3.0 Current Site Investigation Activities

This chapter summarizes SI activities conducted by Shaw at Training Area T-31, Parcels 184(7) and 185(7), including UXO avoidance activities, environmental sampling and analysis, and groundwater monitoring well installation activities.

3.1 UXO Avoidance

UXO avoidance was performed at Training Area T-31, Parcels 184(7) and 185(7), following methodology outlined in the SAP. Shaw UXO personnel used a low-sensitivity magnetometer to perform a surface sweep of the area of investigation prior to site access. After the area was cleared for access, sample locations were monitored following procedures outlined in the SAP.

3.2 Environmental Sampling

Environmental sampling performed during the SI at Training Area T-31, Parcels 184(7) and 185(7), included the collection of surface and depositional soil samples, subsurface soil samples, groundwater samples, and surface water/sediment samples for chemical analysis. Sample locations were determined by observing site physical characteristics during a site walk and by reviewing historical documents and aerial photographs. The sample locations, media, and rationale are summarized in Table 3-1. Sampling locations are shown on Figure 3-1. Samples were submitted for laboratory analysis of site-related parameters listed in Section 3.4.

3.2.1 Surface and Depositional Soil Sampling

Surface soil samples were collected from 8 locations and depositional soil samples were collected from 3 locations at Training Area T-31, Parcels 184(7) and 185(7), as shown on Figure 3-1. Soil sampling locations and rationale are presented in Table 3-1. Sample designations and analytical parameters are listed in Table 3-2. Soil sampling locations were determined in the field by the on-site geologist based on UXO avoidance activities, sampling rationale, presence of surface structures, and site topography.

Sample Collection. Surface soil samples were collected from the uppermost foot of soil using a direct-push technology (DPT) sampling system, following the methodology specified in the SAP. Depositional soil samples were collected from the upper six inches of soil with a stainless-steel hand auger. Surface soil and depositional soil samples were collected by first removing surface debris (e.g., rocks and vegetation) from the immediate sample area. The soil was then collected with the sampling device and screened with a photoionization detector (PID) in

Table 3-1

Sampling Locations And Rationale
Training Area T-31, Parcels 184(7) and 185(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Media	Sample Location Rationale
CWM-184-MW01	Surface soil, subsurface soil, and groundwater	Surface soil, subsurface soil, and groundwater samples were collected in the eastern area of Parcel 184(7), upslope of Training Area T-31, to determine if potential site-specific chemicals have impacted site media.
CWM-184-MW02	Surface soil, subsurface soil, and groundwater	Surface soil, subsurface soil, and groundwater samples were collected south and downslope of the concrete pads near the center of Parcel 184(7) to determine if potential site-specific chemicals have impacted site media.
CWM-184-MW03	Surface soil, subsurface soil, and groundwater	Surface soil, subsurface soil, and groundwater samples were collected downslope of the depression located in the western portion of Parcel 184(7) to determine if potential site-specific chemicals have impacted site media.
CWM-184-MW04	Surface soil, subsurface soil, and groundwater	Surface soil, subsurface soil, and groundwater samples were collected downslope of the depression located in the western portion of Parcel 184(7) to determine if potential site-specific chemicals have impacted site media.
CWM-184-MW05	Surface soil, subsurface soil, and groundwater	Surface soil, subsurface soil, and groundwater samples were collected near the concrete pad located in the southeastern portion of Parcel 184(7) to determine if potential site-specific chemicals have impacted site media.
CWM-184-DEP01	Depositional soil	A depositional soil sample was collected from the creek bed of Cave Creek outside the north corner of Parcel 184(7) to determine if potential site-specific chemicals have impacted site media.
CWM-185-MW01	Surface soil, subsurface soil, and groundwater	Surface soil, subsurface soil, and groundwater samples were collected at the end of a dirt road and downslope of the central portion of Parcel 185(7) to determine if potential site-specific chemicals have impacted site media.
CWM-185-MW02	Surface soil, subsurface soil, and groundwater	Surface soil, subsurface soil, and groundwater samples were collected downslope of Training Area T-31 in the southwest portion of Parcel 185(7) to determine if potential site-specific chemicals have impacted site media.
CWM-185-GP01	Surface soil and subsurface soil	Surface and subsurface soil samples were collected in the middle portion of Parcel 185(7), next to a pit containing one metal smoke pot and some metallic debris, to determine if potential site-specific chemicals have impacted site media.
CWM-185-DEP01	Depositional soil	A depositional soil sample was collected in an intermittent stream near the southeastern corner of Parcel 185(7) to determine if potential site-specific chemicals have impacted site media.
CWM-185-DEP02	Depositional soil	A depositional soil sample was collected in an intermittent stream southeast of Parcel 185(7) to determine if potential site-specific chemicals have impacted site media.
CWM-185-SW/SD02	Surface water and sediment	Surface water and sediment samples were collected southwest of Parcel 185(7), in an intermittent stream that flows into Cave Creek, to determine if potential site-specific chemicals have impacted site media.

Table 3-2

Soil Sample Designations and Analytical Parameters
Training Area T-31, Parcels 184(7) and 185(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples		Analytical Parameters
			Field Duplicates	MS/MSD	
CWM-184-MW01	CWM-184-MW01-SS-TL0001-REG	0-1			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW01-DS-TL0002-REG	4-5			
CWM-184-MW02	CWM-184-MW02-SS-TL0003-REG	0-1			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW02-DS-TL0004-REG	5-6			
CWM-184-MW03	CWM-184-MW03-SS-TL0005-REG	0-1			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW03-DS-TL0006-REG	5-6			
CWM-184-MW04	CWM-184-MW04-SS-TL0007-REG	0-1			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW04-DS-TL0008-REG	2-3			
CWM-184-MW05	CWM-184-MW05-SS-TL0009-REG	0-1			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW05-DS-TL0010-REG	7-8			
CWM-184-DEP01	CWM-184-DEP01-DEP-TL0011-REG	0-0.5			VOCs, SVOCs, Metals, and CWM Breakdown Products
CWM-185-MW01	CWM-185-MW01-SS-TF0001-REG	0-1			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-185-MW01-DS-TF0002-REG	4-5		CWM-185-MW01-DS-TF0002-MS/MSD	
CWM-185-MW02	CWM-185-MW02-SS-TF0003-REG	0-1			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-185-MW02-DS-TF0004-REG	2-3	CWM-185-MW02-DS-TF0005-FD		
CWM-185-GP01	CWM-185-GP01-SS-TF0007-REG	0-1			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-185-GP01-DS-TF0008-REG	7-8			
CWM-185-DEP01	CWM-185-DEP01-DEP-TF0009-REG	0-0.5			VOCs, SVOCs, Metals, and CWM Breakdown Products
CWM-185-DEP02	CWM-185-DEP02-DEP-TF0010-REG	0-0.5			

CWM - Chemical warfare material.
FD - Field duplicate.
MS/MSD - Matrix spike/matrix spike duplicate.
QA/QC - Quality assurance/quality control.
REG - Field sample.
SVOC - Semivolatile organic compound.
VOC - Volatile organic compound.

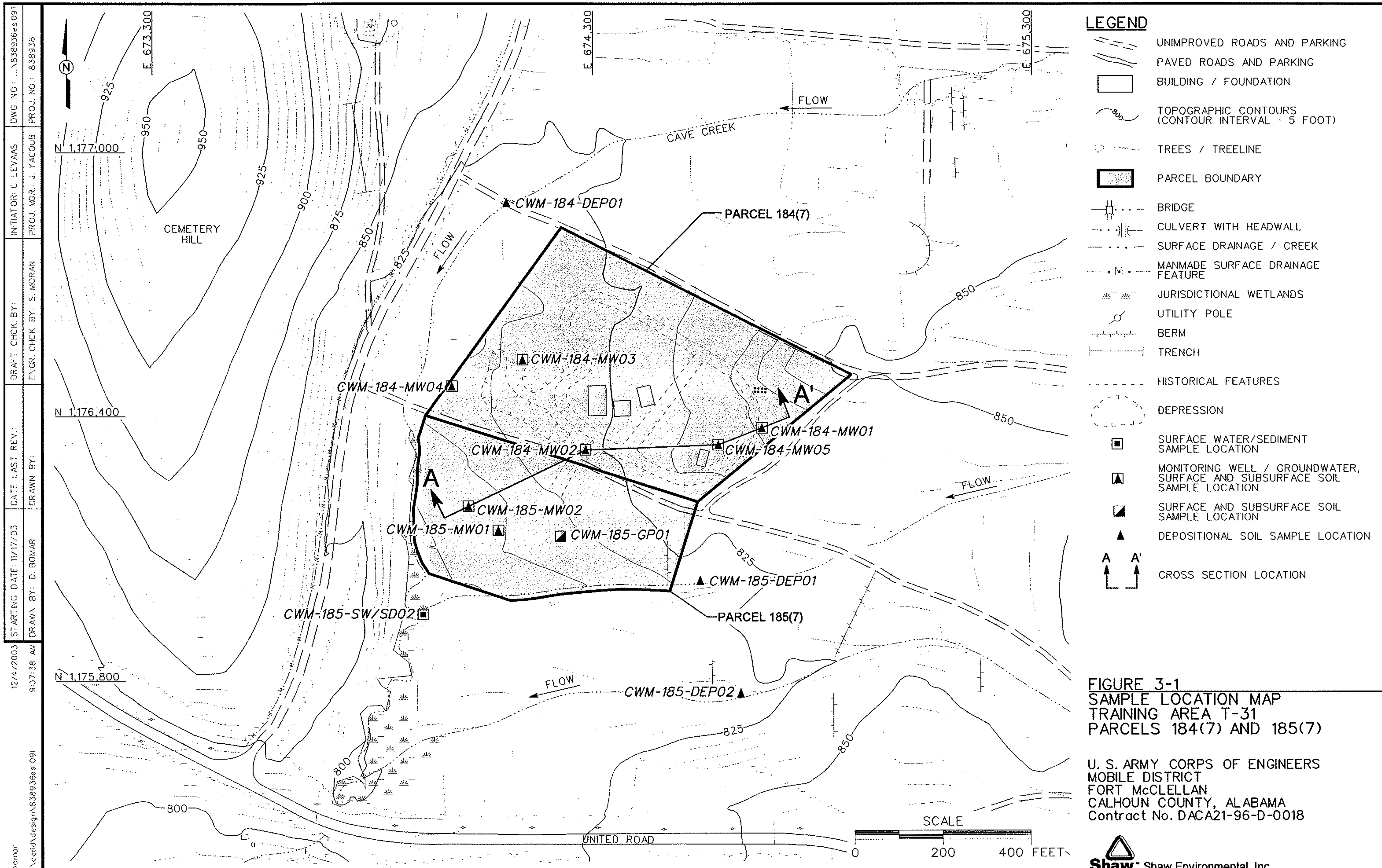


FIGURE 3-1
SAMPLE LOCATION MAP
TRAINING AREA T-31
PARCELS 184(7) AND 185(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

Shaw Environmental, Inc.

accordance with procedures outlined in the SAP. The soil fraction for VOC analysis was then collected directly from the sampler using three EnCore® samplers. The remaining soil was transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.4.

3.2.2 Subsurface Soil Sampling

Subsurface soil samples were collected from 8 soil borings at Training Area T-31, Parcels 184(7) and 185(7), as shown on Figure 3-1. Subsurface soil sampling locations and rationale are presented in Table 3-1. Sample designations, depths, and analytical parameters are listed in Table 3-2. Soil boring locations were determined in the field by the on-site geologist based on UXO avoidance activities, sampling rationale, presence of surface structures, and site topography.

Sample Collection. Subsurface soil samples were collected from soil borings at depths greater than one foot below ground surface (bgs) in the unsaturated zone. The soil borings were advanced and samples collected using the DPT sampling procedures specified in the SAP. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.4.

Subsurface soil samples were collected continuously until DPT sampler refusal was encountered at depths ranging from 3 to 8 feet bgs. Samples were field screened using a PID to measure for volatile organic vapors in accordance with procedures outlined in the SAP. The sample displaying the highest reading was selected and sent to the laboratory for analysis; however, at those locations where PID readings were below background, the deepest sample interval above the saturated zone was submitted for analysis. The soil fraction for VOC analysis was collected directly from the sampler using three EnCore® samplers. The remaining soil was then transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. The on-site geologist constructed a detailed boring log for each soil boring. The boring logs are included in Appendix B. At the completion of soil sampling, boreholes were filled with bentonite pellets hydrated with potable water, following borehole abandonment procedures summarized in the SAP.

3.2.3 Monitoring Well Installation

Seven permanent groundwater monitoring wells were installed in the saturated zone at Training Area T-31, Parcels 184(7) and 185(7), to collect groundwater samples for laboratory analysis. The well locations are shown on Figure 3-1. Table 3-3 summarizes construction details of the wells installed at the site. The well construction logs are included in Appendix B.

Shaw contracted Miller Drilling Company to install the permanent wells with a hollow-stem auger drill rig at seven of the DPT soil boring locations. The wells were installed following procedures outlined in the SAP. The borehole at each well location was advanced with a 4.25-inch inside diameter (ID) hollow-stem auger from ground surface to the saturated zone. The borehole was augered to the completion depth of the DPT boring and samples were collected from that depth to the bottom of the borehole. A 2-foot-long, 2-inch ID carbon steel split-spoon sampler was driven at 5-foot intervals to collect residuum for observing and describing lithology. The drill cuttings were logged to determine lithologic changes and the approximate depth of groundwater encountered during drilling. This information was used to determine the optimal placement of the monitoring well screen interval and to provide site-specific geological and hydrogeological information. Soil characteristics were described using the "Burmeister Identification System" described in Hunt (1986) and the Unified Soil Classification System as outlined in American Society for Testing and Materials (ASTM) Method D 2488 (ASTM, 2000). The boring logs are included in Appendix B.

Upon reaching the target depth in each borehole, a 10- to 25-foot length of 2-inch ID, 0.010-inch continuous slot, Schedule 40 polyvinyl chloride (PVC) screen with an end cap was placed through the auger to the bottom of the borehole. The screen and end cap were attached to 2-inch ID, flush-threaded Schedule 40 PVC riser. A filter pack consisting of number 1 filter sand (environmentally safe, clean fine sand, sieve size 20 to 40) was tremied around the well screen to approximately 5 feet above the top of the well screen as the augers were removed. At well CWM-184-MW05, the filter pack also included a layer of extra fine filter sand (sieve size 30 to 70). A bentonite seal, consisting of approximately 3 feet of bentonite pellets, was placed immediately on top of the filter sand and hydrated with potable water. At wells where the bentonite seal was installed below the water table surface, the bentonite pellets were allowed to hydrate in the groundwater. The bentonite seal placement and hydration followed procedures in the SAP. Bentonite-cement grout was tremied into the remaining annular space of the well. A well cap was placed on the PVC casing. A locking protective steel casing was placed over the

Table 3-3

Monitoring Well Construction Summary
Training Area T-31, Parcels 184(7) and 185(7)
Fort McClellan, Calhoun County, Alabama

Well Location	Northing	Easting	Ground Elevation (ft amsl)	TOC Elevation (ft amsl)	Well Depth (ft bgs)	Screen Length (ft)	Screen Interval (ft bgs)	Well Material
CWM-184-MW01	1176371.46	674687.71	840.59	842.80	45	15	30 - 45	2" ID Sch. 40 PVC
CWM-184-MW02	1176321.26	674285.24	827.08	829.17	30	15	15 - 30	2" ID Sch. 40 PVC
CWM-184-MW03	1176526.15	674141.84	828.35	830.40	35	15	20 - 35	2" ID Sch. 40 PVC
CWM-184-MW04	1176466.11	673981.59	821.95	824.20	20	10	10 - 20	2" ID Sch. 40 PVC
CWM-184-MW05	1176332.99	674588.45	837.39	839.29	50	25	25 - 50	2" ID Sch. 40 PVC
CWM-185-MW01	1176139.01	674086.35	820.26	822.19	25	15	10 - 25	2" ID Sch. 40 PVC
CWM-185-MW02	1176193.20	674018.53	819.14	821.24	20	10	10 - 20	2" ID Sch. 40 PVC

Permanent wells installed using hollow-stem auger.
Horizontal coordinates referenced to the U.S. State Plane Coordinate System, Alabama East Zone, North American Datum of 1983.
Elevations referenced to the North American Vertical Datum of 1988.

2" ID Sch. 40 PVC - 2-inch inside diameter, Schedule 40, polyvinyl chloride.
amsl - Above mean sea level.
bgs - Below ground surface.
ft - Feet.
TOC - Top of casing.

PVC well casing, and a concrete pad was constructed around the well head. Four protective steel posts were installed around the well pad.

The monitoring wells were developed by surging and pumping with a 2-inch-diameter submersible pump in accordance with methodology outlined in the SAP. The submersible pump used for well development was moved in an up-and-down fashion to encourage any residual well installation materials to enter the well. These materials were then pumped out of the well in order to reestablish the natural hydraulic flow conditions. Development continued until the water turbidity was less than 20 nephelometric turbidity units, until the well was repeatedly pumped dry and allowed to recharge, or for a maximum of eight hours. The well development logs are included in Appendix C.

3.2.4 Water Level Measurements

The depth to groundwater was measured in the permanent wells at the site on May 23, 2003, following procedures outlined in the SAP. Depth to groundwater was measured with an electronic water level meter. The meter probe and cable were cleaned before use at each well, following decontamination methodology presented in the SAP. Measurements were referenced to the top of the PVC well casing. A summary of groundwater level measurements for Training Area T-31, Parcel 184(7) and 185(7), is presented in Table 3-4.

3.2.5 Groundwater Sampling

A total of fourteen groundwater samples were collected from the seven monitoring wells installed at Training Area T-31, Parcels 184(7) and 185(7), during two phases of sampling. The second round of sampling was conducted to confirm the presence of VOCs detected in the initial samples. The well/groundwater sampling locations are shown on Figure 3-1. The groundwater sampling locations and rationale are listed in Table 3-1. The groundwater sample designations and analytical parameters are listed in Table 3-5.

Sample Collection. Groundwater samples were collected using either a peristaltic pump or submersible bladder pump equipped with Teflon™ tubing, following the procedures outlined in the SAP. Samples for VOC analysis collected using a peristaltic pump were retrieved using the "tube evacuation" method described in the SAP. Groundwater samples were collected after purging a minimum of three well volumes and after field parameters (temperature, pH, dissolved oxygen, specific conductivity, oxidation-reduction potential, and turbidity) stabilized. Field parameters were measured using a calibrated water-quality meter, as summarized in Table 3-6.

Table 3-4

Groundwater Elevations
Training Area T-31, Parcels 184(7) and 185(7)
Fort McClellan, Calhoun County, Alabama

Well Location	Date	Depth to Water (ft BTOC)	Top of Casing Elevation (ft amsl)	Ground Elevation (ft amsl)	Groundwater Elevation (ft amsl)
CWM-184-MW01	23-May-03	9.70	842.80	840.59	833.10
CWM-184-MW02	23-May-03	2.31	829.17	827.08	826.86
CWM-184-MW03	23-May-03	5.11	830.40	828.35	825.29
CWM-184-MW04	23-May-03	2.52	824.20	821.95	821.68
CWM-184-MW05	23-May-03	7.94	839.29	837.39	831.35
CWM-185-MW01	23-May-03	1.80	822.19	820.26	820.39
CWM-185-MW02	23-May-03	2.71	821.24	819.14	818.53

Elevations referenced to the North American Vertical Datum of 1988.

amsl - Above mean sea level.
BTOC - Below top of casing.
ft - Feet.

Table 3-5

Groundwater Sample Designations and Analytical Parameters
Training Area T-31, Parcels 184(7) and 185(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	QA/QC Samples		Analytical Parameters
		Field Duplicates	MS/MSD	
CWM-184-MW01	CWM-184-MW01-GW-TL3001-REG			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW01-GW-TL3006-REG			VOCs
CWM-184-MW02	CWM-184-MW02-GW-TL3002-REG			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW02-GW-TL3007-REG			VOCs
CWM-184-MW03	CWM-184-MW03-GW-TL3003-REG			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW03-GW-TL3008-REG			VOCs
CWM-184-MW04	CWM-184-MW04-GW-TL3004-REG			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW04-GW-TL3009-REG			VOCs
CWM-184-MW05	CWM-184-MW05-GW-TL3005-REG		CWM-184-MW05-GW-TL3001-MS/MSD	VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-184-MW05-GW-TL3010-REG	CWM-184-MW05-GW-TL3011-FD		VOCs
CWM-185-MW01	CWM-185-MW01-GW-TF3001-REG	CWM-185-MW01-GW-TF3003-FD		VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-185-MW01-GW-TF3004-REG			VOCs
CWM-185-MW02	CWM-185-MW02-GW-TF3002-REG			VOCs, SVOCs, Metals, and CWM Breakdown Products
	CWM-185-MW02-GW-TF3005-REG		CWM-185-MW02-GW-TF3005-MS/MSD	VOCs

CWM - Chemical warfare material.
FD - Field duplicate.
MS/MSD - Matrix spike/matrix spike duplicate.
QA/QC - Quality assurance/quality control.
REG - Field sample.
SVOC - Semivolatile organic compound.
VOC - Volatile organic compound.

Table 3-6

Groundwater and Surface Water Field Parameters
Training Area T-31, Parcels 184(7) and 185(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Date	Sample Medium	Specific Conductivity (mS/cm)	Dissolved Oxygen* (mg/L)	ORP (mV)	Temperature (°C)	Turbidity (NTU)	pH (SU)
CWM-184-MW01	6-Dec-01	GW	0.028	7.02	330	17.9	1.9	5.27
	8-Jan-03	GW	0.055	0.54	18.6	14.6	1.6	5.75
CWM-184-MW02	7-Dec-01	GW	0.103	11.02	425	15.2	9.4	5.95
	10-Jan-03	GW	0.160	0.48	23.2	14.0	1.8	6.14
CWM-184-MW03	11-Dec-01	GW	0.267	11.49	345	11.1	6.1	7.69
	8-Jan-03	GW	0.239	1.96	75.3	16.6	12	7.46
CWM-184-MW04	13-Dec-01	GW	0.255	8.42	44	17.4	100	8.23
	14-Jan-03	GW	0.216	2.92	129.8	14.8	500	7.55
CWM-184-MW05	5-Dec-01	GW	0.254	10.95	369	17.8	9.1	7.03
	10-Jan-03	GW	0.279	0.22	-145.3	14.5	7.6	7.17
CWM-185-MW01	4-Dec-01	GW	0.299	10.31	135	19.0	4.0	7.39
	9-Jan-03	GW	0.225	4.39	167.1	16.3	1.8	7.26
CWM-185-MW02	4-Dec-01	GW	0.396	10.67	250	17.0	3.1	7.79
	9-Jan-03	GW	0.169	4.41	150.9	14.7	90	7.69
CWM-185-SW/SD02	9-Nov-01	SW	2.230	6.69	141	12.7	7.4	2.30

* - Some dissolved oxygen readings are artificially elevated due to air in sampling equipment.
°C - Degrees Celsius.
GW - Groundwater.
mg/L - Milligram per liter.
mS/cm - Millisiemen per centimeter.
mV - Millivolt.
NTU - Nephelometric turbidity unit.
ORP - Oxidation-reduction potential.
SU - Standard unit.
SW - Surface water.

Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-5 using methods outlined in Section 3.4.

3.2.6 Surface Water Sampling

One surface water sample was collected at Training Area T-31, Parcels 184(7) and 185(7), at the location shown on Figure 3-1. The surface water sampling location and rationale are listed in Table 3-1. Sample designations and analytical parameters are listed in Table 3-7. The actual sampling location was determined in the field, based on drainage pathways and observations.

Sample Collection. The surface water sample was collected by dipping a stainless-steel pitcher in the water and pouring the water into the sample containers following procedures in the SAP. The surface water sample was collected after field parameters had been measured using a calibrated water quality meter. Surface water field parameters are listed in Table 3-6. The sample collection logs is included in Appendix A. The sample was analyzed for the parameters listed in Table 3-7 using methods outlined in Section 3.4.

3.2.7 Sediment Sampling

One sediment sample was collected at the same sample location as the surface water sample at Training Area T-31, Parcels 184(7) and 185(7), as shown on Figure 3-1. The sediment sampling location and rationale are presented in Table 3-1. The sediment sample designations and analytical parameters are listed in Table 3-7. The actual sediment sampling location was determined in the field, based on drainage pathways and field observations.

Sample Collection. The sediment sample was collected with a stainless-steel hand auger and placed in a clean stainless-steel bowl following procedures in the SAP. The sediment fraction for VOC analysis was collected directly from the bowl using three EnCore® samplers. The remaining sample was then homogenized and placed in the appropriate sample containers. Sample collection logs are included in Appendix A. The sediment sample was analyzed for the parameters listed in Table 3-7 using methods outlined in Section 3.4.

3.3 Surveying of Sample Locations

Sample locations were surveyed using global positioning system survey techniques and conventional civil survey techniques described in the SAP. Horizontal coordinates were referenced to the U.S. State Plane Coordinate System, Alabama East Zone, North American

Table 3-7

Surface Water and Sediment Sample Designations and Analytical Parameters
Training Area T-31, Parcels 184(7) and 185(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	QA/QC Samples Field Duplicates	Analytical Parameters
CWM-185-SW/SD02	CWM-185-SW/SD02-SW-TF2002-REG		VOCs, SVOCs, Metals, CWM Breakdown Products, TOC[a], Grain Size[a]
	CWM-185-SW/SD02-SD-TF1002-REG	CWM-185-SW/SD02-SD-TF1003-FD	

[a] Sediment sample only

CWM - Chemical warfare material.
FD - Field duplicate.
QA/QC - Quality assurance/quality control.
REG - Field sample.
SD - Sediment.
SVOC - Semivolatile organic compound.
SW - Surface water.
TOC - Total organic carbon.
VOC - Volatile organic compound.

Datum of 1983. Elevations were referenced to the North American Vertical Datum of 1988. Horizontal coordinates and elevations are included in Appendix D.

3.4 Analytical Program

Samples collected during the SI were analyzed for various chemical and physical parameters based on potential site-specific chemicals and on EPA, Alabama Department of Environmental Management, FTMC, and USACE requirements. Phase I samples collected at Parcels 184(7) and 185(7) were analyzed for the following parameters using EPA SW-846 methods, including Update III methods where applicable:

- Target compound list (TCL) VOCs – EPA Method 8260B
- TCL SVOC – EPA Method 8270C
- Target analyte list metals – EPA Method 6010B/7000
- CWM breakdown products (including orthosulfur compounds)– EPA Methods 8270M and 8321

The sediment samples were analyzed for the following additional parameters:

- Total organic carbon (TOC) - EPA Method 9060
- Grain Size - ASTM Method D-422.

Phase II groundwater samples were only analyzed for TCL VOCs (EPA Method 8260B).

3.5 Sample Preservation, Packaging, and Shipping

Sample preservation, packaging, and shipping followed requirements specified in the SAP. Sample containers, sample volumes, preservatives, and holding times for the analyses required in this SI are listed in Appendix B of the SAP. Sample documentation and chain-of-custody records were completed as specified in the SAP.

Completed analysis request and chain-of-custody records (Appendix A) were secured and included with each shipment of sample coolers to EMAX Laboratories, Inc. in Torrance, California.

3.6 Investigation-Derived Waste Management and Disposal

Investigation-derived waste (IDW) was managed and disposed as outlined in Appendix D of the SAP. The IDW generated during the SI at Training Area T-31, Parcels 184(7) and 185(7), was segregated as follows:

- Drill cuttings
- Purge water from well development, sampling activities, and decontamination fluids
- Spent well materials and personal protective equipment.

Solid IDW was stored inside the fenced area surrounding Buildings 335 and 336 in lined roll-off bins prior to characterization and final disposal. Solid IDW was characterized using toxicity characteristic leaching procedure analyses. Based on the results, drill cuttings, spent well materials, and personal protective equipment generated during the SI were disposed as nonhazardous waste at the Industrial Waste Landfill at FTMC.

Liquid IDW was contained in the 20,000-gallon sump associated with the Building T-338 vehicle washrack. Liquid IDW was characterized by VOC, SVOC, and metals analyses. Based on the analyses, liquid IDW was discharged as nonhazardous waste to the FTMC wastewater treatment plant on the Main Post.

3.7 Variances/Nonconformances

Two variances to the SFSP were recorded during completion of the SI at Parcels 184(7) and 185(7). The variances did not alter the intent of the investigation or the sampling rationale presented in the SFSP. The variances are summarized in Table 3-8 and the variance reports are included in Appendix E.

No nonconformances were recorded during completion of the SI.

3.8 Data Quality

The field sample analytical data are presented in tabular form in Appendix F. The field samples were collected, documented, handled, analyzed, and reported in a manner consistent with the SI work plan; the FTMC SAP and installation-wide quality assurance plan; and standard, accepted methods and procedures. Data were reported and evaluated in accordance with Corps of Engineers South Atlantic Savannah Level B criteria (USACE, 2001) and the stipulated requirements for the generation of definitive data presented in the SAP. Chemical data were reported via hard-copy data packages by the laboratory using Contract Laboratory Program-like forms.

Table 3-8

Variances to the Site-Specific Field Sampling Plan
Training Area T-31, Parcels 184(7) and 185(7)
Fort McClellan, Calhoun County, Alabama

Variance to the SFSP	Justification for Variance	Impact to Site Investigation
The Final Site-Specific Field Sampling Plan proposed the collection of surface water and sediment samples at sample locations CWM-184-SW/SD01, CWM-185-SW/SD01, and CWM-185-SW/SD03. Surface water and sediment samples were not collected at these locations. Depositional soil samples CWM-184-DEP01, CWM-185-DEP01, and CWM-185-DEP02 were collected at these locations, respectively.	Surface water and sediment samples were not collected at these locations because surface water and sediment were not present in the creek during sample collection. Several attempts were made to collect surface water and sediment samples, but all attempts were unsuccessful.	None. Depositional soil samples collected from these locations are representative samples.
The Final Site-Specific Field Sampling Plan proposed the collection of seven surface and subsurface soil samples in order to determine if potential site-specific chemicals are present. Eight surface and subsurface soil samples were collected for analysis to determine if potential site-specific chemicals are present.	The Shaw site manager made a decision to collect one additional surface and subsurface soil sample at sample location CWM-185-GP01, located next to a large pit containing debris. This additional surface and subsurface soil sample was collected to determine if potential site-specific chemicals are present.	None. The additional samples provide additional data to determine if potential site-specific chemicals are present.

Data Validation. The reported analytical data were validated by Level III criteria in accordance with EPA National Functional Guidelines. The data validation results are summarized by parcel in quality assurance reports, which include the data validation summary reports (Appendix G). Selected results were qualified based on the implementation of accepted data validation procedures and practices. These qualified parameters are highlighted in the report. The validation-assigned qualifiers were added to the FTMC Shaw Environmental Management System database for tracking and reporting. The qualified data were used in comparisons to the SSSLs and ESVs developed by Shaw. Rejected data (assigned an "R" qualifier) were not used in the comparisons with the SSSLs and ESVs. The data presented in this report, except where qualified, meet the principle data quality objective for this SI.

4.0 Site Characterization

Subsurface investigations performed at Training Area T-31, Parcels 184(7) and 185(7), provided soil, geologic, and groundwater data used to characterize the geology and hydrogeology of the site.

4.1 Regional and Site Geology

4.1.1 Regional Geology

Calhoun County includes parts of two physiographic provinces, the Piedmont Upland Province and the Valley and Ridge Province. The Piedmont Upland Province occupies the extreme eastern and southeastern portions of the county and is characterized by metamorphosed sedimentary rocks. The generally accepted range in age of these metamorphics is Cambrian to Devonian.

The majority of Calhoun County, including the Main Post of FTMC, lies within the Appalachian fold-and-thrust structural belt (Valley and Ridge Province), where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold-and-thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust-faulted, with major structures and faults striking in a northeast-southwest direction.

Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock, referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within an individual thrust sheet (Osborne and Szabo, 1984). Geologic contacts in this region generally strike parallel to the faults, and repetition of lithologic units is common in vertical sequences. Geologic formations within the Valley and Ridge Province portion of Calhoun County have been mapped by Warman and Causey (1962), Osborne and Szabo (1984), and Moser and DeJarnette (1992) and vary in age from Lower Cambrian to Pennsylvanian.

The basal unit of the sedimentary sequence in Calhoun County is the Cambrian Chilhowee Group. The Chilhowee Group consists of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984), but in Calhoun County is either undifferentiated or divided into the Cochran and Nichols Formations and an upper, undifferentiated Wilson Ridge and Weisner Formation. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish gray siltstone and mudstone. Massive to laminated greenish gray and black mudstone makes up the Nichols Formation, with thin interbeds of siltstone and very fine-grained sandstone (Osborne et al., 1988). These two formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appears to dominate the unit and consists primarily of coarse-grained, vitreous quartzite and friable, fine- to coarse-grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consists of sandy and micaceous shale and silty, micaceous mudstone, which are locally interbedded with the coarse clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of FTMC belongs to the Weisner Formation (Osborne and Szabo, 1984).

The Cambrian Shady Dolomite overlies the Weisner Formation northeast, east, and southwest of the Main Post and consists of interlayered bluish gray or pale yellowish gray sandy dolomitic limestone and siliceous dolomite with coarsely crystalline, porous chert (Osborne et al., 1989). A variegated shale and clayey silt have been included within the lower part of the Shady Dolomite (Cloud, 1966). Material similar to this lower shale unit was noted in core holes drilled by the Alabama Geologic Survey on FTMC (Osborne and Szabo, 1984). The character of the Shady Dolomite in the FTMC vicinity and the true assignment of the shale at this stratigraphic interval are still uncertain (Osborne, 1999).

The Rome Formation overlies the Shady Dolomite and locally occurs to the northwest and southeast of the Main Post, as mapped by Warman and Causey (1962) and Osborne and Szabo (1984), and immediately to the west of Reilly Airfield (Osborne and Szabo, 1984). The Rome Formation consists of variegated, thinly interbedded grayish-red-purple mudstone, shale, siltstone, and greenish red and light gray sandstone, with locally occurring limestone and dolomite. The Conasauga Formation overlies the Rome Formation and occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman and Causey, 1962; Osborne and Szabo, 1984) and the northern portion of the Main Post (Osborne et al., 1997). The Conasauga Formation is composed of dark gray, finely to coarsely crystalline, medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989).

Overlying the Conasauga Formation is the Knox Group, which is composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group is undifferentiated in Calhoun County and consists of light to medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weather to a chert residuum (Osborne and Szabo, 1984). The Knox Group underlies a large portion of the Pelham Range area.

The Ordovician Newala and Little Oak Limestones overlie the Knox Group. The Newala Limestone consists of light to dark gray, micritic, thick-bedded limestone with minor dolomite. The Little Oak Limestone consists of dark gray, medium- to thick-bedded, fossiliferous, argillaceous to silty limestone with chert nodules. These limestone units are mapped as undifferentiated at FTMC and in other parts of Calhoun County. The Athens Shale overlies the Ordovician limestone units. The Athens Shale consists of dark gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989). These units occur within an eroded "window" in the uppermost structural thrust sheet at FTMC and underlie much of the developed area of the Main Post.

Other Ordovician-aged bedrock units mapped in Calhoun County include the Greensport Formation, Colvin Mountain Sandstone, and Sequatchie Formation. These units consist of various siltstones, sandstones, shales, dolomites, and limestones and are mapped as one undifferentiated unit in some areas of Calhoun County. The only Silurian-age sedimentary formation mapped in Calhoun County is the Red Mountain Formation. This unit consists of interbedded red sandstone, siltstone, and shale with greenish gray to red silty and sandy limestone.

The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone with shale interbeds, dolomudstone, and glauconitic limestone (Osborne et al., 1988). This unit occurs locally in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of dark to light gray limestone with abundant chert nodules and greenish gray to grayish red phosphatic shale, with increasing amounts of calcareous chert toward the upper portion of the formation (Osborne and Szabo, 1984). These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian age, which consists of thin-bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone. Osborne and Szabo (1984) reassigned the Floyd Shale, which was mapped by Warman and Causey (1962) on the Main Post of FTMC, to the Ordovician Athens Shale based on fossil data.

The Pennsylvanian Parkwood Formation overlies the Floyd Shale and consists of a medium to dark gray, silty, clay shale and mudstone with interbedded light to medium gray, very fine to fine grained argillaceous, micaceous sandstone. Locally the Parkwood Formation also contains beds of medium- to dark-gray argillaceous, bioclastic to cherty limestone and beds of clayey coal up to a few inches thick (Raymond et al., 1988). The Parkwood Formation in Calhoun County is generally found within a structurally complex area known as the Coosa deformed belt. In the deformed belt, the Parkwood Formation and Floyd Shale are mapped as undifferentiated because their lithologic similarity and significant deformation make it impractical to map the contact (Thomas and Drahovzal, 1974; Osborne et al., 1988). The undifferentiated Parkwood Formation and Floyd Shale are found throughout the western quarter of Pelham Range.

The Jacksonville thrust fault is the most significant structural geologic feature in the vicinity of the Main Post of FTMC, both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama, and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City fault (Osborne and Szabo, 1984). The Ordovician sequence that makes up the Eden thrust sheet is exposed at FTMC through an eroded window, or fenster, in the overlying thrust sheet. Rocks within the window display complex folding, with the folds being overturned and tight to isoclinal. The carbonates and shales locally exhibit well-developed cleavage (Osborne and Szabo, 1984). The FTMC window is framed on the northwest by the Rome Formation; north by the Conasauga Formation; northeast, east, and southwest by the Shady Dolomite, and southeast and southwest by the Chilhowee Group (Osborne et al., 1997). Two small klippen of the Shady Dolomite, bounded by the Jacksonville fault, have been recognized adjacent to the Pell City fault at the FTMC window (Osborne et al., 1997).

The Pell City fault serves as a fault contact between the bedrock within the FTMC window and the Rome and Conasauga Formations. The trace of the Pell City fault is also exposed approximately nine miles west of the FTMC window on Pelham Range, where it traverses northeast to southwest across the western quarter of Pelham Range. Here, the trace of the Pell City fault marks the boundary between the Pell City thrust sheet and the Coosa deformed belt.

The eastern three-quarters of Pelham Range is located within the Pell City thrust sheet, while the remaining western quarter of Pelham is located within the Coosa deformed belt. The Pell City thrust sheet, a large-scale thrust sheet containing Cambrian and Ordovician rock, is relatively less structurally complex than the Coosa deformed belt (Thomas and Neathery, 1982). The Pell City thrust sheet is exposed between the traces of the Jacksonville and Pell City faults along the western boundary of the FTMC window and along the trace of the Pell City fault on Pelham Range (Thomas and Neathery, 1982; Osborne et al., 1988). The Coosa deformed belt is a narrow (approximately 5 to 20 miles wide) northeast-to-southwest-trending linear (approximately 90 miles in length) zone of complex structure consisting mainly of thin, imbricate thrust slices. The structure within these imbricate thrust slices is often internally complicated by small-scale folding and additional thrust faults (Thomas and Drahovzal, 1974).

4.1.2 Site Geology

Soils within the area of investigation fall mainly into two mapping units: the Atkins silt loam and the Jefferson gravelly fine sandy loam (U.S. Department of Agriculture [USDA], 1961).

The Atkins series consists of poorly drained, strongly acid soils that are developing in general alluvium. The parent material has washed mainly from soils underlain by sandstone and shale. The Atkins soils have a dark grayish-brown mottled silt loam surface soil. The subsoil is light brownish-gray to light olive-gray mottled silt loam or clay loam. The Atkins silt loam, 0 to 2 percent slopes, is a poorly drained, friable, low-producing soil that is developing in alluvium in first bottoms. In many areas, the surface soil and subsoil are lighter gray and more prominently mottled. The thickness of alluvium ranges from 2 to 6 feet or more. Runoff is very slow, infiltration is medium to slow, permeability is slow, and the capacity for available moisture is high (USDA, 1961).

The Jefferson series consists of well-drained, strongly acid soils that occur in small areas on fans and on foot slopes. These soils have developed from old local alluvium that washed or sloughed from ridges of sandstone, shale, and Weisner quartzite. The surface soil is dark grayish-brown fine sandy loam, and the subsoil is yellowish-brown, light fine sandy clay. The Jefferson gravelly fine sandy loam, 2 to 6 percent slopes eroded, is a friable soil developed from old local alluvium on foot slopes and fans along the bases of ridges and mountains. Runoff and infiltration are medium, permeability is moderate, and the capacity for available moisture is high (USDA, 1961).

Bedrock at the site is mapped as the Cambrian Shady Dolomite, as shown on Figure 4-1 (Osborne et al., 1988). The Shady Dolomite is typically bluish gray, thick bedded, medium crystalline limestone with a local unit of silty clay and clayey siltstone at the base (Raymond et al., 1988). Alluvial deposits are also mapped in the area. The alluvial deposits consist of variable colored sand, silt, clay, and gravel and may locally contain organic matter, peat, shells, and shell deposits (Osborne et al., 1988).

A geologic cross-section was constructed from the hollow-stem auger boring data, as shown on Figure 4-2. The geologic cross-section location is shown on Figure 3-1. Based on the boring logs from the seven monitoring wells installed at Parcels 184(7) and 185(7), residuum at the site is predominantly yellowish orange to light brown clay and varying amounts of sand, with little to trace silt and little gravel. Competent bedrock was not encountered during drilling, although highly weathered and fractured dolomite was encountered at approximately 21 feet bgs at CWM-185-MW01.

4.2 Site Hydrology

4.2.1 Surface Hydrology

Precipitation in the form of rainfall averages about 53 inches annually in Anniston, Alabama, with infiltration rates annually exceeding evapotranspiration rates (U.S. Department of Commerce, 1998). The major surface water features at the Main Post of FTMC include Remount Creek, Cane Creek, and Cave Creek. These waterways flow in a general northwest to westerly direction toward the Coosa River on the western boundary of Calhoun County.

Ground elevation within the area of investigation ranges from approximately 805 to 850 feet above mean sea level. Surface water at the site follows site topography and flows in a southwesterly direction. One unnamed intermittent stream converges with Cave Creek immediately southwest of the area of investigation to form a single stream that flows south-southwest away from the site through wetlands.

4.2.2 Hydrogeology

Static groundwater levels were measured in the monitoring wells at Training Area T-31 on May 23, 2003, as summarized in Table 3-4. A groundwater elevation map was constructed using the May 2003 water level data and is shown on Figure 4-3. As shown on the figure, groundwater flow at the site is predominantly to the west-southwest, following the general topography.

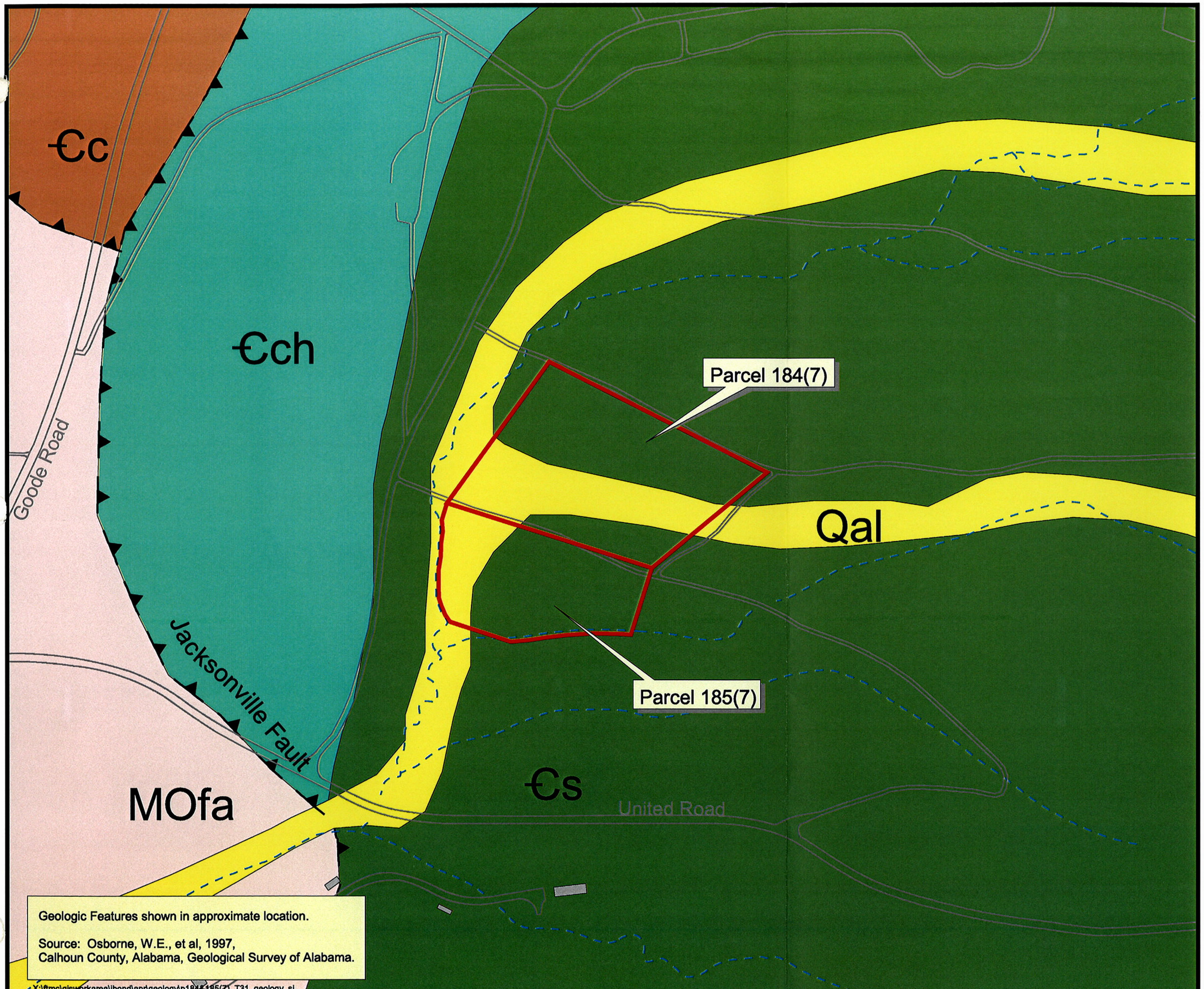


Figure 4-1

Site Geologic Map

Training Area T-31
Parcels 184(7) and 185(7)
Fort McClellan, Alabama

Legend

- Area of Investigation
- Buildings
- Roads
- Streams (dashed where intermittent)

Geology

Qal	Quaternary - Alluvium
MOfa	Mississippian/Ordovician - Floyd and Athens Shale, Undifferentiated
Ꞓc	Cambrian - Conasauga Formation
Ꞓs	Cambrian - Shady Dolomite
Ꞓch	Cambrian - Chilhowee Group, undifferentiated
	Thrust Fault (dashed where inferred; barbs on upper plate)

300 0 300 Feet

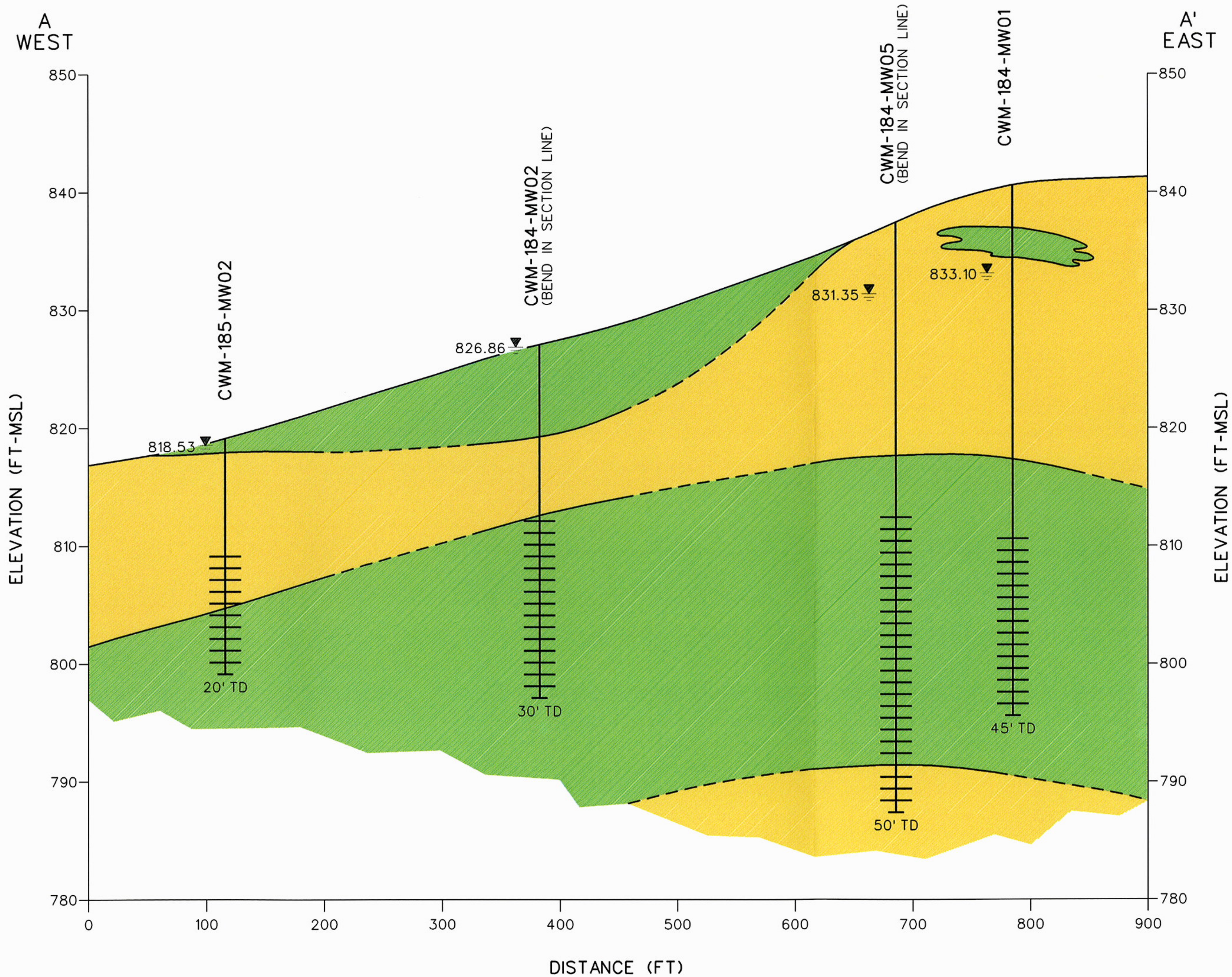
NAD83 State Plane Coordinates

N

Shaw™ Shaw Environmental, Inc.

U.S. Army Corps of Engineers Mobile District

Contract No. DACA21-96-D-0018



LEGEND

SCREEN INTERVAL

WATER TABLE

818.53 GROUNDWATER ELEVATION (FT MSL) (MAY 23, 2003)

CONTACT DASHED WHERE INFERRED

CLAY, LITTLE SAND, TRACE SILT

SAND AND CLAY, LITTLE SILT, LITTLE GRAVEL

NOTE:

1. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.

HORIZONTAL

0 100 200 FEET

VERTICAL

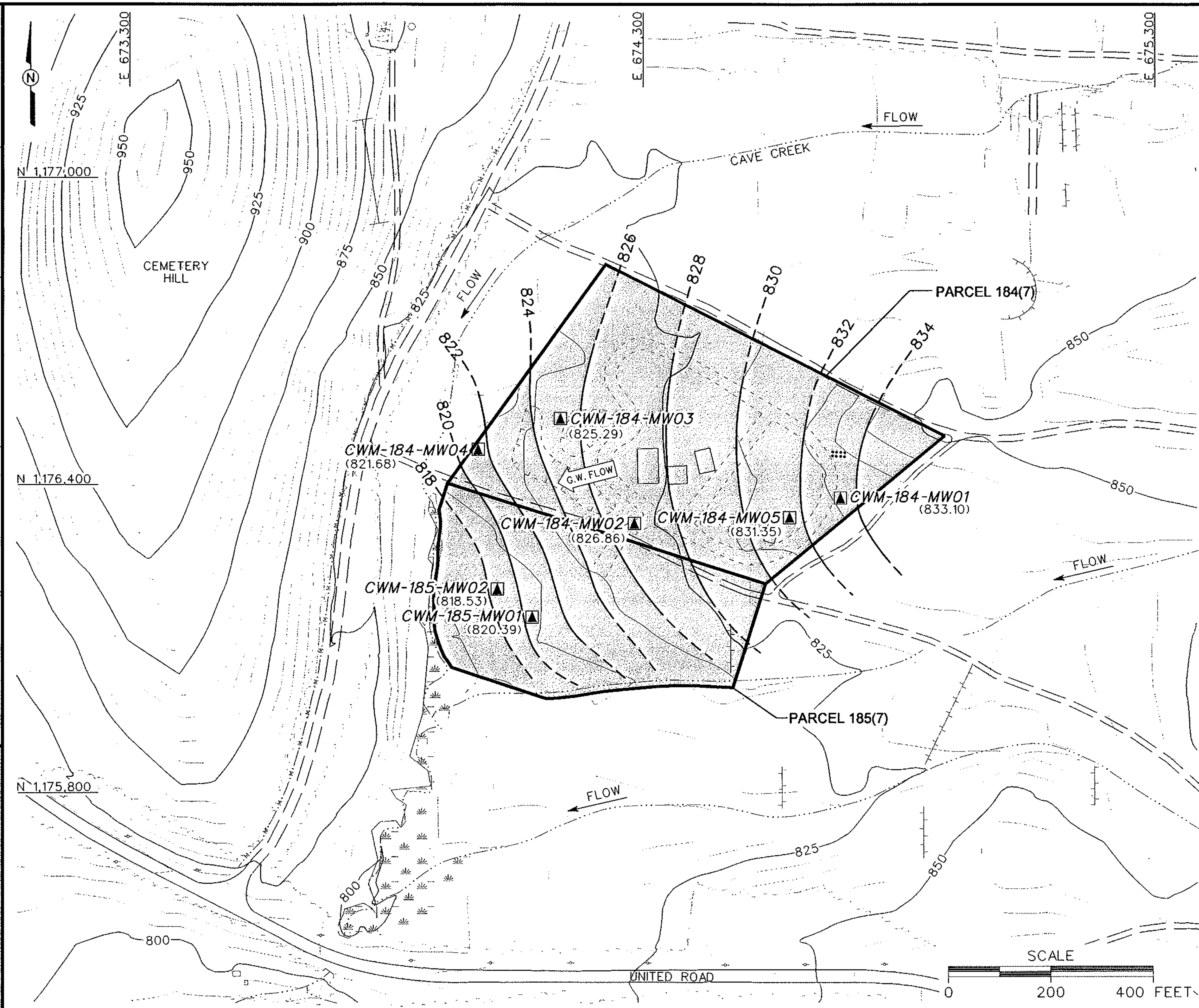
0 10 20 FEET

FIGURE 4-2
GEOLOGIC CROSS SECTION A-A'
TRAINING AREA T-31
PARCELS 184(7) AND 185(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

Shaw Shaw Environmental, Inc.

DWG. NO.: ...\838936es.090
PROJ. NO.: 838936
INITIATOR: C. LEVAAS
PROJ. MGR.: J. YACOUB
DRAFT. CHCK. BY:
ENGR. CHCK. BY: S. MORAN
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 11/17/03
DRAWN BY: D. BOMAR
12/4/2003 9:40:57 AM
dbomar c:\cadd\design\838936es.090



LEGEND

- UNIMPROVED ROADS AND PARKING
- PAVED ROADS AND PARKING
- BUILDING
- TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 5 FOOT)
- GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- (833.10) GROUNDWATER ELEVATION (FT MSL) (MAY 23, 2003)
- G.W. FLOW — GROUNDWATER FLOW DIRECTION
- TREES / TREELINE
- PARCEL BOUNDARY
- BRIDGE
- CULVERT WITH HEADWALL
- SURFACE DRAINAGE / CREEK
- MANMADE SURFACE DRAINAGE FEATURE
- JURISDICTIONAL WETLANDS
- UTILITY POLE
- BERM
- TRENCH
- HISTORICAL FEATURES
- DEPRESSION
- MONITORING WELL / GROUNDWATER, SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION

FIGURE 4-3
GROUNDWATER ELEVATION MAP TRAINING AREA T-31 PARCELS 184(7) AND 185(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

Shaw™ Shaw Environmental, Inc.

DWG. NO.: ...\838936es.073
PROJ. NO.: 838936
INITIATOR: C. LEVAAS
PROJ. MGR.: J. YACOUB
DRAFT. CHCK. BY:
ENGR. CHCK. BY: S. MORAN
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 11/17/03
DRAWN BY: D. BOMAR

12/4/2003 11:02:28 AM
c:\cadd\design\838936es.073
dbomar