

June 29, 2018

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Ms. Jan Trent  
Hydrogeologist  
State Remediation Section  
Site Assessment, Remediation &  
Revitalization Division  
Bureau of Land and Waste Management  
South Carolina Department of Health and  
Environmental Control  
2600 Bull Street  
Columbia, South Carolina 29201

SCANNED

JUL 02 2018

SITE ASSESSMENT,  
REMEDATION &  
REVITALIZATION

**Re: Source Area Pilot Study Work Plan  
Honea Path Plant (BLWM ID# 400238)  
415 Brick Mill Road, Honea Path, South Carolina  
AEM Project No. 1320-1801**


Dear Ms. Trent:

On behalf of Ingersoll Rand, please find enclosed one electronic copy (on computer disc) and one hardcopy of the Source Area Pilot Study Work Plan located at the former Ingersoll Rand facility in Honea Path, South Carolina.

If you need anything else or have any questions, please call us at (404) 329-9006.

Sincerely,

**Atlanta Environmental Management, Inc.**

  
Leona Miles, CHMM  
Senior Project Manager

  
Michael Brock  
Vice President

/krf

cc: Michael Goldstein (via e-mail)  
Janet Hart (AEM)

Enclosures

CD Scanned  
PM Copy

# Source Area Pilot Study Work Plan

**Honea Path Plant  
Honea Path, South Carolina**

AEM Project No. 1320-1802-2

**RECEIVED**

June 29, 2018

JUL 02 2018

SITE ASSESSMENT,  
REMEDICATION &  
REVITALIZATION

*Prepared For:*

**Ingersoll Rand  
800-E Beaty Street  
Davidson, North Carolina 28036**

*Prepared By:*



**ATLANTA ENVIRONMENTAL MANAGEMENT, INC.**

*Environmental Consulting, Engineering, Hydrogeologic Services*

2580 Northeast Expressway • Atlanta, Georgia 30345  
Office (404) 329-9006 • Fax (404) 329-2057

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## SECTION 1.0 INTRODUCTION

This Source Area Pilot Study Work Plan has been prepared on behalf of Ingersoll Rand for the former Ingersoll Rand Honea Path Plant (HPP) located at 415 Brick Mill Road, Honea Path, Anderson County, South Carolina. This Work Plan presents technical justification, objectives, and implementation procedures for a proposed pilot testing of soil vapor extraction (SVE) and an aquifer pumping test. This Work Plan also summarizes previous on-site characterization activities and data, geology and hydrogeology, and the system elements and monitoring plan for the proposed pilot testing. This Work Plan is divided into four sections:

- Section 1 provides an introduction and site background.
- Section 2 provides the pilot study objectives.
- Section 3 presents the proposed scope of work for the pilot studies.
- Section 4 presents the schedule and reporting.

The HPP is located on approximately 466 acres in a semi-rural area typically composed of woods and farm land at 415 Brick Mill Road, Honea Path, South Carolina (see Figure 1). The facility consists of a main manufacturing building, a smaller storage building to the rear of the plant, and a small wastewater treatment plant located northeast of the main plant building. Topographic features include the gullies and intermittent drainage features located on the northeastern, northern, and northwestern property boundaries (see Figure 2).

Two former trichloroethene (TCE) aboveground storage tanks (ASTs) have been used at the facility. The original TCE AST was located near the northern corner of the main plant building adjacent to a former methanol AST along the back-fence line within an unpaved area (see Figure 2). The TCE and methanol ASTs were removed in 1989. The TCE AST was then moved to the current AST tank farm until TCE was no longer used at the plant in 1992.

In 2006, Sanborn Head & Associates (SHA) collected soil samples as part of a Phase I/II assessment (SHA, 2006). Soil boring locations from this investigation (SH-01, -02, -03, -04, and SB-01 through SB-09) are shown on Figure 3. Three soil borings (SB-04, -05, and -06) were completed near the current AST tank farm. TCE was reported at 93 milligrams per kilogram (mg/kg) in the 10- to 12-foot (ft) sample collected from soil boring SB-05. This concentration exceeds both the Environmental Protection Agency (EPA) Industrial Soil Screening Level (SSL), which is 6.0 mg/kg, and the Maximum Contaminant Level (MCL) risk-based SSL, which is 0.0018 mg/kg. No volatile organic compounds (VOCs) were reported in soil samples collected from SB-04 and SB-06 (see Figure 3).

In October 2016, Atlanta Environmental Management, Inc. (AEM) collected additional soil samples to better assess soil in the upgradient plume areas near the plant (AEM, 2016). Soil boring locations from this investigation (B-01 through B-06) are shown on Figure 3. TCE was reported at concentrations ranging up to 57 mg/kg in the 10-ft sample collected from boring B-01 located 15 ft southwest of SHA boring SB-05 (see Figures 3 and 4).

Based on the results of the 2016 soil investigation, 15 soil samples were collected from 6 soil borings and analyzed for VOCs in July 2017 to assess the lateral and vertical extent of VOCs previously identified in soil borings B-01 and SB-05. No VOCs were identified in these soil samples above laboratory reporting limits.

## SECTION 2.0 PILOT STUDY OBJECTIVES

The purpose of the SVE pilot test is to collect data for purposes of determining the implementability of this technology in the soil source area as well as tailoring and designing a full-scale vapor extraction system. The objective of the aquifer pumping test effort is to collect data to evaluate the overall effectiveness of installing an additional groundwater recovery well in the soil source area.

### 2.1 SVE PILOT STUDY

The SVE pilot test will target the unsaturated soil mass centered around historical soil borings SB-05 and B-01 (see Figure 5). The groundwater depth in the pilot test area is approximately 25 feet below land surface (bls). The SVE pilot test well will be screened from 5 to 25 feet. The primary objective of the SVE pilot test is:

- Collect data to estimate the feasibility of SVE. These data include the radius of influence (ROI) and soil vapor flow velocities (i.e., the *ex situ* velocity of soil vapor extracted from the test point) at different applied vacuums. If SVE is determined to be a viable alternative, the data can be used to design the full-scale layout.
- Identify potential interference by subsurface structures that may influence extraction point ROI.
- Assess possible anisotropy in extraction point ROI.
- Evaluate the potential effect of vacuum-induced groundwater mounding.
- Determine the expected range of VOC concentrations in extracted soil vapor for estimating potential VOC mass removal rates for full-scale design.
- Determine the expected VOC constituent composition in extracted soil vapor to determine whether an air permit will be required or to determine an appropriate and cost-effective technology for treatment of extracted soil vapor in the full-scale design (e.g., granular activated carbon [GAC], thermal oxidation, or catalytic oxidation).

### 2.2 AQUIFER PUMPING TEST PILOT STUDY

Recovery well MW-19A is located downgradient of the soil source area. This well was originally installed as a 4-inch monitoring well screened in the partially weathered rock (PWR). This well was later converted to a recovery well as the concentrations of VOCs in this area were the highest detected on site. Recovery well MW-19A operates at approximately 0.5 gallon per minute (gpm) and, while effective in recovering VOC impacted groundwater, the rate at which the recovery occurs is not effective in controlling migration of VOCs downgradient. The aquifer pumping pilot study will be conducted upgradient of recovery well MW-19A, more closely sited to the soil source area (see Figure 5).

The primary objectives of the aquifer pumping pilot test are:

- To provide information about the yield and drawdown in the soil source area screened across the residuum and PWR.
- To determine the specific discharge drawdown in the soil source area to design an appropriate extraction system (i.e., layout, pumps, discharge areas, etc.).

## SECTION 3.0 PILOT STUDY SCOPE OF WORK

### 3.1 SVE PILOT STUDY

The scope of work for the SVE pilot test will consist of the following tasks: vapor extraction point installation, observation well installation, performance monitoring, and data evaluation. Soil sampling for laboratory analysis will be performed during installation of the pilot test points to provide supplemental characterization of soil conditions.

One SVE pilot test well and three observation wells will be installed in the vicinity of historical soil sample borings SB-05 and B-01. The observation wells will be installed to an approximate depth of 25 feet and will be screened from approximately 5 feet to 25 feet bls. The SVE pilot test well and observation wells will be installed utilizing either hollow stem auger/air rotary or roto-sonic drilling methods. The locations of the observation wells are estimated at 5, 10, and 20 feet from the SVE well. The observation well located 5 feet from the SVE control well is to determine whether the vacuum short circuits to land surface near the SVE well. The location of these wells is provided in Figure 5. Note that the location of these wells may be affected by underground utilities and/or subsurface structures, and thus the locations may be modified in the field.

A vacuum will be applied to the SVE pilot test well for a period of 4 hours. A minimum blower capacity of 80 cubic feet per minute at a maximum vacuum of 12 inches of mercury (in-Hg) will be specified to accommodate a range of operating conditions for flow and vacuum and to achieve the step test vacuum range. The vacuum is estimated to range between 4 and 10 in-Hg.

The SVE pilot test well will be constructed of nominal 4-inch-diameter, schedule 40 polyvinyl chloride (PVC) with a 0.040-inch factory slotted well screen. The annulus surrounding the screened interval will be filled with gravel filter pack from the bottom of the boring up to approximately 0.5 foot above the top of the screened interval. Above the gravel filter pack, a field-hydrated bentonite (medium chips) seal will be installed to within approximately 2 feet bls. The blower system will be connected to the extraction point casing using flexible hoses, cam lock connectors, and wellhead fittings. A typical SVE well construction diagram is provided as Figure 6.

The observation wells will be constructed of nominal 1-inch-diameter, schedule 40 PVC with a 0.040-inch factory slotted well screen and will be installed similarly to the vapor extraction points. Figure 7 shows a schematic of a typical observation well point installation. The screened interval for each observation well is estimated at 5–25 feet bls; however, this may be refined based on observed lithology.

The observation wells will be monitored every 30 minutes for wellhead vacuum to ensure that adequate influence is observed. An initial groundwater level will be taken before the vacuum test and immediately following the vacuum test. Vacuum pressure will be increased at



designated intervals in an effort to determine the optimum vacuum for the SVE well. Soil vapor from the extraction points will be conveyed in temporary above-grade PVC piping and/or flexible hoses to a vapor-liquid separator where entrained water will be removed prior to vapor phase treatment.

Once the optimum vacuum is established, a four-hour pilot test will be conducted. The flow rate, vacuum influence, and off gas readings via a photoionization detector (PID) will be collected every 30 minutes from the observation wells. Following the four-hour pilot test, one off gas sample will be collected for analysis of VOCs via EPA Method TO-15.

Any condensate generated from the SVE pilot test will be containerized and discharged to the on-site groundwater treatment system.

### 3.2 AQUIFER PUMPING TEST PILOT STUDY

Pumping test (drawdown test) is a field experiment in which a test (control) well is pumped at a controlled rate and water-level response (drawdown) is measured in one or more surrounding observation wells as well as the test well being pumped. Response data from pumping tests are used to (1) estimate the hydraulic properties of an aquifer, (2) evaluate well performance, and (3) identify non-flow aquifer boundaries that may limit the lateral extent of aquifers as well. The goal of a pumping test is to estimate hydraulic properties of an aquifer system. For the aquifer being studied, the objective is to determine transmissivity and storativity (storage coefficient).

#### 3.2.1 Aquifer Pumping Pilot Test Approach

To determine the effectiveness of installing a new recovery well in the area of both the known soil and groundwater chlorinated solvent source areas, a single constant rate pumping test will be conducted for the study area. Due to site constraints, the control well is anticipated to be downgradient of the soil source area, although upgradient of the current 4-inch-diameter recovery well MW-19A (see Figure 5). Utilizing this scenario, MW-19A can also be used as an observation well for the pumping test.

The scope of work for the aquifer pumping pilot test will consist of the following tasks:

**Utility Clearance:** Prior to any drilling activities, all underground utility locations within the study area will be cleared by a private utility locator. The South Carolina utility protection agency (SC811) will be notified within 72 hours of commencement of the work. Proposed well locations will be pre-marked prior to the utility clearance.

**Selecting Observation Well Locations:** Up to three observation wells will be installed as part of the pumping test. The proposed location for the observation wells is included on Figure 5. Site access constraints will also be considered when selecting the observation well locations. The study area is located in a high traffic (semitrailer) area.

**Well Installation:** One 6-inch-diameter, schedule 40 PVC control well and up to three 2-inch-diameter, schedule 40 PVC observation wells are proposed (see Figure 5). Proposed

wells will be drilled and installed in accordance with current U.S. EPA Region 4 guidance documents. Wells will be installed with the use of either hollow-stem auger and air-rotary, or sonic drilling technologies. Special care will be taken to contain formation fluids generated (extracted) during the drilling phase. Drill cuttings will be containerized in 55-gallon steel drums or lined metal roll-off boxes, pending laboratory characterization and future disposal.

Based on available lithologic information, the control and observation wells will be installed to a depth of approximately 90 feet to the top of bedrock. In general, observation wells will penetrate the tested aquifer to the same stratigraphic horizon as the control well. The control well will be screened from the groundwater surface to the bottom of the well using 0.010-inch stainless steel vee-wire screen or equivalent.

A 4-inch-diameter, stainless-steel submersible or pneumatic pump will be installed. The pump will be placed just above the bottom of the well; however, the final depth at which the pump is set will be determined by the depth of the control well. In the case of MW-19A, the existing pump system (pneumatic pump, discharge line, and wiring) will be removed, if necessary, to utilize this well as an observation point.

The observation wells will be screened from the groundwater surface to the depth of the well using schedule 40, PVC, 0.010-inch slot screen. The annulus space around the screen (to a depth of 2 feet above the screen) for each will be filled with fine silica sand (sand pack). The sand pack will be capped with 2–3 feet of bentonite chips and hydrated as needed. The remaining annulus space will be sealed with a Portland I-bentonite grout.

The new wells will be completed with flush-mounted vaults to allow for vehicular traffic. The observation wells will be completed using standard 8-inch-diameter, metal well vaults placed within 2-ft by 2-ft by 4-inch concrete pads. Upon completion of the pumping test, the control well will be completed with 10-inch-diameter, metal well vaults placed within 2-ft by 2-ft by 4-inch concrete pads, or with larger concrete pads and metal vaults. Figure 8 presents an example of a typical well construction diagram.

**Elevation Survey:** Surveyed top of casing (TOC) and ground surface elevations (to nearest 100<sup>th</sup> of a foot) for the control well and each of the observation well will be collected. The survey point (bench mark) for the TOC for each well will be clearly marked with black ink using a permanent marking pen. During the subsequent pumping test, water level measurements will be recorded from the bench mark established for each well.

**Establishing Baseline Trends:** Baseline (pre-test) water level measurements will be collected for the control well and observation wells approximately one week prior to the pumping tests. Baseline water level measurements will also be made in all wells within the anticipated area of influence.

AEM will also identify major activities that may impact the test data. Such activities may include localized recharge of the aquifer, barometric response, loading of the aquifer by heavy truck traffic, or other surface disturbances.

**Flow Rate Control and Measurements:** Measuring the flow rate during a pumping test will be accomplished with the use of an in-line flowmeter and/or container and stopwatch. Flow rates will be recorded with sufficient frequency to demonstrate a constant rate. In the event of temporary test interruption (e.g., power failure), pumping stop and restart times will be noted to allow for proper interpretation of the test.

**Pre and Post Groundwater Sampling:** Prior to commencing the groundwater pump test the pump test well, observation wells, and MW-19A will be sampled to establish baseline VOC concentrations. Following the pump test, the same wells will be sampled again to determine the effect on groundwater concentrations.

**Step-Drawdown Test:** Initially, a preliminary step-drawdown test will be implemented to determine the specific capacity of the recovery well being tested and to identify optimum extraction rates for a well. The discharge rate in the pumping well will be increased from an initially low constant rate through a sequence of pumping intervals (steps) of progressively higher constant rates. Each step is typically of equal duration, lasting from approximately one to two hours.

**Aquifer Pump Test:** During a pumping test, water levels in the control and observation wells will be measured through the use of pressure transducer sensors with data loggers. Pressure transducers combined with data loggers provide rapid and accurate measurements of water levels in wells. As a back-up, a manual technique (electric water level meter) may also be employed to gauge select wells.

A logarithmic schedule for recording water levels will be utilized during a constant-rate pumping test. Based on the anticipated hydraulic head in the wells (length of the water column in each well), down-hole, vented, pressure transducers rated for at least 30 pounds per square inch gauged (PSIG), which is rated for up to 70 feet of water, will be utilized.

Pre- and post-test water-level measurements will be recorded, as they are essential for the identification of trends (e.g., barometric fluctuations) that may require correction prior to pumping test data interpretation.

The estimated duration for the pumping test is approximately 24 hours. However, the decision to terminate the pumping test will be made in the field.

**Containment, Transport, and Disposal of Pumped Water:** As the extracted water is anticipated to be impacted by chlorinated solvents, care will be taken to prevent any discharge to the surface. The extracted water will either be routed to the existing Phase I/II groundwater treatment system (via the current underground discharge lines servicing MW-19A) or be temporarily contained in 1,500-gallon high density polyethylene (HDPE) storage tanks for later transport and disposal (treatment) to the existing groundwater treatment system.

### 3.2.2 Aquifer Pumping Test Equipment

At a minimum, the following equipment will be utilized and/or be made available during the scheduled pumping test:

- 110v and/or 220v generator
- Submersible stainless-steel centrifugal and/or pneumatic pump
- Discharge pipe (PVC/steel), connections, and fittings
- Transfer hoses and connections
- Storage tanks for pumped water
- Flow measurement device(s)
- Pressure transducer(s), cables, data logger(s)
- Data Logger with appropriate software
- Electric water-level sounder(s)
- Stopwatch
- Barometric sensor
- Flashlights/lanterns
- Data collection forms, log book, permanent-ink pens
- Computer with appropriate software
- Manufacturer's operating manuals for equipment
- Measuring wheel or tape measure
- Tool kit

### 3.2.3 Aquifer Pumping Test Evaluation

The type-curve (Theis) method for measuring groundwater flow toward a well allows for the determination of two unknown parameters—the storage coefficient ( $S$ ) and Transmissivity ( $T$ ) of the aquifer—which in turn allows for the calculation of hydraulic conductivity ( $K$ ), specific storage ( $S_s$ ), and specific yield ( $S_y$ ). These subsequent parameters allow for the determination of seepage velocity (horizontal flow rate) within the aquifer and the potential well yield that can be sustained continuously. Likewise, the area of influence (capture zone) for a pumped control well can be estimated by observing drawdown within the surrounding observation wells.

## **SECTION 4.0 SCHEDULE AND REPORTING**

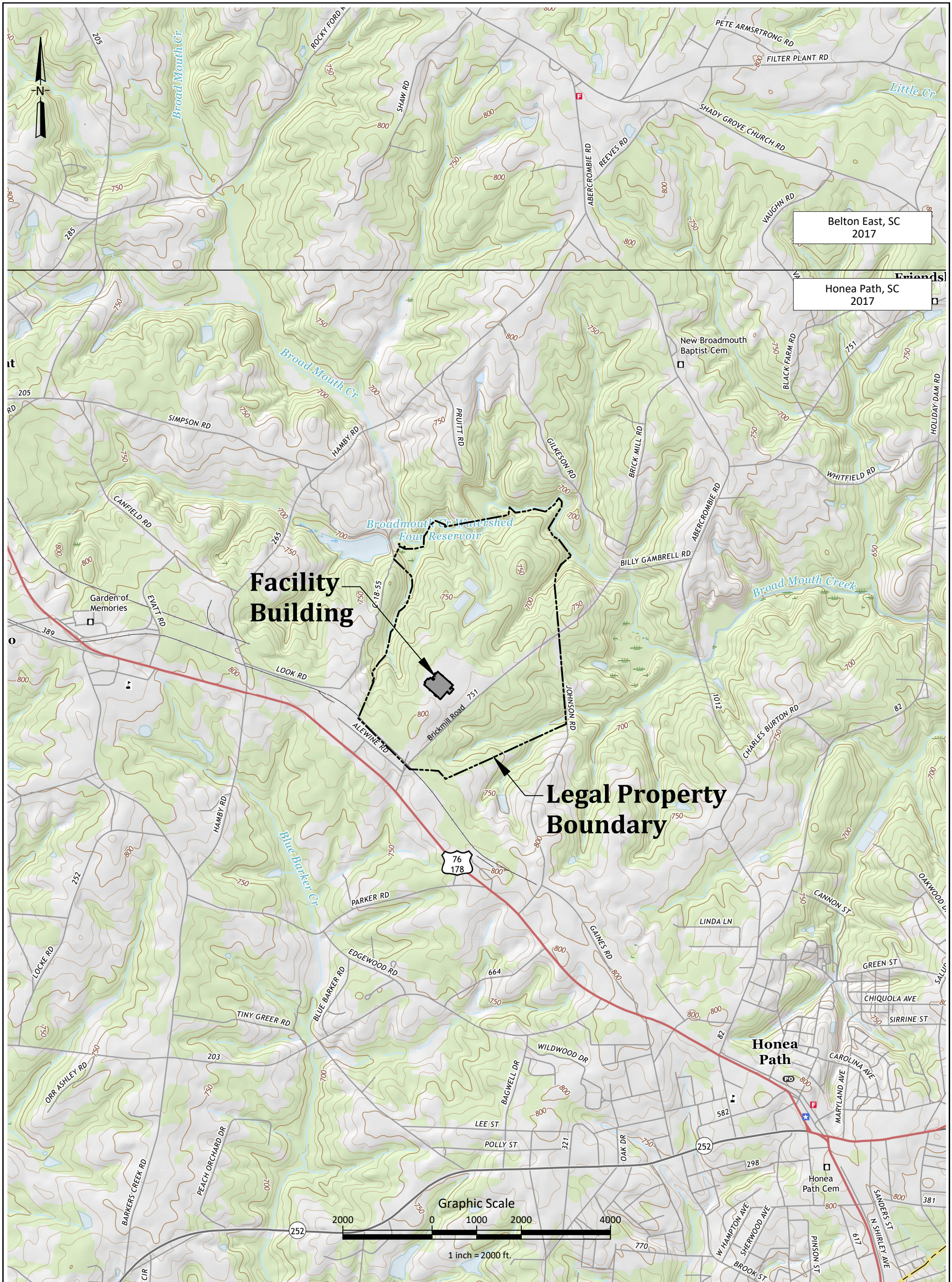
It is anticipated that pilot testing will be conducted between September and October 2018. The proposed pilot testing activities are expected to be performed over a four-week period. During the first week, the wells will be installed and the SVE testing will be completed. During the second and third weeks, the aquifer pumping test well(s) and observations will be installed. Also, any equipment associated with the SVE pilot test will be removed. The pumping test will be conducted during the third and fourth weeks.

An official report of pilot test data and findings will not be prepared. Instead, all data obtained from the pilot studies will be incorporated into the Final Focused Feasibility Study.

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# FIGURES





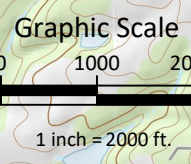
Belton East, SC  
2017


Honea Path, SC  
2017

**Facility Building**

**Legal Property Boundary**

**Honea Path**



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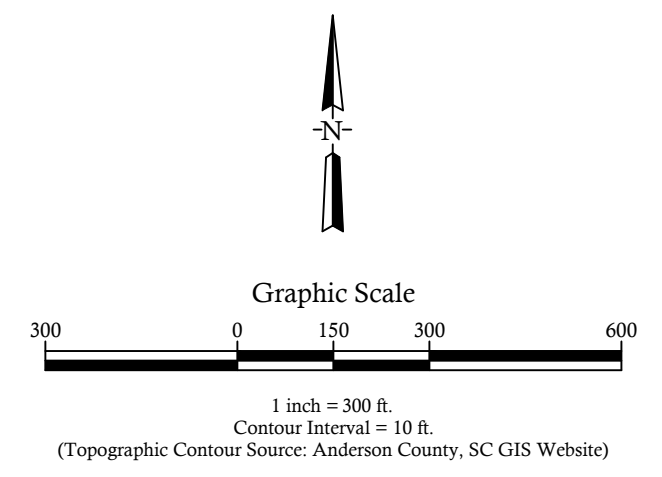
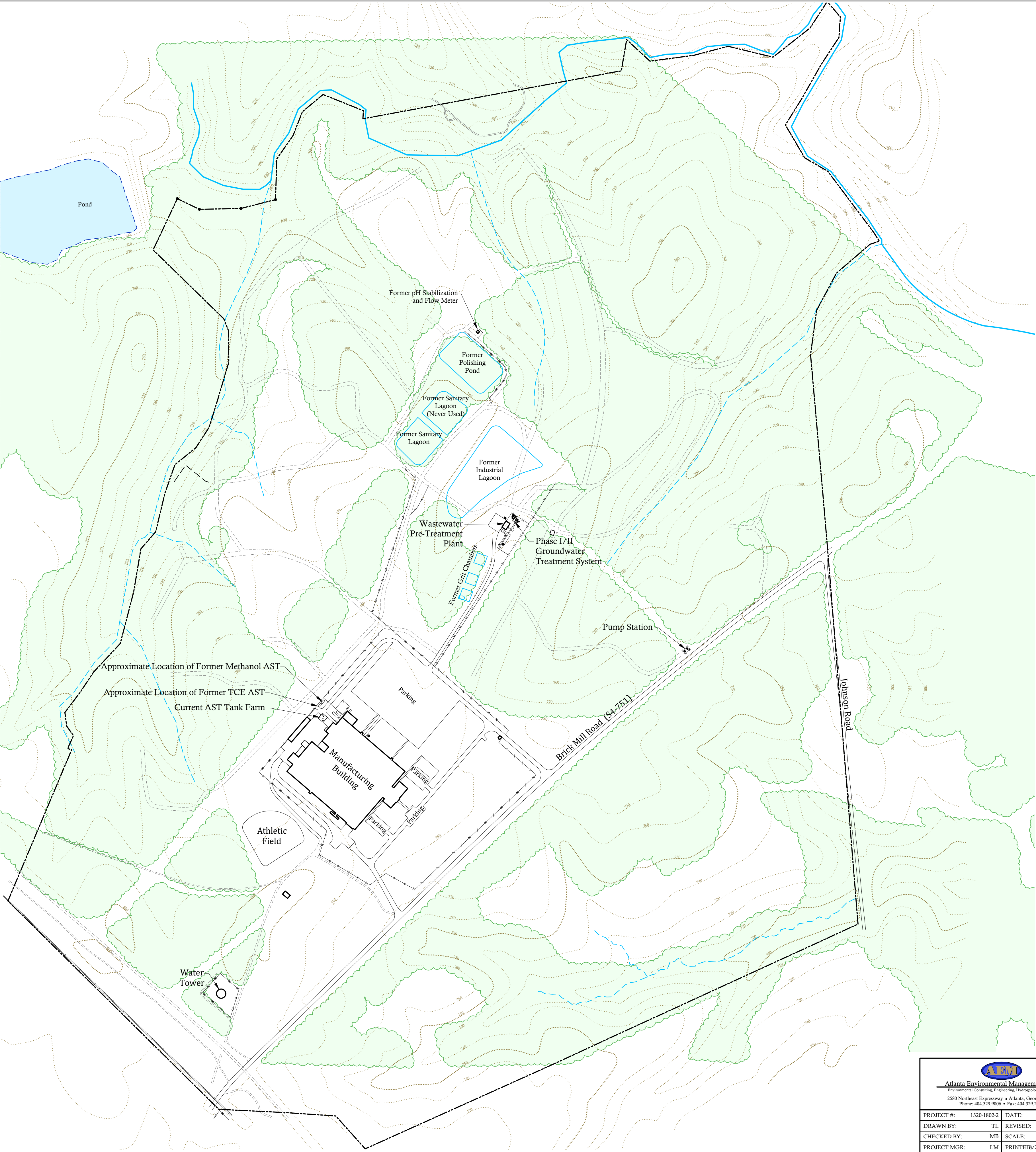
Honea Path Plant  
415 Brick Mill Road  
Honea Path, South Carolina


<p>Facility Location</p>	<p>Figure <b>1</b></p>
--------------------------	----------------------------



**Legend**

- Site Boundary
- Topographic Contour (ft. AMSL)  
Contour Interval = 50 ft.
- Topographic Contour (ft. AMSL)  
Contour Interval = 10 ft.
- Fenceline
- Creek
- Intermittent Stream
- Railroad
- Trail



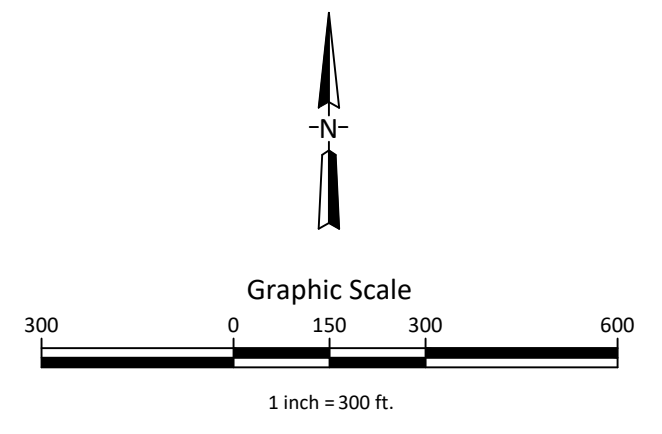
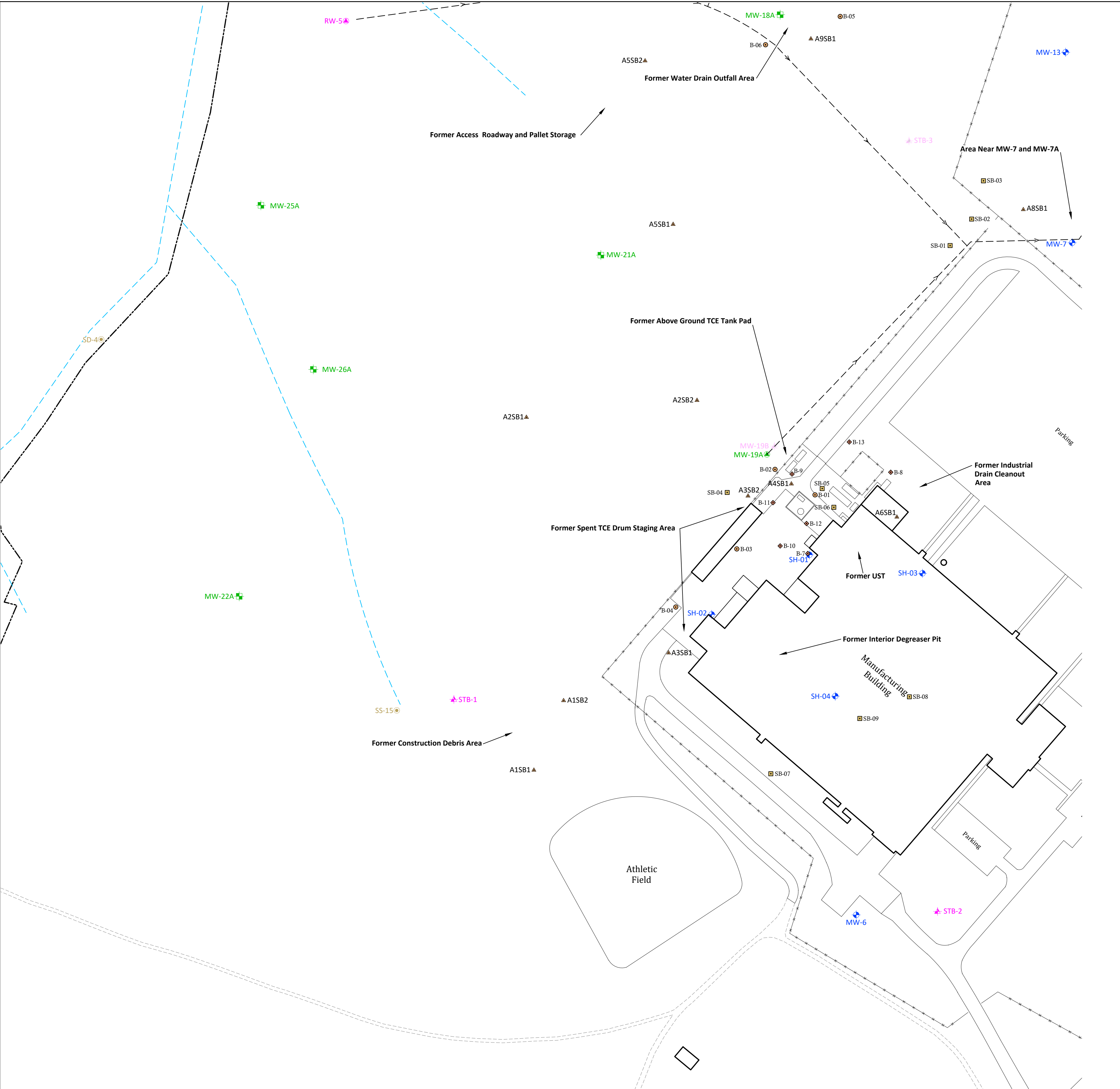
 <b>Atlanta Environmental Management, Inc.</b> Environmental Consulting, Engineering, Hydrogeologic Services 2580 Northeast Expressway • Atlanta, Georgia 30345 Phone: 404.329.9006 • Fax: 404.329.2057		Honea Path Plant 415 Brick Mill Road Honea Path, South Carolina	
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			<b>Site Plan</b>
			<b>Figure 2</b>


G:\DWG\1320-1802 Honea Path\02-02 Site Plan



**Legend**




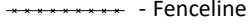
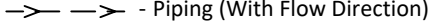
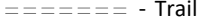
- ◆ - Soil Boring (2017)
  - - Previous Soil Boring (2016)
  - ▲ - Previous Soil Boring (1993)
  - - Previous Soil Boring (2006)
  - ⊕ - Residuum Aquifer Zone Monitoring Well
  - ⊕ - Residuum Aquifer Zone Monitoring Well (Abandoned) (MW-30 Abandoned on February 28, 2012)
  - ⊕ - Residuum Aquifer Zone Recovery Well
  - ⊕ - Partially Weathered Rock Aquifer Zone Monitoring Well
  - ⊕ - Partially Weathered Rock Aquifer Zone Observation Well
  - ▲ - Partially Weathered Rock Aquifer Zone Recovery Well
  - ▲ - Bedrock Aquifer Zone Monitoring Well (Former Soil Test Boring)
  - ▲ - Recovery Well (Screened Across Three Zones)
  - - Surface Water Sample Location
- 
- Site Boundary
  - - - Fenceline
  - Creek
  - - - Intermittent Stream
  - Piping (With Flow Direction)
  - Railroad




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<b>Historical Soil Boring Locations Source Area</b>			Figure <b>3</b>


G:\DWG\1320-1802 Honea Path\02\03 Historical Sampling


# Legend

-  - Soil Boring
-  - Residuum Aquifer Zone Monitoring Well
-  - Partially Weathered Rock Aquifer Zone Recovery Well
-  - Fenceline
-  - Piping (With Flow Direction)
-  - Trail

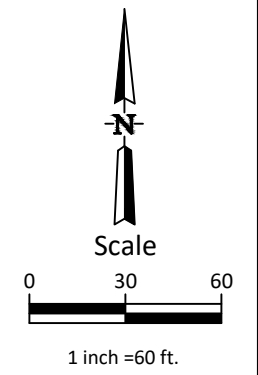
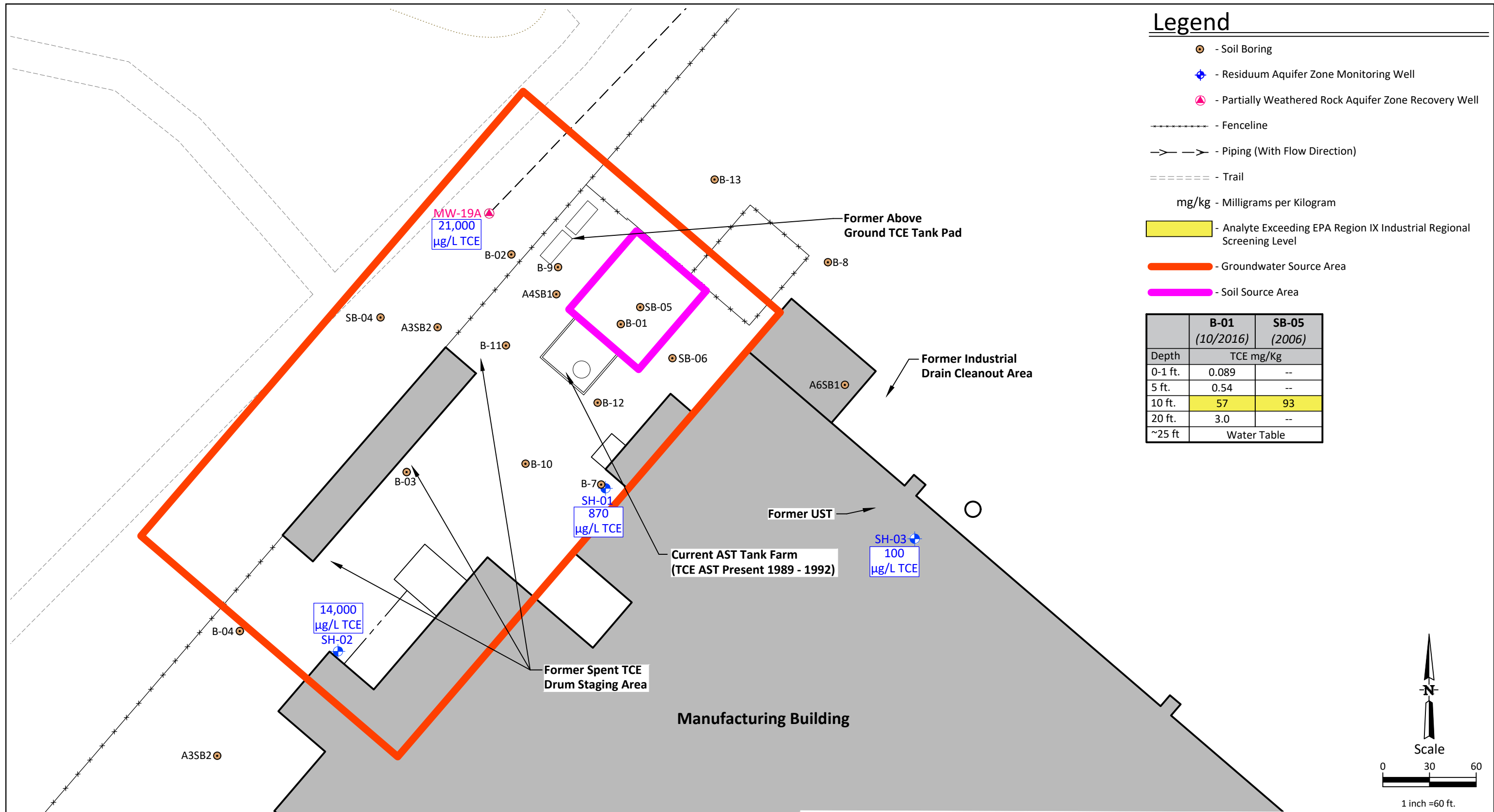
mg/kg - Milligrams per Kilogram


 - Analyte Exceeding EPA Region IX Industrial Regional Screening Level

 - Groundwater Source Area

 - Soil Source Area

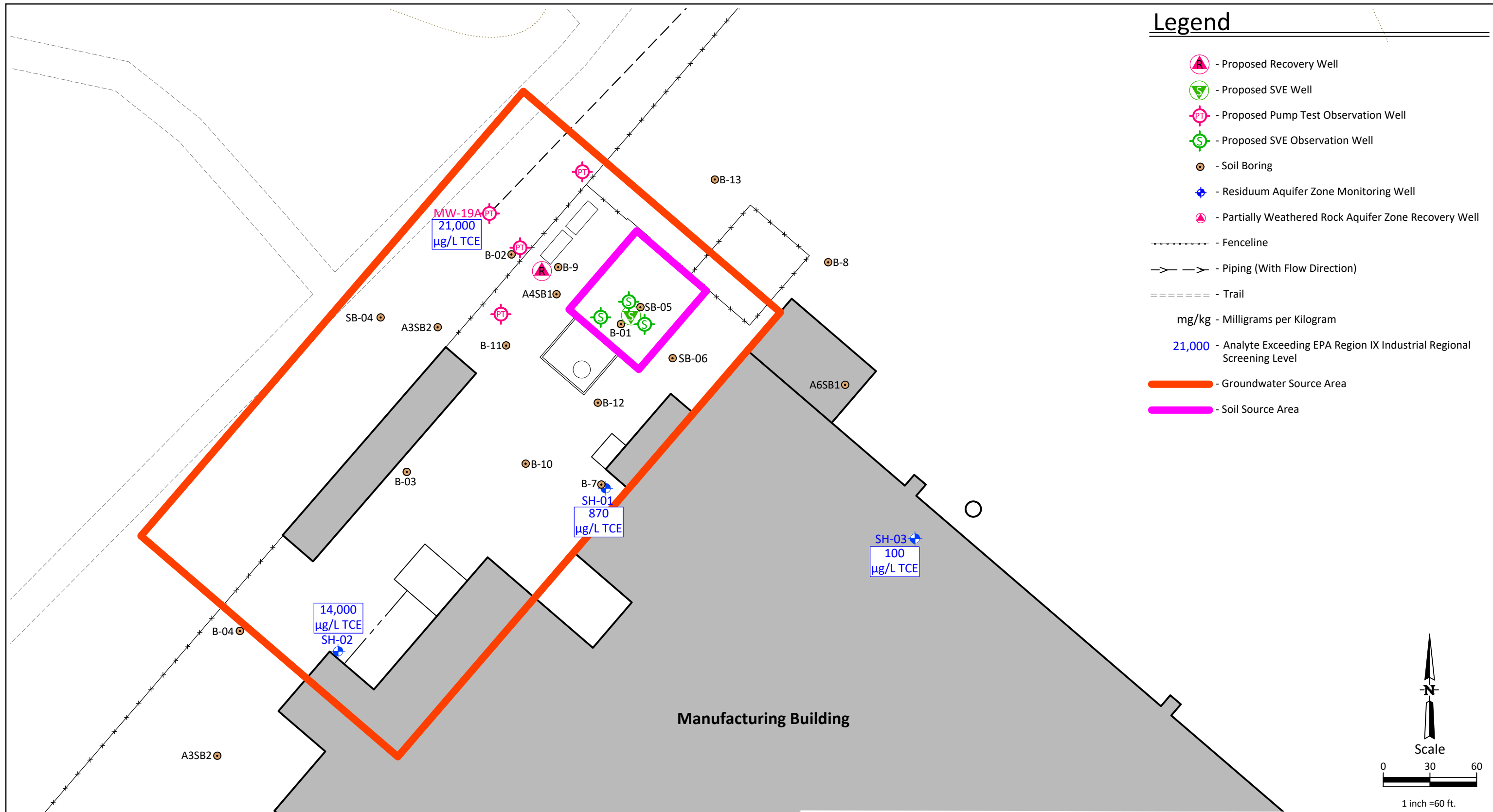
	B-01 (10/2016)	SB-05 (2006)
Depth	TCE mg/Kg	
0-1 ft.	0.089	--
5 ft.	0.54	--
10 ft.	57	93
20 ft.	3.0	--
~25 ft	Water Table	



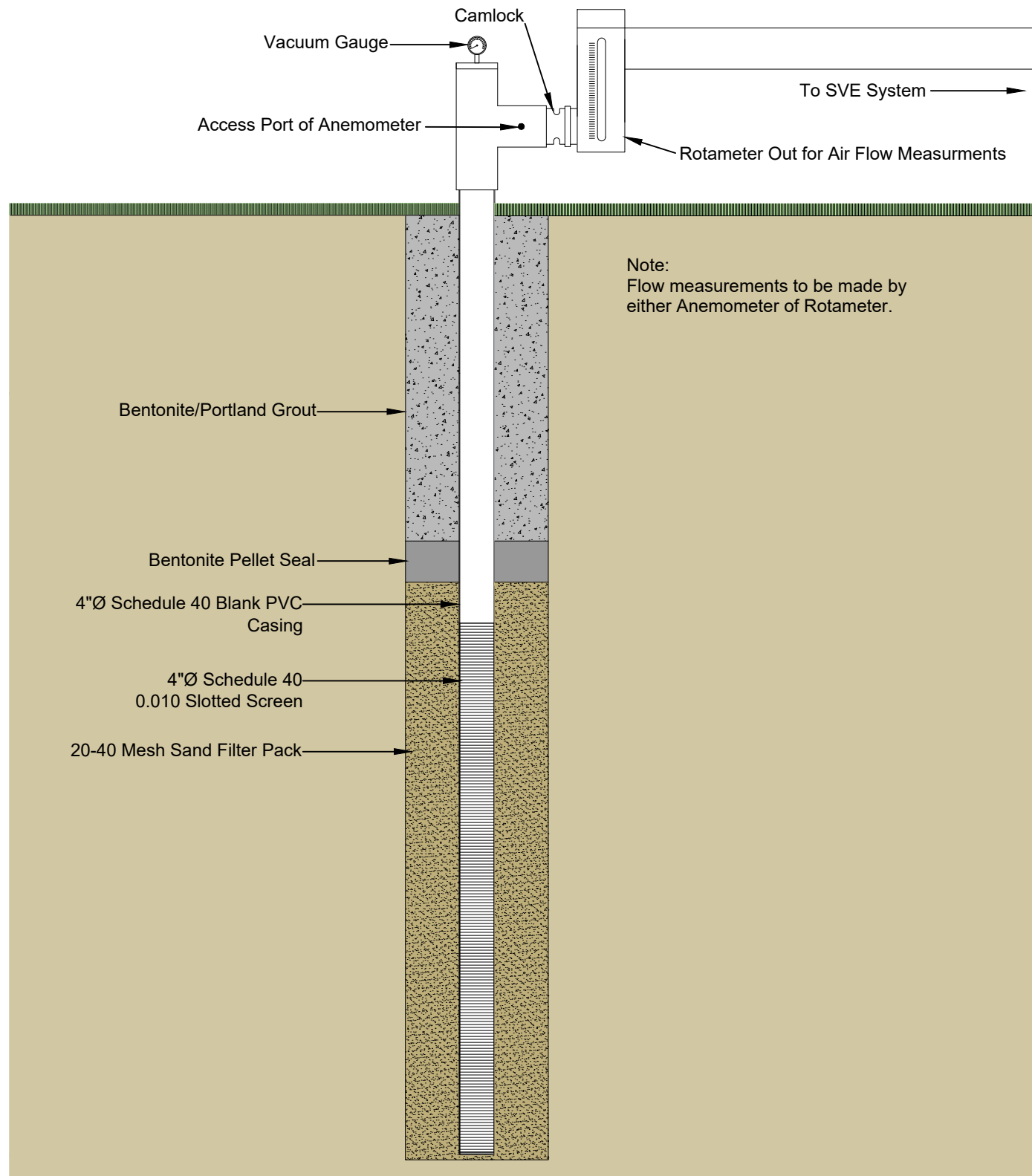
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Soil and Groundwater Source Area			Figure <b>4</b>
G:\DWG\1320-1802 Honea Path\02\04 Source Areas			

# Legend

- Proposed Recovery Well
- Proposed SVE Well
- Proposed Pump Test Observation Well
- Proposed SVE Observation Well
- Soil Boring
- Residuum Aquifer Zone Monitoring Well
- Partially Weathered Rock Aquifer Zone Recovery Well
- Fenceline
- Piping (With Flow Direction)
- Trail
- mg/kg - Milligrams per Kilogram
- 21,000 - Analyte Exceeding EPA Region IX Industrial Regional Screening Level
- Groundwater Source Area
- Soil Source Area



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PROJECT #:	1320-1802-2	DATE:	June 25, 2018
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CHECKED BY:	LM	SCALE:	1" = 2000'
PROJECT MGR:	LM	PRINTED:	6/25/2018 1:51 PM
<b>Proposed SVE Well, Recovery Well, and Observation Well Locations</b>			Figure <b>5</b>
G:\DWG\1320-1802 Honea Path\02\05 Proposed SVE Recovery and OB			



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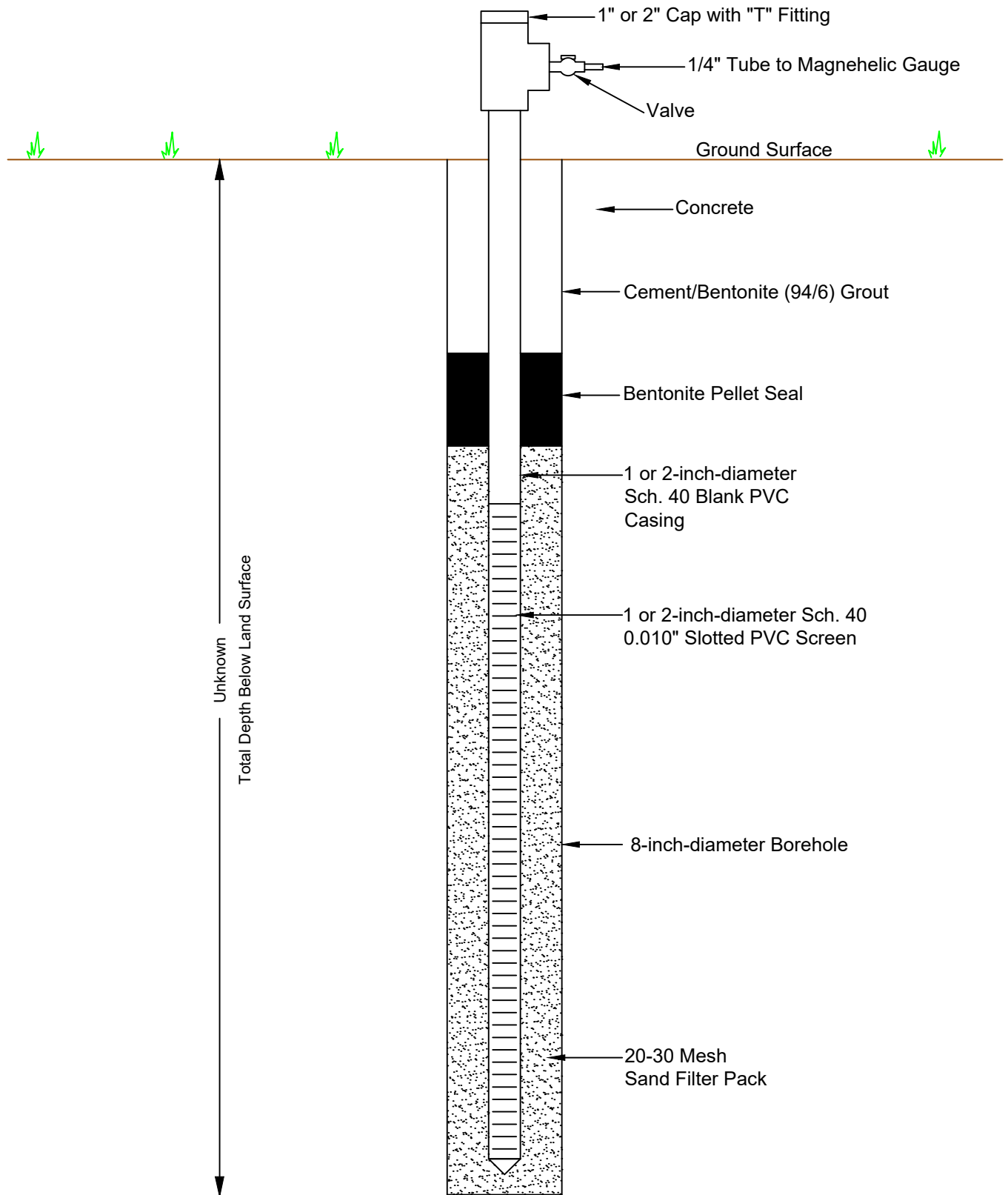
Honea Path Plant  
415 Brick Mill Road  
Honea Path, South Carolina

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Typical SVE Well Construction Diagram

Figure

6



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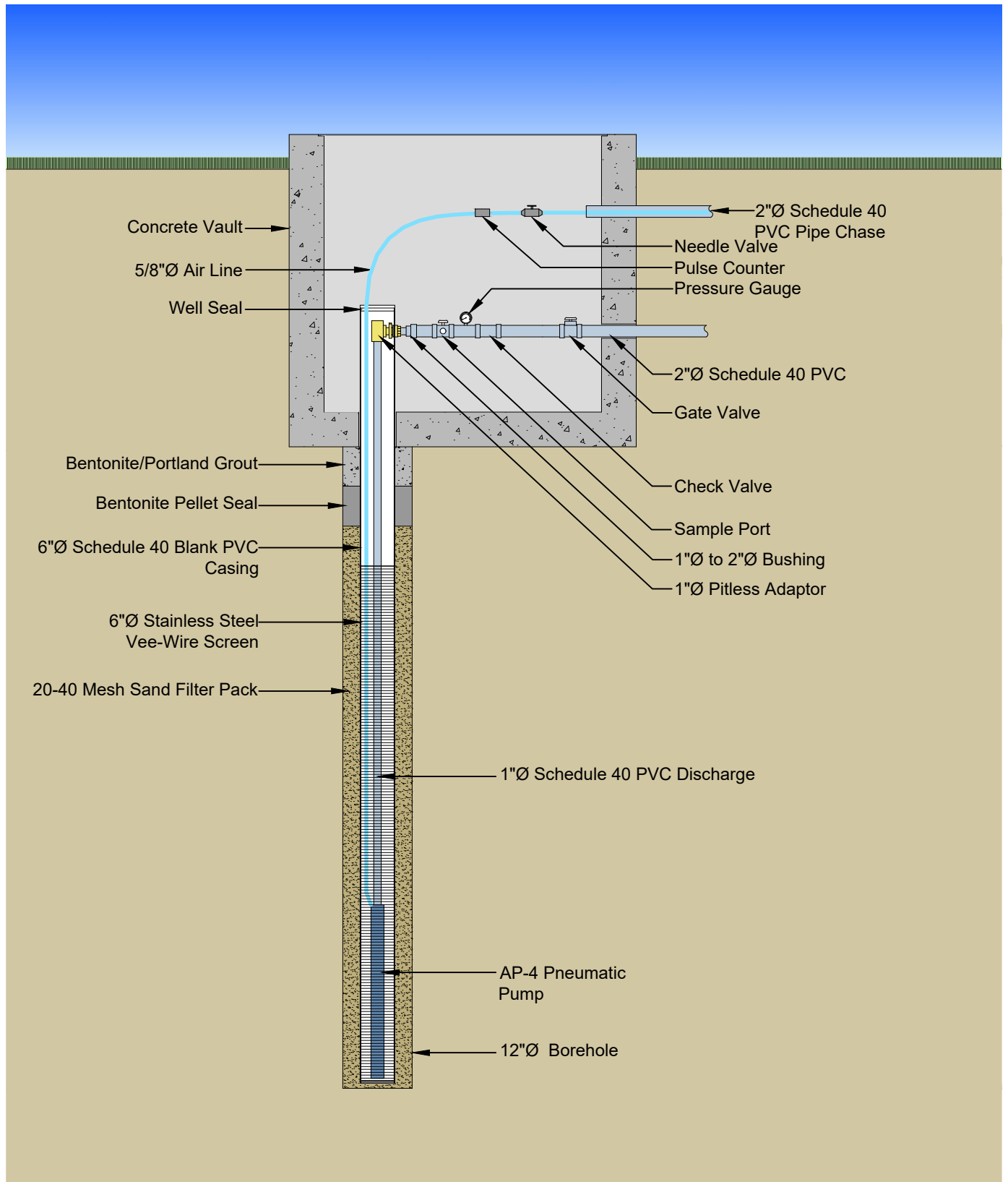
Honea Path Plant  
 415 Brick Mill Road  
 Honea Path, South Carolina

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Typical Observation Well Construction Diagram

Figure

7



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Typical Pneumatic Recovery Well  
 Construction Diagram

Figure

8