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Letter of Transmittal

Attention:	Mr. Addie Walker - SCDHEC	Date:	8-20-15
Project reference:	Shakespeare – Newberry	Project number:	60328308

We are sending you the following:

Number of originals:	Number of copies:	Description:
	2	Revised SIWP Addendum

Hi Addie –

Please find attached one hard copy and one electronic copy of the updated version of the SIWP Addendum. This version includes the most recent revisions requested in your July 30, 2015 letter to Philips.

Should you have any questions or need anything else with respect to the attached, please let me know at your convenience.

Sincerely,

Scott E. Ross

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AUG 20 2015
SC Department of Health and Environmental Control

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SITE ASSESSMENT, REMEDIATION & REVITALIZATION

59

AECOM Technical Services, Inc.

Submitted by:
AECOM
Columbia, S.C
July 2015

Site Investigation Work Plan Addendum
Shakespeare Composite Structures, LLC

Voluntary Cleanup Contract 14-6271-RP

File # 51025

19845 US Highway 76

Newberry, SC

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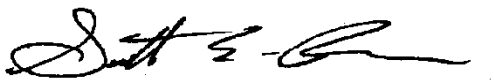
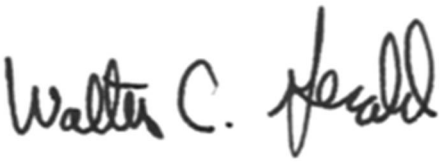


Prepared By: Scott E. Ross, P.G.
Project Manager



Reviewed by: Walter Gerald, P.G
Sr. Program Manager

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List of Acronyms

BLS	below land surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cis-1,2 DCE	cis-1,2 - Dichloroethene
CVOCs	chlorinated volatile organic compounds
DI	deionized
DO	dissolved oxygen
DOT	Department of Transportation
EPA	United States Environmental Protection Agency
FBQSTP	Field Branches Quality System and Technical Procedures
HASP	Health and Safety Plan
HSA	hollow stem auger
IDW	investigation derived waste
MCL	maximum contaminant level
NGVD	National Geodetic Vertical Datum
NTu	Nephlometric Turbidity Units
µg/L	micrograms per liter
mg/L	milligrams per liter
ORP	oxidation-reduction potential
PCE	tetrachloroethene
PPE	personal protective equipment
QC	quality control
RECs	recognized environmental conditions
RI	remedial investigation

RSL	Regional Screening Level
SC	Specific Conductance
SESD	EPA Region IV Science and Ecosystems Support Division
SOPs	Standard Operating Procedures
SU	Standard Unit
TCE	Trichloroethene
TCL	Target Compound List
USCS	Unified Soil Classification System
VCC	voluntary cleanup contract
VOCs	volatile organic compounds

1.0 INTRODUCTION

The Shakespeare Composite Structures, LLC (Shakespeare) facility has been designing and producing fiberglass products at their manufacturing facility located in Newberry, South Carolina (the facility) since the mid-1960s. In December 2013, Shakespeare retained AECOM Technical Services, Inc. (AECOM) to perform a Phase I Environmental Site Assessment (Phase I ESA) at their facility. The Phase I ESA was followed by a Phase II ESA, which investigated several potential environmental impacts identified at the facility during the Phase I ESA. The Phase II ESA and subsequent phases of investigative efforts have identified concentrations of chlorinated volatile organic compounds (CVOCs) in soil and groundwater beneath the facility. As a result of the investigation findings to date, Shakespeare has requested AECOM assist with further evaluating groundwater conditions beneath the facility. This document serves as the Site Investigation Work Plan Addendum (Work Plan). The Work Plan outlines the rationale for performing additional investigative efforts and the technical approaches that will be used to collect additional data from the Site.

1.1 Physical Setting

The Shakespeare facility is located on US Highway 76, approximately 1 mile northwest of the City of Newberry (**Figure 1-1**). The Shakespeare facility occupies 24.24-acres. The property includes the main production building and the pole winder building, totaling approximately 250,000 square-feet under roof. The property also has several smaller structures located at the west end of the property including a less than 90-day hazardous waste storage building, a residual resin curing building, along with other smaller storage buildings.

An asphaltic employee parking lot is located to the southwest of the main building, which is accessed from U.S. Highway 76 to the southwest of the subject property. The south end of the property contains another asphalt-paved area, which is the former employee overflow parking area where equipment and other materials currently are staged. There is a covered shed area at the southeast end of the property where finished products are packaged for shipment. The area between the two buildings in the center of the property is mostly grassed and is used for equipment or material storage, and some grassed areas are present at the west and northwest sides of the property. Loading docks are located on the northwest and southeast corners of each building and are accessed via concrete-paved or asphalt-paved driveways from U.S. Highway 76. The northwest, northeast, and southeast perimeters of the subject property are fenced, and locking gates are present at the two driveways beyond the employee parking lot (**Figure 1-2**).

General land use surrounding the facility consists of agricultural, residential, undeveloped and commercial/light industrial properties. Uses of adjacent properties identified during the site visit are as follows:

North: The facility is bordered immediately to the north by a rail line and undeveloped land planted with pine trees. The property bounding the facility to the north is owned by J.L. Dickert.

East: The facility is bordered immediately to the east by a residential parcel, beyond which is vacant land (pine trees) and vacant buildings formerly occupied by the Dickert Lumber company. The property east of the private residence up to Lumber road is also owned by J.L. Dickert.

South: The facility is bordered to the south by U.S. Highway 76 and properties owned by the Newberry County Airport and Walter Shealy. The property owned by Mr. Shealy is primarily farmland with a few small residences located sporadically across more than 60 acres.

West: There three properties located immediately to the west of the facility. The property the bounds the facility is owned by Harriet Boazman. The properties to the west of the Boazman property are owned by Edna Ringer and Kimberly Chapman, respectively.

The Shakespeare site (the Site) includes the Shakespeare facility along with several of the properties referenced above, that lie to the south, west and north where investigative efforts have been performed to date.

1.2 Site Operational Background

According to information reviewed in previous documents and confirmed with Shakespeare personnel, the subject property was undeveloped, wooded land until purchased from Ruth Amis in 1965. The main building was constructed in the mid-1960s and used for fiberglass production; that building is constructed of concrete block covered with brick on three sides; the floor a concrete slab-on-grade foundation, with several observed subgrade sumps or vaults. The pole winder building reportedly was constructed in the late 1970s; it is a concrete block building with sheet metal siding on parts of the building, with a concrete slab on grade floor. Both buildings are one story although there are some elevated second floor offices in the main building, and the former “tower” area extends upward about two floors. Each building has several small, added-on portions, primarily consisting of the three LRB areas for wastewater treatment (fiberglass separation).

The facility is used for the design and manufacture of large fiberglass utility poles and cross arms, and other fiberglass outdoor products such as signs and sign posts. The manufacturing processes include the following categories: materials receiving, formulation of resin mixes, pultrusion of fiberglass products, extrusion of plastic products, winding of fiberglass poles, painting and heat curing of poles, testing of materials, warehouse/storage of finished goods, and packaging/shipping. Fiberglass rolls are wrapped around molds, and then a resin mix is applied as a coating. Sanding and grinding of poles occurs, and painting, drying, and heat curing are also performed. Manufacturing is conducted inside two separate buildings. The main building houses pultrusion and extrusion activities, and large and small poles are fabricated in the pole winder building. Manufactured materials are packaged indoors and outdoors for shipment (AECOM, 2013).

1.3 Summary of Previous Investigative Efforts

As mentioned above, Shakespeare retained AECOM to assist with multiple ESAs to determine if the facility had any environmental issues or concerns. The ESAs were followed by multiple phases of more in depth subsurface investigation both at the facility and on properties adjacent to the facility. The activities completed during each phase of work are briefly summarized in this section.

1.3.1 Phase I ESA

In December 2013, AECOM performed a Phase I ESA at the Newberry facility. In accordance with American Society of Testing and Materials (ASTM) standards the Phase I ESA included review of

historical records for the facility, inspection of the property, and the identification of 11 areas which were determined to be known as recognized environmental conditions (RECs). Based on the identification of these RECs, Shakespeare requested that a follow-up Phase II ESA be performed at the facility (AECOM, 2013).

1.3.2 Phase II ESA

In January 2014, AECOM initiated the Phase II ESA at the facility. The Phase II included investigation of groundwater, soil, sediment, and surface water at various locations across the facility. In total 11 RECs were investigated. A brief list of the Phase II ESA activities is as follows:

- Installation and sampling of eight shallow temporary monitoring wells (TMW-1 through TMW-8)
- Collection and analysis of four surface soil samples;
- Collection and analysis of 15 subsurface soil samples;
- Collection of a sediment sample from a storm water drain in the eastern portion of the property (REC-7a); and
- Collection of a sediment and surface water sample from the storm water outfall located on the northwestern side of the property (REC-7b).

Samples of these media were analyzed for a variety of parameters. Analytical results from the Phase II indicated that the CVOC trichloroethene (TCE), and degradation compounds cis-1,2 Dichloroethene (Cis-1,2 DCE) and vinyl chloride (VC) are present above their respective drinking water standards (maximum contaminant levels – MCL) in groundwater beneath the facility. As a result of the detection of these CVOCs, Shakespeare requested that AECOM initiate a more thorough investigation of the facility. Results of the Phase II ESA are discussed in more detail in the Site Investigation Summary (AECOM, 2014a).

1.3.3 Site Investigation

In March 2014, AECOM developed the Site Investigation Work Plan (SIWP) (AECOM, 2014b). The SIWP outlined the rationale for performing additional investigative efforts at the Site and referenced technical approaches and methodologies to be used to collect additional data from the Site based on the results of the Phase II ESA. The SIWP included plans for additional soil and groundwater sampling. The SIWP was originally intended for submittal to Shakespeare only, however, it was prepared assuming it may be submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) for review at a later date. Therefore, the SIWP was developed assuming the Site would eventually be evaluated utilizing procedures consistent with the National Contingency Plan (NCP) which are part of the USEPA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The SIWP included references to the USEPA Region 4 Standard Operating Procedures and guidance.

The original SIWP was implemented in April 2014. This sub-phase of work included the following efforts:

- Installation and sampling of 10 shallow temporary monitoring wells (TMW-9 through TMW-18) attempting to delineate the horizontal extent of groundwater impacts on the facility property.

- Installation of nine permanent monitoring wells (MW-1 through MW-9). Each of these wells was installed as replacements for temporary wells.

- Collection of additional subsurface soil samples from Phase II ESA boring locations B-12, B-13, and B-16. The intent of this phase of soil sampling was to focus on possible source areas based on their historical use and results from the initial Phase II ESA sampling efforts in these areas. Field personnel utilized the AQR Color-Tec® field screening tool to determine which subsurface samples from each boring would be submitted for chemical analysis.

Results of this phase of the site investigation indicated CVOC impacted groundwater may be migrating off-site and subsurface soils beneath portions of the facility contain low concentrations of CVOCs. Results of the Phase II ESA and soil and groundwater investigation efforts performed as part of this early phase of the Site Investigation are included in the Site Investigation Summary (AECOM, 2014a).

Following review of the first phase of SI results, AECOM and Shakespeare implemented a subsequent soil and groundwater sampling phase of work attempting to identify likely source areas for the CVOCs beneath the Site. This source investigation phase of work was initiated in May 2014 and included the following:

- Advancement of 28 soil borings at locations within and adjacent to the main production building and the pole winder building at the facility. The soil borings allowed collection of continuous subsurface soil cores from land surface to approximately 25 feet or drilling refusal. Soil samples were collected at one to two foot intervals screened using a photoionization detector (PID) and evaluated using the AQR Color-Tec® field screening tool to determine which soil samples from each boring would be submitted for chemical analysis.

- Installation of 15 shallow temporary monitoring wells to further delineate potential source areas and boundaries for CVOC impacts in groundwater.

- Collection of groundwater samples from four existing permanent monitoring wells for geochemical and biological analyses to determine attenuation conditions beneath the Site.

- Collection of samples from seven private water supply wells located on properties adjacent to the facility.

This phase of investigative work detected CVOCs in soils beneath the Main Building and Pole Winder building. These results coupled with anecdotal information from facility personnel regarding historic use of solvents indicated a primary source area for CVOCs underlies the western portion of the Main Building with other, smaller source areas under the east central portion of the Main Building and under the western portion of the Pole Winder building. Although the CVOCs are present in subsurface soils, the majority of the concentrations do not exceed screening values and therefore no additional investigative efforts have been proposed for soils at the site.

Groundwater results generated during this phase of the investigation confirmed that CVOC impacted groundwater has migrated to the north and west of the Site. In addition, two private water wells located to the west and southwest of the Site were found to contain elevated CVOC concentrations. As a result,

Shakespeare installed organic compound filter systems on these wells within days of the discovery of the presence of CVOCs. The results of this phase of work led to an even more elaborate groundwater investigation both on and off-site. Results of the Phase II ESA and soil and groundwater investigation efforts performed as part of the early phase of the Site Investigation are included in the Site Investigation Summary (AECOM, 2014a).

1.3.4 Expanded Investigation

Following a brief meeting with SCDHEC representatives in June 2014 to present results of the Phase II and Site Investigation efforts. Shakespeare submitted a brief work plan to SCDHEC presenting a scope of work for additional groundwater investigative activities and requesting a permit to perform these proposed efforts. This investigation effort was implemented in mid-July 2014 and completed in late August 2014. The additional phase of work (Expanded Investigation) included a more elaborate investigation of groundwater quality in multiple depth zones at locations on- and off-site the AQR Color-Tec® field screening tool in an attempt to delineate the extent of CVOCs in groundwater. Color-Tec® field screening results were used to guide the sampling efforts both vertically and horizontally. More specifically this investigation included the following:

- Collection of shallow and intermediate depth groundwater samples from 12 locations (TMW-34 through TMW-41, TMW-101 through TMW-107) on private properties to the south and west of the Shakespeare facility;
- Collection of shallow and intermediate depth groundwater samples from 57 locations (TMW-42 through TMW-99) on property that bounds the northern side of the Shakespeare facility;
- Collection of groundwater samples from intermediate depth intervals at seven locations (TMW-44, TMW-45, TMW-46, TMW-47, TMW-48, TMW-49, TMW-50, TMW-51, TMW-100, and TMW-106) beneath the Shakespeare property;
- Installation and sampling of four deep bedrock wells on the Shakespeare property (MW-2D, MW-3D, MW-6D, MW-7D);
- Installation and sampling of three deep bedrock wells on private properties to the south and west of the Shakespeare facility (RDW-1, RDW-2, and SDW-1); and
- Collection of three surface water samples (SW-1, SW-2, SW-3) from a small creek that bounds the northern end of the groundwater sampling grid on the property that bounds the northern side of the Shakespeare facility (Dickert Property).

Results of the initial portion of the Expanded Investigation have determined that CVOC impacted groundwater in the shallow zone has migrated several hundred yards to the north of the Shakespeare facility and to a lesser extent to the west of the facility. The investigation also determined that the competent surface of the underlying granite bedrock is deeper than originally anticipated. It has also become apparent that zones of partially weathered bedrock exist at relatively shallow depths across the Site and they may have an effect on the migration of shallow CVOC impacted groundwater. The investigation has also indicated that CVOC impacted groundwater is also migrating into the uppermost fracture zones in the granite bedrock underlying the Shakespeare facility and to the southwest.

Results of the Expanded Investigation efforts are discussed in more detail in the Summary of Investigative Efforts report (AECOM, 2014c).

1.4 Additional Site Investigation Objectives

As a result of the investigative efforts performed to date, Shakespeare entered into a responsible party - voluntary cleanup contract (RP-VCC) with the SCDHEC in September 2014. SCDHEC has reviewed the results of the investigative efforts performed to date and has requested Shakespeare submit a plan to complete the delineation of the vertical and horizontal extent of CVOC impacts to groundwater both on and off-site and to evaluate the potential risks these compounds pose to human health and the environment. The investigation and risk evaluation information will be used to determine if a remedy for the CVOC impacted groundwater is necessary.

This work plan addendum is intended to present the scope of the investigative efforts and the procedures to be used during the investigation. Based on the information collected to date from the Site, the objectives of the Site Investigation are as follows:

- Verify the horizontal extent of CVOCs off-site with the installation of permanent monitoring wells;
- Conduct further evaluation of groundwater quality in the intermediate zone on and off-site to determine the distribution of elevated CVOC concentrations at greater depths above bedrock;
- Delineate the vertical extent of impact in bedrock;
- Sampling of isolated bedrock fracture zones to determine possible routes of preferential migration;
- Implementation of a groundwater sampling program using the permanent monitoring well network to be established at the Site; and
- Provide data to be used in evaluation of the potential risks the CVOCs may pose to possible human and or ecological receptors.

The following sections of this SI Work Plan Addendum review the rationale for the investigation and describe, in detail, the sampling methods to be used during field activities.

2.0 RATIONALE FOR SITE INVESTIGATION

Previous rounds of investigation have included the collection of soil and groundwater samples from numerous locations across the Site and off-site. The results of the previous investigative efforts have indicated the presence of CVOCs TCE, cis-1,2 DCE and VC in groundwater above their respective drinking water standards in multiple groundwater samples from beneath the Site as well as locations on private property to the north and west of the Site. In accordance with the RP-VCC, Shakespeare has developed this plan presenting investigative efforts to be used to determine the extent of impact to environmental media at the Site. This section discusses the rationale and objectives for the implementation of the SI Work Plan Addendum.

2.1 Soil

During the Phase II ESA and initial phase of the (SI) numerous surface and subsurface soil samples were collected from beneath the Shakespeare facility. The results of the soil investigation efforts identified areas of limited impact and possible source areas for CVOCs in soil. Based on the results of the previous investigations, Shakespeare is not proposing additional soil investigation efforts in this work plan.

2.2 Groundwater

Investigative efforts to date have determined that elevated concentrations of CVOCs extend from beneath the facility to the north and west, in groundwater at multiple depths. The intent of the additional groundwater investigative efforts presented in this work plan is to fill data gaps for the shallow zone to the southwest of the Site, in the intermediate zone beneath facility, and in bedrock beneath the Site. This will be accomplished using a variety of methods including the installation and sampling of temporary wells, permanent well installation, and vertical profiling of groundwater quality.

2.2.1 Shallow Zone

As shown in **Figure 2-1**, the lateral extent of impacts to shallow groundwater has been delineated in all directions except to the south-southwest, near TMW107. As part of the next round of investigative work, Shakespeare will collect shallow groundwater samples from at least three locations surrounding TMW107 to determine the extent of impact to the shallow zone in this area. The Color-Tec® field screening methodology will be used to screen samples from these additional propose locations. Should field screening indicate the presence of CVOCs, additional borings will be advanced at locations in various directions to allow collection of additional samples for field screening. Results for samples collected from additional locations in this area will help determine where permanent wells will be installed on the Shealy property.

The extent of impact to the shallow zone in other directions off-site has primarily been delineated; therefore this investigative phase of work will include the installation of 14 shallow permanent monitoring wells at select off-site locations. **Figure 2-1** shows the extent of TCE in shallow zone groundwater and the proposed locations of permanent monitoring wells to be installed as part of this effort.

The locations of and rationale for the proposed shallow permanent wells is briefly discussed below:

- Based on the variations of concentrations and widespread distribution of CVOCs in groundwater, Shakespeare is proposing to install nine (9) shallow permanent wells on property to the north (Dickert Property) of the facility. This includes wells at the location with the highest TCE concentration detected at the Site to date (1600 ug/L at TMW-42) and at locations bounding the edges of the CVOC plume.
- Two (2) shallow wells are proposed for the Boazman property located west of the facility. One will be installed in the vicinity of the water well and one will also be installed between the former locations of TMWs 40 and 41.
- One (1) well is proposed for the Chapman property, as a downgradient monitoring point.
- One (1) shallow well on the south side of the main building on the plant site.
- Two (2) wells are proposed for the Shealy property, southwest of the facility, across US Highway 76, also as downgradient monitoring points.

Table 2-1 lists the proposed shallow wells to be installed during this effort.

2.2.2 Intermediate Zone

The previous phases of investigation have determined that multiple zones of groundwater beneath the area, including the upper section of granite bedrock, have been impacted by CVOCs. During the previous phase of work, AECOM utilized direct push drilling technology (DPT), field screening, and confirmatory analysis in a vertical profiling process to determine the impact to groundwater between the shallow zone (water table) and the underlying bedrock. However due to difficult drilling conditions and varying depths to zones of partially weathered bedrock beneath the area, the distribution of CVOCs within the intermediate depth interval beneath the Site has not been fully determined. Therefore, as part of this additional investigation efforts Shakespeare will be using roto-sonic drilling technology and push point sampling to allow further delineation of impact to groundwater quality in the intermediate aquifer zone. The intermediate zone sampling is proposed for nine locations, as shown on **Figure 2-2**.

The depths at which the intermediate samples will be collected will depend on the location of the borings. Some of the proposed locations are at points where previous attempts were made to perform the vertical profiling of groundwater quality including several former sample points on the facility property (TMW-42, TMW-44, TMW-45, TMW-47, and TMW-48). DPT drilling during the previous phase of work was halted at many of these locations by bedrock zones encountered at varying depths. The anticipated depths at which the profiling will be initiated at a particular location are presented in **Table 2-2**.

This vertical profiling effort will include on-site analysis of groundwater samples using the Color-Tec® screening methodology. Results of the vertical profiling field screening will be used to determine the location for and depth at which intermediate zone monitoring wells will be installed. For the purposes of

this work plan, it is assumed that up to ten (10) intermediate zone wells will be installed as a result of this field screening effort.

Each of the permanent shallow and intermediate zone wells to be installed during this investigation will be constructed in accordance with SC Well Standards and Regulations (SC.R16-71). This will include installation of a two inch diameter Sch-40 PVC well screen; sand filter pack material, bentonite seal, cement grout and completion of each well at land surface with a concrete pad and 8 inch diameter bolt down steel cover. Well boring advancement and well installation procedures to be used during this investigation are discussed in Section 3.2.2.

Each well and boring location will also be surveyed for elevation and location by a SC Registered Land Surveyor.

2.2.3 Bedrock Groundwater Investigation

The bedrock well installation program completed in August 2014 determined the horizontal extent of CVOCs in several directions. However, SCDHEC has requested that additional bedrock wells be installed to more fully delineate the horizontal extent of CVOCs. As a result, two additional bedrock wells will be installed at locations requested by the SCDHEC, northeast of the former Shakespeare facility on private property and to the west of the Shakespeare facility on private property.

Results of the bedrock well installation program also indicated that at a minimum, the groundwater in the uppermost fracture zone in the underlying granite bedrock is impacted by elevated CVOC concentrations (**Figure 2-3**). It is currently unknown how many fracture zones are impacted by CVOCs. Shakespeare will perform vertical profiling in the bedrock by advancing an additional bedrock boring at the west end of the Shakespeare property, to allow testing of deeper fracture zones for the presence of CVOCs. The actual location of this bedrock well will be determined by AECOM, Shakespeare, and SCDHEC, The intent of this effort is to determine if CVOC impacted groundwater is isolated to the more shallow fracture zones or if it is migrating through fracture zones at multiple depths and to determine the vertical extent of CVOC impact in the bedrock in this area. Once its maximum depth is reached the bedrock boring will be converted to a monitoring well, with the well screen installed across a fracture zone that is found to not contain CVOCs during the field screening.

2.2.4 Well Development

Each of the permanent wells to be installed during this investigation will be developed in accordance with procedures to be referenced in Section 3.2.3. This will entail surging and over-pumping of each well to remove suspended silts and clays from the well by conditioning the surrounding sand filter pack. Water quality parameters including pH, specific conductivity (SC), temperature (Temp) and turbidity (Turb) will be monitored and recorded during the development process. All well development water will be containerized, handled and staged in accordance with procedures referenced in Section 3.2.7 below.

2.2.5 Groundwater Sampling

Each of the 19 existing groundwater monitoring wells and the 32 additional wells to be installed during this phase of work will be sampled as part of a site-wide sampling effort. Groundwater samples collected from each well will be analyzed for Target Compound List Volatile Organic Compounds (TCL VOCs). The wells to be sampled as part of this synoptic event will include the following:

- Nine (9) shallow wells located outside of the facility buildings (MW-1 through MW-9);
- Ten (10) shallow wells located within the Shakespeare facility buildings (TMW-21, TMW-22, TMW-23, TMW-24, TMW-25, TMW-29, TMW-30, TMW-31, TMW-32, and TMW-33);
- Six (6) previously installed bedrock wells (MW2D, MW3D, MW6D, MW7D, RDW1 and RDW2);
- Fifteen (15) newly proposed shallow wells;
- Nine (9) proposed intermediate wells; and
- Three proposed additional bedrock wells.

Table 2-3 lists the wells to be sampled during this phase of work and the proposed analytical parameters for each well. Temporary monitoring wells and permanent wells will be purged and sampled in accordance with protocols referenced in section 3.2.4 below.

2.2.6 Water Well Sampling

In addition to the monitoring well network, groundwater samples will also be collected from a select number of water wells located to the west of the Site. The wells to be sampled include the Boazman Well, five wells located on the Shealy Property (PW-1, PW-2, PW-3, PW-5, and an unused well located to the north of PW-2), and the Chapman well (PW-4). **Table 2-3** also lists the water wells to be sampled during this phase of work.

Water wells will be purged and sampled in accordance with protocols referenced in section 3.2.4 below.

2.3 Surface Water

Based on field observations during previous phases of work at the Site, it appears that shallow groundwater may discharge to shallow creeks that bound the northern and western portions of the Site (**Figure 2-4**). During the recently completed expanded investigation phase of work, three surface water samples (SW-1 though SW-3) were collected from a shallow creek that bounds the northern portion of the Site on the Dickert property. A trace amount of CVOC daughter compound Cis-1,2 DCE was detected in one sample (SW-1) at 0.51 ug/L.

As part of this investigative effort, Shakespeare will collect additional surface water samples from three locations on the Dickert property and from approximately four locations on the creek that bounds the western portion of the Site, on the Shealy Property (**Table 2-4**). The proposed sample locations are depicted on **Figure 2-4**. Procedures to be used for surface water sample collection are discussed in Section 3.2.5.

2.4 Sample Analysis

Based on the analytical results for previous investigative efforts all groundwater samples collected during this investigation will be analyzed for the Target Compound List (TCL) of volatile organic compounds (TCL VOCs) using EPA SW-846 analytical method 8260c. The full TCL VOC analysis is a typical suite of parameters that would be required when following Remedial Investigation (RI)

procedures in accordance with USEPA and SCDHEC VCC guidance. In addition, at the request of the SCDHEC, groundwater samples collected from one upgradient well (MW-1) and one downgradient well (MW-7) will also be analyzed for Target Analyte List Metals (TAL Metals). MW-1 was chosen for TAL Metals analysis as it is a background well. MW-7 was selected for TAL Metals analysis because it is within the area of shallow zone TCE impacts. However the CVOC concentrations and water quality conditions are not at levels that are believed to readily promote dissolution of metals. As indicated above, **Tables 2-3** and **2-4** list the samples to be collected during this investigation and the parameters for which samples will be analyzed during this round of investigation.

3.0 FIELD ACTIVITIES

This section of the SI Work Plan Addendum discusses the methods to be used when performing the investigative efforts. Procedures detailed in the USEPA Region 4 Science and Ecosystem Support Division (SESD) Field Branches Quality System and Technical Procedures (FBQSTP) will be used during the execution of the investigative efforts. Where the SESD Technical documents do not specify procedures for activities described in this work plan, AECOM Standard Operating Procedures (SOPs) or other appropriate procedures are referenced. Copies of the referenced procedures are included in Appendix A.

A site-specific Health and Safety Plan (HASP) has also been prepared by AECOM for this project. The HASP is being submitted under separate cover.

3.1 Field Investigation Preparation Activities

Preparation for field work will include: resolution of Site access issues; selection and procurement of qualified subcontractors for analytical and field work; procurement of necessary field and sampling equipment; establishment of a field headquarters; designation of an IDW storage area; and designation and construction of a temporary equipment decontamination area.

3.1.1 Resolution of Access Issues and Permits

Prior to the commencement of field activities, written permission for access to all properties where sampling will be performed will be obtained. Additionally, the accessibility of all proposed sampling locations will be confirmed (i.e., potential obstacles to drilling such as underground water, sewer, gas, electric and telephone lines or above-ground cables, buildings or other above-ground structures will be identified). Should the relocation of any sampling locations be deemed necessary, minor adjustments in sampling locations of 50 feet or less will be considered to be in conformance with the Work Plan and will not require client approval. Significant changes in sampling locations of greater than 50 feet will be proposed for the client's approval during the sampling activities. Sampling relocations, regardless of their magnitude, will be documented in the field log including the reason for the change and summarized in the Source Investigation report.

In accordance with the South Carolina Well Standards [R.61-71(H)(1)(a)], a permit for well installation is required prior to initiation of drilling activities. AECOM will acquire the well permit on behalf of Shakespeare as part of this effort. Submittal of this Work Plan will serve as the written request for the permit to perform the drilling activities referenced herein.

3.1.2 Selection of Qualified Subcontractors

Qualified subcontracting firms will be procured prior to implementation of the field program. The criteria to be utilized for subcontractor selection are presented in the following sections.

3.1.2.1 Drilling Subcontractor

The well installation program will require procurement of a SC well drilling contractor. The drilling firm will be required to meet the following criteria:

- Proven experience on a variety of hazardous waste sites;
- Proven technical capabilities;
- Suitably experienced staff;
- Adequate drilling equipment and supplies;
- State of South Carolina Registration for boring advancement and monitoring well installation;
- Employee health and safety training certification in accordance with the provisions of OSHA 29 CFR 1910, SARA Section 126(d), and AECOM contractor health and safety criteria, and
- Appropriate contractor and worker liability insurance.

Selection of a drilling subcontractor and all appropriate contractual agreements will be finalized prior to initiation of the field program.

3.1.2.2 Land Surveying Subcontractor

The new monitoring wells will be appropriately located and their elevations determined with respect to the most recent geodetic datum using a licensed surveyor. AECOM will utilize an in-house South Carolina Professional Land Surveyor, based in South Carolina to perform the survey effort.

3.1.2.3 Laboratory Subcontractor

AECOM will contract a SCDHEC-certified laboratory to perform the sample analysis required for this project. The laboratory will be National Environmental Laboratory Accreditation Conference (NELAC) certification and will also be certified by the SCDHEC. Shealy Environmental Services, Inc. (Shealy) based in West Columbia, South Carolina has been selected to perform chemical analyses.

3.2 Site Investigation Procedures

As discussed in Section 2, the Site Investigation will consist of an additional phase of groundwater investigation as well as a limited investigation of surface water quality. This section of the Work Plan details the procedures that will be used to investigate both media along with quality and other project related efforts to be performed.

3.2.1 Groundwater Investigation

As indicated in Section 2.2 above the groundwater investigation will include the following:

- Installation and sampling of approximately three shallow temporary monitoring wells;
- Installation of 14 shallow permanent monitoring wells;

- Vertical profiling of intermediate groundwater quality beneath the Site;
- Installation of up to nine intermediate monitoring wells;
- Vertical profiling of groundwater quality in bedrock fractures;
- Development and sampling of the newly installed permanent wells; Collection of groundwater elevation data from the expanded well network;
- Collection of groundwater samples from the Site monitoring well network; and
- Collection of groundwater samples from water wells.

The proposed locations for the temporary wells and additional permanent wells are shown in **Figures 2-1 through 2-3**. The temporary well points and permanent shallow wells will be installed in accordance with procedures described in the USEPA Region 4 SESD protocol (USEPA 2008) for Design and Installation of Monitoring Wells (SESD GUID-101-R0; (**Appendix A**) with drill rig capable of utilizing direct push technology and/or hollow stem augers (HSAs) as well as roto-sonic technology. Well boring advancement and well installation procedures are discussed below.

3.2.1.1 Well Boring Advancement

Soil borings advanced during this phase of work for shallow temporary monitoring well installation will be advanced using a DPT/Geoprobe™, roto-sonic or HSA style drilling rigs. The well borings will be advanced to depths determined appropriate by information collected in the field and as determined by the AECOM field hydrogeologist.

During well boring advancement, soil cores/samples will be obtained for geologic characterization and soil classification. Soil core collection will entail the use of a variety of tools depending on the drill technology. Depending on the drilling technology that will be used, these sampling tools include two-inch diameter by two foot stainless steel split spoons utilized during HSA drilling, 2-1/4-inch diameter by 5 foot Geoprobe™ soil core barrel with acetate liner, or a 4 inch diameter, 10 foot long stainless steel core barrel utilized by roto-sonic drill rig. Soil cores will be collected continuously from land surface to the target depth for a boring in order to identify potential confining layers if present, and to accurately determine the water table depth. Soil recovery and soil type will be determined and logged.

Soils collected during the well boring process will be visually classified and described on boring logs using the Unified Soil Classification System (USCS). Copies of the boring logs will be included in the SI Report to be prepared following completion of this investigation.

Borings advanced as part of the intermediate zone vertical profiling will be advanced using roto-sonic drilling techniques. The roto-sonic drilling procedure will utilize a 10 foot long, 4 inch inside diameter (5 ¾ inch outside diameter) core barrel that will be advanced into the subsurface. Once the core barrel is advanced its maximum length, a 6 inch inside diameter outer casing will be advanced over the core barrel to the same depth. The core barrel is then removed from inside the casing allowing extraction of a soil core. The intermediate zone vertical profiling borings will be advanced at locations and depths specified in **Table 2-2**. The methods to be used to collect groundwater samples for field screening from these borings are discussed in Section 3.2.1.3, below.

In the event that it becomes necessary to terminate a boring short of its intended completion depth (i.e., a boulder or other obstacle is encountered), the boring will be abandoned in accordance with the SC Well Standards [R.61-71(H)(2)(e)]. Borehole abandonment will include backfilling of the borehole with a cement and bentonite grout (at a mixture of approximately nine to one) via tremie pipe from the bottom up. A new boring will be advanced as close as possible, within 10 feet from the abandoned boring. Soil coring will be resumed below the abandoned boring termination depth.

Soil cuttings generated during boring installation will be containerized in Department of Transportation (DOT) approved 55-gallon drums and staged on site. Handling and disposal of the soil cuttings is addressed in Section 3.2.7 which discusses investigation derived waste (IDW). Soil sampling equipment will be constructed of stainless steel. Soil boring and sampling equipment will be decontaminated between borings in accordance with procedures described in Section 3.2.7.

3.2.1.2 Shallow Temporary Well Installation

As indicated above, the results from previous rounds of investigation have indicated the presence of elevated concentrations of CVOCs in shallow groundwater beneath the various portions of the Site. The lateral extent of impact in the shallow zone has been primarily delineated. A data gap has been identified to the southwest of the facility on the Shealy property in the vicinity of location TMW107. In order to delineate the extent of elevated CVOCs in this area several additional temporary wells will be installed to allow collection of groundwater samples for field screening and confirmatory analysis. The proposed locations of the temporary monitoring wells are shown on **Figure 2-1.**

The shallow temporary wells will be constructed using 1-inch diameter, flush-threaded, schedule 40 PVC casing and 10-foot long 0.010 slotted PVC screens. This will entail the advancement of a soil boring to target depths between 25 and 30 feet BLS, if possible. Total well depth and placement of the screen interval will be based on location-specific data needs, local geology, and depth to the static water table, and will be determined by the geologist in the field. Once the soil boring advancement is completed, well materials including the screen and riser pipe will be installed through a temporary outer casing advanced as the soil boring core barrel is advanced. Once the well materials are in place the outer casing will be removed.

Temporary wells will remain in place in place long enough to allow for the collection of a groundwater sample. If the temporary well is to be left in place for more than 48 hours, the annulus surrounding the well pipe will be back-filled with clean silica sand to within two feet of land surface. The remaining annulus will be back-filled with bentonite pellets to land surface. The bentonite pellets will then be hydrated, which will allow a seal to develop around the temporary well at land surface preventing surface water infiltration. If the temporary well will be sampled immediately after installation, an outer filter pack and surface seal will not be installed around the well material.

Groundwater samples collected from the temporary wells will be screened on-site using the AQR Color-Tec® screening method. The Color-Tec® screening method utilizes a tetrachloroethene (PCE) colorimetric gas detector tube to estimate the concentration of total chlorinated ethenes. This method can detect the presence of PCE and /or related degradation products; however, it cannot quantify the concentration for a specific compound. A more detailed description of the AQR Color-Tec® methodology is included in **Appendix A** to this report. If the screening method has a positive result, an additional temporary well boring will be advanced at a location to be determined by Shakespeare and the AECOM

field Hydrogeologist. This methodology will continue at a location until field screening results determine the lateral extent of the CVOCs has been determined.

Confirmation samples will be collected from select shallow temporary well locations and submitted to an SCDHEC certified laboratory for analysis. The locations at which the confirmation samples will be collected will be determined by the AECOM field hydrogeologist during the sampling program.

After sampling of a temporary well has been completed, it will be abandoned in accordance with the SC Well Standards and Regulations as referenced above.

3.2.1.3 Intermediate Vertical Profiling Borings

As indicated above the intermediate zone vertical profiling borings will be advanced using roto-sonic drilling technology. Once a boring has been advanced to a specific target depth, a two inch diameter, five foot long, stainless steel well point sampler will be lowered through the outer casing and then advanced into the undisturbed subsurface to the desired screen interval. A submersible pump will then be used to purge water from this interval to for field screening and possible confirmatory analysis. A sample from the interval will be collected in a 40 milliliter vial for field screening. Purging efforts and sample collection procedures will be performed in accordance with groundwater sampling procedures described in Section 3.2.3.2.

Once a sample has been collected from a depth interval, it will be screened on site using the Field personnel will use the Color-Tec® screening method to evaluate groundwater for the presence of CVOCs. If the screening method has a positive result, the intermediate boring will be advanced 10 more feet to allow for collection of a groundwater sample from a deeper zone. This methodology will continue at a location until field screening results are non-detect or competent bedrock is encountered.

Confirmation samples will be collected from various intervals in an intermediate boring and submitted to an SCDHEC certified laboratory for analysis. The depths at which the confirmation samples will be collected will be determined by the field geologist during boring advancement.

3.2.1.4 Bedrock Vertical Profiling Boring

As indicated in Section 2.2.3 above, some fracture zones within the underlying granitic bedrock contain elevated concentrations of CVOCs. The distribution of the CVOCs within fracture zones has not been determined, therefore during this phase of work, one additional bedrock boring is proposed for a location on-site to determine the fracture zone intervals and to test the intervals separately for the presence of CVOCs. The proposed location for this bedrock well will be determined by AECOM, Shakespeare, and SCDHEC during the field program.

The proposed bedrock well borings will be advanced using either roto-sonic or a combination of mud-rotary and wireline coring techniques. Core samples will be visually examined by an AECOM field Hydrogeologist to identify separate fracture zones. When a separate fracture zone is encountered, field personnel will direct the purging of the fracture zone to allow collection of a groundwater sample for field screening using the Color-Tec® method. As the boring is advanced deeper into the bedrock, and separate fracture zones are identified an inflatable packer system will be used to isolate the deepest fracture zone from influence of groundwater from overlying fractures. The packer system will be inflated, sealing the borehole above the deepest fracture zone, Groundwater will then be purged from an isolated fracture zone using a submersible pump. Groundwater quality parameters will be monitored

during this purging effort and recorded as indicted in Section 3.2.3.3 below. Once purging of an interval is complete, a sample will be collected for field screening using the Color-Tec® screening method. Should field screening results for a sample from the fracture zone indicate that CVOCs are present; the bedrock boring will continue to be advanced until field screening indicates that CVOCs are not present in an underlying fracture zone. The total depth of this bedrock boring will be determined based on field screening results.

Once its maximum depth is reached, the bedrock boring will be converted to a monitoring well. Well screen placement will be set across a fracture zone that is found to not contain CVOCs during the field screening. The bedrock well to be constructed at that location will include a five foot long pre-packed 2 inch diameter well screen, surrounded by additional sand filter pack, as needed to fill the annular space. The bentonite clay well seal and grout will be installed to ensure impacted groundwater encountered in overlying fracture zones does not migrate downward into an unimpacted fracture zone. Well seal, grouting and wellhead completion will also be constructed in accordance with the SC Well Standards and Regulations (SC.R61-71).

3.2.1.5 Permanent Monitoring Well Installation Procedures

During this phase of SI, 15 shallow, up to ten intermediate zone monitoring wells, and three bedrock wells will be installed at the site to allow monitoring of groundwater elevations and water quality (**Figures 2-1 through 2-3**).

Permanent monitoring wells will be installed in accordance with SESD GUID-101-R0 protocol using a roto-sonic drilling rig. Shallow and intermediate permanent monitoring wells will be constructed using two-inch diameter, flush-threaded, schedule 40 PVC casing and 10 foot long, 0.010-inch slotted PVC screens. Total well depth and placement of the screen interval will be based on location-specific data needs, local geology, and will be determined by the geologist in the field.

As discussed in Section 3.2.1.1 above, soil and/or rock cores will be collected during well bore advancement to allow examination and classification of sediments and to help determine the depths at which to install the wells. Once shallow and/or intermediate well boring advancement is completed, the well materials will be installed through the six inch diameter sonic casing. Shallow and intermediate permanent monitoring wells will be centered within a borehole while an appropriately graded clean silica sand is placed in the annular space surrounding the well screen to a depth of approximately two feet above the top of the screen. The filter pack will be directly overlain by a layer of bentonite chips no less than two feet thick. The bentonite seal will be hydrated prior to installation of a cement/bentonite grout. The grout seal, containing a mixture of approximately nine pounds cement to one pound bentonite, will extend from the top of the bentonite seal to a depth of two to three feet below ground surface.

Each bedrock well will have a surface casing that fully penetrates the weathered residuum and saprolite overlying the bedrock. The surface casing will be grouted in place and allowed to cure for up to 48 hours before drilling into bedrock will commence.

AECOM will utilize a rock coring system to obtain samples of the bedrock. Core samples will be collected continuously on five foot intervals from the top of the bedrock to a depth determined in the field by the AECOM geologist. Information obtained from the rock cores will be used to determine the depth at which the bedrock wells will be completed. Ideally, wells will be set to capture groundwater from obvious fracture zones encountered in the bedrock. Once the well boring has been sampled to a

desired depth, the borehole will be flushed with fresh water to remove any drilling fluid and/or debris generated during drilling. The bedrock wells will then be completed as an open hole and will not have any internal well screen or filter materials.

Each of the shallow and intermediate permanent monitoring wells will be completed flush with the ground surface using an 8-inch diameter cast iron bolt-down well cover setinto a 2 ft x 2 ft x 6 inch concrete pad. The bedrock wells will have a 12 inch diameter cast iron bolt down cover. Each permanent monitoring well will also be secured with a cap and lock.

All well construction details and/or boring information will be noted on monitoring well construction logs to be completed during the field investigation.

3.2.1.6 Well Development

Following their installation, each permanent well will be developed in accordance with the USEPA Region 4 SESD GUID-101-R0. Well development will be performed to remove fine-grained materials from the monitoring wells and to enhance the hydraulic connection between the screen interval and the surrounding aquifer. If not removed, fine-grained materials may clog the well sand pack and screen, potentially diminishing well productivity and preventing the collection of representative groundwater samples.

The permanent monitoring wells will be developed no sooner than 24 hours following installation, to allow the well construction materials to set. Water quality parameters will also be measured using a YSI 556 water quality meter and HF Scientific or equivalent turbidity meter. During well development the following water quality parameters will be monitored:

- pH;
- Temperature;
- Specific Conductance; and
- Turbidity.

Adequate well development is achieved when the pH, specific conductance, and temperature of the groundwater have stabilized and the turbidity has either stabilized or is below 10 Nephlometric Turbidity Units (NTu). Stabilization shall be generally defined as pH constant within 0.1 Standard Unit (SU), temperature and SC constant within 10%.

A minimum of three well volumes will be removed before a well may be considered developed. If, after removal of three well volumes, the development criteria have not been achieved, the process will continue until either the criteria have been met, or ten well volumes have been removed. It is then at the discretion of the project manager to consider a well developed or whether development activities should continue.

Water generated by well development activities will be stored in 55-gallon drums, polyethylene totes or comparable containers. The development water containers will be labeled as such with the date of

generation and applicable source information. The containers will be transported to a designated on-storage area and characterized for off-Site disposal at the conclusion of the SI field activities.

3.2.2 Groundwater Sampling

As indicated above, groundwater samples will be collected from each of the newly installed temporary and permanent wells. Groundwater samples will be collected from the new monitoring wells in accordance with procedures detailed in the USEPA Region IV SESD protocol for Groundwater Sampling (SESDPROC-301-R2; **Appendix A**) as described below. The sampling procedures are described in this section.

3.2.2.1 Temporary Wells

The temporary wells will be purged and sampled as soon after their installation as possible. Field personnel will utilize a peristaltic pump to develop/purge a temporary well prior to sample collection. Field personnel will measure and record field parameters including pH, specific conductance, temperature, and turbidity during the development/purge effort.

3.2.2.2 Intermediate Vertical Profile Borings

Sampling of groundwater in the intermediate profiling borings will be performed using a stainless steel submersible pump. The roto-sonic drilling process uses water to charge the outer surface casing during borehole advancement, when necessary. During profiling interval purging efforts, field parameters will be monitored to ensure water quality parameters indicate representative groundwater is being evacuated for sampling. Field personnel will measure and record field parameters including pH, specific conductance, temperature, and turbidity during the purge effort. Samples for field screening will be collected when the field parameters have stabilized.

If possible samples for field screening will be collected using the submersible pump, however if volatilization during purging and sampling becomes a concern then field personnel may utilize a disposable bailer to collect a sample from the well point.

3.2.2.3 Bedrock Vertical Profile Boring

Sampling of groundwater in the bedrock vertical profile boring will be performed using a stainless steel submersible pump. During profiling interval purging efforts, field parameters will be monitored to ensure water quality parameters indicate representative groundwater is being evacuated for sampling. Field personnel will measure and record field parameters including pH, specific conductance, temperature, and turbidity during the purge effort. Samples for field screening will be collected when the field parameters have stabilized.

Samples for field screening will be collected using a submersible pump and dedicated, disposable tubing. When using a submersible pump, the flow rate of the pump will be adjusted to as low a speed as possible to limit the possibility of volatilization of organics during purging and sampling process.

3.2.2.4 Permanent Monitoring Wells

Permanent monitoring wells will be purged and sampled using the low flow-low volume sampling procedures with either a peristaltic pump or submersible pump. The primary choice of equipment for sampling a well using this method is the peristaltic pump; however, should the water column be deeper

than the depth from which a peristaltic pump can evacuate water, a submersible pump will be used to purge a deep well. Disposable Teflon lined tubing will be used with either the peristaltic pump or submersible pump during the purging and/or sampling process.

Prior to purging a well, clean polyethylene sheeting will be placed on the ground around the well to provide a clean working surface. Total depth and depth to water from the top of the PVC casing will be measured with an electronic water level indicator and recorded in the field log and groundwater collection record. The volume of the standing water column will then be calculated in order to determine the required purge volume. The volume of the standing water column in a well is calculated using the following general equation:

$V = 0.041(D^2)(H)$

Where: H = length of water column in feet

D = diameter of well in inches

V = volume of water in gallons

The volume per linear foot for a 2-inch well equals 0.163 gallons per foot. The length of the water column (total depth minus depth to water) may be multiplied by 0.163 to obtain the volume of standing water within a 2-inch diameter well.

When purging with a peristaltic pump, a section of ¼-inch diameter, disposable Teflon lined polyethylene, or dedicated Teflon extraction tubing will be inserted into the middle portion of the water column in a well. The extraction tubing will be connected to a disposable section of 3/8 inch diameter silicon tubing that runs through the pump device. This tubing is connected to another section of ¼-inch diameter tubing that is used for discharge tubing. Purging of a well will be performed from within the screened interval.

Water quality parameters (pH, specific conductance, temperature, turbidity, dissolved oxygen (DO), and oxidation reduction potential (ORP) will be measured using a water quality meter equipped with a flow-through cell (YSI or equivalent). Turbidity may also be measured with a HF Scientific, LaMotte, or equivalent turbidity meter. The water quality meter(s) will be calibrated twice per day, prior to field use each morning and after field use each evening.

As a general rule, water quality readings will be taken periodically to determine when purging is completed. An adequate well purge is achieved when the pH, specific conductance and temperature of the groundwater have stabilized and the turbidity has either stabilized or is below 10 NTU. Should the low flow-low volume sampling procedure not be appropriate for sampling wells due to lack of stabilization, field personnel will utilize alternative methods specified in the USEPA SOP for groundwater sampling (SESDPROC-301-R2). There are no criteria establishing the number of readings required to determine stability. However, if the parameters have not stabilized within five purge volumes, it is the discretion of the project manager whether to collect a sample or to continue purging.

As indicated in Section 2.4, groundwater samples collected during this investigation will be analyzed for TCL VOCs using SW-846 Method 8260C.

3.2.3 Surface Water Sampling

As indicated in Section 2.3, surface water samples will be collected from three locations on the Dickert Property.

Surface water samples will be collected in accordance with procedures described in the USEPA FBQSTP SESDPROC-201. Samples will be collected by submerging bottles directly into the water column where the water column is sufficiently deep enough to allow, without inadvertently elevating turbidity. A sample bottle will be lowered into the water column with the cap in-place. Once the mouth of the bottle is at the desired sampling depth, the cap will be removed allowing water to fill the container. For bottles containing preservative, the bottle will be submerged enough to allow surface water to slowly fill the bottle preventing the preservative from washing out of the sample container.

When possible, water quality parameters will also be measured in the field at the time of sample collection using a YSI 556 water quality meter. The field parameters measured during surface water sampling will be pH, specific conductance, temperature, DO and ORP. At locations where surface water samples are to be collected, field parameters will be measured by submerging the water quality instrument probe into flowing surface water. Field measurements and visual observations including color and a description of the general conditions at each surface water sampling location will be recorded on surface water sampling logs.

3.2.4 Well and Sample Location and Elevation Survey

Subsequent to the completion of SI field activities, all borings, new monitoring wells and surface water sample points will be located using standard global positioning system (GPS) and/or conventional survey methodology by a registered land surveyor.

Wells, borings and sample points will be surveyed for elevation referenced to the National Geodetic Vertical Datum (NGVD) and horizontal location referenced to the SC State Plane Coordinate System North American Datum (NAD-83) by a qualified professional land surveyor (see Section 3.1.2.2) in accordance with the USEPA Region 4 SESD protocol for Global Positioning Systems (USEPA, 2011) (**Appendix A**). Surveying of monitoring well locations will provide horizontal control and vertical data for the ground surface, the top of the outer protective casing, and the top of the PVC well casing at each location. The top of PVC casing elevation will be surveyed at a permanently designated point marked into the top of the well casing. The designated point should be exposed only when the protective cap is removed and be the point from which all water level measurements are taken. Vertical elevation data should be surveyed to an accuracy of 0.01 feet and horizontal position data to an accuracy of 0.1 feet.

3.2.5 Investigation-Derived Waste (IDW)

IDW generated during the field program will be managed in accordance with the USEPA Region 4 SESD protocol for Management of Investigation Derived Waste (USEPA, 2010) (**Appendix A**). Materials which may become IDW include: personal protective equipment (PPE), disposable equipment, soil cuttings from drilling or hand auguring, sediments, groundwater obtained through well development or well purging, and cleaning and decontamination fluids. All soil cuttings, residual sample materials, groundwater, cleaning and decontamination fluids will be containerized in DOT approved 55-gallon drums or a roll-off container and temporarily staged at a central Site location pending results of laboratory analyses and selection of final disposal method(s). IDW materials such as non-hazardous

PPE, disposable equipment, and general refuse will also be placed into a separate drum, roll-off container, or existing refuse bin, and disposed in accordance with applicable guidance.

Based on the results of previous investigative phases at the Site, solid and liquid IDW will be handled as disposed of a as non-hazardous waste. Final disposal options will be determined following completion of field activities, after review of validated analytical data for samples collected from the Site. Analytical results for groundwater samples will be compared to the corresponding Toxicity Characteristic Leaching Procedure (TCLP) concentrations. If groundwater sample results do not exceed the TCLP concentrations, then liquid IDW can be disposed of as non-hazardous.

IDW generated in areas of obvious impacts will be segregated and containerized separately from other IDW. If areas with DNAPL are encountered during the investigation, if required by a disposal facility, samples collected from the Site may be analyzed for an expanded list of parameters including TCLP). These data will also be utilized to determine an appropriate disposal method for IDW from the obviously impacted areas.

3.2.6 Quality Control (QC) and Handling Procedures

The QC and handling procedures for equipment and samples collected at the site are briefly described below.

3.2.6.1 Sample Containment, Handling and Shipping

To minimize sample leakage and breakage, sample containers will be sealed and placed in shipping containers surrounded by bubble wrap or equivalent packing material. Ice will be included for those samples that require refrigeration. Chain-of-custody forms, identifying each sample contained in a shipping container, will be completed. One copy of the chain-of-custody form will be retained for the field records; the remaining copies will be placed inside a Ziploc™-type bag, and the bag sealed and taped to the inside cover of the shipping container. Chain-of-custody procedures are described in AECOM SOP 7510 (**Appendix A**).

Samples will be delivered daily to the Shealy Environmental Services, Inc. facility by AECOM field personnel. All samples will be handled and shipped in accordance with the procedures included in the USEPA Region 4 SESD protocol for Packaging, Marking, Labeling and Shipping of Environmental and Waste Samples (USEPA, 2011) (**Appendix A**).

3.2.6.2 Field Equipment Calibration

Sampling activities detailed in this work plan call for the use of field equipment including a photoionization detector (PID), water quality meter turbidity meter, electronic water level indicator, and a GPS. The water quality meter will be capable of measuring pH, specific conductance, temperature, DO, and ORP. All field equipment will be calibrated prior to each use (at the beginning of each day) and a post-calibration check performed at the conclusion of each use (at the end of each day). All instruments will be calibrated, maintained, and operated in accordance of the manufacturer's specifications.

3.2.7 Field Equipment Decontamination

Reusable equipment used in the field investigations at the site will be cleaned between sample collection efforts. Cleaning of equipment is performed to prevent cross-contamination between samples and to

maintain a clean working environment for all personnel. Cleaning of sampling equipment will be performed in accordance with the USEPA Region 4 SESD protocol for Field Equipment Cleaning and Decontamination (USEPA, 2011) (**Appendix A**).

For all sampling equipment used for the collection of samples for trace organic compounds and/or metals analyses:

- clean equipment with tap water and a laboratory grade non-phosphate detergent,
- rinse thoroughly with tap water,
- rinse thoroughly with deionized (DI) water,
- double rinse with organic free water
- wrap with aluminum foil, place in a plastic bag, and seal to prevent contamination if equipment is going to be stored or transported.

Cleaning and decontamination of all down hole drilling equipment will be conducted in accordance with Section 3.7 of the Region 4 SESD protocol for Field Equipment Cleaning and Decontamination (USEPA, 2011).

Solvents, detergents, and rinse waters used to clean field equipment will not be reused during field decontamination. Procedures for handling and disposition of IDW, including used wash water, rinse water, and spent solvents will be conducted in accordance with Section 3.2.7.