Decision Documents for Site FST-001

EPD letter approving CAP for SWMU #3 dated	July 8, 2004
EPD letter approving RTC for SWMU #3 dated	July 25, 2001
Transmittal letter & pages sent in RTC for SWMU #3 dated	July 3, 2001
GA EPD letter received approving CAP for SWMU #2 dated	May 2, 2001
Transmittal letter sent for SWMU #2 dated	March 23, 2001
GA EPD letter received w/ comments for SWMU #3 dated	May 3, 2001
Transmittal letter to GA EPD for SWMU #3 dated	March 23, 2001
Decision Document for SWMUs #2 & #3 dated	March 15, 2001
Decision Document for SWMU #1 dated	August 14, 2000
Decision Document for SWMU #1 dated	May 9, 2000
Decision Document for SWMU #1 dated	February 22, 2000
SWMU #2 CAP dated (No transmittal letter)	December 2000
SWMU #3 CAP dated (No transmittal letter)	December 2000
Decision Document (Not signed)	no date
Decision Document (Not signed)	no date
GA EPD letter approving replacement pages for SWMU #1 dated	June 1, 2000
Transmittal letter w/ RTC for *CAP SWMU #1* dated	May 22, 2000
GA EPD letter approving RTC for SWMU #1 dated	April 20, 2000
GA EPD letter for *16 SWMUs* dated	December 8, 2000
Revised Final RFI for 16 SWMUs dated	April 2000
Transmittal letter for SWMU #1 dated (Missing Replacement Pages)	April 10, 2000

GA EPD letter w/ Comments for SWMU #1 dated	March 14, 2000
Transmittal letter to GA EPD for SWMU #1 CAP dated	March 2, 2000
Corrective Action Plan for SWMU #1 dated	December 1999
GA EPD letter approving RTC for SWMU #1 dated	July 27, 1999
Revised Final RFI for SWMU #1 dated	March 1999
Transmittal letter w/ RTC for SWMU #1 dated	March 31, 1999
GA EPD letter w/ Comments for SWMU #1 dated	January 14, 1999
Transmittal letter *Final RFI for SWMU #1* dated	September 14, 1998

Georgia Department of Natural Resources
2 Martin Luther King Jr. Drive, S.E., Suite 1470, Atlanta, Georgia 30334
Lonice C. Barrett, Commissioner
Environmental Protection Division
Carol A. Couch, Ph.D., Director
404/656-2833

July 8, 2004

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Michael W. Biering, Colonel, U.S. Army
Director, Public Works
Headquarters, 3D Infantry Division (Mechanized) and Fort Stewart
Directorate of Public Works, Building 1137
Environmental Branch (ATTN: Tressa Rutland)
1550 Frank Cochran Drive
Fort Stewart, GA 31314-4927

RE: Modifications to the Fort Stewart Hazardous Waste Facility Permit #HW-045(S&T); EPA ID No. GA9 210 020 872.

Dear Colonel Biering:

The Hazardous Waste Management Branch of the Georgia Environmental Protection Division (GA EPD) has made tentative decisions:

(1) to delete Section I.H (Compliance Schedule) from the Fort Stewart Hazardous Waste Facility Permit #HW-045(S&T) (Permit) given that your facility has met the Conditions regarding installation of a new fence and gate around the boundary of the Explosive Ordnance Disposal Area which contains the permitted Miscellaneous Units;

(2) to insert additional text in Permit Condition I.C.1 [i.e., "Sampling protocol shall follow the guidance as set forth in the most recent edition of the Environmental Protection Agency Region IV Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM)"];

(3) to approve the Corrective Action Plan for Camp Oliver Landfill [Solid Waste Management Unit (SWMU) 2] dated March 2001 (See the attached Statement of Basis);

(4) to approve the Corrective Action Plan for TAC-X Landfill (SWMU 3) dated March 2001, as amended (See the attached Statement of Basis);

(5) to approve the Corrective Action Plan Corrective Action Plan for the Inactive Explosive Ordnance Disposal Area located approximately Nine (9) Miles Northeast of the Garrison Area, the Inactive Explosive Ordnance Disposal Area in Red Cloud Range, Hotel Area, and the Inactive Explosive Ordnance Disposal Area located approximately Three (3) Miles Northeast of Garrison Area (SWMUs 8, 9 & 11, respectively) dated May 2001 (See the attached

Statement of Basis);

(6) to approve the Corrective Action Plan for the Inactive Explosive Ordnance Disposal Area North of Garrison Area (SWMU 10) dated July 2001 (See the attached Statement of Basis);

(7) to approve the Corrective Action Plan for the Industrial Wastewater Treatment Plant (SWMU 18) dated September 2001 (See the attached Statement of Basis);

(8) to approve the Corrective Action Plan for the Evans Army Heliport Petroleum, Oil and Lubricants Storage Facility (SWMU 29) dated June 2001 (See the attached Statement of Basis);

(9) to approve the Corrective Action Plan for the Wright Army Airfield Bulk Fuel System (SWMU 35) dated January 2002 (See the attached Statement of Basis); and

(10) that No Further Action is required at the following twenty-eight SWMUs (See the attached Statements of Basis).

- Old Fire Training Area (SWMU 14)
- Defense Reutilization and Maintenance Office Hazardous Waste Storage Area (SWMU 17)
- Old Sludge Drying Beds (SWMU 19)
- 3rd Squadron 7th Calvary Motor Pool and four (4) associated Oil/Water Separators (SWMU 27A)
- 1st BN, 3d ADA Motor Pool and associated Oil/Water Separator (SWMU 27B)
- 92d ECB (H) Motor Pool and associated Oil/Water Separator (SWMU 27C)
- 26th SPT BN Motor Pool and associated Oil/Water Separator (SWMU 27D)
- 703d SPT BN (Main) Motor Pool and associated two (2) Oil/Water Separators (SWMU 27E)
- DISCOM Motor Pool and associated Oil/Water Separator (SWMU 27G)
- DOL Maintenance Motor Pool and associated two (2) Oil/Water Separators (SWMU 27H)
- NGTC Block 9900, 10300 Motor Pool and associated two (2) Oil/Water Separators (SWMU 27I)
- GANG MATES Motor Pool and associated two (2) Oil/Water Separators (SWMU 27J)
- 3rd BN, 69th Armor Motor Pool Wash Rack and Oil/Water Separator (SWMU 27K)
- NGTC Block 10200 Wash Rack and Oil/Water Separator (SWMU 27L)
- NGTC Block 10100 Wash Rack and Oil/Water Separator (SWMU 27M)
- NGTC Block 9800 Wash Rack and Oil/Water Separator (SWMU 27N)
- NGTC Block 9700 Wash Rack and Oil/Water Separator (SWMU 27O)
- NGTC Block 9500 Wash Rack and Oil/Water Separator (SWMU 27P)
- NGTC Block 9400 Wash Rack and Oil/Water Separator (SWMU 27Q)
- 396 Transportation Company Wash Rack and Oil/Water Separator (SWMU 27R)
- Two (2) 103d MI BN Wash Racks and associated two (2) Oil/Water Separators (SWMU

27S)

- 293 MP Company Wash Rack and Oil/Water Separator (SWMU 27T)
- Two (2) Wright Army Airfield Wash Racks and Oil/Water Separator (SWMU 27U)
- Auto Craft Center Oil/Water Separator (SWMU 27V)
- Directorate of Engineering and Housing Asphalt Tanks (SWMU 31)
- Supply Diesel Tank (SWMU 32)
- Directorate of Engineering and Housing Equipment Wash Rack (SWMU 34)
- National Guard Training Center Equalization Basin (SWMU 37)

Please note that the tentative decisions listed above have been incorporated into the Draft Permit attached to this correspondence. In addition, our tentative decisions are based upon the requirements set forth in the Georgia Hazardous Waste Management Act, as amended, O.C.G.A. §12-8-60, *et seq.*; and the Rules for Hazardous Waste Management, Chapter 391-3-11, promulgated pursuant thereto, as amended (Rules), Chapter 391-3-11, which incorporates by reference the Code of Federal Regulations found in 40 CFR Parts 124, 260-268, 270, 273 and 279.

Before making a final decision to incorporate these changes into the Fort Stewart Hazardous Waste Facility, Permit #HW-045(S&T); Section 391-3-11 of the Rules requires GA EPD to provide an opportunity for public comment. Please note, in the attached Public Notice, that the forty-five (45) day public comment period will begin on July 18, 2004 and end on August 31, 2004. The attached Public Notice will be published in *The Savannah Morning News* on July 18, 2004, and a radio announcement will also be broadcast on WSSJ (FM) 92.3 1 twice a day for three consecutive days beginning July 19, 2004. In accordance with Section 391-3-11.11(4)(h) of the Rules, Fort Stewart will be billed for all costs associated with advertising of this Public Notice.

Should you have any questions concerning this correspondence, please contact Albert Wilson of my staff at (404)463-7513.

Sincerely,

David Yardumian
for Jim Ussery, Program Manager
Hazardous Waste Management Branch

Attachments(10)
c: Mr. Jon Johnston, EPA Region IV
Ms. Anita Shipley, EPA Region IV
File: Fort Stewart(Y)
R:\BRENTR\STEWART\PERMIT\FY2004MOD\MODLETT

STATEMENT OF BASIS	GEORGIA ENVIRONMENTAL PROTECTION DIVISION
PROPOSED ACTION FOR CAMP OLIVER LANDFILL FORT STEWART LIBERTY COUNTY, GEORGIA	JUNE 2004

INTRODUCTION: Fort Stewart is currently operating under a Hazardous Waste Facility Permit issued by the Environmental Protection Division of the Georgia Department of Natural Resources under the authority of the Georgia Hazardous Waste Management Act, O.C.G.A Section 12-8-60, *et seq.*, as amended. Section IV of this Permit requires Fort Stewart to investigate solid waste management units which have released or have the potential to release hazardous constituents into the environment. The Camp Oliver Landfill meets this first criterion and is listed as Solid Waste Management Unit No. 2 in Appendix A of the Permit.

Fort Stewart completed investigation of the Camp Oliver Landfill and reported its findings in a Phase II Resource Conservation and Recovery Act Facility Investigation Report for Sixteen Solid Waste Management Units dated April 2000. Because hazardous constituents were detected at the solid waste management unit in surface and subsurface soils at levels requiring corrective action; the Georgia Environmental Protection Division has made a tentative decision to modify the facility's Permit in order to approve the Corrective Action Plan for Camp Oliver Landfill dated March 2001.

PURPOSE: The purpose of this Statement of Basis is to solicit public involvement on the Georgia Environmental Protection Division's tentative decision prior to modification of the facility's Permit.

PROCEDURES FOR REACHING A FINAL DECISION: After the forty-five day public comment period closes, the Georgia Environmental Protection Division will make a final decision on the Camp Oliver Landfill. The agency will do so by sending a Notice of Decision, along with a written Response to Comments, to the facility and any person who submitted comments during the public comment period and/or requested notice of the final decision. In addition, the permit modification (reflecting that the Corrective Action Plan for the Camp Oliver Landfill dated March 2001 is approved) will become final upon issuance of the Notice of Decision.

PROPOSED ACTION: The Georgia Environmental Protection Division is proposing that the Corrective Action Plan for the Camp Oliver Landfill be approved based upon the investigation findings documented in the Phase II Resource Conservation and Recovery Act Facility Investigation Report for Sixteen Solid Waste Management Units dated April 2000. The Corrective Action Plan proposes proper abandonment of six permanent monitoring wells and a combination of land use restrictions prohibitions. Land use restrictions will be documented and/or enforced through deed recordation, the facility's Base Master Plan (i.e., "zoning" restrictions), signage and long-term operation and maintenance of the selected remedy. Note that one permanent monitoring well would remain because it was installed as part of the groundwater monitoring plan for the Land Application System that is adjacent to the Camp Oliver Landfill. More detailed information concerning the proposed action for the Camp Oliver Landfill may be found in the Corrective Action Plan located in the Administrative Record.

BACKGROUND: The Camp Oliver Landfill is located approximately 17 miles northwest of the Fort Stewart garrison area along Fort Stewart Road 129. It is just north of the bivouac area on the northern side of a small hill. From the 1960s to 1979, the area was used for disposal of refuse from troop training activities and nearby residents via open-pit burning. The landfill was officially closed in 1970; however, the trench method of solid waste disposal was reported to have continued. General refuse from ground maintenance activities and construction debris were placed in the landfill from 1979 to 1984 during the annual three to four month period of training activities. The landfill is reported to be fifteen feet wide by three hundred feet long by five to six feet deep. The waste disposed of at the landfill included garbage and refuse, grass clippings, tree branches, root stumps and chunks of asphalt and concrete. No evidence of disposal of toxic or hazardous wastes was indicated in the records searched by Fort Stewart. There is little obvious surface evidence that a landfill or open dumping area existed. During a site reconnaissance in November 1995, small soil piles, some roofing tin, and wooden construction-type debris were observed. Also, spent small weapons cartridges were observed in the ditch along the site's southwestern and southeastern boundaries. A site reconnaissance in September 1996 indicated no evidence of any landfill operations. Grass, small trees and bushes now cover the area.

RESULTS OF INVESTIGATION: Investigation of the Camp Oliver Landfill was conducted between January 1998 and November 1999 and is documented in the Phase II Resource Conservation and Recovery Act Facility Investigation Report for Sixteen Solid Waste Management dated April 2000. The field efforts during this investigation directly applicable to the Camp Oliver Landfill included collection of eleven surface soil samples from three surface soil locations, five soil boring locations and three monitoring wells; eight subsurface soil samples from five soil boring locations and three monitoring wells; two sediment and two surface water samples from two locations in Canoochee Creek; and eighteen groundwater samples from five locations using Direct Push Technology and from seven permanent monitoring wells. Hazardous constituents were detected in surface and subsurface soils at levels requiring corrective action. More detailed information concerning the investigation for the unit may be found in the report located in the Administrative Record.

ADMINISTRATIVE RECORD: Copies of the Fort Stewart Permit, Resource Conservation and Recovery Act Facility Investigation Report and the Corrective Action Plan described in this Statement of Basis are in the facility's Administrative Record and are available for public review. During the public comment period, the Administrative Record is available for public review at:

Georgia Environmental Protection Division
Hazardous Waste Management Branch
Floyd Tower East, Suite 1154
2 Martin Luther King Jr. Drive, S.E.
Atlanta, Georgia 30334
Monday - Friday; 8:00 a.m. to 4:30 p.m.
(404)656-2833

Liberty County Public Library
236 Memorial Drive
Hinesville, Georgia 31313
Monday – Thursday; 9:00 a.m. to 9:00 p.m.
Friday & Saturday; 9:00 a.m. to 6:00 p.m.
Sunday; 2:00 p.m. to 6:00 p.m.
(912)368-4003

OPPORTUNITIES FOR PUBLIC COMMENT: The Georgia Environmental Protection Division solicits input from the community on the proposed Corrective Action Plan for the Camp Oliver Landfill. The public is also invited to provide comments on any other aspect of the investigation at the unit. The Georgia Environmental Protection Division has set a public comment period from July 18, 2004 through August 31, 2004 to encourage public participation in the selection process. Written comments must be received during the comment period and should be directed, in writing, to Jim Ussery at the following address.

Georgia Environmental Protection Division
Hazardous Waste Management Branch
Floyd Tower East, Suite 1154
2 Martin Luther King Jr. Drive, S.E.
Atlanta, Georgia 30334

For additional information regarding public participation, please contact Albert Wilson of the Georgia Environmental Protection Division at (404)656-2833.

file copy

8/18/01

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

July 25, 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 TAC-X Landfill [Solid Waste Management Unit (SWMU) 3] dated March 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 correspondence (Stanley to Khaleghi) dated July 3, 2001 containing Replacement Pages 5-2, B-6 & B-7 to be inserted into our two (2) copies of the above-referenced document. Based upon our review, GA EPD (1) has determined that Fort Stewart has appropriately responded to our comments in correspondence (Khaleghi to Stanley) dated May 3, 2001 and (2) tentatively approves the Corrective Action Plan for SWMU 3 dated March 2001, as amended by the Replacement Pages referenced in the preceding sentence.

Please note that a final decision concerning the Corrective Action Plan for SWMU 3 dated March 2001, as amended, 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\SWMU3\CAPTENTAPPROVAL

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 09 2001

Office of the Directorate

EXPRESS MAIL

Georgia Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30334

Dear Mr. Khaleghi:

Fort Stewart is pleased to provide the Georgia Environmental Protection Division (GA EPD) two copies of replacement pages 5-2, B-6, and B-7 for insertion into the Final Corrective Action Plan for the TAC-X Landfill (Solid Waste Management Unit 3) at Fort Stewart, Georgia, dated March 2001, EPA ID No. GA9 210 020 872. These replacement pages address Comment 1 and Comment 2 received from GA EPD in correspondence dated May 3, 2001 (Khaleghi to Stanley) and should complete the report. In addition, a Response to Comment table has been provided for your use and convenience.

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, Directorate of Public Works Environmental Branch, at (918) 296-9492 or (912) 767-7919, respectively, should questions arise regarding the enclosed documents.

Sincerely,

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

Enclosures

5.0 CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN

This section presents a conceptual design and plan for implementation of the selected corrective action alternative. Based on the level and type of subsurface soil and groundwater contamination, a cost-effective corrective action was selected that would adequately protect human health. The technology evaluation presented in Chapter 4 compared two different corrective action alternatives and two optional alternatives based on their effectiveness at protecting human health and on their life-cycle costs. Based on that evaluation, Alternative 1 was selected because it will provide a sufficient level of protection of human health cost-effectively.

5.1 SELECTED CORRECTIVE ACTION

The selected corrective action alternative 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 as well as physical barriers. Land-use restrictions will be documented and/or enforced through deed recordation, the BMP, zoning restrictions, and signage.

Alternative 1 has been selected because it will provide effective protection of human health cost-effectively. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered to be cost-effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized excavation below ground would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Groundwater monitoring as described under Alternatives 1a and 2a would not provide enough additional protection to human health to justify the increased costs. The groundwater presently does not present a risk to human health. No COCs have been identified in subsurface soil, groundwater, or sediment. The COCs identified in surface soil (arsenic) and surface water [benzo(*b*)fluoranthene] were detected at concentrations below their respective remedial levels. The institutional controls described for Alternative 1 will provide a sufficient level of protection of human health 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 cost-effectively implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

5.1.1 Effectiveness

Post-mounted warning signs and documented land-use restrictions will be highly effective and will provide long-term reliability with respect to preventing human exposure through physical contact with the buried waste within the boundaries of SWMU 3. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land-use controls during ownership by DoD. Prior to planning any construction activities at the FSMR, the BMP must be reviewed. In addition, all construction projects will be reviewed during the planning stages for approval by the Base Master Planner and the FSMR Directorate of Public Works (DPW). These land-use controls will remain in effect after transfer from DoD ownership by restrictions imposed through deed recordation.

Additionally, the proposed abandonment of monitoring wells (MW1, MW2, MW3, MW4, MW5, MW6, MW7, and MW8) and the groundwater-use restrictions will provide an effective method for preventing the use of groundwater for drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at the FSMR and is not used. The BMP will be modified to officially restrict its use, further preventing use of the surficial groundwater at the site.

An annual O&M program will be administered to replace or repair warning signs, 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 or repair of warning signs.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of SWMU 3. Warning signs will be most effective over the short term. Current risk is below remedial levels, and use of the site is limited to outdoor classroom-style training, so access is already limited.

5.1.2 Implementability

Very few factors limit implementability of the institutional controls under evaluation. On-site personnel or contractors can readily perform posting of signs. The materials for the installation of warning signs are readily available to local contractors. Annual 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 the necessary land-use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to allow for incorporation of land-use controls into the BMP and to facilitate deed recordation.

5.1.3 Cost

The estimated total life-cycle cost of installation of warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $174,154. This alternative provides adequate protection of human health and the environment.

5.2 CONCEPTUAL DESIGN

During the period of ownership by DoD, institutional controls will be recorded to ensure implementation in the BMP. 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 hazards associated with SWMU 3, warning signs stating restrictions on human activity within the SWMU will be mounted on poles around the boundary of the site (see Figure 4-1).

All activities that would involve disturbance of the subsurface will be minimized in accordance with all land-use control mechanisms. Activities that will be prohibited include military training activities that would disturb the subsurface soil, hunting, recreational activities, and construction of residential facilities; however, the following activities, conducted in a manner that would minimize disturbance of the subsurface, will be permitted.

- timber harvesting (possible in the future),
- performance of wildlife studies,
- provision and maintenance of feed lots for deer, and
- outdoor classroom-style military training (subsurface disturbance not allowed).

Introduction

This appendix presents the requirements for the Base Master Plan (BMP) and deed recordation for the implementation of the selected remedial alternative for the area identified as the TAC-X Landfill [Solid Waste Management Unit (SWMU) 3]. The selected remedial alternative for the TAC-X Landfill is protective of human health and includes the following features:

- BMP, deed recordation, and zoning controls that restrict the use of groundwater and prohibit intrusion into subsurface soil;
- abandonment of eight monitoring wells (MW1, MW2, MW3, MW4, MW5, MW6, MW7, and MW8);
- installation of warning signs; and
- implementation of an Operations and Maintenance (O&M) Plan to maintain the conditions of the signage.

The selected alternative is fully described in Chapter 5 of this report.

The requirements for the BMP identify land-use restrictions and requirements to be incorporated into and enforced by the Fort Stewart Military Reservation BMP until transfer of ownership of the TAC-X Landfill from the federal government. The requirements for deed recordation identify the present (i.e., as of December 2000) applicable requirements for the area identified as the TAC-X Landfill upon its future transfer out of government ownership.

Base Master Plan
for
Solid Waste Management Unit 3,
TAC-X Landfill

The information/items and restrictions below will be included in the BMP, which will be effective until the transfer of ownership of the TAC-X Landfill property.

1. The following information will be documented in the BMP:

   a. All activities on the property that may result in disturbance of subsurface soil and/or substantially interfere with implementation of the O&M Plan are prohibited.

   b. 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.

   c. Military training exercises that may disturb the subsurface soil, hunting, and recreational activities are expressly prohibited.

   d. All construction within the property boundaries is expressly prohibited.

   e. The O&M Plan for the TAC-X Landfill, which requires maintenance of permanent markers (signs) every 200 feet to delineate the restricted area, is to be implemented. The BMP shall reference the O&M Plan or include the plan as an attachment or appendix.

   f. The BMP will also document the following specific activities that will be permitted within the boundaries of the subject site:

      (1) timber harvesting,
      (2) performance of wildlife studies,
      (3) provision and maintenance of feed lots for deer, and
      (4) outdoor classroom-style military training (subsurface disturbance not allowed).

2. Site Survey:

   a. The BMP will include a written description of the boundaries of the site in accordance with the survey plat included in this Corrective Action Plan. Both the written description and the survey plat are presented in Appendix C.

   b. A copy of the survey plat, which indicates the location and dimensions of the disposal unit with respect to permanently surveyed benchmarks, will be included in the BMP. The survey plat is presented in Appendix C.

Deed Recordation

Deed recordation will be provided at the time of transfer out of government ownership and will comply with *DoD Guidance on Land Use Controls for Property Transferred Out of Federal Ownership* (Working Draft). Deed recordation for the TAC-X Landfill (SWMU 3) will conform to the following requirements:

1. Deed recordation will be made through the execution of a restrictive covenant for the property. The covenant will be recorded with the clerk of the superior court for the county of Bryan. The language will be consistent with applicable state property and environmental laws in effect at the time of transfer.

2. A copy of the restrictive covenant should be provided to the zoning or land-use planning authority that has jurisdiction over this property. Such restrictions should run with the land and be binding on the owner's successors and assignees.

3. The restrictive covenant will be written by the real estate office of the Savannah District of the U.S. Army Corps of Engineers. As required by the real estate office, the following items will be provided to facilitate preparation of the deed:

   a. a survey plat (see Appendix C of this Corrective Action Plan),
   b. a legal description of the property, and
   c. use restrictions and other provisions (see Item 4 below).

4. The following restrictions/provisions may be documented in the restrictive covenant:

   a. The subject area will be limited to industrial use only.

   b. Activities on the property that may result in disturbance of subsurface soil and/or substantially interfere with implementation of the O&M Plan will be restricted.

   c. Any use of shallow groundwater beneath the subject property will be prohibited, except where monitoring is determined to be necessary by regulatory authorities.

   d. Maintenance of permanent markers (signs) approximately every 200 feet around the perimeter of the site that meet the requirements established by this Corrective Action Plan for SWMU 3 will be required to delineate the restricted area.

   e. The legal office of the U.S. Army Corps of Engineers and its telephone number will be included as the point of contact and documented in the 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.

5. After the language is drafted, the disposal agent should coordinate with the Georgia Environmental Protection Division for verification that the restrictions reflect the environmental concerns of the site.

6. The property disposal agent's office should also provide a copy of the deed to local offices such as the Building Permits Division and the Water Resources Branch.

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Georgia Depart ıt 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

May 2, 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 Camp Oliver Landfill [Solid Waste Management Unit (SWMU) 2] dated March 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) has reviewed the above-referenced document submitted in response to our correspondence (Khaleghi to Stanley) dated December 8, 2000 and determined that it is complete. Based upon our review, GA EPD tentatively approves the Corrective Action Plan for SWMU 2 dated March 2001. Please note that a final decision will be made by GA EPD pending the outcome of a forty-five day public comment period which will occur during the next modification of the Corrective Action Module (i.e., Section IV) and Appendix A in the 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, Unit Coordinator
Hazardous Waste Management Branch

c: Mr. Larry Rogers, GA EPD-Southeast Regional Office
File: Fort Stewart(R)
R:\BRENTR\STEWART\SWMU2\CAPAPPROVAL

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

REPLY TO
ATTENTION OF

MAR 23 2001

Office of the Directorate

CERTIFIED MAIL

Georgia Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30334

Dear Mr. Khaleghi:

Fort Stewart is pleased to submit two copies of the Final Corrective Action Plan for the Camp Oliver Landfill (Solid Waste Management Unit 2) at Fort Stewart, Georgia, dated March 2001, EPA ID No. GA4 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, Directorate of Public Works Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively, should questions arise regarding the enclosed documents.

Sincerely,

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

Enclosures

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

S 2 July 01

May 3, 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 TAC-X Landfill [Solid Waste Management Unit (SWMU) 3] dated March 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) has reviewed the above-referenced document submitted in response to our correspondence (Khaleghi to Stanley) dated December 8, 2000 and generated the following comments.

1. The text in Section 5.2 (Page 5-2) and in Item Nos. 1(c) & 1(f) (Page B-6) are inconsistent with respect to military training exercises to be allowed within the boundaries of SWMU 3 as part of the proposed final remedy. Please correct this discrepancy in the revision, noting that GA EPD is agreeable to Fort Stewart conducting military training exercises (outdoor classroom-style which do not disturb subsurface soil) within the boundaries of SWMU 3.

2. Please confirm that SWMU 3 is located in Evans County or modify the second sentence in Item No. 1 on page B-7 appropriately.

The revision for the SWMU 3 Corrective Action Plan, appropriately addressing the comments above, should be submitted to GA EPD within sixty (60) days from receipt of this correspondence in the form of revised/new pages or a totally revised document. Note that two (2) copies of the revised plan are requested by GA EPD in accordance with Condition IV.G.2 in your Hazardous Waste Facility Permit #HW-045(S&T). Should Fort Stewart decide to submit revised or new pages, please number with appropriate page numbers and the date revised, e.g., Page 6 (Revised 06/20/2001).

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\SWMU3\CAPCOMMENTS

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

MAR 23 2001

Office of the Directorate

CERTIFIED MAIL

Georgia Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30334

Dear Mr. Khaleghi:

Fort Stewart is pleased to submit two copies of the Final Corrective Action Plan for the TAC-X Landfill (Solid Waste Management Unit 3) at Fort Stewart, Georgia, dated March 2001, EPA ID No. GA4 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, Directorate of Public Works Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively, should questions arise regarding the enclosed documents.

Sincerely,

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

Enclosures

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

REPLY TO
ATTENTION OF

15 MAR 2001

AFZP-PWV-E (200-1a)

MEMORANDUM FOR HEADQUARTERS, FORSCOM, DCSPIM,
ATTN: STEPHANIE SIGLER, 1777 HARDEE AVENUE SW
FORT MCPHERSON, GA 30330-1062

SUBJECT: Decision Documents for Final Remedial Action at Fort Stewart and Hunter Army Airfield, Georgia

1. The attached decision documents are provided for your use and convenience in documenting the distribution of fiscal year 01 funding for the Final Remedial Action (FRA) at the following sites:

a. FST-02, Camp Oliver Landfill.
b. FST-03, TAC-X Landfill.
c. HAA-13, Former Pumphouse 2 (Only one of the 3 areas listed under this site [Pumphouses 1, 2 and 6])

2. Although HAA-13 includes three areas, HAAF's former Pumphouses 1, 2 and 6, only Pumphouse 2 is being considered for final remedial action at this time. Pumphouse 6 was granted a "No Further Action Required" status in Nov 98. A final remedial action for Pumphouse 1 is still awaiting development and review.

3. Mr. Joe King at the Army Environmental Center has received copies of these decision documents for review and approval.

4. The point of contact for this memorandum is Ms. Melanie Little or Ms. Tressa Rutland, DPW Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively.

FOR THE COMMANDER:

Enclosures

GREGORY V. STANLEY
COL, EN
Director, Public Works

DECISION DOCUMENT FOR THE FINAL REMEDIAL ACTION AT THE TAC-X LANDFILL (SWMU 3)

FORT STEWART, GEORGIA

15 MAR 2001

PURPOSE

This decision document describes the selected Final Remedial Action (FRA) for the TAC-X Landfill (SWMU 3) located at Fort Stewart, Georgia, which consists of Institutional Controls (ICs). Specifically, the ICs proposed for FST-03 includes documentation in the Base Master Plan (BMP), deed recordation, zoning controls, maintenance of existing physical barriers, installing warning signs, and implementation of the Operation & Maintenance (O&M) plan. The selected ICs are described in detail in the *Final Corrective Action Plan for the TAC-X Landfill (Solid Waste Management Unit 3),* dated March 2001. The document will be reviewed by Georgia Environmental Protection Division (GA EPD) and comments and/or tentative approval is anticipated in June 2001. FST-03 is a Defense Site Environmental Restoration Tracking System (DSERTS) site and the FRA will be funded using fiscal year (FY) 2001 Environment, Restoration Account (E,RA) funds.

This decision document presents the justification for the selected FRA and specifically provides details on the following:

- Site Location and History
- Nature and Extent of Contamination
- Remedial Response Objectives
- Conceptual Design and Implementation
- Public Notification
- Declaration

Site Location and History

SWMU 3, which is approximately 3.5 miles south-southwest of Pembroke, Georgia, and less than 1 mile southeast of Dean Field and the TAC-X (Noncommissioned Officers' Academy), was active from the 1960s until 1982. The waste disposed of at the landfill from the 1960s to 1979 included residential waste, food cans, brush, plastic, and cardboard boxes. From 1979 to 1982, the wastes included grass clippings, tree branches, root stumps, and chunks of asphalt and concrete.

The TAC-X Landfill comprises approximately 6.3 acres, with two trenchlike depressions present at the site. One of the trenches is reportedly unused. The reported dimensions of the disposal trench are 20 feet wide by 400 feet long by 5 feet to 6 feet deep. A site reconnaissance in November 1993 observed household-type debris (e.g., plastic spoons and bags) within the overburden pile on the western side of the disposal trench. Aged refuse is reported to be present at the bottom of the disposal trench (Geraghty and Miller 1992). A site reconnaissance in September 1996 indicated no evidence of any landfill operations. The site is nearly flat, but slopes gently toward the south. Pine trees, brush, and grass cover most of the site. The southernmost portion of the site is marshy, with surface water present.

Nature and Extent of Contamination

The results of chemical analyses performed during the Phase I and Phase II RCRA Facility Investigations (RFIs) indicated that soil, groundwater, and sediment contain organic and metal

contaminants at concentrations greater than their reference background concentrations. No contaminants were detected in surface water. A tabular summary of site-related contaminants for SWMU 3 is presented in Table 1.

SOIL Eleven surface soil samples were collected from four monitoring well boring locations, three soil boring locations, and four surface soil samples during the Phase I and Phase II RFIs. No VOCs were detected in surface soil. Low, isolated concentrations of bis(2-ethylhexyl)phthalate (an SVOC) and four pesticides (alpha-BHC, gamma-BHC, heptachlor epoxide, and methoxychlor) were detected in surface soil. Arsenic, chromium, and lead were detected at concentrations above reference background criteria in one of ten surface soil samples. Bis(2-ethylhexyl)phthalate, alpha-BHC, gamma-BHC, heptachlor epoxide, methoxychlor, arsenic, chromium, and lead were considered to be site-related contaminants (SRCs) in surface soil.

Seven subsurface soil samples were collected during the Phase II RFI from four monitoring well boring locations and three soil boring locations. Two VOCs (2-butanone and acetone), one SVOC [bis(2-ethylhexyl)phthalate], and three pesticides (4,4'-DDE; aldrin; and methoxychlor) were detected in subsurface soil. Chromium and cadmium were detected at concentrations above reference background criteria in one (MW6) of seven subsurface soil samples. Acetone, 2-Butanone; bis(2-ethylhexyl)phthalate; 4,4'-DDE; aldrin; methoxychlor; cadmium; and chromium were considered to be SRCs in subsurface soil at SWMU 3.

GROUNDWATER Low, isolated concentrations of acetone (a VOC) and three pesticides (4,4'-DDT; beta-BHC; and delta-BHC) were detected in groundwater collected from Geoprobe locations. Barium, cadmium, chromium, lead, and mercury were detected at concentrations above reference background criteria in groundwater collected from Geoprobe locations. However, corresponding dissolved metal concentrations for all five constituents were below reference background concentrations, indicating that the total metals might be associated with particulates in the groundwater.

A low, isolated concentration of 2-hexanone (a VOC) was detected in groundwater collected from monitoring well MW6. Mercury was detected at concentrations (0.15 μg/L and 0.16 μg/L) slightly above the reference background criteria (0.14 μg/L) in two of eight groundwater samples collected from the monitoring wells.

Acetone, 2-Hexanone; 4,4'-DDT; beta-BHC; delta-BHC; barium; cadmium; chromium; lead; and mercury were considered to be SRCs in groundwater.

SURFACE WATER AND SEDIMENT One SVOC [benzo(b)fluoranthene] was detected in surface water. Arsenic, barium, chromium, and lead were detected in surface water at concentrations above reference background criteria.

Seven VOCs were detected in sediment. However, after resampling, only six of the seven VOCs are considered to be SRCs in sediment: 2-butanone, 2-hexanone, acetone, benzene, carbon disulfide, and toluene.

Arsenic, barium, chromium, lead, mercury, and selenium were detected in sediment at concentrations above reference background criteria. Sediment samples from SWS1 had significantly higher concentrations than did those from SWS2.

RISK ASSESSEMENT A Baseline Human Health Risk Assessment (BHHRA) and an Ecological Risk Assessment was conducted for the site. The BHHRA addressed the risks associated with exposure to the following human health constituents of potential concern (COPCs): arsenic (surface soil, surface water, and sediment), chromium (surface water), lead (surface water), mercury (groundwater), delta-BHC (groundwater), and benzo(*b*)fluoranthene (surface water). No contaminant migration COPCs were identified for this site. Based on the required assessment only two constituents were identified as Contaminants of Concern (COCs) at the site and are summarized in Table 2.The ecological risk assessment concluded that there is no present ecological risk at SWMU 3 and that the site is unlikely to pose an ecological risk in the future; therefore further investigation and/or evaluation of ecological COPCs was not required.

Remedial Response Objectives

Based on the findings of the site characterization at SWMU 3, the primary goal and purpose for implementing corrective measures at this site is limited to protection of human health and safety. To achieve this goal, the following remedial response objective has been established for the site: to prohibit the ingestion of shallow groundwater from the subject site and to prohibit the disturbance of surface and subsurface soil to minimize contact with soil and buried waste. 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) will not be evaluated. Implementation of the selected remedial response will achieve the best overall results with respect to such factors as long-term reliability and effectiveness, short-term effectiveness, implementability, and cost.

Conceptual Design and Implementation

This section presents a conceptual design and plan for implementation of the selected corrective action alternative for SWMU 3. Based on the level and type of soil contamination, a cost-effective corrective action was selected that would adequately protect human health and safety. The technology evaluation presented in Chapter 4.0 of the March 2001 Corrective Action Plan for the site compared different corrective action alternatives based on their effectiveness at protecting human health and safety, life-cycle costs, and technical factors. All the alternatives evaluated included institutional controls (ICs): BMP, deed recordation, zoning controls, maintenance of existing physical barriers, well abandonment, post-mounted warning signs, and implementation of an O&M Plan. Variations of alternatives included groundwater monitoring and installation of fencing. The selected corrective action alternative 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. Land-use restrictions will be documented and/or enforced through deed recordation, the BMP, zoning restrictions, and signage.

Alternative 1 has been selected because it will provide effective protection of human health at a relatively low cost. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered cost-effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized soil excavation would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Groundwater monitoring as described under Alternatives 1a and 2a does not provide enough additional protection to human health to justify its increased costs. The groundwater presently does not present a risk to human health. The institutional controls described for Alternative 1 will provide a sufficient level of protection of human health 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 cost-effectively implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

Effectiveness Post-mounted warning signs and documented land-use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to physical contact with the buried waste within the boundaries of SWMU 3. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land-use controls during ownership by the Department of Defense. Prior to the planning of any construction activities at the Installation, the BMP must be reviewed. In addition, the Base Master Planner and the DPW will review all construction projects during the planning stages for approval. These land-use controls will remain in effect after transfer of Department of Defense ownership by restrictions imposed through deed recordation.

Additionally, the proposed abandonment of monitoring wells (MW1, MW2, MW3, MW4, MW5, MW6, MW7, and MW8) and the groundwater-use restrictions will provide an effective method for preventing the use of groundwater for drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at the Installation and is not used. The BMP will be modified to officially restrict its use, further preventing use of the surficial groundwater at the site.

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

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of SWMU 3. Warning signs will be most effective over the short term. Current risk is below remedial levels, and use of the site is limited to outdoor classroom-style training, 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 posting of signs. The materials for the installation of warning signs are readily available to local contractors. Annual 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 the necessary land-use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to allow for incorporation of land-use controls into the BMP and to facilitate deed recordation.

Cost The estimated total life-cycle cost of installation of warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $174,154 (E,RA funds). This alternative provides adequate protection of human health and the environment.

Public Notification

GA EPD will prepare a notification which explicitly describes the FRA selected for SWMU 3, and per Fort Stewart's Hazardous Waste Permit HW-045(S&T) the public will be afforded the

opportunity to review the notification and/or the entire Corrective Action Plan for a period of thirty days. At the conclusion of the review period, GA EPD will either grant final approval of the selected FRA or revise their tentative approval based on review and comments received by the public. It is anticipated that this review period will occur in July 2001 (i.e., after receipt of projected GA EPD June 2001 tentative approval) and final approval (i.e., after public review period) from GA EPD will be provided to the Installation in early September 2001; however, GA EPD will provide tentative approval of the Corrective Action Plan prior to this timeframe which will allow Fort Stewart to proceed with implementation of the recommended FRA.

Declaration

The selected Final Remedial Action for SWMU 3 is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to the FRA, and will be cost-effective.

As the selected course of action for SWMU 3 was presented in the March 2001 Corrective Action Plan and will be approved by GA EPD, the five-year review will not apply to the proposed FRA.

This decision document was developed by the Fort Stewart Directorate of Public Works, with support from the U.S. Army Corps of Engineers and SAIC.

Table 1. Summary of Site-Related Contaminants, SWMU 3

Analyte	Maximum Concentration (mg/kg)			Maximum Concentration (μg/L)	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
2-Butanone	ND	0.0044	0.495	ND	ND
2-Hexanone	ND	ND	0.0034	5.6	ND
Acetone	ND	0.0932	0.618	264	ND
Benzene	ND	ND	0.0033	ND	ND
Carbon disulfide	ND	ND	0.006	ND	ND
Methylene chloride	ND	ND	ND	ND	ND
Toluene	ND	ND	0.212	ND	ND
Semivolatile Organic Compounds					
Benzo(*b*)fluoranthene	ND	ND	ND	ND	6.6
Bis(2-ethylhexyl)phthalate	0.248	0.387	ND	ND	ND
Pesticides/PCBs					
4,4'-DDE	ND	0.00064	ND	ND	ND
4,4'-DDT	ND	ND	ND	0.025	ND
Aldrin	ND	0.00061	ND	ND	ND
alpha-BHC	0.00047	ND	ND	ND	ND
beta-BHC	ND	ND	ND	0.016	ND
delta-BHC	ND	ND	ND	0.082	ND
gamma-BHC (Lindane)	0.0012	ND	ND	ND	ND
Heptachlor epoxide	0.00054	ND	ND	ND	ND
Methoxychlor	0.0086	0.0048	ND	ND	ND
Metals					
Arsenic	24[a]	BRBC	29.7	ND	7.3
Barium	BRBC	BRBC	60	92.3	59.6
Cadmium	ND	0.25	ND	0.82	ND
Chromium	7.8	25.5	23.3	6.8	13.9
Lead	73.97[a]	BRBC	14.7	11.1	9
Mercury	BRBC	BRBC	0.08	0.46	ND
Selenium	BRBC	BRBC	2.6	BRBC	ND

[a]Phase I RFI data.
BRBC = Below reference background criteria.
ND = Not detected.

Table 2. Remedial Levels, SWMU 3

Constituent of Concern	Maximum Detected Concentration (mg/kg)	Risk-based Remedial Levels (mg/kg) ILCR		
		1×10^{-6}	1×10^{-5}	5×10^{-5}
Surface Soil				
Arsenic	24	0.6	6.1	**30.3**
Surface Water				
Benzo(*b*)fluoranthene	0.0066	0.0010	0.0101	**0.0505**

Bold indicates concentrations above recommended remedial levels.
ILCR = Incremental Lifetime Cancer Risk

AFZP-PWV-E (200-1a) 15 MAR 01

MEMORANDUM FROM DIRECTOR OF PUBLIC WORKS

MEMORANDUM FOR GARRISON COMMANDER

SUBJECT: Landfill Corrective Action Plans

1. Purpose: To obtain approval (and signature) of the following Corrective Action Plans (CAPs) for submittal to the Georgia Environmental Protection Division (GA EPD) by EOM.

a. Final Corrective Action Plan for the Camp Oliver Landfill (Solid Waste Management Unit 2) at Fort Stewart Military Reservation Fort Stewart, Georgia, dated March 2001.

b. Final Corrective Action Plan for the TAC-X Landfill (Solid Waste Management Unit 3) at Fort Stewart Military Reservation Fort Stewart, Georgia, dated March 2001.

2. Discussion: The Camp Oliver and TAC-X landfills are listed on Fort Stewart's Hazardous Waste Permit #HW-045 (S&T), renewed 14 Aug 97 and amended 18 Nov 00, as Solid Waste Management Units (SWMUs) 2 and 3, respectively. After required site investigation, the GA EPD ordered development of a CAP for each site. The DPW's Environmental Branch recommended the least expensive alternative, the institutional controls without groundwater monitoring (a savings of approximately $20k per site per year). The controls include deed recordation requirements (page B-7). It is important to note that these are only implemented at the time of transfer of the property from government ownership. As the GA EPD has approved this action at the South Central Landfill (SWMU 1) and tentatively approved this action for these sites, only institutional control options are presented in the CAPs. GA EPD agreed that restricting access to the area via the "institutional controls" would eliminate the requirement for a two-foot clay cap over these sites. As the Camp Oliver and TAC-X landfills are approximately 8.8 and 6.3 acres in size, respectively, this represents a significant savings to the Installation.

3. Coordination: The SJA (Mr. Terry Peters), Range Control, and the following DPW Divisions have reviewed the document: Operations and Maintenance, Engineering's Master Planning, Business Management's Real Estate, and Environmental & Natural Resources. All comments have been incorporated into the Final Report.

AFZP-PWV-E (200-1a)
SUBJECT: Landfill Corrective Action Plans

4. Resource Impact: None identified.

5. Conclusions. The CAP for the referenced facilities recommends Alternative 1: Institutional Controls with Post-Mounted Warning Signs. This alternative is described on pages 4-7 and 4-8 of the Camp Oliver and TAC-X reports, respectively, and includes installation of warning signs around the perimeter of the landfills, as depicted on Figure 4-1, page 4-9 of both reports. The estimated capital cost to install the warning signs is tabulated under Appendix D. This work is eligible for Environmental Restoration, Army (ER,A) funding.

6. Recommendation. The GC sign the signature page found in Appendix B (page B-3) regarding the Base Master Plan and Deed Recordation Requirements.

7. The POC regarding this matter is Ms. Tressa Rutland, Directorate of Public Works Environmental Branch, at 767-2010/7919.

Encls
as

GREGORY V. STANLEY
COL, EN
Director, Public Works

8. COMMAND ACTION:

Approved ✓ Disapproved _____

16 MAR 01
Date

WILLIAM R. BETSON
COL, AR
Garrison Commander

DEPARTMENT OF THE AR
HEADQUA RS, 3D INFANTRY DIVISION (MECHANIZED) AND T STEWART
DIRECTORATE OF PUBLIC WORKS
1550 FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-4927

14 AUG 2000

REPLY TO
ATTENTION OF

AFZP-PWV-E (200-1a)

MEMORANDUM FOR HEADQUARTERS, FORSCOM, DCSPIM,
ATTN: STEPHANIE SIGLER, 1777 HARDEE AVENUE SW.,
FORT MCPHERSON, GA 30330-1062

SUBJECT: Decision Documents for Fort Stewart and Hunter Army Airfield, Georgia

1. The attached decision documents are provided for your use and convenience in documenting the distribution of fiscal year 99 through 01 funding for the:

a. Interim Remedial Action (IRA) at FST-31, the Former DEH Asphalt Tanks (FY 99).
b. Final Remedial Action (FRA) at FST-01, the Post South Central Landfill (FY00).
c. IRA at HAA-12, the Old Property Disposal Yard (FY99).
d. FRA at HAA-12, the Old Property Disposal Yard (FY00 or FY01).

2. As noted above, the IRA's for FST-31 and HAA-12 were funded in FY99, prior to the requirement to submit a decision document for interim remedial actions. However, at the request of FORSCOM, decision documents (DDs) were prepared for these two sites.

a. The DD for FST-31 summarizes the site conditions prior to implementation of the IRA. In addition, the document provides justification for the actions taken at the site. Implementation of the IRA was conducted April 12-20, 1999, and the site is now pending approval by the Georgia Environmental Protection Division of a "No Further Action Required" status.

b. The DD for HAA-12 incorporates information regarding the FY99 funded IRA into the document for the FRA. The FRA is programmed to be funded 4th QTR FY00 or 1st QTR FY01.

3. Mr. Joe King at the Army Environmental Center has received a copy of these decision documents for review and approval.

4. The point of contact for this memorandum is Ms. Melanie Little or Ms. Tressa Rutland, DPW Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively.

FOR THE COMMANDER:

Enclosures

GREGORY V. STANLEY
COL, EN
Director, Public Works

DECISION DOCUMENT FOR FINAL REMEDIAL ACTION AT THE POST SOUTH CENTRAL LANDFILL (FST-01) FORT STEWART, GEORGIA

PURPOSE OF THE FINAL REMEDIAL ACTION

This decision document describes the selected Final Remedial Action (FRA) for the Post South Central Landfill (FST-01) at Fort Stewart, Georgia, which consists of Institutional Controls (ICs). Specifically, the ICs proposed for FST-01 include documentation in the Base Master Plan (BMP), deed recordation, zoning controls, maintenance of existing physical barriers, abandonment of eight monitoring wells, installing post-mounted warning signs, and implementation of the Operation & Maintenance (O&M) plan tentatively approved by the Georgia Environmental Protection Division (GA EPD). The selected remedial action is described in detail in the *Final Corrective Action Plan for the South Central Landfill (SWMU 1)*, dated December 1999, and tentatively approved by GA EPD, pending the outcome of the scheduled public review and comment period (August 2000).

This decision document presents the justification for the selected FRA and specifically provides details on the following:

- Site History
- Nature and Extent of Contamination
- Contaminant Fate and Transport
- Preliminary Risk Evaluation (Human and Ecological)
- Human Health Baseline Risk Assessment
- Justification and Purpose of Corrective Action
- Conceptual Design and Implementation
- Public Notification
- Declaration

SITE HISTORY

FST-01, which is located approximately 0.75 mile northwest of the Fort Stewart main cantonment area, has been used for solid waste disposal since the 1940s. Disposal practices at the landfill have ranged from burn-pit to trench-and-fill operations. During the Phase I RFI conducted in 1997, the old, inactive portion of FST-01 was discovered east of the active landfill. The old, inactive portion of the landfill is heavily forested and estimated to encompass approximately 143 acres.

The active, permitted landfill operations are being constructed on the clay cap of the former trench-and-fill portion of the landfill. The active, permitted landfill is comprised of two cells: the eastern cell covers approximately 35 acres, while the western cell, which is closed, covers about 30 acres. The active landfill is operated under Permit No. 089-010 D (SL), issued by the state of Georgia in 1982. The nonputrescible landfill is operated under Permit No. 089-020 D (L), issued by the state of Georgia in 1982. Since 1983, the Post South Central Landfill has been operated under the provisions of the Design and Operation Plan as an area fill landfill with appropriate groundwater monitoring. As a permitted facility, the Post South Central Landfill must meet closure and post-closure requirements in accordance with the requirements of 40 CFR 258.60 and Chapter 391-3-4, Rules of the GA EPD.

Active Landfill
From 1960 to 1970, the active landfill's eastern cell operated as a garbage, paper waste, and construction debris landfill. Other waste disposed of included sludge from wash racks, sludge from industrial and sanitary wastewater treatment plants, waste air filters from the paint booth in the Directorate of Logistics Allied Trades Shop, grease from mess halls, autoclaved infectious wastes bagged in special containers, and ash from the energy plant. Operational practices have prohibited the disposal of ordnance at the landfill; however, some explosive ordnance has been discovered during routine operations. Upon such discoveries, the subject explosive ordnance has been removed and properly disposed of by Fort Stewart (FSGA). From 1970 to 1982, trench-and-fill operations were used in the active Post South Central Landfill's eastern cell. The trench-and-fill operation has moved from east to west, with previously filled land being restored to forest.

Beginning in the spring of 1982, tumulus refuse disposal operations began, representing the present-day disposal practices at the landfill. These operations have been performed over the western portion of the trench-and-fill area of the landfill. The active portion of the Post South Central Landfill is comprised of two cells that are constructed on the clay cap of the former trench-and-fill landfill. The eastern cell covers approximately 35 acres and the western cell about 30 acres. Wastes disposed of at the active landfill include dry, construction-type waste; putrescible garbage; and properly packaged asbestos.

The northwest portion of the Post South Central Landfill was previously a borrow pit for the site and is presently being used for disposal of demolition/construction debris (nonputrescible waste).

Based upon the results reported in the Revised Final Phase II RFI Report (SAIC 1999) for the active portion of FST-01, a few constituents present in the groundwater were detected above maximum contaminant levels (MCLs) [i.e., bis(2-ethylhexyl)phthalate at SC-M9 and NMW-2A]. In accordance with the GA EPD-approved recommendation for corrective action, these constituents will continue to be monitored through the Groundwater Monitoring Plan (GMP), approved by the GA EPD Land Protection Division. Corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells is not required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify if any contaminant levels become elevated and/or any trends develop in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. All analytical data will continue to be submitted to the GA EPD Land Protection Division. The implementation of the GMP for the Active Landfills is funded with OMA dollars, as part of the Installation's compliance monitoring program.

Old, Inactive Landfill
During the Phase I RFI, it was discovered that an older portion of the landfill existed east of the active landfill and continued to Georgia State Route 144/119. The old, inactive landfill is estimated to encompass approximately 80 acres. Aerial photographs dated 1947 and 1957 indicate disposal was occurring at the old, inactive landfill during that period.

A 1966 aerial photograph shows approximately two-thirds of the old landfill immediately west of Georgia State Route 144/119 with successional vegetation, indicating that by that time the landfill was no longer being used. Disposal at the current, active Post South Central Landfill site and complete vegetative cover of the old, inactive landfill area are evident in a 1975 aerial photograph; these conditions continue today. Additional prominent site features associated with the old, inactive portion of the landfill include a fenced cemetery, a dumpster maintenance area, and a drainage ditch to drain the low area around a dumpster maintenance area. The dumpster maintenance area is located on the south side of the FST-01 access road, approximately 600 feet from the Wilson Avenue entrance gate. Dumpsters are stored and refurbished at the facility. A drainage ditch, which begins southwest of the dumpster cleaning area, circles the area, and ultimately discharges to the marshy area along Taylors Creek, was dug to drain the low area around the dumpster cleaning area so that the area could be built.

The old, inactive landfill received all waste generated at Fort Stewart during its operation. According to previous operators, this waste included materials similar to those currently received at the active landfill in addition to sludges from the sewage treatment plant, scrap metal, demolition/construction debris, sanitary/municipal waste, and drummed waste from the tear gas training facility. According to information provided by former landfill employees, operational practices at the old, inactive landfill involved excavation of a large pit to below the water table; stockpiling of the excavated soil; disposal and compaction of the solid waste; and covering with the stockpiled, excavated soil. In addition, intermittent burning in the large pits was used to reduce the volume of the disposed waste. Again, former employees have stated that this operational practice was discontinued because it was reducing air quality and there was concern regarding live rounds discharging during the burning. The disposal areas were covered with local soil that had been removed during excavation of the pits and the surrounding area. Some areas of the old, inactive landfill were planted with pines, whereas other areas were allowed to revegetate naturally with successional species.

Based on the findings presented in the Revised Final Phase II RFI Report dated March 1999 (SAIC 1999), a "no further action required" status was assigned to the old, inactive portion of FST-01 for investigative purposes. As recommended by the Phase II RFI Report and as agreed to with GA EPD, a Corrective Action Plan (CAP) was recommended for FST-01 because buried waste will remain in place. The CAP is necessary to control intrusive activities at this site and to be protective of the health of humans potentially coming in contact with the buried waste and to prevent the use of groundwater as a drinking water source.

NATURE AND EXTENT OF CONTAMINATION

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

The reference background criteria for the Post South Central Landfill have been developed based on data from background samples collected across Fort Stewart for Solid Waste Management Units (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.

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 (e.g., more than 20) are collected to define background, a background upper tolerance level can be calculated. In cases in which too few samples (e.g., 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 Fort Stewart, 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 site-related contaminants (SRCs) if their concentrations were above the reference background concentrations. Organics were considered SRCs if they were simply detected because organic constituents are considered anthropomorphic in nature.

Appendix G of the Revised Final Phase II RFI Report (SAIC 1999) presented the summary of background data as well as the two-times-mean background concentrations. Given the limited background data, the mean concentration for soils 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.

Isolated low levels of organic contamination (VOCs, SVOCs, and pesticides) and metals are present in soil; however, no clear distribution or trends of contaminants are evident. Acetone, methylene chloride, toluene, and 1,2,4-trichlorobenzene were detected in surface soil. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected in two surface soil samples, SC-M13 and SC-M18. 1,2,4-Trichlorobenzene, pyrene, 2-butanone, acetone, methylene chloride, styrene, and toluene were detected in subsurface soil.

Selenium was detected in surface soil above the reference surface soil background concentration in a single soil sample. Selenium concentrations in surface soil were not above the FSGA reference background concentrations for subsurface soil.

Low levels of VOCs, SVOCs, metals, and Radium 226/228 are present in the surficial aquifer; however, no clear distribution or trends of contaminants are evident. Trichloroethene was detected in a single groundwater sample (direct-push sample GP-7) above its respective MCL. Bis(2-ethylhexyl) phthalate was detected in groundwater above its MCL (6 μg/L) at two locations (NMW-2A and SC-M9) at concentrations of 7.8 μg/L and 61.4 μg/L, respectively. Metals were detected in groundwater, with only one containing a concentration above the MCL. Lead was detected at 18.4 μg/L at monitoring

well SC-M17 (action level 15 μg/L). However, the filtered lead concentration at SC-M17 was nondetect, indicating that the lead may be associated with colloid particulates in the groundwater. Barium, cadmium, chromium, iron, and lead were detected above the FSGA reference background concentrations. Low levels of Radium 226/228 were detected in the groundwater. The combined Radium 226/228 concentrations exceeded the MCL at two locations (SC-M5 and SC-M19). The groundwater field sampling data (dissolved oxygen, oxidation-reduction potential, pH) do not indicate that leachate is impacting the groundwater.

Low levels of organics, metals, and Radium 226/228 were detected in sediment and surface water. Chromium, lead, mercury, and Radium 228 were detected in sediment above site-specific background criteria. Two VOCs (acetone and 2-butanone) were detected in one sediment sample, and one SVOC (1,2,4-trichlorobenzene) was detected in two sediment samples. Diethyl phthalate and pyrene were detected in surface water. Radium 228 was detected in surface water above the site-specific background criterion. A tabular summary of SRCs for the Post South Central Landfill (FST-01) is presented in Table 1.

CONTAMINANT FATE AND TRANSPORT

Contaminant fate and transport analysis provided an assessment of the potential migration pathways and transport mechanisms affecting the chemicals at the sites. In particular, the leachability of contaminants from soil to groundwater and their natural attenuation in groundwater were evaluated.

Acetone and methylene chloride in the soil at the Post South Central Landfill exceeded EPA Generic Soil Screening Levels (GSSLs). These constituents may leach into groundwater at concentrations that exceed groundwater standards [i.e., concentrations that exceed the MCL or, in the absence of an MCL, the risk-based concentration (RBC) for drinking water]. The concentration of acetone exceeded the GSSL in only one out of nine detections in soil. This soil sample, SC-M16, was located outside of the boundary of the landfill or the area affected by the landfill operations. Therefore, the acetone present in this sample is not associated with the landfill operations. Acetone is not considered a contaminant migration contaminant of potential concern (COPC). Acetone was detected in groundwater above its RBC as established by EPA Region III and was considered to be a human health COPC in groundwater.

All of the detected methylene chloride concentrations (seven out of 25 soil samples) exceeded the GSSL. One of the detections of methylene chloride (SC-M15) was located outside the boundary of the landfill or the area affected by the landfill operations. The maximum concentration of methylene chloride (52.2 μg/kg) was detected at SC-M15. Methylene chloride was the only contaminant migration COPC in soil around the old, inactive portion of the landfill. Methylene chloride was not detected in groundwater.

Selenium exceeded its reference background criterion in soil; however, it did not exceed its GSSL based on leaching to groundwater; therefore, selenium was not considered a contaminant migration COPC.

Chromium, lead, and Radium 226/228 exceeded their respective RBCs/MCLs in groundwater. The one elevated concentration of lead may be due to colloid particulates in the groundwater. Off-site migration of chromium, lead, and Radium 226/228 will be limited, however, because of their high retardation factors.

Bis(2-ethylhexyl)phthalate and trichloroethene exceeded their MCLs but were not found in soils. Therefore, bis(2-ethylhexyl)phthalate and trichloroethene were not screened as contaminant migration COPCs in soils. Maximum groundwater concentrations of bis(2-ethylhexyl)phthalate and trichloroethene were detected at 61.4 μg/L (MCL 6 μg/L) and 5.4 μg/L (MCL 5 μg/L), respectively. These two concentrations above MCLs represent only a single detection out of 51 groundwater samples (23 direct-push, two vertical-profile, and 22 groundwater monitoring wells). Bis(2-ethylhexyl)phthalate and trichloroethene were detected in the groundwater only and not in soils, indicating that these contaminants may have leached in the past or are potentially leaching directly from a very confined or small point source. Off-site migration of these organic contaminants will be limited due to retardation and degradation through various processes as well as the slow movement of groundwater (12.8 feet/year). At the velocity of 12.8 feet/year, site groundwater will take 94 years to reach Taylors Creek. In reality, contaminants will move slower than groundwater due to retardation, and the organic contaminants will gradually decay in nature.

PRELIMINARY RISK EVALUATION

Human Health Preliminary Risk Evaluation

The human health preliminary risk evaluation included a Step 1 risk evaluation to determine potential human health risks associated with the contaminants. Human health COPCs have been identified as those constituents present at concentrations higher than their reference background criteria and higher than their respective risk-based or applicable or relevant and appropriate requirement-based screening criteria. Based on the results of the screening and the weight-of-evidence analysis, potential human health COPCs have been identified for groundwater. There are no human health COPCs for surface soil, subsurface soil, surface water, or sediment.

The initial human health COPCs for groundwater were identified because they present a potential threat to human health as a result of use of groundwater as a source of drinking water. The initial human health COPCs for groundwater are iron, acetone, benzene, chromium, lead, Radium 226, Radium 228, bis(2-ethylhexyl)phthalate, 1,2-*cis*-dichloroethene, and trichloroethene. Iron, Radium 226, and Radium 228 are not hazardous constituents as defined by Section I.E of FSGA's Hazardous Waste Facility Permit #HW-045 (S&T) and are not subject to the corrective action requirements under the terms and conditions of the permit or under the Georgia Hazardous Waste Management Act, O.C.G.A §12-8-60, et seq., as amended, and the Rules for Hazardous Waste Management, Chapter 391-3-11, promulgated pursuant thereto, as amended. Therefore, iron, Radium 226, and Radium 228 were eliminated as human health COPCs in groundwater at FST-01.

A baseline human health risk assessment (BHHRA) was performed to quantitatively assess the risks associated with exposure to human health COPCs in groundwater. In addition, the baseline risk assessment evaluated the risks associated with the leaching of the contaminant migration COPC (methylene chloride) to groundwater underlying the site and migrating off-site via groundwater. A tabular summary of contaminant screening of groundwater results to action levels is presented in Table 2.

Ecological Preliminary Risk Evaluation

The Phase II RFI performed an ecological preliminary risk evaluation (EPRE) for potential terrestrial and aquatic receptors at the site. The EPRE for the Post South Central Landfill identified ecological COPCs in groundwater based on a comparison of their maximum site concentrations to EPA Region IV ecological screening values (ESVs). No ecological COPCs were identified in surface water or sediment. Preliminary risk calculations for identified ecological COPCs in surface soil (selenium and DDT) and groundwater [barium, iron, lead, bis(2-ethylhexyl)phthalate, and total xylenes] were based on a comparison of detected concentrations to toxicity reference values (TRVs) for surrogate species representing ecological receptors. Uncertainty analysis of the ecological COPCs in surface soil and groundwater resulted in their being eliminated as ecological COPCs. The uncertainty analysis is summarized below.

Selenium and the pesticide DDT and its metabolites were detected in surface soil at the Post South Central Landfill at concentrations that exceeded both reference background criteria and the TRVs for terrestrial receptors. Selenium was detected in only one of eight surface soil samples at FST-01 at only slightly above its background concentration (0.69 mg/kg versus 0.63 mg/kg).

Selenium was not detected in the other seven soil samples. Therefore, selenium is not considered an ecological COPC in surface soil at SWMU 1. DDT and its metabolites in surface soil at SWMU 1 are ecological COPCs for birds with small home ranges ingesting soil-dwelling invertebrates. DDT and its metabolites are likely to be present in surface soil in most areas of Georgia and the southeast due to the past widespread use of DDT as an insecticide. Assuming the effects of DDT, DDE, and DDD are additive, the combined exposure at each of the two sampling locations at which these constituents were detected does not exceed the lowest-observed-adverse-effect level (LOAEL) dose. The fact that maximum estimated doses lie between the no-observed-adverse-effect level and the LOAEL suggests that the pesticides and their metabolites are not ecological COPCs in surface soil at FST-01.

Barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes (total) are present in groundwater at the Post South Central Landfill at concentrations that exceed EPA Region IV ESVs for surface water. Bis(2-ethylhexyl)phthalate was detected in groundwater at concentrations above background criteria and that resulted in estimated exposures exceeding TRVs for terrestrial ecological receptors that ingest fish and other aquatic biota. The ecological COPCs in groundwater are barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes for aquatic biota and bis(2-ethylhexyl)phthalate for birds ingesting fish exposed to groundwater potentially discharging to surface water. The concentrations of these constituents in numerous monitoring wells and direct-push groundwater samples exceeded background criteria and risk-based screening or reference values.

However, none of these constituents is an ecological COPC in surface water and sediment at FST-01. This suggests that dilution, degradation, sorption, or other processes are operating to reduce the low concentrations in groundwater discharging to Taylors and Mill creeks or that groundwater at FST-01 has not yet migrated to the creeks. Groundwater flow rates indicate that it takes approximately 94 years for groundwater to reach Mill and

Taylors creeks. Therefore, groundwater constituents are not ecological COPCs at the present time because they have not been indicated as ecological COPCs in surface water and sediment. The groundwater constituents are not likely to be ecological COPCs in the future because of their low concentrations and associated small hazard quotients (HQs) and the continued natural attenuation processes occurring in the subsurface soil (e.g., dilution, degradation, absorption).

In summary, the Phase II RFI (SAIC 1999) concluded that there is no present ecological risk at FST-01 and that the site is unlikely to pose an ecological risk in the future.

BASELINE HUMAN HEALTH RISK ASSESSMENT

A BHHRA was performed to assess groundwater around FST-01. The human health COPCs identified in groundwater include acetone, benzene, bis(2-ethylhexyl)phthalate, 1,2-*cis*-dichloroethene, trichloroethene, chromium, and lead. Methylene chloride was identified as a contaminant migration COPC based on its potential to leach into groundwater, resulting in potential exposure of receptors. Although acetone was identified as a contaminant migration COPC, it was detected above its GSSL in only SC-M16, which was located in an area determined to not be impacted by FST-01; therefore, the potential for acetone to leach into groundwater from soil was not evaluated in the BHHRA. Potential future groundwater concentrations of methylene chloride were estimated using the Seasonal Soil Compartment Model. This concentration was included in the risk assessment in addition to the human health COPCs.

The potential current and future receptors evaluated included an on-site and off-site worker, a resident (adult and child), and a child playing in Taylors Creek, a point of groundwater discharge. The worker and resident were evaluated based on a potential drinking water scenario in which drinking water is obtained from the surficial aquifer. The Installation worker is the only likely receptor population. However, GA EPD guidance states that resident populations must be evaluated as both on-site and off-site receptors. Groundwater underlying FST-01 flows predominantly in the direction of Taylors Creek, where it is likely to discharge to surface waters; therefore, the potential risk to a child playing in Taylors Creek was also evaluated.

Constituents migrating off-site were modeled to determine groundwater concentrations at the points of exposure. The model assumed that the maximum measured concentration of a constituent was present in groundwater at the northern boundary of the old, inactive landfill. It was assumed that all off-site receptors come into contact with the groundwater at some point north of the site, which is the predominant direction of groundwater flow. The exposure-point groundwater concentrations of COPCs for the off-site receptors were negligible; therefore, potential risks resulting from exposure of off-site receptors would be well below target values.

Ingestion, dermal absorption, and inhalation were evaluated as the potential exposure pathways (i.e., routes of exposure of the constituent to the body). The risks associated with carcinogenic hazardous constituents were estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen [i.e., the incremental lifetime cancer risk (ILCR)]. The ILCRs for the individual carcinogens are

summed to provide the total ILCR. A total ILCR of less than 1E-6 does not represent a significant carcinogenic risk. The risks associated with the systemic effects of noncarcinogenic toxicity were evaluated by comparing an estimated intake (mg/kg/day) to a reference dose. This ratio of estimated intake over the reference dose is termed the HQ. The sum of all of the HQs for a given exposure route (i.e., oral, inhalation, or dermal) is called the hazard index (HI). HIs less than 1.0 indicate that the sum of exposures to all of the constituents present is not likely to result in adverse health effects. Lead does not have a reference dose, but it does have a maximum acceptable blood-lead concentration of 10 µg/dL in children, which represents the most sensitive receptor population. The blood-lead levels for children ages 1 to 7 were estimated to determine if there is an unacceptable risk associated with exposure to lead in groundwater.

Constituents present in groundwater at FST-01 do not present a significant noncarcinogenic risk to human health. The quantitative estimates of noncarcinogenic risks were below their target values for both on-site occupational and residential receptor populations. The carcinogenic risks for the occupational receptor population was below the target risk value of 1E-6; however, the carcinogenic risk for the on-site residential receptors exceeded the target value with an ILCR of 8.9E-6. This value includes an ILCR of 3.4E-6 resulting from exposure to methylene chloride that may leach into groundwater. The other risk drivers are benzene (ILCR = 2.5E-6) and bis(2-ethylhexyl)phthalate (ILCR = 2.1E-6).

The remedial levels for benzene and bis(2-ethylhexyl)phthalate were based on their respective MCLs (5 µg/L and 6 µg/L, respectively). The MCL for benzene was greater than the maximum detected value of 2.5 µg/L; therefore, corrective action is not required to address the presence of benzene in groundwater. Groundwater concentrations of bis(2-ethylhexyl)phthalate exceeding the remedial level were detected in only those wells (NMW-2A and SC-M9) associated with the active landfill; therefore, bis(2-ethylhexyl)phthalate is not associated with the old, inactive landfill (Table 3) and is not addressed in this Decision Document.

The remedial soil level for methylene chloride was determined to be 3.3 mg/kg and represents a concentration of the constituent in soil that is not likely to leach into groundwater and result in groundwater concentrations that exceed the MCL for methylene chloride (5 µg/L). Only four sampling locations indicated methylene chloride above the 3.3 mg/kg remedial level. SC-M11, SC-M12, SC-M14, and SC-M16 had methylene chloride concentrations of 9.2 mg/kg, 13.7 mg/kg, 3.9 mg/kg, and 52.2 mg/kg, respectively; SC-M16 is not located within the boundaries of the FST-01 (Table 4).

The exposure scenario for methylene chloride soil contamination leaching to groundwater assumes that in the future a residence will be built on-site and that the household drinking water will come directly from the surficial aquifer. Current planning under the Fort Stewart Base Master Plan (BMP), which goes through the year 2020, does not include construction of any facilities on the old, inactive portion of the landfill. Methylene chloride degrades rapidly in groundwater (its biodegradation half-life in groundwater equals 112 days); therefore, the methylene chloride potentially leaching to groundwater would completely degrade before any structure would be built on the site. In addition, methylene chloride was not detected in any of the

groundwater samples associated with the old, inactive portion of the landfill, including those located in the area of the methylene chloride soil contamination (SC-M11, SC-M12, and SC-M14), indicating that natural attenuation of methylene chloride may be occurring. Therefore, given the unlikely possibility of exposure of an on-site resident to methylene chloride in the surficial groundwater and the restricted usage through 2020 under the BMP, Fort Stewart's recommendation of no further action for methylene chloride in soil, as presented in the Revised Final Phase II RFI Report, was approved by GA EPD.

In conclusion, of the two constituents detected in groundwater [benzene and bis(2-ethylhexyl)phthalate], benzene was not detected above its MCL and bis(2-ethylhexyl)phthalate was detected in monitoring wells (NMW-2A and SC-M9) located around the active portion of the landfill, indicating that this constituent is associated with the active landfill and not the old, inactive landfill. The active portion of FST-01 is operated under Permit Nos. 089-010D (SL) and 089-020D (L), and bis(2-ethylhexyl)phthalate, which was detected above the MCL at SC-M9 and NMW-2A, will continue to be monitored through the GMP, as approved by the GA EPD Land Protection Division, and corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells will not be required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify any elevation of contaminant levels and/or development of any trends in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. The active portion of FST-01 will continue to be monitored in association with the approved GMP, and all analytical data will continue to be submitted to the GA EPD Land Protection Division.

Methylene chloride was indicated in soil above its remedial level as a contaminant migration COPC at three locations around the old, inactive portion of the landfill; therefore, methylene chloride was identified as a contaminant migration COPC in soil based on the unlikely possibility of exposure to someone constructing a residence on the site and drinking groundwater containing methylene chloride. Fort Stewart's recommendation of no further action, as presented in the Revised Final Phase II Report, was approved by GA EPD as long as restricted use of the groundwater, as currently planned in the BMP, was maintained and controlled.

JUSTIFICATION AND PURPOSE OF CORRECTIVE ACTION

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.

Remedial Response Objectives

Based on the findings of the site characterization at this site, the primary goal and purpose for implementing corrective measures at the old, inactive portion of FST-01 is limited to protection of human health and safety. To achieve this goal, two primary remedial response objectives have been established for FST-01: (1) to prohibit the ingestion of shallow groundwater from the subject site; (2) to limit the disturbance of subsurface soils to minimize contact with buried waste; and (3) to identify procedures to evaluate the subsurface characteristics prior to any construction within the boundary of the old, inactive portion of the landfill. Any corrective measures that pose a significant threat to human health and safety during implementation (e.g., methods that would involve disturbance of subsurface soils) will not be evaluated. Implementation of the selected remedial response will achieve the best overall results with respect to such factors as long-term reliability and effectiveness, short-term effectiveness, implementability, and cost.

CONCEPTUAL DESIGN AND IMPLEMENTATION

Based on the level and type of subsurface soil and groundwater contamination, a cost-effective corrective action was selected that would adequately protect human health.

Based on the technology evaluation performed for the site (see Table 5 above), Alternative 1 (see CAP, SAIC 1999) was selected because it will provide a sufficient level of protection of human health at a relatively low cost. The selected corrective action alternative 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, BMP, zoning restrictions, and signage. In addition to establishment of prohibitions for groundwater use, eight monitoring wells will be abandoned. No additional access barriers will be constructed because existing man-made and natural physical barriers, which include site access gates, Taylors Creek, existing roads, and natural and man-made drainage features, are suitable for restricting human activity.

Justification of Selection

Alternative 1 has been selected because it will provide effective protection of human health at a relatively low cost. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered cost effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized excavation below ground would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Additionally, suitable physical barriers are already present at the subject site to discourage human activity that might result in disturbance of the subsurface (e.g., vehicular traffic, hunting). Institutional controls described for Alternative 1 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 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. Warning signs and documented land use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to physical contact with the buried waste within the boundaries of the old, inactive portion of FST-01. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land use controls during ownership by DoD. Prior to the planning of any construction activities at FSGA, the BMP must be reviewed. In addition, all construction projects will be reviewed for approval by the Base Master Planner and the Fort Stewart Directorate of Public Works during the planning stages. These land use controls will remain in effect after transfer of DoD ownership by restrictions imposed through deed recordation.

Existing natural and man-made barriers will provide long-term reliability and effectiveness in preventing unauthorized access. The existing access gates at landfill access points are closed and locked during non-operational hours. Since the installation of the gate at Wilson Avenue, FSGA has observed a marked decrease in activity (i.e., vehicular traffic) at this site. Taylors Creek provides a natural barrier along the northern boundary of the site.

Additionally, the proposed well abandonment and groundwater use restrictions will provide an effective method for preventing the use of groundwater as drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at Fort Stewart and is not used. The BMP will be modified to officially restrict use, further avoiding use of the surficial groundwater at the site.

An annual O&M program will be administered to replace or repair warning signs, which may deteriorate over time. 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 potentially replacing or repairing warning signs.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of FST-01. Posting of warning signs together with existing access restrictions will be most effective over the short term. There is no current risk, and the site is 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 posting of signs. Suitable barriers already exist that restrict unauthorized access to the site. 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; 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 warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $44,843. Alternative 2, which would provide the same land use controls as Alternative 1 but would also include installation of fencing, was significantly more expensive ($126,679) than the selected alternative.

PUBLIC NOTIFICATION

GA EPD has prepared a notification which explicitly describes the FRA selected for FST-01, and per Fort Stewart's Hazardous Waste Permit HW-045(S&T) the public will be afforded to review the notification and/or the entire Corrective Action Plan for a period of thirty days. At the conclusion of the review period, GA EPD will either grant final approval of the selected FRA or revise their tentative approval based on review and comments received by the public. It is anticipated that this review period will occur in August 2000 and final approval from GA EPD will be provided to the Installation in early September 2000.

DECLARATION

The selected Final Remedial Action are protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to the FRA, and will be cost-effective.

Due to the fact that the selected course of action was presented in the CAP and approved by GA EPD, the five-year review will not apply to the proposed FRA.

This decision document was developed by the Directorate of Public Works at Fort Stewart, with support from the U.S. Army Corps of Engineers and Science Applications International Corporation.

Table 1. Summary of Site-Related Contaminants

Analyte	Maximum Concentration			Maximum Concentration	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
	µg/kg			*µg/L*	
1,1,2,2-Tetrachloroethane				0.69	
1,1-Dichloroethane				0.56	
1,2-Dichloropropane				0.24	
1,2-*cis*-Dichloroethene				21	
1,2-*trans*-Dichloroethene				1.6	
2-Butanone		14.1	14.5	8.6	
Acetone	44,100	638	297	1,140	
Benzene				2.5	
Chlorobenzene				9.8	
Chloroform				22	
Ethylbenzene				26.9	
Methylene chloride	52.2	2.8			
Styrene		0.67		0.29	
Tetrachloroethene				0.36	
Toluene	59.4	6.1		17.8	
Trichloroethene				5.4	
Xylenes, total				212	
Semivolatile Organic Compounds					
	µg/kg			*µg/L*	
1,2,4,Trichlorobenzene	3.2	2.4	3.4		
4-Methylphenol				1.1	
Bis(2-ethylhexyl)phthalate				61.4	
Diethyl phthalate				5.2	0.86
Pyrene		2.5			0.1
Radionuclides					
	pCi/g			*pCi/L*	
Radium 226				1.63	
Radium 228			1.29	6.9	3.97
Pesticides					
	mg/kg			*mg/L*	
4,4'-DDD	3.8				
Dieldrin				0.025	
Heptachlor		0.39			
Metals					
	mg/kg			*mg/L*	
Barium				134	
Cadmium				0.59	
Chromium			3.5	11.6	
Iron				22,000	
Lead			6	18.4	
Mercury			0.02		
Selenium	0.69				

Table 2. Contaminant Screening of Groundwater Results to Action Levels

Analyte	Freq. of Detection	Minimum Detected	Maximum Detected	Human Health Criterion	Human Health COPC	Justification
Metals (µg/L)						
Barium	21/21	20.9	134	260	No	Max Detect < Risk Criteria
Cadmium	2/21	0.25	0.59	1.8	No	Max Detect < Risk Criteria
Chromium	7/21	0.71	11.6	10.9	Yes	Max Detect > Risk Criteria
Iron	21/21	76.5	22,000	1,100	Yes	Max Detect > Risk Criteria
Lead	17/21	0.12	18.4	15 [a]	Yes	Max Detect > Risk Criteria
Radionuclides (pCi/L)						
Radium 226	10/21	0.501	1.63	0.161 [b]	Yes	Max Detect > Risk Criteria
Radium 228	21/21	1.33	6.9	0.192 [b]	Yes	Max Detect > Risk Criteria
Pesticides (µg/L)						
Delta-BHC	1/21	0.04	0.04	ND	No	Weight of Evidence [c]
Dieldrin	1/21	0.025	0.025	0.0042	No	Weight of Evidence [c]
Semivolatile Compounds (µg/L)						
4-Methylphenol	1/21	1.1	1.1	18	No	Max Detect < Risk Criteria
Bis(2-ethylhexyl)phthalate	8/21	0.53	61.4	4.8	Yes	Max Detect > Risk Criteria
Diethyl phthalate	6/21	0.56	5.2	2,900	No	Max Detect < Risk Criteria
Volatile Compounds (µg/L)						
1,1,2,2-Tetrachloroethane	1/50	0.69	0.69	0.052	No	Weight of Evidence [c]
1,1-Dichloroethane	1/50	0.56	0.56	81	No	Max Detect < Risk Criteria
1,2-Dichloropropane	1/50	0.24	0.24	0.16	No	Weight of Evidence [c]
1,2-*cis*-Dichloroethene	9/46	0.4	21	6.1	Yes	Max Detect > Risk Criteria
1,2-*trans*-Dichloroethene	1/46	1.6	1.6	12	No	Max Detect < Risk Criteria
2-Butanone	1/50	8.6	8.6	190	No	Max Detect < Risk Criteria
Acetone	11/32	15.1	1,140	370	Yes	Max Detect > Risk Criteria
Benzene	3/50	0.23	2.5	0.36	Yes	Max Detect > Risk Criteria
Chlorobenzene	1/50	9.8	9.8	3.9	No	Weight of Evidence [c]
Chloroform	2/50	0.51	22	0.15	No	Weight of Evidence [c]
Ethylbenzene	13/50	0.22	26.9	130	No	Max Detect < Risk Criteria
Styrene	1/50	0.29	0.29	160	No	Max Detect < Risk Criteria
Tetrachloroethene	1/50	0.36	0.36	1.1	No	Max Detect < Risk Criteria
Toluene	11/50	0.27	17.8	75	No	Max Detect < Risk Criteria
Trichloroethene	3/50	0.35	5.4	1.6	Yes	Max Detect > Risk Criteria
Xylenes, total	16/50	0.43	212	1,200	No	Max Detect < Risk Criteria

[a]Lead action level of 15 mg/L is based on a blood lead concentration of 10 mg/dL.
[b]Risk-based concentrations for radionuclides have been calculated for use at U.S. Department of Energy facilities (DOE/ORO 1998).
[c]Weight-of-evidence analysis indicated this constituent was detected infrequently (frequency of detection of 5 percent or less).
ND = No data available.

Table 3. Remedial Levels for Groundwater and Soil

Chemical	Groundwater Remedial Level MCL (μg/L)	Maximum Groundwater Concentration (μg/L)	Target Groundwater Concentration (μg/L)	Remedial Level Soils (mg/kg)	Maximum Soil Concentration (mg/kg)
Benzene	5	2.5	NA	NA	NA
Bis(2-ethylhexyl)phthalate	6	61.4	NA	NA	NA
Methylene chloride	NA	NA	5	3.3	13.7

NA = Not applicable.

Table 4. Location of Exceedances above Remedial Levels

Chemical	Groundwater		Soil	
	Concentration above Remedial Level (μg/L)	Location[a]	Concentration above Remedial Level (mg/kg)	Location[b]
Bis(2-ethylhexyl)phthalate	61	SC-M9	NA	NA
	7.8	NMW-2A	NA	NA
Methylene chloride	NA	NA	9.2	SC-M11
	NA	NA	13.7	SC-M12
	NA	NA	3.9	SC-M14

Note: Exceedances of acetone in surface soil were at only SC-M19, which was not impacted by SWMU 1.
[a]Groundwater locations are presented on Figure 5-5 of the Revised Final Phase II RFI Report (SAIC 1999).
[b]Surface soil locations are presented on Figure 5-1 of the Revised Final Phase II RFI Report (SAIC 1999).
NA = Not applicable.

Table 5. Corrective Action Alternatives

Corrective Action	Description	Protection of Human Health	Cost	Comments
Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Well Abandonment, 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 and groundwater usage. This alternative would also include abandonment of eight groundwater monitoring wells.	Protection of human health would be primarily dependent upon enforcement of compliance with land use controls. Existing physical barriers (access gate and creek) provide effective restrictions on human access to the site to further discourage any unauthorized excavation activities.	$44,843	Least expensive providing sufficient level of protection.
Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Partial Wood Fence Barrier, Maintenance of Existing Physical Barriers, Post-mounted and 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 and groundwater usage. Physical barriers to be installed would include a 3,500-linear-foot, pretreated wood fence along the eastern boundary curving westward to SC-M18. This alternative would also include abandonment of eight groundwater monitoring wells.	In addition to the protection provided by Alternative 1, human access would be further restricted by fencing along the eastern and southeastern boundaries of the site. The fencing would be slightly more effective than signs alone in deterring or discouraging unauthorized excavation activities, but even fencing would not totally prevent someone from gaining access to the site.	$126,679	Significantly more expensive with only slight increase in level of protection compared to Alternative 1.

Record of Decision / Decision Document

DSERTS# EST-01

Date Received 5-11-00

Installation Fort Stewart

Title DD for FRA at the Post Central Landfill

Type DD for FRA

Date Signed

AFZP-DEV (200-1a) 9 May 00

MEMORANDUM FROM DPW, FORT STEWART, GEORGIA 31314

MEMORANDUM FOR FORSCOM, DCSPIM, ATTN: Stephanie Sigler

SUBJECT: Decision Document for Final Remedial Action at the Post South Central Landfill (FST-01), Fort Stewart, Georgia

1. The attached decision document is provided for your use and convenience in documenting the distribution of fiscal year 00 funding for the Final Remedial Action (FRA) at FST-01, the Post South Central Landfill.

2. Mr. Joe King at the Army Environmental Center has received a copy of this decision document for review and approval.

3. POC for this memorandum is Ms. Melanie Little or Ms. Tressa Rutland, DPW Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively.

Sincerely,

Gregory V. Stanley
Colonel, U.S., Army
Director, Public Works

Enclosure

DECISION DOCUMENT FOR FINAL REMEDIAL ACTION AT THE
POST SOUTH CENTRAL LANDFILL (FST-01)
FORT STEWART, GEORGIA

PURPOSE OF THE FINAL REMEDIAL ACTION

This decision document describes the selected Final Remedial Action (FRA) for the Post South Central Landfill (FST-01) at Fort Stewart, Georgia.

FST-01, which is located approximately 0.75 mile northwest of the Fort Stewart main cantonment area, has been used for solid waste disposal since the 1940s. Disposal practices at the landfill have ranged from burn-pit to trench-and-fill operations. During the Phase I RFI conducted in 1997, the old, inactive portion of
FST-01 was discovered east of the active landfill. The old, inactive portion of the landfill is heavily forested and estimated to encompass approximately 143 acres.

The active, permitted landfill operations are being constructed on the clay cap of the former trench-and-fill portion of the landfill. The active, permitted landfill is comprised of two cells: the eastern cell covers approximately 35 acres, while the western cell, which is closed, covers about 30 acres. The active landfill is operated under Permit No. 089-010 D (SL), issued by the state of Georgia in 1982. The nonputrescible landfill is operated under Permit No. 089-020 D (L), issued by the state of Georgia in 1982. Since 1983, the Post South Central Landfill has been operated under the provisions of the Design and Operation Plan as an area fill landfill with appropriate groundwater monitoring. As a permitted facility, the Post South Central Landfill must meet closure and post-closure requirements in accordance with the requirements of 40 CFR 258.60 and Chapter 391-3-4, Rules of the GA EPD.

Active Landfill

From 1960 to 1970, the active landfill's eastern cell operated as a garbage, paper waste, and construction debris landfill. Other waste disposed of included sludge from wash racks, sludge from industrial and sanitary wastewater treatment plants, waste air filters from the paint booth in the Directorate of Logistics Allied Trades Shop, grease from mess halls, autoclaved infectious wastes bagged in special containers, and ash from the energy plant. Operational practices have prohibited the disposal of ordnance at the landfill; however, some explosive ordnance has been discovered during routine operations. Upon such discoveries, the subject explosive ordnance has been removed and properly disposed of by FSMR. From 1970 to 1982, trench-and-fill operations were used in the active Post South Central Landfill's eastern cell. The trench-and-fill operation has moved from east to west, with previously filled land being restored to forest.

Beginning in the spring of 1982, tumulus refuse disposal operations began, representing the present-day disposal practices at the landfill. These operations have been performed over the western portion of the trench-and-fill area of the landfill. The active portion of the Post South Central Landfill is comprised of two cells that are constructed on the clay cap of the former trench-and-fill landfill. The eastern cell covers approximately 35 acres and the western cell about 30 acres. Wastes disposed of at the active landfill

include dry, construction-type waste; putrescible garbage; and properly packaged asbestos.

The northwest portion of the Post South Central Landfill was previously a borrow pit for the site and is presently being used for disposal of demolition/construction debris (nonputrescible waste).

Based upon the results reported in the Revised Final Phase II RFI Report (SAIC 1999) for the active portion of FST-01, a few constituents present in the groundwater were detected above maximum contaminant levels (MCLs) [i.e., bis(2-ethylhexyl)phthalate at SC-M9 and NMW-2A]. In accordance with the GA EPD-approved recommendation for corrective action, these constituents will continue to be monitored through the Groundwater Monitoring Plan (GMP), approved by the GA EPD Land Protection Division. Corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells is not required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify if any contaminant levels become elevated and/or any trends develop in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. All analytical data will continue to be submitted to the GA EPD Land Protection Division. The implementation of the GMP for the Active Landfills is funded with OMA dollars, as part of the Installation's compliance monitoring program.

Old, Inactive Landfill

During the Phase I RFI, it was discovered that an older portion of the landfill existed east of the active landfill and continued to Georgia State Route 144/119. The old, inactive landfill is estimated to encompass approximately 80 acres. Aerial photographs dated 1947 and 1957 indicate disposal was occurring at the old, inactive landfill during that period. A 1966 aerial photograph shows approximately two-thirds of the old landfill immediately west of Georgia State Route 144/119 with successional vegetation, indicating that by that time the landfill was no longer being used. Disposal at the current, active Post South Central Landfill site and complete vegetative cover of the old, inactive landfill area are evident in a 1975 aerial photograph; these conditions continue today. Additional prominent site features associated with the old, inactive portion of the landfill include a fenced cemetery, a dumpster maintenance area, and a drainage ditch to drain the low area around a dumpster maintenance area. The dumpster maintenance area is located on the south side of the FST-01 access road, approximately 600 feet from the Wilson Avenue entrance gate. Dumpsters are stored and refurbished at the facility. A drainage ditch, which begins southwest of the dumpster cleaning area, circles the area, and ultimately discharges to the marshy area along Taylors Creek, was dug to drain the low area around the dumpster cleaning area so that the area could be built.

The old, inactive landfill received all waste generated at Fort Stewart during its operation. According to previous operators, this waste included materials similar to those currently received at the active landfill in addition to sludges from the sewage treatment plant, scrap metal, demolition/construction debris, sanitary/municipal waste, and drummed waste from the tear gas training facility. According to information provided by former landfill employees, operational practices at the old, inactive landfill involved excavation of a large pit to below the water table; stockpiling of the excavated soil;

disposal and compaction of the solid waste; and covering with the stockpiled, excavated soil. In addition, intermittent burning in the large pits was used to reduce the volume of the disposed waste. Again, former employees have stated that this operational practice was discontinued because it was reducing air quality and there was concern regarding live rounds discharging during the burning. The disposal areas were covered with local soil that had been removed during excavation of the pits and the surrounding area. Some areas of the old, inactive landfill were planted with pines, whereas other areas were allowed to revegetate naturally with successional species.

Based on the findings presented in the Revised Final Phase II RFI Report dated March 1999 (SAIC 1999), a "no further action required" status was assigned to the old, inactive portion of FST-01 for investigative purposes. As recommended by the Phase II RFI Report and as agreed to with GA EPD, a Corrective Action Plan (CAP) was recommended for FST-01 because buried waste will remain in place. The CAP is necessary to control intrusive activities at this site and to be protective of the health of humans potentially coming in contact with the buried waste and to prevent the use of groundwater as a drinking water source.

Nature and Extent of Contamination

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

The reference background criteria for the Post South Central Landfill have been developed based on data from background samples collected across Fort Stewart for Solid Waste Management Units (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.

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 (e.g., more than 20) are collected to define background, a background upper tolerance level can be calculated. In cases in which too few samples (e.g., 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 Fort Stewart, 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 site-related contaminants (SRCs) if their concentrations were above the reference background concentrations. Organics were considered SRCs if they were simply detected because organic constituents are considered anthropomorphic in nature.

Appendix G of the Revised Final Phase II RFI Report (SAIC 1999) presented the

summary of background data as well as the two-times-mean background concentrations. Given the limited background data, the mean concentration for soils 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.

Isolated low levels of organic contamination (VOCs, SVOCs, and pesticides) and metals are present in soil; however, no clear distribution or trends of contaminants are evident. Acetone, methylene chloride, toluene, and 1,2,4-trichlorobenzene were detected in surface soil. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected in two surface soil samples, SC-M13 and SC-M18. 1,2,4-Trichlorobenzene, pyrene, 2-butanone, acetone, methylene chloride, styrene, and toluene were detected in subsurface soil.

Selenium was detected in surface soil above the reference surface soil background concentration in a single soil sample. Selenium concentrations in surface soil were not above the FSMR reference background concentrations for subsurface soil.

Low levels of VOCs, SVOCs, metals, and Radium 226/228 are present in the surficial aquifer; however, no clear distribution or trends of contaminants are evident. Trichloroethene was detected in a single groundwater sample (direct-push sample GP-7) above its respective MCL. Bis(2-ethylhexyl)phthalate was detected in groundwater above its MCL (6 μg/L) at two locations (NMW-2A and SC-M9) at concentrations of 7.8 μg/L and 61.4 μg/L, respectively. Metals were detected in groundwater, with only one containing a concentration above the MCL. Lead was detected at 18.4 μg/L at monitoring well SC-M17 (action level 15 μg/L). However, the filtered lead concentration at SC-M17 was nondetect, indicating that the lead may be associated with colloid particulates in the groundwater. Barium, cadmium, chromium, iron, and lead were detected above the FSMR reference background concentrations. Low levels of Radium 226/228 were detected in the groundwater. The combined Radium 226/228 concentrations exceeded the MCL at two locations (SC-M5 and SC-M19). The groundwater field sampling data (dissolved oxygen, oxidation-reduction potential, pH) do not indicate that leachate is impacting the groundwater.

Low levels of organics, metals, and Radium 226/228 were detected in sediment and surface water. Chromium, lead, mercury, and Radium 228 were detected in sediment above site-specific background criteria. Two VOCs (acetone and 2-butanone) were detected in one sediment sample, and one SVOC (1,2,4-trichlorobenzene) was detected in two sediment samples. Diethyl phthalate and pyrene were detected in surface water. Radium 228 was detected in surface water above the site-specific background criterion. A tabular summary of SRCs for the Post South Central Landfill (FST-01) is presented in Table 1 below:

Table 1. Summary of Site-related Contaminants

Analyte	Maximum Concentration			Maximum Concentration	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
	µg/kg			*µg/L*	
1,1,2,2-Tetrachloroethane				0.69	
1,1-Dichloroethane				0.56	

1,2-Dichloropropane				0.24	
1,2-*cis*-Dichloroethene				21	
1,2-*trans*-Dichloroethene				1.6	
2-Butanone		14.1	14.5	8.6	
Acetone	44,100	638	297	1,140	
Benzene				2.5	
Chlorobenzene				9.8	
Chloroform				22	
Ethylbenzene				26.9	
Methylene chloride	52.2	2.8			
Styrene		0.67		0.29	
Tetrachloroethene				0.36	
Toluene	59.4	6.1		17.8	
Trichloroethene				5.4	
Xylenes, total				212	
Semivolatile Organic Compounds					
	µg/kg			*µg/L*	
1,2,4,Trichlorobenzene	3.2	2.4	3.4		
4-Methylphenol				1.1	
Bis(2-ethylhexyl)phthalate				61.4	
Diethyl phthalate				5.2	0.86
Pyrene		2.5			0.1
Radionuclides					
	pCi/g			*pCi/L*	
Radium 226				1.63	
Radium 228			1.29	6.9	3.97
Pesticides					
	mg/kg			*mg/L*	
4,4'-DDD	3.8				
Dieldrin				0.025	
Heptachlor		0.39			
Metals					
	mg/kg			*mg/L*	
Barium				134	
Cadmium				0.59	
Chromium			3.5	11.6	
Iron				22,000	
Lead			6	18.4	
Mercury			0.02		
Selenium	0.69				

Contaminant Fate and Transport

Contaminant fate and transport analysis provided an assessment of the potential migration pathways and transport mechanisms affecting the chemicals at the sites. In particular, the leachability of contaminants from soil to groundwater and their natural attenuation in groundwater were evaluated.

Acetone and methylene chloride in the soil at the Post South Central Landfill exceeded EPA Generic Soil Screening Levels (GSSLs). These constituents may leach into groundwater at concentrations that exceed groundwater standards [i.e., concentrations that exceed the MCL or, in the absence of an MCL, the

risk-based concentration (RBC) for drinking water]. The concentration of acetone exceeded the GSSL in only one out of nine detections in soil. This soil sample, SC-M16, was located outside of the boundary of the landfill or the area affected by the landfill operations. Therefore, the acetone present in this sample is not associated with the landfill operations. Acetone is not considered a contaminant migration contaminant of potential concern (COPC). Acetone was detected in groundwater above its RBC as established by EPA Region III and was considered to be a human health COPC in groundwater.

All of the detected methylene chloride concentrations (seven out of 25 soil samples) exceeded the GSSL. One of the detections of methylene chloride (SC-M15) was located outside the boundary of the landfill or the area affected by the landfill operations. The maximum concentration of methylene chloride (52.2 µg/kg) was detected at SC-M15. Methylene chloride was the only contaminant migration COPC in soil around the old, inactive portion of the landfill. Methylene chloride was not detected in groundwater.

Selenium exceeded its reference background criterion in soil; however, it did not exceed its GSSL based on leaching to groundwater; therefore, selenium was not considered a contaminant migration COPC.

Chromium, lead, and Radium 226/228 exceeded their respective RBCs/MCLs in groundwater. The one elevated concentration of lead may be due to colloid particulates in the groundwater. Off-site migration of chromium, lead, and Radium 226/228 will be limited, however, because of their high retardation factors.

Bis(2-ethylhexyl)phthalate and trichloroethene exceeded their MCLs but were not found in soils. Therefore, bis(2-ethylhexyl)phthalate and trichloroethene were not screened as contaminant migration COPCs in soils. Maximum groundwater concentrations of bis(2-ethylhexyl)phthalate and trichloroethene were detected at 61.4 µg/L (MCL 6 µg/L) and 5.4 µg/L (MCL 5 µg/L), respectively. These two concentrations above MCLs represent only a single detection out of 51 groundwater samples (23 direct-push, two vertical-profile, and 22 groundwater monitoring wells). Bis(2-ethylhexyl)phthalate and trichloroethene were detected in the groundwater only and not in soils, indicating that these contaminants may have leached in the past or are potentially leaching directly from a very confined or small point source. Off-site migration of these organic contaminants will be limited due to retardation and degradation through various processes as well as the slow movement of groundwater (12.8 feet/year). At the velocity of 12.8 feet/year, site groundwater will take 94 years to reach Taylors Creek. In reality, contaminants will move slower than groundwater due to retardation, and the organic contaminants will gradually decay in nature.

Preliminary Risk Evaluation

Human Health Preliminary Risk Evaluation

The human health preliminary risk evaluation included a Step 1 risk evaluation to determine potential human health risks associated with the contaminants. Human health COPCs have been identified as those constituents present at concentrations higher than their reference background criteria and higher than their respective risk-based or applicable or relevant and appropriate requirement-based screening criteria. Based on the results of the screening

and the weight-of-evidence analysis, potential human health COPCs have been identified for groundwater. There are no human health COPCs for surface soil, subsurface soil, surface water, or sediment.

The initial human health COPCs for groundwater were identified because they present a potential threat to human health as a result of use of groundwater as a source of drinking water. The initial human health COPCs for groundwater are iron, acetone, benzene, chromium, lead, Radium 226, Radium 228, bis(2-ethylhexyl)phthalate, 1,2-*cis*-dichloroethene, and trichloroethene. Iron, Radium 226, and Radium 228 are not hazardous constituents as defined by Section I.E of FSMR's Hazardous Waste Facility Permit #HW-045 (S&T) and are not subject to the corrective action requirements under the terms and conditions of the permit or under the Georgia Hazardous Waste Management Act, O.C.G.A §12-8-60, et seq., as amended, and the Rules for Hazardous Waste Management, Chapter 391-3-11, promulgated pursuant thereto, as amended. Therefore, iron, Radium 226, and Radium 228 were eliminated as human health COPCs in groundwater at FST-01.

A baseline human health risk assessment (BHHRA) (see Section 2.10) was performed to quantitatively assess the risks associated with exposure to human health COPCs in groundwater. In addition, the baseline risk assessment evaluated the risks associated with the leaching of the contaminant migration COPC (methylene chloride) to groundwater underlying the site and migrating off-site via groundwater. A tabular summary of contaminant screening of groundwater results to action levels is presented in Table 2.

Ecological Preliminary Risk Evaluation

The Phase II RFI performed an ecological preliminary risk evaluation (EPRE) for potential terrestrial and aquatic receptors at the site. The EPRE for the Post South Central Landfill identified ecological COPCs in groundwater based on a comparison of their maximum site concentrations to EPA Region IV ecological screening values (ESVs). No ecological COPCs were identified in surface water or sediment. Preliminary risk calculations for identified ecological COPCs in surface soil (selenium and DDT) and groundwater [barium, iron, lead, bis(2-ethylhexyl)phthalate, and total xylenes] were based on a comparison of detected concentrations to toxicity reference values (TRVs) for surrogate species representing ecological receptors. Uncertainty analysis of the ecological COPCs in surface soil and groundwater resulted in their being eliminated as ecological COPCs. The uncertainty analysis is summarized below.

Selenium and the pesticide DDT and its metabolites were detected in surface soil at the Post South Central Landfill at concentrations that exceeded both reference background criteria and the TRVs for terrestrial receptors. Selenium was detected in only one of eight surface soil samples at FST-01 at only slightly above its background concentration (0.69 mg/kg versus 0.63 mg/kg).

Table 2. Contaminant Screening of Groundwater Results to Action Levels

Analyte	Freq. of Detection	Minimum Detected	Maximum Detected	Human Health Criterion	Human Health COPC	Justification
Metals (µg/L)						
Barium	21/21	20.9	134	260	No	Max Detect < Risk Criteria
Cadmium	2/21	0.25	0.59	1.8	No	Max Detect < Risk Criteria
Chromium	7/21	0.71	11.6	10.9	Yes	Max Detect > Risk Criteria
Iron	21/21	76.5	22,000	1,100	Yes	Max Detect > Risk Criteria
Lead	17/21	0.12	18.4	15 [a]	Yes	Max Detect > Risk Criteria
Radionuclides (pCi/L)						
Radium 226	10/21	0.501	1.63	0.161 [b]	Yes	Max Detect > Risk Criteria
Radium 228	21/21	1.33	6.9	0.192 [b]	Yes	Max Detect > Risk Criteria
Pesticides (µg/L)						
Delta-BHC	1/21	0.04	0.04	ND	No	Weight of Evidence [c]
Dieldrin	1/21	0.025	0.025	0.0042	No	Weight of Evidence [c]
Semivolatile Compounds (µg/L)						
4-Methylphenol	1/21	1.1	1.1	18	No	Max Detect < Risk Criteria
Bis(2-ethylhexyl)phthalate	8/21	0.53	61.4	4.8	Yes	Max Detect > Risk Criteria
Diethyl phthalate	6/21	0.56	5.2	2,900	No	Max Detect < Risk Criteria
Volatile Compounds (µg/L)						
1,1,2,2-Tetrachloroethane	1/50	0.69	0.69	0.052	No	Weight of Evidence [c]
1,1-Dichloroethane	1/50	0.56	0.56	81	No	Max Detect < Risk Criteria
1,2-Dichloropropane	1/50	0.24	0.24	0.16	No	Weight of Evidence [c]
1,2-*cis*-Dichloroethene	9/46	0.4	21	6.1	Yes	Max Detect > Risk Criteria
1,2-*trans*-Dichloroethene	1/46	1.6	1.6	12	No	Max Detect < Risk Criteria
2-Butanone	1/50	8.6	8.6	190	No	Max Detect < Risk Criteria
Acetone	11/32	15.1	1,140	370	Yes	Max Detect > Risk Criteria
Benzene	3/50	0.23	2.5	0.36	Yes	Max Detect > Risk Criteria
Chlorobenzene	1/50	9.8	9.8	3.9	No	Weight of Evidence [c]
Chloroform	2/50	0.51	22	0.15	No	Weight of Evidence [c]
Ethylbenzene	13/50	0.22	26.9	130	No	Max Detect < Risk Criteria
Styrene	1/50	0.29	0.29	160	No	Max Detect < Risk Criteria
Tetrachloroethene	1/50	0.36	0.36	1.1	No	Max Detect < Risk Criteria
Toluene	11/50	0.27	17.8	75	No	Max Detect < Risk Criteria
Trichloroethene	3/50	0.35	5.4	1.6	Yes	Max Detect > Risk Criteria
Xylenes, total	16/50	0.43	212	1,200	No	Max Detect < Risk Criteria

[a]Lead action level of 15 mg/L is based on a blood lead concentration of 10 mg/dL.
[b]Risk-based concentrations for radionuclides have been calculated for use at U.S. Department of Energy facilities (DOE/ORO 1998).
[c]Weight-of-evidence analysis indicated this constituent was detected infrequently (frequency of detection of 5 percent or less).
ND = No data available.

Selenium was not detected in the other seven soil samples. Therefore, selenium is not considered an ecological COPC in surface soil at SWMU 1. DDT and its metabolites in surface soil at SWMU 1 are ecological COPCs for birds with small home ranges ingesting soil-dwelling invertebrates. DDT and its metabolites are likely to be present in surface soil in most areas of Georgia and the southeast due to the past widespread use of DDT as an insecticide. Assuming the effects of DDT, DDE, and DDD are additive, the combined exposure at each of the two sampling locations at which these constituents were detected does not exceed the lowest-observed-adverse-effect level (LOAEL) dose. The fact that maximum estimated doses lie between the no-observed-

adverse-effect level and the LOAEL suggests that the pesticides and their metabolites are not ecological COPCs in surface soil at FST-01.

Barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes (total) are present in groundwater at the Post South Central Landfill at concentrations that exceed EPA Region IV ESVs for surface water. Bis(2-ethylhexyl)phthalate was detected in groundwater at concentrations above background criteria and that resulted in estimated exposures exceeding TRVs for terrestrial ecological receptors that ingest fish and other aquatic biota. The ecological COPCs in groundwater are barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes for aquatic biota and bis(2-ethylhexyl)phthalate for birds ingesting fish exposed to groundwater potentially discharging to surface water. The concentrations of these constituents in numerous monitoring wells and direct-push groundwater samples exceeded background criteria and risk-based screening or reference values. However, none of these constituents is an ecological COPC in surface water and sediment at FST-01. This suggests that dilution, degradation, sorption, or other processes are operating to reduce the low concentrations in groundwater discharging to Taylors and Mill creeks or that groundwater at FST-01 has not yet migrated to the creeks. Groundwater flow rates indicate that it takes approximately 94 years for groundwater to reach Mill and Taylors creeks. Therefore, groundwater constituents are not ecological COPCs at the present time because they have not been indicated as ecological COPCs in surface water and sediment. The groundwater constituents are not likely to be ecological COPCs in the future because of their low concentrations and associated small hazard quotients (HQs) and the continued natural attenuation processes occurring in the subsurface soil (e.g., dilution, degradation, absorption).

In summary, the Phase II RFI (SAIC 1999) concluded that there is no present ecological risk at FST-01 and that the site is unlikely to pose an ecological risk in the future.

Baseline Human Health Risk Assessment

A BHHRA was performed to assess groundwater around FST-01. The human health COPCs identified in groundwater include acetone, benzene, bis(2-ethylhexyl)phthalate, 1,2-*cis*-dichloroethene, trichloroethene, chromium, and lead. Methylene chloride was identified as a contaminant migration COPC based on its potential to leach into groundwater, resulting in potential exposure of receptors. Although acetone was identified as a contaminant migration COPC, it was detected above its GSSL in only SC-M16, which was located in an area determined to not be impacted by FST-01; therefore, the potential for acetone to leach into groundwater from soil was not evaluated in the BHHRA. Potential future groundwater concentrations of methylene chloride were estimated using the Seasonal Soil Compartment Model. This concentration was included in the risk assessment in addition to the human health COPCs.

The potential current and future receptors evaluated included an on-site and off-site worker, a resident (adult and child), and a child playing in Taylors Creek, a point of groundwater discharge. The worker and resident were evaluated based on a potential drinking water scenario in which drinking water is obtained from the surficial aquifer. The Installation worker is the only likely receptor population. However, GA EPD guidance states that resident populations must be evaluated as both on-site and off-site receptors. Groundwater underlying FST-01 flows predominantly in the direction of Taylors Creek, where it is likely to discharge to surface waters; therefore, the potential risk to a child playing in Taylors Creek was also evaluated.

Constituents migrating off-site were modeled to determine groundwater concentrations at the points of exposure. The model assumed that the maximum measured concentration of a constituent was present in groundwater at the northern boundary of the old, inactive landfill. It was assumed that all off-site receptors come into contact with the groundwater at some point north of the site, which is the predominant direction of groundwater flow. The exposure-point groundwater concentrations of COPCs for the off-site receptors were negligible; therefore, potential risks resulting from exposure of off-site receptors would be well below target values.

Ingestion, dermal absorption, and inhalation were evaluated as the potential exposure pathways (i.e., routes of exposure of the constituent to the body). The risks associated with carcinogenic hazardous constituents were estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen [i.e., the incremental lifetime cancer risk (ILCR)]. The ILCRs for the individual carcinogens are summed to provide the total ILCR. A total ILCR of less than 1E-6 does not represent a significant carcinogenic risk. The risks associated with the systemic effects of noncarcinogenic toxicity were evaluated by comparing an estimated intake (mg/kg/day) to a reference dose (Tables 2-3 and 2-4). This ratio of estimated intake over the reference dose is termed the HQ. The sum of all of the HQs for a given exposure route (i.e., oral, inhalation, or dermal) is called the hazard index (HI). HIs less than 1.0 indicate that the sum of exposures to all of the constituents present is not likely to result in adverse health effects. Lead does not have a reference dose, but it does have a maximum acceptable blood-lead concentration of 10 µg/dL in children, which represents the most sensitive receptor population. The blood-lead levels for children ages 1 to 7 were estimated to determine if there is an unacceptable risk associated with exposure to lead in groundwater.

Table 3. Remedial Levels for Groundwater and Soil

Chemical	Groundwater Remedial Level MCL (µg/L)	Maximum Groundwater Concentration (µg/L)	Target Groundwater Concentration (µg/L)	Remedial Level Soils (mg/kg)	Maximum Soil Concentration (mg/kg)
Benzene	5	2.5	NA	NA	NA
Bis(2-ethylhexyl)phthalate	6	61.4	NA	NA	NA
Methylene chloride	NA	NA	5	3.3	13.7

NA = Not applicable.

Table 4. Location of Exceedances above Remedial Levels

Chemical	Groundwater		Soil	
	Concentration above Remedial Level (µg/L)	Location[a]	Concentration above Remedial Level (mg/kg)	Location[b]
Bis(2-ethylhexyl)phthalate	61	SC-M9	NA	NA
	7.8	NMW-2A	NA	NA
Methylene chloride	NA	NA	9.2	SC-M11
	NA	NA	13.7	SC-M12

	NA	NA	3.9	SC-M14

Note: Exceedances of acetone in surface soil were at only SC-M19, which was not impacted by SWMU 1.
[a]Groundwater locations are presented on Figure 5-5 of the Revised Final Phase II RFI Report (SAIC 1999).
[b]Surface soil locations are presented on Figure 5-1 of the Revised Final Phase II RFI Report (SAIC 1999).
NA = Not applicable.

Constituents present in groundwater at FST-01 do not present a significant noncarcinogenic risk to human health. The quantitative estimates of noncarcinogenic risks were below their target values for both on-site occupational and residential receptor populations. The carcinogenic risks for the occupational receptor population was below the target risk value of 1E-6; however, the carcinogenic risk for the on-site residential receptors exceeded the target value with an ILCR of 8.9E-6. This value includes an ILCR of 3.4E-6 resulting from exposure to methylene chloride that may leach into groundwater. The other risk drivers are benzene (ILCR = 2.5E-6) and bis(2-ethylhexyl)phthalate (ILCR = 2.1E-6).

The remedial levels for benzene and bis(2-ethylhexyl)phthalate were based on their respective MCLs (5 µg/L and 6 µg/L, respectively). The MCL for benzene was greater than the maximum detected value of 2.5 µg/L; therefore, corrective action is not required to address the presence of benzene in groundwater. Groundwater concentrations of bis(2-ethylhexyl)phthalate exceeding the remedial level were detected in only those wells (NMW-2A and SC-M9) associated with the active landfill; therefore, bis(2-ethylhexyl)phthalate is not associated with the old, inactive landfill (Table 3) and is not addressed in this Decision Document.

The remedial soil level for methylene chloride was determined to be 3.3 mg/kg and represents a concentration of the constituent in soil that is not likely to leach into groundwater and result in groundwater concentrations that exceed the MCL for methylene chloride (5 µg/L). Only four sampling locations indicated methylene chloride above the 3.3 mg/kg remedial level. SC-M11, SC-M12, SC-M14, and SC-M16 had methylene chloride concentrations of 9.2 mg/kg, 13.7 mg/kg, 3.9 mg/kg, and 52.2 mg/kg, respectively; SC-M16 is not located within the boundaries of the FST-01 (Table 4).

The exposure scenario for methylene chloride soil contamination leaching to groundwater assumes that in the future a residence will be built on-site and that the household drinking water will come directly from the surficial aquifer. Current planning under the Fort Stewart Base Master Plan (BMP), which goes through the year 2020, does not include construction of any facilities on the old, inactive portion of the landfill. Methylene chloride degrades rapidly in groundwater (its biodegradation half-life in groundwater equals 112 days); therefore, the methylene chloride potentially leaching to groundwater would completely degrade before any structure would be built on the site. In addition, methylene chloride was not detected in any of the groundwater samples associated with the old, inactive portion of the landfill, including those located in the area of the methylene chloride soil contamination (SC-M11, SC-M12, and SC-M14), indicating that natural attenuation of methylene chloride may be occurring. Therefore, given the unlikely possibility of exposure of an on-site resident to methylene chloride in the surficial groundwater and the restricted usage through 2020 under the BMP, Fort Stewart's recommendation of no further action for methylene chloride in soil, as presented in the Revised Final Phase II RFI Report, was approved by GA EPD.

In conclusion, of the two constituents detected in groundwater [benzene and

bis(2-ethylhexyl)phthalate], benzene was not detected above its MCL and bis(2-ethylhexyl)phthalate was detected in monitoring wells (NMW-2A and SC-M9) located around the active portion of the landfill, indicating that this constituent is associated with the active landfill and not the old, inactive landfill. The active portion of FST-01 is operated under Permit Nos. 089-010D (SL) and 089-020D (L), and bis(2-ethylhexyl)phthalate, which was detected above the MCL at SC-M9 and NMW-2A, will continue to be monitored through the GMP, as approved by the GA EPD Land Protection Division, and corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells will not be required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify any elevation of contaminant levels and/or development of any trends in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. The active portion of FST-01 will continue to be monitored in association with the approved GMP, and all analytical data will continue to be submitted to the GA EPD Land Protection Division.

Methylene chloride was indicated in soil above its remedial level as a contaminant migration COPC at three locations around the old, inactive portion of the landfill; therefore, methylene chloride was identified as a contaminant migration COPC in soil based on the unlikely possibility of exposure to someone constructing a residence on the site and drinking groundwater containing methylene chloride. Fort Stewart's recommendation of no further action, as presented in the Revised Final Phase II Report, was approved by GA EPD as long as restricted use of the groundwater, as currently planned in the BMP, was maintained and controlled.

JUSTIFICATION AND PURPOSE OF CORRECTIVE ACTION

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.

Remedial Response Objectives

Based on the findings of the site characterization at this site, the primary goal and purpose for implementing corrective measures at the old, inactive portion of FST-01 is limited to protection of human health and safety. To achieve this goal, two primary remedial response objectives have been established for FST-01: (1) to prohibit the ingestion of shallow groundwater from the subject site; (2) to limit the disturbance of subsurface soils to minimize contact with buried waste; and (3) to identify procedures to evaluate the subsurface characteristics prior to any construction within the boundary of the old, inactive portion of the landfill. Any corrective measures that pose a significant threat to human health and safety during implementation (e.g., methods that would involve disturbance of subsurface soils) will not be evaluated. Implementation of the selected remedial response will achieve the best overall results with respect to such factors as long-term reliability and

effectiveness, short-term effectiveness, implementability, and cost.

Conceptual Design and Implementation
Based on the level and type of subsurface soil and groundwater contamination, a cost-effective corrective action was selected that would adequately protect human health.

Table 5. Corrective Action Alternatives

Corrective Action	Description	Protection of Human Health	Cost	Comments
tive 1: Institutional s: BMP, Deed ation, Zoning Controls, ance of Existing l Barriers, Well nment, Post-mounted g Signs, Implementation l Plan	This action would require legal and local land use controls and signage to enforce restrictions on land and groundwater usage. This alternative would also include abandonment of eight groundwater monitoring wells.	Protection of human health would be primarily dependent upon enforcement of compliance with land use controls. Existing physical barriers (access gate and creek) provide effective restrictions on human access to the site to further discourage any unauthorized excavation activities.	$44,843	Least expensive prov sufficient level of protection.
ive 2: Institutional : BMP, Deed tion, Zoning Controls, andonment, Partial ence Barrier, ance of Existing Barriers, Post-mounted e-mounted Warning entation of O&M	This action would require legal and local land use controls and signage to enforce restrictions on land and groundwater usage. Physical barriers to be installed would include a 3,500-linear-foot, pretreated wood fence along the eastern boundary curving westward to SC-M18. This alternative would also include abandonment of eight groundwater monitoring wells.	In addition to the protection provided by Alternative 1, human access would be further restricted by fencing along the eastern and southeastern boundaries of the site. The fencing would be slightly more effective than signs alone in deterring or discouraging unauthorized excavation activities, but even fencing would not totally prevent someone from gaining access to the site.	$126,679	Significantly more expensive with only increase in level of protection compared Alternative 1.

Based on the technology evaluation performed for the site (see Table 5 above), Alternative 1 (see CAP, SAIC 1999) was selected because it will provide a sufficient level of protection of human health at a relatively low cost. The selected corrective action alternative 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, BMP, zoning restrictions, and signage. In addition to establishment of prohibitions for groundwater use, eight monitoring wells will be abandoned. No additional access barriers will be constructed because existing man-made and natural physical barriers, which include site access gates, Taylors Creek, existing roads, and natural and man-made drainage features, are suitable for restricting human activity.

Justification of Selection
Alternative 1 has been selected because it will provide effective protection of human health at a relatively low cost. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered cost effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized excavation below ground would be minimal and would not justify the significantly greater

expense of implementing Alternative 2. Additionally, suitable physical barriers are already present at the subject site to discourage human activity that might result in disturbance of the subsurface (e.g., vehicular traffic, hunting). Institutional controls described for Alternative 1 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 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. Warning signs and documented land use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to physical contact with the buried waste within the boundaries of the old, inactive portion of FST-01. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land use controls during ownership by DoD. Prior to the planning of any construction activities at the FSMR, the BMP must be reviewed. In addition, all construction projects will be reviewed for approval by the Base Master Planner and the Fort Stewart Directorate of Public Works during the planning stages. These land use controls will remain in effect after transfer of DoD ownership by restrictions imposed through deed recordation.

Existing natural and man-made barriers will provide long-term reliability and effectiveness in preventing unauthorized access. The existing access gates at landfill access points are closed and locked during non-operational hours. Since the installation of the gate at Wilson Avenue, the FSMR has observed a marked decrease in activity (i.e., vehicular traffic) at this site. Taylors Creek provides a natural barrier along the northern boundary of the site.

Additionally, the proposed well abandonment and groundwater use restrictions will provide an effective method for preventing the use of groundwater as drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at Fort Stewart and is not used. The BMP will be modified to officially restrict use, further avoiding use of the surficial groundwater at the site.

An annual O&M program will be administered to replace or repair warning signs, which may deteriorate over time. 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 potentially replacing or repairing warning signs.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of FST-01. Posting of warning signs together with existing access restrictions will be most effective over the short term. There is no current risk, and the site is 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 posting of signs. Suitable barriers already exist that restrict unauthorized access to the site. 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; 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 warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $44,843. Alternative 2, which would provide the same land use controls as Alternative 1 but would also include installation of fencing, was significantly more expensive ($126,679) than the selected alternative.

DECLARATION

The selected Final Remedial Action are protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to the FRA, and will be cost-effective.

Due to the fact that the selected course of action was presented in the CAP and approved by GA EPD, the five-year review will not apply to the proposed FRA.

This decision document was developed by the Department of Pubic Works at Fort Stewart, with support from the U.S. Army Corps of Engineers and SAIC.

AFZP-PWV-E (200-1a) 22 FEB 2000

MEMORANDUM FROM DIRECTOR OF PUBLIC WORKS

MEMORANDUM FOR GARRISON COMMANDER

SUBJECT: Corrective Action Plan for the Post South Central Landfill

1. Purpose. To obtain approval (and signature) of the Final Corrective Action Plan (CAP) for the Post South Central Landfill (Solid Waste Management Unit 1) at Fort Stewart, Georgia, dated December 1999, for submittal to Georgia Environmental Protection Division (GA EPD) by 15 Mar 00.

2. Discussion. The inactive portion of the Post South Central Landfill is listed on Fort Stewart's Hazardous Waste Permit #HW-045 (S&T), renewed 14 Aug 97, as Solid Waste Management Unit 1. After required investigation of the site, development of a Corrective Action Plan (CAP) was ordered by the GA EPD. The DPW's Environmental Branch recommended the least expensive alternative, the institutional controls. The controls include deed recordation requirements (page B-8). It is important to note that these are only implemented at the time of transfer of the property from government ownership. The GA EPD has tentatively approved this action agreeing that restricting access to the area via the ''institutional controls'' would eliminate the requirement for a two foot clay cap over this site (over 80 acres in size) and also eliminate the requirement for additional groundwater monitoring for the inactive portion of the site. These are major victories for Fort Stewart, as the cost of either the clay cap and/or monitoring range between $500K and $1.5 million (capital costs alone). Thus, the Environmental Branch is very pleased with GA EPD's willingness to accept the minimal institutional controls that are presented in the enclosed report.

3. Coordination. The SJA (Mr. Terry Peters) and the following DPW Divisions have reviewed the document: Operations and Maintenance, Engineering (to include Master Planning and Real Estate) and Environmental & Natural Resources. All comments have been incorporated into the Final report.

4. Resource Impact. None (Note: The inactive portion of the landfill is restricted from military maneuvers. Therefore, this is not a new restriction, but rather a formalization of current policy).

AFZP-PWV-E (200-1a)
SUBJECT: Corrective Action Plan for the Post South Central Landfill

5. Conclusions. The CAP for the Post South Central Landfill recommends Alternative 1: Institutional Controls with Post-Mounted Warning Signs. This alternative is described on pages 4-4 and 4-5 of the report, and includes installation of warning signs around the perimeter of the inactive portion of the landfill, as depicted on Figure 4-1, page 4-7. The estimated capital costs to install the 54 warning signs is $16,510 (page D-3). This work is eligible for Environmental Restoration, Army (ER,A) funding.

6. Recommendation. The GC sign the signature page found in Appendix B (page B-3) regarding the Base Master Plan and Deed Recordation Requirements.

7. The POC regarding this matter is Ms. Tressa Rutland, Directorate of Public Works Environmental Branch, at 767-2010/7919.

Encls
as

GREGORY V. STANLEY
COL, EN
Director, Public Works

8. COMMAND ACTION:

Approved ✓ Disapproved _____

1 MAR 00
Date

WILLIAM R. BETSON
COL, AR
Garrison Commander

FINAL

FORSCOM

CORRECTIVE ACTION PLAN

for the

3d Inf Div (Mech)

CAMP OLIVER LANDFILL (SOLID WASTE MANAGEMENT UNIT 2) at FORT STEWART MILITARY RESERVATION FORT STEWART, GEORGIA

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract No. DACA21-95-D-0022
Delivery Order 0062

December 2000

00-275(PPT)/113000

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FINAL

CORRECTIVE ACTION PLAN
for the
CAMP OLIVER LANDFILL
(SOLID WASTE MANAGEMENT UNIT 2)
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 0062

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

December 2000

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 22851 PROFESSIONAL ENGINEER P. STOLL

12/8/00

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

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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ACRONYMS

amsl	above mean sea level
AT123D	Analytical Transient 1-, 2-, 3-Dimensional (Model)
bgs	below ground surface
BHHRA	baseline human health risk assessment
BMP	Base Master Plan
CAP	Corrective Action Plan
CMCOC	contaminant migration constituent of concern
CMCOPC	contaminant migration constituent of potential concern
COC	constituent of concern
COPC	constituent of potential concern
DERP	Defense Environmental Restoration Program
DO	dissolved oxygen
DoD	U.S. Department of Defense
DPT	direct-push technology
DPW	Directorate of Public Works
ECOPC	ecological constituent of potential concern
EPA	U.S. Environmental Protection Agency
EPRE	ecological preliminary risk evaluation
ESV	ecological screening value
FSMR	Fort Stewart Military Reservation
GEPD	Georgia Environmental Protection Division
GSSL	Generic Soil Screening Level
HHCOC	human health constituent of concern
HHCOPC	human health constituent of potential concern
HHPRE	human health preliminary risk evaluation
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
LAS	Land Application System
MCL	maximum contaminant level
O&M	operations and maintenance
ODAST	One-dimensional Analytical Solute Transport (Model)
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
Redox	oxidation-reduction potential
RFI	RCRA Facility Investigation
SAIC	Science Applications International Corporation
SESOIL	Seasonal Soil Compartment (Model)
SRC	site-related contaminant
SVOC	semivolatile organic compound
SWMU	solid waste management unit
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VOC	volatile organic compound

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1.0 INTRODUCTION

1.1 SCOPE

This report documents the Corrective Action Plan (CAP) for the Camp Oliver Landfill, Solid Waste Management Unit (SWMU) 2 at the Fort Stewart Military Reservation (FSMR), Georgia. A Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in November and December of 1997. The revised final Phase II RFI Report for 16 SWMUs (SAIC 2000) determined that this SWMU required a CAP to evaluate appropriate remedial actions to eliminate or minimize potential risks associated with the Camp Oliver Landfill. Implementation of the remedy selected in this CAP is required for this site to protect the health of humans coming in contact with the site. 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. 0062.

The Camp Oliver Landfill is located approximately 17 miles northwest of the Fort Stewart garrison area along Fort Stewart Road 129. It is just north of the bivouac area on the northern side of a small hill and is approximately 8.8 acres in size. The landfill is reported to be 15 feet wide by 300 feet long by 5 feet to 6 feet deep (Geraghty and Miller 1992). The waste disposed of at the landfill included garbage and refuse, grass clippings, tree branches, root stumps, and chunks of asphalt and concrete. Further background information concerning the landfill is provided in Chapter 2. The history of the Camp Oliver Landfill is summarized in Section 2.1.

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" status has been assigned to the Camp Oliver Landfill for investigative purposes. As recommended by the revised final Phase II RFI Report for 16 SWMUs and as concurred to by GEPD (approval letter from Mr. Bruce Khaleghi to Colonel Gregory Stanley dated December 2000), a CAP has been prepared for SWMU 2 because buried waste will remain in place. Implementation of the selected remedy documented by this CAP is necessary to control intrusive activities at this site, to be protective of the health of humans potentially coming in contact with the buried waste, and to prevent the use of groundwater as a drinking water source. As recommended in the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000), this CAP has been prepared to evaluate the use of institutional controls to protect human health. 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 remedy and includes plans for its implementation, along with a plan for operations and maintenance (O&M) of the selected remedy. Also included in this plan are a detailed cost estimate and a schedule of implementation for the selected corrective action.

1.2 SITE BACKGROUND

In 1980 and 1981, a groundwater and surface water investigation was performed at the site. The investigation indicated the presence of iron in groundwater at levels that exceeded the drinking water standard. Surface water analysis indicated high iron concentrations near the landfill and fecal coliform contamination. A Phase I RFI was conducted at SWMU 2 to determine if a release to the environment had occurred and to decide if the site had the potential for a release to the environment. The results of the Phase I RFI conducted in July and October 1993 indicated that metals were present in the subsurface soil,

groundwater, and surface water. Based on these findings, GEPD instructed the Fort Stewart Directorate of Public Works (DPW) to conduct a Phase II RFI of the landfill.

The objectives for the Phase II RFI, as defined by the Work Plan (SAIC 1997) approved by GEPD on October 10, 1997, were as follows:

- determine the horizontal and vertical extents 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.

The scope of the Phase II RFI fieldwork included the activities listed below.

- Initial screening consisting of using direct-push technology (DPT) techniques to collect groundwater samples from three Geoprobe borings for volatile organic compound (VOC) analysis. Determination of the characteristics of the leachate at this site using Geoprobe screening locations.

- Installation of a vertical-profile boring in the center of the landfill to determine the vertical extent of groundwater contamination. Collection of groundwater grab samples at 10-foot intervals and analysis for VOCs.

- Installation of five soil borings.

- Installation of a new background monitoring well because the existing background well (MW1) was dry. Abandonment of MW1 in accordance with GEPD requirements. Installation of two new downgradient monitoring wells. Redevelopment of existing wells. Collection of geotechnical soil samples from the three monitoring well boreholes.

- Collection of a surface soil sample and a subsurface soil sample from each boring/well. Also, collection of three surface soil samples from within the boundary of SWMU 2. Analysis of all surface and subsurface soil samples for VOCs, semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and RCRA metals.

- Collection of groundwater samples from seven monitoring wells, and analysis for VOCs, SVOCs, pesticides/PCBs, and RCRA metals. Measurement of conductivity, temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (Redox), and turbidity in the field during sampling.

- Collection of two surface water samples and two sediment samples from Canoochee Creek. The upstream location was northwest of the site, while the downstream location was north-northeast of the site.

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 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. The Camp Oliver Landfill (SWMU 2) is a listed SWMU in Fort Stewart's Subpart B Permit (Appendix A) and, therefore, is subject to investigation according to Title 40, Code of Federal Regulations, Part 264.101(c) [as reported in Section 10.1 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: (1) Introduction, (2) Site Characterization and Remedial Investigation Results, (3) Justification/Purpose of Corrective Action, (4) Screening of Corrective Actions, (5) Conceptual Design and Implementation Plan, and (6) References. Chapter 1 (Introduction) provides an explanation of the scope of the CAP, presents general background information on the FSMR and specific background information on the site, and provides regulatory background information. Chapter 2 (Site Characterization and Remedial Investigation Results) provides an overview of the site; physical and environmental descriptions; and the nature and extent of contamination, contaminant fate and transport, and preliminary risk evaluation information. Chapter 3 (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. Chapter 4 (Screening of Corrective Actions) presents an evaluation of corrective actions and screens the corrective actions against established objectives and balancing factors. Chapter 5 (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. Reference information is presented in Chapter 6. The O&M Plan for the selected remedy is presented as Appendix A. Appendix B presents the Base Master Plan (BMP) and deed recordation requirements. Appendix C presents a site description, direction to the site, and the topographic surveys of SWMU 2. Appendix D presents cost estimates for the alternatives.

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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 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. These activities comprise the Installation's primary mission today. The 24th Infantry Division, which was reflagged as the 3d Infantry Division in May 1996, was permanently stationed at Fort Stewart in 1975.

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 Camp Oliver Landfill is located northwest of the garrison area within Evans County (Figure 2-3).

2.1 SITE LOCATION AND HISTORY

The Camp Oliver Landfill is located approximately 17 miles northwest of the Fort Stewart garrison area along Fort Stewart Road 129. It is just north of the bivouac area on the northern side of a small hill. From the 1960s to 1979, the area was used for disposal of refuse from troop training activities and nearby residents via open-pit burning. The landfill was officially closed in 1970; however, the trench method of solid waste disposal was reported to have continued. General refuse from ground maintenance activities and construction debris were placed in the landfill from 1979 to 1984 during the annual 3- to 4-month period of training activities. The landfill is reported to be 15 feet wide by 300 feet long by 5 feet to 6 feet deep (Geraghty and Miller 1992). The waste disposed of at the landfill included garbage and refuse, grass clippings, tree branches, root stumps, and chunks of asphalt and concrete. No evidence of disposal of toxic or hazardous wastes was indicated in the records searched by Environmental Science and Engineering (1982). There is little obvious surface evidence that a landfill or open dumping area existed. During a site reconnaissance in November 1995, small soil piles, some roofing tin, and wooden construction-type debris were observed. Also, spent small weapons cartridges were observed in the ditch along the site's southwestern and southeastern boundaries. A site reconnaissance in September 1996 indicated no evidence of any landfill operations. Grass, small trees, and bushes now cover the area.

Based on the findings presented in the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000), a "no further action required" status was assigned to the investigation of the nature and extent of potential contamination associated with SWMU 2. As recommended by the revised final Phase II RFI Report for 16 SWMUs and as concurred to by GEPD (approval letter from Mr. Bruce Khaleghi to Colonel Gregory Stanley dated December 2000), a CAP was recommended for SWMU 2 because buried waste will remain in place. The CAP is necessary to control intrusive activities at this site, to be protective of the health of humans potentially coming in contact with the buried waste, and to prevent the use of groundwater as a drinking water source.

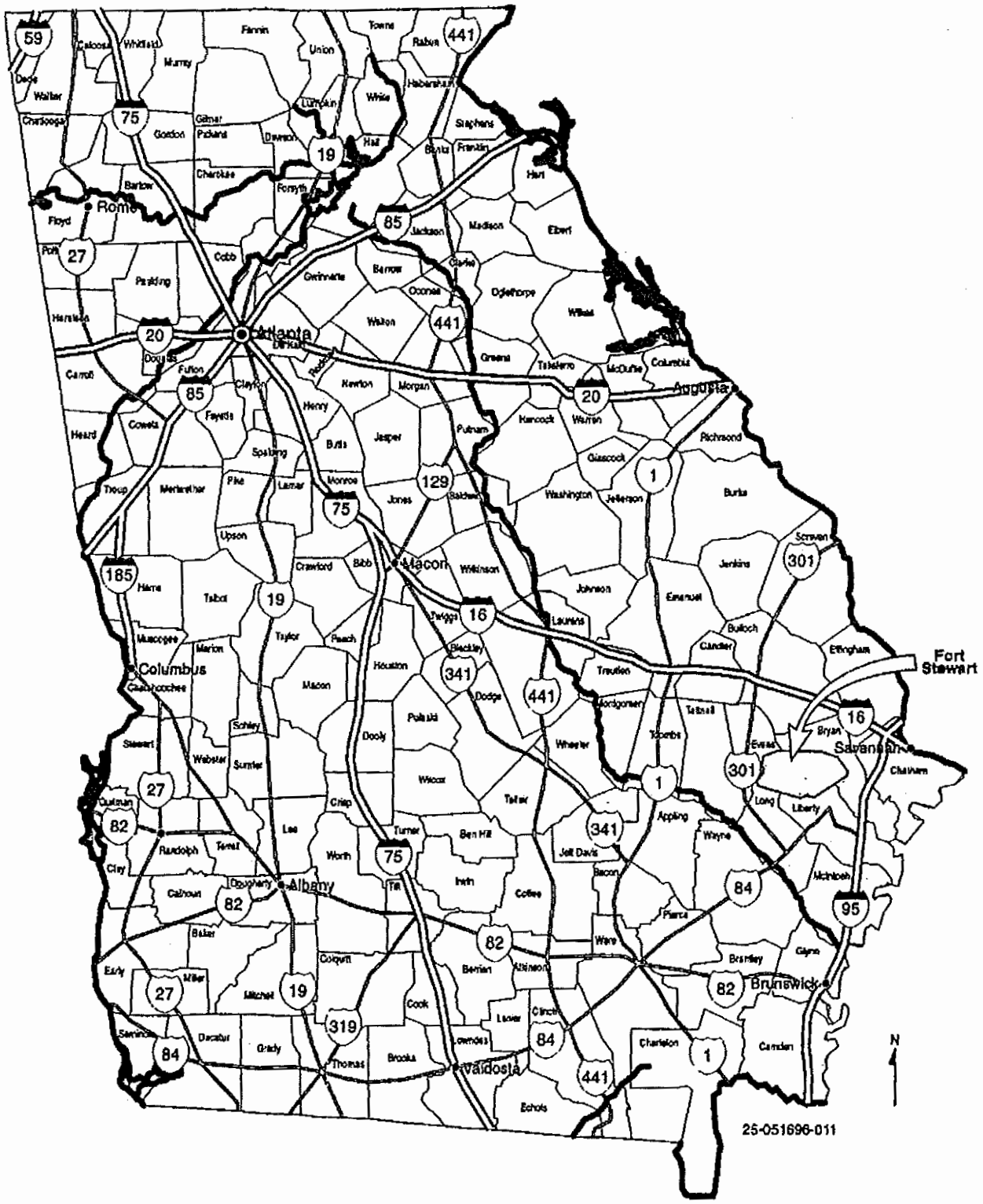

Figure 2-1. Regional Location Map for Fort Stewart Military Reservation, Georgia

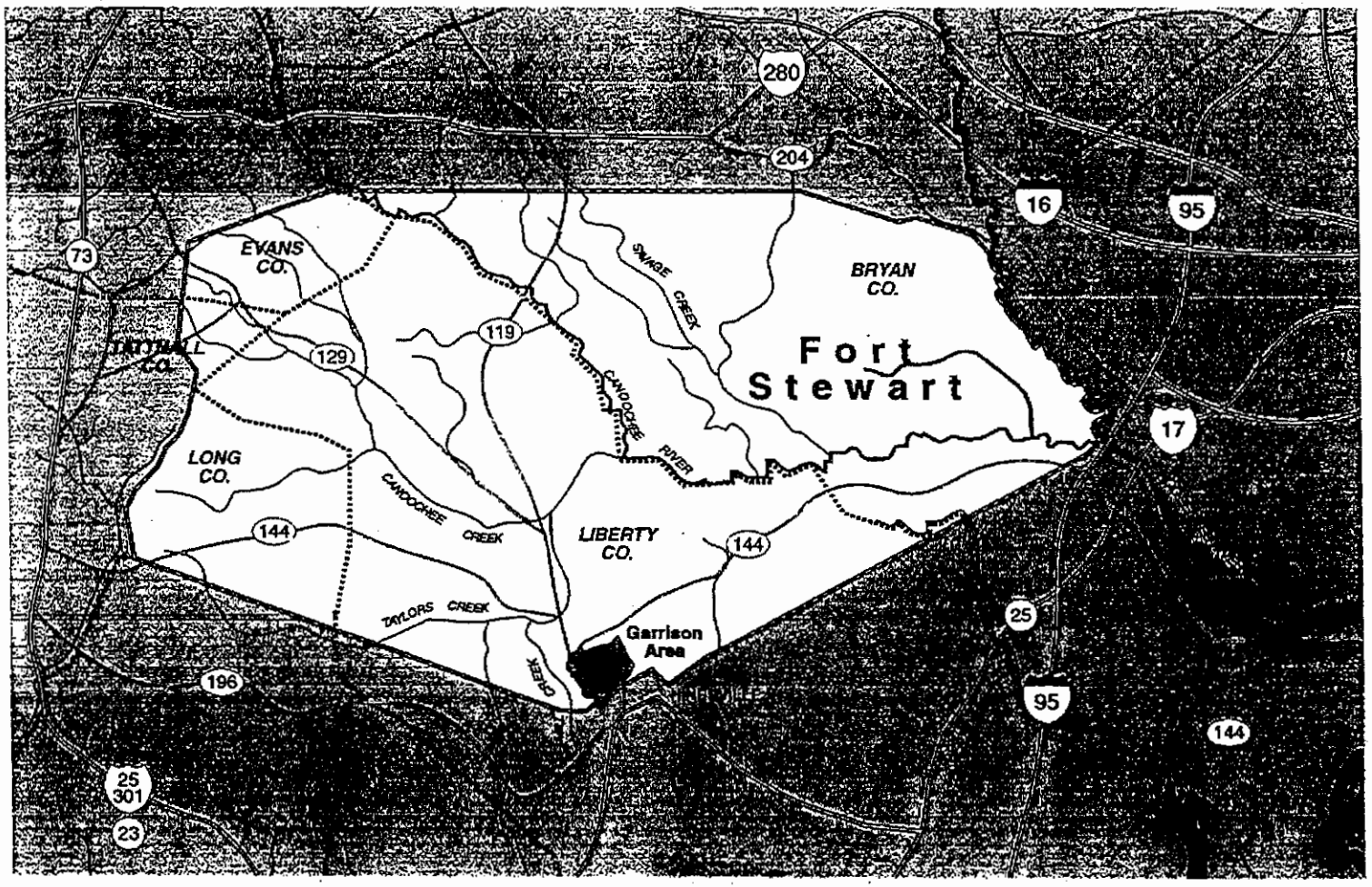

Figure 2-2. Location Map for Fort Stewart Military Reservation, Georgia

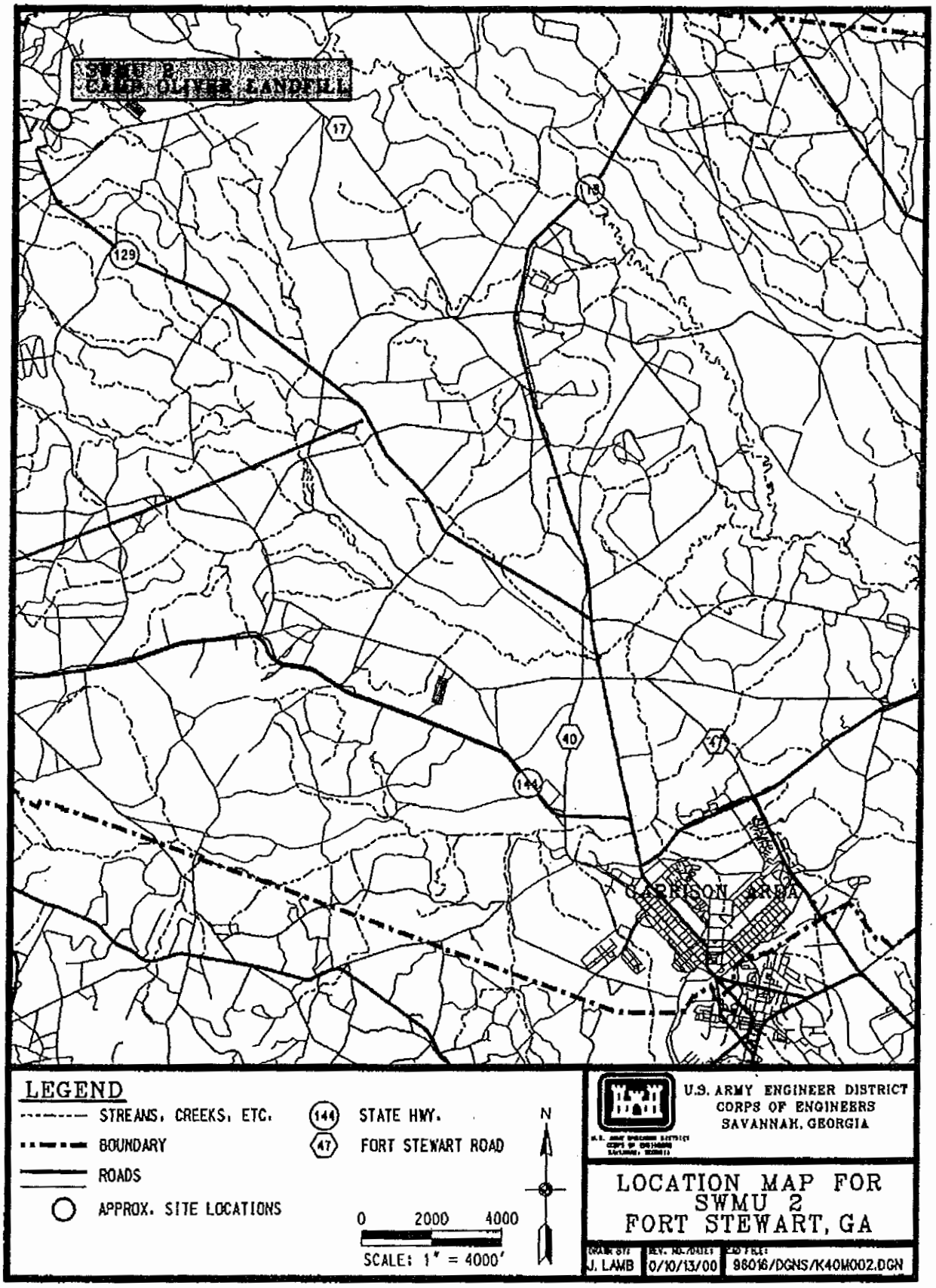

Figure 2-3. Location of the Camp Oliver Landfill (SWMU 2), Fort Stewart, Georgia

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).

SWMU 2 is approximately 8.8 acres in size and consists mostly of unmanaged grasslands with immature trees. A barbed-wire fence runs along the western boundary of the landfill. Areas of dense trees cover some portions. Existing site features and topography are presented in Figure 2-4. There are approximately 25 feet of relief across the site. The elevation of the site is approximately 150 feet amsl along the southern boundary and slopes gently to approximately 125 feet amsl along the northern boundary. Canoochee Creek is located approximately 450 feet north of the northern boundary of SWMU 2. The surface water flow direction is from the northern boundary of SWMU 2 toward Canoochee Creek.

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).

2.3 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 in thickness and is dominated by clastics. The Tertiary section is approximately 2,170 feet in thickness 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.

Boring logs showing the types of soil encountered during the Phase II RFI at the Camp Oliver Landfill in soil screening probes, groundwater screening probes, and monitoring well boreholes are provided in Appendix B of the revised final Phase II RFI Report (SAIC 2000). Geological cross sections of the site, depicting the lithology and stratigraphy of the unconsolidated soil deposits beneath the site, as inferred

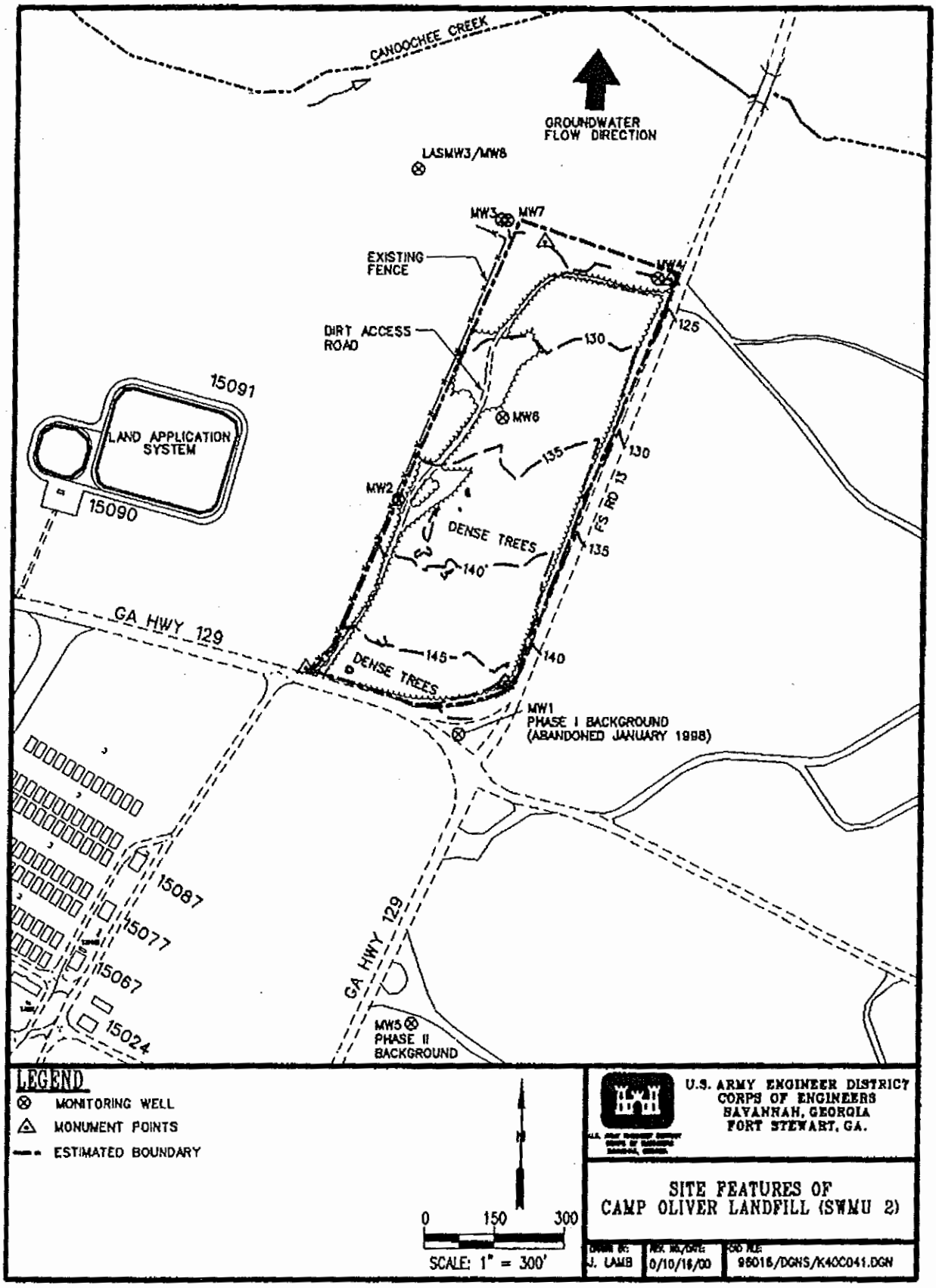

Figure 2-4. Site Features of the Camp Oliver Landfill (SWMU 2), Fort Stewart, Georgia

from the soil boring logs, are shown on Figures 10.1-2 and 10.1-3 of the revised final Phase II RFI Report (SAIC 2000).

The cross sections indicate that the soil present across the SWMU 2 landfill consists of alternating layers of sand and clayey sands, as shown in cross sections A-A′ and B-B′ (Figures 10.1-2 and 10.1-3) of the revised final Phase II RFI Report (SAIC 2000).

Geotechnical soil samples were collected from the three monitoring well boreholes, and the results are presented in Table 10.1-3 of the revised final Phase II RFI Report (SAIC 2000). The geotechnical analytical results indicated that tested soil was sand, with the proportion of fine-grained particles varying from 3.7 percent to 11.8 percent by weight. Soil from the screened intervals in MW5 and MW6 indicated a plasticity limit of 21 and 21.8, respectively; however, soil from MW7 was nonplastic. The soil from the screened interval in MW5 had a permeability of 1.40×10^{-6} cm/sec, which is typical for 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 northeastern boundary of the reservation). Canoochee Creek is a tributary of the Canoochee River that drains much of the western portion of the FSMR. Canoochee Creek is located approximately 450 feet north of the northern boundary of the landfill. Based on the topography, the surface water flow direction is to the north toward Canoochee Creek.

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 aquifer, 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. This aquifer could be used for domestic lawn and agricultural irrigation; however, there are no wells in the area of SWMU 2 known to be used for these purposes.

Water levels were measured in January and February of 1998 in seven of the eight new and existing monitoring wells at the Camp Oliver Landfill. [One of the existing monitoring wells (MW1) was abandoned due to insufficient water in the well.] Elevation of the water table varied from approximately 119 feet amsl along the northern boundary of the site to approximately 135 feet amsl along the southern boundary of the site. Figure 10.1-4 of the revised final Phase II RFI Report (SAIC 2000) presents a map of the potentiometric surface based on the water levels measured during the Phase II RFI. The shallow groundwater flow direction across the site is to the north (Figure 2-4) toward Canoochee Creek, and the hydraulic gradient is 0.0148 foot/foot.

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.

Both terrestrial and aquatic fauna are abundant in the unimproved areas of the FSMR. Major game species found on the Installation include white-tailed deer, feral hog, wild turkey, rabbit, squirrel, and bobwhite in addition to numerous other mammal, bird, reptile, and amphibian species (Environmental Science and Engineering 1982). Dominant fish include bluegill, largemouth bass, crappie, sunfish, channel catfish, minnows, and shiners. Three federally listed threatened or endangered species reside at the FSMR: the American bald eagle, Eastern indigo snake, and red-cockaded woodpecker.

The habitats at SWMU 2 are classified as "unmanaged grasslands" and "aquatic habitats." The site includes successional fields of unmanaged grasses, with scattered mature hardwoods and immature pine. Unimproved roads run within 50 feet of the southern and eastern sides of the site's boundaries. A mature pine-oak forest borders the northern and northwestern sides. Surface water runoff flows into Canoochee Creek, which runs within 450 feet of the northern boundary of SWMU 2.

Groundhog holes were abundant throughout the grass-covered area of the site, and nine-banded armadillos were spotted on many occasions throughout the investigation. Evidence of white-tailed deer and coyote (*Canis latrans*) was also apparent.

2.7 NATURE AND EXTENT OF CONTAMINATION

The results of chemical analyses performed during the Phase I and Phase II RFIs indicate that soil, groundwater, and sediment contain organic and metal contaminants at concentrations greater than their reference background concentrations. No contaminants were detected in surface water.

The reference background criteria for the Camp Oliver Landfill 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 the Burn Pits (SWMUs 4A–4F), Active Explosive Ordnance Disposal 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) is presented in Table 5-1 of the revised final Phase II RFI Report (SAIC 2000).

EPA Region IV methodology (EPA 1995) was used as guidance for the development of the background data set for screening metals data. In cases in which enough samples (e.g., more than 20) are collected to define background, a background upper tolerance level can be calculated. In cases in which too few samples (e.g., fewer than 20) are collected to define background, background can be calculated as two times the mean background concentration (EPA 1995). 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, 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 (SRCs) if their concentrations were above the reference background concentrations. Organics were considered to be SRCs if they were simply detected because organic constituents are considered anthropomorphic in nature.

Appendix G of the revised final Phase II RFI Report (SAIC 2000) presents a summary of the background data as well as the two-times-mean background concentrations. Given the limited background data, the mean concentration established by the U.S. Geological Survey (USGS) for soil in the eastern United States (USGS 1984) 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. The nature and extent of contamination by medium is summarized below. A tabular summary of SRCs by medium for the Camp Oliver Landfill is presented in Table 2-1.

2.7.1 Surface Soil

Eleven surface soil samples were collected at SWMU 2 during the Phase II RFI from three surface soil locations, five soil boring locations, and three monitoring wells. 2-Butanone and acetone were detected in one surface soil sample from MW6. Acetone was also detected in surface soil samples collected from SB2 and SB5. Bis(2-ethylhexyl)phthalate was detected in one of the surface soil samples at SB2. Fourteen pesticides were detected in the surface soil. These pesticides were 4,4'-DDD; 4,4'-DDE; 4,4'-DDT; aldrin; alpha-chlordane; alpha-BHC; delta-BHC; dieldrin; endosulfan II; endosulfan sulfate; endrin ketone; heptachlor; heptachlor epoxide; and methoxychlor. Arsenic, barium, cadmium, chromium,

Table 2-1. Summary of Site-related Contaminants, SWMU 2

Analyte	Maximum Concentration (mg/kg)			Maximum Concentration (µg/L)	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
2-Butanone	0.0055	0.0076	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	ND	9.9	ND
Acetone	0.511	ND	ND	ND	ND
Toluene	ND	ND	ND	15.6	ND
Xylenes, total	ND	ND	ND	15.3	ND
Semivolatile Organic Compounds					
Bis(2-ethylhexyl)phthalate	1.1	0.229	ND	ND	ND
Pesticides/PCBs					
4,4'-DDD	0.0032	ND	ND	ND	ND
4,4'-DDE	0.01	0.0088	ND	ND	ND
4,4'-DDT	0.0042	0.0089	ND	ND	ND
Aldrin	0.0011	ND	ND	ND	ND
alpha-BHC	0.00024	0.00056[a]	ND	ND	ND
alpha-Chlordane	0.00095	ND	0.00071	ND	ND
delta-BHC	0.0016	ND	ND	ND	ND
Dieldrin	0.003	ND	ND	ND	ND
Endosulfan II	0.0018	ND	ND	ND	ND
Endosulfan sulfate	0.0032	ND	ND	ND	ND
Endrin ketone	0.0026	ND	ND	ND	ND
Heptachlor	0.001	ND	ND	ND	ND
Heptachlor epoxide	0.00076	ND	ND	ND	ND
Methoxychlor	0.012	ND	ND	ND	ND
Metals					
Arsenic	3.4	BRBC	ND	ND	ND
Barium	29.5	24.5	ND	BRBC	BRBC
Cadmium	0.2	BRBC	ND	ND	ND
Chromium	47.5	22.5	ND	ND	BRBC
Lead	19.7	BRBC	ND	12.6[a]	ND
Mercury	0.04	0.23	ND	0.21	ND
Selenium	BRBC	BRBC	ND	2.5	ND

[a]Maximum concentration detected excluding data from the site-specific background location (MW5).
BRBC = Below reference background criterion.
ND = Not detected.

lead, and mercury were detected in surface soil samples from one or more of the monitoring wells, soil borings, and surface soil locations at concentrations above the reference background criteria and were considered to be potential SRCs. However, arsenic, barium, lead, and mercury might not be site related. Arsenic was detected at less than two times the reference background criterion, including the site-specific background concentration. While barium was elevated above background at most locations, the maximum concentration was less than two times background, and the sampling locations at which the exceedances of reference background occurred were widely distributed, suggesting that barium occurs naturally in surface soil in this area. Cadmium was detected at only one surface soil sampling location at a concentration only slightly above the reference background criterion. Lead was found in only one surface soil sample, SS3, at a concentration that was only slightly more than two times the reference background

criterion. Mercury was detected at a maximum concentration of 0.04 mg/kg, compared to the reference background criterion of 0.03 mg/kg.

2.7.2 Subsurface Soil

Eight subsurface soil samples were collected from five soil borings and three monitoring wells during the Phase II RFI. 2-Butanone was the only VOC detected in subsurface soil samples and is considered to be an SRC in subsurface soil. Bis(2-ethylhexyl)phthalate was the only SVOC detected (SB5) and is considered to be an SRC in subsurface soil. Alpha-BHC was detected in subsurface soil samples from MW5 and SB1. No other pesticides/PCBs were detected in the subsurface soil samples from the monitoring wells. 4,4'-DDE and 4,4'-DDT were detected in soil boring SB1. No pesticides/PCBs were detected in the subsurface soil samples from SB2, SB3, SB4, and SB5. 4,4'-DDE; 4,4'-DDT; and alpha-BHC are considered to be SRCs in subsurface soil. Analytical results from subsurface soil samples collected during the Phase I RFI did not indicate concentrations of RCRA metals that exceeded reference background concentrations. However, analytical results from subsurface soil samples collected from SB2, SB3, and SB5 during the Phase II RFI indicated concentrations of barium, chromium, and mercury that did exceed reference background concentrations. RCRA metals that exceeded the reference background criteria at this site were primarily detected at locations around its perimeter, with no metals detected at the most central sampling location (MW6). Barium, chromium, and mercury are considered to be potential SRCs in subsurface soil.

2.7.3 Groundwater

Three groundwater screening wells and one vertical-profile boring (VP1) were installed within the boundary of the landfill using DPT techniques and were analyzed for VOCs. The analytical laboratory missed the holding times for VOCs for one of the intervals of the vertical-profile boring installed during the initial sampling endeavor (January 1998). Another vertical-profile boring (VP2) was installed next to the previous location, and groundwater was resampled in May 1998; however, the groundwater was inadvertently analyzed for only benzene, toluene, ethylbenzene, and total xylenes. In addition, seven groundwater samples were collected from three newly installed monitoring wells and four existing monitoring wells. The groundwater samples from the monitoring wells were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals.

VOCs were detected in groundwater at relatively low concentrations at three sampling locations (MW6, VP1 and VP2). These VOCs included 4-methyl-2-pentanone, toluene, and total xylenes, which were considered to be potential SRCs in groundwater. Bis(2-ethylhexyl)phthalate was detected in MW8 at a concentration of 240 µg/L, which exceeds its maximum contaminant level (MCL). Bis(2-ethylhexyl)phthalate was believed to be the result of field or laboratory contamination; therefore, with the concurrence of GEPD (SAIC 1999), the groundwater at MW8 was resampled on July 10, 1999. Bis(2-ethylhexyl)phthalate was not detected in MW8 during the resampling. The elevated concentration of bis(2-ethylhexyl)phthalate initially detected was considered to be the result of field or laboratory contamination; therefore, bis(2-ethylhexyl)phthalate is not an SRC at SWMU 2. No pesticides/PCBs were detected in the groundwater samples.

Mercury was detected at four of the six groundwater sampling locations that were analyzed for RCRA metals at concentrations that slightly exceeded the reference background criterion. Lead was detected at two locations (MW5 and MW8) at concentrations that exceeded the reference background criterion. Lead exceeded its MCL at MW5, which is a background sampling location. Selenium was detected at only one location, MW3, at a concentration that slightly exceeded the reference background criterion. Barium was detected at all monitoring well sampling locations at concentrations that were below the reference background criterion. Lead, mercury, and selenium are considered to be potential SRCs in groundwater.

Lead is not considered to be site related because it was detected at an off-site location (MW8), it was not detected in any on-site wells above the reference background criterion, and it was detected at its highest concentration at the upgradient sampling location. Mercury was detected at levels near the detection limit and was detected above the reference background criterion at the upgradient sampling location; therefore, mercury is not considered to be site related. Selenium was detected in only one well (MW3), which is downgradient, but at a concentration only slightly above the reference background criterion (i.e., 2.5 µg/L versus 1.90 µg/L); therefore, selenium is not considered to be site related.

2.7.4 Surface Water and Sediment

Two surface water and sediment samples were collected from Canoochee Creek, one upstream sample and one downstream sample. The surface water and sediment samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals.

No organic contaminants were detected in surface water, and metals constituents were detected below reference background criteria; therefore there are no SRCs in surface water.

No VOCs, SVOCs, or RCRA metals were observed in the downstream sediment sample (SWS1). Alpha-chlordane, a pesticide, was observed in the downstream and upstream sediment samples. The downstream concentration of alpha-chlordane was less than the upstream concentration. Alpha-chlordane is considered to be a potential SRC in sediment.

2.8 CONTAMINANT FATE AND TRANSPORT

2.8.1 Leachability Analysis

Contaminant fate and transport analysis provided an assessment of the potential migration pathways and transport mechanisms affecting the chemicals at the site. In particular, the leachability of contaminants from soil and sediment to groundwater and their natural attenuation in groundwater were evaluated.

The site characterization identified inorganic, organic, and pesticide SRCs in surface soil and subsurface soil. Two VOCs, one SVOC, six metals, and 14 pesticides were identified as SRCs in soil. These constituents were compared to EPA Generic Soil Screening Levels (GSSLs; EPA 1996a) to determine if these constituents may leach from soil into groundwater at concentrations that exceed groundwater standards [i.e., concentrations that exceed the MCL or, in the absence of an MCL, the risk-based concentration for drinking water (EPA 1996b)].

Based on the leachability analysis, arsenic, chromium, mercury, alpha-BHC, and delta-BHC exceeded their respective GSSLs and were indicated as contaminant migration constituents of potential concern (CMCOPCs) in soil.

No CMCOPCs were identified in sediment.

Of the CMCOPCs, alpha-BHC, delta-BHC, chromium, and arsenic were not detected in groundwater. Mercury was detected in groundwater, but at concentrations that did not exceed its MCL.

2.8.2 Fate and Transport Modeling

Fate and transport modeling was performed to quantitatively assess the risks associated with exposure to CMCOPCs (alpha-BHC, delta-BHC, arsenic, chromium, and mercury) in soil and ecological constituents

of potential concern (ECOPCs; see Section 2.9.2) for the baseline human health risk assessment (BHHRA; see Section 2.9.3) and ecological risk evaluation, respectively.

2.8.2.1 Migration to groundwater beneath the source

Potential groundwater concentrations resulting from leaching of CMCOPCs (arsenic, chromium, mercury, alpha-BHC, and delta-BHC) were estimated using the Seasonal Soil Compartment (SESOIL) Model. The maximum concentrations of constituents detected above the water table were used as the source concentrations for the SESOIL model. A description of the SESOIL model and the results of the SESOIL modeling are summarized in Appendix K of the revised final Phase II RFI Report (SAIC 2000).

Alpha-BHC and arsenic were eliminated as CMCOPCs and were not modeled. Alpha-BHC was not modeled because the maximum concentration (0.00056 mg/kg) was detected below the water table and would not be a source of alpha-BHC leaching into the groundwater from the unsaturated zone. The other soil samples collected above the water table did not have concentrations of alpha-BHC that exceeded its GSSL. In addition, alpha-BHC was not detected in the groundwater; therefore, alpha-BHC was not considered to be a CMCOPC and was not evaluated further.

The maximum concentration of arsenic was identified in surface soil. However, this concentration (3.4 mg/kg) did not exceed the subsurface soil reference background criterion for arsenic (8.04 mg/kg). Given the relative thickness of subsurface soil and the higher concentrations of arsenic present in this soil stratum, the contribution of arsenic to groundwater from surface soil is not likely to be significant. In addition, arsenic was not identified as a constituent of potential concern (COPC) in groundwater, indicating that arsenic is not leaching to groundwater in significant concentrations; therefore, the potential for arsenic to leach into groundwater was not addressed further.

SESOIL modeling input parameters and results for delta-BHC, mercury, and chromium are presented in Appendix K, Tables K-2.1, K-3.1, and K-4.1 of the revised final Phase II RFI Report (SAIC 2000), respectively. Modeling results indicated that delta-BHC naturally attenuates before reaching the water table. The SESOIL model estimated the maximum groundwater concentrations of mercury and chromium to be 0.0025 mg/L and 1.73 mg/L, respectively.

2.8.2.2 Migration of groundwater to surface water

COPCs [CMCOPCs leaching to groundwater and ECOPCs (see Section 2.9.2)] in groundwater may migrate to Canoochee Creek. The One-dimensional Analytical Solute Transport (ODAST) Model was used to estimate groundwater concentrations of the CMCOPCs (mercury and chromium) and ECOPCs [lead and mercury (see Section 2.9.2)] at Canoochee Creek. The Analytical Transient 1-,2-,3-Dimensional (AT123D) Model was used to estimate the surface water concentration of organic constituents (total xylenes, an ECOPC) in groundwater. The models assumed that the concentrations in Canoochee Creek are equal to the concentrations in the adjacent groundwater. This assumption is conservative, given that it assumes that there is no dilution of the constituents upon discharge of groundwater into the surface water body.

The ODAST model assumed that the concentration of metals at the source location remains constant at the SESOIL–predicted concentration for a period of 70 years. The ODAST model was simulated for a period of 1,000 years. The ODAST modeling results indicated that chromium and lead do not migrate to Canoochee Creek and estimated that the maximum concentration of mercury in groundwater adjacent to Canoochee Creek was 0.45 µg/L.

The AT123D model predicted the concentration of total xylenes at Canoochee Creek (the nearest surface water body) to be 0.31 μg/L.

2.9 PRELIMINARY RISK EVALUATION

2.9.1 Human Health Preliminary Risk Evaluation

The human health preliminary risk evaluation (HHPRE) included a Step 1 risk evaluation to determine potential human health risks associated with the contaminants present at the site. Human health constituents of potential concern (HHCOPCs) were defined as those constituents present at concentrations higher than their reference background criteria and higher than their respective risk-based or applicable or relevant and appropriate requirement–based screening criteria. SRCs for surface soil, subsurface soil, groundwater, surface water, and sediment evaluated under the HHPRE are presented in Table 2-1.

Arsenic and chromium in surface soil are considered to be HHCOPCs because they exceeded their risk-screening criteria for exposure of a residential receptor.

No HHCOPCs were identified in subsurface soil, groundwater, surface water, or sediment.

A BHHRA (see Section 2.9.3) was performed to quantitatively assess the risks associated with exposure to the HHCOPCs, arsenic and chromium, in surface soil.

2.9.2 Ecological Preliminary Risk Evaluation

The Phase II RFI performed an ecological preliminary risk evaluation (EPRE) for potential terrestrial and aquatic receptors [see Chapter 8 of the revised final Phase II RFI Report (SAIC 2000)]. The EPRE for the Camp Oliver Landfill identified ECOPCs in groundwater (total xylenes, lead, and mercury) based on a comparison of their maximum site concentrations to EPA Region IV ecological screening values (ESVs; EPA 1996c). No SRCs were identified in surface water. No ECOPCs were identified in sediment. Preliminary risk calculations for ECOPCs identified in surface soil (4,4'-DDE; cadmium; chromium; and lead) and groundwater (total xylenes, lead, and mercury) were based on a comparison of detected concentrations to toxicity reference values for surrogate species representing ecological receptors. Uncertainty analysis of the ECOPCs in surface soil and groundwater resulted in their being eliminated as ECOPCs. The uncertainty analysis is summarized below.

4,4'-DDE; cadmium; chromium; and lead in surface soil at SWMU 2 were identified as ECOPCs because the preliminary hazard quotients (HQs) exceeded 1. Supplemental risk calculations for 4,4'-DDE; cadmium; chromium; and lead resulted in HQs less than 1; therefore, 4,4'-DDE; cadmium; chromium; and lead in surface soil are unlikely to pose a risk to robins (surrogate species), and further investigation and/or evaluation of these constituents in surface soil is not warranted.

Total xylenes, lead, and mercury were identified as ECOPCs because they occur at levels that exceed the EPA Region IV surface water ESVs (EPA 1996c). These ECOPCs are unlikely to be potential hazards to aquatic biota living in downgradient surface water bodies because the maximum concentrations at the point of discharge to the nearest surface water body predicted by modeling do not exceed the EPA Region IV surface water ESVs under current conditions and are unlikely to do so under future conditions.

Mercury in surficial groundwater at SWMU 2 was identified as a potential ECOPC for terrestrial receptors at this site during the preliminary risk evaluation. Supplemental risk calculations resulted in an HQ of less than 1, and modeling indicated that the maximum concentrations at the point of discharge to

the nearest surface water body do not exceed surface water ESVs; therefore, mercury is not considered to be an ECOPC in groundwater for terrestrial receptors.

In summary, the Phase II RFI Report (SAIC 2000) concluded that there is no present ecological risk at SWMU 2 and that the site is unlikely to pose an ecological risk in the future.

2.10 BASELINE HUMAN HEALTH RISK ASSESSMENT

A BHHRA was performed to assess surface soil, potential migration of contaminants from soil to groundwater, and subsequent migration of contaminants to surface water around SWMU 2. The COPCs addressed in the baseline risk assessment included HHCOPCs (arsenic and chromium) and CMCOPCs (alpha-BHC, delta-BHC, arsenic, chromium, and mercury). After further analysis of the potential for the CMCOPCs to migrate to groundwater (see Section 2.8), it was concluded that alpha-BHC, delta-BHC, and arsenic are not likely to leach into groundwater at concentrations that present an unacceptable risk to human health; therefore, the potential risks associated with these constituents as CMCOPCs were not quantified in the HHBRA. In addition, modeling indicated that chromium in groundwater was not likely to migrate to surface water (see Section 2.8.2.2); therefore, chromium in surface water was not quantified as an HHCOPC. The baseline risk assessment included an evaluation of the risks associated with exposure to the following COPCs: arsenic (surface soil), chromium (surface soil and groundwater), and mercury (groundwater and surface water). The potential risks associated with exposure to COPCs in groundwater were based on the estimated groundwater concentrations derived from the leachate modeling (see Section 2.8.2.1). The surface water concentration for mercury was estimated based on the groundwater migration model (see Section 2.8.2.2).

Ingestion, dermal absorption, and inhalation were evaluated as the potential exposure pathways (i.e., routes of exposure of the constituent to the body). The risks associated with carcinogenic hazardous constituents were estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen [i.e., the incremental lifetime cancer risk (ILCR)]. The ILCRs for the individual carcinogens are summed to provide the total ILCR. A total ILCR of less than 1×10^{-6} does not represent a significant carcinogenic risk. The risks associated with the systemic effects of noncarcinogenic toxicity were evaluated by comparing an estimated intake (mg/kg/day) to a reference dose. This ratio of estimated intake over the reference dose is the HQ. The sum of all of the HQs for a given exposure route (i.e., oral, inhalation, or dermal) is the hazard index (HI). HIs less than 1.0 indicate that the sum of exposures to all of the constituents present is not likely to result in adverse health effects.

Given the absence of potential migration pathways resulting in exposure of a receptor population, current land-use receptor populations are limited to on-site receptors. The receptor populations assessed for current land use include an Installation worker and a juvenile trespasser. The hunter is also a potential current land-use receptor, but it was determined that exposure via bioaccumulation into venison is not likely to be a significant pathway, so this receptor was not assessed. Future land-use populations include an Installation worker, an on-site trespasser, an off-site juvenile wader, and an off-site sportsman fishing in Canoochee Creek. The Installation worker and resident adult represent both on-site and off-site receptors. The resident population was divided into a child and an adult resident because the differences in behavior, exposure duration, and physiology between an adult and a child result in different intakes. The child is more sensitive to noncarcinogenic toxicity because this receptor has a higher intake relative to body weight. Although the resident adult is often more sensitive to carcinogenic effects, given the receptor's longer exposure duration, the resident child has significantly higher intake rates for certain exposure pathways that offset the adult's longer exposure duration, resulting in higher carcinogenic risks for the resident child; therefore, the resident adult was evaluated for only carcinogenic risks, but the resident child was evaluated for both noncarcinogenic and carcinogenic risks. The reader is referred to the

revised final Phase II RFI Report (SAIC 2000), Appendix I, Section 1.2.2 ("Identification of Potential Receptor Populations and Associated Exposure Pathways") for a more detailed discussion on the potential exposure pathways and the differences between the exposures of adult and child resident receptors.

All of the identified COPCs are considered to be constituents of concern (COCs) based on the results of the risk characterization. The risk values for chromium and mercury in groundwater exceeded the systemic target risk value for all of the potentially exposed receptors. The risk values for arsenic in soil exceeded the target risk values for the current and future on-site Installation worker, the on-site resident child, and the on-site resident adult. The risk values for chromium in surface soil exceeded the target risk values for the on-site resident child. Mercury migrating to surface water exceeded the systemic target risk value for the sportsman.

Remedial levels in surface soil were derived for arsenic and chromium based on direct exposure of a receptor population. Remedial levels in soil were derived for chromium and mercury based on the potential of these constituents to leach into groundwater and for mercury to subsequently migrate to surface water. The development of the remedial levels for each constituent is summarized below:

Arsenic. The risk-based remedial levels for this human health constituent of concern (HHCOC) were calculated for both carcinogenic and noncarcinogenic risks. Arsenic was the only HHCOC that contributed significantly to the carcinogenic risks at this site. A risk-based remedial level based on an HI of 0.5 (11.68 mg/kg) was recommended. This value takes into account the potential contribution of other HHCOCs to the noncarcinogenic risks associated with the site; the ILCR associated with this remedial level would be below the target ILCR of 1×10^{-4} (Table 2-2).

The recommended risk-based remedial level for arsenic (11.68 mg/kg) is higher than the maximum detected value of 3.4 mg/kg; therefore, arsenic is not an HHCOC in soil.

Chromium. Chromium was identified as both an HHCOC and a contaminant migration constituent of concern (CMCOC). All of the risk-based remedial levels for direct exposure to chromium in surface soil were less than the reference background concentration. Similarly, all of the risk-based remedial levels based on leaching to groundwater were less than the reference background concentration. Therefore, the reference surface soil background criterion (6.21 mg/kg) is recommended as the remedial level for chromium in surface soil based on direct exposure.

Chromium in surface soil was also identified as possible CMCOPC based on its potential to leach to groundwater. The recommended risk-based soil remedial level (4.6 mg/kg) for chromium based on leaching to groundwater was less than the reference subsurface soil background concentration (11.60 mg/kg). Given the comparative thickness of the subsurface soil and its proximity to groundwater relative to surface soil, the amount of chromium (CMCOC) potentially leaching to groundwater from the subsurface soil is likely to be much greater than the contribution from the chromium in the surface soil; therefore, the reference subsurface soil background criterion (11.60 mg/kg) was recommended as the remedial level (based on leaching) for chromium in soil.

Mercury. Mercury was identified as a CMCOC for both groundwater and surface water. The remedial level for protection of groundwater was based on the MCL, given that this value was less than the remedial level based on the recommended HI of 0.5. However, the risk-based remedial level for the protection of surface water (0.003 mg/kg) was less than the remedial level based on the protection of groundwater (0.13 mg/kg) based on the MCL for mercury (Table 2-2); therefore, the surface water point of exposure will determine the remedial level.

Table 2-2. Remedial Levels, SWMU 2

SOIL BASED ON DIRECT EXPOSURE								
Constituent of Concern	Maximum Detected Concentration (mg/kg)	Reference Background Criterion Surface Soil	Risk-based Remedial Levels (mg/kg)					
			HI			ILCR		
			1	0.5	0.1	1×10^{-6}	1×10^{-5}	1×10^{-4}
Arsenic	3.4[a]	2.10	23.37	11.68	2.34	0.6	6.1	60.6
Chromium	47.5	6.21	1.53	0.77	0.15	NA[b]	NA[b]	NA[b]

SOIL BASED ON PROTECTION OF GROUNDWATER AND SURFACE WATER							
Constituent of Concern	Maximum Detected Concentration (mg/kg)	Reference Background Criterion Subsurface Soil	Risk-based Remedial Levels (mg/kg)				Remedial Levels Based on the MCL (mg/kg)
			HI				
			3	1	0.5	0.1	
Groundwater Point of Exposure[c]							
Chromium	47.5	11.60	3.74	1.25	0.62	0.12	4.6
Mercury	0.23	0.05	1.28	0.43	0.21	0.04	0.13[d]
Surface Water Point of Exposure[c]							
Mercury	0.23	0.05	0.02	0.006	0.003[e]	0.001	NA[f]

[a]Maximum detected concentration of constituent below recommended remedial level.
[b]NA = Not applicable; toxicity data required for calculation of remedial level were not available.
[c]Groundwater represents groundwater underlying the site, and surface water represents surface water in Canoochee Creek.
[d]Remedial level for mercury based on protection of groundwater.
[e]Risk-based remedial level for mercury based on protection of surface water.
[f]NA = Not applicable; MCLs are not applicable to surface water.
Bold indicates values that are the recommended remedial values.

The risk-based remedial level of 0.003 mg/kg was less than the subsurface soil background concentration (0.05 mg/kg); therefore, the recommended remedial value for mercury is 0.05 mg/kg, the subsurface soil background concentration.

In conclusion, chromium and mercury were identified as COCs for soil at SWMU 2. Chromium was identified as a COC based on direct exposure and its potential migration (leaching) to groundwater. Chromium was detected above its respective remedial level in surface and subsurface soil across the SWMU 2 site, including at the background location (MW5), indicating that chromium may be naturally elevated in this area. The observed chromium concentrations in surface and subsurface soil were on the low end of the concentration range (1 mg/kg to 1,000 mg/kg) established by the USGS for the eastern United States (USGS 1984) and may represent natural variability in the soil. Chromium was not detected in groundwater.

Mercury was identified as a COC based on its potential migration (leaching) to groundwater. Mercury was elevated in only one out of seven subsurface soil samples. The mercury concentrations in the remaining subsurface soil locations were either nondetect (four locations) or below the subsurface reference background criterion (two locations). The observed mercury concentration in soil was on the low end of the concentration range (0.01 mg/kg to 3.4 mg/kg) established by the USGS for the eastern United States (USGS 1984). The only elevated mercury detection could be attributable to natural variability or an anomaly in the soil rather than representative of widespread contamination. Mercury was

not detected above its MCL in groundwater, indicating that its movement/migration is highly retarded by its physiochemical properties and by site conditions.

The Phase II RFI concluded that chromium in surface and subsurface soil and mercury in subsurface soil do not require additional investigation and/or evaluation. In addition, the Phase II RFI recommended that institutional controls be implemented at the site to be protective of human health because the source will remain in place.

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 OBJECTIVES

Based on the findings of the site characterization at this SWMU, the primary goal and purpose for implementing corrective measures at SWMU 2 is limited to protection of human health and safety. To achieve this goal, two primary remedial response objectives have been established for SWMU 2: (1) to prohibit the ingestion of shallow groundwater from the subject site and (2) to prohibit the disturbance of surface and subsurface soil to minimize contact with soil and buried waste. Any corrective measures that pose a significant threat to human health during implementation (e.g., methods that would involve disturbance of subsurface soil) will not be evaluated. Implementation of the selected remedial response 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

As discussed in Chapter 2, remedial levels were developed for the HHCOCs and CMCOCs at SWMU 2. Chromium and mercury were identified as COCs for soil at the site. Chromium was identified as a COC in soil based on direct exposure and its potential migration (leaching) to groundwater. Mercury was identified as a COC in soil based on only its potential migration (leaching) to groundwater and subsequent potential migration to surface water. The remedial level for the protection of human health from direct contact with chromium in soil took into consideration an HI of 0.5 and the reference background concentration. The selection of the remedial level for soil potentially leaching to groundwater was based on the soil's leaching to groundwater at levels exceeding MCLs. In addition, because mercury may subsequently migrate to surface water, its remedial level was based on the lower of the level for protection of surface water or the level for protection of groundwater. In addition, soil remedial levels defaulted to surface and/or subsurface soil reference background criteria if the risk-based remedial level was less than the reference background criterion. The recommended remedial levels for chromium and mercury are presented in Table 2-2.

Chromium was detected above its respective remedial level in surface and subsurface soil (6.21 mg/kg and 11.60 mg/kg, respectively) across the SWMU 2 site, including at the background location (MW5), indicating that chromium may be naturally elevated in this area. The observed chromium concentrations in surface and subsurface soil were on the low end of the concentration range (1 mg/kg to 1,000 mg/kg) established by the USGS for the eastern United States (USGS 1984) and may represent natural variability in the soil. Chromium was not detected in groundwater.

Mercury was elevated above its remedial level (0.05 mg/kg) in only one out of seven subsurface soil samples. The mercury concentrations in the remaining subsurface soil locations were either nondetect (four locations) or below the subsurface reference background criterion (two locations). The observed mercury concentration in soil was on the low end of the concentration range (0.01 mg/kg to 3.4 mg/kg) established by the USGS for the eastern United States (USGS 1984). The only elevated mercury detection could be attributable to natural variability or an anomaly in the soil rather than representative of widespread contamination. Mercury was not detected above its MCL in groundwater, indicating that its movement/migration is highly retarded by its physiochemical properties and by site conditions.

The revised final Phase II RFI Report for 16 SWMUs (SAIC 2000) concluded that chromium in surface and subsurface soil and mercury in subsurface soil do not require additional investigation and/or evaluation. There are presently no constituents in the groundwater around SWMU 2 at concentrations above remedial levels. With the concurrence of GEPD (approval letter from Mr. Bruce Khaleghi to Colonel Gregory Stanley dated December 2000), the revised final Phase II RFI Report for 16 SWMUs recommended that institutional controls be implemented at SWMU 2. Institutional controls will be protective of human health because land-use restrictions will limit direct contact with the surface and subsurface soil and remaining buried refuse and will restrict the use of shallow groundwater for drinking purposes.

4.0 SCREENING OF CORRECTIVE ACTIONS

This section identifies corrective action technologies applicable to the Camp Oliver Landfill. The technologies that are retained following screening are then presented as corrective action alternatives that address limiting exposure to subsurface contamination. These alternatives are then evaluated with respect to protection of human health and life-cycle cost.

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 the risk to human health.

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. An 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, operations, 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, and maintaining long-term control of the site.

4.1.3 Cost

Relative costs are included for the corrective actions. The estimates are intended to facilitate evaluation and comparison among alternatives; therefore, typical 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: (1) no action, (2) institutional controls: land-use controls, and (3) institutional controls: physical barriers. Additionally, an option to monitor groundwater will be evaluated for both corrective action categories involving institutional controls. 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 that screening evaluation are also 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; therefore, the no action alternative will be eliminated from further evaluation.

Institutional controls include actions taken to restrict access to contaminated areas by establishing legal land-use controls and/or by providing physical barriers to 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, controls implemented through the BMP, zoning controls, and placement of signs restricting access. Physical barriers include installation of a barbed-wired, chain-link fence around the site boundary. Abandonment of groundwater wells no longer needed for site monitoring is also considered as a method for discouraging the use of groundwater at the site. Groundwater monitoring of selected wells would provide information associated with constituent concentration trends, as constituents may continue to leach to groundwater over time. This activity would involve the use of selected wells for groundwater monitoring purposes only and the abandonment of the remaining wells.

4.3 CORRECTIVE ACTION ALTERNATIVES

The technologies retained following the screening-level step were combined in various ways to develop alternatives that would meet the remedial response objective of protection of human health. Two alternatives were identified and subsequently evaluated. The option of groundwater monitoring instead of well abandonment will also be evaluated for each of the two alternatives.

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

- Alternative 1a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Groundwater Monitoring, Abandonment of Unused Wells, Post-mounted Warning Signs, Implementation of O&M Plan

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

Table 4-1. Evaluation of Corrective Actions, SWMU 2

Action	Description	Effectiveness	Implementability	Cost[a]
No Action	The no action alternative provides a baseline against which other actions can be compared. Under the no action alternative, all source materials, soil, 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 buried waste by human disturbance.	This alternative would not address the corrective action objectives for the site. This alternative would not provide protection of human health because there would not be sufficient controls to prevent human exposure to buried waste.	There would be no implementability involved for 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. Land-use restrictions and institutional control requirements that would be enforced would include restrictions through deed recordation, the BMP and zoning controls, warning signs posted around the site, groundwater use restriction (monitoring only, if necessary), well abandonment, 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 would be prohibited under the deed recordation.	Land-use restrictions would be effective and provide long-term reliability with respect to preventing human exposure to buried waste 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 exposure to contaminated media. 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 would be readily implementable. 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, abandonment of the wells, and implementation of the O&M Plan for 30 years would range between approximately $120,000 and $130,000.
Institutional Controls: Physical Barriers	Physical barriers would reduce potential hazards by limiting exposure of humans to contaminated soil. Physical barriers would include chain-link fencing topped with barbed wire, landfill access gates, and warning signs around the site.	This technology would be effective and provide long-term reliability with respect to minimizing human exposure to buried waste within the boundaries of the site by physically restricting access.	Physical barriers would be readily implementable. 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.	Installation of fencing would be expensive. The costs for fencing, including 30 years of O&M, would range between approximately $125,000 and $145,000.

Note: Footnote appears on page 4-4.

Table 4-1. Evaluation of Corrective Actions, SWMU 2 (continued)

Action	Description	Effectiveness	Implementability	Cost[a]
Groundwater Monitoring	Groundwater monitoring would serve to provide information concerning trends associated with the concentrations of constituents over time. Monitoring would continue on an annual basis for a period of 5 years to evaluate potential constituent leaching from the buried waste.	Monitoring would provide an effective method for evaluating concentrations of constituents in groundwater over time.	Technologies and resources are available for collection and analysis of groundwater resources.	Groundwater sampling is relatively expensive. The cost for groundwater sampling for 5 years would range between approximately $80,000 and $100,000. This includes other direct costs (e.g., pumps, meters), travel and per diem for the sampling crew, laboratory analysis, quality assurance, and reporting for five sampling events.

[a]An approximate range of the capital and O&M costs for 30 years is presented for evaluation of the relative costs of the alternative. The range does not include engineering management, health and safety, contractor profit, or contingency costs.

- Alternative 2a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Chain-link Fence Barrier, Fence-mounted Warning Signs, Groundwater Monitoring, Abandonment of Unused Wells, 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; therefore, two primary evaluation factors were used in the preferred corrective action alternative: protection of human health and life-cycle costs.

4.3.1.1 Protection of human health

The effectiveness of each proposed alternative at protecting human health at this site is dependent upon its ability to prohibit human activity associated with disturbance of subsurface soil and usage of shallow groundwater. For each alternative the level of protection of human health was evaluated and compared with those of the other alternatives. For retained Alternatives 1 and 2, usage of groundwater would be prohibited through abandonment of existing wells and through legal land-use controls (i.e., BMP, deed recordation, and zoning). For both options to these alternatives, usage of groundwater for drinking would be prohibited, and environmental monitoring would be required for 5 years to evaluate potential constituent leaching from the buried waste through legal land-use controls (i.e., BMP and deed recordation). For both alternatives and their options, legal land-use controls and warning signs would also restrict activities associated with disturbance of subsurface soil. In Alternative 2 additional protection would be provided through the use of fencing to restrict access to the site.

4.3.1.2 Life-cycle costs

The life-cycle cost estimates are budget estimates based on conceptual design and are to be used for purposes of comparison. 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 the 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.

4.3.2 Evaluation of Corrective Action Alternatives

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

The alternatives would include the following common features:

- BMP, deed recordation, and zoning controls to prohibit the use of groundwater for drinking water and intrusion into subsurface soil;
- abandonment of site monitoring wells;
- installation of warning signs; and
- implementation of an O&M Plan to maintain the conditions of the signage.

Table 4-2. Corrective Action Alternatives, SWMU 2

Corrective Action	Description	Protection of Human Health	Cost	Comments
Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Well Abandonment, 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 and groundwater usage. This alternative would also include abandonment of six groundwater monitoring wells (MW2–MW7).	Protection of human health would be primarily dependent upon enforcement of compliance with land-use controls. Existing natural (creek, heavily forested, etc.) and physical barriers (barbed-wire fence on west side) provide effective restrictions on human access to the site to further discourage any unauthorized excavation activities.	$194,662	Least expensive providing sufficient level of protection.
Alternative 1a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Post-mounted Warning Signs, Implementation of O&M Plan	This action has similar requirements to those of Alternative 1; however, four of the wells (MW2, MW4, MW5, and MW7) would be used for groundwater monitoring for a 5-year period to evaluate potential constituent leaching from buried waste. MW3 and MW6 would be abandoned, and MW2, MW4, MW5, and MW7 would be abandoned at the completion of the groundwater monitoring program.	Protection of human health would be similar to that afforded by Alternative 1. Data generated from groundwater monitoring could be used to determine the need to provide further protection of human health.	$340,148	Moderately expensive providing increased level of protection.
Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Chain-link Fence Barrier, Maintenance of Existing Physical Barriers, 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 and groundwater usage. Physical barriers to be installed would include a 2,807-linear-foot chain-link fence topped with barbed wire along the entire perimeter of the site. This alternative would also include abandonment of six groundwater monitoring wells.	In addition to the protection provided by Alternative 1a, human access would be further restricted by fencing along the boundaries of the site. The fencing would be more effective than signs alone in deterring or discouraging unauthorized entry and/or excavation activities.	$344,876	Significantly more expensive with only slight increase in level of protection compared to that afforded by Alternative 1.
Alternative 2a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Chain-link Fence Barrier, Maintenance of Existing Physical Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Fence-mounted Warning Signs, Implementation of O&M Plan	This action has similar requirements to those of Alternative 2; however, four of the wells (MW2, MW4, MW5, and MW7) would be used for groundwater monitoring for a 5-year period to evaluate potential constituent leaching from buried waste. MW3 and MW6 would be abandoned, and MW2, MW4, MW5, and MW7 would be abandoned at the completion of the groundwater monitoring program.	Protection of human health would be similar to that afforded by Alternative 2. Data generated from groundwater monitoring could be used to determine the need to provide further protection of human health.	$488,815	Most expensive providing highest level of protection.

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 life-cycle cost.

Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Well Abandonment, 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 by preventing human exposure to buried waste by the establishment of legal land-use restrictions. The BMP is an effective tool for ensuring that unauthorized disturbance of subsurface soil at the site and ingestion of groundwater from the site are prohibited while the property is under DoD ownership. 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 hazards associated with SWMU 2, warning signs stating restrictions on human activity within the SWMU would be posted at 200-foot intervals around the boundary of the site. The placement of signs for Alternative 1 is shown in Figure 4-1. Signs and existing natural barriers would be effective for restricting human access to the site because they 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. Natural barriers presently exist and will remain at SWMU 2 that restrict easy human access to the site. These include Canoochee Creek to the north, dense trees on and around the perimeter of the site, and ditches and steep slopes along the southern (along Fort Stewart Road 129) and eastern perimeters (along Fort Stewart Road 13) of the SWMU. Existing physical barriers (barbed-wire fence on the west side), which provide additional land-use restrictions, would also be maintained. Shallow groundwater is not used as a source of drinking water at the site, and given the availability of the underlying Floridan Aquifer, it is unlikely that the shallow groundwater would ever be used for drinking water. The six monitoring wells (MW2, MW3, MW4, MW5, MW6, MW7) installed as part of either the Phase I or Phase II RFI and remaining at the SWMU 2 site would be abandoned. Monitoring well LAS/MW8, which was discovered during the Phase II RFI, would remain because it was installed as part of the groundwater monitoring plan for the Land Application System (LAS) that is adjacent to SWMU 2. Institutional controls prohibiting the use of groundwater would, therefore, be effective in protecting human health.

This is the least expensive of the two alternatives and options, with a life-cycle cost of approximately $194,662.

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

This optional alternative has the same features as described in Alternative 1 with the exception that four wells (MW2, MW4, MW5, and MW7) would be used for groundwater monitoring, and the remaining wells (MW3 and MW6) would be abandoned. Use of groundwater wells for the purpose of drinking water would be expressly prohibited by land-use restrictions provided by the BMP and deed recordation. Provisions for groundwater monitoring would be documented in both the BMP and deed recordation. These provisions would include monitoring of one upgradient well (MW5) and three downgradient wells (MW2, MW4 and MW7). Groundwater samples would be collected from these wells once every year for a period of 5 years to evaluate potential constituent leaching from the buried waste. No specific

monitoring requirements are specified under RCRA for corrective action at SWMUs; however, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires a 5-year review to evaluate the performance and residual risk associated with a selected alternative (including alternatives in which wastes remains in place). Five years of groundwater monitoring was selected based on the 5-year review requirement for remedial actions under CERCLA. The results would be presented in an annual report, in association with the O&M report. Groundwater samples would be analyzed for only the soil COCs: chromium and mercury. With the concurrence of GEPD, monitoring wells MW2, MW4, MW5, and MW7 would be abandoned after the completion of the groundwater monitoring program. The monitoring wells to be sampled and to be abandoned are identified on Figure 4-1.

The sampling of groundwater annually for 5 years has a significant impact on the costs of this alternative. The groundwater monitoring alone costs $88,063, resulting in a life-cycle cost of approximately $340,148, or nearly one and a half times Alternative 1's life-cycle cost.

Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Chain-link Fence Barrier, Fence-mounted Warning Signs, Implementation of O&M Plan

This alternative is similar to Alternative 1 in that the land-use control provisions would remain the same (i.e., BMP, deed recordation, zoning control). Also, the six existing wells (MW2–MW7) would be abandoned, existing natural barriers (creek, dense trees, etc.) would remain. However, the barbed wire fence along the western perimeter of SWMU 2 would be removed. Approximately 2,807 linear feet of 6-foot-high chain-link fencing topped with three strands of barbed wire would be installed around the perimeter of the SWMU. The fence would provide a physical deterrent to public access around the entire landfill. Fence-mounted warning signs would be positioned approximately every 200 feet. Two 20-foot-wide gates would be installed to allow access to the site for inspection and maintenance. The placement of signage and fencing for Alternative 2 is shown in Figure 4-2. The effectiveness of Alternative 2 would be significantly greater to that of Alternative 1 due to the greater level of protection against inadvertent intruders as a result of the fencing. The effectiveness of Alternative 2 at preventing the use of groundwater would be equal to that of Alternative 1. An O&M Plan would be implemented as discussed under Alternative 1 that would also include maintenance and repair of the fence and signs.

This alternative is more expensive than Alternative 1, with a life-cycle cost of approximately $344,876 or nearly one and a half times Alternative 1's life-cycle cost.

Alternative 2a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Chain-link Fence Barrier, Fence-mounted Warning Signs, Implementation of O&M Plan

This optional alternative has the same features as described in Alternative 2 with the exception that four wells would be used for groundwater monitoring, and the remaining wells (MW3 and MW6) would be abandoned. Use of groundwater wells for the purpose of drinking water would be expressly prohibited by land-use restrictions provided by the BMP and deed recordation. Provisions for groundwater monitoring would be documented in both the BMP and deed recordation. These provisions would include monitoring of one upgradient well (MW5) and three downgradient wells (MW2, MW4 and MW7). Groundwater samples would be collected from these wells once every year for a period of 5 years to evaluate potential constituent leaching from the buried waste. No specific monitoring requirements are specified under RCRA for corrective action at SWMUs; however, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires a 5-year review to evaluate the performance and residual risk associated with a selected alternative (including alternatives in which wastes remains in place). Five years of groundwater monitoring was selected based on the 5-year review requirement for

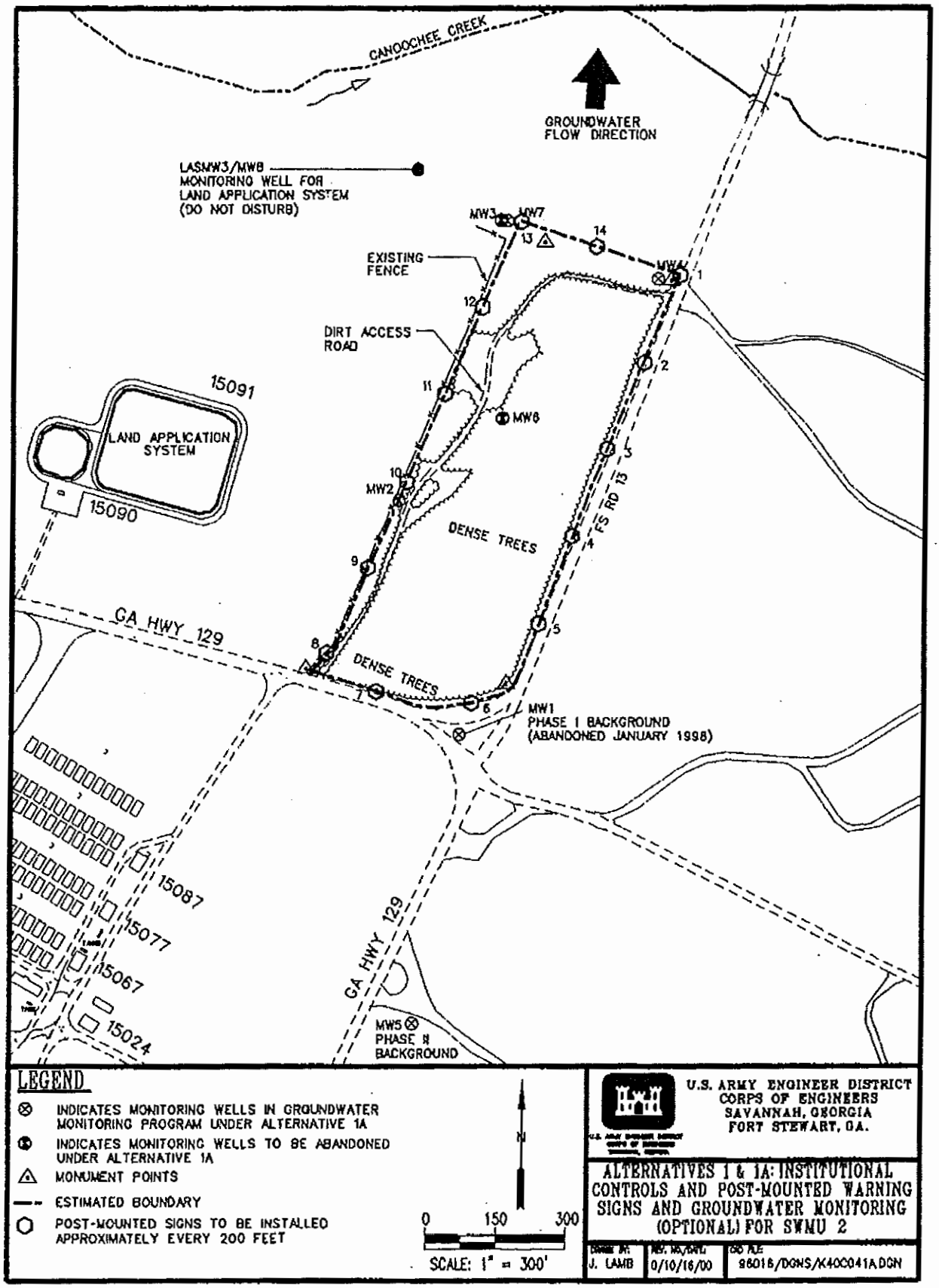

Figure 4-1. Alternatives 1 and 1a: Institutional Controls with Post-mounted Warning Signs and Groundwater Monitoring (Optional)

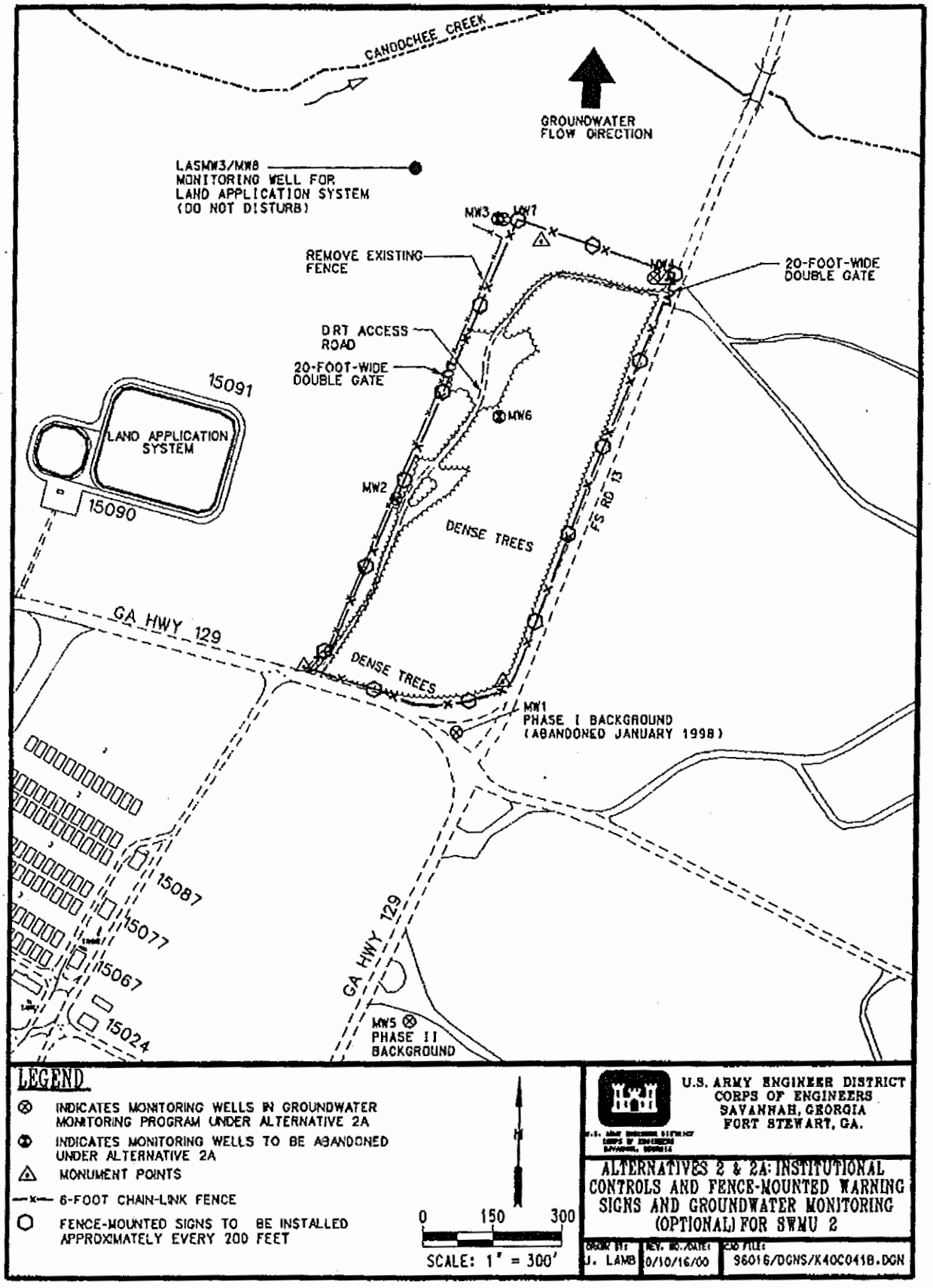

Figure 4-2. Alternatives 2 and 2a: Institutional Controls with Chain-link Fence Barrier and Fence-mounted Warning Signs and Groundwater Monitoring (Optional)

remedial actions under CERCLA. The results would be presented in an annual report, in association with the O&M report. Groundwater samples would be analyzed for only the soil COCs: chromium and mercury. With the concurrence of GEPD, monitoring wells MW2, MW4, MW5, and MW7 would be abandoned after the completion of the groundwater monitoring program. The monitoring wells to be sampled and to be abandoned are identified in Figure 4-2.

The fencing combined with the sampling of groundwater annually for 5 years makes this alternative the most expensive. The groundwater monitoring alone costs $88,063, resulting in a life-cycle cost of approximately $488,815, or approximately 44 percent more than Alternative 1a and Alternative 2.

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5.0 CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN

This section presents a conceptual design and plan for implementation of the selected corrective action alternative. Based on the level and type of subsurface soil and groundwater contamination, a cost-effective corrective action was selected that would adequately protect human health. The technology evaluation presented in Chapter 4 compared two different corrective action alternatives and two optional alternatives based on their effectiveness for protecting human health and their life-cycle costs. Based on that evaluation, Alternative 1 was selected because it will provide a sufficient level of protection of human health at a relatively low cost.

5.1 SELECTED CORRECTIVE ACTION

The selected corrective action alternative 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 natural physical barriers. Land-use restrictions will be documented and/or enforced through deed recordation, BMP, zoning restrictions, and signage. Alternative 1, which consists of institutional controls (i.e., land-use restrictions) and warning signs, is protective of human health for the COCs (i.e., chromium and mercury) because it limits the potential disturbance of the surface and subsurface soil and prevents the use of groundwater for drinking water and irrigation use. Chromium was identified as a COC because of the possibility of direct exposure and because of its potential migration (leaching) to groundwater. Mercury was identified as a COC only because of its potential migration (leaching) to groundwater. Chromium was not detected in groundwater, and mercury was not detected above its MCL. Implementation of institutional controls would put in place administrative procedures that would prevent/control the disturbance of surface and subsurface soil, eliminating the possibility of continual and long-term exposure to chromium in soil. Warning signs would inform the occasional on-site receptor (e.g., workers, hunters) of the restrictions, thereby reducing the potential risk from inadvertent surface soil disturbance. Institutional controls would also put in place administrative procedures that would prevent/control the use of groundwater for drinking water and irrigation purposes, eliminating the potential exposure of humans to chromium and mercury in groundwater. As discussed in Section 3.3, chromium and mercury have not been identified in groundwater as current risks to human health and have been only estimated to be potential COCs in groundwater based on very conservative modeling (assuming the maximum soil concentration, a constant source, etc.).

Alternative 1 has been selected because it will provide effective protection of human health at a relatively low cost. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered cost-effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized soil excavation would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Groundwater monitoring as described under Alternatives 1a and 2a does not provide enough additional protection to human health to justify its increased costs. The groundwater presently does not present a risk to human health. The institutional controls described for Alternative 1 will provide a sufficient level of protection of human health 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 cost-effectively implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

5.1.1 Effectiveness

Post-mounted warning signs and documented land-use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to physical contact with the buried waste within the boundaries of SWMU 2. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land-use controls during ownership by DoD. Prior to the planning of any construction activities at the FSMR, the BMP must be reviewed. In addition, all construction projects will be reviewed during the planning stages for approval by the Base Master Planner and the FSMR DPW. These land-use controls will remain in effect after transfer of DoD ownership by restrictions imposed through deed recordation.

Additionally, the proposed abandonment of monitoring wells (MW2, MW3, MW4, MW5, MW6, and MW7) and the groundwater-use restrictions will provide an effective method for preventing the use of groundwater for drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at the FSMR and is not used. The BMP will be modified to officially restrict its use, further preventing use of the surficial groundwater at the site.

An annual O&M program will be administered to replace or repair warning signs, 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 or repair of warning signs.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of SWMU 2. Warning signs will be most effective over the short term. There is no current risk, and the site is not being used, so access is already limited.

5.1.2 Implementability

Very few factors limit implementability of the institutional controls under evaluation. On-site personnel or contractors can readily perform posting of signs. The materials for the installation of warning signs are easily available to local contractors. Annual 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 the necessary land-use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to allow for incorporation of land-use controls into the BMP and to facilitate deed recordation.

5.1.3 Cost

The estimated total life-cycle cost of installation of warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $194,662. This alternative provides adequate protection of human health and the environment.

5.2 CONCEPTUAL DESIGN

During the period of ownership by DoD, institutional controls will be recorded to ensure implementation in the BMP. 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 hazards associated with SWMU 2, warning signs stating restrictions on human activity within SWMU 2 will be mounted on poles around the boundary of the SWMU (see Figure 4-1).

All activities that would involve disturbance of the subsurface will be minimized in accordance with all land-use control mechanisms. Activities that will be prohibited include military training exercises, hunting, recreational activities, and construction of residential facilities. However, the following activities, conducted in a manner that would minimize disturbance of the subsurface, will be permitted:

- timber harvesting (possible in the future),
- performance of wildlife studies, and
- provision and maintenance of feed lots for deer.

5.2.1 Establishment of Institutional Controls

Prior to installation of warning signs at the SWMU, 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 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 this SWMU 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 2 has been used as a landfill. The purchase agreement(s) and deed recordation or lease agreement 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 the 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 (Appendix C) by a professional land surveyor certified in the state of Georgia. The plat will be included in the BMP. The survey plat indicates the location and dimensions of the SWMU 2 with respect to permanently surveyed benchmarks. The plat contains a prominently displayed note that states Fort Stewart's obligation to prohibit disturbance of SWMU 2 in accordance with this CAP.

5.2.2 Warning Signs

Fourteen permanent warning signs will be mounted on poles at approximately 200-foot intervals surrounding the perimeter of SWMU 2, as shown in Figure 4-1. These signs will be worded as shown below.

FORMER LANDFILL
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 of weather-resistant construction. The signs will have a brown background and white lettering.

The positioning of each sign will provide maximum visibility from all locations outside the SWMU's boundaries. All signs will be permanently labeled (for identification purposes) on the back with a numerical identification number as shown on Figure 4-1.

The warning signs at the Camp Oliver Landfill will be inspected annually in accordance with the O&M Plan. Damaged signs will be repaired or replaced as needed. Repair or replacement of signs will occur within 1 month after inspection. Should damage be observed between inspections, repair or replacement will occur within 1 month following observation.

5.2.3 Well Abandonment

Six monitoring wells (MW2, MW3, MW4, MW5, MW6, and MW7) will be properly abandoned. The abandonment of monitoring wells will include removal of the protective guard posts, concrete pad and surface casing and grouting the wells to ground surface. The debris from the abandonment of the monitoring wells will be disposed of at the Fort Stewart Sanitary Landfill.

5.3 COST ESTIMATE

A detailed cost estimate is provided in Appendix D for implementation of institutional controls at the Camp Oliver Landfill. The life-cycle cost estimate for the selected institutional controls alternative is $194,662, which includes $24,350 for capital costs and $101,237 for O&M for 30 years.

5.4 IMPLEMENTATION SCHEDULE

Implementation of the corrective action will begin once approval of this CAP is received from GEPD. The schedule presented in Table 5-1 has been established for implementation of institutional controls at this site.

Table 5-1. Corrective Action Implementation Schedule, SWMU 2

Task	Time from GEPD Approval of CAP (days)
Procure signs and materials.	90
Record institutional controls in BMP and any other approved implementing document.	120
Perform well abandonment.	120
Install warning signs.	120
Perform inspections (implement O&M Plan).	Annually[a]
Repair/replace signs.	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 warning signs, with subsequent reports submitted annually thereafter.

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FINAL

FORSCOM

CORRECTIVE ACTION PLAN

for the

3d Inf Div (Mech)

TAC-X LANDFILL (SOLID WASTE MANAGEMENT UNIT 3) at FORT STEWART MILITARY RESERVATION FORT STEWART, GEORGIA

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract No. DACA21-95-D-0022
Delivery Order 0062

December 2000

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FINAL

CORRECTIVE ACTION PLAN
FOR THE
TAC-X LANDFILL
(SOLID WASTE MANAGEMENT UNIT 3)
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 0062

Prepared by
Science Applications International Corporation
800 Oak Ridge Turnpike
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December 2000

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. Further certify that this report was prepared by myself or by a subordinate working under my direction.

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

00-275(doc)/121800

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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ACRONYMS

amsl	above mean sea level
AWQC	Ambient Water Quality Criterion
bgs	below ground surface
BHHRA	baseline human health risk assessment
BMP	Base Master Plan
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMCOPC	contaminant migration constituent of potential concern
COC	constituent of concern
DERP	Defense Environmental Restoration Program
DO	dissolved oxygen
DoD	U.S. Department of Defense
DPW	Directorate of Public Works
ECOPC	ecological constituent of potential concern
EPA	U.S. Environmental Protection Agency
ESV	ecological screening value
FSMR	Fort Stewart Military Reservation
GEPD	Georgia Environmental Protection Division
GSSL	Generic Soil Screening Level
HHCOPC	human health constituent of potential concern
HHPRE	human health preliminary risk evaluation
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
MCL	maximum contaminant level
O&M	operations and maintenance
ODAST	One-dimensional Analytical Solute Transport
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
Redox	oxidation-reduction potential
RFI	RCRA Facility Investigation
SRC	site-related contaminant
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

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1.0 INTRODUCTION

1.1 SCOPE

This report documents the Corrective Action Plan (CAP) for the TAC-X Landfill, Solid Waste Management Unit (SWMU) 3 at the Fort Stewart Military Reservation (FSMR), Georgia. A Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in November and December of 1997. The revised final Phase II RFI Report (SAIC 2000) determined that this SWMU required a CAP to evaluate appropriate remedial actions to eliminate or minimize potential risks associated with the TAC-X Landfill. Implementation of the remedy selected in this CAP is required for this site to protect the health of humans coming in contact with the site. This report has been prepared by Science Applications International Corporation for the U.S. Army Corps of Engineers (USACE), Savannah District, under Contract DACA21-95-D-0022, Delivery Order No. 0062.

The TAC-X Landfill is located about 1.25 miles south of the northern Fort Stewart boundary, approximately 3.5 miles south-southwest of Pembroke, Georgia, and less than 1 mile southeast of Dean Field and the TAC-X (Noncommissioned Officers' Academy). The site is accessed by a 0.1-mile unpaved road on the southwestern side of Fort Stewart Road 42. The TAC-X Landfill comprises approximately 6.3 acres, with two trenchlike depressions present at the site. One of the trenches is reportedly unused. The reported dimensions of the disposal trench are 20 feet wide by 400 feet long by 5 feet to 6 feet deep. A site reconnaissance in November 1993 observed household-type debris (e.g., plastic spoons and bags) within the overburden pile on the western side of the disposal trench. Aged refuse is reported to be present at the bottom of the disposal trench (Geraghty and Miller 1992). Further background information concerning the landfill is provided in Chapter 2. The history of the TAC-X Landfill is summarized in Section 2.1.

Based on the findings presented in the revised final Phase II RFI Report for 16 SWMUs dated April 2000 (SAIC 2000), a "no further action required" status has been assigned to the TAC-X Landfill for investigative purposes. As recommended by the revised final Phase II RFI Report for 16 SWMUs and as concurred to by the Georgia Environmental Protection Division (GEPD) (approval letter from Mr. Bruce Khaleghi to Colonel Gregory Stanley dated December 8, 2000), a CAP has been prepared for SWMU 3 because buried waste will remain in place. Implementation of the selected remedy documented by this CAP is necessary to control intrusive activities at this site, to be protective of the health of humans potentially coming in contact with the buried waste, 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. 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 remedy and includes plans for its implementation along with a plan for operations and maintenance (O&M) of the selected remedy. Also included in this plan are a detailed cost estimate and a schedule of implementation for the selected corrective action.

1.2 SITE BACKGROUND

USACE installed four monitoring wells in 1980, and groundwater and surface water samples were collected that same year. Iron was detected at concentrations that exceeded the drinking water standard. Chemical data from the site indicated that the surface water in the area was not being significantly

degraded as a result of past operation of the landfill. Iron concentrations in the surface water near the landfill were reported as high; however, concentrations of iron near background values were reported a short distance from the landfill. Four soil borings were installed to a depth of 50 feet, and one soil boring was installed to a depth of 100 feet during a 1982 Environmental Science and Engineering study. Subsurface soil samples were collected for analysis of geotechnical parameters. No samples were submitted for analysis of chemical parameters. In 1993, as part of the Phase I RFI, one surface soil sample was collected from a location near the southern end of the marshy area and analyzed for volatile organic compounds (VOCs), total RCRA metals, and pesticides/polychlorinated biphenyls (PCBs). Groundwater samples were collected from four monitoring wells using non-low-flow techniques. Groundwater was analyzed for VOCs, total RCRA metals, and pesticides/PCBs. Due to drought conditions, a surface water sample was not collected from the marshy area. Arsenic and lead are considered to be site-related contaminants (SRCs) in surface soil based upon the Phase I RFI. 2-Butanone was detected in groundwater. Lead was detected in monitoring well TX-M3 at a concentration above the reference background criterion, but not above its U.S. Environmental Protection Agency (EPA) action level. Non-low-flow techniques were used to collect the groundwater samples, and the elevated lead concentration might be due to particulates in groundwater. The Phase I RFI recommended that a Phase II RFI be performed at SWMU 3.

The objectives for the Phase II RFI, as defined by the Phase II RFI Sampling and Analysis Plan (SAIC 1997) approved by GEPD on October 10, 1997, were as follows:

- determine the horizontal and vertical extents 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.

The scope of the Phase II fieldwork included the following activities:

- Initial installation of three soil borings and one background well. It was determined during redevelopment of existing wells during the Phase II RFI, however, that the screened intervals of presently existing monitoring wells MW2, MW3, and MW4 were below the water table; therefore, three additional monitoring wells (MW6, MW7, and MW8) were installed near existing wells at the water table. A surface soil sample and a subsurface soil sample were collected from each boring/well. In addition, three surface soil samples were collected from within the trenches of the landfill. All surface and subsurface soil samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), pesticides/PCBs, and RCRA metals.

- Installation of four groundwater monitoring wells. Geotechnical samples were collected from the four monitoring well boreholes. The groundwater samples collected from the four newly installed and four existing monitoring wells were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals. Conductivity, temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (Redox), and turbidity were measured in the field during sampling.

- Collection of groundwater samples from three hand-auger holes located in the depression area downgradient of the trenches. The groundwater samples collected from the three hand-auger locations were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals. In addition, dissolved RCRA metals analysis was performed on the groundwater samples. Conductivity, temperature, pH, DO, Redox, and turbidity were measured in the field during sampling.

- Collection of two surface water samples and two sediment samples from the depression area into which the two trenches drain. No upstream locations were available at the site for sampling. The surface water and sediment samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals. One of the sediment locations (SWS1) was resampled for VOCs only on November 30, 1999, to confirm or deny the elevated concentrations of VOCs detected in the first set of samples.

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 for carrying out the DERP to the Secretary of Defense. The Installation Restoration Program was established as part of the DERP 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 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. The TAC-X Landfill (SWMU 3) is a listed SWMU in Fort Stewart's Subpart B Permit (Appendix A) and, therefore, is subject to investigation according to Title 40, Code of Federal Regulations, Part 264.101(c) [as reported in Section 10.2 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: (1) Introduction, (2) Site Characterization and Remedial Investigation Results, (3) Justification/Purpose of Corrective Action, (4) Screening of Corrective Actions, (5) Conceptual Design and Implementation Plan, and (6) References. Chapter 1 (Introduction) provides an explanation of the scope of the CAP, presents general background information on the FSMR and specific background information on the site, and provides regulatory background information. Chapter 2 (Site Characterization and Remedial Investigation Results) provides an overview of the site; physical and environmental descriptions; and the nature and extent of contamination, contaminant fate and transport, and preliminary risk evaluation information. Chapter 3 (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. Chapter 4 (Screening of Corrective Actions) presents an evaluation of corrective actions and screens the corrective actions against established objectives and balancing factors. Chapter 5 (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. Reference information is presented in Chapter 6. The O&M Plan for the selected remedy is presented as Appendix A. Appendix B presents the Base Master Plan (BMP) and deed recordation requirements. Appendix C presents a site description, directions to the site, and the topographic survey of SWMU 3. Appendix D presents cost estimates for the alternatives.

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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 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. These activities comprise the Installation's primary mission today. The 24th Infantry Division, which was reflagged as the 3d Infantry Division in May 1996, was permanently stationed at Fort Stewart in 1975.

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 TAC-X Landfill is located in Bryan County, south of the northern Fort Stewart boundary, approximately 3.5 miles south-southwest of Pembroke, Georgia (Figure 2-3).

2.1 SITE LOCATION AND HISTORY

SWMU 3, which is approximately 3.5 miles south-southwest of Pembroke, Georgia, and less than 1 mile southeast of Dean Field and the TAC-X (Noncommissioned Officers' Academy), was active from the 1960s until 1982. The waste disposed of at the landfill from the 1960s to 1979 included residential waste, food cans, brush, plastic, and cardboard boxes. From 1979 to 1982, the wastes included grass clippings, tree branches, root stumps, and chunks of asphalt and concrete.

The TAC-X Landfill comprises approximately 6.3 acres, with two trenchlike depressions present at the site. One of the trenches is reportedly unused. The reported dimensions of the disposal trench are 20 feet wide by 400 feet long by 5 feet to 6 feet deep. A site reconnaissance in November 1993 observed household-type debris (e.g., plastic spoons and bags) within the overburden pile on the western side of the disposal trench. Aged refuse is reported to be present at the bottom of the disposal trench (Geraghty and Miller 1992). A site reconnaissance in September 1996 indicated no evidence of any landfill operations. The site is nearly flat, but slopes gently toward the south. Pine trees, brush, and grass cover most of the site. The southernmost portion of the site is marshy, with surface water present.

Based on the findings presented in the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000), a "no further action required" status was assigned to the investigation of the nature and extent of potential contamination associated with SWMU 3. As recommended by the revised final Phase II RFI Report for 16 SWMUs and as concurred to by GEPD (approval letter from Mr. Bruce Khaleghi to Colonel Gregory Stanley dated December 8, 2000), a CAP was recommended for SWMU 3 because buried waste will remain in place. The CAP is necessary to control intrusive activities at this site, to be protective of the health of humans potentially coming in contact with the buried waste, and to prevent the use of groundwater as a drinking water source.

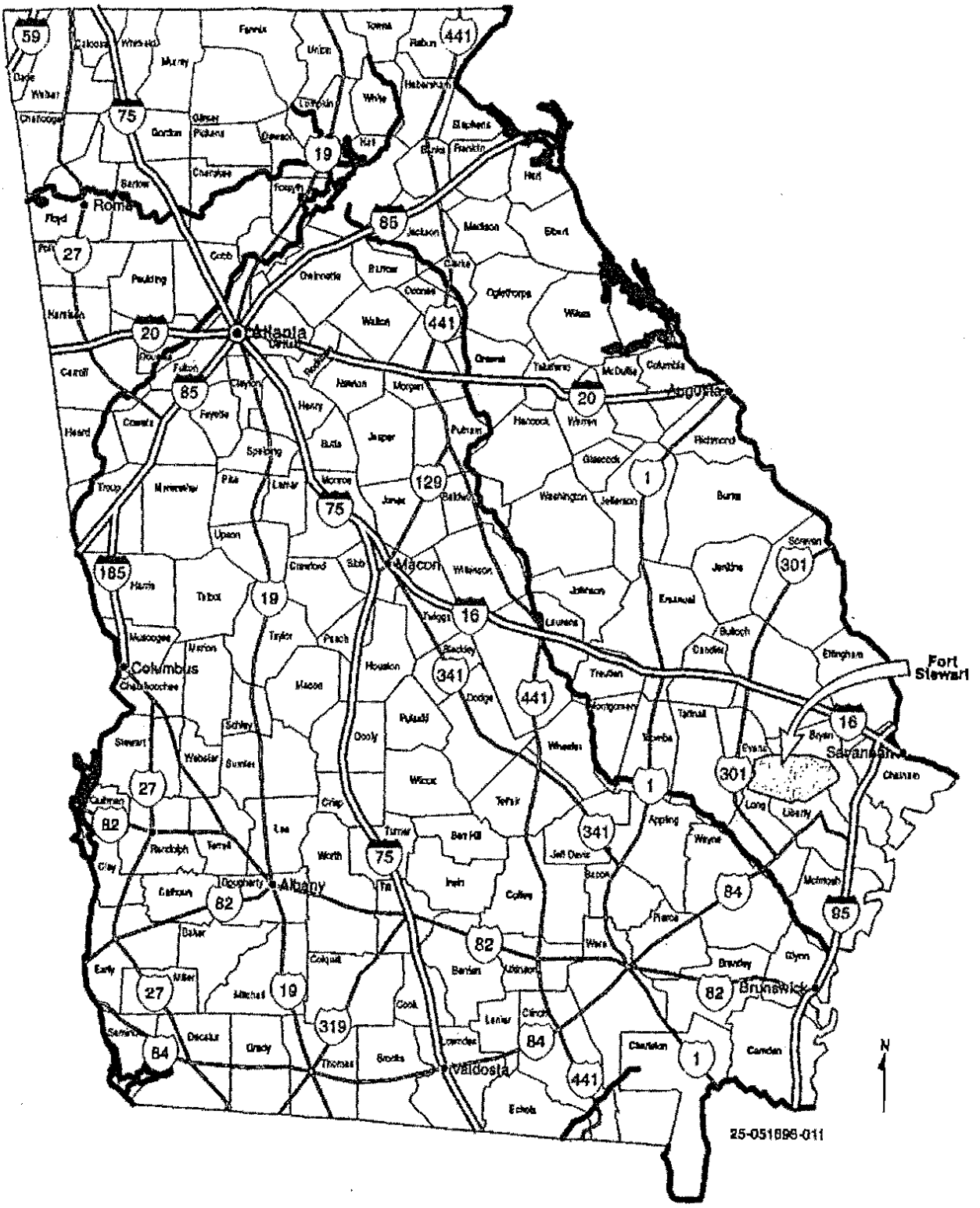

Figure 2-1. Regional Location Map for Fort Stewart Military Reservation, Georgia

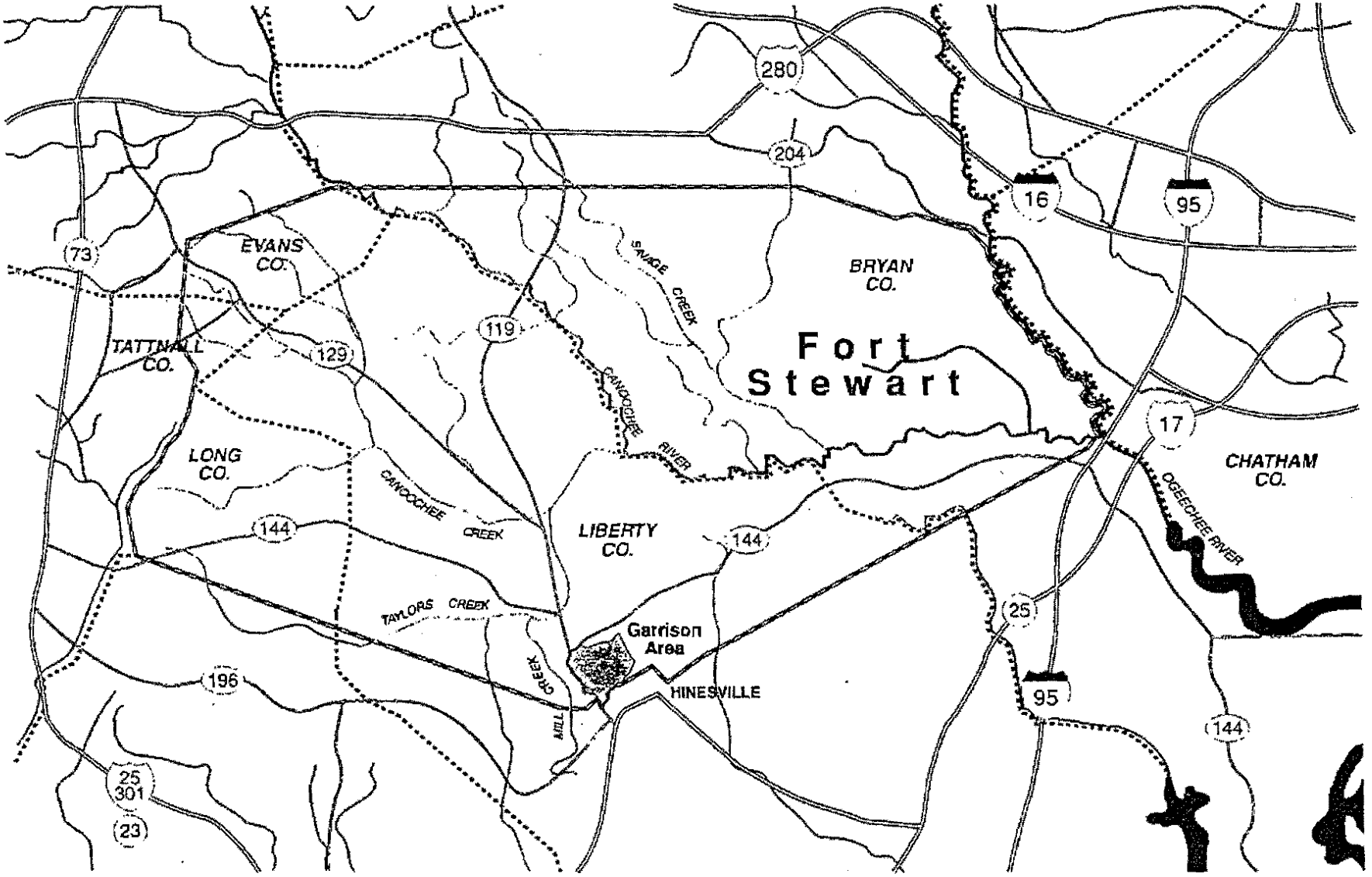

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Figure 2-2. Location Map for Fort Stewart Military Reservation, Georgia

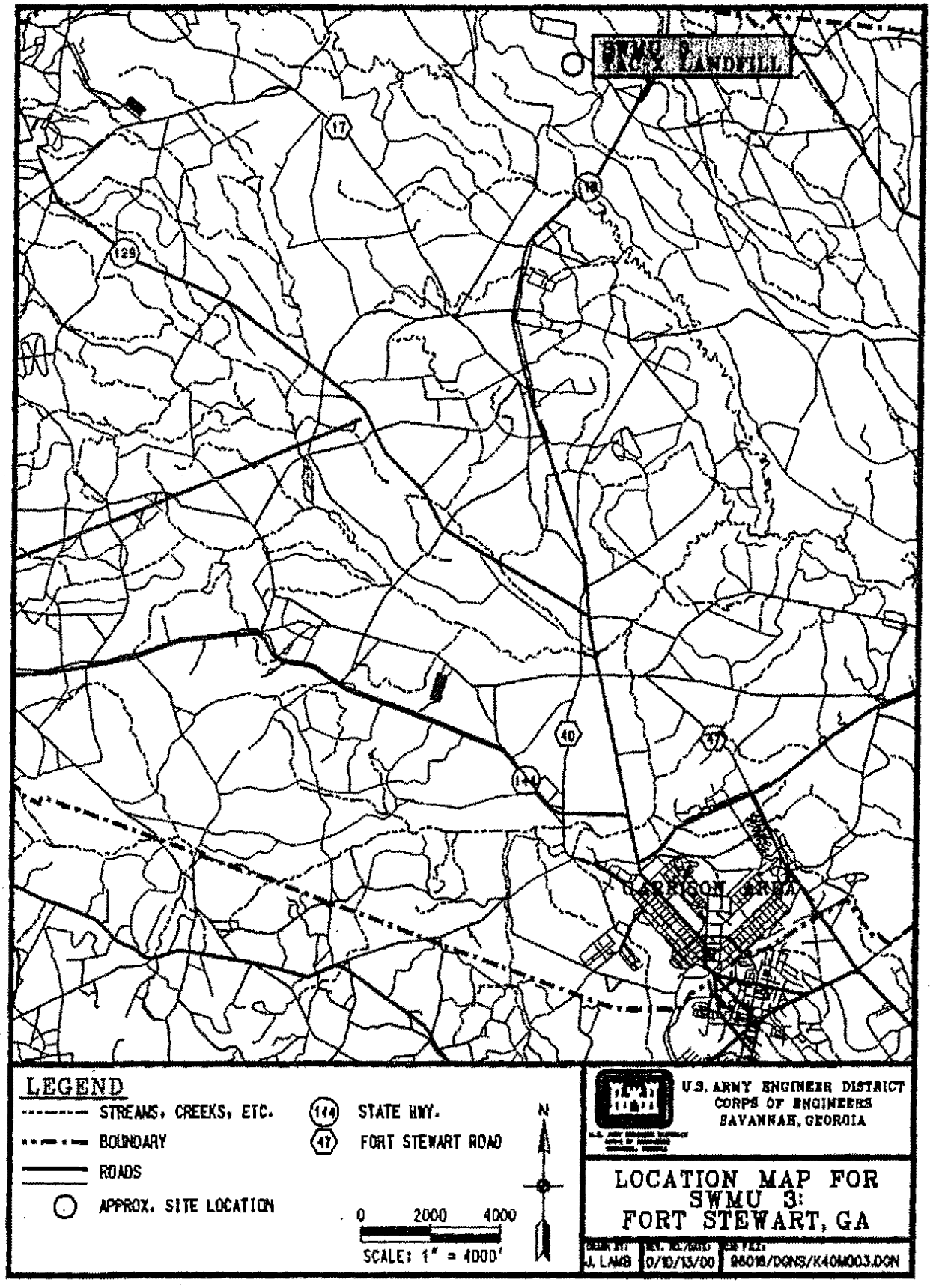

Figure 2-3. Location of the TAC-X Landfill (SWMU 3), Fort Stewart, Georgia

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).

There are approximately 6 feet of relief across the TAC-X Landfill. The elevation is approximately 73 feet amsl along the northern boundary and slopes gently to approximately 67 feet amsl along the southern boundary. Two disposal trenches run approximately north to south, terminating in a small, swampy depression. Standing water can accumulate in the depression after rainfall events and was present during the Phase II investigation. Soil from the trenches is mounded along their sides. The site is heavily forested. Existing site features and topography are presented in Figure 2-4.

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).

2.3 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 in thickness and is dominated by clastics. The Tertiary section is approximately 2,170 feet in thickness 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.

Boring logs showing the types of soil encountered during the Phase II RFI at the TAC-X Landfill in soil screening probes, groundwater screening probes, and monitoring well boreholes are provided on pages A.2-1 through A.2-19 in Appendix A of the revised final Phase II RFI Report for 16 SWMUs

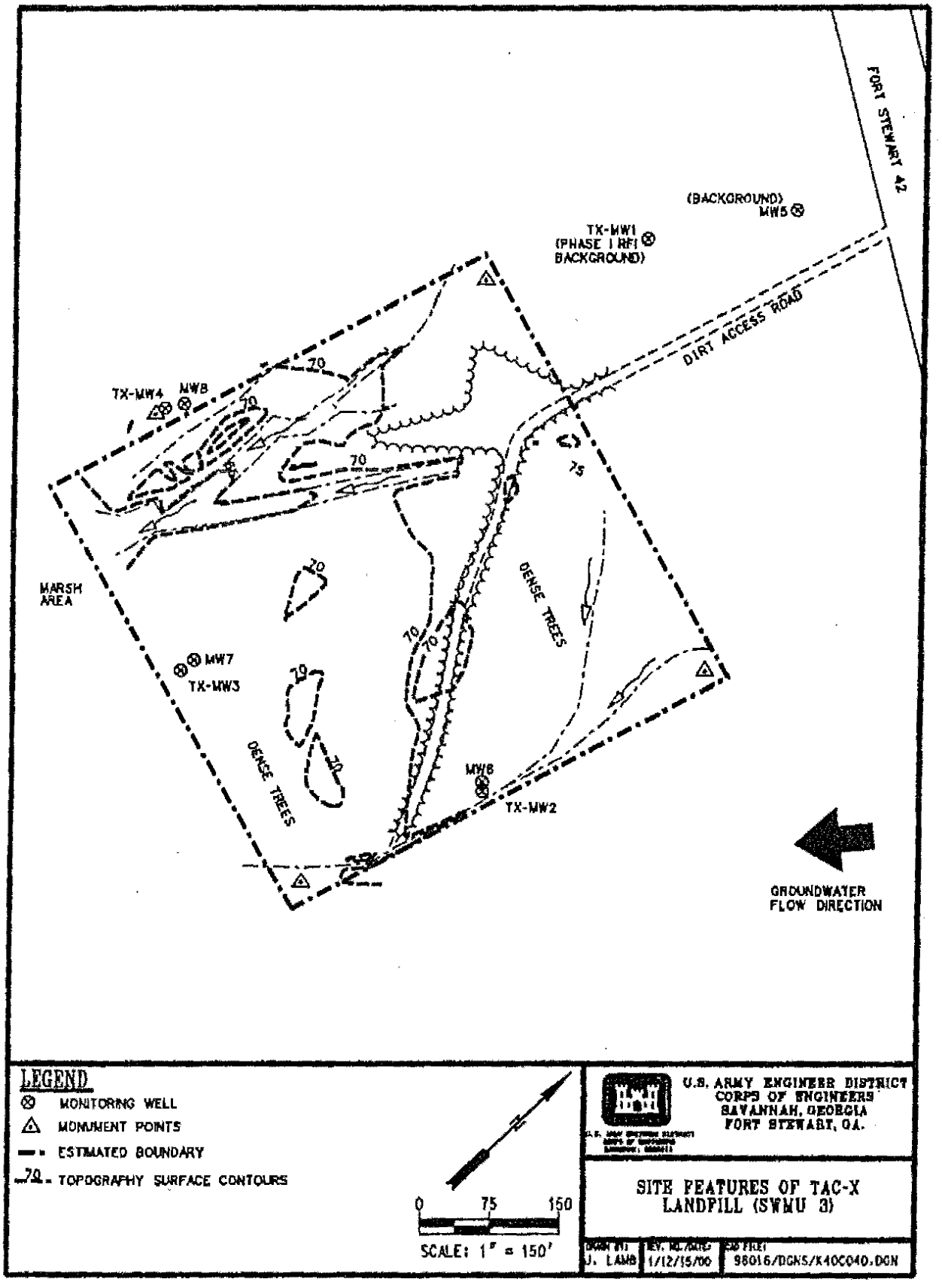

Figure 2-4. Site Features of the TAC-X Landfill (SWMU 3), Fort Stewart, Georgia

(SAIC 2000). Geological cross sections of the site, depicting the lithology and stratigraphy of the unconsolidated soil deposits beneath the site, as inferred from the soil boring logs, are shown on Figures 10.2-2 and 10.2-3 of the revised final Phase II RFI Report.

The soil present across the TAC-X Landfill consists of alternating layers of sand and clayey sands, as indicated in cross sections A-A' and B-B' [Figures 10.2-2 and 10.2-3, respectively, of the revised final Phase II RFI for 16 SWMUs (SAIC 2000)].

Geotechnical soil samples were collected from the four monitoring well boreholes (MW5–MW8), and the results are presented in Table 10.2-3 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000). The geotechnical analytical results indicated that tested soil was sand, with the proportion of fine-grained particles varying from 1.3 percent to 5.2 percent by weight. Soil from all the monitoring wells was non-plastic. The soil from the screened intervals in MW-5 and MW-6 had a permeability of 4.50×10^{-5} cm/sec and 1.20×10^{-6} cm/sec, respectively, which is typical for 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, which drains much of the western portion of the FSMR. The surface drainage at the site flows to the swampy depression along the south/southwestern boundary of the site. The trenches on-site also drain to the swampy depression. The swampy area ultimately makes its way to the Canoochee River.

2.5 HYDROGEOLOGY

The hydrogeology in the vicinity of the FSMR is dominated by two aquifers, referred to as the Principal Artesian Aquifer and the surficial aquifer, 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.

Groundwater was encountered at approximately 5 feet bgs along the northern boundary of the site at SB1 to approximately 12 feet bgs along the southern boundary. The shallow groundwater flow direction across the site is to the south-southwest toward the swampy depression area, and the hydraulic gradient is 0.0093 foot/foot [see Figure 10.2-4 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000)]. The deep groundwater flow direction across the site is also to the south-southeast, and the hydraulic gradient is 0.002 foot/foot (see Figure 10.2-5 of the revised final Phase II RFI Report).

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.

Both terrestrial and aquatic fauna are abundant in the unimproved areas of the FSMR. Major game species found on the Installation include white-tailed deer, feral hog, wild turkey, rabbit, squirrel, and bobwhite in addition to numerous other mammal, bird, reptile, and amphibian species (Environmental Science and Engineering 1982). Dominant fish include bluegill, largemouth bass, crappie, sunfish, channel catfish, minnows, and shiners. Three federally listed threatened or endangered species reside at the FSMR: the American bald eagle, Eastern indigo snake, and red-cockaded woodpecker.

The habitats at SWMU 3 are classified as "forestlands" consisting mainly of well-spaced, mature pine and aquatic habitats. The surrounding forest is mixed pine–hardwood and much denser, with a thick understory. Just south of the old trench area is a wetland, or ephemeral pond, with tannic water exceeding 1 foot in depth at many places. Sediments in this area are soft and organic. Aquatic flora occurs along the old trenches and at the mouth of the wetland area.

2.7 NATURE AND EXTENT OF CONTAMINATION

The results of chemical analyses performed during the Phase I and Phase II RFIs indicated that soil, groundwater, and sediment contain organic and metal contaminants at concentrations greater than their reference background concentrations. No contaminants were detected in surface water.

The reference background criteria for the TAC-X Landfill 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 the Burn Pits (SWMUs 4A–4F), Active Explosive Ordnance Disposal 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) is presented in Table 5-1 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000).

EPA Region IV methodology (EPA 1995) was used as guidance for the development of the background data set for screening metals data. In cases in which enough samples (e.g., more than 20) are collected to define background, a background upper tolerance level can be calculated. In cases in which too few samples (e.g., fewer than 20) are collected to define background, background can be calculated as two times the mean background concentration (EPA 1995). 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, 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. Because there was no upstream surface water or sediment location for SWMU 3, the site-specific background location for the Former 724th Tanker Purging Station (SWMU 26) was used for SWMU 3.

Inorganics were considered to be SRCs if their concentrations were above the reference background concentrations. Organics were considered to be SRCs if they were simply detected because organic constituents are considered anthropomorphic in nature.

Appendix G of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000) presents a summary of the background data as well as the two-times-mean background concentrations. Given the limited background data, the mean concentration established by the U.S. Geological Survey for soil in the eastern United States (USGS 1984) 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. The nature and extent of contamination by medium is summarized below. A tabular summary of SRCs by medium for the TAC-X Landfill is presented in Table 2-1. The Phase I and Phase II RFI sample locations are presented in Figure 2-5.

2.7.1 Surface Soil

Eleven surface soil samples were collected from four monitoring well boring locations, three soil boring locations, and four surface soil samples during the Phase I and Phase II RFIs. No VOCs were detected in surface soil. Low, isolated concentrations of bis(2-ethylhexyl)phthalate (an SVOC) and four pesticides (alpha-BHC, gamma-BHC, heptachlor epoxide, and methoxychlor) were detected in surface soil. Arsenic, chromium, and lead were detected at concentrations above reference background criteria in one of 10 surface soil samples. Bis(2-ethylhexyl)phthalate, alpha-BHC, gamma-BHC, heptachlor epoxide, methoxychlor, arsenic, chromium, and lead were considered to be SRCs in surface soil.

2.7.2 Subsurface Soil

Seven subsurface soil samples were collected during the Phase II RFI from four monitoring well boring locations and three soil boring locations. Two VOCs (2-butanone and acetone), one SVOC [bis(2-ethylhexyl)phthalate], and three pesticides (4,4'-DDE; aldrin; and methoxychlor) were detected in

Table 2-1. Summary of Site-related Contaminants, SWMU 3

Analyte	Maximum Concentration (mg/kg)			Maximum Concentration (µg/L)	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
2-Butanone	ND	0.0044	0.495	ND	ND
2-Hexanone	ND	ND	0.0034	5.6	ND
Acetone	ND	0.0932	0.618	264	ND
Benzene	ND	ND	0.0033	ND	ND
Carbon disulfide	ND	ND	0.006	ND	ND
Methylene chloride	ND	ND	ND	ND	ND
Toluene	ND	ND	0.212	ND	ND
Semivolatile Organic Compounds					
Benzo(*b*)fluoranthene	ND	ND	ND	ND	6.6
Bis(2-ethylhexyl)phthalate	0.248	0.387	ND	ND	ND
Pesticides/PCBs					
4,4'-DDE	ND	0.00064	ND	ND	ND
4,4'-DDT	ND	ND	ND	0.025	ND
Aldrin	ND	0.00061	ND	ND	ND
alpha-BHC	0.00047	ND	ND	ND	ND
beta-BHC	ND	ND	ND	0.016	ND
delta-BHC	ND	ND	ND	0.082	ND
gamma-BHC (Lindane)	0.0012	ND	ND	ND	ND
Heptachlor epoxide	0.00054	ND	ND	ND	ND
Methoxychlor	0.0086	0.0048	ND	ND	ND
Metals					
Arsenic	24[a]	BRBC	29.7	ND	7.3
Barium	BRBC	BRBC	60	92.3	59.6
Cadmium	ND	0.25	ND	0.82	ND
Chromium	7.8	25.5	23.3	6.8	13.9
Lead	73.97[a]	BRBC	14.7	11.1	9
Mercury	BRBC	BRBC	0.08	0.46	ND
Selenium	BRBC	BRBC	2.6	BRBC	ND

[a]Phase I RFI data.
BRBC = Below reference background criteria.
ND = Not detected.

subsurface soil. Chromium and cadmium were detected at concentrations above reference background criteria in one (MW6) of seven subsurface soil samples. 2-Butanone; acetone; bis(2-ethylhexyl)phthalate; 4,4'-DDE; aldrin; methoxychlor; cadmium; and chromium were considered to be SRCs in subsurface soil at SWMU 3.

2.7.3 Groundwater

Low, isolated concentrations of acetone (a VOC) and three pesticides (4,4'-DDT; beta-BHC; and delta-BHC) were detected in groundwater collected from Geoprobe locations. Barium, cadmium, chromium, lead, and mercury were detected at concentrations above reference background criteria in groundwater collected from Geoprobe locations. However, corresponding dissolved metal concentrations for all five constituents were below reference background concentrations, indicating that the total metals might be associated with particulates in the groundwater.

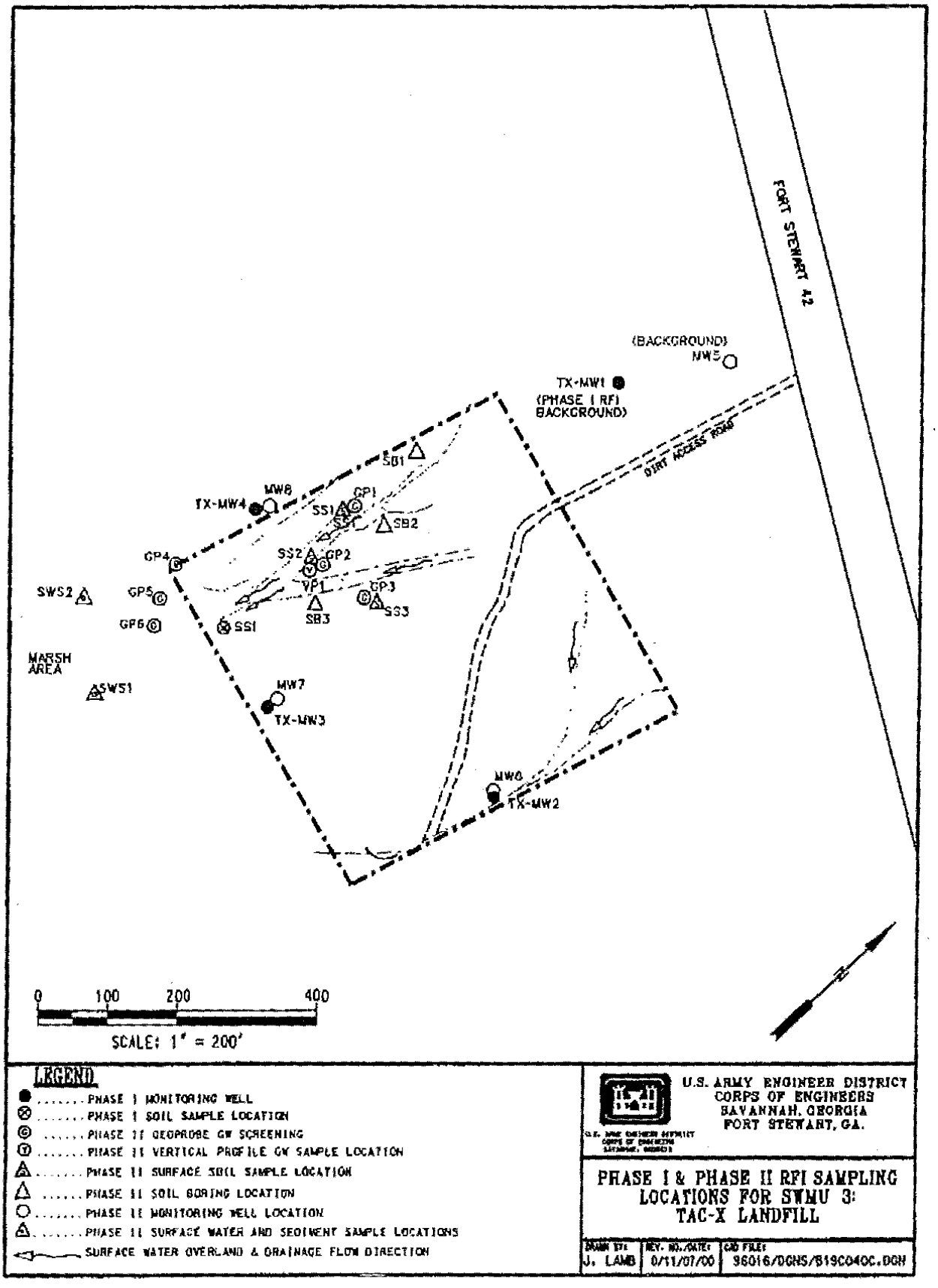

Figure 2-5. Phase I and Phase II RFI Sampling Locations, SWMU 3

A low, isolated concentration of 2-hexanone (a VOC) was detected in groundwater collected from monitoring well MW6. Mercury was detected at concentrations (0.15 μg/L and 0.16 μg/L) slightly above the reference background criteria (0.14 μg/L) in two of eight groundwater samples collected from the monitoring wells.

2-Hexanone; acetone; 4,4'-DDT; beta-BHC; delta-BHC; barium; cadmium; chromium; lead; and mercury were considered to be SRCs in groundwater.

2.7.4 Surface Water

One SVOC [benzo(*b*)fluoranthene] was detected in surface water. Arsenic, barium, chromium, and lead were detected in surface water at concentrations above reference background criteria.

Seven VOCs (acetone, methylene chloride, 2-butanone, 2-hexanone, benzene, carbon disulfide, and toluene) were detected in sediment. Acetone and methylene chloride were initially detected at one of two sediment locations at concentrations of 7.7 mg/kg and 6.49 mg/kg, respectively. These elevated concentrations were believed to be the result of field and laboratory contamination, and the location was resampled. Acetone was detected at a concentration of 0.618 mg/kg, and methylene chloride was not detected in the resampled sediment, indicating that the elevated levels of acetone and methylene chloride were probably the results of field or laboratory contamination. Methylene chloride is not considered to be an SRC in sediment. 2-Butanone, 2-hexanone, benzene, carbon disulfide, and toluene were detected in only the resampled sediment; therefore, 2-butanone, 2-hexanone, acetone, benzene, carbon disulfide, and toluene are considered to be SRCs in sediment.

Arsenic, barium, chromium, lead, mercury, and selenium were detected in sediment at concentrations above reference background criteria. Sediment samples from SWS1 had significantly higher concentrations than did those from SWS2.

2.8 CONTAMINANT FATE AND TRANSPORT

2.8.1 Leachability Analysis

Contaminant fate and transport analysis provided an assessment of the potential migration pathways and transport mechanisms affecting the chemicals at the site. In particular, the leachability of contaminants from soil and sediment to groundwater and their natural attenuation in groundwater were evaluated.

The site characterization identified inorganic, organic, and pesticide SRCs in surface soil, subsurface soil, and sediment (Table 2-1). These constituents were compared to EPA Generic Soil Screening Levels (GSSLs; EPA 1996a) to determine if these constituents might leach from soil or sediment into groundwater at concentrations that exceed groundwater standards [i.e., concentrations that exceed the maximum contaminant level (MCL) or, in the absence of an MCL, the risk-based concentration for drinking water (EPA 1996b)].

Based on the leachability analysis, there are no contaminant migration constituents of potential concern (CMCOPCs) in surface or subsurface soil.

Of the SRCs identified in sediment, only arsenic, at a concentration of 29.7 mg/kg, slightly exceeded its GSSL of 29 mg/kg [see Table 10.2-12 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000)]. Arsenic was detected in surface water; however, the surface water concentration

(0.0073 mg/L) did not exceed its MCL (0.05 mg/L). Arsenic was not detected in groundwater. Arsenic in sediment was not considered to be a CMCOPC based on leaching to groundwater.

2.8.2 Fate and Transport Modeling

Fate and transport modeling was performed to quantitatively assess the risks associated with exposure to mercury in deep surficial groundwater [an ecological constituent of potential concern (ECOPC; see Section 2.9.2)] for the uncertainty evaluation of the preliminary ecological risk evaluation.

2.8.3 Migration of groundwater to surface water

Fate and transport modeling was performed to quantitatively assess the risk to ecological receptors from mercury in deep surficial groundwater that may migrate to Canoochee River approximately 10,000 feet downgradient of SWMU 3. The One-dimensional Analytical Solute Transport (ODAST) Model was used to estimate the concentration of mercury in the deep groundwater at Canoochee River. The model assumed that the concentration in Canoochee River are equal to the concentration in the adjacent groundwater. This assumption is conservative, given that it assumes that there is no dilution of the constituents upon discharge of groundwater into the surface water body that is approximately 10,000 feet downgradient of the site.

The ODAST model assumed that the concentration of metals at the source location would remain constant for a period of 70 years. The ODAST model was simulated for a period of 1,000 years. The ODAST modeling results estimated that the concentration of mercury in Canoochee River will be 1.8E-7 µg/L.

2.9 PRELIMINARY RISK EVALUATION

2.9.1 Human Health Preliminary Risk Evaluation

The human health preliminary risk evaluation (HHPRE) included a Step 1 risk evaluation to determine potential human health risks associated with the constituents present at the site. Human health constituents of potential concern (HHCOPCs) were defined as those constituents present at concentrations higher than their reference background criteria and higher than their respective risk-based or applicable or relevant and appropriate requirement–based screening criteria [see Table 10.2-13 of the revised final Phase II RFI Report (SAIC 2000)]. SRCs for surface soil, subsurface soil, groundwater, surface water, and sediment evaluated under the HHPRE are presented in Table 2-1.

Arsenic was the only constituent identified as a potential HHCOPC in surface soil.

No HHCOPCs were identified in subsurface soil at SWMU 3.

Based on the human health screening, delta-BHC and mercury are HHCOPCs in groundwater.

The maximum concentrations of benzo(*b*)fluoranthene and arsenic exceeded the human health criteria and Ambient Water Quality Criterion (AWQC) for surface water. Chromium and lead exceeded their respective AWQCs. Therefore, benzo(*b*)fluoranthene, arsenic, chromium, and lead are HHCOPCs for surface water.

Arsenic was the only chemical identified as a potential HHCOPC in sediment.

A baseline human health risk assessment (BHHRA; see Section 2.10) was performed to quantitatively assess the risks associated with exposure to the HHCOPCs: arsenic in surface soil and sediment; delta-BHC and mercury in groundwater; and benzo(*b*)fluoranthene, arsenic, chromium, and lead in surface water.

2.9.2 Ecological Preliminary Risk Evaluation

Acetone, arsenic, barium, carbon disulfide, and selenium were identified as ECOPCs in sediment. Preliminary and supplemental risk calculations, however, resulted in hazard quotients (HQs) of less than one for wildlife receptors; therefore, ECOPCs in sediment are unlikely to pose a risk to wildlife receptors.

Benzo(*b*)fluoranthene, barium, and lead were indicated as ECOPCs in surface water. Preliminary and supplemental risk calculations for mink and green herons exposed to ECOPCs in surface water, however, resulted in HQs of less than one; therefore, ECOPCs in surface water are unlikely to pose a risk to wildlife receptors.

Chromium and lead were indicated as ECOPCs in surface soil at SWMU 3. Supplemental risk calculations for chromium and lead, however, resulted in HQs of less than one; therefore, chromium and lead in surface soil are unlikely to pose a risk to robins.

Barium; cadmium; lead; mercury; 4,4'-DDT; and delta-BHC in shallow groundwater are ECOPCs for wetland biota because they are present at levels exceeding surface water ecological screening values (ESVs). The unfiltered shallow groundwater (hand-augered samples) overestimates the potential concentration (dissolved portion) of constituents in surface water; therefore, the wetlands biota located in the marshy area are not at a significant risk from these constituents.

Mercury and 4,4'-DDT in shallow surficial groundwater are ECOPCs for wildlife receptors. Based on the magnitude of the HQs calculated in the supplemental risk calculations, mercury and 4,4'-DDT are unlikely to be potential hazards to wildlife receptors feeding in the marshy area adjacent to SWMU 3.

Mercury in deep surficial groundwater at SWMU 3 is an ECOPC for aquatic biota and wildlife receptors. Mercury is unlikely to be a potential hazard to aquatic biota living in downgradient surface water bodies because the predicted maximum discharge concentration of mercury from modeling after dilution does not exceed the ESV. Mercury is unlikely to be a potential hazard to wildlife receptors ingesting aquatic biota living in downgradient surface water bodies because the supplemental risk calculations using the mean groundwater concentration of mercury result in HQs of less than one for mink and 3.0 for green herons using conservative exposure assumptions.

In summary, the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000) concluded that there is no present ecological risk at SWMU 3 and that the site is unlikely to pose an ecological risk in the future; therefore further investigation and/or evaluation of ECOPCs was not required.

2.10 BASELINE HUMAN HEALTH RISK ASSESSMENT

The BHHRA addressed the risks associated with exposure to the following HHCOPCs: arsenic (surface soil, surface water, and sediment), chromium (surface water), lead (surface water), mercury (groundwater), delta-BHC (groundwater), and benzo(*b*)fluoranthene (surface water). No CMCOPCs were identified for this site.

The potential risks associated with exposure to lead were quantified based on the blood-lead levels resulting from exposure to lead in various media. The potential risks associated with exposure to lead could not be quantified, given that the Integrated Exposure Uptake Biokinetic Model for Lead in Children (EPA 1994) used to estimate blood-lead levels does not address intermittent exposures such as incidental ingestion of surface water as a result of wading. Given that the primary exposure pathway is incidental ingestion, the exposure concentration in surface water was compared to risk-based screening values for drinking water.

Current on-site receptor populations include an Installation worker, a juvenile trespasser, and a sportsman. However, due to the limited potential exposure of a sportsman from bioaccumulation, the sportsman was not assessed in the baseline risk assessment. Future on-site and off-site land-use populations include an Installation worker, a juvenile trespasser/wader, and a resident (adult and child). These receptor populations represent both on-site and off-site receptors. The residential receptor population was divided into an adult and a child because the adult receptor is at greater risk from exposure to carcinogens, while the child is at greater risk from exposure to noncarcinogens. The reader is referred to Appendix I, Section I.2.2 ("Identification of Potential Receptor Populations and Associated Exposure Pathways") of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000) for a more detailed discussion on the potential exposure pathways and the differences between the exposure of the adult and child resident receptors.

Juvenile receptors (i.e., a juvenile trespasser and a juvenile wader) had incremental lifetime cancer risks (ILCRs) that exceeded the target level of 1×10^{-6}. Benzo(*b*)fluoranthene in surface water is the risk driver, with ILCRs that exceeded 1×10^{-6} for all of the juvenile receptors; therefore, benzo(*b*)fluoranthene was identified as a constituent of concern (COC) in surface water.

The on-site Installation workers (both current and future) had ILCRs that exceeded the target level of 1×10^{-6}. Arsenic in surface soil is the risk driver, with ILCRs that exceeded 1×10^{-6} for both the current and future Installation workers; therefore, arsenic was identified as a COC in surface soil.

The ILCRs for the future on-site resident child and resident adult exceeded the target level of 1×10^{-6}, with ILCR values of 1.21×10^{-5} and 7.30×10^{-6}, respectively. Arsenic in surface soil was identified as a COC for both of these receptors, with a ILCRs of 1.17×10^{-5} for the resident child and 6.40×10^{-6} for the resident adult.

Chromium (surface water), lead (surface water), mercury (groundwater), and delta-BHC (groundwater) are not risk drivers at this site; therefore, these constituents are not considered to be COCs. Arsenic was identified as a COC in surface soil only. It is not a COC in surface water or sediment. Benzo(*b*)fluoranthene was identified as a COC in surface water.

Remedial levels were derived for arsenic in surface soil and benzo(*b*)fluoranthene in surface water based on an ILCR of 5.0×10^{-5}. The development of remedial levels for arsenic and benzo(*b*)fluoranthene is summarized below:

Arsenic. The recommended risk-based remedial level for arsenic in surface soil is 30.3 mg/kg (Table 2-2). This concentration is greater than the maximum detected concentration of 24 mg/kg. Given that the maximum concentration is below the recommended remedial value, no further action is required to address the presence of arsenic in surface soil.

Table 2-2. Remedial Levels for Surface Soil and Surface Water, SWMU 3

Constituent of Concern	Maximum Detected Concentration (mg/kg)	Risk-based Remedial Levels (mg/kg)		
		ILCR		
		1×10^{-6}	1×10^{-5}	5×10^{-5}
Surface Soil				
Arsenic	24	0.6	6.1	30.3
Surface Water				
Benzo(*b*)fluoranthene	0.0066	0.0010	0.0101	0.0505

Bold indicates concentrations above recommended remedial levels.

Benzo(*b*)fluoranthene. The recommended risk-based remedial level for benzo(*b*)fluoranthene in surface water is 0.0505 mg/L (Table 2-2). This value is greater than the maximum detected value of 0.0066 mg/L. Given that the maximum concentration is below the recommended remedial value, no further action is required to address the presence of benzo(*b*)fluoranthene in surface water.

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 OBJECTIVES

Based on the findings of the site characterization at this SWMU, the primary purpose for implementing corrective measures at SWMU 3 is limited to protection of human health and safety. To achieve this goal, two primary remedial response objectives have been established for SWMU 3: (1) to prohibit the ingestion of shallow groundwater from the subject site and (2) to prohibit the disturbance of surface and subsurface soil to minimize contact with soil and buried waste. Any corrective measures that pose a significant threat to human health during implementation (e.g., methods that would involve disturbance of subsurface soil) will not be evaluated. Implementation of the selected remedial response 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

As discussed in Chapter 2, remedial levels were developed for the COC at SWMU 3. Arsenic was identified as a COC for surface soil at the site. Benzo(*b*)fluoranthene was identified as a COC in surface water through direct exposure. The maximum concentrations of arsenic in surface soil and benzo(*b*)fluoranthene in surface water were below their respective remedial levels (Table 2-2); therefore, the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000) concluded that no further action was needed to address arsenic in surface soil and benzo(*b*)fluoranthene in surface water. With the concurrence of GEPD (approval letter from Mr. Bruce Khaleghi to Colonel Gregory Stanley dated December 8, 2000), the revised final Phase II RFI Report recommended that institutional controls be implemented at SWMU 3. Institutional controls will be protective of human health because land-use restrictions will limit direct contact with the potential buried debris and the use of shallow groundwater for drinking purposes.

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4.0 SCREENING OF CORRECTIVE ACTIONS

This section identifies corrective action technologies applicable to the TAC-X Landfill. The technologies that are retained following screening are then presented as corrective action alternatives that address limiting exposure to subsurface contamination. These alternatives are then evaluated with respect to protection of human health and life-cycle cost.

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 the risk to human health.

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. An 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, operations, 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, and maintaining long-term control of the site.

4.1.3 Cost

Relative costs are included for the corrective actions. The estimates are intended to facilitate evaluation and comparison among alternatives; therefore, typical 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: (1) no action, (2) institutional controls: land-use controls, and (3) institutional controls: physical barriers. Additionally, an option to monitor groundwater will be evaluated for both corrective action categories involving institutional controls. 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 that screening evaluation are also 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; therefore, the no action alternative will be eliminated from further evaluation.

Institutional controls include actions taken to restrict access to contaminated areas by establishing legal land-use controls or by providing physical barriers to 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, controls implemented through the BMP, zoning controls, and placement of signs restricting access. Physical barriers include installation of a barbed-wired, chain-link fence around the site boundary. Abandonment of groundwater wells no longer needed for site monitoring is also considered as a method for discouraging the use of groundwater at the site. Groundwater monitoring of selected wells would provide information associated with contaminant concentration trends because contaminants might continue to leach to groundwater over time. This activity would involve the use of selected wells for groundwater monitoring purposes only and the abandonment of the remaining wells.

4.3 CORRECTIVE ACTION ALTERNATIVES

The technologies retained following the screening-level step were combined in various ways to develop alternatives that would meet the remedial response objective of protection of human health. Two alternatives were identified and subsequently evaluated. The option of groundwater monitoring instead of well abandonment will also be evaluated for each of the two alternatives.

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

- Alternative 1a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Natural Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Post-mounted Warning Signs, Implementation of O&M Plan

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

Table 4-1. Evaluation of Corrective Actions, SWMU

Action	Description	Effectiveness	Implementability	Cost[a]
No Action	The no action alternative provides a baseline against which other actions can be compared. Under the no action alternative, all source materials, soil, 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 buried waste by human disturbance.	This alternative would not address the corrective action objectives for the site. This alternative would not provide protection of human health because there would not be sufficient controls to prevent human exposure to buried waste.	There would be no implementability involved for 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. Land-use restrictions and institutional control requirements that would be enforced would include restrictions through deed recordation, the BMP and zoning controls, warning signs posted around the site, groundwater use restriction (monitoring only, if necessary), well abandonment, 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 would be prohibited under the deed recordation.	Land-use restrictions would be effective and provide long-term reliability with respect to preventing human exposure to buried waste 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 exposure to contaminated media. 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 would be readily implementable. 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, abandonment of the wells, and implementation of the O&M Plan for 30 years would range between approximately $90,000 and $120,000.
Institutional Controls: Physical Barriers	Physical barriers would reduce potential hazards by limiting exposure of humans to contaminated soil. Physical barriers would include chain-link fencing topped with barbed wire, landfill access gates, and warning signs around the site.	This technology would be effective and provide long-term reliability with respect to minimizing human exposure to buried waste within the boundaries of the site by physically restricting access.	Physical barriers would be readily implementable. 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.	Installation of fencing would be expensive. The costs for fencing, including 30 years of O&M, would range between approximately $170,000 and $190,000.

Note: Footnote appears on page 4-4.

Table 4-1. Evaluation of Corrective Actions, SWMU 3 (continued)

Action	Description	Effectiveness	Implementability	Cost[a]
Groundwater Monitoring	Groundwater monitoring would serve to provide information concerning trends associated with the concentrations of constituents over time. Monitoring would continue on an annual basis for a period of 5 years to evaluate potential constituent leaching from the buried waste.	Monitoring would provide an effective method for evaluating concentrations of constituents in groundwater over time.	Technologies and resources are available for collection and analysis of groundwater resources.	Groundwater sampling is relatively expensive. The cost for groundwater sampling for 5 years would range between approximately $90,000 and $110,000. This includes other direct costs (e.g., pumps, meters), travel and per diem for the sampling crew, laboratory analysis, quality assurance, and reporting for five sampling events.

[a]An approximate range of the capital and O&M costs for 30 years is presented for evaluation of the relative costs of the alternative. The range does not include engineering management, health and safety, contractor profit, or contingency costs.

- Alternative 2a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Natural Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Chain-link Fence Barrier, 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; therefore, two primary evaluation factors were used in the preferred corrective action alternative: protection of human health and life-cycle costs.

Protection of Human Health

The effectiveness of each proposed alternative at protecting human health at this site is dependent upon its ability to prohibit human activity associated with disturbance of subsurface soil and usage of shallow groundwater. For each alternative the level of protection of human health was evaluated and compared with those of the other alternatives. For retained Alternatives 1 and 2, usage of groundwater would be prohibited through abandonment of existing wells and through legal land-use controls (i.e., BMP, deed recordation, and zoning). For both options to these alternatives, usage of groundwater for drinking would be prohibited, and environmental monitoring would be required for 5 years to evaluate potential constituent leaching from buried waste through legal land-use controls (i.e., BMP and deed recordation). For both alternatives and their options, legal land-use controls and warning signs would also restrict activities associated with disturbance of subsurface soil. In Alternative 2 additional protection would be provided through 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 purposes of comparison. 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 the labor and material costs, site conditions, competitive market conditions, final project scope, and implementation schedule at the time the corrective action was initiated. The life-cycle cost estimates are not adjusted to present worth costs, and no escalation factors have been applied.

4.3.2 Evaluation of Corrective Action Alternatives

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

The alternatives would include the following common features:

- BMP, deed recordation, and zoning controls to prohibit the use of groundwater for drinking water and intrusion into subsurface soil;
- abandonment of site monitoring wells;
- installation of warning signs; and
- implementation of an O&M Plan to maintain the conditions of the signage.

Table 4-2. Corrective Action Alternatives, SWMU 3

Corrective Action	Description	Protection of Human Health	Cost	Comments
Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Natural Barriers, Well Abandonment, 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 and groundwater usage. This alternative would also include abandonment of eight (MW1–MW8) groundwater monitoring wells.	Protection of human health would be primarily dependent upon enforcement of compliance with land-use controls. Existing natural barriers (e.g., heavily forested, swampy areas) provide effective restrictions on human access to the site to further discourage any unauthorized excavation activities.	$174,154	Least expensive providing sufficient level of protection.
Alternative 1a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Natural Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Post-mounted Warning Signs, Implementation of O&M Plan	This action has similar requirements to those of Alternative 1; however, four of the wells (MW5, MW6, MW7, and MW8) would be used for groundwater monitoring for a 5-year period to evaluate potential constituent leaching from buried waste. MW1, MW2, MW3, and MW4 would be abandoned, and MW5, MW6, MW7, and MW8 would be abandoned at the completion of the groundwater monitoring program.	Protection of human health would be similar to that afforded by Alternative 1. Data generated from groundwater monitoring could be used to determine the need to provide further protection of human health.	$344,344	Moderately expensive providing increased level of protection.
Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Natural Barriers, Well Abandonment, 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 and groundwater usage. Physical barriers to be installed would include a 2,098-linear-foot chain-link fence topped with barbed wire along the entire perimeter of the site. This alternative would also include abandonment of eight (MW1–MW8) groundwater monitoring wells.	In addition to the protection provided by Alternative 1a, human access would be further restricted by fencing along the boundaries of the site. The fencing would be more effective than signs alone in deterring or discouraging unauthorized entry and/or excavation activities.	$285,881	Significantly more expensive with only slight increase in level of protection to potential buried waste compared to that afforded by Alternative 1.

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Table 4-2. Corrective Action Alternatives, SWMU 3 (continued)

Corrective Action	Description	Protection of Human Health	Cost	Comments
Alternative 2a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Natural Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Chain-link Fence Barrier, Fence-mounted Warning Signs, Implementation of O&M Plan	This action has similar requirements to those of Alternative 2; however, four of the wells (MW5, MW6, MW7, and MW8) would be used for groundwater monitoring for a 5-year period to evaluate potential constituent leaching from buried waste. MW1, MW2, MW3, and MW4 would be abandoned, and MW5, MW6, MW7, and MW8 would be abandoned at the completion of the groundwater monitoring program.	Protection of human health would be similar to that afforded by Alternative 2. Data generated from groundwater monitoring could be used to determine the need to provide further protection of human health.	$454,521	Most expensive providing highest level of protection.

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 life-cycle cost.

Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Natural Barriers, Well Abandonment, 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 by preventing human exposure to buried waste by the establishment of legal land-use restrictions. The BMP is an effective tool for ensuring that unauthorized disturbance of subsurface soil at the site and ingestion of groundwater from the site are prohibited while the property is under DoD ownership. 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 was transferred; community, transferee, or governmental notice (if needed); and self-certification (if feasible). To reduce potential exposure to health hazards associated with SWMU 3, warning signs stating restrictions on human activity within the SWMU would be posted at 200-foot intervals around the boundary of the site. The placement of signs for Alternative 1 is shown in Figure 4-1. Signs and existing natural barriers (e.g., heavily forested, swampy areas) would be effective at restricting human access to the site because they 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. Shallow groundwater is not used as a source of drinking water at the site, and given the availability of the underlying Floridan Aquifer, it is unlikely that the shallow groundwater would ever be used for drinking water. The eight monitoring wells (MW1 through MW8) installed as part of either the Phase I or Phase II RFI and remaining at the SWMU 3 site would be abandoned. Institutional controls prohibiting the use of groundwater would, therefore, be effective at protecting human health.

This is the least expensive of the two alternatives and options, with a life-cycle cost of approximately $174,154.

Alternative 1a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Natural Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Post-mounted Warning Signs, Implementation of O&M Plan

This optional alternative has the same features as those described in Alternative 1, with the exception that four wells (MW5, MW6, MW7, and MW8) would be used for groundwater monitoring, and the remaining wells (MW1, MW2, MW3, and MW4) would be abandoned. Use of groundwater wells for the purpose of drinking water would be expressly prohibited by land-use restrictions provided by the BMP and deed recordation. Provisions for groundwater monitoring would be documented in both the BMP and deed recordation. These provisions would include monitoring of one upgradient well (MW5) and three downgradient wells (MW6, MW7, and MW8). Groundwater samples would be collected from these wells once every year for a period of 5 years to evaluate potential constituent leaching from the buried waste. No specific monitoring requirements are specified under RCRA for corrective actions at SWMUs; however, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires a 5-year review to evaluate the performance and residual risk associated with a selected alternative (including alternatives in which waste remains in place). Five years of groundwater monitoring was selected based on the 5-year review requirement for remedial actions under CERCLA. The results would be presented in an annual report, in association with the O&M report. Groundwater samples would be analyzed for the potential SRCs: VOCs, SVOCs, and RCRA metals. With the concurrence of GEPD,

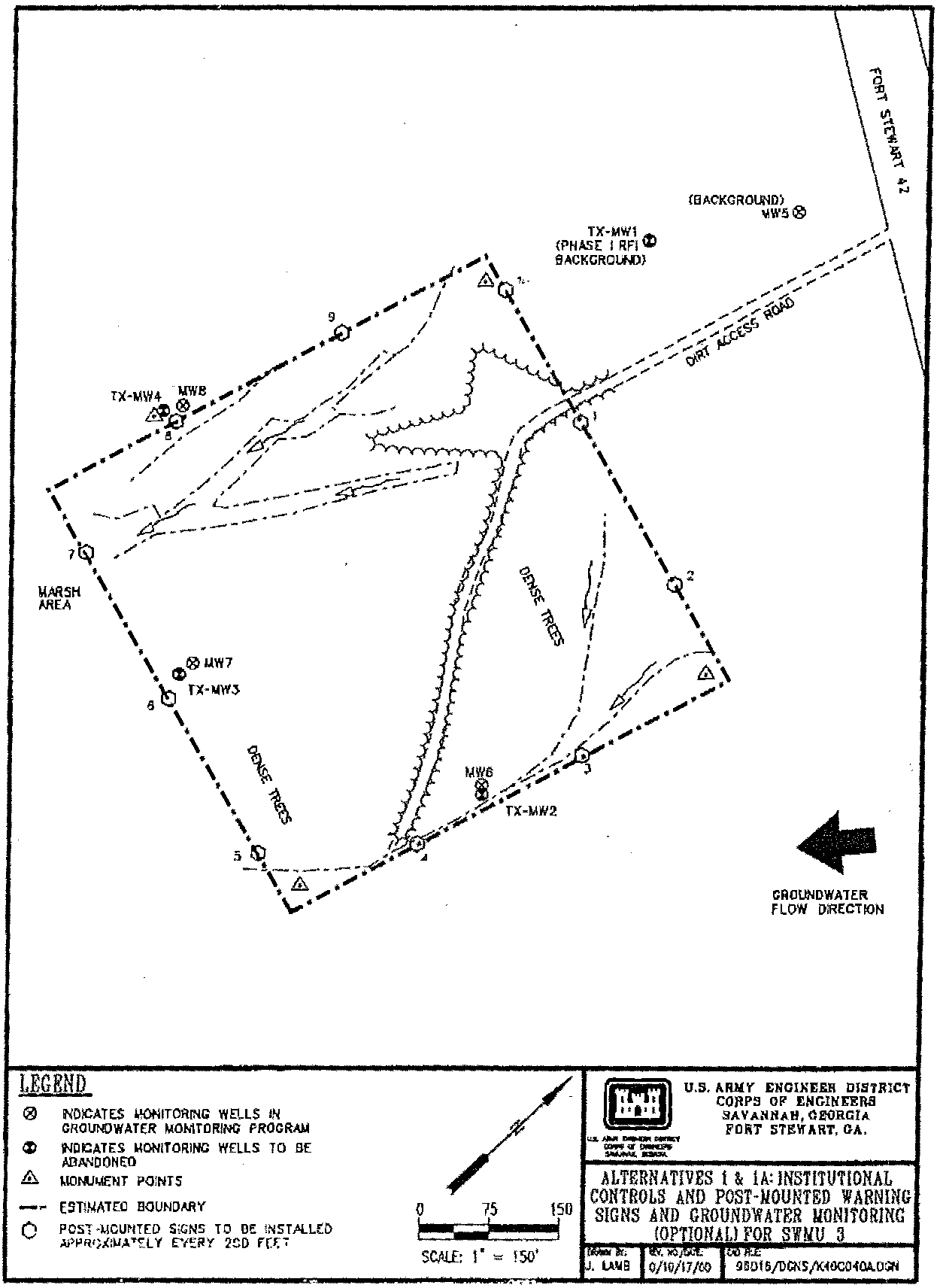

Figure 4-1. Alternatives 1 and 1a: Institutional Controls with Post-mounted Warning Signs and Groundwater Monitoring (Optional), SWMU 3

monitoring wells MW5, MW6, MW7, and MW8 would be abandoned after the completion of the groundwater monitoring program. The monitoring wells to be sampled and to be abandoned are identified on Figure 4-1.

The sampling of groundwater annually for 5 years has a significant impact on the cost of this alternative. The groundwater monitoring alone costs $104,000, resulting in a life-cycle cost of approximately $344,344 or nearly two times Alternative 1's life-cycle cost.

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

This alternative is similar to Alternative 1 in that the land-use control provisions would remain the same (i.e., BMP, deed recordation, zoning control). Also, the eight existing wells (MW1 through MW8) would be abandoned, existing physical barriers would be maintained, and an O&M Plan would be implemented. This alternative would also provide approximately 2,098 linear feet of 6-foot-high chain-link fencing topped with three strands of barbed wire. The fence would provide a physical deterrent to public access around the entire landfill. Fence-mounted warning signs would be positioned approximately every 200 feet. One 20-foot-wide gate would be installed to allow access to the site for inspection and maintenance. 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 due to the greater level of protection against inadvertent intruders as a result of the fencing. The effectiveness of Alternative 2 at preventing the use of groundwater would be equal to that of Alternative 1. The O&M Plan would also include maintenance and repair of the fence and signs.

This alternative is more expensive than Alternative 1. The capital cost for the installation of fencing is approximately $45,658, resulting in a life-cycle cost of approximately $285,881, or nearly one and one-half times Alternative 1's life-cycle cost.

Alternative 2a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Natural Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Chain-link Fence Barrier, Fence-mounted Warning Signs, Implementation of O&M Plan

This optional alternative has the same features as those described in Alternative 2, with the exception that four wells (MW5, MW6, MW7, and MW8) would be used for groundwater monitoring, and the remaining wells (MW1, MW2, MW3, and MW4) would be abandoned. Use of groundwater wells for the purpose of drinking water would be expressly prohibited by land-use restrictions provided by the BMP and deed recordation. Provisions for groundwater monitoring would be documented in both the BMP and deed recordation. These provisions would include monitoring of one upgradient well (MW5) and three downgradient wells (MW6, MW7, and MW8). Groundwater samples would be collected from these wells once every year for a period of 5 years to evaluate potential constituent leaching from the buried waste. No specific monitoring requirements are specified under RCRA for corrective actions at SWMUs; however, CERCLA requires a 5-year review to evaluate the performance and residual risk associated with a selected alternative (including alternatives in which waste remains in place). Five years of groundwater monitoring was selected based on the 5-year review requirement for remedial actions under CERCLA. The results would be presented in an annual report, in association with the O&M report. Groundwater samples would be analyzed for the potential SRCs: VOCs, SVOCs, and RCRA metals. With the concurrence of GEPD, monitoring wells MW5, MW6, MW7, and MW8 would be abandoned after the completion of the groundwater monitoring program. The monitoring wells to be sampled and to be abandoned are identified in Figure 4-2.

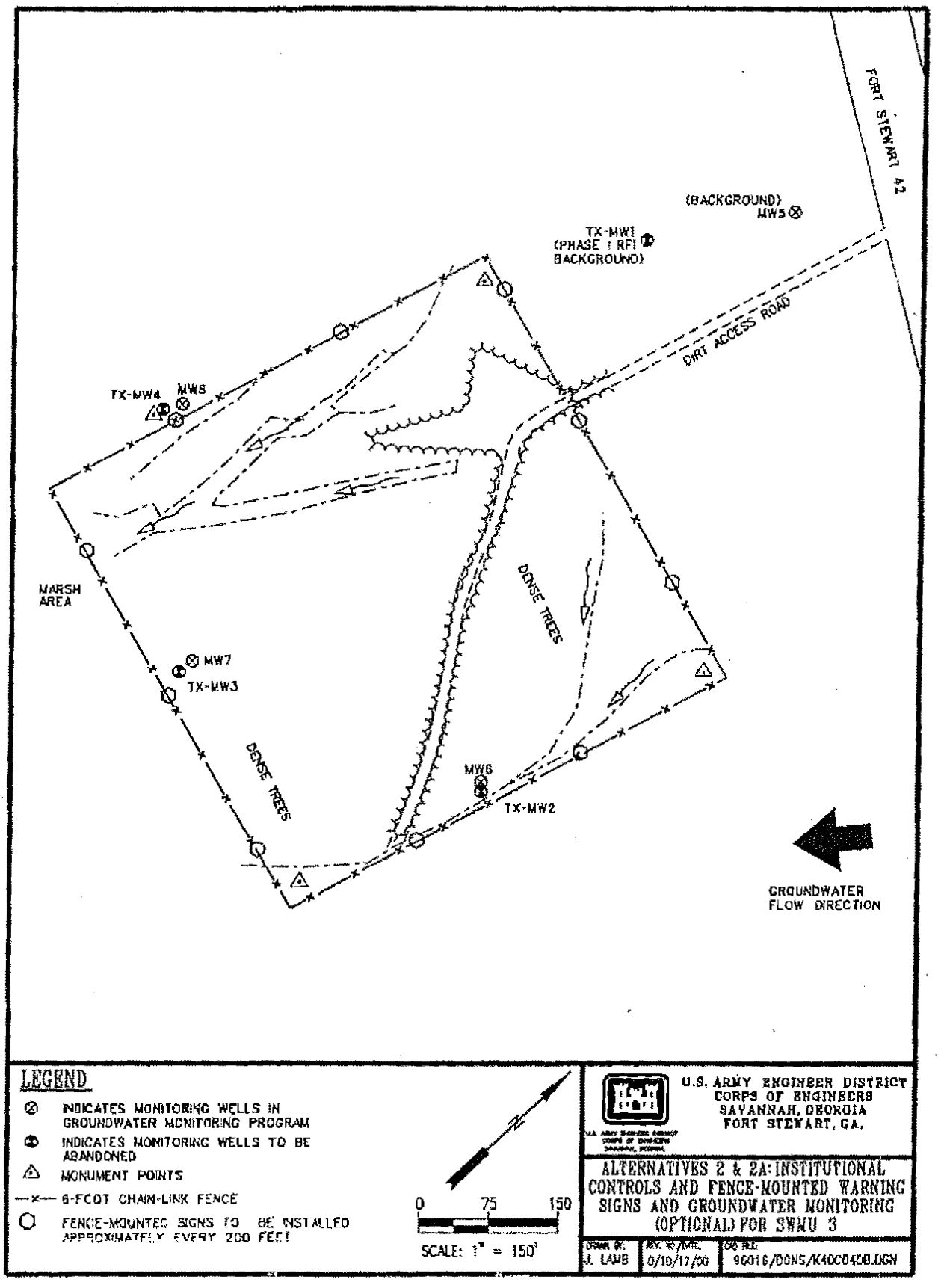

Figure 4-2. Alternatives 2 and 2a: Institutional Controls with Chain-link Fence Barrier and Fence-mounted Warning Signs and Groundwater Monitoring (Optional), SWMU 3

The fencing combined with the sampling of groundwater annually for 5 years makes this alternative the most expensive. The groundwater monitoring alone costs $104,000, resulting in a life-cycle cost of approximately $454,521, or approximately 24 percent and 37 percent more than Alternative 1a and Alternative 2, respectively.

5.0 CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN

This section presents a conceptual design and plan for implementation of the selected corrective action alternative. Based on the level and type of subsurface soil and groundwater contamination, a cost-effective corrective action was selected that would adequately protect human health. The technology evaluation presented in Chapter 4 compared two different corrective action alternatives and two optional alternatives based on their effectiveness at protecting human health and on their life-cycle costs. Based on that evaluation, Alternative 1 was selected because it will provide a sufficient level of protection of human health cost-effectively.

5.1 SELECTED CORRECTIVE ACTION

The selected corrective action alternative 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 as well as physical barriers. Land-use restrictions will be documented and/or enforced through deed recordation, the BMP, zoning restrictions, and signage.

Alternative 1 has been selected because it will provide effective protection of human health cost-effectively. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered to be cost-effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized excavation below ground would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Groundwater monitoring as described under Alternatives 1a and 2a would not provide enough additional protection to human health to justify the increased costs. The groundwater presently does not present a risk to human health. No COCs have been identified in subsurface soil, groundwater, or sediment. The COCs identified in surface soil (arsenic) and surface water [benzo(*b*)fluoranthene] were detected at concentrations below their respective remedial levels. The institutional controls described for Alternative 1 will provide a sufficient level of protection of human health 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 cost-effectively implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

5.1.1 Effectiveness

Post-mounted warning signs and documented land-use restrictions will be highly effective and will provide long-term reliability with respect to preventing human exposure through physical contact with the buried waste within the boundaries of SWMU 3. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land-use controls during ownership by DoD. Prior to planning any construction activities at the FSMR, the BMP must be reviewed. In addition, all construction projects will be reviewed during the planning stages for approval by the Base Master Planner and the FSMR Directorate of Public Works (DPW). These land-use controls will remain in effect after transfer from DoD ownership by restrictions imposed through deed recordation.

Additionally, the proposed abandonment of monitoring wells (MW1, MW2, MW3, MW4, MW5, MW6, MW7, and MW8) and the groundwater-use restrictions will provide an effective method for preventing the use of groundwater for drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at the FSMR and is not used. The BMP will be modified to officially restrict its use, further preventing use of the surficial groundwater at the site.

An annual O&M program will be administered to replace or repair warning signs, 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 or repair of warning signs.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of SWMU 3. Warning signs will be most effective over the short term. Current risk is below remedial levels, and use of the site is limited to outdoor classroom-style training, so access is already limited.

5.1.2 Implementability

Very few factors limit implementability of the institutional controls under evaluation. On-site personnel or contractors can readily perform posting of signs. The materials for the installation of warning signs are readily available to local contractors. Annual 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 the necessary land-use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to allow for incorporation of land-use controls into the BMP and to facilitate deed recordation.

5.1.3 Cost

The estimated total life-cycle cost of installation of warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $174,154. This alternative provides adequate protection of human health and the environment.

5.2 CONCEPTUAL DESIGN

During the period of ownership by DoD, institutional controls will be recorded to ensure implementation in the BMP. 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 hazards associated with SWMU 3, warning signs stating restrictions on human activity within the SWMU will be mounted on poles around the boundary of the site (see Figure 4-1).

All activities that would involve disturbance of the subsurface will be minimized in accordance with all land-use control mechanisms. Activities that will be prohibited include military training activities that would disturb the subsurface soil, hunting, recreational activities, and construction of residential facilities; however, the following activities, conducted in a manner that would minimize disturbance of the subsurface, will be permitted

- timber harvesting (possible in the future),
- performance of wildlife studies,
- provision and maintenance of feed lots for deer, and
- outdoor classroom-style military training (subsurface disturbance not allowed).

5.2.1 Establishment of Institutional Controls

Prior to installation of warning signs at the SWMU, 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 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 this SWMU 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 3 has been used as a landfill. The purchase agreement(s) and deed recordation or lease agreement 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 the 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 (Appendix C) by a professional land surveyor certified in the state of Georgia. The plat will be included in the BMP. The survey plat indicates the location and dimensions of SWMU 3 with respect to permanently surveyed benchmarks. The plat contains a prominently displayed note that states Fort Stewart's obligation to prohibit disturbance of SWMU 3 in accordance with this CAP.

5.2.2 Warning Signs

Ten permanent warning signs will be mounted on poles at approximately 200-foot intervals surrounding the perimeter of SWMU 3, as shown in Figure 4-1. These signs will be worded as shown below.

FORMER LANDFILL
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 paint and of weather-resistant construction. The signs will have a brown background and white lettering.

The positioning of each sign will provide maximum visibility from all locations outside the SWMU's boundaries. All signs will be permanently labeled (for identification purposes) on the back with a numerical identification number as shown on Figure 4-1.

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

5.2.3 Well Abandonment

Eight monitoring wells (MW1, MW2, MW3, MW4, MW5, MW6, MW7, and MW8) will be properly abandoned. The abandonment of monitoring wells will include removal of the protective guard posts, concrete pad, and surface casing and grouting of the wells to ground surface. The debris from the abandonment of the monitoring wells will be disposed of at the Fort Stewart Sanitary Landfill.

5.3 COST ESTIMATE

A detailed cost estimate for implementation of institutional controls at the TAC-X Landfill is provided in Appendix D. The life-cycle cost estimate for the selected institutional controls alternative is $174,154, which includes $19,538 for capital costs and $92,819 for O&M.

5.4 IMPLEMENTATION SCHEDULE

Implementation of the corrective action will begin once approval of this CAP is received from GEPD. The schedule presented in **Table 5-1** has been established for implementation of institutional controls at this site.

Table 5-1. Corrective Action Implementation Schedule, SWMU 3

Task	Time from GEPD Approval of CAP (days)
Procure signs and materials.	90
Record institutional controls in BMP and any other approved implementing document.	120
Perform well abandonment.	120
Install warning signs.	120
Perform inspections (implement O&M Plan).	Annually[a]
Repair/replace signs.	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 warning signs, with subsequent reports submitted annually thereafter.

6.0 REFERENCES

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

REPLY TO
ATTENTION OF

AFZP-PWV-E (200-1a)

MEMORANDUM FOR HEADQUARTERS, FORSCOM, DCSPIM,
ATTN: STEPHANIE SIGLER, 1777 HARDEE AVENUE SW
FORT MCPHERSON, GA 30330-1062

SUBJECT: Decision Documents for Final Remedial Action at Fort Stewart and Hunter Army Airfield, Georgia

1. The attached decision documents are provided for your use and convenience in documenting the distribution of fiscal year 01 funding for the Final Remedial Action (FRA) at the following sites:

a. FST-02, Camp Oliver Landfill.
b. FST-03, TAC-X Landfill.
c. HAA-13, Former Pumphouse 2 (Only one of the 3 areas listed under this site [Pumphouses 1, 2 and 6])

2. Although HAA-13 includes three areas, HAAF's former Pumphouses 1, 2 and 6, only Pumphouse 2 is being considered for final remedial action at this time. Pumphouse 6 was granted a "No Further Action Required" status in Nov 98. A final remedial action for Pumphouse 1 is still awaiting development and review.

3. Mr. Joe King at the Army Environmental Center has received copies of these decision document for review and approval.

4. The point of contact for this memorandum is Ms. Melanie Little or Ms. Tressa Rutland, DPW Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively.

FOR THE COMMANDER:

Enclosures

GREGORY V. STANLEY
COL, EN
Director, Public Works

DECISION DOCUMENT FOR THE FINAL REMEDIAL ACTION AT THE CAMP OLIVER LANDFILL (SWMU 2)

FORT STEWART, GEORGIA

PURPOSE

This decision document describes the selected Final Remedial Action (FRA) for the Camp Oliver Landfill (SWMU 2) located at Fort Stewart, Georgia, which consists of Institutional Controls (ICs). Specifically, the ICs proposed for FST-02 includes documentation in the Base Master Plan (BMP), deed recordation, zoning controls, maintenance of existing physical barriers, installing warning signs, and implementation of the Operation & Maintenance (O&M) plan. The selected ICs are described in detail in the *Final Corrective Action Plan for the Camp Oliver Landfill (Solid Waste Management Unit 2)*, dated March 2001. The document will be reviewed by Georgia Environmental Protection Division (GA EPD) and comments and/or tentative approval is anticipated in June 2001. FST-02 is a Defense Site Environmental Restoration Tracking System (DSERTS) site and the FRA will be funded using fiscal year (FY) 2001 Environment, Restoration Account (E,RA) funds.

This decision document presents the justification for the selected FRA and specifically provides details on the following:

- Site Location and History
- Nature and Extent of Contamination
- Remedial Response Objectives
- Conceptual Design and Implementation
- Public Notification
- Declaration

Site Location and History

The Camp Oliver Landfill is located approximately 17 miles northwest of the Fort Stewart garrison area along Fort Stewart Road 129. It is just north of the bivouac area on the northern side of a small hill and is reported to be 15 feet wide by 300 feet long by 5 feet to 6 feet deep. From the 1960s to 1979, the area was used for disposal of refuse from troop training activities and nearby residents via open-pit burning. The landfill was officially closed in 1970; however, the trench method of solid waste disposal was reported to have continued. General refuse from ground maintenance activities and construction debris were placed in the landfill from 1979 to 1984 during the annual 3- to 4-month period of training activities.

The disposed waste included garbage and refuse, grass clippings, tree branches, root stumps, and chunks of asphalt and concrete. No evidence of toxic or hazardous waste disposal was indicated in the records searched by Environmental Science and Engineering (1982).

Currently, there is little obvious surface evidence that a landfill or open dumping area existed. During a site reconnaissance in November 1995, small soil piles, some roofing tin, and wooden construction-type debris were observed. Also, spent small weapons cartridges were observed in the ditch along the site's southwestern and southeastern boundaries. A site reconnaissance in September 1996 indicated no evidence of any landfill operations. Grass, small trees, and bushes now cover the area.

Nature and Extent of Contamination

(A tabular summary of site-related contaminants for SWMU 2 is presented in Table 1.)

SOIL Eleven surface soil samples were collected at SWMU 2 during the Phase II RFI from three surface soil locations, five soil boring locations, and three monitoring wells. Acetone and 2-Butanone were detected in one surface soil sample from MW6. Acetone was also detected in surface soil samples collected from SB2 and SB5. Bis(2-ethylhexyl)phthalate was detected in one of the surface soil samples at SB2. Fourteen pesticides were detected in the surface soil. These pesticides were 4,4'-DDD; 4,4'-DDE; 4,4'-DDT; aldrin; alpha-chlordane; alpha-BHC; delta-BHC; dieldrin; endosulfan II; endosulfan sulfate; endrin ketone; heptachlor; heptachlor epoxide; and methoxychlor. Arsenic, barium, cadmium, chromium, lead, and mercury were detected in surface soil samples from one or more of the monitoring wells, soil borings, and surface soil locations at concentrations above the reference background criteria and were considered to be potential site-related contaminants (SRCs). Arsenic was detected at less than two times the reference background criterion, including the site-specific background concentration. While barium was elevated above background at most locations, the maximum concentration was less than two times background, and the sampling locations at which the exceedances of reference background occurred were widely distributed, suggesting that barium occurs naturally in surface soil in this area. Cadmium was detected at only one surface soil sampling location at a concentration only slightly above the reference background criterion. Lead was found in only one surface soil sample, SS3, at a concentration that was only slightly more than two times the reference background criterion. Mercury was detected at a maximum concentration of 0.04 mg/kg, compared to the reference background criterion of 0.03 mg/kg.

Eight subsurface soil samples were collected from five soil borings and three monitoring wells during the Phase II RFI. The only VOC detected in subsurface soil samples was 2-Butanone and is considered to be an SRC in subsurface soil. Bis(2-ethylhexyl)phthalate was the only SVOC detected (SB5) and is considered to be an SRC in subsurface soil. Alpha-BHC was detected in subsurface soil samples from MW5 and SB1. No other pesticides/PCBs were detected in the subsurface soil samples from the monitoring wells. 4,4'-DDE and 4,4'-DDT were detected in soil boring SB1. No pesticides/PCBs were detected in the subsurface soil samples from SB2, SB3, SB4, and SB5. 4,4'-DDE; 4,4'-DDT; and alpha-BHC are considered to be SRCs in subsurface soil. Analytical results from subsurface soil samples collected during the Phase I RFI did not indicate concentrations of RCRA metals that exceeded reference background concentrations. However, analytical results from subsurface soil samples collected from SB2, SB3, and SB5 during the Phase II RFI indicated concentrations of barium, chromium, and mercury that did exceed reference background concentrations. RCRA metals that exceeded the reference background criteria at this site were primarily detected at locations around its perimeter, with no metals detected at the most central sampling location (MW6). Barium, chromium, and mercury are considered to be potential SRCs in subsurface soil.

GROUNDWATER Three groundwater screening wells and one vertical-profile boring (VP1) were installed within the boundary of the landfill using DPT techniques and were analyzed for VOCs. The analytical laboratory missed the holding times for VOCs for one of the intervals of the vertical-profile boring installed during the initial sampling endeavor (January 1998). Another vertical-profile boring (VP2) was installed next to the previous location, and groundwater was resampled in May 1998; however, the groundwater was inadvertently analyzed for only benzene, toluene, ethylbenzene, and total xylenes. In addition, seven groundwater samples were collected from three newly installed monitoring wells and four existing monitoring wells. The groundwater samples from the monitoring wells were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals.

VOCs were detected in groundwater at relatively low concentrations at three sampling locations (MW6, VP1 and VP2). These VOCs included 4-methyl-2-pentanone, toluene, and total xylenes, which were considered to be potential SRCs in groundwater. Bis(2-ethylhexyl)phthalate was detected in MW8 at a concentration of 240 µg/L, which exceeds its maximum contaminant level (MCL). Bis(2-ethylhexyl)phthalate was believed to be the result of field or laboratory contamination; therefore, with the concurrence of GA EPD (SAIC 1999), the groundwater at MW8 was resampled on July 10, 1999. Bis(2-ethylhexyl)phthalate was not detected in MW8 during the resampling. The elevated concentration of bis(2-ethylhexyl)phthalate initially detected was considered to be the result of field or laboratory contamination; therefore, bis(2-ethylhexyl)phthalate is not an SRC at SWMU 2. No pesticides/PCBs were detected in the groundwater samples.

Mercury was detected at four of the six groundwater sampling locations that were analyzed for RCRA metals at concentrations that slightly exceeded the reference background criterion. Lead was detected at two locations (MW5 and MW8) at concentrations that exceeded the reference background criterion. Lead exceeded its MCL at MW5, which is a background sampling location. Selenium was detected at only one location, MW3, at a concentration that slightly exceeded the reference background criterion. Barium was detected at all monitoring well sampling locations at concentrations that were below the reference background criterion. Lead, mercury, and selenium are considered to be potential SRCs in groundwater. Lead is not considered to be site related because it was detected at an off-site location (MW8), it was not detected in any on-site wells above the reference background criterion, and it was detected at its highest concentration at the upgradient sampling location. Mercury was detected at levels near the detection limit and was detected above the reference background criterion at the upgradient sampling location; therefore, mercury is not considered to be site related. Selenium was detected in only one well (MW3), which is downgradient, but at a concentration only slightly above the reference background criterion (i.e., 2.5 µg/L versus 1.90 µg/L); therefore, selenium is not considered to be site related.

SURFACE WATER AND SEDIMENT Two surface water and sediment samples were collected from Canoochee Creek, one upstream sample and one downstream sample. The surface water and sediment samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals. No organic contaminants were detected in surface water, and metals constituents were detected below reference background criteria; therefore there are no SRCs in surface water.

While no VOCs, SVOCs, or RCRA metals were observed in the downstream sediment sample (SWS1), Alpha-chlordane, a pesticide, was observed in the downstream and upstream sediment samples. The downstream concentration of alpha-chlordane was less than the upstream concentration. Alpha-chlordane is considered to be a potential SRC in sediment.

RISK ASSESSEMENT A Baseline Human Health Risk Assessment (BHHRA) and an Ecological Risk Assessment was conducted for the site. The constituents of potential concern (COPCs) addressed in the baseline risk assessment included human health COPCs (arsenic and chromium) and contaminant migration COPCs (alpha-BHC, delta-BHC, arsenic, chromium, and mercury). Based on the required human health risk assessment, remedial levels were developed for the constituents identified as Contaminants of Concern (COCs) and are summarized in Table 2. The ecological risk assessment concluded that there is no present ecological risk at SWMU 2 and that the site is unlikely to pose an ecological risk in the future; therefore further investigation and/or evaluation of ecological COPCs was not required.

Remedial Response Objectives

Based on the findings of the site characterization at SWMU 2, the primary goal and purpose for implementing corrective measures at this site is limited to protection of human health and safety. To achieve this goal, the following remedial response objective has been established for the site: to prohibit the ingestion of shallow groundwater from the subject site and to prohibit the disturbance of surface and subsurface soil to minimize contact with soil and buried waste. 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) will not be evaluated. Implementation of the selected remedial response will achieve the best overall results with respect to such factors as long-term reliability and effectiveness, short-term effectiveness, implementability, and cost.

Conceptual Design and Implementation

This section presents a conceptual design and plan for implementation of the selected corrective action alternative for SWMU 2. Based on the level and type of soil contamination, a cost-effective corrective action was selected that would adequately protect human health and safety. The technology evaluation presented in Chapter 4.0 of the March 2001 Corrective Action Plan for the site compared different corrective action alternatives based on their effectiveness at protecting human health and safety, life-cycle costs, and technical factors. All the alternatives evaluated included institutional controls (ICs): BMP, deed recordation, zoning controls, maintenance of existing physical barriers, well abandonment, post-mounted warning signs, and implementation of an O&M Plan. Variations of alternatives included groundwater monitoring and installation of fencing. The selected corrective action alternative 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. Land-use restrictions will be documented and/or enforced through deed recordation, the BMP, zoning restrictions, and signage.

Alternative 1 has been selected because it will provide effective protection of human health at a relatively low cost. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered cost-effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized soil excavation would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Groundwater monitoring as described under Alternatives 1a and 2a does not provide enough additional protection to human health to justify its increased costs. The groundwater presently does not present a risk to human health. The institutional controls described for Alternative 1 will provide a sufficient level of protection of human health 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 cost-effectively implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

Effectiveness Post-mounted warning signs and documented land-use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to physical contact with the buried waste within the boundaries of SWMU 2. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land-use controls during ownership by the Department of Defense. Prior to the planning of any construction activities at the Installation, the BMP must be reviewed. In addition, the Base Master Planner and the DPW will review all construction projects during the planning stages for approval. These land-use controls will remain in effect after transfer of Department of Defense ownership by restrictions imposed through deed recordation.

Additionally, the proposed abandonment of monitoring wells (MW2, MW3, MW4, MW5, MW6, and MW7) and the groundwater-use restrictions will provide an effective method for preventing the use of groundwater for drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at the Installation and is not used. The BMP will be modified to officially restrict its use, further preventing use of the surficial groundwater at the site.

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

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of SWMU 2. Warning signs will be most effective over the short term. There is no current risk, and the site is 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 posting of signs. The materials for the installation of warning signs are readily available to local contractors. Annual 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 the necessary land-use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to allow for incorporation of land-use controls into the BMP and to facilitate deed recordation.

Cost The estimated total life-cycle cost of installation of warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $194,662 (E,RA funds). This alternative provides adequate protection of human health and the environment.

Public Notification

GA EPD will prepare a notification which explicitly describes the FRA selected for SWMU 2, and per Fort Stewart's Hazardous Waste Permit HW-045(S&T) the public will be afforded the opportunity to review the notification and/or the entire Corrective Action Plan for a period of thirty days. At the conclusion of the review period, GA EPD will either grant final approval of the selected FRA or revise their tentative approval based on review and comments received by the public. It is anticipated that this review period will occur in July 2001 (i.e., after receipt of projected GA EPD June 2001 tentative approval) and final approval (i.e., after public review period) from GA EPD will be provided to the Installation in early September 2001; however, GA EPD will provide tentative approval of the Corrective Action Plan prior to this timeframe which will allow Fort Stewart to proceed with implementation of the recommended FRA.

Declaration

The selected Final Remedial Action for SWMU 2 is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to the FRA, and will be cost-effective.

As the selected course of action for SWMU 2 was presented in the March 2001 Corrective Action Plan and will be approved by GA EPD, the five-year review will not apply to the proposed FRA.

This decision document was developed by the Fort Stewart Directorate of Public Works, with support from the U.S. Army Corps of Engineers and SAIC.

Table 1. Summary of Site-Related Contaminants

Analyte	Maximum Concentration (mg/kg)			Maximum Concentration (µg/L)	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
2-Butanone	0.0055	0.0076	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	ND	9.9	ND
Acetone	0.511	ND	ND	ND	ND
Toluene	ND	ND	ND	15.6	ND
Xylenes, total	ND	ND	ND	15.3	ND
Semivolatile Organic Compounds					
Bis(2-ethylhexyl)phthalate	1.1	0.229	ND	ND	ND
Pesticides/PCBs					
4,4'-DDD	0.0032	ND	ND	ND	ND
4,4'-DDE	0.01	0.0088	ND	ND	ND
4,4'-DDT	0.0042	0.0089	ND	ND	ND
Aldrin	0.0011	ND	ND	ND	ND
alpha-BHC	0.00024	0.00056[a]	ND	ND	ND
alpha-Chlordane	0.00095	ND	0.00071	ND	ND
delta-BHC	0.0016	ND	ND	ND	ND
Dieldrin	0.003	ND	ND	ND	ND
Endosulfan II	0.0018	ND	ND	ND	ND
Endosulfan sulfate	0.0032	ND	ND	ND	ND
Endrin ketone	0.0026	ND	ND	ND	ND
Heptachlor	0.001	ND	ND	ND	ND
Heptachlor epoxide	0.00076	ND	ND	ND	ND
Methoxychlor	0.012	ND	ND	ND	ND
Metals					
Arsenic	3.4	BRBC	ND	ND	ND
Barium	29.5	24.5	ND	BRBC	BRBC
Cadmium	0.2	BRBC	ND	ND	ND
Chromium	47.5	22.5	ND	ND	BRBC
Lead	19.7	BRBC	ND	12.6[a]	ND
Mercury	0.04	0.23	ND	0.21	ND
Selenium	BRBC	BRBC	ND	2.5	ND

[a]Maximum concentration detected excluding data from the site-specific background location (MW5).
BRBC = Below reference background criterion.
ND = Not detected.

Table 2. Remedial Levels, SWMU 2

SOIL BASED ON DIRECT EXPOSURE

Constituent of Concern	Maximum Detected Concentration (mg/kg)	Reference Background Criterion Surface Soil	Risk-based Remedial Levels (mg/kg)					
			HI			ILCR		
			1	0.5	0.1	1×10^{-6}	1×10^{-5}	1×10^{-4}
Arsenic	3.4[a]	2.10	23.37	11.68	2.34	0.6	6.1	60.6
Chromium	47.5	6.21	1.53	0.77	0.15	NA[b]	NA[b]	NA[b]

SOIL BASED ON PROTECTION OF GROUNDWATER AND SURFACE WATER

Constituent of Concern	Maximum Detected Concentration (mg/kg)	Reference Background Criterion Subsurface Soil	Risk-based Remedial Levels (mg/kg)				Remedial Levels Based on the MCL (mg/kg)
			HI				
			3	1	0.5	0.1	
Groundwater Point of Exposure[c]							
Chromium	47.5	11.60	3.74	1.25	0.62	0.12	4.6
Mercury	0.23	0.05	1.28	0.43	0.21	0.04	0.13[d]
Surface Water Point of Exposure[c]							
Mercury	0.23	0.05	0.02	0.006	0.003[e]	0.001	NA[f]

[a]Maximum detected concentration of constituent below recommended remedial level.
[b]NA = Not applicable; toxicity data required for calculation of remedial level were not available.
[c]Groundwater represents groundwater underlying the site, and surface water represents surface water in Canoochee Creek.
[d]Remedial level for mercury based on protection of groundwater.
[e]Risk-based remedial level for mercury based on protection of surface water.
[f]NA = Not applicable; MCLs are not applicable to surface water.
Bold indicates values that are the recommended remedial values.
HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
MCL = Maximum Contaminant Level

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

REPLY TO
ATTENTION OF

AFZP-PWV-E (200-1a)

MEMORANDUM FOR HEADQUARTERS, FORSCOM, DCSPIM,
ATTN: STEPHANIE SIGLER, 1777 HARDEE AVENUE SW
FORT MCPHERSON, GA 30330-1062

SUBJECT: Decision Documents for Final Remedial Action at Fort Stewart and Hunter Army Airfield, Georgia

1. The attached decision documents are provided for your use and convenience in documenting the distribution of fiscal year 01 funding for the Final Remedial Action (FRA) at the following sites:

a. FST-03, TAC-X Landfill.
b. FST-03, TAC-X Landfill.
c. HAA-13, Former Pumphouse 2 (Only one of the 3 areas listed under this site [Pumphouses 1, 2 and 6])

2. Although HAA-13 includes three areas, HAAF's former Pumphouses 1, 2 and 6, only Pumphouse 2 is being considered for final remedial action at this time. Pumphouse 6 was granted a "No Further Action Required" status in Nov 98. A final remedial action for Pumphouse 1 is still awaiting development and review.

3. Mr. Joe King at the Army Environmental Center has received copies of these decision document for review and approval.

4. The point of contact for this memorandum is Ms. Melanie Little or Ms. Tressa Rutland, DPW Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively.

FOR THE COMMANDER:

Enclosures

GREGORY V. STANLEY
COL, EN
Director, Public Works

DECISION DOCUMENT FOR THE FINAL REMEDIAL ACTION AT THE TAC-X LANDFILL (SWMU 3)

FORT STEWART, GEORGIA

PURPOSE

This decision document describes the selected Final Remedial Action (FRA) for the TAC-X Landfill (SWMU 3) located at Fort Stewart, Georgia, which consists of Institutional Controls (ICs). Specifically, the ICs proposed for FST-03 includes documentation in the Base Master Plan (BMP), deed recordation, zoning controls, maintenance of existing physical barriers, installing warning signs, and implementation of the Operation & Maintenance (O&M) plan. The selected ICs are described in detail in the *Final Corrective Action Plan for the TAC-X Landfill (Solid Waste Management Unit 3),* dated March 2001. The document will be reviewed by Georgia Environmental Protection Division (GA EPD) and comments and/or tentative approval is anticipated in June 2001. FST-03 is a Defense Site Environmental Restoration Tracking System (DSERTS) site and the FRA will be funded using fiscal year (FY) 2001 Environment, Restoration Account (E,RA) funds.

This decision document presents the justification for the selected FRA and specifically provides details on the following:

- Site Location and History
- Nature and Extent of Contamination
- Remedial Response Objectives
- Conceptual Design and Implementation
- Public Notification
- Declaration

Site Location and History

SWMU 3, which is approximately 3.5 miles south-southwest of Pembroke, Georgia, and less than 1 mile southeast of Dean Field and the TAC-X (Noncommissioned Officers' Academy), was active from the 1960s until 1982. The waste disposed of at the landfill from the 1960s to 1979 included residential waste, food cans, brush, plastic, and cardboard boxes. From 1979 to 1982, the wastes included grass clippings, tree branches, root stumps, and chunks of asphalt and concrete.

The TAC-X Landfill comprises approximately 6.3 acres, with two trenchlike depressions present at the site. One of the trenches is reportedly unused. The reported dimensions of the disposal trench are 20 feet wide by 400 feet long by 5 feet to 6 feet deep. A site reconnaissance in November 1993 observed household-type debris (e.g., plastic spoons and bags) within the overburden pile on the western side of the disposal trench. Aged refuse is reported to be present at the bottom of the disposal trench (Geraghty and Miller 1992). A site reconnaissance in September 1996 indicated no evidence of any landfill operations. The site is nearly flat, but slopes gently toward the south. Pine trees, brush, and grass cover most of the site. The southernmost portion of the site is marshy, with surface water present.

Nature and Extent of Contamination

The results of chemical analyses performed during the Phase I and Phase II RCRA Facility Investigations (RFIs) indicated that soil, groundwater, and sediment contain organic and metal

contaminants at concentrations greater than their reference background concentrations. No contaminants were detected in surface water. A tabular summary of site-related contaminants for SWMU 3 is presented in Table 1.

SOIL Eleven surface soil samples were collected from four monitoring well boring locations, three soil boring locations, and four surface soil samples during the Phase I and Phase II RFIs. No VOCs were detected in surface soil. Low, isolated concentrations of bis(2-ethylhexyl)phthalate (an SVOC) and four pesticides (alpha-BHC, gamma-BHC, heptachlor epoxide, and methoxychlor) were detected in surface soil. Arsenic, chromium, and lead were detected at concentrations above reference background criteria in one of ten surface soil samples. Bis(2-ethylhexyl)phthalate, alpha-BHC, gamma-BHC, heptachlor epoxide, methoxychlor, arsenic, chromium, and lead were considered to be site-related contaminants (SRCs) in surface soil.

Seven subsurface soil samples were collected during the Phase II RFI from four monitoring well boring locations and three soil boring locations. Two VOCs (2-butanone and acetone), one SVOC [bis(2-ethylhexyl)phthalate], and three pesticides (4,4'-DDE; aldrin; and methoxychlor) were detected in subsurface soil. Chromium and cadmium were detected at concentrations above reference background criteria in one (MW6) of seven subsurface soil samples. Acetone, 2-Butanone; bis(2-ethylhexyl)phthalate; 4,4'-DDE; aldrin; methoxychlor; cadmium; and chromium were considered to be SRCs in subsurface soil at SWMU 3.

GROUNDWATER Low, isolated concentrations of acetone (a VOC) and three pesticides (4,4'-DDT; beta-BHC; and delta-BHC) were detected in groundwater collected from Geoprobe locations. Barium, cadmium, chromium, lead, and mercury were detected at concentrations above reference background criteria in groundwater collected from Geoprobe locations. However, corresponding dissolved metal concentrations for all five constituents were below reference background concentrations, indicating that the total metals might be associated with particulates in the groundwater.

A low, isolated concentration of 2-hexanone (a VOC) was detected in groundwater collected from monitoring well MW6. Mercury was detected at concentrations (0.15 μg/L and 0.16 μg/L) slightly above the reference background criteria (0.14 μg/L) in two of eight groundwater samples collected from the monitoring wells.

Acetone, 2-Hexanone; 4,4'-DDT; beta-BHC; delta-BHC; barium; cadmium; chromium; lead; and mercury were considered to be SRCs in groundwater.

SURFACE WATER AND SEDIMENT One SVOC [benzo(b)fluoranthene] was detected in surface water. Arsenic, barium, chromium, and lead were detected in surface water at concentrations above reference background criteria.

Seven VOCs were detected in sediment. However, after resampling, only six of the seven VOCs are considered to be SRCs in sediment: 2-butanone, 2-hexanone, acetone, benzene, carbon disulfide, and toluene.

Arsenic, barium, chromium, lead, mercury, and selenium were detected in sediment at concentrations above reference background criteria. Sediment samples from SWS1 had significantly higher concentrations than did those from SWS2.

RISK ASSESSEMENT A Baseline Human Health Risk Assessment (BHHRA) and an Ecological Risk Assessment was conducted for the site. The BHHRA addressed the risks associated with exposure to the following human health constituents of potential concern (COPCs): arsenic (surface soil, surface water, and sediment), chromium (surface water), lead (surface water), mercury (groundwater), delta-BHC (groundwater), and benzo(*b*)fluoranthene (surface water). No contaminant migration COPCs were identified for this site. Based on the required assessment only two constituents were identified as Contaminants of Concern (COCs) at the site and are summarized in Table 2.The ecological risk assessment concluded that there is no present ecological risk at SWMU 3 and that the site is unlikely to pose an ecological risk in the future; therefore further investigation and/or evaluation of ecological COPCs was not required.

Remedial Response Objectives

Based on the findings of the site characterization at SWMU 3, the primary goal and purpose for implementing corrective measures at this site is limited to protection of human health and safety. To achieve this goal, the following remedial response objective has been established for the site: to prohibit the ingestion of shallow groundwater from the subject site and to prohibit the disturbance of surface and subsurface soil to minimize contact with soil and buried waste. 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) will not be evaluated. Implementation of the selected remedial response will achieve the best overall results with respect to such factors as long-term reliability and effectiveness, short-term effectiveness, implementability, and cost.

Conceptual Design and Implementation

This section presents a conceptual design and plan for implementation of the selected corrective action alternative for SWMU 3. Based on the level and type of soil contamination, a cost-effective corrective action was selected that would adequately protect human health and safety. The technology evaluation presented in Chapter 4.0 of the March 2001 Corrective Action Plan for the site compared different corrective action alternatives based on their effectiveness at protecting human health and safety, life-cycle costs, and technical factors. All the alternatives evaluated included institutional controls (ICs): BMP, deed recordation, zoning controls, maintenance of existing physical barriers, well abandonment, post-mounted warning signs, and implementation of an O&M Plan. Variations of alternatives included groundwater monitoring and installation of fencing. The selected corrective action alternative 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. Land-use restrictions will be documented and/or enforced through deed recordation, the BMP, zoning restrictions, and signage.

Alternative 1 has been selected because it will provide effective protection of human health at a relatively low cost. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered cost-effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized soil excavation would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Groundwater monitoring as described under Alternatives 1a and 2a does not provide enough additional protection to human health to justify its increased costs. The groundwater presently does not present a risk to human health. The institutional controls described for Alternative 1 will provide a sufficient level of protection of human health and an adequate degree of long-term reliability and effectiveness as well as short-term effectiveness. The institutional controls under

opportunity to review the notification and/or the entire Corrective Action Plan for a period of thirty days. At the conclusion of the review period, GA EPD will either grant final approval of the selected FRA or revise their tentative approval based on review and comments received by the public. It is anticipated that this review period will occur in July 2001 (i.e., after receipt of projected GA EPD June 2001 tentative approval) and final approval (i.e., after public review period) from GA EPD will be provided to the Installation in early September 2001; however, GA EPD will provide tentative approval of the Corrective Action Plan prior to this timeframe which will allow Fort Stewart to proceed with implementation of the recommended FRA.

Declaration

The selected Final Remedial Action for SWMU 3 is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to the FRA, and will be cost-effective.

As the selected course of action for SWMU 3 was presented in the March 2001 Corrective Action Plan and will be approved by GA EPD, the five-year review will not apply to the proposed FRA.

This decision document was developed by the Fort Stewart Directorate of Public Works, with support from the U.S. Army Corps of Engineers and SAIC.

Table 1. Summary of Site-Related Contaminants, SWMU 3

Analyte	Maximum Concentration (mg/kg)			Maximum Concentration (µg/L)	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
2-Butanone	ND	0.0044	0.495	ND	ND
2-Hexanone	ND	ND	0.0034	5.6	ND
Acetone	ND	0.0932	0.618	264	ND
Benzene	ND	ND	0.0033	ND	ND
Carbon disulfide	ND	ND	0.006	ND	ND
Methylene chloride	ND	ND	ND	ND	ND
Toluene	ND	ND	0.212	ND	ND
Semivolatile Organic Compounds					
Benzo(*b*)fluoranthene	ND	ND	ND	ND	6.6
Bis(2-ethylhexyl)phthalate	0.248	0.387	ND	ND	ND
Pesticides/PCBs					
4,4'-DDE	ND	0.00064	ND	ND	ND
4,4'-DDT	ND	ND	ND	0.025	ND
Aldrin	ND	0.00061	ND	ND	ND
alpha-BHC	0.00047	ND	ND	ND	ND
beta-BHC	ND	ND	ND	0.016	ND
delta-BHC	ND	ND	ND	0.082	ND
gamma-BHC (Lindane)	0.0012	ND	ND	ND	ND
Heptachlor epoxide	0.00054	ND	ND	ND	ND
Methoxychlor	0.0086	0.0048	ND	ND	ND
Metals					
Arsenic	24[a]	BRBC	29.7	ND	7.3
Barium	BRBC	BRBC	60	92.3	59.6
Cadmium	ND	0.25	ND	0.82	ND
Chromium	7.8	25.5	23.3	6.8	13.9
Lead	73.97[a]	BRBC	14.7	11.1	9
Mercury	BRBC	BRBC	0.08	0.46	ND
Selenium	BRBC	BRBC	2.6	BRBC	ND

[a]Phase I RFI data.
BRBC = Below reference background criteria.
ND = Not detected.

Table 2. Remedial Levels, SWMU 3

Constituent of Concern	Maximum Detected Concentration (mg/kg)	Risk-based Remedial Levels (mg/kg) ILCR		
		1×10^{-6}	1×10^{-5}	5×10^{-5}
Surface Soil				
Arsenic	24	0.6	6.1	30.3
Surface Water				
Benzo(*b*)fluoranthene	0.0066	0.0010	0.0101	0.0505

Bold indicates concentrations above recommended remedial levels.
ILCR = Incremental Lifetime Cancer Risk

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

June 1, 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: Corrective Action Plan (CAP) for the Post South Central Landfill [Solid Waste Management Unit (SWMU) 1] dated December 1999; 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 correspondence (Stanley to Khaleghi) dated May 22, 2000 which contains Replacement Pages 2-6, 4-6 and 5-4 to be inserted into our four (4) copies of the above-referenced document. Based upon our review, GA EPD tentatively approves the Corrective Action Plan for SWMU 1 dated December 1999, as amended by Replacement Pages 2-6, 4-6 and 5-4 [Also see our correspondence (Khaleghi to Stanley) dated April 20, 2000]. Please note that a final decision will be made by GA EPD pending the outcome of a forty-five day public comment period which is scheduled to occur this Summer when the Corrective Action Module (i.e., Section IV) and Appendix A of your Hazardous Waste Facility Permit #HW-045(S&T) are modified.

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\SWMU1\CAP3X.APP

DEPARTMENT OF THE ARMY
HE U 3D INFANTRY DIVISION (MECHANIZ A T STEWART
DIRECTORATE OF PUBLIC WORKS
1550FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-492,

REPLY TO
ATTENTION OF

May 22, 2000

Office of the Directorate

EXPRESS MAIL

Georgia Environmental Protection Division
Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30334

Dear Mr. Khaleghi:

Fort Stewart is pleased to submit to the Georgia Environmental Protection Division the following replacement pages for the Corrective Action Plan for the Post South Central Landfill [Solid Waste Management Unit (SWMU) 1], dated December 1999; EPA ID No. GA9 210 020 872.

- page 2-6, Old, Inactive Landfill section, 3rd line: text was changed from "80 acres" to "143 acres".
- page 4-6, 10th line: text regarding "Four additional post-mounted signs" was revised to "Two additional" signs.
- page 5-4, next to last paragraph on page: the text reference to figure was revised from "Figure 4-1" to "Figure A-2".

Fort Stewart has enclosed four sets of replacement pages for the above referenced report. These pages are being submitted with all errata corrected and with the date of revision indicated adjacent to the page number (bottom center of each page).

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, Directorate of Public Works Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively, should questions arise regarding the replacement pages.

Sincerely,

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

Enclosures

restrictions. The BMP is an effective tool for ensuring that unauthorized disturbance of subsurface soils at the site, and ingestion of groundwater from the site, is prohibited while the property is under DoD ownership. If this property were ever 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 hazards associated with the old, inactive portion of SWMU 1, warning signs stating restrictions on human activity within the SWMU would be posted at 200-foot intervals around the boundary of the SWMU. Two additional post-mounted signs would be installed at the western entrance to the site. The placement of signs for Alternative 1 is shown in Figure 4-1. Signs and existing natural barriers are effective for restricting human access to the site because they 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. Existing barriers, which provide additional land use restrictions, would also be maintained. Shallow groundwater is not used as a source of drinking water at the site, and given the availability of the underlying Floridan Aquifer, it is unlikely that the shallow groundwater would ever be used for drinking water. Institutional controls prohibiting the use of groundwater would, therefore, be effective in protecting human health.

This is the less expensive of the two alternatives, with a life-cycle cost of approximately $44,843.

Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Partial Wood Fence Barrier, Maintenance of Existing Physical Barriers, Post-mounted and 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). Also, the eight existing wells would be abandoned, existing physical barriers would be maintained, and an O&M Plan would be implemented. This alternative would additionally provide approximately 3,514 linear feet of pretreated, split-rail wood fence. The fence would provide a physical deterrent to public access around a portion of the landfill at which there is a greater likelihood of site access by the public from Georgia State Route 119/144. The fence would run along the Georgia State Route 144 boundary to the Wilson Avenue access gate on the north and from the Wilson Avenue access gate on the south along the Wilson Avenue boundary, rounding westward to a position near monitoring well SC-M18. Fence-mounted warning signs would be positioned every 200 feet. Also, post-mounted warning signs would be installed every 200 feet around the remainder of the unfenced boundary of the old, inactive landfill. Four additional post-mounted signs would be installed at both the eastern and western entrances to the site. The placement of signage and fencing for Alternative 2 is shown in Figure 4-2. The effectiveness of Alternative 2 would be similar to that of Alternative 1, with somewhat greater protection against inadvertent intruders as a result of the fencing. The effectiveness of the fencing would be limited because it would not extend completely around the site and would not prevent access by those who disregard warnings. The effectiveness of Alternative 2 at protecting groundwater would be equal to that of Alternative 1. The O&M Plan would also include maintenance and repair of the treated wood fence and signs.

This alternative is more expensive than Alternative 1, with a life-cycle cost of approximately $126,679 or nearly three times Alternative 1's life-cycle cost.

FSMR. From 1970 to 1982, trench-and-fill operations were used in the active Post South Central Landfill's eastern cell. The trench-and-fill operation has moved from east to west, with previously filled land being restored to forest.

Beginning in the spring of 1982, tumulus refuse disposal operations began, representing the present-day disposal practices at the landfill. These operations have been performed over the western portion of the trench-and-fill area of the landfill. The active portion of the Post South Central Landfill is comprised of two cells that are constructed on the clay cap of the former trench-and-fill landfill. The eastern cell covers approximately 35 acres and the western cell about 30 acres. Wastes disposed of at the active landfill include dry, construction-type waste; putrescible garbage; and properly packaged asbestos.

The northwest portion of the Post South Central Landfill was previously a borrow pit for the site and is presently being used for disposal of demolition/construction debris (nonputrescible waste).

Based upon the results reported in the Revised Final Phase II RFI Report (SAIC 1999) for the active portion of SWMU 1, a few constituents present in the groundwater were detected above maximum contaminant levels (MCLs) [i.e., bis(2-ethylhexyl)phthalate at SC-M9 and NMW-2A]. In accordance with the GEPD–approved recommendation for corrective action, these constituents will continue to be monitored through the GMP, approved by the GEPD Land Protection Division. Corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells is not required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify if any contaminant levels become elevated and/or any trends develop in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. All analytical data will continue to be submitted to the GEPD Land Protection Division.

Old, Inactive Landfill

During the Phase I RFI, it was discovered that an older portion of the landfill existed east of the active landfill and continued to Georgia State Route 144/119. The old, inactive landfill is estimated to encompass approximately 143 acres. Aerial photographs dated 1947 and 1957 indicate disposal was occurring at the old, inactive landfill during that period. A 1966 aerial photograph shows approximately two-thirds of the old landfill immediately west of Georgia State Route 144/119 with successional vegetation, indicating that by that time the landfill was no longer being used. Disposal at the current, active Post South Central Landfill site and complete vegetative cover of the old, inactive landfill area are evident in a 1975 aerial photograph; these conditions continue today. Additional prominent site features associated with the old, inactive portion of the landfill include a fenced cemetery, a dumpster maintenance area, and a drainage ditch to drain the low area around a dumpster maintenance area. The dumpster maintenance area is located on the south side of the SWMU 1 access road, approximately 600 feet from the Wilson Avenue entrance gate (see Figure 2-4). Dumpsters are stored and refurbished at the facility. A drainage ditch, which begins southwest of the dumpster cleaning area, circles the area, and ultimately discharges to the marshy area along Taylors Creek, was dug to drain the low area around the dumpster cleaning area so that the area could be built (see Figure 2-4). The aerial photographs of the SWMU 1 site from 1947 through 1992 are presented in Figure 2-5.

The old, inactive landfill received all waste generated at FSMR during its operation. According to previous operators, this waste included materials similar to those currently received at the active landfill in addition to sludges from the sewage treatment plant, scrap metal, demolition/construction debris, sanitary/municipal waste, and drummed waste from the tear gas training facility. According to information provided by former landfill employees, operational practices at the old, inactive landfill involved excavation of a large pit to below the water table; stockpiling of the excavated soil; disposal and

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

April 20, 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: Corrective Action Plan (CAP) for the Post South Central Landfill [Solid Waste Management Unit (SWMU) 1] dated December 1999; 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 correspondence (Stanley to Khaleghi) dated April 10, 2000 which contains Replacement Pages 2-1, 2-4, 4-4, A-4 & B-5 and Replacement Survey Plats (Drawing Nos. TS-4 & TS-4C) to be inserted into our four (4) copies of the above-referenced document. Based upon our review, GA EPD (1) has determined that Fort Stewart has appropriately responded to our comments on the December 1999 version of this plan [See correspondence (Khaleghi to Stanley) dated March 14, 2000] and (2) tentatively approves the Corrective Action Plan for SWMU 1 dated December 1999, as amended by the Replacement Pages and Survey Plats referenced in the preceding sentence.

Please note that a final decision will be made by GA EPD pending the outcome of a forty-five day public comment period which is scheduled to occur this Summer when the Corrective Action Module (i.e., Section IV) and Appendix A of your Hazardous Waste Facility Permit #HW-045(S&T) are modified. 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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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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REVISED FINAL

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

ote: 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[a] and Cd	None	None	Benzene	NP	NP	None	Xylenes	NP	NA	

hase II RFI was not required at this time. The Phase II RFI will be conducted upon closure of the Red Cloud Range, Hotel Area.
/ith the concurrence of GEPD, fate and transport analysis and human health and ecological preliminary risk assessments were deemed unnecessary. SRCs were determined solely on omparison to background criteria (see Table ES-1).
esults from sediment within the NGTC Equalization Basin.
HP = Bis(2-ethylhexyl)phthalate.
HBRA = Human health baseline risk assessment.
A = Not applicable.
= Sample not collected based on field screening results or because no medium (i.e., surface water) was available during the RFI.
= No pathway exists.
OC = Semivolatile organic compound.
OC = 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

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

APR 10 2000

REPLY TO
ATTENTION OF

OFFICE OF THE DIRECTORATE

CERTIFIED MAIL
7099-3400-0010-5455-4396

Georgia Environmental Protection Division
Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30334

Dear Mr. Khaleghi:

Fort Stewart is pleased to receive the Georgia Environmental Protection Division's correspondence dated, March 14, 2000, in reference to the Corrective Action Plan for the Post South Central Landfill [Solid Waste Management Unit (SWMU) 1], dated December 1999; EPA ID No. GA9 210 020 872.

In response to the comments received from GA EPD, Fort Stewart has enclosed four sets of replacement pages for the above referenced report. These pages are being submitted with all errata corrected and with the date of revision indicated adjacent to the page number (bottom center of each page). In addition, a response to comments table has also been provided.

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, Directorate of Public Works Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively, should questions arise regarding the response to comments and/or the replacement pages.

Sincerely,

Thomas C. Fry 04/09/00
for Gregory V. Stanley
Colonel, U.S., Army
Director, Public Works

Enclosures

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

March 14, 2000

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Gregory Stanley, Colonel, U.S. Army
Director, Public Works
ATTN: AFZP-DEV (Melanie Little)
Department of the Army
Headquarters, 3D Infantry Division (Mechanized) and Fort Stewart
1557 Frank Cochran Drive
Fort Stewart, GA 31314-4928

RE: Corrective Action Plan for the Post South Central Landfill [Solid Waste Management Unit (SWMU) 1] dated December 1999; 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 submitted with correspondence (Stanley to Khaleghi) dated March 2, 2000 and generated the following comments.

1. The Corrective Action Plan for SWMU 1 is exceptionally well-written and researched. GA EPD continues to appreciate the efforts of Ms. Melanie Little of your staff and those of your environmental contractor, Science Applications International Corporation (SAIC), in providing permitting and corrective action documents of excellent quality to our agency. We maintain that Fort Stewart Corrective Action Program continues to experience enormous progress in large part due to those efforts referenced in the preceding sentence.

2. Monitoring Well No. "SC-MW10" should read "SC-MW17" in the second bullet of Section 4.3.2 (page 4-4) and in the second bullet of the *Introduction* Section in Appendix B (page B-5).

3. The *Reporting* Section of the Operations and Maintenance Plan in Appendix A (See page A-4) should be modified to (1) indicate that each annual report will be titled, "Corrective Action Plan Progress Report for SWMU 1" and (2) clarify the schedule for submission of the reports to GA EPD [e.g., within four hundred and twenty-five (425) days after the installation of warning signs at the old, inactive portion of the Post South Central Landfill and annually thereafter].

4. The first paragraph in Section 2.1 (page 2-1) states that the old, inactive portion of the Post South Central Landfill is estimated to encompass eighty (80) acres and references Figure 2-4. However, the *Site Description* on page C-3 of Appendix C conflicts with this statement both in terms of acreage and of defining the northern perimeter of the landfill at Taylors Creek. Please correct these two (2) discrepancies in the revision.

5. The two (2) survey plats in Appendix C must be revised to indicate the boundary of the old, inactive portion of the Post South Central Landfill and to contain the seal and signature of a Professional Land Surveyor registered in the State of Georgia.

The revision for the SWMU 1 Corrective Action Plan, appropriately addressing the comments above, must be submitted within thirty (30) days of receipt of this correspondence in the form of revised/new pages or a totally revised document. Should Fort Stewart decide to submit revised or new pages, please number with appropriate page numbers and the date revised, e.g., Page 6 (Revised 04/06/2000). Note that four (4) copies of the revised pages are required to be submitted to GA EPD in accordance with Condition IV.G.2 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, Unit Coordinator
Hazardous Waste Management Branch

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

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DEPARTMENT OF THE ARMY
HEADQU... ...S, 3D INFANTRY DIVISION (MECHANIZED) AN... ... STEWART
DIRECTORATE OF PUBLIC WORKS
1557 FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-4928

March 2, 2000

REPLY TO
ATTENTION OF

Office of the Directorate

CERTIFIED MAIL

Georgia Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30334

Dear Mr. Khaleghi:

Fort Stewart is pleased to submit four copies of the Corrective Action Plan for the Post South Central Landfill (SWMU 1) at Fort Stewart, Georgia dated ~~November~~ December 1999, as required by Conditions IV.E.1 and IV.E.2 of the Installation's Hazardous Waste Facility Permit #HW-045 (S&T) dated August 14, 1997.

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, Directorate of Public Works Environmental Branch, at (405) 364-8461 or (912) 767-2010, respectively, should questions arise regarding the enclosed documents.

Sincerely,

Thomas C. Fey 03/02/00
for Gregory V. Stanley
Colonel, U.S. Army
Director, Public Works

Enclosures

FINAL

FORSCOM

3d Inf Div (Mech)

CORRECTIVE ACTION PLAN

FOR THE

POST SOUTH CENTRAL LANDFILL (SOLID WASTE MANAGEMENT UNIT 1) AT FORT STEWART, GEORGIA

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract No. DACA21-95-D-0022
Delivery Order 0039

December 1999

99-159F(PPT)/120699

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FINAL

CORRECTIVE ACTION PLAN
for the
POST SOUTH CENTRAL LANDFILL
(SOLID WASTE MANAGEMENT UNIT 1)
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 0039

Prepared by:
Science Applications International Corporation
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Oak Ridge, Tennessee 37831

December 1999

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 22851 PROFESSIONAL ENGINEER P. A. STOLL

12/29/99

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CORRECTIVE ACTION PLAN

for the

POST SOUTH CENTRAL LANDFILL (SOLID WASTE MANAGEMENT UNIT 1)

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 0039

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Oak Ridge, Tennessee 37831

December 1999

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ACRONYMS

amsl	above mean sea level
bgs	below ground surface
BHHRA	baseline human health risk assessment
BMP	Base Master Plan
CAP	Corrective Action Plan
CFR	Code of Federal Regulations
COPC	contaminant of potential concern
DERP	Defense Environmental Restoration Program
DoD	U.S. Department of Defense
EPA	U.S. Environmental Protection Agency
EPRE	ecological preliminary risk evaluation
ESV	ecological screening value
FSMR	Fort Stewart Military Reservation
GEPD	Georgia Environmental Protection Division
GMP	Groundwater Monitoring Plan

GSSL	Generic Soil Screening Level
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
LOAEL	lowest-observed-adverse-effect level
MCL	maximum contaminant level
O&M	operations and maintenance
PCB	polychlorinated biphenyl
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SRC	site-related contaminant
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TRV	toxicity reference value
VOC	volatile organic compound

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1.0 INTRODUCTION

1.1 SCOPE

This report documents the Corrective Action Plan (CAP) for the Post South Central Landfill, Solid Waste Management Unit (SWMU) 1 at the Fort Stewart Military Reservation (FSMR), Georgia. A Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in November and December of 1997. The Revised Final Phase II RFI Report (SAIC 1999) determined that this SWMU requires a CAP to evaluate appropriate remedial actions to eliminate or minimize potential risks associated with the old, inactive portion of the Post South Central Landfill. Implementation of the remedy selected in this CAP is required for this site to protect the health of humans coming in contact with the site. This report has been prepared by Science Applications International Corporation for the U.S. Army Corps of Engineers, Savannah District, under Contract DACA21-95-D-0022, Delivery Order No. 0039.

The Post South Central Landfill (SWMU 1) is located approximately 0.75 mile northwest of Fort Stewart's main cantonment area. The area now referred to as the Post South Central Landfill comprises 87 acres bounded on the north by Taylors Creek, on the west and south by Mill Creek, a tributary of Taylors Creek, and to the east by Georgia State Highways 119 and 144. The Post South Central Landfill is divided into two sections: the current, permitted landfill, which contains both closed and active sections, and the old, inactive landfill, which was identified during the Phase I RFI and ceased operation prior to 1966.

The Post South Central Landfill is operated under Permit No. 089-010 D (SL), issued by the state of Georgia in 1982. The nonputrescible landfill is operated under Permit No. 089-020 D (L), issued by the state of Georgia in 1982. Since 1983 the Post South Central Landfill has been operated under the provisions of the Design and Operation Plan as an area fill landfill with appropriate groundwater monitoring. The histories of the active and old, inactive landfill of the Post South Central Landfill are summarized in Section 2.1.

Based on the findings presented in the Revised Final Phase II RFI Report dated March 1999 (SAIC 1999), a "no further action required" status has been assigned to the old, inactive portion of SWMU 1 for investigative purposes. As recommended by the Phase II RFI and as agreed to with the Georgia Environmental Protection Division (GEPD), a CAP has been prepared for SWMU 1 because buried waste will remain in place. Implementation of the selected remedy documented by this CAP is necessary to control intrusive activities at this site and to be protective of the health of humans potentially coming in contact with the buried waste and to prevent the use of groundwater as a drinking water source. As agreed to with GEPD, this CAP has been prepared to evaluate the use of institutional controls to protect human health. 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 remedy and includes plans for its implementation along with a plan for operations and maintenance (O&M) of the selected remedy. Also included in this plan are a detailed cost estimate and a schedule of implementation for the selected corrective action.

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 FSMR that required some type of RFI action (Geraghty and Miller 1992); SWMU 1 was among these 24. The Phase I RFI at SWMU 1 was conducted to determine if a release to the environment had occurred and to decide if the site had the potential for a release to the environment. Results of the Phase I RFI conducted in July and October 1993 indicated that metals, pesticides, and Radium 226/228 were elevated in the groundwater around the active portion of the landfill. Based on these findings and the discovery of the existence of the old, inactive landfill located to the east of the active portion of the landfill, GEPD instructed the Fort Stewart Directorate of Public Works to conduct a Phase II RFI around both the active and inactive portions of the landfill.

The objectives for the Phase II RFI, as defined by the Phase II RFI Sampling and Analysis Plan approved by GEPD on October 10, 1997, were as follows:

- determine the horizontal and vertical extents 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.

The scope of the Phase II fieldwork included the following activities:

- Collecting direct-push soil samples using a push probe at ten locations within the boundary of the old, inactive landfill. Direct-push soil samples were analyzed for volatile organic compounds (VOCs).

- Collecting direct-push groundwater samples using a push probe at 25 locations, including two vertical-profile probes. The 25 locations included 11 locations (one vertical-profile) within the estimated boundary of the old, inactive landfill and 14 locations (one vertical-profile) around the perimeter of the old, inactive landfill. Direct-push groundwater samples were analyzed for VOCs.

- Installing nine permanent groundwater monitoring wells both upgradient and downgradient of the site. Soil samples from the well boreholes were analyzed for VOCs, semivolatile organic compounds (SVOCs), RCRA metals, pesticides/polychlorinated biphenyls (PCBs), and Radium 226/228.

- Groundwater sampling at the 13 existing monitoring wells around the active portion of the landfill and at the nine newly installed monitoring wells around the old, inactive portion of the landfill. Groundwater samples were analyzed for VOCs, SVOCs, RCRA metals, pesticides/PCBs, and Radium 226/228.

- Collecting surface water and sediment samples at four locations (upstream and downstream of SWMU 1) within Taylors and Mill creeks, which border two sides of the site. Surface water and sediment samples were analyzed for VOCs, SVOCs, RCRA metals, pesticides/PCBs, and Radium 226/228.

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.

The active landfill operates under Permit No. 089-010 D (SL) and the nonputrescible landfill operates under Permit No. 089-020 D (L). These active portions of the landfill must meet closure and postclosure requirements in accordance with the requirements of 40 Code of Federal Regulations (CFR) 258.60 and Chapter 391-3-4, Rules of the GEPD. The active landfill has a network of groundwater compliance monitoring wells located around it as part of the Groundwater Monitoring Plan (GMP) for operation, closure, and postclosure approved by GEPD January 25, 1996. Groundwater monitoring wells SC-M1A, -M3, -M6A, -M7, -M8, -M9, -M10, and -M11 and NMW-1, -2A, and -3 have been included in the monitoring network presented in the Closure/Postclosure Plan for the Post South Central Sanitary Landfill.

As recommended in the Revised Final Phase II RFI Report (SAIC 1999) and approved by GEPD, eight groundwater monitoring wells associated with the old, inactive portion of SWMU 1 (SC-M12 through SC-M19) will be abandoned by grouting the wells to the surface and removing the surface completion following approval of this CAP by GEPD. SC-M11, one of the monitoring wells associated with the old, inactive portion of SWMU 1, will not be abandoned and will be included with the monitoring network associated with the active landfill and the nonputrescible landfill.

1.4 REPORT ORGANIZATION

This CAP report is divided into six chapters: (1) Introduction; (2) Site Characterization and Remedial Investigation Results; (3) Justification/Purpose of Corrective Action; (4) Screening of Corrective Actions; (5) Conceptual Design and Implementation Plan; and (6) References. Chapter 1.0 (Introduction) provides an explanation of the scope of the CAP, presents general background information on FSMR and specific background information on the site, and provides regulatory background information. Chapter 2.0 (Site Characterization and Remedial Investigation Results) provides an overview of the site; physical and environmental descriptions; and the 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. 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. Reference information is presented in Chapter 6.0. The O&M Plan for the selected remedy is presented as Appendix A.

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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 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. These 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 Post South Central Landfill is located within Liberty County northwest of the garrison area (Figure 2-3).

2.1 SITE LOCATION AND HISTORY

SWMU 1, which is located approximately 0.75 mile northwest of the Fort Stewart main cantonment area, has been used for solid waste disposal since the 1940s. Disposal practices at the landfill have ranged from burn-pit to trench-and-fill operations. During the Phase I RFI conducted in 1997, the old, inactive portion of SWMU 1 was discovered east of the active landfill. The old, inactive portion of the landfill is heavily forested and estimated to encompass approximately 143 acres (Figure 2-4: area encompassed by green boundary line).

The active, permitted landfill operations are being constructed on the clay cap of the former trench-and-fill portion of the landfill. The active, permitted landfill is comprised of two cells: the eastern cell covers approximately 35 acres, while the western cell, which is closed, covers about 30 acres. The active landfill is operated under Permit No. 089-010 D (SL), issued by the state of Georgia in 1982. The nonputrescible landfill is operated under Permit No. 089-020 D (L), issued by the state of Georgia in 1982. Since 1983 the Post South Central Landfill has been operated under the provisions of the Design and Operation Plan as an area fill landfill with appropriate groundwater monitoring. As a permitted facility, the Post South Central Landfill must meet closure and postclosure requirements in accordance with the requirements of 40 CFR 258.60 and Chapter 391-3-4, Rules of the GEPD.

Active Landfill

From 1960 to 1970, the active landfill's eastern cell operated as a garbage, paper waste, and construction debris landfill. Other waste disposed of included sludge from wash racks, sludge from industrial and sanitary wastewater treatment plants, waste air filters from the paint booth in the Directorate of Logistics Allied Trades Shop, grease from mess halls, autoclaved infectious wastes bagged in special containers, and ash from the energy plant. Operational practices have prohibited the disposal of ordnance at the landfill; however, some explosive ordnance has been discovered during routine operations. Upon such discoveries, the subject explosive ordnance has been removed and properly disposed of by

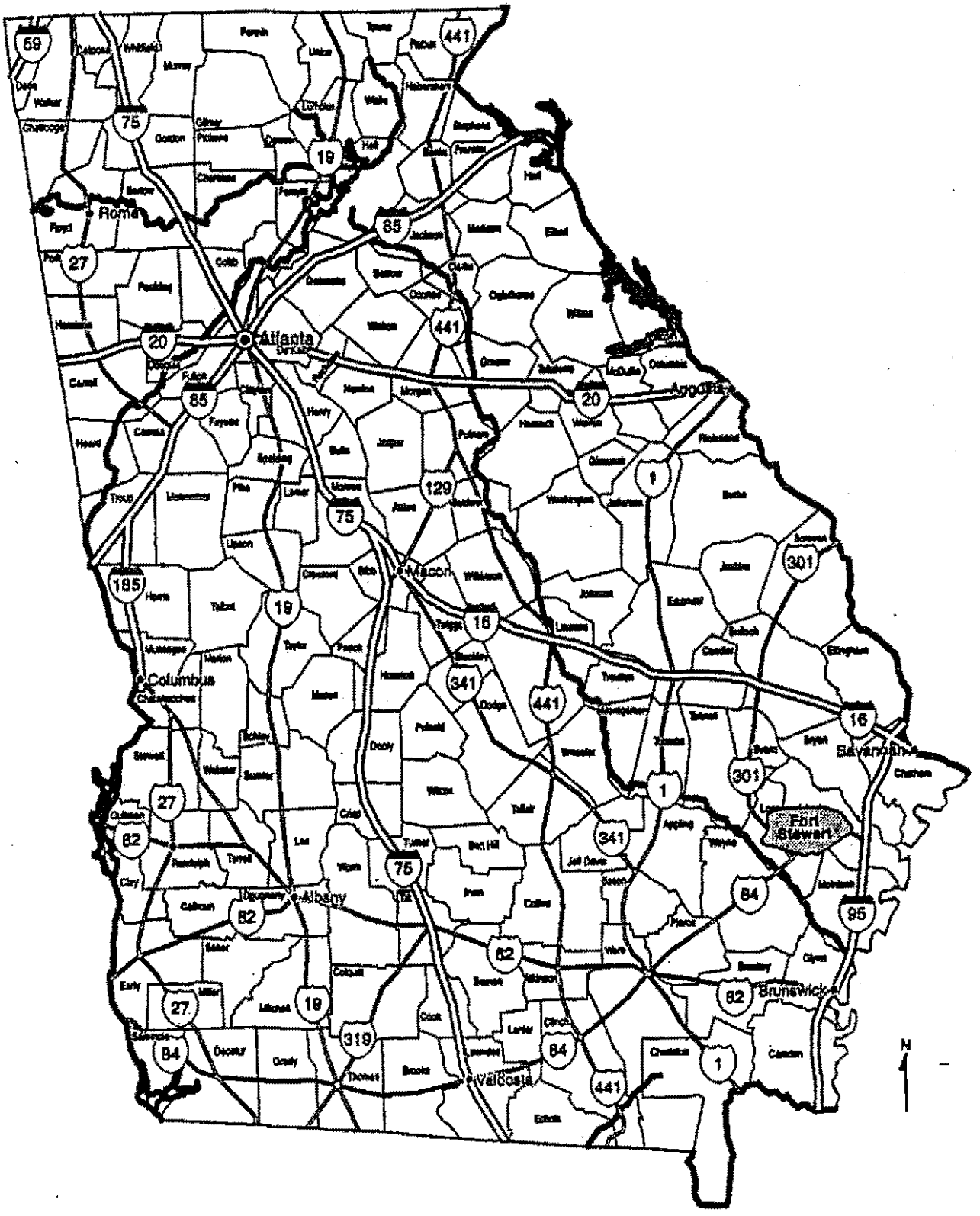


Figure 2-1. Regional Location Map for Fort Stewart Military Reservation, Georgia

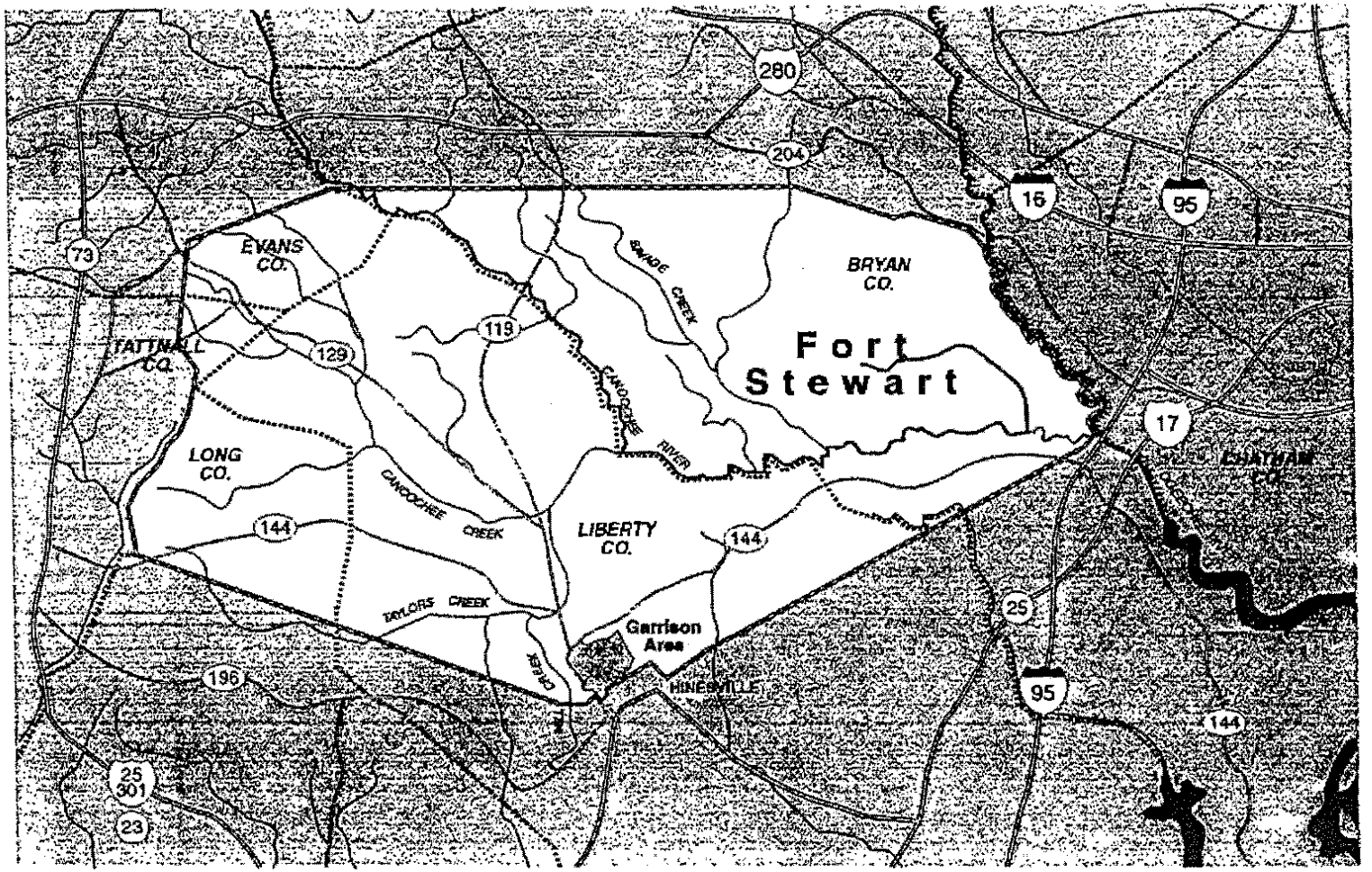


Figure 2-2. Location Map for Fort Stewart Military Reservation, Georgia

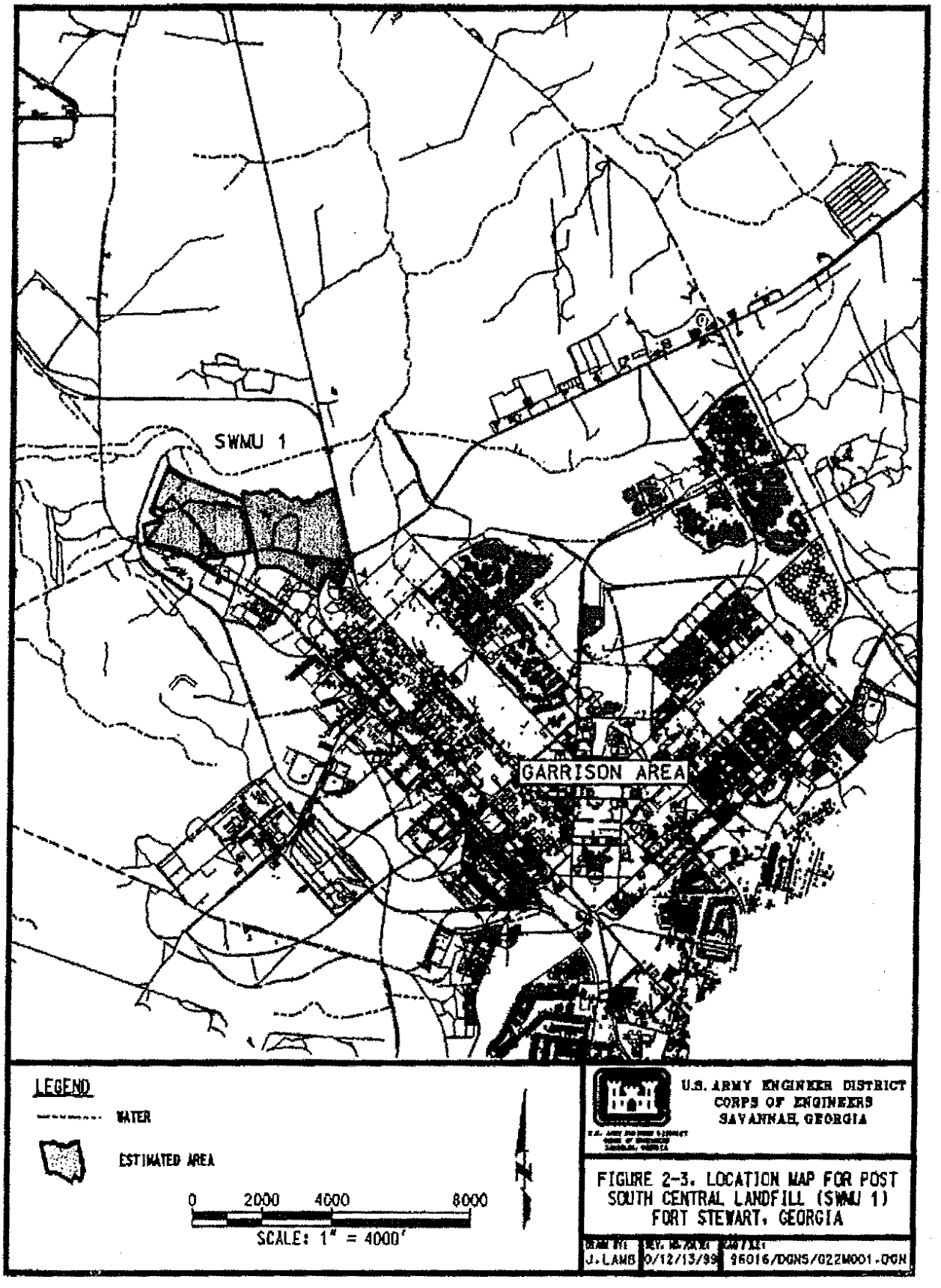


Figure 2-3. Location of the Post South Central Landfill (SWMU 1), Fort Stewart, Georgia

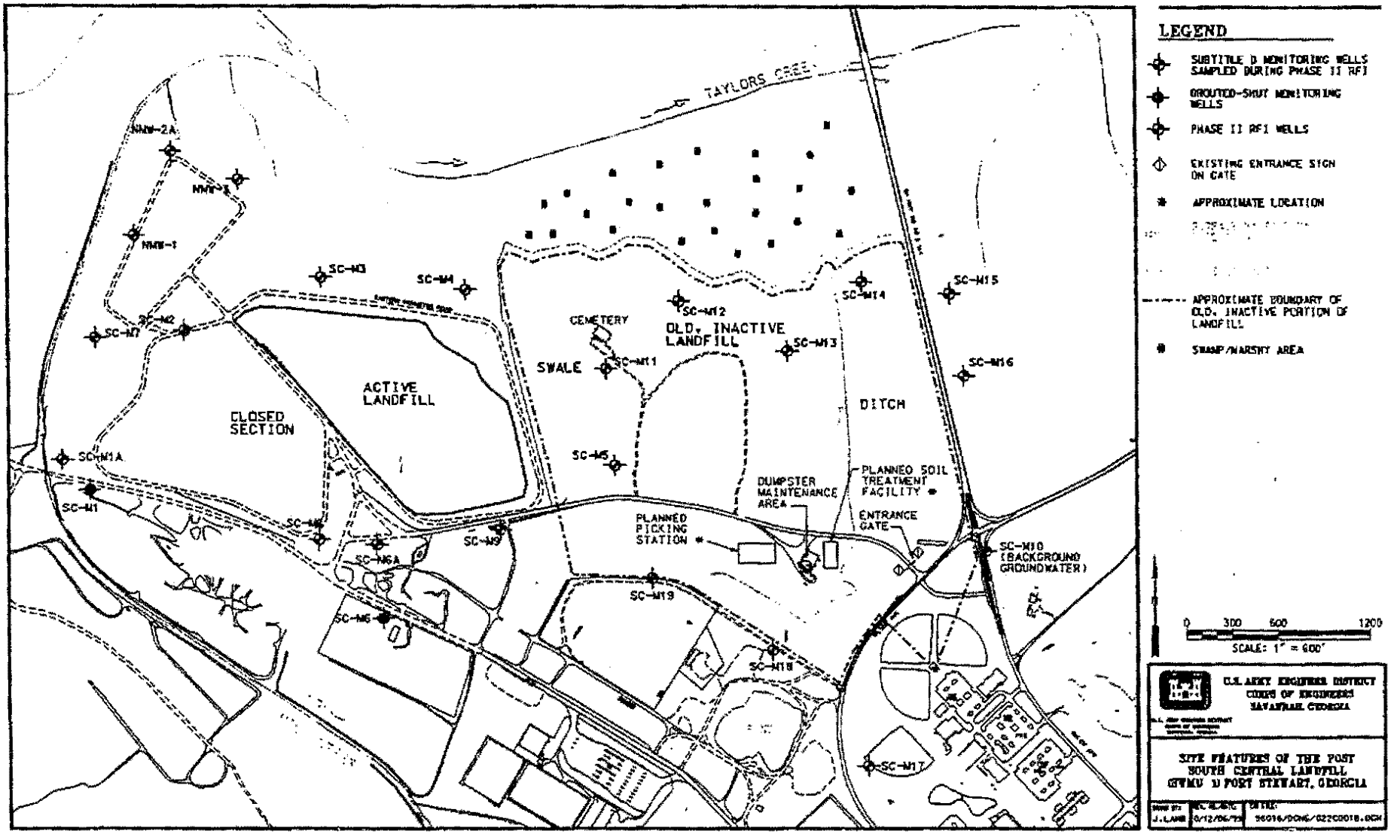


Figure 2-1. Site Features of the Post South Central Landfill (SWMU 1), Fort Stewart, Georgia

FSMR. From 1970 to 1982, trench-and-fill operations were used in the active Post South Central Landfill's eastern cell. The trench-and-fill operation has moved from east to west, with previously filled land being restored to forest.

Beginning in the spring of 1982, tumulus refuse disposal operations began, representing the present-day disposal practices at the landfill. These operations have been performed over the western portion of the trench-and-fill area of the landfill. The active portion of the Post South Central Landfill is comprised of two cells that are constructed on the clay cap of the former trench-and-fill landfill. The eastern cell covers approximately 35 acres and the western cell about 30 acres. Wastes disposed of at the active landfill include dry, construction-type waste; putrescible garbage; and properly packaged asbestos

The northwest portion of the Post South Central Landfill was previously a borrow pit for the site and is presently being used for disposal of demolition/construction debris (nonputrescible waste).

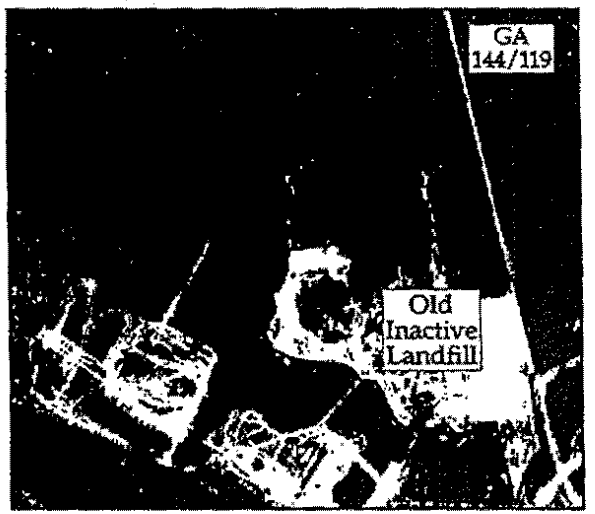
Based upon the results reported in the Revised Final Phase II RFI Report (SAIC 1999) for the active portion of SWMU 1, a few constituents present in the groundwater were detected above maximum contaminant levels (MCLs) [i.e., bis(2-ethylhexyl)phthalate at SC-M9 and NMW-2A]. In accordance with the GEPD-approved recommendation for corrective action, these constituents will continue to be monitored through the GMP, approved by the GEPD Land Protection Division. Corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells is not required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify if any contaminant levels become elevated and/or any trends develop in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. All analytical data will continue to be submitted to the GEPD Land Protection Division.

Old, Inactive Landfill

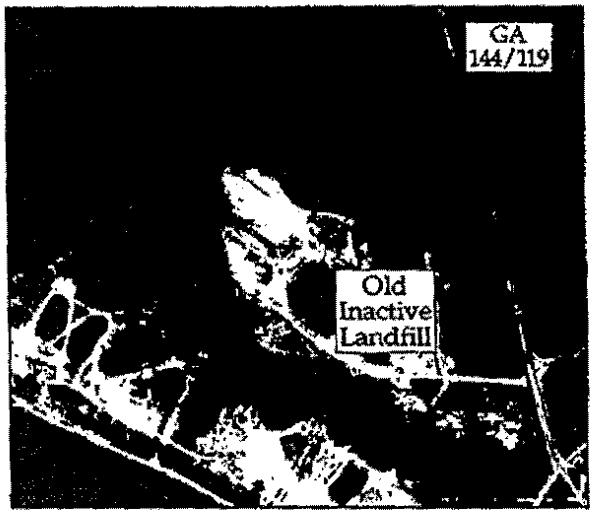
During the Phase I RFI, it was discovered that an older portion of the landfill existed east of the active landfill and continued to Georgia State Route 144/119. The old, inactive landfill is estimated to encompass approximately 80 acres. Aerial photographs dated 1947 and 1957 indicate disposal was occurring at the old, inactive landfill during that period. A 1966 aerial photograph shows approximately two-thirds of the old landfill immediately west of Georgia State Route 144/119 with successional vegetation, indicating that by that time the landfill was no longer being used. Disposal at the current, active Post South Central Landfill site and complete vegetative cover of the old, inactive landfill area are evident in a 1975 aerial photograph; these conditions continue today. Additional prominent site features associated with the old, inactive portion of the landfill include a fenced cemetery, a dumpster maintenance area, and a drainage ditch to drain the low area around a dumpster maintenance area. The dumpster maintenance area is located on the south side of the SWMU 1 access road, approximately 600 feet from the Wilson Avenue entrance gate (see Figure 2-4). Dumpsters are stored and refurbished at the facility. A drainage ditch, which begins southwest of the dumpster cleaning area, circles the area, and ultimately discharges to the marshy area along Taylors Creek, was dug to drain the low area around the dumpster cleaning area so that the area could be built (see Figure 2-4). The aerial photographs of the SWMU 1 site from 1947 through 1992 are presented in Figure 2-5.

The old, inactive landfill received all waste generated at FSMR during its operation. According to previous operators, this waste included materials similar to those currently received at the active landfill in addition to sludges from the sewage treatment plant, scrap metal, demolition/construction debris, sanitary/municipal waste, and drummed waste from the tear gas training facility. According to information provided by former landfill employees, operational practices at the old, inactive landfill involved excavation of a large pit to below the water table; stockpiling of the excavated soil; disposal and

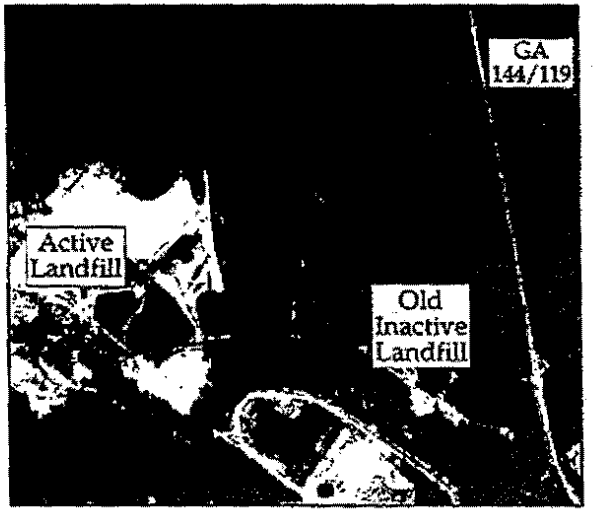
1947



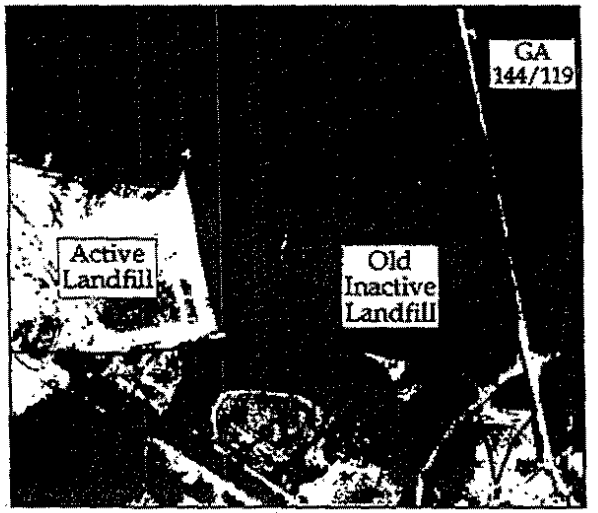
1957



1966



1975



1992

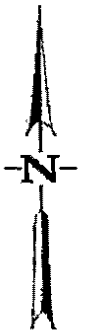


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Figure 2-5. Aerial Photographs of the Post South Central Landfill (SWMU 1)

compaction of the solid waste; and covering with the stockpiled, excavated soil. In addition, intermittent burning in the large pits was used to reduce the volume of the disposed waste. Again, former employees have stated that this operational practice was discontinued because it was reducing air quality and there was concern regarding live rounds discharging during the burning. The disposal areas were covered with local soil that had been removed during excavation of the pits and the surrounding area. Some areas of the old, inactive landfill were planted with pines, whereas other areas were allowed to revegetate naturally with successional species.

Based on the findings presented in the Revised Final Phase II RFI Report dated March 1999 (SAIC 1999), a "no further action required" status was assigned to the old, inactive portion of SWMU 1 for investigative purposes. As recommended by the Phase II RFI and as agreed to with GEPD, a CAP was recommended for SWMU 1 because buried waste will remain in place. The CAP is necessary to control intrusive activities at this site and to be protective of the health of humans potentially coming in contact with the buried waste and to prevent the use of groundwater as a drinking water source.

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).

The Post South Central Landfill occupies a low-lying, flat region on the coastal plain of Georgia and is situated in the Penholoway terrace. The surface topography of the old, inactive landfill portion of the Post South Central Landfill ranges from approximately 70 feet amsl along the southern boundary to approximately 60 feet amsl along the northern boundary.

The Post South Central Landfill is bounded on the north by Taylors Creek, a tributary of Canoochee Creek, and on the southwest by Mill Creek, a tributary of Taylors Creek. Taylors Creek is approximately 1,200 feet from the northern boundary of the old, inactive landfill, while Mill Creek is approximately 4,000 feet southwest of the old, inactive landfill and along the western edge of the active landfill. A drainage swale (shallow ditch) that discharges into Taylors Creek is located between the active landfill and the old, inactive landfill. Another drainage ditch that runs south to north is located in the eastern portion of the old, inactive landfill and discharges to a swampy area adjacent to Taylors Creek. Swampy areas are located along Mill and Taylors creeks, which are to the west and north, respectively, of the Post South Central Landfill.

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).

2.3 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 in thickness and is dominated by clastics. The Tertiary section is approximately 2,170 feet in thickness 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.

Boring logs showing the types of soils encountered during the Phase II RFI at the Post South Central Landfill in soil screening probes, groundwater screening probes, and monitoring well boreholes are given in Appendix B of the Revised Final Phase II RFI Report (SAIC 1999). Geological cross sections of the site are shown on Figures 4-3 and 4-4 of the Revised Final Phase II RFI Report (SAIC 1999), depicting the lithology and stratigraphy of the unconsolidated soil deposits beneath the site, as inferred from the soil boring logs.

The cross sections indicate that the soils present across the SWMU 1 landfill are predominantly sand. In the lower-lying areas northeast of the old, inactive landfill, a 1-foot-thick highly organic layer is present at ground surface. The surficial materials are generally sands or silty sands from 7 feet to 10 feet thick. In the wells that transect the landfill (SC-M4, SC-M11, SC-M5, SC-M19, and SC-M18), a sandy clay layer (7 feet to 10 feet bgs) approximately 4 feet thick is present below the sands or silty sands. A sand layer at 11 feet to 14 feet bgs underlies this sandy clay layer. In the wells across the northern edge of the landfill (SC-M4, SC-M12, SC-M14, and SC-M15), the sands are underlain by a clay layer (7 feet to 10 feet bgs) that is up to 10 feet thick.

The geotechnical analytical results indicated that tested soils are silty sands with the proportion of fine-grained particles varying from 0 percent to 8 percent by weight. All the soils except those at MW-11 were nonplastic. The soil from the screened interval in MW-11 had a permeability of 5.66×10^{-5} cm/sec, while the permeability at VP-2 was determined to be 8.96×10^{-4} cm/sec, which is typical for slightly silty 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. The Post South Central Landfill is bounded on the north by Taylors Creek, a tributary of Canoochee Creek, and on the southwest by Mill Creek, a tributary of Taylors Creek. Taylors Creek is approximately 1,100 feet from the northern boundary of the old, inactive landfill, while Mill Creek is approximately 4,000 feet southwest of the old, inactive landfill. A drainage swale is located between the active landfill and the old, inactive landfill. In addition, another drainage ditch, which runs south to north, is located approximately 700 feet west of

GA 144/119 in the old, inactive landfill. The drainage ditch discharges to the swampy areas adjacent to Taylors Creek. Swampy areas are located along Mill and Taylors creeks, which are to the west and north, respectively, of the Post South Central Landfill.

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 aquifer, 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 based on geotechnical data from the monitoring wells installed during the Phase II RFI. This aquifer could be used for domestic lawn and agricultural irrigation; however, there are no wells in the area of SWMU 1 known to be used for these purposes

Water levels were measured on November 8, 1997, in the 23 temporary piezometers at the Post South Central Landfill. Elevation of the water table varied from 50.29 feet (GP-12) to 68.7 feet (GP-18) amsl. Figure 4-5 of the Revised Final Phase II RFI Report (SAIC 1999) presents a map of the potentiometric surface based on the water levels in the temporary piezometers. These data were used to determine the placement of permanent monitoring wells around the old, inactive landfill. Based on the groundwater contours obtained from the Geoprobe locations, the groundwater is flowing north toward Taylors Creek at an average of 0.0086 foot/foot.

Water levels were also measured in the 22 (existing and new) monitoring wells around the Post South Central Landfill on April 19, 1998. Figure 4-6 of the Revised Final Phase II RFI Report (SAIC 1999) presents the potentiometric surface based on the water levels in the monitoring wells. There is a discrepancy between the historical survey data and the Phase II RFI survey data for the top-of-casing elevations for existing wells SC-M4, SC-M5, SC-M9, and SC-M10. The four existing wells were surveyed during the Phase II RFI to locate the existing wells with respect to the new wells. As a result of the current survey data, top-of-casing elevations for these wells may vary by as much as 3.5 feet between the historical survey data and the current Phase II RFI survey data, and the source of this discrepancy could not be discerned. The difference in elevation data disallows meaningful interpretations of

groundwater contours between the existing and newly installed wells. However, interpretation of the groundwater flow may be performed if the active landfill and the old, inactive landfill are evaluated individually against the water-level measurements and their respective surveyed data sets. The historical monitoring well elevations were used to develop the groundwater contours around the active portion of the landfill, whereas the new survey data were used to assess the groundwater flow around the old, inactive landfill. The groundwater contours from the monitoring wells indicate that there is a groundwater divide in the southern portion of the old, inactive landfill near SC-M10 and GP-10. North of the groundwater divide, the groundwater flows north toward Taylors Creek at an average of 0.0086 foot/foot. South of the groundwater divide, the groundwater flows southwest toward Mill Creek at an average of 0.003 foot/foot.

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.

Both terrestrial and aquatic fauna are abundant in the unimproved areas of the FSMR. Major game species found on the Installation include white-tailed deer, feral hog, wild turkey, rabbit, squirrel, and bobwhite in addition to numerous other mammal, bird, reptile, and amphibian species (Environmental Science and Engineering 1982). Dominant fish include bluegill, largemouth bass, crappie, sunfish, channel catfish, minnows, and shiners. Three federally listed threatened or endangered species reside at the FSMR: the American bald eagle, Eastern indigo snake, and red-cockaded woodpecker.

2.7 NATURE AND EXTENT OF CONTAMINATION

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

The reference background criteria for the Post South Central Landfill 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), Active Explosive Ordnance Disposal 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 (SAIC 1999).

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 (e.g., more than 20) are collected to define background, a background upper tolerance level can be calculated. In cases in which too few samples (e.g., 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 site-related contaminants (SRCs) if their concentrations were above the reference background concentrations. Organics were considered SRCs if they were simply detected because organic constituents are considered anthropomorphic in nature.

Appendix G of the Revised Final Phase II RFI Report (SAIC 1999) presents the summary of background data as well as the two-times-mean background concentrations. Given the limited background data, the mean concentration for soils 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.

Isolated low levels of organic contamination (VOCs, SVOCs, and pesticides) and metals are present in soil; however, no clear distribution or trends of contaminants are evident. Acetone, methylene chloride, toluene, and 1,2,4-trichlorobenzene were detected in surface soil. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected in two surface soil samples, SC-M13 and SC-M18. 1,2,4-Trichlorobenzene, pyrene, 2-butanone, acetone, methylene chloride, styrene, and toluene were detected in subsurface soil.

Selenium was detected in surface soil above the FSMR reference surface soil background concentration in a single soil sample. Selenium concentrations in surface soil were not above the FSMR reference background concentrations for subsurface soil.

Low levels of VOCs, SVOCs, metals, and Radium 226/228 are present in the surficial aquifer; however, no clear distribution or trends of contaminants are evident. Trichloroethene was detected in a single groundwater sample (direct-push sample GP-7) above its respective MCL. Bis(2-ethylhexyl)phthalate was detected in groundwater above its MCL (6 µg/L) at two locations (NMW-2A and SC-M9) at concentrations of 7.8 µg/L and 61.4 µg/L, respectively. Metals were detected in groundwater, with only one containing a concentration above the MCL. Lead was detected at 18.4 µg/L at monitoring well SC-M17 (action level 15 µg/L). However, the filtered lead concentration at SC-M17 was nondetect, indicating that the lead may be associated with colloid particulates in the groundwater. Barium, cadmium, chromium, iron, and lead were detected above the FSMR reference background concentrations. Low levels of Radium 226/228 were detected in the groundwater. The combined Radium 226/228 concentrations exceeded the MCL at two locations (SC-M5 and SC-M19). The groundwater field sampling data (dissolved oxygen, oxidation-reduction potential, pH) do not indicate that leachate is impacting the groundwater.

Low levels of organics, metals, and Radium 226/228 were detected in sediment and surface water. Chromium, lead, mercury, and Radium 228 were detected in sediment above site-specific background criteria. Two VOCs (acetone and 2-butanone) were detected in one sediment sample, and one SVOC (1,2,4-trichlorobenzene) was detected in two sediment samples. Diethyl phthalate and pyrene were detected in surface water. Radium 228 was detected in surface water above the site-specific background criterion.

A tabular summary of SRCs for the Post South Central Landfill is presented in Table 2-1.

2.8 CONTAMINANT FATE AND TRANSPORT

Contaminant fate and transport analysis provided an assessment of the potential migration pathways and transport mechanisms affecting the chemicals at the sites. In particular, the leachability of contaminants from soil to groundwater and their natural attenuation in groundwater were evaluated.

Acetone and methylene chloride in the soil at the Post South Central Landfill exceeded EPA Generic Soil Screening Levels (GSSLs). These constituents may leach into groundwater at concentrations that exceed groundwater standards [i.e., concentrations that exceed the MCL or, in the absence of an MCL, the risk-based concentration (RBC) for drinking water]. The concentration of acetone exceeded the GSSL in only one out of nine detections in soil. This soil sample, SC-M16, was located outside of the boundary of the landfill or the area affected by the landfill operations. Therefore, the acetone present in this sample is not associated with the landfill operations. Acetone is not considered a contaminant migration contaminant of potential concern (COPC). Acetone was detected in groundwater above its RBC as established by EPA Region III and was considered to be a human health COPC in groundwater.

All of the detected methylene chloride concentrations (seven out of 25 soil samples) exceeded the GSSL. One of the detections of methylene chloride (SC-M15) was located outside the boundary of the landfill or the area affected by the landfill operations. The maximum concentration of methylene chloride (52.2 µg/kg) was detected at SC-M15. Methylene chloride was the only contaminant migration COPC in soil around the old, inactive portion of the landfill. Methylene chloride was not detected in groundwater.

Selenium exceeded its reference background criterion in soil; however, it did not exceed its GSSL based on leaching to groundwater; therefore, selenium was not considered a contaminant migration COPC.

Chromium, lead, and Radium 226/228 exceeded their respective RBCs/MCLs in groundwater. The one elevated concentration of lead may be due to colloid particulates in the groundwater. Off-site migration of chromium, lead, and Radium 226/228 will be limited, however, because of their high retardation factors.

Bis(2-ethylhexyl)phthalate and trichloroethene exceeded their MCLs but were not found in soils. Therefore, bis(2-ethylhexyl)phthalate and trichloroethene were not screened as contaminant migration COPCs in soils. Maximum groundwater concentrations of bis(2-ethylhexyl)phthalate and trichloroethene were detected at 61.4 µg/L (MCL 6 µg/L) and 5.4 µg/L (MCL 5 µg/L), respectively. These two concentrations above MCLs represent only a single detection out of 51 groundwater samples (23 direct-push, two vertical-profile, and 22 groundwater monitoring wells). Bis(2-ethylhexyl)phthalate and trichloroethene were detected in the groundwater only and not in soils, indicating that these contaminants may have leached in the past or are potentially leaching directly from a very confined or small point source. Off-site migration of these organic contaminants will be limited due to retardation and degradation through various processes as well as the slow movement of groundwater (12.8 feet/year). At

Table 2-1. Summary of Site-related Contaminants

Analyte	Maximum Concentration			Maximum Concentration	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
	µg/kg			*µg/L*	
1,1,2,2-Tetrachloroethane				0.69	
1,1-Dichloroethane				0.56	
1,2-Dichloropropane				0.24	
1,2-*cis*-Dichloroethene				21	
1,2-*trans*-Dichloroethene				1.6	
2-Butanone		14.1	14.5	8.6	
Acetone	44,100	638	297	1,140	
Benzene				2.5	
Chlorobenzene				9.8	
Chloroform				22	
Ethylbenzene				26.9	
Methylene chloride	52.2	2.8			
Styrene		0.67		0.29	
Tetrachloroethene				0.36	
Toluene	59.4	6.1		17.8	
Trichloroethene				5.4	
Xylenes, total				212	
Semivolatile Organic Compounds					
	µg/kg			*µg/L*	
1,2,4,Trichlorobenzene	3.2	2.4	3.4		
4-Methylphenol				1.1	
Bis(2-ethylhexyl)phthalate				61.4	
Diethyl phthalate				5.2	0.86
Pyrene		2.5			0.1
Radionuclides					
	pCi/g			*pCi/L*	
Radium 226				1.63	
Radium 228			1.29	6.9	3.97
Pesticides					
	mg/kg			*mg/L*	
4,4'-DDD	3.8				
Dieldrin				0.025	
Heptachlor		0.39			
Metals					
	mg/kg			*mg/L*	
Barium				134	
Cadmium				0.59	
Chromium			3.5	11.6	
Iron				22,000	
Lead			6	18.4	
Mercury			0.02		
Selenium	0.69				

the velocity of 12.8 feet/year, site groundwater will take 94 years to reach Taylors Creek. In reality, contaminants will move slower than groundwater due to retardation, and the organic contaminants will gradually decay in nature.

2.9 PRELIMINARY RISK EVALUATION

2.9.1 Human Health Preliminary Risk Evaluation

The human health preliminary risk evaluation included a Step 1 risk evaluation to determine potential human health risks associated with the contaminants. Human health COPCs have been identified as those constituents present at concentrations higher than their reference background criteria and higher than their respective risk-based or applicable or relevant and appropriate requirement-based screening criteria. Based on the results of the screening and the weight-of-evidence analysis, potential human health COPCs have been identified for groundwater. There are no human health COPCs for surface soil, subsurface soil, surface water, or sediment.

The initial human health COPCs for groundwater were identified because they present a potential threat to human health as a result of use of groundwater as a source of drinking water. The initial human health COPCs for groundwater are iron, acetone, benzene, chromium, lead, Radium 226, Radium 228, bis(2-ethylhexyl)phthalate, 1,2-*cis*-dichloroethene, and trichloroethene. Iron, Radium 226, and Radium 228 are not hazardous constituents as defined by Section I.E of FSMR's Hazardous Waste Facility Permit #HW-045 (S&T) and are not subject to the corrective action requirements under the terms and conditions of the permit or under the Georgia Hazardous Waste Management Act, O.C.G.A §12-8-60, et seq., as amended, and the Rules for Hazardous Waste Management, Chapter 391-3-11, promulgated pursuant thereto, as amended. Therefore, iron, Radium 226, and Radium 228 were eliminated as human health COPCs in groundwater at SWMU 1.

A baseline human health risk assessment (BHHRA) (see Section 2.10) was performed to quantitatively assess the risks associated with exposure to human health COPCs in groundwater. In addition, the baseline risk assessment evaluated the risks associated with the leaching of the contaminant migration COPC (methylene chloride) to groundwater underlying the site and migrating off-site via groundwater. A tabular summary of contaminant screening of groundwater results to action levels is presented in Table 2-2.

2.9.2 Ecological Preliminary Risk Evaluation

The Phase II RFI performed an ecological preliminary risk evaluation (EPRE) for potential terrestrial and aquatic receptors at the site. The EPRE for the Post South Central Landfill identified ecological COPCs in groundwater based on a comparison of their maximum site concentrations to EPA Region IV ecological screening values (ESVs). No ecological COPCs were identified in surface water or sediment. Preliminary risk calculations for identified ecological COPCs in surface soil (selenium and DDT) and groundwater [barium, iron, lead, bis(2-ethylhexyl)phthalate, and total xylenes] were based on a comparison of detected concentrations to toxicity reference values (TRVs) for surrogate species representing ecological receptors. Uncertainty analysis of the ecological COPCs in surface soil and groundwater resulted in their being eliminated as ecological COPCs. The uncertainty analysis is summarized below.

Selenium and the pesticide DDT and its metabolites were detected in surface soil at the Post South Central Landfill at concentrations that exceeded both reference background criteria and the TRVs for terrestrial receptors. Selenium was detected in only one of eight surface soil samples at SWMU 1 at only

Table 2-2. Contaminant Screening of Groundwater Results to Action Levels

Analyte	Freq. of Detection	Minimum Detected	Maximum Detected	Human Health Criterion	Human Health COPC	Justification
Metals (µg/L)						
Barium	21/21	20.9	134	260	No	Max Detect < Risk Criteria
Cadmium	2/21	0.25	0.59	1.8	No	Max Detect < Risk Criteria
Chromium	7/21	0.71	11.6	10.9	Yes	Max Detect > Risk Criteria
Iron	21/21	76.5	22,000	1,100	Yes	Max Detect > Risk Criteria
Lead	17/21	0.12	18.4	15 [a]	Yes	Max Detect > Risk Criteria
Radionuclides (pCi/L)						
Radium 226	10/21	0.501	1.63	0.161 [b]	Yes	Max Detect > Risk Criteria
Radium 228	21/21	1.33	6.9	0.192 [b]	Yes	Max Detect > Risk Criteria
Pesticides (µg/L)						
Delta-BHC	1/21	0.04	0.04	ND	No	Weight of Evidence [c]
Dieldrin	1/21	0.025	0.025	0.0042	No	Weight of Evidence [c]
Semivolatile Compounds (µg/L)						
4-Methylphenol	1/21	1.1	1.1	18	No	Max Detect < Risk Criteria
Bis(2-ethylhexyl)phthalate	8/21	0.53	61.4	4.8	Yes	Max Detect > Risk Criteria
Diethyl phthalate	6/21	0.56	5.2	2,900	No	Max Detect < Risk Criteria
Volatile Compounds (µg/L)						
1,1,2,2-Tetrachloroethane	1/50	0.69	0.69	0.052	No	Weight of Evidence [c]
1,1-Dichloroethane	1/50	0.56	0.56	81	No	Max Detect < Risk Criteria
1,2-Dichloropropane	1/50	0.24	0.24	0.16	No	Weight of Evidence [c]
1,2-*cis*-Dichloroethene	9/46	0.4	21	6.1	Yes	Max Detect > Risk Criteria
1,2-*trans*-Dichloroethene	1/46	1.6	1.6	12	No	Max Detect < Risk Criteria
2-Butanone	1/50	8.6	8.6	190	No	Max Detect < Risk Criteria
Acetone	11/32	15.1	1,140	370	Yes	Max Detect > Risk Criteria
Benzene	3/50	0.23	2.5	0.36	Yes	Max Detect > Risk Criteria
Chlorobenzene	1/50	9.8	9.8	3.9	No	Weight of Evidence [c]
Chloroform	2/50	0.51	22	0.15	No	Weight of Evidence [c]
Ethylbenzene	13/50	0.22	26.9	130	No	Max Detect < Risk Criteria
Styrene	1/50	0.29	0.29	160	No	Max Detect < Risk Criteria
Tetrachloroethene	1/50	0.36	0.36	1.1	No	Max Detect < Risk Criteria
Toluene	11/50	0.27	17.8	75	No	Max Detect < Risk Criteria
Trichloroethene	3/50	0.35	5.4	1.6	Yes	Max Detect > Risk Criteria
Xylenes, total	16/50	0.43	212	1,200	No	Max Detect < Risk Criteria

[a]Lead action level of 15 mg/L is based on a blood lead concentration of 10 mg/dL.
[b]Risk-based concentrations for radionuclides have been calculated for use at U.S. Department of Energy facilities (DOE/ORO 1998).
[c]Weight-of-evidence analysis indicated this constituent was detected infrequently (frequency of detection of 5 percent or less).
ND = No data available.

slightly above its background concentration (0.69 mg/kg versus 0.63 mg/kg). Selenium was not detected in the other seven soil samples. Therefore, selenium is not considered an ecological COPC in surface soil at SWMU 1. DDT and its metabolites in surface soil at SWMU 1 are ecological COPCs for birds with small home ranges ingesting soil-dwelling invertebrates. DDT and its metabolites are likely to be present in surface soil in most areas of Georgia and the southeast due to the past widespread use of DDT as an insecticide. Assuming the effects of DDT, DDE, and DDD are additive, the combined exposure at each of the two sampling locations at which these constituents were detected does not exceed the lowest-observed-adverse-effect level (LOAEL) dose. The fact that maximum estimated doses lie between the

no-observed-adverse-effect level and the LOAEL suggests that the pesticides and their metabolites are not ecological COPCs in surface soil at SWMU 1.

Barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes (total) are present in groundwater at the Post South Central Landfill at concentrations that exceed EPA Region IV ESVs for surface water. Bis(2-ethylhexyl)phthalate was detected in groundwater at concentrations above background criteria and that resulted in estimated exposures exceeding TRVs for terrestrial ecological receptors that ingest fish and other aquatic biota. The ecological COPCs in groundwater are barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes for aquatic biota and bis(2-ethylhexyl)phthalate for birds ingesting fish exposed to groundwater potentially discharging to surface water. The concentrations of these constituents in numerous monitoring wells and direct-push groundwater samples exceeded background criteria and risk-based screening or reference values. However, none of these constituents is an ecological COPC in surface water and sediment at SWMU 1. This suggests that dilution, degradation, sorption, or other processes are operating to reduce the low concentrations in groundwater discharging to Taylors and Mill creeks or that groundwater at SWMU 1 has not yet migrated to the creeks. Groundwater flow rates indicate that it takes approximately 94 years for groundwater to reach Mill and Taylors creeks. Therefore, groundwater constituents are not ecological COPCs at the present time because they have not been indicated as ecological COPCs in surface water and sediment. The groundwater constituents are not likely to be ecological COPCs in the future because of their low concentrations and associated small hazard quotients (HQs) and the continued natural attenuation processes occurring in the subsurface soil (e.g., dilution, degradation, absorption).

In summary, the Phase II RFI (SAIC 1999) concluded that there is no present ecological risk at SWMU 1 and that the site is unlikely to pose an ecological risk in the future.

2.10 BASELINE HUMAN HEALTH RISK ASSESSMENT

A BHHRA was performed to assess groundwater around SWMU 1. The human health COPCs identified in groundwater include acetone, benzene, bis(2-ethylhexyl)phthalate, 1,2-*cis*-dichloroethene, trichloroethene, chromium, and lead. Methylene chloride was identified as a contaminant migration COPC based on its potential to leach into groundwater, resulting in potential exposure of receptors. Although acetone was identified as a contaminant migration COPC, it was detected above its GSSL in only SC-M16, which was located in an area determined to not be impacted by SWMU 1; therefore, the potential for acetone to leach into groundwater from soil was not evaluated in the BHHRA. Potential future groundwater concentrations of methylene chloride were estimated using the Seasonal Soil Compartment Model. This concentration was included in the risk assessment in addition to the human health COPCs.

The potential current and future receptors evaluated included an on-site and off-site worker, a resident (adult and child), and a child playing in Taylors Creek, a point of groundwater discharge. The worker and resident were evaluated based on a potential drinking water scenario in which drinking water is obtained from the surficial aquifer. The Installation worker is the only likely receptor population. However, GEPD guidance states that resident populations must be evaluated as both on-site and off-site receptors. Groundwater underlying SWMU 1 flows predominantly in the direction of Taylors Creek, where it is likely to discharge to surface waters; therefore, the potential risk to a child playing in Taylors Creek was also evaluated.

Constituents migrating off-site were modeled to determine groundwater concentrations at the points of exposure. The model assumed that the maximum measured concentration of a constituent was present in groundwater at the northern boundary of the old, inactive landfill. It was assumed that all off-site

receptors come into contact with the groundwater at some point north of the site, which is the predominant direction of groundwater flow. The exposure-point groundwater concentrations of COPCs for the off-site receptors were negligible; therefore, potential risks resulting from exposure of off-site receptors would be well below target values.

Ingestion, dermal absorption, and inhalation were evaluated as the potential exposure pathways (i.e., routes of exposure of the constituent to the body). The risks associated with carcinogenic hazardous constituents were estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen [i.e., the incremental lifetime cancer risk (ILCR)]. The ILCRs for the individual carcinogens are summed to provide the total ILCR. A total ILCR of less than 1E-6 does not represent a significant carcinogenic risk. The risks associated with the systemic effects of noncarcinogenic toxicity were evaluated by comparing an estimated intake (mg/kg/day) to a reference dose (Tables 2-3 and 2-4). This ratio of estimated intake over the reference dose is termed the HQ. The sum of all of the HQs for a given exposure route (i.e., oral, inhalation, or dermal) is called the hazard index (HI). HIs less than 1.0 indicate that the sum of exposures to all of the constituents present is not likely to result in adverse health effects. Lead does not have a reference dose, but it does have a maximum acceptable blood–lead concentration of 10 µg/dL in children, which represents the most sensitive receptor population. The blood–lead levels for children ages 1 to 7 were estimated to determine if there is an unacceptable risk associated with exposure to lead in groundwater.

Table 2-3. Remedial Levels for Groundwater and Soil

Chemical	Groundwater Remedial Level MCL (µg/L)	Maximum Groundwater Concentration (µg/L)	Target Groundwater Concentration (µg/L)	Remedial Level Soils (mg/kg)	Maximum Soil Concentration (mg/kg)
Benzene	5	2.5	NA	NA	NA
Bis(2-ethylhexyl)phthalate	6	61.4	NA	NA	NA
Methylene chloride	NA	NA	5	3.3	13.7

NA = Not applicable.

Table 2-4. Location of Exceedances above Remedial Levels

Chemical	Groundwater		Soil	
	Concentration above Remedial Level (µg/L)	Location[a]	Concentration above Remedial Level (mg/kg)	Location[b]
Bis(2-ethylhexyl)phthalate	61	SC-M9	NA	NA
	7.8	NMW-2A	NA	NA
Methylene chloride	NA	NA	9.2	SC-M11
	NA	NA	13.7	SC-M12
	NA	NA	3.9	SC-M14

Note: Exceedances of acetone in surface soil were at only SC-M19, which was not impacted by SWMU 1.
[a]Groundwater locations are presented on Figure 5-5 of the Revised Final Phase II RFI Report (SAIC 1999).
[b]Surface soil locations are presented on Figure 5-1 of the Revised Final Phase II RFI Report (SAIC 1999).
NA = Not applicable.

Constituents present in groundwater at SWMU 1 do not present a significant noncarcinogenic risk to human health. The quantitative estimates of noncarcinogenic risks were below their target values for both on-site occupational and residential receptor populations. The carcinogenic risks for the occupational receptor population was below the target risk value of 1E-6; however, the carcinogenic risk for the on-site residential receptors exceeded the target value with an ILCR of 8.9E-6. This value includes an ILCR of 3.4E-6 resulting from exposure to methylene chloride that may leach into groundwater. The other risk drivers are benzene (ILCR = 2.5E-6) and bis(2-ethylhexyl)phthalate (ILCR = 2.1E-6).

The remedial levels for benzene and bis(2-ethylhexyl)phthalate were based on their respective MCLs (5 µg/L and 6 µg/L, respectively). The MCL for benzene was greater than the maximum detected value of 2.5 µg/L; therefore, corrective action is not required to address the presence of benzene in groundwater. Groundwater concentrations of bis(2-ethylhexyl)phthalate exceeding the remedial level were detected in only those wells (NMW-2A and SC-M9) associated with the active landfill; therefore, bis(2-ethylhexyl)phthalate is not associated with the old, inactive landfill (Table 2-3) and is not addressed in this CAP.

The remedial soil level for methylene chloride was determined to be 3.3 mg/kg and represents a concentration of the constituent in soil that is not likely to leach into groundwater and result in groundwater concentrations that exceed the MCL for methylene chloride (5 µg/L). Only four sampling locations indicated methylene chloride above the 3.3 mg/kg remedial level. SC-M11, SC-M12, SC-M14, and SC-M16 had methylene chloride concentrations of 9.2 mg/kg, 13.7 mg/kg, 3.9 mg/kg, and 52.2 mg/kg, respectively; SC-M16 is not located within the boundaries of the SWMU 1 (Table 2-4).

The exposure scenario for methylene chloride soil contamination leaching to groundwater assumes that in the future a residence will be built on-site and that the household drinking water will come directly from the surficial aquifer. Current planning under the FSMR Base Master Plan (BMP), which goes through the year 2020, does not include construction of any facilities on the old, inactive portion of the landfill. Methylene chloride degrades rapidly in groundwater (its biodegradation half-life in groundwater equals 112 days); therefore, the methylene chloride potentially leaching to groundwater would completely degrade before any structure would be built on the site. In addition, methylene chloride was not detected in any of the groundwater samples associated with the old, inactive portion of the landfill, including those located in the area of the methylene chloride soil contamination (SC-M11, SC-M12, and SC-M14), indicating that natural attenuation of methylene chloride may be occurring. Therefore, given the unlikely possibility of exposure of an on-site resident to methylene chloride in the surficial groundwater and the restricted usage through 2020 under the BMP, Fort Stewart's recommendation of no further action for methylene chloride in soil, as presented in the Revised Final Phase II RFI Report, was approved by GEPD.

In conclusion, of the two constituents detected in groundwater [benzene and bis(2-ethylhexyl)phthalate], benzene was not detected above its MCL and bis(2-ethylhexyl)phthalate was detected in monitoring wells (NMW-2A and SC-M9) located around the active portion of the landfill, indicating that this constituent is associated with the active landfill and not the old, inactive landfill. The active portion of SWMU 1 is operated under Permit Nos. 089-010D (SL) and 089-020D (L), and bis(2-ethylhexyl)phthalate, which was detected above the MCL at SC-M9 and NMW-2A, will continue to be monitored through the GMP, as approved by the GEPD Land Protection Division, and corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells will not be required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify any elevation of contaminant levels and/or development of any trends in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. The active portion of

SWMU 1 will continue to be monitored in association with the approved GMP, and all analytical data will continue to be submitted to the GEPD Land Protection Division.

Methylene chloride was indicated in soil above its remedial level as a contaminant migration COPC at three locations around the old, inactive portion of the landfill; therefore, methylene chloride was identified as a contaminant migration COPC in soil based on the unlikely possibility of exposure to someone constructing a residence on the site and drinking groundwater containing methylene chloride. Fort Stewart's recommendation of no further action, as presented in the Revised Final Phase II Report, was approved by GEPD as long as restricted use of the groundwater, as currently planned in the BMP, was maintained and controlled.

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 OBJECTIVES

Based on the findings of the site characterization at this SWMU, the primary goal and purpose for implementing corrective measures at the old, inactive portion of SWMU 1 is limited to protection of human health and safety. To achieve this goal, two primary remedial response objectives have been established for SWMU 1: (1) to prohibit the ingestion of shallow groundwater from the subject site; (2) to limit the disturbance of subsurface soils to minimize contact with buried waste; and (3) to identify procedures to evaluate the subsurface characteristics prior to any construction within the boundary of the old, inactive portion of the landfill. Any corrective measures that pose a significant threat to human health and safety during implementation (e.g., methods that would involve disturbance of subsurface soils) will not be evaluated. Implementation of the selected remedial response 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

As presented in Chapter 2.0, remedial levels (see Table 2-3) were developed for methylene chloride in soil and benzene and bis(2-ethylhexyl)phthalate in groundwater. Soil remedial levels are based on leaching to groundwater at levels exceeding MCLs or Region III risk-based values. Groundwater remedial levels are based on MCLs, which take into consideration both human health and the technology limitations. In the absence of an MCL, the EPA Region III risk-based values for groundwater were used to derive remedial levels. MCLs were available for all of the constituents of concern [benzene (5 µg/L), bis(2-ethylhexyl)phthalate (6 µg/L), and methylene chloride (5 µg/L)] and were selected as remedial levels in groundwater (see Table 2-3).

The maximum concentration of benzene (2.5 µg/L) was less than its remedial level/MCL of 5 µg/L; therefore, remedial action for benzene is not required for this site.

Groundwater concentrations of bis(2-ethylhexyl)phthalate exceeding the remedial level were detected in groundwater wells NMW-2A and SC-M9. These wells are located around the active landfill, indicating that this constituent is associated with the active landfill and not the old, inactive landfill. The active portion of SWMU 1 is operated under Permit Nos. 089-010D (SL) and 089-020D (L), and the few constituents detected above MCLs [e.g., bis(2-ethylhexyl)phthalate at SC-M9 and NMW-2A] will continue to be monitored through the GMP, as approved by the GEPD Land Protection Division, and corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells will not be required. The GMP will allow continued evaluation of potential contaminant migration to the

groundwater and surface water and will identify any elevation of contaminant levels and/or development of any trends in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. The active portion of SWMU 1 will continue to be monitored in association with the approved GMP, and all analytical data will continue to be submitted to the GEPD Land Protection Division.

The remedial level for methylene chloride in soils was calculated based on its potential to leach into groundwater. The remedial soil level for methylene chloride was determined to be 3.3 mg/kg and to represent a concentration in soil that is not likely to leach into groundwater and result in groundwater concentrations that exceed the MCL for methylene chloride (5 μg/L). Three locations around the old, inactive portion of the landfill indicated soil concentrations above this remedial level. However, methylene chloride degrades rapidly in groundwater (its biodegradation half-life in groundwater equals 112 days). Because methylene chloride was not detected in any groundwater samples collected around the old, inactive portion of the landfill, it may be naturally attenuated prior to reaching the groundwater. Current planning through 2020 under the BMP controls construction as well as the usage of groundwater for human consumption on the site, eliminating the potential of human exposure to methylene chloride in soil and potentially in groundwater. GEPD approved no further action for methylene chloride in soil as long as current planning through the BMP is maintained.

In conclusion, there are presently no constituents in the groundwater around the old, inactive landfill at concentrations above remedial levels. The only contaminant in soil is methylene chloride, based on its potential to leach to groundwater. Methylene chloride in soil does not require remediation, however, as long as the use of shallow groundwater for drinking purposes is restricted. Current planning through 2020 under the BMP restricts the use of shallow groundwater for drinking purposes.

4.0 SCREENING OF CORRECTIVE ACTIONS

This section identifies corrective action technologies applicable to the old, inactive portion of the Post South Central Landfill. The technologies that are retained following screening are then presented as corrective action alternatives that address limiting exposure to subsurface contamination. These alternatives are then evaluated with respect to protection of human health and life-cycle cost.

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.

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, typical 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: (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 that screening evaluation are also shown on 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; therefore, the no action alternative will be eliminated from further evaluation.

Institutional controls include actions taken to restrict access to contaminated areas by establishing legal land use controls or by providing physical barriers to access. Physical barriers and/or land use restrictions would provide effective, affordable, and readily implementable methods for preventing human exposure to buried waste at the site. Land use controls include deed recordation, controls implemented through the BMP, zoning controls, and placement of signs restricting access. Physical barriers include installation of a two-rail, preservative-treated wood fence along a portion of the site boundary. Other physical barriers already exist at the site and include access gates, which are locked during nonoperational hours; natural barriers, including Taylors Creek and natural drainage features; roads; and man-made drainage features. Abandonment of groundwater wells no longer needed for site monitoring is also considered as a method for discouraging the use of groundwater at the subject 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. Two alternatives were identified and subsequently evaluated.

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

2. Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Partial Wood Fence Barrier, Maintenance of Existing Physical Barriers, Post-mounted and 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; therefore, two primary evaluation factors were used in the preferred corrective action alternative: protection of human health and life-cycle costs.

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 buried waste by human disturbance.	This alternative would not address the corrective action objectives for the site. This alternative would not provide protection of human health because there would not be sufficient controls to prevent human exposure to buried waste.	There would be no implementability involved for 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 soils and groundwater. Land use restrictions and institutional control requirements that would be enforced would include restrictions through deed recordation, base master planning and zoning controls, warning signs posted around the site, well abandonment, 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 soils would be prohibited under the deed recordation.	Land use restrictions would be effective and provide long-term reliability with respect to preventing human exposure to buried waste 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 exposure to contaminated media. The BMP is an effective tool for ensuring establishment of land use restriction because requirements of the BMP are enforced by the FSMR in accordance with written policies and procedures.	These institutional controls would 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. Deed recordation, BMP and zoning controls, post signage, abandonment of the wells, and implementation of the O&M Plan would cost less than $50,000.
Institutional Controls: Physical Barriers	Physical barriers would reduce potential hazards by limiting exposure of humans to contaminated soil and groundwater. Physical barriers would include split-rail fencing, existing landfill access gate, warning signs around site, existing drainage features, and natural barriers (creek, natural drainage features).	This technology would be effective and provide long-term reliability with respect to minimizing human exposure to buried waste within the boundaries of the site by physically restricting their access.	Physical barriers would be readily implementable. The property will remain under federal ownership.	Installation of fencing would be expensive (approximately $50,000 for installation and approximately an additional $40,000 for 30 years of O&M). Use of existing physical barriers would involve no additional cost.

Protection of Human Health

The effectiveness of each proposed alternative to protect human health at this site is dependent upon its ability to prohibit human activity associated with disturbance of subsurface soils and usage of shallow groundwater. For each alternative the level of protection of human health was evaluated and compared. For both retained alternatives, usage of groundwater would be prohibited through abandonment of existing wells and through legal land use controls (BMP, deed recordation, and zoning). For both alternatives, legal land use controls, warning signs, and maintenance of existing physical barriers (Taylors Creek and existing access gate) would also restrict activities associated with disturbance of subsurface soils. In Alternative 2 additional protection would be provided by the use of fencing to restrict access to portions of 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. Costs are estimated for capital construction, administration, and O&M. 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.

4.3.2 Evaluation of Corrective Action Alternatives

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

The alternatives would include the following common features:

- BMP, deed recordation, and zoning controls that establish controls to prohibit the use of groundwater and minimize intrusion into subsurface soils;
- abandonment of eight site monitoring wells (SC-M12, -M13, -M14, -M15, -M16, -M17, -M18, and -M19);
- 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 life-cycle cost.

Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Well Abandonment, 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 by preventing human exposure to buried waste by the establishment of legal land use

Table 4-2. Corrective Action Alternatives

Corrective Action	Description	Protection of Human Health	Cost	Comments
Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Well Abandonment, 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 and groundwater usage. This alternative would also include abandonment of eight groundwater monitoring wells.	Protection of human health would be primarily dependent upon enforcement of compliance with land use controls. Existing physical barriers (access gate and creek) provide effective restrictions on human access to the site to further discourage any unauthorized excavation activities.	$44,843	Least expensive providing sufficient level of protection.
Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Partial Wood Fence Barrier, Maintenance of Existing Physical Barriers, Post-mounted and 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 and groundwater usage. Physical barriers to be installed would include a 3,500-linear-foot, pretreated wood fence along the eastern boundary curving westward to SC-M18. This alternative would also include abandonment of eight groundwater monitoring wells.	In addition to the protection provided by Alternative 1, human access would be further restricted by fencing along the eastern and southeastern boundaries of the site. The fencing would be slightly more effective than signs alone in deterring or discouraging unauthorized excavation activities, but even fencing would not totally prevent someone from gaining access to the site.	$126,679	Significantly more expensive with only slight increase in level of protection compared to Alternative 1.

restrictions. The BMP is an effective tool for ensuring that unauthorized disturbance of subsurface soils at the site, and ingestion of groundwater from the site, is prohibited while the property is under DoD ownership. If this property were ever 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 hazards associated with the old, inactive portion of SWMU 1, warning signs stating restrictions on human activity within the SWMU would be posted at 200-foot intervals around the boundary of the SWMU. Four additional post-mounted signs would be installed at both the eastern and western entrances to the site. The placement of signs for Alternative 1 is shown in Figure 4-1. Signs and existing natural barriers are effective for restricting human access to the site because they 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. Existing barriers, which provide additional land use restrictions, would also be maintained. Shallow groundwater is not used as a source of drinking water at the site, and given the availability of the underlying Floridan Aquifer, it is unlikely that the shallow groundwater would ever be used for drinking water. Institutional controls prohibiting the use of groundwater would, therefore, be effective in protecting human health.

This is the less expensive of the two alternatives, with a life-cycle cost of approximately $44,843.

Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Partial Wood Fence Barrier, Maintenance of Existing Physical Barriers, Post-mounted and 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). Also, the eight existing wells would be abandoned, existing physical barriers would be maintained, and an O&M Plan would be implemented. This alternative would additionally provide approximately 3,514 linear feet of pretreated, split-rail wood fence. The fence would provide a physical deterrent to public access around a portion of the landfill at which there is a greater likelihood of site access by the public from Georgia State Route 119/144. The fence would run along the Georgia State Route 144 boundary to the Wilson Avenue access gate on the north and from the Wilson Avenue access gate on the south along the Wilson Avenue boundary, rounding westward to a position near monitoring well SC-M18. Fence-mounted warning signs would be positioned every 200 feet. Also, post-mounted warning signs would be installed every 200 feet around the remainder of the unfenced boundary of the old, inactive landfill. Four additional post-mounted signs would be installed at both the eastern and western entrances to the site. The placement of signage and fencing for Alternative 2 is shown in Figure 4-2. The effectiveness of Alternative 2 would be similar to that of Alternative 1, with somewhat greater protection against inadvertent intruders as a result of the fencing. The effectiveness of the fencing would be limited because it would not extend completely around the site and would not prevent access by those who disregard warnings. The effectiveness of Alternative 2 at protecting groundwater would be equal to that of Alternative 1. The O&M Plan would also include maintenance and repair of the treated wood fence and signs.

This alternative is more expensive than Alternative 1, with a life-cycle cost of approximately $126,679 or nearly three times Alternative 1's life-cycle cost.

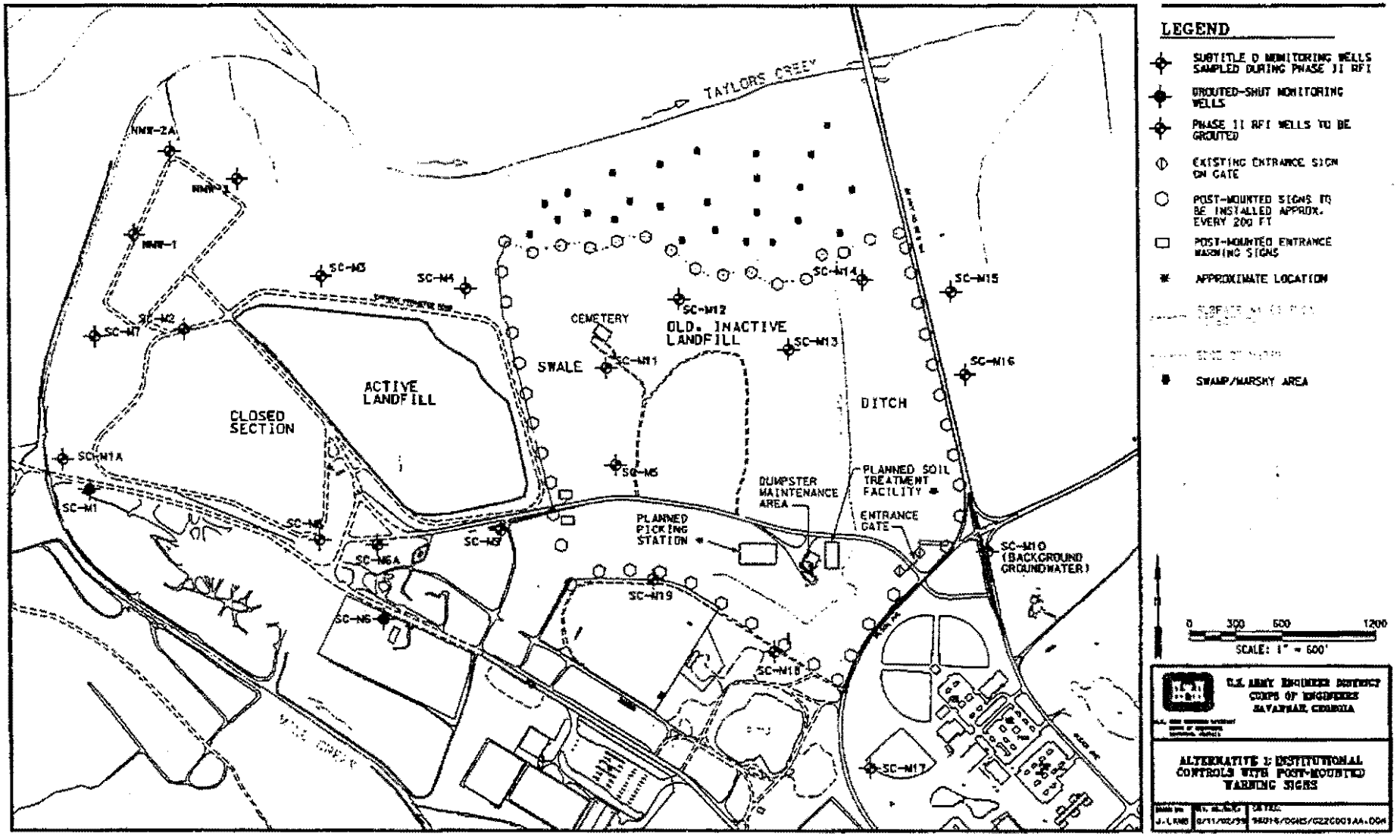

Figure 4-1. Alternative 1: Institutional Controls with Post-mounted Warning Signs

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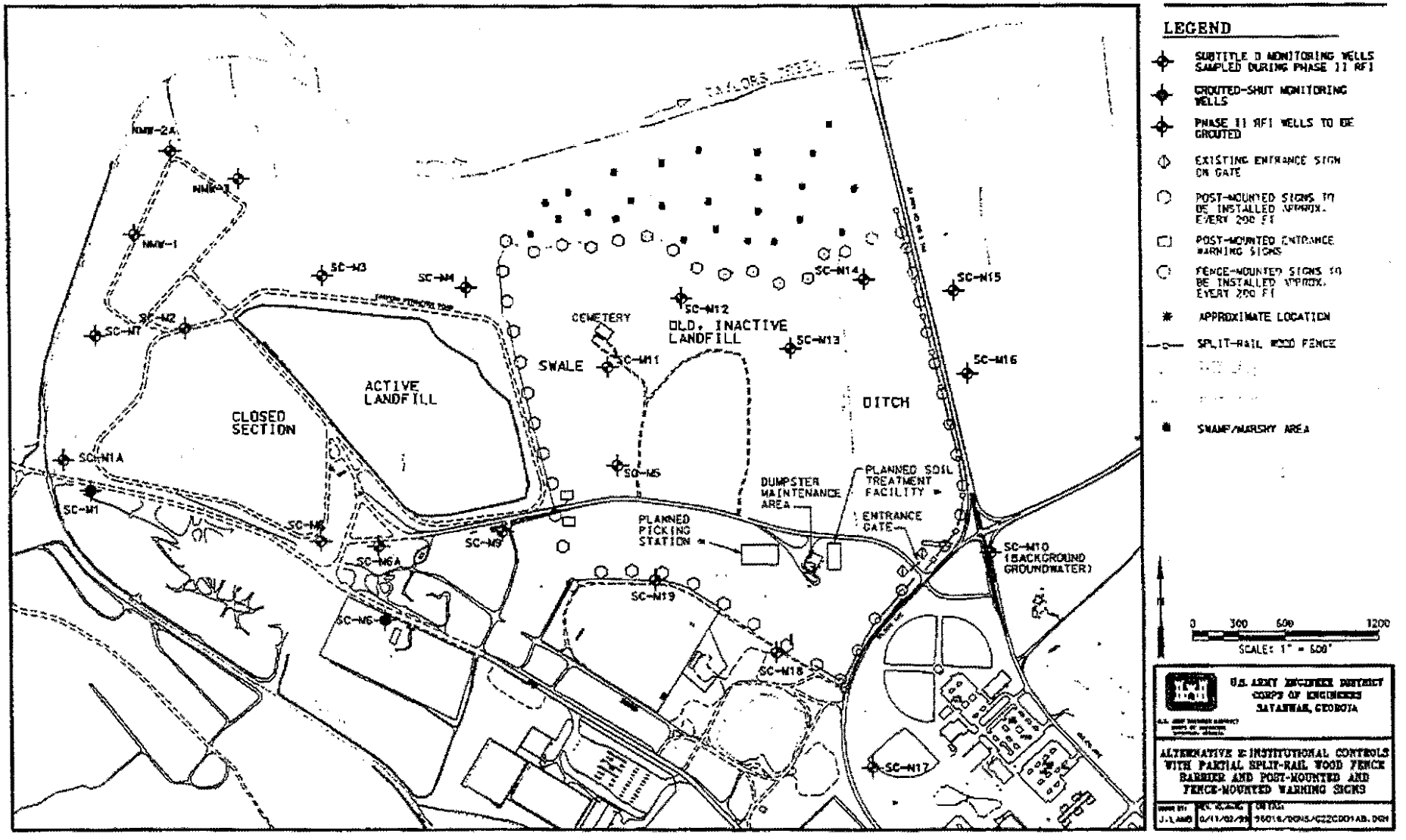

Figure 4-2. Alternative 2: Institutional Controls with Partial Split-rail Wood Fence Barrier and Post-mounted and Fence-mounted Warning Signs

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5.0 CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN

This section presents a conceptual design and plan for implementation of the selected corrective action alternative. Based on the level and type of subsurface soil and groundwater contamination, a cost-effective corrective action was selected that would adequately protect human health. The technology evaluation presented in Chapter 4.0 compared two different corrective action alternatives based on their effectiveness for protecting human health and their life-cycle costs. Based on that evaluation, Alternative 1 was selected because it will provide a sufficient level of protection of human health at a relatively low cost.

5.1 SELECTED CORRECTIVE ACTION

The selected corrective action alternative 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, BMP, zoning restrictions, and signage. In addition to establishment of prohibitions for groundwater use, eight monitoring wells will be abandoned (see Figure 4-1). No additional access barriers will be constructed because existing man-made and natural physical barriers, which include site access gates, Taylors Creek, existing roads, and natural and man-made drainage features, are suitable for restricting human activity.

Justification of Selection

Alternative 1 has been selected because it will provide effective protection of human health at a relatively low cost. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered cost effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized excavation below ground would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Additionally, suitable physical barriers are already present at the subject site to discourage human activity that might result in disturbance of the subsurface (e.g., vehicular traffic, hunting). Institutional controls described for Alternative 1 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 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. Warning signs and documented land use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to physical contact with the buried waste within the boundaries of the old, inactive portion of SWMU 1. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land use controls during ownership by DoD. Prior to the planning of any construction activities at the FSMR, the BMP must be reviewed. In addition, all construction projects will be reviewed for approval by the Base Master Planner and the FSMR Directorate of Public Works during the planning stages. These land use controls will remain in effect after transfer of DoD ownership by restrictions imposed through deed recordation.

Existing natural and man-made barriers will provide long-term reliability and effectiveness in preventing unauthorized access. The existing access gates at landfill access points are closed and locked during nonoperational hours. Since the installation of the gate at Wilson Avenue, the FSMR has observed a

marked decrease in activity (i.e., vehicular traffic) at this site. Taylors Creek provides a natural barrier along the northern boundary of the site (see Figure 4-1).

Additionally, the proposed well abandonment and groundwater use restrictions will provide an effective method for preventing the use of groundwater as drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at the FSMR and is not used. The BMP will be modified to officially restrict use, further avoiding use of the surficial groundwater at the site.

An annual O&M program will be administered to replace or repair warning signs, which may deteriorate over time (see Appendix A). Implementation of the O&M Plan will ensure the effectiveness of this program. The annual O&M Plan will be administered in conjunction with the permitted/active Post South Central Landfill detection monitoring program. The O&M program for this CAP will involve inspection as well as potentially replacing or repairing warning signs.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of SWMU 1. Posting of warning signs together with existing access restrictions will be most effective over the short term. There is no current risk, and the site is 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 posting of signs. Suitable barriers already exist that restrict unauthorized access to the site. O&M inspections require few resources with respect to inspection personnel and materials for repair. The annual O&M Plan will be administered in conjunction with the permitted/active Post South Central Landfill detection monitoring program. 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; 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 warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $44,843. Alternative 2, which would provide the same land use controls as Alternative 1 but would also include installation of fencing, was significantly more expensive ($126,679) than the selected alternative.

5.2 CONCEPTUAL DESIGN

During the period of ownership by DoD, institutional controls will be recorded to ensure implementation in the BMP. 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 hazards associated with the old, inactive portion of SWMU 1, warning signs stating restrictions on human activity within SWMU 1 will be posted around the boundary of the SWMU (see Figure 4-1). The existing access gates on the eastern side of the subject site will be maintained to further restrict human activity. Other natural and man-made barriers (Taylors Creek, drainage features) already exist at the subject site.

All activities that would involve disturbance of the subsurface will be minimized in accordance with all land use control mechanisms. Activities that will be prohibited include military training exercises, hunting, recreational activities, and construction of residential facilities. However, the following activities, conducted in a manner that would minimize disturbance of the subsurface, will be permitted:

- resurfacing of the landfill access road;
- clearing/cleaning up any drainage ditches in the area of the old landfill;
- timber harvesting;
- performance of fish and wildlife studies;
- provision and maintenance of feed lots for deer;
- maintenance/rehabilitation of existing facilities and/or utilities;
- construction of facilities and/or utilities to support the operation and/or maintenance of the permitted landfills and/or recycling center [i.e., picking station, soil treatment facility, etc. (see Figure 2-4)]; and
- construction of other facilities and/or utilities to support the mission of FSMR, as required, designed to eliminate or minimize impact to the subsurface soils in this area.

Any construction of facilities and/or utilities will ensure that design practices eliminate or minimize the impact to subsurface soils. Construction of residential facilities will be expressly prohibited. No construction of nonresidential facilities will be permitted without the appropriate level of protection of health and safety. Soil sampling and analysis will be performed to determine the presence and extent of any contamination at the site of construction to facilitate a determination of the appropriate level of protection. Soil sampling analytical results may need to be provided to GEPD prior to construction, as determined by the Fort Stewart Directorate of Public Works. Appropriate waste disposal practices will be implemented, as required, for all hazardous and solid waste generated during construction. Prior to construction, surveys, studies, analyses, investigations, or plans will be prepared and reviewed, if required.

Establishment of Institutional Controls

Prior to posting of warning signs at the SWMU, 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 in Sections 4.2.2 and 5.2. Reference to documents relevant to the corrective actions performed at this SWMU 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 the old, inactive portion of the SWMU 1 source unit has been used to manage hazardous materials. 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 the U.S. Army Corps of Engineers 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 (notices, media use restrictions, self-certification) will be evaluated and implemented as necessary and appropriate.

A survey plat has been prepared (Appendix C) by a professional land surveyor certified in the state of Georgia. The plat will be included in the BMP. The survey plat indicates the location and dimensions of the old, inactive portion of the SWMU 1 source unit with respect to permanently surveyed benchmarks. The plat contains a prominently displayed note that states Fort Stewart's obligation to restrict disturbance of the old, inactive portion of the SWMU 1 source unit in accordance with this CAP.

Permanent warning signs will be posted at 200-foot intervals surrounding the perimeter of SWMU 1, as shown in Figure 4-1. These signs will be worded as follows:

FORMER LANDFILL
NO TRESPASSING
CONTACT DPW
REGARDING USE RESTRICTIONS
767-2010

Warning signs presently exist on the access gate at Wilson Avenue, and additional warning signs will be posted on each side of the access road at the western entrance to the site, as shown in Figure 4-1. These two signs will be posted 50 feet to 75 feet inside the gate and will be worded as follows:

YOU ARE ENTERING A FORMER LANDFILL 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 bolted to galvanized steel posts that are cemented in the ground. The positioning of each sign will provide maximum visibility from all positions outside the SWMU boundaries. All signs will be permanently labeled (for identification purposes) on the back with a numerical identification number as shown on Figure 4-1.

The warning signs will be inspected annually at the old, inactive portion of the Post South Central Landfill in accordance with the O&M Plan. Damaged signs and/or signposts will be repaired or replaced as needed. Repair or replacement of signs will occur within 1 month after inspection. Should damage be observed between inspections, repair or replacement will occur within 1 month following observation.

5.3 COST ESTIMATE

A detailed cost estimate is provided in Appendix D for implementation of institutional controls at the old, inactive portion of the Post South Central Landfill. The life-cycle cost estimate for the selected institutional controls alternative is $44,843, which includes $25,591 for capital costs and $19,252 for O&M.

Capital costs include materials and labor associated with mounting 24-inch by 24-inch aluminum signage bolted onto 8-foot galvanized steel posts. The quantity of signs was based on measured boundary lineage of the site (one sign per every 200 feet and four signs on each side of the entrance). The cost estimate provides for 2-foot-deep, power-augured postholes with the posts set in cement. Additional capital costs are also required for well abandonment, which includes the cost for mobilization/demobilization, labor and materials, and managerial oversight. Costs that would be associated with the deed recordation are also included.

O&M costs include the prices of annual inspections and sign and post repair/replacement every 5 years for 30 years. The costs for sign and post repair/replacement every 5 years was assumed to be equivalent to 25 percent of the amount of initial installation.

5.4 IMPLEMENTATION SCHEDULE

Implementation of the corrective action will begin once approval of this CAP is received from GEPD. The schedule, presented in Table 5-1, has been established for implementation of institutional controls at this site.

Table 5-1. Corrective Action Implementation Schedule

Task	Time from GEPD Approval of CAP (days)
Procure signs and materials	90
Record institutional controls in BMP and any other approved implementing document	120
Perform well abandonment	120
Post signs	120
Perform inspections[a] (Implement O&M Plan)	Annually
Repair/replace signage	As needed
Notify GEPD of property transfer	Prior to property transfer
Establish appropriate legal land use controls for property transfer (deed recordation, lease or purchase agreements, etc.)	Prior to property transfer

[a]The annual O&M program will be administered in conjunction with the permitted/active Post South Central Landfill detection monitoring program.

S: 27 NOV 99

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

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July 27, 1999

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Ovidio E. Perez, Colonel, U.S. Army
Director, Public Works
ATTN: AFZP-DEV (Melanie Little)
Department of the Army
Headquarters, 3D Infantry Division (Mechanized) and Fort Stewart
1557 Frank Cochran Drive
Fort Stewart, GA 31314-4928

RE: Phase II RCRA Facility Investigation (RFI) Report for the Post South Central Landfill [Solid Waste Management Unit (SWMU) 1] dated March 1999; Fort Stewart; EPA ID No. GA9 210 020 872.

Dear Colonel Perez:

The Hazardous Waste Management Branch of the Georgia Environmental Protection Division (GA EPD) is in receipt of Fort Stewart correspondence (Perez to Khaleghi) dated July 13, 1999 which contained Replacement Pages 9-10 and 9-11 (i.e., modified Tables 9-3 and 9-4) to be inserted into our four (4) copies of the above-referenced document. Based upon our review of the submittal, GA EPD has determined that:

1. Fort Stewart has sufficiently responded to our comment in correspondence (Khaleghi to Perez) dated June 22, 1999;

2. The Phase II RFI Report for SWMU 1 dated March 1999, as amended by Replacement Pages 9-10 and 9-11 (i.e., modified Tables 9-3 and 9-4), is complete; and

3. Corrective action is required at SWMU 1 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 Hazardous Waste Facility Permit #HW-045(S&T), Fort Stewart must submit a Corrective Action Plan for SWMU 1 to GA EPD within one hundred and twenty (120) days from receipt of this correspondence. Should you have any questions concerning this letter, please contact Brent Rabon or Madeleine Kellam 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)
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FORSCOM

3d Inf Div (Mech)

PHASE II
RCRA FACILITY INVESTIGATION REPORT
for the
SOUTH CENTRAL LANDFILL (SWMU 1)
at
Fort Stewart, Georgia

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract No. DACA21-95-D-0022
Delivery Order 0012

March 1999

98-054P(PPT)/032599

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10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 SUMMARY OF FINDINGS

The RFI presented in this report was conducted to collect additional analytical data for determining the nature and extent of contamination in environmental media and their potential adverse effects to human health and the environment in the vicinity of the South Central Landfill. The data were derived from a series of screening and primary samples collected from surface and subsurface soil, sediment, surface water, and groundwater in the study area. The samples collected were analyzed for a number of COPCs, including VOCs, SVOCs, pesticides/PCBs, RCRA metals, and Radium 226/228.

The following section summarizes the significant findings of the Phase II RFI sampling and analysis.

Soil. Low levels of organic constituents (VOCs, SVOCs, and pesticides) and metals are present in soil; however no clear distribution or trends of constituents are evident.

- Isolated, low concentrations of acetone, methylene chloride, toluene, 1,2,4-trichlorobenzene were detected in surface soil above reference background criteria.

- 4,4'-DDD; 4,4'-DDE; and 4,4'-DDT were detected in two surface soil samples, SC-M13 and SC-M18.

- Selenium was detected in surface soil above FSMR reference background in a single soil sample. Selenium concentrations in surface soil were not above FSMR reference background concentrations for subsurface soil.

- Isolated, low concentrations of 1,2,4-trichlorobenzene, pyrene, heptachlor, 2-butanone, acetone, methylene chloride, styrene, and toluene were detected in subsurface soil above reference background criteria.

Groundwater. The groundwater flow at the site is essentially directed to the north toward Mill and Taylors creeks, with a slight groundwater divide near the southern part of SWMU 1 at the old, inactive landfill. Flow at the southern boundary may be directed to the southwest toward Mill Creek. Low levels of VOCs, SVOCs, metals, and Radium 226/228 are present in the surficial aquifer; however, no clear distribution or trends of contaminants are evident.

- Trichloroethene was detected in a single groundwater sample (direct-push location GP-7) above its MCL. Bis(2-ethylhexyl)phthalate was detected in groundwater above its MCL at two locations (NMW-2A and SC-M9) at concentrations of 7.8 µg/L and 61.4 µg/L, respectively.

- Metals were detected in groundwater, with only one sample detected above MCLs. Lead was detected at 18.4 µg/L at monitoring well SC-M17 (MCL 15 µg/L). However, the filtered lead concentration at SC-M17 was nondetect, indicating the lead may be associated with colloid particulates in the groundwater. Barium, cadmium, chromium, iron, and lead

were detected above FSMR reference background concentrations. Iron concentrations were consistent with iron data collected under compliance monitoring.

- Low levels of Radium 226/228 were detected in the groundwater. Radium 226/228 were detected above the MCL in two groundwater samples at SC-M5 and SC-M19.

- The groundwater field sampling data do not indicate that leachate is impacting the groundwater.

Surface Water and Sediment. Low levels of organics, metals, and Radium 228 were detected in sediment and surface water.

- No metals were detected in surface water above the site-specific background criteria.

- Diethyl phthalate and pyrene were detected in surface water one of three samples above site-specific background criteria.

- Radium 228 was detected in three of three surface water samples above the site-specific background criterion.

- Chromium, lead, mercury, and Radium 228 were detected in sediment above site-specific background criteria.

- Two VOCs (acetone and 2-butanone) and one SVOC (1,2,4-trichlorobenzene) were detected in sediment samples above site-specific background criteria (nondetect), respectively.

10.2 CONCLUSIONS

Several assessments were conducted to determine the significance of the contaminant concentrations found at the South Central Landfill with respect to their impact on human health and the environment. The assessments included:

- A contaminant fate and transport analysis (Chapter 6.0), which provided an assessment of the potential migration pathways and transport mechanisms affecting the chemical compounds found at the site.

- An HHPRE (Chapter 7.0), which employed a Step 1 risk screening to develop human health COPCs that were evaluated during the baseline risk assessment.

- An EPRE (Chapter 8.0) for terrestrial and aquatic receptors in the study area.

The following summarizes the conclusions regarding contaminant fate and transport:

- Selenium exceeded its reference background criteria in surface soil; however, it did not exceed its GSSL based on leaching to groundwater. Therefore, selenium is not considered a contaminant migration COPC.

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- In the groundwater, none of the metals, except lead, exceeded its MCL; however, this elevated value may be due to colloid particulates in the groundwater. Radium 228 also exceeded its MCL. Off-site migration of lead and Radium 228 will be limited because of their high retardation factors.

- Organics in the site soil that exceeded EPA GSSLs and are, therefore, of concern for leaching from soil to groundwater, include acetone and methylene chloride. The concentration of acetone in surface soil is particularly high (44,100 μg/kg), which is above its GSSL of 800 μg/kg. The 44,100 μg/kg was the only detection (out of six) of acetone that exceeds its GSSL. All of the detected methylene chloride concentrations (5 of 11 surface and 1 of 9 subsurface soil samples) exceeded its GSSL. Solubility of acetone is very high, and retardation in groundwater is low and has the potential to migrate off-site. Concentration of acetone in groundwater is above its RBC. Methylene chloride was not detected in groundwater. Two of the soil sampling locations (SC-MW15 and SC-MW16) were located outside the area impacted by landfill operations. Therefore, soil concentrations of acetone and methylene chloride at these locations were outside the influence of potential contaminants from SWMU 1. Methylene chloride was the only contaminant migration COPC in soil around the old, inactive portion of the landfill.

- Bis(2-ethylhexyl)phthalate and trichloroethene exceeded their respective MCLs in one of 51 groundwater samples, but were not screened as contaminant migration COPCs in soils because they were not detected in surface or subsurface soils. Maximum groundwater concentrations of bis(2-ethylhexyl)phthalate and trichloroethene were detected at 61.4 μg/L (MCL 6 μg/L) and 5.4 μg/L (MCL 5 μg/L), respectively. These two concentrations above MCLs represent only a single detection out of 51 groundwater samples (23 direct-push, 2 vertical profiles, and 22 groundwater monitoring wells). Bis(2-ethylhexyl)phthalate and trichloroethene were detected in the groundwater only and not in soil, indicating that these contaminants may have leached in the past or are potentially leaching directly from a very confined or small point source. Off-site migration of these organic contaminants will be limited due to retardation and degradation through various processes as well as the slow movement of groundwater (12.8 feet/year). At the velocity of 12.8 feet/year, it is expected to take 94 years for the site groundwater at the northern boundary of the old, inactive landfill, near SC-M12 to reach Taylors Creek (approximately 1,200 feet). In reality, contaminants will move slower than groundwater due to retardation, and the organic contaminants will gradually decay in nature.

- The contaminant fate and transport analysis concluded that methylene chloride may present a risk to human health as a result of leaching into groundwater. Therefore, a baseline risk assessment was performed to quantify the potential risk associated with this constituent and to determine if it presents a potential risk to human health.

The following summarizes the conclusions of the HHPRE.

- Based on the results of the screening and the weight-of-evidence analysis, potential human health COPCs have been identified for surface soil and groundwater. There are no human health COPCs for subsurface soil, surface water, or sediment.

- The initial human health COPCs for groundwater were identified because they present a potential threat to human health as a result of using groundwater as a source of drinking

water. The initial human health COPCs for groundwater are iron; lead; chromium; Radium 226; Radium 228; acetone; benzene; bis(2-ethylhexyl)phthalate; 1,2-*cis*-dichloroethene; and trichloroethene. Iron, Radium 226, and Radium 228 are not hazardous constituents as defined by Section I.E of FSMR's Hazardous Waste Facility Permit #HW-045(S&T) and are not subject to the corrective action requirements under the terms and conditions of the permit or under the Georgia Hazardous Waste Management Act, O.C.G.A §12-8-60, et seq., as amended, and the Rules for Hazardous Waste Management, Chapter 391-3-11, promulgated pursuant thereto, as amended. Therefore, iron, Radium 226, and Radium 228 are eliminated as human health COPCs in groundwater at SWMU 1.

- The HHPRE identified human health COPCs for groundwater. Therefore, a baseline risk assessment was performed to quantify the potential risk associated with these constituents and to determine if they present a potential risk to human health.

The following summarizes the conclusions of the EPRE.

- Selenium and the pesticide DDT and its metabolites were detected in surface soil at the South Central Landfill at concentrations that exceeded both reference background criteria and that resulted in exposures that exceed the TRVs for terrestrial receptors. Selenium was detected in only one of nine surface soil samples at SWMU 1 at only slightly above its reference background concentration (0.69 mg/kg versus 0.41 mg/kg, respectively). Selenium was not detected in the other eight surface soil samples. Therefore, selenium is not considered an ecological COPC in surface soil at SWMU 1. DDT and its metabolites in surface soil at SWMU 1 are ecological COPCs for birds with small home ranges ingesting soil-dwelling invertebrates. DDT and its metabolites are likely to be present in surface soil in most areas of Georgia and the southeast due to past widespread use as an insecticide. Assuming the effects of DDT, DDE, and DDD are additive, the combined exposure at each of the two sampling locations do not exceed the LOAEL dose. The fact that maximum estimated doses lie between the NOAEL and LOAEL suggests that the pesticides and its metabolites are not ecological COPCs in surface soil at SWMU 1.

- Barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes (total) are present in groundwater at the South Central Landfill at concentrations that exceed EPA Region IV ESVs for surface water. Bis(2-ethylhexyl)phthalate was detected in groundwater at concentrations above background criteria and that result in estimated exposures exceeding TRVs for terrestrial ecological receptors that ingest fish and other aquatic biota. The ecological COPCs in groundwater are barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes for aquatic biota and bis(2-ethylhexyl)phthalate for birds ingesting fish exposed to groundwater emerging as surface water. The concentration of these constituents in numerous monitoring wells and direct-push groundwater samples exceed background criteria and risk-based screening or reference values. However, none of these constituents is an ecological COPC in surface water and sediment at SWMU 1. This suggests that dilution, degradation, adsorption, or other processes are operating to reduce the low concentrations in groundwater discharging to Taylors and Mill creeks or that groundwater at SWMU 1 has not yet migrated to the creeks. Groundwater flow rates indicate that it takes approximately 94 years for groundwater to reach Mill and Taylors creeks. Therefore, groundwater constituents are not ecological COPCs at the present time because they have not been indicated as ecological COPCs in surface water and sediment. The groundwater constituents are not likely to be ecological COPCs in the future because of their low concentrations and

associated small hazard quotients and the continued natural attenuation processes occurring in the subsurface soil (i.e., dilution, degradation, absorption, etc.).

The following summarizes the conclusions of the BHHRA.

- The human health COPCs identified in groundwater include acetone, benzene, bis(2-ethylhexyl)phthalate, 1,2-*cis*-dichloroethene, trichloroethene, chromium, and lead. Methylene chloride was identified as a contaminant migration COPC based on its potential to leach into groundwater, resulting in potential exposure of receptors.

- Constituents in groundwater do not present a significant risk to off-site receptors because the groundwater concentrations of the COPCs at the point of exposure are negligible.

- Constituents present in groundwater at SWMU 1 do not present a significant noncarcinogenic risk to human health. The quantitative estimates of noncarcinogenic risks were below their target values for both on-site occupational and residential receptor populations. The carcinogenic risks for the occupational receptor population was below the target risk value of 1E-6; however, the carcinogenic risk for the on-site residential receptor exceeded the target value with an ILCR of 8.9E-6. This value includes an ILCR of 3.4E-6 resulting from exposure to methylene chloride that may leach into groundwater. The other risk drivers are benzene (ILCR = 2.5E-6) and bis(2-ethylhexyl)phthalate (ILCR = 2.1E-6).

- The remedial levels for benzene and bis(2-ethylhexyl)phthalate were based on the MCLs (5 µg/L and 6 µg/L, respectively) for these constituents. The MCL for benzene (5 µg/L) was greater than the maximum detected value of 2.5 µg/L. Therefore, corrective action is not required to address the presence of benzene in groundwater. Bis(2-ethylhexyl)phthalate exceeded its remedial level (MCL) at two locations (SC-M9 and NMW-2A) located around the active portion of the landfill. The remedial soil level for methylene chloride was determined to be 3.3 mg/kg and to represent a concentration of the constituent in soil that is not likely to leach into groundwater resulting in groundwater concentrations that exceed the MCL for methylene chloride (5 µg/L).

10.3 RISK MANAGEMENT AND SITE RECOMMENDATIONS

The results of the RFI and the conclusions reached through analysis of data and conduct of the assessments referenced above indicate that the following future additional actions are warranted at the South Central Landfill site. Recommendations for further action are as follows:

- An ERA is not warranted because the EPRE at the South Central Landfill indicated there is no present ecological risk and the site is unlikely to pose an ecological risk in the future.

- The results of the BHHRA on groundwater indicate that bis(2-ethylhexyl)phthalate exceeds its remedial level (MCL) in two groundwater monitoring wells (NMW-2A and SC-M9) around the active portion of the landfill. In addition, methylene chloride present in soils at three locations around the old, inactive landfill (SC-M11, SC-M12, and SC-M14) may leach into groundwater, resulting in groundwater concentrations that exceed the MCL.

- Results of the SESOIL modeling have shown that three of the detected concentrations of methylene chloride in soils from the old, inactive landfill (SC-M11, SC-M12, and SC-M14), exceeded the soil remedial levels for protection of groundwater. Therefore, the methylene chloride at these locations may leach into groundwater at concentrations that present a carcinogenic risk above the target risk (>10E-6) to an on-site resident using the surficial groundwater as a source of drinking water. However, the potential of this type of exposure taking place is very small. The exposure scenario assumes that in the future a residence will be built on-site and that the household drinking water supply comes directly from the surficial aquifer. Current planning, which goes through the year 2020, does not include the construction of any facilities on the inactive portion of the landfill. Given that methylene chloride degrades rapidly in groundwater (half-life in groundwater equals 112 days), the methylene chloride leaching into groundwater would completely degrade before any structure would be built on the site. It should be noted that methylene chloride was not detected in any of the groundwater samples associated with the old, inactive landfill, including those located in the area of the methylene chloride soil contamination (SC-MW11, SC-M12, or SC-W14). Therefore, potential exposure of a residential receptor to methylene chloride is not a likely scenario. Given the unlikely possibility of exposure of an on-site resident to methylene chloride in the surficial groundwater, Fort Stewart respectively requests that the old, inactive portion of SWMU 1 be assigned a "No Further Action Required" status for investigative purposes.

- At the active portion of SWMU 1, which is operated under Permit No. 089-010D (SL) and 089-020D (L), the few constituents detected above MCLs [i.e., bis(2-ethylhexyl)phthalate at SC-M9 and NMW-2A] will continue to be monitored through the GMP, approved by the GEPD Land Protection Division, and corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells is not required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify if any contaminant levels become elevated and/or any trends develop in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. Thus, it is recommended that the active portion of SWMU 1 continue to be monitored in association with the approved GMP. All analytical data will continue to be submitted to the GEPD Land Protection Division.

- Based on the information in this report, Fort Stewart recommends that a CAP proposing institutional controls (deed restrictions, land use restrictions, etc.) be prepared for the old, inactive portion of the landfill. FSMR recommends that the monitoring wells (SC-M11 through SC-M19) around the old, inactive portion of the landfill be abandoned by grouting the wells to the surface and removing the surface completion. The monitoring wells around the old, inactive portion of the landfill will be abandoned upon approval of the CAP by GEPD. It is anticipated that the CAP will be submitted to GEPD in the first fiscal quarter (October through December) 2000.

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DEPARTMENT OF THE ARMY
HEADQUARTERS, 3D INFANTRY DIVISION (MECHANIZED) AND FORT STEWART
DIRECTORATE OF PUBLIC WORKS
1557 FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-4928

March 31, 1999

REPLY TO
ATTENTION OF

Directorate of Public Works

CERTIFIED MAIL

Georgia Department of Natural Resources
Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30334

Dear Mr. Khaleghi:

Fort Stewart is pleased to receive the Georgia Environmental Protection Division's (GA EPD) correspondence dated January 14, 1999, in reference to the Final Phase II RCRA Facility Investigation (RFI) Report for the Post South Central Landfill [Solid Waste Management Unit (SWMU 1)], dated September 1998; Fort Stewart; EPA ID No. GA9 210 020 872.

In response to the comments received from GA EPD, Fort Stewart has enclosed four copies of the Revised Final RCRA Facility Investigation (RFI) Report for the Post South Central Landfill [Solid Waste Management Unit (SWMU 1)], dated March 1999. Fort Stewart agrees to comply with your comments listed in the referenced correspondence. A formal response to comments table is provided as an enclosure, located within the front pocket of each Revised Final Phase II RFI Report.

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.

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Please contact Ms. Melanie Little or Ms. Tressa Rutland, Directorate of Public Works Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively, should questions arise regarding the response to comments and/or the Revised Final Phase II RFI Report.

Sincerely,

for Thomas C. Fry 03/31/99
Ovidio E. Perez
Colonel, U.S. Army
Director, Public Works

Enclosures

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

January 14, 1999

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Ovidio E. Perez, Colonel, U.S. Army
Director, Public Works
ATTN: AFZP-DEV (Melanie Little)
Department of the Army
Headquarters, 3D Infantry Division (Mechanized) and Fort Stewart
1557 Frank Cochran Drive
Fort Stewart, GA 31314-4928

RE: Phase II RCRA Facility Investigation (RFI) Report for the Post South Central Landfill [Solid Waste Management Unit (SWMU) 1] dated September 1998; Fort Stewart; EPA ID No. GA9 210 020 872.

Dear Colonel Perez:

The Hazardous Waste Management Branch of the Georgia Environmental Protection Division has reviewed the above-referenced document and generated the following comments.

General Comments

1. GA EPD concurs with the Fort Stewart recommendations in the Executive Summary (page xv) and Section 9.3 (page 9-5) to continue monitoring the active portion of the Post South Central Landfill (SWMU 1) in accordance with the Groundwater Monitoring Plan approved by the Land Protection Branch of the Georgia Environmental Protection Division. The active landfill is operated pursuant to the requirements of Permit No. 089-010D(SL) & 089-020D(L) and the Georgia Comprehensive Solid Waste Management Act, O.C.G.A. §12-8-20, et seq, as amended; and the Rules for Solid Waste Management, Chapter 391-3-4, promulgated pursuant thereto, as amended.

   In addition, the Hazardous Waste Management Branch of the Georgia Environmental Protection Division (GA EPD) tentatively agrees with implicit Fort Stewart recommendation that No Further Action is required for the active portion of the Post South Central Landfill (SWMU 1) as identified in Figure 2.4 of the above-referenced report; however, a final decision by GA EPD will be made pending the outcome of a public comment period which will occur when the Corrective Action Module of your Hazardous Waste Facility Permit #HW-045(S&T) is modified.

2. With respect to the old inactive portion of the Post South Central Landfill (SWMU 1), GA EPD will review the results of the Human Health Baseline Risk Assessment to be submitted in the revised SWMU 1 RFI Report (See Specific Comment No. 14 below) in order to determine if groundwater monitoring is warranted as part of a Corrective Action Plan (CAP). Our current position is that Fort Stewart will be required to submit a SWMU 1 CAP which minimally proposes institutional controls [e.g., signage and deed restrictions (both civil and military; See Comment No. 3 below)]. Please modify, in a manner consistent with this Comment, the recommendations regarding the old, inactive portion of SWMU 1 which are contained in the Executive Summary (page xv) and Section 9.3 (page 9-5).

3. For your information and in anticipation of creating a CAP for SWMU 1, please note that GA EPD regards military deed restrictions to include incorporation of land use restrictions for the old, inaction portion of the SWMU 1 source unit into the Fort Stewart Base Management Plan and civil deed restrictions to include the following.

   a. Fort Stewart must submit to the local zoning authority, or the authority with jurisdiction over local land use, a survey plat indicating the location and dimensions of the old, inactive portion of the SWMU 1 source unit with respect to permanently surveyed benchmarks. This plat must be prepared by a professional land surveyor certified in the State of Georgia. The plat, filed with the local zoning authority or the authority with jurisdiction over local land use, must contain a note, prominently displayed, which states Fort Stewart's obligation to restrict disturbance of the old, inactive portion of the SWMU 1 source unit in accordance with a Corrective Action Plan approved by GA EPD.

   b. Fort Stewart must record, in accordance with Georgia State law, a notation on the deed to the facility property--or on some other instrument which is normally examined during title search--that will in perpetuity notify any potential purchaser of the property that the land (i.e., the old, inactive portion of the SWMU 1 source unit) has been used to manage hazardous constituents.

   In addition and in the first SWMU 1 CAP Progress Report submitted to GA EPD, Fort Stewart will be required to provide documentation that the requirements above have been completed, including a copies of the documents in which the notations have been placed and a copy of the survey plat.

Specific Comments

Section 5.0 - Contaminant Nature and Extent

4. The Georgia Safe Drinking Water Act Maximum Concentration Limit (MCL) for benzene

is 5 µg/L; please modify the value provided in Table 5.5 (pages 5-17 through 5-19).

5. Table 5-6 (page 5-20) shows a box (indicating a concentration above the MCL) around 1,1-Dichloroethane (1,1-DCA) concentration detected in groundwater sample from monitoring well SC-M7. 1,1-DCA has no MCL. The table should be revised to delete the box.

6. The correct MCLs for 1,2-Dichloropropane and 1,2-cis-Dichloroethene are 5 and 70 µg/L, respectively. Please modify Table 5-6 on pages 5-20 and 5-21 appropriately.

7. In the first bullet of the *VOCs* subsection on page 5-33, the sentence should be revised to delete the reference to monitoring well SC-M14.

8. In the second bullet of the *SVOCs* subsection on page 5-33, the third sentence should be revised to state that two groundwater samples contained levels of bis(2-ethylhexyl)phthalate above its MCL of 6 µg/L: NMW-2A and SC-M9 contained 7.8 µg/L and 61.4 µg/L of the hazardous constituent, respectively.

9. In the first bullet of the *RCRA Metals* subsection on page 5-34, the first sentence should be revised to reflect that the barium concentration of 134 µg/L was found in groundwater from monitoring well SC-M11, rather than SC-M1.

10. In the seventh bullet of the *RCRA Metals* subsection on page 5-34, the sentence should be revised to state that the mercury concentration of 0.04 µg/L was found in groundwater from monitoring well SC-M12, rather than SC-M14.

11. In the *Radium 226/228* subsection on page 5-34, the units should be modified to read pCi/L instead of pCi/g and the monitoring well designation "NWM-2A" should be corrected to read "NMW-2A." In addition, the MCL for the <u>sum</u> of Radium 226 and 228 is 5 pCi/L (i.e., the constituents do not have individual MCLs). Therefore, please (1) add a sentence to this subsection which states that monitoring well SC-M19, with a combined Radium 226/228 concentration of 5.78, exceeds it respective MCL and (2) modify the MCLs provided in Table 5-6 (pages 5-22 and 5-23) appropriately.

<u>Section 6.0 - Contaminant Fate and Transport</u>

12. The *Release Mechanisms* subsection on page 6-7 states that "Buried materials in the landfill have decomposed and leachate from these materials has contaminated both groundwater and subsurface soil at low levels typically below MCLs and, in most instances, below reference background criteria." Please note (1) that MCLs are not directly comparable to detections of hazardous constituents in subsurface soils and (2) that hazardous constituents detected in environmental media equal to or less than background concentrations should not be classified

as "contaminated." Modify the referenced sentence in a manner which is consistent with the preceding sentence.

13. The second paragraph of the *Release Mechanisms* subsection on page 6-7 contains the following incomplete sentence: "Whether it is the contaminant's K_d or controlled." Fort Stewart should complete the sentence in the revised SWMU 1 RFI Report.

Section 7.0 - Human Health Preliminary Risk Evaluation

14. Because Chemicals of Potential Concern (COPCs) were identified in surface soil and groundwater in Section 7.0, Fort Stewart must complete a Human Health Baseline Risk Assessment in the revised SWMU 1 RFI Report. Please modify the Executive Summary and Sections 7.0 & 9.0 appropriately.

15. Future on and off-site residential scenarios must be evaluated in the baseline risk assessment requested by GA EPD in Comment No. 14 above. The future residential scenario should give readers of the revised SWMU 1 RFI Report perspective on the possible risks involved with residents contacting contaminants in all environmental medias (e.g., groundwater, soils, sediments and surface water). Please specifically note that the proposal, in Section 7.2.3 on pages 7-4 & 7-5, to neglect human receptor exposure to groundwater is inconsistent with the policy in Georgia that states that all groundwater is considered a potential drinking water source[1]. Therefore, the future resident (both adult and child receptor) and base worker ingestion of groundwater should be included in the revised risk assessment.

16. The oral reference dose (RfDo) for chromium VI has changed from 5.0 E-03 mg/kg-day to 3.0 E-03 mg/kg-day; therefore, the Risk-Based Concentration (RBC) value for chromium VI in tap water has changed from 18 µg/L to 10.9 µg/L. Please modify Table 7.4 and Sections 4.4.3, 4.5 & 9.0 appropriately.

17. Information on the toxicity of the Constituents of Concern (COCs) needs to be gathered and summarized in a Toxicity Profiles subsection within Section 7.0 (or in a referenced Appendix). Information such as the weight of evidence for carcinogens, toxicity endpoints, how the numerical toxicity factors were developed, and a list of literature references (e.g., IRIS, HEAST, etc.) should be included in the profile for each chemical.

Section 8.0 - Ecological Preliminary Risk Evaluation

18. GA EPD (1) has determined that the Ecological Preliminary Risk Evaluation (EPRE) presented in Section 8.0 is sufficient and (2) concurs with the Conclusions and Recommendations in

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[1] 1996. Georgia Environmental Protection Division Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units.

Section 9.0 regarding the EPRE.

Section 9.0 - Conclusions and Recommendations

19. Fort Stewart has properly integrated detections of iron, Radium 226 and Radium 288 into the risk assessments for SWMU 1; however, this metal and two radionuclides are not hazardous constituents as defined by Section I.E of your Hazardous Waste Facility Permit #HW-045(S&T) (Permit) and are not subject to the corrective action requirements under the terms and conditions of your Permit or under the Georgia Hazardous Waste Management Act, O.C.G.A. §12-8-60, et seq, as amended, and the Rules for Hazardous Waste Management, Chapter 391-3-11, promulgated pursuant thereto, as amended.

    Utilizing the justification provided in the paragraph above, please add text to Section 9.2 (Conclusions) which states that corrective action is not required for the detections of iron, Radium 226 and 228 in groundwater at the old, inactive portion of SWMU 1.

The revision for the SWMU 1 RFI Report, appropriately addressing the comments above, must be submitted within forty-five (45) days of receipt of this correspondence in the form of revised/new pages or a totally revised work plan. Note that four (4) copies of the revised SWMU 1 RFI Report are required to be submitted to GA EPD. Should Fort Stewart decide to submit revised or new pages, please number with appropriate page numbers and the date revised, e.g., Page 6 (Revised 01/26/99). Should you have any questions concerning this correspondence, please contact Brent Rabon or Madeleine Kellam 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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DEPARTMENT OF THE ARMY
HEADQUAR[illegible] 3D INFANTRY DIVISION (MECHANIZED) AND F[illegible] TEWART
Directorate of Public Works
1557 Frank Cochran Drive
Fort Stewart, Georgia 31314-4928

SEP 14 1998

REPLY TO
ATTENTION OF

Director, Public Works

CERTIFIED MAIL
Z-098-024-176

Georgia Environmental Protection Division
Attention: Mr. Bruce Khaleghi
205 Butler Street, Southeast
Suite 1154
Atlanta, Georgia 30334

Dear Mr. Khaleghi:

Fort Stewart is pleased to submit four copies of the Final Resource Conservation and Recovery Act Facility Investigation (RFI) Report for the South Central Landfill (Solid Waste Management Unit (SWMU) 1) located at Fort Stewart, Georgia.

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, Directorate of Public Works Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively, should questions arise regarding the enclosed report.

Sincerely,

Dale F. Kiefer
for Ovidio E. Perez
Colonel, U.S., Army
Director, Public Works

Enclosures