3.0 Physical Characteristics of Study Area

The physical characteristics of the Small Weapons Repair Shop, Parcel 66(7), are important to understanding the current nature and extent of contamination and the future transport of contaminants. These characteristics can be described in terms of demography and land reuse, meteorology, physiography, sensitive environments, soils, geology, hydrology, and hydrogeology.

3.1 Demography and Land Reuse

FTMC includes 45,679 acres of government-owned and formerly leased land situated in the foothills of the Appalachian Mountains of northeast Alabama. The post is located in Calhoun County (population 112,249), approximately 60 miles northeast of Birmingham (population 242,820), approximately 75 miles northwest of Auburn (population 42,987), and approximately 90 miles west of Atlanta, Georgia (population 416,474). The city of Anniston (population 24,276) adjoins the Main Post on the south and east. The city of Weaver (population 2,619) is located approximately 1 mile northwest of the Main Post, and the city of Oxford (population 14,592) is approximately 5 miles south of Anniston (Science Applications International Corporation [SAIC], 2000; U.S. Census Bureau, 2000). In Calhoun County, 5 percent of the total labor force is in the armed forces. Of the civilian labor force, the top five industries in which people are employed are: retail trade (18.7 percent); manufacturing, durable goods (12.3 percent); public administration (12.0 percent); manufacturing, non-durable goods (10.8 percent); and educational services (9.0 percent) (U.S. Census Bureau, 1990).

Projected land reuse for FTMC is presented in the *Fort McClellan Comprehensive Reuse Plan* (EDAW, Inc., 1997). Parcel 66(7) is projected for industrial reuse.

3.2 Meteorology

FTMC is situated in a temperate, humid climate. Summers are long and hot, and winters are usually short and mild to moderately cold. The climate is influenced by frontal systems moving from northwest to southeast, and temperatures change rapidly from warm to cool due to the inflow of northern air. The average annual temperature is 63 degrees Fahrenheit (°F). Summer temperatures usually reach 90°F or higher about 70 days per year, but temperatures above 100°F are rare. Freezing temperatures are common in winter but are usually of short duration. The first frost may arrive by late October. Snowfall averages 0.5 to 1 inch. On rare occasions, several inches of snow accumulate from a single storm. At Anniston, the average date of the first 32°F temperature is November 6, and the last is March 30. This provides a growing season of 221 days (ESE, 1998).

The average annual rainfall is approximately 53 inches and is well distributed throughout the year, as indicated on Figure 3-1. The more intense rains usually occur during the warmer months, and some flooding occurs nearly every year. Drought conditions are rare, though the entire southeastern United States has been experiencing drought conditions for the three years previous to this writing. Approximately 80 percent of the flood-producing storms are of the frontal type and occur in the winter and spring, lasting from 2 to 4 days each. Summer storms are usually thunderstorms with intense precipitation over small areas, and these sometimes result in serious local floods. Occasionally, several wet years or dry years occur in series. Annual rainfall records indicate no characteristic order or pattern.

Winds in the FTMC area are seldom strong and frequently blow from the northeast. However, there is no truly persistent wind direction. Normally, only light breezes or calm prevails, except during passages of cyclonic disturbances, when destructive local wind storms develop, some into tornadoes, with winds of 100 miles per hour or more.

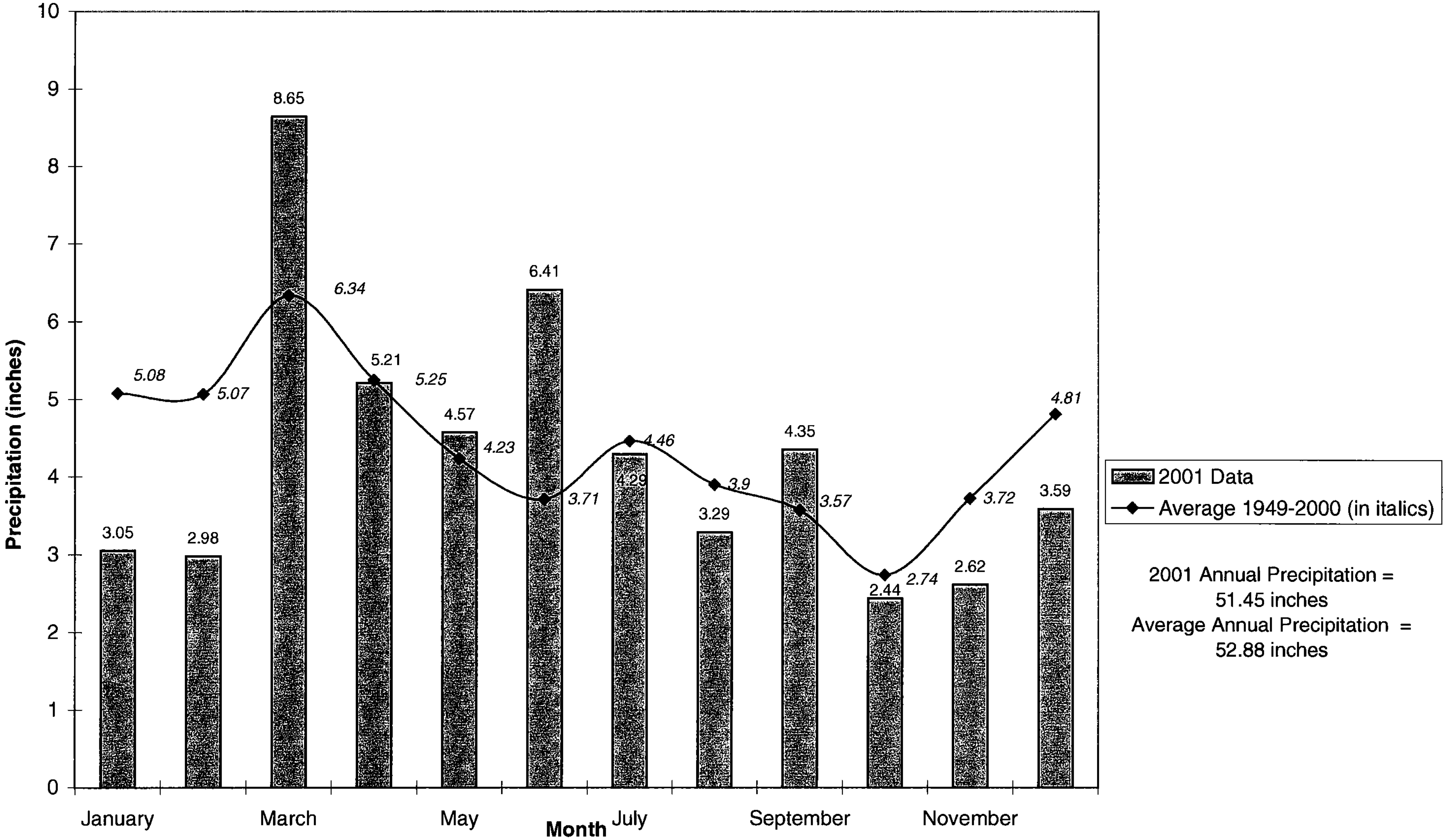
3.3 Physiography

All of FTMC except for the easternmost portion of the Choccolocco Corridor lies within the Valley and Ridge Physiographic Province. The easternmost portion of the Choccolocco Corridor lies within the Piedmont Physiographic Province. Local relief on the Main Post of FTMC is in excess of 1,320 feet. The lower elevations (700 feet above mean sea level [msl]) occur along Cane Creek, near Baltzell Gate Road, while the maximum elevations (2,063 feet above msl) occur on Choccolocco Mountain, which traverses the eastern boundary of area in a north/south direction, with the steep easterly slopes grading abruptly into Choccolocco Valley. The western slopes are more continuous, with the southern extension maintaining elevations up to 900 feet above msl near the western reservation boundary. The northern extension decreases in elevation in the vicinity of Reilly Airfield. The central portion of FTMC is characterized by flat to gently sloping land (SAIC, 2000).

Parcel 66(7) is relatively flat, with an elevation of approximately 780 feet above mean sea level (Figure 1-4). However, the parcel is located on a topographical divide. The northern portion of the parcel slopes gently to the north, and the southern portion of the parcel slopes gently to the

Figure 3-1

2001 Precipitation and Average Annual Precipitation, Anniston, Alabama
Small Weapons Repair Shop, Parcel 66(7)
Fort McClellan, Calhoun County, Alabama



2001 data from National Climatic Data Center Unedited Local Climatological Data, Station 13871.
1949-2000 averaged data from National Weather Service, Normals and Records, Anniston, Alabama.

KN2\4040\P66\RI\DRAFT\66 Figure 3-1.xls(2001)\5/16/02(8:49 AM) south. Cane Creek, located approximately 1,300 feet southwest of the parcel, flows to the northwest.

3.4 Sensitive Environments

3.4.1 Wetlands

FTMC has an estimated 3,424 acres of delineated wetlands. Major wetland communities were originally characterized and mapped in 1984. However, regulatory criteria for identifying wetlands have significantly changed since this original study was performed. Consequently, the USACE performed a supplementary mapping and evaluation study in 1992 to identify larger wetland complexes (Reisz Engineering [Reisz], 1998). The following are recognized wetland communities located within FTMC (Reisz, 1998): Bottomland Hardwoods, Depressions, Mixed Shrub Communities, Shrub Depression, and Herbaceous Wetlands.

Wetland habitats at FTMC are generally located in various topographical depressions, near stream seepage, and in valleys along creek floodplains (Weston, 1990; SAIC 1993). The indicator plant species that assist in defining a wetland include water oaks, sweet gum, bulrush, needlerush, and cattail. The Main Post, Pelham Range, and Choccolocco Corridor have an abundance of wetlands representing important habitats for a wide variety of plants and animals. Wetland communities found on the Main Post are the Marcheta Hill Orchard Seep, Cane Creek Seep, South Branch of Cane Creek, and 200 acres west of the airstrip that comprise the tributary to Victoria Creek (Garland, 1996; USACE, 1992). Pelham Range wetland communities occur along the banks of Cane Creek, Willett Spring, and Cabin Creek Spring (Alabama Department of Conservation and Natural Resources, 1994a and b). Additionally, wetland habitat potentially exists at or around the installation's lakes, namely, Lake Reilly, Lake Conteras, Lake Yahou, and Lake Willett, and along the nearly 10 miles of creeks, namely, Cane Creek and Cave Creek (Weston, 1990).

Parcel 66(7) is not located within a designated wetland area. The closest designated wetland area is approximately 3,000 feet north of the site, along Cave Creek (IT, 2002).

3.4.2 Sensitive Habitats

FTMC operated under the guidelines of the Endangered Species Act of 1973, the regulations of the U.S. Fish and Wildlife Service (USFWS), Army Regulation 200-3, and the Endangered Species Management Plan (ESMP) (Garland, 1996). The overall objectives of the ESMP are to sustain the existing habitat that supports populations of species identified in the ESMP and to promote the augmentation of these species into unoccupied land that has similar habitats.

The ESMP identifies 11 special interest natural areas (SINA) on the Main Post. SINAs are locations where the habitat fosters one or more rare, threatened, or endangered species. Because these species are sensitive to environmental degradation, SINAs require management practices that promote the continued well being of these ecosystems. According to the ESMP, the 11 SINAs located on the Main Post include:

- Mountain Longleaf Community Complex
- Cave Creek Seep
- Moorman Hill Mountain Juniper
- Frederick Hill Aster Site
- Bains Gap Seep
- Marcheta Hill Crow-Poison Seep
- Marcheta Hill Orchid Seep
- South Branch of Cane Creek Seep
- Stanley Hill Chestnut Oak Forest
- Reynolds Hill Turkey Oak
- Davis Hill Honeysuckle.

Parcel 66(7) is not located within a SINA. The closest SINA is approximately 1.6 miles southeast of the site (IT, 2002).

3.4.3 Threatened and Endangered Species

Rare species deserving unofficial protection and management measures in the State of Alabama are inventoried and ranked by the Alabama Natural Heritage Program. The sensitivity of these rare species to environmental degradation is used to gauge the well-being of the habitat as a whole. Two species of fauna listed by the USFWS as endangered or threatened have been recorded on FTMC. They are the gray bat (*Myotis grisescens*), which uses the Cane Creek Corridor as foraging habitat, and the blue shiner (*Cyprinella caerulea*), located within the Choccolocco Creek watershed. An additional endangered species, the red-cockaded woodpecker, historically has inhabited the installation. Because there are no surface water bodies in the immediate vicinity of Parcel 66(7), the gray bat and blue shiner are not present at the site. The red-cockaded woodpecker has not been observed at FTMC in the recent past.

3.5 Soils

The soil associations found at FTMC (U.S. Department of Agriculture [USDA], 1961), include:

- ***Anniston-Allen, Decatur-Cumberland.*** Alluvium, resulting from weathering of older residual soils developed from sandstone, shale, and quartzite; deep, well-drained, level to moderately steep soils in valleys underlain by limestone and shale. Subsoil is dark red sandy clay loam. Cumberland and Decatur soils are dark reddish brown gravelly loam developed from weathered limestone.

- ***Clarksville-Fullerton.*** Well-drained to moderately well-drained stony or cherty soils developed in the residuum of cherty limestone. This association is limited to Pelham Range. The soils are generally dark brown to dark gray-brown silt loam.

- ***Rarden-Montevallo-Lehew.*** Moderately deep or shallow soils on ridgetops and steep slopes and in local alluvium in draws. Soils are developed from the residuum of shale and fine-grained, micaceous sandstone; reddish brown to dark gray-brown to yellow-brown silt loam, clay, or silty clay.

- ***Stony Rough Land.*** Shallow, steep, and stony soils formed from the weathering of sandstone, limestone, and Talladega Slate. Infiltration is slow; the soils contain many boulders and fragments with clayey residuum. This association underlies a large portion of the Main Post at FTMC.

3.5.1 Site-Specific Soils

The soil mapped at Parcel 66(7) is the Rarden silty clay loam. This soil type is found on the uplands and is usually developed from the residuum of shale, fine-grained sandstone, or limestone. The surface soil ranges from dark brown to yellowish brown in color. The subsoil consists of a silt clay to clay that ranges in color from strong brown to yellowish brown. The runoff and infiltration of this soil are considered medium. The permeability of this soil is slow, the capacity for available moisture and organic matter content are low (USDA, 1961).

3.6 Geology

The regional geology in the vicinity of FTMC and site-specific geology at Parcel 66(7) are discussed in the following sections.

3.6.1 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 the 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, and 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 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 locally occurs 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). In Calhoun County, the Parkwood Formation 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. 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 is a large-scale thrust sheet containing Cambrian and Ordovician rocks. It 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 zone of complex structure (approximately 90 miles in length) 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).

3.6.2 Site-Specific Geology

Parcel 66(7) is located within the eroded geologic "window" in the uppermost structural thrust sheet at FTMC. The mapping unit exposed at this parcel is the Mississippian/Ordovician Floyd and Athens Shale, undifferentiated (Figure 3-2). The Floyd Shale consists of thin-bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone. Athens Shale is comprised of dark gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989).

Two geologic cross sections were constructed from hollow-stem auger and bedrock coring data collected during the RI at Parcel 66(7). The locations of the geologic cross sections are shown on Figure 3-3, and the cross sections are presented on Figures 3-4 and 3-5. The geologic data collected show that the upper part of the residuum consists of brown to brownish gray to yellowish orange silty clay and clay, with occasional intervals of highly weathered shale. This sequence extends from the ground surface to a depth, in some places, of around 10 to 13 feet bgs. Underlying this interval, and included as residuum, is a variable thickness of highly weathered, light gray to black shale that extends to a maximum depth of approximately 30 feet bgs. The base of the residuum is defined where auger refusal was encountered.

Competent bedrock underlying the residuum consisted of moderately hard, slightly weathered, fractured, dark gray to black shale (Figures 3-4 and 3-5). Some of the fractures in the shale were filled with quartz and/or dolomite. The description of the bedrock encountered during rock coring and drilling activities is consistent with the mapped undifferentiated Floyd and Athens Shale. Appendix B contains the boring logs and well completion diagrams.

3.7 Surface Water Hydrology

The regional surface water hydrology in the vicinity of FTMC and site-specific surface water hydrology at Parcel 66(7) are discussed in the following sections.

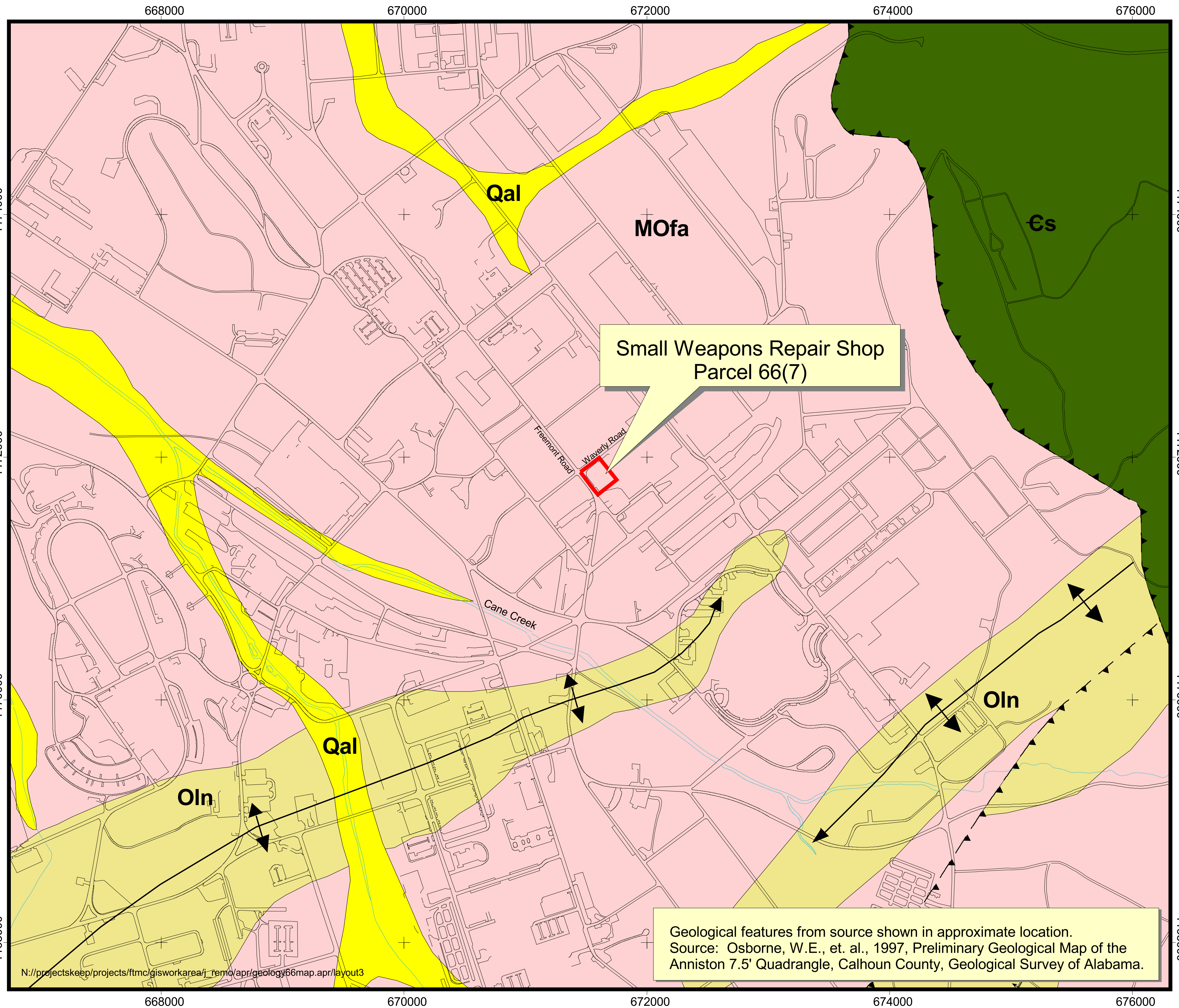
3.7.1 Regional Surface Water Hydrology

Portions of three drainage basins (Cane Creek, Choccolocco Creek, and Tallasseehatchee Creek) are found within the Main Post of FTMC. All three of these drainage basins eventually empty into the Coosa River, approximately 16 miles west of the Main Post. Figure 3-6 is a map showing the surface water hydrology and drainage basins of the Main Post and Choccolocco Corridor.

Figure 3-2

Site Geologic Map Small Weapons Repair Shop, Parcel 66(7)

Fort McClellan
Calhoun County, Alabama



Legend

Parcel Boundary

Roads

Streams

Geology

Symbol	Description
Qal	Quaternary - Alluvium
MOfa	Mississippian/Ordovician Floyd and Athens Shale, Undifferentiated
Oln	Ordovician Little Oak and Newala Limestones, Undifferentiated
Ꞓs	Cambrian Shady Dolomite

Thrust Fault

Inferred Thrust Fault

Plunging Anticline

800 0 800 Feet

NAD 83 State Plane Coordinates

U.S. Army Corps of Engineers Mobile District

N

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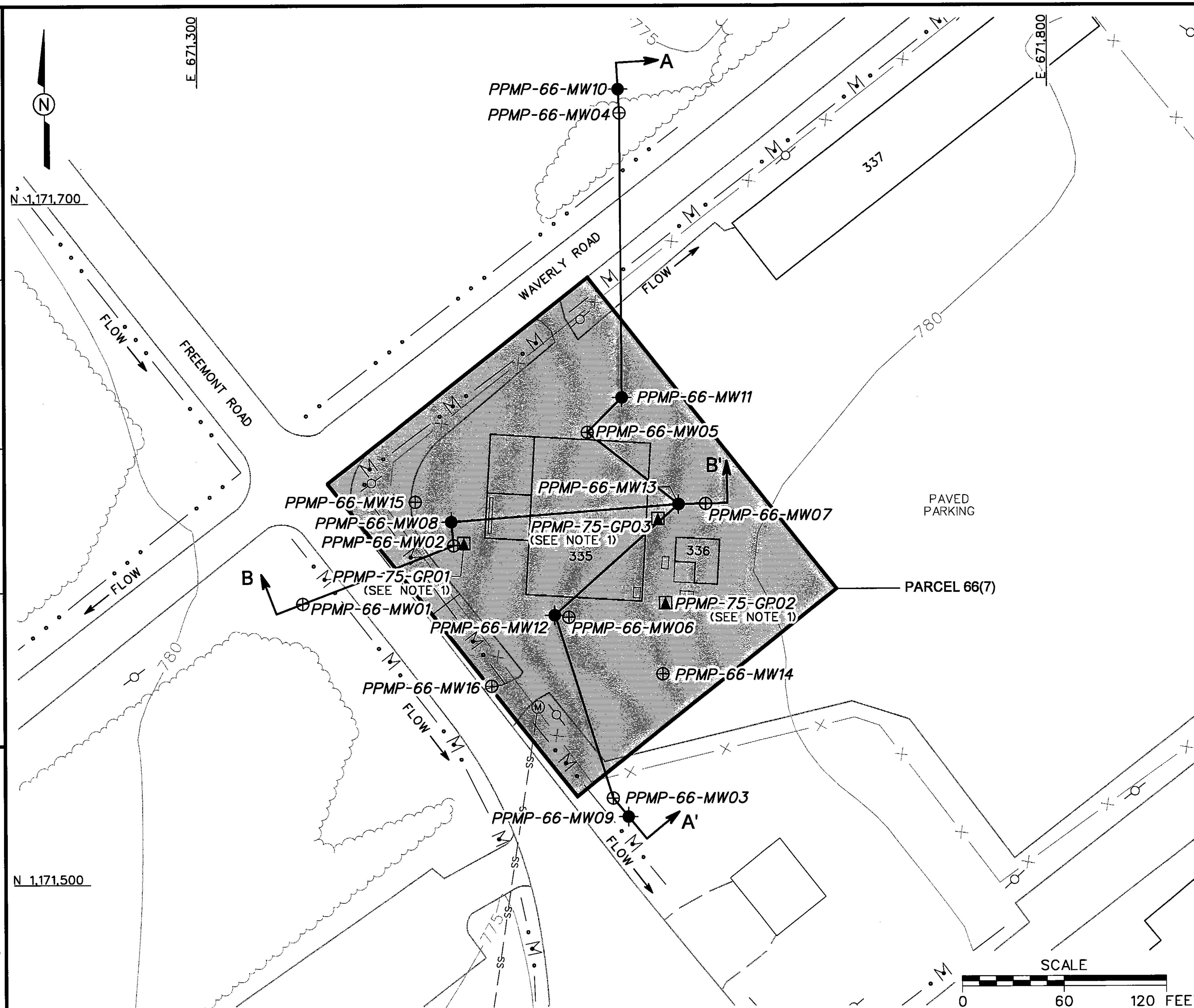
Contract No. DACA21-96-D-0018



LEGEND

- UNIMPROVED ROADS AND PARKING
- PAVED ROADS AND PARKING
- BUILDING
- TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 5 FOOT)
- TREES / TREELINE
- PARCEL BOUNDARY
- CULVERT WITH HEADWALL
- SURFACE DRAINAGE / CREEK
- MANMADE SURFACE DRAINAGE FEATURE
- SURFACE WATER FLOW DIRECTION
- FENCE
- UTILITY POLE
- SANITARY SEWER LINE
- MANHOLE
- BEDROCK MONITORING WELL AND GROUNDWATER SAMPLE LOCATION
- RESIDUUM MONITORING WELL AND GROUNDWATER SAMPLE LOCATION
- GROUNDWATER, SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION
- A A' CROSS SECTION LOCATION

NOTE:

1. RESIDUUM MONITORING WELL LOCATION.

FIGURE 3-3
CROSS SECTION LOCATION MAP
SMALL WEAPONS REPAIR SHOP
PARCEL 66(7)

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

IT CORPORATION
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DWG. NO.: ...\796887es.431 | PROJ. NO.: 796887
INITIATOR: J. REMO | PROJ. MGR.: J. YACOUB
DRAFT. CHCK. BY: | ENGR. CHCK. BY: S. MORAN
DATE LAST REV.: | DRAWN BY:
STARTING DATE: 05/07/02 | DRAWN BY: D. BOMAR
05/16/02 01:14:25 PM
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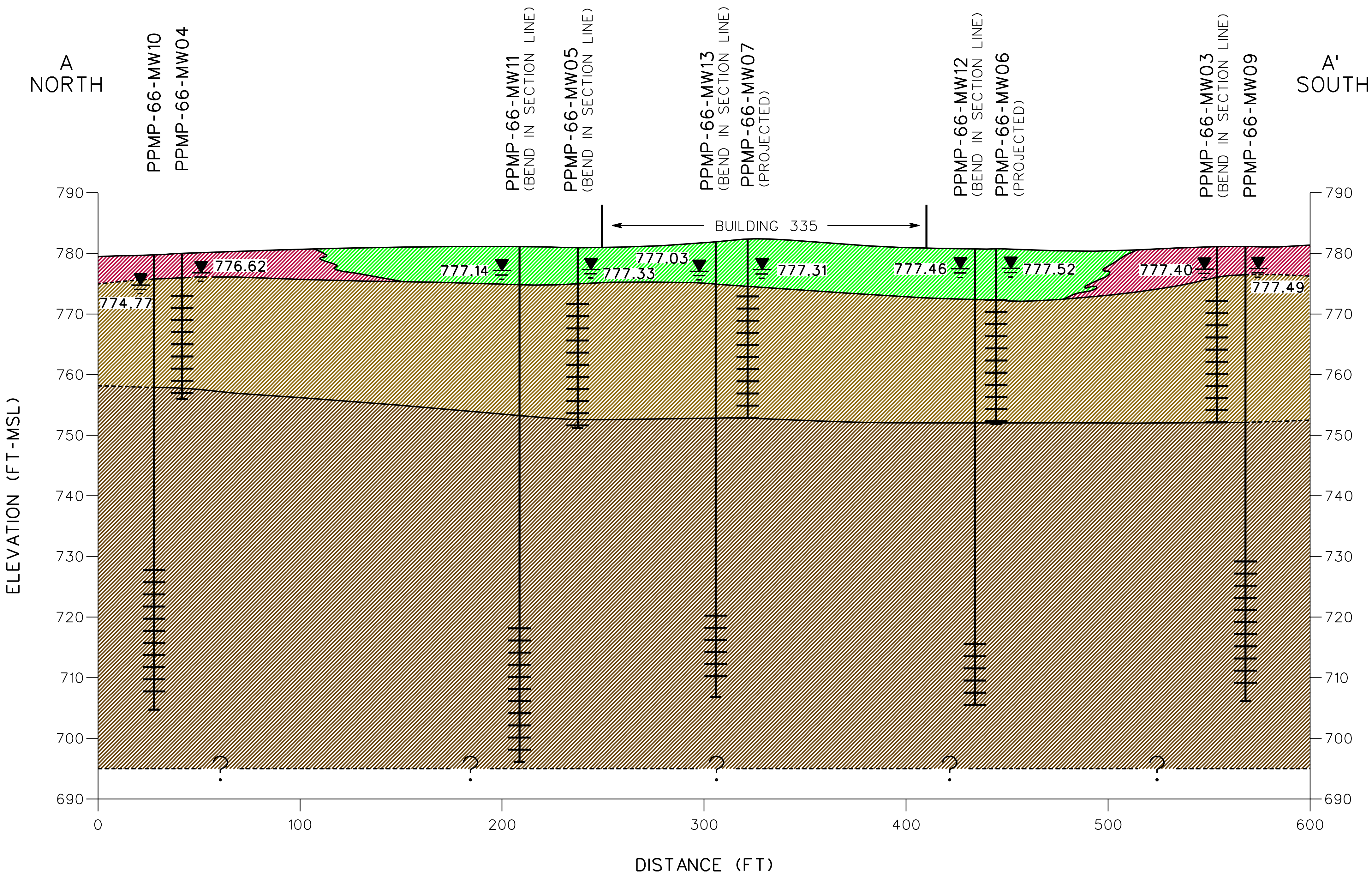

LEGEND

SCREEN INTERVAL

WATER TABLE (JANUARY 2002)

774.77 GROUNDWATER ELEVATION (FT MSL)

---- ? ----- CONTACT DASHED WHERE INFERRED

CLAY

SILTY CLAY

WEATHERED SHALE

SHALE

NOTES:

1. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
2. DASHED WHERE INFERRED.

FIGURE 3-4

GEOLOGIC CROSS SECTION A-A'
SMALL WEAPONS REPAIR SHOP
PARCEL 66(7)

HORIZONTAL
0 60 120 FEET

VERTICAL
0 20 40 FEET

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

IT CORPORATION
A Member of The IT Group

DWG. NO.: ...\796887es.380
PROJ. NO.: 796887
INITIATOR: J. REMO
PROJ. MGR.: J. YACOUB
DRAFT. CHCK. BY:
ENGR. CHCK. BY: S. MORAN
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 03/26/02
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05/16/02
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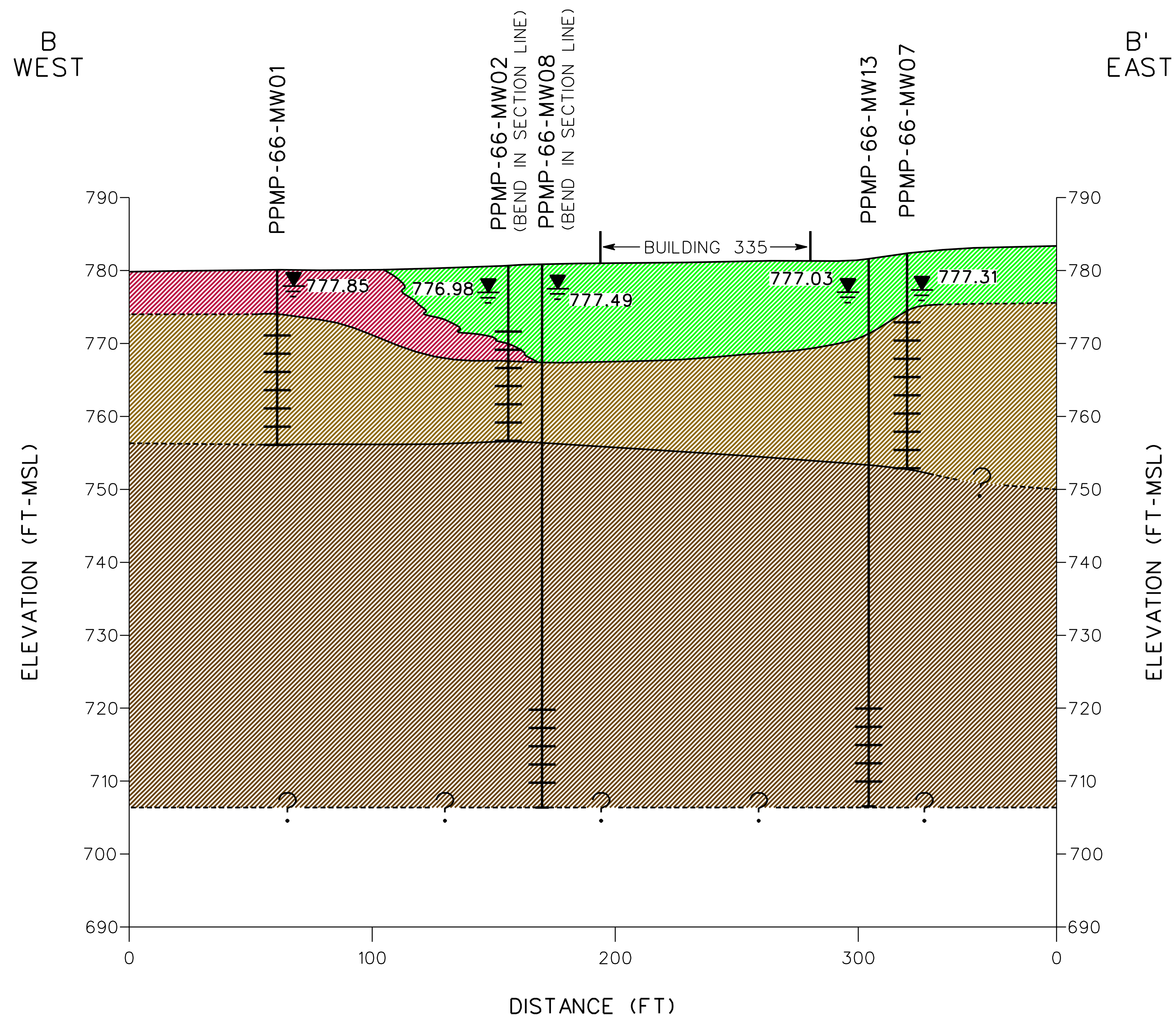

LEGEND

SCREEN INTERVAL

WATER TABLE (JANUARY 2002)

776.98 GROUNDWATER ELEVATION (FT MSL)

---- ? ---- CONTACT DASHED WHERE INFERRED

CLAY

SILTY CLAY

WEATHERED SHALE

SHALE

NOTES:

1. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
2. DASHED WHERE INFERRED.

HORIZONTAL
0 60 120 FEET

VERTICAL
0 20 40 FEET

FIGURE 3-5
GEOLOGIC CROSS SECTION B-B'
SMALL WEAPONS REPAIR SHOP
PARCEL 66(7)

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

IT CORPORATION
A Member of The IT Group

DWG. NO.: ...\796887es.381
PROJ. NO.: 796887
INITIATOR: J. REMO
PROJ. MGR.: J. YACOUB
DRAFT. CHCK. BY:
ENGR. CHCK. BY: S. MORAN
DATE LAST REV.:
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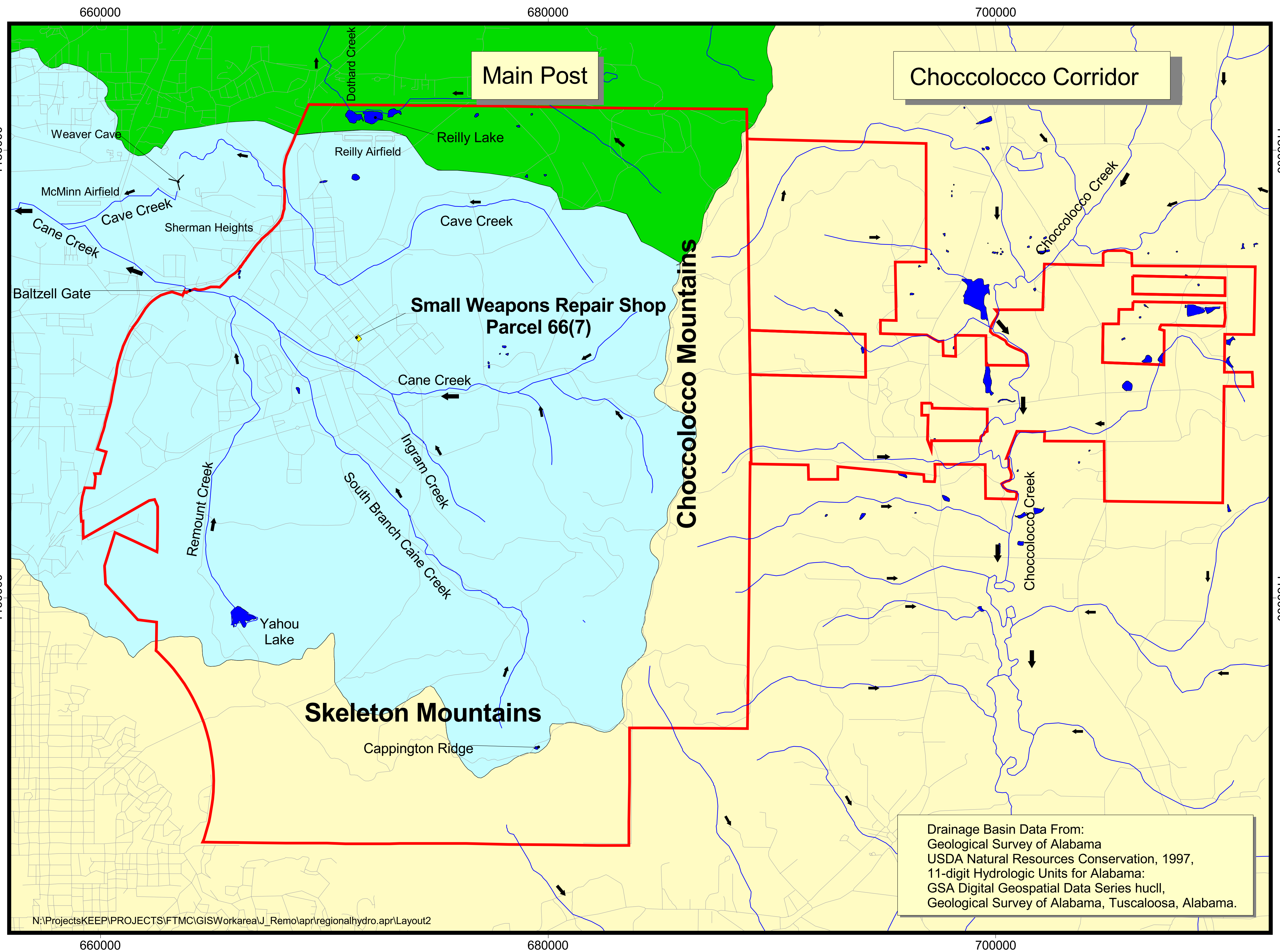

Figure 3-6

Surface Water Hydrology and Drainage Basins Map

Fort McClellan
Calhoun County, Alabama

Legend

- Main Post and Choccolocco Corridor Boundries
- Major Streams
- Roads
- Ponds and Lakes
- Surface Water Flow Direction
- Cave
- Cane Creek Drainage Basin
- Tallasseehatchee Creek Drainage Basin
- Choccolocco Creek Drainage Basin

4500 0 4500 Feet

NAD 83 State Plane Coordinates

N

U.S. Army Corps of Engineers Mobile District

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Contract No. DACA21-96-D-0018

STARTING DATE: 03/27/02 | DRAWN BY: D. BOMAR | DATE LAST REV.: | DRAWN BY: | DRAFT. CHCK. BY: | ENGR. CHCK. BY: S. MORAN | INITIATOR: J. REMO | PROJ. MGR.: J. YACOUB | DWG. NO.: 796887ES.382 | PROJ. NO.: 796887

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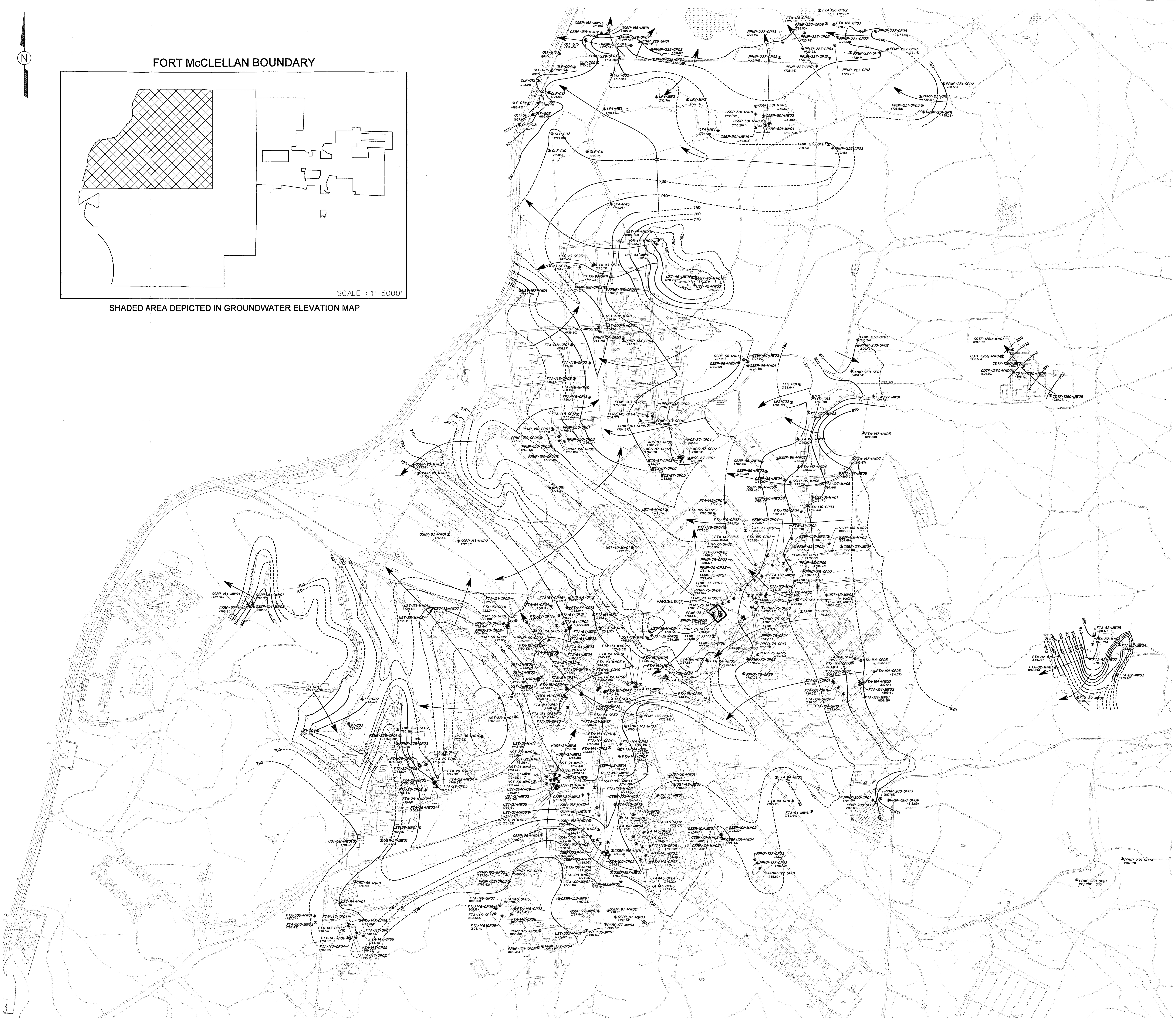

LEGEND:

GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)

(754.47) GROUNDWATER ELEVATION (FT MSL) (MARCH 2000)

GROUNDWATER FLOW DIRECTION

GROUNDWATER ELEVATION LOCATIONS

PARCEL BOUNDARY

SCALE

0 500 1000 FEET

FIGURE 3-7
BASEWIDE GROUNDWATER FLOW MAP
MARCH 2000

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MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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The Choccolocco Mountains located in the eastern portion of the Main Post and the Skeleton Mountains located in the southern portion of the Main Post form a major surface water divide. East of the Choccolocco Mountains, FTMC consists of a narrow strip called Choccolocco Corridor, which extends approximately 3.5 to 4 miles from the mountains across the floodplain of Choccolocco Creek to the base of Rattlesnake Mountain. Choccolocco Creek and its tributaries drain all of Choccolocco Corridor and the eastern and southernmost portions of the Main Post (Figure 3-6). The Choccolocco Creek drainage basin covers approximately 7.5 square miles of the Main Post.

On the western side of Choccolocco Mountains are the Cane Creek and Tallasseehatchee Creek drainage basins (Figure 3-6). The headwaters of the Cane Creek drainage basin originate in the Choccolocco Mountains and flow west through the main cantonment. Cane Creek has four named tributaries on Post: Cave Creek, Remount Creek, South Branch of Cane Creek, and Ingram Creek. Although Cave Creek is a tributary to Cane Creek, it occurs as a separate drainage basin within the confines of the Main Post. Cave Creek eventually joins Cane Creek off-post east of the unincorporated development of Sherman Heights, near McMinn Airfield. Cane Creek and its tributaries receive surface runoff from the central portion of the Post and exit the reservation at Baltzell Gate. Cave Creek and its unnamed tributaries drain the north-central portion of the Post. Cave Creek exits the Post near the unincorporated development of Sherman Heights. The on-post drainage area of the Cane Creek basin covers approximately 19.6 square miles.

The Tallasseehatchee Creek drainage basin drains the northernmost portion of the Main Post (Figure 3-6). Most of the surface runoff from this portion of the Main Post collects in unnamed tributaries to Reilly Lake. Reilly Lake then empties into Dothard Creek, a tributary to the Tallasseehatchee, and exits the Main Post northwest of Reilly Airfield. The Tallasseehatchee drainage basin covers approximately 2.5 square miles of the Main Post.

Most surface water bodies are fed, at least in part, by fresh water springs. Fresh water springs occur abundantly on installation lands, often appearing along the trace of thrust faults. Karst features, including developed caves and sinkholes, have been identified in the FTMC area (SAIC, 2000).

Fresh water marshes are located along Cane Creek; most are limited to the cumulatively larger downstream watershed of Pelham Range. Only one major marsh area, the 25-acre marsh near Reilly Lake, occurs on the Main Post (SAIC, 2000).

3.7.2 Site-Specific Surface Water Hydrology

Parcel 66(7) is located on a local topographical divide and is mostly overlain by asphalt or concrete; only small areas along the northern and western boundaries are covered by grass. Surface runoff from the site collects in man-made ditches located along the northern and western boundaries of the parcel. Runoff from the northern and eastern portions of the parcel collects in a ditch along the northern boundary and eventually empties into Cave Creek. Runoff from the southern and western portions of the parcel collects in a ditch along the western boundary of the parcel and eventually empties into Cane Creek.

3.8 Hydrogeology

The regional hydrogeology in the vicinity of FTMC and site-specific hydrogeology at Parcel 66(7) are discussed in the following sections

3.8.1 Regional Hydrogeology

The hydrogeology of Calhoun County has been investigated by the Geologic Survey of Alabama (Moser and DeJarnette, 1992) and the U.S. Geological Survey in cooperation with the General Services Administration (Warman and Causey, 1962) and ADEM (Planert and Pritchette, 1989). Groundwater in the vicinity of FTMC occurs in residuum derived from bedrock decomposition along fault zones within fractured bedrock and from the development of karst frameworks. Groundwater flow may be estimated to be toward major surface water features. Areas with well-developed residuum horizons may subtly reflect the surface topography, but the groundwater flow direction also may exhibit the influence of pre-existing structural fabrics or the presence of perched water horizons on unweathered ledges or impermeable clay lenses.

Precipitation and subsequent infiltration provide recharge to the groundwater flow system in the region. The main recharge areas for the aquifers in Calhoun County are located in the valleys. The ridges generally consist of sandstone, quartzite, and slate, which are resistant to weathering, relatively unaffected by faulting and, therefore, relatively impermeable. The ridges have steep slopes and thin to no soil cover, which enhances runoff to the edges of the valleys (Planert and Pritchette, 1989).

The thrust fault zones typical of the county form large storage reservoirs for groundwater. Points of discharge occur as springs, effluent streams, and lakes. Coldwater Spring is one of the largest springs in the State of Alabama, with a discharge of approximately 32 million gallons per day. This spring is the main source of water for the Anniston Water Department, from which FTMC buys its water. The spring is located approximately 5 miles southwest of Anniston and discharges from the brecciated zone of the Jacksonville Fault (Warman and Causey, 1962).

Shallow groundwater on FTMC occurs principally in the residuum developed from Cambrian sedimentary and carbonate bedrock units of the Weisner Formation and Shady Dolomite and locally in lower Ordovician carbonates. The residuum may yield adequate groundwater for domestic and livestock needs but may go dry during prolonged dry weather. Bedrock permeability is locally enhanced by fracture zones associated with thrust faults and by the development of solution (karst) features.

Two major aquifers were identified by Planert and Pritchette (1989): the Knox-Shady and Tuscumbia-Fort Payne aquifers. The continuity of the aquifers has been disrupted by the complex geologic structure of the region, such that each major aquifer occurs repeatedly in different areas. The Knox-Shady aquifer group occurs over most of Calhoun County and is the main source of groundwater in the county. It consists of the Cambrian- and Ordovician-aged quartzite and carbonates. The Conasauga Formation is the most utilized unit of the Knox-Shady aquifer, with twice as many wells drilled as any other unit (Moser and DeJarnette, 1992). Neither the Knox-Shady aquifer nor the Tuscumbia-Fort Payne aquifer is mapped within the immediate vicinity of Parcel 66(7). Furthermore, there are no potable water supply wells within a 1-mile radius of Parcel 66(7).

Regional groundwater flow in the bedrock was approximated for the FTMC vicinity by the U.S. Geological Survey (Scott et al., 1987). Regional groundwater elevation ranged from 800 feet above msl on the main Base to about 600 feet above msl to the west on Pelham Range, based on water depths in wells completed across multiple formations. Groundwater elevation contours suggest that regional groundwater flow is from the Main Post northwest toward the city of Weaver; however, there is not enough groundwater data to support this interpretation. Scott et al. (1987) concluded that the groundwater surface broadly coincides with the surface topography and that the regional aquifers are hydraulically connected. Groundwater flow on a local scale may be more complex and may be affected by geologic structures such as shallow thrust faults, rock fracture systems, and karst development in soluble formations.

A Basewide potentiometric surface map was constructed using groundwater elevation measurements collected in March 2000. The groundwater elevations and groundwater flow directions are presented on Figure 3-7. Groundwater elevations on the Main Post ranged from 680 feet above msl to 1,060 feet above msl, and groundwater flow appears to be to the northwest. Shallow groundwater occurs in weathered residuum derived from the bedrock and in thin sediment deposits that are very similar to the decomposed rock. The shallow groundwater more closely follows the local topography.

3.8.2 Site-Specific Hydrogeology

The following sections summarize the results from groundwater elevation data and slug testing data collected at Parcel 66(7).

3.8.2.1 Groundwater Flow

Static groundwater levels were measured in the permanent residuum and bedrock monitoring wells at Parcel 66(7) and the surrounding area on January 7 and 8, 2002 (Table 2-6). Regional groundwater flow across the area of the Main Post that includes Parcel 66(7) is from east to west. Groundwater flow across the area appears to be influenced by a topographic high located to the west of the site that has created a local groundwater divide in the vicinity of Parcel 66(7) (Figure 3-8). This interpretation is based on the January 2002 groundwater elevations from residuum monitoring wells and on topography.

Groundwater elevation maps for Parcel 66(7) were constructed for both the residuum (Figure 3-9) and bedrock (Figure 3-10) water-bearing zones. In the residuum, the axis of a groundwater divide is located just to the west of Building 335. Groundwater flow in the northern portion of the site is to the north towards Cave Creek; groundwater flow in the southwestern part of the parcel is to the south towards Cane Creek (Figures 3-8 and 3-9). Based on the January 2002 groundwater elevation data, groundwater flow in the bedrock water-bearing zone (Figure 3-10) is similar to the groundwater flow regime in the residuum water-bearing zone. The position of the divide in the deeper bedrock aquifer, however, has shifted slightly to the east.

3.8.2.2 Aquifer Characteristics

The horizontal hydraulic gradients of the residuum and bedrock water-bearing zones are low, indicating a relatively flat water table. An arithmetic mean values of less than 0.01 feet per foot (ft/ft) in the residuum and only slightly above 0.01 ft/ft in the bedrock (Table 3-1) were obtained from the January 2002 data.

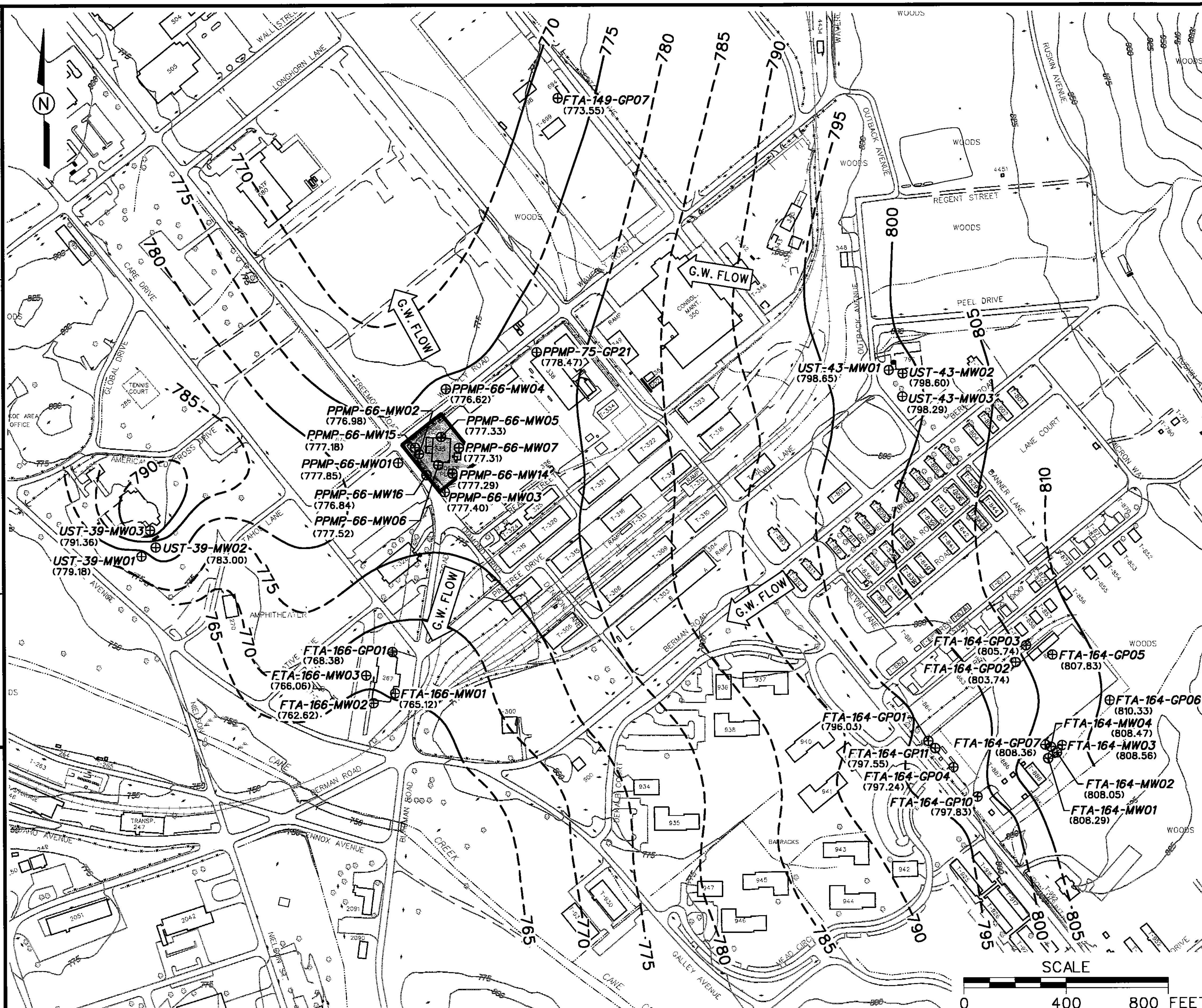

FIGURE 3-8
GROUNDWATER ELEVATION MAP
RESIDUUM MONITORING WELLS
JANUARY 2002
SMALL WEAPONS REPAIR SHOP
PARCEL 66(7) AND ADJACENT AREAS

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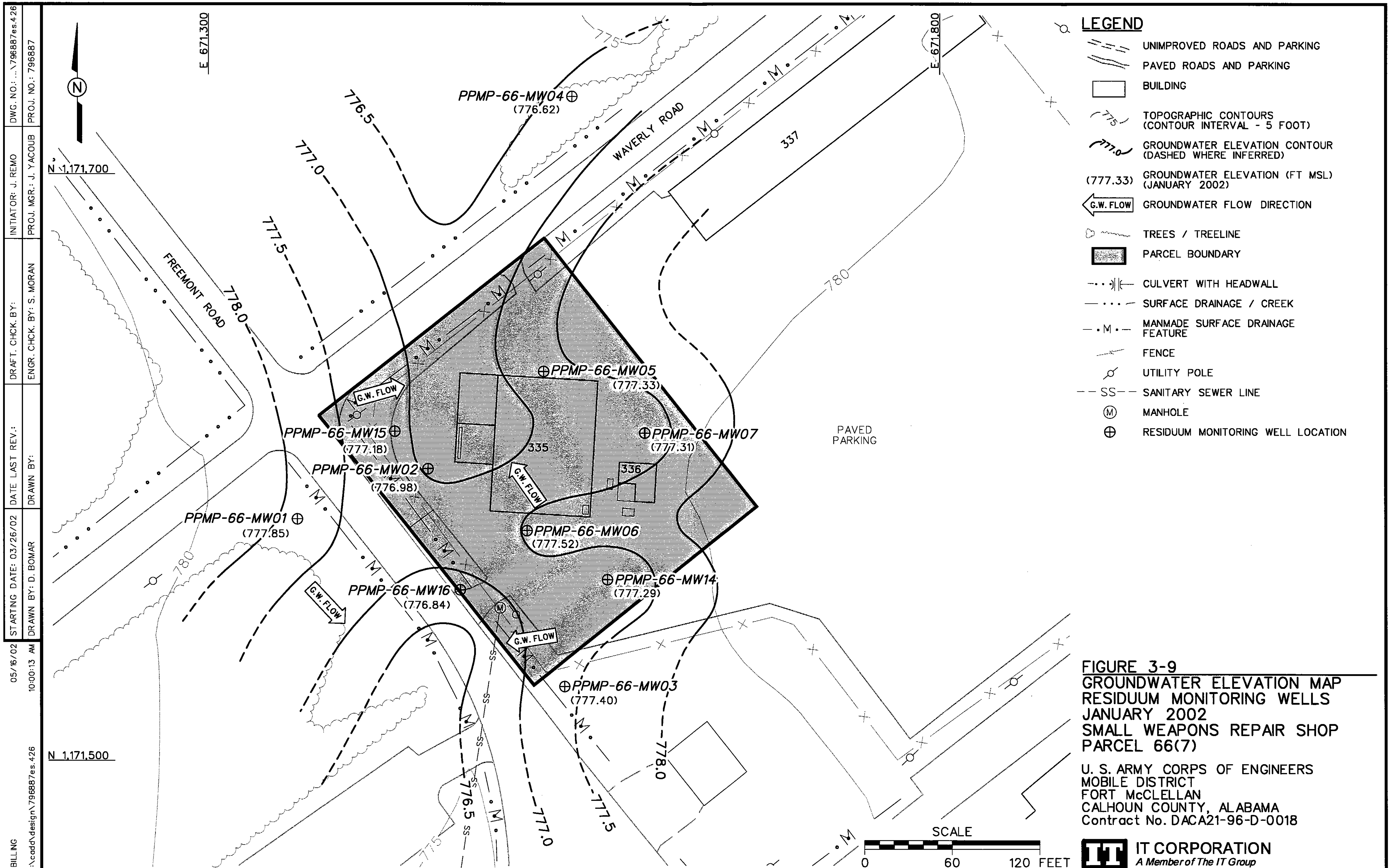

FIGURE 3-9
GROUNDWATER ELEVATION MAP
RESIDUUM MONITORING WELLS
JANUARY 2002
SMALL WEAPONS REPAIR SHOP
PARCEL 66(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
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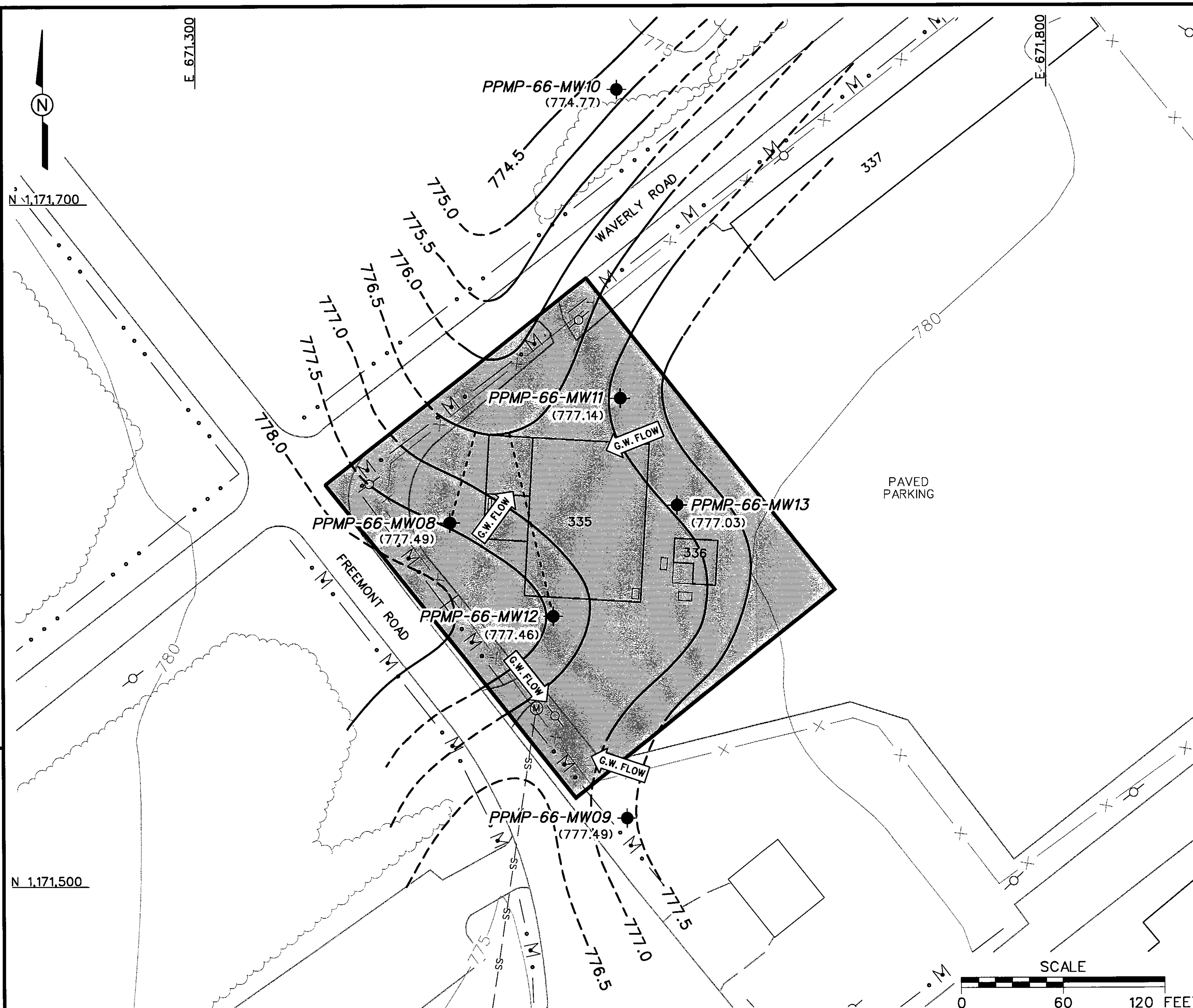

LEGEND

- UNIMPROVED ROADS AND PARKING
- PAVED ROADS AND PARKING
- BUILDING
- TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 5 FOOT)
- GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- (777.03) GROUNDWATER ELEVATION (FT MSL) (JANUARY 2002)
- G.W. FLOW GROUNDWATER FLOW DIRECTION
- TREES / TREELINE
- PARCEL BOUNDARY
- CULVERT WITH HEADWALL
- SURFACE DRAINAGE / CREEK
- MANMADE SURFACE DRAINAGE FEATURE
- FENCE
- UTILITY POLE
- SS SANITARY SEWER LINE
- (M) MANHOLE
- BEDROCK MONITORING WELL LOCATION
- LINE OF TRANSECT FOR HORIZONTAL HYDRAULIC GRADIENTS

FIGURE 3-10
GROUNDWATER ELEVATION MAP
BEDROCK MONITORING WELLS
JANUARY 2002
SMALL WEAPONS REPAIR SHOP
PARCEL 66(7)

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Table 3-1

Horizontal Hydraulic Gradients
Small Weapons Repair Shop, Parcel 66(7)
Fort McClellan, Calhoun County, Alabama

Zone	Upgradient Well or Transect	GW Elevation Jan 2002 (ft above msl)	Downgradient Well or Transect	GW Elevation Jan 2002 (ft above msl)	Distance (ft)	Elevation Difference (ft)	Horizontal Hydraulic Gradient
Residuum	PPMP-66-MW06	777.52	PPMP-66-MW02	776.98	80	0.54	0.00675
	PPMP-66-MW06	777.52	PPMP-66-MW16	776.84	60	0.68	0.01133
	PPMP-66-MW01	777.85	PPMP-MW02	776.98	95	0.87	0.00916
Artihmetic Mean							0.00908
Bedrock	N22E Transect *	777.49	N22E Transect	776.5 Contour	58	0.99	0.01707
	From PPMP-66-MW08		From PPMP-66-MW08				
	N9W Transect *	777.46	N9W Transect	776.5 Contour	115	0.96	0.00835
	From PPMP-66-MW12		From PPMP-66-MW12				
Arithmetic Mean							0.01271

* Line of transect shown on Figure 3-10.
ft - Feet.
GW - Groundwater.
msl - Mean sea level.

Calculations of vertical hydraulic gradients between adjacent bedrock and residuum wells are presented in Table 3-2. The vertical hydraulic gradients calculated from the January 2002 groundwater elevation data are minimal indicating either weak upward flow (- values) or downward flow (+ values). The varying positive and negative hydraulic conductivity values suggest semi-confined conditions across Parcel 66(7). Although downward gradients are indicated in well clusters within the area of suspected contamination, the values are considered weak and ranged from 0.00147 ft/ft to 0.0075 ft/ft.

Hydraulic conductivity values calculated from both rising and falling head slug tests conducted in six wells at Parcel 66(7) are presented in Table 3-3. The slug test data and methodology are included in Appendix E. Hydraulic conductivity values for residuum wells ranged from approximately 0.01 ft/day to 0.92 ft/day, with a geometric mean of 0.07 ft/day. For the bedrock wells, conductivity values ranged from approximately 0.03 ft/day to 0.30 ft/day, with a geometric mean of 0.09 ft/day. The average linear velocity was calculated for groundwater flow in the residuum and bedrock. Arithmetic mean horizontal hydraulic gradients and geometric mean hydraulic conductivity values presented in Tables 3-1 and 3-3, respectively, were used. Effective porosities were estimated at 30 percent for the residuum and 15 percent for the bedrock. Based on these parameters, groundwater flow velocities were calculated to be approximately 0.0022 ft/day for the residuum and 0.0078 ft/day for the bedrock.

Table 3-2

Vertical Hydraulic Gradients
Small Weapons Repair Shop, Parcel 66(7)
Fort McClellan, Calhoun County, Alabama

Well Cluster ID	Midpoint of Screen (ft bgs)	GW Elevation Jan 02) (ft above msl)	dH (ft)	dL (ft)	Vertical Hydraulic Gradient (I)
PPMP-66-MW02	16.5	776.98	-0.51	39.6	-0.01288
PPMP-66-MW08	56.1	777.49			
PPMP-66-MW03	19	777.4	-0.09	23	-0.00391
PPMP-66-MW09	42	777.49			
PPMP-66-MW07	19.5	777.31	0.28	37.1	0.00755
PPMP-66-MW13	56.6	777.03			
PPMP-66-MW06	18.5	777.52	0.06	40.7	0.00147
PPMP-66-MW12	59.2	777.46			
PPMP-66-MW05	19.3	777.33	0.19	33.7	0.00564
PPMP-66-MW11	53	777.14			

I, Vertical hydraulic gradient = dH / dL , + if downward gradient, - if upward gradient.
dH - head shallower well - head deeper well.
dL - vertical distance between mid-point screens.
ft bgs - feet below ground surface.
ft amsl - feet above mean sea level.
GW - Groundwater.

Table 3-3

Summary of Hydraulic Conductivities
Small Weapons Repair Shop, Parcel 66(7)
Fort McClellan, Calhoun County, Alabama

Well No.	Date Tested	Aquifer Response	Saturated Aquifer Thickness (Assumed)	Test Type	Transmisivities T (ft^2/day)	Hydraulic Conductivities K (ft/min)	Hydraulic Conductivities K (cm/sec)	Hydraulic Conductivities K (ft/day)
Residuum								
PPMP-66-MW01	8/29/01	Confined	18.00	Falling	2.28E-01	8.81E-06	4.48E-06	1.27E-02
				Rising	6.20E-01	2.39E-05	1.22E-05	3.44E-02
PPMP-66-MW03	8/30/01	Unconfined	24.94	Falling	2.29E+01	6.37E-04	3.24E-04	9.17E-01
				Rising	1.45E+01	4.04E-04	2.05E-04	5.81E-01
PPMP-66-MW06	8/29/01	Confined	19.00	Falling	3.90E-01	1.43E-05	7.24E-06	2.05E-02
				Rising	6.20E-01	2.26E-05	1.15E-05	3.26E-02
Maximum					2.29E+01	6.37E-04	3.24E-04	9.17E-01
Minimum					2.28E-01	8.81E-06	4.48E-06	1.27E-02
Geometric Mean					**1.50E+00**	**5.09E-05**	**2.59E-05**	**7.34E-02**
Bedrock								
PPMP-66-MW10	8/30/01	Unconfined	68.82	Rising	2.03E+01	2.05E-04	1.04E-04	2.96E-01
PPMP-66-MW11	8/30/01	Confined	78.00	Falling	insufficient data			
				Rising	insufficient data			
PPMP-66-MW12	8/29/01	Unconfined	73.13	Falling	insufficient data			
				Rising	2.10E+00	2.00E-05	1.01E-05	2.88E-02
Maximum					2.03E+01	2.05E-04	1.04E-04	2.96E-01
Minimum					2.10E+00	2.00E-05	1.01E-05	2.88E-02
Geometric Mean					**6.54E+00**	**6.40E-05**	**3.25E-05**	**9.22E-02**

Notes: 1 Saturated Aquifer Thickness
For a confined Aquifer, this is the distance from the base of the upper confining unit to the top of the lower confining unit.
For an unconfined aquifer, this is the distance from the water table to the top of the lower confining unit.
2 Analysis Method
Cooper, Bredehoeft, Papadopulos (1967) method is used for the well with confined aquifers response.
Bouwer and Rice (1976) method is used for the well with unconfined aquifers response.