SITE: Former UST 117, HAA-09 R1, HAAF, GEORGIA

FSGA CAP-Part A submission to GA EPD -	5 June 2000
GA EPD CAP-Part A Approval -	5 Sep 2000
FSGA CAP-Part B Submittal -	6 Aug 2001
GA EPD Cap-Part B Review Comments -	28 Sep 2001
FSGA CAP-Part B Response to review comments with Revised CAP-Part B -	6 Nov 2001
GA EPD CAP-Part B Approval (letter not found) -	Unknown
GA EPD Approval of NFA -	6 Oct 2003
GA EPD NFA Approval -	26 Sep 2006

Georgia Department of Natural Resources

Environmental Protection Division
Underground Storage Tank Management Program
4244 International Parkway, Suite 104, Atlanta, Georgia 30354
Noel Holcomb, Commissioner
Carol A. Couch, Ph.D., Director
(404) 362-2687

September 26, 2006

Thomas C. Fry
U.S. Army/HQ 3rd Inf. Div. (Mech) and Ft. Stewart
Directorate of Public Works
1550 Frank Cochran Drive, Building 1137
Fort Stewart, GA 31314-4927

SUBJECT: UST Closure Report
No Further Action Required:
Hunter Army Airfield – UST 117
Bulk Fuel Farm-Building 7002
Hunter Army Airfield, Chatham County, GA
Facility ID: 9025113*1

Dear Mr. Fry:

The Georgia Underground Storage Tank Management Program (USTMP) has received your consultant's letter, dated August 25, 2006, that forwarded a properly prepared UST Closure Report. The report was prepared by CAPE Environmental, Inc.

Based on current requirements of the Georgia Underground Storage Tank Act, the Georgia Rules for Underground Storage Tank Management (GUST Rules) and the data submitted, the USTMP has determined that **no further action is required for the referenced release.**

However, further corrective action may be required if mandated through more stringent State or Federal statutory or regulatory changes. Additional measures may also be required if existing or future drinking water systems or surface water bodies within two miles of the site are impacted by any dissolved contamination resulting from this release, or if previously unidentified soil contamination, dissolved contamination or free product are identified as originating from this site.

If you have any questions, please contact me at 404.362.4529.

Sincerely,

William E. Logan
Senior Geologist
Corrective Action Unit II

WEL;
S: land/landdocs/williaml/pending06/9025113R1.34
cc: Steve Scavone, CAPE Inc.
Lisa L. Lewis, GA EPD
File (CA): CHATHAM; 9025113

Georgia Department of Natural Resources

Environmental Protection Division
Underground Storage Tank Management Program
4244 International Parkway, Suite 104, Atlanta, Georgia 30354
Lonice Barrett, Commissioner
David M. Word, Assistant Director
(404) 362-2687

October 6, 2003

Thomas C. Fry
U.S. Army/HQ 3rd Inf. Div. (Mech) and Ft. Stewart
Directorate of Public Works
1550 Frank Cochran Drive, Building 1137
Fort Stewart, GA 31314-4927

SUBJECT: Corrective Action Plan (CAP)-Part B Monitoring Report
No Further Action Required:
Hunter AAF, Former UST #117
Building 7002, Bulk Fuel Facility (HAA-09)
Savannah, Chatham County, GA
Facility ID: 9025113*1

Dear Mr. Fry:

The Georgia Underground Storage Tank Management Program (USTMP) has received your consultant's letter, dated September 8, 2003, that forwarded a properly certified CAP-Part B Monitoring Report. The report was prepared by Science Applications International Corporation (SAIC).

Based on current requirements of the Georgia Underground Storage Tank Act, the Georgia Rules for Underground Storage Tank Management (GUST Rules) and the data submitted, the USTMP has determined that **no further action is required for the referenced release. Please proceed with corrective action for Building 7009.**

However, further corrective action may be required if mandated through more stringent State or Federal statutory or regulatory changes. Additional measures may also be required if existing or future drinking water systems or surface water bodies within two miles of the site are impacted by any dissolved contamination resulting from this release, or if previously unidentified soil contamination, dissolved contamination or free product are identified as originating from this site.

Please submit a Completion Report and Certification, documenting that the associated monitoring wells have been properly abandoned, by **December 4, 2003**. If you have any questions, please contact William E. Logan at 404.362.4529.

Sincerely,

Lisa L. Lewis
Unit Coordinator
Corrective Action Unit II

WEL;
S: land/landdocs/williaml/pending03/9025113. 34
cc: Patricia A. Stoll, P.E., SAIC
Larry Rogers, GA EPD Coastal District
William E. Logan, GA EPD
File (CA): Chatham; 9025113

DEPARTMENT OF THE ARMY
HEADQUARTERS, 3D INFANTRY DIVISION (MECHANIZED) AND FORT STEWART
DIRECTORATE OF PUBLIC WORKS
1550 FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-4927

REPLY TO
ATTENTION OF

NOV 06 2001

Office of the Directorate

CERTIFIED MAIL
7099 3400 0010 5449 5248

Georgia Department of Natural Resources
Underground Storage Tank Management Program
Attention: Mr. William Logan
4244 International Parkway, Suite 104
Atlanta, Georgia 30354

Dear Mr. Logan:

Fort Stewart is pleased to receive the Georgia Environmental Protection Division's (GA EPD) correspondence dated September 28, 2001 providing review comments on the Corrective Action Plan (CAP)-Part B submitted for former underground storage tank #117, Building 7002, Facility Identification Number 9-025113*1, Hunter Army Airfield (HAAF), Georgia. The enclosed table provides responses to each of GA EPD's comments (a through h). In addition, some of the responses to comments required revisions to the CAP-Part B text. Therefore, replacement pages are also provided as Enclosure 2.

Based on the information contained in the enclosed table and the previously submitted CAP-Part B report, Fort Stewart/HAAF continues to recommend that semi-annual monitoring be conducted at the site for one year to confirm that the benzene and naphthalene concentrations (groundwater) remain below their respective alternate concentration levels (refer to Section III.D.5 of the CAP-Part B Report). If you have any questions or comments, please contact Ms. Tressa Rutland, Directorate of Public Works, Environmental Branch at (912) 767-2010.

Sincerely,

Thomas C. Fry
for Gregory V. Stanley
Colonel, U.S. Army
Director, Public Works

Enclosures

Fort Stewart Comment Responses
to
GA EPD Review Comments on the
Corrective Action Plan–Part B: Hunter AAF, Former UST #117
Building 7002, Bulk Fuel Facility (HAA-09), Facility ID: 9-025113*1
Savannah, Chatham County, GA

GA EPD Review Comment	Fort Stewart Comment Response
a. ATL calculations do not yield a meaningful result and are not appropriate for the site. The contaminated soils are already below the water table and are in contact with groundwater (TPH 163 mg/kg at 5 feet deep. During tank closure contaminated soils were returned to the excavation). Depth to water table is <5 feet. Request for monitoring only cannot therefore be based on the ATL calculation.	At boring location SB/MW-22, the maximum benzene concentration in soil was 1.13 mg/kg at 0.0 to 2.0 ft bgs which is above the GEPD STLs and is above the water table; therefore, it was appropriate to calculate ATLs for BTEX constituents. However, as discussed in Section III B, Fate and Transport Model, the recommendation for natural attenuation/monitoring only was based on the nature and extent of contamination, the results of the fate and transport modeling of the contaminants, and the ACL calculations for groundwater not the ATLs for soil.
b. Laboratory reports for soils are not originals. Please submit original lab reports with original signature of certification.	As agreed during a phone conference held on 10-24-01 between representatives from Fort Stewart, SAIC, and William Logan of the GEPD, ***all future*** UST reports submitted to the GEPD will contain original lab reports with original signature of certification and original validation codes.
c. Method 8270B is not a valid EPD approved testing Method for BTEX. Please resample by Method 8021G or 8260B and resubmit results. All future samples should be tested by 8021G and 8260B.	The soil sampling activities conducted at boring locations E-1 through E-6 was conducted by the subcontractor responsible for the AST upgrade. Apparently, the analytical method listed on the laboratory report provided by their subcontractor (Method 8270B) is a typographical error. According to SAIC project chemist, Nile Luedtke, the analytical method used for the analysis could only have been 8260B because there is no physical way the laboratory could have tested for BTEX compounds using the method cited (8270B). Fort Stewart apologizes for this confusion.
d. Lab reports for groundwater are not originals and a signed certification of results has not been included. Please submit original lab reports together with signed laboratory certification. Please identify method used for groundwater analyses.	As agreed during a phone conference held on 10-24-01 between representatives from Fort Stewart, SAIC, and William Logan of the GEPD, ***all future*** UST reports submitted to the GEPD will contain original lab reports with original signature of certification and original validation codes. The analytical methods used for groundwater analyses were as follows: BTEX - 8260B PAH - 8270 TPHDRO/GRO- 8015-Mod
e. The fate and transport model does not indicate the coucentration at the source used for modeling purposes. Please indicate concentration values used at the source.	The maximum observed groundwater concentration (i.e., 553 ug/L) was conservatively used as the source concentration because the groundwater concentration based on leaching from soil was predicted to be less than the observed groundwater concentration.
f. The model does not indicate the assumed time of the release. Please indicate the date of release on which the model is based.	The model is not based on a specific date for the time of release. Instead, steady-state conditions are conservatively assumed based on the maximum observed benzene concentration of 553 ug/L; and is consistent with the approach requested by GA EPD, USTMP in a meeting in January 1999.
g. It appears the maximum benzene concentration of the latest sampling event was used as the initial concentration prior to calibration. This should not be used as an initial concentration at the source. It is preferred that the current contaminant distribution not be used as the initial concentration prior to calibration.	The model was calibrated assuming steady-state conditions based on the maximum benzene concentration 553 ug/L observed in the groundwater during the CAP-Part A investigation conducted in December 1999. The latest sampling, conducted in December 2000, revealed a maximum observed benzene concentration of 251 ug/L. As a result, the CAP-Part A concentration of 553 ug/L was used as the initial concentration (see also response to comment e, above).
h. Please indicate which wells were used to calibrate and outline the details of the calibration process. Please designate 2 validation wells with values predicted by the model over the next 2 years, so that the model may be validated through the monitoring of the specified wells.	Monitoring wells MW-21 and MW-22 were used for model calibration. The details of the calibration are provided in the revised text (see enclosure to this correspondence). Also, the predicted concentrations over the next two years for monitoring wells MW-22 and MW-32 are provided in the revised text for monitoring purposes as requested.

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ATTACHMENT A: FATE AND TRANSPORT MODELING RESULTS A-1

- the model has received adequate peer review,
- the model has been applied to other similar sites, and
- the model is easy to use.

The AT123D meets all of the above criteria and was selected for performing fate and transport analysis for this site. AT123D is a well-known and commonly used analytical groundwater pollutant fate and transport model. This model computes the spatial-temporal concentration distribution of chemicals in the aquifer system and predicts the transient spread of a chemical plume through a groundwater aquifer. The fate and transport processes accounted for in AT123D are advection, dispersion, adsorption/retardation, and decay. This model can be used as a tool for estimating the dissolved concentration of a chemical in one, two, or three dimensions in the groundwater resulting from a mass release (either continuous or instant or depleting source) over a source area (i.e., point, line, area, or volume source).

SESOIL is used to simulate the vertical transport of contaminants from the source areas down through the vadose zone to the shallow groundwater (water table). SESOIL is an acronym for Seasonal Soil compartment model and is a one-dimensional, vertical transport code for the unsaturated soil zone, and is designed to simultaneously model water transport and pollutant fate. The program was originally developed by EPA and has been extensively modified to enhance its capabilities (Hetrick et al. 1989, Hetrick et al. 1986, and Hetrick and Travis 1988).

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

SESOIL is well recognized and accepted by the scientific community utilizing soil-chemical fate models. Some of the attributes of SESOIL that make it particularly attractive and suitable for the vadose zone soil leaching at this site are as follows:

- SESOIL has been extensively validated and shown to work under a number of scenarios. It has also been used for similar applications in other parts of the country and is capable of providing the information required from this study.

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

- The model can be divided into as few as two layers and as many as four layers, with as many as 10 sub-layers in each of the layers. This compartmental nature of the model allows for user-specified tailoring to suit a particular site.

The maximum soil concentration of benzene at this site was above the water table (i.e., 1.13 mg/kg from 0.0 to 2.0 feet). Modeling of leaching to groundwater by percolating rainwater was performed with SESOIL in order to determine the predicted maximum concentration in the leachate at the water table interface and the soil ATLs. Since the predicted leachate concentration was lower than the maximum groundwater concentration at the source (i.e., 553 μg/L), the steady-state model was developed by calibrating the model against the maximum estimated concentration beneath the site. The potential receptor is a storm drain located approximately 120 feet southwest of the site.

Vertical migration of the contaminant plume through the confining unit to the Principal Artesian aquifer is improbable. The confining unit has a vertical hydraulic conductivity on the order of 10^{-8} cm/sec and ranges from 15 to 90 feet in thickness. Assuming a vertical gradient of 1.0 foot/foot and an effective porosity of 0.06 (Mills et al. 1985) for the confining unit, the groundwater travel time is estimated to be 87 years. Therefore, it would take more than 400 years for the benzene contamination to migrate through the confining layer. The surficial aquifer in which the contaminant plume is located is not used as a source of drinking water.

The fate and transport modeling results are presented in Appendix VI and were based on the assumption of a continuous source of contamination (i.e., steady state) of infinite duration. In summary, benzene and naphthalene were modeled from the center of the plume in the vicinity of MW-22 to one potential downgradient location at which a receptor might encounter migrating groundwater contamination. The location was a storm drain that is located approximately 120 feet downgradient (southwest) from the center of the source area. This storm drain is part of a series of drains used to drain the bermed areas around the ASTs at the BFF. These drains empty into Lamar Canal. This is the nearest possible location at which a receptor might encounter migrating groundwater contamination due to a possible hydraulic connection between the groundwater and the surface water in Lamar Canal.

The AT123D Model was used to determine the impact of dissolved hydrocarbons on potential receptors. The AT123D Model was calibrated to the maximum observed site concentration of benzene (i.e., MW-22, 553 μg/L) and naphthalene (i.e., MW-22, 528 μg/L) in the groundwater assuming steady-state (continuous) concentrations. In reality, the source of contamination will deplete due to biodegradation and natural attenuation. The modeling results indicate that benzene should reach the storm drain at a concentration of 62.10 μg/L, which is below the state IWQS of 71.28 μg/L. Naphthalene is predicted to reach the storm drain at a concentration of 4.19 μg/L, which is below the risk-based value of 6.5 μg/L.

The modeling results estimated a DAF of 8.9 and 126.3 for the lateral migration of benzene and naphthalene in groundwater to the storm drain, respectively. Simulations were also performed to predict the concentrations of benzene over a simulation period of 2 years in monitoring wells MW-22 and MW-32. The results are presented in Table 10.

III.B.4.d. Conclusions and recommendations

The conclusions below are based on a review of the CAP–Part A SI and CAP–Part B SI results using a risk-based approach and the fate and transport modeling:

- Free product was detected in MW-22 during the CAP–Part B SI and removed on December 1, 2000. Free product has not been detected at the site since this event.

- The vertical and horizontal extent of soil contamination below applicable GUST STLs was delineated during the CAP–Part A and CAP–Part B SIs.

- The vertical and horizontal extent of groundwater contamination below federal MCLs and Georgia IWQS was delineated during the CAP–Part A and CAP–Part B SIs.

- Risk-based screening results show that concentrations of BTEX compounds in soil exceed their respective initial screening levels. However, using the results of the fate and transport modeling, only the benzene concentration detected at SB-07 and MW-22 exceeded the site-specific ATL of 0.387 mg/kg. For the sample collected from SB-07, the detection limit was above the reporting limit. Subsequent sampling at this location indicated that benzene was not present in the soil above its STL. Subsequent sampling at

SB-22 to delineate the horizontal extent of the benzene contamination in the soil indicated that benzene concentrations above its ATL was limited to the SB-22 location. At SB-22, the soil sample was collected from 0.0 to 2.0 feet BGS, which is above the water table. Groundwater samples collected at this location (MW-22) detected benzene concentrations of 553 µg/L and 174 µg/L during the CAP–Part A and CAP–Part B SIs, respectively. However, both of these concentrations are below the ACL of 634.4 µg/L. Because the concentration above the benzene ATL is limited to only SB/MW-22, the benzene contamination is above the water table, and the groundwater concentrations are below the benzene ACL, active remediation/removal of the soil is not recommended.

- Risk-based screening results show that benzene and naphthalene in groundwater exceed their respective initial screening levels. However, using the results of the fate and transport modeling, benzene and naphthalene did not exceed their site-specific ACLs of 634.4 µg/L and 820.95 µg/L, respectively.

- Fate and transport modeling of benzene and naphthalene, assuming a continuous, steady-state source, indicates that benzene will not exceed the state IWQS and that naphthalene will not exceed the risk-based concentration at the nearest downgradient receptor, the storm drain.

- Based on the CAP–Part B data, the environmental site ranking score is 3,250 (Appendix X).

Considering that the site is located within the confines of HAAF and that the most recent benzene concentrations in groundwater exceeded the IWQS but not the ACL, natural attenuation is recommended as the corrective action for the site; therefore, a monitoring only plan is recommended. Detailed sampling and analysis recommendations are provided in Section III.D.

III.C. DESIGN AND OPERATION OF CORRECTIVE ACTION SYSTEMS

III.C.1. System Effectiveness/Basis for Selection

The selected corrective action approach, natural attenuation of groundwater, was chosen following evaluation of numerous established and innovative active and passive remediation alternatives. A three-step screening process was used to select the preferred remedy for the Former UST 117, Building 7002 site. This alternative selection process is illustrated in Figure 21.

III.C.1.a. Theory and feasibility

The remedies evaluated for aromatic hydrocarbons in soil and groundwater at this site include monitored natural attenuation, oxygen-injection-enhanced bioremediation, air sparging with soil vapor extraction, and six-phase heating. Based on the hydrocarbon concentrations in the soil and water, natural attenuation is the preferred alternative. Natural attenuation is based on the premise that fuel-type hydrocarbons are readily biodegraded in most environmental systems. Biodegradation of BTEX has been documented for sites similar to the UST 117 site (e.g., shallow water table, permeable silty sand). In fact, the conditions at the Former UST 117, Building 7002 site are similar to other sites that have proven ideal for biodegradation (Abou-Rizk, Leavitt, and Graves 1995). Site groundwater flow and the geology of the site are conducive to aerobic biodegradation, which is known to produce the most rapid biodegradation rates for hydrocarbons. Finally, the primary sources have been removed; therefore, subsurface conditions (e.g., dissolved oxygen, oxidation-reduction potential, and background nutrient availability) will steadily improve with time.

Other remedial options that were considered introduce more risk of exposure due to contaminant release into other matrices (e.g., soil gas, air, and treatment canisters) or as a result of excavation. In addition, the excessive

costs associated with an aggressive remediation system do not result in added protection to the industrial worker receptor.

The Georgia IWQS for benzene of 71.28 µg/L and the risk-based screening level of 6.5 µg/L for naphthalene were exceeded in the groundwater during the CAP–Part B SI. No other compounds exceeded their respective IWQSs or risk-based screening levels during any of the past sampling rounds. The ACLs proposed for benzene and naphthalene are 634.4 µg/L and 820.95 µg/L, respectively, and the CAP–Part B concentrations did not exceed this value; however, the site ranking score (i.e., > 2,500) indicates that a year of monitored natural attenuation is warranted to confirm site conditions.

III.D. IMPLEMENTATION

III.D.1. Milestone Schedule

A milestone schedule for the monitoring only plan has been prepared. A Gantt chart showing milestone activities and anticipated duration is provided in Figure 22. HAAF will notify GA EPD USTMP of any significant changes to the proposed schedule time and will provide an updated Gantt chart, as necessary.

III.D.2. Progress Reporting

An annual monitoring report will be submitted to GA EPD that will summarize all previous annual sampling events.

III.D.3. Certificate of Completion Report

Petition for permanent closure will be submitted with the final monitoring only report unless HAAF determines the wells should remain in place to provide a means of monitoring the active site. GA EPD will provide final approval for decommissioning of the monitoring wells, which will be requested in the final monitoring only report. Decommissioning of the monitoring wells will be completed in accordance with the USACE design manual for monitoring wells. Decommissioning will comply with all applicable state and federal standards.

The certification below will be submitted to GA EPD within 30 days of submittal of the final progress report.

> I hereby certify that the Corrective Action Plan–Part B, dated _____, 20__, for Hunter Army Airfield, Former UST 117, Building 7002 site, Facility ID #9-025113*1, including any and all certified amendments thereto, has been implemented in accordance with the schedules, specifications, sampling programs, and conditions contained therein, and that the plan's stated objectives have been met.
>
> _____
> Signature (Owner/Operator)

III.D.4. Inspection Schedule and Preventative Maintenance Program

During each sampling event, wells will be visually inspected for changes or damage. Any notable observations will be recorded in the subsequent progress report. Any required repairs to ensure the monitoring wells remain in conformance with GA EPD and U.S. Environmental Protection Agency (EPA) performance standards will be made as needed.

III.D.5. Periodic Monitoring

Groundwater samples from monitoring wells MW-19, MW-20, MW-21A (replacement well), MW-22, MW-32, MW-33, and MW-34 will be collected semiannually for 1 year and analyzed for BTEX and PAH compounds. Monitoring will continue at the site for a year to ensure that the benzene and naphthalene concentrations remain below their respective ACLs of 634.4 μg/L and 820.95 μg/L, and that free product is not present.

During each sampling event, water levels and free product measurements in all monitoring wells will be collected. Specific conductivity, pH, and temperature analysis will be completed for each sample from the monitoring wells at which analytical samples were collected. The samples will be shipped to an approved laboratory for BTEX analysis using EPA Methods 8021B/8260B and PAH analysis using EPA Methods 8100/8270C/8310.

III.D.6. Effectiveness of Corrective Action

The monitoring only plan will be discontinued once the objectives of the corrective action have been achieved; that is, the concentrations of COPCs in groundwater remain below their respective ACLs for 1 year, and no free product has been detected.

III.D.7. Confirmatory Soil Sampling Plan

No excavation of soil is planned; therefore, confirmatory sampling will not be conducted.

III.D.8. Stockpiled Bulk Soil Sampling

No stockpiled soil will be generated from this corrective action; therefore, no soil sampling will be conducted.

III.D.9. Termination Conditions

Prior to termination of the monitoring only plan, concentrations of benzene and naphthalene in groundwater must be at or below their respective ACLs, and it must be shown that free product no longer exists at the site. Achievement of these conditions will take precedence over the site ranking score.

III.D.10. Post-completion Site Restoration Activities

After termination has been granted, equipment and debris related to the monitoring program will be removed from the site.

III.E. PUBLIC NOTIFICATION

The Former UST 117, Building 7002 site is located entirely within the confines of the HAAF, a federal facility. The U.S. Government owns all of the property contiguous to the site. The Fort Stewart DPW has complied with the public notice requirements defined by GA EPD guidance by publishing an announcement in the *Savannah Morning News* on April 1, and April 8, 2001. A copy of the newspaper announcement used for public notification is presented in Appendix XI of this report.

IV. CLAIM FOR REIMBURSEMENT

HAAF is a federally owned facility and has funded the investigation for the Former UST 117, Building 7002 site, Facility ID: 9-025113*1, using Department of Defense Environmental Restoration Account Funds. Application for GUST Trust Fund reimbursement is not being pursued at this time.

Former UST 117, Building 7002
Hunter Army Airfield
Chatham County, Facility ID: 9-025113*1

TABLE 10: CAP–PART B NATURAL ATTENUATION MODELING RESULTS (BENZENE CONCENTRATION VS. TIME) FOR THE FORMER UST 117 SITE

Time (year)	Predicted Maximum Benzene Concentration in Groundwater (µg/L)	
	MW-22	MW-32
0.0 (12/00)	174.0	109.0
0.5 (06/01)	114.0	89.1
1.0 (12/01)	75.9	84.3
1.5 (06/02)	51.6	74.2
2.0 (12/02)	31.6	62.3

Note: Time 0.0 is equal to December 2000, which was the last groundwater sampling event conducted at the site. Monitoring wells MW-22 and MW-32 will be sampled semiannually for 1 year as part of the monitoring only program to validate the fate and transport modeling results. As predicted by the model, benzene concentrations in both wells should be below the In-stream Water Quality Standard (IWQS) of 71.28 µg/L by the end of year 2 (i.e., December 2002).

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ATTACHMENT A

FATE AND TRANSPORT MODELING RESULTS

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Table A-1. CAP–Part A Natural Attenuation Modeling Results (Benzene Concentration vs. Distance) for the Former UST 117 Site

Distance to Receptor (ft)	Distance to Receptor (m)	Predicted Maximum Benzene Concentration in Groundwater (µg/L)
0.0	0.0	553
32.8	10.0	435
39.4	12.0	365
49.2	15.0	273
59.1	18.0	209
65.6	20.0	178
78.7	24.0	130
98.4	30.0	90.8
120.1	36.6	62.1
131.2	40.0	51.8
164.0	50.0	31.4
196.9	60.0	20
229.7	70.0	13.1
262.5	80.0	8.74
295.3	90.0	5.95
341.2	104.0	3.6
393.7	120.0	2
492.1	150.0	0.8
656.2	200.0	0.2

Table A-2. CAP–Part B Natural Attenuation Modeling Results (Naphthalene Concentration vs. Distance) for the Former UST 117 Site

Distance to Receptor (ft)	Distance to Receptor (m)	Predicted Maximum Naphthalene Concentration in Groundwater (µg/L)
0.0	0.0	529
6.6	2.0	536
9.8	3.0	533
13.1	4.0	526
16.4	5.0	512
23.0	7.0	458
29.5	9.0	366
32.8	10.0	312
39.4	12.0	214
49.2	15.0	120
59.1	18.0	71
65.6	20.0	51
78.7	24.0	25.3
98.4	30.0	10.9
120.1	36.6	4.19
196.9	60.0	0.174
341.2	104.0	6.70 E-04
393.7	120.0	0
492.1	150.0	0
656.2	200.0	0

Table A-3. CAP–Part B Natural Attenuation Modeling Results (Benzene Concentration vs. Time) for the Former UST 117 Site

Time (year)	Predicted Maximum Benzene Concentration in Groundwater (µg/L)	
	MW-22	MW-32
0.0 (12/00)	174.0	109.0
0.5 (06/01)	114.0	89.1
1.0 (12/01)	75.9	84.3
1.5 (06/02)	51.6	74.2
2.0 (12/02)	31.6	62.3

Note: Time 0.0 is equal to December 2000, which was the last groundwater sampling event conducted at the site. Monitoring wells MW-22 and MW-32 will be sampled semiannually for 1 year as part of the monitoring only program to validate the fate and transport modeling results. As predicted by the model, benzene concentrations in both wells should be below the In-stream Water Quality Standard (IWQS) of 71.28 µg/L by the end of year 2 (i.e., December 2002).

Figure A-1. AT123D Modeled Maximum Concentration of Benzene in the Groundwater Versus Downgradient Distance from the Source

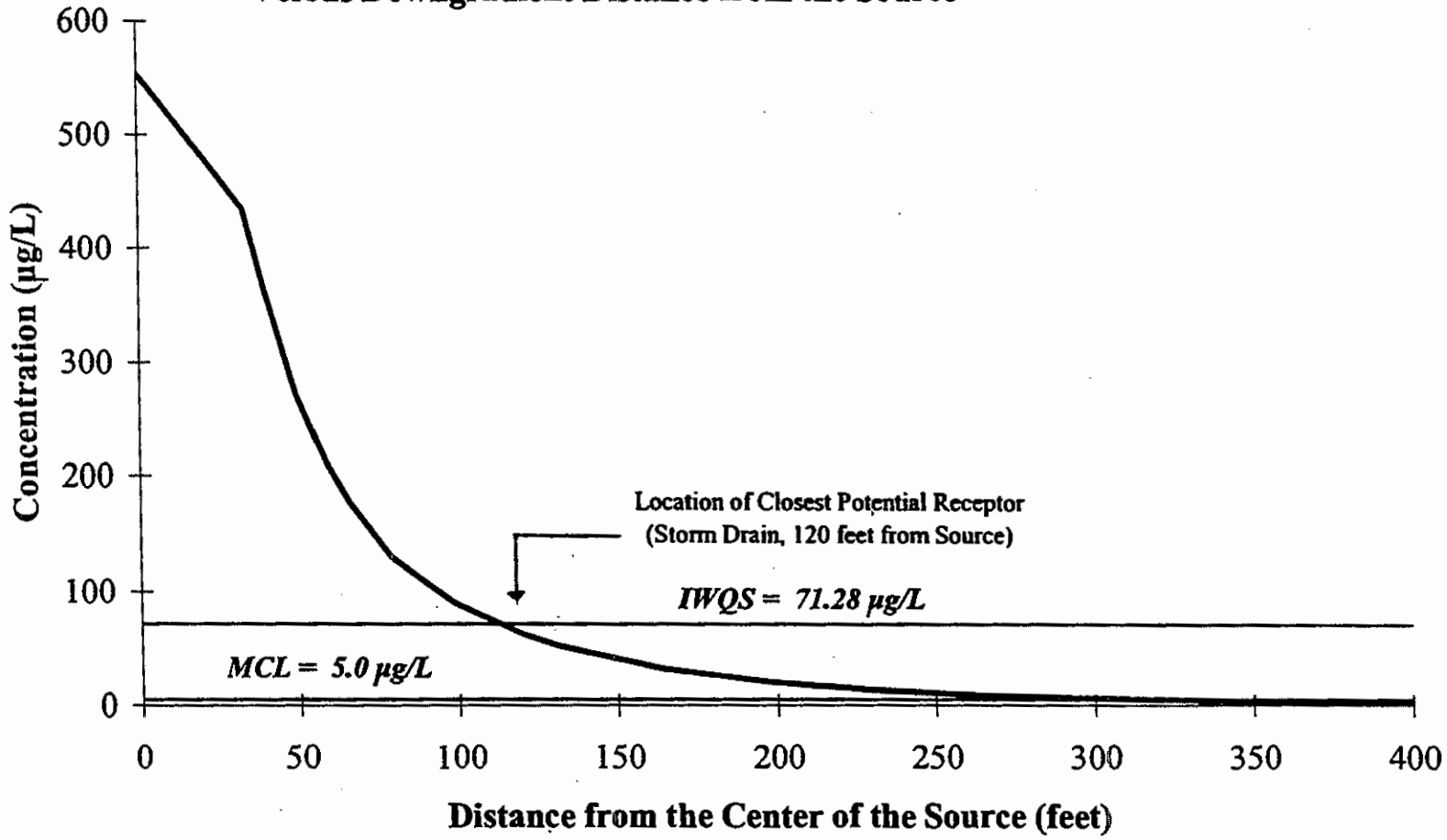


Figure A-1. AT123D Modeled Maximum Concentration of Benzene in the Groundwater Versus Downgradient Distance from the Source

Figure A-2. AT123D Modeled Maximum Concentration of Naphthalene in the Groundwater Versus Downgradient Distance from the Source

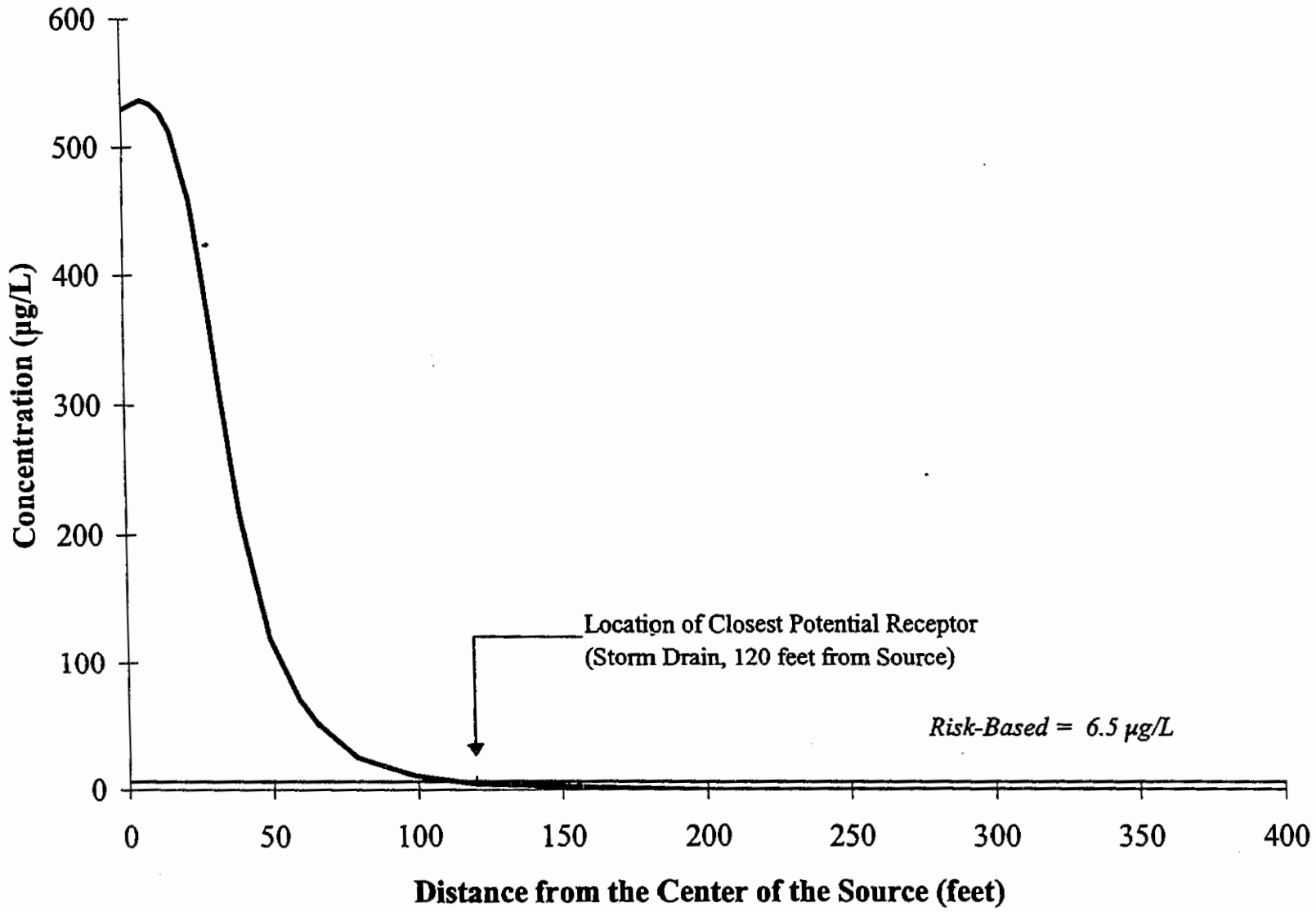
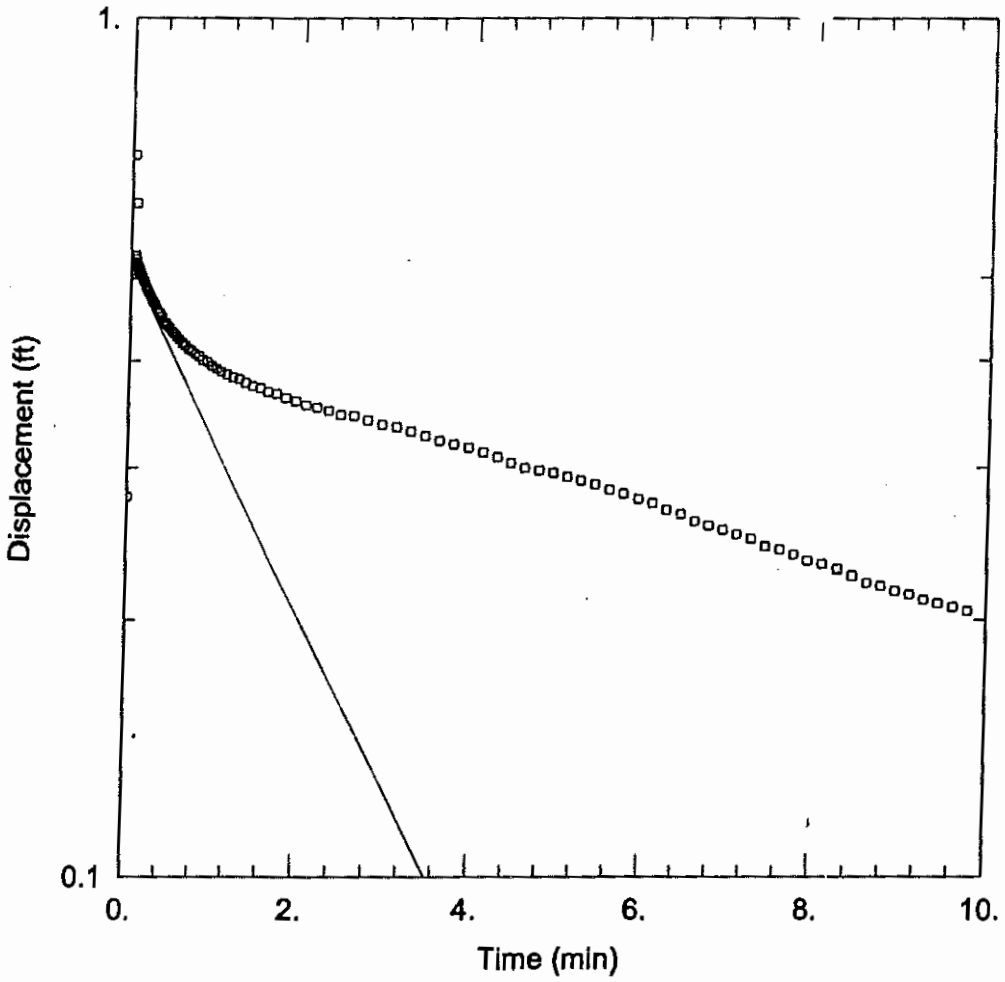


Figure A-2. AT123D Modeled Maximum Concentration of Naphthalene in the Groundwater Versus Downgradient Distance from the Source



WELL TEST ANALYSIS

Data Set: C:\WINDOWS\DESKTOP\BF-MW-E4.AQT
Date: 01/22/01 Time: 10:09:30

PROJECT INFORMATION

Company: SAIC
Client: USACE-Savannah
Test Location: Hunter Army Airfield
Test Date: 12-04-00

AQUIFER DATA

Saturated Thickness: 10.72 ft
Anisotropy Ratio (Kz/Kr): 1.

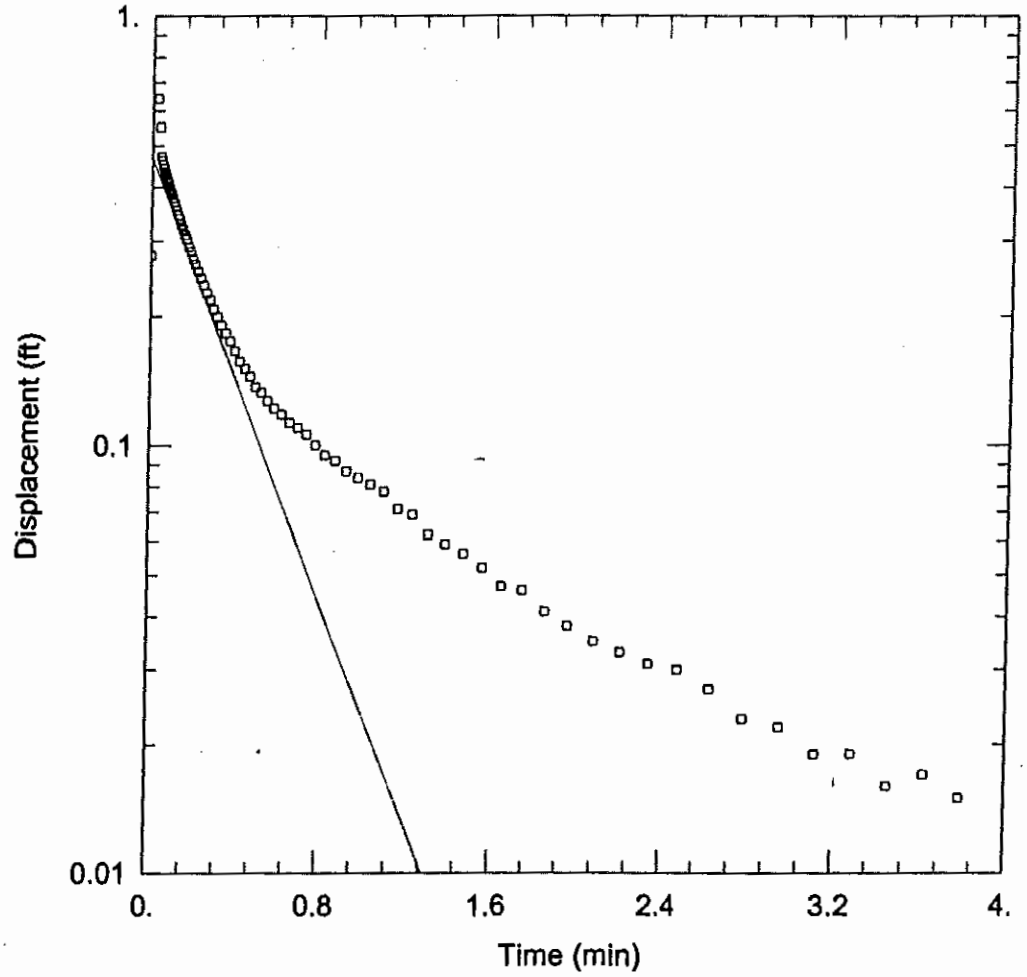
WELL DATA

Initial Displacement: 0.278 ft
Casing Radius: 0.008 ft
Screen Length: 10. ft
Water Column Height: 10.72 ft
Wellbore Radius: 0.33 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001994 ft/min
y0 = 0.5165 ft

Figure A-3. Slug Test Analysis for MW-E4 at the Former UST 117, Building 7002 Site



WELL TEST ANALYSIS

Data Set: C:\WINDOWS\DESKTOP\BF-MW-E5.AQT
Date: 01/22/01 Time: 10:10:44

PROJECT INFORMATION

Company: SAIC
Client: USACE-Savannah
Test Location: Hunter Army Airfield
Test Date: 12-04-00

AQUIFER DATA

Saturated Thickness: 10.7 ft
Anisotropy Ratio (Kz/Kr): 1.

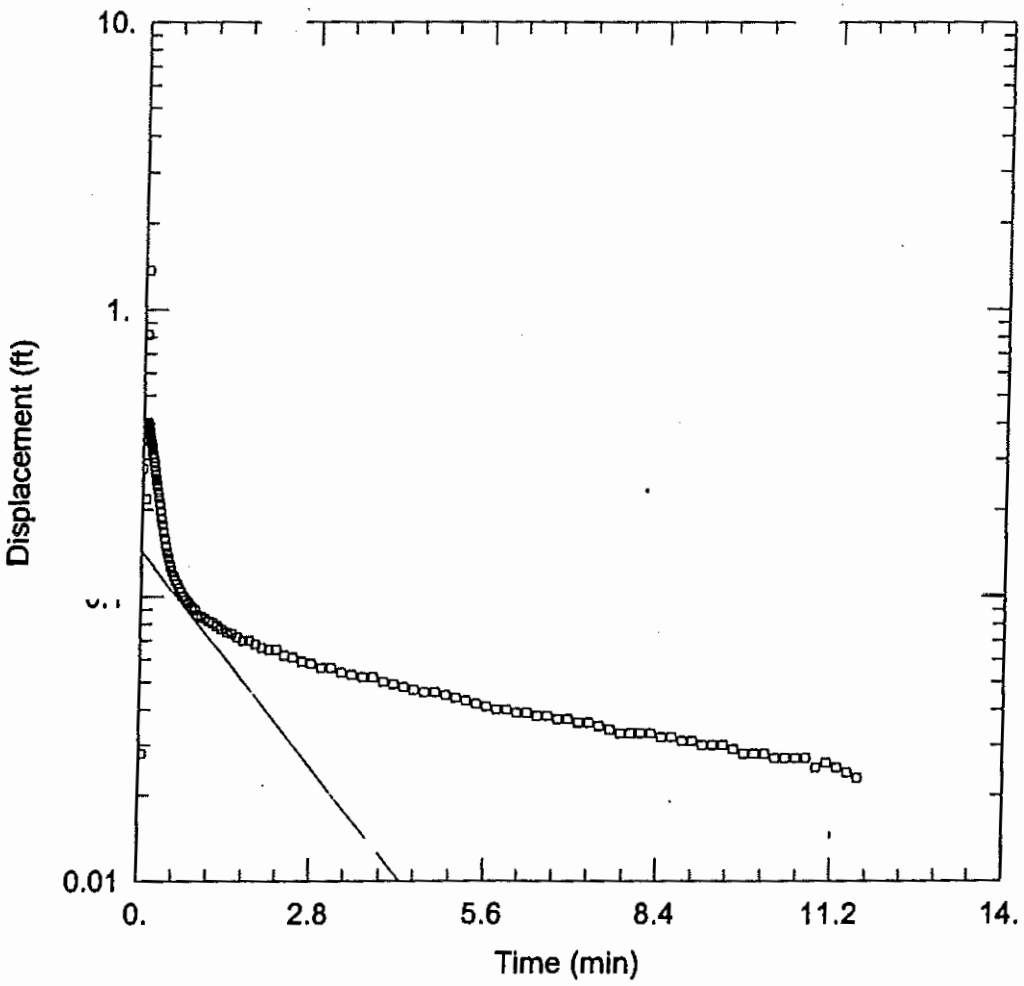
WELL DATA

Initial Displacement: 0.278 ft
Casing Radius: 0.008 ft
Screen Length: 10. ft
Water Column Height: 10.7 ft
Wellbore Radius: 0.33 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.01269 ft/min
y0 = 0.4673 ft

Figure A-4. Slug Test Analysis for MW-E5 at the Former UST 117, Building 7002 Site



WELL TEST ANALYSIS

Data Set: C:\WINDOWS\DESKTOP\BF-MW-E6.AQT
Date: 01/22/01 Time: 10:10:07

PROJECT INFORMATION

Company: SAIC
Client: USACE-Savannah
Test Location: Hunter Army Airfield
Test Date: 12-04-00

AQUIFER DATA

Saturated Thickness: 9.76 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.278 ft
Casing Radius: 0.008 ft
Screen Length: 10. ft
Water Column Height: 9.76 ft
Wellbore Radius: 0.33 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.002624 ft/min
y0 = 0.1433 ft

Figure A-5. Slug Test Analysis for MW-E6 at the Former UST 117, Building 7002 Site

TABLE A-4. AT123D FATE AND TRANSPORT MODEL INPUT AND OUTPUT VALUES FOR BENZENE AT THE FORMER UST 117, BUILDING 7002 SITE

NO. OF POINTS IN X-DIRECTION	14
NO. OF POINTS IN Y-DIRECTION	2
NO. OF POINTS IN Z-DIRECTION	1
NO. OF ROOTS: NO. OF SERIES TERMS	400
NO. OF BEGINNING TIME STEP	13
NO. OF ENDING TIME STEP	241
NO. OF TIME INTERVALS FOR PRINTED OUT SOLUTION	12
INSTANTANEOUS SOURCE CONTROL = 0 FOR INSTANT SOURCE	1
SOURCE CONDITION CONTROL = 0 FOR STEADY SOURCE	0
INTERMITTENT OUTPUT CONTROL = 0 NO SUCH OUTPUT	1
CASE CONTROL =1 THERMAL, = 2 FOR CHEMICAL, = 3 RAD	2

AQUIFER DEPTH, = 0.0 FOR INFINITE DEEP (METERS) ...	0.1524E+02
AQUIFER WIDTH, = 0.0 FOR INFINITE WIDE (METERS) ...	0.0000E+00
BEGIN POINT OF X-SOURCE LOCATION (METERS)	-0.9100E+01
END POINT OF X-SOURCE LOCATION (METERS)	0.9100E+01
BEGIN POINT OF Y-SOURCE LOCATION (METERS)	-0.6100E+01
END POINT OF Y-SOURCE LOCATION (METERS)	0.6100E+01
BEGIN POINT OF Z-SOURCE LOCATION (METERS)	0.0000E+00
END POINT OF Z-SOURCE LOCATION (METERS)	0.0000E+00

POROSITY	0.1800E+00
HYDRAULIC CONDUCTIVITY (METER/HOUR)	0.9000E-01
HYDRAULIC GRADIENT	0.3500E-02
LONGITUDINAL DISPERSIVITY (METER)	0.1000E+02
LATERAL DISPERSIVITY (METER)	0.3000E+01
VERTICAL DISPERSIVITY (METER)	0.1000E+01
DISTRIBUTION COEFFICIENT, KD (M**3/KG)	0.7900E-04
HEAT EXCHANGE COEFFICIENT (KCAL/HR-M**2-DEGREE C)..	0.0000E+00

MOLECULAR DIFFUSION MULTIPLY BY POROSITY (M**2/HR)	0.3530E-05
DECAY CONSTANT (PER HOUR)	0.4000E-04
BULK DENSITY OF THE SOIL (KG/M**3)	0.1320E+04
ACCURACY TOLERANCE FOR REACHING STEADY STATE	0.1000E-02
DENSITY OF WATER (KG/M**3)	0.1000E+04
TIME INTERVAL SIZE FOR THE DESIRED SOLUTION (HR) ..	0.7300E+03
DISCHARGE TIME (HR)	0.8760E+06
WASTE RELEASE RATE (KCAL/HR), (KG/HR), OR (CI/HR) .	0.2210E-04

RETARDATION FACTOR	0.1579E+01
RETARDED DARCY VELOCITY (M/HR)	0.1108E-02
RETARDED LONGITUDINAL DISPERSION COEF. (M**2/HR) ..	0.1109E-01
RETARDED LATERAL DISPERSION COEFFICIENT (M**2/HR) .	0.3337E-02
RETARDED VERTICAL DISPERSION COEFFICIENT (M**2/HR).	0.1120E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.0000E+00 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
-24.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00
-24.	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.8760E+04 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.159E-02	0.296E-02	0.494E+00	0.489E+00	0.354E+00	0.282E+00	0.188E+00	0.124E+00	0.947E-01	0.516E-01
-24.	0.902E-05	0.149E-04	0.415E-03	0.477E-03	0.479E-03	0.462E-03	0.422E-03	0.367E-03	0.326E-03	0.234E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.225E-01	0.758E-02	0.451E-04	0.000E+00
-24.	0.133E-03	0.567E-04	0.518E-06	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1752E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.376E-02	0.608E-02	0.537E+00	0.540E+00	0.410E+00	0.339E+00	0.245E+00	0.179E+00	0.147E+00	0.977E-01
-24.	0.125E-03	0.178E-03	0.241E-02	0.289E-02	0.316E-02	0.320E-02	0.319E-02	0.308E-02	0.297E-02	0.262E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.582E-01	0.310E-01	0.216E-02	0.948E-06
-24.	0.207E-02	0.141E-02	0.154E-03	0.881E-07

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.2628E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.476E-02	0.738E-02	0.548E+00	0.553E+00	0.425E+00	0.355E+00	0.262E+00	0.197E+00	0.166E+00	0.116E+00
-24.	0.280E-03	0.379E-03	0.406E-02	0.492E-02	0.556E-02	0.572E-02	0.586E-02	0.588E-02	0.581E-02	0.551E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.761E-01	0.467E-01	0.719E-02	0.485E-04
-24.	0.485E-02	0.387E-02	0.984E-03	0.888E-05

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.3504E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.519E-02	0.792E-02	0.552E+00	0.558E+00	0.431E+00	0.361E+00	0.269E+00	0.204E+00	0.173E+00	0.124E+00
-24.	0.390E-03	0.518E-03	0.500E-02	0.609E-02	0.696E-02	0.722E-02	0.749E-02	0.763E-02	0.764E-02	0.746E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.840E-01	0.546E-01	0.120E-01	0.306E-03
-24.	0.690E-02	0.593E-02	0.225E-02	0.792E-04

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.4380E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.538E-02	0.815E-02	0.553E+00	0.560E+00	0.433E+00	0.363E+00	0.271E+00	0.207E+00	0.176E+00	0.127E+00
-24.	0.455E-03	0.597E-03	0.548E-02	0.669E-02	0.769E-02	0.801E-02	0.836E-02	0.858E-02	0.865E-02	0.858E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.876E-01	0.585E-01	0.153E-01	0.825E-03
-24.	0.814E-02	0.725E-02	0.341E-02	0.263E-03

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.5256E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X -31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.546E-02	0.825E-02	0.554E+00	0.560E+00	0.434E+00	0.364E+00	0.272E+00	0.208E+00	0.177E+00	0.129E+00
-24.	0.491E-03	0.640E-03	0.572E-02	0.700E-02	0.807E-02	0.841E-02	0.882E-02	0.908E-02	0.918E-02	0.918E-02

CONTINUE

Y	X 30.	37.	60.	104.
0.	0.893E-01	0.603E-01	0.174E-01	0.147E-02
-24.	0.882E-02	0.803E-02	0.426E-02	0.535E-03

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.6132E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X -31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.550E-02	0.830E-02	0.554E+00	0.561E+00	0.434E+00	0.364E+00	0.273E+00	0.209E+00	0.178E+00	0.129E+00
-24.	0.510E-03	0.663E-03	0.584E-02	0.715E-02	0.826E-02	0.862E-02	0.905E-02	0.934E-02	0.945E-02	0.950E-02

CONTINUE

Y	X 30.	37.	60.	104.
0.	0.900E-01	0.612E-01	0.185E-01	0.208E-02
-24.	0.919E-02	0.846E-02	0.482E-02	0.828E-03

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.7008E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X

Y	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.552E-02	0.832E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.520E-03	0.675E-03	0.590E-02	0.723E-02	0.836E-02	0.872E-02	0.917E-02	0.947E-02	0.960E-02	0.966E-02

CONTINUE

X

Y	30.	37.	60.	104.
0.	0.904E-01	0.617E-01	0.192E-01	0.258E-02
-24.	0.939E-02	0.869E-02	0.516E-02	0.109E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.7884E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

X

Y	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.553E-02	0.833E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.525E-03	0.681E-03	0.593E-02	0.727E-02	0.841E-02	0.878E-02	0.923E-02	0.954E-02	0.967E-02	0.975E-02

CONTINUE

X

Y	30.	37.	60.	104.
0.	0.906E-01	0.619E-01	0.195E-01	0.294E-02
-24.	0.950E-02	0.882E-02	0.537E-02	0.129E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.8760E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.528E-03	0.685E-03	0.595E-02	0.729E-02	0.843E-02	0.881E-02	0.926E-02	0.958E-02	0.971E-02	0.980E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.907E-01	0.620E-01	0.197E-01	0.319E-02
-24.	0.955E-02	0.889E-02	0.549E-02	0.144E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.9636E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.530E-03	0.686E-03	0.596E-02	0.730E-02	0.845E-02	0.882E-02	0.928E-02	0.960E-02	0.973E-02	0.982E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.907E-01	0.621E-01	0.199E-01	0.335E-02
-24.	0.958E-02	0.893E-02	0.555E-02	0.155E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1051E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.530E-03	0.687E-03	0.596E-02	0.730E-02	0.845E-02	0.883E-02	0.929E-02	0.961E-02	0.974E-02	0.984E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.908E-01	0.621E-01	0.199E-01	0.345E-02
-24.	0.960E-02	0.894E-02	0.559E-02	0.161E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1139E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.531E-03	0.688E-03	0.596E-02	0.731E-02	0.846E-02	0.883E-02	0.929E-02	0.961E-02	0.975E-02	0.984E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.908E-01	0.621E-01	0.199E-01	0.352E-02
-24.	0.961E-02	0.896E-02	0.561E-02	0.166E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1226E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X -31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.531E-03	0.688E-03	0.597E-02	0.731E-02	0.846E-02	0.884E-02	0.929E-02	0.961E-02	0.975E-02	0.985E-02

CONTINUE

Y	X 30.	37.	60.	104.
0.	0.908E-01	0.621E-01	0.200E-01	0.356E-02
-24.	0.961E-02	0.896E-02	0.563E-02	0.168E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1314E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X -31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.531E-03	0.688E-03	0.597E-02	0.731E-02	0.846E-02	0.884E-02	0.929E-02	0.962E-02	0.975E-02	0.985E-02

CONTINUE

Y	X 30.	37.	60.	104.
0.	0.908E-01	0.621E-01	0.200E-01	0.358E-02
-24.	0.961E-02	0.896E-02	0.563E-02	0.170E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1402E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.531E-03	0.688E-03	0.597E-02	0.731E-02	0.846E-02	0.884E-02	0.930E-02	0.962E-02	0.975E-02	0.985E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.908E-01	0.621E-01	0.200E-01	0.359E-02
-24.	0.961E-02	0.897E-02	0.564E-02	0.171E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1489E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.531E-03	0.688E-03	0.597E-02	0.731E-02	0.846E-02	0.884E-02	0.930E-02	0.962E-02	0.975E-02	0.985E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.908E-01	0.621E-01	0.200E-01	0.360E-02
-24.	0.962E-02	0.897E-02	0.564E-02	0.172E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1577E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.531E-03	0.688E-03	0.597E-02	0.731E-02	0.846E-02	0.884E-02	0.930E-02	0.962E-02	0.975E-02	0.985E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.908E-01	0.621E-01	0.200E-01	0.360E-02
-24.	0.962E-02	0.897E-02	0.564E-02	0.172E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1664E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.531E-03	0.688E-03	0.597E-02	0.731E-02	0.846E-02	0.884E-02	0.930E-02	0.962E-02	0.975E-02	0.985E-02

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.908E-01	0.621E-01	0.200E-01	0.361E-02
-24.	0.962E-02	0.897E-02	0.564E-02	0.172E-02

STEADY STATE SOLUTION HAS BEEN OBTAINED BEFORE FINAL SIMULATING TIME

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1752E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

					X					
Y	175200.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.554E-02	0.834E-02	0.554E+00	0.561E+00	0.435E+00	0.365E+00	0.273E+00	0.209E+00	0.178E+00	0.130E+00
-24.	0.531E-03	0.688E-03	0.597E-02	0.731E-02	0.846E-02	0.884E-02	0.930E-02	0.962E-02	0.975E-02	0.985E-02

CONTINUE

					X
Y	30.	37.	60.	104.	
0.	0.908E-01	0.621E-01	0.200E-01	0.361E-02	
-24.	0.962E-02	0.897E-02	0.564E-02	0.172E-02	

TABLE A-5. AT123D FATE AND TRANSPORT MODEL INPUT AND OUTPUT VALUES FOR NAPHTHALENE AT THE FORMER UST 117, BUILDING 7002 SITE

NO. OF POINTS IN X-DIRECTION 14
NO. OF POINTS IN Y-DIRECTION 2
NO. OF POINTS IN Z-DIRECTION 1
NO. OF ROOTS: NO. OF SERIES TERMS 400
NO. OF BEGINNING TIME STEP 13
NO. OF ENDING TIME STEP 241
NO. OF TIME INTERVALS FOR PRINTED OUT SOLUTION 12
INSTANTANEOUS SOURCE CONTROL = 0 FOR INSTANT SOURCE 1
SOURCE CONDITION CONTROL = 0 FOR STEADY SOURCE 0
INTERMITTENT OUTPUT CONTROL = 0 NO SUCH OUTPUT 1
CASE CONTROL =1 THERMAL, = 2 FOR CHEMICAL, = 3 RAD 2

AQUIFER DEPTH, = 0.0 FOR INFINITE DEEP (METERS) ... 0.1524E+02
AQUIFER WIDTH, = 0.0 FOR INFINITE WIDE (METERS) ... 0.0000E+00
BEGIN POINT OF X-SOURCE LOCATION (METERS) ..... -0.9100E+01
END POINT OF X-SOURCE LOCATION (METERS) ..... 0.9100E+01
BEGIN POINT OF Y-SOURCE LOCATION (METERS) ..... -0.6100E+01
END POINT OF Y-SOURCE LOCATION (METERS) ..... 0.6100E+01
BEGIN POINT OF Z-SOURCE LOCATION (METERS) ..... 0.0000E+00
END POINT OF Z-SOURCE LOCATION (METERS) ..... 0.0000E+00

POROSITY ..... 0.1800E+00
HYDRAULIC CONDUCTIVITY (METER/HOUR) 0.9000E-01
HYDRAULIC GRADIENT 0.8900E-02
LONGITUDINAL DISPERSIVITY (METER) ..... 0.1000E+02
LATERAL DISPERSIVITY (METER) ..... 0.3000E+01
VERTICAL DISPERSIVITY (METER) ..... 0.1000E+01
DISTRIBUTION COEFFICIENT, KD (M**3/KG) 0.1190E-02
HEAT EXCHANGE COEFFICIENT (KCAL/HR-M**2-DEGREE C).. 0.0000E+00

MOLECULAR DIFFUSION MULTIPLY BY POROSITY (M**2/HR) 0.2700E-05
DECAY CONSTANT (PER HOUR) 0.1110E-03
BULK DENSITY OF THE SOIL (KG/M**3) ..... 0.1350E+04
ACCURACY TOLERANCE FOR REACHING STEADY STATE 0.1000E-02
DENSITY OF WATER (KG/M**3) ..... 0.1000E+04
TIME INTERVAL SIZE FOR THE DESIRED SOLUTION (HR) .. 0.7300E+03
DISCHARGE TIME (HR) ..... 0.8760E+06
WASTE RELEASE RATE (KCAL/HR), (KG/HR), OR (CI/HR) . 0.7677E-04

RETARDATION FACTOR ..... 0.9925E+01
RETARDED DARCY VELOCITY (M/HR) 0.4484E-03
RETARDED LONGITUDINAL DISPERSION COEF. (M**2/HR) .. 0.4485E-02
RETARDED LATERAL DISPERSION COEFFICIENT (M**2/HR) . 0.1347E-02
RETARDED VERTICAL DISPERSION COEFFICIENT (M**2/HR). 0.4499E-03

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.0000E+00 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X: -31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
-24.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

CONTINUE

Y	X: 30.	37.	60.	104.
0.	0.000E+00	0.000E+00	0.000E+00	0.000E+00
-24.	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.8760E+04 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X: -31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.891E-04	0.257E-03	0.480E+00	0.458E+00	0.261E+00	0.166E+00	0.784E-01	0.372E-01	0.223E-01	0.660E-02
-24.	0.410E-08	0.102E-07	0.183E-05	0.192E-05	0.158E-05	0.137E-05	0.102E-05	0.690E-06	0.504E-06	0.215E-06

CONTINUE

Y	X: 30.	37.	60.	104.
0.	0.114E-02	0.102E-03	0.119E-09	0.000E+00
-24.	0.528E-07	0.629E-08	0.172E-13	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1752E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X: -31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.443E-03	0.935E-03	0.520E+00	0.502E+00	0.302E+00	0.203E+00	0.110E+00	0.616E-01	0.422E-01	0.183E-01
-24.	0.859E-06	0.154E-05	0.631E-04	0.710E-04	0.681E-04	0.640E-04	0.558E-04	0.459E-04	0.391E-04	0.252E-04

CONTINUE

Y	X: 30.	37.	60.	104.
0.	0.602E-02	0.146E-02	0.225E-05	0.000E+00
-24.	0.122E-04	0.407E-05	0.110E-07	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.2628E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.643E-03	0.125E-02	0.527E+00	0.510E+00	0.310E+00	0.212E+00	0.117E+00	0.685E-01	0.485E-01	0.231E-01
-24.	0.408E-05	0.653E-05	0.163E-03	0.188E-03	0.191E-03	0.186E-03	0.171E-03	0.151E-03	0.136E-03	0.101E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.908E-02	0.295E-02	0.280E-04	0.662E-11
-24.	0.618E-04	0.292E-04	0.540E-06	0.206E-12

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.3504E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.716E-03	0.136E-02	0.528E+00	0.511E+00	0.312E+00	0.213E+00	0.119E+00	0.703E-01	0.503E-01	0.247E-01
-24.	0.739E-05	0.113E-04	0.226E-03	0.264E-03	0.275E-03	0.271E-03	0.257E-03	0.234E-03	0.216E-03	0.172E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.103E-01	0.371E-02	0.782E-04	0.327E-08
-24.	0.116E-03	0.646E-04	0.300E-05	0.187E-09

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.4380E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.740E-03	0.139E-02	0.528E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.708E-01	0.508E-01	0.251E-01
-24.	0.940E-05	0.140E-04	0.255E-03	0.299E-03	0.315E-03	0.312E-03	0.299E-03	0.277E-03	0.258E-03	0.212E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.107E-01	0.402E-02	0.123E-03	0.327E-07
-24.	0.151E-03	0.907E-04	0.691E-05	0.296E-08

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.5256E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.747E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.509E-01	0.253E-01
-24.	0.104E-04	0.153E-04	0.266E-03	0.313E-03	0.331E-03	0.329E-03	0.317E-03	0.295E-03	0.277E-03	0.230E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.108E-01	0.413E-02	0.150E-03	0.120E-06
-24.	0.168E-03	0.105E-03	0.105E-04	0.148E-07

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.6132E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.749E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.107E-04	0.158E-04	0.270E-03	0.318E-03	0.337E-03	0.335E-03	0.323E-03	0.302E-03	0.284E-03	0.237E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.417E-02	0.164E-03	0.257E-06
-24.	0.175E-03	0.111E-03	0.128E-04	0.390E-07

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.7008E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.109E-04	0.160E-04	0.271E-03	0.319E-03	0.339E-03	0.337E-03	0.326E-03	0.305E-03	0.286E-03	0.240E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.418E-02	0.170E-03	0.399E-06
-24.	0.178E-03	0.114E-03	0.141E-04	0.700E-07

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.7884E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.339E-03	0.338E-03	0.326E-03	0.305E-03	0.287E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.172E-03	0.512E-06
-24.	0.179E-03	0.115E-03	0.147E-04	0.990E-07

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.8760E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.340E-03	0.338E-03	0.327E-03	0.306E-03	0.288E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.173E-03	0.586E-06
-24.	0.179E-03	0.116E-03	0.150E-04	0.121E-06

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.9636E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.340E-03	0.338E-03	0.327E-03	0.306E-03	0.288E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.174E-03	0.629E-06
-24.	0.179E-03	0.116E-03	0.151E-04	0.135E-06

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1051E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.340E-03	0.338E-03	0.327E-03	0.306E-03	0.288E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.174E-03	0.651E-06
-24.	0.179E-03	0.116E-03	0.152E-04	0.143E-06

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1139E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.340E-03	0.338E-03	0.327E-03	0.306E-03	0.288E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.174E-03	0.662E-06
-24.	0.179E-03	0.116E-03	0.152E-04	0.147E-06

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1226E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.340E-03	0.338E-03	0.327E-03	0.306E-03	0.288E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.174E-03	0.667E-06
-24.	0.179E-03	0.116E-03	0.152E-04	0.149E-06

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1314E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.340E-03	0.338E-03	0.327E-03	0.306E-03	0.288E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.174E-03	0.669E-06
-24.	0.179E-03	0.116E-03	0.152E-04	0.150E-06

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1402E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.340E-03	0.338E-03	0.327E-03	0.306E-03	0.288E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.174E-03	0.670E-06
-24.	0.179E-03	0.116E-03	0.152E-04	0.151E-06

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1489E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.340E-03	0.338E-03	0.327E-03	0.306E-03	0.288E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.174E-03	0.670E-06
-24.	0.179E-03	0.116E-03	0.152E-04	0.151E-06

STEADY STATE SOLUTION HAS BEEN OBTAINED BEFORE FINAL SIMULATING TIME.

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1577E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.1190E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	-31.	-28.	0.	5.	10.	12.	15.	18.	20.	24.
0.	0.750E-03	0.140E-02	0.529E+00	0.512E+00	0.312E+00	0.214E+00	0.120E+00	0.710E-01	0.510E-01	0.253E-01
-24.	0.110E-04	0.161E-04	0.272E-03	0.320E-03	0.340E-03	0.338E-03	0.327E-03	0.306E-03	0.288E-03	0.241E-03

CONTINUE

Y \ X	30.	37.	60.	104.
0.	0.109E-01	0.419E-02	0.174E-03	0.670E-06
-24.	0.179E-03	0.116E-03	0.152E-04	0.151E-06

Table A-6. AT123D Fate and Transport Model Input and Output Values for Benzene (Concentration vs. Time) at the Former UST 117, Building 7002 Site

NO. OF POINTS IN X-DIRECTION 2
NO. OF POINTS IN Y-DIRECTION 1
NO. OF POINTS IN Z-DIRECTION 1
NO. OF ROOTS: NO. OF SERIES TERMS 400
NO. OF BEGINNING TIME STEP 61
NO. OF ENDING TIME STEP 175
NO. OF TIME INTERVALS FOR PRINTED OUT SOLUTION 6
INSTANTANEOUS SOURCE CONTROL = 0 FOR INSTANT SOURCE 1
SOURCE CONDITION CONTROL = 0 FOR STEADY SOURCE 0
INTERMITTENT OUTPUT CONTROL = 0 NO SUCH OUTPUT 1
CASE CONTROL =1 THERMAL, = 2 FOR CHEMICAL, = 3 RAD 2

AQUIFER DEPTH, = 0.0 FOR INFINITE DEEP (METERS) ... 0.1524E+02
AQUIFER WIDTH, = 0.0 FOR INFINITE WIDE (METERS) ... 0.0000E+00
BEGIN POINT OF X-SOURCE LOCATION (METERS) ..... -0.9100E+01
END POINT OF X-SOURCE LOCATION (METERS) ..... 0.9100E+01
BEGIN POINT OF Y-SOURCE LOCATION (METERS) ..... -0.6100E+01
END POINT OF Y-SOURCE LOCATION (METERS) ..... 0.6100E+01
BEGIN POINT OF Z-SOURCE LOCATION (METERS) ..... 0.0000E+00
END POINT OF Z-SOURCE LOCATION (METERS) ..... 0.0000E+00

POROSITY ..... 0.1800E+00
HYDRAULIC CONDUCTIVITY (METER/HOUR) 0.9000E-01
HYDRAULIC GRADIENT 0.3500E-02
LONGITUDINAL DISPERSIVITY (METER) ..... 0.1000E+02
LATERAL DISPERSIVITY (METER) ..... 0.3000E+01
VERTICAL DISPERSIVITY (METER) ..... 0.1000E+01
DISTRIBUTION COEFFICIENT, KD (M**3/KG) 0.7900E-04
HEAT EXCHANGE COEFFICIENT (KCAL/HR-M**2-DEGREE C).. 0.0000E+00

MOLECULAR DIFFUSION MULTIPLY BY POROSITY (M**2/HR) 0.3530E-05
DECAY CONSTANT (PER HOUR) 0.4000E-04
BULK DENSITY OF THE SOIL (KG/M**3) ..... 0.1320E+04
ACCURACY TOLERANCE FOR REACHING STEADY STATE 0.1000E-02
DENSITY OF WATER (KG/M**3) ..... 0.1000E+04
TIME INTERVAL SIZE FOR THE DESIRED SOLUTION (HR) .. 0.7300E+03
DISCHARGE TIME (HR) ..... 0.4380E+05
WASTE RELEASE RATE (KCAL/HR), (KG/HR), OR (CI/HR) . 0.2210E-04

RETARDATION FACTOR ..... 0.1579E+01
RETARDED DARCY VELOCITY (M/HR) 0.1108E-02
RETARDED LONGITUDINAL DISPERSION COEF. (M**2/HR) .. 0.1109E-01
RETARDED LATERAL DISPERSION COEFFICIENT (M**2/HR) . 0.3337E-02
RETARDED VERTICAL DISPERSION COEFFICIENT (M**2/HR). 0.1120E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.0000E+00 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.000E+00	0.000E+00

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.4380E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.553E+00	0.345E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.4818E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.289E+00	0.468E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.5256E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.176E+00	0.672E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.5694E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.114E+00	0.840E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.6132E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X 0.	46.
0.	0.759E-01	0.891E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.6570E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X 0.	46.
0.	0.516E-01	0.843E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.7008E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X 0.	46.
0.	0.356E-01	0.742E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.7446E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X 0.	46.
0.	0.248E-01	0.623E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.7884E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X 0.	46.
0.	0.174E-01	0.506E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.8322E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.123E-01	0.402E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.8760E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.875E-02	0.315E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.9198E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.624E-02	0.243E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.9636E+05 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.446E-02	0.187E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1007E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y \ X	0.	46.
0.	0.320E-02	0.142E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1051E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X: 0.	46.
0.	0.230E-02	0.108E-01

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1095E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X: 0.	46.
0.	0.166E-02	0.811E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1139E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X: 0.	46.
0.	0.120E-02	0.609E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1183E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X: 0.	46.
0.	0.864E-03	0.456E-02

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1226E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

Y	X: 0.	46.
0.	0.626E-03	0.341E-02

STEADY STATE SOLUTION HAS NOT BEEN REACHED BEFORE FINAL SIMULATING TIME.

DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT 0.1270E+06 HRS
(ADSORBED CHEMICAL CONC. = 0.7900E-01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00

		X
Y	0.	46.
0.	0.454E-03	0.255E-02

Former UST 117, Building 7002
Hunter Army Airfield

TABLE A-7. GEOTECHNICAL PARAMETERS FOR THE FORMER UST 117, BUILDING 7002 SITE

Building ID	Tank ID	Facility ID	Sample ID	Sample Depth	Classifi-cation	Moisture Content (%)	Total Organic Carbon (%)	Specific Gravity	Porosity, n	Per-meability (cm/s)
7002	117	9-025113*1	BFGT11	2.0 to 4.0	CH	28.9	0.1	2.65	0.49	1.42E-08

NOTE: CH = Sandy, fat clay.
UST = Underground storage tank.

Tue 10/2/01

Georgia Department of Natural Resources

Environmental Protection Division
Underground Storage Tank Management Program
4244 International Parkway, Suite 104, Atlanta, Georgia 30354
Lonice Barrett, Commissioner
Harold F. Reheis, Director
(404)362-2687

September 28, 2001

Colonel Gregory V. Stanley
U.S. Army/HQ 3rd Inf. Div. (Mech) and Ft. Stewart
Directorate of Public Works
1550 Frank Cochran Drive, Building 1137
Fort Stewart, GA 31314-4927

SUBJECT: **Review Information Leading to a Deficiency Determination of Corrective Action Plan (CAP)-Part B:**
Hunter AAF, Former UST #117
Building 7002, Bulk Fuel Facility (HAA-09)
Savannah, Chatham County, GA
Facility ID: 9025113*1

Dear Colonel Stanley:

The Georgia Underground Storage Tank Management Program (USTMP) has received your letter, dated August 6, 2001, that forwarded a properly certified CAP-Part B. The report was prepared by Science Applications International Corporation (SAIC).

We have conducted a technical review of the CAP-Part B. The basis for this review is the Georgia Rules for Underground Storage Tank Management (GUST Rules, revised 1996). Our comments are outlined in the enclosure. Please amend the CAP-Part B to address these by **November 9, 2001.**

Unless one of the outlined EPD Comments requests otherwise, you are required to submit only your responses to these comments. Resubmittal of a complete CAP-Part B is not necessary.

If you have any questions, please contact me at (404) 362-2687.

Sincerely,

William E. Logan
Senior Geologist
Corrective Action Unit II

WEL:
s:/land/landdocs/williaml/pending01/9025113.15
Enclosure
cc with EPD comments: C. Allison Bailey, SAIC
Lisa L. Lewis, GA EPD
Mr. Larry Rogers, GA EPD Coastal District
File (CA): Chatham, 9025113

EPD Review Comments

Corrective Action Plan (CAP)-Part B:
Hunter AAF, Former UST #117
Building 7002, Bulk Fuel Facility (HAA-09)
Savannah, Chatham County, GA
Facility ID: 9025113*1

September 28, 2001

a. ATL calculations do not yield a meaningful result and are not appropriate for the site. The contaminated soils are already below the water table and are in contact with groundwater (TPH 163 mg/kg at 5 feet deep. During tank closure contaminated soils were returned to the excavation). Depth to water table is < 5 feet. Request for monitoring only cannot therefore be based on the ATL calculation.
b. Laboratory reports for soils are not originals. Please submit original lab reports with original signature of certification.
c. Method 8270B is not a valid EPD approved testing Method for BTEX. Please resample by Method 8021G or 8260B and resubmit results. All future samples should be tested by 8021G and 8260B.
d. Lab reports for groundwater are not originals and a signed certification of results has not been included. Please submit original lab reports together with signed laboratory certification. Please identify method used for groundwater analyses.
e. The fate and transport model does not indicate the concentration at the source used for modeling purposes. Please indicate concentration values used at the source.
f. The model does not indicate the assumed time of the release. Please indicate the date of release on which the model is based.
g. It appears the maximum benzene concentration of the latest sampling event was used as the initial concentration prior to calibration. This should not be used as an initial concentration at the source. It is preferred that the current contaminant distribution not be used as the initial concentration prior to calibration.
h. Please indicate which wells were used to calibrate and outline the details of the calibration process.
Please designate 2 validation wells with values predicted by the model over the next 2 years, so that the model may be validated through the monitoring of the specified wells.

DEPARTMENT OF THE ARMY
HEADQUARTERS, 3D INFANTRY DIVISION (MECHANIZED) AND FORT STEWART
DIRECTORATE OF PUBLIC WORKS
1550 FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-4927

REPLY TO
ATTENTION OF

06 AUG 2001

Office of the Directorate

CERTIFIED MAIL
7099 3400 0010 5449 3336

Georgia Department of Natural Resources
Underground Storage Tank Management Program
Attention: Mr. William Logan
4244 International Parkway, Suite 104
Atlanta, Georgia 30303

Dear Mr. Logan:

Fort Stewart is pleased to receive the Georgia Environmental Protection Division's (GA EPD) correspondence dated September 5, 2000 approving the Corrective Action Plan (CAP)-Part A submitted for former Underground Storage Tank #117, Building 7002, Facility Identification Number 9-025113*1, Hunter Army Airfield (HAAF), Georgia. As recommended in the CAP-Part A, a CAP-Part B has been prepared for this site, and is provided for your review and comment.

Based on the information contained in the enclosed CAP-Part B report and the site score of 3250 (see Appendix X), Fort Stewart/HAAF recommends that semi-annual monitoring be conducted at the site for one year to confirm that the benzene and naphthalene concentrations (groundwater) remain below their respective alternate concentration levels (refer to Section III.D.5).

If you have any questions or comments regarding this recommendation or the enclosed report, please contact Ms. Tressa Rutland or Ms. Melanie Little, Directorate of Public Works, Environmental Branch, at (912) 767-2010 or (918) 296-9492, respectively.

Sincerely,

For Thomas C. Fry
Gregory V. Stanley
Colonel, U.S. Army
Director, Public Works

Enclosure

6 Aug 2001

FINAL

CORRECTIVE ACTION PLAN–PART B
FORMER UNDERGROUND STORAGE TANK 117
BUILDING 7002
BULK FUEL FACILITY (HAA-09)
FACILITY IDENTIFICATION NUMBER: 9-025113*1
HUNTER ARMY AIRFIELD, GEORGIA

Prepared for
U.S. Army Corps of Engineers
Savannah District
Under Contract Number DACA21-95-D-0022
Delivery Order No. 0051

Prepared by
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
P.O. Box 2502
Oak Ridge, Tennessee 37831

July 2001

00-367P(doc)/071801

II. SITE INVESTIGATION REPORT

This represents the Site Investigation (SI) Report for the Former Underground Storage Tank (UST) 117, Building 7002 site, Facility ID: 9-025113*1, located at the Bulk Fuel Facility (BFF) at Hunter Army Airfield (HAAF), Georgia (Figure 1). This Corrective Action Plan (CAP)–Part B Report follows the guidance published by the Georgia Environmental Protection Division (GA EPD) in February 1995; however, the organization of the appendices for this report mirrors that of the appendices listed in the CAP–Part A template issued by GA EPD in May 1998. Report figures and tables are located in Appendices I and II, respectively.

The Former UST 117, Building 7002 site is located near the northwestern boundary of the HAAF at the BFF as illustrated in Figure 2. The facility is approximately 600 feet by 1,200 feet and covers an area of approximately 16.5 acres. The facility contains three aboveground storage tanks (ASTs) with capacities of approximately 500,000 gallons each, aboveground and underground piping, and off-loader stations and pump stations for the distribution of fuel to and from the ASTs. In the past, the BFF has been used to store jet propulsion (JP-4) fuel, motor gasoline, #2 fuel oil, diesel, and aviation gasoline, and was used to supply fuel to pump houses. Currently, the BFF and associated ASTs and pipelines are used to store JP-8 and to supply fuel to the USTs located at Pump House #3, Pump House #4, and Pump House #5.

According to operational information maintained by the Fort Stewart Directorate of Public Works (DPW), a 550-gallon vertically oriented UST, used to store JP-4 fuel, was previously located in the north–central portion of the facility. This UST (UST 117), along with the ancillary piping, was purged and closed in-place by filling with grout on September 30, 1996, by Anderson Columbia Environmental, Inc. (ACE). In addition, a 2,000-gallon, non-regulated bulk storage overflow tank (UST 131) was removed by Earth Tech, Inc., on June 24, 1999. Refurbishment activities began at the BFF in 1999 and included the upgrading of ASTs 7007 and 7009, the installation of a new aboveground fuel pipeline, and the demolition of ASTs 7001 and 7003. Activities were completed in early 2001.

The site is located within an average or higher groundwater pollution susceptibility area and is more than 500 feet from a withdrawal point but less than 500 feet to a surface water body (Lamar Canal). Since public water supply wells exist within 2 miles of the site, as defined in Georgia Underground Storage Tank (GUST) Management Rule 391-5-15-.09, the appropriate soil threshold levels (STLs) are those presented in Table A, Column 1 of GUST Rule 391-5-15.

ACE performed the Initial Site Characterization (ISC) in September 1996 (ACE 1997). The ISC consisted of closing UST 117 in place on September 30, 1996. The UST piping was drained into the tank, and all remaining contents were subsequently removed using a vacuum truck and/or compressor-driven barrel vacuum device. The piping and the tank were then closed in-place by filling with grout. One soil sample (8102-TK117-S1) was collected from alongside the closed tank at a depth of 5 feet below ground surface (BGS) and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX), total petroleum hydrocarbons (TPH), and polynuclear aromatic hydrocarbons (PAHs). The soil sample was reported to contain benzene at a concentration of 0.013 mg/kg, which exceeds the Georgia Environmental Protection Division (GA EPD) applicable STL for benzene of 0.005 mg/kg (i.e., Table A, column 1). In addition, TPH was reported at a concentration of 163 mg/kg in the soil sample. The Closure Report, dated January 1997, was submitted to GA EPD.

Following the ISC, Science Applications International Corporation (SAIC) conducted a soil gas survey at the BFF in January 1999 to identify areas of significant contaminant concentration (SAIC 1999). The soil gas survey identified distinct continuous soil gas contaminant plumes for combined PAHs, benzene, TPH–diesel-range organics (DRO), and TPH–gasoline-range organics (GRO) with areas of significant contaminant concentrations ("hot spots") identified around Pumping Stations 7002 and 7008; ASTs 7001,

7003, 7005, and 7009; and the rail spur. The most significant areas of contamination were determined to be associated with AST 7003 and Pumping Station 7002, where the highest concentrations of benzene were noted. Sediment and surface water sampling activities were also conducted as part of the soil gas survey investigation. Sediment and surface water samples were collected from Lamar Canal in May 1999 to assess the potential impact of petroleum contaminants from the BFF (SAIC 1999). The evaluation of the surface water data indicated that petroleum-related compounds were not impacting the Lamar Canal surface water. However, the sediment data indicated that petroleum-related compounds were present at multiple isolated sampling locations downstream of the BFF.

Based on the results of the soil gas survey investigation activities, optimal sample locations were recommended for the implementation of a CAP–Part A SI. The CAP–Part A SI was conducted by SAIC in November and December 1999 and January 2000. The SI included the installation of 31 soil borings/monitoring wells, 6 vertical-profile borings, collecting soil and sediment samples for BTEX, PAH, TPH–DRO, TPH–GRO, and volatile organic compound (VOC) headspace analyses; collecting groundwater and surface water samples for BTEX and PAH analyses; collecting one undisturbed geotechnical sample; collecting water level and free product measurements; and conducting a survey of public and nonpublic drinking water supplies within a 2.0- and 0.5-mile radius of the site.

The CAP–Part A Report (SAIC 2000a), describing the results of the ISC and CAP–Part A investigation activities, was submitted to the GA EPD Underground Storage Tank Management Program (USTMP) in June 2000. The GA EPD USTMP conducted a technical review of the CAP–Part A Report. In a correspondence dated September 5, 2000 (Logan 2000), GA EPD approved the technical proposal contained in the CAP–Part A Report for further investigation of the groundwater contamination.

The CAP–Part B SI was conducted by SAIC in November and December 2000 and March 2001. This investigation was performed in accordance with the technical approach described in the SI Plan provided in the CAP–Part A Report (SAIC 2000a) and the requirements of *Addendum #11 to the Work Plan for Preliminary Groundwater and Corrective Action Plan–Part A/Part B Investigations at Former Underground Storage Tank Sites, Fort Stewart, Georgia* (SAIC 2000b). The CAP–Part B SI consisted of performing the following activities:

- installing seven shallow soil borings for soil sampling;
- installing three shallow borings for soil sampling and the installation of 1-inch-diameter monitoring wells to collect groundwater samples;
- collecting two sediment samples from Lamar Canal;
- collecting groundwater samples from all existing site groundwater monitoring wells;
- performing in situ permeability (slug) tests in two of the 2-inch-diameter wells (installed by Earth Tech); and
- collecting a comprehensive round of site water level and free product measurements.

In addition, as part of the facility upgrade activities, Earth Tech, Inc., installed six shallow borings for soil sampling and the installation of 2-inch-diameter monitoring wells around AST 7009. The soil samples were collected by Earth Tech Inc., during borehole installation in January 2000. However, the groundwater samples were collected by SAIC in December 2000 as part of the CAP–Part B SI. The Earth Tech, Inc., borings will herein afterwards be referenced with the CAP–Part B SI.

All soil and sediment samples were analyzed for BTEX, TPH–DRO and TPH–GRO. All groundwater samples were analyzed for BTEX and PAHs.

The CAP–Part B SI soil and sediment analytical laboratory results are included in Appendix V, and the groundwater analytical laboratory results are included in Appendix VIII of this document. This SI Report presents the findings of the CAP–Part B investigation.

The CAP–Part B for the Former UST 117, Building 7002 site was performed by SAIC for the Fort Stewart DPW, Environmental Branch, through the U.S. Army Corps of Engineers (USACE), Savannah District, under contract number DACA21-95-D-022, delivery order 0051.

II.A. HORIZONTAL AND VERTICAL EXTENT OF CONTAMINATION

The horizontal and vertical extent of petroleum contamination in soil and groundwater has been delineated by activities performed during the ISC, CAP–Part A SI, and CAP–Part B SI.

II.A.1. Delineation of Soil Contamination

Petroleum-related contaminants detected in soil at the UST 117 site during the ISC, CAP–Part A, and CAP–Part B SI included BTEX, anthracene, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, benzo(*k*)fluoranthene, chrysene, dibenzo(*a,h*)anthracene, fluoranthene, fluorene, indeno(1,2,3-*cd*)pyrene, naphthalene, phenanthrene, pyrene, TPH–DRO, and TPH–GRO. BTEX and TPH compounds were present in the soil sample collected during the ISC. During the CAP–Part A SI, BTEX, TPH–DRO, TPH–GRO, benzo(*b*)fluoranthene, benzo(*k*)fluoranthene, fluoranthene, fluorene, and naphthalene were detected. The remaining constituents were detected in the soil samples collected during the CAP–Part B investigation.

II.A.1.a. Contaminant concentrations

II.A.1.a.1. Initial Site Characterization

During the ISC, one soil sample was collected from alongside the tank. The sample contained concentrations of benzene and TPH as indicated in Tables 1a and 1b. The benzene concentration exceeded the applicable GUST STL (i.e., Table A, Column 1).

II.A.1.a.2. CAP–Part A Site Investigation

During the CAP–Part A SI, 31 soil samples were collected for geochemical analysis from 31 shallow soil borings ranging in depths from 10.7 to 13.5 feet BGS, as presented in Figure 3. Field screening methods were used during drilling to select soil samples for geochemical analysis.

The analytical results for soil sampling are summarized in Tables 2a and 2b and presented in the plan view in Figures 3 and 4a. The results exceeding applicable GUST STLs are shown in the cross-sections in Figure 3. The results of the soil and sediment samples collected during the CAP–Part A investigations are summarized below:

- Benzene was detected in 12 of the 31 soil samples at concentrations ranging from 0.0005 J mg/kg in SB-12 to 1.130 mg/kg in SB-22, and there were 4 samples with detection limits above the reporting limits. A total of six of these concentrations and detection limits exceeded the benzene STL of 0.005 mg/kg.

- Toluene was detected in 15 of the 31 soil samples at concentrations ranging from 0.0005 J mg/kg in SB-28 to 0.404 mg/kg in SB-22, and there were 4 samples with detection limits above the reporting limits. A total of two these concentrations and detection limits exceeded the toluene STL of 0.400 mg/kg.

- Ethylbenzene was detected in 8 of the 31 soil samples at concentrations ranging from 0.0006 J mg/kg in SB-29 to 13.6 J mg/kg in SB-22, and there were 2 samples with detection limits above the reporting limits. A total of four concentrations and detection limits exceeded the ethylbenzene STL of 0.370 mg/kg.

- Xylenes were detected in 7 of the 31 soil samples at concentrations ranging from 0.0006 J mg/kg in SB-14 to 74.6 J mg/kg in SB-22, and there were 2 samples with detection limits above the reporting limits. Only one of these samples had a concentration above the xylene STL of 20 mg/kg.

- Four PAH compounds were detected in 6 of the 31 soil samples. None of the concentrations exceeded their respective STLs.

- TPH–DRO was detected in 8 of the 31 soil samples at concentrations ranging from 6.5 mg/kg in SB-14 to 3450.0 mg/kg in SB-22.

- TPH–GRO was detected in 17 of the 31 soil samples at concentrations ranging from 0.07 mg/kg to 4520.0 mg/kg in SB-22.

Concentrations of BTEX exceeded the applicable GUST STLs (i.e., Table A, Column 1). The highest concentration of soil contamination was reported for the soil sample collected from boring SB-22 at a depth of 0.0 to 2.0 feet BGS. Benzene was reported at 1.130 mg/kg, toluene at 0.404 mg/kg, ethylbenzene at 13.6 mg/kg, and total xylenes at 74.6 mg/kg. Each of the compounds were reported above their respective STLs. Benzene and toluene were also detected in boring SB-20 at concentrations above the STLs. For the soil samples collected from borings SB-07, SB-09, SB-10, and SB-17, the volatile reporting limits were elevated causing the values for the BTEX compounds to be qualified as non-detects although their detection limits were above their applicable STLs. Alternate threshold levels (ATLs) for BTEX were calculated (Appendix VI). The ATL for benzene is 0.387 mg/kg, 12.210 mg/kg for toluene, 61.850 mg/kg for ethylbenzene, and 74.60 mg/kg for xylene. The ATL for benzene was exceeded in soil collected from borings SB-07 and SB-22. The ATLs for ethylbenzene and toluene were not exceeded in any of the soil samples. For xylene, the maximum concentration (74.6 mg/kg in SB-22) is equal to the calculated ATL.

II.A.1.a.3. CAP–Part B Site Investigation

During the CAP–Part A SI, the vertical extent of soil contamination was determined; however, the horizontal extent of soil contamination was not. Therefore, the CAP–Part A SI recommended collecting additional soil samples to delineate the horizontal extent of contamination around locations SB-7 and SB-22 (Figure 3).

During the CAP–Part B SI, 10 soil samples were collected for geochemical analysis from 10 shallow soil borings ranging in depth from 6.0 to 13.0 feet BGS. In addition, 12 soil samples were collected for geochemical analysis from the six Earth Tech, Inc., soil borings installed to a depth of 14 feet BGS.

The analytical results for the soil sampling are summarized in Tables 2c and 2d and presented in the plan view in Figures 3 and 4b. The results exceeding applicable STLs are shown in the cross-sections in Figure 3. The results of the soil samples collected during the CAP–Part B SI are summarized below:

- Benzene was detected in 5 of the 22 soil samples at concentrations ranging from 0.0018 mg/kg in SB-37 to 0.0763 mg/kg in SB-38. Only one soil sample (SB-38) had a concentration (0.0763 mg/kg) that exceeded the benzene STL of 0.005 mg/kg.

- Toluene was detected in 7 of the 22 soil samples at concentrations ranging from 0.00043 J mg/kg in SB-34 to 0.0388 mg/kg in SB-36. None of the concentrations exceeded the toluene STL of 0.400 mg/kg.

- Ethylbenzene was detected in 7 of the 22 soil samples at concentrations ranging from 0.0064 mg/kg in SB-37 to 4.5 mg/kg in MW-E3. A total of two of these concentrations exceeded the ethylbenzene STL of 0.370 mg/kg.

- Xylenes were detected in 8 of the 22 soil samples at concentrations ranging from 0.001 J mg/kg in MW-E4 to 17.0 mg/kg in MW-E3. None of these samples had concentrations above the xylene STL of 20 mg/kg.

- Ten PAH compounds were detected in 13 of the 21 soil samples. None of the concentrations exceeded their respective STLs.

- TPH–DRO was detected in 7 of the 22 soil samples at concentrations ranging from 8.6 mg/kg in SB-37 to 1,660 mg/kg in SB-22. There is no STL for TPH–DRO.

- TPH–GRO was detected in 14 of the 22 soil samples at concentrations ranging from 0.0644 mg/kg in SB-35 to 3240.0 mg/kg in SB-38. There is no STL for TPH–DRO.

Concentrations of benzene in the soil sample collected from SB-38 and concentrations of ethylbenzene in the soil sample collected from MW-E3 and SB-38 exceeded their respective applicable GUST STLs (i.e., Table A, Column 1). However, none of the benzene or ethylbenzene concentrations exceeded their respective ATLs (Appendix VI).

II.A.1.b. Field screening results

Field screening through VOC headspace analysis was performed during drilling for soil collected during the CAP–Part A and CAP–Part B investigations.

For each 2-foot interval drilled, soil grab samples were collected in glass jars and covered with aluminum foil. These samples corresponded to potential analytical sample aliquots collected from the same interval. After allowing at least 15 minutes for volatilization and temperature equilibration, the headspace VOC concentration was measured with a photoionization detector to quantify the VOCs present. The field screening results for each boring are indicated on each boring log.

For boreholes from which two soil samples were sent to the analytical laboratory for analysis, sample selection was based on field headspace readings and was as described below.

- In cases in which no contamination was detected by field headspace gas analysis in any of the borehole intervals, two soil samples were sent for chemical analyses: one from the interval nearest to the midpoint between the ground surface and the water table and one from the interval above the water table.

- In cases in which contamination was detected by field headspace gas analysis in one or more of the borehole intervals, two soil samples were sent for chemical analyses: one from the interval with the highest detected organic vapor concentration and one from the interval with the lowest detected organic vapor concentration.

Field headspace readings were also used to select soil samples for boreholes from which only one sample was sent to the analytical laboratory. The sample was selected as described below:

- In cases in which no contamination was detected by field headspace gas analysis in any of the borehole intervals, the sample above the water table was selected.

- In cases in which contamination was detected by field headspace gas analysis in one or more of the borehole intervals, the interval with the highest detected organic vapor concentration was selected.

II.A.2. Delineation of Groundwater Contamination

Petroleum-related contaminants detected in groundwater at the Former UST 117 site during the CAP–Part A SI and CAP–Part B SI included benzene, ethylbenzene, toluene, total xylenes, ancenaphthene, fluorene, naphthalene, and phenanthrene. These constituents were present in 64 of the 105 groundwater samples collected during the CAP–Part A and CAP–Part B investigations. Benzene was the only constituent to exceed its In-stream Water Quality Standard (IWQS) during the CAP–Part A and CAP–Part B investigations. Naphthalene was identified in 17 groundwater samples during the CAP–Part A and CAP–Part B SIs. Naphthalene does not have a Georgia IWQS or federal maximum contaminant level (MCL); however, several concentrations were above the current risk-based screening level of 6.5 µg/L. The other PAH constituents detected were all below applicable regulatory threshold values.

II.A.2.a. Horizontal extent of groundwater contamination

II.A.2.a.1. Initial Site Characterization

Groundwater samples were not collected during tank closure activities as part of the ISC.

II.A.2.a.2. CAP–Part A Site Investigation

During the CAP–Part A SI, 66 groundwater samples were collected for geochemical analysis from 31 shallow monitoring wells (MW-01 through MW-31) and 6 vertical-profile borings (VP-02 through VP-07), as presented in Tables 3a and 3b. The monitoring well construction diagrams were presented in Appendix VII of the CAP–Part A Report (SAIC 2000).

Benzene was identified in 18 groundwater samples during the CAP–Part A SI at concentrations ranging from 0.21 µg/L to 553.0 µg/L, as illustrated in the plan view and cross-section on Figure 5. The benzene concentrations in three samples collected from MW-21, MW-22, and VP-04 were above the Georgia IWQS of 71.28 µg/L and the federal MCL of 5 µg/L. The benzene concentrations in 11 samples exceeded the risk-based concentration of 0.36 µg/L; however, none of the concentrations exceeded the benzene alternate concentration limit (ACL) of 634.4 µg/L (see Appendix VI). The analytical detection limit for benzene was less than 2 µg/L in all samples.

Toluene was identified in 38 groundwater samples during the CAP–Part A SI at concentrations ranging from 0.28 J µg/L to 2.8 µg/L, as illustrated in the plan view and cross-section on Figure 6. The concentrations did

not exceed the Georgia IWQS of 200,000 µg/L; the federal MCL of 1,000 µg/L; or the risk-based screening level of 750 µg/L. The analytical detection limit for toluene was less than 2 µg/L in all samples.

Ethylbenzene was identified in 18 groundwater samples during the CAP–Part A SI at concentrations ranging from 0.10 J µg/L to 86.7 µg/L, as illustrated in the plan view and cross-section in Figure 7. The concentrations did not exceed the Georgia IWQS of 28,718 µg/L; the federal MCL of 700 µg/L; or the risk-based screening level of 1,300 µg/L. The analytical detection limit for ethylbenzene was less than 2 µg/L in all samples.

Total xylenes were identified in 12 groundwater samples during the CAP–Part A SI at concentrations ranging from 0.36 J µg/L to 710 µg/L, as illustrated in the plan view and cross-section in Figure 8. There is no Georgia IWQS for xylenes. The concentrations did not exceed the federal MCL of 10,000 µg/L or the risk-based screening level of 12,000 µg/L. The analytical detection limit for total xylenes was less than 3.0 µg/L in all samples.

Naphthalene was identified in five groundwater samples during the CAP–Part A SI. Naphthalene concentrations ranged from 2.0 µg/L in MW-20 to 101 µg/L in MW-22, as illustrated on Figure 9. This compound does not have a Georgia IWQS or federal MCL; however, concentrations in three samples (MW-10, MW-21, and MW-22) are above the current risk-based screening level of 6.5 µg/L. The concentration in sample MW-21 is above the CAP–Part A calculated site ACL for naphthalene of 57.85 µg/L (SAIC 2000) but below the revised CAP–Part B site ACL of 820.95 µg/L (Appendix VI).

II.A.2.a.3. CAP–Part B Site Investigation

During the CAP–Part A SI, it was determined that benzene concentrations in three groundwater samples were above the IWQS of 71.28 µg/L; however, their concentrations were below the benzene ACL of 634.4 µg/L. In addition, naphthalene was determined to exceed the risk-based screening level of 6.5 µg/L in three groundwater samples with one sample exceeding the CAP–Part A calculated site ACL for naphthalene of 57.85 µg/L. The vertical extent of groundwater contamination was determined during the CAP–Part A SI. As a conservative measure, the CAP–Part A SI recommended that a CAP–Part B SI be conducted to confirm the site conditions, ensure groundwater monitoring locations exist downgradient of the area of highest groundwater contamination, and validate the fate and transport model.

During the CAP–Part B SI conducted in November and December 2000, three additional monitoring wells were installed: (1) adjacent to VP-04; (2) downgradient of MW-22; and (3) cross-gradient of MW-22. One groundwater sample was collected from each of these three new wells (MW-32, MW-33, and MW-34). Groundwater samples were also collected from 30 of the existing CAP–Part A wells and from the 6 monitoring wells installed by Earth Tech, Inc. Monitoring well MW-15 could not be sampled as it had been inadvertently destroyed during the BFF upgrade activities prior to December 2000. A total of 39 groundwater samples were collected for geochemical analysis, as presented in Tables 3c and 3d. Monitoring well locations are presented in Figure 2.

A comprehensive round of water level measurements was also collected on December 1, 2000. During this event, it was discovered that approximately 0.58 feet of free product was present in MW-22 (Table 4). The product was pumped from the well resulting in the recovery of approximately 0.066 gallons. Subsequent measurements collected on February 1 and March 12, 2001, indicate that all free product has been removed. Free product has not been detected in any of the other wells located at the Former UST 117, Building 7002 site.

A site survey conducted on May 1, 2001, determined that during the removal efforts of ASTs 7001 and 7003 at the BFF in April 2001, monitoring wells MW-21 and MW-24 were destroyed. In addition, the construction of a haul road for the AST removal efforts damaged the concrete pads around monitoring wells MW-17, MW-20, MW-22, MW-23, MW-25, and MW-26, and may have damaged the wells below the surface.

Benzene was identified in 10 groundwater samples during the CAP–Part B SI at concentrations ranging from 0.29 J µg/L to 251 µg/L, as illustrated in the plan view and cross-section on Figure 10. The benzene concentrations in three samples collected from MW-21, MW-22, and MW-32 were above the Georgia IWQS of 71.28 µg/L and the federal MCL of 5 µg/L. The benzene concentrations in eight samples exceeded the risk-based concentration of 0.36 µg/L; however, none of the concentrations exceeded the benzene ACL of 634.4 µg/L (see Appendix VI). The analytical detection limit for benzene was less than 2 µg/L in all samples.

Toluene was identified in 10 groundwater samples during the CAP–Part B SI at concentrations ranging from 0.27 J µg/L to 5.7 µg/L, as illustrated in the plan view and cross section on Figure 11. The concentrations did not exceed the Georgia IWQS of 200,000 µg/L; the federal MCL of 1,000 µg/L; or the risk-based screening level of 750 µg/L. The analytical detection limit for toluene was less than 2 µg/L in all samples.

Ethylbenzene was identified in 13 groundwater samples during the CAP–Part B SI at concentrations ranging from 0.18 J µg/L to 128 µg/L, as illustrated in the plan view and cross-section in Figure 12. The concentrations did not exceed the Georgia IWQS of 28,718 µg/L; the federal MCL of 700 µg/L; or the risk-based screening level of 1,300 µg/L. The analytical detection limit for ethylbenzene was less than 2 µg/L in all samples.

Total xylenes were identified in 13 groundwater samples during the CAP–Part B SI at concentrations ranging from 0.30 µg/L to 734 µg/L, as illustrated in the plan view and cross-section in Figure 13. There is no Georgia IWQS for xylenes. The concentrations did not exceed the federal MCL of 10,000 µg/L or the risk-based screening level of 12,000 µg/L. The analytical detection limit for total xylenes was less than 3.0 µg/L in all samples.

Acenaphthene and fluorene were detected in two groundwater samples (MW-E1 and MW-E5), and phenanthrene was detected in one groundwater sample (MW-E5); however, none of the concentrations exceeded applicable Georgia IWQS or the risk-based screening levels.

Naphthalene was identified in 12 groundwater samples during the CAP–Part B SI. Naphthalene concentrations ranged from 0.58 J µg/L to 528 µg/L, as illustrated on Figure 14. This compound does not have a Georgia IWQS or federal MCL; however, concentrations in seven samples are above the current risk-based screening level of 6.5 µg/L. None of the concentrations are above the CAP–Part B SI calculated site ACL for naphthalene of 820.95 µg/L (Appendix VI).

II.A.2.a.4. Conclusions of the horizontal extent of site groundwater contamination

Figures 5 through 14 demonstrate that the horizontal extent of groundwater contamination has been delineated. Petroleum contaminants identified in groundwater at the Former UST 117, Building 7002 site included BTEX constituents normally associated with gasoline and diesel releases as well as PAH constituents, which probably represent less soluble biodegradation products of such a release. During the CAP–Part A and CAP–Part B investigations, benzene was the only compound detected that exceeded the Georgia IWQS of 71.28 µg/L; however, none of the concentrations exceeded the benzene ACL of 634.4 µg/L. None of the PAH constituents detected during the CAP–Part A or CAP–Part B SI exceeded their respective Georgia IWQS. Naphthalene was detected at concentrations exceeding the risk-based screening level of 6.5 µg/L. However, none of the naphthalene concentrations exceeded the CAP–Part B calculated site naphthalene ACL of 820.95 µg/L.

II.A.2.b. Vertical extent of groundwater contamination

The vertical extent of groundwater contamination was not investigated during the ISC. During the CAP–Part A SI, the vertical extent of groundwater was delineated through groundwater sampling below the water table. Six vertical-profile borings (VP-02 through VP-07) were advanced below the water table, and groundwater samples were collected at 5-foot intervals. Drilling was stopped at a refusal depth of 43.0 feet BGS. This refusal depth may have indicated the Hawthorn Formation. The benzene concentrations in groundwater were found to decrease with depth. During the vertical groundwater investigation, the highest benzene concentration (81.8 µg/L) was observed in VP-4 from the 13.0- to 18.0-foot sample interval. The following sample interval, 18.0 to 23.0 feet BGS, had a benzene concentration of 1.4 µg/L. The deepest interval, 38.0 to 43.0 feet BGS, in VP-4 had a benzene concentration of 0.21 J µg/L, indicating that the vertical extent of groundwater contamination had been delineated and is confined to the Surficial Aquifer.

II.A.3. Delineation of Free Product Plume

Free product was identified at the Former UST 117, Building 7002 site during the CAB–Part B SI. On December 1, 2000, approximately 0.58 feet of free product was discovered in MW-22. The product was removed from the well by pumping, resulting in the recovery of approximately 0.066 gallons. Subsequent measurements collected on February 1 and March 12, 2001, indicate that all free product has been removed. Free product has not been detected in any of the other wells located at the Former UST 117, Building 7002 site.

II.A.4. Delineation of Sediment and Surface Water Contamination

II.A.4.a. CAP-Part A Investigation

A total of nine sediment samples and eight surface water samples were collected from Lamar Canal during the CAP–Part A SI. The analytical results for the sediment samples are summarized in Tables 2e and 2f. The analytical results for the surface water samples are summarized in Tables 3e and 3f. The sampling locations for these samples are shown on Figure 15. The results of the sampling activities are summarized below:

- Benzene was not detected in any of the sediment samples. In sediment sample SD-3, the detection limit for benzene was above the reporting limit and exceeded the STL of 0.005 mg/kg; however, the concentration was below the ATL.

- Toluene was detected in seven of the nine sediment samples at concentrations ranging from 0.00036 J mg/kg in SD-08 to 2.81 mg/kg in SD-3. Only sediment sample SD-3 had a toluene concentration that exceeded the STL of 0.400 mg/kg. However, this concentration was below the ATL.

- Ethylbenzene was not detected in any of the sediment samples. In sediment sample SD-3, the detection limit for ethylbenzene was above the reporting limit; however, the concentration did not exceed the STL.

- Xylene was not detected in any of the sediment samples. In sediment sample SD-3, the detection limit for xylene was above the reporting limit; however, the concentration did not exceed the STL.

- Seven PAH compounds were reported in two of the nine sediment samples. However, none of the concentrations exceeded their respective STLs.

- TPH–DRO was detected in two of the nine sediment samples at concentrations of 9.2 J mg/kg and 9.2 mg/kg.
- TPH–GRO was also detected in two of the nine sediment samples at concentrations of 0.232 mg/kg and 0.160 mg/kg.
- Benzene was the only compound detected in the eight surface water samples collected. Surface water sample SD-5 contained a benzene concentration of 0.17 µg/L. This concentration did not exceed the IWQS of 71.28 µg/L or the MCL of 5 µg/L.

The CAP–Part A SI recommended collecting additional sediment samples adjacent to location SD-3 because this location contained concentrations of benzene and toluene above their respective STLs and is located adjacent to the storm drain system draining the area with identified groundwater contamination.

II.A.4.b. CAP–Part B Investigation

During the CAP–Part B SI, two sediment samples (SD-10 and SD-11) were collected downgradient of the site from Lamar Canal adjacent to SD-3 and near the storm drain. The sampling locations are shown on Figure 15, and analytical data for these samples are shown on Tables 2e and 2f. No BTEX or PAH compounds were detected in either of the two samples collected. No surface water samples were collected during the CAP–Part B SI.

II.B. LOCAL AND SITE HYDROGEOLOGY

Discussion of the local and site hydrogeology is based on field observations and investigative activities performed during the CAP–Part A SI and CAP–Part B SI of the Former UST 117, Building 7002 site and is presented in detail in Appendix X.

II.B.1. Documentation of Local Groundwater Conditions

II.B.1.a. Groundwater usage

According to the Groundwater Pollution Susceptibility Map of Georgia (GA EPD 1992), the Former UST 117, Building 7002 site is located within an average or higher groundwater pollution susceptibility area. A total of five public groundwater supply wells are located within a 2-mile radius of the Former UST 117, Building 7002 site. Four of these wells (PWS #1, PWS #2, PWS #3, and PWS #4A) are located within the confines of the HAAF. The other well (PWS #25) is located approximately 0.8 miles northwest of the site in Savannah, Georgia. All of the groundwater supply wells are classified as public wells and supply water either to HAAF or the City of Savannah for drinking and non-drinking purposes. These wells range in depth from approximately 300 feet to 600 feet deep and draw groundwater from the Principal Artesian (also known as the Floridan) Aquifer. A complete discussion of the water supply wells at HAAF and near the Former UST 117, Building 7002 site is provided in Appendix III. The locations of the wells within the 2-mile radius and within a 500-foot radius are shown on Figures 16 and 17, respectively.

II.B.1.b. Aquifer description

The hydrogeology in the vicinity of HAAF is dominated by two aquifers referred to as the Principal Artesian and the Surficial Aquifers (Miller 1990). 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 groundwater 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 feet 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 feet to 10 feet BGS (Miller 1990). 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 approximately 50 feet BGS; thus, the effective aquifer thickness would be approximately 45 feet. Groundwater encountered at the Former UST 117, Building 7002 site is part of the Surficial Aquifer system.

The confining layer for the Principal Artesian Aquifer is the phosphatic clay of the Hawthorn Group and ranges in thickness from 15 feet 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, argillacerous 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.

Based on the fact that all public and non-public water supply wells draw water from the Floridan Aquifer, and that the Hawthorn confining unit separates the Floridan Aquifer from the Surficial Aquifer, it is concluded that there is no hydraulic interconnection between the Former UST 117, Building 7002 site (and associated plumes, if applicable) and water supply withdrawal points.

II.B.1.c. Surface water

The water resources survey conducted during the CAP–Part A SI is presented in Appendix III. Surface water bodies including Lamar Canal, Pond 29, and several unnamed drainage ditches are located within a 1-mile radius of the Former UST 117, Building 7002 site and are shown in Figure 17. Lamar Canal is located approximately 180 feet south–southeast (downgradient) of the BFF site. A series of storm drains and catch basins are located along the southern border of the BFF and are used to drain the bermed area around each of the ASTs (Figure 2). One of the storm drains is located approximately 120 feet from the area of greatest soil and groundwater contamination (SB/MW-22) in the vicinity of AST 7003. The invert elevation of the storm drain is unknown; however, based on the shallow depth to the water table (2.26 feet BGS), it is assumed that the storm drain is below the water table. Therefore, the storm drain is considered as a preferential pathway. Based on the location of Lamar Canal relative to the associated plumes, the Former UST 117, Building 7002 site is classified as being located less than 500 feet from a surface water body.

II.B.2. Stratigraphic Boring Logs

The local stratigraphy of HAAF and vicinity is presented in Section II.B.2.a, and the site stratigraphy from the CAP–Part A and CAP–Part B investigations is presented in Section II.B.2.b.

II.B.2.a. Local stratigraphy

HAAF is located within the Barrier Island Sequence District of the Coastal Plain Physiographic Province of the Southeast United States (Clark and Zisa 1976). The Barrier Island Sequence District in Chatham County is characterized by the existence of several marine terraces (step-like topographic surfaces that decrease in elevation toward the coast). These marine terraces, and their associated deposits, are the result of sea level fluctuations that occurred during the Pleistocene Epoch. The surficial (Quaternary) deposits in Chatham County, in decreasing elevation and area, are part of the Okefenokee, Wicomico, Penholoway, Pamlico, and Silver Bluff terrace complexes (Wilkes et al. 1974; GA DNR 1976; Huddlestun 1988).

HAAF, as well as most of Chatham County, is underlain by the Pleistocene Pamlico Terrace. The Pleistocene Satilla Formation (formerly known as the Pamlico Formation) consists of deposits of the Pamlico Terrace complex and other terrace complexes in the region. The Satilla Formation is a lithologically heterogeneous unit that consists of variably bedded to non-bedded sand and variably bedded silty to sandy clay. During the Pleistocene, these sand and clay deposits were formed in offshore and inner continental shelf, barrier island, and marsh/lagoonal-type environments (Huddlestun 1988). According to the Geologic Map of Georgia (GA DNR 1976), clay beds of marsh origin, which were deposited on the northwest side of the former Pamlico Barrier Island complex, exist in the western quarter of HAAF. Very fine- to coarse-grained sand deposits of barrier island origin are more common throughout the remaining areas of HAAF.

II.B.2.b. Site stratigraphy

As determined from soil borings drilled during the CAP–Part A SI and CAP–Part B SI, the lithologies present within 15 feet of the surface at the Former UST 117, Building 7002 site appear to correlate with the regional stratigraphic section. The lithology underlying the study area consists of interbedded layers of sand with varying amounts of silt and clay concluded to be part of the Satilla Formation. Soil groups at HAAF include the Chipley, Leon, Ellabelle, Kershaw, Pelham, Albany, Wahee, and Ogeechee (Wilkes et al. 1974). CAP–Part B SI soil boring logs are provided in Appendix IV.

II.B.3. Stratigraphic Cross Sections

Stratigraphic cross sections have been developed based on the CAP–Part A SI and CAP–Part B SI soil boring logs. Figure 3 presents four cross sections that illustrate the geology described in Section II.B.2.b.

II.B.4. Referenced or Documented Calculations

Referenced or documented calculations performed to support the CAP–Part B SI include those used in developing and interpreting the results of the groundwater slug testing and the site ATLs and ACLs (Appendix VI and Attachment A).

II.B.4.a. Geotechnical analysis

A soil sample for geotechnical analysis was collected as part of the CAP–Part A investigation. The results were provided in the CAP–Part A Report (SAIC 2000) and are summarized in Table 5 of this document. Additional geotechnical sampling was not performed as part of the CAP–Part B SI.

II.B.4.b. Slug testing

Slug tests were conducted on shallow wells MW-E4, MW-E5, and MW-E6 on January 4, 2000. The slug test data were evaluated using the Bouwer & Rice method in the AQTESOLVE Professional v2.5 (1999) groundwater modeling software. Calculated hydraulic conductivity values are 0.0010 cm/sec, 0.0064 cm/sec, and 0.0013 cm/sec, respectively. The average hydraulic conductivity of the surficial aquifer around the Former UST 117, Building 7002 site is 0.0029 cm/sec. Calculations for determining the hydraulic conductivity and transmissivity from the slug test data are presented in Attachment A.

II.B.5. Direction of Groundwater Flow

II.B.5.a. Well construction details

Following contact with fully saturated material in a soil boring, a water level measurement was taken to determine the remaining depth to be drilled. This measurement was necessary to ensure the placement of at least 5 feet of well screen below the water table, in accordance with the Work Plan.

The monitoring well casing installed by SAIC consisted of a 1-inch inside diameter, Schedule 40, flush-thread, polyvinyl chloride (PVC) riser pipe and screen in 10-foot sections (MW-01 through MW-34). Earth Tech, Inc., installed 2-inch inside diameter, Schedule 40, flush-thread PVC riser pipe and screen in 10-foot sections (MW-E1 through MW-E6). The well screen slot size was 0.010 inch. Table 6 summarizes construction details for CAP–Part A SI and CAP–Part B SI monitoring wells. Well construction diagrams for the CAP–Part B SI are presented in Appendix VII. Following installation of the well casing, filter-pack sand was poured and extended to a measured level at least 0.5 foot above the top of the well screen.

Well seals were composed of 3/8-inch bentonite pellets and allowed to hydrate before filling of the annular space above the seal. The total volume of potable water used to hydrate the pellets averaged 2 gallons per well. The well seal extended to a measured level of at least 0.5 foot above the top of the filter pack.

Above the well seal, the remaining annular space was completed with a 1-foot-long, flush-mount, sheet steel protective casing that was grouted in place with a 12-inch-diameter × 4-inch-thick, high-strength concrete pad or a 3-foot × 3-foot × 4-inch-thick pad, depending upon whether the borehole was located in concrete or grass. Well casings were capped with expandable locking caps. Protective casings were covered with bolted cast-iron manhole covers. Inscribed monitoring well identification plates were permanently affixed to the inside of each manhole cover.

II.B.5.b. Potentiometric mapping

Water level measurements were collected during the CAP–Part A SI at least 24 hours after installation in January 2000 and during CAP–Part B SI groundwater sampling activities in March 2001. Data obtained from these measurements are presented in Tables 7a and 7b. During the CAP–Part A SI in January, groundwater flowed to the southeast (Figure 18). During the CAP–Part B SI in March 2001, groundwater was also determined to flow to the southeast (Figure 19).

II.B.5.c. Equipotential flow net

An equipotential flow net based on the March 2001 water level measurements and the contoured potentiometric surface is presented in Figure 20.

III. REMEDIAL ACTION PLAN

III.A. CORRECTIVE ACTION COMPLETED OR IN PROGRESS

III.A.1. Recovery/Removal of Free Product

Free product was identified in monitoring well MW-22 on December 1, 2000. Corrective action activities at the site consisted of pumping the free product from well MW-22, resulting in the recovery of approximately 0.066 gallons of free product on December 1, 2000. Subsequent measurements collected on February 1 and March 12, 2001, indicate that all of the free product has been removed (Table 4). Free product has not been detected in any of the other wells located at the Former UST 117, Building 7002 site.

III.A.2. Remediation/Treatment of Contaminated Backfill Material and Native Soils

Anderson Columbia closed UST 117 in place on September 30, 1996. No soil was excavated or removed from the site.

III.B. OBJECTIVES OF CORRECTIVE ACTION

III.B.1. Removal of Free Product That Exceeds One-Eighth Inch

During the CAP–Part B investigation in December 2000, free product was detected in monitoring well MW-22. All free product was removed from MW-22 on December 1, 2000. On February 1 and March 12, 2001, additional measurement activities were conducted. Free product was not measured in MW-22 during either of these events. However, it is recommended that all of the site wells be monitored for the presence of free product during the recommended semi-annual basis for the next year. If free product is detected, removal activities will be commenced.

III.B.2. Remediate Groundwater Contamination

The CAP–Part A and CAP–Part B SIs documented groundwater contamination that exceeded the benzene IWQS at locations MW-21, MW-22, VP-4, and MW-34. During the CAP–Part A SI, the benzene concentration at the site in December 1999 was 553 µg/L in well MW-22, which is above the IWQS of 71.28 µg/L. This concentration was the maximum concentration observed during the CAP–Part A and CAP–Part B SIs. However, this concentration does not exceed the calculated benzene ACL of 634.4 µg/L (Appendix VI). During the CAP–Part B SI, the highest benzene concentration at the site was 251 µg/L, which was observed in well MW-21. Because MW-21 was destroyed during the removal efforts of ASTs 7001 and 7003, it is recommended that a replacement well (MW-21A) be installed in its former location.

The CAP–Part A and CAP–Part B SIs documented groundwater contamination that exceeded the naphthalene risk-based screening level of 6.5 µg/L at locations MW-9, MW-10, MW-20, MW-21, MW-22, MW-E1, and MW-E5. During the CAP–Part B SI, the maximum naphthalene concentration of 528 µg/L was observed in MW-22; however, this concentration does not exceed the CAP–Part B calculated ACL of 820.95 µg/L. None of the other PAH constituents were detected at concentrations above their respective IWQS or risk-based screening levels during the CAP–Part A or CAP–Part B SI.

As a result of the CAP–Part B SI, monitored natural attenuation of the site is recommended to confirm that benzene and naphthalene concentrations remain below their respective ACLs over the next 12 months (i.e., confirmatory sampling).

III.B.3. Remediate Soil Contamination

The results from the CAP–Part A investigation indicate that concentrations of benzene, toluene, ethylbenzene, and xylenes exceeded the applicable GUST STLs (i.e., Table A, Column 1). The highest concentration of soil contamination was reported for the soil sample collected from boring SB-22 at a depth of 0.0 to 2.0 feet BGS. Benzene was reported at 1.130 mg/kg, toluene at 0.404 mg/kg, ethylbenzene at 13.6 mg/kg and, xylenes at 74.6 mg/kg. Each of the compounds were reported above their respective STLs. Benzene and toluene were also detected in boring SB-20 and at sediment sampling location SD-3 at concentrations above the STLs. For the soil samples collected from borings SB-07, SB-09, SB-10, and SB-17, the volatile reporting limits were elevated causing the values for the BTEX compounds to be qualified as non-detects. ATLs for benzene, toluene, ethylbenzene, and xylene were calculated (Appendix VI). The ATL for benzene is 0.387 mg/kg, 12.210 mg/kg for toluene, 61.850 mg/kg for ethylbenzene, and 74.60 mg/kg for xylene. The ATL for benzene was exceeded in soil collected from borings SB-07, and SB-22. The ATLs for ethylbenzene and toluene were not exceeded in any of the soil samples. For xylene, the maximum concentration (74.6 mg/kg in SB-22) is equal to the calculated ATL.

To delineate the horizontal extent of soil contamination around location SB-07 and SB-22, additional soil samples were collected as part of the CAP–Part B SI. The results of the CAP–Part B investigation indicate that concentrations of benzene and ethylbenzene in the soil sample collected from SB-38, located adjacent to MW-22, exceeded their respective applicable GUST STLs (i.e., Table A, Column 1); however, the concentrations were below the ATLs. In addition, ethylbenzene was detected in MW-E3 above its STL; however, the concentration was below the ATL. The GUST STLs were not exceeded in any of the other soil or sediment samples collected during the CAP–Part B SI. The ATLs were not exceeded in any of the CAP–Part B sediment samples. Both the benzene and the xylene concentrations are below the risk-based screening levels (i.e., 200 mg/kg and 1,000,000 mg/kg, respectively) that are protective of soil exposure during industrial land use.

The subsequent sampling at SB-22 to delineate the horizontal extent of the benzene contamination in the soil indicated that benzene concentrations above its ATL were limited to the SB-22 location. At SB-22, the soil sample was collected from 0.0 to 2.0 feet BGS, which is above the water table. Groundwater samples collected at this location (MW-22) detected benzene concentrations of 553 μg/L and 174 μg/L, during the CAP–Part A and CAP–Part B SIs, respectively. However, both of these concentrations are below the ACL of 634.4 μg/L. Because the benzene concentration exceeding its ATL is limited to only SB/MW-22, the benzene contamination is above the water table, and the groundwater concentrations are below the benzene ACL, active remediation/removal of the soil is not recommended.

III.B.4. Provide Risk-based Corrective Action

A risk-based approach was used to determine the need for further action at the Former UST 117, Building 7002 site. Due to the nature of the contamination, the risk-based approach was limited to human health concerns. Ecological risk concerns are negligible because of the land use surrounding the site. The analytical results from surface water and sediment sampling in the drainage ditch indicate that the habitat potentially associated with Lamar Canal is not impacted by the former UST operations.

The methods for assessing human health concerns for the site were derived from GUST CAP–Part B guidance (GA EPD 1995) and recent GA EPD guidance (GA EPD 1996). These were supplemented by the additional

guidance documents on risk assessment methods referenced in this section. In general, the risk-based corrective action (RBCA) approach is performed in two steps:

1. Results are screened against readily available regulatory levels and risk-based screening levels to identify contaminants of potential concern (COPCs).

2. Site-specific ACLs are developed for COPCs using the results of the fate and transport modeling and identified receptor locations.

The following sections present the conceptual model of the exposure setting and potential receptors as well as the general methodology employed to perform the screening for COPCs and the development of ACLs.

III.B.4.a. Potential receptor survey

The exposure assessment identifies any potentially complete pathways between the contaminant source and potential receptors. This involves identifying potential current and future receptors, release mechanisms through which contamination might come into contact with the receptors, and routes of exposure through which receptors might be exposed.

The Former UST 117, Building 7002 site is located within an active military installation and within an access-controlled fence. Lamar Canal is located approximately 180 feet south–southeast (downgradient) of the BFF site. A series of storm drains and catch basins are located along the southern border of the BFF and are used to drain the bermed area around each of the ASTs. One of these storm drains is located 120 feet from AST 7003.

No connection between site contamination and current off-site receptors has been identified. Site contamination has migrated to the Surficial Aquifer. The Hawthorn Group, which is approximately 90 feet of clay, separates the Surficial Aquifer from the deep drinking water aquifer, the Floridan Aquifer. There appears to be no vertical migration from the Surficial Aquifer to the Floridan Aquifer. None of the HAAF's current water supply wells are located downgradient of the Former UST 117, Building 7002 site. The Hawthorn Group, a thick and highly effective confining unit, separates the water supply wells from the Surficial Aquifer.

Current on-site receptors have not been identified for the site. Potential future on-site receptors might include industrial workers and military residents.

Potential future on-site industrial receptors may come in direct contact with site soil contamination during construction or excavation activities. No near-term on-site receptors are likely to come into contact with groundwater unless the Surficial Aquifer discharges into the catch basin or Lamar Canal.

III.B.4.b. Screening for chemicals of potential concern

III.B.4.b.1. Screening Methodology

The purpose of a risk evaluation screening is to identify the COPCs and areas of concern at a site, and possibly to identify sites for which no further action is needed. The first step in the risk process uses screening levels that are readily obtainable and that, due to their conservative nature, can be used with a high degree of confidence to indicate sites for which no further action is required.

An American Society for Testing and Materials (ASTM 1995) Tier 1-type risk evaluation process will be applied to the data collected for the Former UST 117, Building 7002 site to identify any COPCs and media for which no further action is needed. The risk evaluation screen involves the steps listed below:

- identify potential migration and exposure pathways associated with the site, and identify potential exposure scenarios that should be used to select screening levels;
- identify risk-based screening levels and regulatory-based screening levels for each contaminant;
- compare site-related concentrations to screening levels to determine if any COPCs exist at the site; and
- compare detection limits to screening levels to identify potential false-negative screening results.

The screening levels for the Former UST 117, Building 7002 site data have been taken from the following sources based on GA EPD guidance (GA EPD 1996):

- Georgia IWQS (GA EPD 1998),
- GUST STLs (i.e., Table A, column 1),
- soil screening levels developed by the U.S. Environmental Protection Agency (EPA) (1996), and
- soil and groundwater risk-based concentrations developed by EPA Region 3 (EPA 1999).

These values reflect screening levels based on a combination of regulatory screening levels (i.e., IWQS and GUST STLs), and calculated risk-based values (i.e., EPA Region 3 risk-based concentrations).

Screening levels inherently incorporate assumptions about land use. In identifying COPCs, it is generally accepted that screening levels will reflect any potential future land uses and, thus, they usually reflect a conservative residential use scenario (EPA 1991; EPA 1996; ASTM 1995). Based on GA EPD guidance, risk-based screening levels reflect residential land use for groundwater and industrial land use for deep soils (i.e., > 2 feet BGS) (GA EPD 1996).

Default residential exposure scenarios for groundwater assume that use of the land could someday be residential and that the following exposures could occur:

- ingestion of groundwater, and
- inhalation of volatiles during showering.

The default industrial exposure assumptions for deep soils (i.e., > 2 feet BGS) assume that the following exposures could occur:

- incidental ingestion of soil, and
- inhalation of volatiles and dust.

EPA's *Soil Screening Guidance* (EPA 1996) provides two options for selecting soil values that address protection of groundwater. One value assumes no contaminant dilution or attenuation would occur between the soil and groundwater; a second value assumes a 20-fold dilution attenuation factor (DAF). A DAF of 20 was used to develop soil screening values protective of groundwater at the Former UST 117, Building 7002 site.

If applicable or relevant and appropriate requirement (ARAR)- or risk-based values are not available, it generally means that (1) the chemical is not considered to be toxic except perhaps at extremely high

concentrations (e.g., aluminum, sodium); (2) the dose-response data do not indicate a toxic effect; or (3) EPA is currently reviewing toxicity information, and no reference dose or cancer slope factor is currently available.

III.B.4.b.2. Risk-based screening results

The risk-screening process is a systematic screening of sample results to determine site-related COPCs. Constituent concentrations below risk- or ARAR-based screening levels were not considered to be COPCs and were not evaluated further. Table 8 presents the results of the risk-based screening for the CAP–Part A and the CAP–Part B SI soil data. Table 9 presents the results of the risk-based screening for the CAP–Part A SI and CAP–Part B SI groundwater data.

During the CAP–Part A SI, BTEX compounds were detected above GUST and risk-based screening levels based on leaching to groundwater in seven soil of the 53 soil samples collected. BTEX compounds were identified as COPCs for soil at the site.

The detection limits for benzene, toluene, ethylbenzene, and several PAHs exceeded GUST and risk-based screening levels in several samples during the CAP–Part A and CAP–Part B SIs. Many results were estimated due to detections below the detection limits. No soil data were rejected. No COPCs for soils were selected for the site based on the detection limits.

During the CAP–Part A SI, 66 groundwater samples were collected from 31 shallow monitoring wells and 6 vertical profiles. Benzene was identified in 18 groundwater samples at concentrations ranging from 0.21 μg/L to 553.0 μg/L. A total of 11 of these results exceeded the risk-based concentration of 0.36 μg/L. Concentrations in three of these samples (MW-21, MW-22, and VP-4) exceeded the benzene IWQS of 71.28 μg/L. Naphthalene was detected in five groundwater samples with concentrations ranging from 2.0 μg/L in MW-20 to 101.0 μg/L in MW-22. Concentrations in three samples (MW-10, MW-21, and MW-22) exceeded the risk-based screening levels for naphthalene of 6.5 μg/L. An IWQS does not exist for naphthalene. Toluene, ethylbenzene, and total xylenes were detected but at concentrations below their respective IWQS and risk-based screening levels.

Thirty-nine groundwater samples were collected during the CAP–Part B SI. Benzene was detected in 11 samples from 39 wells at concentrations above screening levels. The detections ranged from 0.29 μg/L at well MW-E4 to 251 μg/L at well MW-21. A total of nine of these results exceeded the risk-based screening level of benzene of 0.36 μg/L. Three of the 11 results also exceeded the IWQS for benzene of 71.28 μg/L. Naphthalene was detected in 12 of the 39 samples at concentrations above screening levels. The detections ranged from 0.58 μg/L in MW-31 to 528 μg/L in MW-22. A total of seven of these results exceeded the risk-based screening levels for naphthalene of 6.5 μg/L. An IWQS does not exist for naphthalene. Ethylbenzene, toluene, xylenes, acenapthene, fluorene, and phenanthrene were detected below screening values for the CAP–Part B SI. Benzene and naphthalene were selected as COPCs for groundwater at the Former UST 117, Building 7002 site.

Detection limits achieved for several PAHs during both the CAP–Part A and CAP–Part B SIs exceeded their respective IWQSs and/or risk-based screening levels for the groundwater data. For these constituents, screening levels represent values below analytically achievable levels. No additional COPCs were selected for groundwater based on the detection limit screening.

III.B.4.c. Site-specific levels

Detections exceeding the conservative generic screening levels are considered to be COPCs. ATLs and ACLs are developed, when appropriate, for the COPCs using site-specific information from the fate and transport modeling and applicable regulatory levels.

III.B.4.c.1. Alternate threshold levels

Benzene, ethylbenzene, toluene, and xylenes were identified as COPC for soil at the site. ATL calculations for these compounds are presented in Appendix VI and are based on the Analytical Transient 1-, 2-, 3-Dimensional (AT123D) modeling. The ATLs for soil at the site were determined to be as follows:

- 0.387 mg/kg for benzene,
- 12.210 mg/kg for toluene,
- 61.850 mg/kg for ethylbenzene,
- 74.6 mg/kg for toluene.

III.B.4.c.2. Alternative concentration limits

Benzene and naphthalene were identified as COPCs for groundwater at the site. Benzene and naphthalene were modeled to the potential downgradient location at where a receptor may come in contact with migrating site contamination. This was determined to be a storm drain located 120 feet downgradient from the center of the source area. Fate and transport modeling was used to develop a site-specific DAF between the source and the receptor location (see III.B.4.c.3 below). The modeling results estimated a DAF for benzene of 8.9 and a DAF of 126.3 for naphthalene for the storm drain. Compound-specific regulatory levels or risk-based screening criteria were used in conjunction with the site-specific DAFs identified for the potential migration of contamination from the site to determine the ACL for each compound. The ACL calculations are presented in Appendix VI. The ACLs associated with the drainage ditch were determined to be as follows:

- 634.4 μg/L for benzene (i.e., 8.9 × 71.28 μg/L), and
- 820.9 μg/L for naphthalene (i.e., 126.3 × 6.5 μg/L).

III.B.4.c.3. Fate and transport model

Site-specific DAFs between the source and the receptor locations were developed. The DAF is a numerical value that represents the attempt to mathematically quantify the natural physical, chemical, and biological processes (e.g., advection-dispersion, sorption-retardation, biodegradation, and volatilization) that result in the decrease of a chemical concentration in an environmental medium. In simple terms, the DAF is the ratio of chemical concentration at the source (or the point of origin) to the concentration at the exposure point. The DAFs reflect the natural attenuation concepts outlined in the ASTM's RBCA protocol (ASTM 1995).

Fate and transport models are used as tools for developing DAFs. The application of fate and transport models at any release site must ensure that the modeling results are protective of human health and the environment. Therefore, the selection process of a predictive model at a release site must consider its performance, characteristics, and applicability to the site being considered. The following characteristics were considered before selecting an appropriate model for the Installation:

- the model provides conservative predictions,
- the model is technically sound,
- the model is a public-domain model or is readily available,

- the model has received adequate peer review,
- the model has been applied to other similar sites, and
- the model is easy to use.

The AT123D meets all of the above criteria and was selected for performing fate and transport analysis for this site. AT123D is a well-known and commonly used analytical groundwater pollutant fate and transport model. This model computes the spatial-temporal concentration distribution of chemicals in the aquifer system and predicts the transient spread of a chemical plume through a groundwater aquifer. The fate and transport processes accounted for in AT123D are advection, dispersion, adsorption/retardation, and decay. This model can be used as a tool for estimating the dissolved concentration of a chemical in one, two, or three dimensions in the groundwater resulting from a mass release (either continuous or instant or depleting source) over a source area (i.e., point, line, area, or volume source).

SESOIL is used to simulate the vertical transport of contaminants from the source areas down through the vadose zone to the shallow groundwater (water table). SESOIL is an acronym for Seasonal Soil compartment model and is a one-dimensional, vertical transport code for the unsaturated soil zone, and is designed to simultaneously model water transport and pollutant fate. The program was originally developed by EPA and has been extensively modified to enhance its capabilities (Hetrick et al. 1989, Hetrick et al. 1986, and Hetrick and Travis 1988).

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

SESOIL is well recognized and accepted by the scientific community utilizing soil-chemical fate models. Some of the attributes of SESOIL that make it particularly attractive and suitable for the vadose zone soil leaching at this site are as follows:

- SESOIL has been extensively validated and shown to work under a number of scenarios. It has also been used for similar applications in other parts of the country and is capable of providing the information required from this study.

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

- The model can be divided into as few as two layers and as many as four layers, with as many as 10 sub-layers in each of the layers. This compartmental nature of the model allows for user-specified tailoring to suit a particular site.

The maximum soil concentration of benzene at this site was above the water table (i.e., 1.13 mg/kg from 0.0 to 2.0 feet). Modeling of leaching to groundwater by percolating rainwater was performed with SESOIL in order to determine the predicted maximum concentration in the leachate at the water table interface and the soil ATLs. Since the predicted leachate concentration was lower than the maximum groundwater concentration at the source (i.e., 553 μg/L), the steady-state model was developed by calibrating the model against the maximum estimated concentration beneath the site. The potential receptor is a storm drain located approximately 120 feet southwest of the site.

Vertical migration of the contaminant plume through the confining unit to the Principal Artesian aquifer is improbable. The confining unit has a vertical hydraulic conductivity on the order of 10^{-8} cm/sec and ranges from 15 to 90 feet in thickness. Assuming a vertical gradient of 1.0 foot/foot and an effective porosity of 0.06 (Mills et al. 1985) for the confining unit, the groundwater travel time is estimated to be 87 years. Therefore, it would take more than 400 years for the benzene contamination to migrate through the confining layer. The surficial aquifer in which the contaminant plume is located is not used as a source of drinking water.

The fate and transport modeling results are presented in Appendix VI and were based on the assumption of a continuous source of contamination (i.e., steady state) of infinite duration. In summary, benzene and naphthalene were modeled from the center of the plume in the vicinity of MW-22 to one potential downgradient location at which a receptor might encounter migrating groundwater contamination. The location was a storm drain that is located approximately 120 feet downgradient (southwest) from the center of the source area. This storm drain is part of a series of drains used to drain the bermed areas around the ASTs at the BFF. These drains empty into Lamar Canal. This is the nearest possible location at which a receptor might encounter migrating groundwater contamination due to a possible hydraulic connection between the groundwater and the surface water in Lamar Canal.

The AT123D Model was used to determine the impact of dissolved hydrocarbons on potential receptors. The AT123D Model was calibrated to the maximum observed site concentration of benzene (i.e., MW-22, 553 μg/L) and naphthalene (i.e., MW-22, 528 μg/L) in the groundwater assuming steady-state (continuous) concentrations. In reality, the source of contamination will deplete due to biodegradation and natural attenuation. The modeling results indicate that benzene should reach the storm drain at a concentration of 62.10 μg/L, which is below the state IWQS of 71.28 μg/L. Naphthalene is predicted to reach the storm drain at a concentration of 4.19 μg/L, which is below the risk-based value of 6.5 μg/L.

The modeling results estimated a DAF of 8.9 and 126.3 for the lateral migration of benzene and naphthalene in groundwater to the storm drain, respectively. Simulations were also performed to predict the concentrations of benzene over a simulation period of 2 years in monitoring wells MW-22 and MW-32. The results are presented in Table 10.

III.B.4.d. Conclusions and recommendations

The conclusions below are based on a review of the CAP–Part A SI and CAP–Part B SI results using a risk-based approach and the fate and transport modeling:

- Free product was detected in MW-22 during the CAP–Part B SI and removed on December 1, 2000. Free product has not been detected at the site since this event.

- The vertical and horizontal extent of soil contamination below applicable GUST STLs was delineated during the CAP–Part A and CAP–Part B SIs.

- The vertical and horizontal extent of groundwater contamination below federal MCLs and Georgia IWQS was delineated during the CAP–Part A and CAP–Part B SIs.

- Risk-based screening results show that concentrations of BTEX compounds in soil exceed their respective initial screening levels. However, using the results of the fate and transport modeling, only the benzene concentration detected at SB-07 and MW-22 exceeded the site-specific ATL of 0.387 mg/kg. For the sample collected from SB-07, the detection limit was above the reporting limit. Subsequent sampling at this location indicated that benzene was not present in the soil above its STL. Subsequent sampling at

SB-22 to delineate the horizontal extent of the benzene contamination in the soil indicated that benzene concentrations above its ATL was limited to the SB-22 location. At SB-22, the soil sample was collected from 0.0 to 2.0 feet BGS, which is above the water table. Groundwater samples collected at this location (MW-22) detected benzene concentrations of 553 µg/L and 174 µg/L during the CAP–Part A and CAP–Part B SIs, respectively. However, both of these concentrations are below the ACL of 634.4 µg/L. Because the concentration above the benzene ATL is limited to only SB/MW-22, the benzene contamination is above the water table, and the groundwater concentrations are below the benzene ACL, active remediation/removal of the soil is not recommended.

- Risk-based screening results show that benzene and naphthalene in groundwater exceed their respective initial screening levels. However, using the results of the fate and transport modeling, benzene and naphthalene did not exceed their site-specific ACLs of 634.4 µg/L and 820.95 µg/L, respectively.

- Fate and transport modeling of benzene and naphthalene, assuming a continuous, steady-state source, indicates that benzene will not exceed the state IWQS and that naphthalene will not exceed the risk-based concentration at the nearest downgradient receptor, the storm drain.

- Based on the CAP–Part B data, the environmental site ranking score is 3,250 (Appendix X).

Considering that the site is located within the confines of HAAF and that the most recent benzene concentrations in groundwater exceeded the IWQS but not the ACL, natural attenuation is recommended as the corrective action for the site; therefore, a monitoring only plan is recommended. Detailed sampling and analysis recommendations are provided in Section III.D.

III.C. DESIGN AND OPERATION OF CORRECTIVE ACTION SYSTEMS

III.C.1. System Effectiveness/Basis for Selection

The selected corrective action approach, natural attenuation of groundwater, was chosen following evaluation of numerous established and innovative active and passive remediation alternatives. A three-step screening process was used to select the preferred remedy for the Former UST 117, Building 7002 site. This alternative selection process is illustrated in Figure 21.

III.C.1.a. Theory and feasibility

The remedies evaluated for aromatic hydrocarbons in soil and groundwater at this site include monitored natural attenuation, oxygen-injection-enhanced bioremediation, air sparging with soil vapor extraction, and six-phase heating. Based on the hydrocarbon concentrations in the soil and water, natural attenuation is the preferred alternative. Natural attenuation is based on the premise that fuel-type hydrocarbons are readily biodegraded in most environmental systems. Biodegradation of BTEX has been documented for sites similar to the UST 117 site (e.g., shallow water table, permeable silty sand). In fact, the conditions at the Former UST 117, Building 7002 site are similar to other sites that have proven ideal for biodegradation (Abou-Rizk, Leavitt, and Graves 1995). Site groundwater flow and the geology of the site are conducive to aerobic biodegradation, which is known to produce the most rapid biodegradation rates for hydrocarbons. Finally, the primary sources have been removed; therefore, subsurface conditions (e.g., dissolved oxygen, oxidation-reduction potential, and background nutrient availability) will steadily improve with time.

Other remedial options that were considered introduce more risk of exposure due to contaminant release into other matrices (e.g., soil gas, air, and treatment canisters) or as a result of excavation. In addition, the excessive

costs associated with an aggressive remediation system do not result in added protection to the industrial worker receptor.

The Georgia IWQS for benzene of 71.28 µg/L and the risk-based screening level of 6.5 µg/L for naphthalene were exceeded in the groundwater during the CAP–Part B SI. No other compounds exceeded their respective IWQSs or risk-based screening levels during any of the past sampling rounds. The ACLs proposed for benzene and naphthalene are 634.4 µg/L and 820.95 µg/L, respectively, and the CAP–Part B concentrations did not exceed this value; however, the site ranking score (i.e., > 2,500) indicates that a year of monitored natural attenuation is warranted to confirm site conditions.

III.D. IMPLEMENTATION

III.D.1. Milestone Schedule

A milestone schedule for the monitoring only plan has been prepared. A Gantt chart showing milestone activities and anticipated duration is provided in Figure 22. HAAF will notify GA EPD USTMP of any significant changes to the proposed schedule time and will provide an updated Gantt chart, as necessary.

III.D.2. Progress Reporting

An annual monitoring report will be submitted to GA EPD that will summarize all previous annual sampling events.

III.D.3. Certificate of Completion Report

Petition for permanent closure will be submitted with the final monitoring only report unless HAAF determines the wells should remain in place to provide a means of monitoring the active site. GA EPD will provide final approval for decommissioning of the monitoring wells, which will be requested in the final monitoring only report. Decommissioning of the monitoring wells will be completed in accordance with the USACE design manual for monitoring wells. Decommissioning will comply with all applicable state and federal standards.

The certification below will be submitted to GA EPD within 30 days of submittal of the final progress report.

> I hereby certify that the Corrective Action Plan–Part B, dated _____, 20__, for Hunter Army Airfield, Former UST 117, Building 7002 site, Facility ID #9-025113*1, including any and all certified amendments thereto, has been implemented in accordance with the schedules, specifications, sampling programs, and conditions contained therein, and that the plan's stated objectives have been met.
>
> _____
> Signature (Owner/Operator)

III.D.4. Inspection Schedule and Preventative Maintenance Program

During each sampling event, wells will be visually inspected for changes or damage. Any notable observations will be recorded in the subsequent progress report. Any required repairs to ensure the monitoring wells remain in conformance with GA EPD and U.S. Environmental Protection Agency (EPA) performance standards will be made as needed.

III.D.5. Periodic Monitoring

Groundwater samples from monitoring wells MW-19, MW-20, MW-21A (replacement well), MW-22, MW-32, MW-33, and MW-34 will be collected semiannually for 1 year and analyzed for BTEX and PAH compounds. Monitoring will continue at the site for a year to ensure that the benzene and naphthalene concentrations remain below their respective ACLs of 634.4 µg/L and 820.95 µg/L, and that free product is not present.

During each sampling event, water levels and free product measurements in all monitoring wells will be collected. Specific conductivity, pH, and temperature analysis will be completed for each sample from the monitoring wells at which analytical samples were collected. The samples will be shipped to an approved laboratory for BTEX analysis using EPA Methods 8021B/8260B and PAH analysis using EPA Methods 8100/8270C/8310.

III.D.6. Effectiveness of Corrective Action

The monitoring only plan will be discontinued once the objectives of the corrective action have been achieved; that is, the concentrations of COPCs in groundwater remain below their respective ACLs for 1 year, and no free product has been detected.

III.D.7. Confirmatory Soil Sampling Plan

No excavation of soil is planned; therefore, confirmatory sampling will not be conducted.

III.D.8. Stockpiled Bulk Soil Sampling

No stockpiled soil will be generated from this corrective action; therefore, no soil sampling will be conducted.

III.D.9. Termination Conditions

Prior to termination of the monitoring only plan, concentrations of benzene and naphthalene in groundwater must be at or below their respective ACLs, and it must be shown that free product no longer exists at the site. Achievement of these conditions will take precedence over the site ranking score.

III.D.10. Post-completion Site Restoration Activities

After termination has been granted, equipment and debris related to the monitoring program will be removed from the site.

III.E. PUBLIC NOTIFICATION

The Former UST 117, Building 7002 site is located entirely within the confines of the HAAF, a federal facility. The U.S. Government owns all of the property contiguous to the site. The Fort Stewart DPW has complied with the public notice requirements defined by GA EPD guidance by publishing an announcement in the *Savannah Morning News* on April 1, and April 8, 2001. A copy of the newspaper announcement used for public notification is presented in Appendix XI of this report.

IV. CLAIM FOR REIMBURSEMENT

HAAF is a federally owned facility and has funded the investigation for the Former UST 117, Building 7002 site, Facility ID: 9-025113*1, using Department of Defense Environmental Restoration Account Funds. Application for GUST Trust Fund reimbursement is not being pursued at this time.

Georgia Department of Natural Resources

Environmental Protection Division
Underground Storage Tank Management Program
4244 International Parkway, Suite 104, Atlanta, Georgia 30354
Lonice C. Barrett, Commissioner
Harold F. Reheis, Director
(404)362-2687

September 5, 2000

Colonel Gregory V. Stanley
Director, Public Works
U.S. Army/HQ3d Inf. Div. (Mech.)
1550 Frank Cochran Drive
Ft. Stewart, GA 31314-4927

SUBJECT: **Notice to Implement Corrective Action Plan (CAP)-Part A:**
Hunter AAF, Former UST #117
Building 7002
Savannah, Chatham County, GA
Facility ID: 9025113*1

Dear Colonel Stanley:

The Georgia Underground Storage Tank Management Program (USTMP) has received your letter, dated June 5, 2000, that forwarded a CAP-Part A Report. The report was prepared by Science Applications International Corporation.

The technical proposal contained in the CAP-Part A, for further investigation, monitoring and/or remediation of the current release is hereby approved by the USTMP. As a result of your CAP-Part A being technically approved, you are authorized to begin implementation of this plan.

Please submit an updated milestone schedule by **October 5, 2000**, listing specific dates, events and a timetable to complete the proposed activities. If you have any technical questions, please contact me at (404)362-2687.

Sincerely,

William E. Logan
Senior Geologist
Corrective Action Unit II

WEL;
s:\landdocs\williaml\pending00\9025113.120

cc: C. Allison Bailey, P.G., Science Applications International Corporation
Lisa Lewis, GA EPD
Larry Rogers, EPD Coastal District

File (CA): Chatham; 9025113

DEPARTMENT OF THE ARMY
HEADQUARTERS, 3D INFANTRY DIVISION (MECHANIZED) AND FORT STEWART
DIRECTORATE OF PUBLIC WORKS
1550 FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-4927

REPLY TO
ATTENTION OF

JUN 05 2000

Office of the Directorate

CERTIFIED MAIL

Georgia Department of Natural Resources
Underground Storage Tank Management Program
Attention: Mr. William Logan
4244 International Parkway, Suite 104
Atlanta, Georgia 30354

Dear Mr. Logan:

Fort Stewart is pleased to receive the Georgia Environmental Protection Division's (GA EPD) correspondence dated April 3, 2000 approving the Closure Report submitted for former underground storage tank #117, Building 7002, Facility Identification Number 9-025113*1, Hunter Army Airfield (HAAF), Georgia. As recommended in the Closure Report and required by GA EPD, a Corrective Action Plan-Part A has been prepared for this site, and is provided for your review and comment.

Based on the information contained in the enclosed CAP-Part A report and the site score of 3250 (see Appendix X), Fort Stewart/HAAF recommends that a CAP-Part B investigation be conducted at Facility Identification Number 9-025113*1 (UST #117). Specifically, Fort Stewart/HAAF proposes to install seven shallow soil borings for additional delineation of soil contamination, collect two sediment samples from Lamar Canal, install three shallow one-inch monitoring wells at this site to determine the horizontal extent of groundwater contamination, and resample each of the existing 37 site monitoring wells (Section IV of the CAP-Part A form). If you have any questions or comments, please contact Ms. Melanie Little or Ms. Tressa Rutland, Directorate of Public Works, Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively.

Sincerely,

for Thomas C. Fry
Gregory V. Stanley
Colonel, U.S. Army
Director, Public Works

Enclosure

CORRECTIVE ACTION PLAN PART A

Facility Name: Former UST 117, Building 7002 Street Address: Bulk Fuel Facility, Perimeter Road

Facility ID: 9-025113*1 City: HAAF County: Chatham Zip Code: 31406

Latitude: 32°01'45" Longitude: 81°08'40"

Submitted by UST Owner/Operator:
Name: Thomas C. Fry/Environmental Branch
Company: U.S. Army/HQ 3d, Inf. Div. (Mech)
Address: DPW, Building 1137 (Fry)
1550 Frank Cochran Drive
City: Fort Stewart State: Georgia
Zip Code: 31314-4927
Telephone: (912) 767-1078/2010

Prepared by Consultant/Contractor:
Name: C. Allison Bailey
Company: SAIC
Address: P.O. Box 2502
City: Oak Ridge State: TN
Zip Code: 37831
Telephone: (865) 481-8719

I. PLAN CERTIFICATION:

A. UST Owner/Operator Certification

I hereby certify that the information contained in this plan and in all the attachments is true, accurate, and the plan satisfies all criteria and requirements of rule 391-3-15-09 of the Georgia Rules for Underground Storage Tank Management.

Name: Thomas C. Fry
Signature: Thomas C. Fry Date: 06/05/00

B. 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 groundwater 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: C. Allison Bailey, P.G.
Signature: C. Allison Bailey
Date: 5-31-00

C. ALLISON BAILEY
GEORGIA REGISTERED PROFESSIONAL GEOLOGIST
No 1530
Georgia Stamp or Seal

General: READ THE GUIDANCE DOCUMENT FOR CAP PART-A BEFORE COMPLETING THIS FORM. FAILURE TO READ THE GUIDANCE DOCUMENT WILL MOST LIKELY RESULT IN PREPARATION OF AN UNACCEPTABLE REPORT. All text, figures, and tables requested in their respective sections should be prepared strictly in accordance with the Georgia EPD CAP-A guidance document. Please fill out this form as provided. Do not change the size of the fields or alter the placement of each section on each page.

(Appendix I: All Report Figures)
(Appendix II: All Report Tables)

II. INITIAL RESPONSE REPORT

A. Initial Abatement

Were initial abatement actions initiated? YES ____ NO X
If Yes, please summarize. If No, please explain why not.

Actions were not required to abate imminent hazards and/or emergency conditions at the Former Underground Storage Tank (UST) 117, Building 7002 site. Therefore, contaminant migration and release prevention, fire and vapor mitigation, or emergency free product removal were not performed prior to, or during, the closure of UST 117.

B. Free Product Removal

(Table 1: Summary of Free Product Removal – must include Free Product thickness in each well in which it was detected, and volume of product removed)

Free Product Detected? YES ____ NO X
If Yes, please summarize free product recovery efforts.

Continuing free product recovery proposed? YES ____ NO X
If yes, please indicate the method and frequency of removal.

C. Tank History

List current and former UST's operated at site based on owner/operator knowledge consistent with EPA 7530-1 Form). Systems must be illustrated on Figure 2 (Site Plan), as described in section D below.

CURRENT UST SYSTEMS (if applicable)

Tank ID Number	Capacity (gal)	Substance Stored	Age (yrs)	Meets 1998 Upgrade Standards (Yes/No)
N/A	N/A	N/A	N/A	N/A

FORMER UST SYSTEMS (if applicable)

Tank ID Number	Capacity (gal)	Substance Stored	Date Closed In-place
117	550	JP-4 fuel	September 30, 1996

D. Initial Site Characterization

(Figure 1: Vicinity/Location Map)
(Figure 2: Site Plan)

1. Regulated Substance Released (gasoline, diesel, used oil, etc.): JP-4 fuel
   Discuss how this determination was made and circumstances of discovery.

Characterization of petroleum-related contamination at the Former UST 117 site, located at the Bulk Fuel Facility (BFF), was initiated during UST system closure activities on September 30, 1996, by Anderson Columbia Environmental, Inc. (ACE). The vertically oriented tank and ancillary piping were purged and closed in place by filling with grout. One soil sample (8102-TK117-S1) was collected from alongside the closed tank at a depth of 5 feet below ground surface (BGS) [Figure 7]. The soil sample was reported to contain benzene at a concentration of 0.013 mg/kg. This exceeds the Georgia Environmental Protection Division (GA EPD) applicable soil threshold level for benzene of 0.005 mg/kg (i.e., Table A, column 1). In addition, total petroleum hydrocarbon (TPH) was reported at a concentration of 163 mg/kg in the soil sample (Tables 5a and 5b).

Other activities conducted at the BFF included the removal of a 2000-gallon, non-regulated bulk storage overflow tank (UST 131) on June 24, 1999, by Earth Tech, Inc. (Earth Tech 1999) and a soil gas survey of the BFF conducted in January 1999 by Science Applications International Corporation (SAIC 1999b). It should also be noted that the BFF is currently being refurbished with activities including upgrading aboveground storage tanks (ASTs) 7007 and 7009 and installing new aboveground fuel pipeline. In addition, Earth Tech, Inc., installed six 2-inch-diameter monitoring wells around AST 7009 as part of the AST upgrade activity (Figure 8) (Earth Tech 2000). Future upgrade activities will include demolition of ASTs 7001 and 7003.

2. Source(s) of Contamination: Unknown; piping leakage or tank overflow suspected.
   Discuss how this determination was made.

Although ACE (1996) presented a diagram showing approximate locations of the former UST and associated ancillary piping, a detailed schematic diagram is not available. The major source of contamination at the Former UST 117, Building 7002 site is believed to have been piping leakage or tank overflow.

3. Local Water Resources

(Figure 3: Quadrangle Map - Public and Private drinking water and surface water)
(Appendix III: Water resources survey documentation, including, but not limited to: USGS database search, interview forms, and documentation of field survey)

a. *Site located in high/average* X *OR low* ____ *groundwater pollution susceptibility area?*

b. *Water Supplies within applicable radii?* YES X NO ____
If yes,
i. *Nearest public water supply located within:* 2,712 *feet*

ii. *Nearest down-gradient public water supply located within:* >10,560 *feet*

iii. *Nearest non-public water supply located within:* >10,560 *feet*

iv. *Nearest down-gradient non-public water supply located within:* >10,560 *feet*

c. *Surface Water Bodies and sewers:*

i. *Nearest surface water located within:* 340 *feet*

ii. *Nearest down-gradient surface water located within:* 340 *feet*

iii. *Nearest storm or sanitary sewer located within:* 120 *feet*

iv. *Depth to bottom of sewer at a point nearest the plume:* >5.0 *feet*

4. Impacted Environmental Media

a. *Soil Impacted*
(Table 2: Soil Analysis Results)
(Figure 4: Soil Quality Map)
(Appendix IV: Soil Boring Logs)
(Appendix V: Soil Laboratory Reports)
(Appendix VI: ATL Calculations, if applicable)

Provide a brief discussion of soil sampling.

Soil samples were collected at 2.0-foot intervals during the installation of 31 boreholes (SB-01 through SB-31) (Figure 4). Field headspace gas analyses were performed on each sample to determine organic vapor concentration. Soil samples were selected from each borehole for laboratory chemical analysis of benzene, toluene, ethylbenzene, and xylene (BTEX); TPH gasoline-range organics/diesel-range organics (GROs/DROs); polynuclear aromatic hydrocarbons (PAHs); and geotechnical analysis (Table 2 and Appendix V). In each borehole, one sample was collected from the interval where the highest vapor concentration was recorded or the interval located immediately above the water table if elevated vapor concentrations were not detected. An undisturbed (Shelby-tube) soil sample, SB-GT, was also collected and analyzed to determine vadose zone and aquifer characteristics at the site. In addition to the soil investigation, a total of 9 sediment samples (SD-1 through SD-9) were collected from along Lamar Canal and analyzed for the same parameters as the soil samples (Figure 10). The sediment data are reported on Table 7 and in Appendix V. Refer to Attachment A for complete documentation of the technical approach implemented during this investigation.

i. Soil contamination above applicable threshold levels? YES _X_ NO _____

If yes, indicate highest concentrations in soil along with locations and depths detected.

The highest concentration of soil contamination was reported for the soil sample collected from boring SB-22 at a depth of 0.0 to 2.0 feet BGS (Table 2a). Benzene was reported at 1.130 mg/kg, toluene at 0.404 mg/kg, ethylbenzene at 13.6 mg/kg, and total xylenes at 74.6 mg/kg. Each of the compounds was reported above its applicable soil threshold level of 0.005 mg/kg, 0.400 mg/kg, 0.370 mg/kg, and 20.0 mg/kg, respectively. Benzene and toluene were also detected in boring SB-20 at concentrations above their applicable soil threshold levels. For the soil samples collected from borings SB-07, SB-09, SB-10, and SB-17, the volatile reporting limits were elevated causing many of the values for the BTEX compounds to be qualified as non-detects although their concentrations were above their applicable soil threshold levels. For evaluation purposes, these data have been considered using a value of less than the detection limit.

ii. ATLs calculated? YES _X_ NO _____

If yes, present ATLs.

ATLs for benzene, toluene, ethylbenzene, and xylene in soil were calculated. The ATL for benzene is 0.387 mg/kg, 12.210 mg/kg for toluene, 61.850 mg/kg for ethylbenzene, and 74.6 mg/kg for xylene. The ATL for benzene was exceeded in soil collected from borings SB-07 and SB-22. The ATLs for ethylbenzene and toluene were not exceeded in any of the soil samples. For xylene, the maximum concentration (74.6 mg/kg in SB-22) is equal to the calculated ATL. Please refer to Appendix VI for the ATL calculations.

iii. If ATLs calculated, is soil contamination above ATLs? YES _X_ NO _____ N/A _____

b. Groundwater Impacted

(Table 3: Groundwater Analysis Results)
(Figure 5: Groundwater Quality Map)
(Appendix VII: Monitoring Well Details)
(Appendix VIII: Groundwater Laboratory Results)

Provide a brief discussion of groundwater sampling.

At 26 borehole locations, one groundwater sample was collected from a depth interval of approximately 1.0 to 5.0 feet below the water table using a direct-push sampling device (Figure 5). After the water sample was collected, a permanent 1-inch-diameter polyvinyl chloride (PVC) monitoring well was installed in the boring and developed. At 5 borehole locations (SB-17 and SB-20 through SB-23), one groundwater sample was collected through the 10-foot screen. At the vertical profile locations (VP-2 through VP-7), discrete groundwater samples were collected every 5 feet below the water table down to approximately 43 feet BGS [the estimated depth of the Hawthorn confining unit]. Although the Hawthorn was not encountered, the vertical profile was terminated at this depth because of the difficulty experienced during the extraction of groundwater samples. Chemical parameters for groundwater samples submitted for laboratory analysis included BTEX and PAHs (Table 3 and Appendix VIII). Refer to Attachment A for complete documentation of the technical approach for collecting groundwater samples during this investigation.

i. Groundwater contamination above MCLs? YES _X_ NO _____

ii. Groundwater contamination above In-Stream Water Quality Standards? YES _X_ NO _____

If yes, indicate highest concentrations in groundwater along with the locations.

The highest concentration of contamination was reported in the groundwater sample collected from location SB-22 at a depth of 2.0 to 12.0 feet BGS (Table 3a). Benzene was reported at 553 µg/L, and naphthalene was reported at 101 µg/L. The benzene concentration is above its MCL of 5 µg/L and its In-Stream Water Quality Standard (IWQS) of 71.28 µg/L. Naphthalene does not have a regulatory level; however, this concentration exceeds the risk-based screening level of 6.5 µg/L. For evaluation purposes, an ACL of 634.4 µg/L was calculated for benzene and 57.85 µg/L for naphthalene. Based on the ACL, the maximum benzene concentration at this site is below the ACL. However, the maximum naphthalene concentration exceeds its ACL. Please refer to Appendix VI for the ACL calculations.

c. *Surface Water Impacted?* YES _____ NO X

If Yes, indicate concentration(s) of surface water sample(s) taken from the surface water body/bodies impacted.

A total of 8 surface water samples were collected from Lamar Canal during the investigation (Figure 10). Chemical parameters for the surface water samples submitted for laboratory analysis included BTEX and PAHs (Table 8 and Appendix VIII). Only benzene was detected in one surface water sample (SD-5) at a concentration of 0.17 µg/L. This concentration is well below the IWQS of 71.28 µg/L and the MCL of 5.0 µg/L. Refer to Attachment A for complete documentation of the technical approach used to collect surface water samples.

d. *Point of Withdrawal Impacted?* YES _____ NO X N/A _____

If Yes, indicate concentration(s) of water sample(s) taken from withdrawal point(s).

5. Other Geologic/Hydrogeologic Data

a. *Depth to Groundwater:* 2.72 to 4.60 feet BGS *(Table 4: Groundwater Elevations)*

b. *Groundwater Flow Direction:* Southeast *(Figure 6: Potentiometric Surface Map)*

c. *Hydraulic Gradient:* 0.0035 feet/feet

d. *Geophysical Province:* Coastal Plain

e. *Unique geologic/hydrogeological conditions:* The Hawthorn Formation acts as a confining unit between the surficial and Floridan aquifers.

6. Corrective Action Completed or In-Progress (if applicable)
(Table 5: UST System Closure Sampling)
(Figure 7: UST System Closure Sampling)
(Appendix IX: Contaminated Soil Disposal Manifests)

a. *Underground Storage Tank (UST) System Closure:* N/A _____

If applicable, summarize UST system closure activities conducted.

ACE closed UST 117 in-place on September 30, 1996. The UST piping was drained into the tank, and all remaining contents were subsequently removed using a vacuum truck and/or compressor-driven barrel vacuum device. The piping and the tank were then closed in-place by filling with grout.

b. Excavation and Treatment/Disposal of Backfill Materials and Native Soils
Check one: *No UST removal performed* X
Returned to UST excavation ____
Excavated soils treated or disposed off site ____
If soils were excavated, summarize excavation and treatment/disposal activities:

Former UST 117 was closed in place. No soil was excavated during the closure activities.

7. Site Ranking:
Environmental Site Sensitivity Score: *3250*
(Appendix X: Site Ranking Form)

8. Conclusions and Recommendations
Complete applicable section below, one section only

a. No Further Action Required (if applicable) N/A X
(provide justification)

b. Monitoring Only (if applicable) N/A X
(provide justification)

c. CAP-B (if applicable N/A ____
(provide justification)

The vertical extent of soil contamination was determined during the CAP-Part A investigation; however, the horizontal extent of soil contamination was not determined. At location SB-22, the maximum soil concentrations for benzene (1.13 mg/kg), toluene (0.404 mg/kg), ethylbenzene (13.6 mg/kg), and xylene (74.6 mg/kg) were detected. All of these concentrations were found to exceed their respective soil threshold levels (STLs). Therefore, alternate threshold levels (ATLs) were calculated for each compound. Based on the calculated ATLs, the maximum benzene concentration in soil (1.13 mg/kg) was found to exceed its ATL of 0.3867 mg/kg. For toluene and ethylbenzene, their maximum soil concentrations are well below their respective ATLs of 12.210 mg/kg and 61.850 mg/kg. For xylene, the maximum soil concentration is equal to the calculated ATL of 74.6 mg/kg.

The groundwater sample collected at SB-22 was found to contain the highest concentrations of benzene (553 µg/L), toluene (0.86 µg/L), ethylbenzene (86.7 µg/L), xylene (352 µg/L), and naphthalene (101 µg/L). Of these detected compounds, only benzene was found to exceed its respective maximum contaminant level (MCL) of 5.0 µg/L and the In-stream Water Quality Standard (IWQS) of 71.28 µg/L. Naphthalene does not have a regulatory level; however, the maximum concentration exceeds the risk-based screening level of 6.5 µg/L. Alternate concentration levels (ACLs) were calculated for both of these compounds. Based on the calculated ACLs, the maximum benzene concentration in groundwater does not exceed its ACL of 634 µg/L. However, the maximum naphthalene concentration in groundwater exceeded its ACL of 57.85 µg/L. As a conservative measure, a comprehensive round of groundwater sampling is recommended to confirm the site conditions and validate the fate and transport modeling. The vertical extent of groundwater contamination was determined during the CAP-Part A investigation; therefore, further investigation of the vertical extent of groundwater contamination is not warranted.

III. MONITORING ONLY PLAN (if applicable): N/A X

A. Monitoring points

B. Period/Frequency of monitoring and reporting

C. Monitoring Parameters

D. Milestone Schedule

E. Scenarios for site closure or CAP-Part B

IV. SITE INVESTIGATION PLAN (if applicable): N/A _____

(Figure 8: Proposed additional boring/monitoring well location)

A. Proposed Investigation of Horizontal and Vertical Extent of Contamination In:

1. Soil N/A _____

Seven shallow soil borings will be installed as part of the CAP-Part B investigation for the purpose of collecting soil samples only to delineate the horizontal extent of contamination around location SB-7 and SB-22 (Figure 8). In addition, three shallow, 1-inch monitoring wells will be installed that will also require soil sampling for the CAP-Part B investigation. One soil sample will be collected from each boring and analyzed for BTEX, PAHs, and TPH-DRO and TPH-GRO. The soil samples will be collected from the 2.0-foot sample interval with the highest headspace reading or from the sample interval above the soil/water interface if no contamination is observed. It is also recommended that two additional sediment samples be collected from Lamar Canal near former sampling location SD-03 to investigate the area where the storm drain discharges into Lamar Canal. The samples will be analyzed for BTEX, PAHs, and TPH-DRO, and TPH-GRO. Analytical results from the soil samples collected from the CAP-Part B investigation borings located in the area of highest contamination will be used to supercede previous analytical data for the purpose of the site ranking form.

2. Groundwater

a. Free Product N/A___X___

b. Dissolved phase NA_____

Three shallow, 1-inch monitoring wells will be installed along the southern border of the Bulk Fuel Facility outside the fence and south of AST 7003 as part of the CAP-Part B investigation (Figure 8). The proposed locations are: (1) at the location of VP-04, (2) downgradient of MW-22, and (3) cross-gradient of MW-22. These wells will be installed to ensure groundwater monitoring locations exist downgradient of the area of highest soil and groundwater contamination The shallow wells will be screened across the water table with 3 to 5 feet of screen above the water table in order to detect the presence of free product. All monitoring wells will be completed flush with the ground surface.

One groundwater sample will be collected from each of the three new monitoring wells. In addition, one sample will be collected from each of the 31 monitoring wells completed during the CAP-Part A investigation and from each of the six 2-inch-diameter monitoring wells installed by Earth Tech, Inc. (Figure 8). Each groundwater sample will be analyzed for BTEX and PAHs.

3. Surface Water N/A _____

Surface water samples were collected during the CAP-Part A investigation (Tables 8a and 8b and Appendix VIII). The analytical results indicate that the surface water in Lamar Canal is not being contaminated by the Former UST 117 site or the Bulk Fuel Facility. Therefore, additional surface water sampling activities are not recommended for the CAP-Part B investigation.

B. Proposed Investigation of Vadose Zone And Aquifer Characteristics:

During the CAP-Part A investigation, vadose zone characteristics at the Former UST 117, Building 7002 site were determined by collecting an undisturbed (Shelby-tube) soil sample (SB-GT), which was analyzed for geotechnical parameters. The geotechnical results are presented in Appendix VI, Table VI-A. Therefore, further investigation of the vadose zone is not being proposed. However, in-situ permeability tests are recommended to address the aquifer characteristics. Therefore, slug tests are proposed to be conducted in two of the 2-inch-diameter wells located around AST 7009.

V. PUBLIC NOTICE

(Figure 9. Tax Map)
(Appendix XI: Copies of public notification letters & certified return receipts or newspaper notice if approved)

Former UST 117, Building 7002, Facility ID: 9-025113*1, is located within the confines of HAAF, which is part of the Fort Stewart Military Reservation, a federally owned facility. All of the property contiguous to the site is owned by the U.S. Government. The Fort Stewart Directorate of Public Works has complied with the public notice requirements defined by Georgia Department of Natural Resources (GA DNR) guidance by publishing an announcement in the local newspaper over a period of 2 weeks. Publication of this announcement has been completed simultaneously with the submittal of this CAP-Part A report for review by the GA DNR EPD Underground Storage Tank Management Program (USTMP). A copy of the newspaper announcement used for public notification is presented in Appendix XI.

VI. CLAIM FOR REIMBURSEMENT (for GUST Trust Fund sites only): N/A X

(Appendix XII: GUST Trust Fund Reimbursement Application and Claim for reimbursement)

HAAF is a federally owned facility and has funded the investigation for the Former UST 117, Building 7002 site, Facility ID: 9-025113*1, using Environmental Restoration Account funds. Application for Georgia Underground Storage Tank Trust Fund reimbursement is not being pursued at this time.

File Copy

DEPARTMENT OF THE ARMY
HEADQUARTERS, 3D INFANTRY DIVISION (MECHANIZED) AND FORT STEWART
DIRECTORATE OF PUBLIC WORKS
1550 FRANK COCHRAN DRIVE
FORT STEWART, GEORGIA 31314-4927

REPLY TO
ATTENTION OF

JUN 05 2000

Office of the Directorate

CERTIFIED MAIL
7099-3400-0005-3614.4971

Georgia Department of Natural Resources
Underground Storage Tank Management Program
Attention: Mr. William Logan
4244 International Parkway, Suite 104
Atlanta, Georgia 30354

Dear Mr. Logan:

Fort Stewart is pleased to receive the Georgia Environmental Protection Division's (GA EPD) correspondence dated April 3, 2000 approving the Closure Report submitted for former underground storage tank #117, Building 7002, Facility Identification Number 9-025113*1, Hunter Army Airfield (HAAF), Georgia. As recommended in the Closure Report and required by GA EPD, a Corrective Action Plan-Part A has been prepared for this site, and is provided for your review and comment.

Based on the information contained in the enclosed CAP-Part A report and the site score of 3250 (see Appendix X), Fort Stewart/HAAF recommends that a CAP-Part B investigation be conducted at Facility Identification Number 9-025113*1 (UST #117). Specifically, Fort Stewart/HAAF proposes to install seven shallow soil borings for additional delineation of soil contamination, collect two sediment samples from Lamar Canal, install three shallow one-inch monitoring wells at this site to determine the horizontal extent of groundwater contamination, and resample each of the existing 37 site monitoring wells (Section IV of the CAP-Part A form). If you have any questions or comments, please contact Ms. Melanie Little or Ms. Tressa Rutland, Directorate of Public Works, Environmental Branch, at (405) 364-8461 or (912) 767-7919, respectively.

Sincerely,

for Thomas C. Fry
Gregory V. Stanley
Colonel, U.S. Army
Director, Public Works

Enclosure

CORRECTIVE ACTION PLAN PART A

Facility Name: Former UST 117, Building 7002 Street Address: Bulk Fuel Facility, Perimeter Road

Facility ID: 9-025113*1 City: HAAF County: Chatham Zip Code: 31406

Latitude: 32°01'45" Longitude: 81°08'40"

Submitted by UST Owner/Operator:
Name: Thomas C. Fry/Environmental Branch
Company: U.S. Army/HQ 3d, Inf. Div. (Mech)
Address: DPW, Building 1137 (Fry)
1550 Frank Cochran Drive
City: Fort Stewart State: Georgia
Zip Code: 31314-4927
Telephone: (912) 767-1078/2010

Prepared by Consultant/Contractor:
Name: C. Allison Bailey
Company: SAIC
Address: P.O. Box 2502
City: Oak Ridge State: TN
Zip Code: 37831
Telephone: (865) 481-8719

I. PLAN CERTIFICATION:

A. UST Owner/Operator Certification

I hereby certify that the information contained in this plan and in all the attachments is true, accurate, and the plan satisfies all criteria and requirements of rule 391-3-15-09 of the Georgia Rules for Underground Storage Tank Management.

Name: Thomas C. Fry
Signature: Thomas C. Fry Date: 06/05/00

B. 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 groundwater 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: C. Allison Bailey, P.G.
Signature: C. Allison Bailey
Date: 5-31-00

C. ALLISON BAILEY
GEORGIA REGISTERED PROFESSIONAL GEOLOGIST
No 1530
Georgia Stamp or Seal

General: READ THE GUIDANCE DOCUMENT FOR CAP PART-A BEFORE COMPLETING THIS FORM. FAILURE TO READ THE GUIDANCE DOCUMENT WILL MOST LIKELY RESULT IN PREPARATION OF AN UNACCEPTABLE REPORT. All text, figures, and tables requested in their respective sections should be prepared strictly in accordance with the Georgia EPD CAP-A guidance document. Please fill out this form as provided. Do not change the size of the fields or alter the placement of each section on each page.

(Appendix I: All Report Figures)
(Appendix II: All Report Tables)

II. INITIAL RESPONSE REPORT

A. Initial Abatement

Were initial abatement actions initiated? YES ____ NO X
If Yes, please summarize. If No, please explain why not.

Actions were not required to abate imminent hazards and/or emergency conditions at the Former Underground Storage Tank (UST) 117, Building 7002 site. Therefore, contaminant migration and release prevention, fire and vapor mitigation, or emergency free product removal were not performed prior to, or during, the closure of UST 117.

B. Free Product Removal

(Table 1: Summary of Free Product Removal – must include Free Product thickness in each well in which it was detected, and volume of product removed)

Free Product Detected? YES ____ NO X
If Yes, please summarize free product recovery efforts.

Continuing free product recovery proposed? YES ____ NO X
If yes, please indicate the method and frequency of removal.

C. Tank History

List current and former UST's operated at site based on owner/operator knowledge consistent with EPA 7530-1 Form). Systems must be illustrated on Figure 2 (Site Plan), as described in section D below.

CURRENT UST SYSTEMS (if applicable)

Tank ID Number	Capacity (gal)	Substance Stored	Age (yrs)	Meets 1998 Upgrade Standards (Yes/No)
N/A	N/A	N/A	N/A	N/A

FORMER UST SYSTEMS (if applicable)

Tank ID Number	Capacity (gal)	Substance Stored	Date Closed In-place
117	550	JP-4 fuel	September 30, 1996

D. Initial Site Characterization

(Figure 1: Vicinity/Location Map)
(Figure 2: Site Plan)

1. Regulated Substance Released (gasoline, diesel, used oil, etc.): JP-4 fuel
   Discuss how this determination was made and circumstances of discovery.

Characterization of petroleum-related contamination at the Former UST 117 site, located at the Bulk Fuel Facility (BFF), was initiated during UST system closure activities on September 30, 1996, by Anderson Columbia Environmental, Inc. (ACE). The vertically oriented tank and ancillary piping were purged and closed in place by filling with grout. One soil sample (8102-TK117-S1) was collected from alongside the closed tank at a depth of 5 feet below ground surface (BGS) [Figure 7]. The soil sample was reported to contain benzene at a concentration of 0.013 mg/kg. This exceeds the Georgia Environmental Protection Division (GA EPD) applicable soil threshold level for benzene of 0.005 mg/kg (i.e., Table A, column 1). In addition, total petroleum hydrocarbon (TPH) was reported at a concentration of 163 mg/kg in the soil sample (Tables 5a and 5b).

Other activities conducted at the BFF included the removal of a 2000-gallon, non-regulated bulk storage overflow tank (UST 131) on June 24, 1999, by Earth Tech, Inc. (Earth Tech 1999) and a soil gas survey of the BFF conducted in January 1999 by Science Applications International Corporation (SAIC 1999b). It should also be noted that the BFF is currently being refurbished with activities including upgrading aboveground storage tanks (ASTs) 7007 and 7009 and installing new aboveground fuel pipeline. In addition, Earth Tech, Inc., installed six 2-inch-diameter monitoring wells around AST 7009 as part of the AST upgrade activity (Figure 8) (Earth Tech 2000). Future upgrade activities will include demolition of ASTs 7001 and 7003.

2. Source(s) of Contamination: Unknown; piping leakage or tank overflow suspected.
   Discuss how this determination was made.

Although ACE (1996) presented a diagram showing approximate locations of the former UST and associated ancillary piping, a detailed schematic diagram is not available. The major source of contamination at the Former UST 117, Building 7002 site is believed to have been piping leakage or tank overflow.

3. Local Water Resources

(Figure 3: Quadrangle Map - Public and Private drinking water and surface water)
(Appendix III: Water resources survey documentation, including, but not limited to: USGS database search, interview forms, and documentation of field survey)

a. *Site located in high/average* X *OR low* ____ *groundwater pollution susceptibility area?*

b. *Water Supplies within applicable radii?* YES X NO ____
If yes,
i. *Nearest public water supply located within:* 2,712 *feet*

ii. *Nearest down-gradient public water supply located within:* >10,560 *feet*

iii. *Nearest non-public water supply located within:* >10,560 *feet*

iv. *Nearest down-gradient non-public water supply located within:* >10,560 *feet*

c. *Surface Water Bodies and sewers:*

i. *Nearest surface water located within:* 340 *feet*

ii. *Nearest down-gradient surface water located within:* 340 *feet*

iii. *Nearest storm or sanitary sewer located within:* 120 *feet*

iv. *Depth to bottom of sewer at a point nearest the plume:* >5.0 *feet*

4. Impacted Environmental Media

a. *Soil Impacted*
(Table 2: Soil Analysis Results)
(Figure 4: Soil Quality Map)
(Appendix IV: Soil Boring Logs)
(Appendix V: Soil Laboratory Reports)
(Appendix VI: ATL Calculations, if applicable)

Provide a brief discussion of soil sampling.

Soil samples were collected at 2.0-foot intervals during the installation of 31 boreholes (SB-01 through SB-31) (Figure 4). Field headspace gas analyses were performed on each sample to determine organic vapor concentration. Soil samples were selected from each borehole for laboratory chemical analysis of benzene, toluene, ethylbenzene, and xylene (BTEX); TPH gasoline-range organics/diesel-range organics (GROs/DROs); polynuclear aromatic hydrocarbons (PAHs); and geotechnical analysis (Table 2 and Appendix V). In each borehole, one sample was collected from the interval where the highest vapor concentration was recorded or the interval located immediately above the water table if elevated vapor concentrations were not detected. An undisturbed (Shelby-tube) soil sample, SB-GT, was also collected and analyzed to determine vadose zone and aquifer characteristics at the site. In addition to the soil investigation, a total of 9 sediment samples (SD-1 through SD-9) were collected from along Lamar Canal and analyzed for the same parameters as the soil samples (Figure 10). The sediment data are reported on Table 7 and in Appendix V. Refer to Attachment A for complete documentation of the technical approach implemented during this investigation.

i. Soil contamination above applicable threshold levels?

YES _X_ NO _____

If yes, indicate highest concentrations in soil along with locations and depths detected.

The highest concentration of soil contamination was reported for the soil sample collected from boring SB-22 at a depth of 0.0 to 2.0 feet BGS (Table 2a). Benzene was reported at 1.130 mg/kg, toluene at 0.404 mg/kg, ethylbenzene at 13.6 mg/kg, and total xylenes at 74.6 mg/kg. Each of the compounds was reported above its applicable soil threshold level of 0.005 mg/kg, 0.400 mg/kg, 0.370 mg/kg, and 20.0 mg/kg, respectively. Benzene and toluene were also detected in boring SB-20 at concentrations above their applicable soil threshold levels. For the soil samples collected from borings SB-07, SB-09, SB-10, and SB-17, the volatile reporting limits were elevated causing many of the values for the BTEX compounds to be qualified as non-detects although their concentrations were above their applicable soil threshold levels. For evaluation purposes, these data have been considered using a value of less than the detection limit.

ii. ATLs calculated? YES _X_ NO _____

If yes, present ATLs.

ATLs for benzene, toluene, ethylbenzene, and xylene in soil were calculated. The ATL for benzene is 0.387 mg/kg, 12.210 mg/kg for toluene, 61.850 mg/kg for ethylbenzene, and 74.6 mg/kg for xylene. The ATL for benzene was exceeded in soil collected from borings SB-07 and SB-22. The ATLs for ethylbenzene and toluene were not exceeded in any of the soil samples. For xylene, the maximum concentration (74.6 mg/kg in SB-22) is equal to the calculated ATL. Please refer to Appendix VI for the ATL calculations.

iii. If ATLs calculated, is soil contamination above ATLs?

YES _X_ NO _____ N/A _____

b. Groundwater Impacted

(Table 3: Groundwater Analysis Results)
(Figure 5: Groundwater Quality Map)
(Appendix VII: Monitoring Well Details)
(Appendix VIII: Groundwater Laboratory Results)

Provide a brief discussion of groundwater sampling.

At 26 borehole locations, one groundwater sample was collected from a depth interval of approximately 1.0 to 5.0 feet below the water table using a direct-push sampling device (Figure 5). After the water sample was collected, a permanent 1-inch-diameter polyvinyl chloride (PVC) monitoring well was installed in the boring and developed. At 5 borehole locations (SB-17 and SB-20 through SB-23), one groundwater sample was collected through the 10-foot screen. At the vertical profile locations (VP-2 through VP-7), discrete groundwater samples were collected every 5 feet below the water table down to approximately 43 feet BGS [the estimated depth of the Hawthorn confining unit]. Although the Hawthorn was not encountered, the vertical profile was terminated at this depth because of the difficulty experienced during the extraction of groundwater samples. Chemical parameters for groundwater samples submitted for laboratory analysis included BTEX and PAHs (Table 3 and Appendix VIII). Refer to Attachment A for complete documentation of the technical approach for collecting groundwater samples during this investigation.

i. Groundwater contamination above MCLs? YES _X_ NO _____

ii. Groundwater contamination above In-Stream Water Quality Standards?

YES _X_ NO _____

If yes, indicate highest concentrations in groundwater along with the locations.

The highest concentration of contamination was reported in the groundwater sample collected from location SB-22 at a depth of 2.0 to 12.0 feet BGS (Table 3a). Benzene was reported at 553 µg/L, and naphthalene was reported at 101 µg/L. The benzene concentration is above its MCL of 5 µg/L and its In-Stream Water Quality Standard (IWQS) of 71.28 µg/L. Naphthalene does not have a regulatory level; however, this concentration exceeds the risk-based screening level of 6.5 µg/L. For evaluation purposes, an ACL of 634.4 µg/L was calculated for benzene and 57.85 µg/L for naphthalene. Based on the ACL, the maximum benzene concentration at this site is below the ACL. However, the maximum naphthalene concentration exceeds its ACL. Please refer to Appendix VI for the ACL calculations.

c. *Surface Water Impacted?* YES _____ NO X

If Yes, indicate concentration(s) of surface water sample(s) taken from the surface water body/bodies impacted.

A total of 8 surface water samples were collected from Lamar Canal during the investigation (Figure 10). Chemical parameters for the surface water samples submitted for laboratory analysis included BTEX and PAHs (Table 8 and Appendix VIII). Only benzene was detected in one surface water sample (SD-5) at a concentration of 0.17 µg/L. This concentration is well below the IWQS of 71.28 µg/L and the MCL of 5.0 µg/L. Refer to Attachment A for complete documentation of the technical approach used to collect surface water samples.

d. *Point of Withdrawal Impacted?* YES _____ NO X N/A _____

If Yes, indicate concentration(s) of water sample(s) taken from withdrawal point(s).

5. Other Geologic/Hydrogeologic Data

a. *Depth to Groundwater:* 2.72 to 4.60 feet BGS *(Table 4: Groundwater Elevations)*

b. *Groundwater Flow Direction:* Southeast *(Figure 6: Potentiometric Surface Map)*

c. *Hydraulic Gradient:* 0.0035 feet/feet

d. *Geophysical Province:* Coastal Plain

e. *Unique geologic/hydrogeological conditions:* The Hawthorn Formation acts as a confining unit between the surficial and Floridan aquifers.

6. Corrective Action Completed or In-Progress (if applicable)
(Table 5: UST System Closure Sampling)
(Figure 7: UST System Closure Sampling)
(Appendix IX: Contaminated Soil Disposal Manifests)

a. *Underground Storage Tank (UST) System Closure:* N/A _____

If applicable, summarize UST system closure activities conducted.

ACE closed UST 117 in-place on September 30, 1996. The UST piping was drained into the tank, and all remaining contents were subsequently removed using a vacuum truck and/or compressor-driven barrel vacuum device. The piping and the tank were then closed in-place by filling with grout.

b. Excavation and Treatment/Disposal of Backfill Materials and Native Soils

Check one: *No UST removal performed* X
Returned to UST excavation ____
Excavated soils treated or disposed off site ____

If soils were excavated, summarize excavation and treatment/disposal activities:

Former UST 117 was closed in place. No soil was excavated during the closure activities.

7. Site Ranking:
Environmental Site Sensitivity Score: *3250*
(Appendix X: Site Ranking Form)

8. Conclusions and Recommendations
Complete applicable section below, one section only

a. No Further Action Required (if applicable) N/A X
(provide justification)

b. Monitoring Only (if applicable) N/A X
(provide justification)

c. CAP-B (if applicable N/A ____
(provide justification)

The vertical extent of soil contamination was determined during the CAP-Part A investigation; however, the horizontal extent of soil contamination was not determined. At location SB-22, the maximum soil concentrations for benzene (1.13 mg/kg), toluene (0.404 mg/kg), ethylbenzene (13.6 mg/kg), and xylene (74.6 mg/kg) were detected. All of these concentrations were found to exceed their respective soil threshold levels (STLs). Therefore, alternate threshold levels (ATLs) were calculated for each compound. Based on the calculated ATLs, the maximum benzene concentration in soil (1.13 mg/kg) was found to exceed its ATL of 0.3867 mg/kg. For toluene and ethylbenzene, their maximum soil concentrations are well below their respective ATLs of 12.210 mg/kg and 61.850 mg/kg. For xylene, the maximum soil concentration is equal to the calculated ATL of 74.6 mg/kg.

The groundwater sample collected at SB-22 was found to contain the highest concentrations of benzene (553 µg/L), toluene (0.86 µg/L), ethylbenzene (86.7 µg/L), xylene (352 µg/L), and naphthalene (101 µg/L). Of these detected compounds, only benzene was found to exceed its respective maximum contaminant level (MCL) of 5.0 µg/L and the In-stream Water Quality Standard (IWQS) of 71.28 µg/L. Napbthalene does not have a regulatory level; however, the maximum concentration exceeds the risk-based screening level of 6.5 µg/L. Alternate concentration levels (ACLs) were calculated for both of these compounds. Based on the calculated ACLs, the maximum benzene concentration in groundwater does not exceed its ACL of 634 µg/L. However, the maximum naphthalene concentration in groundwater exceeded its ACL of 57.85 µg/L. As a conservative measure, a comprehensive round of groundwater sampling is recommended to confirm the site conditions and validate the fate and transport modeling. The vertical extent of groundwater contamination was determined during the CAP-Part A investigation; therefore, further investigation of the vertical extent of groundwater contamination is not warranted.

III. MONITORING ONLY PLAN (if applicable): N/A X

A. Monitoring points

B. Period/Frequency of monitoring and reporting

C. Monitoring Parameters

D. Milestone Schedule

E. Scenarios for site closure or CAP-Part B

IV. SITE INVESTIGATION PLAN (if applicable): N/A _____

(Figure 8: Proposed additional boring/monitoring well location)

A. Proposed Investigation of Horizontal and Vertical Extent of Contamination In:

1. Soil N/A _____

Seven shallow soil borings will be installed as part of the CAP-Part B investigation for the purpose of collecting soil samples only to delineate the horizontal extent of contamination around location SB-7 and SB-22 (Figure 8). In addition, three shallow, 1-inch monitoring wells will be installed that will also require soil sampling for the CAP-Part B investigation. One soil sample will be collected from each boring and analyzed for BTEX, PAHs, and TPH-DRO and TPH-GRO. The soil samples will be collected from the 2.0-foot sample interval with the highest headspace reading or from the sample interval above the soil/water interface if no contamination is observed. It is also recommended that two additional sediment samples be collected from Lamar Canal near former sampling location SD-03 to investigate the area where the storm drain discharges into Lamar Canal. The samples will be analyzed for BTEX, PAHs, and TPH-DRO, and TPH-GRO. Analytical results from the soil samples collected from the CAP-Part B investigation borings located in the area of highest contamination will be used to supercede previous analytical data for the purpose of the site ranking form.

2. Groundwater

a. Free Product N/A___X___

b. Dissolved phase NA_____

Three shallow, 1-inch monitoring wells will be installed along the southern border of the Bulk Fuel Facility outside the fence and south of AST 7003 as part of the CAP-Part B investigation (Figure 8). The proposed locations are: (1) at the location of VP-04, (2) downgradient of MW-22, and (3) cross-gradient of MW-22. These wells will be installed to ensure groundwater monitoring locations exist downgradient of the area of highest soil and groundwater contamination The shallow wells will be screened across the water table with 3 to 5 feet of screen above the water table in order to detect the presence of free product. All monitoring wells will be completed flush with the ground surface.

One groundwater sample will be collected from each of the three new monitoring wells. In addition, one sample will be collected from each of the 31 monitoring wells completed during the CAP-Part A investigation and from each of the six 2-inch-diameter monitoring wells installed by Earth Tech, Inc. (Figure 8). Each groundwater sample will be analyzed for BTEX and PAHs.

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(Appendix XII: GUST Trust Fund Reimbursement Application and Claim for reimbursement)

HAAF is a federally owned facility and has funded the investigation for the Former UST 117, Building 7002 site, Facility ID: 9-025113*1, using Environmental Restoration Account funds. Application for Georgia Underground Storage Tank Trust Fund reimbursement is not being pursued at this time.