FINAL

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CORRECTIVE ACTION PLAN

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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

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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

Prepared by:
Science Applications International Corporation
800 Oak Ridge Turnpike
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.

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

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POST SOUTH CENTRAL LANDFILL (SOLID WASTE MANAGEMENT UNIT 1)

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Fort Stewart Military Reservation Fort Stewart, Georgia

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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
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

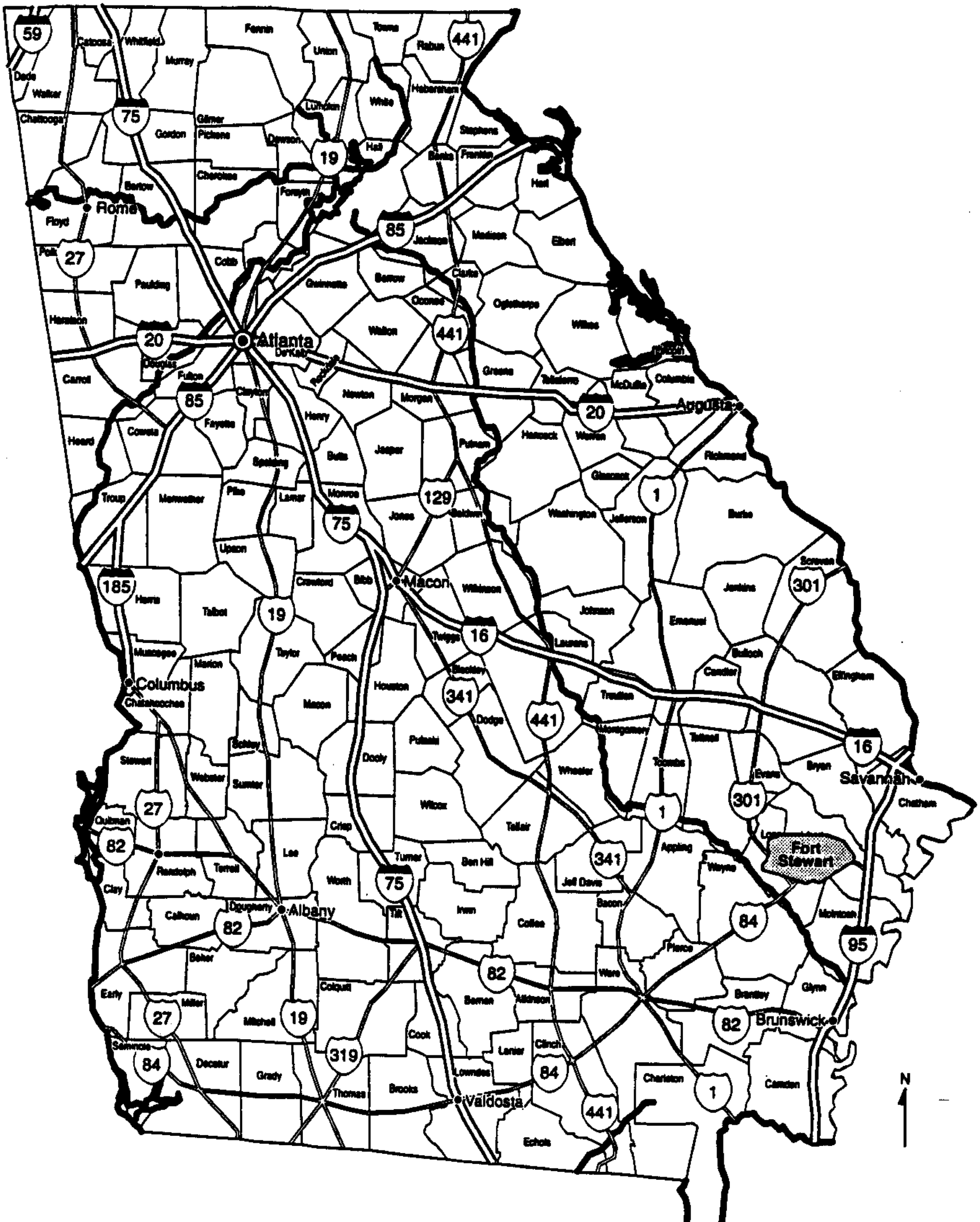

Figure 2-1. Regional Location Map for Fort Stewart Military Reservation, Georgia

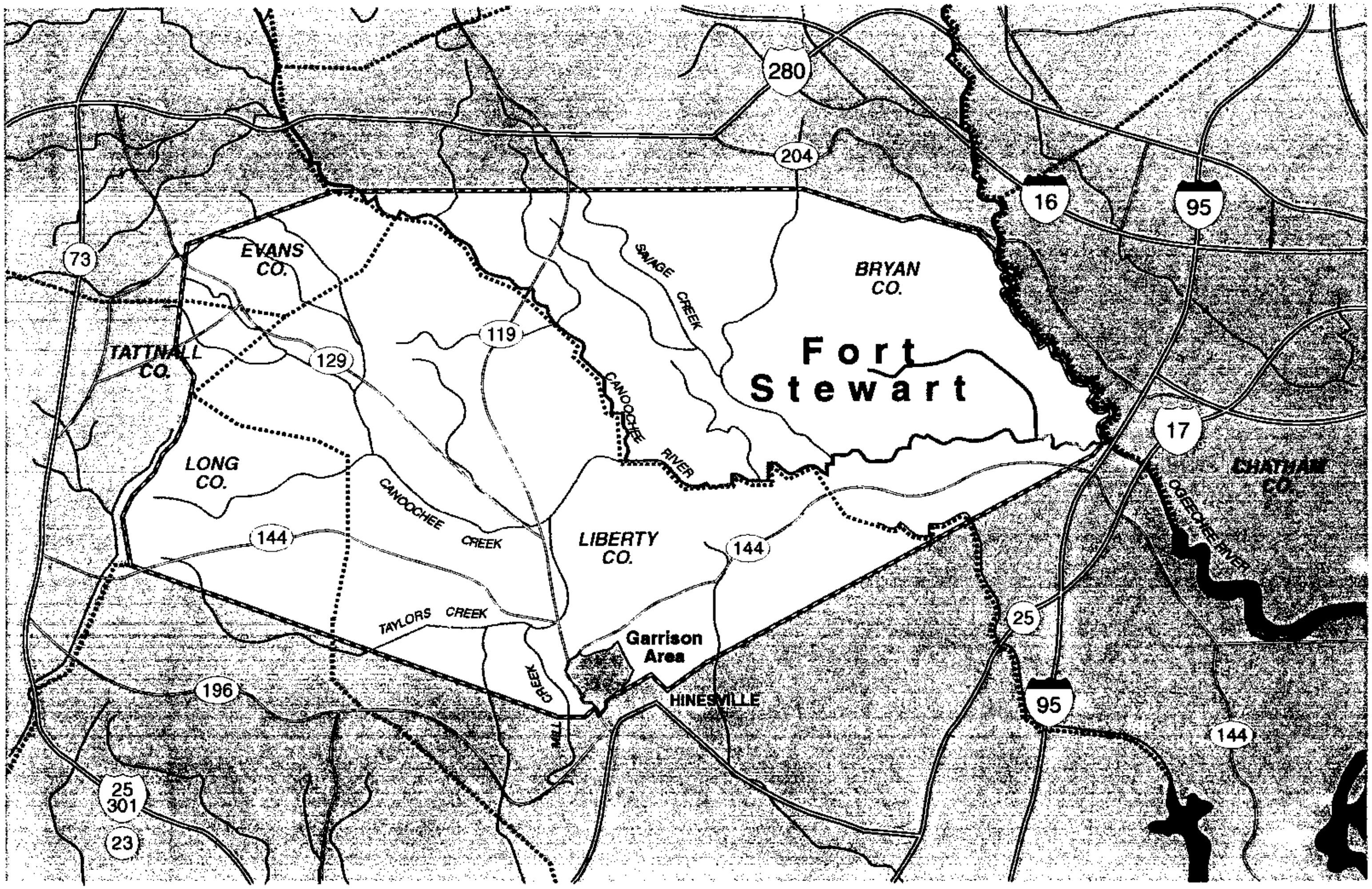

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Figure 2-2. Location Map for Fort Stewart Military Reservation, Georgia

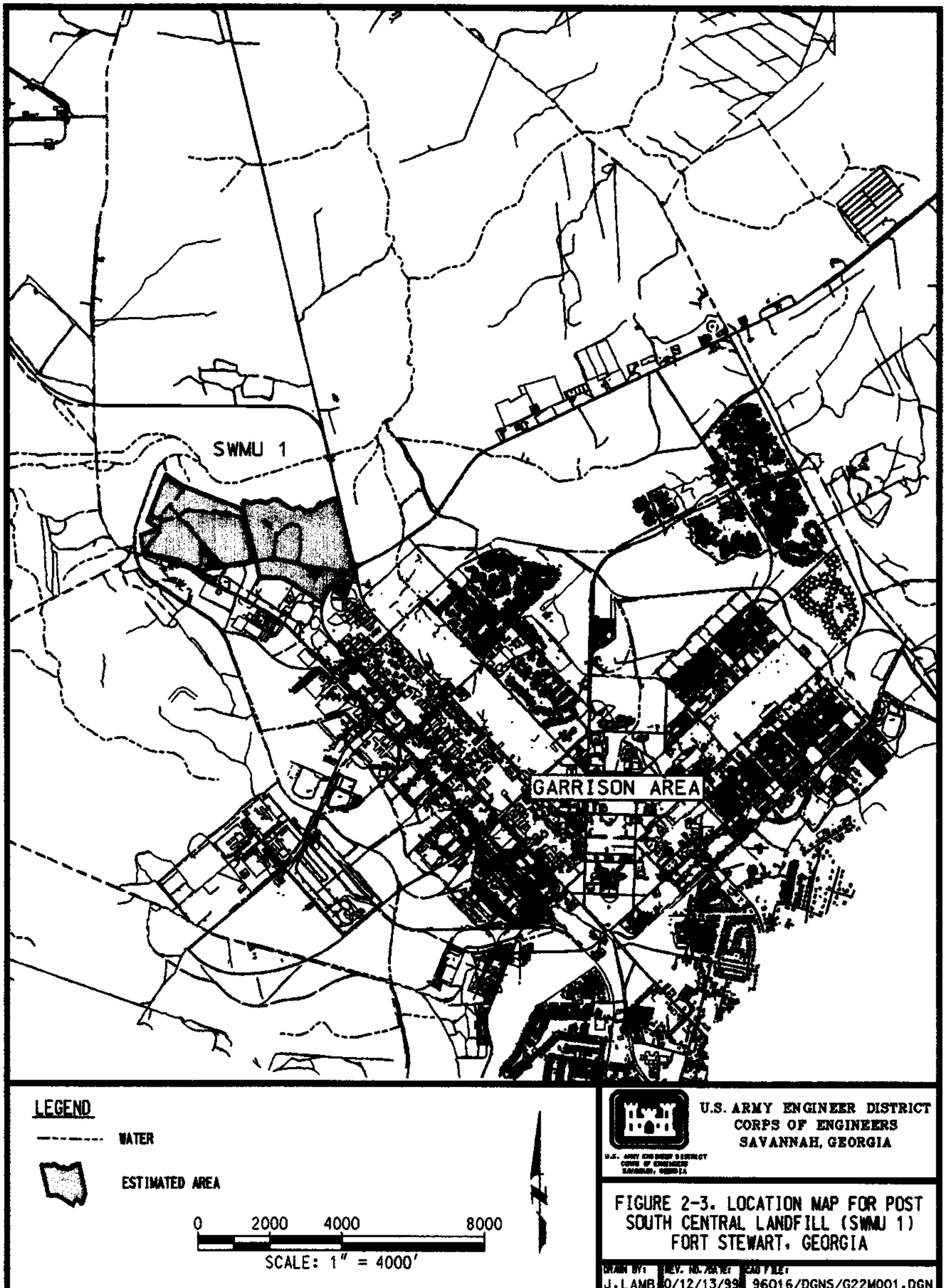

Figure 2-3. Location of the Post South Central Landfill (SWMU 1), Fort Stewart, Georgia

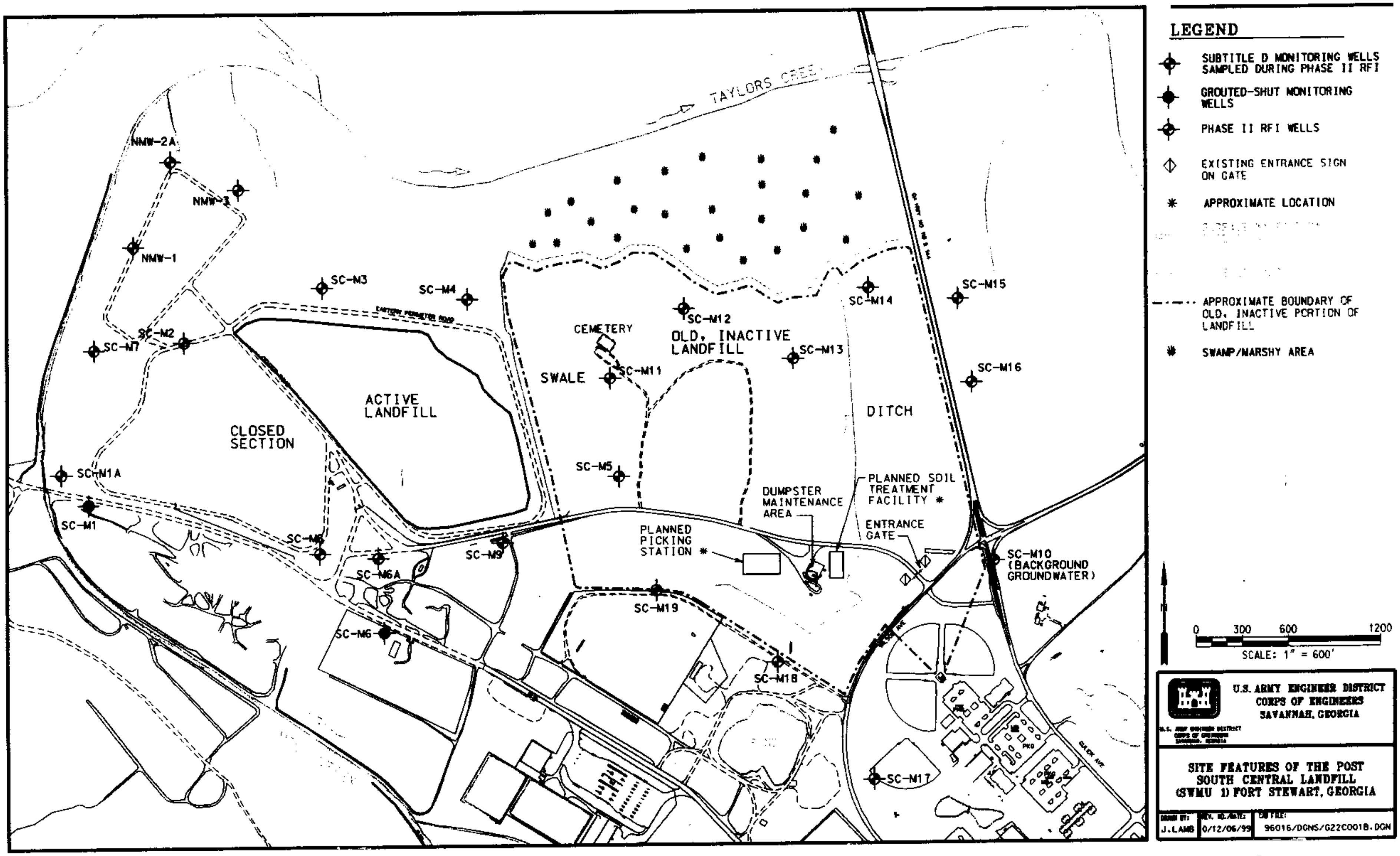

Figure 2-4. Site Features of the Post South Central Landfill (SWMU 1), Fort Stewart, Georgia

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

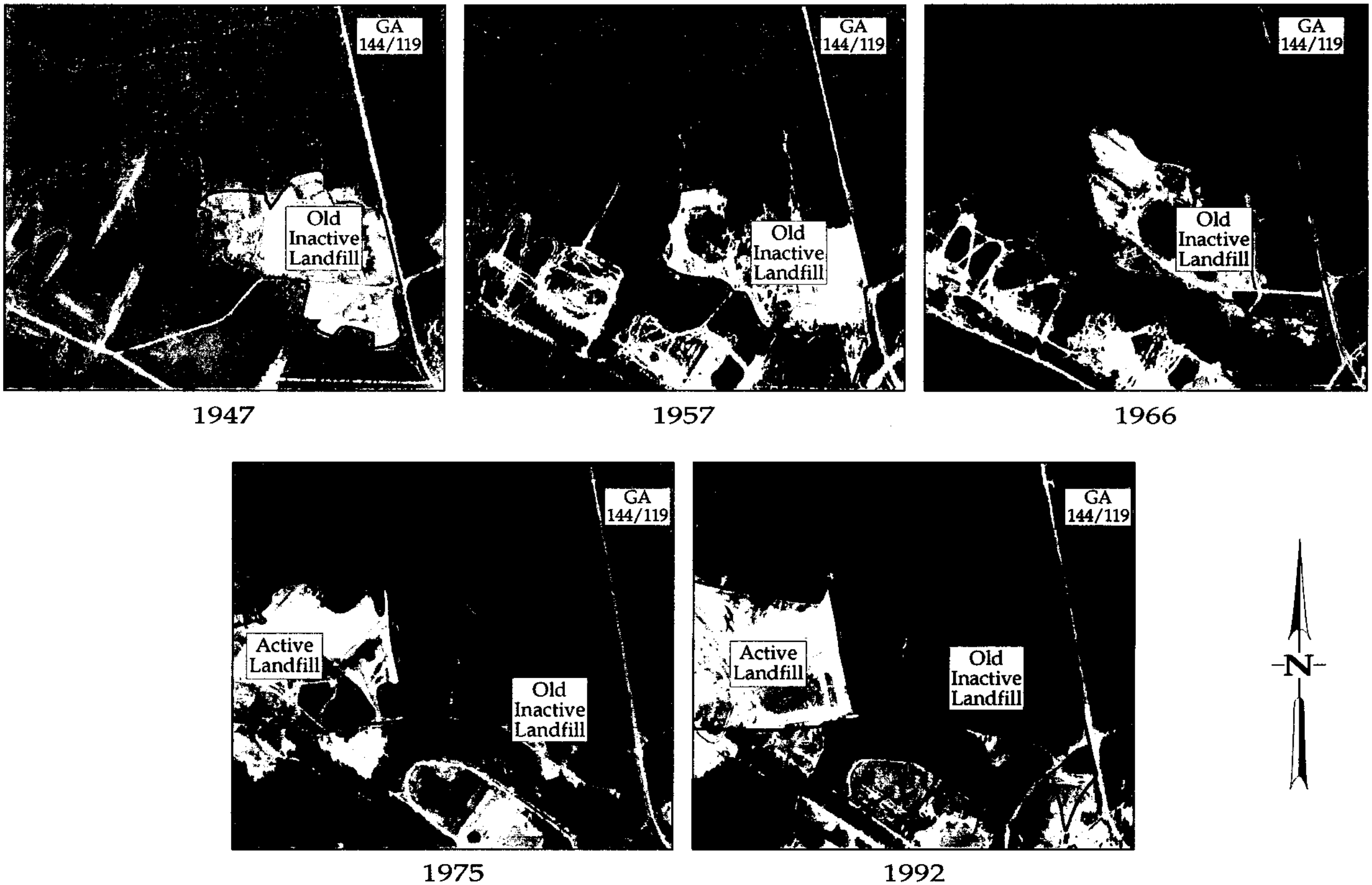

Figure 2-5. Aerial Photographs of the Post South Central Landfill (SWMU 1)

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.

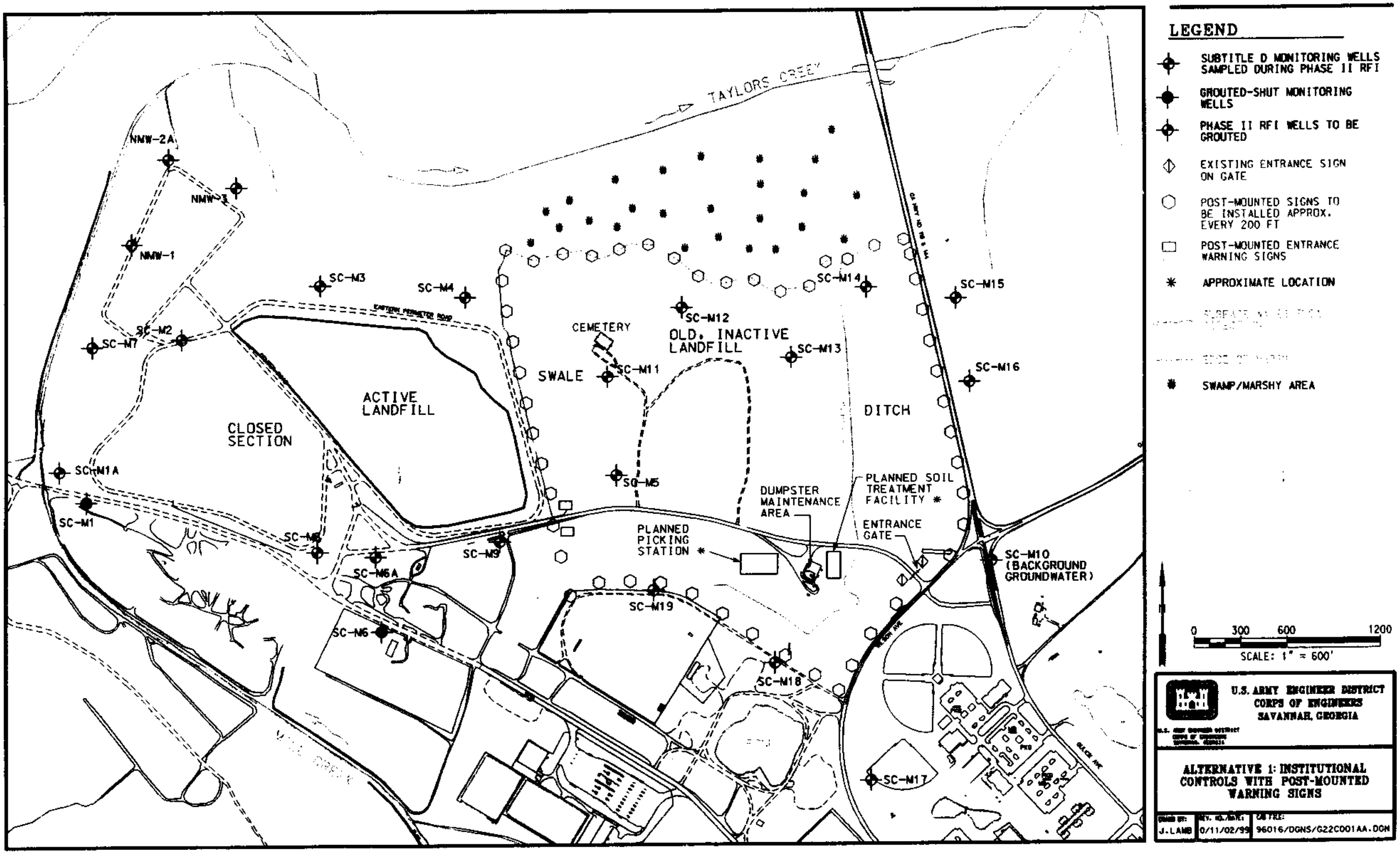

Figure 4-1. Alternative 1: Institutional Controls with Post-mounted Warning Signs

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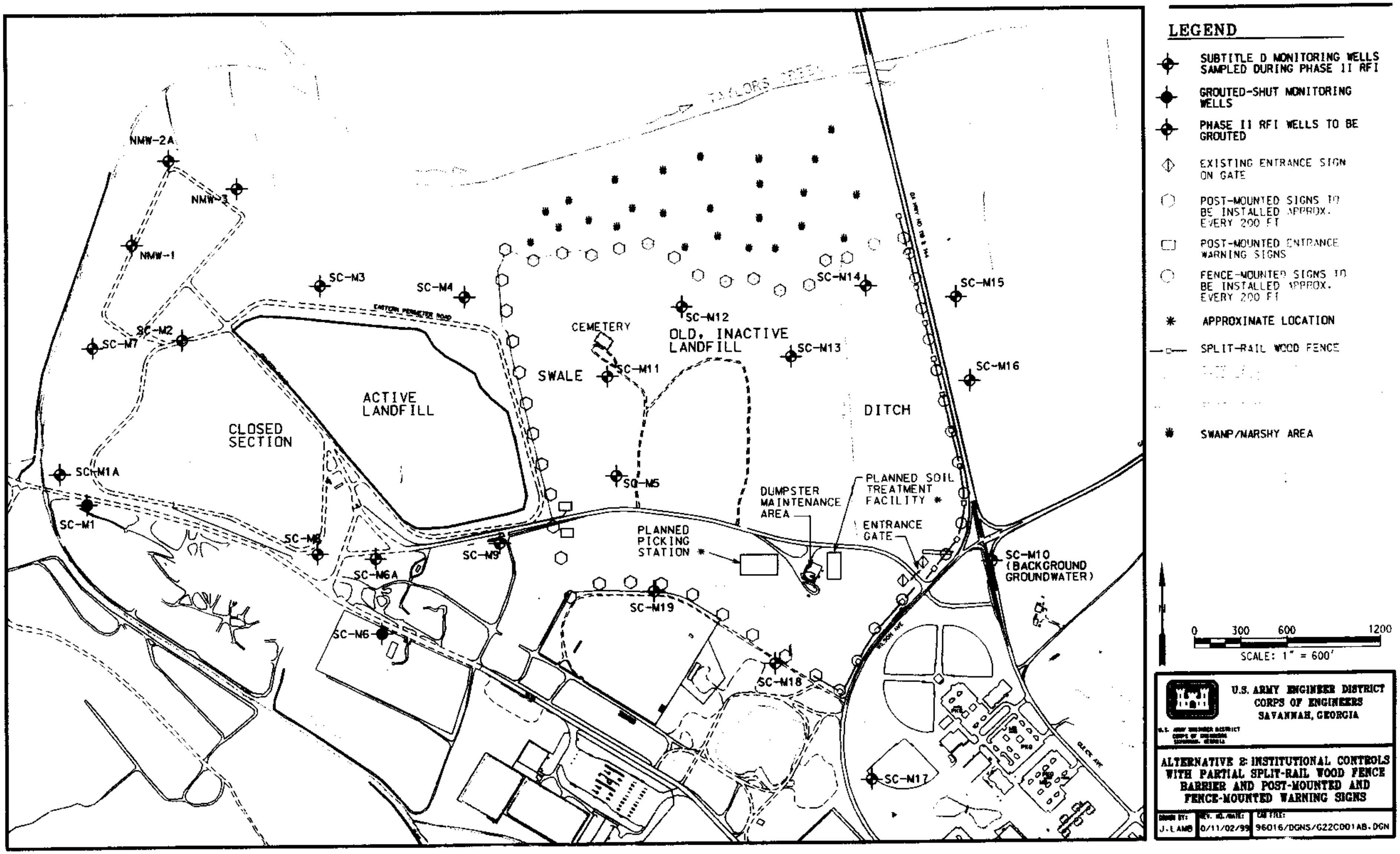

Figure 4-2. Alternative 2: Institutional Controls with Partial Split-rail Wood Fence Barrier and Post-mounted and Fence-mounted Warning Signs

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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.

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APPENDIX A

OPERATIONS AND MAINTENANCE PLAN

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OPERATIONS AND MAINTENANCE PLAN

The following Operations and Maintenance (O&M) Plan will be implemented for a period of 30 years to ensure that signs and barriers remain in good condition. O&M will include documented inspections as well as any necessary repairs to or replacement of materials (e.g., signs, posts, fencing). This plan outlines the roles and responsibilities for O&M (Table A-1) and provides a detailed description of O&M requirements for this site.

Table A-1. O&M Roles and Responsibilities

Role	Responsibilities
Inspection and Maintenance Supervisor	• Facilitate assignment of qualified personnel to perform inspections. • Provide instruction to qualified personnel. • Establish dates for annual inspections. • Collect, sign, and maintain field inspection and maintenance logs. • Facilitate acquisition and provision of materials for repair or replacement of warning signs. • Acquire maintenance support to make any necessary repairs or replacements of warning signs by preparing work requests. • Provide any necessary instruction to maintenance personnel regarding repair or replacement of warning signs. • File documentation associated with repairs/replacements. • Prepare and submit annual O&M reports to GEPD.
O&M Inspector	• Walk/drive around perimeter of the site. • Observe any damage to warning signs and any signs of human activity within the boundary of the solid waste management unit. • Document all findings and repair/replacement recommendations on Inspection and Maintenance Logsheet. • Submit Inspection and Maintenance Logsheet and Site Inspection Map to Inspection and Maintenance Supervisor. • Verbally clarify findings to Inspection and Maintenance supervisor as needed.
Maintenance Personnel	• Acquire materials necessary for repair/replacement of warning signs. • Perform repairs or replace signs as described by work request. • Document that work request has been performed. • Provide documentation of completed work to Inspection and Maintenance Supervisor.

Detailed Description of O&M Activities

General. An Inspection and Maintenance Supervisor will be assigned to provide oversight and administration of O&M activities performed at Solid Waste Management Unit (SWMU) 1. The supervisor will ensure that qualified and trained personnel are selected to perform inspection and maintenance activities. Inspections and maintenance will be performed annually beginning 1 year after installation of warning signs at the old, inactive portion of the Post South Central Landfill. All activities associated with field inspections and maintenance activities will be recorded in field inspection logs and maintenance documentation.

Inspections. The O&M Inspector will walk or drive the perimeter of the SWMU and observe any damage or deterioration of warning signs and signposts. Any evidence of human activity within the boundaries of the SWMU will also be noted. Information from the field inspection observations shall be documented in the Inspection and Maintenance Logsheet (Figure A-1) and the Site Inspection Map (Figure A-2). Information to be documented in the log will include the year of inspection, the number of signs to be repaired/replaced, the identification number of signs that require repair or replacement, and the signature of the inspector. The inspector will present the field logs and Site Inspection Map to the Inspection and Maintenance Supervisor within 24 hours of inspection. The inspector will also verbally report any findings that require clarification.

The inspector will use the Site Inspection Map (Figure A-2) to document which signs will require repair or replacement as well as which signs were checked, but will not require repair or replacement. Markings on the Site Inspection Map shall be made in accordance with the instructions provided on Figure A-2.

Maintenance. The Inspection and Maintenance Supervisor will ensure procurement of any additional materials and supplies needed to repair or replace warning signs using work requests. The supervisor will ensure that maintenance personnel are assigned to perform any needed repairs or replacements. The Inspection and Maintenance Supervisor shall provide a detailed description of the needed repairs or replacements to the maintenance personnel. The maintenance personnel will acquire the necessary supplies to make repairs or replace signs. The maintenance personnel, in accordance with the schedule requested by the supervisor, will perform the repair and/or replacement of warning signs. The maintenance personnel will document the repairs and replacements of signage on the Inspection and Maintenance Logsheet provided by the Inspection and Maintenance Supervisor (see Figure A-1). The completed maintenance log will be signed and dated by the maintenance personnel and submitted to the Inspection and Maintenance Supervisor for review and approval. All documentation associated with maintenance will be filed and maintained by the supervisor.

Reporting. Inspections and maintenance activities will also be summarized in an annual report entitled the Corrective Action Plan Progress Report for SWMU 1. The Inspection and Maintenance Supervisor will be responsible for preparing the report based on information provided in the Inspection and Maintenance Logsheets. The Inspection and Maintenance Supervisor will prepare and submit the initial Corrective Action Plan Progress Reports for SWMU 1 to GEPD for review and approval within 425 days after the installation of the warning signs at the old, inactive portion of the Post South Central Landfill and annually thereafter.

INSPECTION AND MAINTENANCE LOGSHEET
WARNING SIGNS AND POSTS
AT THE OLD, INACTIVE PORTION OF THE POST SOUTH CENTRAL LANDFILL (SWMU 1)

Year	Signs/Posts Requiring Repair		Signs/Posts Requiring Replacement		Inspector Signature	Maintenance Personnel Signature	Supervisor Approval Signature	Comments
	Qty	Identification Numbers	Qty	Identification Numbers				

Figure A-1. Inspection and Maintenance Logsheet

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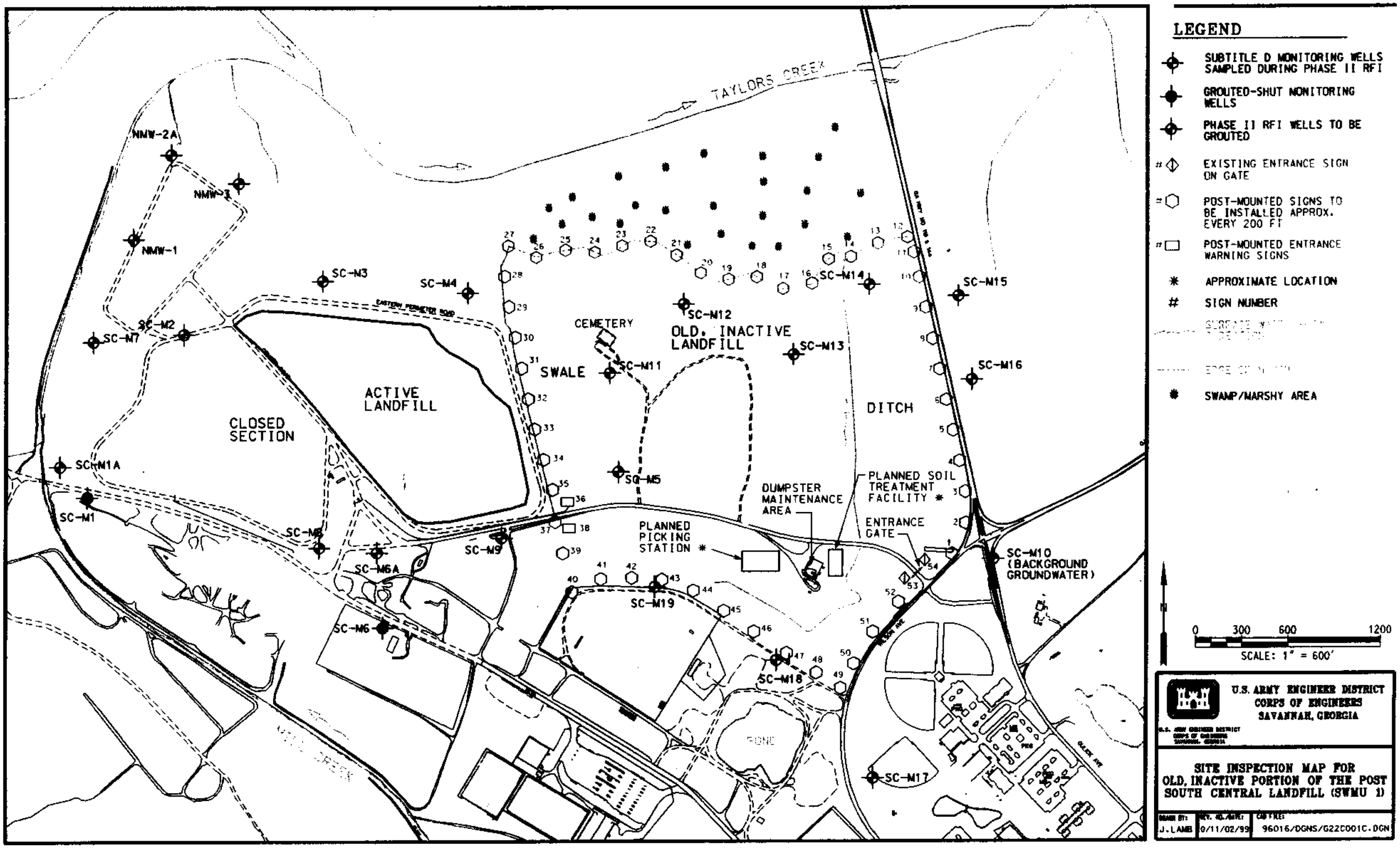

Figure A-2. Site Inspection Map

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APPENDIX B

BASE MASTER PLAN AND DEED RECORDATION REQUIREMENTS

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I certify that I have read and concur with the land recordation requirements presented in the Base Master Plan for the Post South Central Landfill.

Principal Executive Officer or Authorized Agent
Fort Stewart Military Reservation

Date

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Introduction

Appendix B 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 old, inactive portion of the Post South Central Landfill [Solid Waste Management Unit (SWMU) 1]. The selected remedial alternative for the old, inactive portion of the Post South Central Landfill is protective of human health and includes the following features:

- BMP, deed recordation, and zoning controls that establish controls to restrict the use of groundwater and control intrusion into subsurface soils;
- abandonment of eight monitoring wells (SC-M12, -M13, -M14, -M15, -M16, -M17, -M18, and -M19);
- 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 4.0 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 old, inactive portion of the Post South Central Landfill from the federal government. The requirements for deed recordation identify the present (i.e., as of December 1999) applicable requirements for the area identified as the old, inactive portion of the Post South Central Landfill upon its future transfer out of the government ownership.

Base Master Plan

The following information/items and restrictions will be included in the BMP, which will be effective until the transfer of ownership of the old, inactive portion of the Post South Central Landfill property.

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

   a. Except as permitted by items f and g, all activities on the property that may result in disturbance of subsurface soils and/or substantially interfere with implementation of the O&M Plan are prohibited.

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

   c. Military training exercises, hunting, and recreational activities are expressly prohibited.

   d. Construction of residential facilities is expressly prohibited.

   e. The O&M Plan for the old, inactive portion of the Post South Central Landfill, which requires maintenance of permanent markers (signs) on each side of the site 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. resurfacing of the landfill access road;

      2. clearing/cleaning up of any drainage ditches in the area of the old landfill;

      3. timber harvesting;

      4. performance of fish and wildlife studies;

      5. provision and maintenance of feed lots for deer;

      6. maintenance/rehabilitation of existing facilities and/or utilities;

      7. 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 item g)]; and

      8. construction of other facilities and/or utilities to support the mission of FSMR, as required, will be designed to eliminate or minimize impact to the subsurface soils in this area (see item g).

   g. Construction of nonresidential facilities will not be permitted without the appropriate level of protection of health and safety. Soil sampling and analyses 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. 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, as applicable.

2. Site Survey:

   a. The BMP will include a written description of the boundaries of the site according to 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 landfills cells or other hazardous waste disposal units 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 old, inactive portion of the Post South Central Landfill (SWMU 1) 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 superior court for the county of Liberty. 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 soils 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) on each side of the site to delineate the restricted area will be required.

   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 for verification with the Georgia Environmental Protection Division 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.

APPENDIX C

SITE DESCRIPTION AND SURVEY PLAT

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SITE DESCRIPTION FOR THE OLD, INACTIVE PORTION OF THE POST SOUTH CENTRAL LANDFILL AS OF DECEMBER 1999

The old, inactive portion of the Post South Central Landfill [Solid Waste Management Unit (SWMU) 1] consists of an area of approximately 143 acres that is bounded on the north by Taylors Creek, on the west by the active portion of the Post South Central Landfill, on the east by Georgia State Highways 199 and 144, and to the south by the access road to Childrens Pond. Six topographic survey points define the eastern, western, and southern perimeters of the old, inactive portion of the landfill (see enclosed survey plat). Taylors Creek defines the northern perimeter. A significant marshy/swampy area exists along Taylors Creek that defines the northern perimeter of the landfill disposal area. An asphalt-paved road begins at Wilson Avenue and runs east to west through the old, inactive portion of the Post South Central Landfill and provides access to the active portion of the Post South Central Landfill. The old, inactive portion of the Post South Central Landfill is primarily forested with pines and successional vegetation north of the access road. As of December 1999, significant site features at the old, inactive portion of the Post South Central Landfill included: (1) a dumpster maintenance area, (2) softball fields, (3) a fenced cemetery, and (4) a drainage ditch to drain the low area around the dumpster maintenance area. The dumpster maintenance area is located on the southern side of the SWMU 1 access road, approximately 600 feet from the Wilson Avenue entrance gate. A drainage ditch begins southwest of the dumpster maintenance area, circles the dumpster maintenance area, and ultimately discharges to the marshy area along Taylors Creek. The enclosed plat, based on a survey performed in October 1999, defines the current site features of the old, inactive portion of the Post South Central Landfill.

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(Survey plat on two oversized sheets.)

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APPENDIX D

COST ESTIMATE

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	Cost Estimate	Alternative 1	Alternative 2
		Institutional Controls: Land Use Controls with Signs	Institutional Controls: Land Use Controls with Signs and Fence
1.0	**Capital Costs**		
1.1	**Engineering Services**		
1.1.1	Work Plan/Site Safety and Health Plan	$ 2,000	$ 3,000
1.1.2	Contracting/Procurement	$ 1,000	$ 1,000
1.1.3	Engineering Oversight	$ 1,200	$ 1,200
1.1	**Total Costs for Engineering Services**	**$ 4,200**	**$ 5,200**
1.2	**Installation/Establishment of Institutional Controls**		
1.2.1	Warning Sign/Post Installation	$ 4,110	$ 3,599
1.2.2	Split-rail Fence Installation	--	$ 33,168
1.2.3	Abandonment of Groundwater Wells		
	1.2.3.1 Mobilization/Demobilization	$ 2,000	$ 2,000
	1.2.3.2 Well Abandonment	$ 3,200	$ 3,200
1.2.4	Deed Recordation	$ 3,000	$ 3,000
1.2	**Total Installation/Establishment of Institutional Controls**	**$ 12,310**	**$ 44,967**
1.0	**Total Capital Costs**	**$ 16,510**	**$ 50,167**
2.0	**Operations and Maintenance (30 years)**		
2.1	Replacement/Repair of Warning Signs and/or Posts*	$ 6,162	$ 5,400
2.2	Replacement/Repair of Fencing**	--	$ 19,902
2.3	Annual Inspection and Reports	$ 2,659	$ 2,659
2.4	Administration of Operations and Maintenance Plan Requirements	$ 3,600	$ 3,600
2.0	**Total Costs for Operations and Maintenance**	**$ 12,421**	**$ 31,561**
	Subtotal Project Costs	**$ 28,931**	**$ 81,728**
	Engineering Management (10 percent of subtotal)	$ 2,893	$ 8,173
	Contingency (20 percent of subtotal)	$ 5,786	$ 16,346
	Health and Safety (15 percent of subtotal)	$ 4,340	$ 12,259
	Contractor Profit (10 percent of subtotal)	$ 2,893	$ 8,173
	Total Project Costs	**$ 44,843**	**$ 126,679**

* Assumes sign and/or post repair/replacement allowance of 25 percent of total installation cost every 5 years for a period of 30 years.

** Assumes fence repair/replacement allowance of 10 percent of total installation cost every 5 years for a period of 30 years.

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