FORSCOM

FIFTH SEMIANNUAL MONITORING EVENT

3d Inf Div (Mech)

Facility ID #9-089036 (USTs 208 & 209)
Building 275
Fort Stewart, Georgia

Submitted to

Fort Stewart/Directorate of Public Works
Environmental and Natural Resources Division
Environmental Branch

Prepared by

U.S. Army Corps of Engineers
Savannah District

NOVEMBER 2005

FIFTH SEMIANNUAL MONITORING EVENT
FOR
UNDERGROUND STORAGE TANKS 208 & 209
FACILITY ID #9-089036
BUILDING 275
FORT STEWART, GEORGIA

Prepared for:

Fort Stewart Directorate of Public Works

Prepared by:

U.S. Army Corps of Engineers - Savannah District

November 2005

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List of Abbreviations and Acronyms

ACL	alternate concentration limit
AMSL	above mean sea level
BGS	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
BTOC	below top of casing
CAP	Corrective Action Plan
DAF	dilution attenuation factor
GA EPD	Georgia Environmental Protection Division
IWQS	In-stream Water Quality Standards
ND	not detected
NFAR	no further action required
NRC	no regulatory criteria
PAH	polynuclear aromatic hydrocarbon
SAIC	Science Applications International Corporation
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
USTMP	Underground Storage Tank Management Program

MONITORING ONLY REPORT

Submittal Date: September 2005 Monitoring Report Number: 5th Semiannual Event

For Period Covering: January 2005 to January 2006

Facility Name: USTs 208 & 209, Building 275 Street Address: Bultman Avenue & E. 4th Street

Facility ID: 9-089036 City: Fort Stewart County: Liberty Zip Code: 31314

Latitude: 31° 51′ 44″ Longitude: 81° 05′ 45″

Submitted by UST Owner/Operator:		Prepared by:	
Name:	Thomas C. Fry/ Environmental Branch	Name:	Z. Haverland
Company:	U.S. Army/HQ 3d, Inf. Div (Mech)	Company:	USACE-Savannah
Address:	Directorate of Public Works, Bldg. 1137 1550 Frank Cochran Drive	Address:	100 W. Oglethorpe Ave
City:	Fort Stewart State: GA	City:	Savannah State: GA
Zip Code:	31314-4927	Zip Code:	31402
Telephone:	(912) 767-2010	Telephone:	(912) 652-5200

I. REGISTERED PROFESSIONAL ENGINEER OR PROFESSIONAL GEOLOGIST CERTIFICATION

I hereby certify that I have directed and supervised the field work and preparation of this plan, in accordance with State Rules and Regulations. As a registered professional geologist and/or professional engineer, I certify that I am a qualified ground-water professional, as defined by the Georgia State Board of Professional Geologists. All of the information and laboratory data in this plan and in all of the attachments are true, accurate, complete, and in accordance with applicable State Rules and Regulations.

Name: Anna Butler

Signature: Anna Butler

Date: 11/8/05

ANNA H. BUTLER
No. 1227

II. PROJECT SUMMARY

(Appendix I, Figure 1: Site Location Map)

Provide a brief description or explanation of the site and a brief chronology of environmental events leading up to this report.

Former USTs 208 & 209, Facility ID #9-089036, were located near Building 275 at Fort Stewart, Georgia. UST 208 was used to store gasoline, and UST 209 was used to store diesel. Both USTs were removed from the site in 1995. SAIC performed a CAP-Part A investigation in 1996 and a CAP-Part B investigation in 1997 to determine the extent of petroleum contamination at the site. Four monitoring wells and five soil borings were installed during these investigations. The CAP-Part B Report (SAIC 1998a) recommended semiannual monitoring of three of the four monitoring wells: 42-05, 42-07, and 42-08. Based on comments received from GA EPD, USTMP on the CAP-Part B report, three additional monitoring wells were installed. The additional analytical data were presented in the First Annual Monitoring Only Report (SAIC 1999a), which was submitted to GA EPD USTMP in May 1999 and is pending review. In addition, it was recommended that the semiannual monitoring be revised to include wells 42-05, 42-07, 42-11, and 42-12. Based on analytical results collected during the third semiannual sampling event (July 1999), Fort Stewart added monitoring well 42-10 to the monitoring program beginning in January 2000.

As part of the Second Annual Monitoring Only Report, the fate and transport modeling was revised to reflect a continuous source of contamination based on the benzene concentrations observed during the semiannual monitoring events. The revised fate and transport modeling results are summarized in Attachment A of the Second Annual Monitoring Only Report.

The purpose of the fourth semiannual monitoring was to confirm the results of the fate and transport modeling and that natural attenuation was taking place at the site. The measured benzene concentrations have been below the benzene ACL for the last four semiannual sampling events (i.e., since June 1998.

This fifth semiannual sampling event was initiated to verify status of the ground-water quality conditions at the site. The results of this event, four years after the previous sampling indicate similar levels of dissolved benzene in well 42-10, however, free product was observed in well 42-07, within the former tank pit. A ground-water sample was not collected from well 42-07, however, free product thickness measured 0.6 feet.

III. ACTIVITIES AND ASSESSMENT OF EXISTING CONDITIONS

A. Potentiometric Data:

(Appendix I, Figure 2a and 2b: Potentiometric Surface Maps)
(Appendix II, Table 1: Groundwater Elevations)

Discuss groundwater flow at this site and implications for this project.

During the third semiannual sampling event in July 1999, ground-water elevations were measured in all existing monitoring wells to determine the ground-water flow direction. However, ground-water elevations were measured again in August due to a 100-yr rain event that preceded the July 1999 sampling event. In August 1999, the ground-water flow direction was towards the east and the ground-water gradient was approximately 0.0025 ft/ft.

During the fourth semiannual sampling event in January 2000, ground-water elevations were measured in all existing monitoring wells to determine the ground-water flow direction. In January 2000, the ground-water flow direction was towards the northeast and the ground-water gradient was approximately 0.0015 ft/ft.

During the fifth semiannual sampling event in July 2005, ground-water elevations were measured in all of the monitoring wells to determine the ground-water flow direction. In July 2005, the ground-water flow direction was toward the northeast, and the ground-water gradient was approximately 0.0072 ft/ft.

B. **Analytical Data:**

(Appendix I, Figure 3a and 3b: Groundwater Quality Maps)
(Appendix I, Figure 4: Trend of Contaminant Concentrations)
(Appendix II, Table 2, Groundwater Analysis Results)
(Appendix III, Laboratory Analysis Results)

Discuss groundwater analysis results, trend of contaminant concentrations, and implications for this project.
During the third semiannual sampling event in July 1999, monitoring wells 42-05, 42-07, 42-11, and 42-12 were sampled for BTEX. Analytical results from the third sampling event showed estimated concentrations below the analytical reporting limits or no detectable BTEX concentrations in wells 42-05 and 42-12. BTEX compounds were present in wells 42-07 and 42-11. However, benzene was the only constituent to exceed its IWQS and was detected at 242 µg/L in well 42-07 and 3.4 µg/L in well 42-11. The benzene concentration in well 42-07, located in the former tank pit, decreased from the previous sampling event in January 1999. The benzene concentrations in 42-07 and 42-11 were below the ACL of 556 µg/L during this event.

During the fourth semiannual sampling event in January 2000, monitoring wells 42-05, 42-07, 42-10, 42-11, and 42-12 were sampled for BTEX. Analytical results from the fourth sampling event showed no detectable BTEX concentrations in wells 42-05 and 42-12. BTEX compounds were present in wells 42-07, 42-10, and 42-11. However, benzene was the only constituent to exceed its IWQS and was detected at 183 µg/L in well 42-07, 39 µg/L in well 42-10, and 1.0 µg/L in well 42-11. The benzene concentration in well 42-07, located in the former tank pit, decreased from the previous sampling event in July 1999. The benzene concentrations in 42-07, 42-10, and 42-11 were below the ACL of 556 µg/L during this event.

During the fifth semiannual sampling event in July 2005, monitoring wells 42-05, 42-07, 42-10, 42-11, and 42-12 were sampled for BTEX. Analytical results showed no detectable BTEX concentrations in wells 42-05 and 42-12. BTEX compounds were present in wells 42-10 and 42-11. Free product was encountered in the former tank pit well 42-07 with a measured thickness of 0.6 feet. A ground-water sample was not collected from well 42-07 during this event. The benzene concentrations in the down gradient wells 42-10, and 42-11 remain below the ACL of 556 µg/L. Figure 4 shows the variation in benzene concentrations in ground water for all the wells.

As recommended in the First Annual Monitoring Only Report, PAH analysis was discontinued for the site beginning with the third semiannual sampling event in July 1999.

The closest surface water bodies are a drainage ditch and Peacock Creek located at 700 feet and 7500 feet, respectively, down gradient from the site. Previous and current analytical results indicate that the storm drain is not impacted by benzene in ground water above the IWQS of 71.28 μg/L. Thus, the distance from the nearest contaminant plume to downgradient surface water or utility trenches was considered to be less than or equal to 500 feet in the site ranking form.

IV. SITE RANKING (Note: re-rank site after each monitoring event)

(Appendix IV: Site Ranking Form)

Environmental Site Sensitivity Score:
25,750 (June 1998 – First Semiannual Monitoring Event)
25,750 (Jan. 1999 – Second Semiannual Monitoring Event)
3250 (July 1999 – Third Semiannual Monitoring Event)
3250 (Jan. 2000 – Fourth Semiannual Monitoring Event)
51,000 (July 2005 – Fifth Semiannual Monitoring Event)

V. CONCLUSIONS/RECOMMENDATIONS

Provide justification of no-further-action-required (NFAR) recommendation or briefly discuss future monitoring plans for this site.

Recommended future action will include free product removal at well 42-07 and the monitoring-only program at this site will be continued.

The Monitoring Only plan will be conducted in accordance with Section III.D of the CAP-Part B Report (SAIC 1998a) and approved by GA EPD USTMP in correspondence dated August 15, 1998 (Logan 1998).

VI. REIMBURSEMENT

Attached ______ N/A __X__

(Appendix V: Reimbursement Application)

Fort Stewart is a federally owned facility and has funded the investigation for the former USTs 208 & 209 site, Building 275, Facility ID #9-089036, using Department of Defense Environmental Restoration Account Funds. Application for Georgia Underground Storage Tank Trust Fund reimbursement is not being pursued at this time.

APPENDIX I

REPORT FIGURES

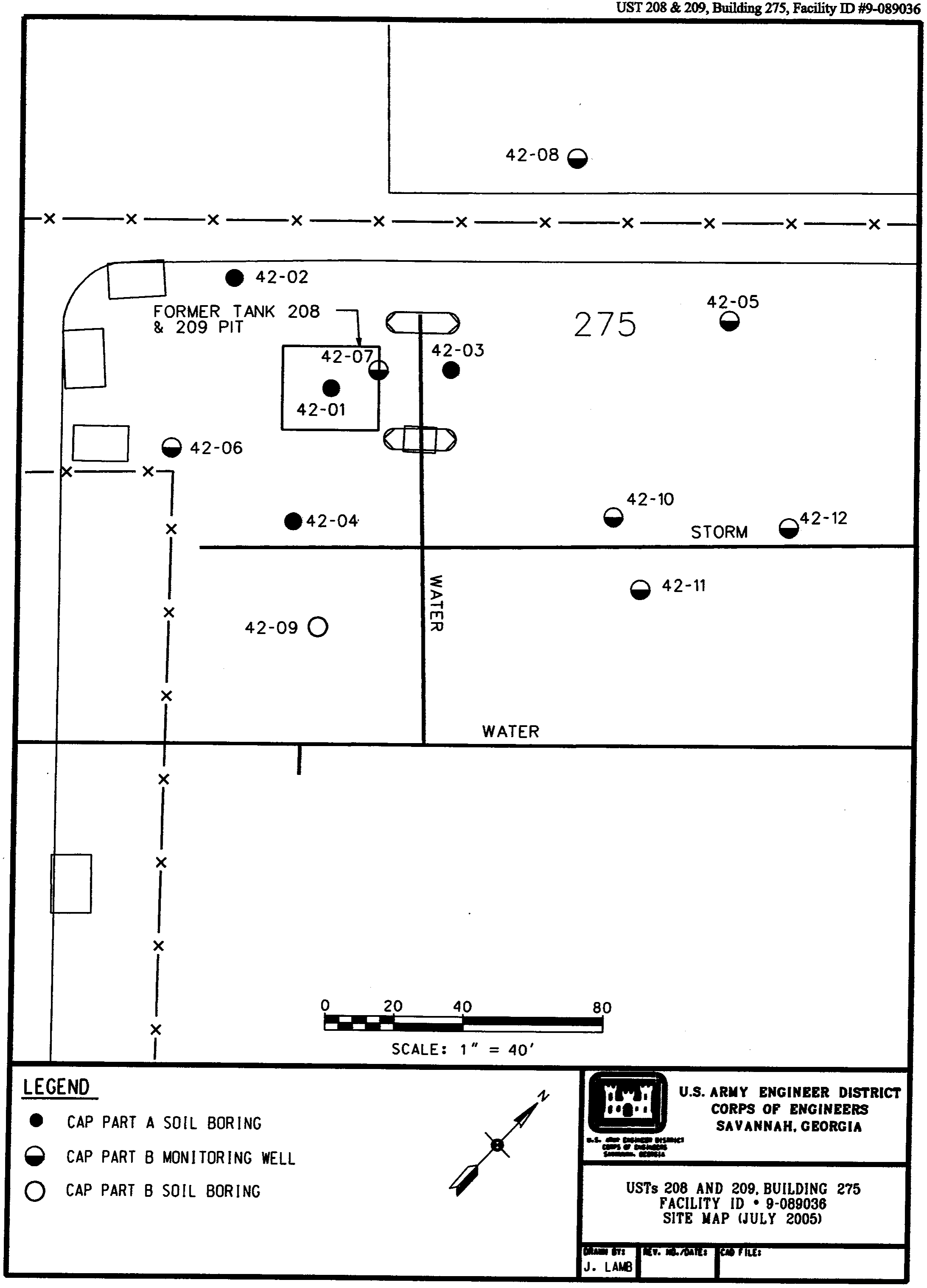

42-08
42-02
FORMER TANK 208
& 209 PIT
42-07
42-01
42-03
275
42-05
42-06
42-04
42-10
STORM
42-12
42-11
42-09
WATER
WATER
0
20
40
80
SCALE: 1" = 40'
LEGEND
● CAP PART A SOIL BORING
◒ CAP PART B MONITORING WELL
○ CAP PART B SOIL BORING
N
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SAVANNAH, GEORGIA
USTs 208 AND 209, BUILDING 275
FACILITY ID • 9-089036
SITE MAP (JULY 2005)
DRAWN BY:
J. LAMB
REV. NO./DATE:
CAD FILE:

Figure 1

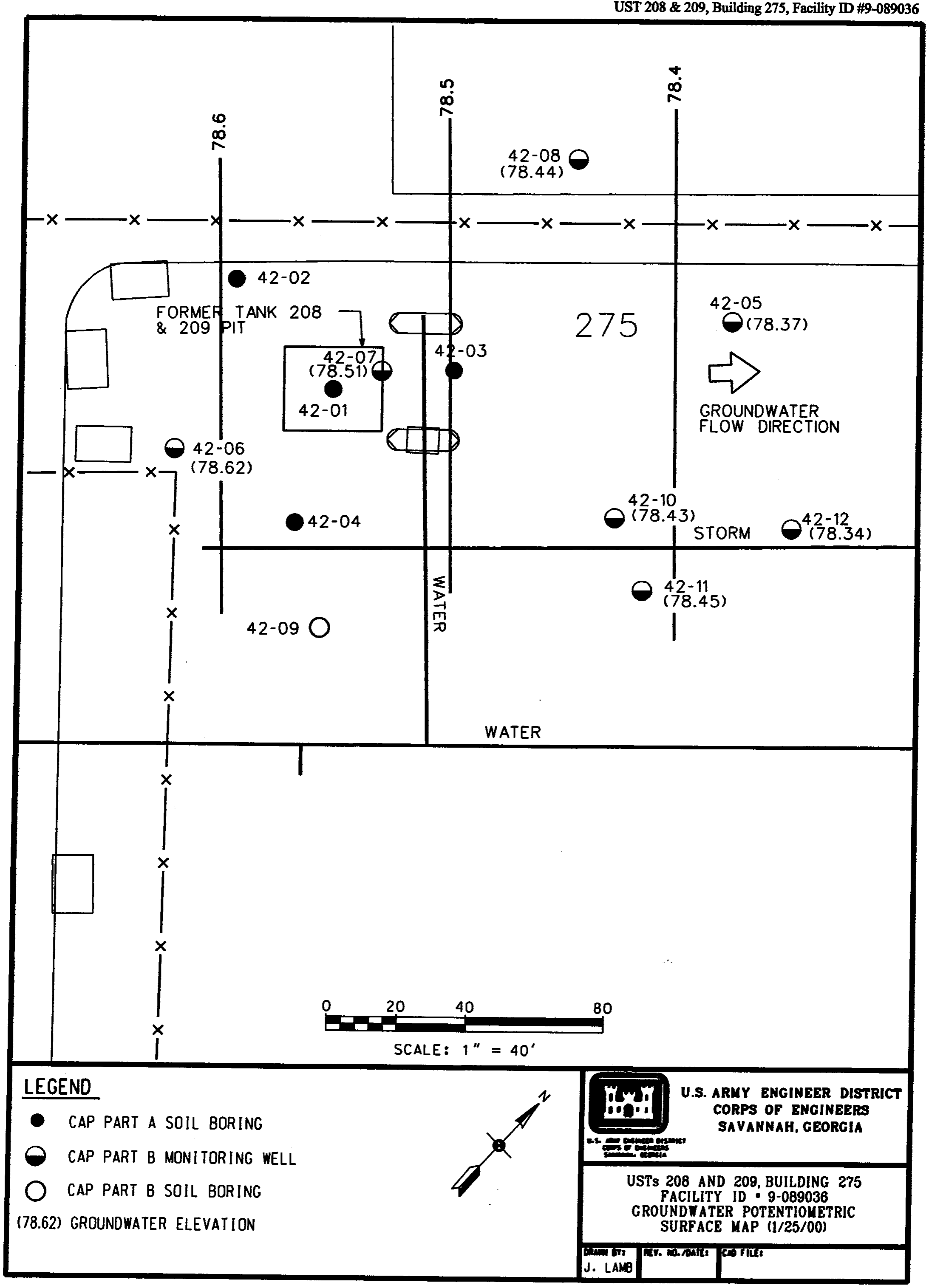

78.6
78.5
78.4
42-08
(78.44)
42-02
FORMER TANK 208
& 209 PIT
275
42-05
(78.37)
42-07
(78.51)
42-03
42-01
GROUNDWATER
FLOW DIRECTION
42-06
(78.62)
42-10
(78.43)
42-04
STORM
42-12
(78.34)
42-11
(78.45)
WATER
42-09
WATER
0
20
40
80
SCALE: 1" = 40'
LEGEND
● CAP PART A SOIL BORING
◒ CAP PART B MONITORING WELL
○ CAP PART B SOIL BORING
(78.62) GROUNDWATER ELEVATION
N
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SAVANNAH, GEORGIA
USTs 208 AND 209, BUILDING 275
FACILITY ID • 9-089036
GROUNDWATER POTENTIOMETRIC
SURFACE MAP (1/25/00)
DRAWN BY:
J. LAMB
REV. NO./DATE:
CAD FILE:

Figure 2a.

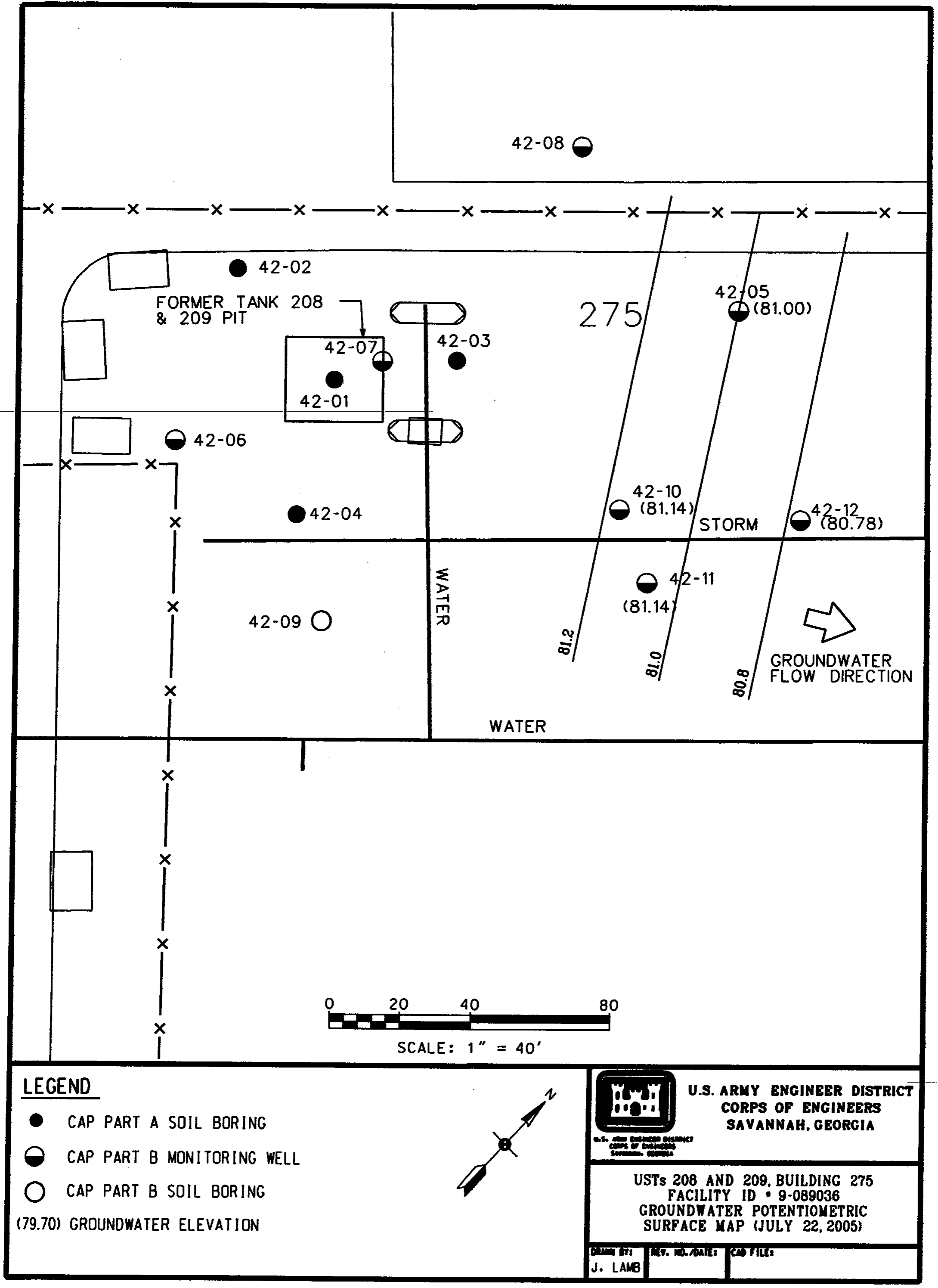

42-08
42-02
FORMER TANK 208
& 209 PIT
42-07
42-01
42-03
275
42-05
(81.00)
42-06
42-10
(81.14)
STORM
42-12
(80.78)
42-04
42-11
(81.14)
WATER
42-09
81.2
81.0
80.8
GROUNDWATER
FLOW DIRECTION
WATER
0
20
40
80
SCALE: 1" = 40'
LEGEND
● CAP PART A SOIL BORING
CAP PART B MONITORING WELL
○ CAP PART B SOIL BORING
(79.70) GROUNDWATER ELEVATION
N
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SAVANNAH, GEORGIA
USTs 208 AND 209, BUILDING 275
FACILITY ID • 9-089036
GROUNDWATER POTENTIOMETRIC
SURFACE MAP (JULY 22, 2005)
DRAWN BY:
J. LAMB
REV. NO./DATE:
CAD FILE:

Figure 2b

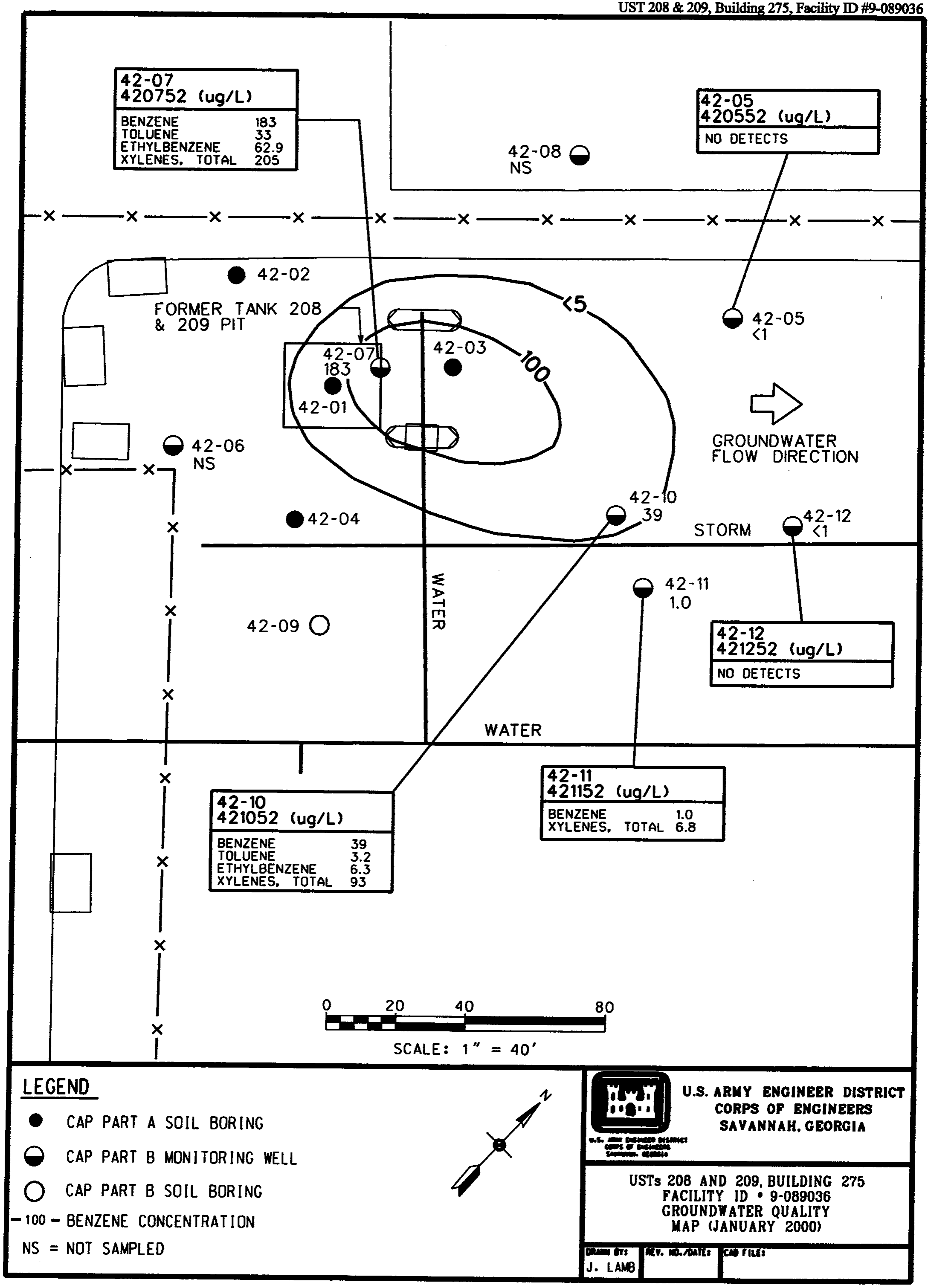

42-07
420752 (ug/L)
BENZENE 183
TOLUENE 33
ETHYLBENZENE 62.9
XYLENES, TOTAL 205
42-05
420552 (ug/L)
NO DETECTS
42-08 NS
42-02
FORMER TANK 208 & 209 PIT
<5
42-05 <1
42-07 183
42-03
100
42-01
42-06 NS
GROUNDWATER FLOW DIRECTION
42-10 39
42-04
STORM
42-12 <1
WATER
42-11 1.0
42-09
42-12
421252 (ug/L)
NO DETECTS
WATER
42-11
421152 (ug/L)
BENZENE 1.0
XYLENES, TOTAL 6.8
42-10
421052 (ug/L)
BENZENE 39
TOLUENE 3.2
ETHYLBENZENE 6.3
XYLENES, TOTAL 93
0 20 40 80
SCALE: 1" = 40'
LEGEND
● CAP PART A SOIL BORING
CAP PART B MONITORING WELL
○ CAP PART B SOIL BORING
-100- BENZENE CONCENTRATION
NS = NOT SAMPLED
N
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SAVANNAH, GEORGIA
USTs 208 AND 209, BUILDING 275
FACILITY ID • 9-089036
GROUNDWATER QUALITY
MAP (JANUARY 2000)
DRAWN BY: J. LAMB
REV. NO./DATE:
CAD FILE:

Figure 3a

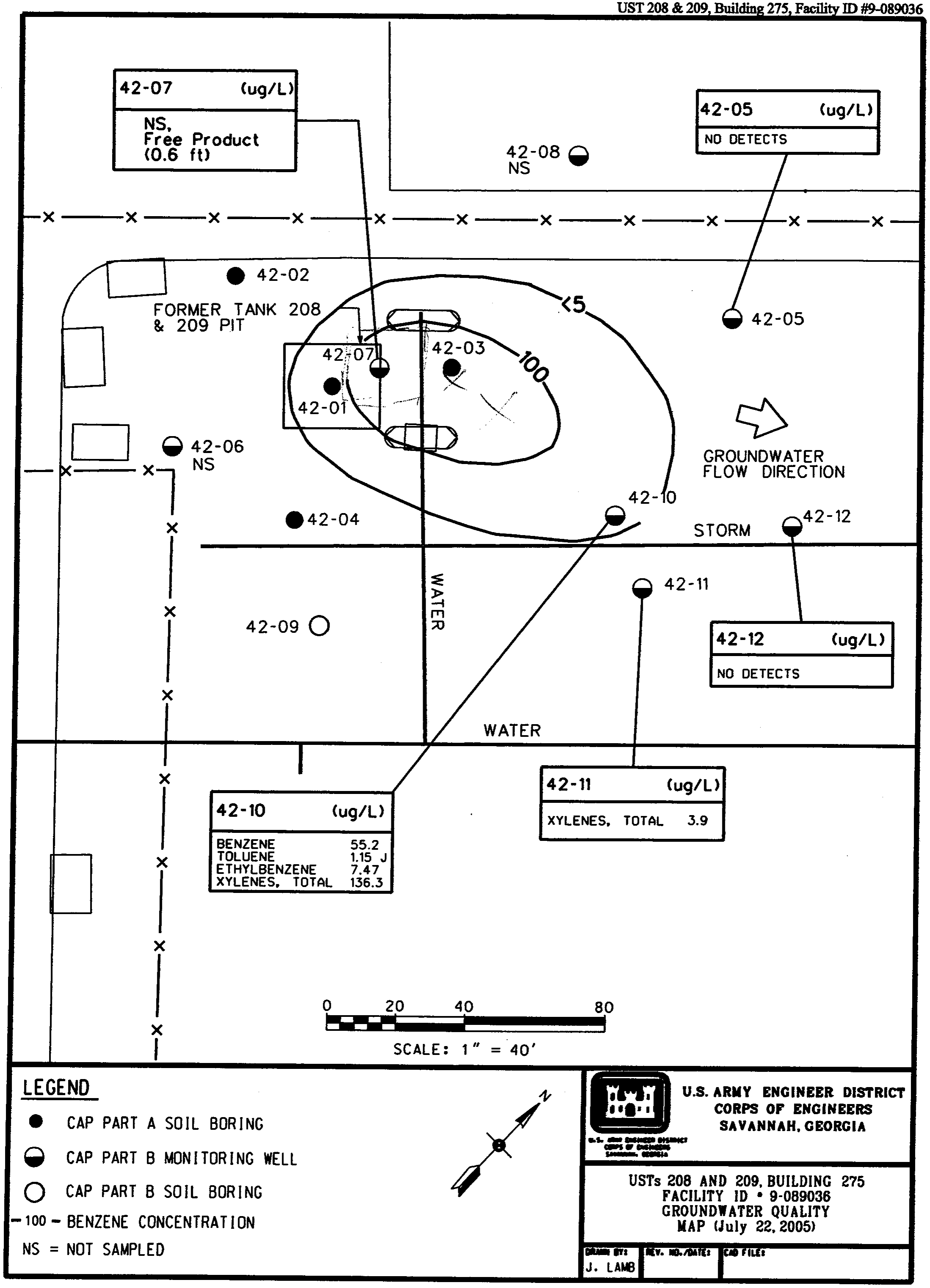
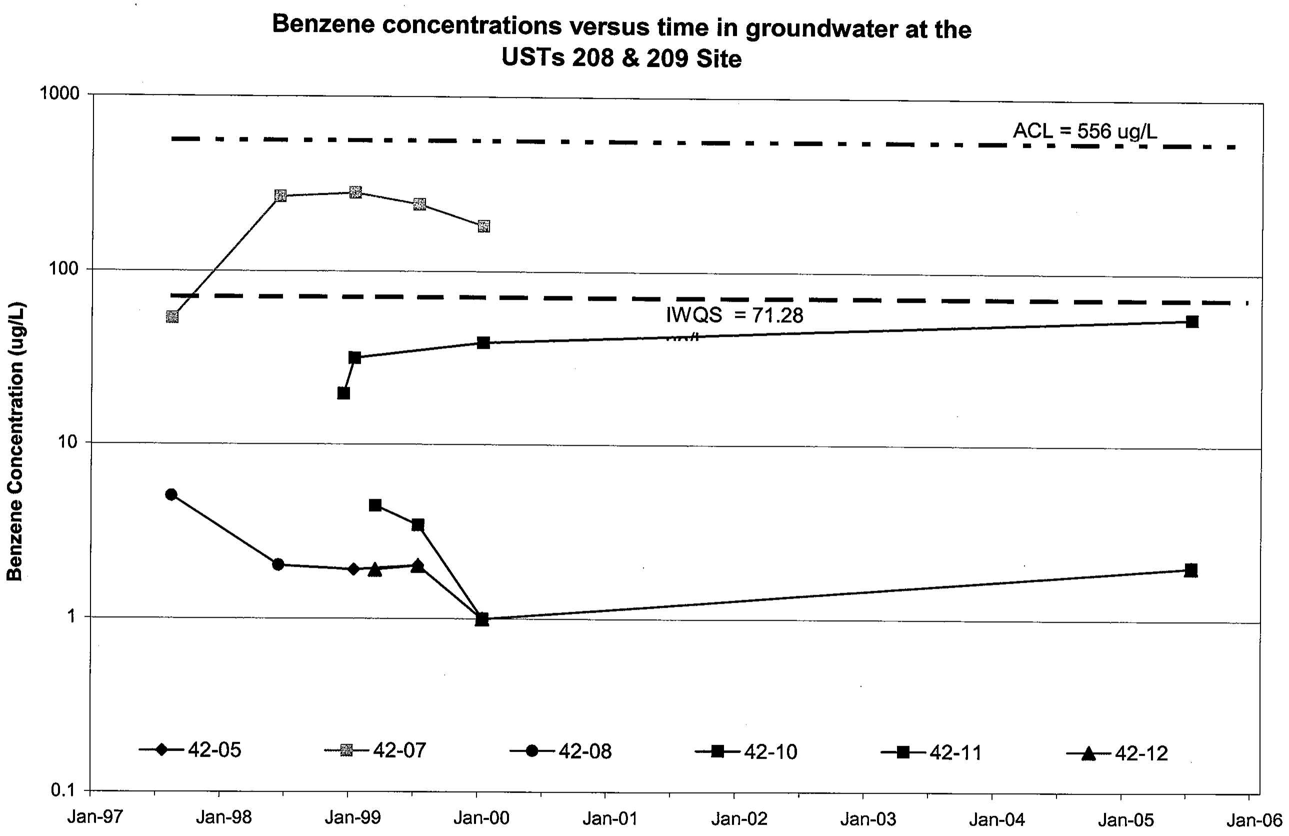

42-07 (ug/L)
NS, Free Product (0.6 ft)
42-05 (ug/L)
NO DETECTS
42-08 NS
42-02
FORMER TANK 208 & 209 PIT
42-07
42-03
42-01
<5
100
42-05
GROUNDWATER FLOW DIRECTION
42-06 NS
42-10
42-04
STORM
42-12
42-11
42-09
WATER
WATER
42-12 (ug/L)
NO DETECTS
42-10 (ug/L)
BENZENE 55.2
TOLUENE 1.15 J
ETHYLBENZENE 7.47
XYLENES, TOTAL 136.3
42-11 (ug/L)
XYLENES, TOTAL 3.9
0 20 40 80
SCALE: 1" = 40'
LEGEND
CAP PART A SOIL BORING
CAP PART B MONITORING WELL
CAP PART B SOIL BORING
100 BENZENE CONCENTRATION
NS = NOT SAMPLED
N
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SAVANNAH, GEORGIA
USTs 208 AND 209, BUILDING 275
FACILITY ID • 9-089036
GROUNDWATER QUALITY
MAP (July 22, 2005)
DRAWN BY:
J. LAMB
REV. NO./DATE:
CAD FILE:

Figure 3b



NOTE: The detection limit was 5 ug/L in August 1997, 2 ug/L from December 1997 to July 1999, 1 ug/L during January 2000 and 2 in July 2005.
Well 42-08 was not sampled. Well 42-07 was not sampled, measured free product.

Figure 4. Trend of Benzene Concentrations

APPENDIX II

REPORT TABLES

Table 1. Groundwater Elevations

Well Number	Date of Measurement	Top of Casing Elevation (ft AMSL)	Screened Interval (ft BGS)	Depth of Free Product (ft BTOC)	Water Depth (ft BTOC)	Product Thickness (feet)	Corrected Groundwater Elevation (ft AMSL)
First Semiannual Monitoring Event – July 1998							
42-05	7/21/1998	85.16	4.0 – 14.0		6.34		78.82
42-06	7/21/1998	83.42	4.0 – 11.0		4.44		78.98
42-07	7/21/1998	84.47	3.5 – 13.5		5.55		78.92
42-08	7/21/1998	83.36	3.8 – 13.8		4.47		78.79
Second Semiannual Monitoring Event – March 1999							
42-05	3/11/1999	85.16	4.0 – 14.0		5.72		79.44
42-06	3/11/1999	83.42	4.0 – 11.0		3.86		79.56
42-07	3/11/1999	84.47	3.5 – 13.5		5.5		78.97
42-08	3/11/1999	83.36	3.8 – 13.8		3.87		79.49
42-10	3/11/1999	84.55	2.2 – 12.2		5.19		79.36
42-11	3/11/1999	84.55	3.3 – 13.3		5.19		79.36
42-12	3/11/1999	84.78	3.3 – 13.3		5.5		79.28
Third Semiannual Monitoring Event – August 1999							
42-05	8/24/1999	85.16	4.0 – 14.0		4.97		80.19
42-06	8/24/1999	83.42	4.0 – 11.0		2.92		80.5
42-07	8/24/1999	84.47	3.5 – 13.5		4.13		80.34
42-08	8/24/1999	83.36	3.8 – 13.8		3.04		80.32
42-10	8/24/1999	84.55	2.2 – 12.2		4.43		80.12
42-11	8/24/1999	84.55	3.3 – 13.3		4.42		80.13
42-12	8/24/1999	84.78	3.3 – 13.3		4.7		80.08
Fourth Semiannual Monitoring Event – January 2000							
42-05	1/25/2000	85.16	4.0 – 14.0		6.79		78.37
42-06	1/25/2000	83.42	4.0 – 11.0		4.8		78.62
42-07	1/25/2000	84.47	3.5 – 13.5		5.96		78.51
42-08	1/25/2000	83.36	3.8 – 13.8		4.92		78.44
42-10	1/25/2000	84.55	2.2 – 12.2		6.12		78.43
42-11	1/25/2000	84.55	3.3 – 13.3		6.1		78.45
42-12	1/25/2000	84.78	3.3 – 13.3		6.44		78.34
Fifth Semiannual Monitoring Event – July 2005							
42-05	7/22/2005	85.16	4.0 – 14.0		4.16		81.0
42-07	7/22/2005	84.47	3.5 – 13.5		4.15		80.87
42-10	7/22/2005	84.55	2.2 – 12.2		3.41		81.14
42-11	7/22/2005	84.55	3.3 – 13.3		3.41		81.14
42-12	7/22/2005	84.78	3.3 – 13.3		4.00		80.78

NOTE:

AMSL	above mean sea level
BGS	below ground surface
BTOC	below top casing

Table 2. Groundwater Analytical Results

Sample Location	Sample ID	Date Sampled	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Xylenes (µg/L)	Naphthalene (µg/L)	MTBE (µg/L)	Total BTEX (µg/L)	Total PAH (µg/L)
First Semiannual Monitoring Event – June 1998										
42-05	420522	6/30/1998	2 U	2 U	2 U	6 U	NA	NA	ND	ND
42-07	420722	6/30/1998	**267 =**	56.6 J	120 J	143 J	NA	NA	586.6	218.7
42-08	420822	6/30/1998	2 U	2 U	2 U	6 U	NA	NA	ND	ND
Second Semiannual Monitoring Event – January 1999										
42-05	420532	1/10/1999	1.9 J	4.8 =	1.9 J	8.8 =	NA	NA	17.4	ND
42-07	420732	1/10/1999	**281 =**	61.1 =	94.7 =	260 =	NA	NA	696.8	109
42-10	421032	1/10/1999	31.7 =	3.7 U	3.2 =	71.9 =	NA	NA	106.8	20.3
Third Semiannual Monitoring Event – July 1999										
42-05	420542	7/9/1999	2 U	0.61 J	2 U	6 U	NA	NA	0.61	NA
42-07	420742	7/11/1999	**242 =**	35.4 =	73.2 =	178 =	NA	NA	528.6	NA
42-11	421142	7/9/1999	3.4 =	2 U	2 U	9.5 =	NA	NA	12.9	NA
42-12	421242	7/9/1999	2 U	2 U	2 U	6 U	NA	NA	ND	NA
Fourth Semiannual Monitoring Event – January 2000										
42-05	420552	1/26/2000	1 U	1 U	1 U	3 U	NA	NA	ND	NA
42-07	420752	1/26/2000	**183 =**	33 =	62.9 =	205 =	NA	NA	483.9	NA
42-10	421052	1/26/2000	39 =	3.2 =	6.3 =	93 =	NA	NA	111.5	NA
42-11	421152	1/26/2000	1 =	1 U	1 U	6.8 =	NA	NA	6.8	NA
42-12	421252	1/26/2000	1 U	1 U	1 U	3 U	NA	NA	ND	NA
Fifth Semiannual Monitoring Event – July 2005										
42-05	732704	7/22/2005	2 U	2 U	2 U	2 U	2 U	2 U	ND	NA
42-07	-	7/22/2005	**FREE PRODUCT**							
42-10	732707	7/22/2005	55.2 =	1.4 J	6.41 J	136.1 =	79.9 =	79.8 =	199.11	NA
42-11	732708	7/22/2005	2 U	2 U	2 U	3.88 =	9.86 =	9.94 =	3.88	NA
42-12	732706	7/22/2005	2 U	2 U	2 U	2 U	2 U	2 U	ND	NA
In-Stream Water Quality Standards (GA EPD Chapter 391-3-6)			71.28	200,000	28,718	NRC			NRC	NRC
Alternate Concentration Limits			556	1.56E+06	2.24E+05	-			-	-

NOTE:

Bold values exceed the IWQS
Italics exceed the ACL

BTEX	Benzene, toluene, ethylbenzene, and xylene
BGS	Below ground surface
ND	Not detected
NRC	No regulatory criteria
PAH	Polynuclear aromatic hydrocarbon

Laboratory Qualifiers:

U	Indicates the compound was not detected at the concentration reported.
UJ	Indicates that the compound was not detected above an approximated sample quantitation limit.
J	Indicates the value for the compound is an estimated value.
=	Indicates the compound was detected at the concentration reported.

	U.S. ARMY CORPS OF ENGINEERS **SAVANNAH DISTRICT** **GEOLOGY and HYDROGEOLOGY**	GROUND WATER FIELD DATA LOG

1. CLIENT: Ft. Stewart
DATE: 7-22-05 TIME: 1350
SAMPLED BY: Steve Widincamp & Horace Cooper
WEATHER CONDITIONS: Cloudy, 99° F

Location: Ft. Stewart UST 208-209	Sample ID: UST-208-209-42-5-7-05

PRESERVATIVE: Ice, HCL
ANALYSES REQUESTED: VOC's
OF CONTAINERS: 9
SAMPLING METHOD: ☐ Peristaltic Pump
☒ Bladder Pump
LOW FLOW: ☒ YES ☒ NO
SAMPLES FILTERED: ☐YES ☒NO
DUPLICATE SAMPLE: ☒YES ☐NO

2. WATER LEVEL DATA

MEASURING POINT: ☒Top of casing ☐Other:
METHOD OF MEASUREMENT: Water Level Indicator

3. WELL EVACUATION DATA

Well Depth (wd): 15.00 (ft)
Diameter (d): 0.167 (ft)
Depth to Water (dw): 4.16 (ft)
Well Volume = (5.904 × d^2 (wd-dw)) = 1.785 (gallons)
Flow Rate : 500 (ml/min)
Length of Time Purged: 30 (minutes)
Purge Start Time: 1320
Amount Purged= 3.9 (gallons)

4. FIELD PARAMETERS

INSTRUMENT	CALIBRATED
pH Meter –Hydrolab Minisonde 4a	☒
Conductivity Meter - Hydrolab Minisonde 4a	☒
Temperature – Hydrolab Minisonde 4a	☒
Turbidity Meter – Hach 2100 P	☒
DO Meter – Hydrolab Minisonde 4a	☒
ORP Meter – Hydrolab Minisonde 4a	☒
CO_2– Hach Digital Titrator	☐

Time	1335	1340	1350			
pH	5.34	5.35	5.34			
Sp.Cond ($_{u}$s)	186.0	186.0	186.1			
Temp. °C	30.0	30.0	30.0			
Turbidity	178	179	183			
DO	2.99	2.99	2.89			
ORP	44	43	45			

5. COMMENTS

Water had a yellow tint.
Duplicate sample taken @ 1330. (UST-208-209-DUP1-7-05)
MS/MSD taken.

	U.S. ARMY CORPS OF ENGINEERS **SAVANNAH DISTRICT** **GEOLOGY and HYDROGEOLOGY**	GROUND WATER FIELD DATA LOG

1. CLIENT: Ft. Stewart
DATE: 7-22-05 TIME: 1440
SAMPLED BY: Steve Widincamp & Horace Cooper
WEATHER CONDITIONS: Sunny, 101° F

Location: Ft. Stewart UST 208-209	Sample ID:UST-208-209-42-12-7-05

PRESERVATIVE: Ice, HCL
ANALYSES REQUESTED: VOC's
OF CONTAINERS: 3
SAMPLING METHOD: ☐ Peristaltic Pump
☒ Bladder Pump
LOW FLOW: ☒ YES ☐ NO
SAMPLES FILTERED: ☐ YES ☒ NO
DUPLICATE SAMPLE: ☐ YES ☒ NO

2. WATER LEVEL DATA

MEASURING POINT: ☒ Top of casing ☐ Other:
METHOD OF MEASUREMENT: Water Level Indicator

3. WELL EVACUATION DATA

Well Depth (wd): 13.50 (ft)
Diameter (d): 0.167 (ft)
Depth to Water (dw): 4.00 (ft)
Well Volume = ($5.904 \times d^2$ (wd-dw)) = 1.564 (gallons)
Flow Rate : 500 (ml/min)
Length of Time Purged: 37 (minutes)
Purge Start Time: 1403
Amount Purged= 4.8 (gallons)

4. FIELD PARAMETERS

INSTRUMENT	CALIBRATED
pH Meter –Hydrolab Minisonde 4a	☒
Conductivity Meter - Hydrolab Minisonde 4a	☒
Temperature – Hydrolab Minisonde 4a	☒
Turbidity Meter – Hach 2100 P	☒
DO Meter – Hydrolab Minisonde 4a	☒
ORP Meter – Hydrolab Minisonde 4a	☒
CO_2– Hach Digital Titrator	☐

Time	1420	1430	1440			
pH	5.11	5.09	5.09			
Sp.Cond ($_u$s)	113.2	111.1	110.1			
Temp. °C	30.1	30.0	30.0			
Turbidity	829	>1000	>1000			
DO	33	34	35			
ORP	1.22	1.20	1.24			

5. COMMENTS

Turbidity got worse as well was purged.

	U.S. ARMY CORPS OF ENGINEERS **SAVANNAH DISTRICT** **GEOLOGY and HYDROGEOLOGY**	GROUND WATER FIELD DATA LOG

1. CLIENT: Ft. Stewart
DATE: 7-22-05 TIME: 1456
SAMPLED BY: Steve Widincamp & Horace Cooper
WEATHER CONDITIONS: Sunny, 101° F

Location: Ft. Stewart UST 208-209 | Sample ID:UST-208-209-42-10-7-05

PRESERVATIVE: Ice, HCL
ANALYSES REQUESTED: VOC's
OF CONTAINERS: 3
SAMPLING METHOD: ☒ Peristaltic Pump
☐ Bladder Pump
LOW FLOW: ☐ YES ☒ NO
SAMPLES FILTERED: ☐YES ☒NO
DUPLICATE SAMPLE: ☐YES ☒NO

2. WATER LEVEL DATA

MEASURING POINT: ☒Top of casing ☐Other:
METHOD OF MEASUREMENT: Water Level Indicator

3. WELL EVACUATION DATA

Well Depth (wd): 13.55 (ft) Diameter (d): 0.167 (ft)
Depth to Water (dw): 3.41 (ft)
Well Volume = (5.904 × d^2 (wd-dw)) = 1.670 (gallons)
Flow Rate : N/A (ml/min)
Length of Time Purged: 49 (minutes) Purge Start Time: 1407
Amount Purged= 7.0 (gallons)

4. FIELD PARAMETERS

INSTRUMENT	CALIBRATED
pH Meter –Hydrolab Minisonde 4a	☒
Conductivity Meter - Hydrolab Minisonde 4a	☒
Temperature – Hydrolab Minisonde 4a	☒
Turbidity Meter – Hach 2100 P	☒
DO Meter – Hydrolab Minisonde 4a	☒
ORP Meter – Hydrolab Minisonde 4a	☒
CO_2– Hach Digital Titrator	☐

Time	1450	1453	1456			
pH	4.44	4.43	4.41			
Sp.Cond ($_{u}$s)	103.9	103.7	103.7			
Temp. °C	29.6	29.5	29.6			
Turbidity	482	464	472			
DO	0.70	0.60	0.53			
ORP	150	149	148			

5. COMMENTS

Turbidity got worse as well was purged.

U.S. ARMY CORPS OF ENGINEERS **SAVANNAH DISTRICT** **GEOLOGY and HYDROGEOLOGY**	GROUND WATER FIELD DATA LOG

1. CLIENT: Ft. Stewart
DATE: 7-22-05 TIME: 1525
SAMPLED BY: Steve Widincamp & Horace Cooper
WEATHER CONDITIONS: Sunny, 101° F

Location: Ft. Stewart UST 208-209	Sample ID:UST-208-209-42-11-7-05

PRESERVATIVE: Ice, HCL
ANALYSES REQUESTED: VOC's
OF CONTAINERS: 3
SAMPLING METHOD: ☐ Peristaltic Pump
☒ Bladder Pump LOW FLOW: ☒ YES ☐ NO
SAMPLES FILTERED: ☐ YES ☒ NO DUPLICATE SAMPLE: ☐ YES ☒ NO

2. WATER LEVEL DATA

MEASURING POINT: ☒ Top of casing ☐ Other:
METHOD OF MEASUREMENT: Water Level Indicator

3. WELL EVACUATION DATA

Well Depth (wd): 13.55 (ft) Diameter (d): 0.167 (ft)
Depth to Water (dw): 3.41 (ft)
Well Volume = (5.904 × d^2 (wd-dw)) = 1.670 (gallons)
Flow Rate : 500 (ml/min)
Length of Time Purged: 35 (minutes) Purge Start Time: 1450
Amount Purged= 4.6 (gallons)

4. FIELD PARAMETERS

INSTRUMENT	CALIBRATED
pH Meter –Hydrolab Minisonde 4a	☒
Conductivity Meter - Hydrolab Minisonde 4a	☒
Temperature – Hydrolab Minisonde 4a	☒
Turbidity Meter – Hach 2100 P	☒
DO Meter – Hydrolab Minisonde 4a	☒
ORP Meter – Hydrolab Minisonde 4a	☒
CO$_2$– Hach Digital Titrator	☐

Time	1505	1513	1515	1525		
pH	4.37	4.23	4.21	4.20		
Sp.Cond ($_u$s)	111.5	102.7	101.8	100.3		
Temp. °C	28.4	28.2	28.0	28.0		
Turbidity	>1000	>1000	>1000	>1000		
DO	1.82	1.73	1.72	1.72		
ORP	130	142	142	142		

5. COMMENTS

Blank taken @ 1600. (UST-208-209-BLK1-7-05)

APPENDIX III

LABORATORY ANALYTICAL RESULTS

AML
Analytical Management Laboratories, Inc.
est. 1993

Certificate of Analysis

August 22, 2005

Mr. Mark Harvison
Project Chemist, CESAS-EN-GG
U.S. Army Corps of Engineers, Savannah District
100 W. Oglethorpe Ave.
P. O. Box 889
Savannah, GA 31401-3640
Phone: 912-652-5151
Fax: 912-652-5311

Dear Mr. Harvison:

Project Name: **Ft Stewart**
W912-HN-05-D-0013, Task Order No. 0005
AML Work Order Number: **7326**

Attached, please find the hardcopy analytical report (111 total pages) for environmental samples collected by USACE-SAV for the project described above. Problems encountered in the analysis of these samples are documented in the laboratory case narrative. The electronic data deliverables (EDDs) for this report will be e-mailed within a few days of this report. Please feel free to contact me by phone (913-829-0101-ext. 24), fax (913-829-1181) or email (klindquist@amlabinc.com) if you have any questions.

Respectfully Submitted,

Kendall L. Lindquist, MBA
Operations Manager

The test results contained within this report meet or exceed the requirements of NELAC and/or the specific certification program that is applicable. NELAP Accrediting Authority : Kansas Department of Health and Environment

- **Safe Drinking Water Act (Drinking Water)**
- **Clean Water Act (Waste Water)**
- **Soil/Hazardous Waste**

Certificate Number: E-10254 - Effective Date: 05/01/2005 - Expiration Date: 04/30/200
Florida: E87892 North Carolina: 627 South Carolina: 76003001

General Case Narrative

Project Name: **Ft Stewart**
W912-HN-05-D-0013, Task Order No. 0005
AML Work Order Number: **7326**

Project and Sample Information

Task order information, completed copies of the chain of custody form(s), and Analytical Management Laboratories (AML) sample condition upon receipt form (s) are included in the Sample Information section. The AML laboratory information management system (LIMS)-generated sample status and receipt report, showing field sample identifiers and corresponding laboratory identifiers is also included. When applicable, the suffix, F has been appended to field sample numbers for samples that have been filtered in the field or laboratory. Separate AML laboratory sample numbers are normally assigned to filtered and unfiltered samples. When applicable, AML VOC soil sample collection and preservation record showing field sample weights and preservation procedures are also included in this section.

Reports

The hardcopy laboratory reports and electronic data deliverables (EDDs) were prepared using a Horizon/Chemware LIMS. Under the procedure used by the laboratory, the hardcopy reports are actually generated using information contained in a database, which is also used to generate electronic deliverables. This procedure was implemented to assure data integrity between the two media. The attached report is organized as follows:

Cover Letter
Laboratory Case Narrative
Sample Information
Sample Result Forms, organized in the following order: by fraction and by sample.

QC Summary organized in the following order: by fraction, by matrix, and by analytical batch number. The QC Summary for each analytical batch contain the following, when applicable:

1. QC Association Form or Method Blank Summary (EPA CLP Form-4 equivalents)
2. Surrogate Recovery Summary, when applicable (EPA CLP Form-2 equivalents)
3. Method Blank (MB) Results (EPA CLP Form-1 equivalents)
4. Laboratory Control Sample (LCS) Results (EPA Form-1 equivalents)
5. LCS duplicate (LCSD) Results (EPA Form-1 equivalents), when available
6. Matrix Spike (MS) Results (EPA Form-1 equivalents)
7. MS duplicate (MSD) Results (EPA CLP Form-1 equivalents)
8. LCS Recoveries Summary (EPA Form-3 equivalents)
9. LCSD (when applicable) Recoveries and RPD Summary (EPA Form-3 equivalents)

10. MS Recoveries Summary (EPA Form-3 equivalents); and
11. MSD Recoveries and RPD Summary (EPA CLP Form-3 equivalents)
12. Post Digestion Spike (PDS) study Results, when applicable (EPA Form-1 equivalents)
13. Serial Dilution (SD) study Results, when applicable (EPA Form-1 equivalents)
14. PDS Recoveries Summary (EPA Form-3 equivalents)
15. RPD for SD results, when applicable (EPA Form-3 equivalents)

Sample Result Forms

Sample results are shown on modified CLP Form 1 equivalents with the following qualifiers:
U = Not detected or detected below method detection limit (MDL) or reliable detection limit (RDL).
J = Detected above MDL or RDL but below the method quantitation limit (MQL).
J = RPD >40% between primary and confirmation column results for GC and HPLC methods.
E = Detected at levels in excess of the upper calibration limit.
R = Rejected due to significant QA outliers.
MDLs, and MQLs have been adjusted for sample weight or volume, dilution, and percent solids, when applicable. Quantitative results for analytes detected in the sample (positive results) are shown under the column labeled "Result". Results coded with the qualifier E should not be used unless additional analyses were unavailable due to other limitations. Data coded as E should not be compared to other data since non-linearity in calibration may be a severe problem for some analytes.

MDL=Method Detection Limit (Lowest amount that can be reported as positive based on statistical considerations).

LLR = Lowest Level for reporting (MDL<LLR<MQL). This is the lowest amount that AML reports as positive on a routine basis. The LLR is typically one half of the MQL in our laboratories. However, it can be as low as the MDL and it equals MDL for some parameters. The center of excellence (CX) at Omaha has been pushing the laboratories to use 'RDL or Reliable detection limit" as the equivalent of LLR. However, RDL is defined as two times the MDL, which makes it very difficult for the laboratories to use this term.

MQL=Method Quantitation Limit. It is the lowest point on our calibration curve. It is the equivalent of the reporting limit (RL) and/or practical quantitation limit (PQL) used by most laboratories. The term "Reporting Limit" has become meaningless since the laboratories are required to report results below this limit as an estimated result with a "J" flag).

Multiple sample result forms may be provided for one or more of the following reasons, if in the professional judgment of the laboratory that sample results for a given compound may be more accurate from one of the multiple analyses:
Sample was reanalyzed for surrogate recovery outliers;
Sample was reanalyzed at a dilution;
One of the analyses was performed outside holding times; and

A replicate analysis was performed for internal quality control purposes

QC Association Forms

The list consisting of MB, LCS, LCSD (if any), MS (whenever available), MSD (whenever available), and field samples associated with each QC batch are shown on QC Association Forms, which are CLP Form-4 equivalents. Additional items such as PDS, SD (and CCAL) may be included for some parameters. Separate forms are included for each QC batch for each matrix and fraction. The QC batch numbers shown on these reports are based on LIMS.

Surrogate Recovery Forms (when applicable)

A summary of the system monitoring compound recoveries for organic analyses is included in this section. EPA CLP Form 2 equivalents are used to report surrogate recoveries. The QC limits from the Department of Defense Quality Systems Manual for Environmental Laboratories, Final Version 2, June 2002 (DoD QSM) is used with the exception of VOCs since limits are incomplete for all the surrogates in soil. The QC limits from USACE EM 200-1-3, Appendix I (Shell) are used for VOCs. The Shell document requires limits for controlled matrices (MB, LCS, and LCSD) to be tighter than those for actual matrix samples (MS, MSD, and samples). Corrective action involving re-extraction and/or reanalysis is performed for samples that exceed the surrogate QC limits. Specific corrective action procedures employed for this project and test-specific requirements are described in parameter-specific case narratives.

Method Blank Result Forms

Laboratory method blank samples were analyzed with each QC batch as described in the QC Association Form. Analytical results for method blanks are shown on CLP Form 1 equivalents. They include data for all target compounds/analytes and surrogates. The MB amount should not exceed one half of the applicable MQL for each target analyte with the exception of common laboratory contaminants. The source of contamination is investigated, corrected, and reanalysis performed whenever possible if the blank contamination above one half of the MQL exceeds 1/10 of the specified regulatory limit and/or the measured concentration of any sample in the associated QC sample batch. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Laboratory Control Sample (LCS) Report Forms

Laboratory control samples were analyzed with each QC batch as described in the QC Association Form. LCS results of these QC analyses are shown in CLP Form 1. LCS recoveries and RPDs for duplicates (if performed) are shown on EPA Form-3 equivalents. The laboratory statistical control (3-sigma) and marginal (4-sigma) exceedence (ME) limits are compared periodically with QC limits from DoD QSM, which are used as default limits in this report. When the 3-sigma control limit is exceeded for any analyte, associated data is flagged "ME" and 4-sigma ME limits are applied automatically. The total number of method analytes, and the number of ME analytes are tracked and compared against the number allowed per DoD QSM. This information is also provided at the bottom of each Form-3 report. Analytes with LCS recoveries that exceed the 4-sigma limits a[illegible] flagged ME* and reanalysis will be required for the affected analyte if it is a contaminant of concern. If the number of marginal exceedences are greater than those allowed by DoD QSM, reanalysis of the affected QC batch is performed. The relative percent difference (RPDs) for the LCS duplicates, a voluntary laboratory QC parameter is also computed to track in-house precision and provided on Form-3 reports for duplicates. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Matrix Spike/Matrix Spike Duplicate Recoveries Report Forms
The MS/MSD results are shown in EPA CLP Form-1 equivalents. See section on LCS for additional details. The RPDs for MS duplicates that are outside the applicable QC limits are flagged with an asterisk (*). The effect of matrix is taken into account in determining corrective action procedures based on MS and MSD results, recoveries, and RPD. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Calibration
Instruments were calibrated in accordance with applicable method. Deviations are shown in parameter-specific case narratives. Copies of initial calibration and calibration verification summaries and associated raw data will be maintained in project files and made available for detailed client review, if necessary.

Test Methods and Holding Times
Analyses were performed within applicable holding times except as noted in parameter-specific case narratives.

Batch-specific Quality Control Procedures
Quality control data from method blanks and laboratory control samples are used as batch QC elements. In accordance with EPA, USACE, and DoD guidelines, QC data from matrix spikes are used as matrix-specific QC elements and QC data from surrogates, internal standard areas, etc. are used as sample-specific QC elements. When the batch QC elements are outside their QC limits, results for associated samples are evaluated and corrective actions that affect the entire sample set are performed. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Matrix-specific or Sample-specific Quality Control Procedures
Sample concentrations exceeding the upper calibration limit, surrogate recoveries outside the QC limits, calibration parameters (e.g. ICAL, CALV, ICV, CCV, ICB, CCB, etc.) not within QC limits, etc. are used as sample-specific and/or sample-group specific QC elements for one or more associated samples during instrumental analysis. Serial dilution, standard addition, MS recoveries, etc. are used as matrix-specific QC elements for one or more associated samples. When these QC elements are outside their QC limits, associated individual sample results are evaluated and appropriate corrective actions are performed. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Manual Integration

Manual integration operations that have potential to improve accuracy of analysis are performed, as necessary (shown with a "M" flag on raw data) based on visual inspection of peak shapes for each target analyte. Such operations are technically defensible and they are not aimed at meeting the minimum technical requirements of the analytical procedure.

Statement

To the best of our knowledge, this data package is in compliance with the terms and conditions of the contract/purchase order/delivery order/task order as applicable, both technically and for completeness, for other than the conditions detailed in this case narrative. The quality assurance manager or his designee, as verified by the signature on the cover letter has authorized release of data contained in this report. In accordance with NELAP guidelines and our certificate (No. E-10254) requirements, this report has been paginated and it may not be reproduced for distribution, except in full, without written approval from Analytical Management Laboratories.

VOCs Analysis

Calibration and sample analyses were performed using GC/MS by SW-846 Method 8260B. The BFB tune criteria were met for the analyses. Corrective actions were attempted in response to QC outliers requiring such action as described below. When corrective actions were not successful, data released by the laboratory may require qualification for usability in accordance with client procedures and project requirements.

Initial Calibration (ICAL) -Water

Six-point initial calibration (2-µg/L to 60-µg/L) was employed. The response factors for the SPCC compounds and the %RSDs for the CCC compounds were within method QC limits for the ICAL. The %RSDs for the mean response factor of the target compounds were within QC limits (15% desirable and 30% maximum) for a vast majority of the target compounds. The response factor method was employed for quantitation with linear/non-linear regression methods for a small subset of target compounds that did not meet the recommended 15% RSD criterion. Acceptable initial calibrations were not obtained for the following compounds, which were detected in project samples: None.

Initial Calibration Verification (ICV)

A second source standard was employed for the ICV. The QC recovery limits are 80% to 120% for both aqueous and soil samples. There is no allowance for any outliers.

Continuing Calibration Verification (CCVs)

A same source standard was employed for the CCV. The instrument tune and response factors for the SPCC compounds and the %RSDs for the CCC compounds were within method QC limits for the CCVs. Acceptable CCVs were not obtained for the following compounds, which were detected in project samples: None.

Method Blank
No significant anomalies were noted with the exception of the random detection of common laboratory contaminants.
QC Batch 2665: None.
QC Batch 2666: None.
QC Batch 2667: None.
QC Batch 2668: None.
QC Batch 2687: None.

Surrogate Recoveries
Four SW-846 Method 8260B surrogates were employed. The recoveries for all four surrogates should be within QC limits for acceptability of the data. The USACE Shell limits are applied for environmental samples (70-130 for all samples, MS, and MSD) and interference-free matrices (80-120 for water and 75-125 for soil MB, LCS, and LCSD). Samples exceeding QC limits are re-analyzed using dilution, if necessary. Surrogate recoveries were within QC limits for the project samples with the following exception(s):
QC Batch 2665: None.
QC Batch 2666: None.
QC Batch 2667: None.
QC Batch 2668: None.
QC Batch 2687: None.

Laboratory Control Sample Recoveries
The DoD QSM LCS control and marginal exceedence limits are listed in the LCS/LCSD recovery form for aqueous and soil samples. The statistically allowable number of sporadic marginal failures (SMFs) or marginal exceedences (ME) based on the number of target compounds for this method is 3. Expanded SMF QC limits are applicable for the SMF compounds. Compounds that may have recoveries outside the QC limits in the LCS may be within the QC limits in the LCSD. QC outliers requiring corrective action:
QC Batch 2665: None.
QC Batch 2666: None.
QC Batch 2667: None.
QC Batch 2668: None.
QC Batch 2687: None.

Matrix Spike Recoveries
Additional sample vials were collected for matrix spike analysis on two project samples (169701 and 169711. The DoD QSM QC control and marginal exceedence limits are listed in the MS/MSD recovery form for aqueous and soil samples. Expanded SMF QC limits are applicable for the 3 allowable SMF compounds. Compounds that may have recoveries outside the QC limits in the MS may be within the QC limits in MSD.
QC outliers requiring corrective action:
QC Batch 2665: None.
QC Batch 2666: None.
QC Batch 2667: None.

QC Batch 2668: None.
QC Batch 2687: None.

Matrix Spike Duplicates

The %RPD for matrix spike duplicate results are calculated to assess precision. QC outliers requiring corrective action:

QC Batch 2665: None.
QC Batch 2666: None.
QC Batch 2667: None.
QC Batch 2668: None.
QC Batch 2687: None.

Internal Standard Areas and Retention Times

Three SW-846 internal standard (IS) are used for calibration and analysis. Internal standard (IS) areas for the associated samples ±50% of the areas observed for the ICV, beginning CCV, or the mid-point of the ICAL for all three internal standards. The IS retention times for the associated samples should also be within QC limits (±30-seconds of those for the nearest CCV). Samples exceeding QC limits are re-analyzed using dilution, if necessary. QC outliers requiring corrective action:

QC Batch 2665: None.
QC Batch 2666: None.
QC Batch 2667: None.
QC Batch 2668: None.
QC Batch 2687: None.

Project Samples:

QC Batch 2665: None.
QC Batch 2666: Sample -11 required dilution due to analytes exceeding the upper linear calibration range of the instrument. The dilution can be found in Batch 2668.
QC Batch 2667: Samples -17 and -18 required dilution due to analytes exceeding the upper linear calibration range of the instrument. The dilutions can be found in Batch 2687.
QC Batch 2668: None.
QC Batch 2687: None.

AML
Analytical Management Laboratories, Inc.

15130 South Keeler
Olathe, Kansas 66062
Phone (913) 829-0101
Fax (913) 829-1181

33721

Page 1 of 3

Chain of Custody Record / Request for Analysis

Client Contact Name: Mark Harvison
Company Name: USACE
Address: 100 W. Oglethorpe Ave.
City, State, Zip: Savannah GA. 31401
Phone #: (912) 652-5151 Ext:
Fax #: (912) 652-5311
Email:

Project Name: Ft. Stewart
Project Number: 0005
Purchase Order Number:
Project Due Date:
Project Comments:
Sampler's Signature: Sto Winkop

Analyses/Method to be Performed (Check all that apply)

Specify method # ---> 8260

Preservative: List total number of bottles for each preservative type.

Please include any information that may be useful in the analysis of the sample.
Example: high concentration
List analytes
MS/MSD

Lab ID	Sample Description	Date	Time	Matrix	Total # Containers	HCl	HNO_3	NaOH	H_2SO_4	Unpreserved	4° C	VOCs (8260)	SVOCs	Pesticides	PCBs	Herbicides	Metals (specify)	DRO	GRO	Explosives	Anions (specify)	Comments:
[illegible]	UST-61-22-08-7-05	7-21-05	1040	AQ	3	3					3	3										
[illegible]	61-Dup1-7-05	7-21-05	0900	AQ	3	3					3	3										
[illegible]	UST-61-22-09-7-05	7-21-05	1350	AQ	4	4					4	4										
[illegible]	UST-33-35-15-12-7-05	7-21-05	1410	AQ	3	3					3	3										MS/MSD
[illegible]	UST-33-35-Dup2-7-05	7-21-05	1300	AQ	3	3					3	3										
[illegible]	UST-33-35-15-11-7-05	7-21-05	1447	AQ	9	9					9	9										~~MS/MSD~~ SAW
[illegible]	UST-33-35-15-09-7-05	7-21-05	1533	AQ	3	3					3	3										MS/MSD
[illegible]	UST-33-35-15-10-7-05	7-21-05	1615	AQ	3	3					3	3										
[illegible]	UST-33-35-15-14-7-05	7-21-05	1641	AQ	3	3					3	3										
[illegible]	UST-33-35-15-15-7-05	7-21-05	1654	AQ	3	3					3	3										

CUSTODY

Relinquished By:	Sto Winkop	Date/Time:	7-25-05/1900	Received By:	Shipped	Date/Time:
Relinquished By:		Date/Time:		Received By:		Date/Time: 07/26/05 0800AM

By signing the request (chain of custody) you are ordering work from Analytical Management Laboratories, Inc. which constitutes the acceptance of the terms and conditiions on the back of this form.

Delivery Method
☐ Delivered in Person
☑ Courier UPS
☐ Airbill # Z389376211001557[illegible]

Custody Seals
☑ Yes ☐ No
☐ Intact
☐ Broken

Coolant
☑ Ice
☐ Blue Ice
☐ None

Cooler Temp
[illegible]
☑ Temp Blank
☐ [illegible]

Receiving Comments:

Analytical Management Laboratories, Inc.

15130 South Keeler
Olathe, Kansas 66062
Phone (913) 829-0101
Fax (913) 829-1181

33722

Page 2 of 3

Chain of Custody Record / Request for Analysis

Client Contact Name: Mark Harrison
Company Name: USACE
Address: 100 W. Oglethorpe Ave.
City, State, Zip: Savannah GA. 31401
Phone #: (912) 652-5151 Ext:
Fax #: (912) 652-5311
Email:

Project Name: Ft. Stewart
Project Number: 0005
Purchase Order Number:
Project Due Date:
Project Comments:
Sampler's Signature: St Wi

Laboratory Project Number:

Analyses/Method to be Performed (Check all that apply)

Preservative: List total number of bottles for each preservative type.

Please include any information that may be useful in the analysis of the sample.
Example: high concentration
List analytes
MS/MSD

Lab ID	Sample Description	Date	Time	Matrix	Total # Containers	HCl	HNO_3	NaOH	H_2SO_4	Unpreserved	4° C	VOCs	SVOCs	Pesticides	PCBs	Herbicides	Metals (specify)	DRO	GRO	Explosives	Anions (specify)	Comments:
										Specify method # --->		8260										
33626-11	UST-33-35-15-13-7-05	7-21-05	1730	AQ	3	3					3	3										
33626-12	UST-33-35-Blk1-7-05	7-21-05	1800	AQ	3	3					3	3										
33626-13	UST-82-32-10-7-05	7-22-05	0800	AQ	3	3					3	3										
33626-14	UST-82-32-11-7-05	7-22-05	0844	AQ	9	9					9	9										ms/msD
33626-15	Trip Blank			AQ	2	2					2	2										
33626-16	UST-82-Dup1-7-05	7-22-05	0815	AQ	3	3					3	3										
33626-17	UST-82-32-7-7-05	7-22-05	0942	AQ	3	3					3	3										
33626-18	UST-82-32-8-7-05	7-22-05	1025	AQ	3	3					3	3										
33626-19	UST-82-Blk1-7-05	7-22-05	1030	AQ	3	3					3	3										
33626-20	UST-210-43-09-7-05	7-22-05	1230	AQ	6	6					6	6										ms/msD

CUSTODY

Relinquished By:	Steve Wi	Date/Time:	7-25-05/1800	Received By:	Shipped	Date/Time:	
Relinquished By:		Date/Time:		Received By:		Date/Time:	07/26/05 0800am

By signing the request (chain of custody) you are ordering work from Analytical Management Laboratories, Inc. which constitutes the acceptance of the terms and conditiions on the back of this form.

Delivery Method	Custody Seals	Coolant	Cooler Temp.	Receiving Comments:
☐ Delivered in Person ☑ Courier UPS ☐ Airbill #: 1Z5373621 10015596	☑ Yes ☐ No ☑ Intact ☐ Broken	☑ Ice ☐ Blue Ice ☐ None	2.1 °C ☑ Temp. Blank ☐ Cooler	

AML
Analytical Management Laboratories, Inc.
est. 1993

Certificate of Analysis

August 22, 2005

Mr. Mark Harvison
Project Chemist, CESAS-EN-GG
U.S. Army Corps of Engineers, Savannah District
100 W. Oglethorpe Ave.
P. O. Box 889
Savannah, GA 31401-3640
Phone: 912-652-5151
Fax: 912-652-5311

Dear Mr. Harvison:

Project Name: **Ft Stewart**
W912-HN-05-D-0013, Task Order No. 0005
AML Work Order Number: 7327

Attached, please find the hardcopy analytical report (56 total pages) for environmental samples collected by USACE-SAV for the project described above. Problems encountered in the analysis of these samples are documented in the laboratory case narrative. The electronic data deliverables (EDDs) for this report will be e-mailed within a few days of this report. Please feel free to contact me by phone (913-829-0101-ext. 24), fax (913-829-1181) or email (klindquist@amlabinc.com) if you have any questions.

Respectfully Submitted,

Kendall L. Lindquist, MBA
Operations Manager

The test results contained within this report meet or exceed the requirements of NELAC and/or the specific certification program that is applicable. NELAP Accrediting Authority : Kansas Department of Health and Environment

- **Safe Drinking Water Act (Drinking Water)**
- **Clean Water Act (Waste Water)**
- **Soil/Hazardous Waste**

Certificate Number: E-10254 - Effective Date: 05/01/2005 - Expiration Date: 04/30/2006
Florida: E87892 North Carolina: 627 South Carolina: 76003001

General Case Narrative

Project Name: **Ft Stewart**
W912-HN-05-D-0013, Task Order No. 0005
AML Work Order Number: 7327

Project and Sample Information

Task order information, completed copies of the chain of custody form(s), and Analytical Management Laboratories (AML) sample condition upon receipt form (s) are included in the Sample Information section. The AML laboratory information management system (LIMS)-generated sample status and receipt report, showing field sample identifiers and corresponding laboratory identifiers is also included. When applicable, the suffix, F has been appended to field sample numbers for samples that have been filtered in the field or laboratory. Separate AML laboratory sample numbers are normally assigned to filtered and unfiltered samples. When applicable, AML VOC soil sample collection and preservation record showing field sample weights and preservation procedures are also included in this section.

Reports

The hardcopy laboratory reports and electronic data deliverables (EDDs) were prepared using a Horizon/Chemware LIMS. Under the procedure used by the laboratory, the hardcopy reports are actually generated using information contained in a database, which is also used to generate electronic deliverables. This procedure was implemented to assure data integrity between the two media. The attached report is organized as follows:

Cover Letter
Laboratory Case Narrative
Sample Information
Sample Result Forms, organized in the following order: by fraction and by sample.

QC Summary organized in the following order: by fraction, by matrix, and by analytical batch number. The QC Summary for each analytical batch contain the following, when applicable:

1. QC Association Form or Method Blank Summary (EPA CLP Form-4 equivalents)
2. Surrogate Recovery Summary, when applicable (EPA CLP Form-2 equivalents)
3. Method Blank (MB) Results (EPA CLP Form-1 equivalents)
4. Laboratory Control Sample (LCS) Results (EPA Form-1 equivalents)
5. LCS duplicate (LCSD) Results (EPA Form-1 equivalents), when available
6. Matrix Spike (MS) Results (EPA Form-1 equivalents)
7. MS duplicate (MSD) Results (EPA CLP Form-1 equivalents)
8. LCS Recoveries Summary (EPA Form-3 equivalents)
9. LCSD (when applicable) Recoveries and RPD Summary (EPA Form-3 equivalents)

10. MS Recoveries Summary (EPA Form-3 equivalents); and
11. MSD Recoveries and RPD Summary (EPA CLP Form-3 equivalents)
12. Post Digestion Spike (PDS) study Results, when applicable (EPA Form-1 equivalents)
13. Serial Dilution (SD) study Results, when applicable (EPA Form-1 equivalents)
14. PDS Recoveries Summary (EPA Form-3 equivalents)
15. RPD for SD results, when applicable (EPA Form-3 equivalents)

Sample Result Forms

Sample results are shown on modified CLP Form 1 equivalents with the following qualifiers:
U = Not detected or detected below method detection limit (MDL) or reliable detection limit (RDL).
J = Detected above MDL or RDL but below the method quantitation limit (MQL).
J = RPD >40% between primary and confirmation column results for GC and HPLC methods.
E = Detected at levels in excess of the upper calibration limit.
R = Rejected due to significant QA outliers.
MDLs, and MQLs have been adjusted for sample weight or volume, dilution, and percent solids, when applicable. Quantitative results for analytes detected in the sample (positive results) are shown under the column labeled "Result". Results coded with the qualifier E should not be used unless additional analyses were unavailable due to other limitations. Data coded as E should not be compared to other data since non-linearity in calibration may be a severe problem for some analytes.

MDL=Method Detection Limit (Lowest amount that can be reported as positive based on statistical considerations).

LLR = Lowest Level for reporting (MDL<LLR<MQL). This is the lowest amount that AML reports as positive on a routine basis. The LLR is typically one half of the MQL in our laboratories. However, it can be as low as the MDL and it equals MDL for some parameters. The center of excellence (CX) at Omaha has been pushing the laboratories to use 'RDL or Reliable detection limit" as the equivalent of LLR. However, RDL is defined as two times the MDL, which makes it very difficult for the laboratories to use this term.

MQL=Method Quantitation Limit. It is the lowest point on our calibration curve. It is the equivalent of the reporting limit (RL) and/or practical quantitation limit (PQL) used by most laboratories. The term "Reporting Limit" has become meaningless since the laboratories are required to report results below this limit as an estimated result with a "J" flag).

Multiple sample result forms may be provided for one or more of the following reasons, if in the professional judgment of the laboratory that sample results for a given compound may be more accurate from one of the multiple analyses:
Sample was reanalyzed for surrogate recovery outliers;
Sample was reanalyzed at a dilution;
One of the analyses was performed outside holding times; and

A replicate analysis was performed for internal quality control purposes

QC Association Forms

The list consisting of MB, LCS, LCSD (if any), MS (whenever available), MSD (whenever available), and field samples associated with each QC batch are shown on QC Association Forms, which are CLP Form-4 equivalents. Additional items such as PDS, SD (and CCAL) may be included for some parameters. Separate forms are included for each QC batch for each matrix and fraction. The QC batch numbers shown on these reports are based on LIMS.

Surrogate Recovery Forms (when applicable)

A summary of the system monitoring compound recoveries for organic analyses is included in this section. EPA CLP Form 2 equivalents are used to report surrogate recoveries. The QC limits from the Department of Defense Quality Systems Manual for Environmental Laboratories, Final Version 2, June 2002 (DoD QSM) is used with the exception of VOCs since limits are incomplete for all the surrogates in soil. The QC limits from USACE EM 200-1-3, Appendix I (Shell) are used for VOCs. The Shell document requires limits for controlled matrices (MB, LCS, and LCSD) to be tighter than those for actual matrix samples (MS, MSD, and samples). Corrective action involving re-extraction and/or reanalysis is performed for samples that exceed the surrogate QC limits. Specific corrective action procedures employed for this project and test-specific requirements are described in parameter-specific case narratives.

Method Blank Result Forms

Laboratory method blank samples were analyzed with each QC batch as described in the QC Association Form. Analytical results for method blanks are shown on CLP Form 1 equivalents. They include data for all target compounds/analytes and surrogates. The MB amount should not exceed one half of the applicable MQL for each target analyte with the exception of common laboratory contaminants. The source of contamination is investigated, corrected, and reanalysis performed whenever possible if the blank contamination above one half of the MQL exceeds 1/10 of the specified regulatory limit and/or the measured concentration of any sample in the associated QC sample batch. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Laboratory Control Sample (LCS) Report Forms

Laboratory control samples were analyzed with each QC batch as described in the QC Association Form. LCS results of these QC analyses are shown in CLP Form 1. LCS recoveries and RPDs for duplicates (if performed) are shown on EPA Form-3 equivalents. The laboratory statistical control (3-sigma) and marginal (4-sigma) exceedence (ME) limits are compared periodically with QC limits from DoD QSM, which are used as default limits in this report. When the 3-sigma control limit is exceeded for any analyte, associated data is flagged "ME" and 4-sigma ME limits are applied automatically. The total number of method analytes, and the number of ME analytes are tracked and compared against the number allowed per DoD QSM. This information is also provided at the bottom of each Form-3 report. Analytes with LCS recoveries that exceed the 4-sigma limits are flagged ME* and reanalysis will be required for the affected analyte if it is a contaminant of concern. If the number of marginal exceedences are greater than those allowed by DoD QSM, reanalysis of the affected QC batch is performed. The relative percent difference (RPDs) for the LCS duplicates, a voluntary laboratory QC parameter is also computed to track in-house precision and provided on Form-3 reports for duplicates. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Matrix Spike/Matrix Spike Duplicate Recoveries Report Forms
The MS/MSD results are shown in EPA CLP Form-1 equivalents. See section on LCS for additional details. The RPDs for MS duplicates that are outside the applicable QC limits are flagged with an asterisk (*). The effect of matrix is taken into account in determining corrective action procedures based on MS and MSD results, recoveries, and RPD. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Calibration
Instruments were calibrated in accordance with applicable method. Deviations are shown in parameter-specific case narratives. Copies of initial calibration and calibration verification summaries and associated raw data will be maintained in project files and made available for detailed client review, if necessary.

Test Methods and Holding Times
Analyses were performed within applicable holding times except as noted in parameter-specific case narratives.

Batch-specific Quality Control Procedures
Quality control data from method blanks and laboratory control samples are used as batch QC elements. In accordance with EPA, USACE, and DoD guidelines, QC data from matrix spikes are used as matrix-specific QC elements and QC data from surrogates, internal standard areas, etc. are used as sample-specific QC elements. When the batch QC elements are outside their QC limits, results for associated samples are evaluated and corrective actions that affect the entire sample set are performed. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Matrix-specific or Sample-specific Quality Control Procedures
Sample concentrations exceeding the upper calibration limit, surrogate recoveries outside the QC limits, calibration parameters (e.g. ICAL, CALV, ICV, CCV, ICB, CCB, etc.) not within QC limits, etc. are used as sample-specific and/or sample-group specific QC elements for one or more associated samples during instrumental analysis. Serial dilution, standard addition, MS recoveries, etc. are used as matrix-specific QC elements for one or more associated samples. When these QC elements are outside their QC limits, associated individual sample results are evaluated and appropriate corrective actions are performed. Specific corrective action procedures employed for this project are described in parameter-specific case narratives.

Manual Integration

Manual integration operations that have potential to improve accuracy of analysis are performed, as necessary (shown with a "M" flag on raw data) based on visual inspection of peak shapes for each target analyte. Such operations are technically defensible and they are not aimed at meeting the minimum technical requirements of the analytical procedure.

Statement

To the best of our knowledge, this data package is in compliance with the terms and conditions of the contract/purchase order/delivery order/task order as applicable, both technically and for completeness, for other than the conditions detailed in this case narrative. The quality assurance manager or his designee, as verified by the signature on the cover letter has authorized release of data contained in this report. In accordance with NELAP guidelines and our certificate (No. E-10254) requirements, this report has been paginated and it may not be reproduced for distribution, except in full, without written approval from Analytical Management Laboratories.

VOCs Analysis

Calibration and sample analyses were performed using GC/MS by SW-846 Method 8260B. The BFB tune criteria were met for the analyses. Corrective actions were attempted in response to QC outliers requiring such action as described below. When corrective actions were not successful, data released by the laboratory may require qualification for usability in accordance with client procedures and project requirements.

Initial Calibration (ICAL) -Water

Six-point initial calibration (2-µg/L to 60-µg/L) was employed. The response factors for the SPCC compounds and the %RSDs for the CCC compounds were within method QC limits for the ICAL. The %RSDs for the mean response factor of the target compounds were within QC limits (15% desirable and 30% maximum) for a vast majority of the target compounds. The response factor method was employed for quantitation with linear/non-linear regression methods for a small subset of target compounds that did not meet the recommended 15% RSD criterion. Acceptable initial calibrations were not obtained for the following compounds, which were detected in project samples: None.

Initial Calibration Verification (ICV)

A second source standard was employed for the ICV. The QC recovery limits are 80% to 120% for both aqueous and soil samples. There is no allowance for any outliers.

Continuing Calibration Verification (CCVs)

A same source standard was employed for the CCV. The instrument tune and response factors for the SPCC compounds and the %RSDs for the CCC compounds were within method QC limits for the CCVs. Acceptable CCVs were not obtained for the following compounds, which were detected in project samples: None.

Method Blank
No significant anomalies were noted with the exception of the random detection of common laboratory contaminants.
Water - QC Batch 2669: None.
Water - QC Batch 2687: None.

Surrogate Recoveries
Four SW-846 Method 8260B surrogates were employed. The recoveries for all four surrogates should be within QC limits for acceptability of the data. The USACE Shell limits are applied for environmental samples (70-130 for all samples, MS, and MSD) and interference-free matrices (80-120 for water and 75-125 for soil MB, LCS, and LCSD). Samples exceeding QC limits are re-analyzed using dilution, if necessary. Surrogate recoveries were within QC limits for the project samples with the following exception(s):
Water - QC Batch 2669: None.
Water - QC Batch 2687: None.

Laboratory Control Sample Recoveries
The DoD QSM LCS control and marginal exceedence limits are listed in the LCS/LCSD recovery form for aqueous and soil samples. The statistically allowable number of sporadic marginal failures (SMFs) or marginal exceedences (ME) based on the number of target compounds for this method is 3. Expanded SMF QC limits are applicable for the SMF compounds. Compounds that may have recoveries outside the QC limits in the LCS may be within the QC limits in the LCSD. QC outliers requiring corrective action:
Water - QC Batch 2669: None.
Water - QC Batch 2687: None.

Matrix Spike Recoveries
Additional sample vials were collected for matrix spike analysis on two project samples (169701 and 169711. The DoD QSM QC control and marginal exceedence limits are listed in the MS/MSD recovery form for aqueous and soil samples. Expanded SMF QC limits are applicable for the 3 allowable SMF compounds. Compounds that may have recoveries outside the QC limits in the MS may be within the QC limits in MSD.
QC outliers requiring corrective action:
Water - QC Batch 2669: None.
Water - QC Batch 2687: None.

Matrix Spike Duplicates
The %RPD for matrix spike duplicate results are calculated to assess precision.
QC outliers requiring corrective action:
Water - QC Batch 2669: None.
Water - QC Batch 2687: None.

Internal Standard Areas and Retention Times
Three SW-846 internal standard (IS) are used for calibration and analysis. Internal standard (IS) areas for the associated samples ±50% of the areas

observed for the ICV, beginning CCV, or the mid-point of the ICAL for all three internal standards. The IS retention times for the associated samples should also be within QC limits (±30-seconds of those for the nearest CCV). Samples exceeding QC limits are re-analyzed using dilution, if necessary. QC outliers requiring corrective action:
Water - QC Batch 2669: None.
Water - QC Batch 2687: None.

Project Samples:
Water - QC Batch 2669: Benzene was over the initial calibration range in sample 732707. As a corrective action, the sample was reanalyzed at a dilution (1/5) in Batch 2687.
Water - QC Batch 2687: None.

Field Sample Information

(COC, Sample Status and Receipt Report, Sample Condition
Upon Receipt Report)

SDG 7327

(Sample Delivery Group Number)

Analytical Management Laboratories, Inc.

15130 South Keeler
Olathe, Kansas 66062
Phone (913) 829-0101
Fax (913) 829-1181

33726

Page 3 of 3

Chain of Custody Record / Request for Analysis

Client Contact Name: Mark Harrison
Company Name: USACE
Address: 100 W. Oglethorpe Ave.
City, State, Zip: Savannah GA. 31401
Phone #: (912) 652-5851 Ext:
Fax #: (912) 652-5311
Email:

Project Name: Ft. Stewart
Project Number: 0005
Purchase Order Number:
Project Due Date:
Project Comments:
Sampler's Signature: St Widup

Analyses/Method to be Performed (Check all that apply)

Laboratory Project Number: 33227

Preservative: List total number of bottles for each preservative type.

Please include any information that may be useful in the analysis of the sample. Example: high concentration, List analytes, MS/MSD

Lab ID	Sample Description	Date	Time	Matrix	Total # Containers	HCl	HNO_3	NaOH	H_2SO_4	Unpreserved	4° C	VOCs	SVOCs	Pesticides	PCBs	Herbicides	Metals (specify)	DRO	GRO	Explosives	Anions (specify)	Comments:
Specify method # --->												8260										
33227-01	UST-210-Dup1-7-05	7-22-05	1260	AQ	3	3					3	3										
33227-02	UST-210-43-10-7-05	7-22-05	1310	AQ	3	3					3	3										
33227-03	UST-210-BlK1-7-05	7-22-05	1315	AQ	3	3					3	3										
MS/MSD 33227-04	UST-208-209-42-5-7-05	7-22-05	1350	AQ	9	9					9	9										
33227-05	UST-208-209-Dup1-7-05	7-22-05	1330	AQ	3	3					3	3										MS/MSD
33227-06	UST-208-209-42-12-7-05	7-22-05	1440	AQ	3	3					3	3										
33227-07	UST-208-209-42-10-7-05	7-22-05	1456	AQ	3	3					3	3										
33227-08	UST-208-209-42-11-7-05	7-22-05	1525	AQ	3	3					3	3										Time-1456
	~~UST-208-209-42-7-7-05~~	~~7-22-05~~		~~AQ~~																		
33227-09	UST-208-209-BlK1-7-05	7-22-05	1600	AQ	3	3					3	3										SOW

CUSTODY					
Relinquished By: Steve Widup	Date/Time: 7-25-05/1800	Received By: Shipped	Date/Time:		
Relinquished By:	Date/Time:	Received By:	Date/Time: 07/26/05 0800am		

By signing the request (chain of custody) you are ordering work from Analytical Management Laboratories, Inc. which constitutes the acceptance of the terms and conditiions on the back of this form.

Delivery Method	Custody Seals	Coolant	Cooler Temp	Receiving Comments:
☐ Delivered by Client ☑ Courier ☑ Airbill #: 589376211001 5876	☐ Yes ☐ No ☐ Intact ☐ Broken	☑ Ice ☐ Blue Ice ☐ None	2 ☐ Temp. Blank ☐ Cooler	

1A - Equivalent

VOLATILE ORGANICS ANALYSIS DATA SHEET

Lab Name:	Analytical Managment Laboratories	Sample ID:	UST-208-209-42-5-7-05
Client ID:	CESAS	Project ID	Ft Stewart, DO# 0005
Matrix:	W	Project Num	7327
Sample g/ml:	25	Lab Sample ID:	732704
% Solids: not dec.		Date Collected:	7/22/05 Time: 13:50
Instrument ID	V5973B	Dilution Factor:	1
Analytical Method:	8260B	Date Analyzed:	8/1/05 Time: 15:32
Prep Method:	EPA 5030	Date Received:	7/26/05 8:00:00 AM
Analytical Batch:	2669		

CAS NO.	COMPOUND	RESULT	Units	Q	LLR	MQL
71-43-2	Benzene		µg/l	U	0.139	2
100-41-4	Ethylbenzene		µg/l	U	0.1	2
1634-04-4	Methyl-tert-butyl-ether		µg/l	U	0.1	2
m+p xylene	m-Xylene and p-Xylene		µg/l	U	0.216	2
91-20-3	Naphthalene		µg/l	U	0.139	2
95-47-6	o-Xylene		µg/l	U	0.102	2
108-88-3	Toluene		µg/l	U	0.105	2

EPA Lab Code:KS00902

Kansas Certification:E-10254

1A - Equivalent
VOLATILE ORGANICS ANALYSIS DATA SHEET

Lab Name: Analytical Managment Laboratories
Client ID: CESAS
Matrix: W
Sample g/ml: 25
% Solids: not dec.
Instrument ID V5973B
Analytical Method: 8260B
Prep Method: EPA 5030
Analytical Batch: 2687

Sample ID: UST-208-209-42-10-7-05
Project ID Ft Stewart, DO# 0005
Project Num 7327
Lab Sample ID: 732707
Date Collected: 7/22/05 Time: 14:56
Dilution Factor: 5
Date Analyzed: 8/4/05 Time: 0:07
Date Received: 7/26/05 8:00:00 AM

CAS NO.	COMPOUND	RESULT	Units	Q	LLR	MQL
71-43-2	Benzene	55.2	µg/l		0.695	10
100-41-4	Ethylbenzene	6.41	µg/l	J	0.5	10
1634-04-4	Methyl-tert-butyl-ether	79.8	µg/l		0.5	10
m+p xylene	m-Xylene and p-Xylene	86.8	µg/l		1.08	10
91-20-3	Naphthalene	79.9	µg/l		0.695	10
95-47-6	o-Xylene	49.3	µg/l		0.51	10
108-88-3	Toluene	1.4	µg/l	J	0.525	10

EPA Lab Code:KS00902
Kansas Certification:E-10254

FORM I VOA - Equivalent

1A - Equivalent

VOLATILE ORGANICS ANALYSIS DATA SHEET

Lab Name: Analytical Managment Laboratories

Client ID: CESAS

Matrix: W

Sample g/ml: 25

% Solids: not dec.

Instrument ID V5973B

Analytical Method: 8260B

Prep Method: EPA 5030

Analytical Batch: 2669

Sample ID: UST-208-209-42-11-7-05

Project ID Ft Stewart, DO# 0005

Project Num 7327

Lab Sample ID: 732708

Date Collected: 7/22/05 Time: 15:25

Dilution Factor: 1

Date Analyzed: 8/1/05 Time: 17:05

Date Received: 7/26/05 8:00:00 AM

CAS NO.	***COMPOUND***	***RESULT***	***Units***	***Q***	***LLR***	***MQL***
71-43-2	Benzene		µg/l	U	0.139	2
100-41-4	Ethylbenzene		µg/l	U	0.1	2
1634-04-4	Methyl-tert-butyl-ether	9.94	µg/l		0.1	2
m+p xylene	m-Xylene and p-Xylene	2.28	µg/l		0.216	2
91-20-3	Naphthalene	9.86	µg/l		0.139	2
95-47-6	o-Xylene	1.6	µg/l	J	0.102	2
108-88-3	Toluene		µg/l	U	0.105	2

EPA Lab Code:KS00902

Kansas Certification:E-10254

1A - Equivalent

VOLATILE ORGANICS ANALYSIS DATA SHEET

Lab Name:	Analytical Managment Laboratories	Sample ID:	UST-208-209-42-12-7-05
Client ID:	CESAS	Project ID	Ft Stewart, DO# 0005
Matrix:	W	Project Num	7327
Sample g/ml:	25	Lab Sample ID:	732706
% Solids: not dec.		Date Collected:	7/22/05 Time: 14:40
Instrument ID	V5973B	Dilution Factor:	1
Analytical Method:	8260B	Date Analyzed:	8/1/05 Time: 16:17
Prep Method:	EPA 5030	Date Received:	7/26/05 8:00:00 AM
Analytical Batch:	2669		

CAS NO.	COMPOUND	RESULT	Units	Q	LLR	MQL
71-43-2	Benzene		µg/l	U	0.139	2
100-41-4	Ethylbenzene		µg/l	U	0.1	2
1634-04-4	Methyl-tert-butyl-ether		µg/l	U	0.1	2
m+p xylene	m-Xylene and p-Xylene		µg/l	U	0.216	2
91-20-3	Naphthalene		µg/l	U	0.139	2
95-47-6	o-Xylene		µg/l	U	0.102	2
108-88-3	Toluene		µg/l	U	0.105	2

EPA Lab Code:KS00902

Kansas Certification:E-10254

FORM I VOA - Equivalent

APPENDIX IV

SITE RANKING FORMS

SITE RANKING FORM

Facility Name: USTs 208 & 209, Building 275 **Ranked by:** Z. Haverland

County: Liberty **Facility ID #:** 9-089036 **Date Ranked:** 9/29/2005

SOIL CONTAMINATION

A. Total PAHs –
Maximum Concentration found on the site
(Assume <0.660 mg/kg if only gasoline was stored on site)

☐ ≤0.660 mg/kg = 0
☐ >0.66 - 1 mg/kg = 10
☐ >1 - 10 mg/kg = 25
* ☒ >10 mg/kg = 50

** CAP-Part A Soil Sample 4203B1*

B. Total Benzene -
Maximum Concentration found on the site

☐ ≤0.005 mg/kg = 0
☐ >0.005 - .05 mg/kg = 1
☐ >0.05 - 1 mg/kg = 10
* ☒ >1 - 10 mg/kg = 25
☐ >10 - 50 mg/kg = 40
☐ >50 mg/kg = 50

** CAP-Part A Soil Sample 4203B1*

C. Depth to Groundwater
(bls = below land surface)

☐ >50' bls = 1
☐ >25' - 50' bls = 2
☐ >10' - 25' bls = 5
☒ ≤10' bls = 10

Fill in the blanks: (A. 50) + (B. 25) = (75) x (C. 10) = (D. 750)

GROUNDWATER CONTAMINATION

E. Free Product (Nonaqueous-phase liquid hydrocarbons; See Guidelines For definition of "sheen").

☐ No free product = 0
☐ Sheen - 1/8" = 250
☒ >1/8" - 6" = 500
☐ >6" - 1ft. = 1,000
☐ For every additional inch, add another 100 points = 1,000 + ______

F. Dissolved Benzene -
Maximum Concentration at the site
(One well must be located at the source of the release.)

☐ ≤5 µg/L = 0
☒ >5 - 100 µg/L = 5
☐ >100 - 1,000 µg/L = 50
☐ >1,000 - 10,000 µg/L = 500
☐ >10,000 µg/L = 1500

Fill in the blanks: (E. 1000) + (F. 5) = (G. 1005)

Facility Name: USTs 208 & 209, Building 275 **County:** Liberty **Facility ID #:** 9-089036

POTENTIAL RECEPTORS (MUST BE FIELD-VERIFIED)

Distance from nearest contaminant plume boundary to the nearest downgradient and hydraulically connected Point of Withdrawal for water supply. **If the point of withdrawal is not hydraulically connected, evidence as outlined in the CAP-A guidance document MUST be presented to substantiate this claim.**

H. Public Water Supply

☐ Impacted = 2000
☐ ≤500' = 500
☐ >500' - ¼ mi = 25
☐ ¼ mi - 1 mi = 10
☐ >1 mi - 2 mi = 2
* ☒ > 2 mi = 0

For lower susceptibility areas only:
☐ >1 mi = 0

I. Non-Public Water Supply

☐ Impacted = 1000
☐ ≤100' = 500
☐ >100' - 500' = 25
☐ >500' - ¼ mi = 5
☐ >¼ - ½ mi = 2
☒ >½ mi = 0

For lower susceptibility areas only:
☐ >¼ mi = 0

Note: If site is in lower susceptibility area, do not use the shaded areas.

* For justification that withdrawal point is not hydraulically connected, see attached text.

J. Distance from nearest Contaminant Plume boundary to downgradient Surface Waters **OR UTILITY TRENCHES & VAULTS** (a utility trench may be omitted from ranking if its invert elevation is more than 5 feet above the water table)

☐ Impacted = 500
* ☒ ≤500' = 50
☐ >500' - 1,000' = 5
☐ >1,000' = 2

** Concentrations at the storm drain do not exceed IWQS*

K. Distance from any Free Product to basements and crawl spaces

☐ Impacted = 500
☐ <500' = 50
☐ >500' - 1,000' = 5
☒ >1,000' or no free product. = 0

Fill in the blanks: (H.__0__) + (I.__0__) + (J.__50__)+ (K.__0__) = L.__50__

(G.__1005__) x (L.__50__) = M.__50250__

(M.__50250__) + (D.__750__) = N.__51000__

P. **SUSCEPTIBILITY AREA MULTIPLIER**

☐ If site is located in a Low Ground-Water Pollution Susceptibility Area = 0.5

☒ All other sites = 1

Q. **EXPLOSION HAZARD**

Have any explosive petroleum vapors, possibly originating from this release, been detected in any subsurface structure (e.g., utility trenches, basements, vaults, crawl spaces, etc.)?

☐ Yes = 200,000

☒ No = 0

Fill in the blanks: (N.__51000__) x (P.__1__) = (__51000__) + (Q.__0__)

= __51000 (Based on CAP Part A soil data and July 2005 ground-water data)__
ENVIRONMENTAL SENSITIVITY SCORE

OTHER GEOLOGIC AND HYDROLOGIC DATA

The following information is presented to provide supplemental information to Item H of the Site Ranking Form and provides detailed information relating to the geologic and hydrogeologic conditions at Fort Stewart, which supports Fort Stewart's determination that the water withdrawal point(s) located at Fort Stewart are not hydraulically connected to the surficial aquifer.

1.0 REGIONAL AND LOCAL GEOLOGY

Fort Stewart is located within the coastal plain physiographic province. This province is typified by nine southeastward dipping strata that increase in thickness from 0 feet at the fall line located approximately 150 miles inland from the Atlantic coast, to approximately 4,200 feet at the coast. State geologic records describe a probable petroleum exploration well (the No. 1 Jelks-Rogers) located in the region as encountering crystalline basement rocks at a depth of 4,254 feet BGS. This well provides the most complete record for Cretaceous, Tertiary, and Quaternary sedimentary strata in the region.

The Cretaceous section was found to be approximately 1,970 feet thick and dominated by clastics. The Tertiary section was found to be approximately 2,170 feet thick and dominated by limestone with a 175-foot-thick cap of dark green phosphatic clay. This clay is regionally extensive and is known as the Hawthorn Group. The interval from approximately 110 feet to the surface is Quaternary in age and composed primarily of sand with interbeds of clay or silt. This section is undifferentiated into separate formations (Herrick and Vochis 1963).

State geologic records contain information regarding a well drilled in October 1942, 1.8 miles north of Flemington at Liberty Field of Camp Stewart (now known as Fort Stewart). This well is believed to be an artesian well located approximately one-quarter mile north of the runway at Wright Army Airfield within the Fort Stewart Military Reservation. The log for this well describes a 410-foot section, the lowermost 110 feet of which consisted predominantly of limestone sediments, above which 245 feet of dark green phosphatic clay typical of the Hawthorn Group was encountered. The uppermost portion of the section was found to be Quaternary-age interbedded sands and clays. The top 15 feet of these sediments were described as sandy clay (Herrick and Vochis 1963).

The surface soil located throughout the Fort Stewart garrison area consists of Stilson loamy sand. The surface layer of this soil is typically dark grayish-brown loamy sand measuring approximately 6 inches in depth. The surface layer is underlain by material consisting of pale yellow loamy sand and extends to a depth of approximately 29 inches. The subsoil is dominantly sandy clay loam and extends to a depth of 72 inches or more (Herrick and Vochis 1963).

2.0 REGIONAL AND LOCAL HYDROGEOLOGY

The hydrogeology in the vicinity of Fort Stewart is dominated by two aquifers referred to as the Principal Artesian and the surficial aquifers. The Principal Artesian aquifer is the lowermost hydrologic unit and is regionally extensive from South Carolina through Georgia, Alabama, and most of Florida. Known elsewhere as the Floridan, this aquifer is composed primarily of Tertiary-age limestone, including the Bug Island Formation, the Ocala Group, and the Suwannee Limestone. These formations are approximately 800 feet thick, and ground water from this aquifer is used primarily for drinking water (Arora 1984).

The uppermost hydrologic unit is the surficial aquifer, which consists of widely varying amounts of sand and clay ranging from 55 to 150 feet in thickness. This aquifer is primarily used for domestic lawn and agricultural irrigation. The top of the water table ranges from approximately 2 to 10 feet BGS (Geraghty and Miller 1993). The base of the aquifer corresponds to the top of the underlying dense clay of the Hawthorn Group. The Hawthorn Group was not encountered during drilling at this site but is believed to be located at 40 to 50 feet BGS; thus, the effective aquifer thickness would be approximately 35 to 45 feet. Soil surveys for Liberty and Long Counties describe the occurrence of a perched water table within the Stilson loamy sands present within Fort Stewart (Looper 1980).

The confining layer for the Principal Artesian aquifer is the phosphatic clay of the Hawthorn Group and ranges in thickness from 15 to 90 feet. The vertical hydraulic conductivity of this confining unit is on the order of 10^{-8} cm/sec. There are minor occurrences of aquifer material within the Hawthorn Group; however, they have limited utilization (Miller 1990). The Hawthorn Group has been divided into three formations: Coosawhatchie Formation, Markshead Formation, and Parachula Formation, which are listed from youngest to oldest.

The Coosawhatchie Formation is composed predominantly of clay but also has sandy clay, argillaceous sand, and phosphorite units. The formation is approximately 170 feet thick in the Savannah Georgia area. This unit disconformably overlies the Markshead Formation and is distinguished from the underlying unit by dark phosphatic clays or phosphorite in the lower part and fine-grained sand in the upper part.

The Markshead Formation is approximately 70 feet thick in the Savannah Georgia area and consists of light-colored phosphatic, slightly dolomitic, argillaceous sand to fine-grained sandy clay with scattered beds of dolostone and limestone.

The Parachula Formation consists of sand, clay, limestone, and dolomite, and is approximately 10 feet thick in the Savannah, Georgia, area. The Parachula Formation generally overlies the Suwannee Limestone in Georgia.

Ground water encountered at all the underground storage tank investigation sites is part of the Surficial Aquifer system. Based on the fact that all public and non-public water supply wells draw water from the Principal (Floridan) Aquifer, and that the Hawthorn confining unit separates the Principal Aquifer from the Surficial Aquifer, it is concluded that there is no hydraulic interconnection between the Surficial Aquifer (and associated ground-water plumes, if applicable) located beneath former UST sites and identified water supply withdrawal points at Fort Stewart.

APPENDIX V

REIMBURSEMENT APPLICATION

Fort Stewart is a federally owned facility and has funded the investigation for the former USTs 208 & 209 site, Building 275, Facility ID #9-089036, using U.S. Department of Defense Environmental Restoration Account Funds. Application for Georgia Underground Storage Tank Trust Fund reimbursement is not being pursued at this time.

ATTACHMENT A

SUMMARY OF FATE AND TRANSPORT MODELING RESULTS

A.1 FATE AND TRANSPORT MODELING

A.1 FATE AND TRANSPORT MODELING

In summary, the Analytical Transient 1-, 2-, 3-Dimensional (AT123D) Model was used to model contaminant migration to three potential downgradient receptors: a storm drain located approximately 80 feet east of the tank pit, a drainage ditch located approximately 700 feet east of the site, and Peacock Creek located approximately 7500 feet east of the site. The invert elevation of the storm drain was located below the water table elevation and was considered a potential preferential pathway for contaminant migration.

A.1.1 Summary of CAP–Part B Report Fate and Transport Modeling Results

The fate and transport modeling performed as part of the *Corrective Action Plan–Part B Report for USTs 208 & 209, Facility IDs #9-089079, Building 275, Fort Stewart, Georgia* (SAIC 1998) was based on the analytical data collected during the CAP–Parts A and B investigations. This fate and transport model was based on the assumption that the source of contamination was removed at the time of the tank removal and was no longer present and the maximum observed benzene concentration in groundwater (i.e., 281 μg/L in temporary piezometer 42-07 during the CAP-Part A investigation). The ACLs for the site were calculated based on risk based methodology. The ACLs for the site were 990 μg/L for benzene and 30,000 μg/L for ethylbenzene. GA EPD USTMP approved the proposed ACLs in correspondence dated August 15, 1998 approving the CAP-Part B Report (Logan 1998).

After submittal of the CAP-Part B Report, GA EPD indicated that fate and transport modeling should assume a continuous source of contamination of infinite duration. As a result, the modeling results were revised in the First Annual Monitoring Only Report using these assumptions

A.1.2 Summary of First Annual Monitoring Only Report Fate and Transport Modeling Results

As a result of the benzene concentrations observed during the semiannual monitoring, the fate and transport modeling results were revised in the *First Annual Monitoring Only Report for USTs 208 & 209, Facility IDs #9-089035, Building 275, Fort Stewart, Georgia* (SAIC 1999) to reflect more recent site conditions. The revised fate and transport modeling that was based on the assumption of a continuous source of contamination of infinite duration at the site based on the maximum predicted or observed benzene concentration in groundwater. These modeling results were based on a liquid phase concentration of 1880 μg/L at the source due to partitioning from the maximum benzene soil concentration of 3.7 mg/kg observed in well 42-03 during the CAP-Part A investigation. The modeling results indicated that, due to dilution attenuation, benzene may reach the storm drain at a concentration of up to 240 μg/L. No detectable concentrations of benzene were predicted to reach the drainage ditch and Mill Creek at detectable concentrations. Based on modeling results, the estimated dilution attenuation factor (DAF) for benzene at the storm drain was 7.8, while the DAFs at the drainage ditch and Peacock Creek are infinity, indicating that the concentration at this receptor was predicted to be zero. Alternate concentration limits (ACLs) were not developed for the drainage ditch or Peacock Creek because the ACLs would be infinite. For the storm drain, the proposed ACL for benzene was 556 μg/L (i.e., 7.8 × 71.28 μg/L = 121 μg/L), the proposed ACL for ethylbenzene was 2.24E+05 (i.e., 7.8 × 28,718 μg/L = 2.24E+05 μg/L), and the proposed ACL for toluene was 1.56E+06 (i.e., 7.8 × 20,000 μg/L = 1.56E+06 μg/L).

A.1.3 Summary of Second Annual Monitoring Only Report Fate and Transport Modeling Results

As a result of the benzene concentrations observed during the semiannual monitoring, the fate and transport modeling results were revised in the *Second Annual Monitoring Only Report for USTs 208 & 209, Facility IDs #9-089035, Building 275, Fort Stewart, Georgia* (SAIC 200) to reflect more recent site conditions. The model was calibrated by matching the benzene concentration of 281 µg/L in well 42-07 on January 10, 1999, and 39 µg/L in well 42-10 on January 26, 2000. A source loading was assumed for a certain period of time to attain steady-state. Once the steady-state condition was reached, source loading was stopped and contamination was allowed to spread based on the contaminant mass already present in the aquifer from past loadings.

The revised modeling results indicated that, due to dilution attenuation, benzene does not impact the storm drain, located 80 feet downgradient of the former tank pit, at a concentration above the IWQS of 71.28 µg/L. No detectable concentrations of benzene were predicted to reach the drainage ditch and Peacock Creek. Based on the revised modeling results, the estimated DAF for benzene at the storm drain was revised to 16.1, while the DAFs at the drainage ditch and Peacock Creek remain at infinity, indicating that the concentrations at these receptors are predicted to be zero. The ACLs were not revised based on the latest modeling results .

A.1.4 Fate and Transport Modeling Conclusions

The conclusions below are based on fate and transport modeling that assumes a continuous source of contamination of infinite duration at the site based on the maximum observed benzene concentration in groundwater (i.e., 281 µg/L in January 1999) during the semiannual monitoring events.

- Benzene concentration in groundwater has never exceeded the benzene ACL of 556 µg/L during the CAP-Part A, CAP-Part B, or semiannual monitoring events.
- Benzene contamination does not impact the closest downgradient receptor, a storm drain, above the IWQS.
- Benzene contamination will never exceed the IWQS at the drainage ditch or Peacock Creek.

A.2 REFERENCES

Logan, William E. 1998. Letter to John Spears (Fort Stewart Directorate of Public Works, Environmental Branch), August 15, 1998.

SAIC (Science Applications International Corporation) 1998. *CAP-Part B Report for USTs 208 & 209, Facility ID #9-089036, Building 275, Fort Stewart, GA,* April.

SAIC 1999. *First Annual Monitoring Only Report for USTs 208 & 209, Facility ID #9-089036, Building 275, Fort Stewart, GA,* May.

SAIC 2000. *Second Annual Monitoring Only Report for USTs 208 & 209, Facility ID #9-089036, Building 275, Fort Stewart, GA,* May.