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Site Investigation Work Plan

HAA-18 Boundary Investigation
Hunter Army Airfield
Savannah, Georgia

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Site Investigation Work Plan

**HAA-18, Boundary
Investigation**
Hunter Army Airfield

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Acronyms

BTEX	Benzene, Toluene, Ethylbenzene, Xylene
DPT	Direct-push technology
bgs	Below ground surface
GAEPD	Georgia Environmental Protection Division
HAAF	Hunter Army Airfield
HGL	HydroGeoLogic, Inc.
MCA	Military Construction Account
msl	Mean sea level
PVC	Polyvinyl Chloride
µg/L	Micrograms per liter
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound

1. Introduction

The U.S. Army Environmental Command (USAEC) has retained ARCADIS on behalf of Hunter Army Airfield (HAAF) to investigate the potential soil and groundwater impacts at the Boundary Investigation Site, also known as site HAA-18. During the March 2006 sampling event conducted to delineate the groundwater impacts at HAA-15 (Military Construction Account [MCA] Barracks Site) at HAAF, petroleum hydrocarbons were detected in a monitor well located along the North Perimeter Road. The petroleum hydrocarbons were determined to be unrelated to the HAA-15 plume and the area was designated as HAA-18, Boundary Investigation Site (Figure 1-1). A soil and groundwater investigation was conducted in 2007 to evaluate potential sources for the petroleum hydrocarbon detections. Additional groundwater sampling and elevation data collection were conducted in 2008 and early 2009. A Site Investigation Data Summary Report presenting all data collected to date for the HAA-18 investigation was submitted in April 2009 (ARCADIS 2009).

Based on a review of all available data, the primary volatile organic compounds (VOCs) detected in groundwater at HAA-18 are petroleum hydrocarbons (benzene, toluene, ethylbenzene, and xylenes [BTEX] and naphthalene). Previous investigation activities indicate the source(s) are potentially located outside of HAAF property upgradient of HAA-18. This work plan describes further investigation activities to delineate impacts in onsite soil and groundwater. The proposed approach to this delineation consists of installing and sampling three additional monitor wells. In addition, shallow soil samples will be taken in locations proximate to a former pipeline that was reportedly abandoned in place (U.S. Army Corps of Engineers (USACE) 2005). The locations of the proposed monitor wells were based on data collected from direct push technology (DPT) borings previously installed by the USACE in 2007.

2. Background and Regulatory Status

HAA-18 was defined as an area of concern when petroleum hydrocarbons were detected in groundwater and a subsequent environmental site assessment confirmed the presence of VOCs (USACE 2008). Site HAA-18 is not currently regulated under a Georgia Environmental Protection Division (GAEPD) program. A Data Summary Report for site HAA-18 was submitted to the GAEPD in May, 2009 (ARCADIS 2009). HAAF will pursue delineation of contaminated groundwater on a voluntary basis while GAEPD reviews the Data Summary Report.

The first goal at HAA-18 is to fully delineate the extent of onsite impacts. The results of the 2007 investigation and this proposed investigation will be utilized to assess impacts and develop a Conceptual Site Model. Documentation will be submitted to GAEPD in accordance with the requirements of the designated regulatory program.

3. Site Description and Setting

3.1 Site Description

HAAF is an active military installation located in Savannah, Georgia, encompassing areas of industrial, commercial, and temporary residential property occupied by a variety of administrative, maintenance, and barracks facilities as well as a 10-acre, man-made storm water retention pond and active air field (Figure 1-1). HAA-18 is located in the northeastern portion of HAAF and is bound by Interstate Highway 516 to the northeast, HAAF property to the east and south, and by a CSX switching yard and rail lines to the west. A 6-inch underground fuel pipeline that was constructed in 1958 and was reportedly abandoned in place in the 1960s enters HAAF from the north and runs along the western boundary to the Bulk Fuel Storage Facility (USACE 2005). A 2007 investigation identified low levels of VOCs in shallow soil and a plume of dissolved VOCs in groundwater at HAA-18. A site map depicting the HAA-18 area and the current monitor well network is shown on Figure 3-1.

3.2 Physical Setting

HAAF is located on a southwest-northeast trending ridge of about 20 feet to 40 feet elevation above sea level and is surrounded on all sides by lower topography of about 10 to 15 feet elevation. The first runways were probably constructed on the highest part of the ridge when first built in 1928. The HAA-18 site, located at the northeastern boundary of HAAF is an area of lower topography at approximately 15 feet above sea level.

3.3 Regional Geology/Hydrogeology

HAAF is located on the lower coastal plain physiographic province, which is typified by very low relief that slopes toward the Atlantic Ocean. The geology is composed of a seaward thickening sequence of unconsolidated sediments. Previous regional investigations suggest that there has been minor structural deformation in the Savannah, Georgia area during deposition of the sediments starting in the early Cretaceous Period. The sediments form a thickening wedge into the Atlantic Ocean deposited from sediment erosion of the Blue Ridge Mountains. The total thickness of the sediments in the Savannah, Georgia, area is over 2,000 feet.

The most important water supply aquifer in the lower coastal plain of Georgia and Florida is the Floridan Aquifer. The Floridan Aquifer is a regionally extensive aquifer

that is approximately 800 feet thick at Savannah. The top of the Floridan Aquifer at HAAF is approximately 200 feet below ground surface (bgs). It is composed primarily of Oligocene age and Eocene age porous limestones. The Floridan Aquifer is the principal water supply aquifer throughout coastal Georgia and most of Florida.

This investigation focuses on groundwater quality in the uppermost aquifer system only. The uppermost aquifer system at and surrounding Savannah, Georgia is underlain by two continuous clay units, which are effective confining units that preclude downward groundwater migration of shallow groundwater to the deeper Floridan water supply aquifer. These two clay units are named the Coosawhatchie Formation and Berryville Clay member of the Hawthorne Group (Huddleston 1988). Lithologic samples and fossils suggest that these two units were deposited during the Middle Miocene Period in a low energy open marine environment over a wide area. The open ocean depositional environment resulted in the widespread and continuous nature of these clay units. A deep test well in Savannah (GGS-3139) shows that the clay units extend from a depth of 45 feet to 167 feet near HAAF. Due to the thick confining unit that separates the uppermost aquifer system from the underlying Floridan Aquifer, there is minimal potential for shallow groundwater to impact deeper groundwater quality in the underlying Floridan Aquifer.

After deposition of the Hawthorne Clays, there was no preserved deposition of sediments at the study area until the late Pleistocene Period. The sediments overlying the Hawthorne Group clays to land surface are composed of a sequence of near shore to shoreface (barrier island) sediments that prograde over the Hawthorne Group marine clays. Published investigations have identified nine sets of overlapping relict beach ridges of Pleistocene age to Holocene age on the lower coastal plain that prograde towards the Atlantic Ocean. Each barrier sequence forms a ridge (also termed terrace) that is progressively lower and closer to the modern barrier island. The ancient beaches formed during higher sea levels and are parallel to the modern beach. Each barrier system is at a consistent elevation above sea level with about 20 feet relief above surrounding land. HAAF is located on a relict beach ridge named the Pamlico Terrace from about 20 feet mean sea level (msl) to 40 feet msl. This abandoned beach ridge was formed during the late Pleistocene (>10,000 years) age. The Pamlico Terrace sediments are about 50 feet thick at HAAF.

4. Previous Investigations and Data Collection Efforts

4.1 MCA Barracks Site Investigation: 2005 and 2006 Site Investigations

The VOCs in groundwater near North Perimeter Road were first discovered in 2006 by HydroGeoLogic, Inc. (HGL) during a site investigation for the HAA-15 site (also known as MCA Barracks site), where chlorinated VOCs are the constituents of concern. The monitor well network installed for site HAA-15 extends north of the HAA-15 plume to near the North Perimeter Road and the HAAF property boundary (Figure 4-1). In 2006, well HGL-3C was sampled as part of HAA-15 investigation activities and petroleum hydrocarbons were detected (including benzene at 14 micrograms per liter [$\mu\text{g/L}$]). The BTEX detection was inconsistent with the chlorinated VOCs found at the HAA-15 site. Therefore, a separate investigation was initiated to assess the area near well HGL-3C. The results of the 2006 sampling were summarized in the Draft Compliance Status Report, MCA Barracks Site (HGL, 2007).

4.2 North Perimeter Road: 2007 Preliminary Investigation

In 2007 the USACE – Savannah District conducted a site assessment to investigate the petroleum hydrocarbons detected in well HGL-3C. The investigation included soil and groundwater sampling using DPT installed temporary borings, field screening and sampling of shallow soils, and installation and sampling of five permanent groundwater monitor wells. At each DPT boring location, shallow soils were field screened for VOC vapors using a photo ionization detector and groundwater samples were collected from two discrete intervals (10 ft bgs and 25 ft bgs). Based on the results from the DPT investigation, five permanent monitor wells were installed and sampled and ten soil samples were collected for laboratory analysis. The results of the investigation were presented in the *North Perimeter Road Preliminary Investigation* (USACE 2008) and a summary of the results is provided in the following sections.

4.2.1 Groundwater Sampling Results

The results from the USACE investigation confirmed the presence of VOCs in groundwater in the North Perimeter Road area. Naphthalene and BTEX were the primary VOCs detected. The results indicated the impacts were predominantly in the deeper groundwater zone (15 to 39 ft bgs) near well HGL-3C. Monitor well construction data are provided in Table 4-1 and historical groundwater elevation data are provided in Table 4-2. DPT groundwater results from 2007 are provided in Table 4-3.

In the shallow groundwater zone, naphthalene was detected in four DPT samples taken at 10 ft bgs. BTEX was not detected in shallow groundwater during the 2007 DPT investigation. Two of the impacted samples were collected from locations near well HGL-3C (DPT-2S and DPT-14S). The remaining two impacted samples were collected from locations further southwest where naphthalene was not detected in the deeper groundwater (DPT-3S and DPT-4S). The highest concentration of naphthalene in shallow groundwater was detected in sample DPT-2S (42 µg/L), which was the closest sampling point to the rail siding. There were no samples from shallow monitor wells during the 2007 investigation. Groundwater data for the shallow zone are illustrated on Figure 4-2.

In the deeper groundwater zone, DPT samples collected from 25 ft bgs proximate to well HGL-3C (DPT-1D, DPT-2D, DPT-6D) had the highest detections of petroleum hydrocarbons. The highest concentrations of all constituents of concern were from the wells closest to the facility boundary. Deep wells MW-2 and HGL-3C also had detections of petroleum hydrocarbons, predominantly naphthalene and benzene. Total VOCs were highest in sample DPT-1D, where naphthalene was detected at 950 µg/L. Groundwater data for the deep zone are illustrated on Figure 4-3.

4.2.2 Soil Sampling Results

The results from the soil sampling indicated the presence of low concentrations of VOCs in shallow soils (1.2 – 4.0 ft bgs) in the North Perimeter Road area. However, the concentrations did not indicate a source in the area. One or more VOCs were detected in 8 of the 10 soil samples. Acetone was detected most frequently and at the highest concentrations. Acetone concentrations ranged from 7.2 to 78 µg/L. Toluene, acetone, and methylene chloride were the only constituents detected in both soil and groundwater. Other organic constituents detected in soil included 1,2,3-trichloropropane, 1,1-dichloropropene, 2-hexanone, and p-Isopropyltoluene. All of the constituents detected in shallow soil were below the HSRA Notification concentrations. Soil analytical data are provided in Table 4-4 and illustrated on Figure 4-4.

4.3 December 2008 Groundwater Sampling

4.3.1 Top-of-Casing Survey

In December 2008, a survey of well location and top-of-casing elevation was performed by Chatham Surveying Services, Inc., a licensed surveyor under contract with ARCADIS. These data were used to calculate relative groundwater elevations and

groundwater flow direction at the site. A copy of the survey drawing is provided in Appendix A.

4.3.2 Water Level Measurements

A comprehensive set of water level data was collected from all wells prior to sampling in December 2008. The data were used to generate a water level elevation figure (Figure 4-5). The data indicate groundwater is flowing south from offsite onto HAAF property. Water level data are provided in Table 4-2 and water elevations from December 2008 are illustrated on Figure 4-5.

4.3.3 Groundwater Sampling Results

In December 2008, ARCADIS collected groundwater samples from all six existing monitor wells at HAA-18 (including well HGL-3C). The wells were sampled using peristaltic pumps and low-flow sampling methodology. Dissolved VOCs were detected in all wells except for HGL-3C. Benzene was detected in samples from four monitor wells at concentrations ranging from 1.1 to 82 µg/L. The highest constituent concentration was 100 µg/L of toluene in the sample from MW-4. Groundwater data are provided in Table 4-5 and on Figure 4-3.

The December 2008 groundwater data and the September 2007 data show some differences. In September 2007, wells HGL-3C and MW-2 were the only impacted wells. In December 2008, all of the wells except for HGL-3C showed impacts. The reason for the different results is not known. Additional monitor well sampling will be required to confirm site conditions.

4.4 February 2009 Water Level Gauging

Water levels were collected in February 2009 to confirm the groundwater flow direction at HAA-18. Even though the water levels increased approximately a foot compared to the previous water level elevations, the data confirmed that groundwater is flowing from offsite toward the HAAF facility property. Water level data are provided in Table 5, and water elevations are illustrated on Figure 4-6. The water level data from September 2007 are illustrated in Figure 4-7 for comparison.

4.5 Off-site Fuel Pipeline

The Phase II Report for Hunter Army Airfield (USACE 2005) stated that a pipeline that initiated at the Southland Tank Farm System at the Savannah Dock and terminated at the Bulk Fuel Facility entered the HAAF property in the HAA-18 area. The report further stated that the six-inch pipeline was buried 30-inches below street level and conveyed jet fuel to the storage tanks and fueling pits. An interviewee cited in the report stated that the pipeline was abandoned in place. Drawings of the pipeline location included in the Archive Search Report for HAA-15 MCA Barracks Site (USACE 2004) show that the pipeline entered HAAF between the current locations of monitor well HGL-3 and MW-4. The estimated location of the abandoned pipeline based in these figures is included on Figure 3-1. Additional shallow soil sampling to evaluate potential impacts associated with the pipeline is discussed in Section 6.

5. HAA-18 Local Geology/Hydrogeology

The observed depth to groundwater at HAA-18 ranges from 1 foot to 5 feet bgs across the site. Groundwater flow within the uppermost aquifer exists under unconfined conditions. A geologic cross section at HAA-15 that extends to HAA-18 shows a massive homogeneous sand unit at the surface that extends from land surface at the runway down to about 10 to 20 feet depth. This is illustrated in Figure 5-1 which shows southwest to northeast cross section A-A'. The massive fine grained sand unit at the top of the sequence (14 feet thick at the HGL-9 well cluster) is part of the beach. The water table is about 2 to 4 feet deep in this sand. A 10-acre man-made pond at HAA-15 is the surface expression of the water table as shown on the cross section. A series of silty clay units interbedded with fine sand units and silt units underlies the massive sand unit. These units are interpreted as marsh and bay or lagoon deposits behind the Pamlico barrier. The HAA-18 area manifests individual clay units that are typical of the marsh behind the barrier.

A persistent clay unit at HAA-15 divides the shallow aquifer system into separate aquifers. Although previous investigations at HAA-15 defined the upper 60 to 70 feet as a single shallow aquifer, significant downward vertical hydraulic gradients suggest that the uppermost aquifer system at HAA-15 is composed of at least two distinct aquifers north of the hangers. The boring logs for Monitor Wells HGL-2B/C and 3B/C are included in Appendix B. A table that summarizes groundwater elevations at well pairs is included in Appendix C. At HAA-15, vertical hydraulic gradients exceed 1 foot downward at four well pairs (HGL-1, HGL-6, HGL-7, and HGL-8) in nested wells where the screen intervals are separated by 10 feet. This robust downward gradient suggests that the aquifers are separated at some locations by the clayey silt unit acting as a confining unit. Water elevations show very small vertical gradients at the property boundary to the west (HAA-18 area), which suggests the two units of the split aquifer system are limited in extent.

Previous investigations calculated hydraulic conductivities at HAA-15 to vary from 8 feet/year to 250 feet/year and similar variations should be expected in the HAA-18 area. Widely varying hydraulic conductivities in sediments are typical in back barrier sequences and represent the variation from low energy marsh deposits of clays and silts to high energy tidal channel deposits of well sorted sands. Overall, the local stratigraphy of HAA-18 closely fits the depositional environment of a lagoon and/or marsh behind a barrier island up to a beach.

The groundwater flow direction at HAA-18 conforms to the shallow groundwater flow pattern at Hunter Army Airfield. Shallow groundwater flow at Hunter Army Airfield follows the topographic relief, i.e. the water table mimics the topography. The airfield is on a gentle Northeast Southwest trending ridge that is about 15 to 20 feet above the surrounding surface. Groundwater in the shallow aquifer system flows away from this ridge to the nearest drainage ditches and small first order streams. Groundwater along the Northwest slope of the ridge at nearby HAA-15 flows to the northwest down the slope. However, at HAA-18 there is a subtle reversed topographic gradient of about five feet downward to the southeast to a drainage ditch. The water table follows this decrease in elevation back towards Hunter Army Airfield away from the perimeter road. The drainage ditch is considered the local discharge boundary for the shallow groundwater. Shallow groundwater will always flow to this ditch. An estimated geologic cross section is illustrated in Figure 5-1. A site map with topographic contours is included as Figure 5-2.

5.1 Extent of Impacts

5.1.1 Groundwater Impacts

Investigations at HAA-18 assessed VOCs in groundwater and soil. Low levels of VOCs were detected in shallow soils. However, no continuing source to groundwater was identified. The primary constituents of concern at HAA-18 are naphthalene and BTEX in groundwater.

VOC impacted groundwater in the shallow zone is depicted on Figure 4-2 and represents the results of DPT samples from approximately 10 feet bgs. VOC impacted groundwater in the deeper zone is depicted on Figure 4-3 and represents DPT results from 25 ft bgs and monitor wells with screens ranging from 15 to 39 feet bgs.

5.1.2 Soil Impacts

The surface soil sample results from the 2007 USACE investigation were in compliance with Type 1 Risk Reduction Standard values. None of the results were above notification concentrations and the presence of a specific source was not indicated. Results are illustrated in Figure 4-4.

5.2 Data Gaps

The investigation indicated low concentration VOC and naphthalene impacts to soil and groundwater. Soil and groundwater quality data do not indicate any specific source areas on HAAF property. According to all available water level data for the HAA-18 site, groundwater flows onto HAAF property from offsite and the source(s) potentially exist off of HAAF property. Consequently, it is not possible at this time to fully investigate the largest data gap, the location of source(s). The other data gap of significance is that the downgradient extent of the groundwater plume has not been fully bounded by permanent monitor wells.

6. Proposed Investigation

Based on the data gaps discussed above, the focus of the proposed investigation is to delineate the downgradient extent of the groundwater contaminant plume.

Previous data do not indicate a specific on-site source location. However, additional shallow soil sampling is warranted along the route of the reportedly abandoned pipeline to confirm or eliminate it as a potential source.

All procedures and techniques utilized for this investigation will conform to U.S. Environmental Protection Agency (USEPA) Region 4 Science and Ecosystem Support Division guidance. All groundwater samples collected will be analyzed by Shealy Environmental Services, Inc. or other Georgia-certified laboratory.

The activities comprising the investigation of impacts at HAA-18 include the installation of three groundwater monitor well pairs in locations selected to establish the extent of groundwater impacts. The groundwater impacts above Type I Risk Reduction Standards and the proposed monitor well locations are shown on Figure 6-1. After installation and development, the new and existing groundwater monitor wells will be sampled to delineate groundwater impacts. The wells will also provide additional data for evaluation of the groundwater flow in the area. Stadia will be installed in the canals as necessary to obtain data on surface water hydraulics.

Additional shallow soil samples will be obtained with DPT to investigate potential impacts related to the abandoned pipeline.

6.1 Groundwater Monitor Wells

Three 2-inch-diameter monitor well pairs will be installed downgradient of the current HAA-18 monitoring wells and previous DPT sampling locations to provide verification of the extent of groundwater impacts determined during the May 2007 Geoprobe temporary boring program. The monitor well pairs will be screened at the water table and in the deep surficial groundwater at approximately 35 to 40 ft bgs. The proposed monitor well locations are presented on Figure 6-1. The wells will be constructed of 2-inch-diameter Schedule 40 Polyvinyl Chloride (PVC). Specific depths will be based on lithologic logs from temporary borings. The wells shall have 10-foot screens set to sample a specific interval previously identified with DPT results. Well screens will consist of a 2-inch inside diameter, flush threaded, 0.010-in. slotted PVC. The surface completions will be above-ground unless located around buildings or in

populated areas. The monitor wells will be surveyed for location and elevation by a land surveyor registered in the state of Georgia. All soil wastes from installation of monitor wells will be segregated by borehole and collected in Department of Transportation approved 55-gallon drums.

6.2 Baseline Sampling of New and Existing Monitor Wells

Groundwater samples will be collected from the new monitor wells and the six existing wells to assess current water quality conditions. A minimum of two sampling events conducted during typical high and low water table seasons will be required to evaluate contaminant distribution and movement at the site. Low-flow techniques will be used to collect groundwater samples from the selected monitor wells. Field measurements will include pH, specific conductance, temperature, oxidation-reduction potential, dissolved oxygen, and turbidity. The groundwater will be analyzed for VOCs by USEPA Method 8260B and Semivolatile Organic Compounds by USEPA Method 8270D.

During each sampling event, a complete set of water-level measurements will be collected from existing monitor wells installed for HAA-18 as well as new monitor wells installed for this investigation. These water-level measurements will provide a comprehensive view of relative groundwater flow directions in the area.

6.3 Soil Sampling Along Abandoned Pipeline

DPT locations for vertical and horizontal delineation of soil impacts associated with the reportedly abandoned pipeline will extend initially to a depth of approximately 6 feet bgs. Borings will be extended in depth if field screening results indicate deeper impacts. Samples will be collected at intervals determined with field screening equipment. Samples will be collected for laboratory analysis from the subset of initial borings that showed elevated vapors. Soil samples will be analyzed for United States Environmental Protection Agency (USEPA) Method 8260B and USEPA Method 8270C. Pipeline location will be verified prior to soil sampling. Geophysical methods will be employed as necessary. The initial investigation area is presented on Figure 6-2.

7. Closing Summary

The intent of this investigation is to fully delineate the impacted groundwater at HAA-18. Previous data indicate that the source(s) are potentially off of HAAF property. However, the abandoned pipeline located in the area will also be investigated as a potential source.

When sufficient data have been obtained to provide a consistent and complete Conceptual Site Model for on-site impacts, the results of the investigation will be included in a Compliance Status Report or other appropriate document as determined by HAAF and GAEPD.

8. References

- ARCADIS. 2009. Final Site Investigation Summary Report, HAA-18 Boundary Investigation, Hunter Army Airfield, Savannah, Georgia. April.
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Tables

Table 4-1
Monitor Well Construction Detail
Hunter Army Airfield, Savannah, Georgia
HAA-18 (North Perimeter Road)

Well ID	Installation Date	Well Depth (ft bgs)	Screen Interval (ft bgs)	Northing Coordinate	Easting Coordinate
MW -1	9/1/2007	28.8 ft	18.8 - 28.8	741307.62	976478.18
MW -2	9/1/2007	30.5 ft	20.5 - 30.5	741511.53	975936.10
MW -3	9/1/2007	25.5 ft	15.5 - 25.5	741505.30	975758.78
MW -4	9/1/2007	29.1 ft	19.1 - 29.1	741294.55	975562.77
MW -5	9/1/2007	30.0 ft	20 - 30	740922.90	975626.24
HGL-2B*	3/1/2006	26.0 ft	15 - 25	740679.10	975180.65
HGL-2C*	3/12/2006	44.0 ft	34 - 44	740679.10	975180.65
HGL-3B	3/14/2006	24.7 ft	14.7 - 24.7	741608.26	976012.63
HGL-3C	3/14/2006	39.42 ft	29.4 - 39.4	741608.26	976012.63

Notes:

Wells surveyed on December 16, 2008 by Chatham Surveying Services, Inc.

Well coordinates are based on State Plane (NAD '83)

Elevations are based on NAVD 1988

Installation Date for MW -1 through 5 is approximate

* - Data from HAA-15 historical documents.

ft bgs: feet below ground surface

TOC: Top of casing

Table 4-2
Groundwater Elevation Data
Hunter Army Airfield, Savannah, Georgia
HAA-18 (North Perimeter Road)

Well ID	Date	Well Depth (ft BGS)	TOC Elevation (ft above MSL)	Water Level (ft BTOC)	Groundwater Elevation (ft above MSL)
MW -1	9/5/2007	28.8	13.31	1.15	12.16
MW -1	12/16/2008	28.8	13.31	1.60	11.71
MW -1	2/26/2008	28.8	13.31	2.23	11.08
MW -2	9/5/2007	30.5	15.90	3.73	12.17
MW -2	12/16/2008	30.5	15.90	4.00	11.90
MW -2	2/26/2008	30.5	15.90	4.93	10.97
MW -3	9/5/2007	25.5	14.62	-	-
MW -3	12/16/2008	25.5	14.62	1.57	13.05
MW -3	2/26/2008	25.5	14.62	2.67	11.95
MW -4	9/6/2007	29.1	15.65	3.66	11.99
MW -4	12/16/2008	29.1	15.65	3.98	11.67
MW -4	2/26/2008	29.1	15.65	4.94	10.71
MW -5	9/6/2007	30.0	14.70	3.10	11.60
MW -5	12/16/2008	30.0	14.70	3.65	11.05
MW -5	2/26/2008	30.0	14.70	4.30	10.40
HGL-3C	9/5/2007	39.4	14.49	2.25	12.24
HGL-3C	12/16/2008	39.4	14.49	2.44	12.05
HGL-3C	2/26/2008	39.4	14.49	3.36	11.13
HGL-3B	9/5/2007	24.7	14.57*	-	-
HGL-3B	12/16/2008	24.7	14.57*	-	-
HGL-3B	2/26/2008	24.7	14.57*	3.39	11.18

Notes:

ft BGS: feet below ground surface

ft BTOC: feet below top of casing

MSL: mean sea level

- : No data

Water level data for September 2007 were obtained from groundwater sampling logs in the North Perimeter Road Preliminary Investigation (USACE, 2008).

* TOC elevation for HGL-3B is from historical survey data

Table 4-3
DPT Groundwater Results
Hunter Army Airfield, Savannah, Georgia
HAA-18 (North Perimeter Road)

DPT Boring Location	DPT-1S	DPT-1D	DPT-2S	DPT-2D	DPT-3S	DPT-3D	DPT-4S	DPT-4D	DPT-5S	DPT-5D
Sample ID	PR-DPT-1S	PR-DPT-1D	PR-DPT-2S	PR-DPT-2D	PR-DPT-3S	PR-DPT-3D	PR-DPT-4S	PR-DPT-4D	PR-DPT-5S	PR-DPT-5D
Date	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007
Depth	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft
Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Analyte:										
VOCs, 8260B:										
Acetone	< 5.0	< 5.0	< 5.0	< 5.0	13	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	< 1.0	9.3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	< 1.0	7.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Isopropylbenzene	< 1.0	2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m-Xylene/p-Xylene	< 2.0	2.1	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Naphthalene	< 1.0	950	42	74	6.4	< 1.0	20	< 1.0	< 1.0	< 1.0
o-Xylene	< 1.0	5.7	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	< 1.0	1.8	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

DPT Boring Location	DPT-6S	DPT-6D	DPT-7S	DPT-7D	DPT-8S	DPT-8D	DPT-9S	DPT-9D	DPT-10S	DPT-10D
Sample ID	PR-DPT-6S	PR-DPT-6D	PR-DPT-7S	PR-DPT-7D	PR-DPT-8S	PR-DPT-8D	PR-DPT-9S	PR-DPT-9D	PR-DPT-10S	PR-DPT-10D
Date	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/22/2007	5/22/2007	5/22/2007	5/22/2007	5/22/2007	5/22/2007
Depth	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft
Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Analyte:										
VOCs, 8260B:										
1,2,4-Trimethylbenzene	< 1.0	< 1.0	< 1.0	< 1.0	1.2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	< 1.0	18	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	< 1.0	6.8	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m-Xylene/p-Xylene	< 2.0	3.2	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Naphthalene	< 1.0	45	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	< 1.0	6.3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	< 1.0	0.72	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl chloride	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3	< 1.0

Table 4-3
DPT Groundwater Results
Hunter Army Airfield, Savannah, Georgia
HAA-18 (North Perimeter Road)

DPT Boring Location	DPT-11S	DPT-11D	DPT-12S	DPT-12D	DPT-13S	DPT-13D	DPT-14S	DPT-14D	DPT-15S	DPT-15D
Sample ID	PR-DPT-11S	PR-DPT-11D	PR-DPT-12S	PR-DPT-12D	PR-DPT-13S	PR-DPT-13D	PR-DPT-14S	PR-DPT-14D	PR-DPT-15S	PR-DPT-15D
Date	5/22/2007	5/22/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007	5/23/2007
Depth	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft
Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Analyte:										
VOCs, 8260B:										
Acetone	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	12	< 5.0	< 5.0
Naphthalene	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	14	< 1.0	< 1.0	< 1.0

DPT Boring Location	DPT-16S	DPT-16D	DPT-17S	DPT-17D	DPT-18S	DPT-18D	DPT-19S	DPT-19D	DPT-20S	DPT-20D
Sample ID	PR-DPT-16S	PR-DPT-16D	PR-DPT-17S	PR-DPT-17D	PR-DPT-18S	PR-DPT-18D	PR-DPT-19S	PR-DPT-19D	PR-DPT-20S	PR-DPT-20D
Date	5/24/2007	5/24/2007	5/23/2007	5/23/2007	5/24/2007	5/24/2007	5/24/2007	5/24/2007	5/24/2007	5/24/2007
Depth	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft
Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Analyte:										
VOCs, 8260B:										
Acetone	7.2	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Naphthalene	< 1.0	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

DPT Boring Location	DPT-21S	DPT-21D	DPT-22S	DPT-22D	DPT-23S	DPT-23D	DPT-24S	DPT-24D	DPT-25S	DPT-25D
Sample ID	PR-DPT-21S	PR-DPT-21D	PR-DPT-22S	PR-DPT-22D	PR-DPT-23S	PR-DPT-23D	PR-DPT-24S	PR-DPT-24D	PR-DPT-25S	PR-DPT-25D
Date	5/24/2007	5/24/2007	5/24/2007	5/24/2007	5/23/2007	5/23/2007	5/24/2007	5/24/2007	5/24/2007	5/24/2007
Depth	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft	10 ft	25 ft
Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Analyte:										
VOCs, 8260B:										
Acetone	< 5.0	< 5.0	< 5.0	34	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Methylene Chloride	< 1.0	< 1.0	2.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:

Bold = Detection

VOCs = Volatile Organic Compounds

Table 4-4
DPT Soil Sampling Results
Hunter Army Airfield, Savannah, Georgia
HAA-18 (North Perimeter Road)

Sample ID	HSRA	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9	SS-10
Sample Depth	Notification	2.5-3.2 ft	3.0-4.0 ft	2.4-2.9 ft	1.4-1.9 ft	1.4-1.9 ft	1.2-1.8 ft	1.6-2.2 ft	3.0-3.5 ft	2.9-3.6 ft	2.2-2.9 ft
Date	Concentrations	8/10/2007	8/10/2007	8/10/2007	8/10/2007	8/10/2007	8/10/2007	8/10/2007	8/10/2007	8/10/2007	8/10/2007
Unit	(µg/Kg)	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg
Analyte:											
VOCs, 8260B:											
1,1-Dichloropropene	1,000,000	< 6.0	< 5.5	< 6.9	9.4	8.7	< 5.8	< 6.7	< 4.2	< 5.8	< 7.0
1,2,3-Trichloropropane	540	< 6.0	< 5.5	< 6.9	29	30	< 5.8	< 6.7	< 4.2	< 5.8	< 7.0
2-Hexanone	--	< 60	< 55	< 69	< 65	9.6	< 58	< 67	< 42	< 58	< 70
Acetone	2740	< 60	25	56	63	78	76	19	7.2	< 58	58
Methylene Chloride	80	< 6.0	< 5.5	< 6.9	4.1	< 6.6	< 5.8	4.2	3.1	< 5.8	< 7.0
p-Isopropyltoluene	--	< 6.0	< 5.5	< 6.9	< 6.5	< 6.6	2.1	< 6.7	< 4.2	< 5.8	< 7.0
Toluene	14,400	< 6.0	< 5.5	< 6.9	< 6.5	< 6.6	1.2	< 6.7	0.86	< 5.8	< 7.0

Notes:

VOCs = Volatile Organic Compounds

Bold = Detection above laboratory reporting limit

There is no 1,1-Dichloropropene notification concentration, listed concentration based on dichloropropene mixture.

-- = No HSRA Notification Concentration exists for this compound

Table 4-5
Groundwater Monitor Well Sample Results
Hunter Army Airfield, Savannah, Georgia
HAA-18 (North Perimeter Road)

Sample Location	MW -1	MW -1	MW -2	MW -2	MW -3	MW -3	MW -3	MW -4	MW -4	MW -5	MW -5	HGL-3C	HGL-3C	HGL-3C
Sample ID	P-MW -1-9-07	P-MW 1 (121608)	P-MW -2-9-07	P-MW 2 (121608)	P-MW -3-9-07	P-DUP	P-MW 3 (121608)	P-MW -4-9-07	P-MW 4 (121608)	P-MW -5-9-07	P-MW 5 (121608)	MCA-GWHGL-3C-0306	P-HGL-3-9-07	P-HGL (121608)
Date	9/5/2007	12/16/2008	9/5/2007	12/16/2008	9/5/2007	9/5/2007	12/16/2008	9/6/2007	12/16/2008	9/6/2007	12/16/2008	3/1/2006	9/5/2007	12/16/2008
Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Analyte:														
VOCs, 8260B:														
1,2,3-Trichlorobenzene	< 1.0	< 0.50	< 1.0	< 0.50	< 1.0	< 1.0	< 0.50	< 1.0	< 0.50	< 1.0	< 0.50	-	1.7	< 0.50
1,2,4-Trichlorobenzene	< 1.0	< 0.50	< 1.0	< 0.50	< 1.0	< 1.0	< 0.50	< 1.0	< 0.50	< 1.0	< 0.50	-	1.1	< 0.50
1,2-Dichloroethane	< 1.0	2.2	< 1.0	< 0.50	< 1.0	< 1.0	< 0.50	< 1.0	< 0.50	< 1.0	< 0.50	-	< 1.0	< 0.50
4-Isopropyltoluene	< 1.0	1.5	2.9	< 0.50	< 1.0	< 1.0	< 0.50	< 1.0	< 0.50	< 1.0	< 0.50	-	< 1.0	< 0.50
Acetone	< 5.0	38	< 5.0	< 10	< 5.0	< 5.0	< 10	< 5.0	22	< 5.0	< 10	-	< 5.0	< 10
Benzene	< 1.0	82	9.3	3.3	< 1.0	< 1.0	1.1	< 1.0	76	< 1.0	< 0.50	14	11	< 0.50
Chloromethane	< 1.0	< 0.50	< 1.0	< 0.50	< 1.0	< 1.0	< 0.50	< 1.0	0.63	< 1.0	< 0.50	-	< 1.0	< 0.50
Cyclohexane	NA	56	NA	< 0.50	NA	NA	< 0.50	NA	10	NA	< 0.50	-	NA	< 0.50
Ethylbenzene	< 1.0	8.6	< 1.0	< 0.50	< 1.0	< 1.0	< 0.50	< 1.0	6.9	< 1.0	< 0.50	10	4.7	< 0.50
Isopropylbenzene	< 1.0	6.7	< 1.0	< 0.50	< 1.0	< 1.0	< 0.50	< 1.0	1	< 1.0	< 0.50	-	< 1.0	< 0.50
Methylcyclohexane	NA	15	NA	< 5.0	NA	NA	< 5.0	NA	< 5.0	NA	< 5.0	-	NA	< 5.0
Methylene Chloride	< 1.0	1.9	< 1.0	< 0.50	< 1.0	< 1.0	< 0.50	< 1.0	3.7	< 1.0	1.2	< 1.0	< 1.0	< 0.50
m-Xylene/p-Xylene	< 2.0	NA	< 2.0	NA	< 2.0	< 2.0	NA	< 2.0	NA	< 2.0	NA	5.1	0.81	NA
Naphthalene	< 1.0	20	14	3.6	< 1.0	< 1.0	2.1	< 1.0	< 0.50	< 1.0	< 0.50	-	360	< 0.50
o-Xylene	< 1.0	NA	< 1.0	NA	< 1.0	< 1.0	NA	< 1.0	NA	< 1.0	NA	7.6	3.4	NA
Toluene	< 1.0	3.7	< 1.0	< 0.50	< 1.0	< 1.0	< 0.50	< 1.0	100	< 1.0	< 0.50	1.6	1	< 0.50
Xylenes (total)	< 3.0	8.8	< 3.0	< 0.50	< 3.0	< 3.0	20	< 3.0	60	< 3.0	< 0.50	12.7	4.21	< 0.50

Notes:
VOCs: Volatile Organic Compounds
Bold = Detection
NA: Laboratory did not analyze analyte in 8260B run
"-": Not Reported in Source Report

ARCADIS

Figures

CITY: (KNOXVILLE) DIV/GROUP: (ENV) DB: (BALTIMORE) LD: (BALTIMORE) PIC: (E.WERTH) PM: (C.BERTZ) TM: (S.BOSTIAN/H.ENGLEIGH)
 PROJECT: GP08HAFSH18B.DAOWP PATH: G:\GIS\GP08HAFSH18B\WORK PLAN\F1-1 HAA18_WP_REG.mxd SAVED: 30JUL2009



HUNTER ARMY AIRFIELD, GEORGIA HAA-18 SITE INVESTIGATION WORK PLAN

Site Location Map



FIGURE
 1-1

CITY: (KNOXVILLE) DIV: GROUP: (ENV) DB: (BALTIMORE) LD: (BALTIMORE) PIC: (E.WERTH) PM: (C.BERTZ) TM: (S.BOSTIAN/H. ENGLISH)
PROJECT: GP08HAF-SH188.DAOWP PATH: G:\GIS\GP08HAF-SH188\2009 SI WORK PLAN\F3-1 HAA18_WP_site.mxd SAVED: 20CT2009



LEGEND

- Storm Water System
- Flow Direction
- Monitor Well (deep)
- Estimated Location of 6" Pipeline (abandoned in place)

REFERENCES:

- USACE (2004).
- JAMES M. KEATON SURVEY (DECEMBER 15, 2008).
- AERIAL: SAGIS (FLOWN IN 2008).

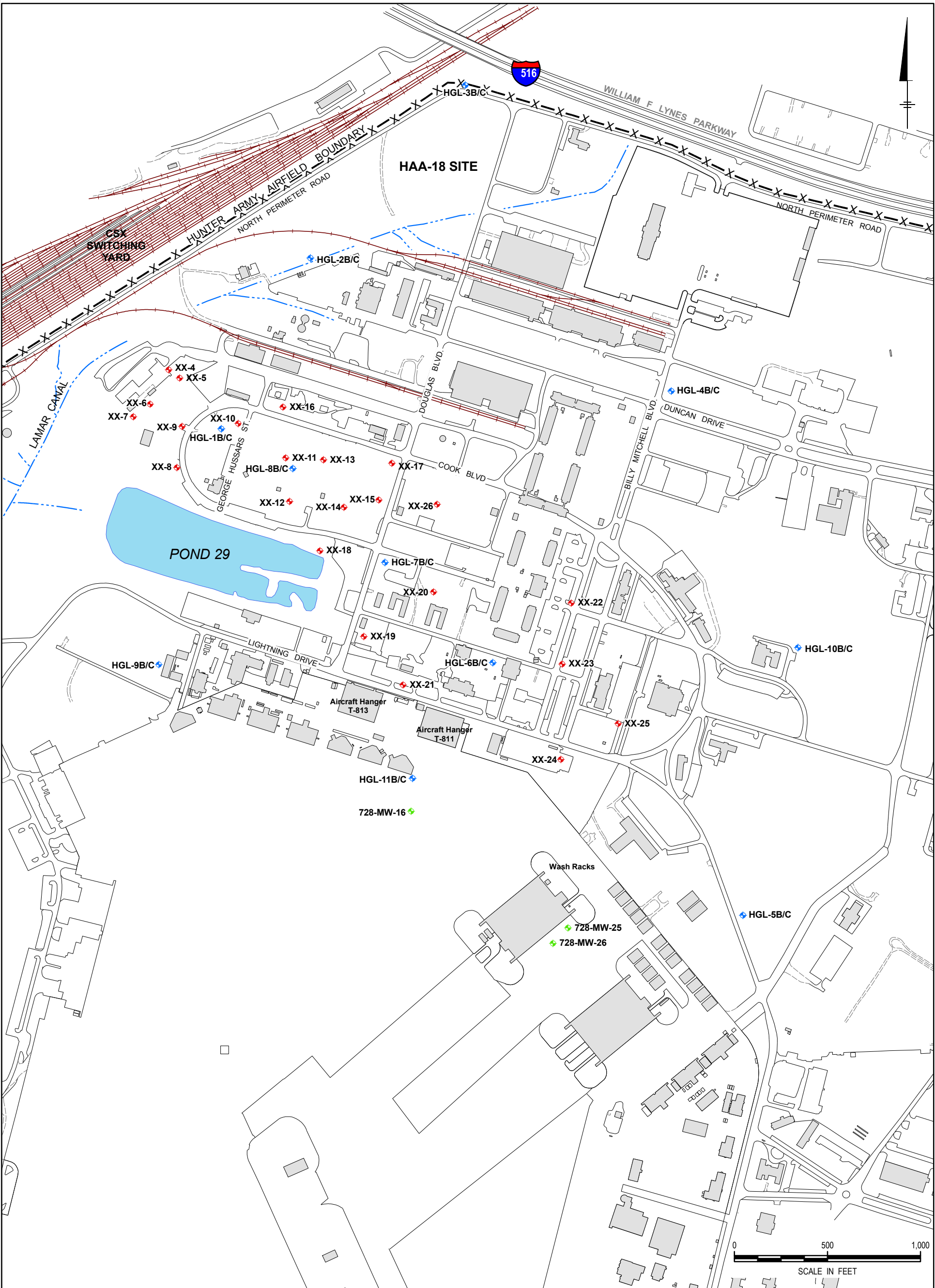
HUNTER ARMY AIRFIELD, GEORGIA
HAA-18 SITE INVESTIGATION WORK PLAN

Site Map with Monitor-Well Locations



FIGURE

3-1



REFERENCE: Compliance Status Report (HGL 2007).

- LEGEND**
- Monitor Well (1995)
 - Vertical Profile/Monitor Well (2000, 2001)
 - Monitor Well (2006)

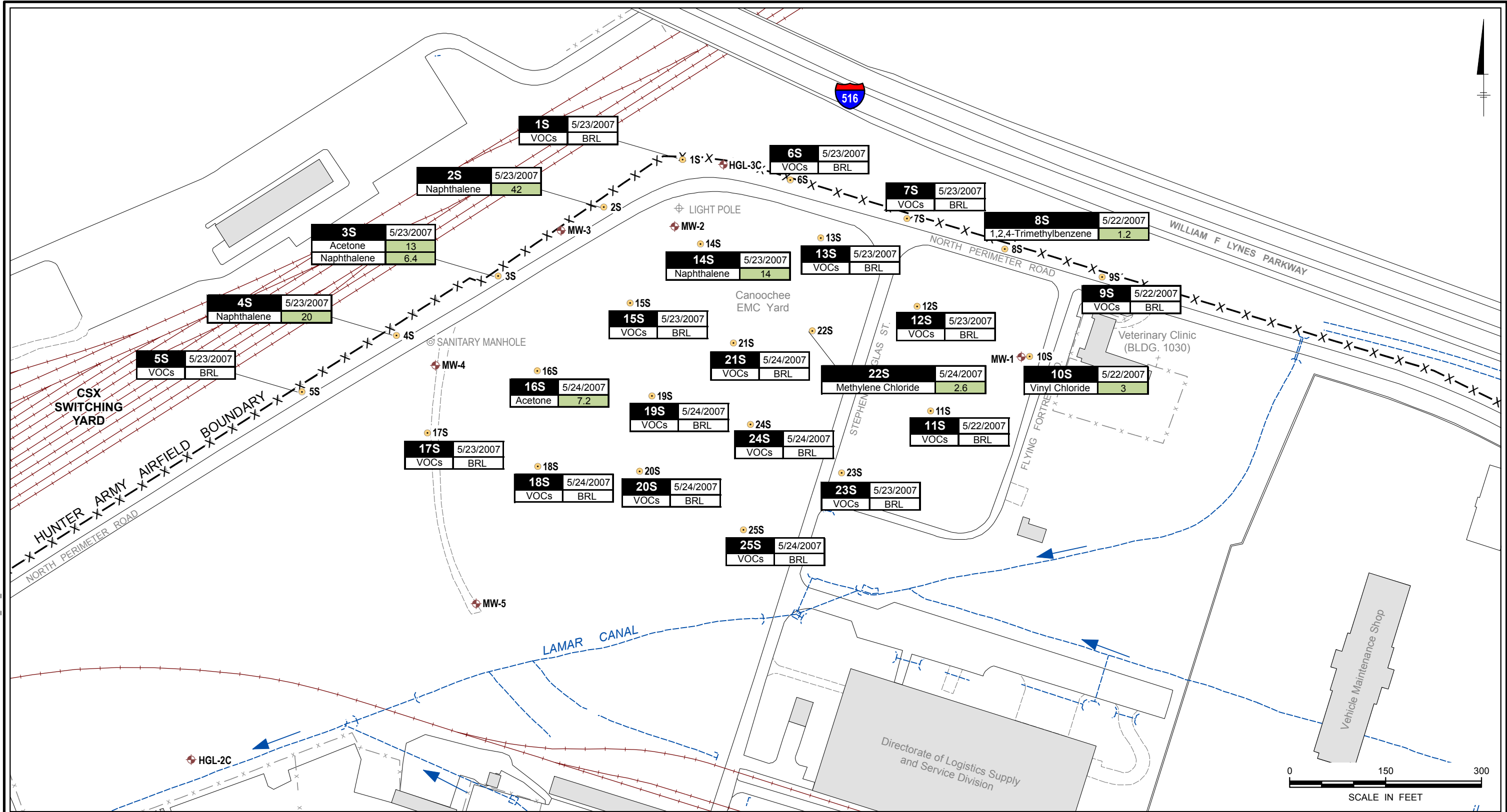
HUNTER ARMY AIRFIELD, GEORGIA
HAA-18 SITE INVESTIGATION WORK PLAN

HAA-15 Monitor-Well Network



FIGURE
4-1

CITY: (KNOXVILLE) DIV: (GROUP: (ENV) DB: (BALTOM) LD: (BALTOM) PIC: (E.WERTH) PM: (C.BERTZ) TM: (S.BOSTIAN/H. ENGLISH)
PROJECT: GP08HAFSH188.DAOWP PATH: G:\GIS\GP08HAFSH188\2009 SI\WORK\PLAN\F4-2 HAA18_WP_VOCs GW-S.mxd - SAVED: 18SEP2009



LEGEND

--- Storm Water System
→ Flow Direction
⊕ Monitor Well (deep)
● Direct Push Boring, May 2007

DPT Sample	
Analyte	Result

Sample Date	
Analyte	Result

DPT - Direct Push Technology
VOCs - Volatile Organic Compounds
BRL - Below Laboratory Reporting Limit

NOTES:
1) All samples were collected using Direct Push Technology.
2) Samples analyzed for VOCs by 8260B.
3) All concentrations in micrograms per liter (µg/L).
4) Only those analytes with at least one detection are shown.
5) Data collected by USACE during North Perimeter Road Preliminary Investigation.

REFERENCE:
JAMES M. KEATON SURVEY, DECEMBER 15, 2008.

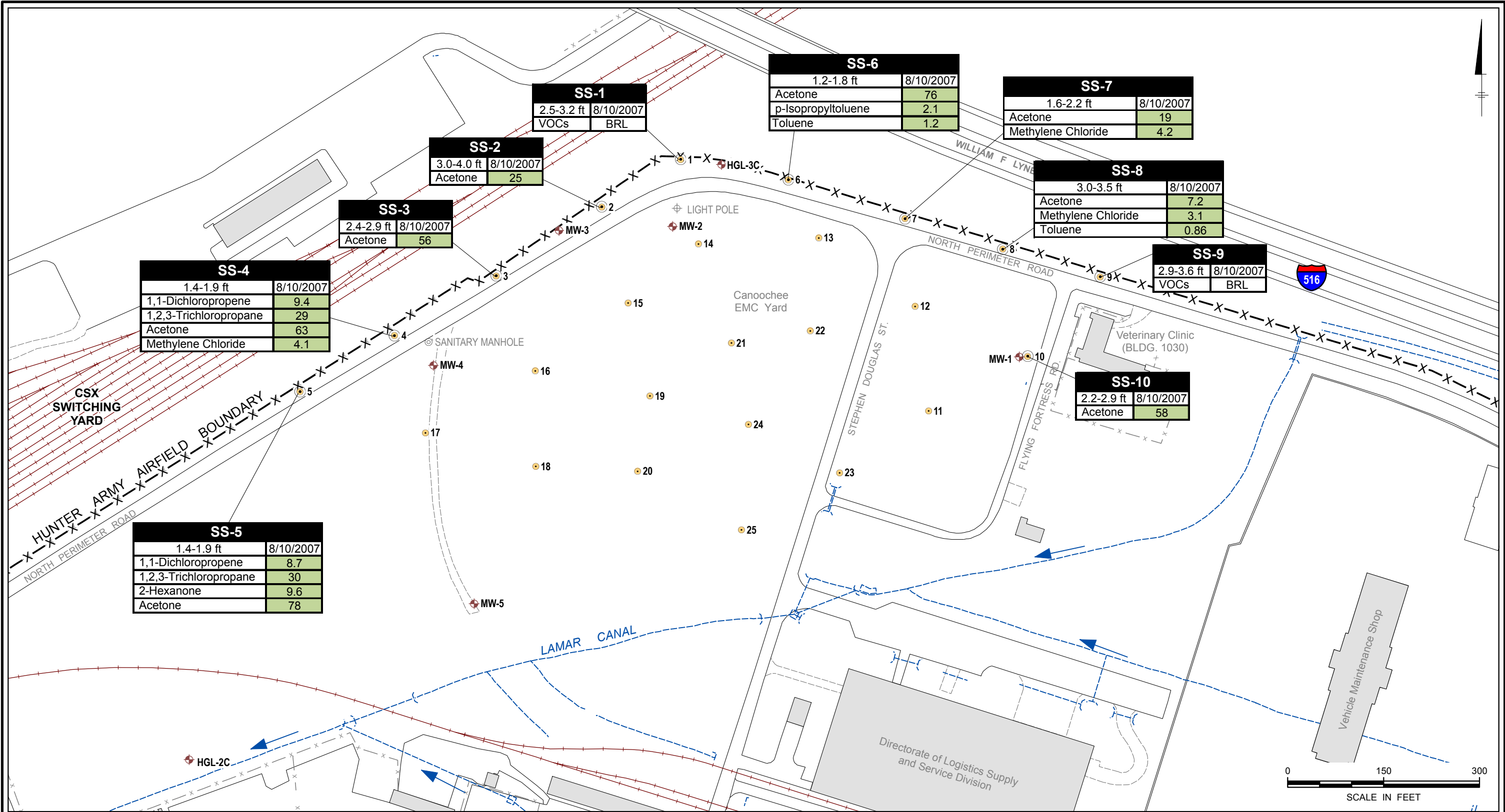
HUNTER ARMY AIRFIELD, GEORGIA
HAA-18 SITE INVESTIGATION WORK PLAN

**VOCs in Groundwater – Shallow Zone (10 ft, bgs)
(May 2007)**

ARCADIS

FIGURE
4-2

CITY: (KNOXVILLE) DIV: (GROUP: (ENV) DB: (BALTO) PIC: (E: WERTH) PM: (C: BERTZ) TM: (S: BOSTIAN: (H: ENGLISH) PROJECT: GP08HAFSH18B.DAOWP PATH: G:\GIS\GP08HAFSH18\2009 SI\WORK PLAN\F4.4 HAA18_WP_VOCs SOIL-S.mxd SAVED: 18SEP2009



LEGEND

- Storm Water System
- Flow Direction
- Monitor Well (deep)
- Direct Push Boring, May 2007
- Surface Soil Sample, August 2007

VOCs - Volatile Organic Compounds
BRL - Below Laboratory Reporting Limit

NOTES:

- 1) Samples analyzed for VOCs by 8260B.
- 2) All concentrations in micrograms per kilogram (ug/kg).
- 3) Only those analytes with at least one detection are shown.
- 4) Data collected by USACE during North Perimeter Road Preliminary Investigation.

Soil Sample Location	
Sample Depth	Sample Date
Analyte	Result

REFERENCE:
JAMES M. KEATON SURVEY, DECEMBER 15, 2008.

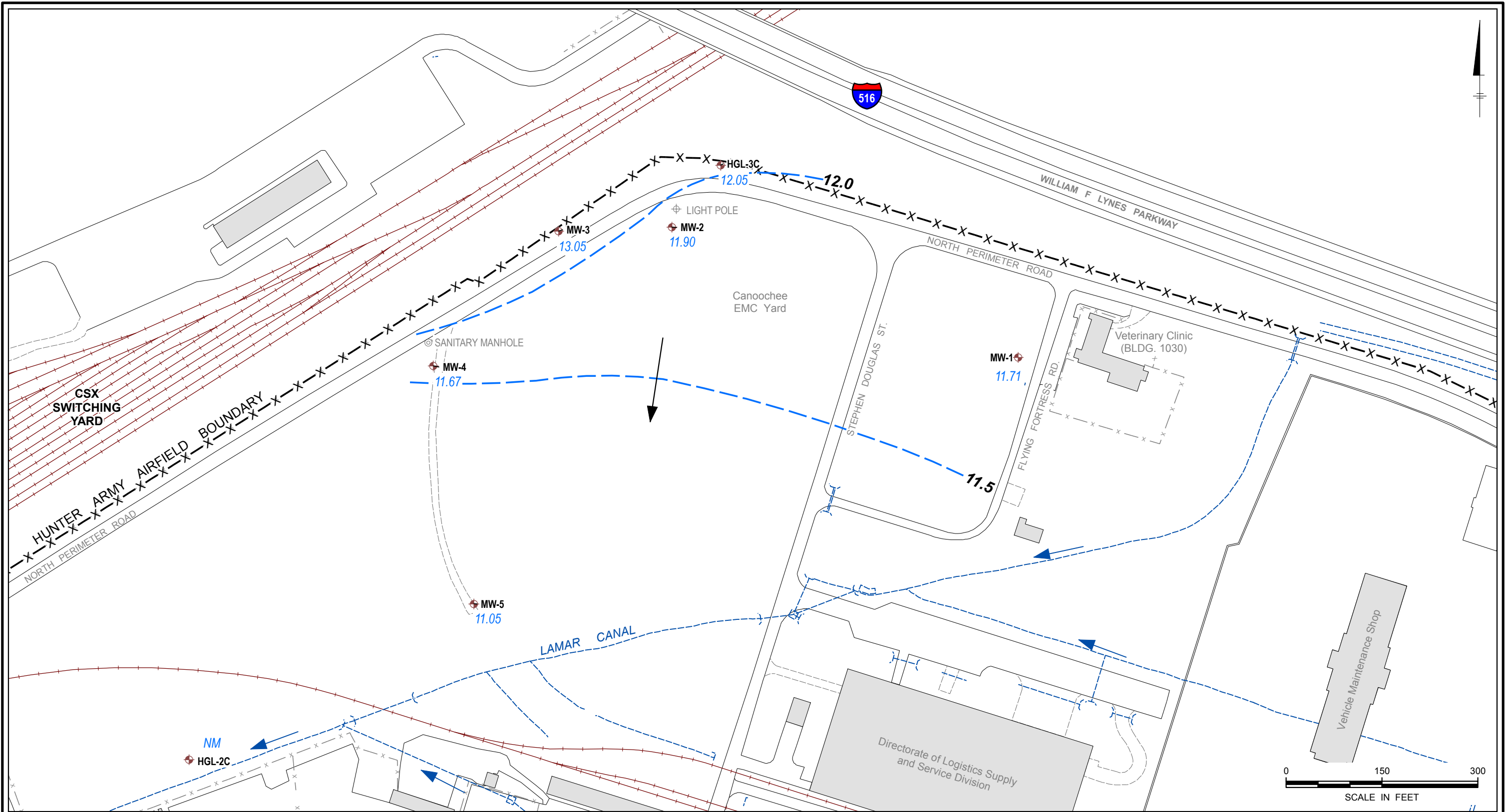
HUNTER ARMY AIRFIELD, GEORGIA
HAA-18 SITE INVESTIGATION WORK PLAN

VOCs in Shallow Soils

ARCADIS

FIGURE
4-4

CITY: (KNOXVILLE) DIV/GROUP: (ENV) DB: (BALTIM) PIC: (E.WERTH) PM: (C.BERTZ) TM: (S.BOSTIAN/H. ENGLISH)
PROJECT: GP08HAFSH188.DAOWP PATH: G:\GIS\GP08HAFSH18\2009 SITEWORK PLAN\F4-5 HAA18_WP_WLE_200812.mxd SAVED: 18SEP2009



LEGEND

- | | |
|------------------------|--|
| --- Storm Water System | --- Groundwater Contour (ft, msl) (inferred where dashed) |
| → Flow Direction | → General Direction of Groundwater Flow |
| ⬮ Monitor Well (deep) | 11.05 Water-Level Elevation, (ft, msl)
Measured December 12, 2008 |
| | NM Not Measured |

REFERENCE:
JAMES M. KEATON SURVEY, DECEMBER 15, 2008.

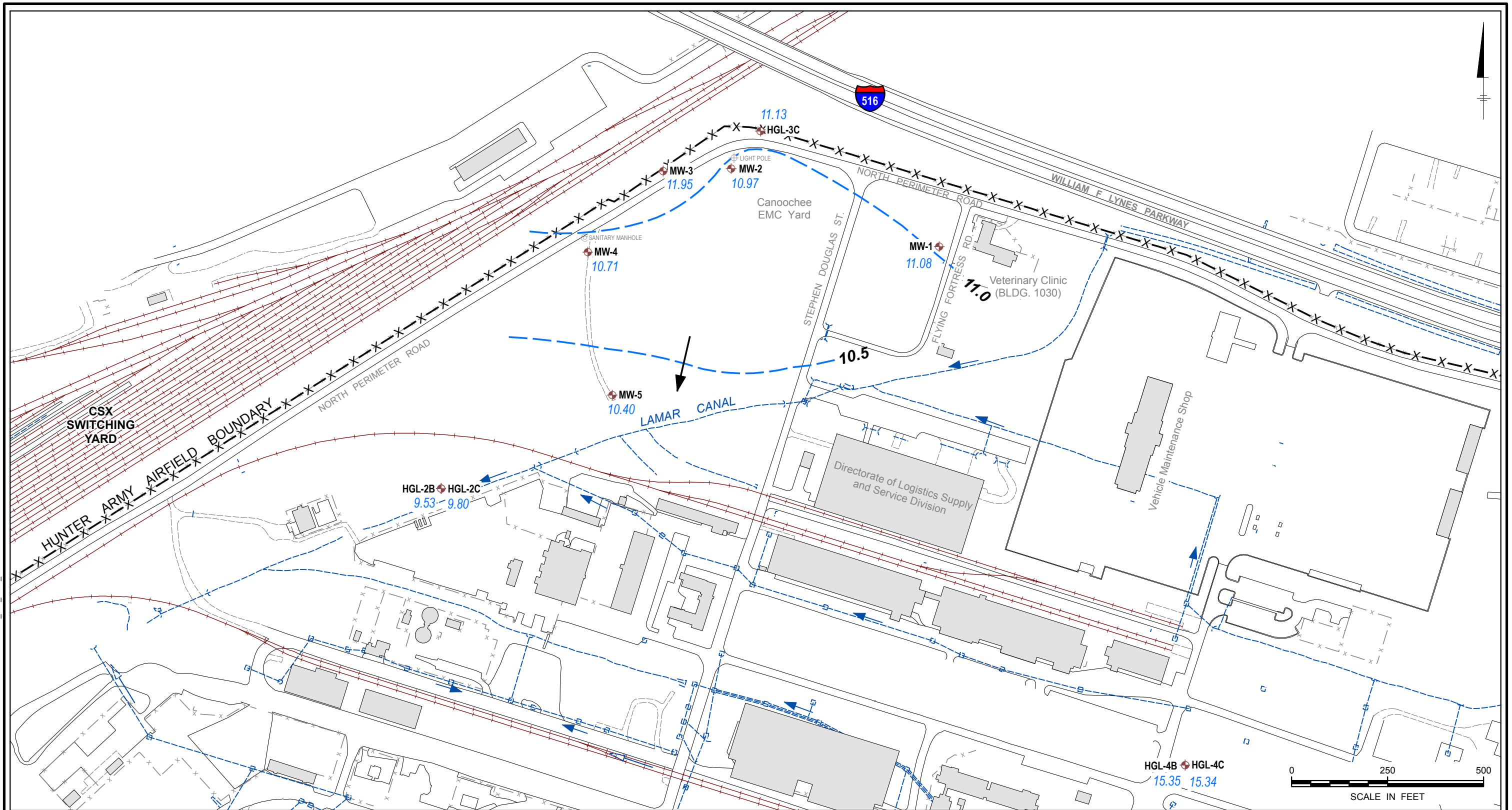
HUNTER ARMY AIRFIELD, GEORGIA
HAA-18 SITE INVESTIGATION WORK PLAN

**Groundwater Elevations
(December 2008)**



FIGURE
4-5

CITY: (KNOXVILLE) DIV: (GROUP: (ENV) DB: (BALTIMORE) LD: (BALTIMORE) PIC: (E. WERTH) PM: (C. BERTZ) TM: (S. BOSTIAN) H: (ENGLISH)
PROJECT: GP08HAFSH188.DAOWP PATH: G:\GIS\GP08HAFSH182009 SI WORK PLAN\F4-6 HAA18_WP_WLE_200902.mxd SAVED: 18SEP2009



LEGEND

- Storm Water System
- Flow Direction
- Monitor Well (deep)
- Groundwater Contour (ft, msl) (inferred where dashed)
- General Direction of Groundwater Flow
- 9.53 Water-Level Elevation, (ft, msl)
Measured February 27, 2009

REFERENCE:
JAMES M. KEATON SURVEY, DECEMBER 15, 2008.

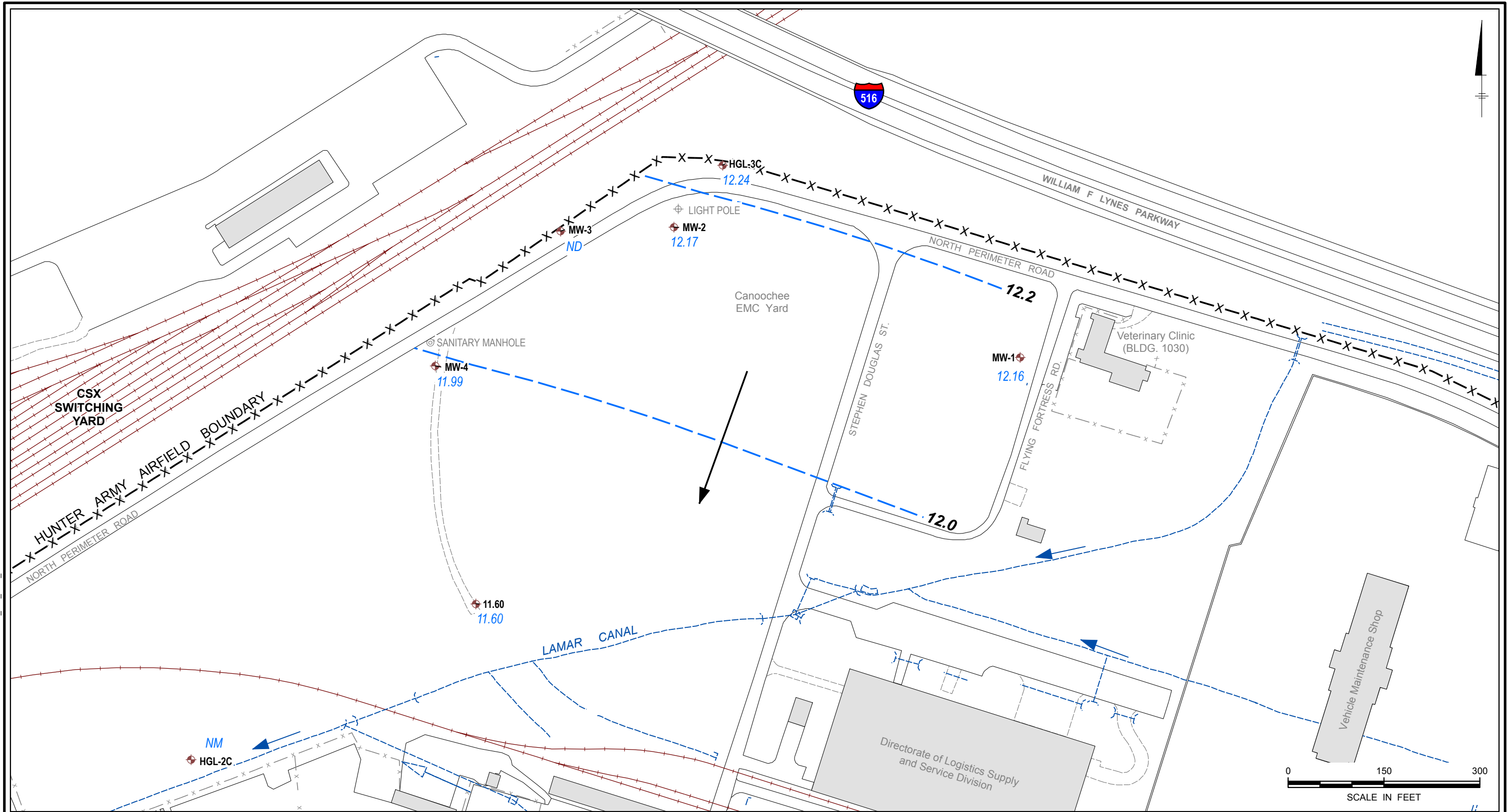
HUNTER ARMY AIRFIELD, GEORGIA
HAA-18 SITE INVESTIGATION WORK PLAN

Groundwater Elevations
(February 2009)



FIGURE
4-6

CITY: (KNOXVILLE) DIV/GROUP: (ENV) DB: (BALTO) PIC: (E.WERTH) PM: (C.BERTZ) TM: (S.BOSTIAN/H. ENGLISH)
PROJECT: GP08HAFSH188.DAOWP PATH: G:\GIS\GP08HAFSH18\2009 SI\WORK\PLAN\F4-7 HAA18_WP_WLE_200709.mxd SAVED: 18SEP2009



LEGEND

- Storm Water System
- Flow Direction
- Monitor Well (deep)
- Groundwater Contour (ft, msl) (inferred where dashed)
- General Direction of Groundwater Flow
- Water-Level Elevation, (ft, msl)
Measured September 5-6, 2007

- NM Not Measured
- ND Not Usable Data

NOTE:
Water-level data obtained from sampling logs in "North Perimeter Road Preliminary Investigation" (USACE, 2008).
Logs for wells MW-4 and MW-5 are dated September 6, 2007; logs for all other wells are dated September 5, 2007.

REFERENCE:
JAMES M. KEATON SURVEY, DECEMBER 15, 2008.

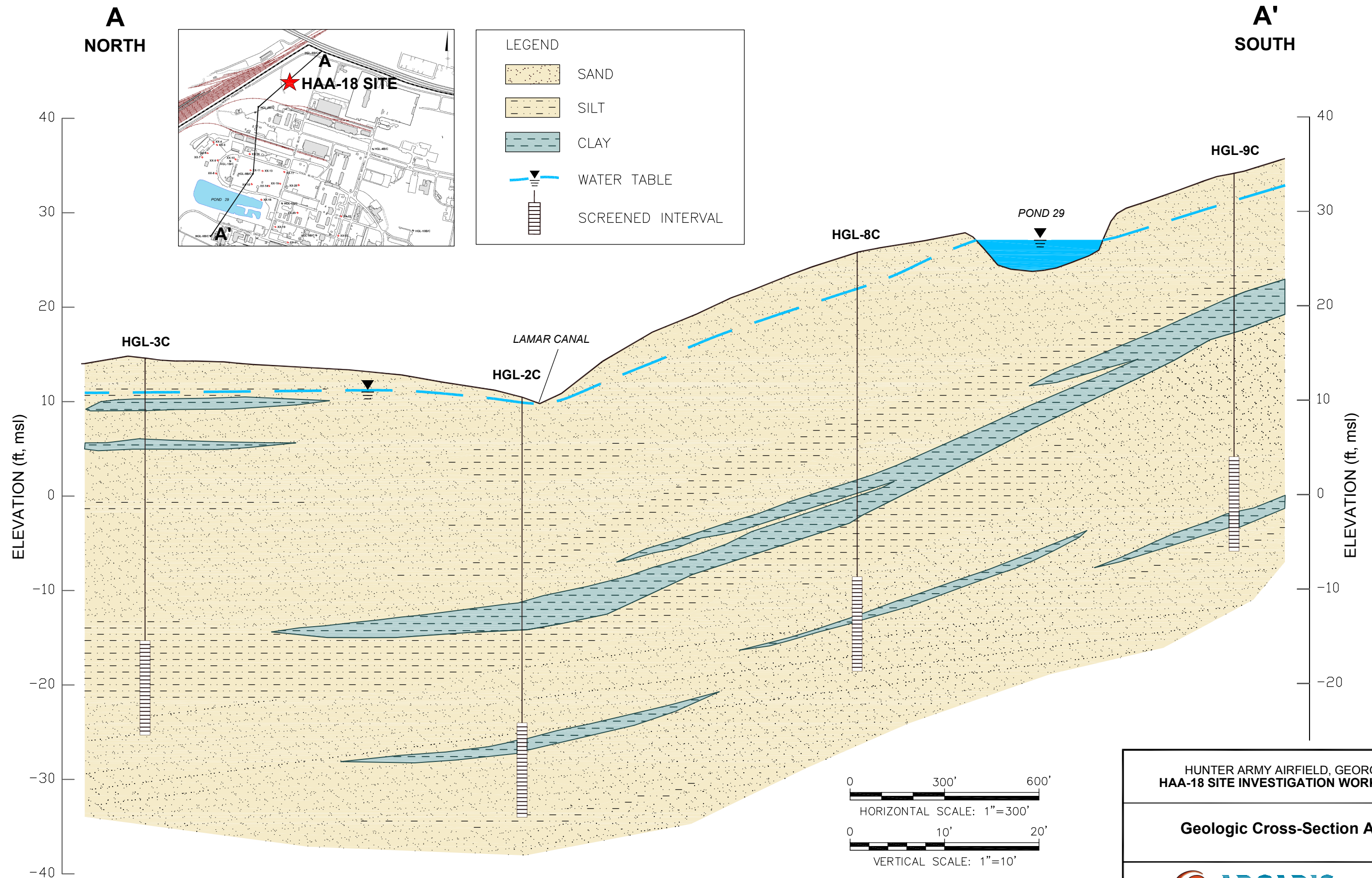
HUNTER ARMY AIRFIELD, GEORGIA
HAA-18 SITE INVESTIGATION WORK PLAN

**Groundwater Elevations
(September 2007)**

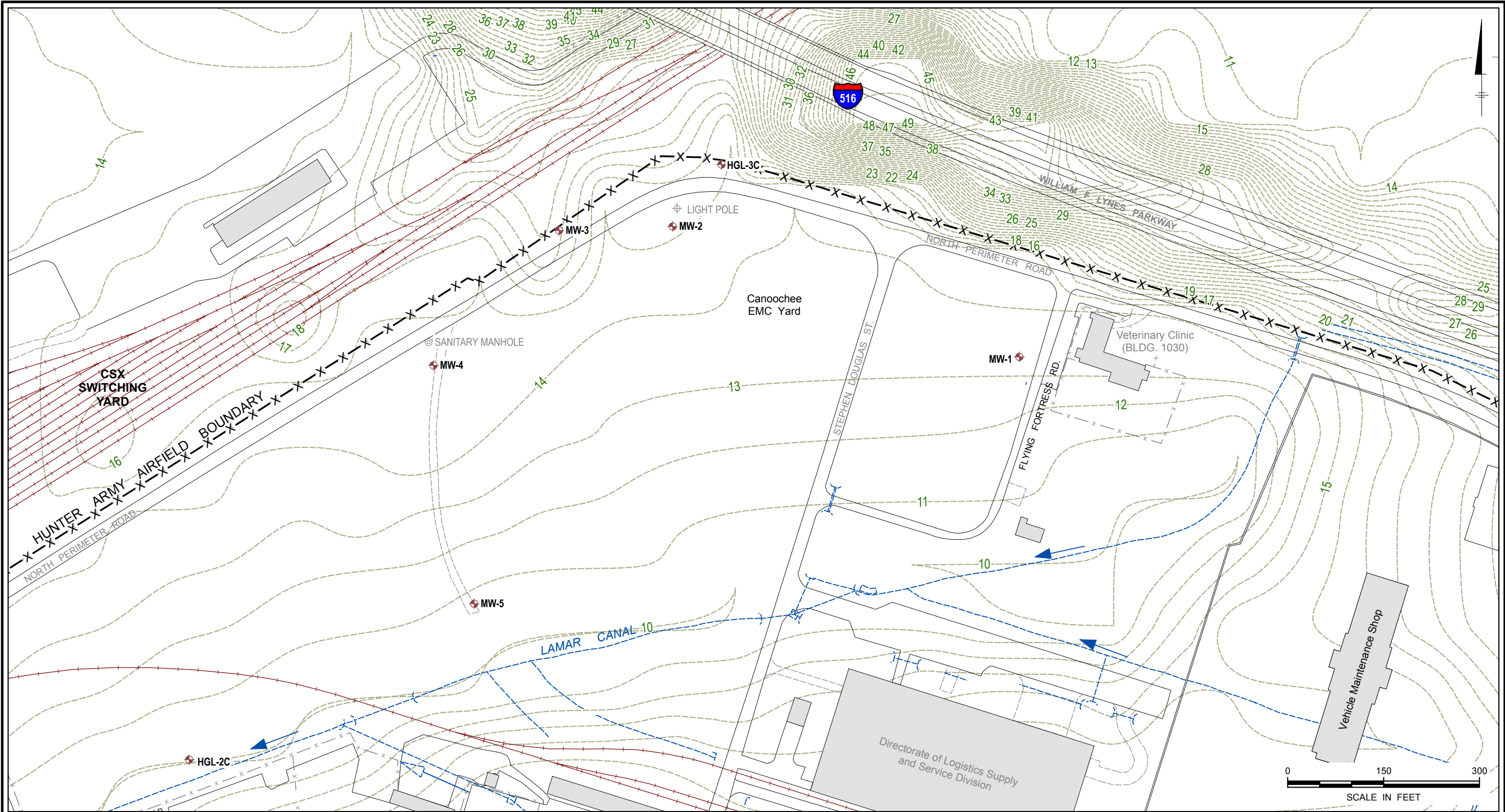


FIGURE
4-7

CITY: KNOXVILLE DIV: GROUP/ENV DB: (R/HOOTMAN) LD: (B/ALTON) PIC: (E/VERTH) PM: (C/BERTZ) TM: (S/POSTAND WILLIS)
G:\GIS\GP08\HAF5\H18\2009 SI\WORK\PLAN5-1 HAA18_WP_XSECA.dwg LAYOUT: B. SAVED: 8/7/2009 2:59 PM ACADVER: 17.1S (LMS TECH) PAGES: 17.1S (LMS TECH) PLOTSETUP: PLT: FULL CTF PLOTTED: 8/7/2009 2:59 PM BY: ALTON, BRENDA



CITY: (KNOXVILLE) DIV: (GROUP: (ENV) DB: (BALTIM) LD: (BALTIM) PIC: (E.WERTH) PM: (C.BERTZ) TM: (S.BOSTIAN/H. ENGLISH)
PROJECT: GP08HAFSH188.DAOWP PATH: G:\GIS\GP08HAFSH18\2009 SITEWORK\PLANF5-2 HAA18_WP_CTR.mxd SAVED: 12SEP2009



LEGEND

- Storm Water System
- Flow Direction
- Topographic Contour Line (ft, msl)
- Monitor Well (deep)

SOURCE: 1-Foot Topographic Contours (SAIC 2008).

REFERENCE:
JAMES M. KEATON SURVEY, DECEMBER 15, 2008.

HUNTER ARMY AIRFIELD, GEORGIA
HAA-18 SITE INVESTIGATION WORK PLAN

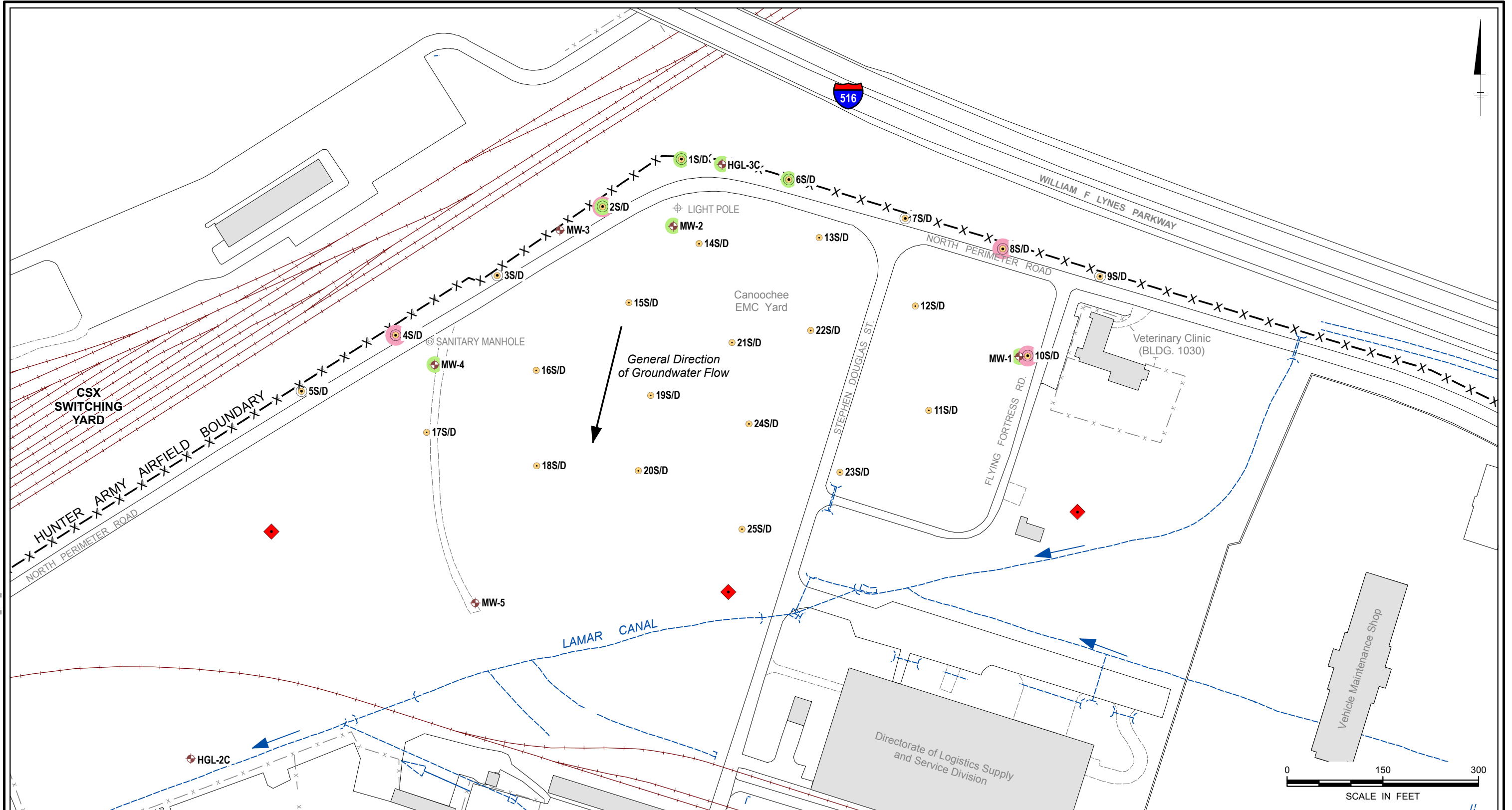
Site Map with Topographic Contours



FIGURE

5-2

CITY: KNOXVILLE DIV/GRP: (ENV) DB: (BAL) PIC: (E.WERTH) PM: (C.BERTZ) TM: (S.BOSTIAN/H. ENGLISH)
PROJECT: GP08HAFSH188.DAOWP PATH: G:\GIS\GP08HAFSH182009 SITEWORK\PLAN\Fig-1 HAA18_WP_PROP MW.mxd SAVED: 18SEP2009



LEGEND

- Storm Water System
- Flow Direction
- Monitor Well (deep)
- Direct Push Boring, May 2007
- Surface Soil Sample, August 2007
- Proposed Monitor-Well Pair
- At least one exceedance of Type I Risk Reduction Standard in Shallow Groundwater
- At least one exceedance of Type I Risk Reduction Standard in Deep Groundwater

REFERENCE:
JAMES M. KEATON SURVEY, DECEMBER 15, 2008.

HUNTER ARMY AIRFIELD, GEORGIA
HAA-18 SITE INVESTIGATION WORK PLAN

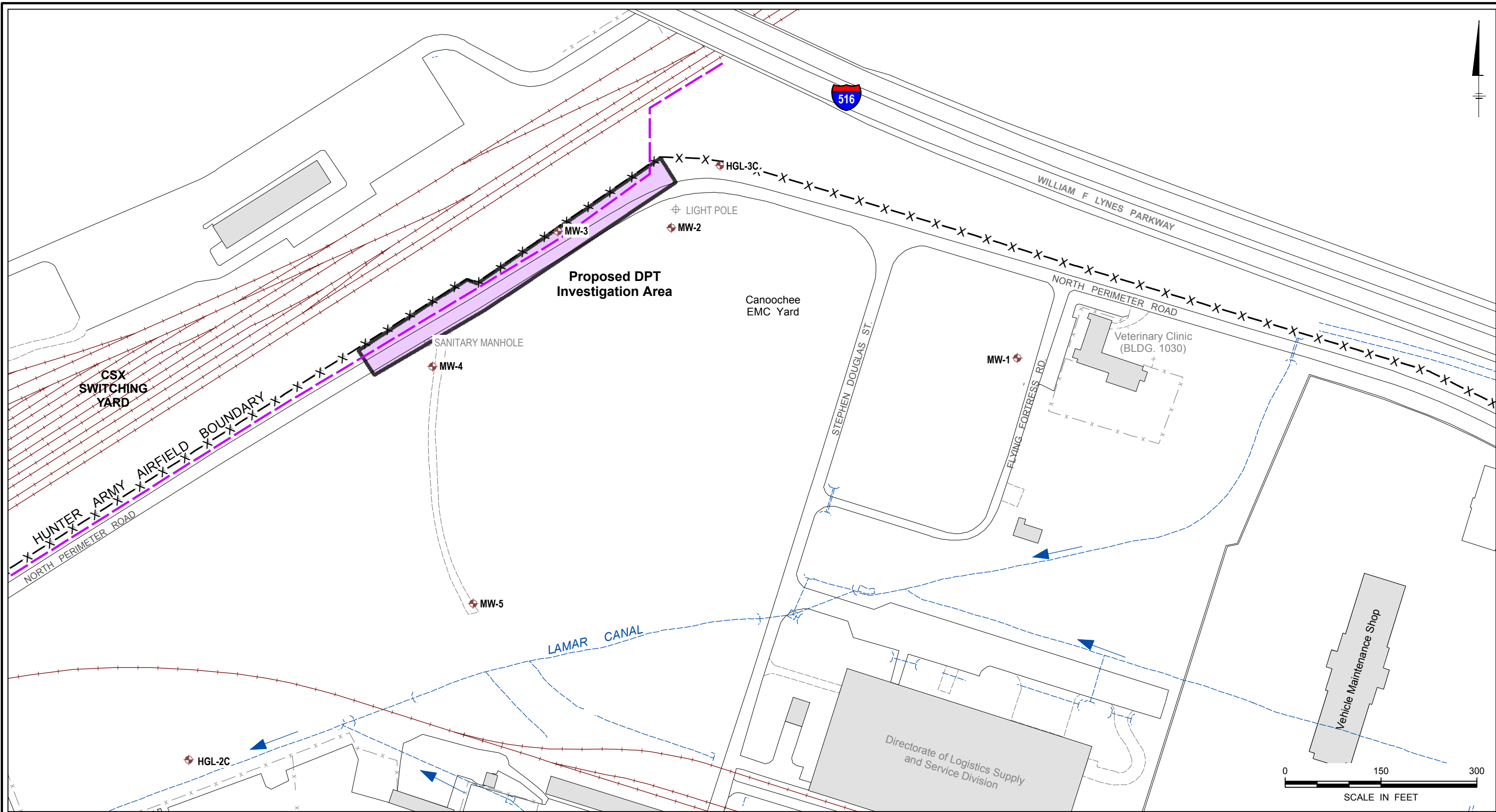
Proposed Monitor Wells



FIGURE

6-1

CITY: (KNOXVILLE) DIV/GRP: (ENV) DB: (BALTO) PIC: (E.WERTH) PM: (C.BERTZ) TM: (S.BOSTIAN/H. ENGLISH)
PROJECT: GP08HAF-SH188.DAOWP PATH: G:\GIS\GP08HAF-SH182009 SI\WORK PLAN\F6-2 HAA18_WP_PropDPT.mxd SAVED: 20CT2009



LEGEND

- Storm Water System
- Flow Direction
- Monitor Well (deep)
- Estimated Location of 6" Pipeline (abandoned in place)
- Proposed DPT Investigation Area

REFERENCES:
1) USACE (2004).
2) JAMES M. KEATON SURVEY (DECEMBER 15, 2008).

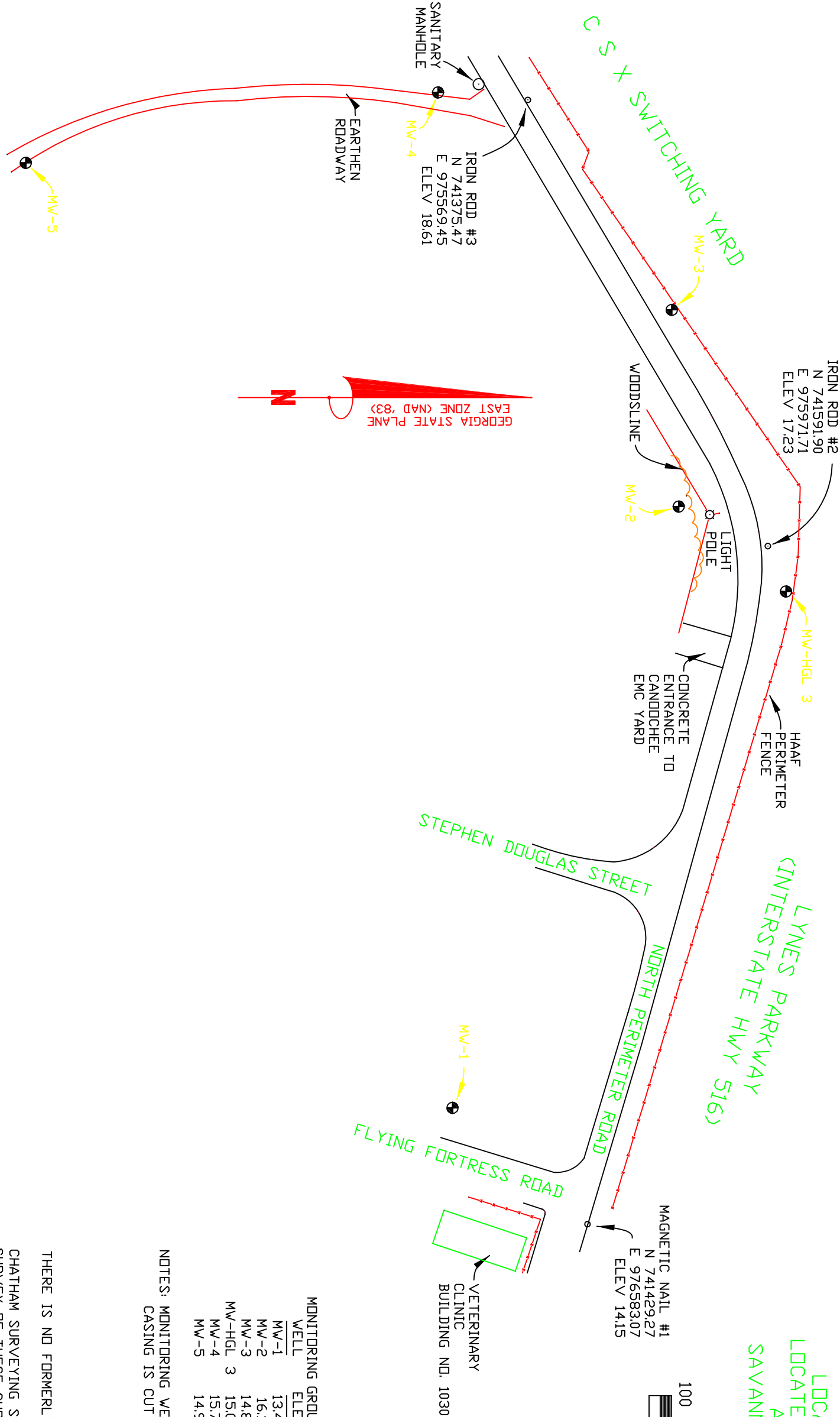
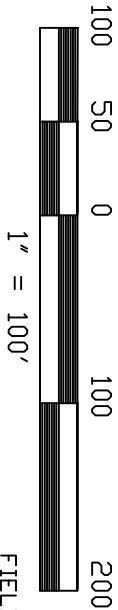
HUNTER ARMY AIRFIELD, GEORGIA HAA-18 SITE INVESTIGATION WORK PLAN	
Proposed DPT Investigation Area	
	FIGURE 6-2

Appendix A

Professional Survey Report

LOCATION OF MONITORING WELLS
LOCATED NEAR NORTH PERIMETER ROAD
AT HUNTER ARMY AIRFIELD
SAVANNAH, CHATHAM COUNTY, GEORGIA
FOR
ARCADIS USA, INC.

FIELD AS-BUILT:
DECEMBER 12, 2008
DATE OF DRAWING:
DECEMBER 15, 2008



MONITORING WELL	GROUND ELEV.	PAD ELEV.	LID ELEV.	TOP OF CASING	NORTHING COORDINATE	EASTING COORDINATE
MW-1	13.43	N-A	13.53	13.31	741307.62	976478.18
MW-2	16.11	N-A	16.21	15.90	741511.53	975936.10
MW-3	14.86	N-A	14.96	14.62	741505.30	975758.78
MW-HGL 3	15.09	N-A	15.09	14.49	741608.26	976012.63
MW-4	15.75	N-A	15.76	15.65	741294.55	975562.77
MW-5	14.96	N-A	14.91	14.70	740922.90	975626.24

NOTES: MONITORING WELL #4 DOES NOT HAVE A CAP ON THE CASING.
CASING IS CUT TO HIGH TO ALLOW CAP TO FIT UNDER LID.

THERE IS NO FORMERLY DELINEATED PARCEL EXISTING FOR THIS SITE.

CHATHAM SURVEYING SERVICES, INC. HAS PERFORMED A LOCATION SURVEY OF THESE SHOWN WELLS. THE ADJACENT PAVEMENT, FENCE, AND UTILITIES ARE SHOWN FOR ORIENTATION ONLY. THE ADDITION OF ANY OTHER FEATURES ON THIS DRAWING IS BY OTHERS.

REFERENCES: DATA SHEET FOR CHATHAM COUNTY DISK C-37

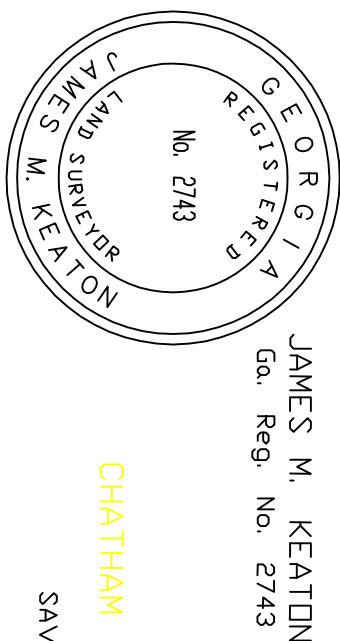
SHOWN HORIZONTAL COORDINATES ARE GEORGIA STATE PLANE (NAD '83) AND ARE BASED ON CHATHAM COUNTY DISK C-37.
SAID COORDINATES WERE TRANSFERRED TO THE SITE BY GPS.

WELL COORDINATES ARE BASED ON SAME SAID HORIZONTAL DATUM.

ELEVATIONS ARE NAVD 1988. ELEVATIONS BASED ON SAME AFORESAID DISK AND GPS SESSION.

ELEVATIONS CAN BE CONVERTED TO NGVD 1929 BY ADDING A FACTOR OF 0.94' TO THE NAVD 1988 VALUES.

EQUIPMENT USED: SOKKIA SET 4110 TOTAL STATION
SOKKIA STRATUS LI GPS RECEIVER SYSTEM.
SOKKIA C320 AUTOMATIC LEVEL.



JAMES M. KEATON
Ga. Reg. No. 2743

CHATHAM SURVEYING SERVICES, INC.

P.O. BOX 61649
SAVANNAH, GEORGIA 31420
912-303-0302

Appendix B

Boring Profile and Well Construction
Details



Borehole ID: HGL2 (GW046)

Project No: OMA009-001-02-02-03

Project: Monitoring Well Installation

Client: USACE

Location: MCA Barracks - Hunter AAF

Northing(ft): 740673.98

Date: 3/1/2006

Geologist: M. Jackson

Checked By: P. Dacyk

Ground Surface Elevation(ft msl): 12.88

Easting(ft): 975182.18

SUBSURFACE PROFILE					SAMPLE			Water Level	Remarks
Depth	Symbol	Description	USCS	Elevation	Recovery %	Blow Counts	PID (ppm)		
2					N/A				Topsoil
4				9					
6		Silty Sand Light olive gray (5Y 6/1), very moist, 80% medium sand, 20% silt at 5' wet	SM	7	100%	1-2-4-2	1.1		
8		Well Graded Sand Light olive gray (5Y 6/1), wet, 95% medium to fine sand			100%	1-2-4-6	3.2		
10		at 10' brown organic zones - appear to be wood fibers	SW		100%	4-3-5-5	6.3		
12					100%	2-3-6-12	6.3		
14		Silty Sand	SM	0	100%	1-2-3-6	9.7		
16		Poorly Graded Sand Light olive gray (5Y 6/1), wet, well sorted, coarse sand at 14' coarsening downwards to very coarse	SP	-3	100%	3-5-6-5	8.8		
18		Well Graded Sand Light olive gray (5Y 6/1), wet, coarse to medium sand with silty zoness	SW	-4	100%	3-5-6-8	9.6		
20		Silty Sand Medium gray (N5), wet, 80% medium to fine sand, 20% silt	SM	-7	100%	5-7-9-6	9.6		

Drilled By: SAEDACCO

Drill Method: 4.25" HSA

Drilling Equipment: Mobile

Sampling Equipment: 2' split spoon, 2" diameter (Driven by 140 lb. hammer with 30" drop)

HGL
Northway 10 Executive Park
313 Ushers Road
Ballston Lake, NY 12019

Boring Diameter: 8.5"

Total Depth Drilled: 44'

Sheet 1 of 3



Borehole ID: HGL2 (GW046)

Project No: OMA009-001-02-02-03

Project: Monitoring Well Installation

Client: USACE

Location: MCA Barracks - Hunter AAF

Northing(ft): 740673.98

Date: 3/1/2006

Geologist: M. Jackson

Checked By: P. Dacyk

Ground Surface Elevation(ft msl): 12.88

Easting(ft): 975182.18

SUBSURFACE PROFILE					SAMPLE			Water Level	Remarks
Depth	Symbol	Description	USCS	Elevation	Recovery %	Blow Counts	PID (ppm)		
22		at 20' coarse to medium sand grading to a fine sand with 15% silt at 21.5' medium bluish gray (5B 5/1)	SM	-9	100%	7-6-6-7	9.5		
24		Clayey Silt Medium gray (N5), very moist to wet, slightly plastic, soft, 55% silt, 45% clay	ML	-12	50%	5-4-5-11	6.7		
26		Poorly Graded Sand Medium bluish gray (5B 5/1), wet, slightly dense, fine sand with little silt (<5%)	SP	-13	40%	4-3-7-11	4.1		
28		Silty Sand Medium bluish gray (5B 5/1), wet, slightly dense, coarse sand with 15% silt	SM		50%	4-4-4-5	4.8		
30					40%	4-3-5-4	5.7		
32		at 30' to 32' clayey silt lenses (0.5" thick), trace gravel (subround, 0.125" x 0.125")			95%	4-3-5-4	4.2		
34					90%	12-24-27-29	5.7		
36		at 34' to 36', minor clayey silt lenses			50%	7-10-10-10	4.8		
38				-25	70%	6-13-16-12	6.9		
40		Clayey Silt with Sand No recovery	ML						
			SP	-27	NR	6-9-9-7	NR		

Drilled By: SAEDACCO

Drill Method: 4.25" HSA

Drilling Equipment: Mobile

Sampling Equipment: 2' split spoon, 2" diameter (Driven by 140 lb. hammer with 30" drop)

HGL
Northway 10 Executive Park
313 Ushers Road
Ballston Lake, NY 12019

Boring Diameter: 8.5"

Total Depth Drilled: 44'

Sheet 2 of 3



Borehole ID: HGL2 (GW046)

Project No: OMA009-001-02-02-03

Project: Monitoring Well Installation

Client: USACE

Location: MCA Barracks - Hunter AAF

Northing(ft): 740673.98

Date: 3/1/2006

Geologist: M. Jackson

Checked By: P. Dacyk

Ground Surface Elevation(ft msl): 12.88

Easting(ft): 975182.18

SUBSURFACE PROFILE					SAMPLE		Water Level	Remarks
Depth	Symbol	Description	USCS	Elevation	Recovery %	Blow Counts	PID (ppm)	
42		Poorly Graded Sand Light olive gray (5YR 6/1), wet, slightly dense, medium sand with little silt (<5%) at 42' clayey silt lenses	SP	-30	95	6-7-9-8	5.6	Bottom of borehole at 44'. Soil sampled to depth with 4.25" augers. Installed nested wells with 8.25" augers.
44		Clayey Silt Dark greenish gray (5GY 4/1), moist, slightly stiff to slightly soft, slightly plastic, 50% clay, 50% silt	ML	-31	85	—	6.9	
46								1130 Scan soil samples with PID. High moisture in bags (sweaty).
48								
50								
52								
54								
56								
58								
60								

Drilled By: SAEDACCO

Drill Method: 4.25" HSA

Drilling Equipment: Mobile

Sampling Equipment: 2' split spoon, 2" diameter (Driven by 140 lb. hammer with 30" drop)

HGL
Northway 10 Executive Park
313 Ushers Road
Ballston Lake, NY 12019

Boring Diameter: 8.5"

Total Depth Drilled: 44'

Sheet 3 of 3



Borehole ID: HGL-3

Project No: OMA009-001-02-02-03

Project: Monitoring Well Installation

Client: USACE

Location: MCA Barracks - Hunter AAF

Northing(ft): 741606.43

Date: 3-8-2006

Geologist: M. Jackson

Checked By: P. Dacyk

Ground Surface Elevation(ft msl): 14.45

Easting(ft): 976012.78

SUBSURFACE PROFILE					SAMPLE			Water Level	Remarks
Depth	Symbol	Description	USCS	Elevation	Recovery %	Blow Counts	PID (ppm)		
2		Silty Sand Dark yellowish brown, moist, 70% very fine sand, 30% silt	SM		N/A				
4		Silty Clay with Sand Light olive gray (5Y 6/1) with dark yellowish orange (10YR 6/6) and grayish blue green (5BG 5/2) mottling, wet, stiff, 50% clay, 45% silt, 5% sand	CL	10	95	2-3-3-12	4.2		Appears to be HC staining in 4' to 5.5' soil sample
6		Poorly Graded Sand Pale yellowish brown (10YR 6/2), wet, fine sand	SP	9	95	10-8-6-5	1.6		
8		at 6' - 6.5' and 7.75' - 8' silty clay zones (same as 4' - 5.5')	ML	6	95	1-1-2-6	8.6		
10		Clayey Silt Dusky yellowish green (5GY 5/2), wet, soft, moderately plastic, 60% silt, 40% clay		5	95	2-2-6-7	5.1		
12		Poorly Graded Sand Dusky yellowish green (5GY 5/2), wet, loose, 100% fine sand	SP		95	3-4-4-4	2.7		
14		at 9.75' light gray (N7) at 11' medium gray (N5), minor 0.125" silty clay lense		0					
16		Clayey Silty Sand Dark greenish gray (5GY 4/1), wet, soft, 55% fine sand, 30% silt, 15% clay	SM	-1	90	8-10-13-12	2.7		
18		Poorly Graded Sand Medium light gray (N6)	SP	-2	80	10-20-32-35	3.6		
20		Clayey Silty Sand Dark greenish gray (5GY 4/1)	SM	-3					
		Poorly Graded Sand	SP	-4					
		Poorly Graded Sand	SM	-5	90	11-13-12-12	7.6		
		Silty Sand	SP	-6					

Drilled By: SAEDACCO

Drill Method: 2.25" HSA

Drilling Equipment: GP1100E

Sampling Equipment: 2' split spoon, 2" diameter (Driven by 140 lb. hammer with 30" drop)

HGL
Northway 10 Executive Park
313 Ushers Road
Ballston Lake, NY 12019

Boring Diameter: 4.375"

Total Depth Drilled: 40'

Sheet 1 of 2



Borehole ID: HGL-3

Project No: OMA009-001-02-02-03

Project: Monitoring Well Installation

Client: USACE

Location: MCA Barracks - Hunter AAF

Northing(ft): 741606.43

Date: 3-8-2006

Geologist: M. Jackson

Checked By: P. Dacyk

Ground Surface Elevation(ft msl): 14.45

Easting(ft): 976012.78

SUBSURFACE PROFILE					SAMPLE			Water Level	Remarks
Depth	Symbol	Description	USCS	Elevation	Recovery %	Blow Counts	PID (ppm)		
22		Poorly Graded Sand Silty Sand with Clayey Silt/Silty clay Medium gray (N5)				13-13-20-20	6.8		Due to heaving sand stop split spoon sampling at 24'. Begin logging cuttings from augers 20 - 25 Auger = Medium gray (N5), wet, clasts of clayey silt/silty clay (50% silt / 50% clay) in a silty sand matrix 25 - 30 Auger = Same as 20 -25 Auger 30 - 35 Auger = Medium gray (N5), wet, clayey silt/silty clay with sand (10%) and gravel (10%), (40% clay, 40% silt) 35 - 40 Auger = Same as 30 - 35 Auger Drill first with 2.25" augers to collect soil samples. Install wells by drilling with 6.625" augers.
24						4-4-6-17			
26							6.8		
28							6.8		
30		Clayey Silt/Silty Clay with Sand	N/A	-16	N/A		9.7		
32									
34							7.2		
36									
38									
40				-26					

Drilled By: SAEDACCO

Drill Method: 2.25" HSA

Drilling Equipment: GP1100E

Sampling Equipment: 2' split spoon, 2" diameter (Driven by 140 lb. hammer with 30" drop)

HGL
Northway 10 Executive Park
313 Ushers Road
Ballston Lake, NY 12019

Boring Diameter: 4.375"

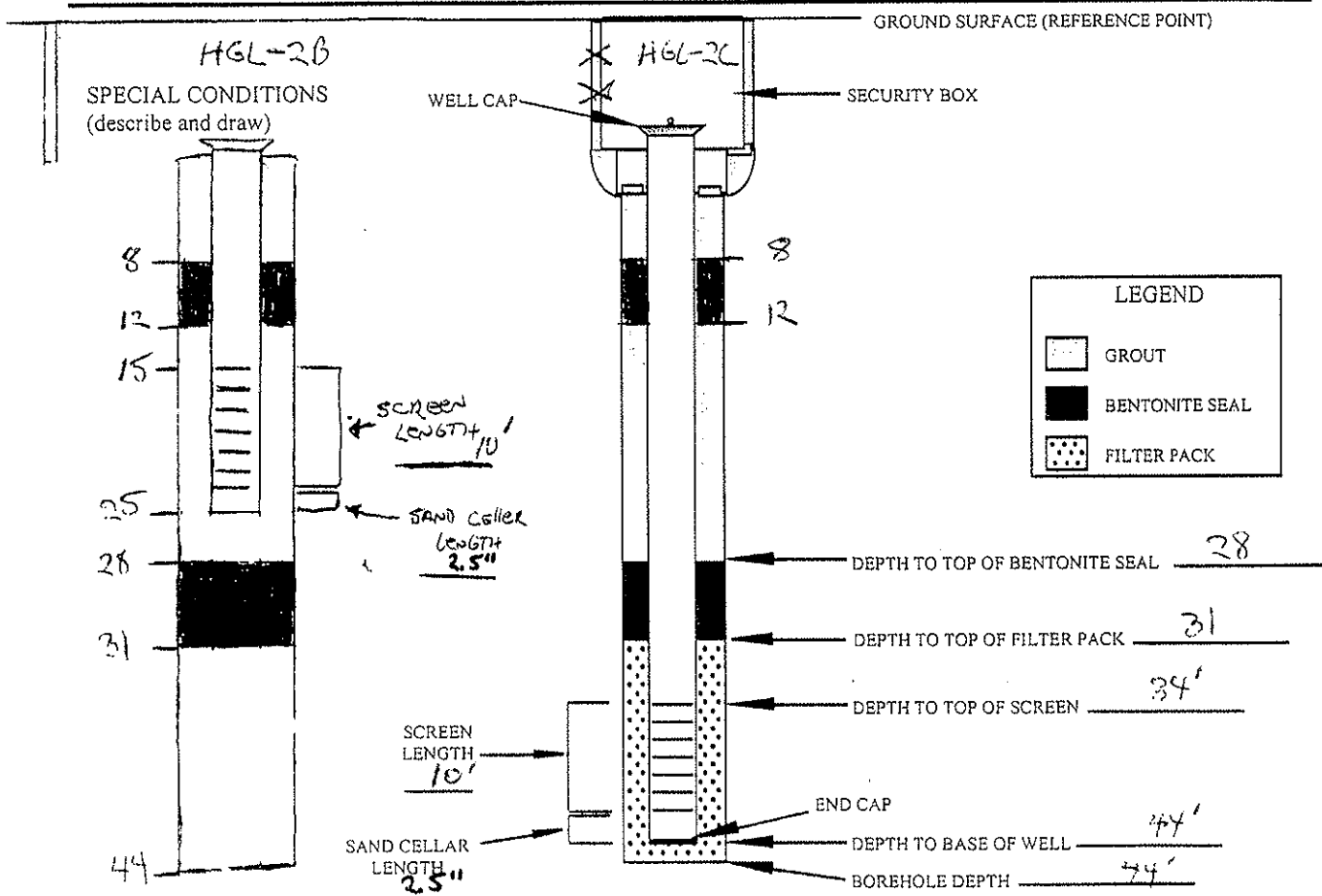
Total Depth Drilled: 40'

Sheet 2 of 2

WELL CONSTRUCTION DETAILS AND ABANDONMENT FORM

FIELD REPRESENTATIVE: M. Jackson

DIMENSIONS OF SECURITY BOX: _____

DRILLING CONTRACTOR: SAEDACCOTYPE OF FILTER PACK: FILTER
#2 SANDDRILLING TECHNIQUE: HSAGRADIATION: #2AUGER SIZE AND TYPE: HSA 8 1/4AMOUNT OF FILTER PACK USED: 21 BAGS (50 # BAGS)BOREHOLE IDENTIFICATION: HGL-2TYPE OF CEMENT: PORTLAND CEMENT TYPE I/IIBOREHOLE DIAMETER: 13.75"AMOUNT CEMENT USED: 3 BAGSWELL IDENTIFICATION: HGL-2B, HGL-2CGROUT MATERIALS USED: 20:1 PORTLAND-BENTONITE GELWELL CONSTRUCTION START DATE: 3/1/06TYPE OF BENTONITE: HOLE PLUGWELL CONSTRUCTION FINISH DATE: 3/1/06AMOUNT BENTONITE USED: 2 BAGSSCREEN MATERIAL: Schedule 40 PVCTYPE OF WELL CAP: 2" EXPANDABLESCREEN DIAMETER: 2"TYPE OF END CAP: PVC SLIP CAP
ThreadedSTRATUM-SCREENED INTERVAL (FT): 15-25, 34-44SCREEN SLOT SIZE: 0.010COMMENTS: LOG LITHOLOGY WITH
4 1/4" augers. In small, nested wells
with 8 1/4" augers.CASING MATERIAL: Schedule 40 PVCCASING DIAMETER: 2"

NOT TO SCALE

INSTALLED BY: MICHAEL WILSONINSTALLATION OBSERVED BY: MIKE JACKSON

DISCREPANCIES: _____

PROJECT NAME: MCA BARRACKS - RENTER AAF PROJECT #: CMAC09-001-02-02-03

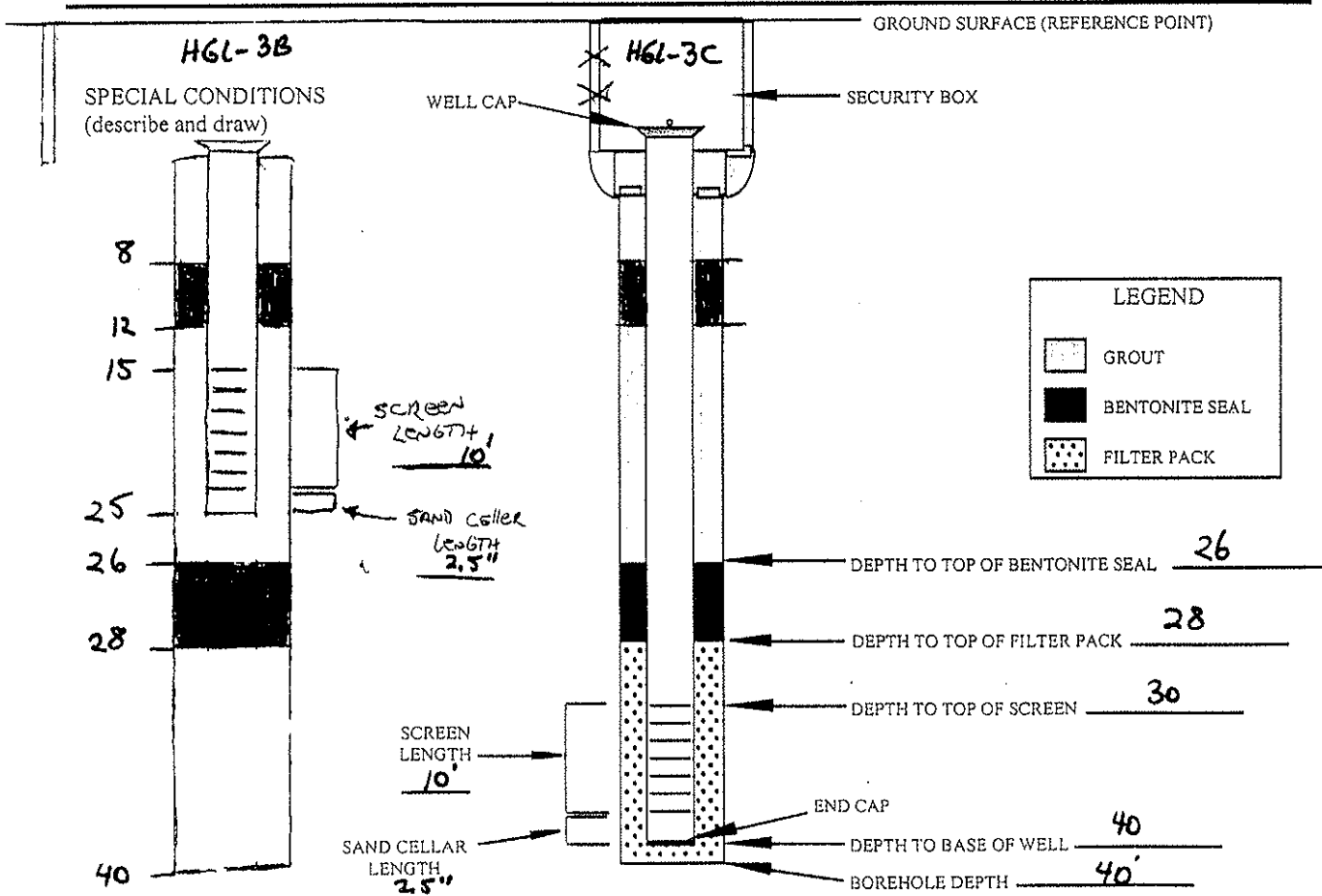
HGL-2B → 9 BAGS SAND, 1 BAG BENTONITE HOLE PLUG

HGL-2C → 12 BAGS OF SAND, 1 BAG BENTONITE HOLE PLUG

WELL CONSTRUCTION DETAILS AND ABANDONMENT FORM

FIELD REPRESENTATIVE: M. Jackson

DIMENSIONS OF SECURITY BOX: _____

DRILLING CONTRACTOR: SAEDACCOTYPE OF FILTER PACK: FILTER #2 SANDDRILLING TECHNIQUE: HSAGRADIATION: #2AUGER SIZE AND TYPE: 6 7/8" HSAAMOUNT OF FILTER PACK USED: 23 BAGS (50 lb bags)BOREHOLE IDENTIFICATION: HGL-3 (GW76)TYPE OF CEMENT: PORTLAND CEMENT TYPE I/IIBOREHOLE DIAMETER: 11"AMOUNT CEMENT USED: 2 BAGSWELL IDENTIFICATION: HGL-3B, HGL3CGROUT MATERIALS USED: 20:1 PORTLAND-BENTONITE GELWELL CONSTRUCTION START DATE: 3/8/06TYPE OF BENTONITE: 3/8" SHARREL BENTONITE PELLETS/HOLE PLUGWELL CONSTRUCTION FINISH DATE: 3/8/06AMOUNT BENTONITE USED: 1/2 Bucket Pellets / 2 BAGS HOLE PLUGSCREEN MATERIAL: Schedule 40 PVCTYPE OF WELL CAP: 2" EXPANDABLE CAPSCREEN DIAMETER: 2"TYPE OF END CAP: PVC 5/8" CAPSTRATUM-SCREENED INTERVAL (FT): 15'-25', 30'-40'SCREEN SLOT SIZE: 0.010COMMENTS: Log LITHOLOGY WITH 2 1/4 AUGERS. Install wells WITH 6 5/8" AUGERSCASING MATERIAL: Schedule 40 PVCCASING DIAMETER: 2"INSTALLED BY: ROBERT MILLERINSTALLATION OBSERVED BY: MIKE JACKSON

DISCREPANCIES:

PROJECT NAME: MCA BARRACKS - HUNTER AAF PROJECT #: OMA009-001-02-02-03

HGL-3B → 11 BAGS OF SAND, 2 BAGS BENTONITE HOLE PLUG

HGL-3C → 12 BAGS OF SAND, 1/2 BUCKET BENTONITE PELLETS

Appendix C

Vertical Groundwater Elevations from
HAA-15 Work Plan

Appendix C
Groundwater Elevations At Well Pairs
HAA-15 (MCA Barracks Site)
Hunter Army Airfield - Savannah, Georgia

Well Identification	Total Well Depth (ft bgs)	Screened Interval (ft bgs)	Top of Casing Elevation (ft AMSL)	Date of Water Level Measurement	Depth to Water (ft BTOC)	March 2006 Water Level Elevation (ft AMSL)
HGL-1B	25	15-25	21.50	3/11/06	4.22	17.28
HGL-1C	40	30-40	21.48	3/11/06	9.9	11.58
HGL-2B	25	15-25	12.71	3/11/06	2.85	9.86
HGL-2C	44	34-44	12.75	3/12/06	2.52	10.23
HGL-3B	25	15-25	14.01	3/16/06	2.48	11.53
HGL-3C	40	30-40	13.93	3/16/06	2.56	11.37
HGL-4B	25	15-25	21.50	3/17/06	5.58	15.92
HGL-4C	40	30-40	21.47	3/17/06	5.58	15.89
HGL-5B	24	14-24	28.69	3/14/06	2.26	26.43
HGL-5C	39	29-39	28.71	3/14/06	2.33	26.38
HGL-6B	25	15-25	35.74	3/17/06	7.73	28.01
HGL-6C	40	30-40	35.55	3/17/06	8.95	26.60
HGL-7B	25	15-25	33.64	3/15/06	7.85	25.79
HGL-7C	44	34-44	33.64	3/15/06	11.59	22.05
HGL-8B	23.5	13.5-23.5	25.91	3/16/06	3.89	22.02
HGL-8C	44	34-44	25.93	3/16/06	9.94	15.99
HGL-9B	24	14-24	33.97	3/13/06	6.63	27.34
HGL-9C	39	29-39	33.89	3/13/06	6.85	27.04
HGL-10B	25	15-25	23.39	3/12/06	3.96	19.43
HGL-10C	40	30-40	23.39	3/17/08	3.96	19.43
HGL-11B	25	15-25	36.37	3/14/06	8.15	28.22
HGL-11C	40	30-40	36.39	3/14/06	8.21	28.18

Notes:

ft bgs - feet below ground surface

ft AMSL - feet above mean sea level

ft BTOC - feet below top of casing