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FINAL

CORRECTIVE ACTION PLAN FOR THE OLD RADIATOR SHOP/PAINT BOOTH (SOLID WASTE MANAGEMENT UNIT 24B) 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
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Savannah District
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The undersigned certifies that I am a qualified groundwater scientist who has received a baccalaureate or postgraduate degree in the natural sciences or engineering and have sufficient training and experience in groundwater hydrology and related fields, as demonstrated by state registration and completion of accredited university courses, to enable me to make sound professional judgments regarding groundwater monitoring and contaminant fate and transport. I further certify that this report was prepared by myself or by a subordinate working under my direction.

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

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ACRONYMS

amsl	above mean sea level
AT123D	Analytical Transient 1-, 2-, 3-Dimensional
bgs	below ground surface
BHHRA	baseline human health risk assessment
CAP	Corrective Action Plan
CFR	Code of Federal Regulations
CMCOC	contaminant migration constituent of concern
CMCOPC	contaminant migration constituent of potential concern
COC	constituent of concern
COPC	constituent of potential concern
CY	calendar year
DO	dissolved oxygen
DPT	direct-push technology
DPW	Directorate of Public Works
ECOPC	ecological constituent of potential concern
EPA	U.S. Environmental Protection Agency
EPRE	ecological preliminary risk evaluation
FSMR	Fort Stewart Military Reservation
GEPD	Georgia Environmental Protection Division
GSSL	generic soil screening level
HHCOC	human health constituent of concern
HHCOPC	human health constituent of potential concern
HHPRE	human health preliminary risk evaluation
ILCR	incremental lifetime cancer risk
MCL	maximum contaminant level
O&M	operations and maintenance
PAH	polycyclic aromatic hydrocarbon
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
Redox	oxidation-reduction potential
RfD	reference dose
RFI	RCRA facility investigation
SESOIL	Seasonal Soil Compartment
SRC	site-related constituent
SVOC	semivolatile organic compound
SWMU	solid waste management unit
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 SCOPE OF THE CORRECTIVE ACTION PLAN

Solid Waste Management Unit (SWMU) 24B, the Old Radiator Shop/Paint Booth, is located in Building 1056, which is in the southern portion of the garrison area on the eastern side of Tilton Avenue. Building 1056 housed a radiator shop and a paint booth in the past and is currently used for equipment repair and storage. A Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) has been completed for SWMU 24B, and the results were reported in the *Addendum for SWMU 24B: Old Radiator Shop/Paint Booth to the Revised Final Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, Georgia* (SAIC 2001). With the concurrence of the Georgia Environmental Protection Division (GEPD), the addendum report (approved by GEPD December 6, 2002) recommended that a Corrective Action Plan (CAP) be developed.

The conclusions and recommendations listed below were presented in the addendum to the revised final Phase II RFI report (SAIC 2001).

- The nature and extent of groundwater contamination at the site was determined during the Phase II RFI and supplemental data collection activities, and the information gathered is sufficient for development of a CAP.
- The extent of surface soil contamination around SWMU 24B was not fully defined. Elevated levels of constituents were identified in areas unlikely to be contaminated from any operations of the paint booth. The identified soil contamination is probably the result of the building being located in a highly industrialized portion of the garrison area. For the purposes of this study, SWMU 24B will be defined as Building 1056 and contiguous areas.
- Fort Stewart recommended that a CAP be developed for SWMU 24B and submitted to GEPD. The potential abandonment or use of the monitoring wells is evaluated in this report.

This CAP uses information from the RFI to evaluate the feasibility of using institutional controls, capping, and excavation as remedial actions for achieving the objectives of reducing risk from contaminants to less than 1×10^{-5} for carcinogens and the hazard index to less than one for noncarcinogenic toxicants [or maximum contaminant levels (MCLs) for groundwater]. The options analyzed for achieving these objectives included (1) no action, (2) institutional controls, (3) monitored natural attenuation, (4) capping, (5) excavation, and (6) in situ treatment. Implementation of the alternatives was coordinated with potential demolition and construction activities in the area tentatively scheduled to take place in the next 5 years.

This report has been prepared by Science Applications International Corporation for the U.S. Army Corps of Engineers, Savannah District, under Contract No. DACA21-95-D-0022, Delivery Order No. 0078.

1.2 SITE BACKGROUND

A Phase I RFI was conducted at SWMU 24B in January 1998 to determine if a release to the environment had occurred. Five surface soil, four subsurface soil, and six groundwater samples were collected using direct-push technology (DPT) techniques. All samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and RCRA metals. Toluene and methylene chloride were the only VOCs detected in soil. Ten SVOCs—benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, benzo(*k*)fluoranthene, chrysene, fluoranthene, indeno(*1,2,3-cd*)pyrene, phenanthrene, and pyrene—were detected in surface soil samples. Arsenic, barium, cadmium, chromium, lead, and mercury were detected at concentrations above reference background criteria in surface soil. Only one VOC, benzene, was detected in groundwater. Eleven SVOCs—1,2-dichlorobenzene; 4-chloro-3-methylphenol; benzo(*a*)anthracene; benzo(*a*)pyrene; benzo(*b*)fluoranthene; benzo(*g,h,i*)perylene; bis(2-ethylhexyl)phthalate; chrysene; fluoranthene; indeno(*1,2,3-cd*)pyrene; and pyrene—were detected in groundwater. Mercury was the only metal detected at a concentration above the reference background criterion in groundwater. Based on these findings, GEPD directed the Fort Stewart Directorate of Public Works to conduct a Phase II RFI of the Old Radiator Shop/Paint Booth.

The objectives for the Phase II RFI, as defined by the work plan (SAIC 1997,) were

- to determine the horizontal and vertical extent of groundwater contamination;
- to determine whether soil and/or groundwater contaminants present a threat to human health or the environment;
- to determine the need for future action and/or no future action; and
- to gather data necessary to support a CAP, if warranted.

The scope of the Phase II RFI fieldwork performed in January 1998 included the activities listed below.

- Initial screening consisted of using DPT techniques to collect eight groundwater screening samples to determine the horizontal and vertical extent of groundwater contamination. The screening samples were analyzed for VOCs and SVOCs.
- Two vertical-profile borings were installed at the groundwater screening locations that indicated the highest levels of contamination to determine the vertical extent of groundwater contamination. The vertical-profile samples were analyzed for only VOCs.
- The results of the groundwater screening were also used to locate nine monitoring wells (six shallow and three deep) at the site. One shallow and one deep well were also installed upgradient of the site (background).
- Two soil samples were collected from each well boring. In addition, six surface soil samples were collected from areas found to have the greatest contamination during the Phase I investigation. Three of the surface soil samples were analyzed for only RCRA metals. The others were analyzed for VOCs, SVOCs, and RCRA metals.
- Groundwater samples were collected from all wells and analyzed for VOCs, SVOCs, and RCRA metals. Conductivity, temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (Redox), and turbidity were measured in the field during sampling.

The Phase II investigation found that SVOCs in soil are not uniformly distributed across the site, but are found in isolated spots. SVOCs were found in groundwater in the DPT samples, which were highly turbid, but not in the monitoring well samples. This finding suggests that the SVOCs are sorbed onto particles rather than dissolved in the groundwater. The revised final Phase II RFI report (SAIC 2000) recommended that six additional surface soil samples (supplemental) be taken along Tilton Avenue and analyzed for SVOCs and RCRA metals to better define the extent of contamination. The report also recommended better defining the nature and extent of groundwater contamination by collecting an additional set of groundwater samples (supplemental) from the monitoring wells. The groundwater samples were to be analyzed for only VOCs and SVOCs.

The data from the six additional surface soil samples identified 14 SVOCs. These SVOCs were acenaphthylene, anthracene, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, benzo(*k*)fluoranthene, chrysene, fluoranthene, fluorine, indeno(*1,2,3-cd*)pyrene, naphthalene, phenanthrene, and pyrene. Seven of these SVOCs were detected at concentrations higher than those measured in the Phase I and II samples.

The supplemental groundwater samples from the monitoring wells confirmed that the SVOCs detected in the turbid DPT groundwater samples are not found in properly developed and purged monitoring wells. Trichloroethene was detected in the groundwater samples, but no SVOCs were detected.

The results of the supplemental investigation were reported in the addendum to the revised final Phase II RFI report (SAIC 2001).

1.3 REGULATORY BACKGROUND

The regulatory authority governing the action at SWMU 24B at Fort Stewart is Title 40, Code of Federal Regulations (CFR), Part 264, Title II, Subpart C, Section 3004 (Title 42, United States Code, Part 690 et seq.). 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 a Hazardous Waste Permit [Georgia Environmental Division Permit HW-045 (S&T)] to Fort Stewart in August 1987. The permit was renewed in August 1997. The Old Radiator Shop/Paint Booth is a listed SWMU in Fort Stewart's Subpart B Permit and, therefore, is subject to investigation according to 40 CFR 264.101(c) and to corrective action (the subject of this CAP), if necessary.

1.4 REPORT ORGANIZATION

This CAP consists of six chapters. Chapter 1.0 summarizes the scope of the CAP, describes the background of the site and regulatory authority, and gives the report's organization. Chapter 2.0 discusses the site characterization and RFI results and summarizes the risk evaluation and groundwater modeling results. Chapter 3.0 describes the justification and purpose of the corrective action and presents the remedial response objectives and remedial levels developed in the RFI. Chapter 4.0 presents the screening of the corrective actions. Chapter 5.0 summarizes the report's conclusions and recommendations for the corrective action. The references are presented in Chapter 6.0.

This report also contains three appendices. Appendix A presents the contaminant fate and transport modeling results. Appendix B contains a cost estimate summary for the corrective action alternatives. Appendix C contains an Operations and Maintenance (O&M) Plan for the selected corrective action.

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2.0 SITE CHARACTERIZATION

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

The Fort Stewart Military Reservation (FSMR) is located in portions of Liberty, Bryan, Long, Tattnall, and Evans counties, Georgia, approximately 40 miles west-southwest of Savannah, Georgia (Figure 2-1). The cantonment, or garrison area, of the FSMR is located within Liberty County, on the southern boundary of the reservation. The Old Radiator Shop/Paint Booth is located in the southern portion of the garrison area on the eastern side of Tilton Avenue in Building 1056 (Figure 2-2).

2.1 SITE DESCRIPTION AND HISTORY

The operational history of the site is vague. Building 1056 used to be a radiator shop. The area is currently used as an equipment repair and storage area. In 1993 long-time Building 1056 workers were interviewed regarding their knowledge of the history of former operations at this facility. One employee reported an old paint booth to have been located in the northern corner of the building, but to have been out of use for about 18 years. Prior to use as a paint booth, the area reportedly housed the old radiator shop. Other employees indicated that they did not know what materials had been used in the old paint booth and were not aware of a radiator shop having been located in the building.

Other research into former operations at Building 1056 has indicated that a drainpipe led from the building and discharged into a ditch (Figure 2-3). It is unknown whether the drainpipe originally discharged to a ditch running parallel to Building 1056 or to the ditch on the west side of Tilton Avenue. It was reported that the Directorate of Engineering and Housing installed a pipe under Tilton Avenue that connected the drainpipe in Building 1056 to the industrial wastewater pipeline located on the west side of Tilton Avenue (Geraghty and Miller 1992), at which point the discharge was no longer routed to the ditch. The Fort Stewart Plumbing/Mechanical and Electrical Department was not able to determine when the piping from Building 1056 was connected to the industrial wastewater treatment plant drainage system or where the connection was located. There is a visible cut in the asphalt across Tilton Avenue approximately 15 feet southeast of the northwestern corner of Building 1056. It is believed that this is the location of the connection.

If the facility was previously used as a radiator repair shop, the wastes generated would probably have been the same as those generated under its current operations as an engine equipment repair facility. These wastes include caustic cleaning solution, sodium hydroxide, water-based fluorescein dye solution, and spent recirculation wastes from the wet-curtain spray paint booth.

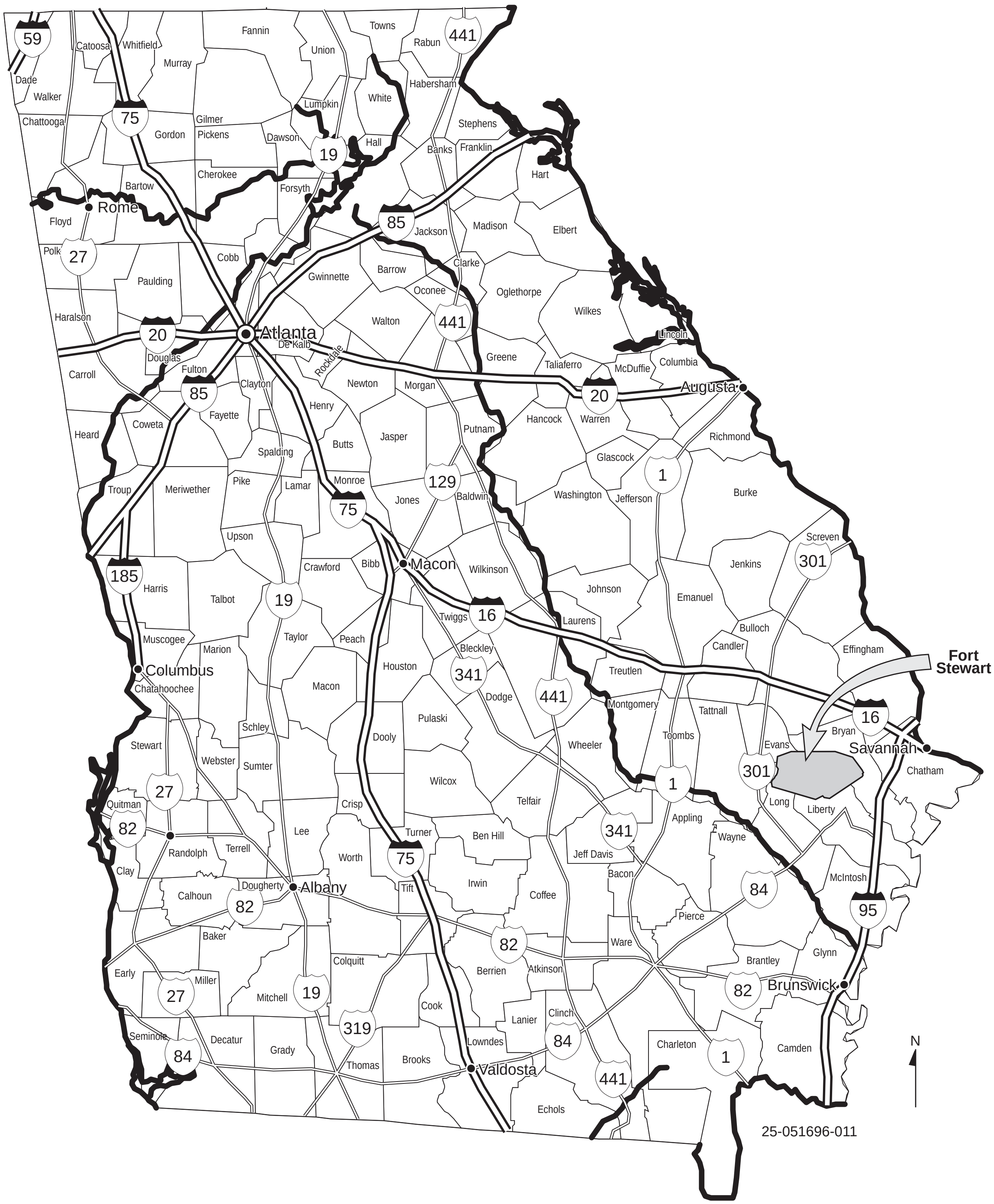

Figure 2.1. Regional Location Map for Fort Stewart Military Reservation, Georgia

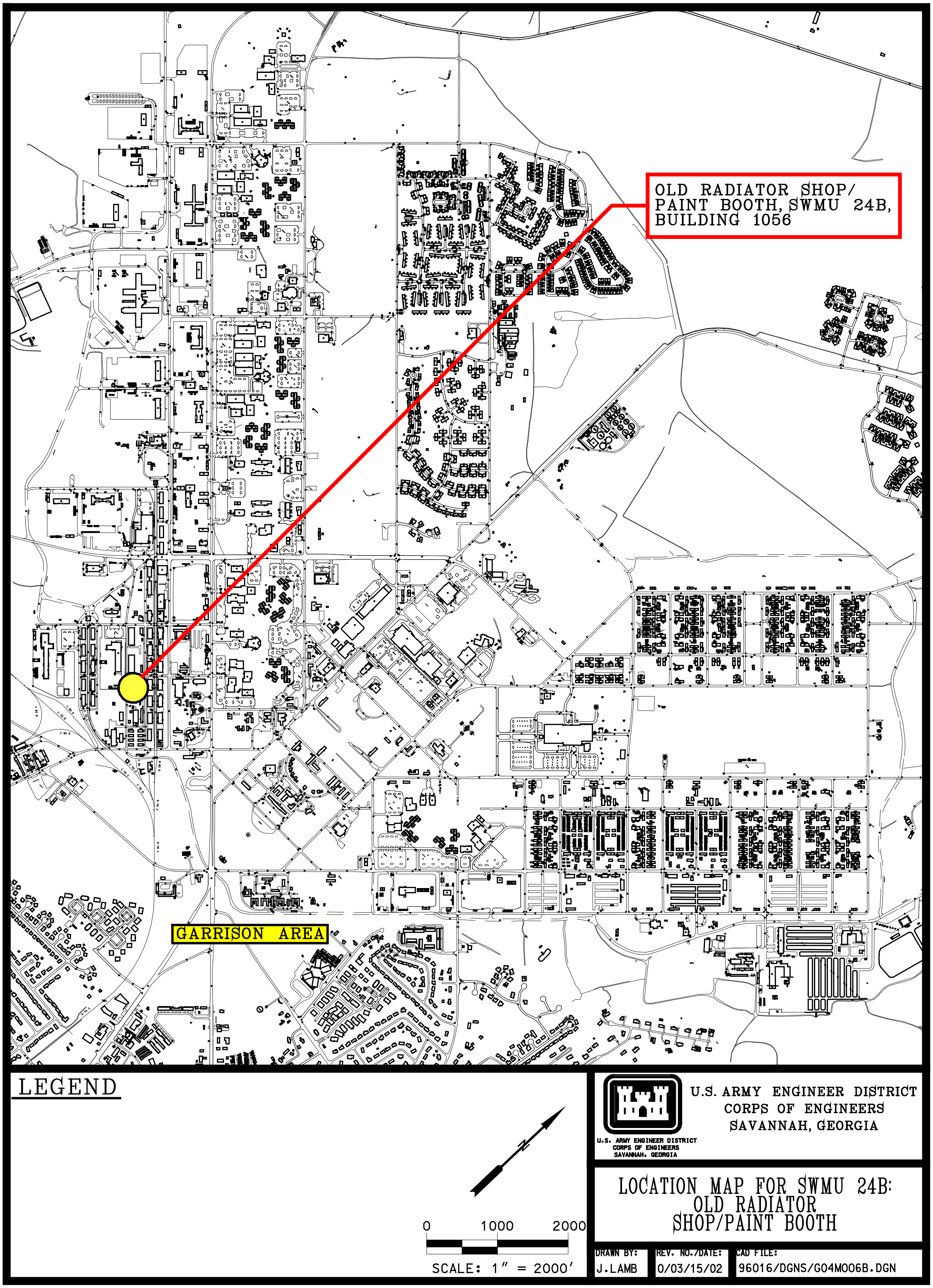

Figure 2-2. Location of SWMU 24B at Fort Stewart, Georgia

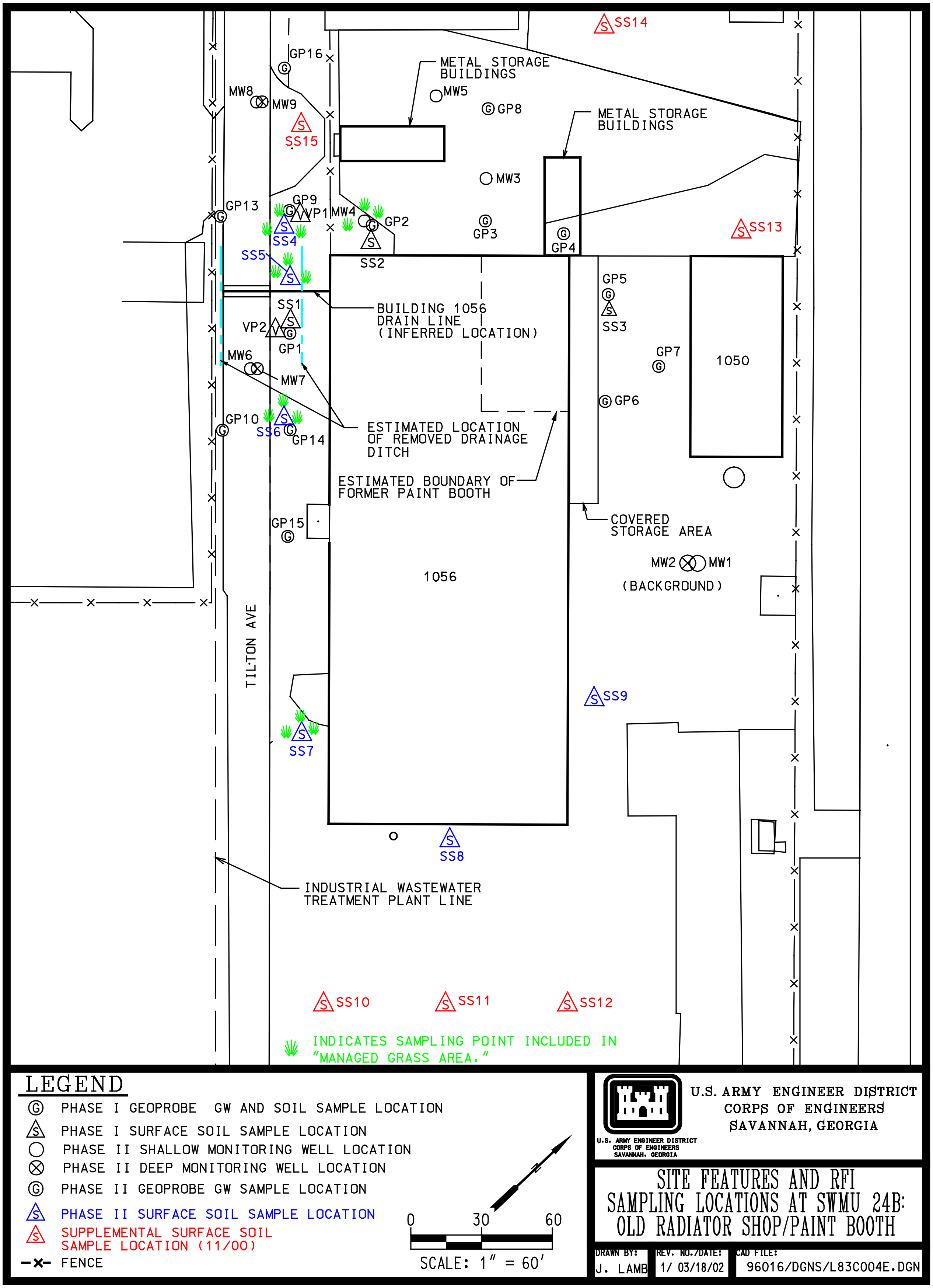

Figure 2-3. Site Features and RFI Sampling Locations at SWMU 24B

2.1.1 Phase I RCRA Facility Investigation

A Phase I RFI was conducted at SWMU 24B in 1993. During the investigation five surface soil samples, four subsurface soil samples, and six groundwater samples were collected using DPT techniques (Figure 2-3). The samples were analyzed for VOCs, SVOCs, and RCRA metals. The results of the Phase I RFI are included in the comprehensive evaluation presented in Section 2.7, "Contaminant Nature and Extent."

2.1.2 Phase II RCRA Facility Investigation Activities

The Phase II RFI was performed in January 1998 and consisted of collection of eight groundwater screening samples to determine horizontal extent, collection of two vertical profiles to determine vertical extent, installation and sampling of nine (six shallow and three deep) monitoring wells, surface and subsurface soil sampling during the installation of the monitoring wells, and collection of an additional six surface soil samples. The Phase II RFI confirmed SVOC contamination in the shallow soil samples. Seventeen SVOCs were detected: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, benzo(*k*)fluoranthene, chrysene, di-*N*-octylphthalate, fluoranthene, fluorine, indeno(*1,2,3-cd*)pyrene, naphthalene, phenanthrene, and pyrene. Three VOCs—carbon disulfide, butanone, and acetone—were also detected. Barium, cadmium, chromium, lead, selenium, and silver were detected at concentrations above their reference concentrations in at least one of the surface soil samples.

In the subsurface soil, the VOCs detected were butanone, acetone, benzene, carbon disulfide, ethylbenzene, tetrachloroethene, toluene, trichloroethene, and xylenes. Only one SVOC, pyrene, was detected in the subsurface soil. The only metals detected at concentrations above their reference background criteria were mercury and selenium.

In groundwater, the turbid samples collected by the DPT technique and the vertical profile contained 12 SVOCs. No metals or VOCs were detected. The developed, purged monitoring well samples contained no SVOCs or VOCs. The shallow well samples contained only one metal, chromium, at a concentration above the reference background criterion. The deep groundwater samples contained arsenic, barium, chromium, lead, and selenium at concentrations above their reference background criteria. The results of the Phase II RFI are included in the comprehensive evaluation presented in Section 2.7, "Contaminant Nature and Extent."

The revised final Phase II RFI report recommended additional sampling to better define the extent of shallow soil contamination and to confirm that the apparent contamination in the groundwater was due to the turbidity in the DPT and vertical-profile samples rather than representative of dissolved contaminants in the groundwater (SAIC 2000).

2.1.3 Supplemental RCRA Facility Investigation Activities

Six additional surface soil samples (Figure 2-3) were collected and analyzed for SVOCs. All nine wells were resampled and analyzed for VOCs and SVOCs. Fourteen SVOCs were detected in the surface soil. Trichloroethene was the only contaminant detected in the groundwater. The results of the supplemental investigation are included in the comprehensive evaluation presented in Section 2.7, "Contaminant Nature and Extent."

2.2 TOPOGRAPHY/PHYSIOGRAPHY/CLIMATE

The FSMR occupies a low-lying, flat region in 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 Installation. 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 1999).

SWMU 24B is generally level and covered with concrete or gravel around Building 1056. The site is heavily congested with stored equipment (e.g., motors, metal boxes). The surface elevation of the site is approximately 85.5 feet amsl.

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

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

2.4 SITE SOIL

The soil present across SWMU 24B consists of alternating layers of sand and silty to clayey sands, as indicated by the DPT and boring logs in Appendix A of the revised final Phase II RFI report (SAIC 2000).

2.5 SITE HYDROLOGY

2.5.1 Groundwater Hydrology

Groundwater was encountered at approximately 6 feet to 8 feet bgs. The shallow groundwater flow direction across the site as measured on November 1, 2001, was to the west, and the hydraulic gradient was 0.0098 foot/foot (Figure 2-4). The deep groundwater was flowing to the southwest to south with a gradient of 0.012 foot/foot (Figure 2-5). The shallow surficial groundwater flow might, therefore, intercept the man-made drainage ditch located approximately 500 feet to the west, and the deep surficial groundwater flow might intercept a tributary of Mill Creek approximately 1,200 feet to the south.

2.5.2 Surface Water Hydrology

There are no surface water/sediment migration pathways at the site. Former drain lines from the facility might have discharged to a ditch alongside Building 1056 that is no longer present or a ditch alongside Tilton Avenue. The closest surface water feature is an approximately 6-foot-deep, man-made drainage ditch located approximately 500 feet to the west. This ditch is capable of intercepting the shallow groundwater from the site. The drainage ditch ultimately discharges into Mill Creek, approximately 2,600 feet to the west. In addition, a tributary of Mill Creek is located approximately 1,200 feet to the south. The deep surficial groundwater might intercept this tributary. Based on current site conditions, therefore, a direct surface water/sediment pathway does not exist for SWMU 24B.

2.6 ECOLOGY

SWMU 24B is classified as an "industrialized area." The site lies within an industrialized portion of the garrison, and its ecological habitat consists of small patches of grasses amongst buildings and structures.

2.7 CONTAMINANT NATURE AND EXTENT

The results of chemical analyses performed during the RFI indicated that the soil and groundwater contain organic and metal contaminants at concentrations greater than their reference background concentrations. No surface water is present at the site.

The reference background criteria for the Old Radiator Shop/Paint Booth were 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 the SWMUs under investigation. In addition, soil samples collected during the Phase I RFI were included in the background data set if they were 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 background sample locations by medium at each SWMU and the source of the data (Phase I and Phase II RFI analytical data) are presented in Table 5-1 of the revised final Phase II RFI report (SAIC 2000).

EPA Region IV methodology (EPA 1995) was used as guidance for the development of the background data set for screening of metals data. In cases in which enough samples (i.e., more than 20) are collected to define background, a background upper tolerance level can be calculated. In cases in which too few samples (e.g., fewer than 20) are collected to define background, background can be calculated as two times the mean background concentration (EPA 1995). Given that fewer than 20 background samples were collected for the FSMR, the latter method was used for calculating reference background concentrations.

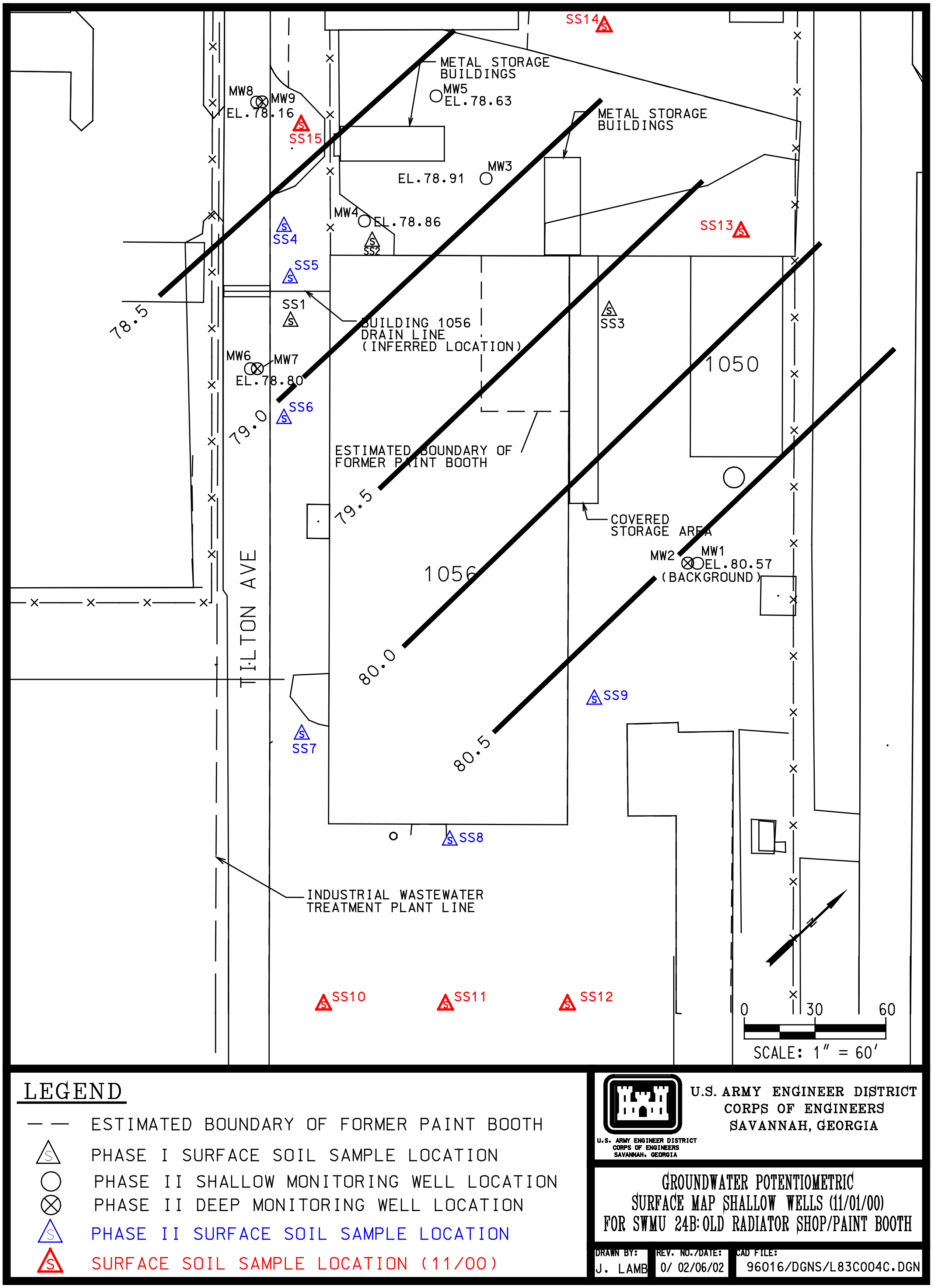

Figure 2-4. Shallow Groundwater Potentiometric Surface Map of SWMU 24B, November 1, 2000

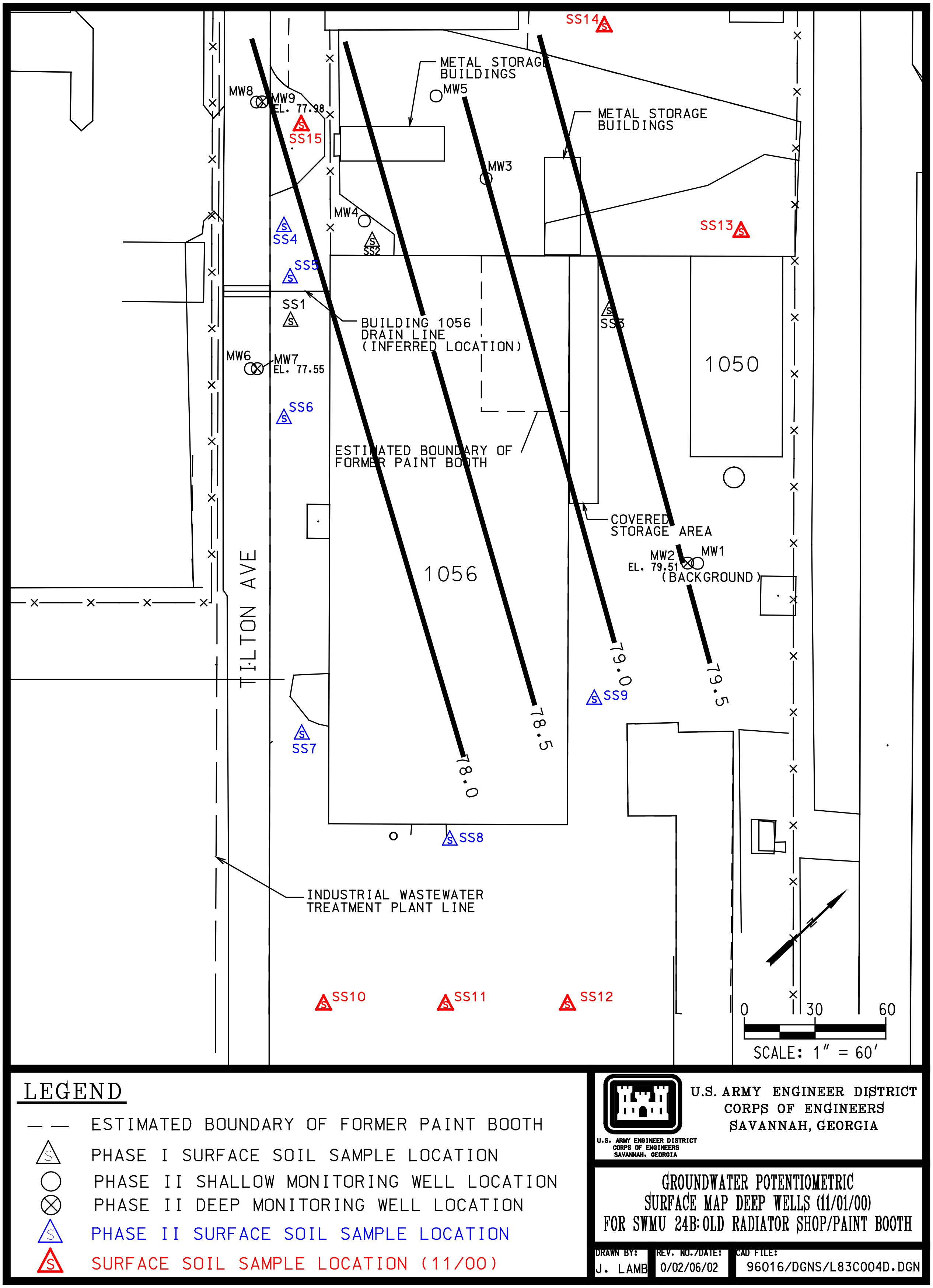

Figure 2-5. Deep Groundwater Potentiometric Surface Map of SWMU 24B, November 1, 2000

The reference background concentrations for surface soil, subsurface soil, and groundwater were calculated as two times the average concentration of all of the locations selected to be in the background data set. If a chemical was not detected at a site, then one-half the detection limit was used as the concentration when calculating the reference mean background concentration.

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

Appendix G of the revised final Phase II RFI report (SAIC 2000) presents a summary of the background data as well as the two-times-mean background concentrations. Given the limited background data, the mean concentration established by the U.S. Geological Survey for soil in the eastern United States (USGS 1984) is also presented for comparative purposes. Because of the limited number of background samples, the screening value for background may be heavily skewed as a result of an outlier in the sampling data. The nature and extent of contamination by medium is summarized below. A tabular summary of SRCs by medium for the Old Radiator Shop/Paint Booth is presented in Table 2-1.

2.7.1 Surface Soil

Twenty-six surface soil samples were collected from the uppermost interval (1 foot to 2 feet) of each monitoring well boring and from the top foot of soil at the surface soil sampling locations. Two surface soil samples were also obtained using a Geoprobe. Three of the Phase II samples, 24B-SS7X through 24B-SS9X, were analyzed for only RCRA metals. The six surface soil samples (24B-SS10 through 24B-SS15) collected during the November 2000 sampling event were analyzed for only SVOCs. The rest of the soil samples taken during the Phase I and Phase II investigations were analyzed for VOCs, SVOCs, and RCRA metals.

Toluene was detected in all three of the Phase I but in none of the Phase II surface soil samples. Butanone and acetone were detected in SS6. Carbon disulfide was detected in MW2, MW6, and MW8.

Seventeen SVOCs were detected in surface soil during the RFI. 2-Methylnaphthalene was detected in MW2 and SS6. Acenaphthene was detected in SS5. Acenaphthylene was detected in MW2, MW4, MW5 drill cuttings, SS4, SS5, SS6, SS10, SS11, SS13, SS14, and SS15. Anthracene was detected in MW2, MW5, SS4, SS5, SS6, SS10, and SS14. Benzo(*a*)anthracene was detected in all the surface soil samples analyzed for SVOCs and also in the shallow soil monitoring well samples obtained during construction of MW2 and MW5. Benzo(*a*)pyrene and pyrene were detected in all the surface soil samples analyzed for SVOCs and also in MW2, MW4, and MW5. Benzo(*b*)fluoranthene, chrysene, and indeno(*1,2,3-cd*)pyrene were detected in all the surface soil samples analyzed for SVOCs and also in MW2 and MW5. Benzo(*g,h,i*)perylene was detected in all the surface soil samples analyzed for SVOCs and also in MW2. Benzo(*k*)fluoranthene was detected in MW2, MW5, SS1, SS10, SS11, SS12, SS13, SS14, and SS15. Di-octylphthalate was detected in SS5. Fluoranthene was detected in all the surface soil samples analyzed for SVOCs except SS12 and also in MW2 and MW5. Fluorene was detected in MW2, SS6, and SS10. Naphthalene was detected in MW2, SS6, and SS10. Phenanthrene was detected in MW2, MW5, SS3, SS4, SS5, SS6, SS10, SS13, SS14, and SS15. Concentrations of SVOCs tended to increase with the distance from Building 1056.

Eight RCRA metals were also detected in surface soil at concentrations above reference values. Arsenic was detected at a concentration above its reference background criterion in SS1. Barium was detected at concentrations above its reference background criterion in MW1, SS1, SS2, SS4, SS5, SS6, SS7X, SS8X, and SS9X. Cadmium was detected at concentrations above its reference background criterion in SS1,

Table 2-1. Summary of Site-Related Contaminants, SWMU 24B

Analyte	Maximum Concentration (mg/kg)			Maximum Concentration (μg/L)	
	Surface Soil[a]	Subsurface Soil[a]	Sediment	Groundwater[a,b]	Surface Water
Volatile Organic Compounds					
Butanone	0.0054	ND	NP	ND	NP
Acetone	0.045	ND	NP	ND	NP
Carbon disulfide	0.0074	0.0024	NP	ND	NP
Methylene chloride	ND	0.0289[c]	NP	ND	NP
Tetrachloroethene	ND	0.004	NP	ND	NP
Toluene	0.142[c]	0.0442[c]	NP	ND	NP
Trichloroethene	ND	0.0026	NP	2.60	NP
Semivolatile Organic Compounds					
2-Methylnaphthalene	0.206	ND	NP	ND	NP
Acenaphthene	0.0196	ND	NP	ND	NP
Acenaphthylene	8.53	ND	NP	ND	NP
Anthracene	2.78	ND	NP	ND	NP
Benzo(*a*)anthracene	38.8	ND	NP	ND	NP
Benzo(*a*)pyrene	48.1	ND	NP	ND	NP
Benzo(*b*)fluoranthene	40.9	ND	NP	ND	NP
Benzo(*g,h,i*)perylene	29.5	ND	NP	ND	NP
Benzo(*k*)fluoranthene	49.3	ND	NP	ND	NP
Chrysene	51.4	ND	NP	ND	NP
Di-*N*-octylphthalate	0.22	ND	NP	ND	NP
Fluoranthene	44	ND	NP	ND	NP
Fluorene	0.825	ND	NP	ND	NP
Indeno(*1,2,3-cd*)pyrene	30.7	ND	NP	ND	NP
Naphthalene	0.68	ND	NP	ND	NP
Phenanthrene	8.21	ND	NP	ND	NP
Pyrene	80.6	0.0392	NP	ND	NP
Metals					
Arsenic	2.7[c]	BRBC	NP	ND	NP
Barium	230[c]	BRBC	NP	97	NP
Cadmium	6.1[c]	BRBC	NP	ND	NP
Chromium	18.3[c]	BRBC	NP	10.7	NP
Lead	690[c]	BRBC	NP	BRBC	NP
Mercury	0.13[c]	0.24	NP	ND	NP
Selenium	0.6	1.2	NP	ND	NP
Silver	0.16	BRBC	NP	ND	NP

[a]Constituents detected at the background location (MW1 or MW2) are not considered to be SRCs.
[b]Groundwater from the most recent sampling event (November 2000) was used to determine VOC and SVOC SRCs. Groundwater from the Phase II RFI was used to determine metal SRCs.
[c]Phase I RFI data.
BRBC = Below reference background criteria.
ND = Not detected.
NP = No pathway exists.
RFI = Resource Conservation and Recovery Act.
SRC = Site-related constituent.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

SS2, SS4, SS5, SS6, SS7X, SS8X, and SS9X. Chromium was detected at concentrations above its reference background criterion in GP2, MW1, SS1, SS2, and SS8X. Lead was detected at concentrations above its reference background criterion in MW1, MW2, MW5, and in all the surface samples that included lead as an analyte. Mercury was detected at a concentration above its reference background criterion in SS1. Selenium was detected at concentrations above its reference background criterion in SS5, SS7X, and SS8X. Silver was detected at concentrations above its reference background criterion in MW1 and SS8X.

2.7.2 Subsurface Soil

Four subsurface samples were obtained from Geoprobe borings, and one subsurface sample was taken from each of the monitoring wells during construction. The samples were analyzed for VOCs, SVOCs, and RCRA metals. Methylene chloride and toluene were detected in GP5. Toluene was also detected in MW1. Butanone, acetone, and benzene were all detected in only MW1. Carbon disulfide was detected in MW1 and MW8. Ethylbenzene was detected in MW1 and MW2. Tetrachloroethene and trichloroethene were detected in MW4. Xylenes were detected in MW1 and MW2. Pyrene in MW3 represented the only detection of SVOCs. Mercury and selenium were the only RCRA metals detected at levels above reference values. Mercury was detected at concentrations above its reference background criterion in MW1, MW4, MW5, MW6, MW7, MW8, and MW9. Selenium was detected at a concentration above its reference background criterion in MW7.

2.7.3 Groundwater

All nine monitoring wells were sampled in November 2000. The groundwater samples were analyzed for VOCs, and SVOCs. No SVOCs were detected. This finding is consistent with the results of the previous Phase II sampling event. One VOC, trichloroethene, was detected in shallow well MW4 at a concentration below its MCL.

Groundwater collected for the Phase II sampling event was also analyzed for RCRA metals. Only one metal, chromium, was detected at concentrations above its reference background criterion in the shallow system. Two metals were detected at concentrations above their reference background criteria in the deep groundwater. Chromium and barium were detected at concentrations above their reference background criteria in MW9. Chromium, barium, arsenic, selenium, and lead were detected at concentrations above their reference background criteria in MW2, the background well.

2.8 CONTAMINANT FATE AND TRANSPORT

This section presents the site-specific components of the conceptual site model developed for SWMU 24B and describes the contaminant release mechanisms through the primary transport medium (groundwater). This section also discusses the fate and transport of contaminants at the site with respect to their leachability and natural attenuation. Chapter 6.0 of the revised final Phase II RFI report (SAIC 2000) presents a general discussion on contaminant fate and transport for the 16 SWMUs of which SWMU 24B is a part. This section provides a site-specific extension of Chapter 6.0 for SWMU 24B.

2.8.1 Generic Soil Screening Analysis

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

The site characterization identified inorganic and organic SRCs in surface and subsurface soil. Seven VOCs, 17 SVOCs, and eight metals were identified as SRCs in soil. These constituents were compared to EPA generic soil screening levels (GSSLs; EPA 1996a) to determine if these constituents might leach from soil into groundwater at concentrations exceeding groundwater standards [i.e., concentrations that exceed the MCL or, in the absence of an MCL, the risk-based concentration (RBC) for drinking water (EPA 1996b)].

Based on the soil screening analysis, methylene chloride, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*k*)fluoranthene, and indeno(*1,2,3-cd*)pyrene were detected at concentrations that exceeded their respective GSSLs and were indicated as contaminant migration constituents of potential concern (CMCOPCs) in soil based on leaching to groundwater. None of the organic CMCOPCs were detected in the groundwater monitoring wells. Of the metal SRCs, arsenic, barium, cadmium, chromium, lead, mercury, and selenium were detected at concentrations that exceeded their respective GSSLs. Only barium and chromium were detected in groundwater monitoring wells at levels above their reference background criteria.

2.8.2 Fate and Transport Modeling

Fate and transport modeling was performed to quantitatively assess the risks associated with exposure to the CMCOPCs in soil. Only groundwater modeling was performed. Surface water is not present at this site. Shallow surficial groundwater might intercept the man-made drainage ditch located approximately 500 feet to the west. The deep groundwater flow might intercept a tributary to Mill Creek approximately 1,200 feet to the southwest.

Fate and transport modeling was performed for all the contaminant migration constituents of concern (CMCOCs), human health constituents of potential concern (HHCOPCs), and ecological constituents of potential concern (ECOPCs). A general discussion of the modeling efforts is presented in Chapter 6.0 and Appendix G of the revised final Phase II RFI report (SAIC 2000) and Attachment B of the addendum to the revised final Phase II RFI report (SAIC 2001), and the site-specific model parameters and results are discussed in Appendix A of this CAP. The leachate from the contaminant source in the soil to the interface between the vadose zone and the water table was modeled using the Seasonal Soil Compartment (SESOIL) Model. Starting with the leachate obtained from the SESOIL Model, saturated flow and contaminant transport were modeled using the Analytical Transient 1-, 2-, 3-Dimensional (AT123D) Model to predict the maximum groundwater concentration directly beneath the source. The measured or modeled concentration in groundwater, whichever was greater, of a constituent was selected. Thereafter, the AT123D Model was used to predict the concentration of the constituent over a distance from the source and the time to achieve the remedial level over the distance. The remedial levels (i.e., target groundwater concentrations) for the CMCOCs in groundwater were identified in the baseline human health risk assessment (BHHRA) for SWMU 24B [see Table 33 of the addendum to the revised final Phase II RFI report (SAIC 2001)]. These levels were based on MCLs or on RBCs, if no MCL was available.

The model was also used to predict natural attenuation in soil. Benzo(*a*)anthracene, benzo(*b*)fluoranthene, and indeno(*1,2,3-cd*)pyrene are expected to degrade to their respective remedial levels in soil in 4 years from the sampling date (October 1999), while benzo(*a*)pyrene is expected to degrade to its remedial level in soil in 8.5 years from October 1999. The results are summarized in Table 2-2. Cadmium, chromium, and lead will remain below their respective remedial levels in groundwater for at least 1,000 years from 1999.

Although the modeling results predicted up to 8.5 years from October 1999 for benzo(*a*)pyrene to achieve its remedial level in soil through natural attenuation, the prediction was probably overestimated. The assumptions used by the model were highly conservative(i.e., the lowest biodegradation rate available in the literature was used in the calculations, and the maximum detected concentration was used as the representative soil concentration): therefore, the predicted soil concentrations, as well as the time required to attenuate, were probably overestimated.

Table 2-2. Natural Attenuation for Organics from Modeling, SWMU 24B

Constituents of Concern	Maximum Concentration (mg/kg)	Sample Date	Time to Attenuate (Years from Sample Date)
Benzo(*a*)anthracene	38.8	October 1999	4
Benzo(*a*)pyrene	48.1	October 1999	8.5
Benzo(*b*)fluoranthene	40.9	November 2000	4
Indeno(*1,2,3-cd*)pyrene	30.7	October 1999	4

2.9 PRELIMINARY RISK EVALUATION

2.9.1 Human Health Preliminary Risk Evaluation

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

- HHCOPCs for surface soil include arsenic, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, benzo(*k*)fluoranthene, indeno(*1,2,3-cd*)pyrene, and lead.

- No HHCOPCs were identified in subsurface soil [see Table 18 of the addendum to the revised final Phase II RFI report (SAIC 2001)]

- Trichloroethene was identified as the only HHCOPC in groundwater.

- A baseline human health risk assessment (BHHRA) (see Section 2.10) was performed to quantitatively assess the risks associated with exposure to the HHCOPCs in surface soil and groundwater.

2.9.2 Ecological Preliminary Risk Evaluation

The Phase II RFI performed an ecological preliminary risk evaluation (EPRE) for potential terrestrial and aquatic receptors [see Chapter 8.0 of the addendum to the revised final Phase II RFI report (SAIC 2001)]. The EPRE for SWMU 24B identified ECOPCs in surface soil [benzo(*k*)fluoranthene, benzo(*a*)pyrene, pyrene, cadmium, chromium, selenium, and lead). No ECOPCs were identified in groundwater based on a comparison of their maximum site concentrations to EPA Region IV ecological screening values (EPA 1996c). Di-*N*-octylphthalate was carried forward as an ECOPC in surface soil because no toxicity reference value was available for that compound for comparison. The results of the EPRE are summarized below.

The average daily doses calculated using a realistic diet, the site-specific area use factor, and the mean surface soil concentrations of ECOPCs do not exceed the lowest observed adverse effects level–based toxicity reference values, and the sum of the hazard quotients is less than 1. Therefore, ECOPCs in surface soil at SWMU 24B do not pose a risk to wildlife receptors.

Fate and transport modeling was performed to estimate the future concentrations of barium in deep surficial groundwater at the nearest surface water body, a tributary to Mill Creek. The model predicted no barium would reach the surface water. Therefore, barium in deep groundwater at SWMU 24B does not pose a risk to aquatic biota.

In summary, the addendum to the revised final Phase II RFI report (SAIC 2001) concluded that there was no present ecological risk at SWMU 24B and that the site was unlikely to pose an ecological risk in the future.

2.10 BASELINE HUMAN HEALTH RISK ASSESSMENT

The HHCOPCs for this site consisted primarily of polycyclic aromatic hydrocarbons (PAHs). The BHHRA addressed the risks associated with exposure to the following constituents: arsenic (surface soil), benzo(*a*)anthracene (surface soil), benzo(*a*)pyrene (surface soil), benzo(*b*)fluoranthene (surface soil), benzo(*g,h,i*)perylene (surface soil), benzo(*k*)fluoranthene (surface soil), indeno(*1,2,3-cd*)pyrene (surface soil), trichloroethene (groundwater), and lead (surface soil).

The CMCOPCs in soil included five PAHs [benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*k*)fluoranthene, and indeno(*1,2,3-cd*)pyrene], seven metals (arsenic, barium, cadmium, chromium, lead, mercury, and selenium), and the VOC methylene chloride. Based on the results of the leachate modeling, none of the CMCOPCs is likely to migrate in concentrations that might present a significant risk to human health; therefore, the potential risks associated with these CMCOPCs leaching to groundwater were not quantified.

Groundwater modeling and analysis concluded that trichloroethene (an HHCOPC) in groundwater would not migrate to surface water.

The potential risks associated with exposure to lead were quantified based on the blood-lead levels resulting from exposure to lead in various media. The potential risks associated with exposure to lead were quantified using the Integrated Exposure Uptake Biokinetic Model for Lead in Children (EPA 1994a). Benzo(*g,h,i*)perylene does not have a reference dose (RfD) value, so the RfD for pyrene was used as a surrogate value (TPHCWG 1997). Given that a surrogate RfD value was used to assess the risk for benzo(*g,h,i*)perylene, the risk values for this constituent were addressed separately from those of other constituents, and the risk values were not used to estimate the total risk for the receptor populations.

The remaining preliminary CMCOPCs [benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*k*)fluoranthene, indeno(*1,2,3-cd*)pyrene, arsenic, barium, cadmium, chromium, lead, mercury, selenium, and methylene chloride] were not considered to be CMCOPCs based on the results of the leachate modeling and were not evaluated further for the groundwater medium.

The current on-site receptor is represented by an Installation worker. There are no current off-site receptor populations. Future receptor populations include an Installation worker and a resident. These receptors represent both on-site and off-site receptor populations and might be exposed to constituents of potential concern (COPCs) in surface soil and groundwater. In addition, other future off-site receptors include a juvenile wader and a sportsman. These receptors might be exposed to COPCs that have migrated to surface water.

The results of the quantitative risk characterization concluded that the following constituents are constituents of concern (COCs) in surface soil: benzo(*a*)pyrene, benzo(*a*)anthracene, benzo(*b*)fluoranthene, indeno(*1,2,3-cd*)pyrene, benzo(*k*)fluoranthene, and arsenic.

Benzo(*a*)pyrene was identified as a COC in surface soil based on the current and future on-site Installation worker, future on-site juvenile trespasser, and both future on-site residential scenarios (adult and child). The following PAHs were identified as COCs in surface soil based on the current and future on-site Installation worker and both future on-site residential scenarios: benzo(*a*)anthracene, benzo(*b*)fluoranthene, and indeno(*1,2,3-cd*)pyrene. Arsenic and benzo(*k*)fluoranthene were identified as COCs in surface soil based on exposure of the future on-site residents.

Remedial levels were derived for all of the constituents identified as COCs. If a constituent was identified as a COC in more than one environmental medium, separate remedial levels were derived for each medium.

Human Health Constituents of Concern. The selection of the recommended remedial level for groundwater took into consideration the MCLs, risk-based remedial levels, and reference background concentrations of inorganics. The risk-based levels [incremental lifetime cancer risk (ILCR) = 1.0×10^{-5}] for arsenic (5.96 mg/kg), benzo(*a*)anthracene (8.93 mg/kg), benzo(*a*)pyrene (0.89 mg/kg), benzo(*b*)fluoranthene (8.93 mg/kg), benzo(*k*)fluoranthene (89.3 mg/kg) and indeno(*1,2,3-cd*)pyrene (8.93 mg/kg) are the recommended remedial levels for those contaminants in soil. The maximum detected concentration of arsenic was 2.7 mg/kg, which is below the recommended remedial level; therefore, no further investigation or study was required to address arsenic in soil. The maximum detected concentration of benzo(*k*)fluoranthene was 49.3 mg/kg, which is below the recommended remedial level; therefore, no further investigation or study was required to address benzo(*k*)fluoranthene in soil.

Figure 2-6 presents the locations of soil samples containing human health constituents of concern (HHCOCs) at concentrations exceeding the remedial levels. The HHCOCs, all SVOCs, are unlikely to have been generated by activities conducted at the Old Radiator Shop/Paint Booth. No samples were obtained under the slab of Building 1056; therefore, no information is available regarding whether the soil beneath the building may contain paint-booth-related constituents.

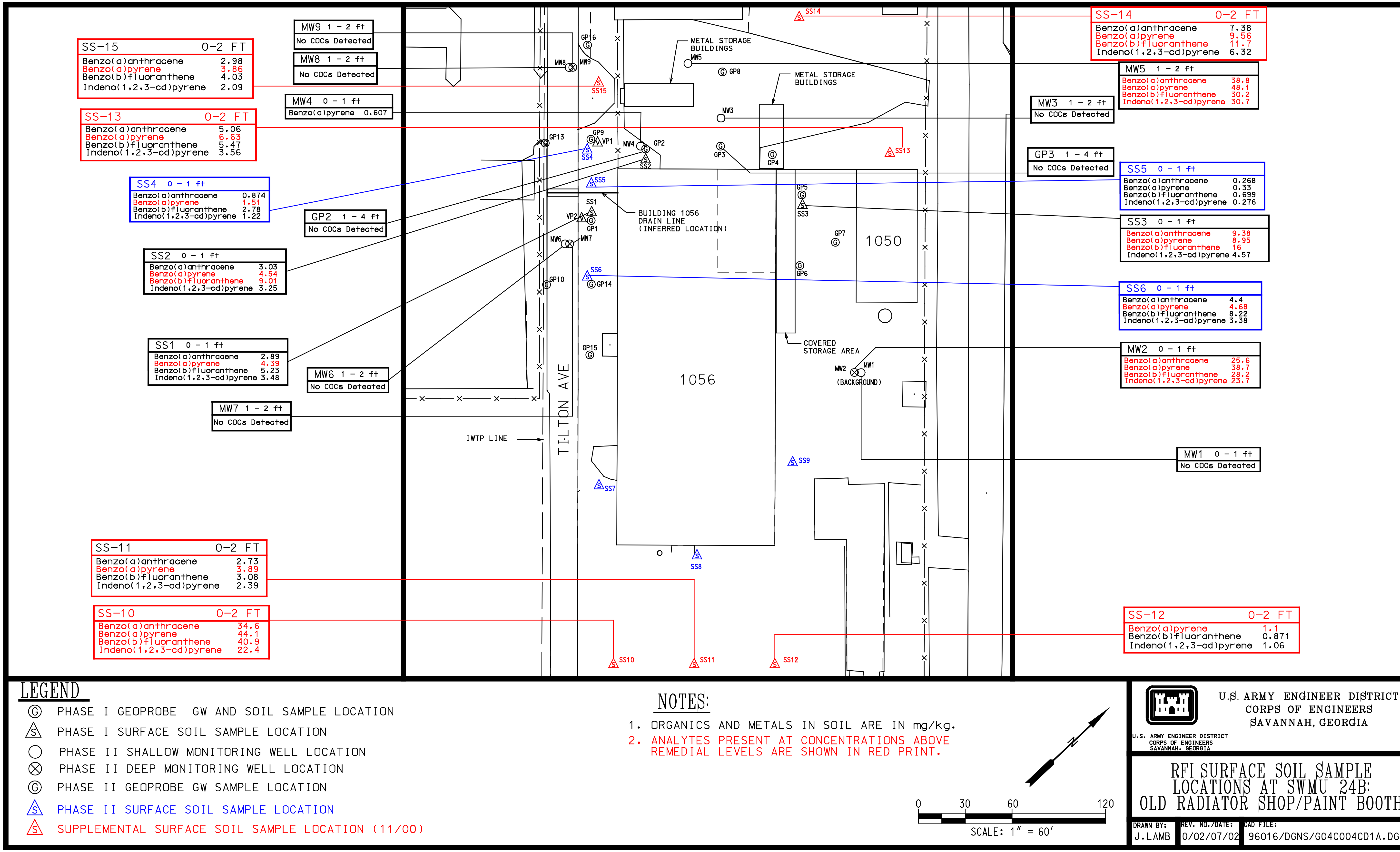

Figure 2-6. Sample Locations above COC Remedial Levels at SWMU 24B

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3.0 JUSTIFICATION AND 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 1994b). 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 the releases so as to reduce or eliminate, to the extent practicable, further releases that might 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

Due to the presence of SVOCs in the surface soil surrounding Building 1056 at concentrations exceeding the risk-based levels, corrective action is warranted at the Old Radiator Shop/Paint Booth. Although the SVOCs are not believed to be from an industrial process that resulted in systematic and routine releases, a corrective action will be undertaken at SWMU 24B because the site is listed in the Hazardous and Solid Waste Amendments permit number HW-045 (S&T). SVOCs are a common soil constituent in heavily industrialized areas because a large number of activities can generate them. These activities include asphalt paving, equipment lubricants, dust suppression, and combustion processes. The extent of SVOC contamination does not appear to be confined to the area immediately surrounding SWMU 24B, but may be ubiquitous throughout the industrialized area of the reservation. Consequently, the physical boundaries of Building 1056 and the area contiguous to it will be used to bound the SWMU for the purposes of this corrective action. This area is illustrated in Figure 3-1. Because the SVOC contaminants identified as requiring a corrective action have not been linked to a systematic or routine release from operations specifically at SWMU 24B, areas outside of the defined SWMU boundary will not be addressed. The remedial objective is to minimize human contact with surface soil containing SVOCs at concentrations greater than the remedial levels within the boundaries of the SWMU and to monitor groundwater for process-related COCs. Building 1056 is scheduled to be removed. Once the building is gone, the soil beneath the building slab can be sampled and evaluated.

3.3 IDENTIFICATION OF REMEDIAL LEVELS

Remedial levels were derived for the COCs identified in the *Addendum for SWMU 24B: Old Radiator Shop/Paint Booth to the Revised Final Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, Georgia* in Section 9.7.2 (SAIC 2001). The COCs were identified because direct contact with the soil presents an unacceptable risk to potential future residents. The remedial levels for all the COCs are protective of the hypothetical future resident; however, it is recognized that future residential exposure is highly unlikely. The remedial levels are based on an ILCR of 1×10^{-5}. The remedial levels for these COCs are presented in Table 3-1.

Table 3-1. Remedial Levels for COCs at SWMU 24B

COC	COC Type	Remedial Level (mg/kg)	Basis
Benzo(*a*)pyrene	HHCOC	0.89	ILCR = 1×10^{-5}
Benzo(*a*)anthracene	HHCOC	8.93	ILCR = 1×10^{-5}
Benzo(*b*)fluoranthene	HHCOC	8.93	ILCR = 1×10^{-5}
Indeno(*1,2,3-cd*)pyrene	HHCOC	8.93	ILCR = 1×10^{-5}

COC = Constituent of concern.
HHCOC = Human health constituent of concern.
ILCR = Incremental lifetime cancer risk.
SWMU = Solid waste management unit.

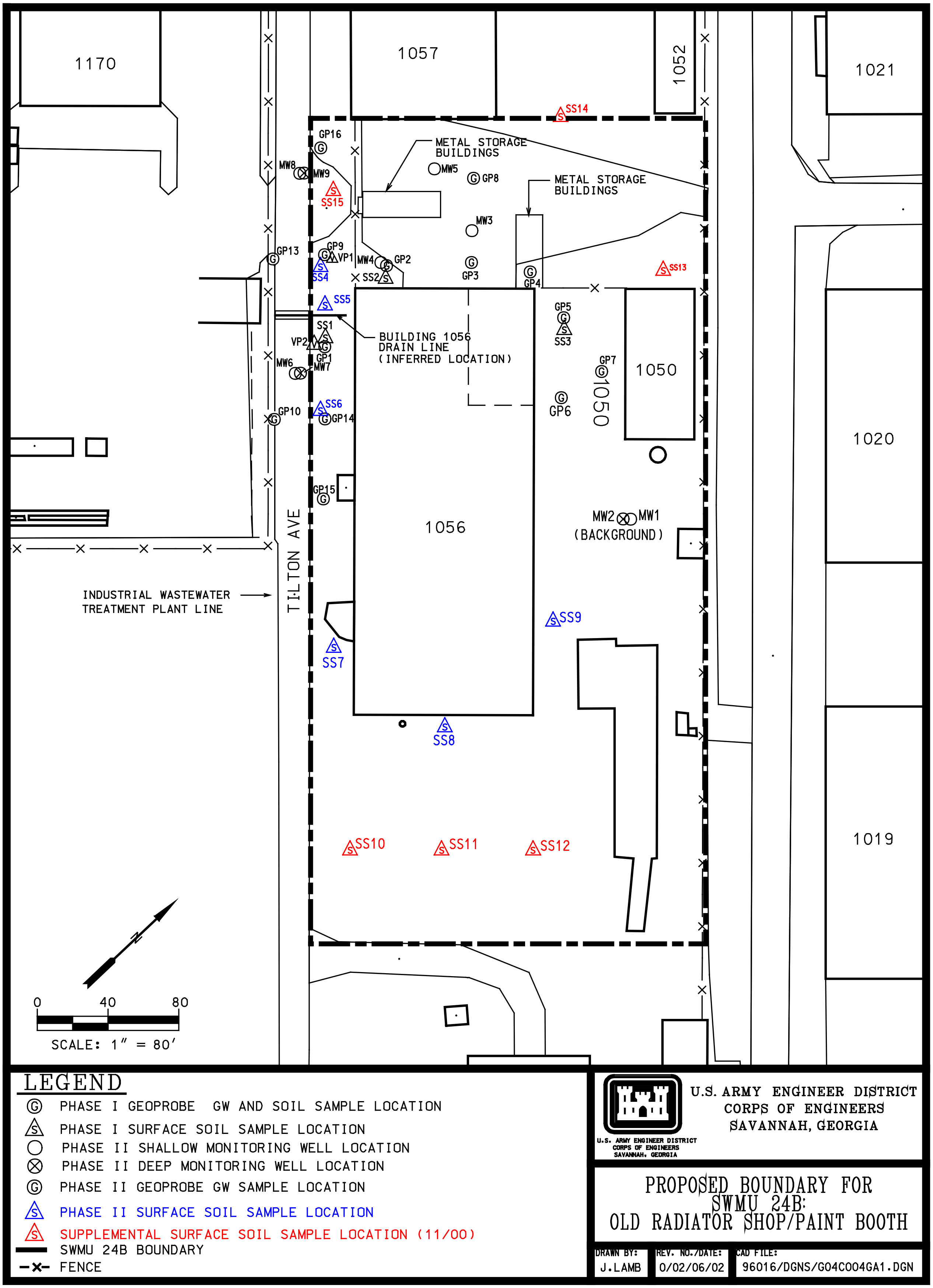

Figure 3-1. Proposed Boundary for SWMU 24B

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4.0 SCREENING OF CORRECTIVE ACTIONS

This section presents the identification of technologies applicable for the remediation at SWMU 24B, the Old Radiator Shop/Paint Booth, and screens the technologies with respect to effectiveness, implementability, and cost. The technologies retained following screening are then combined into corrective action alternatives that address the COCs at the site. These alternatives are then evaluated with respect to the attainment of remedial objectives and minimization of the total 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. Technologies that pass the initial screening phase will be retained for subsequent evaluation as corrective actions.

The technologies are evaluated using three general criteria: effectiveness, implementability, and cost. An explanation of each criterion is provided below.

4.1.1 Effectiveness

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

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 also are 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 considering the material components of the proposed technologies and the locations and quantities of those materials. Administrative factors include ease of obtaining permits, enforcing deed restrictions, or maintaining long-term control of the site.

4.1.3 Cost

Relative costs are included for each corrective action technology to facilitate evaluation and comparison among the alternatives. Detailed cost estimates are not prepared at this screening stage. Potentially applicable technologies are identified in Table 4-1.

Table 4-1. Evaluation of Corrective Actions/Technologies, SWMU 24B

Action/ Technology	Description	Effectiveness	Implementability	Costs
No Action	The "no action" alternative provides a baseline against which other actions can be compared. Under the no action alternative, the site would be left "as is," without implementing any removal, treatment, or other mitigating actions to reduce existing or potential future exposure.	This alternative would not address the remedial response objectives of the site. It would not provide protection of human health or the environment because existing hazards would not be ameliorated. No significant reduction in contaminant concentration would be expected.	There are no impediments to implementation of this alternative because no action is taken. This technology would not present an impediment to future remedial actions.	There would be no cost associated with the no action alternative.
Institutional Controls and Groundwater Monitoring	Technologies associated with institutional controls would reduce potential hazards by limiting exposure of humans to contaminated soil. Excavation permit restrictions would prohibit any construction at the site that might disturb the soil. Access to the site would be controlled to minimize the potential for contact with contaminated soil. Groundwater would be monitored to ensure that contaminants do not migrate.	This technology alone would not reduce concentrations to the remedial levels. The purpose of implementing this technology would be to reduce risk to human health by reducing exposure and to monitor the effectiveness of the technology at protecting groundwater. This technology would effectively protect human health and the environment by minimizing exposure within the boundaries of the site. No significant reduction in contaminant concentration would be expected as a result of implementing this technology.	Very few factors limit implementability of institutional controls. Materials and services for the installation and periodic sampling and analysis of monitoring wells are readily available. The property will remain under federal ownership in the near future. Deed restrictions limiting future uses to industrial development could be imposed if the site is transferred from federal ownership in the future, which is highly unlikely. This alternative is readily implementable. This technology would not present an impediment to future remedial actions.	Low.
Monitored Natural Attenuation	This action would require the monitoring of contaminant levels to ensure that the mass of contamination is being reduced over time in accordance with OSWER Directive 9200.4-17P	Natural attenuation through biodegradation can be effective. Biodegradation of SVOCs is typically rather slow. Modeling has indicated that it would require approximately 8.5 years from October 1999 to successfully achieve the site remedial levels for SVOCs.	This alternative is readily implementable. Confirmatory (1 year after the completion of the attenuation period) soil sampling would be required. Effectiveness might be difficult to demonstrate due to the sporadic distribution of the contamination. This technology would present no impediment to future remedial actions.	Low; confirmatory (1 year after completion of the attenuation period) soil sampling would be required.

Table 4-1. Evaluation of Corrective Actions/Technologies, SWMU 24B (continued)

Action/ Technology	Description	Effectiveness	Implementability	Costs
Capping	Normally, capping is a containment technology that places surface barriers over contaminated soil to reduce the amount of water that infiltrates through the soil and prevent contact with the soil. In this case, the cap would be designed to eliminate direct human contact with the soil. Caps to prevent contact with the soil can be made of clay, asphalt, concrete, or Portland cement. Geosynthetic materials such as geomembranes and geotextiles are frequently used with caps to enhance their effectiveness.	This technology would not reduce contaminant concentrations to the remedial levels. Capping would achieve the objectives by inhibiting the exposure pathway, thereby eliminating the risk to human health from exposure to site soil. Asphaltic caps could release SVOCs, increasing the concentration in soil beneath the cap and partially defeating the purpose of the cap by allowing continued contact with SVOCs on its surface. Natural attenuation would continue under a cap, possibly at a slower rate, however, because of reduced air (oxygen) and water (precipitation) migration from the surface.	The equipment and services required to install a cap are readily available. The cap would have to be removed if additional actions were deemed necessary in the future.	High.
In Situ Treatment	A number of in situ treatment technologies are available for treating SVOCs in soil. These technologies are typically methods of increasing biological degradation of the organic contaminants and include bioventing, specialized bacteria addition, and tilling. Bioventing would reduce contaminants by providing increased oxygen to encourage biodegradation. Inoculation of soil with specialized bacteria has been proposed for several SWMUs at Fort Stewart. Specialized bacteria and nutrients in highly concentrated solutions and specific to biodegrading SVOCs would be injected or mixed with the surface soil. Tilling would reduce the concentration of the contaminants by enhancing bioremediation by more evenly distributing microorganisms and potential nutrients through the contaminated soil column. In addition, nutrients could be tilled into the soil at the same time to further encourage biodegradation.	Bioventing is effective for remediation of organic chemicals in soil; however, SVOCs in soil at SWMU 24B are already in an aerobic environment. The contaminants are located in the surface soil (0 feet to 2 feet bgs), which tends to remain oxygenated. Consequently, bioventing is unlikely to significantly increase natural attenuation. Tilling has been proven to be effective for organic contaminants in surface soil. The effectiveness of the treatment is dependent on the ability to aerate soil in place at the level of contamination. Inoculation with specialized bacteria would accelerate biodegradation of the SVOCs. Nutrients would need to be supplied along with the bacteria.	The equipment is readily available for any of the in situ technologies. The physical obstructions in the area would make implementation of tilling difficult Specialized bacteria would be difficult to disperse because of the sporadic distribution of the SVOCs. A UIC permit would be required for injection of air, bacteria, and/or nutrients.	Moderate.

Table 4-1. Evaluation of Corrective Actions/Technologies, SWMU 24B (continued)

Action/ Technology	Description	Effectiveness	Implementability	Costs
Excavation	Excavation is a method of removing contaminated surface and subsurface soil from hazardous waste sites by scraping, cutting, digging, or scooping using mechanical equipment (e.g. backhoes, excavators, etc.)	Excavation is very effective because contaminated materials are physically removed from the site. Contaminant concentrations in the soil would be reduced to their remedial levels.	Dry to moist earth, gravel, or other non-rock materials above the water table near the surface are easy to excavate and remove from the site. Excavation is a standard construction practice, and adequate materials and services are available to implement this technology. Future remedial actions would not be necessary because the contaminants would be removed from the site.	Moderate capital with minimal O&M costs.

bgs = Below ground surface.
O&M = Operations and maintenance.
OSWER = Office of Solid Waste and Emergency Response.
SVOC = Semivolatile organic compound.
SWMU = Solid waste management unit.
UIC = Underground Injection Control.

4.2 EVALUATION OF CORRECTIVE ACTION TECHNOLOGIES

Six categories of corrective actions were identified: (1) no action, (2) institutional controls, (3) monitored natural attenuation, (4) capping, (5) in situ treatment, and (6) excavation. The no action alternative was not considered to be viable because of the need to respond to risks from constituents within the boundaries of the SWMU, even though the constituents are not thought to have originated from the processes identified as occurring at this site. Monitored natural attenuation was not considered to be viable as a stand-alone remedy because of the difficulty inherent in monitoring soil contamination having the sort of sporadic distribution as seen around SWMU 24B. Uncertainties with respect to the effectiveness of in situ treatments for these SVOCs eliminated such treatments from further consideration. In addition, the sporadic distribution of the SVOCs in the surface soil would make effective application of in situ remedies problematic. Capping and excavation were retained as alternatives. Capping would reduce exposure to the SVOCs in surface soil. An asphalt cap was removed from consideration due to the potential of introducing additional SVOCs as discussed in Table 4-1. Concrete was selected as the capping material because it is ready available, has a long life, and can be integrated with any future construction projects in the area. Upon implementation, excavation removes the contaminants from the site and eliminates any future risk.

4.3 CORRECTIVE ACTION ALTERNATIVES

The technologies retained following the screening step were arranged in various combinations to develop alternatives that would meet the remedial response objectives. The three alternatives listed below were identified for possible implementation to address the contamination in the soil.

- Alternative 1: Institutional Controls and Groundwater Monitoring
- Alternative 2: Concrete Cap with Institutional Controls and Groundwater Monitoring
- Alternative 3: Excavation with Institutional Controls and Groundwater Monitoring

SWMU 24B as well as other structures in the area around the SWMU are scheduled for demolition followed by construction of new maintenance facilities. (Note: The timeline is subject to the availability of federal funds.) The new facilities are still in the design phase; however, the timeframe for demolition of the existing facilities and construction of the new facilities has been estimated to begin in about 5 years. The demolition of SWMU 24B and construction of new facilities in the area were considered and coordinated with the conceptual design of each of the corrective action alternatives.

4.3.1 Evaluation Factors

Based on the results of the technology screening, each of the retained technologies is considered applicable to the site, implementable, and cost effective; therefore, two primary evaluation factors were used in the selection of the preferred corrective action alternative: attainment of remedial objectives and life-cycle cost.

Meeting the Remedial Response Objectives

Remedies were required to meet the remedial response objectives presented in Chapter 3.0. These objectives determined the extent of and technical approaches to each remedy. Each alternative was evaluated on how well it met these objectives.

Life-Cycle Cost

The life-cycle cost estimates are budgetary estimates based on conceptual designs and are used solely for comparison purposes. Costs were estimated for capital construction and for O&M. Cost estimates were derived from current information, including vendor quotes, conventional cost estimating guides (e.g., Means 2002a and Means 2002b), and costs associated with similar projects. The actual cost 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 was initiated. The life-cycle cost estimates were not adjusted to present worth costs, and no escalation factors were applied. Appendix B presents a summary of the life-cycle cost estimates for each alternative.

4.3.2 Evaluation of Corrective Action Alternatives

The three corrective action alternatives are summarized in Table 4-2, along with an evaluation of how well each alternative meets the remedial action objectives and its associated life-cycle costs. Current plans for the site include demolition of Building 1056 within the next 5 years; therefore, Alternatives 2 and 3 would not be initiated until the building had been removed so that the area beneath the building slab could be incorporated into the remedial action. Institutional controls would be maintained for Alternatives 2 and 3 throughout this interim period to prevent inadvertent contact with the soil. All of the alternatives would include the common features described below.

- Groundwater monitoring would be conducted on a biannual basis (every other year) until Building 1056 was demolished (scheduled to occur within the next 5 years) because of the potential for contaminants in soil under the slab to migrate to groundwater. Groundwater monitoring would consist of low-flow sampling of the six shallow surficial groundwater wells (MW1, MW3, MW4, MW5, MW6, and MW8). The groundwater samples would be analyzed for VOCs, SVOCs, and RCRA metals (Figure 4-1). Although VOCs and RCRA metals are not COCs at the site, they are the classes of chemicals most likely to be associated with the paint booth and, therefore, the most likely to be present under the building slab.

- A CAP progress report would be issued annually to report the results of site inspection and maintenance. In years in which groundwater monitoring was performed (biannually), the CAP progress report would include the results of the groundwater monitoring.

- Following building demolition, soil under the slab would be sampled and analyzed for VOCs, SVOCs, and RCRA metals. Following analysis of the data from soil collected under the slab, an addendum to this CAP would be prepared recommending additional actions and/or monitoring based on the new data and coordinating these actions with the final construction design and schedule.

The paragraphs below describe each of the corrective action alternatives and summarize their evaluations.

Alternative 1: Institutional Controls and Groundwater Monitoring

This alternative would provide for the implementation of land use controls during the U.S. Department of Defense's ownership through enforcement by the Fort Stewart Directorate of Public Works (DPW) for 9 years from 1999. Nine years was selected because modeling (see Section 2.8.2) indicated that benzo(*a*)pyrene would require the most time, 8.5 years from October 1999, to biodegrade to concentrations below proposed remedial levels. The institutional controls would include restrictions precluding soil excavation and groundwater use below the site. Signs warning of the contamination would be posted along Tilton Avenue and along existing fences around the site. The proposed locations of the signs are presented in Figure 4-1. Biannual groundwater monitoring, as previously described in the list of

Table 4-2. Evaluation of Corrective Action Alternatives, SWMU 24B

Corrective Action	Description	Ability to Meet Remedial Objectives	Cost	Comments
Alternative 1: Institutional Controls and Groundwater Monitoring	Restrictions would be imposed precluding excavation. Signs would be posted along Tilton Avenue and on the fence warning of the contaminated soil. This alternative would include maintenance of existing fences and pavement.	Would be effective only as long as controls were enforced. Would not physically prevent direct exposure to soil contaminants. Contaminant concentrations in soil would remain unchanged by implementation of this alternative; however, contaminants would be expected to biodegrade during the period in which institutional controls were maintained.	$286,000	Institutional controls would be maintained for 9 years from RFI sampling (September 1999). Decision would be revisited by an addendum to this CAP following soil sampling under Building 1056 slab.
Alternative 2: Concrete Cap with Institutional Controls and Groundwater Monitoring	Following building demolition, the site would be covered with a 4-inch-thick concrete cap. The concrete cap would be integrated into the design of the new maintenance facilities proposed for the area (e.g., parking lot, building slab).	Direct exposure to soil would be prevented by covering soil with cap. Contaminant concentrations in soil would be unchanged. Biodegradation rate might be reduced due to lower moisture and oxygen content in soil under cap. Depending on the time until building demolition, removal objectives could have already been met through natural attenuation before implementation of the remedy.	$648,000	More aggressive response than Alternative 1. Would provide a physical barrier to exposure.
Alternative 3: Excavation with Institutional Controls and Groundwater Monitoring	The entire site would be excavated to achieve the media cleanup standards in the shortest period of time. The excavation of the soil would be performed after the demolition of Building 1056 and prior to construction of new maintenance facilities proposed for the area.	Would be the most effective at achieving objectives. Removing contaminated soil would eliminate potential for exposure. Would meet media cleanup standards. Excavation might not be required if remedial objectives were met by natural attenuation prior to implementation.	$404,000	Most aggressive response. Only alternative that would directly reduce concentrations to remedial levels. Volume (and cost) is likely to be less because it is currently based on 1999 data.

CAP = Corrective Action Plan.
RFI = Resource Conservation and Recovery Act facility investigation.

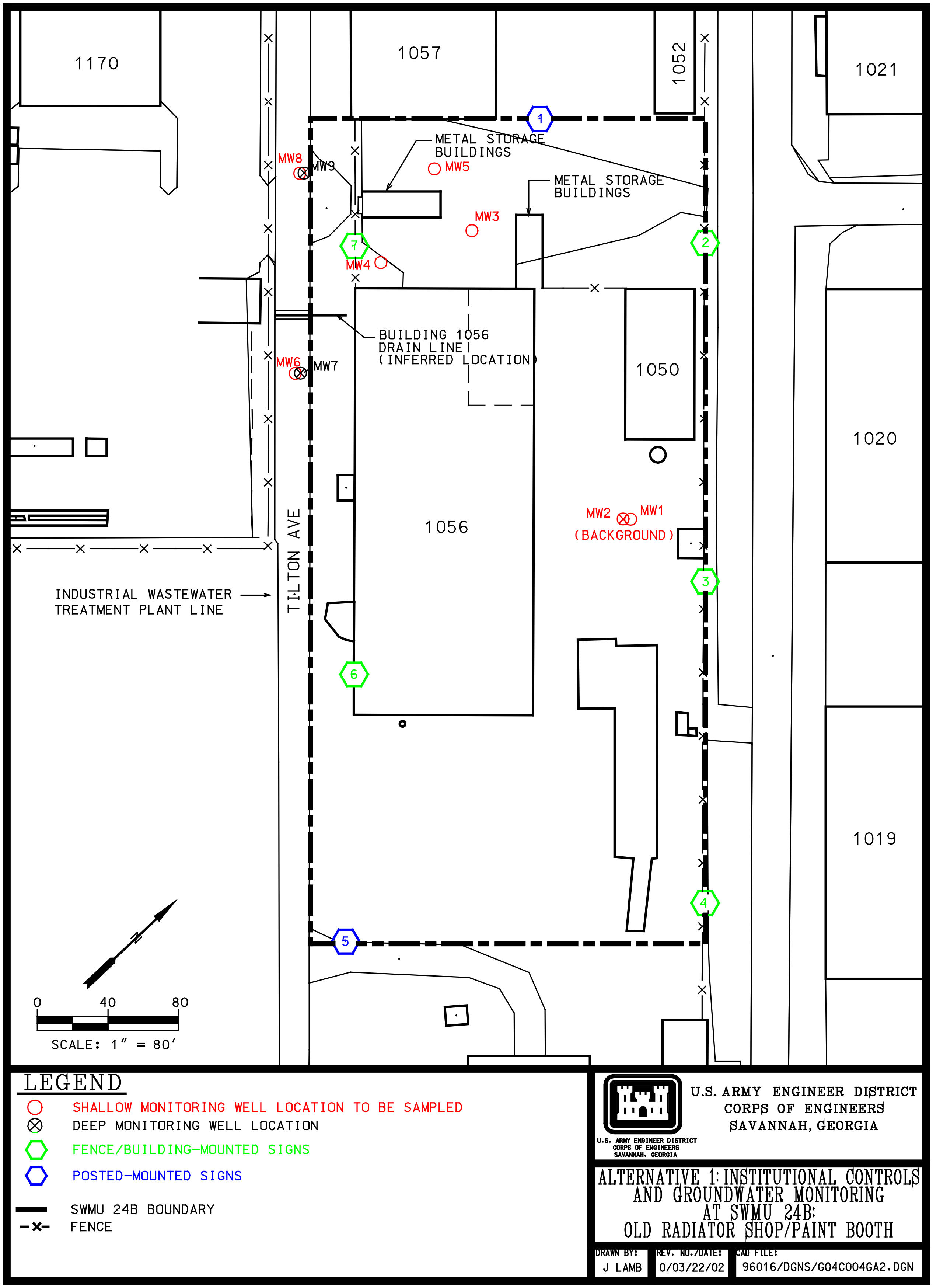

Figure 4-1. Alternative 1: Institutional Controls and Groundwater Monitoring for SWMU 24B

features common to all alternatives, would be implemented until the demolition of Building 1056 (expected to be 5 years) and the sampling of soil under the building footprint. The results of the soil sampling would be published in a CAP addendum, which would determine whether any additional action was required. At this time institutional controls in Alternative 1 last only 1 year longer than those in Alternatives 2 and 3.

Confirmatory surface soil sampling would be conducted after October 2008 (9 years from October 1999) to determine if concentrations of COCs in surface soil were below the remedial levels. The results of the confirmatory sampling would be presented in the annual CAP progress report.

Warning signs and existing fencing would be inspected annually and repaired and/or replaced as needed; as outlined in the O&M Plan. An annual CAP would be issued documenting the inspection and/or repair of signs and existing fencing for the life of the institutional controls. The results of the groundwater monitoring would be presented biannually in the CAP progress report.

This alternative would meet the remedial objective of minimizing human contact with soil by restricting land use through access controls. It would not reduce the concentrations of contaminants to the remedial levels(other than by natural attenuation) and would have the greatest uncertainty of all the alternatives with respect to achieving the objectives because it would require a continuing commitment on the part of the Installation to enforce institutional controls at the site. This alternative would not actively remove the COCs; however, it would prevent their ingestion and dermal absorption and allow natural attenuation to occur.

This would be the least expensive of the three alternatives with a life-cycle cost of approximately $286,000.

Alternative 2: Concrete Cap with Institutional Controls and Groundwater Monitoring

Following demolition of Building 1056 and other structures at the site, a 4-inch-thick concrete cover would be constructed on a gravel base, which could be integrated into future-use plans as a building slab or parking area. The proposed area of the concrete cap is delineated by the site boundaries shown in Figure 4-2. The institutional controls as described in Alternative 1 would be implemented during the period between approval of this CAP and the removal of Building 1056. The results of the soil sampling from beneath the building would be presented in either the annual CAP progress report or the addendum to the CAP. The addendum to the CAP would refine the concrete cap alternative (whether the cap is still needed), integrating/coordinating the alternative with the planned construction activities in the area. At a minimum the following items would be evaluated: potential abandonment of the wells, institutional controls, final cap cover, and updated cost. The concrete cover/parking area would be designed to divert runoff from the concrete cover into the FSMR stormwater drainage system. Annual inspection and repair of cracks would be the only required maintenance activity for the concrete cap.

Warning signs and existing fencing would be inspected annually and repaired and/or replaced as outlined in the O&M Plan during the interim period between the removal of Building 1056 and implementation of this alternative. An annual CAP progress report would be issued documenting the inspection and/or repair of signs and existing fencing. The results of the biannual groundwater monitoring would be presented in the CAP progress report.

The concrete cover would achieve the remedial objectives by providing a barrier to direct contact with the soil. Although it would not actively reduce the concentrations of the COCs to the remedial levels, it would prevent contact with soil, thereby removing the soil ingestion, dermal absorption, and inhalation pathways. This alternative might be more effective in achieving the remedial objectives than Alternative 1 because it would provide a physical barrier to direct soil contact. However, its degree of protectiveness would be dependent on the maintenance of the concrete surface. Even if maintenance ceased at some

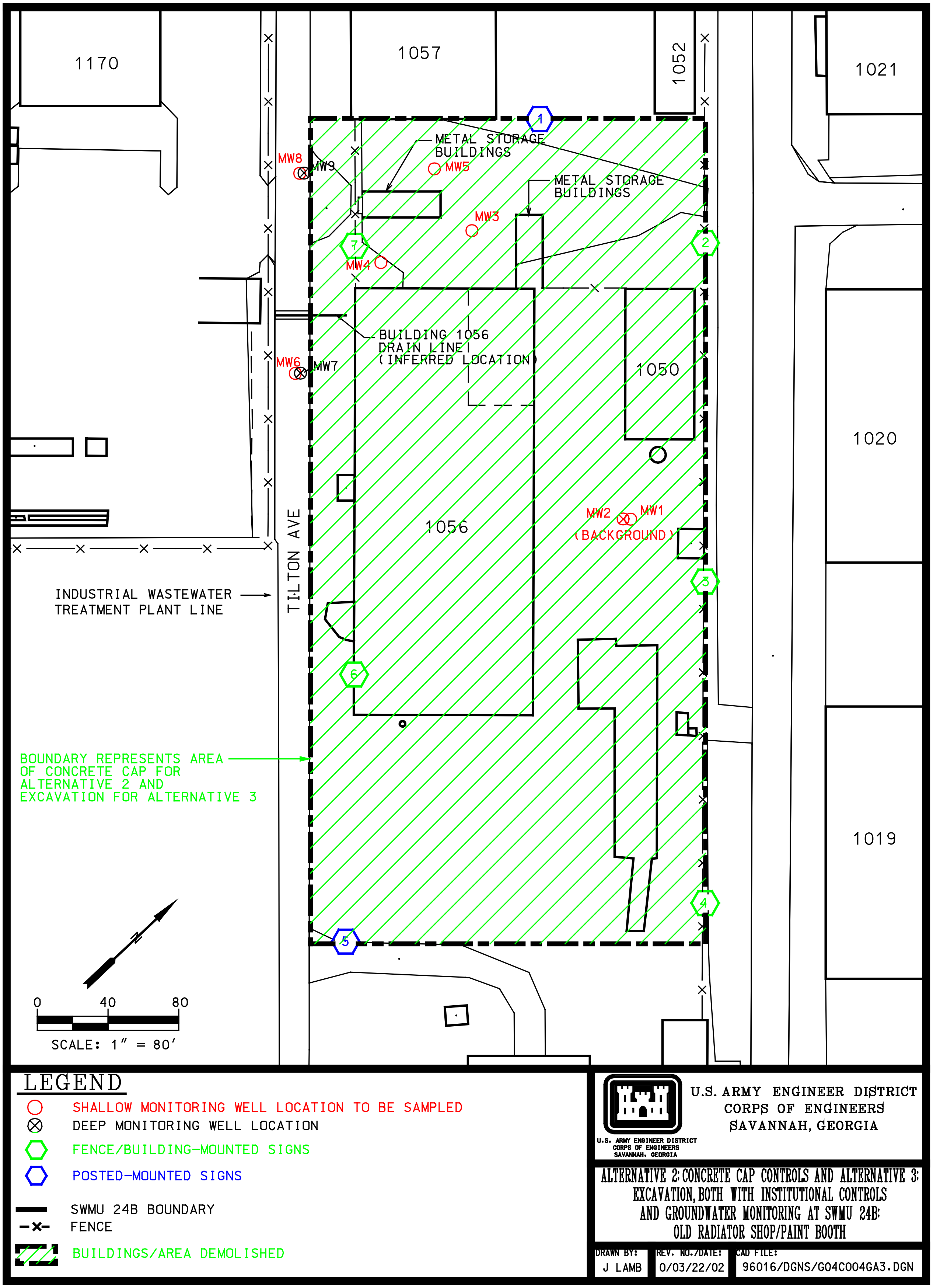

Figure 4-2. Alternative 2: Concrete Cap and Alternative 3: Excavation, Both with Institutional Controls and Groundwater Monitoring for SWMU 24B

future date, a moderately cracked concrete cover would still provide a substantial barrier to direct soil contact. Although biodegradation rates indicate that the COCs will attenuate to remedial levels in fewer than 9 years, natural attenuation might be retarded by the presence of the concrete cap. (The presence of a cap could increase the attenuation time of the contamination.) It is also possible that natural attenuation might have achieved the remedial objectives prior to implementation of this alternative.

This alternative has a life-cycle cost of approximately $648,000. This alternative would be completed in conjunction with planned construction activities at the site, which are expected to occur within 5 years.

Alternative 3: Excavation with Institutional Controls and Groundwater Monitoring

Under this alternative, soil containing contaminants at concentrations exceeding the remedial goals would be excavated and disposed of after Building 1056 was demolished. The institutional controls as described in Alternative 1 would be implemented during the interim period between the approval of this CAP and removal of Building 1056. The results and analysis of the soil sampling would be presented in an addendum to the CAP. The addendum to the CAP would refine the excavation alternative and coordinate it with planned construction activities in the area. The proposed area of excavation is delineated by the site boundaries shown in Figure 4-2. The soil would be excavated to 1 foot bgs using mechanical excavation equipment (e.g., backhoes, excavators). Confirmatory soil sampling within the excavation would not be required because once the soil surface had been removed and the clean backfill had been added, the exposure pathway for the potential contaminants would be eliminated. The excavation would be filled with clean backfill and compacted as required to support the construction of the proposed facilities. The monitoring wells at SWMU 24B would be properly abandoned.

It was assumed that the excavated soil would be disposed of as a nonhazardous solid waste. Lead was detected in two samples during the RFI at concentrations high enough to have the potential to exceed the Toxicity Characteristic Leaching Procedure limits (i.e., greater than 75 mg/kg). Most of the other 30 samples collected during the RFI contained concentrations that were a fraction of that limit. Waste samples would be collected to ensure proper disposal.

Warning signs and existing fencing would be inspected annually and repaired and/or replaced as needed as outlined in the O&M Plan during the interim period between the approval of this CAP and the removal of Building 1056. An annual CAP progress report would be issued documenting the inspection and/or repair of signs and existing fencing. The results of the groundwater monitoring would be presented biannually in the CAP progress report.

Excavation and disposal would achieve the remedial objectives by removing soil containing concentrations of contaminants that exceeded the remedial levels. This alternative would be the most effective alternative at meeting the remedial objectives. Once implemented, there would be no surface soil remaining at the site that would pose a danger to human health.

The life-cycle costs for this alternative would be $404,000. This alternative would be completed in conjunction with the demolition of Building 1056 and any planned new construction in the area, which are expected to occur within 5 years.

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5.0 CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN

This section presents a conceptual design and implementation plan of the selected corrective action alternative. Based on the available data, a cost-effective corrective action has been selected that will prevent contact with COCs present in surface soil at concentrations above remedial levels. The technology evaluation presented in Chapter 4.0 considered three alternatives for the soil and groundwater based on their ability to attain remedial objectives and their life-cycle costs. Based on that evaluation, Alternative 1, which consists of institutional controls and groundwater monitoring, has been selected. In addition, the institutional controls alternative will not pose any impediments to future remedial actions that might be required by the addendum to this CAP. An O&M Plan for this alternative is presented in Appendix C.

5.1 SELECTED CORRECTIVE ACTION

The selected corrective action alternative for SWMU 24B is Alternative 1, which consists of institutional controls and groundwater monitoring. Biannual groundwater monitoring will be conducted until an addendum to this CAP is issued. The addendum will be prepared following demolition of Building 1056 and sampling of the soil beneath the building slab. Analytical data from these soil samples might modify the selected corrective action and conceptual design. Institutional controls (i.e., land use controls) implemented through the Fort Stewart DPW will be used to control activities that might result in exposure to surface soil at the site. Institutional controls will include posting of signs and annual site inspections.

5.1.1 Justification for Selection of Corrective Action

Alternative 1 has been selected as the remedy because it will effectively achieve the remedial goals in a cost-effective manner. Furthermore, until soil samples below the building are collected and their results evaluated, no definitive decision can be made. Implementation of institutional controls will restrict access to surface soil until the soil below the building can be sampled so that any previously undiscovered contamination can be addressed in an addendum to this CAP. Groundwater monitoring will be performed on a biannual basis to ensure that contaminants are not leaching to the groundwater table. Signs prohibiting digging will be posted every 200 feet around the perimeter of the site.

Justification for the selection of this corrective action alternative is provided in the following evaluations of effectiveness, implementability, and cost.

Effectiveness

The selected corrective action will be effective in protecting human health and the environment. No constituents in groundwater are present at concentrations above MCLs, and modeling indicates that MCLs are unlikely to be exceeded in the future. Continued monitoring will ensure early detection of unknown contaminants that might be present in the inaccessible soil beneath the building. Institutional controls will protect workers from exposure to unacceptable levels of contaminants in surface soil until the building is demolished. Specifically, digging restrictions will be imposed through the Fort Stewart DPW requiring precautions such as personal protective equipment. These restrictions will be posted around the perimeter of the site. The addendum to this CAP will address any new risks resulting from the evaluation of the soil beneath the building. These controls are expected to adequately protect human health and the environment against both the known SVOC soil contamination and potential constituents that might be present beneath the building slab.

Implementability

The selected corrective action is readily implementable. The addendum to this CAP will be compiled after the building is demolished, at a time when future use of the property is less uncertain and the final corrective action can be better integrated with future use plans. Institutional controls are conventional technology, and have been successfully implemented at other Fort Stewart sites in the past. Groundwater monitoring is an activity that has been performed at many sites around Fort Stewart in the past, and no impediments to monitoring at this location are anticipated. Monitoring wells are already in place. Institutional controls are very easy to implement. Signs will be mounted on the fence on the northeastern site boundary and on the side of the building on the southwestern boundary. The remainder of the site will have post-mounted signs.

Cost

The estimated life-cycle cost for the selected corrective action is $286,000. Alternative 1, which consists of institutional controls and groundwater monitoring, is lowest in cost among the alternatives evaluated. This cost estimate assumes three rounds of groundwater sampling before the addendum to this CAP is issued.

5.2 CONCEPTUAL DESIGN

The conceptual design and cost estimate presented in this section are based on site history and past experience with similar remedial actions.

5.2.1 Groundwater Monitoring

Groundwater will be monitored to detect any contaminants leaching from SWMU 24B. The six shallow wells at the site [MW1 (background), MW3, MW4, MW5, MW6, and MW8] will be low-flow sampled every other year until the addendum to this CAP is approved. Samples will be analyzed for VOCs, SVOCs, and RCRA metals. Although only SVOCs have been identified as COCs in soil, RCRA metals and VOCs are the chemicals that would be expected to be released from a paint booth. Field measurements of DO, temperature, Redox, conductivity, pH, and turbidity will be performed during groundwater sampling. The locations of these wells are shown in Figure 4-1.

5.2.2 Institutional Controls

The Fort Stewart DPW will enforce land use restrictions and requirements for SWMU 24B. Signage prohibiting digging will be posted every 200 feet around the perimeter of the site as shown in Figure 4-1. These land use restrictions can be modified if conditions change or if additional information (e.g., sample results from soil collected under the building) indicates modification is appropriate. These signs will be worded as shown below.

CONTAMINATED SOIL
NO DIGGING
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 will be of weather-resistant construction. The signs will have a brown background and white lettering.

The positioning of each sign will provide maximum visibility from all locations outside the SWMU's boundaries. All signs will be permanently labeled (for identification purposes) on the back with a numerical identification number as shown in Figure 4-1. The numerical identification number will be located in the front right corner of the warning sign if the sign is installed on the side of a building.

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

5.2.3 Soil Sampling

Following demolition of Building 1056, eight borings will be placed in the area formerly covered by the building. They will be placed in a line parallel to the location of the drainpipe from the former location of the paint booth to the edge of the building footprint. Two intervals will be sampled in each boring, the first in the surface interval (0 to 2 feet bgs) and the second in the interval starting at the depth of the bottom of the drain line (expected to be 2 to 4 feet bgs). The soil samples will be collected using hand augers; however, if a greater depth is required or the consistency of the soil beneath the removed slab prevents the use of hand-auger techniques, hollow-stem-auger techniques might be required to collect the subsurface soil sample. The soil samples will be sent to an off-site analytical laboratory for VOC, SVOC, and RCRA metals analyses.

5.2.4 Addendum to the Corrective Action Plan

The results from the soil sampling described in the previous section as well as a summary of the groundwater monitoring will be published in the CAP addendum. The addendum will evaluate the analytical results and could modify the remedy selected by this CAP.

5.3 COMPLETION CRITERIA

This corrective measures action will be considered complete when both

- soil samples have been collected from beneath Building 1056 and analyzed, and
- the addendum to this CAP has been approved.

Well abandonment is not part of the completion criteria for this CAP because the addendum might require continued groundwater monitoring.

5.4 OPERATIONS AND MAINTENANCE PLAN

Appendix C presents the O&M Plan for the selected remedial alternative. O&M activities include site inspections, sampling and analysis of groundwater, and sampling and analysis of soil beneath Building 1056 following building demolition.

5.5 LIFE-CYCLE COST ESTIMATE

The total life-cycle cost estimate for the institutional controls alternative is $286,000 (see Appendix B for the cost components). Table 5-1 summarizes the life-cycle cost estimate for the selected corrective action. Capital costs, including indirect costs, are estimated to be $18,000 and include engineering services (work plan, Site Safety and Health Plan, contracting/procurement, and permitting). O&M costs, including indirect costs, are estimated to be approximately $176,000. The total cost of Alternative 1 is estimated to be $286,000, including contingencies, management, health and safety, and contractor profit.

Table 5-1. Estimated Cost for Selected Alternative for SWMU 24B

Site	Capital Costs	O&M	Other[a]	Total
SWMU 24B	$18,000	$176,000	$92,000	$286,000

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

5.6 IMPLEMENTATION SCHEDULE

Implementation of institutional controls and groundwater sampling and analysis will begin as soon as practicable after approval of this CAP is received from GEPD. Soil samples from beneath the building cannot be obtained until Building 1056 has been demolished. It is anticipated that the corrective action work plan for institutional controls and groundwater sampling (including appropriate reviews by the Army) will be completed within 3 months after award of a contract to implement the alternative. The work plan for sampling of soil beneath the building will also be prepared at this time as part of the corrective action work plan, although it will not be implemented until the building has been demolished. GEPD review and approval will not be required for the corrective action work plan.

5.7 REPORTS

5.7.1 Corrective Action Plan Progress Reports

CAP progress reports will be prepared annually beginning with completion of the first groundwater sampling event following the approval of this CAP. Each report will summarize institutional control inspections and maintenance. Every other year the reports will include the sampling and analytical results of the groundwater monitoring for that period. Any activities that occurred that required intervention related to the institutional controls will also be reported (e.g., underground utility maintenance). Other activities conducted during the reporting period will also be described in the annual report. A checklist summarizing the items to be addressed in each CAP progress report is presented in the O&M Plan (Appendix C).

A corrective action completion report is not mandated by this CAP. The terms and conditions of the corrective action completion report will be described in the addendum to this CAP.

5.7.2 Addendum to the Corrective Action Plan

An addendum to the CAP will be prepared following demolition of Building 1056 and sampling and analysis of the soil currently under the building slab. The addendum will summarize the groundwater sampling events and present the results of the soil sampling. It will propose modifications to the CAP for

SWMU 24B based on conclusions from the data and then-current land use plans for the site, including integration/coordination of the remedy with the construction of new maintenance facilities in the area.

Potential reports required following the final annual report will be described in the addendum to the CAP. The need for any contingent action (if SRCs are detected in the groundwater or if there are changes in land use, for example) will also be discussed as required.

5.8 IMPLEMENTATION PLAN

Upon approval of this CAP by GEPD, Fort Stewart will request funding, procure a contractor, and implement the groundwater sampling and institutional controls aspects of the corrective action. Funding requests, contractor procurement, and implementation of the remaining aspects (soil sampling below the building) will await finalization of future use plans for SWMU 24B. Upon development of a schedule for demolition of Building 1056, the schedule for the soil sampling and development of an addendum to this CAP will be developed. Any necessary revisions to the O&M Plan that become apparent during preparation of the work plan will be submitted to GEPD for concurrence. Substantive changes in the approach or schedule will require that the public be provided with an opportunity for review and comment, in accordance with the Fort Stewart Hazardous Waste Facility Permit. No other submittals will need to be provided to GEPD prior to implementation of the selected corrective action. All provisions contained within this CAP will be superceded by its addendum.

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6.0 REFERENCES

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APPENDIX A

FATE AND TRANSPORT MODELING

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A.1 INTRODUCTION

Monitored natural attenuation is appropriate as a remedial approach only when it can be demonstrated to be capable of achieving a site's remedial objectives within a reasonable timeframe. To determine whether monitored natural attenuation is an appropriate remedy for soil and groundwater contamination at the Old Radiator Shop/Paint Booth [Solid Waste Management Unit (SWMU) 24B], Fort Stewart, Georgia, fate and transport modeling was performed to determine if contaminants present in soil could be effectively remediated by natural attenuation processes. The following sections summarize the modeling performed for evaluating natural attenuation as an alternative for the Corrective Action Plan at SWMU 24B.

A.2 MODELING APPROACH

A brief summary of the modeling approach is presented below.

1. Develop the conceptual model for each distinct flow path from the source to the receptor location.

2. Perform leachate modeling using the Seasonal Soil Compartment (SESOIL) Model, and calculate the soil-to-leachate dilution attenuation factor (DAF) (i.e., $DAF_{S\text{-}L} = C_S/C_L$, where C_S is the maximum soil concentration at the source and C_L is the predicted maximum leachate concentration).

3. Using the results from the leachate modeling, perform saturated flow and contaminant transport modeling using the Analytical Transient 1-, 2-, 3-Dimensional (AT123D) Model to predict the maximum groundwater concentration ($C_{GWS,P}$) beneath the source.

4. Perform steady-state saturated flow and contaminant transport modeling to predict the maximum concentrations of the constituents of concern (COCs) at the receptor location, using the predicted concentration at the source and the AT123D model, and calculate the lateral flow and transport DAF (e.g., $DAF_{GWS\text{-}GWR} = C_{GWS}/C_{GWR}$, where C_{GWR} is the predicted maximum concentration at the receptor location and C_{GWS} is the concentration of groundwater at the source).

5. Use SESOIL and AT123D results to estimate the minimum time required that would limit the concentration in groundwater to maximum contaminant levels (MCLs) or risk-based concentrations for compounds that do not have MCLs.

A.3 MODELS SELECTED

A.3.1 SESOIL MODEL

The SESOIL model was used to simulate the vertical transport of contaminants from the source areas (estimated from soil contamination areas) down through the vadose zone to the shallow groundwater (water table). SESOIL is a one-dimensional, vertical-transport code for the unsaturated soil zone and is designed to simultaneously model water transport and pollutant fate. The program was originally developed by the U.S. Environmental Protection Agency (Bonazountas and Wagner 1981; Bonazountas and Wagner 1984) and has been extensively modified to enhance its capabilities (Hetrick et al. 1989; Hetrick et al. 1986; Hetrick and Travis 1988).

The SESOIL model defines the "soil compartment" as a soil column extending from the ground surface through the unsaturated zone to the water table. Processes are simulated in SESOIL in both the hydrologic cycle and pollutant cycle, each of which is a separate submodule in the SESOIL code. The hydrologic cycle includes rainfall, surface runoff, infiltration, soil water content, evapotranspiration, and groundwater recharge. The pollutant cycle includes convective transport, volatilization, adsorption/desorption, and degradation/decay. A contaminant in SESOIL can partition in up to four phases (liquid, adsorbed, air, and pure).

SESOIL is well recognized and accepted by the scientific community using soil–chemical fate models. Some of the attributes of SESOIL that make the program particularly attractive and suitable for the vadose zone soil leaching at this site are listed below.

SESOIL has been extensively validated and shown to work under a number of scenarios. The model has also been used for similar applications in other parts of the country and is capable of providing the information required for this study (Bonazountas, Wagner, and Goodwin 1982; Hetrick 1984; Watson and Brown 1985; Hetrick et al. 1986; Melancol, Pollard, and Hern 1986; Hetrick and Travis 1988; Hetrick et al. 1989; Hetrick, Luxmoore, and Tharp 1993).

SESOIL has the advantage of fewer input requirements and faster run times compared to more complex unsaturated zone models, while still maintaining considerable resolution of the pollutant front in both time and space.

The model can be divided into as few as two and as many as four layers, with as many as ten sublayers in each of the layers. This compartmental nature of the model allows for user-specified tailoring to suit a particular site.

A.3.2 AT123D MODEL

AT123D is a well-known and commonly used analytical groundwater pollutant fate and transport model. This model was developed by Yeh (1981) and has since been updated by GSC (1996). The model computes the spatial–temporal concentration distribution of chemicals in the aquifer system and predicts the transient spread of a chemical plume through a groundwater aquifer. The fate and transport processes accounted for in AT123D are advection, dispersion, adsorption/retardation, and decay. This model can be used as a tool for estimating the dissolved concentration of a chemical in three dimensions in the groundwater resulting from a mass release (i.e., continuous, instant, or depleting source) over a source area (i.e., point, line, area, or volume source).

A.4 PARAMETERS

The hydrologic parameters used in the modeling are based on findings from previous investigations. The parameters are selected such that they are representative values and account for the variability in the hydraulic system and the most likely conditions within that variability. Time-varying model runs are performed using the representative values. The chemical-specific model parameters include the solubility in water, organic carbon partition coefficient, Henry's Law constant, soil–water distribution coefficient, diffusion coefficients in air and water, and first-order decay constant. These are literature-based parameters, and a conservative approach was always used for selecting the values of these parameters. The chemical parameters used in the modeling are presented in Table 6-2 of the revised final Phase II

Resource Conservation and Recovery Act facility investigation (RFI) report (SAIC 2000). As an example, the input parameters for the cadmium AT123D file are presented in the attachment to this appendix.

A.5 MODEL APPLICATION AND RESULTS

Both SESOIL (for the unsaturated zone) and AT123D (for the saturated zone) were used to model the COCs. The models were used to determine whether monitored natural attenuation is appropriate as a remedial alternative for achieving the site's remedial objectives for COCs within a reasonable timeframe. The maximum concentration of each COC detected in each depth level was used as the representative concentration in each corresponding sublevel of the model. SESOIL outputs were used in the AT123D model to predict the present groundwater concentrations of COCs.

A.5.1 MODELING OF BENZO(*A*)ANTHRACENE

The results from SESOIL modeling of benzo(*a*)anthracene in soil leaching to groundwater predicted the peak groundwater concentration to be 0 μg/L. The prediction was based on the maximum soil concentration of 38.8 mg/kg [see Table B-3 of the addendum to the revised final Phase II RFI report (SAIC 2001)]. The results further predicted that the peak groundwater concentration beneath the source would remain 0 μg/L for at least 1,000 years from the time of sampling (October 1999); therefore, there will be no impact to groundwater at the receptor locations within 1,000 years from the time of sampling. The constituent has not been detected in groundwater during the sampling events of January 2000 and January 2001. In addition, the SESOIL modeling results predicted the time required for the concentration in soil to achieve the remedial level of 8.93 mg/kg through natural attenuation to be 4 years from October 1999 (Figure A-1).

A.5.2 MODELING OF BENZO(*A*)PYRENE

The results from SESOIL modeling of benzo(*a*)pyrene in soil leaching to groundwater predicted the peak groundwater concentration to be 0 μg/L. The prediction was based on the maximum soil concentration of 48.1 mg/kg [see Table B-3 of the addendum to the revised final Phase II RFI report (SAIC 2001)]. The results further predicted that the peak groundwater concentration beneath the source would remain 0 μg/L for at least 1,000 years from the time of sampling (October 1999); therefore, there will be no impact to groundwater at the receptor locations within 1,000 years from the time of sampling. The constituent has not been detected in groundwater during the sampling events of January 2000 and January 2001. In addition, the SESOIL modeling results predicted the time required for the concentration in soil to achieve the remedial level of 0.89 mg/kg through natural attenuation to be 8.5 years from October 1999 (Figure A-2).

A.5.3 MODELING OF BENZO(*B*)FLUORANTHENE

The results from SESOIL modeling of benzo(*b*)fluoranthene in soil leaching to groundwater predicted the peak groundwater concentration to be 0 μg/L. The prediction was based on the maximum soil concentration of 40.9 mg/kg [see Table B-3 of the addendum to the revised final Phase II RFI report (SAIC 2001)]. The results further predicted that the peak groundwater concentration beneath the source would remain 0 μg/L for at least 1,000 years from the time of sampling (November 2000); therefore, there will be no impact to groundwater at the receptor locations within 1,000 years from the time of sampling.

The constituent has not been detected in groundwater during the sampling events of January 2000 and January 2001. In addition, the SESOIL modeling results predicted the time required for the concentration in soil to achieve the remedial level of 8.93 mg/kg through natural attenuation to be 4 years from November 2000 (Figure A-3).

A.5.4 MODELING OF INDENO(*1,2,3-CD*)PYRENE

The results from SESOIL modeling of indeno(*1,2,3-cd*)pyrene in soil leaching to groundwater predicted the peak groundwater concentration to be 0 μg/L. The prediction was based on the maximum soil concentration of 30.7 mg/kg [see Table B-3 of the addendum to the revised final Phase II RFI report (SAIC 2001)]. The results further predicted that the peak groundwater concentration beneath the source would remain 0 μg/L for at least 1,000 years from the time of sampling (October 1999); therefore, there will be no impact to groundwater at the receptor locations within 1,000 years from the time of sampling. The constituent has not been detected in groundwater during the sampling events of January 2000 and January 2001. In addition, the SESOIL modeling results predicted the time required for the concentration in soil to achieve the remedial level of 8.93 mg/kg through natural attenuation to be 4 years from October 1999 (Figure A-4).

A.5.5 MODELING OF CADMIUM

The results from SESOIL and AT123D modeling of cadmium in soil leaching to groundwater predicted the peak groundwater concentration to be 4.6 μg/L (Figure A-5). The prediction was based on the maximum soil concentration of 6.1 mg/kg [see Table B-3 of the addendum to the revised final Phase II RFI report (SAIC 2001)]. The results further predicted that the peak groundwater concentration beneath the source would be reached more than 1,000 years from the time of sampling (February 1998). The results indicated that the concentrations of the constituent from the site will not exceed the MCL (5 μg/L) at receptor locations within 1,000 years from the time of sampling. The constituent has not been detected in groundwater during the sampling events of January 2000 and January 2001.

A.5.6 MODELING OF CHROMIUM

The results from SESOIL and AT123D modeling of chromium in soil leaching to groundwater predicted the peak groundwater concentration to be 71 μg/L (Figure A-6). The prediction was based on the maximum soil concentration of 18.3 mg/kg [see Table B-3 of the addendum to the revised final Phase II RFI report (SAIC 2001)]. The results further predicted that the peak groundwater concentration beneath the source would be reached more than 320 years from the time of sampling (February 1998). The results indicated that the concentrations of the constituent from the site will not exceed the MCL (100 μg/L) at receptor locations within 1,000 years from the time of sampling. The constituent has not been detected in groundwater during the sampling events of January 2000 and January 2001.

A.5.7 MODELING OF LEAD

The results from SESOIL and AT123D modeling of lead in soil leaching to groundwater predicted the peak groundwater concentration to be 0 μg/L (Figure A-7). The prediction was based on the maximum soil concentration of 690 mg/kg [see Table B-3 of the addendum to the revised final Phase II RFI report (SAIC 2001)]. The results further predicted that the peak groundwater concentration beneath the source would remain 0 μg/L for at least 1,000 years from the time of sampling (February 1998); therefore, there will be no impact to groundwater at the receptor locations within 1,000 years from the time of sampling. The constituent has not been detected in groundwater during the sampling events of January 2000 and January 2001.

A.5.8 CONCLUSIONS AND SUMMARY

Constituent-specific conclusions of the natural attenuation modeling are presented below.

- The estimated timeframe needed for benzo(*a*)anthracene to degrade to below its remedial level in soil is approximately 4 years from October 1999.
- The estimated timeframe needed for benzo(*a*)pyrene to degrade to below its remedial level in soil is approximately 8.5 years from October 1999.
- The estimated timeframe needed for benzo(*b*)fluoranthene to degrade to below its remedial level in soil is approximately 4 years from November 2000.
- The estimated timeframe needed for indeno(*1,2,3-cd*)pyrene to degrade to below its remedial level in soil is approximately 4 years from October 1999.

A.6 LIMITATIONS/ASSUMPTIONS

Based upon the available data, a conservative approach was used that might overestimate the contaminant concentrations in the groundwater. Listed below are important assumptions used in this analysis.

- The use of K_d and R_d to describe the reaction term of the transport equation assumes that an equilibrium relationship exists between the solid- and solution-phase concentrations and that the relationship is linear and reversible.
- Flow and transport in the vadose zone are one dimensional (i.e., only in the vertical direction).
- Initial condition is disregarded in the vadose zone modeling.
- Flow and transport are not affected by density variations.
- Liquid-phase dispersion in the vadose zone is neglected.
- The aquifer is homogenous and isotropic.
- Areal distribution of soil contamination in the vadose zone is not considered; instead, the maximum concentration is used throughout the soil column.
- A steady-state contaminant loading source to the aquifer is assumed for lateral transport.

The inherent uncertainties associated with using these assumptions must be recognized. It is also important to note that the major geochemistry of a solute will change over time and be affected by multiple solutes that are present at the site and any potential future releases, if they occur. Projected concentrations of a solute in the aquifer are expected to be highly conservative due to the use of a steady-state source and a conservative literature-based decay rate.

A.7 REFERENCES

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Figure A-1. SESOIL-Predicted Maximum Soil Concentrations of Benzo(*a*)anthracene Based on Initial Contaminant Loading from SWMU 24B

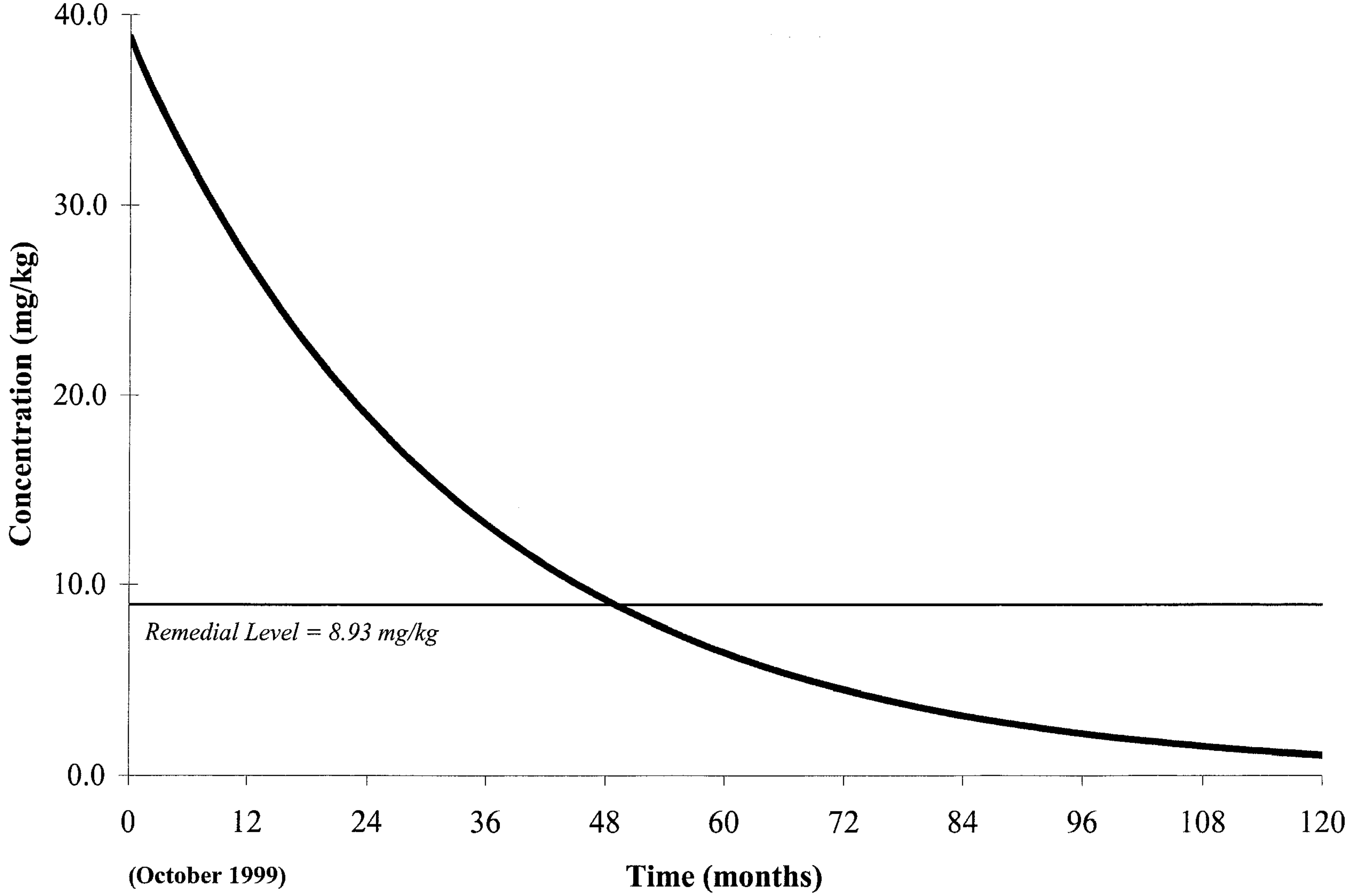

Figure A-2. SESOIL-Predicted Maximum Soil Concentrations of Benzo(*a*)pyrene Based on Initial Contaminant Loading from SWMU 24B

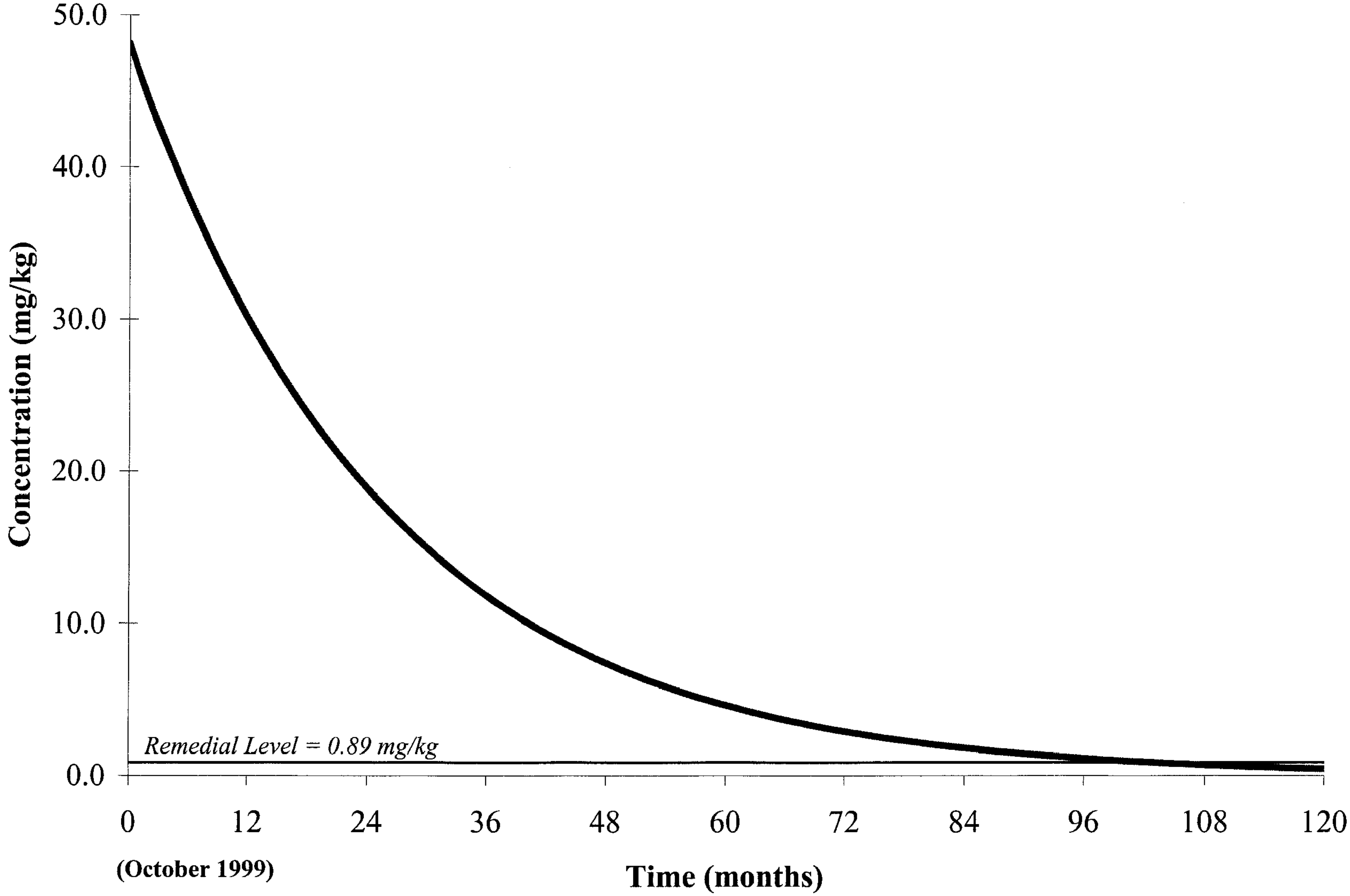

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Figure A-3. SESOIL-Predicted Maximum Soil Concentrations of Benzo(*b*)fluoranthene Based on Initial Contaminant Loading from SWMU 24B

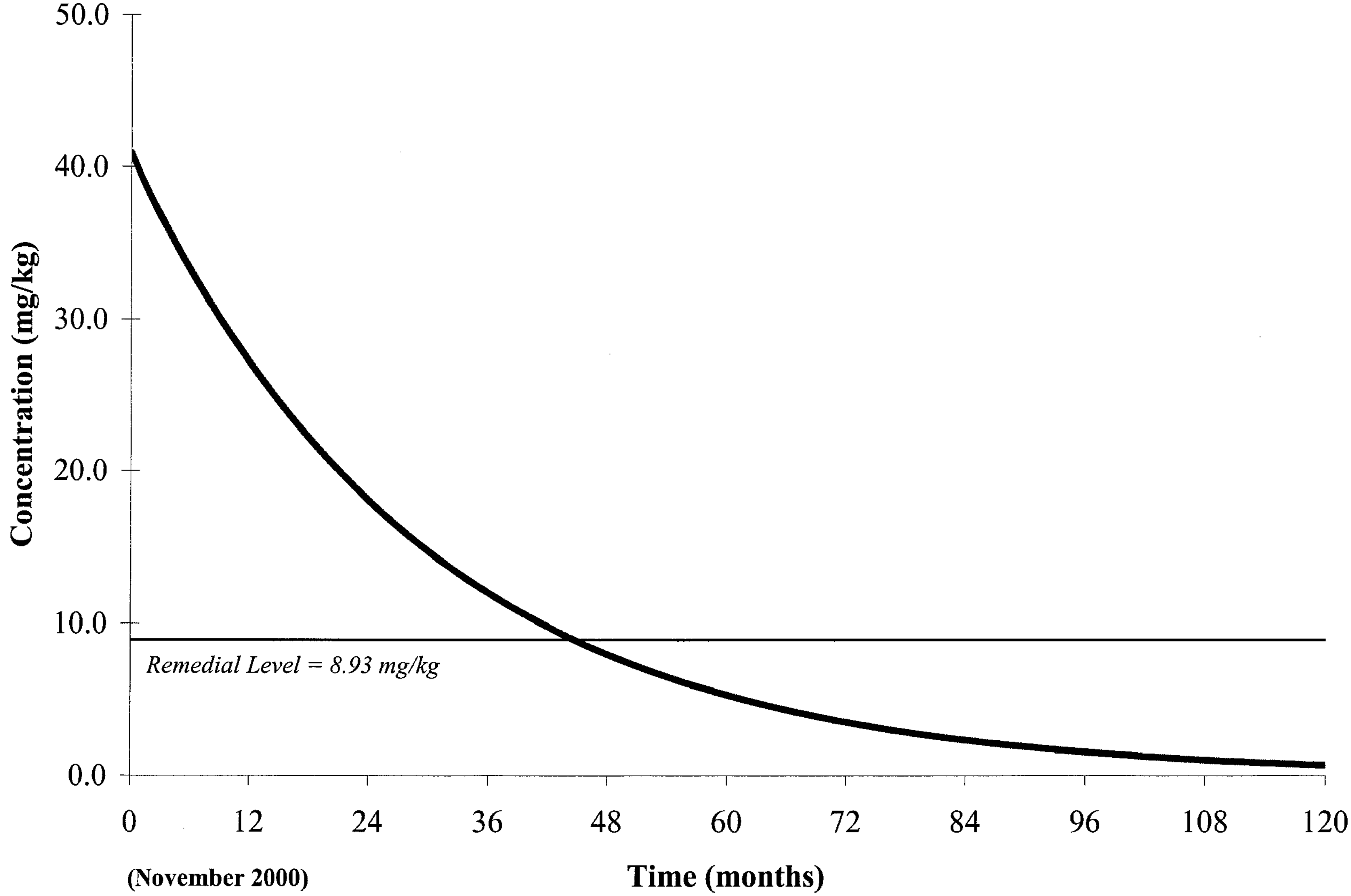

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Figure A-4. SESOIL-Predicted Maximum Soil Concentrations of Indeno(*1,2,3-cd*)pyrene Based on Initial Contaminant Loading from SWMU 24B

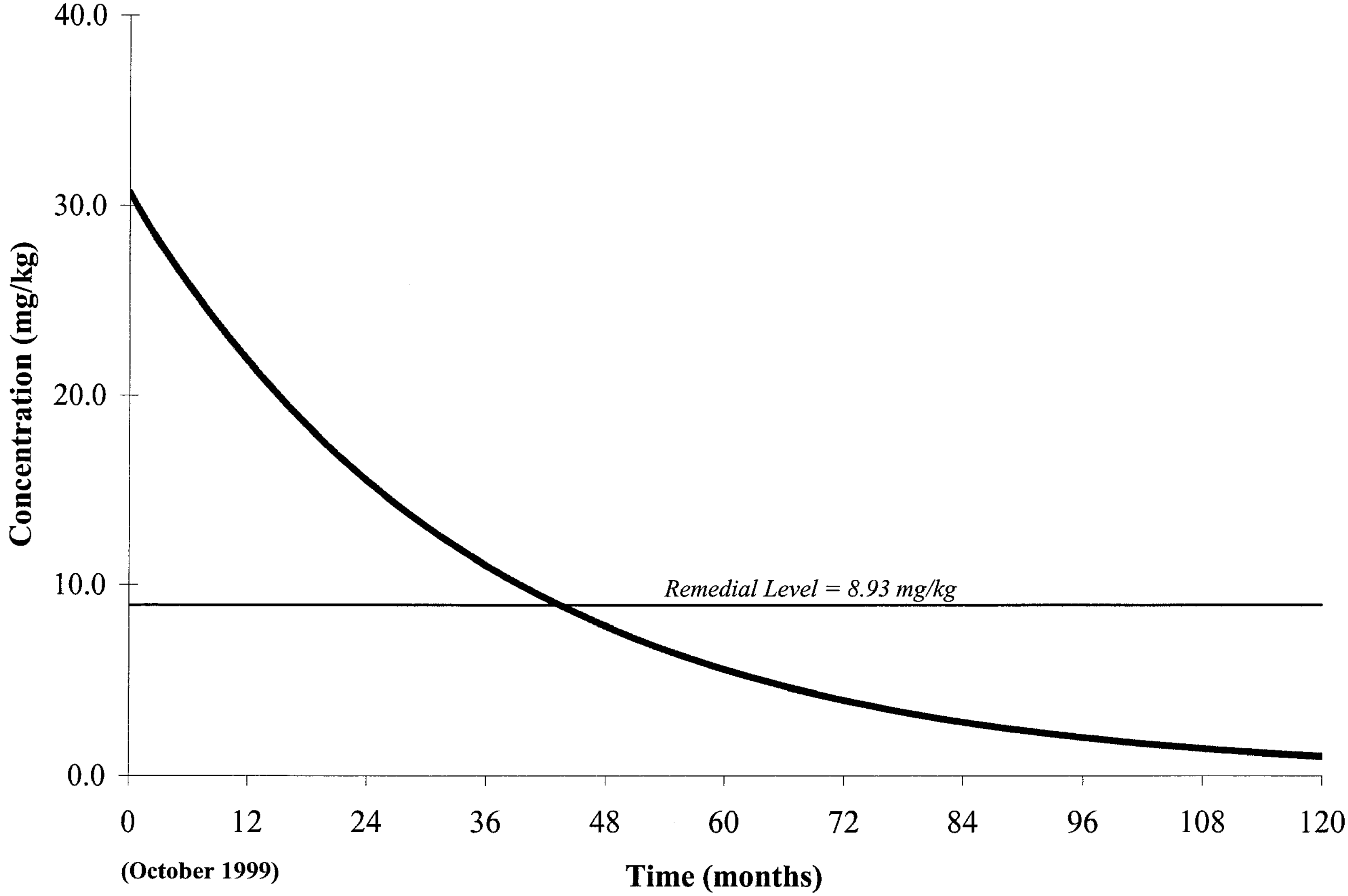

Figure A-5. AT123D-Predicted Concentrations of Cadmium in Groundwater at the Source for SWMU 24B

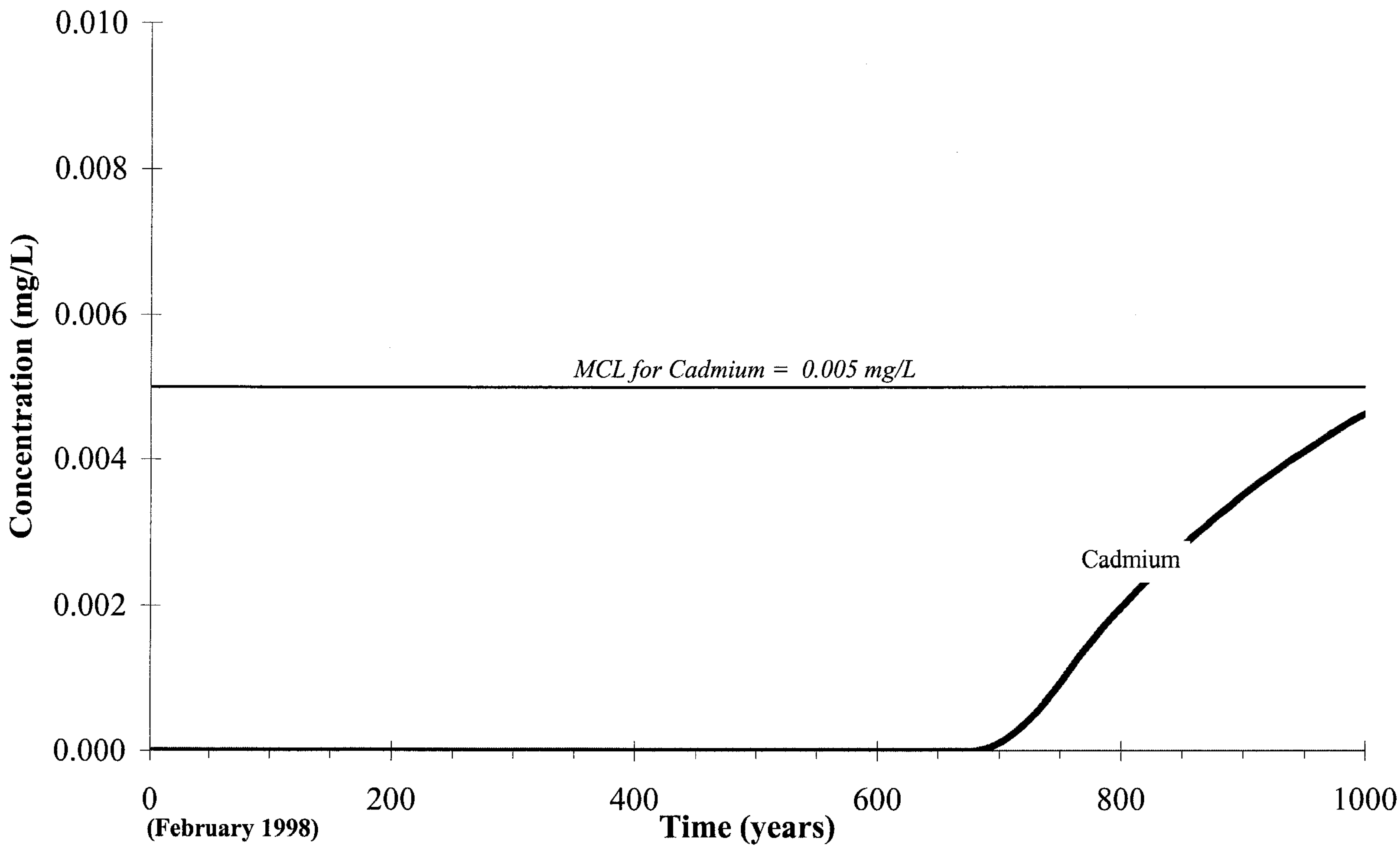

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Figure A-6. AT123D-Predicted Concentrations of Chromium in Groundwater at the Source for SWMU 24B

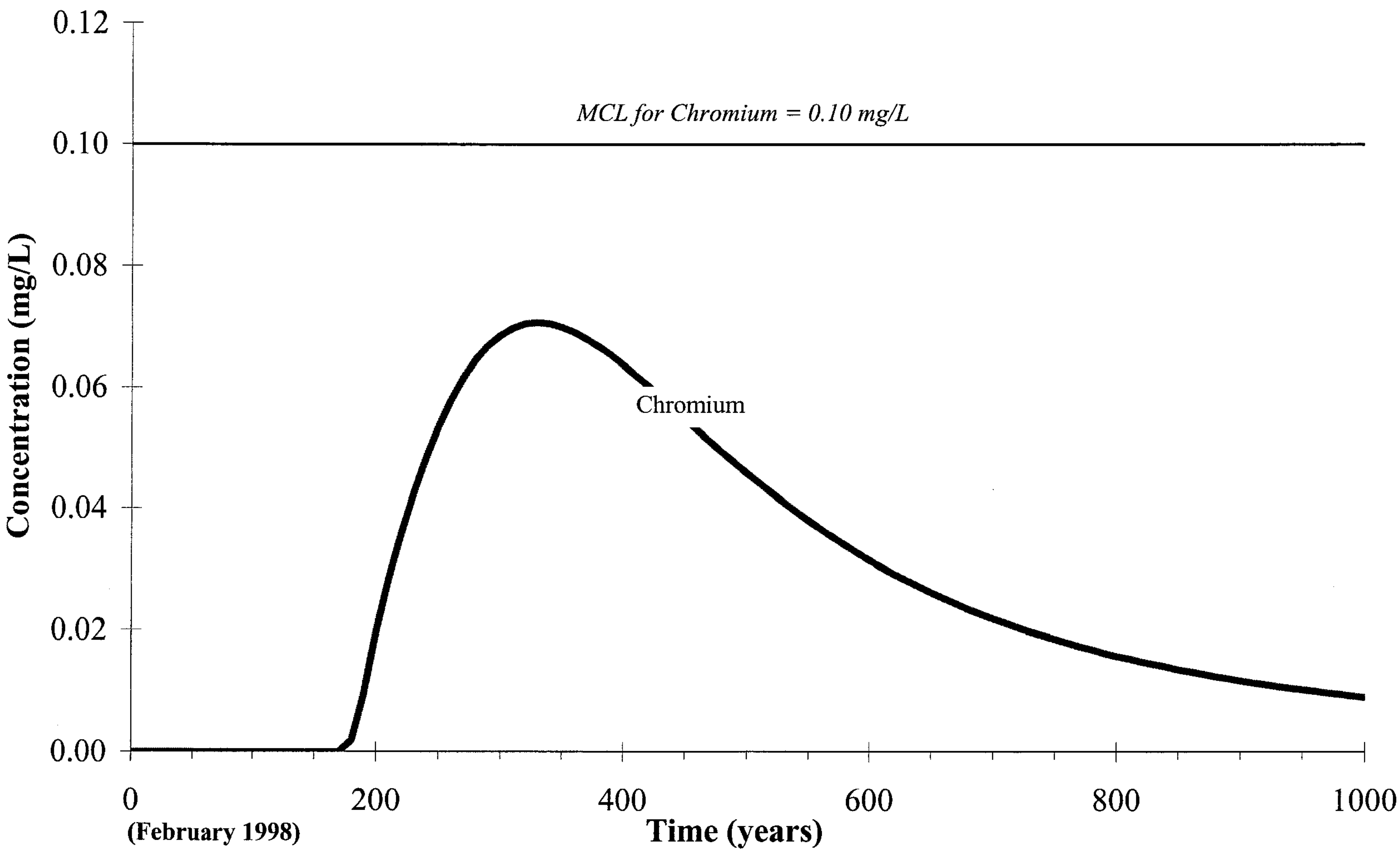
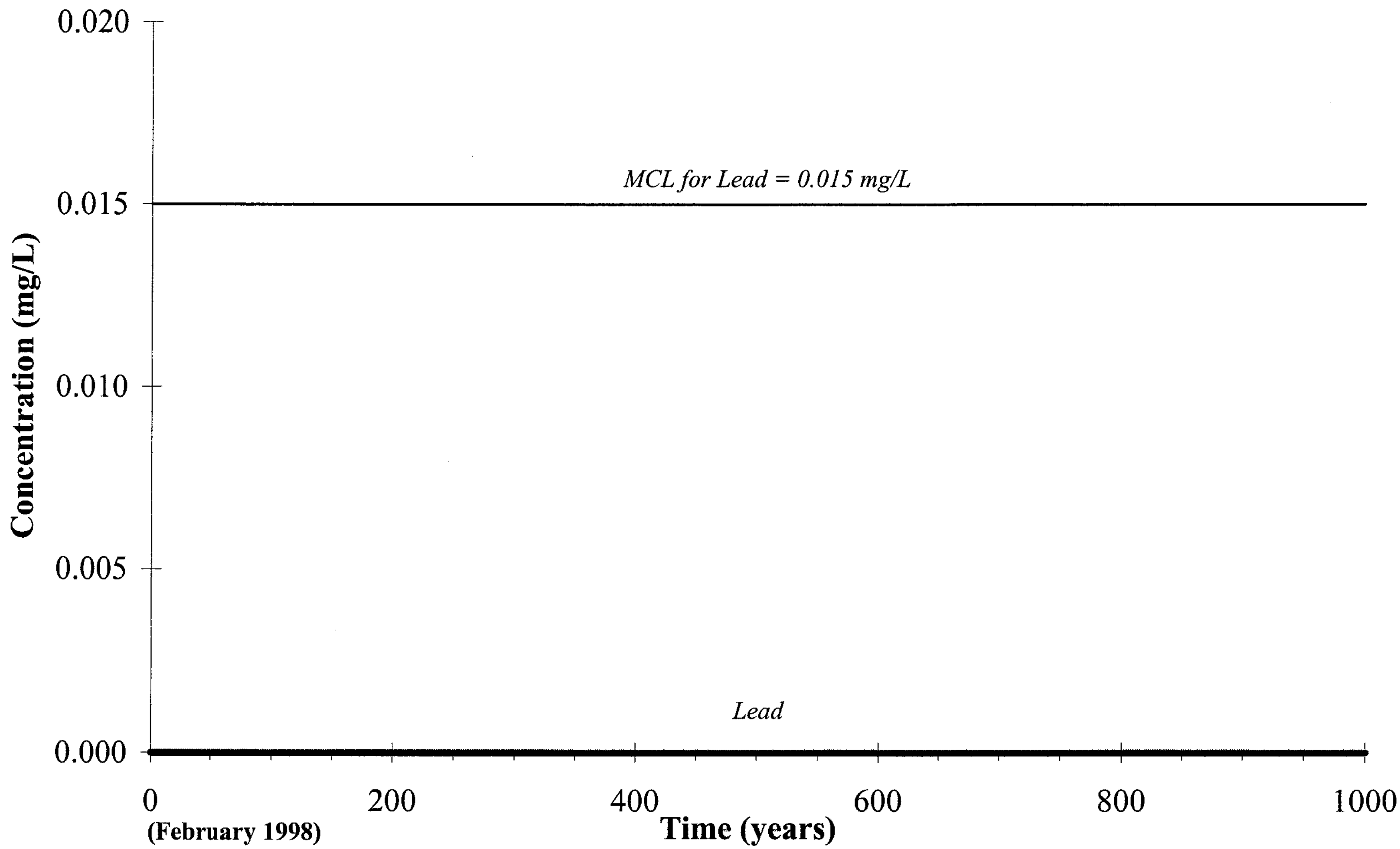


Figure A-7. AT123D-Predicted Concentrations of Lead in Groundwater at the Source for SWMU 24B



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AT123D OUTPUT FILE FOR SWMU 24B

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SWMU 24B Cadmium

NO. OF POINTS IN X-DIRECTION 5
NO. OF POINTS IN Y-DIRECTION 1
NO. OF POINTS IN Z-DIRECTION.. 1
NO. OF ROOTS: NO. OF SERIES TERMS.. 400
NO. OF BEGINNING TIME STEP 11
NO. OF ENDING TIME STEP.. 201
NO. OF TIME INTERVALS FOR PRINTED OUT SOLUTION.................................. 10
INSTANTANEOUS SOURCE CONTROL = 0 FOR INSTANT SOURCE.................... 1
SOURCE CONDITION CONTROL = 0 FOR STEADY SOURCE 1000
INTERMITTENT OUTPUT CONTROL = 0 NO SUCH OUTPUT 1
CASE CONTROL =1 THERMAL, = 2 FOR CHEMICAL, = 3 RAD 2

AQUIFER DEPTH, = 0.0 FOR INFINITE DEEP (METERS).........................0.1524E+02
AQUIFER WIDTH, = 0.0 FOR INFINITE WIDE (METERS)........................0.0000E+00
BEGIN POINT OF X-SOURCE LOCATION (METERS) .... -0.3810E+02
END POINT OF X-SOURCE LOCATION (METERS) ....0.3810E+02
BEGIN POINT OF Y-SOURCE LOCATION (METERS) .... -0.4100E+02
END POINT OF Y-SOURCE LOCATION (METERS) ....0.4100E+02
BEGIN POINT OF Z-SOURCE LOCATION (METERS)............................. -0.1000E+01
END POINT OF Z-SOURCE LOCATION (METERS)..................................0.0000E+00

POROSITY ....0.2000E+00
HYDRAULIC CONDUCTIVITY (METER/HOUR)..0.2900E-01
HYDRAULIC GRADIENT 0.1000E-01
LONGITUDINAL DISPERSIVITY (METER)..0.1500E+02
LATERAL DISPERSIVITY (METER)...0.5000E+01
VERTICAL DISPERSIVITY (METER) ....0.1500E+01
DISTRIBUTION COEFFICIENT, KD (M**3/KG)...0.7500E-01
HEAT EXCHANGE COEFFICIENT (KCAL/HR-M**2-DEGREE C) ....0.0000E+00

MOLECULAR DIFFUSION MULTIPLY BY POROSITY (M**2/HR)..........0.3600E-06
DECAY CONSTANT (PER HOUR)..0.0000E+00
BULK DENSITY OF THE SOIL (KG/M**3) ....0.1530E+04
ACCURACY TOLERANCE FOR REACHING STEADY STATE.................0.1000E-02
DENSITY OF WATER (KG/M**3)..0.1000E+04
TIME INTERVAL SIZE FOR THE DESIRED SOLUTION (HR)..................0.8760E+04
DISCHARGE TIME (HR) ....0.8760E+07
WASTE RELEASE RATE (KCAL/HR), (KG/HR), OR (CI/HR)....................0.0000E+00

LIST OF TRANSIENT SOURCE RELEASE RATE (Generated by SESOIL)

0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
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0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.239E-07	0.671E-07
0.111E-06	0.154E-06	0.198E-06	0.242E-06	0.286E-06	0.330E-06	0.374E-06	0.418E-06	0.463E-06	0.507E-06
0.552E-06	0.596E-06	0.641E-06	0.686E-06	0.731E-06	0.776E-06	0.821E-06	0.866E-06	0.912E-06	0.957E-06
0.100E-05	0.105E-05	0.109E-05	0.114E-05	0.119E-05	0.123E-05	0.128E-05	0.132E-05	0.137E-05	0.142E-05
0.146E-05	0.151E-05	0.156E-05	0.160E-05	0.165E-05	0.170E-05	0.175E-05	0.179E-05	0.184E-05	0.189E-05
0.193E-05	0.198E-05	0.203E-05	0.208E-05	0.212E-05	0.217E-05	0.222E-05	0.227E-05	0.232E-05	0.236E-05
0.241E-05	0.246E-05	0.251E-05	0.256E-05	0.261E-05	0.265E-05	0.270E-05	0.275E-05	0.280E-05	0.285E-05
0.290E-05	0.295E-05	0.300E-05	0.304E-05	0.309E-05	0.314E-05	0.319E-05	0.324E-05	0.329E-05	0.334E-05
0.339E-05	0.344E-05	0.349E-05	0.354E-05	0.359E-05	0.364E-05	0.369E-05	0.374E-05	0.376E-05	0.377E-05
0.378E-05	0.379E-05	0.379E-05	0.380E-05	0.381E-05	0.382E-05	0.383E-05	0.383E-05	0.384E-05	0.385E-05
0.386E-05	0.386E-05	0.387E-05	0.388E-05	0.388E-05	0.389E-05	0.390E-05	0.391E-05	0.391E-05	0.392E-05

0.393E-05	0.393E-05	0.394E-05	0.395E-05	0.395E-05	0.396E-05	0.397E-05	0.398E-05	0.398E-05	0.399E-05
0.399E-05	0.400E-05	0.401E-05	0.401E-05	0.402E-05	0.403E-05	0.403E-05	0.404E-05	0.405E-05	0.405E-05
0.406E-05	0.406E-05	0.407E-05	0.407E-05	0.408E-05	0.409E-05	0.409E-05	0.410E-05	0.410E-05	0.411E-05
0.411E-05	0.412E-05	0.413E-05	0.413E-05	0.414E-05	0.414E-05	0.415E-05	0.415E-05	0.416E-05	0.416E-05
0.417E-05	0.417E-05	0.418E-05	0.418E-05	0.419E-05	0.419E-05	0.420E-05	0.420E-05	0.421E-05	0.421E-05
0.421E-05	0.422E-05	0.422E-05	0.423E-05	0.423E-05	0.424E-05	0.424E-05	0.424E-05	0.425E-05	0.425E-05
0.426E-05	0.426E-05	0.426E-05	0.427E-05	0.427E-05	0.427E-05	0.428E-05	0.428E-05	0.429E-05	0.429E-05
0.429E-05	0.430E-05	0.430E-05	0.430E-05	0.431E-05	0.431E-05	0.431E-05	0.431E-05	0.432E-05	0.432E-05
0.432E-05	0.433E-05	0.433E-05	0.433E-05	0.433E-05	0.434E-05	0.434E-05	0.434E-05	0.434E-05	0.435E-05
0.435E-05	0.435E-05	0.435E-05	0.436E-05	0.436E-05	0.436E-05	0.436E-05	0.436E-05	0.437E-05	0.437E-05
0.437E-05	0.437E-05	0.437E-05	0.438E-05	0.438E-05	0.438E-05	0.438E-05	0.438E-05	0.438E-05	0.438E-05
0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.440E-05	0.440E-05
0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05
0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05
0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05
0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05	0.440E-05
0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.439E-05	0.438E-05
0.438E-05	0.438E-05	0.438E-05	0.438E-05	0.438E-05	0.438E-05	0.437E-05	0.437E-05	0.437E-05	0.437E-05
0.437E-05	0.437E-05	0.436E-05	0.436E-05	0.436E-05	0.436E-05	0.436E-05	0.436E-05	0.435E-05	0.435E-05
0.435E-05	0.435E-05	0.435E-05	0.434E-05	0.434E-05	0.434E-05	0.434E-05	0.433E-05	0.433E-05	0.433E-05
0.433E-05	0.432E-05	0.432E-05	0.432E-05	0.432E-05	0.431E-05	0.431E-05	0.431E-05	0.431E-05	0.430E-05
0.430E-05	0.430E-05	0.429E-05	0.429E-05	0.429E-05	0.429E-05	0.428E-05	0.428E-05	0.428E-05	0.427E-05

RETARDATION FACTOR..0.5748E+03
RETARDED DARCY VELOCITY (M/HR)..0.2523E-05
RETARDED LONGITUDINAL DISPERSION COEF. (M**2/HR)................0.3785E-04
RETARDED LATERAL DISPERSION COEFFICIENT (M**2/HR) 0.1262E-04
RETARDED VERTICAL DISPERSION COEFFICIENT (M**2/HR)............0.3787E-05

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.0000E+00 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.8760E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1752E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.2628E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.3504E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.4380E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.5256E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.6132E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.7008E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.7884E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.8760E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.9636E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1051E+07 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1139E+07 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1226E+07 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1314E+07 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1402E+07 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1489E+07 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1577E+07 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1664E+07 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

STEADY STATE SOLUTION HAS NOT BEEN REACHED BEFORE FINAL SIMULATING TIME

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1752E+07 HRS
(ADSORBED CHEMICAL CONC. = 0.7500E+02 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X					
Y	0.	10.	20.	50.	152.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

APPENDIX B

COST ESTIMATE

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APPENDIX B

Cost Estimate Summaries for Remedial Action Alternatives, SWMU 24B

		Alternative 1	Alternative 2	Alternative 3
		Institutional Controls and Groundwater Monitoring	Concrete Cap with Institutional Controls and Groundwater Monitoring	Excavation with Institutional Controls and Groundwater Monitoring
1.0	**Capital Costs**			
1.1	**Engineering Services**			
1.1.1	Work Plan/SSHP and Remedial Design	$9,354	$20,342	$20,342
1.1.2	Contracting/Procurement	$0	$0	$0
1.1.3	Permitting	$0	$0	$0
1.1.4	Construction Oversight for Monitoring Well Installation	$0	$0	$0
1.1.5	Construction Oversight for Extr./Inj. Installation	$0	$0	$0
1.1.6	Construction Oversight for System Startup	$0	$0	$0
1.1	**Total Costs for Engineering Services**	**$9,354**	**$20,342**	**$20,342**
	Approximate Costs	**~$9,000**	**~$20,000**	**~$20,000**
1.2	**System Installation**			
1.2.1	Site Preparation and Mobilization/Demobilization			
1.2.1.1	Locate Underground Utilities	$818	$1,635	$1,635
1.2.1.2	Define Grid Layout	$0	$0	$0
1.2.1.3	Baseline Groundwater Monitoring	$0	$0	$0
1.2.1.4	Baseline Soil Monitoring	$0	$0	$0
1.2.1	**Total Costs for Site Preparation and Mob/Demob**	**$818**	**$1,635**	**$1,635**
1.2.2	Monitoring Well Installation	$0	$0	$0
1.2.3	Remedial Equipment Installation	$779	$233,345	$779
1.2.4	Excavation and Disposal of Soil at RCRA Landfill	$0	$0	$78,231
1.2.5	Project Closeout	$7,247	$7,247	$7,247
1.2	**Total Costs for System Installation**	**$8,843**	**$242,227**	**$87,892**
1.0	**Total Capital Costs**	**$18,197**	**$262,569**	**$108,234**
	Approximate Costs	**~$18,000**	**~$263,000**	**~$108,000**
2.0	**System Maintenance**			
2.1	Groundwater Monitoring	$52,584	$52,584	$52,584
2.2	Confirmatory Soil Analysis	$0	$0	$0
2.3	Post Building Demolition Soil Analysis	$29,281	$29,281	$24,769
2.4	Operations and Maintenance for System	$4,057	$10,057	$3,403
2.5	Reports	$90,000	$85,000	$85,000
2.0	**Total Costs for System Maintenance**	**$175,922**	**$176,922**	**$165,756**
	Approximate Costs	**~$176,000**	**~$177,000**	**~$166,000**
	Subtotal Project Costs	**$194,120**	**$439,492**	**$273,990**
	Construction Mgmt (10% of subtotal)	$19,412	$43,949	$27,399
	Contingency (20% of subtotal)	$38,824	$87,898	$54,798
	Health and Safety (7.5% of subtotal)	$14,559	$32,962	$20,549
	Contractor Profit (10% of subtotal)	$19,412	$43,949	$27,399
	Total Project Costs	**$286,327**	**$648,250**	**$404,135**
	Approximate Costs	**~$286,000**	**~$648,000**	**~$404,000**

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APPENDIX C

OPERATIONS AND MAINTENANCE PLAN

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C.1 INTRODUCTION

This plan outlines the procedures for operations and maintenance (O&M) of the groundwater monitoring program to monitor the migration of contaminants potentially present beneath Building 1056 that might have originated in the paint booth, Solid Waste Management Unit (SWMU) 24B, Fort Stewart, Georgia. This plan also presents procedures for soil sampling that will be conducted following demolition of Building 1056 and site inspections for maintenance of institutional controls. This O&M Plan is based upon analytical results received and evaluated to date. If the groundwater monitoring program detects any site-related constituents of concern (COCs) at concentrations above remedial levels, then a revised/updated O&M Plan will be submitted to the Georgia Environmental Protection Division. Substantive changes in the remediation approach or schedule will require that the public be provided with an opportunity for review and comment in accordance with the Fort Stewart Hazardous Waste Permit HW-045 (S&T). This O&M Plan will be superceded by the O&M Plan in the addendum to the Corrective Action Plan (CAP), which will be issued following demolition of Building 1056 and evaluation of the soil sampling performed beneath the slab.

No COCs have been identified in groundwater. Although trichloroethene was detected in one well during the November 2000 sampling event, it was detected at a concentration of only 2.6 μg/L, about half the maximum contaminant level (MCL). No organic contaminants were detected in the Phase II Resource Conservation and Recovery Act (RCRA) facility investigation groundwater samples. Chromium was the only inorganic constituent detected at a concentration above its reference background criterion in the shallow groundwater system. Chromium and barium were detected at concentrations above their reference background criteria in the deep groundwater system. Chromium, barium, arsenic, selenium, and lead were all detected at concentrations above their reference background criteria in MW2, the deep background well. Lead in the background well was the only constituent detected at a concentration exceeding its MCL. The purpose of the groundwater monitoring program described in this O&M Plan is to provide early warning of contaminants leaching from the soil at the site. No soil samples have been acquired from beneath the building because the building's presence makes this soil inaccessible. The groundwater monitoring will, therefore, be continued until the building has been demolished and the soil has been sampled and analyzed. The locations of the shallow wells are shown in Figure C-1. The first round of samples will be taken as soon as practicable following approval of the CAP.

C.2 TRAINING

Personnel who participate in field activities during monitoring are subject to the training requirements presented in Table C-1. Casual visitors, such as package deliverers, who access only the staging areas of the site, are not subject to these training requirements. Personnel will also be subject to the requirements specified in this O&M Plan, the Sampling and Analysis Plan (SAP) (as contained within the project-specific work plan), and the project Site Safety and Health Plan (SSHP). The Site Supervisor will be responsible for (1) assessing qualifications and determining skill needs of personnel, (2) ensuring that appropriate training is provided to personnel and that the training (classroom, reading assignments, or on the job) is completed, and (3) forwarding training records for personnel to a Central Records Facility. Health-and-safety-related documentation will also be maintained in on-site project files, in accordance with the SSHP.

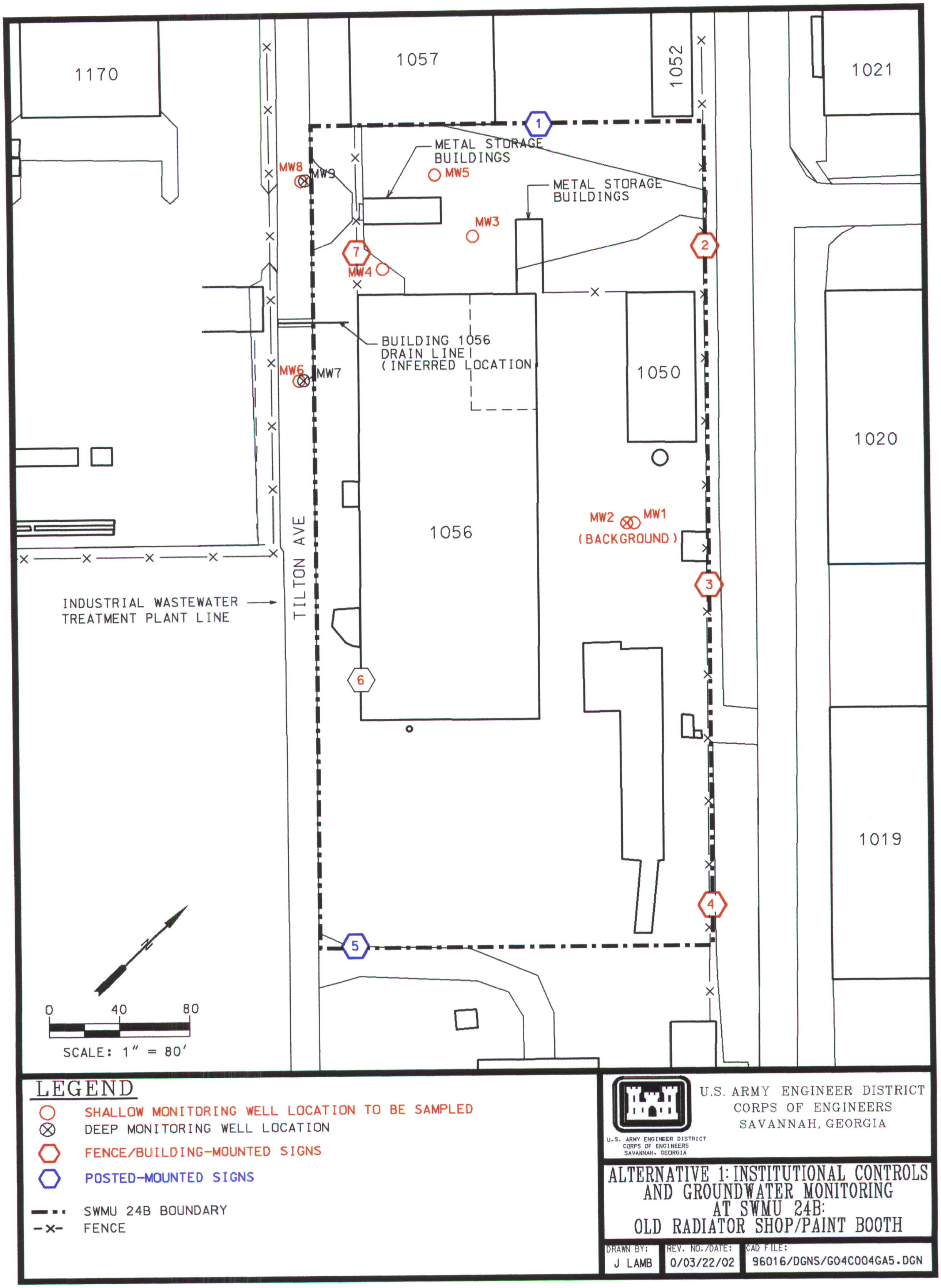

Figure C-1. Alternative 1: Institutional Controls and Groundwater Monitoring for SWMU 24B

Table C-1. Training Requirements, SWMU 24B

Training	Type	Site Inspector	Soil and Groundwater Sampling Worker	Site Supervisor
Health and Safety Training				
Site Safety and Health Plan	Reading	Required	Required	Required
Hazardous Waste Safety (40 hours)	Classroom	Required	Required	Required
Hazardous Waste Safety Annual Refresher (8 hours)	Classroom	Required	Required	Required
Hazardous Waste Safety Supervisor's Training (8 hours)	Classroom			Required
General Hazard Communication Training (contained in 40- and 8-hour courses)	Classroom	Required	Required	Required
Respiratory Protection Training (required only if respirators are worn; contained in 40-hour course)	Classroom	Required	Required	Required
Hearing Conservation Training (contained in 40- and 8-hour courses)	Classroom	Required	Required	Required
Pre-Entry Briefing (including site-specific hazards communication)	OJT	Required	Required	Required
Safety Briefing (daily and whenever conditions or tasks change)	OJT	Required	Required	Required
First Aid/CPR (standard Red Cross or equivalent)	Classroom	At least 2 workers		
Quality Assurance Training				
O&M Plan	Reading	Required	Required	Required
Sampling and Analysis Plan (with addendum)	Reading		Required	Required
Quality Assurance Project Plan, including applicable quality assurance program elements	Reading		Required	Required
General criteria, including applicable codes, standards, and regulations, and the purpose, scope, and implementation of manuals, instructions, and procedures	Reading	Required	Required	Required
Job responsibilities and authority	Reading	Required	Required	Required
Quality Assurance Administrative Procedures	Reading		Required	Required
Quality Assurance Technical Procedures for sampling and analysis	Reading		Required	Required
Demonstration of proficiency for task-specific procedures and equipment	OJT	Required	Required	Required

CPR = Cardiopulmonary resuscitation.
O&M = Operations and maintenance.
OJT = On-the-job training.
SWMU = Solid waste management unit.

C.3 WASTE MANAGEMENT PRACTICES

Wastes generated by operation of the corrective action will be managed in accordance with the RCRA requirements and the investigation-derived waste section of the SAP, as contained in the project-specific work plan. Expected waste generation includes excess soil from hand-auger- and/or hollow-stem-installed soil borings (if needed) for soil sampling under the removed slab, monitoring well purge waters, decontamination fluids, and sanitary waste (uncontaminated compactable and miscellaneous trash). Materials that can be effectively reused, recycled, or decontaminated in the field are not waste materials.

Soil cuttings generated during use of hand-auger sampling techniques and/or drilling of boreholes (if necessary) for soil sampling under the removed slab of Building 1056 will be combined in drums at the point of generation. The drummed wastes will then be transported to a staging area established for the project and temporarily stored until the wastes are transported for final disposal. Analytical data gathered from environmental soil samples will be used to characterize soil waste from the boreholes. If the analytical data are insufficient for characterization of the containerized wastes, the wastes will be sampled and analyzed for RCRA toxicity characteristic contaminants using the Toxicity Characteristic Leaching Procedure (TCLP). Analytical data will be extrapolated to reflect TCLP values (i.e., 20-times-divisor rule for soil). Soil cuttings and spoil materials will be managed as nonhazardous waste pending the analytical results. Based upon the results of the analytical data, the material will be transported to either a permitted RCRA Subtitle D or Subtitle C facility located off the Installation for disposal. The material will be disposed of in accordance with all applicable U.S. Environmental Protection Agency (EPA), U.S. Department of Transportation (DOT), and state of Georgia regulations. Containerized hazardous waste will be transported off-site for disposal within 90 days of receipt of analytical results indicating that the waste is hazardous.

Decontamination and monitoring well purge waters will be accumulated in a poly tank for temporary storage. Analytical data gathered from a grab sample collected directly from the poly tank will be used to characterize liquid wastes. One grab sample will be collected from each filled poly tank and submitted to an off-site laboratory for analysis of volatile organic compounds (VOCs), pH, oil and grease, and phenols. The analytical data reported for the grab samples, the quantity to be released, and the date of the release will be submitted to the Fort Stewart Directorate of Public Works (DPW) water engineer for evaluation.

The water engineer will determine if the liquid waste can be released into the Fort Stewart industrial wastewater treatment plant on a case-by-case basis using In-Stream Water Quality Standards and facility National Pollutant Discharge Elimination System permit requirements as the disposal criteria. In the event that the Fort Stewart DPW water engineer rejects release of the liquid waste into either of the treatment plants, the contents of the subject poly tank will be transferred into 55-gallon, 17E, closed-top drums for disposal off-site. Based upon the results of the analytical data, the material will be transported to either a permitted RCRA Subtitle D or Subtitle C facility located off the Installation for disposal. The material will be disposed of in accordance with all applicable EPA, DOT, and state of Georgia regulations. Containerized hazardous waste will be transported off-site for disposal within 90 days of receipt of sample data indicating that the waste is hazardous.

Sanitary wastes that are noncontaminated will be bagged and placed in a sanitary waste dumpster for disposal at the permitted sanitary landfill in Savannah, Georgia. No free liquids or hazardous substances will be placed in the dumpster.

C.4 SYSTEM OPERATIONS

Groundwater sampling will begin as soon as practicable following approval of this CAP. Concentrations of VOCs, semivolatile organic compounds (SVOCs), and RCRA metals in groundwater will be measured every other year until the addendum to this CAP is approved. The locations of the shallow groundwater monitoring wells to be sampled are shown in Figure C-1.

Soil sampling will be initiated following demolition of Building 1056. Two samples will be collected from each of the eight borings: one sample in the surface interval and one in the interval beginning at the depth of the bottom of the drain line running from the former location of the paint booth to the former ditch. The eight borings will be spaced equidistant in a line parallel to the drain line and close to it.

Site inspections will commence following installation of the signs. The tentative locations of the signs are indicated in Figure C-1. The O&M Inspector will walk around the perimeter of the site to observe any damage to warning signs or evidence of digging within the boundary of the SWMU. The inspector will document all findings and repair/replacement recommendations on the Inspection and Maintenance Logsheet (Attachment C-1) and submit the logsheet to the Site Supervisor. The inspector will also verbally clarify findings to the Site Supervisor as needed. Upon notification of damage to a sign, the Site Supervisor will be responsible for notifying maintenance personnel of the problem. Within 1 month the maintenance personnel will acquire materials necessary for repair or replacement of the signs, perform repairs or replace signs as directed by the work request, and provide documentation to the Site Supervisor that work has been performed.

C.5 SAMPLING AND ANALYSIS

Groundwater monitoring will be conducted biannually until Building 1056 has been demolished to determine whether potential contaminants are migrating from beneath the slab. Soil sampling will be conducted underneath the slab after Building 1056 has been demolished (expected to be in 5 years). All information, data, and resulting decisions will be technically sound, statistically valid, and properly documented by following the Quality Assurance Project Plan (QAPP), as contained in the project-specific work plan. The QAPP will document all monitoring procedures, sampling, field measurements, and sample analyses performed during these activities. Appropriate quality assurance, quality control, and chain-of-custody procedures will be followed in accordance with the U.S. Army Corps of Engineers' *Requirements for the Preparation of Sampling and Analysis Plans* (EM200-1-3), EPA's *EPA Requirements for Quality Assurance Project Plans* (QA/R-5), and EPA's *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (QAMS-005/80). Detailed sampling and analysis procedures will be developed in conjunction with the corrective action work plan. Groundwater sampling will be performed using low-flow sampling techniques.

C.5.1 GROUNDWATER

Groundwater will be sampled from the six shallow monitoring wells [MW1 (background), MW3, MW4, MW5, MW6, and MW8] using low-flow techniques every other year beginning as soon as practicable following approval of this CAP (Table C-2). The last sampling event for these wells took place in November 2000. Water levels will be collected from all site wells to develop a groundwater potentiometric map. Field parameters will be measured at the time of sampling and will include DO, Redox, turbidity, temperature, conductivity, and pH. The groundwater will be sent to an off-site analytical laboratory for VOC, SVOC, and RCRA metals analyses. The biannual groundwater sampling will continue until approval of the addendum to this CAP.

C.5.2 SOIL

Soil sampling will be initiated following demolition of Building 1056, including removal of the concrete slab (Table C-2). Two samples will be collected from each of the eight soil borings: one sample at the surface interval [0 to 2 feet below ground surface (bgs)] and one at the interval beginning at the depth of the bottom of the drain line (expected to be 2 to 4 feet bgs) running from the former location of the paint booth to the former ditch. The eight borings will be spaced equidistant in a line parallel to the drain line and close to it. The soil samples will be collected using hand augers. However, if a greater depth is

Table C-2. Summary of Groundwater and Soil Sampling, SWMU 24B

Groundwater			Soil		
Wells to be Sampled	**Sampling Period**	**Analytes**	**Sampling Locations**	**Sampling Period**	**Analytes**
MW1, MW3, MW4, MW5, MW6, and MW8	Biannually until Building 1056 has been demolished	VOCs, SVOCs, and RCRA metals	Surface and subsurface soil at 8 locations along the drain line	After Building 1056 has been demolished	VOCs, SVOCs, and RCRA metals

RCRA = Resource Conservation and Recovery Act
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

required or the consistency of the soil beneath the removed slab prevents the use of hand-auger techniques, hollow-stem-auger techniques may be required to collect the subsurface soil sample. The soil samples will be sent to an off-site analytical laboratory for VOC, SVOC, and RCRA metals analyses.

C.6 CORRECTIVE ACTION COMPLETION CRITERIA

This corrective measures action will be considered complete when both

- soil samples have been collected from beneath Building 1056 and analyzed and
- the addendum to the CAP has been approved.

Well abandonment is not part of the completion criteria for this CAP because the addendum might require continued groundwater monitoring.

C.7 OPERATIONS AND MAINTENANCE CONTINGENCY PROCEDURES

The results of the biannual groundwater sampling and analysis and site inspections will be evaluated in a biannual CAP progress report. Table C-3 lists the contingency actions that might be considered during the biannual groundwater monitoring.

C.8 OPERATIONS AND MAINTENANCE SCHEDULE

The anticipated schedule for O&M is summarized in Table C-4.

Table C-3. Troubleshooting Guide for Biannual Groundwater Monitoring, SWMU 24B

Problems/Triggers	Considerations	Potential Solutions
Inorganic constituent concentrations in groundwater increase at least 10 percent for two consecutive biannual sampling events, or organic constituents are detected and increase at least 10 percent in subsequent sample.	Transient might be migrating through aquifer, an undiscovered source of contaminant might be present, additional release might have occurred, or constituents in the background well might have migrated on-site.	Modify conceptual site model. Revise the Analytical Transient 1-, 2-, 3-Dimensional numerical model. Extend the duration or frequency of monitoring. Await confirmation from next sampling event. Resample to confirm.
Concentrations of constituents in groundwater increase to a level exceeding MCLs/risk-based concentrations.	Groundwater flow direction might have changed, additional release might have occurred, analytical error might have occurred, or constituents in the background well might have migrated on-site.	
Previously undetected VOCs, SVOCs, or RCRA metals are detected in groundwater.	Distribution coefficients might be higher than those used in the model (i.e., COCs delayed in reaching groundwater by strong sorption), groundwater flow direction shift might move a previously undetected plume to intersect well, transient might be moving through aquifer, previously undetected source in soil might exist, or analytical error might have occurred.	
Land or groundwater use changes.	Remediation objectives or timeframe might no longer be appropriate for new use.	

COC = Constituent of concern.
MCL = Maximum contaminant level.
RCRA = Resource Conservation and Recovery Act.
SVOC = Semivolatile organic compound.
SWMU = Solid waste management unit.
VOC = Volatile organic compound.

Table C-4. Operations and Maintenance Schedule, SWMU 24B

O&M Activity	Frequency	Duration
Baseline groundwater sampling	One-time event	November 2000 for VOCs and SVOCs; October 1999 for metals
Site inspections	Annually until addendum to CAP has been approved	Approximately 5 years, until Building 1056 has been demolished
Groundwater sampling for monitoring	Biannually until addendum to CAP has been approved	Approximately 5 years, until Building 1056 has been demolished
Soil sampling beneath Building 1056 slab	One-time event	As soon as practicable following demolition of Building 1056
Issuing of addendum to CAP	One-time event	As soon as practicable following soil sampling
Implementation of corrective action	One-time event	Schedule to be provided in the addendum to the CAP

CAP = Corrective Action Plan.
O&M = Operations and maintenance.
SVOC = Semivolatile organic compound.
SWMU = Solid waste management unit.
VOC = Volatile organic compound.

C.9 DATA MANAGEMENT AND REPORTING DOCUMENTATION

A data management system will be maintained throughout the corrective action to accumulate, archive, and control project data. The data and operational information will be used to prepare compliance monitoring reports and the addendum to the CAP. The types of data to be maintained in the data management system include those listed below.

- Monitoring and laboratory data, including sample location, date and time of collection, chain of custody, laboratory, test method, analytical results, detection limits, and associated quality control sample results

- Personnel, maintenance, and inspection records, including logbooks, maintenance checklists, or repairs

C.10 CORRECTIVE ACTION PLAN PROGRESS REPORT

A CAP progress report will be prepared annually beginning with completion of the first groundwater sampling event following the approval of this CAP and continuing until the addendum to the CAP is issued. Each report will summarize institutional controls inspections and maintenance. Every other year the reports will include the sampling and analytical results of the groundwater monitoring for that period. Any activities that occurred that required intervention related to the institutional controls will also be reported (e.g., underground utility maintenance). Reports (results of soil sampling from underneath the slab, etc.) required following the final annual report will be described in the addendum to this CAP. The need for any contingent action (if site-related constituents are detected in the groundwater or if there are changes in land use, for example) will also be discussed as required.

A checklist is presented in Attachment C-2 to this O&M Plan summarizing the items to be addressed in each CAP progress report.

C.11 ADDENDUM TO THE CORRECTIVE ACTION PLAN

An addendum to the CAP will be prepared following demolition of Building 1056 and evaluation of the soil samples collected from under the building slab. The addendum will summarize the groundwater sampling events and present the results of the soil sampling. The addendum will propose modifications to the CAP for SWMU 24B based on conclusions from the data and then-current land use plans for the site, including integration/coordination of the remedy with the construction of new maintenance facilities in the area.

ATTACHMENT C-1

INSPECTION AND MAINTENANCE LOGSHEET

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INSPECTION AND MAINTENANCE LOGSHEET
WARNING SIGNS AND POSTS
AT THE OLD RADIATOR SHOP/PAINT BOOTH (SWMU 24B)

Date	Signs/Posts Requiring Repair/Replacement		Inspector Signature	Maintenance Personnel Signature	Supervisor Approval Signature	Comments
	ID #	Status				

Attachment C-1. Inspection and Maintenance Logsheet

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ATTACHMENT C-2

CORRECTIVE ACTION PLAN PROGRESS REPORT CHECKLIST
OLD RADIATOR SHOP/PAINT BOOTH, FORT STEWART, GEORGIA

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Attachment C-2. Corrective Action Plan Progress Report Checklist, Old Radiator Shop/Paint Booth, SWMU 24B

Progress Report Section	Site Inspections	Biannual Monitored Natural Attenuation Sampling
Work accomplished (description of significant activities)	• Date of inspection	• Dates of sampling and analysis, including well inspections • Any monitoring well system maintenance performed
Problems encountered	• Summary of any damage to signs or evidence of prohibited activities • Actions taken to rectify problems	• Summary of any problems encountered • Actions taken to rectify problems
Analysis of trends	• Not applicable	• Comparison of groundwater analytical results to preceding sampling events and comparison of results to risk screening levels
Communications/contacts	• Summaries of major contacts or communications with GEPD, the local community, or others	• Summaries of major contacts or communications with GEPD, the local community, or others
Conclusions and recommendations	• Included in each CAP report	• Need for contingent action (e.g., continued monitored contingent upon active remediation) if MCLs exceeded

CAP = Corrective Action Plan.
GEPD = Georgia Environmental Protection Division.
MCL = Maximum contaminant level.
SWMU = Solid waste management unit.

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