWMU 8 4-7
4-2 Alternative 2: Institutional Controls with Chain-link Fence Barrier and Fence-mounted Warning Signs, SWMU 8 4-8
4-3 Alternative 2: Institutional Controls with Post-mounted Warning Signs, SWMU 9 4-13
4-4 Alternative 3: Institutional Controls with Chain-link Fence Barrier and Fence-mounted Warning Signs, SWMU 9 4-14
4-5 Alternative 1: Institutional Controls with Post-mounted Warning Signs, SWMU 11 4-17
4-6 Alternative 2: Institutional Controls with Chain-link Fence Barrier and Fence-mounted Warning Signs, SWMU 11 4-18
5-1 Specifications for Chain-link Fencing and Gates 5-6

TABLES

2-1 Summary of Site-related Contaminants 2-13
2-2 Summary of Maximum Detected Constituents, SWMU 8 2-14
2-3 Summary of Site-related Contaminants, SWMU 11 2-14
4-1 Evaluation of Corrective Actions 4-3
4-2 SWMU 8: Corrective Action Alternatives 4-5
4-3 SWMU 9: Corrective Action Alternatives 4-10
4-4 SWMU 11: Corrective Action Alternatives 4-15
5-1 Selected Alternative Summary Table 5-1
5-2 Estimated Cost for Selected Alternative for Each SWMU 5-10
5-3 Summary of Primary Physical Components of Each Selected Alternative 5-10
5-4 Corrective Action Implementation Schedule 5-11

ACRONYMS

amsl	above mean sea level
bgs	below ground surface
BMP	Base Master Plan
CAP	Corrective Action Plan
DERP	Defense Environmental Restoration Program
DoD	U.S. Department of Defense
DPT	direct-push technology
DPW	Directorate of Public Works
EOD	explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
EP Tox	Extraction Procedure Toxicity
FSMR	Fort Stewart Military Reservation
GEPD	Georgia Environmental Protection Division
O&M	operations and maintenance
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SAIC	Science Applications International Corporation
SRC	site-related contaminant
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 SCOPE

This report documents the Corrective Action Plan (CAP) for three former explosive ordnance disposal (EOD) areas located at Fort Stewart, Georgia. These three EOD areas include the following: Inactive EOD Area Located Approximately Nine Miles Northeast of Garrison Area, Solid Waste Management Unit (SWMU) 8; Inactive EOD Area in Red Cloud Range, Hotel Area, SWMU 9; and Inactive EOD Area Located Approximately Three Miles Northeast of Garrison Area, SWMU 11. The revised final Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for 16 SWMUs (SAIC 2000) determined that these SWMUs require CAPs to evaluate appropriate remedial actions to eliminate or minimize potential risks associated with the three former EOD areas. Implementation of the remedy selected in this CAP is required for these areas to protect the health and safety of humans coming in contact with the sites. 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. 0037.

Based on the findings presented in the revised final Phase II RFI Report for 16 SWMUs issued by SAIC in April 2000, a no-further-action-required investigative status has been assigned to these three SWMUs. As recommended by the Phase II RFI Report and as concurred to by the Georgia Environmental Protection Division (GEPD), a CAP has been prepared for SWMUs 8, 9, and 11 because surface and subsurface ordnance and debris and associated surface soil contamination will remain in place. Implementation of the selected remedies documented by this CAP is necessary to control intrusive activities at these sites, to be protective of the health and safety of humans potentially coming in contact with contaminants or exploded ordnance debris, and to prevent the use of groundwater as a drinking water source. As concurred to by GEPD, this CAP has been prepared to evaluate the use of institutional controls to protect human health and safety. A "no action" alternative is also presented and evaluated to provide a comparison to the institutional controls alternative.

The CAP describes and provides designs for the selected remedies and includes plans for their implementation, along with a plan for operations and maintenance (O&M) of the remedy selected for each SWMU. Also included in this plan are detailed cost estimates and schedules of implementation for the selected corrective actions.

1.2 SITE BACKGROUND

A RCRA Facility Assessment (RFA) was performed and submitted to GEPD in June 1990. The June 1990 RFA listed 24 SWMUs at the Fort Stewart Military Reservation (FSMR) that required some type of RFI action (Geraghty and Miller 1992). SWMUs 9 and 11 were among these 24. Another RFA was performed and submitted in August 1990 for SWMU 8 (Dames and Moore 1990). Although no further action was recommended in the RFA Report for SWMU 8, GEPD required that this site be included in this CAP to ensure protection of human health and safety. Phase I RFIs at SWMUs 9 and 11 were conducted to determine if a release to the environment had occurred and to decide if the sites had the potential for a release to the environment (Rust 1996). SWMUs 9 and 11 were recommended for a Phase II RFI. Phase II RFIs were performed January 1998, and the results for SWMU 11 have been documented in the revised final Phase II RFI Report (SAIC 2000). Because SWMU 9 is located in an active EOD range and in accordance with the Military Munitions Rule effective August 12, 1997, the Fort Stewart Directorate of Public Works (DPW) requested from GEPD that the Phase II RFI for

SWMU 9 be performed during the closure of the SWMU. GEPD concurred with this recommendation and deferred the Phase II RFI to investigate potential soil and groundwater contamination at SWMU 9 until final closure of the surrounding Red Cloud Range.

The objectives for the Phase II RFI for SWMUs 9 and 11 as defined by the Work Plan (SAIC 1997) approved by GEPD included the following:

- 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 no further action; and
- gather data necessary to support a CAP, if warranted.

Site background information specific to each of the SWMUs is presented in the sections below.

1.2.1 SWMU 8

An RFA performed in 1990 is the only previous investigation documented at SWMU 8. Observations made during this assessment and subsequent site visits indicated that craters contained no solid waste other than bits of shrapnel and other cartridge fragments. No ashes or charred ground was observed from past explosions or burning. The site occupies approximately 1.8 acres. One explosive—2,4-dinitrotoluene —was detected at a concentration of 570 µg/kg at one surface soil location (S4A) and two semivolatile organic compounds (SVOCs) —naphthalene and dibutyl phthalate—were detected at a concentration of 440 µg/kg and 6,300 µg/kg at surface soil locations S1A and S7A, respectively. Analysis for Extraction Procedure Toxicity (EP Tox) metals showed that the soil was not hazardous due to RCRA metals. No further investigation was recommended upon completion of the RFA for this SWMU (Dames and Moore 1990), as concurred by email from Brent Rabon of GEPD to Melanie Little of Fort Stewart dated July 26, 1999.

1.2.2 SWMU 9

SWMU 9, which is one-tenth of an acre in size, is reported to be inactive; however, it is within the boundaries of one of the more active armored vehicle firing ranges (Red Cloud Range) on the FSMR. A site reconnaissance in September 1996, conducted with extreme caution, indicated that the amount of EOD debris is a potential safety hazard. Potential contamination due to disposal of exploded ordnance and unexploded ordnance (UXO) was investigated in 1993 during a Phase I RFI for the 24 SWMUs at Fort Stewart. Analytical results indicated the existence of various levels of metals including arsenic, barium, mercury, and lead in all the samples. Based on these findings, a Phase II RFI was determined to be necessary to further define the nature and extent of contamination. In accordance with the Military Munitions Rule effective August 12, 1997, Fort Stewart DPW requested from GEPD that the Phase II RFI be performed during the closure of the active Red Cloud Range. GEPD concurred with this recommendation [see Comment 137 of Appendix L of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000)] and deferred the Phase II RFI to investigate potential soil and groundwater contamination at SWMU 9 until final closure of the surrounding Red Cloud Range.

1.2.3 SWMU 11

This EOD site is reported to be inactive and is located adjacent to a cleared field (i.e., a feed plot). Numerous blast craters are spread out over nearly 1.8 acres. 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 RFA analytical results indicated the presence 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. No VOCs or explosive residues were detected in surface soil based on the Phase I RFI analytical results. However, analysis of surface soil samples collected during the Phase I RFI indicated the presence of arsenic, barium, silver, chromium, and lead at levels that exceeded background concentrations. Based on these findings, GEPD instructed the Fort Stewart DPW to conduct a Phase II RFI.

The scope of the Phase II fieldwork for SWMU 11 included the following activities described below.

- Initial screening consisted of using direct-push technology (DPT) techniques to collect groundwater samples from Geoprobe borings for explosives analysis. Eight Geoprobes were installed around the perimeter of the EOD area. 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 (if necessary). Because no explosives were observed in the Geoprobe borings and with the concurrence of GEPD, a vertical-profile boring was not installed at the site. In addition, with the concurrence of GEPD, no monitoring wells were installed at the site during the Phase II RFI activities.

- Three surface soil samples were collected from within SWMU 11's boundary and analyzed for explosives and RCRA metals

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

1.3 REGULATORY BACKGROUND

Executive Order 12088, signed in 1978, requires federal facilities to comply with federal, state, and local pollution requirements. The Defense Environmental Restoration Program (DERP) was formally established in fiscal year 1984 to promote and coordinate efforts for the evaluation and cleanup of contamination at U.S. Department of Defense (DoD) installations. Executive Order 12580, signed January 23, 1987, relates to Superfund implementation and assigns responsibility to the Secretary of Defense for carrying out the DERP. The Installation Restoration Program was established as part of the DERP. This program was established to assess potential contamination at DoD installations and formerly used properties and to address site cleanups, as necessary. With the promulgation of RCRA and the subsequent approval of the Georgia Hazardous Waste Management Act by the U.S. Environmental Protection Agency (EPA), the state was granted RCRA permitting authority. In accordance with RCRA, the state issued to Fort Stewart, in August 1987, a Hazardous Waste Facility Permit [Georgia Environmental Division Permit No. HW-045 (S&T)]. The permit was renewed in August 1997. SWMUs 8, 9, and 11 are listed SWMUs in Fort Stewart's Subpart B Permit (Appendix A) and, therefore, are subject to investigation according to Title 40, Code of Federal Regulations, Part 264.101(c) [as reported in RFA for SWMU 8 (Dames and Moore 1990; Sections 10.3 and 10.5 of the revised final Phase II RFI Report for 16 SWMUs, dated April 2000 (SAIC 2000)] and to corrective action (the subject of this CAP), if necessary.

1.4 REPORT ORGANIZATION

This CAP report is divided into six chapters. Chapter 1.0 ("Introduction") provides an explanation of the scope of the CAP, presents general background information on the FSMR and specific background information on each SWMU, and provides regulatory background information. Chapter 2.0 ("Site Characterization and Remedial Investigation Results") provides an overview of each site; physical and environmental descriptions; and nature and extent of contamination, contaminant fate and transport, and preliminary risk evaluation information. Chapter 3.0 ("Justification/Purpose of Corrective Action") presents remedial response objectives and the purpose for corrective action and identifies and describes the corrective action alternatives under evaluation for each SWMU. Chapter 4.0 ("Screening of Corrective Actions") presents an evaluation of corrective actions and screens the corrective actions against established objectives and balancing factors. Chapter 5.0 ("Conceptual Design and Implementation Plan") identifies the selected corrective action, presents design and implementation details, and provides a cost estimate and schedule for the selected remedy for each SWMU. Reference information is presented in Chapter 6.0. The O&M Plan for the selected remedy for each SWMU is presented in Appendix A. Appendices B, C, and D, respectively, contain the Base Master Plan (BMP) and deed recordation requirements, the site descriptions, directions to the sites, and survey plats, and the cost estimates for SWMUs 8, 9, and 11.

2.0 SITE CHARACTERIZATION AND REMEDIAL INVESTIGATION RESULTS

Fort Stewart (then known as Camp Stewart) was established in June 1940 as an antiaircraft artillery training center. Between January and September 1945, the Installation operated as a prisoner-of-war camp. The Installation was deactivated in September 1945. In August 1950 Fort Stewart was reactivated to train antiaircraft artillery units for the Korean Conflict. The training mission was expanded to include armor training in 1953. Fort Stewart was designated a permanent U.S. Army installation in 1956 and became a flight training center in 1966. Aviation training at the Fort Stewart facilities was phased out in 1973. In January 1974 the 1st Battalion, 75th Infantry was activated at Fort Stewart. Fort Stewart then became a training and maneuver area, providing tank, field artillery, helicopter gunnery, and small arms training for regular Army and National Guard units. The 24th Infantry Division, which was reflagged as the 3d Infantry Division in May 1996, was permanently stationed at Fort Stewart in 1975. Training and maneuver activities comprise the Installation's primary mission today.

The FSMR is located in portions of Liberty, Bryan, Long, Tattnall, and Evans counties, Georgia, approximately 40 miles west-southwest of Savannah, Georgia (Figures 2-1 and 2-2). The cantonment, or garrison area, of the FSMR is located within Liberty County, on the southern boundary of the reservation. The three EOD areas included in this CAP are located outside the garrison area to the north and northeast (Figure 2-3).

2.1 SITE LOCATION AND HISTORY

2.1.1 SWMU 8

SWMU 8 is located approximately 9 miles northeast of the cantonment area, between Fort Stewart Roads 53 and 57, 1 mile south of Georgia Highway 144 (see Figure 2-3). The site consists of almost 1.8 acres, mostly clear of trees and vegetation. The site is accessed by an unpaved road off of Tank Trail 57. The access road divides SWMU 8 into two sections approximately equal in area (0.99 acre on the east and 0.84 acre on the west). Three blast craters and one open burning trench are located within the site's boundaries. The present site features and estimated boundary are presented in Figure 2-4. No potential surface water bodies are located at this site.

Between 1983 and 1987, SWMU 8 was used for open detonation and open burning of excess or unused small arms rounds, artillery and mortar rounds pyrotechnics, bulk explosives, rockets, propellants, and hand grenades. These materials were generated when larger packages of small arms or explosives were opened but not consumed within the original operation. For safety and security reasons, they were not restocked but instead destroyed by burning or detonation.

2.1.2 SWMU 9

SWMU 9 is located approximately 11 miles north of the garrison area and about 0.6 mile east of Georgia Highway 119 (see Figure 2-3). This SWMU is located in an area designated as B-12 on the Fort Stewart Installation Map. Open detonation of UXO was performed from 1979 to 1983 (Geraghty and Miller 1992). The site is approximately one-tenth of an acre and consists of three blast craters, with the largest being approximately 9 feet in diameter and 3 feet deep. The present site features and estimated boundary are presented in Figure 2-5. There is a small amount of nonordnance debris (e.g., dead trees, cans, plastic bottles) present within the craters. The vegetation at the site consists of some grasses, weeds, and a few small trees. There are no potential surface water features located at thi site. The SWMU 9 area is

reported to be inactive; however, it is within the boundaries of one of the more active armored vehicle firing ranges on the FSMR. A site reconnaissance in September 1996, conducted with extreme caution, indicated that the amount of EOD debris is a potential safety hazard.

The potential waste disposed of includes excess artillery powder bags, small arms rounds, artillery and mortar rounds, illuminating projectiles, pyrotechnics, bulk explosives, rockets, propellants, and regular smoke grenades. There are no records or information indicating any disposal of chemical/biological agents, acids, solvents, or other hazardous or toxic substances in the EOD area (Environmental Science and Engineering 1982).

2.1.3 SWMU 11

SWMU 11 is located 3 miles northeast of the garrison area, about 2 miles south of Georgia Highway 144, and 1 mile northeast of Wright Army Airfield (see Figure 2-3). 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. The entire site encompasses approximately 1.8 acres. The present site features and estimated boundary are presented in Figure 2-6. 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.

2.2 TOPOGRAPHY/PHYSIOGRAPHY/CLIMATE

The FSMR occupies a low-lying, flat region on the coastal plain of Georgia. Surface elevations range from approximately 20 feet to 100 feet above mean sea level (amsl) within the FSMR and generally decrease from northwest to southeast across the reservation. Terraces dissected by surface water drainages dominate the topography. The terraces are remnants of sea level fluctuations. The four terraces present within the FSMR are the Wicomico, Penholoway, Talbot, and Pamlico (Metcalf and Eddy 1996).

Fort Stewart has a humid, subtropical climate with long, hot summers. Average temperatures range from 50°F in the winter to 80°F in the summer. Average annual precipitation is 48 inches, with slightly more than half falling from June through September. Prolonged drought is rare in the area, but severe local storms (tornadoes and hurricanes) do occur. Under normal conditions wind speeds rarely exceed 5 knots, but gusty winds of more than 25 knots may occur during summer thunderstorms (Geraghty and Miller 1992).

2.2.1 SWMU 8

There are approximately 3 feet to 6 feet of relief across the site. The elevation of the site is approximately 38 feet amsl along the access road and slopes gently downward to approximately 32 feet amsl along the northeastern boundary and to approximately 35 feet amsl along the southeastern boundary.

2.2.2 SWMU 9

There are approximately 3 feet of relief across the site. The elevation of the site is approximately 64 feet amsl along the eastern boundary and slopes gently downward to approximately 61 feet amsl along the western boundary.

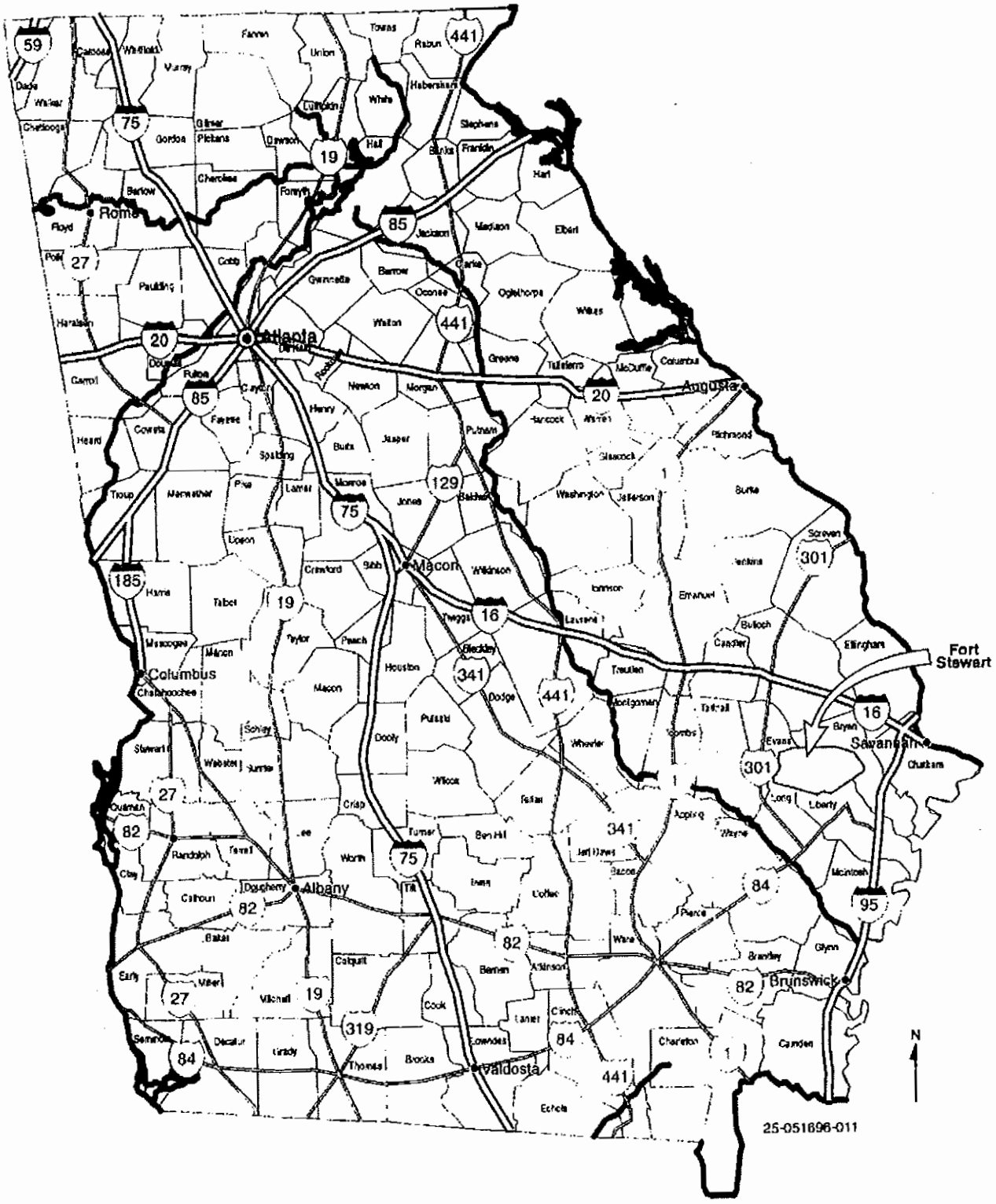

Figure 2-1. Regional Location Map for Fort Stewart Military Reservation, Georgia

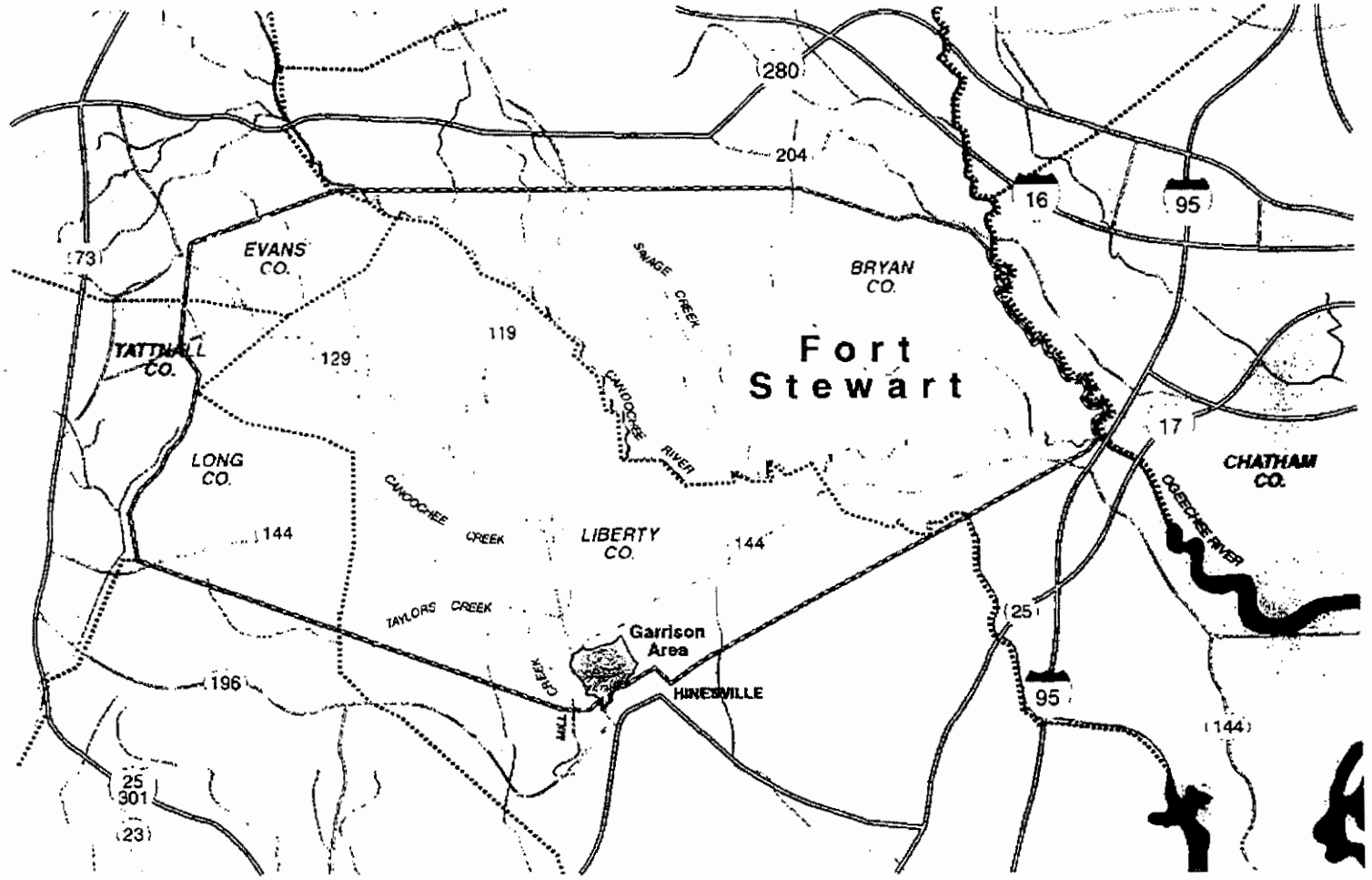

Figure 2-2. Location Map for Fort Stewart Military Reservation, Georgia

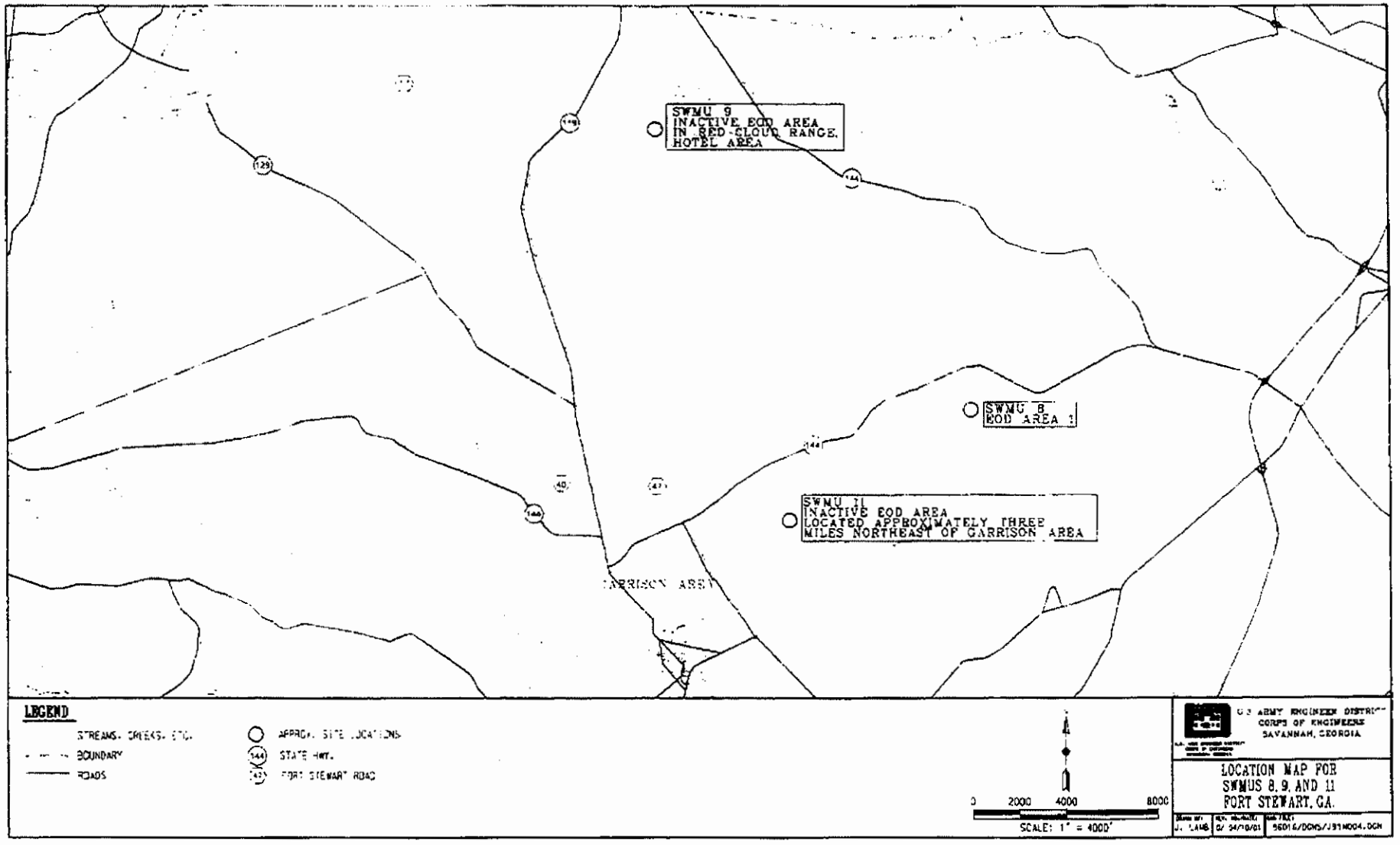

Figure 2-3. Location of SWMUs 8, 9, and 11, Fort Stewart, Georgia

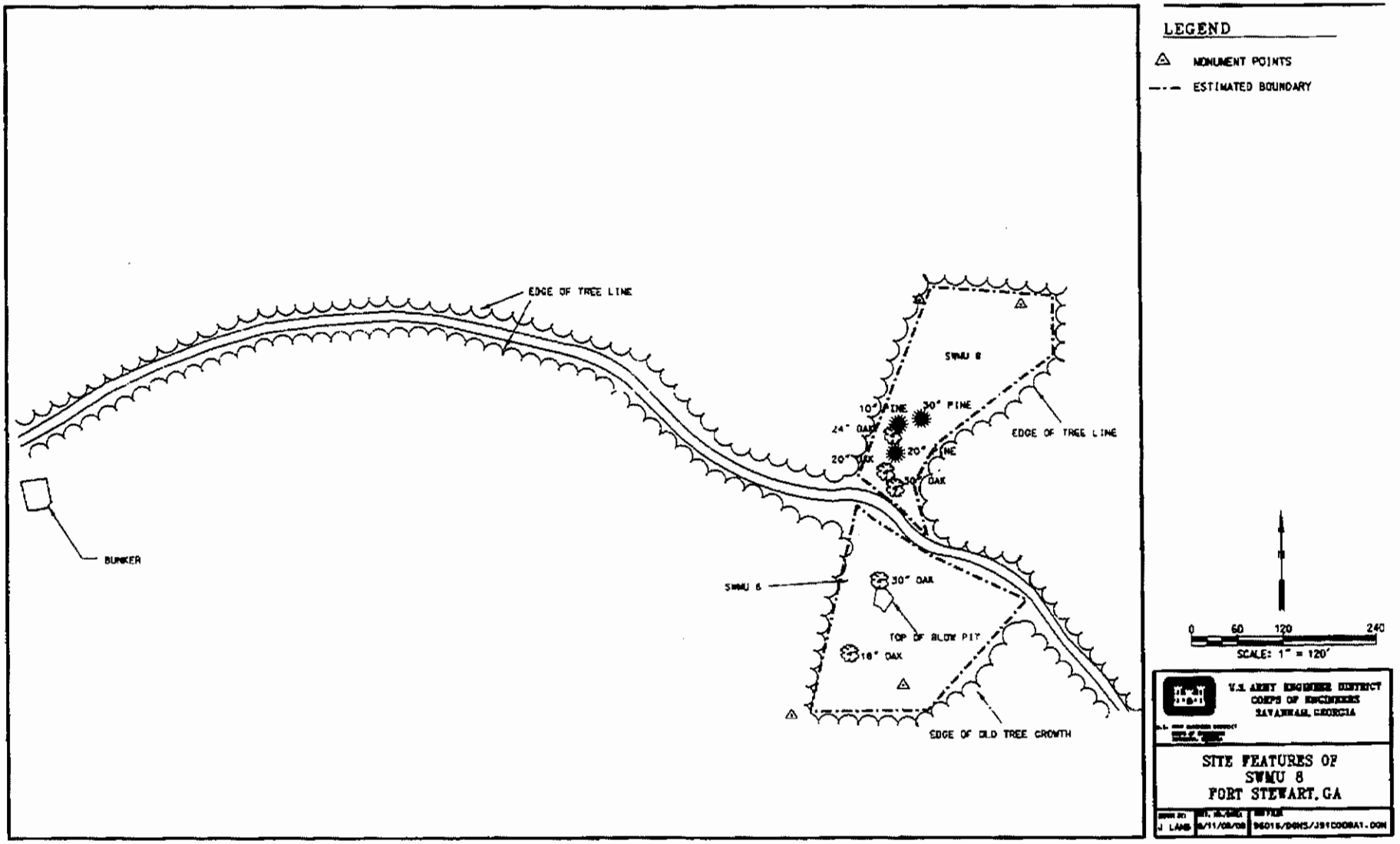

Figure 2-4. Site Features of SWMU 8, Fort Stewart, Georgia

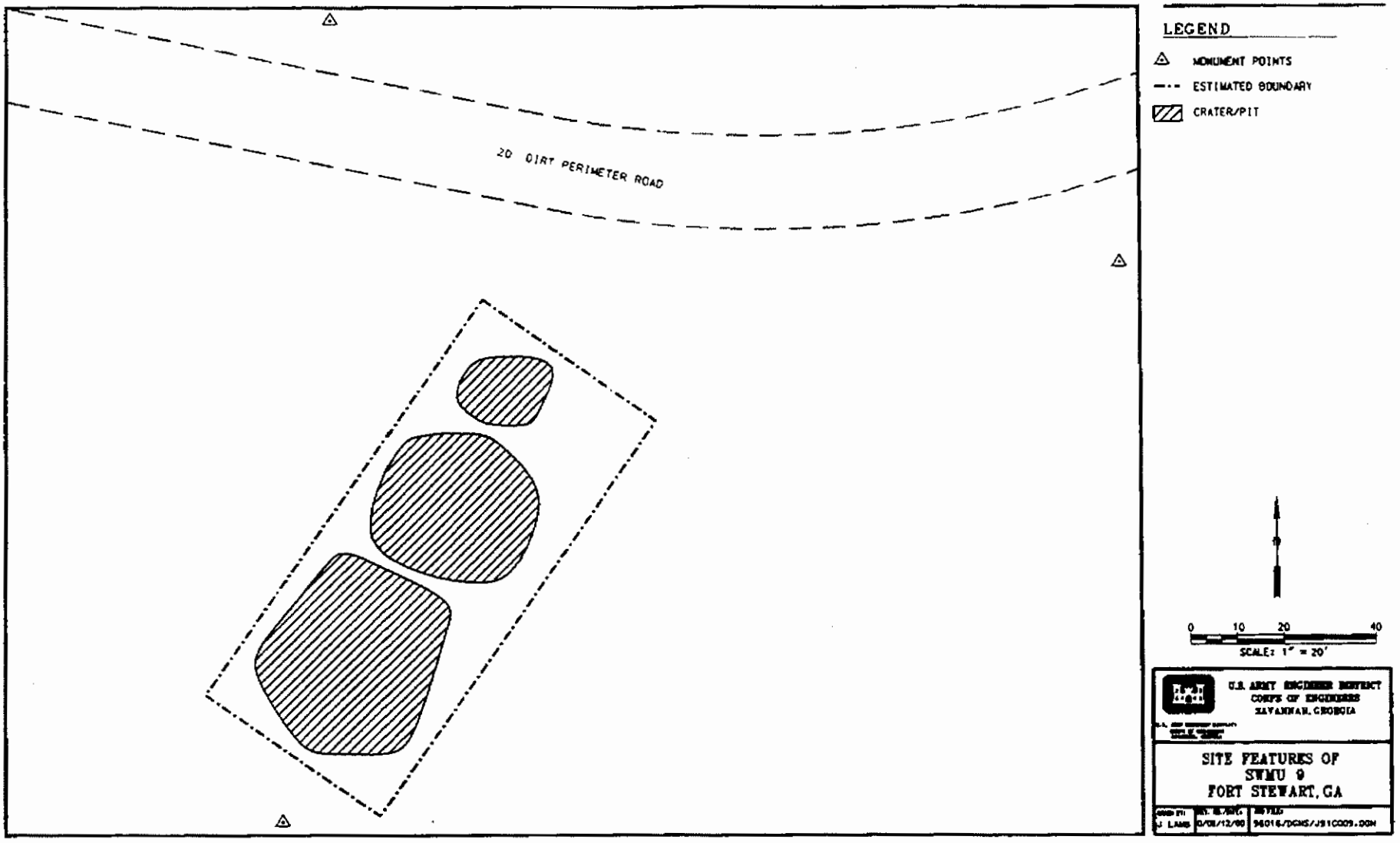

Figure 2-5. Site Features of SWMU 9, Fort Stewart, Georgia

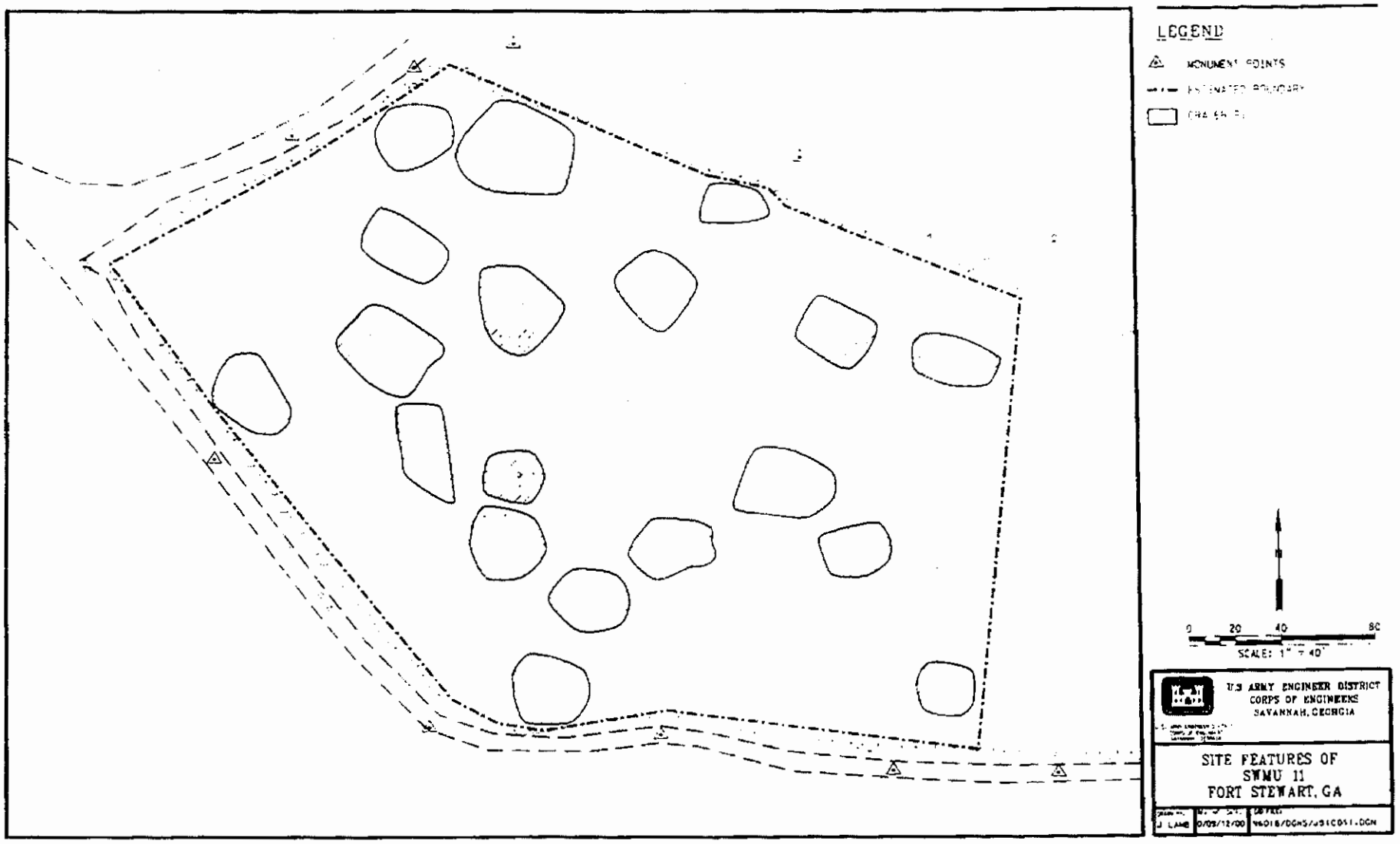

Figure 2-6. Site Features of SWMU 11, Fort Stewart, Georgia

2.2.3 SWMU 11

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.

2.3 SITE GEOLOGY

The FSMR is located within the coastal plain physiographic province. This province is typified by southeastward-dipping strata that increase in thickness from 0 feet at the fall line (located approximately 155 miles inland from the Atlantic coast) to approximately 4,200 feet at the coast. State geologic records describe a probable petroleum exploration well (the No. 1 Jelks-Rogers) located in the region as having encountered crystalline basement rocks at a depth of 4,254 feet below ground surface (bgs). This well provided the most complete record for Cretaceous, Tertiary, and Quaternary strata.

The Cretaceous section is approximately 1,970 feet thick and is dominated by clastics. The Tertiary section is approximately 2,170 feet thick and is dominated by limestone, with a 175-foot-thick cap of dark green phosphatic clay. This clay is regionally extensive and is known as the Hawthorn Group. The interval from approximately 110 feet to the surface is Quaternary in age and composed primarily of sand with interbeds of clay or silt. This section is undifferentiated.

State geologic records contain information regarding a well drilled in October 1942, 1.8 miles north of Flemington at Liberty Field of Camp Stewart (now known as Fort Stewart). This well is believed to have been an artesian well located approximately 0.25 mile north of the runway at Wright Army Airfield within the FSMR. The log for this well describes a 410-foot section, the lowermost 110 feet of which consisted predominantly of limestone, above which 245 feet of dark green phosphatic clay typical of the Hawthorn Group were encountered. The uppermost 55-foot interval was Quaternary-age interbedded sands and clays. The top 15 feet of these sediments were described as sandy clay

Site-specific subsurface soil characterization was not performed at these sites. There were no soil cuttings associated with the Geoprobe installation, so soil samples were not collected for classification. However, the soil present at these sites is expected to be similar to that at other sites at Fort Stewart, which means it should consist of silty and clayey sands.

2.4 SITE HYDROLOGY

The principal surface water body accepting drainage from the FSMR is the Canoochee River, which joins the Ogeechee River (part of the northwestern boundary of the reservation). Canoochee Creek is a tributary of the Canoochee River that drains much of the western portion of the FSMR. Taylors Creek, which is a tributary of the Canoochee Creek, is the nearest surface water body to these EOD areas.

2.4.1 SWMU 8

There are no surface water bodies near this site

2.4.2 SWMU 9

There are no surface water bodies near this site.

2.4.3 SWMU 11

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

2.5 HYDROGEOLOGY

The hydrogeology in the vicinity of the FSMR is dominated by two aquifers, referred to as the Principal Artesian and the surficial aquifers, that are separated by a confining unit, the Hawthorn Group.

The Principal Artesian Aquifer is the lowermost hydrologic unit; is regionally extensive from South Carolina through Georgia, Alabama, and most of Florida; and is regionally known as the Floridan Aquifer. This aquifer is subdivided into upper and lower hydrogeologic units. The upper hydrogeologic unit is composed primarily of Miocene-age argillaceous sands and clays and Oligocene- to Eocene-age limestones (including the Ocala Group and the Suwannee Limestone, where present) at the top. The upper hydrogeologic unit ranges in thickness from 200 feet to 260 feet and is most productive where it is thickest and where secondary permeability is most developed. The lower hydrologic unit is comprised of the Eocene-age Avon Park Limestone at the base. The transmissivity of the aquifer in the Savannah area ranges from about 28,000 square feet/day to 33,000 square feet/day (Krause and Randolph 1989). Groundwater from this aquifer is primarily used for drinking water (Arora 1984). Thirteen groundwater production wells are used for potable water supply on the FSMR, and one additional production well is used for fire protection.

The confining layer for the Principal Artesian Aquifer is the phosphatic clays of the upper Hawthorn Group. These sediments are regionally extensive and range from 60 feet to 80 feet in thickness at the FSMR. There are minor occurrences of aquifer material within the Hawthorn Group; however, they have limited utilization (Miller 1990).

The uppermost hydrologic unit is the surficial aquifer, which consists of widely varying amounts of sand, silt, and clay ranging from 35 feet to 150 feet in thickness. Well yields from this aquifer would range from 2 gallons to 180 gallons per minute based on geotechnical data from the monitoring wells installed during the Phase II RFI performed at other SWMUs across the Installation

Water levels were measured from temporary piezometers at SWMU 11 during the Phase II RFI. The resulting data were used to determine flow direction and the placement of possible permanent monitoring wells around the site. Based on the analytical results from the temporary piezometers and with the concurrence of GEPD, permanent wells were not installed at SWMU 11.

2.5.1 SWMU 8

No groundwater investigations have been performed at this site, so the depth to water and direction of groundwater flow are unknown.

2.5.2 SWMU 9

No groundwater investigations have been performed at this site, so the depth to water and direction of groundwater flow are unknown.

2.5.3 SWMU 11

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

2.6 SITE ECOLOGY

Approximately 7.8 square miles of the 436.8 square miles at the FSMR comprise the garrison area. The remainder is used for ranges and training areas (approximately 11 percent) or held as non-use areas.

Eighty-four percent of the land is forested (approximately 367.2 square miles). Sixty-six percent of the forest area is pine, with the major species including the slash, loblolly, and longleaf pines. Thirty-four percent of the forest is composed of river bottomlands and swamps whose major species include the tupelo, other gum trees, water oak, and bald cypress trees. The open range and training areas comprise 11 percent of the Installation and consist of grasses, shrubs, and scrub tree (oak) growth.

Aquatic habitats on the FSMR include a number of natural or man-made ponds and lakes, the Canoochee River, Canoochee Creek and its tributaries, and a number of bottomland swamps and pools. The Ogeechee River borders the Installation along its northeastern boundary. Organic detritus content is high, and dark coloring of the water is not unusual. Dense growths of aquatic vegetation are also typical, especially during the summer months.

Two types of terrestrial habitats occur at SWMUs 8, 9, and 11: unmanaged grasslands and forestlands. These two habitat types are common and widespread in the FSMR surrounding the cantonment area. These habitat types are briefly described below based on observations made by SAIC personnel during field investigations conducted January through March 1998.

Unmanaged grasslands at the FSMR are typically formerly managed grasslands that have undergone succession into meadows of native grasses and weeds because they are no longer mowed or otherwise disturbed. As is the case with SWMUs 8, 9, and 11, most of these areas are bordered on one or more sides by forest. Many of these areas have more sand on the surface than vegetation. Immature pine trees are commonly found growing sporadically throughout unmanaged grasslands along with sweetgum (*Liquidamber styraciflua*) and blackgum (*Nyssa sylvatica*). Unmanaged grasslands bordered by forests are optimal animal foraging sites and support a diverse fauna, including a large number of small mammals such as shrews, voles, and mice as well as birds and groundhogs (*Marmota monax*). Predators frequent these areas to prey upon the resident fauna. These areas are transitional in nature and would be expected to revert to the surrounding forest type if left undisturbed.

Except for the garrison area, the FSMR consists mainly of managed pine forests of two types: palmetto-pine and pine-oak forest. The forestlands in the vicinity of SWMUs 8, 9, and 11 are pine-oak forests. Characteristic flora of the pine-oak forest or mixed pine/hardwood forest type includes slash pine (*Pinus elliottii*), long-leaf pine (*P. palustris*), loblolly pine (*P. taeda*), sweetgum, blackgum, live oak (*Quercus virginiana*), Southern red oak (*Q. falcata*), and white oak (*Q. alba*). Saw-palmetto (*Serenoa repens*) is commonly found as one of several understory plants. Common species include white-tailed deer (*Odocoileus virginianus*), feral hogs (*Sus scrofa*), wild turkey (*Meleagris gallopavo*), nine-banded armadillos (*Dasypus novemcinctus*), and gray squirrels (*Sciurus carolinensis*).

2.6.1 SWMU 8

The habitats at SWMU 8 are classified as "unmanaged grassland" and "forestland." Two clearings have been created in the surrounding forest at SWMU 8 and are unmanaged grasslands similar to those described above. The forest surrounding the openings at SWMU 8 is similar to the pine-oak forestlands described above.

2.6.2 SWMU 9

The habitats at SWMU 9 are classified as "unmanaged grassland" and "forestland" as described above. The clearing at SWMU 9 is in the process of transition from an unmanaged grassland back to pine-oak forestland, with a great number of small pine trees present in the clearing. The range activities at Red Cloud Range, within which SWMU 9 is contained, can have an adverse impact on the site's ecology.

2.6.3 SWMU 11

This site is classified as "unmanaged grasslands" and "pine-oak forest." SWMU 11 is approximately 1.8 acres in size, with pine-oak forest also bordering the site. 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.

2.7 NATURE AND EXTENT OF CONTAMINATION

Results of chemical analyses performed during the Phase I and Phase II RFIs indicate that soil, groundwater, sediment, and surface water contain organic and metal contaminants at concentrations greater than their reference background concentrations.

The reference background criteria for the inactive EOD areas have been developed based on data from background samples collected across the FSMR for SWMUs under Phase I and/or Phase II RFIs. In general, reference background samples were collected in each medium at locations upgradient or upstream of each site so as to be representative of naturally occurring conditions at SWMUs under investigation. In addition, soil collected during the Phase I RFI [from Burn Pits (SWMUs 4A–4F), the Active EOD Area (SWMU 12A), etc.] was included in the background data set if it was determined to come from upgradient of the site and to be of sufficient quality to be representative of natural background conditions at the FSMR. A summary of the sample locations by medium at each SWMU and the source of the data (Phase I and II RFI analytical data) are presented in Table 5-1 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000).

EPA Region IV methodology (EPA 1996) was used as guidance for the development of the background data set for screening metals data. In cases in which enough samples (i.e., more than 20) are collected to define background, a background upper tolerance level can be calculated. In cases in which too few samples (i.e., fewer than 20) are collected to define background, background can be calculated as two times the mean background concentration (EPA 1996). Given that fewer than 20 background samples were collected for the FSMR, the latter method was used for calculating reference background concentrations.

The reference background concentrations for surface soil, subsurface soil, groundwater, surface water, and sediment 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.

Inorganics were considered to be site-related contaminants (SRC's) if their concentrations were above the reference background concentrations. Organics were considered to be SRC's if they were simply detected because organic constituents are considered to be anthropomorphic in nature.

Appendix G of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000) presents the summary of background data as well as the two-times-mean background concentrations. Given the limited background data, the mean concentration for soil in the eastern United States is also presented for comparative purposes. Because of the limited number of background samples, the screening value for background may be heavily skewed as a result of an outlier in the sampling data.

A tabular summary of SRC's for the four SWMUs addressed by this CAP is provided in Table 2-1.

Table 2-1. Summary of Site-related Contaminants

SWMU	Type of Investigation	Site-related Contaminants				
		Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
8	RFA	2,4-Dinitrotoluene, dibutyl phthalate, and naphthalene	NC	NC	NP	NP
9	Phase I RFI[a]	Arsenic, chromium, and silver	NC	NC	NP	NP
11	Phase II RFI	Arsenic, barium, chromium, lead, and silver	NC[b]	None	NP	NP

[a]The Phase II RFI will be conducted upon closure of the Red Cloud Range, Hotel Area.
[b]In accordance with the GEPD-approved Work Plan (SAIC 1997), subsurface soil was not collected because subsurface soil sampling in an EOD area requires approval by the Secretary of the Army.
NC = Not collected
NP = No pathway exists

2.7.1 SWMU 8

The RFA performed in 1990 is the only previous investigation documented for this site. The investigation included collection of only surface soil samples for analysis for VOCs, SVOCs, explosives, and RCRA Toxicity Characteristic Leaching Procedure (TCLP) metals. One explosive—2,4-dinitrotoluene—was detected at surface soil location S4A, and two SVOCs—naphthalene and dibutyl phthalate—were detected at surface soil locations S1A and S7A, respectively. Table 2-2 presents the locations and concentrations of constituents detected in surface soil at SWMU 8. Because no analysis for total metals was performed at SWMU 8, a determination of inorganics that exceeded the reference background concentration could not be made. However, according to the results of the RFA performed at SWMU 8, no RCRA metals exceeded EP Tox limits. With the concurrence of GEPD, the RFA concluded that the site did not require further investigation.

2.7.2 SWMU 9

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, RCRA metals, and explosives residue. Concentrations of VOCs were not reported above the detection limit in the surface soil samples. Arsenic, chromium, and silver were detected above FSMR reference background criteria in surface soil.

Table 2-2. Summary of Maximum Detected Constituents, SWMU 8

Analyte	Surface Soil Maximum Concentration (µg/kg)	Location of Maximum Detection
2,4-Dinitrotoluene	570	S4A
Naphthalene	440	S1A
Dibutyl phthalate	6,300	S7A

Silver was detected at the site background surface soil location (SS1) and in one other surface soil sample. No explosives residue concentrations were detected in the surface soil samples. With the concurrence of GEPD, potential surface soil and groundwater contamination will be investigated upon closure of the active Red Cloud Range, Hotel Area

2.7.3 SWMU 11

2.7.3.1 Surface soil

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, RCRA metals, and explosives residue. As part of the Phase II RFI, surface soil samples were collected from three locations within the boundary of the EOD area and were analyzed for explosives and RCRA metals. Concentrations of VOCs were not reported above the detection limits in surface soil. No explosives were detected in the surface soil samples. Arsenic, barium, silver, chromium, and lead were detected at levels that exceeded their respective reference background criteria at two or more Phase I RFI sampling locations. Analysis of samples collected during the Phase II RFI indicated that arsenic and barium were present at levels that exceeded their respective reference background criteria. Based on these results, arsenic, barium, silver, chromium, and lead are considered to be SRCs in surface soil at SWMU 11. Table 2-3 presents the maximum concentrations of SRCs by medium for SWMU 11.

Table 2-3. Summary of Site-related Contaminants, SWMU 11

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

[a]Phase I RFI data
NA = Not analyzed.
NC = Not collected.
NP = No pathway exists

With the exception of silver, the maximum detected concentrations of metals are within the range established by the U.S. Geological Survey (USGS) for element concentrations in soil in the eastern United States (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 of these constituents in surface soil is not warranted.

2.7.3.2 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.

2.7.3.3 Groundwater

As part of the Phase II RFI, 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.

2.7.3.4 Surface water

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

2.7.3.5 Sediment

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

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3.0 JUSTIFICATION/PURPOSE OF CORRECTIVE ACTION

3.1 PURPOSE

EPA has established corrective action standards that reflect the major technical components that should be included with a selected remedy (EPA 1988). These include the following: (1) protect human health and the environment: (2) attain media cleanup standards set by the implementing agency; (3) control the source of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment; (4) comply with any applicable standards for management of wastes: and (5) other factors

3.2 REMEDIAL RESPONSE OBJECTIVE

Based on the findings of the site characterization at these SWMUs, the primary goal and purpose for implementing corrective measures at the subject former EOD areas is limited to protection of human health and safety. To achieve this goal, the following remedial response objective has been established for these four EOD sites: to prohibit the disturbance of subsurface soil to prevent contact with buried ordnance and/or contaminated media. Any corrective measures that pose a significant threat to human health and safety during implementation (e.g., methods that would involve disturbance of subsurface soil within the SWMUs' boundaries) will not be evaluated. Implementation of the selected remedial responses will achieve the best overall results with respect to such factors as long-term reliability and effectiveness, short-term effectiveness, implementability, and cost.

3.3 IDENTIFICATION OF REMEDIAL LEVELS

Based upon the current status and results of the investigations at these SWMUs, remedial levels have not been established for these three inactive EOD sites. No further investigation was required for SWMU 8 based upon the results of the RFA; therefore, establishment of remedial levels at this site was unnecessary. Because further investigation of potential surface soil and groundwater at SWMU 9 is pending closure of the active Red Cloud Range, Hotel Area, no remedial levels have been established at this site. No SRC's were detected in groundwater at SWMU 11; metals in surface soil, sediment, or surface water were the only SRC's identified at this SWMU. Given that the concentrations of these metals at SWMU 11 are within the range for naturally occurring concentrations, the potential impacts to human health and the environment are likely to be minimal, and further evaluation and establishment of remedial levels are not warranted

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4.0 SCREENING OF CORRECTIVE ACTIONS

This section identifies corrective action technologies applicable to the subject inactive EOD areas. The technologies that are retained following screening are then presented as corrective action alternatives that address limiting exposure to surface contamination and surface and subsurface ordnance and debris. These alternatives are then evaluated with respect to protection of human health and life-cycle cost for each SWMU.

4.1 SCREENING CRITERIA

The first step in the development of corrective action alternatives involves the identification and screening of technologies applicable to the site. The purpose of this step is to list and evaluate the general suitability of remedial technologies for meeting the stated corrective action objectives. The options presented here will be evaluated for their general ability to protect and reduce risk to human health and safety.

The technologies will be discussed sufficiently to allow them to be compared using three general criteria that will function as balancing factors: effectiveness, implementability, and cost. The explanation of each criterion is provided below.

4.1.1 Effectiveness

This criterion evaluates the extent to which a corrective action reduces overall risk to human health and the environment. It also considers the degree to which the action provides sufficient long-term controls and reliability to prevent exposures that exceed levels protective of human and environmental receptors. Factors considered include performance characteristics, maintenance requirements, and expected durability.

4.1.2 Implementability

This criterion evaluates the technical and administrative factors affecting implementation of a corrective action and considers the availability of services and materials required during implementation. Technical factors assessed include ease and reliability of initiating construction and operations, prospects for implementing any additional future actions, and adequacy of monitoring systems to detect failures. Technical feasibility considers the performance history of the technologies in direct applications or the expected performance for similar applications. Uncertainties associated with construction, operation, and performance monitoring are also considered.

Service and material considerations include equipment and operator availability and applicability or development requirements for prospective technologies. The availability of services and materials is addressed by analyzing the material components of the proposed technologies and then determining the locations and quantities of materials. Administrative factors include ease of obtaining permits, enforcing deed recordation requirements, or maintaining long-term control of the site

4.1.3 Cost

Relative costs are included for corrective actions. The estimates are intended to facilitate evaluation and comparison among alternatives; therefore, cost-estimating contingencies common to all alternatives have

been excluded from the estimates at the screening level of evaluation because all of the alternatives will have similar contingencies.

4.2 EVALUATION OF CORRECTIVE ACTION TECHNOLOGIES

Three categories of corrective actions were identified for these three inactive EOD sites: (1) no action, (2) institutional controls: land use controls, and (3) institutional controls: physical barriers. These corrective action technologies are described in Table 4-1. The technologies were evaluated using the screening criteria of effectiveness, implementability, and cost. Results of the screening evaluations apply to all three SWMUs and are shown in Table 4-1.

The no action alternative provides a baseline against which other options can be compared. Under the no action alternative, no further action would be taken. No cost would be associated with the selection of this alternative. The acceptability of the no action alternative is judged in relation to the assessment of known site risks and by comparison with other corrective action alternatives.

The no action alternative is not considered to be viable because it provides no reliable or effective method for protecting human health and safety; therefore, the no action alternative will be eliminated from further evaluation.

Institutional controls include actions taken to restrict access to areas with surface contamination and surface and subsurface exploded ordnance debris. These restrictions would consist of establishing legal land use controls or installing physical barriers to restrict access. Physical barriers and/or land use restrictions would provide effective, readily implementable, and cost-effective methods for preventing human exposure to buried waste at the site. Land use controls include deed recordation, existing controls (i.e., range security controls at SWMU 9), controls implemented through the BMP, zoning controls, and placement of signs restricting access. Physical barriers include installation of a 6-foot chain-link fence topped with three strands of barbed wire along the entire boundary of each site.

4.3 CORRECTIVE ACTION ALTERNATIVES

The technologies retained following the screening step were used in various combinations to meet the remedial response objective for protection of human health and safety. Two alternatives were identified and subsequently evaluated for SWMUs 8 and 11.

1. Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Post-mounted Warning Signs, Implementation of O&M Plan.

2. Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Chain-link Fence with Barbed Wire, Fence-mounted Warning Signs, Implementation of O&M Plan.

Three alternatives were identified and evaluated for SWMU 9.

1. Alternative 1: Institutional Controls: BMP, Existing Range Control and Security Procedures.

2. Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Post-mounted Warning Signs, Implementation of O&M Plan.

Table 4-1. Evaluation of Corrective Actions

Action	Description	Effectiveness	Implementability	Cost
No Action	The no action alternative provides a baseline against which other actions can be compared. Under the no action alternative, all source materials and groundwater would be left "as is," without implementation of any removal, treatment, or other mitigating actions to reduce existing or potential future human exposure to contaminants or exploded ordnance debris by human disturbance.	This alternative would not address the corrective action objectives for the site. This alternative would not provide protection of human health and safety because there would not be sufficient controls to prevent human exposure to contaminants or exploded ordnance debris.	There would be no implementability issues involved in this alternative because no action would be taken.	There would be no cost associated with the no action alternative.
Institutional Controls, Land Use Controls	Land use controls would reduce potential hazards by limiting exposure of humans to contaminated soil and groundwater and to exploded ordnance debris. Land use restrictions and institutional control requirements that would be enforced would include restrictions through existing land use controls, deed recordation, base master planning and zoning controls, warning signs posted around the site, and applicable state land use control management systems in effect at the time of transfer. Activities such as excavation or construction that would disturb surface soil and/or subsurface soil within the site's boundaries would be prohibited under the deed recordation.	Land use restrictions would be effective and provide long-term reliability with respect to preventing human contact with contaminants or exploded ordnance debris within the boundaries of the site. The technology would not provide physical barriers to restrict access to the site; therefore, noncompliance with these land use restrictions could result in contact with contaminants or exploded ordnance debris. The BMP is an effective tool for ensuring establishment of land use restrictions because requirements of the BMP are enforced by the FSMR in accordance with written policies and procedures.	These institutional controls could be readily implemented. The property will remain under federal ownership for the foreseeable future. The BMP is implementable because procedures and policies are in place at the FSMR to facilitate its implementation.	The costs would be low. The cost for deed recordation, the BMP and zoning controls, post-mounted signs, and implementation of the O&M Plan for 30 years would range between approximately $140,000 and $160,000.
Institutional Controls: Physical Barriers	Physical barriers would reduce potential hazards by limiting contact by humans with contaminants and/or exploded ordnance debris. Physical barriers would include chain-link fencing with barbed wire and warning signs around the site.	This technology would be effective and provide long-term reliability with respect to minimizing human contact with contaminants and/or exploded ordnance debris within the boundaries of the site by physically restricting access.	Physical barriers would be readily implementable at the SWMUs except SWMU 9, where fence installation would be impractical because it is located in an open, active range. The properties will remain under federal ownership.	Installation of fencing would be expensive, and the cost would be dependent upon the linear feet to be installed. The costs for fencing, including 30 years of O&M, would range between approximately $200,000 and $270,000.

3. Alternative 3: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Chain-link Fence with Barbed Wire, Fence-mounted Warning Signs, Implementation of O&M Plan.

4.3.1 Evaluation Factors

Based on the results of the technology screening, each of the retained technologies is considered applicable to the site and implementable for SWMUs 8 and 11; therefore, two primary evaluation factors were used in selecting the preferred corrective action alternative: protection of human health and safety and life-cycle costs. These two evaluation factors were also used in selecting the preferred corrective action alternative for SWMU 9 along with an evaluation of technical factors associated with the current use of the property.

Protection of Human Health and Safety

The effectiveness of each proposed alternative at protecting human health and safety at this site is dependent upon its ability to prohibit human activity associated with disturbance of subsurface soil. For both alternatives, legal land use controls and warning signs would also prohibit activities associated with disturbance of subsurface soil. In Alternative 2 additional protection would be provided by the use of fencing to restrict access to the site.

Life-cycle Costs

The life-cycle cost estimates are budget estimates based on conceptual design and are to be used for comparison purposes. The costs are estimated for capital construction, administration, and O&M. The cost estimates were derived from current information, including vendor quotes and conventional cost estimating guides (e.g., Means 1999 and ECHOS 1998). The actual costs of the project would depend on labor and material costs, site conditions, competitive market conditions, final project scope, and implementation schedule at the time the corrective action is initiated. The life-cycle cost estimates are not adjusted to present worth costs, and no escalation factors have been applied

Technical Factors

Relevant technical factors were evaluated that relate to the applicability, practicality, and uncertainty associated with implementation of corrective actions at SWMU 9. These technical factors relate to current and future land use by DoD at SWMU 9. Current and future land use plans impact selection of a preferred corrective action alternative.

4.3.2 Site-specific Evaluation of Corrective Action Alternatives

4.3.2.1 SWMU 8

The corrective action alternatives are summarized in Table 4-2, along with the associated levels of protection of human health and safety and associated life-cycle costs.

The alternatives would include the following common features:

- BMP, deed recordation, and zoning controls that establish controls to prohibit intrusion into subsurface soil.
- installation of warning signs; and
- implementation of an O&M Plan to maintain the conditions of the signage.

Table 4-2. SWMU 8: Corrective Action Alternatives

Corrective Action	Description	Protection of Human Health and Safety	Cost	Comments
Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Post-mounted Warning Signs, Implementation of O&M Plan	This action would require legal and local land use controls and signage to enforce restrictions on land use.	Protection of human health and safety would be primarily dependent upon enforcement of compliance with land use controls. There are no existing natural or man-made barriers to prevent human access.	$158,176	Least expensive providing reduced level of protection.
Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Chain-link Fence Barrier, Fence-mounted Warning Signs, Implementation of O&M Plan	This action would require legal and local land use controls and signage to enforce restrictions on land use. Physical barriers to be installed would include 1,815 linear feet of 6-foot chain-link fence topped with three strands of barbed wire along the entire boundary of the site.	In addition to the protection provided by Alternative 1, fencing topped with barbed wire would further restrict access. The fencing would be more effective than signs alone in deterring or discouraging unauthorized excavation activities.	$268,041	Significantly more expensive with significant increase in level of protection compared to Alternative 1. However, the increased level of protection justifies the increased cost.

The paragraphs below summarize the evaluation of the two corrective action alternatives with respect to the primary evaluation factors of protection of human health and safety and life-cycle cost.

Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Post-mounted Warning Signs, Implementation of O&M Plan

This alternative would provide for the implementation of land use controls during the period of ownership by DoD through enforcement of the BMP and deed recordation. This alternative would protect human health and safety by preventing human exposure to contaminants or exploded ordnance debris by the establishment of legal land use restrictions. The BMP is an effective tool for preventing the disturbance of subsurface soil at the site. If this property was to be transferred in the future, notification of the property transfer would be made to regulatory authorities. The following provisions would ensure implementation of land use controls subsequent to property transfer; deed recordation; the purchase agreement or lease; zoning controls; applicable state land use control management systems in effect at the time the property is transferred; community, transferee, or governmental notice (if needed); and self-certification (if feasible). To reduce potential exposure to health and safety hazards associated with SWMU 8, warning signs stating restrictions on human activity within the SWMU would be posted at 200-foot intervals around the boundary of the SWMU (total of eight signs). The placement of signs for Alternative 1 is shown in Figure 4-1. Compliance with warning signs would restrict human access to the site because the warning would discourage any inadvertent or unsuspecting excavation activities. Warning signs and posts would be repaired and/or replaced as needed through implementation of a documented O&M Plan.

This is the less expensive of the two alternatives, with a life-cycle cost of approximately $158,176.

Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Fence Barrier, Maintenance of Existing Physical Barriers, Fence-mounted Warning Signs, Implementation of O&M Plan

This alternative is similar to Alternative 1 in that land use control provisions would remain the same (BMP, deed recordation, zoning control), and an O&M Plan would be implemented. This alternative would additionally provide approximately 1,815 linear feet of 6-foot chain-link fencing topped with three strands of barbed wire along the entire boundary of the site. The fence would not extend across the access road but alongside it to allow vehicle traffic through the site while preventing access to the unsafe areas within SWMU 8. The fence would provide a physical barrier to public access around the entire SWMU. Fence-mounted warning signs would be positioned every 200 feet (total of eight signs). A double-sided swing gate with a 20-foot opening would be installed along the roadside of each fenced area (total of two gates) to allow access to both portions of SWMU 8 that border the access road. The placement of signage and fencing for Alternative 2 is shown in Figure 4-2. The effectiveness of Alternative 2 would be significantly greater than that of Alternative 1, with greater protection against inadvertent intruders as a result of the fencing. The O&M Plan would also include maintenance and repair of the chain-link fence and signs.

This alternative is more expensive than Alternative 1, with a life-cycle cost of approximately $268,041, or nearly 1.7 times Alternative 1's life-cycle cost.

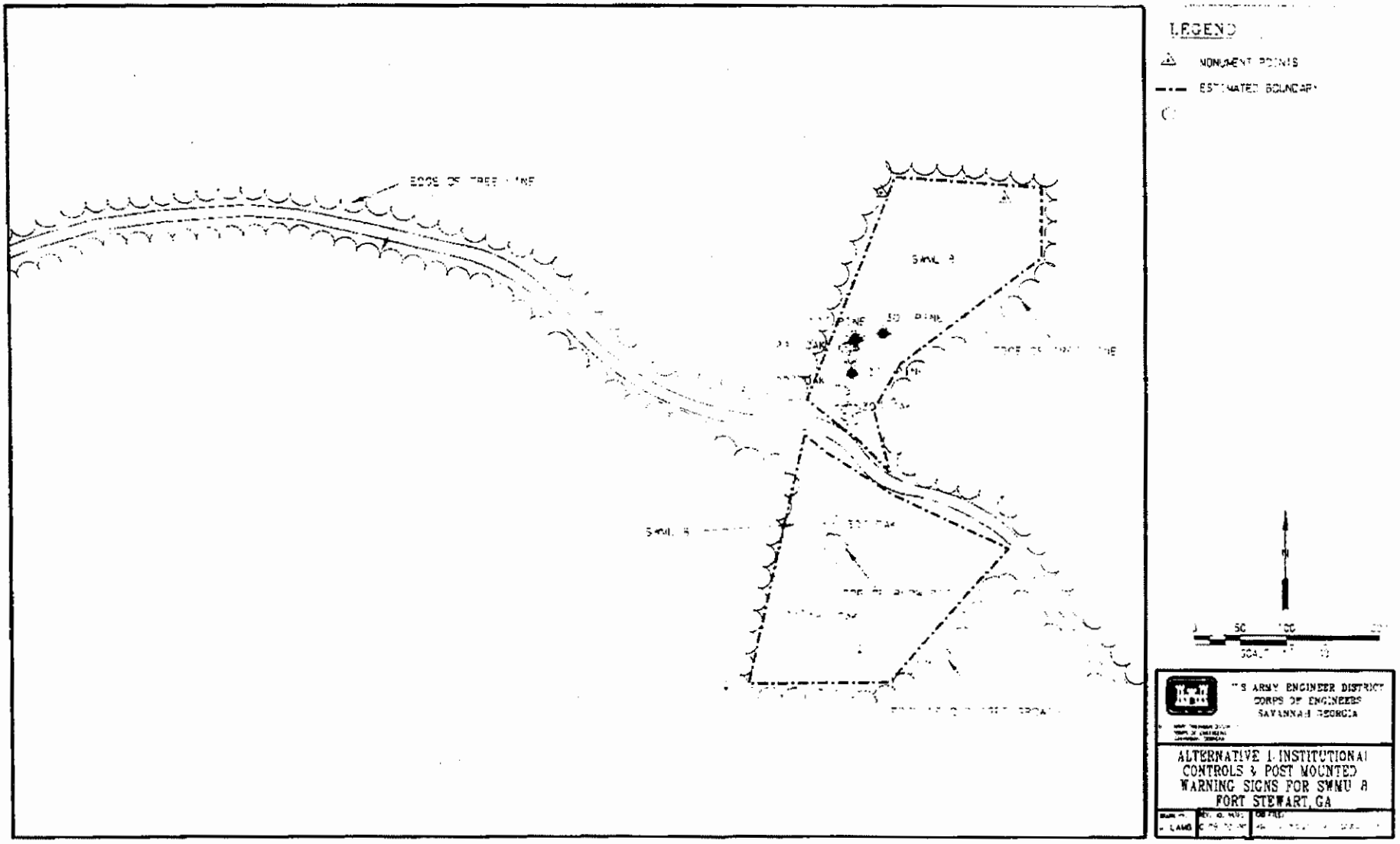

Figure 4-1 Alternative 1: Institutional Controls with Post-mounted Warning Signs: SWMU 8

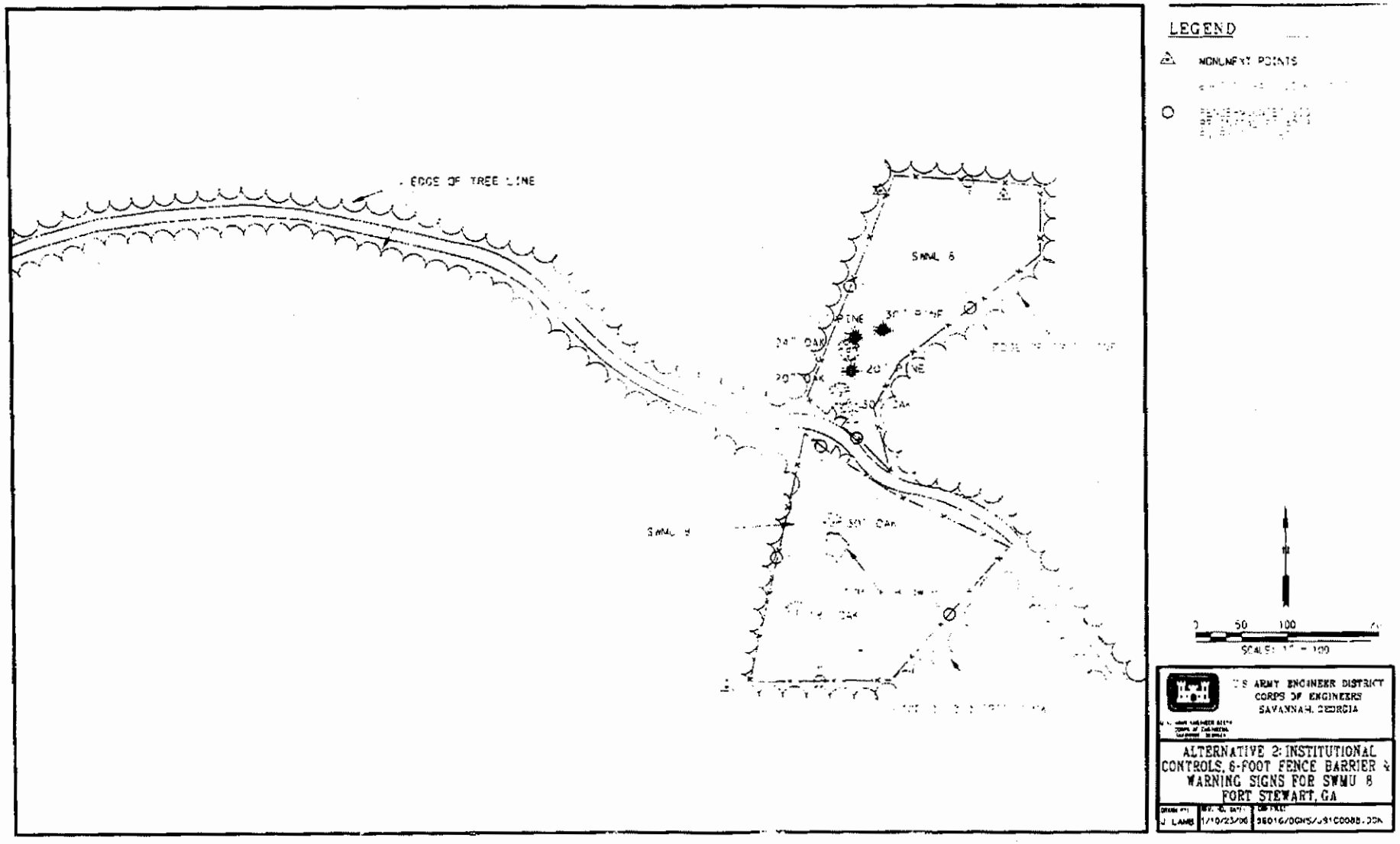

Figure 4-2. Alternative 2: Institutional Controls with Chain-link Fence Barrier and Fence-mounted Warning Signs, SWMU 8

4.3.2.2 SWMU 9

The corrective action alternatives are summarized in Table 4-3, along with the associated level of protection of human health and safety and associated life-cycle costs.

Alternatives 2 and 3 would include the following common features:

- BMP, deed recordation, and zoning controls that establish controls to prohibit intrusion into subsurface soil;
- installation of warning signs; and
- implementation of an O&M Plan to maintain the conditions of the signage.

Similar to Alternatives 2 and 3, Alternative 1 includes establishment of land use controls to prohibit intrusion into subsurface soil. However, additional controls to evaluate the adequacy of existing range control procedures and the security program already in place at the range are not included with Alternative 1.

The paragraphs below summarize the evaluation of the three corrective action alternatives with respect to the primary evaluation factors of protection of human health and safety, technical factors, and life-cycle cost.

Alternative 1: Institutional Controls: BMP and Existing Range Control and Security Procedures

This alternative would provide for the implementation of land use controls during the period of ownership by DoD through enforcement of the BMP and existing range control procedures. These procedures would prevent human access during scheduled firing activities. A warning notice would be posted at the security tower regarding restrictions within SWMU 9. This alternative would protect human health and safety by preventing human exposure to contaminants or exploded ordnance debris by the establishment of legal land use restrictions. The BMP is an effective tool for preventing the disturbance of subsurface soil at the site. If the range property was to be transferred in the future, notification of the property transfer would be made to regulatory authorities.

This is the least expensive of the three alternatives, with a life-cycle cost of approximately $85,483.

Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Post-mounted Warning Signs, Implementation of O&M Plan

This alternative would provide for the implementation of land use controls during the period of ownership by DoD through enforcement of the BMP and deed recordation. This alternative would protect human health and safety by preventing human exposure to contaminants or exploded ordnance debris by the establishment of legal land use restrictions. The BMP is an effective tool for preventing the disturbance of subsurface soil at the site. If this property was to be transferred in the future, notification of the property transfer would be made to regulatory authorities. The following provisions would ensure implementation of land use controls subsequent to property transfer: deed recordation; the purchase agreement or lease; zoning controls; applicable state land use control management systems in effect at the time the property is transferred; community, transferee, or governmental notice (if needed); and self-certification (if feasible). To reduce potential exposure to health and safety hazards associated with SWMU 9, warning signs stating restrictions on human activity within the SWMU would be posted on each side of the SWMU

Table 4-3. SWMU 9: Corrective Action Alternatives

Corrective Action	Description	Protection of Human Health and Safety	Cost	Comments
Alternative 1: Institutional Controls: BMP, Implementation of O&M Plan, Existing Range Control and Security Procedures	This action would require continued implementation of existing range control procedures and use of local land use controls (BMP) to enforce restrictions on land use. A warning notice would be provided at the range control security tower	Protection of human health and safety would be primarily dependent upon enforcement of compliance with land use controls. Execution of existing range control procedures provides adequate protection to human safety for all areas within the range. There are no existing natural or man-made barriers to prevent human access.	$85,483	Least expensive providing reduced level of protection.
Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Post-mounted Warning Signs, Implementation of O&M Plan	This action would require legal and local land use controls and signage to enforce restrictions on land use.	Protection of human health and safety would be primarily dependent upon enforcement of compliance with land use controls. Added measure of protection by use of signage would be limited due to continued destruction of signage from firing within the range. There are no existing natural or man-made barriers to prevent human access.	$149,899	Moderately expensive providing increased level of protection.
Alternative 3: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Chain-link Fence Barrier, Fence-mounted Warning Signs, Implementation of O&M Plan	This action would require legal and local land use controls and signage to enforce restrictions on land use. Physical barriers to be installed would include 301 linear feet of 6-foot chain-link fence topped with barbed wire along the entire boundary of the site.	In addition to the protection provided by Alternative 2, human access would be further restricted by fencing topped with three strands of barbed wire around the boundaries of the site. The fencing would be more effective than signs alone in deterring or discouraging unauthorized excavation activities. However, repairs to damaged fencing and signs would be frequent due to firing activities within the range.	$204,165	Significantly more expensive with significant increase in level of protection compared to Alternative 1. However, the increased cost is not justified because of current use of site and surrounding areas.

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(total of four signs). The placement of signs for Alternative 1 is shown in Figure 4-3. Compliance with warning signs would restrict human access to the site because the warning would discourage any inadvertent or unsuspecting excavation activities. Warning signs and posts would be repaired and/or replaced as needed through implementation of a documented O&M Plan.

This alternative is moderately priced, with a life-cycle cost of approximately $149,899.

Alternative 3: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Fence Barrier, Maintenance of Existing Physical Barriers, Fence-mounted Warning Signs, Implementation of O&M Plan

This alternative is similar to Alternative 2 in that land use control provisions would remain the same (BMP, deed recordation, zoning control), and an O&M Plan would be implemented. This alternative would additionally provide approximately 301 linear feet of 6-foot chain-link fencing topped with three strands of barbed wire along the entire boundary of the site. The fence would provide a physical barrier to public access around the entire area of SWMU 9. Fence-mounted warning signs would be positioned on each side of the SWMU (total of four signs). The placement of signage and fencing for Alternative 2 is shown in Figure 4-4. A 20-foot-wide, double-swing gate would be located on the north side of the fence to allow access into SWMU 9. The effectiveness of Alternative 3 would be significantly greater than that of Alternative 2, with greater protection against inadvertent intruders as a result of the fencing. The O&M Plan would also include maintenance and repair of the chain-link fence and signs. While installation of fencing at this site is feasible, it would be very impractical, because the site is located in an open and active range.

This alternative is more expensive than the other alternatives, with a life-cycle cost of approximately $204,165.

4.3.2.3 SWMU 11

The corrective action alternatives are summarized in Table 4-4, along with the associated level of protection of human health and safety and associated life-cycle costs.

The alternatives would include the following common features:

- BMP, deed recordation, and zoning controls that establish controls to prohibit intrusion into subsurface soil;
- installation of warning signs; and
- implementation of an O&M Plan to maintain the conditions of the signage.

The paragraphs below summarize the evaluation of the two corrective action alternatives with respect to the primary evaluation factors of protection of human health and safety and life-cycle cost.

Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Post-mounted Warning Signs, Implementation of O&M Plan

This alternative would provide for the implementation of land use controls during the period of ownership by DoD through enforcement of the BMP and deed recordation. This alternative would protect human health and safety by preventing human exposure to contaminants or exploded ordnance debris by the establishment of legal land use restrictions. The BMP is an effective tool for preventing the disturbance of

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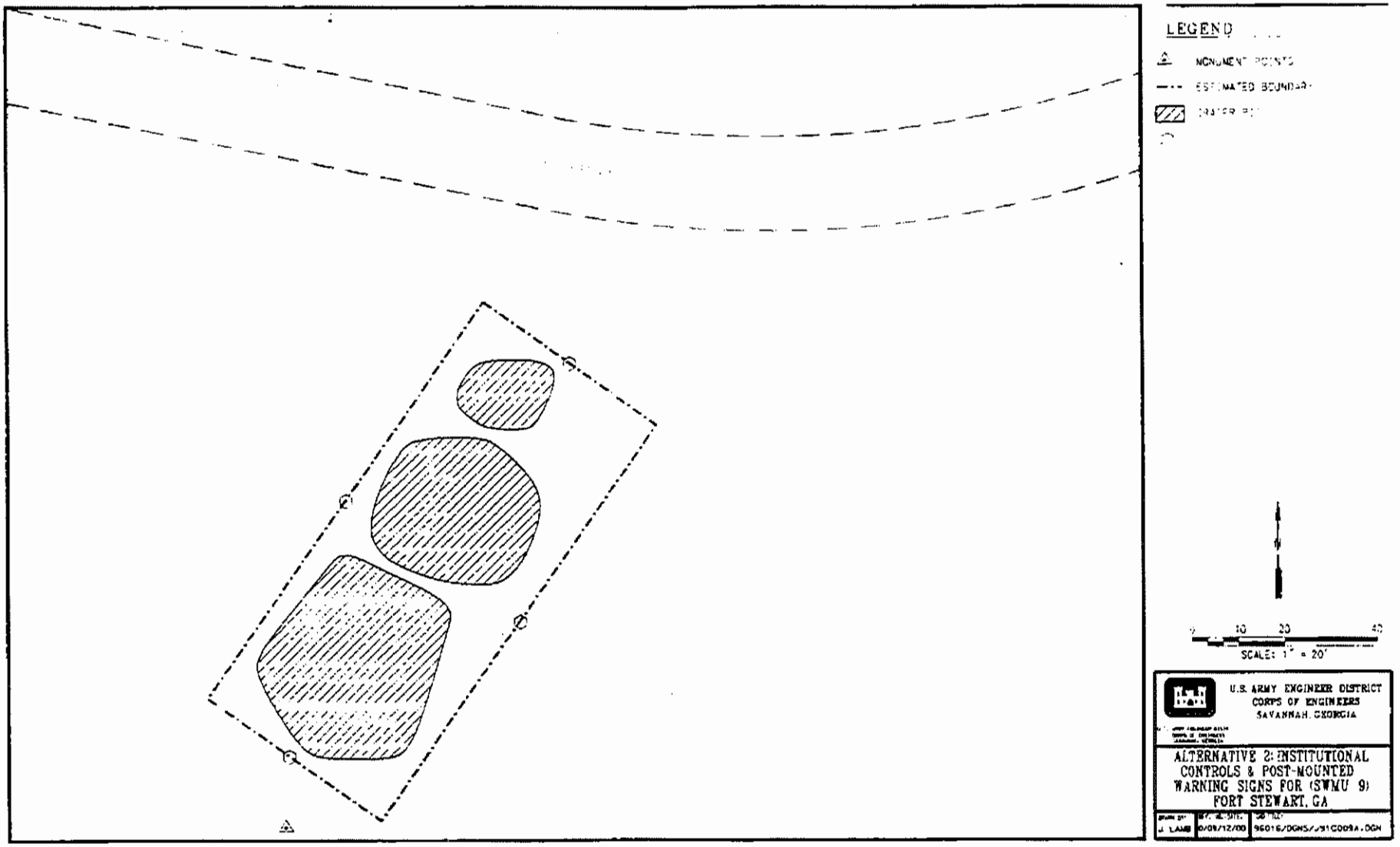

Figure 4-3. Alternative 2: Institutional Controls with Post-mounted Warning Signs, SWMU 9

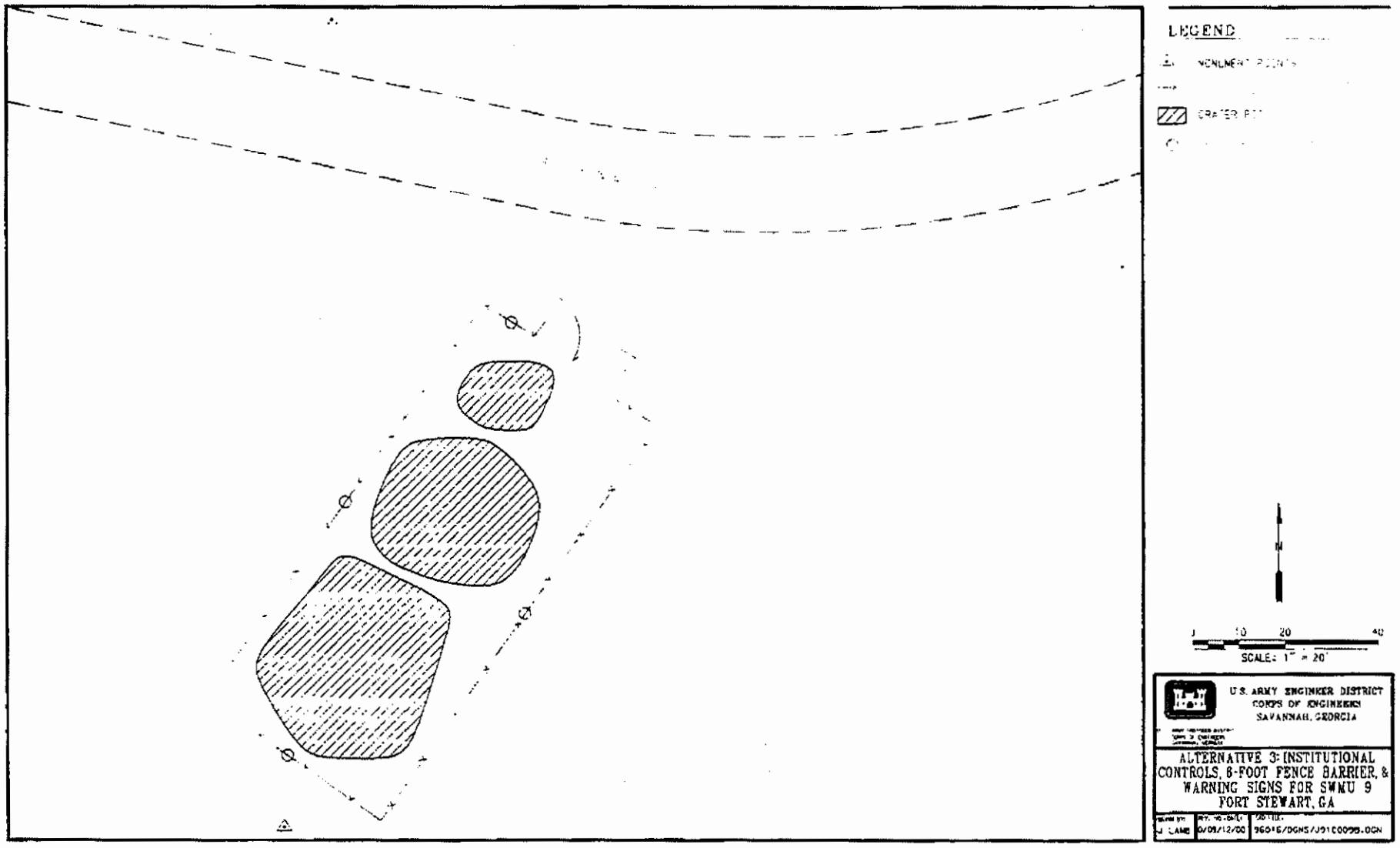

Figure 4-4. Alternative 3: Institutional Controls with Chain-link Fence Barrier and Fence-mounted Warning Signs, SWMU 9

Table 4-4. SWMU 11: Corrective Action Alternatives

Corrective Action	Description	Protection of Human Health and Safety	Cost	Comments
Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Post-mounted Warning Signs, Implementation of O&M Plan	This action would require legal and local land use controls and signage to enforce restrictions on land use.	Protection of human health and safety would be primarily dependent upon enforcement of compliance with land use controls. There are no existing natural or man-made barriers to prevent human access.	$147,109	Least expensive providing reduced level of protection.
Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Chain-link Fence Barrier, Fence-mounted Warning Signs Implementation of O&M Plan	This action would require legal and local land use controls and signage to enforce restrictions on land use. Physical barriers to be installed would include 1,113 linear feet of 6-foot chain-link fence topped with barbed wire along the entire boundary of the site.	In addition to the protection provided by Alternative 1, fencing topped with barbed wire would further restrict access. The fencing would be more effective than signs alone in deterring or discouraging unauthorized excavation activities.	$216,676	Significantly more expensive with significant increase in level of protection compared to Alternative 1. However, the increased level of protection justifies the increased cost.

subsurface soil at the site. If this property was to be transferred in the future, notification of the property transfer would be made to regulatory authorities. The following provisions would ensure implementation of land use controls subsequent to property transfer: deed recordation; the purchase agreement or lease; zoning controls; applicable state land use control management systems in effect at the time the property is transferred; community, transferee, or governmental notice (if needed); and self-certification (if feasible). To reduce potential exposure to health and safety hazards associated with SWMU 11, warning signs stating restrictions on human activity within the SWMU would be posted at 200-foot intervals around the boundary of the SWMU (total of five signs). The placement of signs for Alternative 1 is shown in Figure 4-5. Compliance with warning signs would restrict human access to the site because the warning would discourage any inadvertent or unsuspecting excavation activities. Warning signs and posts would be repaired and/or replaced as needed through implementation of a documented O&M Plan.

This is the less expensive of the two alternatives, with a life-cycle cost of approximately $147,109.

Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Fence Barrier, Maintenance of Existing Physical Barriers, Fence-mounted Warning Signs, Implementation of O&M Plan

This alternative is similar to Alternative 1 in that land use control provisions would remain the same (BMP, deed recordation, zoning control), and an O&M Plan would be implemented. This alternative would additionally provide approximately 1,113 linear feet of 6-foot chain-link fencing topped with three strands of barbed wire along the entire boundary of SWMU 11. The fence would provide a physical barrier to public access around the entire SWMU. Fence-mounted warning signs would be positioned every 200 feet (total of five signs). A 20-foot-wide, double-swing gate would be located on the northwest corner of the fence to allow access for maintenance within the fenced area. The placement of signage and fencing for Alternative 2 is shown in Figure 4-6. The effectiveness of Alternative 2 would be significantly greater than that of Alternative 1, with greater protection against inadvertent intruders as a result of the fencing. The O&M Plan would also include maintenance and repair of the chain-link fence and signs.

This alternative is more expensive than Alternative 1, with a life-cycle cost of approximately $216,676, or more than 1.5 times Alternative 1's life-cycle cost.

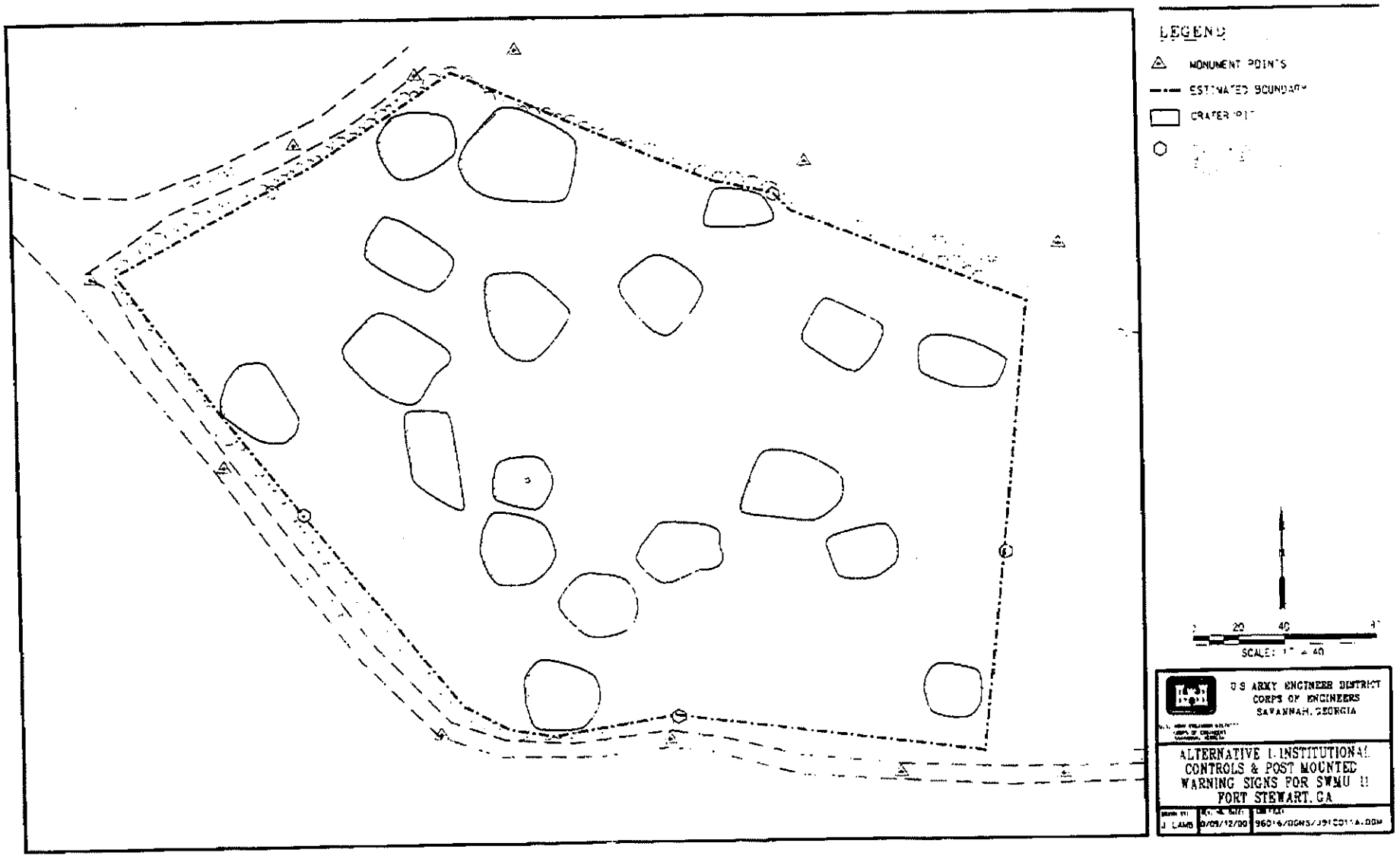

Figure 4-5. Alternative 1: Institutional Controls with Post-mounted Warning Signs, SWMU 11

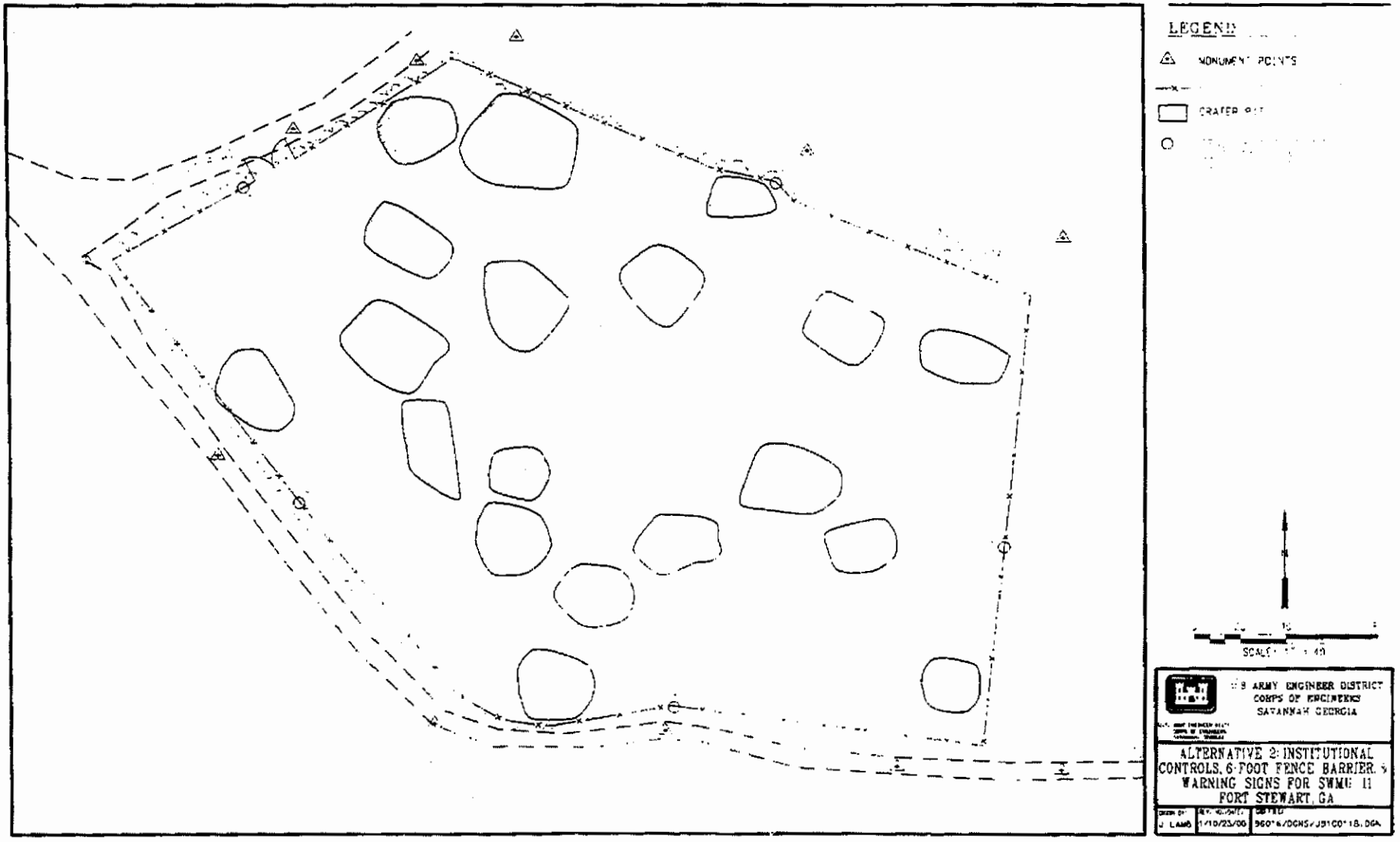

Figure 4-6. Alternative 2: Institutional Controls with Chain link Fence Barrier and Fence-mounted Warning Signs, SWMU 11

5.0 CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN

This section presents a conceptual design and plan for implementation of the selected corrective action alternative for each SWMU. Based on the level and type of soil contamination and the fact that exploded ordnance debris may still be present, a cost-effective corrective action was selected that would adequately protect human health and safety. The technology evaluation presented in Chapter 4 compared two different corrective action alternatives for SWMUs 8 and 11 and three alternatives for SWMU 9 based on their effectiveness at protecting human health and safety, life-cycle costs, and technical factors. The selected alternative and justification for the given selection are presented in Table 5-1.

Table 5-1. Selected Alternative Summary Table

Site	Selected Alternative	Summary of Justification
SWMU 8	Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Fence Barrier, Maintenance of Existing Physical Barriers, Fence-mounted Warning Signs, Implementation of O&M Plan	High level of protection.
SWMU 9	Alternative 1: Institutional Controls: BMP, Implementation of O&M Plan, Existing Range Control and Security Procedures	Sufficient level of protection at a relatively low cost; most practical alternative.
SWMU 11	Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Fence Barrier, Maintenance of Existing Physical Barriers, Fence-mounted Warning Signs, Implementation of O&M Plan	High level of protection.

5.1 SELECTED CORRECTIVE ACTION

5.1.1 SWMU 8

The selected corrective action alternative for SWMU 8 involves a multi-layered approach to restricting human activity within the boundaries of the subject site. The selected set of institutional controls comprising this alternative will provide a combination of land use restrictions and prohibitions and physical barriers. Land use restrictions will be documented and/or enforced through deed recordation, the BMP, zoning restrictions, and signage Six-foot-high chain-link fencing topped with three strands of barbed wire will be provided as a physical barrier to access by humans.

Justification of Selection

Alternative 2 has been selected because it will provide effective protection of human health and safety. Although the posting of warning signs without fencing would be less expensive, the additional degree of protection provided by the fencing is necessary to ensure human safety. The protection that the fence will provide against inadvertent access to the site and unauthorized excavation below the ground surface justifies the moderately greater expense of implementing Alternative 2 rather than Alternative 1. The institutional controls described for Alternative 2 will provide a sufficient level of protection for human health and an adequate degree of long-term reliability and effectiveness as well as short-term effectiveness. The institutional controls under Alternative 2 can be easily and affordably implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

Effectiveness. Chain-link, barbed-wire fencing; warning signs; and documented land use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to contaminants or exploded ordnance debris within the boundaries of SWMU 8. The use of chain-link, barbed-wire fencing provides a high degree of both short-term and long-term reliability for the prevention of site access by humans. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land use controls during ownership by DoD. In addition, all construction will be prohibited under the BMP. These land use controls will remain in effect after transfer from DoD ownership by restrictions imposed through deed recordation.

An annual O&M program will be administered to replace or repair warning signs and fencing, which may deteriorate over time (see Appendix A). Implementation of the O&M Plan will ensure the effectiveness of this program. The O&M program for this CAP will involve inspection as well as potential replacement and/or repair of warning signs and fencing.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried exploded ordnance debris within the boundaries of SWMU 8. Posting of warning signs together with existing access restrictions will be most effective over the short term. The site is remote and not being used, so access is already limited.

Implementability. Very few factors limit implementability of the institutional controls under evaluation. On-site personnel or contractors can readily perform fence installation and posting of signs. O&M inspections require few resources with respect to inspection personnel and materials for repair. Establishment of an adequate combination of land use management tools will require additional time and effort for development, preparation, and processing of the necessary paperwork. However, the time and resources are available to administer and acquire necessary land use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to facilitate incorporation of land use controls into the BMP and to facilitate deed recordation.

Cost. The estimated total life-cycle cost of installation of fencing and warning signs, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $268,041. Although Alternative 1 is less expensive ($109,865), Alternative 2 provides a significantly higher level of protection with respect to preventing access by humans.

5.1.2 SWMU 9

The selected corrective action alternative for SWMU 9 involves a multi-layered approach to restricting human activity within the boundaries of this inactive EOD area. The selected set of institutional controls comprising this alternative will provide a combination of land use restrictions and prohibition. Land use restrictions will be documented and/or enforced through the BMP and existing range control procedures and the existing security program for the range.

Justification of Selection

Alternative 1 has been selected because it will provide effective protection of human health and safety at a relatively low cost due to the use of existing range control and security procedures. Although the installation of fencing and signs or signs alone would provide an additional degree of protection, the use of signs and fencing provided by Alternatives 2 and 3 is not considered practical because the site is located in an open range, and the protection would be rendered ineffective because of current and future range activities. Access controls have already been established through the existing security and range control program. Institutional controls described for Alternative 1 will provide a sufficient level of protection for human health and safety and an adequate degree of long-term reliability and effectiveness

as well as short-term effectiveness. The institutional controls under Alternative 1 can be easily and affordably implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

Effectiveness. Existing land use restrictions and additional documented land use restrictions (i.e., no construction or use of shallow groundwater) will be highly effective and provide long-term reliability with respect to preventing human exposure to contaminants or exploded ordnance debris within the boundaries of SWMU 9. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land use controls during ownership by DoD. In addition, all construction will be prohibited under the BMP. These land use controls will remain in effect after transfer from DoD ownership by restrictions imposed through deed recordation.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to surface and subsurface exploded ordnance debris within the boundaries of SWMU 9. The site is remote, so access is already limited. Access is further restricted in accordance with security and control procedures established for the range. Access must be authorized and scheduled by the security tower authorities for the range. Furthermore, a warning notice will be posted at the tower to restrict activities involving intrusion into the subsurface at SWMU 9.

Implementability. Very few factors limit implementability of the institutional controls under evaluation. Land use controls restricting access are already in place because SWMU 9 is within an active range. Modification to the BMP will require additional time and effort for development, preparation, and processing of necessary paperwork. However, the time and resources are available to administer and acquire necessary land use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to facilitate incorporation of land use controls into the BMP.

Cost. The estimated total life-cycle cost of modification to the BMP and provision of a warning notice for the tower is $85,483. Alternative 2 would be more expensive due to the costs associated with the time and materials required for sign installation and O&M activities. Alternative 3, which would provide the same land use controls as Alternative 2 but would also include installation of fencing, would be significantly more expensive ($118,682) than the selected alternative.

5.1.3 SWMU 11

The selected corrective action alternative for SWMU 11 involves a multi-layered approach to restricting human activity within the boundaries of this inactive EOD area. The selected set of institutional controls comprising this alternative will provide a combination of land use restrictions and prohibitions and physical barriers. Land use restrictions will be documented and/or enforced through deed recordation, the BMP, zoning restrictions, and signage. Six-foot-high chain-link fencing topped with three strands of barbed wire will be provided as a physical barrier to access by humans.

Justification of Selection

Alternative 2 has been selected because it will provide effective protection of human health and safety. Although the posting of warning signs without fencing would be less expensive, the additional degree of protection provided by the fencing is necessary to ensure human safety. The protection that the fence will provide against inadvertent access to the site and unauthorized excavation below the ground surface justifies the moderately greater expense of implementing Alternative 2 rather than Alternative 1. Institutional controls described for Alternative 2 will provide a sufficient level of protection for human health and safety and an adequate degree of long-term reliability and effectiveness as well as short-term

effectiveness. The institutional controls under Alternative 2 can be easily and affordably implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

Effectiveness. Chain-link, barbed-wire fencing; warning signs; and documented land use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to contaminants or exploded ordnance debris within the boundaries of SWMU 11. The use of chain-link, barbed-wire fencing provides a high degree of both short-term and long-term reliability for the prevention of site access by humans. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land use controls during ownership by DoD. In addition, all construction will be prohibited under the BMP. These land use controls will remain in effect after transfer from DoD ownership by restrictions imposed through deed recordation.

An annual O&M program will be administered to replace or repair warning signs and fencing, which may deteriorate over time (see Appendix A). Implementation of the O&M Plan will ensure the effectiveness of this program. The O&M program for this CAP will involve inspection as well as potential replacement and/or repair of warning signs and fencing.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried exploded ordnance and debris within the boundaries of SWMU 11. Posting of warning signs together with existing access restrictions will be most effective over the short term. The site is remote and not being used, so access is already limited.

Implementability. Very few factors limit implementability of the institutional controls under evaluation. On-site personnel or contractors can readily perform fence installation and posting of signs. O&M inspections require few resources with respect to inspection personnel and materials for repair. Establishment of an adequate combination of land use management tools will require additional time and effort for development, preparation, and processing of necessary paperwork. However, the time and resources are available to administer and acquire necessary land use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to facilitate incorporation of land use controls into the BMP and to facilitate deed recordation.

Cost. The estimated total life-cycle cost of installation of fencing and warning signs, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $216,676. Although Alternative 1 is less expensive ($69,567), Alternative 2 provides a significantly higher level of protection with respect to preventing access by humans.

5.2 CONCEPTUAL DESIGNS

5.2.1 SWMU 8

During the period of ownership by DoD, institutional controls will be recorded in the BMP to ensure implementation. Notification of transfer will be made to regulatory authorities upon transfer of property. Land use restrictions and institutional control requirements that are expected to be enforced subsequent to property transfer include the following: deed recordation; the purchase agreement or lease; zoning controls; applicable state land use control management systems in effect at the time the property is transferred; community, transferee, or governmental notice (if needed); and self-certification (if feasible). To reduce potential exposure to human health and safety hazards associated with SWMU 8, 6-foot-high fencing topped with three strands of barbed wire will be installed around the boundary of SWMU 8.

Warning signs stating restrictions on human activity within SWMU 8 will be mounted on the fencing at 200-foot intervals (see Figure 4-2).

All activities within the boundary of the SWMU that would involve disturbance of the subsurface will be prohibited in accordance with all land use control mechanisms. Activities that will be prohibited include military training exercises, hunting, recreational activities, and construction. However, the following activities, conducted in a manner that would minimize disturbance of the subsurface, will be permitted: performance of wildlife studies and provision and maintenance of feed lots for deer.

Establishment of Institutional Controls

Prior to installation of fencing and posting of warning signs at SWMU 8, land use and "zoning-like" requirements for the subject site will be incorporated into the BMP, which will include all restrictions and provisions documented in Appendix B of this report. The BMP will include a description of institutional controls as provided in this CAP. The appropriate implementing document(s) will include land use prohibitions and restrictions, including those related to activities that disturb the subsurface and to construction of new buildings. The appropriate implementing document(s) will also provide allowances for those activities that do not impact the subsurface, as described above. Reference to documents relevant to the corrective actions performed at SWMU 8 will also be included in the BMP.

Deed recordation and the purchase or lease agreement upon property transfer will also incorporate land use controls. Deed recordation provisions and requirements are described in Appendix B. The deed recordation will, in perpetuity, notify any potential purchaser of the property that SWMU 8 has been used as an EOD area. The purchase agreement(s) and deed recordation or lease agreements will reference this CAP and other environmental documents that contain the rationale for the restrictions. As required by the DoD policy "Responsibility for Additional Environmental Cleanup after Transfer of Property," the property disposal agent will ensure that the transfer documents for real property reflect the land use controls. The legal office of USACE and its telephone number will be included as a point of contact in the purchase agreement and deed in case a problem arises with a use control, additional contamination is found, or the transferee wishes to revise or terminate a land use control. All applicable and appropriate state land use control management systems in effect at the time of transfer will also be implemented. Additional land use control mechanisms related to property transfer (e.g., notices, media use restrictions, self-certification) will be evaluated and implemented as necessary and appropriate.

A survey plat has been prepared by a professional land surveyor certified in the state of Georgia (Appendix C). The plat will be included in the BMP. The survey plat indicates the location and dimensions of SWMU 8 with respect to permanently surveyed benchmarks. The plat contains a prominently displayed note that states Fort Stewart's obligation to prohibit disturbance of SWMU 8 in accordance with this CAP.

A 6-foot-high, industrial chain-link fence constructed of 6-gauge galvanized steel topped with three strands of barbed wire will be installed around the perimeter of each portion (878 linear feet and 936 linear feet, respectively) of SWMU 8 bordering the access road. Fencing will include 2-inch-diameter galvanized posts set a minimum of 2 feet bgs in concrete on 10-foot centers. Four-inch-diameter galvanized posts will be installed at each corner and as the supports at each swing gate. One 20-foot-wide (total), double-swing gate will be installed along the side of each fenced area (total of two) that borders the access road (see Figure 4-2). The minimum specifications for the chain-link fencing and gates are presented in Figure 5-1.

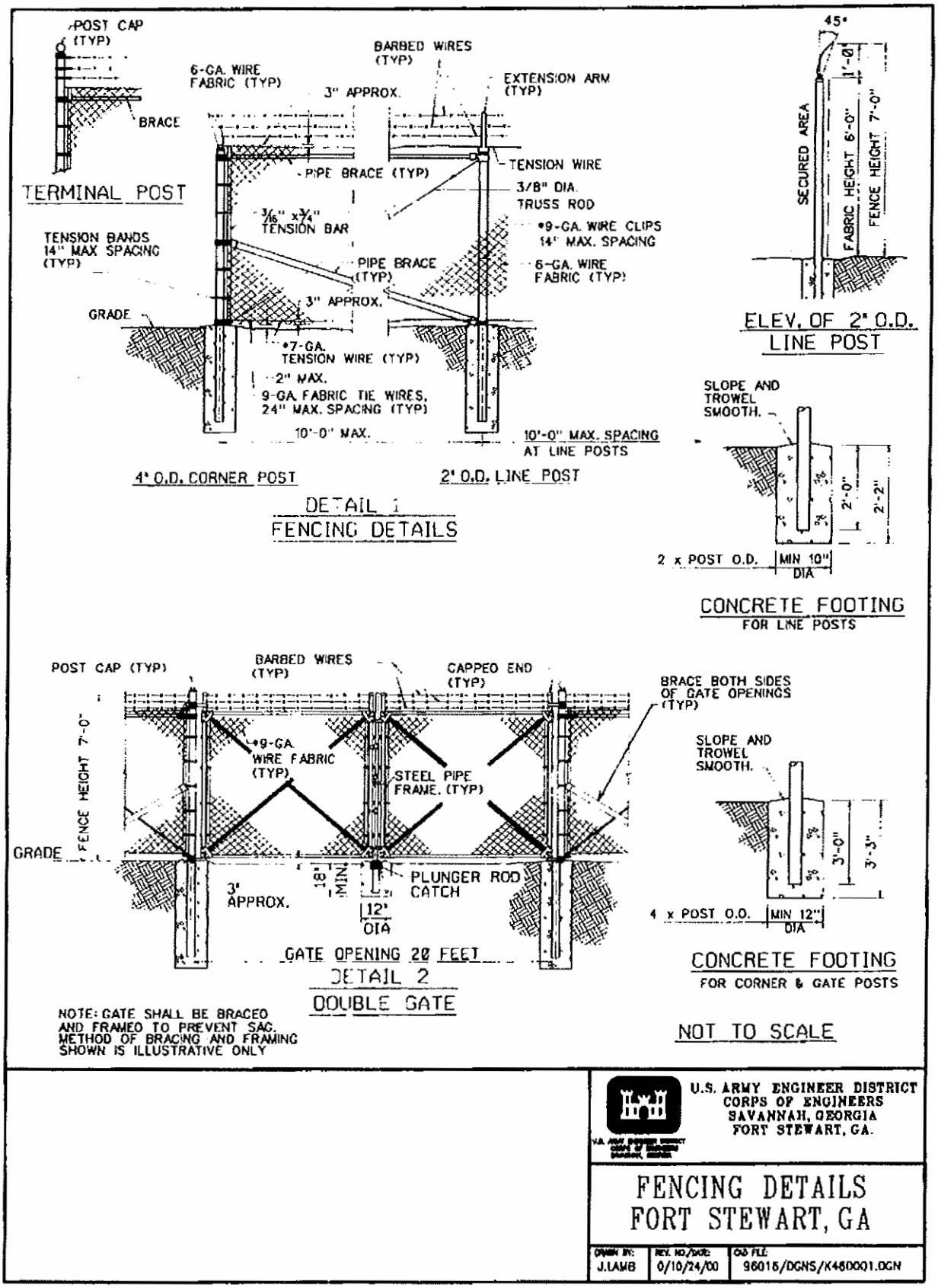

Figure 5-1. Specifications for Chain-link Fencing and Gates

Eight fence-mounted warning signs will be posted at approximately 200-foot intervals surrounding the perimeter of SWMU 8, as shown in Figure 4-2. These signs will be worded as follows:

CAUTION:
FORMER EXPLOSIVE ORDNANCE DISPOSAL AREA
NO TRESPASSING
CONTACT DPW
REGARDING USE RESTRICTIONS
767-2010

Each sign will have the dimensions of 24 inches by 24 inches. Warning signs will be metal plates with reflective painting and weather-resistant construction. The signs will have a brown background and white lettering.

Signs will be permanently mounted to chain-link fencing. All signs will be permanently labeled (for identification purposes) on the back with a numerical identification number as shown on Figure 4-2.

The warning signs and fencing at SWMU 8 will be inspected annually in accordance with the O&M Plan. Damaged fencing will be repaired as needed. Damaged signs will also be repaired or replaced as needed. Repair or replacement of signs or fencing will occur within 1 month of inspection. Should damage be observed between inspections, repair or replacement will occur within 1 month of observation.

5.2.2 SWMU 9

During the period of DoD's ownership, institutional controls will be recorded in the BMP to ensure implementation. Notification of transfer will be made to regulatory authorities upon transfer of property. Land use restrictions and institutional control requirements that are expected to be enforced subsequent to property transfer will be established and implemented for the property upon transfer of the entire range.

All activities that would involve disturbance of the subsurface will be prohibited in accordance with BMP requirements. Activities that will be prohibited include hunting, recreational activities, and/or construction. Only activities associated with, permitted by, and controlled by the range procedures will be permitted on the site.

Establishment of Institutional Controls

Land use and "zoning-like" requirements for the subject site will be incorporated into the BMP, which will include all restrictions and provisions documented in Appendix B of this report. The BMP will include a description of institutional controls as provided in this CAP. The BMP will include land use prohibitions and restrictions, including those related to activities that disturb the subsurface and to construction of new buildings. The BMP will also provide allowances for those activities that do not impact the subsurface, as described above. Reference to documents relevant to the corrective actions performed at SWMU 9 will also be included in the BMP.

These prohibitions and restrictions will be documented in a warning notice posted at the security tower for the range along with a site map showing the location of SWMU 9 relative to the tower. The warning notice will include the following text:

WARNING:
INACTIVE EXPLOSIVE ORDNANCE DISPOSAL AREA
IN RED CLOUD RANGE, HOTEL AREA

The following restrictions/prohibitions apply to the SWMU 9 site:

1. **All activities on the property that may result in disturbance of subsurface soil are expressly prohibited.**

2. **Although use of groundwater beneath the subject property is not expressly prohibited, installation of groundwater wells, including monitoring wells, within the boundaries of this property is expressly prohibited.**

3. **Hunting and recreational activities are expressly prohibited.**

4. **All construction within the property boundaries is expressly prohibited.**

The warning sign installed at the Range Control Tower at the SWMU will be inspected annually in accordance with the O&M Plan. The damaged sign will be repaired or replaced as needed. Repair or replacement of the sign will occur within 1 month of inspection. Should damage be observed between inspections, repair or replacement will occur within 1 month of observation of the damage.

A survey plat has been prepared by a professional land surveyor certified in the state of Georgia (Appendix C). The plat will be included in the BMP. The survey plat indicates the location and dimensions of SWMU 9 with respect to permanently surveyed benchmarks. The plat contains a prominently displayed note that states Fort Stewart's obligation to prohibit disturbance of SWMU 9 in accordance with this CAP.

5.2.3 SWMU 11

During the period of ownership by DoD, institutional controls will be recorded in the BMP to ensure implementation. Notification of transfer will be made to regulatory authorities upon transfer of property. Land use restrictions and institutional control requirements that are expected to be enforced subsequent to property transfer include the following: deed recordation; the purchase agreement or lease; zoning controls; applicable state land use control management systems in effect at the time the property is transferred; community, transferee, or governmental notice (if needed); and self-certification (if feasible). To reduce potential exposure to human health and safety hazards associated with SWMU 11, 6-foot-high chain-link fencing topped with barbed wire will be installed around the boundary of SWMU 11. Warning signs stating restrictions on human activity within SWMU 11 will be mounted on the fencing at 200-foot intervals (see Figure 4-6).

All activities within the boundaries of SWMU 11 that would involve disturbance of the subsurface will be prohibited in accordance with all land use control mechanisms. Activities that will be prohibited include military training exercises, hunting, recreational activities, and construction. However, the following

activities, conducted in a manner that would minimize disturbance of the subsurface, will be permitted: performance of wildlife studies and provision and maintenance of feed lots for deer.

Establishment of Institutional Controls

Prior to installation of fencing and posting of warning signs at SWMU 11, land use and "zoning-like" requirements for the subject site will be incorporated into the BMP, which will include all restrictions and provisions documented in Appendix B of this report. The BMP will include a description of institutional controls as provided in this CAP. The appropriate implementing document(s) will include land use prohibitions and restrictions, including those related to activities that disturb the subsurface and to construction of new buildings. The appropriate implementing document(s) will also provide allowances for those activities that do not impact the subsurface, as described above. Reference to documents relevant to the corrective actions performed at SWMU 11 will also be included in the BMP.

Deed recordation and the purchase agreement or lease agreement upon property transfer will also incorporate land use controls. Deed recordation provisions and requirements are described in Appendix B. The deed recordation will, in perpetuity, notify any potential purchaser of the property that SWMU 11 has been used as an EOD area. The purchase agreement(s) and deed recordation or lease agreements will reference this CAP and other environmental documents that contain the rationale for the restrictions. As required by the DoD policy "Responsibility for Additional Environmental Cleanup after Transfer of Property," the property disposal agent will ensure that the transfer documents for real property reflect the land use controls. The legal office of USACE and its telephone number will be included as a point of contact in the purchase agreement and deed in case a problem arises with a use control, additional contamination is found, or the transferee wishes to revise or terminate a land use control. All applicable and appropriate state land use control management systems in effect at the time of transfer will also be implemented. Additional land use control mechanisms related to property transfer (e.g., notices, media use restrictions, self-certification) will be evaluated and implemented as necessary and appropriate.

A survey plat has been prepared by a professional land surveyor certified in the state of Georgia (Appendix C). The plat will be included in the BMP. The survey plat indicates the location and dimensions of SWMU 11 with respect to permanently surveyed benchmarks. The plat contains a prominently displayed note that states Fort Stewart's obligation to prohibit disturbance of SWMU 11 in accordance with this CAP.

A 6-foot-high, industrial chain-link fence constructed of 6-gauge galvanized steel topped with three strands of barbed wire will be installed around the perimeter of (1,114 linear feet) of SWMU 11. Fencing will include 2-inch-diameter galvanized posts set a minimum of 2 feet bgs in concrete on 10-foot centers. Four-inch-diameter galvanized posts will be installed at each corner and as the supports at each swing gate. One 20-foot-wide (total), double-swing gate will be installed along the northeastern side of SWMU 11 (see Figure 4-6). The minimum specifications for the chain-link fencing and gate are presented Figure 5-1

Five fence-mounted warning signs will be posted at approximately 200-foot intervals surrounding the perimeter of SWMU 11, as shown in Figure 4-6. These signs will be worded as follows:

CAUTION:
FORMER EXPLOSIVE ORDNANCE DISPOSAL AREA
NO TRESPASSING
CONTACT DPW
REGARDING USE RESTRICTIONS
767-2010

Each sign will have the dimensions of 24 inches by 24 inches. Warning signs will be metal plates with reflective painting and weather-resistant construction. The signs will have a brown background and white lettering.

Signs will be permanently mounted to chain-link fencing. All signs will be permanently labeled (for identification purposes) on the back with a numerical identification number as shown on Figure 4-6.

The warning signs and fencing at SWMU 11 will be inspected annually in accordance with the O&M Plan. Damaged fencing will be repaired as needed. Damaged signs will also be repaired or replaced as needed. Repair or replacement of signs or fencing will occur within 1 month of inspection. Should damage be observed between inspections, repair or replacement will occur within 1 month of observation.

5.3 COST ESTIMATES

Detailed cost estimates are provided in Appendix D for implementation of institutional controls at each of the subject inactive EOD areas. The life-cycle cost estimates for the selected institutional controls alternatives for the subject inactive EOD areas are provided in Table 5-2.

Capital costs include materials and labor associated with installation of fencing and/or mounting or posting of 24-inch by 24-inch aluminum signage according to the quantities provided in Table 5-3.

Table 5-2. Estimated Cost for Selected Alternative for Each SWMU

Site	Capital Costs	O&M	Other[a]	Total
SWMU 8	$59,290	$113,639	$95,112	$268,041
SWMU 9	$5,200	$49,950	$30,333	$85,483
SWMU 11	$40,044	$99,747	$76,885	$216,676

[a]Includes engineering management, contingency, health and safety, and contractor profit.

Table 5-3. Summary of Primary Physical Components of Each Selected Alternative

Site	Fencing (feet)	Number of 20-Foot Gates[a]	Number of Signs
SWMU 8	(878 and 936)[a]	2	8
SWMU 9	0	0	1[b]
SWMU 11	1,114	1	5

[a]Two separate areas are required to be fenced.
[b]Sign to be located at the Range Control Tower

The number of signs is based on the measured boundary lineage of the site (approximately one sign per 200 feet). The cost of a single 20-foot-wide, double-swing gate is included for each fenced area. Costs that would be associated with the deed recordation are also included.

O&M costs include the prices of annual inspections and fence and sign repair/replacement every 5 years for 30 years. For SWMUs 8, 9, and 11, the cost for sign repair/replacement every 5 years was assumed to be equivalent to 25 percent of the cost of initial installation. Also, for SWMUs 8 and 11, the cost for fence repair/replacement every 5 years was assumed to be equivalent to 10 percent of the cost of initial installation. The cost of sign and/or fence repairs at SWMU 9 was assumed to be equivalent to the percentage of cost for the initial installation; however, the frequency of repair/replacement was assumed to be every year because fencing and/or signs would be subjected to frequent damage resulting from activities occurring within the active range.

5.4 IMPLEMENTATION SCHEDULE

Implementation of the corrective action will begin at these sites once approval of this CAP is received from GEPD. The schedule presented in Table 5-4 has been established for implementation of institutional controls at this site.

Table 5-4. Corrective Action Implementation Schedule

Task	Frequency of Action or Time from GEPD Approval of CAP (days)
Procure fencing, signs, and materials	90
Record institutional controls in BMP and any other approved implementing document	120
Install fence and post signs at each site	120
Perform inspections (Implement O&M Plan)	Annually[a]
Repair/replace signage and repair fencing	As needed
Notify GEPD of property transfer	Prior to property transfer
Establish appropriate legal land use controls for property transfer (e.g., deed recordation, lease or purchase agreements)	Prior to property transfer

[a]The first O&M report will be submitted to GEPD 455 days after the installation of the fencing and signs, with subsequent reports submitted annually thereafter

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6.0 REFERENCES

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Georgia Department of Natural Resources
205 Butler Street, S.E., Suite 1162, Atlanta, Georgia 30334
Lonice C. Barrett, Commissioner
Environmental Protection Division
Harold F. Reheis, Director
404/656-2833

December 8, 2000

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Gregory V. Stanley, Colonel, U.S. Army
Director, Public Works
Headquarters, 3D Infantry Division (Mechanized) and Fort Stewart
Directorate of Public Works, Building 1137
Environmental Branch (ATTN: Melanie Little)
1550 Frank Cochran Drive
Fort Stewart, GA 31314-4927

RE: Phase II RCRA Facility Investigation (RFI) Report for Sixteen (16) Solid Waste Management Units (SWMUs) dated April 2000; Fort Stewart; EPA ID No. GA9 210 020 872.

Dear Colonel Stanley:

The Hazardous Waste Management Branch of the Georgia Environmental Protection Division (GA EPD) has reviewed the above-referenced document and determined the following.

1. In correspondence (Khaleghi to Perez) dated July 14, 1999, GA EPD forwarded two hundred and seven (207) comments to Fort Stewart documenting our review of the February 1999 version of the Phase II RFI Report for 16 SWMUs. Upon receipt of that letter, your facility responded to each of those comments and created a set of Minutes from our September 14, 1999 Comment Resolution Meeting attended by representatives from Fort Stewart, Science Applications International Corporation and GA EPD [See correspondences (Perez to Khaleghi) dated August 20, 1999 and (Perez to Rabon) dated September 27, 1999, respectively]. Based upon our review of your letters, GA EPD formally approved the Fort Stewart Response to Comments (as clarified and/or modified by the September 14, 1999 Meeting Minutes) in correspondence (Khaleghi to Perez) dated October 4, 1999.

   Fort Stewart has further provided an amended Response to Comments in Appendix L (Volume III) of the Phase II RFI Report for 16 SWMUs dated April 2000 with correct page numbers and citations in order to ease GA EPD's review process. In addition, a notation is provided in the table if a specific comment, or a portion of a comment, is no longer applicable. We appreciate the detail and proactive manner with which Fort Stewart has responded to our comments; the responses are approved with the exception of those for the six (6) SWMUs addressed by Comment Nos. 7-9 below.

2. GA EPD maintains that the corrective action projects required by the Conditions of the Fort Stewart Hazardous Waste Facility Permit #HW-045(S&T) (Permit) have been exceptionally well-managed and well-executed by Ms. Melanie Little of your staff and by Science Applications International Corporation. It is also our opinion that this Phase II RFI Report for 16 SWMUs dated April 2000 is of

superior quality. As GA EPD has stated before, our agency is utilizing a number of the RFI Reports and Corrective Action Plans (CAPs) created by Fort Stewart as examples for other facilities which are regulated by the Georgia Hazardous Waste Management Act, as amended, O.C.G.A. §12-8-60, et seq.; and Rules for Hazardous Waste Management, Chapter 391-3-11, promulgated pursuant thereto, as amended, which incorporates by reference the Code of Federal Regulations found in 40 CFR Parts 124, 260-268, 270, 273 and 279. We continue to appreciate the high degree of professionalism and technical expertise that Fort Stewart brings to these projects.

3. The Phase II RFI Report for 16 SWMUs dated April 2000 is complete, as qualified by Comment Nos. 7-9 below.

4. Corrective action is required at the SWMUs listed below pursuant to 40 CFR §264.101(a), as referenced by the Rules of Georgia Department of Natural Resources Environmental Protection Division Chapter 391-3-11 Section .10. In accordance with Conditions IV.E.1 and IV.E.2 in your Permit, Fort Stewart must submit CAPs for the following SWMUs to GA EPD within ninety (90) days from receipt of this correspondence.

   a. Camp Oliver Landfill (SWMU 2)
   b. TAC-X Landfill (SWMU 3)
   c. Inactive EOD Area located approximately Nine (9) Miles Northeast of the Garrison Area (SWMU 8)
   d. Inactive EOD Area in Red Cloud Range, Hotel Area (SWMU 9)
   e. Inactive EOD Area North of Garrison Area (SWMU 10)
   f. Inactive EOD Area located approximately Three (3) Miles Northeast of Garrison Area (SWMU 11)
   g. Active EOD containing Open Detonation Unit and Open Burn Unit (SWMU 12A), Open Detonation Unit (SWMU 12B) and Open Burn Unit (SWMU 12C)

5. Corrective action is required at the SWMUs listed below pursuant to 40 CFR §264.101(a), as referenced by the Rules of Georgia Department of Natural Resources Environmental Protection Division Chapter 391-3-11 Section .10. In accordance with Conditions IV.E.1 and IV.E.2 in your Permit, Fort Stewart must submit CAPs for the following SWMUs to GA EPD within one hundred and eighty (180) days from receipt of this correspondence.

   a. Industrial Wastewater Treatment Plant (SWMU 18)
   b. Evans Army Heliport POL Storage Facility (SWMU 29)

6. GA EPD tentatively concurs with the Fort Stewart recommendations that No Further Action (NFA) is required at the following SWMUs.

   a. Old Fire Training Area (SWMU 14)
   b. DRMO Hazardous Waste Storage Area (SWMU 17)
   c. Old Sludge Drying Beds (SWMU 19)
   d. 3rd Squadron 7th Cavalry Motor Pool and four (4) associated Oil/Water Separators (SWMU 27A)

e. 1st BN, 3d ADA Motor Pool and associated Oil/Water Separator (SWMU 27B)
f. 92d ECB (H) Motor Pool and associated Oil/Water Separator (SWMU 27C)
g. 26th SPT BN Motor Pool and associated Oil/Water Separator (SWMU 27D)
h. 703d SPT BN (Main) Motor Pool and associated two (2) Oil/Water Separators (SWMU 27E)
i. DISCOM Motor Pool and associated Oil/Water Separator (SWMU 27G)
j. NGTC Block 9900, 10300 Motor Pool and associated two (2) Oil/Water Separators (SWMU 27I)
k. 3rd BN, 69th Armor Motor Pool Wash Rack and Oil/Water Separator (SWMU 27K)
l. NGTC Block 10100 Motor Pool Wash Rack and Oil/Water Separator (SWMU 27M)
m. NGTC Block 9800 Motor Pool Wash Rack and Oil/Water Separator (SWMU 27N)
n. NGTC Block 9700 Motor Pool Wash Rack and Oil/Water Separator (SWMU 27O)
o. NGTC Block 9500 Motor Pool Wash Rack and Oil/Water Separator (SWMU 27P)
p. NGTC Block 9400 Motor Pool Wash Rack and Oil/Water Separator (SWMU 27Q)
q. 396 Transportation Company Wash Rack and Oil/Water Separator (SWMU 27R)
r. Two (2) 103d MI BN Wash Racks and associated two (2) Oil/Water Separators (SWMU 27S)
s. Two (2) Wright Army Airfield Wash Racks and associated Oil/Water Separator (SWMU 27U)
t. Auto Craft Center Oil/Water Separator (SWMU 27V)
u. DEH Asphalt Tanks (SWMU 31)
v. Supply Diesel Tank (SWMU 32)
w. DEH Equipment Wash Rack (SWMU 34)
x. NGTC Equalization Basin (SWMU 37)

Please note that a final decision concerning the corrective action status of the SWMUs listed above will be made by GA EPD through issuance of a Notice of Decision documenting the next modification of your Permit.

7. With respect to the Third (3d) Inf. Engineer Brigade Motor Pool and associated two (2) Oil/Water Separators (SWMU 27F), GA EPD tentatively concurs with the Fort Stewart recommendation that NFA is warranted for the Oil/Water Separator located Northeast of Building 1340. However, consistent with our Comment No. 5 in correspondence (Khaleghi to Perez) dated July 14, 1999; GA EPD will not separate this Oil/Water Separator from the one located Northwest of Building 1340 by further subdividing SWMU 27F in Appendix A of your Permit. Please also note that the investigation results of the second Oil/Water Separator are documented in the Addendum for SWMU 27F/Northwest of Building 1340 dated August 2000 which was received by GA EPD on August 30, 2000 and is currently in process for review by our agency.

8. With respect to the GANG MATES Motor Pool and associated two (2) Oil/Water Separators (SWMU 27J), GA EPD tentatively concurs with the Fort Stewart recommendation that NFA is warranted for the Oil/Water Separator located at Building 10535. However, consistent with our Comment No. 5 in correspondence (Khaleghi to Perez) dated July 14, 1999; GA EPD will not separate this Oil/Water Separator from the one located at Building 10531 by further subdividing SWMU 27J in Appendix A of your Permit. Please also note that the investigation results of the second Oil/Water Separator are documented in the Addendum for SWMU 27J/Building 10531 dated July 2000 which was received by GA EPD on July 20, 2000 and is currently in process for review by our agency.

9. Fort Stewart has submitted Addenda to the Phase RFI Report for 16 SWMUs dated April 2000 for the following SWMUs.

    a. Old Radiator Shop/Paint Booth (SWMU 24B)
    b. DOL Maintenance Motor Pool and associated two (2) Oil Water Separators (SWMU 27H/Buildings 1056 & 1071)
    c. NGTC Block 10200 Wash Rack and Oil/Water Separator (SWMU 27L)
    d. 293 MP Company Wash Rack and Oil/Water Separator (SWMU 27T)

    Please note that the investigation results documented in the Addenda for SWMUs 24B, 27H, 27L and 27T have been received by GA EPD and are currently in process for review by our agency.

Should you have any questions concerning this correspondence, please contact Brent Rabon of my staff at (404)656-2833.

Sincerely,

Bruce Khaleghi, Unit Coordinator
Hazardous Waste Management Branch

c: Mr. Larry Rogers, GA EPD-Southeast Regional Office
File: Fort Stewart(R)
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FORSCOM

3d Inf Div (Mech)

PHASE II RCRA FACILITY INVESTIGATION REPORT

FOR

16 SOLID WASTE MANAGEMENT UNITS AT FORT STEWART, GEORGIA

VOLUME I OF III

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract No. DACA21-95-D-0022
Delivery Order 0009

April 2000

99-183P(PPT)/021600

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 Heliport 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 GEPD 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 1×10^{-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 1×10^{-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[a]	As, Cr, and Ag	NC	NC	NP	NP
10	Phase II	As, Ba, Cr, and Pb	NC[b]	None	Cd, Cr, and Hg	As, Ba, and Pb
11	Phase II	As, Ba, Cr, Pb, and Ag	NC[b]	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)[c]
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-1. Summary of Site-related Contaminants (continued)

SWMU	Type of Investigation	Site-related Contaminants				
		Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
27E (Bldg. 1720)	Phase I	NC	2 VOCs and BEHP	1 SVOC	NP	NP
27F (NW Bldg. 1340)	Phase I	NC	3 VOCs and Pb	10 VOCs and 4 SVOCs	NP	NP
27F (NE Bldg. 1340)	Phase I	3 VOCs	8 VOCs and 4 SVOCs	None	NP	NP
27G	Phase I	NC	3 VOCs	1 SVOC	NP	NP
27H (Bldg. 1071)	Phase I	NC	2 VOCs, 11 SVOCs, Pb, and Hg	1 VOC and 9 SVOCs	NP	NP
27H (Bldg. 1056)	Phase I	NC	1 VOC, 1 SVOC, Cd, and Pb	2 VOCs and 4 SVOCs	NP[d]	NP[d]
27I (Block 9900)	Phase I	NC	1 VOC and Pb	None	NC	1 VOC and Pb
27I (Block 10300)	Phase I	NC	None	None	Pb	None
27J (Bldg. 10535)	Phase I	None	None	1 VOC and 1 SVOC	NP	NP
27J (Bldg. 10531)	Phase I	1 VOC and 1 SVOC	NC	2 SVOCs	NP	NP
27K	Phase I	NC	4 VOCs	1 VOC	NP	NP
27L (Block 10200)	Phase I	None	1 VOC and 1 SVOC	8 VOCs and 2 SVOCs	Acetone	None
27M (Block 10100)	Phase I	1 VOC and Pb	2 SVOCs and Pb	1 VOC	NC	Pb
27N (Block 9800)	Phase I	NC	2 SVOCs and Pb	None	NC	5 SVOCs
27O (Block 9700)	Phase I	Pb	None	1 SVOC	1 VOC	Pb
27P (Block 9500)	Phase I	1VOC and 1 SVOC	1 VOC, 6 SVOCs, and Pb	None	NC	1 VOC and Pb

Note: Footnotes appear on page ES-8.

Table ES-1. Summary of Site-related Contaminants (continued)

SWMU	Type of Investigation	Site-related Contaminants				
		Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
27Q (Block 9400)	Phase I	Pb	None	None	NC	Pb
27R	Phase I	None	1 VOC and 2 SVOCs	None	NP	NP
27S	Phase I	NC	6 VOCs	None	NP	NP
27T	Phase I	4 SVOCs	None	1 VOC and 1 SVOC	NC	4 VOCs, 9 SVOCs, and Cd
27U	Phase I	1 VOC and Pb	2 VOCs and Pb	4 VOCs	NP	NP
27V	Phase I	1 VOC and Pb	1 VOC and Pb	None	NP	NP
29	Phase II	8 VOCs and Ag	16 VOCs and 14 SVOCs	3 VOCs, 3 SVOCs, As, Ba, and Cr	NP	NP
31	Phase II and IRA	None	6 VOCs and 17 SVOCs	4 VOCs	NP	NP
32	Phase II	2 VOCs, Ba, Cd, Cr, Pb, and Hg	2 VOCs, Pb, and Hg	4 VOCs and 2 SVOCs	NP	NP
34	Phase II	4 VOCs, 2 SVOCs, Ba, Cd, Pb, and Hg	1 VOC, Ba, Cd, Cr, and Pb	3 VOCs	NP	NP
37	Phase I	1 VOC and Hg	2 VOCs and Hg	4 VOCs	NP	(4 VOCs, Ba, Cd, Cr, Pb, Hg, and Se)[c]

[a]Phase II RFI was not required at this time. The Phase II RFI will be conducted upon closure of the Red Cloud Range, Hotel Area.
[b]Per the GEPD–approved SAP, subsurface soil was not collected because subsurface soil sampling in an EOD area requires approval by the Secretary of the Army.
[c]Results from sediment within the NGTC Equalization Basin.
[d]Sediment was collected; however, the oil/water separator does not discharge to the drainage ditch.
BEHP = Bis(2-ethylhexyl)phthalate.
NA = Not applicable.
NC = Not collected based on field screening results or because no medium (i.e., surface water) was available during the RFI.
ND = Not detected.
NP = No pathway exists.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

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[a]	NA[a]	NA[a]	NA[a]	NC[a]	NC[a]	NP	NP	NA[a]	NC[a]	NP	NP	
10	NA[b]	NA[b]	NA[b]	NC	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	
11	NA[b]	NA[b]	NA[b]	NC	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	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)[c]	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-2. Summary of CMCOPCs, HHCOPCs, and ECOPCs (continued)

SWMU	CMCOPCs		HHCOPCs					ECOPCs				HHBRA or SPRE Performed?
	Soil	Sediment	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment	Surface Soil	Groundwater	Surface Water	Sediment	
27B	None	NP	None	None	None	NP	NP	None	None	NP	NP	
27C	None	NP	None	None	None	NP	NP	None	2 VOCs	NP	NP	
27D	None	NP	None	None	None	NP	NP	None	None	NP	NP	
27E (Bldg. 1628)	None	NP	None	None	None	NP	NP	None	None	NP	NP	
27E (Bldg. 1720)	None	NP	NA	None	None	NP	NP	NA	1 SVOC	NP	NP	
27F (NW Bldg. 1340)	None	NP	NA	None	4 VOCs and 4 SVOCs	NP	NP	NA	2 VOCs and 4 SVOCs	NP	NP	
27F (NE Bldg. 1340)	1 VOC	NP	None	None	None	NP	NP	None	None	NP	NP	
27G	None	NP	NA	None	1 SVOC	NP	NP	NA	None	NP	NP	HHBRA
27H (Bldg. 1071)	2 SVOCs	NP	NC	1 SVOC	1 VOC and 7 SVOCs	NP	NP	NC	8 SVOCs	NP	NP	
27H (Bldg. 1056)	None	NP	NC	None	3 SVOCs	NP	NP	NC	2 SVOCs	NP	NP	
27I (Block 9900)	None	None	NC	None	None	NC	None	NC	None	NC	Pb	
27I (Block 10300)	None	NA	NC	None	None	Pb	None	NC	None	Pb	None	
27J (Bldg. 10535)	None	NP	None	None	None	NP	NP	None	1 VOC and 1 SVOC	NP	NP	
27J (Bldg. 10531)	None	NP	None	NC	1 SVOC	NP	NP	None	2 SVOCs	NP	NP	
27K	None	NP	NA	None	None	NP	NP	NA	None	NP	NP	
27L (Block 10200)	None	None	None	None	4 VOCs and 2 SVOCs	Acetone	None	None	2 VOCs and 1 SVOC	None	None	
27M (Block 10100)	1 VOC	None	None	None	1 VOC	NC	None	Pb	None	NC	Pb	
27N (Block 9800)	None	None	NA	None	None	NC	1 SVOC	NA	None	NC	None	HHBRA

Note: Footnotes appear on page ES-11.

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

SWMU	CMCOPCs		HHCOPCs					ECOPCs				HHBRA or SPRE Performed?
	Soil	Sediment	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment	Surface Soil	Groundwater	Surface Water	Sediment	
27O (Block 9700)	None	None	None	NA	None	None	None	Pb	1 SVOC	None	Pb	
27P (Block 9500)	None	None	None	None	None	NC	None	None	None	NC	Pb	
27Q (Block 9400)	None	None	None	NA	None	NC	None	Pb	None	NC	Pb	
27R	None	NP	None	None	None	NP	NP	None	None	NP	NP	
27S	None	NP	NA	None	None	NP	NP	NA	None	NP	NP	
27T	None	Cd	1 SVOC	None	None	NA	4 SVOCs	None	1 SVOC	NA	Cd	HHBRA
27U	None	NP	None	None	Benzene	NP	NP	Pb	None	NP	NP	
27V	None	NP	None	None	None	NP	NP	None	None	NP	NP	
29	7 VOCs	NP	None	None	1 VOC, 2 SVOCs, and As	NP	NP	None	1 VOC, 2 SVOCs, and Ba	NP	NP	HHBRA
31	1 VOC and 1 SVOC	NP	None	None	Acetone	NP	NP	None	Xylenes	NP	NP	HHBRA
32	1 VOC	NP	None	None	Acetone	NP	NP	Cd, Pb, and Cr	1 VOC and 1 SVOC	NP	NP	HHBRA
34	2 VOCs	NP	None	None	Acetone	NP	NP	Cd and Pb	1 VOC	NP	NP	HHBRA
37	1 VOC	1 VOC[b] and Cd	None	None	Benzene	NP	NP	None	Xylenes	NP	NA	

[a]Phase II RFI was not required at this time. The Phase II RFI will be conducted upon closure of the Red Cloud Range, Hotel Area.
[b]With the concurrence of GEPD, fate and transport analysis and human health and ecological preliminary risk assessments were deemed unnecessary. SRCs were determined solely on comparison to background criteria (see Table ES-1).
[c]Results from sediment within the NGTC Equalization Basin.
BEHP = Bis(2-ethylhexyl)phthalate.
HHBRA = Human health baseline risk assessment.
NA = Not applicable.
NC = Sample not collected based on field screening results or because no medium (i.e., surface water) was available during the RFI.
NP = No pathway exists.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

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