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ADDENDUM #29
TO THE
WORK PLAN

FOR

PRELIMINARY GROUNDWATER AND CORRECTIVE ACTION PLAN–PART A/PART B INVESTIGATIONS
AT
FORMER UNDERGROUND STORAGE TANK SITES, HUNTER ARMY AIRFIELD
AND
FORT STEWART, GEORGIA

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract Number W912HN-13-R-0023
Delivery Order Number 0001

October 2014

SES Construction and Fuel Services LLC

leidos

13-122(E)/101314

DOCUMENT 20

LEIDOS

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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October 2014

APPROVALS

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October 13, 2014

Patty Stoll, PE, PG — Date
Leidos Project Manager

October 13, 2014

Brian Odom, PG — Date
SES Construction and Fuel Services, LLC Project Manager

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ACRONYMS

AST	aboveground storage tank
BFF	Bulk Fuel Facility
BGS	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Corrective Action Plan
DRO	diesel-range organics
EFR®	Enhanced Fluid Recovery®
GA EPD	Georgia Environmental Protection Division
GAC	granular activated carbon
gpm	gallons per minute
HAAF	Hunter Army Airfield
JP	jet propellant
MAE2	Mid-Atlantic Environmental Equipment, Inc.
O&M	operation and maintenance
OWS	oil/water separator
PAH	polycyclic aromatic hydrocarbon
PVC	polyvinyl chloride
RDW	remediation-derived waste
SAIC	Science Applications International Corporation
SCF	SES Construction and Fuel Services, LLC
TPH	total petroleum hydrocarbons
UIC	underground injection control
USACE	U. S. Army Corps of Engineers
UST	underground storage tank
USTMP	Underground Storage Tank Management Program
VOC	volatile organic compound
WP	work plan
WWTP	waste water treatment plant

1.0 INTRODUCTION

Leidos, formerly a part of Science Applications International Corporation (SAIC), has prepared this Work Plan (WP) Addendum #29 on behalf of SES Construction and Fuel Services, LLC (SCF) for the U.S. Army Corps of Engineers (USACE), Savannah District to supplement 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 1996) and the *Sampling and Analysis Plan for Corrective Action Plan–Part A and B Investigations for Former Underground Storage Tanks at Hunter Army Airfield, Georgia* (SAIC 1998). This WP Addendum #29 presents the planned approach for the second product recovery system pilot study at the Bulk Fuel Facility (BFF) (HAA-09), Former Underground Storage Tank (UST) 117, Building 7009 at Hunter Army Airfield (HAAF), Georgia (Figure 1). SCF, the prime contractor, has subcontracted with Leidos to fulfill the requirements established in the *Statement of Work for the Product Recovery System Pilot Study, Bulk Fuel Facility (HAA-09), Former UST 117, Building 7009, Hunter Army Airfield, Georgia, Facility ID # 9-025113*2* (USACE 2013) under USACE, Savannah District Contract Number W912HN-13-R-0023, Delivery Order Number 0001.

1.1 BACKGROUND

The BFF is approximately 600 by 1,200 ft and covers an area of approximately 16.5 acres (Figure 2). Currently, the facility contains two active aboveground storage tanks (ASTs) (AST 7007 and AST 7009) for the storage of jet propellant (JP)-8 with capacities of approximately 500,000 gal each, above- and underground piping, and off-loader and pump stations for the distribution of fuel to and from the tanks, and a third active AST constructed in 2011 at the location of former AST 7005. The capacity of this third AST is 30,000 barrels or 1,260,000 gal. Previously, UST 117, a 550-gal JP-4 fuel tank, and three 500,000-gal ASTs (AST 7001, AST 7003, and AST 7005) were located at the BFF. Since the closure of UST 117 in 1996, three separate releases have been identified at the BFF under Georgia Environmental Protection Division (GA EPD) Underground Storage Tank Management Program (USTMP) regulations.

In association with the area designated as Release #1, SAIC performed a soil gas survey of the BFF in January 1999 to identify areas of significant contaminant concentrations (SAIC 1999). SAIC conducted a Corrective Action Plan (CAP)–Part A investigation in December 1999 and January 2000 and a CAP–Part B investigation from November 2000 to March 2001 to determine the extent of petroleum contamination at the BFF, including the areas around UST 117, AST 7001, AST 7003, AST 7005, AST 7007, and AST 7009. Thirty-four monitoring wells, seven soil borings, and six vertical-profile borings were installed during these investigations, and surface water and sediment samples were collected from Lamar Canal (Figure 2). The *Corrective Action Plan–Part B Report for the Former Underground Storage Tank 117, Building 7002 Site, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*1, Hunter Army Airfield, Georgia* (SAIC 2001) was submitted to GA EPD USTMP in July 2001.

Release #1: UST 117, Building 7002. UST 117 was a 500-gal UST located near Building 7002 at the BFF. This tank was removed and the piping abandoned in place on September 30, 1996. A CAP–Part A investigation was conducted by SAIC between December 1999 and January 2000 to identify areas of significant contamination concentrations (SAIC 2000). A CAP–Part B investigation was conducted by SAIC from November 2000 to March 2001 to determine the extent of petroleum contamination at the site (SAIC 2001). As part of these investigations, a groundwater plume was identified in the vicinity of AST 7003, which is located 100 to 150 ft south of UST 117. Semiannual monitoring of Release #1 was initiated in July 2002 and discontinued in January 2003. GA EPD USTMP granted no further action status for Release #1 in correspondence dated October 6, 2003 (Lewis 2003). All wells associated with this release were abandoned between February 2006 and January 2008 with the exception of monitoring wells MW-04 and MW-05.

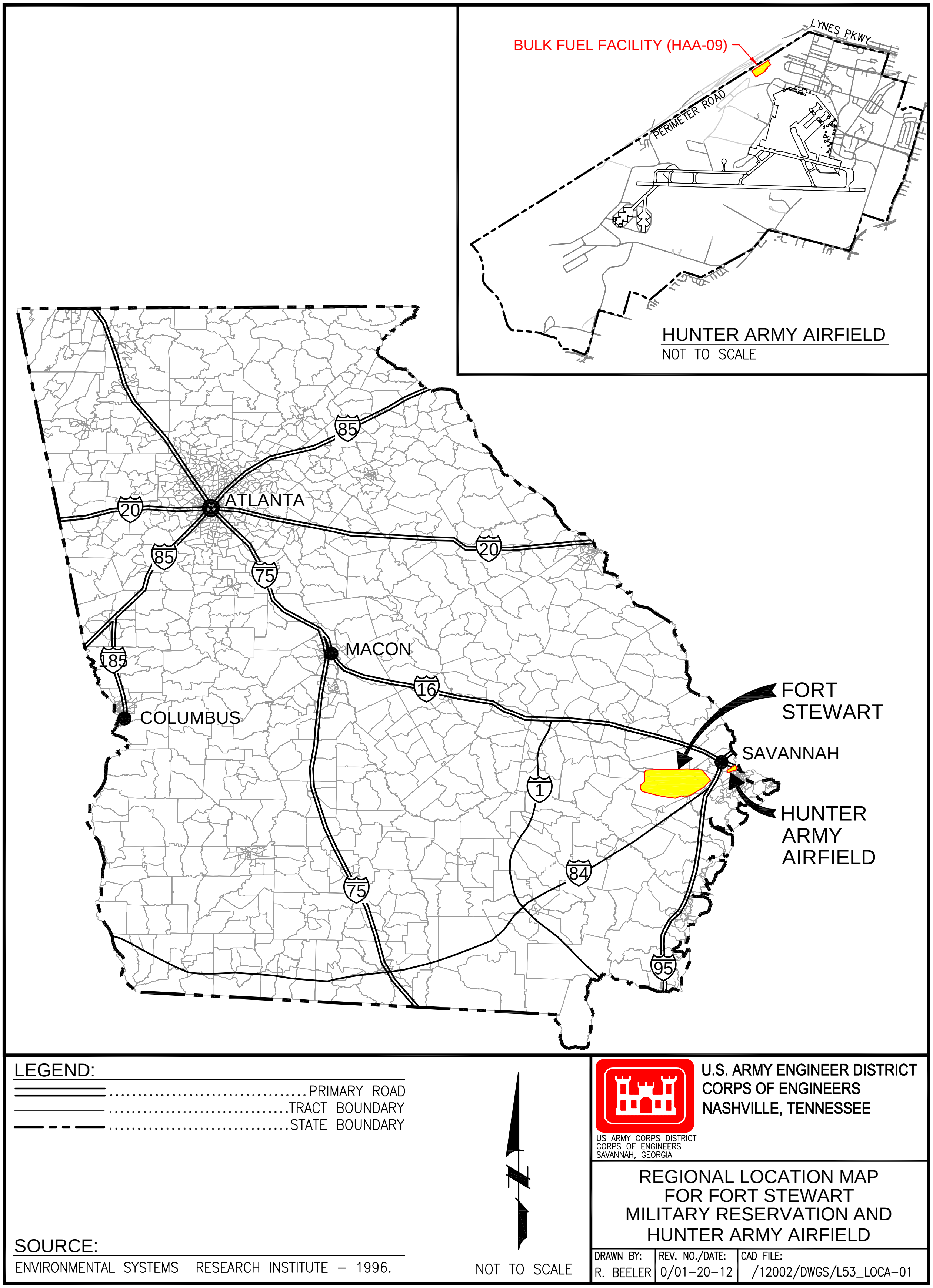


Figure 1. Location of the Bulk Fuel Facility, Hunter Army Airfield, Georgia

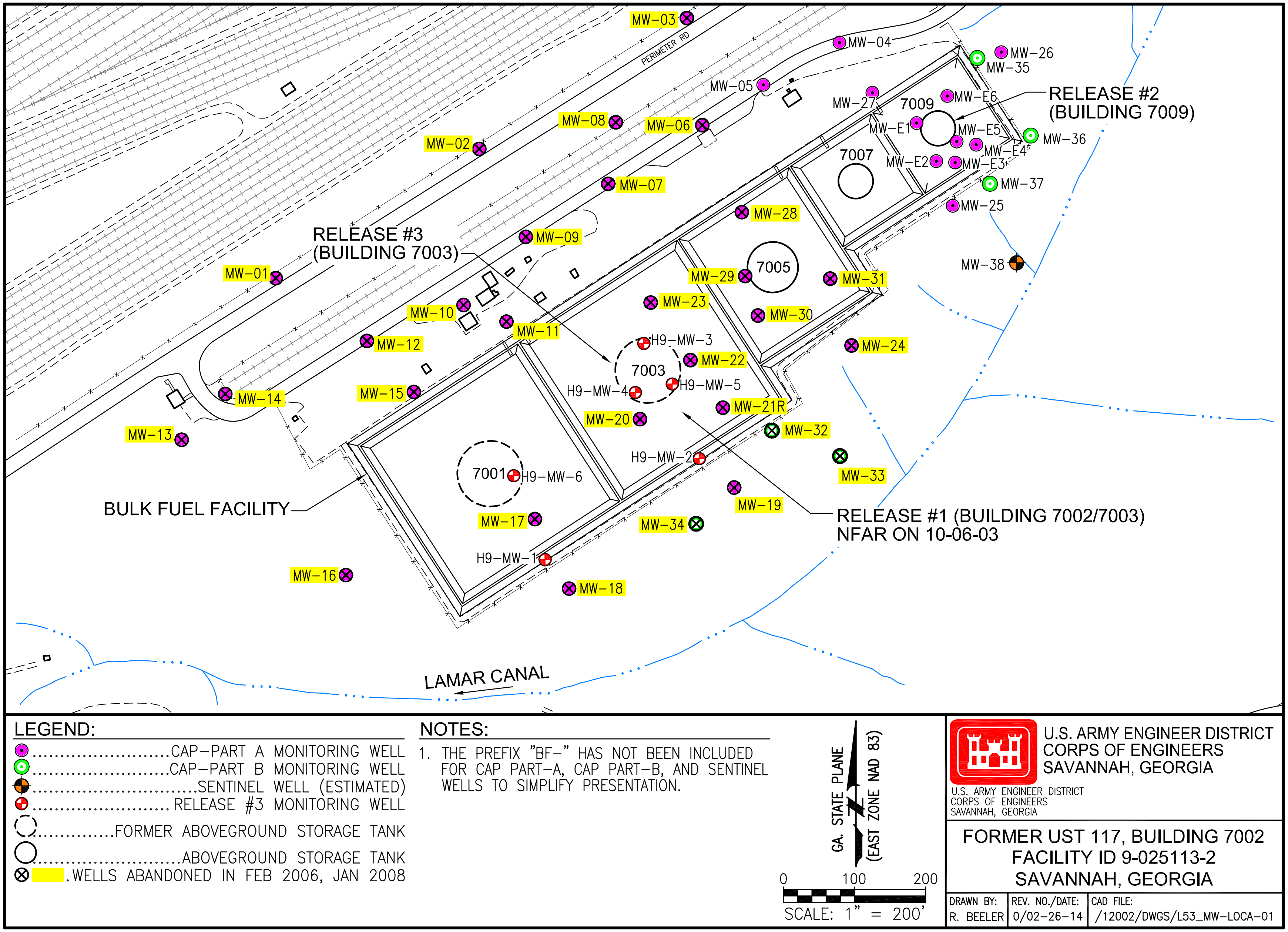


Figure 2. Site Location Map for the Bulk Fuel Facility, Hunter Army Airfield, Georgia

Release #2: AST 7009. In December 1999 and January 2000, the CAP–Part A investigation associated with Release #1 to identify areas of significant contamination concentrations involved collecting samples from the vicinity of AST 7009. A CAP–Part B investigation, which included the vicinity of AST 7009, was conducted by SAIC from November 2000 to March 2001 to determine the extent of petroleum contamination at the site (SAIC 2001). The nature and extent of contamination was determined during the CAP–Part B investigation. In July 2002, as part of the groundwater monitoring for Release #1, free product was observed in well MW-E5, which is located within the bermed area of AST 7009 (identified as Release #2). The prefix "BF-" is sometimes used to distinguish wells located at the BFF from others at HAAF (i.e., BF-MW-E5); however, as all wells within this plan are located at the BFF, this prefix is not included in well identifiers within this document. This tank is approximately 500 ft northeast of AST 7003 and is hydraulically sidegradient to AST 7003. Semiannual monitoring of Release #2 was initiated in July 2004 and discontinued in January 2005 because detected benzene, toluene, ethylbenzene, and xylene (BTEX) and polycyclic aromatic hydrocarbon (PAH) constituents were below the In-Stream Water Quality Standards. Free product removal activities were implemented in July 2004 consisting of absorbent socks in well MW-E5 and bimonthly or quarterly pumping of the same well. In July 2007, an 8-hr Enhanced Fluid Recovery® (EFR®) event was initiated to vacuum extract the free product from well MW-E5 on a quarterly basis. Free product has not been observed in the other wells located within the berm or those located around the perimeter of the berm for AST 7009. EFR® events were conducted on a quarterly basis through the spring of 2010 with biannual groundwater monitoring of sentinel well MW-38. The final EFR® event was conducted in March 2010. Activities conducted under the USTMP are documented in the reports listed below.

- *Soil Gas Survey Report for the Bulk Fuel Facility (HAA-09) at Hunter Army Airfield, Georgia* (SAIC 1999), documents the results of the 1999 soil gas survey that was performed to identify areas of significant contaminant concentrations.

- *Corrective Action Plan–Part A Report for the Former Underground Storage Tank 117, Building 7002 Site, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*1, Hunter Army Airfield, Georgia* (SAIC 2000), documents the results of the CAP–Part A investigation conducted in 1999 and 2000.

- *Corrective Action Plan–Part B Report for the Former Underground Storage Tank 117, Building 7002 Site, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*1, Hunter Army Airfield, Georgia* (SAIC 2001), documents the results of the CAP–Part B investigation conducted in 2000 and 2001.

- *First Annual Monitoring Only Report for Former Underground Storage Tank 117, Building 7002, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*1, Hunter Army Airfield, Georgia* (SAIC 2003), documents the results of the July 2002 and January 2003 monitoring events for Release #1.

- *Second Annual Monitoring and Free Product Removal Report for Former Underground Storage Tank 117, Building 7009, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*2, Hunter Army Airfield, Georgia* (SAIC 2005), documents the results of the July 2004 and January 2005 monitoring events and the free product removal activities conducted between June 2004 and March 2005 for Release #2.

- *Completion Report for Former Underground Storage Tank 117, Building 7002, Release #1, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*1, Hunter Army Airfield, Georgia* (SAIC 2006), documents the well abandonment activities for wells installed as part of the CAP–Parts A and B investigations for UST 117. Wells associated with Release #2 were not abandoned.

- *Third Annual Monitoring and Free Product Removal Report for Former Underground Storage Tank 117, Building 7009, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*2, Hunter Army Airfield, Georgia* (SAIC 2007), documents the results of the free product removal activities between April 2005 and December 2006 for Release #2 and the 2006 free product removal activities for Release #3.

- *Fourth Annual Monitoring and Free Product Removal Report for Former Underground Storage Tank 117, Building 7009, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*2, Hunter Army Airfield, Georgia* (SAIC 2008), documents the results of the 2007 free product removal activities for events for Release #2.

- *2008 Free Product Removal Report for the Bulk Fuel Facility (HAA-09), Building 7009, Hunter Army Airfield, Georgia* (SAIC 2009), documents the results of the 2008 free product removal activities for events for Release #2.

- *2009 Free Product Removal Report for the Bulk Fuel Facility (HAA-09), Building 7009, Hunter Army Airfield, Georgia* (SAIC 2010), documents the results of the 2009 free product removal activities for events for Release #2.

Free product was observed consistently in MW-E5 from 2002 through March 2010. Historical EFR® events at MW-E5 from June 18, 2004, through March 15, 2010, recovered a total of approximately 84 gal of free product. However, free product continued to be measured in the well at thicknesses greater than 1/8 in. (0.01 ft). During the four vacuum events conducted in 2009, free product thickness in MW-E5 ranged from 0.46 to 1.95 ft. In March 2010, free product was present in the well at a thickness of 1.28 ft. Other wells within the bermed area of the BFF remained clean, and BTEX and PAH concentrations from all wells within the vicinity of AST 7009 have remained well below applicable regulatory criteria since the first sampling event in 1999.

By 2010, it was determined that the quarterly vacuum events were not providing the constant treatment needed to remove the measurable free product present at Bulk Fuel Tank 7009 (Release #2). Alternative approaches, such as a soil vapor extraction solution and a surfactant injection solution, were evaluated, and surfactant injection was selected as both a time- and cost-effective option.

Release #3: AST 7003. In May 2006, the concrete foundation and berm for AST 7003 were removed by CAPE Environmental and free product was discovered at a depth of 3 to 4 ft below ground surface (BGS). In August 2006, CAPE Environmental installed four, 2-ft-diameter sumps in the bermed area of former AST 7003. In November 2006, monitoring points were installed on 50-ft centers in the bermed area of the former AST. No water or free product was measured in any of the points; however, soil contamination was identified in the soil headspace readings. Griffin Services was contracted to remove the free product on a routine basis. In November 2009, Arcadis initiated remedial action in the vicinity of former AST 7003. Impacted soil exceeding alternate threshold levels was excavated, and an oxygen-releasing substance was placed in the excavated area to enhance bioremediation of contaminated groundwater. Quarterly groundwater monitoring events through October 2010 demonstrated that dissolved benzene in groundwater near former AST 7003 continued to exceed the alternate concentration limit but that attenuation was occurring. Continued semiannual monitoring demonstrated decreasing concentrations; GA EPD approved no further action for Release #3 in October 2013.

1.2 INITIAL PILOT STUDY

In 2011, the *Corrective Action Plan–Part B Addendum #1, Bulk Fuel Facility (HAA-09), Building 7009, Hunter Army Airfield, Georgia, Facility ID #9-025113*2* proposed a pilot study with the following objective:

- Remove free product in excess of 1/8 in. by using surfactant flooding to flush the free product from the pore space of the fine-grained sand beneath the AST (SAIC 2011a).

Initial pilot study activities were conducted from 2011 to 2012 in accordance with the CAP–Part B Addendum #1 (SAIC 2011a), which was approved by GA EPD through correspondence dated May 2, 2011 (Guentert 2011), and *Addendum #28 to the Work Plan for Preliminary Groundwater and Corrective Action Plan–Part A/Part B Investigations at Former Underground Storage Tank Sites, Hunter Army Airfield and Fort Stewart, Georgia* (SAIC 2011b). Based upon information gathered during prior facility upgrades and removals, a 4- to 5-ft-thick sand foundation was believed to have been installed underneath the concrete pad of each AST at the BFF. Prior activities at the BFF have resulted in a release of fuel into the subsurface in the vicinity of AST 7009. This fuel was believed to remain trapped within a sand foundation by the surrounding silty clay. Because AST 7009 is an active 500,000-gal AST, a surfactant flood of the fine-grained sand was proposed to flush the free product from the pore space without disruption of facility operations.

Surfactant flushing is a free product removal technology involving the injection and subsequent extraction of chemicals to solubilize and/or mobilize free product. The surfactant is injected into a system of wells positioned to sweep the source zone. The chemical flood and the solubilized or mobilized free product are removed through extraction wells, and the produced liquids are then either disposed (usually via off-site treatment) or treated on-site to remove contaminants.

Addendum #28 to the WP identified locations for nine, 1-in. injection points to be installed around the perimeter of AST 7009 and existing monitoring wells MW-E5 and MW-E1 as primary extraction points (SAIC 2011b). The custom injection/product recovery system was manufactured by Mid-Atlantic Environmental Equipment, Inc. (MAE2) and includes a ten-leg injection manifold and five-leg vacuum extraction manifold.

During initial injection well installation activities, field personnel encountered a layer of hard-packed soil coated with crystallized oil instead of the anticipated sand. This contaminated layer limited injection flow and product recovery. However, within the first 5 months of operation, approximately 1,000 gal of surfactant (i.e., Biosolve) in an average 2% solution were injected to treat one pore volume in the vicinity of AST 7009.

Primary effluent treatment steps are outlined below.

1. Extracted groundwater and vapors flowed through a liquid/vapor separator; separated vapor was sent to an air stripper vapor discharge, while liquid-phase effluent continued on to a 20,000-gal Baker frac tank.

2. In the frac tank, particulates and free product were allowed to settle and separate, respectively.

3. From the frac tank, liquid-phase effluent continued on through an oil/water separator (OWS); separated oil was stored for off-site disposal as free-phase product in 55-gal drums and liquid-phase effluent continued on to an air stripper to remove dissolved volatile organic compounds (VOCs).

4. The liquid-phase effluent passed through an ultra-filtration system comprised of sand filters, polymer absorber, and an organo-clay vessel.

5. Finally, the effluent was passed through liquid-phase granular-activated carbon (GAC) as a final polishing step and discharged to the HAAF waste water treatment plant (WWTP).

Two chemical dose systems (one for anti-fouling and one for anti-foaming) were used as required.

By April 2012, the pilot study product recovery system recovered approximately five pore volumes of groundwater and surfactant solution containing approximately 700 gal of free product, roughly half the volume estimated to be present in the subsurface. Recovery costs using the product recovery system dropped 87% per recovered gallon from historical costs using EFR®.

In mid-April 2012, SAIC and USACE agreed to terminate the pilot study treatment phase; the product recovery system was turned off on April 24, 2012. MAE2 disconnected connections to injection and extraction wells, drained lines within and connected to the treatment trailer, and powered down the system. All remediation-derived waste (RDW) was removed from the site.

Details of the initial pilot study are documented in the reports listed below.

- *Pilot Study Interim Progress Report for Corrective Actions at Bulk Fuel Facility (HA-009), Former UST 117, AST 7009, Hunter Army Airfield, Georgia, Facility ID #9-025113*2* (SAIC 2012a) summarizes installation and startup activities for the pilot study product recovery system and discusses field observations related to subsurface conditions at AST 7009.

- *Pilot Study Interim Progress Report #2 for Corrective Actions at Bulk Fuel Facility (HA-009), Former UST 117, AST 7009, Hunter Army Airfield, Georgia, Facility ID #9-025113*2* (SAIC 2012b) provides additional information on pilot study operation and results through May 2012.

- *Pilot Study Interim Progress Report #3 for Corrective Actions at Bulk Fuel Facility (HAA-09), Former UST 117, AST 7009, Hunter Army Airfield, Georgia, Facility ID #9-025113*2* (SAIC 2013) presents the results of four quarterly gauging events following surfactant injection/extraction activities and analytical results of groundwater sampling at two site monitoring wells, MW-E5 and MW-38, in November 2012.

Four rounds of quarterly gauging at extraction wells MW-E1 through MW-E6 were performed between April 30, 2012, and February 2, 2013. Results of the most recent three quarterly events show that free product is accumulating in well MW-E5 again, thus indicating that free product is still tied up in the soil column. Results of groundwater sampling conducted in November 2012 confirm that BTEX concentrations remain well below applicable regulatory criteria.

As outlined in the Final version of this WP Addendum #29 dated March 2014, a second pilot study was initially proposed to determine the applicability of using a co-solvent (i.e., alcohol) to increase the solubility of the crystallized fuel contamination, thus enhancing the surfactant injection/extraction process. However, following the treatability study described in Section 4.1, it was determined that the use of alcohol as a co-solvent was not feasible in field-scale application.

This Revised Final WP Addendum #29 outlines the revised plan for the proposed second pilot study. As in the initial pilot study, surfactant (i.e., Biosolve) was injected into the subsurface to flush out remaining free product trapped within the pore space beneath AST 7009. However, in this second pilot study, injection/extraction activities were focused in the vicinity of existing well MW-E5, where free product continues to accumulate at thicknesses greater than 1/8-in.

1.3 REGULATORY REQUIREMENTS

Following submittal of the Third Annual Monitoring and Free Product Removal Report (SAIC 2007), in correspondence dated February 28, 2008 (Logan 2008), GA EPD USTMP recommended that the site be transferred to the GA EPD Solid Waste Program because the contamination was the result of a release from an AST; therefore, the site is being remediated under the GA EPD Solid Waste Program.

A GA EPD Underground Injection Control (UIC) permit will be required for the injection activities described within this WP Addendum #29.

2.0 PROJECT ORGANIZATION

This chapter presents changes to the project management plan, which is included as Attachment 1 of the WP for Preliminary Groundwater and CAP–Part A/Part B Investigations (SAIC 1996).

Leidos has been subcontracted by SCF to prepare plans and reports, provide field support, and manage second-tier subcontractors during the execution of this pilot study. Second-tier subcontractors are listed in Table 1.

Table 1. Second-tier Subcontractors

Second-tier Subcontractor	Service(s)
Prima Environmental	Soil treatability study
MAE2	O&M of the injection/product recovery system
GEL Laboratories	Analysis of groundwater and liquid effluent samples
Chemtech Consulting Group	Analysis of air samples
Waste Management (TBD)	Transportation and disposal of RDW

MAE2 = Mid-Atlantic Environmental Equipment, Inc.
O&M = Operation and maintenance.
RDW = Remediation-derived waste.
TBD = To be determined.

The organizational chart for the second pilot study at Bulk Fuel Tank 7009 is presented as Figure 3.

The preliminary schedule for the second pilot study is presented as Figure 4. This schedule will be revised, as necessary, throughout the period of performance, and an updated version provided to the USACE Project Manager if a significant revision is made.

3.0 PROJECT SCOPE AND OBJECTIVES

3.1 SCOPE

The scope of this project consists of two primary tasks:

- Task 1: Perform a 6-month Surfactant Injection/Extraction System Operation, and
- Task 2: System Decommissioning.

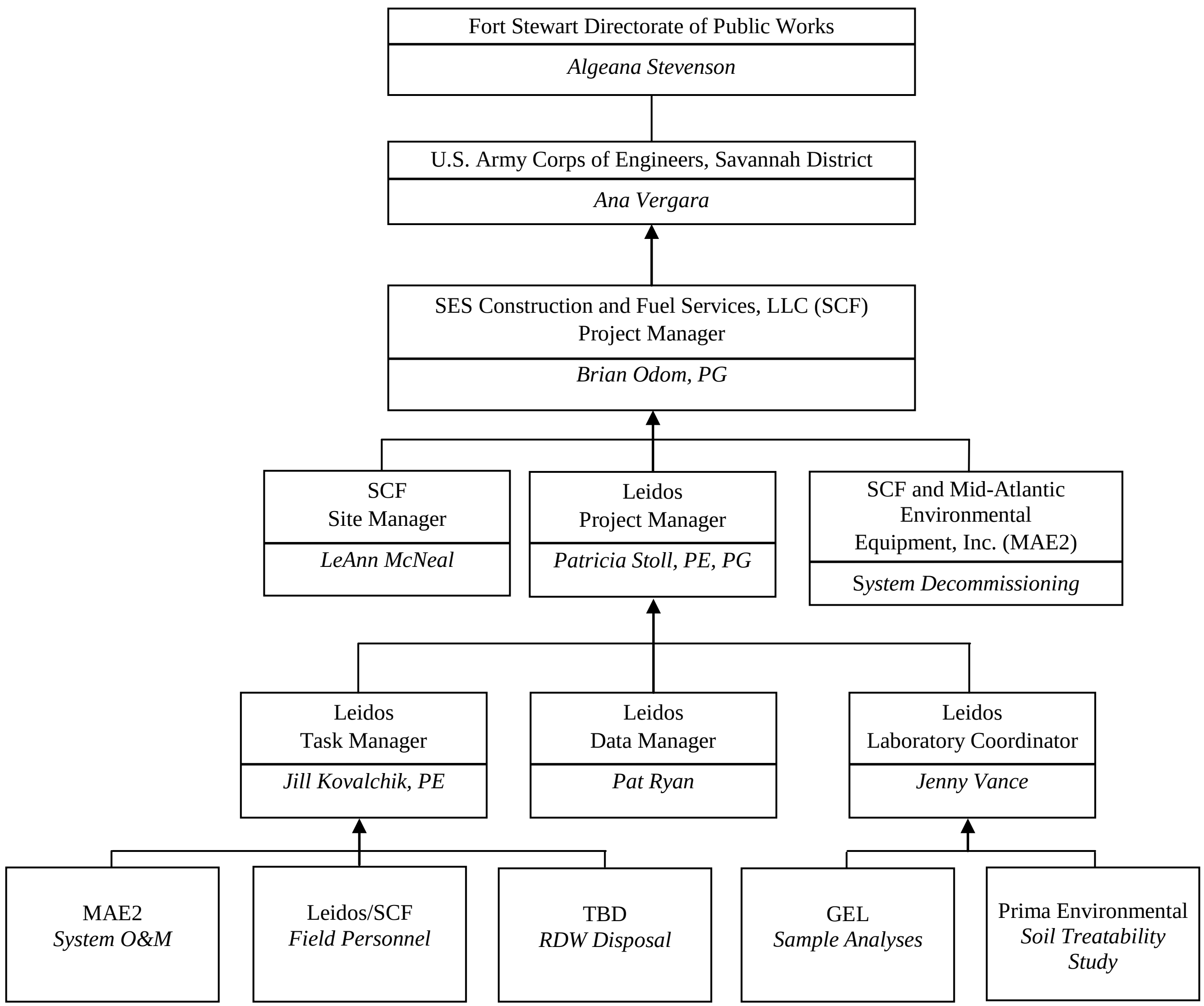
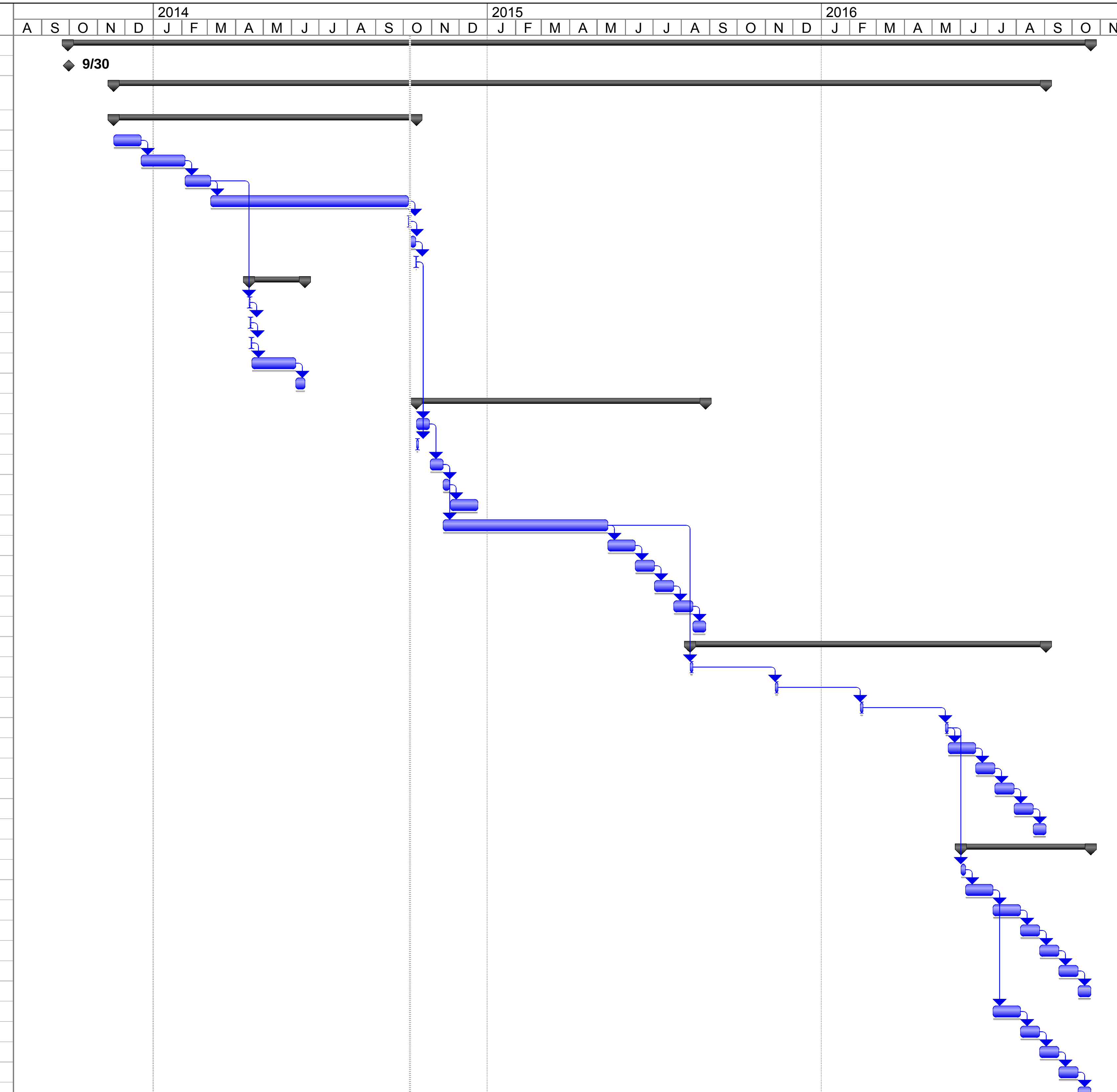


Figure 3. Organizational Chart for the Second Pilot Study at Bulk Fuel Tank 7009

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Bulk Fuels Pilot Study Project**	**800 days**	**Mon 9/30/13**	**Fri 10/21/16**	
2	Notice to proceed	1 day	Mon 9/30/13	Mon 9/30/13	
3	**Task 1 - Perform 6-month Surfactant Injection/Extraction System Operation**	**729 days**	**Mon 11/18/13**	**Fri 9/2/16**	
4	**Task 1.1 - Plan**	**237 days**	**Mon 11/18/13**	**Wed 10/15/14**	
5	Prepare Draft Work Plan	30 edays	Mon 11/18/13	Wed 12/18/13	
6	Government Review Draft Plan	48 edays	Wed 12/18/13	Tue 2/4/14	5
7	Prepare Final Plan	28 edays	Tue 2/4/14	Tue 3/4/14	6
8	Regulatory Review Final Plan	154 days	Wed 3/5/14	Mon 10/6/14	7
9	Prepare Revised Final Plan	2 days	Tue 10/7/14	Wed 10/8/14	8
10	Regulatory Review Revised Final Plan	4 days	Thu 10/9/14	Tue 10/14/14	9
11	Regulatory Approval Revised Final Plan	1 day	Wed 10/15/14	Wed 10/15/14	10
12	**Task 1.2 - Treatability Study**	**43 days**	**Wed 4/16/14**	**Sun 6/15/14**	
13	Mobilize to site	1 day	Wed 4/16/14	Wed 4/16/14	7FS+42 edays
14	Obtain soil for bench scale tests	1 day	Thu 4/17/14	Thu 4/17/14	13
15	Demobilize from site	1 day	Fri 4/18/14	Fri 4/18/14	14
16	Bench Scale Testing	48 edays	Fri 4/18/14	Thu 6/5/14	15
17	Review bench scale test	10 edays	Thu 6/5/14	Sun 6/15/14	16
18	**Task 1.3 - System Operation**	**226 days**	**Wed 10/15/14**	**Thu 8/27/15**	
19	Mobilize to site	14 edays	Wed 10/15/14	Wed 10/29/14	11
20	Install injection wells	2 days	Thu 10/16/14	Fri 10/17/14	11
21	Reconnect system	14 edays	Thu 10/30/14	Thu 11/13/14	19FS+1 day
22	Conduct biannual groundwater sampling event	5 days	Fri 11/14/14	Thu 11/20/14	21
23	Injection Operations	30 edays	Fri 11/21/14	Sun 12/21/14	22FS+1 day
24	Extraction Operations	180 edays	Thu 11/13/14	Tue 5/12/15	21
25	Prepare Draft Progress Report #1	30 edays	Tue 5/12/15	Thu 6/11/15	24
26	Government Review Draft Progress Report #1	21 edays	Thu 6/11/15	Thu 7/2/15	25
27	Prepare Final Progress Report #1	21 edays	Thu 7/2/15	Thu 7/23/15	26
28	Regulatory Review Final Report #1	21 edays	Thu 7/23/15	Thu 8/13/15	27
29	Prepare Revised Final Progress Report #1	14 edays	Thu 8/13/15	Thu 8/27/15	28
30	**Task 1.4 - Quarterly Gauging**	**279 days**	**Mon 8/10/15**	**Fri 9/2/16**	
31	First Quarterly Gauging Event	3 edays	Mon 8/10/15	Thu 8/13/15	24FS+90 edays
32	Second Quarterly Gauging Event	3 edays	Wed 11/11/15	Sat 11/14/15	31FS+90 edays
33	Third Quarterly Gauging Event	3 edays	Fri 2/12/16	Mon 2/15/16	32FS+90 edays
34	Fourth Quarterly Gauging Event	3 edays	Sun 5/15/16	Wed 5/18/16	33FS+90 edays
35	Prepare Draft Progress Report #2	30 edays	Wed 5/18/16	Fri 6/17/16	34
36	Government Review Draft Progress Report #2	21 edays	Fri 6/17/16	Fri 7/8/16	35
37	Prepare Final Progress Report #2	21 edays	Fri 7/8/16	Fri 7/29/16	36
38	Regulatory Review Final Report #2	21 edays	Fri 7/29/16	Fri 8/19/16	37
39	Prepare Revised Final Progress Report #2	14 edays	Fri 8/19/16	Fri 9/2/16	38
40	**Task 2 - Decommission System**	**102 days**	**Wed 6/1/16**	**Fri 10/21/16**	
41	Mobilize to site	5 edays	Wed 6/1/16	Mon 6/6/16	34FS+14 edays
42	Decommission System	30 edays	Mon 6/6/16	Wed 7/6/16	41
43	Prepare Draft Decommissioning Report	30 edays	Wed 7/6/16	Fri 8/5/16	42
44	Government Review Draft Decommissioning Report	21 edays	Fri 8/5/16	Fri 8/26/16	43
45	Prepare Final Decommissioning Report	21 edays	Fri 8/26/16	Fri 9/16/16	44
46	Regulatory Review Final Decommissioning Report	21 edays	Fri 9/16/16	Fri 10/7/16	45
47	Prepare Revised Final Decommissioning Report	14 edays	Fri 10/7/16	Fri 10/21/16	46
48	Prepare Draft Completion Report	30 edays	Wed 7/6/16	Fri 8/5/16	42
49	Government Review Draft Completion Report	21 edays	Fri 8/5/16	Fri 8/26/16	48
50	Prepare Final Completion Report	21 edays	Fri 8/26/16	Fri 9/16/16	49
51	Regulatory Review Final Completion Report	21 edays	Fri 9/16/16	Fri 10/7/16	50
52	Prepare Revised Final Completion Report	14 edays	Fri 10/7/16	Fri 10/21/16	51



Project: Hunter BFF Pilot Study
Date: Wed 10/8/14

Figure 4. Preliminary Project Schedule

3.2 OBJECTIVE

The project objective is to restart a pilot-scale product recovery system around Bulk Fuel Tank 7009 that will consist of a surfactant injection/multi-phase extraction system to recover trapped free-phase product in the vicinity of MW-E5 to determine the feasibility of implementing this technology at the BFF and, potentially, other fuel storage facilities at HAAF.

4.0 FIELD ACTIVITIES

Task 1 field activities fall into five primary subtasks, each of which is further described within this chapter.

- Treatability study – includes the collection of soil from the pilot study area, which was shipped to Prima Environmental for use in a bench-scale study evaluating the effectiveness of three identified potential alcohols.

- Shakedown of product recovery system – includes activities required to return the injection/product recovery system to operating condition.

- Installation of new injection wells – includes six new injection wells surrounding existing monitoring well MW-E5.

- Product recovery operations – includes injections, product recovery activities, and operation and maintenance (O&M) of the system.

- Sampling and gauging – includes sampling of the initial effluent stream prior to discharge to the publically owned treatment works, and routine monitoring of effluent on a biweekly basis along with gauging of wells for free product.

Task 2, system decommissioning, is also addressed within this chapter.

4.1 TREATABILITY STUDY

Field activities commenced with the collection of approximately 5 lb of subsurface soil from one or more locations in the vicinity of monitoring well MW-E5. The ground surface within this area is comprised of gravel overlaying an impermeable liner, followed by native soil/historic fill. Subsurface soil was collected in the following manner:

1. Surface gravel was removed from a footprint of approximately 1 to 2 ft x 1 to 2 ft at the selected borehole location to allow access to the subsurface liner.

2. A hole large enough for the hand auger to advance through was cut from the liner.

3. The hand auger was advanced through the subsurface soil until contaminated material, which is characterized by a hard, crystalline appearance, was encountered.

4. Contaminated soil was retrieved and stored in containers for shipment to the off-site laboratory.

5. Multiple boreholes were required.

6. Upon collection of an adequate soil volume (minimum 5 lb), boreholes were backfilled with native material to the level of the liner.

7. Each hole cut within the liner was patched with high-density polyethylene liner material and approved temporary adhesive until system closure when patches will be permanently repaired.

8. Gravel was replaced above the liner to restore the surface to pre-existing conditions.

The soil sample was packaged for shipment and sent for overnight delivery to Prima Environmental.

Upon receipt of the soil sample, Prima Environmental conducted analysis for total petroleum hydrocarbons-diesel range organics (TPH-DRO) and then initiated the alcohol treatability study. Three alcohol mixtures, including denatured ethanol, t-butanol, n-hexanol, and isopropanol, were added to reactors along with contaminated soil. Following several days of contact time, soil and liquid phases within each reactor were analyzed for TPH-DRO to evaluate the displacement efficiency of the fuel contamination from soil to liquid phase.

Prima Environmental's report indicated that the alcohol mixtures clearly removed more DRO from the contaminated soils than water alone. However, as previously stated, further evaluation of the use of alcohol as a co-solvent was determined not to be feasible for field-scale application.

4.2 SYSTEM SHAKEDOWN

Prior to injection activities, Leidos and MAE2 will conduct a shakedown of the product recovery system to return all components to operating condition.

4.3 INJECTION WELLS

Six new injection wells will be installed at approximately 10-ft spacing surrounding existing monitoring well MW-E5, as shown in Figure 5. Adjustments will be made in the field to avoid placing wells too close to the existing AST, to avoid placing wells within the concrete surrounding the AST, and to remain within the sand underlying and surrounding the AST to the extent possible. Borings will be advanced via hand auger to depths no greater than 10 ft BGS, and screen selection will be determined in the field based upon the thickness of sand encountered in each hole. The new injection wells will be constructed of 1-in., Schedule 40 polyvinyl chloride (PVC) with either a 2- or 5-ft screen set at the sand-clay interface (2-ft screens) or 5 to 10 ft BGS (10-ft screens).

4.4 PRODUCT RECOVERY OPERATIONS

4.4.1 Injection/Extraction Operations

Injection and extraction operations will be similar to those conducted in the first pilot study. Potable water for the injection solution will again be supplied by HAAF through the existing metered fire hydrant located at the site. Injection rates are anticipated to range from approximately 0.5 to 2.0 gallons per minute (gpm) across the six new injection wells. Up to approximately 4,400 gal of solution (6% Biosolve) will be injected in up to two rounds of injections.

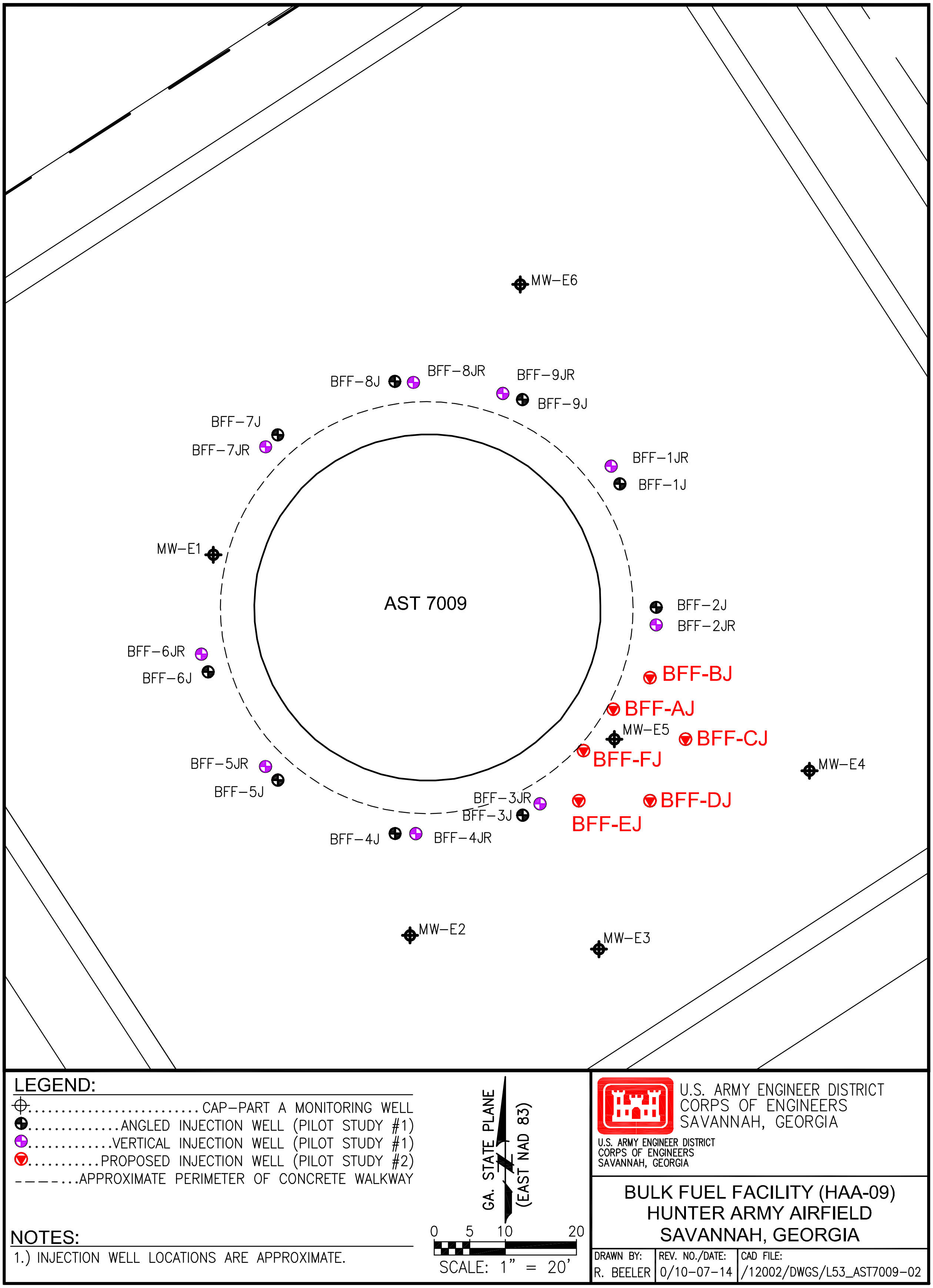


Figure 5. Proposed Injection Wells at AST 7009

Approximately two and a half times the total injected volume, or up to 11,000 gal, will be extracted from the six new injection wells and/or MW-E5. New extraction lines will not be necessary, as the extraction lines installed during the first pilot study remain in place. Extraction rates of approximately 2 to 3 gpm per extraction well will be maintained to prevent migration of the injected fluids from the immediate vicinity yet not dewater the smear zone.

4.4.2 Product Recovery

The product recovery treatment system was fully described in the first pilot study. Primary components of the treatment process are summarized below.

- Extracted material first flows through a liquid/vapor separator; separated vapor is sent to the air stripper vapor discharge, and liquid continues on to the frac tank, where particulates are allowed to settle out before the liquid receives additional treatment.

- Water is pumped from the frac tank to an OWS; the separated oil will be stored for off-site disposal as free-phase product in a 55-gal drum.

- Following the OWS, an air stripper removes VOCs from the liquid stream.

- Next, liquids pass through an ultra-filtration system to remove any remaining surfactant and/or free product. All removed surfactant and free product will be stored for off-site disposal as petroleum-impacted water.

- Finally, the treated water is passed through liquid-phase GAC as a final polishing step and discharged to the HAAF WWTP.

4.4.3 Operation and Maintenance

O&M of the product recovery/injection system will be performed by MAE2 as needed throughout the pilot study.

4.5 SAMPLING AND GAUGING

4.5.1 Initial Effluent Sampling

At system startup, all discharge will be containerized in a 20,000-gal Baker tank and sampled to ensure compliance with HAAF WWTP water acceptance criteria. Once these criteria have been satisfied, the system will discharge directly to the WWTP. Effluent samples will be collected biweekly to ensure continued compliance with the acceptance criteria.

Because the discharge of any generated waste water will be through the HAAF WWTP, there is no need for a modified or new National Pollutant Discharge Elimination System permit. However, the HAAF WWTP must be notified in advance of the anticipated start date and duration of discharges; this notification will be made through Algeana Stevenson, Fort Stewart/HAAF Environmental Coordinator.

4.5.2 Routine Monitoring

Air, groundwater, and effluent samples will be collected during the pilot study. Table 2 lists the frequency of sampling, and Table 3 summarizes the samples to be collected and analyzed.

- Air samples will be collected monthly from the air stripper and analyzed for VOCs to monitor discharge to the atmosphere. Air sampling procedures are included as Appendix A.

- Effluent samples will be collected from the treatment system and analyzed for VOCs, TPH-gasoline-range organics, TPH-DRO, oil and grease, chemical oxidant demand, total dissolved solids, total suspended solids, total iron, hardness, phenols, and pH, initially, prior to any discharge to the HAAF WWTP. Effluent water samples will then be collected biweekly during operation of the system and analyzed for these same parameters to ensure continued compliance with the acceptance criteria of the WWTP.

Table 2. Frequency of Sample Collection During the Second Pilot Study at Bulk Fuel Tank 7009

Frequency	Number of Samples	Analyses	Turn-Around
		Extraction Wells	
Once[a]	2	BTEX	7 days
		Air Stripper	
Monthly	1	VOCs	7 days
		Treatment System Effluent	
Once[b]	1	VOCs, TPH-DRO, TPH-GRO, Oil and Grease, COD, TDS, TSS, Total Iron, Hardness, pH, and phenols	48 hr
Biweekly	1	VOCs, TPH-DRO, TPH-GRO, Oil and Grease, COD, TDS, TSS, Total Iron, Hardness, pH, and phenols	7 days

[a] In last quarter of calendar year 2014.
[b] At system startup.
BTEX = Benzene, toluene, ethylbenzene, and xylenes.
COD = Chemical oxidant demand.
DRO = Diesel-range organics.
GRO = Gasoline-ranges organics.
TDS = Total dissolved solids.
TPH = Total petroleum hydrocarbons.
TSS = Total suspended solids.
VOC = Volatile organic compound.

4.5.3 Groundwater Sampling

Groundwater samples will be collected from MW-E5 and MW-38 for BTEX analysis during the last quarter of calendar year 2014 to meet the biannual sampling requirements of the existing CAP–Part B.

4.5.4 Well Gauging

Following system operation, SCF will gauge the site wells (MW-E1 through MW-E6) for product rebound quarterly for 1 year.

4.5.5 System Decommissioning

System decommissioning will occur following an evaluation of well gauging results. Upon receiving USACE concurrence for decommissioning, the following tasks will be performed by SCF and MAE2:

- Disassemble system piping between the trailer and the injection/extraction wells.
- Disconnect electrical and water lines.

Table 3. Summary of Analytical Samples for the Second Pilot Study at Bulk Fuel Tank 7009

Matrix	Analysis	Analytical Procedure	Number of Field Samples	QC Duplicates	QC Trip Blanks	Total Samples	Holding Time	Preservation Requirements	Sample Containers
Air Samples	VOCs	TO-15	6	0	0	6	14 days	None	SUMMA Canister
Effluent Water Samples	VOCs	SW-846 8260B/5030	13	0	7	20	14 days	HCl to pH <2 Cool, 4°C	Two, 40-mL GSVs
	TPH-GRO	SW-846 8015C	13	0	0	13	14 days	Cool, 4°C	Two, 40-mL GSVs
	TPH-DRO	SW-846 8015C	13	0	0	13	7 days (extraction) 40 days (analysis)	Cool, 4°C	Two, 1-L amber glass bottles with Teflon®-lined lid
	Oil and Grease	EPA 413.2	13	0	0	13	28 days	H_2SO_4 to pH <2 Cool, 4°C	One, 1-L amber glass bottle with Teflon®-lined lid
	COD	EPA 410.4	13	0	0	13	28 days	H_2SO_4 to pH <2 Cool, 4°C	One, 500-mL polybottle
	Phenols	EPA 420.1 or 420.4	13	0	0	13	28 days	H_2SO_4 to pH <2 Cool, 4°C	
	BOD	SM 5210 B	13	0	0	13	24 hr	Cool, 4°C	One, 500-mL polybottle
	TDS and TSS	SM 2540 C	13	0	0	13	7 days	Cool, 4°C	One, 1-L polybottle
	pH	EPA 150.1	13	0	0	13	ASAP	Cool, 4°C	
	Total Iron and Hardness	SW-846 6010C, SM 2340 C	13	0	0	13	180 days	HNO_3 to pH <2	One, 100-mL polybottle
Groundwater Samples	BTEX	SW-846 8260B/5030 and 8260B/5035	2	1	1	4	14 days	HCl to pH <2 Cool, 4°C	Two, 40-mL GSVs

This table is in conformance with Engineering Manual-200-1-3 (USACE 2001).
ASAP = As soon as possible.
BOD = Biological oxidant demand.
BTEX = Benzene, toluene, ethylbenzene, and xylenes.
COD = Chemical oxidant demand.
DRO = Diesel-range organics.
EPA = U. S. Environmental Protection Agency.
GRO = Gasoline-range organics.
GSV = Glass septa vial.
H_2SO_4 = Sulfuric acid.
HCl = Hydrochloric acid.
HNO_3 = Nitric acid.
QC = Quality control.
TDS = Total dissolved solids.
TPH = Total petroleum hydrocarbons.
TSS = Total suspended solids.
VOC = Volatile organic compound.

- Drain and clean the injection/extraction system.
- Properly dispose of filters and liquids.
- Abandon 22 site wells and 600 ft of horizontal PVC pipe.
- Decommission the electrical power supply.

5.0 SAMPLE CHAIN OF CUSTODY/DOCUMENTATION

5.1 FIELD LOGBOOKS

Refer to Attachment 4 of the WP for Preliminary Groundwater and CAP–Part A/Part B Investigations (SAIC 1996).

5.2 SAMPLE NUMBERING SYSTEM

A unique sample numbering scheme will be used to identify each sample designated for laboratory analysis. The purpose of this numbering scheme is to provide a tracking system for the retrieval of analytical and field data on each sample. Sample identification numbers will be used on all sample labels or tags, field data sheets and/or logbooks, chain of custody records, and all other applicable documentation used during the project.

Groundwater samples collected during biannual monitoring will continue to follow the established sample numbering scheme. Samples collected from MW-E5 and MW-38 in the fourth quarter of calendar year 2014 will be identified as BFE5B2 (at MW-E5) and BF38B2 (at MW-38).

Effluent (air and liquid) samples collected for system monitoring will be identified as BFFYYYNN, where

- BFF = Bulk Fuel Facility.
- YYY = sample location; for instance, 602 = product recovery system sample port 602.
- NN = effluent monitoring event within this second pilot study; for instance, 01 = samples collected during the initial monitoring event and 02 = samples collected during this second monitoring event.

This numbering scheme is different than that employed in the first pilot study for ease of field personnel but is designed so that identifiers formerly used will not be duplicated.

5.3 SAMPLE DOCUMENTATION

Refer to Attachment 4 of the WP for Preliminary Groundwater and CAP–Part A/Part B Investigations (SAIC 1996).

5.4 DOCUMENTATION PROCEDURES

Refer to Attachment 4 of the WP for Preliminary Groundwater and CAP–Part A/Part B Investigations (SAIC 1996).

5.5 DATA MANAGEMENT PLAN

Refer to Attachment 2 of the WP for Preliminary Groundwater and CAP–Part A/Part B Investigations (SAIC 1996).

6.0 SAMPLE PACKAGING AND SHIPPING

Refer to Attachment 4 of the WP for Preliminary Groundwater and CAP–Part A/Part B Investigations (SAIC 1996).

7.0 REMEDIATION-DERIVED WASTE

Field personnel will adhere to the procedures outlined in the existing UST investigation WPs (and all addendums) for the disposal and handling of RDW resulting from the pilot study. While awaiting results from chemical testing, all RDW shall be stored in properly labeled poly tanks or drums located in a nearby area designated by USACE or Fort Stewart. All RDW not able to be disposed of at the HAAF WWTP shall be disposed off-site at a permitted facility (either non-hazardous or hazardous, as warranted). Leidos will complete all manifests for waste disposal and will provide 72-hr notice to Fort Stewart prior to removing waste from the site. A Fort Stewart representative must sign each manifest.

8.0 CONTRACTOR CHEMICAL QUALITY CONTROL PROGRAM

Refer to Chapter 5.0 of the WP for Preliminary Groundwater and CAP–Part A/Part B Investigations (SAIC 1996).

9.0 CORRECTIVE ACTIONS

Refer to Chapter 6.0 of the WP for Preliminary Groundwater and CAP–Part A/Part B Investigations (SAIC 1996).

10.0 PLANS AND REPORTS

In addition to this WP Addendum #29, Leidos will prepare a UIC permit application on behalf of the Army and complete a Site Safety and Health Plan/Accident Prevention Plan Addendum to cover activities associated with the second pilot study.

Two progress reports (draft and final) will be prepared: (1) one following the pilot study period of 6 months of operation documenting the operation of the system for that 6-month period, and (2) a second following the fourth quarterly monitoring report.

Letter reports will be prepared following each biweekly monitoring event to provide stakeholders with the results of effluent sampling.

11.0 REFERENCES

Guentert, James S. 2011. Letter to Thomas C. Fry (Fort Stewart Directorate of Public Works Environmental Branch) regarding approval of the Corrective Action Plan–Part B Addendum for AST 7009, Bulk Fuel Facility (HAA-09), May 2.

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SAIC (Science Applications International Corporation) 1996. *Work Plan for Preliminary Groundwater and Corrective Action Plan–Part A/Part B Investigations at Former Underground Storage Tank Sites, Fort Stewart, Georgia*, Oak Ridge, TN.

SAIC 1998. *Sampling and Analysis Plan for Corrective Action Plan–Part A and B Investigations for Former Underground Storage Tanks at Hunter Army Airfield, Georgia*, Oak Ridge, TN.

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SAIC 2003. *First Annual Monitoring Only Report for Former Underground Storage Tank 117, Building 7002, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*1, Hunter Army Airfield, Georgia,* July.

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SAIC 2006. *Completion Report for Former Underground Storage Tank 117, Building 7002, Release #1, Bulk Fuel Facility (HAA-09), Facility ID #9-025113*1, Hunter Army Airfield, Georgia*, July.

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SAIC 2009. *2008 Free Product Removal Report for the Bulk Fuel Facility (HAA-09), Building 7009, Hunter Army Airfield, Georgia*, May.

SAIC 2010. *2009 Free Product Removal Report for the Bulk Fuel Facility (HAA-09), Building 7009, Hunter Army Airfield, Georgia,* May.

SAIC 2011a. *Corrective Action Plan–Part B Addendum #1, Bulk Fuel Facility (HAA-09), Building 7009, Hunter Army Airfield, Georgia, Facility ID #9-025113*2*, April.

SAIC 2011b. *Addendum #28 to the Work Plan for Preliminary Groundwater and Corrective Action Plan–Part A/Part B Investigations at Former Underground Storage Tank Sites, Hunter Army Airfield and Fort Stewart, Georgia*, May.

SAIC 2012a. *Pilot Study Interim Progress Report for Corrective Actions at Bulk Fuel Facility (HA-009), Former UST 117, AST 7009, Hunter Army Airfield, Georgia, Facility ID #9-025113*2*, Final, January.

SAIC 2012b. *Pilot Study Interim Progress Report #2 for Corrective Actions at Bulk Fuel Facility (HA-009), Former UST 117, AST 7009, Hunter Army Airfield, Georgia, Facility ID #9-025113*2*, Final, September.

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USACE (U. S. Army Corps of Engineers) 2001. *Requirements for the Preparation of Sampling and Analysis Plans,* Engineering Manual 200-1-3, February.

USACE 2013. *Statement of Work for the Product Recovery System Pilot Study, Bulk Fuel Facility (HAA-09), Former UST 117, Building 7009, Hunter Army Airfield, Georgia, Facility ID # 9-025113*2*, August.

APPENDIX A AIR SAMPLING PROCEDURE

CHEMTECH GUIDE TO AIR SAMPLING WITH CANISTERS

Chemtech will supply you with vacuum canisters and flow controllers for your field sampling. Samples can be taken as grab (over a short time period of 1 – 5 minutes) or as integrated (over a longer time period of 30 minutes – 24 hours), depending on your project needs.

For either type of sampling, the canister vacuum should be checked prior to initiating collection. Canisters are checked before shipping, but it is important to confirm that the vacuum is correct to collect sufficient sample volume. If the vacuum of the canister is less than 25 inches Hg, please contact your project manager for a replacement.

1. Confirm that the valve is closed (knob is completely tightened in the clockwise direction).
2. Remove the canister cap and attach the gauge.
3. Attach a brass cap over the tee fitting if necessary, to close the sampling train.
4. Open and close the valve quickly.
5. Read the vacuum on the gauge.
6. Record this "Initial Vacuum" reading on the proper column on the sampling report or chain of custody.

For Grab Sampling:

1. Confirm that the canister valve is closed (knob is completely tightened in the clockwise direction).
2. Remove the brass cap from the sampling tee.
3. Attach the particulate filter.
4. Open the valve a half turn and leave open the appropriate time for the canister size
    a. 1L canisters require 3 – 30 seconds for sampling, depending on the particulate filter.
    b. 6L canisters require 16 seconds to 3 minutes, depending on the particulate filter.
5. Close the valve tightly. Some residual vacuum may be left in the canister.
6. Record the "Final Vacuum" reading on the gauge on the sampling report or chain of custody.
7. Replace the brass cap.

For Integrated Sampling:

1. Chemtech will supply flow controllers for the specific time period required by your sampling plan.
2. Ensure that all connections in the sampling train are secure and there are no leaks.
    a. After attaching the flow controller to the canister, place a brass cap at the end of the flow controller.
    b. Quickly open and close the valve.
    c. If the needle on the gauge drops, there is a leak in the train. Refit and tighten your connections and check again.
3. Once the sampling train is verified to be airtight, remove the brass cap.
4. Open the canister valve a half turn.
5. Monitor the sampling periodically to ensure the canister is not filling too quickly.
    a. If the canister appears to be filling too slowly, a valid sample may still be collected.

6. When the sampling time period is over, close the canister valve tightly.
7. Read and record the final canister vacuum on the sampling report or chain of custody.

Important notes for all sampling:

1. Do not use canisters to sample known explosive, radiological or biologically hazardous substances or corrosives.
2. Always use a particulate filter.
3. Do not allow liquid to be pulled into the canister.
4. Do not over-tighten valves.