From: Edmund Q B Henriques <EHenriques@smeinc.com>
Sent: Friday, November 6, 2020 11:48 AM
To: Kuhn, Kimberly M. <kuhnkm@dhec.sc.gov>
Cc: Braswell, Bruce <BBRASWEL@marshfurniture.com>; Bumgarner, Bill <BBUMGARN@marshfurniture.com>; Stanford J Lummus <SLummus@smeinc.com>
Subject: Marsh Lumber - Feasibility Study (Revision#1)

Good morning Kim. Appended is the revised Feasibility Study for the Marsh Lumber VCC site. We are confident that the prior SCDHEC comments have been addressed. We look forward to SCDHEC approval of this milestone document and moving the project along through the process to obtain a Record of Decision and implementation of the selected remedy. Please review and let me know if you have any questions. Also, let me know if a paper copy is currently required by the Department. If required, I will have a paper copy prepared and transmitted by mail.

Kind Regards, Ed

Edmund Q.B. Henriques, P.G.
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BUILT FOR VERSATILITY

Feasibility Study(Revision#1)
Marsh Lumber
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

PREPARED FOR:

Marsh Furniture Company, Inc.
1001 South Centennial Street
High Point, North Carolina 27261

PREPARED BY:

S&ME, Inc.
301 Zima Park Drive
Spartanburg, South Carolina 29302

November 6, 2020

November 6, 2020

South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201-1708

Attention: Ms. Kim Kuhn transmitted by electronic mail to: kuhnkm@dhec.sc.gov

Reference: **Feasibility Study (Revision #1)**
Marsh Lumber - VCC Number 16-5858-RP
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Dear Ms. Kuhn:

S&ME, Inc. (S&ME) has prepared this Feasibility Study for remediation of groundwater contamination at the Marsh Lumber site, VCC number 16-5858-RP. As you will recall, during the October 9, 2019, meeting between representatives of Marsh Furniture Company, Inc. (MARSH), S&ME, and SCDHEC, mutual agreement was reached that the site assessment phase was sufficiently complete and the Bio-Sparging pilot tests had demonstrated favorable results. MARSH requested and verbal agreement was reached that MARSH could move forward with development of a Feasibility Study. MARSH has also communicated to SCDHEC that they are ready to move forward, as soon as possible, with implementation of final remedy.

Our original Feasibility Study was dated May 19, 2020. Feasibility Study (Revision#1) was prepared to address SCDHEC comments received on July 29, 2020. We believe this document addresses the SCDHEC comments and applicable regulatory requirements.

As previously presented, the preferred alternative is Air Sparging. Site specific pilot testing data obtained to date has shown very favorable results. For this preferred alternative, the existing pilot system would be expanded. New air sparging wells will be installed, and pneumatic tubing will be routed through trenches to a centralized control manifold. Air will be delivered by a rotary screw air compressor.

The system is anticipated to reduce the mass and concentration of chemicals of concern. A Site Management Plan will be developed that implements controls to reduce risks associated with residual chemicals of concern in site media and regulates activities that could interfere with the effectiveness of the remedy or cause migration of chemicals of concern. Groundwater monitoring will continue and will include monitoring of natural attenuation parameters as described below.

The modified groundwater monitoring program will likely include periodic sampling of selected wells for analysis of natural attenuation parameters (including carbon dioxide, dissolved oxygen, pH, temperature, specific conductance, oxidation/reduction potential, turbidity, nitrate, nitrite, total organic carbon, dissolved organic carbon, and chlorides).

S&ME appreciates your regulatory program oversight of this project. Please review this document and if you have questions or if you need additional information, please contact Edmund Henriques at 336-288-7180.

Sincerely,

S&ME, Inc.

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Appendices

1.0 Introduction

This report presents an evaluation of the feasibility of remedial alternatives for remediation of wood preserving chemicals at the Marsh Lumber Sawmill located in Pamplico South Carolina (the site, **Figure 1**). S&ME, Inc. (S&ME), has prepared this report on behalf of Marsh Lumber in accordance VCC 16-5858-RP The purpose of this report is to evaluate potential remedial technologies and develop alternatives to address Pentachlorophenol (PCP) that has been confirmed and persists in site groundwater .

This report is organized as follows:

- Site background, including a discussion of site history and previous environmental investigations, is presented in Section 2.0.
- Subsurface conditions, including lithology and the occurrence and movement of groundwater, are presented in Section 3.0.
- The nature and extent of PCP present in the vicinity of the former Green Chain and the chemicals of concern at the site are discussed in Section 4.0.
- Water well receptor survey results are discussed in Section 5.0.
- A preliminary risk assessment is discussed in Section 6.0.
- Interim Remedial Measures previously implemented at the site are discussed in Section 7.0.
- The remedial action objectives are presented in Section 8.0.
- The evaluation of remedial technologies for groundwater is presented in Section 9.0.
- Remedial action alternatives are compared in Section 10.0.
- References used in preparation of this report are listed in Section 11.0.

2.0 Site Background

The subject Marsh Lumber property is located at 119 Sixth Avenue, Pamplico, Florence County, South Carolina. The Property includes approximately 15 acres of an approximate 28 acre parcel identified by the County of Florence as Tax Map Series Number 60005-01-003 (the property does not include the portion of the parcel east of the railroad tracks). The current owner is listed as Marsh Furniture Company, Inc. (MARSH). The property is zoned industrial and occupied by MARSH operations. **Figure 2** was prepared from scans of 1988 As-Built survey drawings depicting the parcel outline and historic site buildings.

The site is in an area characterized by a mixture of residential and light industrial parcels. Based on a review of the Florence County, South Carolina G.I.S. website, the subject site is zoned light industrial. To the north across 7th Avenue, the site is bordered by a light industrial parcel containing a vacant building. To the east across the Seaboard Coast Line Railroad parcel is a Town of Pamplico maintenance operations building and vacant parcels, which are zoned light industrial. The area to the south across East 6th Avenue is composed of residential and light industrial properties. To the west across Marsh Road / N. Walnut Street are the Woodside Cemetery, a vacant woodland parcel, and a few residential parcels. **Figure 3** provides an aerial photograph covering the Marsh Lumber site and vicinity.

2.1 Site History

The following provides a condensed summary of relevant site history.

- On May 17, 1946, MARSH acquired the property from H.M Propst. The former owners had operated a plywood mill on the Property prior to MARSH's acquisition in 1946.
- MARSH's initial activities on the property included operation of a plywood mill up until the 1960s. MARSH constructed and began operation of the first sawmill in 1953. Following 1953, MARSH activities on the property have included lumber handling and storage, saw and dimension milling, and lumber treating and drying. The lumber treatment for the purpose of preventing mold and insect infestation included the use of a dip tank containing liquid sodium pentachlorophenol (PCP) and a drip pad located in an area called the "Green Chain Area." This was a common process for lumber mills during this period.
- A concrete pad was constructed beneath the Green Chain Area conveyor and a portion of the temporary wood drying/storage area sometime around 1987 to 1988. The concrete drip pad beneath the Green Chain was reportedly designed to channel residual wood preservative chemicals to a sump pump where excess liquids were pumped back into a storage unit in the dip tank area.
- The use of PCP-containing products was discontinued by MARSH in 1986 prior to EPA listing of certain wood preserving wastes as hazardous under RCRA in 1990 and the promulgation of RCRA regulation of drip pads in 1991.
- MARSH sawmill operations and associated non-PCP wood treatment activities ceased in 2007. Subsequently, the sawmill building and associated structures were dismantled.
- MARSH currently operates a dimension mill on the subject site. MARSH receives lumber for processing which is already kiln dried, and there is no treatment of lumber at the site.

2.2 Previous Environmental Investigations

Multiple and extensive environmental assessment have been completed at the site over the past 29 years. Most of the assessment work completed relates to the discovery, assessment, and remediation of PCP dissolved in groundwater beneath a portion of the site. The following provides a brief summary of relevant incident history.

- In 1991 a Preliminary Environmental Site Assessment performed on behalf of MARSH identified the Green Chain Area, shop area, and former underground storage tank (UST) areas as potential areas of concern.
- In 1992, a soil and groundwater assessment was initiated in the three areas of concern identified in the 1991 ESA.

  1. Shop Area: In 1992 and 1993, Total Petroleum Hydrocarbons (TPH) were detected in the soil in the shop area; however, petroleum constituents were not detected in the groundwater.
  2. Former UST: In 1992, benzene, toluene, ethylbenzene and xylenes were detected in the soil at the former UST area and groundwater results indicated benzene, toluene, and ethylbenzene in this area. The notice of this release was forwarded to SCDHEC's UST section in September 1993. Further assessment of the UST release was conducted between 2002 and 2004. The UST incident was closed by SCDHEC in 2004 and the monitoring wells were properly abandoned.
  3. Green Chain Area: Beginning in 1992, the soil and groundwater were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, tentatively identified compounds, and the eight Resource Conservation and Recovery Act (RCRA) metals. Multiple soil

samples were collected in the Green Chain Area and the treated wood storage area to assess source and secondary source area contamination. The soil samples were analyzed for base-neutral/acid extractables (no target compounds including PCP were detected) and metals (no results exceeding background). Several tentatively identified compounds (TICs) were reported, however. PCP was detected in the groundwater at concentrations exceeding the Maximum Contaminant Levels.

- Subsequent to 1993, MARSH conducted assessments to identify the source, nature and extent of PCP contamination at the site and implemented remedial measures to address the contamination.
- January 1998, SCDHEC issued a Consent Order to MARSH
- June 1999, a Site Assessment Report was submitted to SCDHEC.
- In 2000, SCDHEC approved semi-annual surface water and groundwater monitoring.
- January 2007, SCDHEC requested an additional down-gradient sentinel well.
- March 2009, MARSH initiated the first bio-sparge pilot test to determine whether this would be a viable remedy for reducing PCP concentrations.
- In March 2013, MARSH was invited by SCDHEC to enter the Department's voluntary cleanup contract (VCC) program in order to reach a CERCLA-quality cleanup at the site.
- In May 2016, MARSH entered into VCC 16-5858-RP with SCDHEC, which involved the assessment phase of work for the PCP incident.
- In 2016 South Carolina Department of Transportation (SCDOT) agreed to relocate the storm water drain line which traverses the site and re-route the line within the road right-of-way.
- In October 2016 a second bio-sparge pilot test was initiated to further evaluate the technology as a viable remedy for reducing PCP concentrations. The pilot test was modified in 2018, to include five additional bio-sparge injection wells. Pilot testing continues to date.
- Between 1998 and 2019, multiple additional soil and groundwater assessment activities were conducted to refine an understanding of the source, nature and extent of PCP contamination at the site
- S&ME's *Investigation Report* dated February 25, 2020, summarized site investigations and findings.

The VCC 16-5858-RP, which covers the PCP incident, is the subject of this feasibility study.

3.0 Subsurface Conditions

Subsurface conditions at the site, including lithology and the occurrence and movement of groundwater, are presented in this section. Subsurface conditions at the site were previously investigated and described in detail in S&ME's *Investigation Report* dated February 25, 2020.

3.1 Geology

The subject site is located within the Atlantic Coastal Plain Physiographic Province. The coastal plain is a gently rolling flat region underlain by a wedge of unconsolidated to semi-consolidated, predominantly clastic sedimentary rocks that range in age from Cretaceous to Holocene. The sedimentary package thickens seaward from a feather edge at their up-dip limit.

Soils in this region are generally interbedded silts, sands, and clays that have been deposited during successive advances and retreats of the ocean over the past several million years. The marine deposits located near rivers and creeks have been eroded and may be overlain by alluvial deposits.

The Town of Pamplico lies on one of a series of nearly level beach terraces formed in the relatively recent geologic past. These terraces have been extensively mapped and are generally identified based on surface elevation (Law Engineering, 1993). Downtown Pamplico and the surrounding area were mapped as part of the Wicomico Terrace. Terrace deposits are typically 40 to 50 feet in thickness and overlie more ancient, consolidated or lithified strata below. The terraces soils are typically characterized by relatively sandy soils near the southeast margin of the terrace. The soils become increasingly clayey in composition proceeding to the northeast, toward the upper margin of the terrace, reflecting an archaic back-bay depositional deposit.

In 1998, it was recognized that the stratigraphy of the site's coastal plain sediments could influence migration and distribution of PCP in the water table aquifer. The 1993 Law Engineering investigations focused primarily on the water table aquifer, with only one boring extended deeper than 20 feet. Between 1999 and 2006, S&ME utilized direct push macro core sampling tools to collect soil cores for geologic descriptions at 44 probe locations and to delineate the distribution of PCP in groundwater.

The uppermost stratigraphic unit at the site consist primarily of an unconsolidated package of sediments primarily classified as silts, clays, clayey silts, sandy silts, and silty sands. The lithologic descriptions do not suggest any distinct lateral continuity of most lithologies. The uppermost stratigraphic unit overlies a relatively continuous clay-rich layer commonly occurring at approximately ±18 feet below land surface (bls.), which overlies a distinct gray semi-consolidated, calcareous, fossiliferous, silty sand unit. The thickness of the clay-rich layer varies, and it appears to pinch and swell on a local scale as one might expect in an archaic *back-bay* sedimentary deposit. The clay-rich layer does exhibit some variability in clay and sand content. In some locations the material may be described as a clayey sand rather than a sandy clay.

The locations of soil borings and direct-push borings completed for this site assessment are depicted on **Figure 4**.

3.2 Hydrogeology

The surficial aquifer is the saturated zone that underlies the land surface and is generally very shallow in the region. It is the first aquifer to receive recharge from precipitation. This recharge water is stored in the surface aquifer as the groundwater migrates toward local discharge points (streams, lakes, or rivers). A portion of the groundwater in the surficial aquifer migrates vertically to recharge deeper, confined to semi-confined aquifers (Campbell and Coes, 2006). On average, only a fraction of the surficial aquifer recharge reaches the deeper aquifers. This often reflects the influence of confining and semi-confining layers, and the substantial amount of time it takes for groundwater to reach these deeper units. The deeper aquifers tend to be less susceptible to contamination from the surface; therefore, they are more often used in the region as potable water sources.

Based upon the topography of the subject site, groundwater flow is anticipated to mimic topography, flowing down dip, perpendicular to topographic contour lines. On this basis, shallow groundwater beneath the site would be forecast to flow generally west/southwest toward the adjacent unnamed tributary of Big Swamp Branch.

Groundwater elevation data collected during multiple prior groundwater monitoring events indicated similar shallow groundwater flow directions.

The water table aquifer in the study area is composed of interbedded layers of silts, clays, clayey silts, sandy silts, and silty sands, with no distinct lateral continuity of the upper most layers. Aquifers composed of layered sediments often exhibit greater vertical than horizontal anisotropy.

In the studied area a clay-rich layer forms the bottom of the water table aquifer. Based upon groundwater analytical data obtained during the 1999 investigations, the clay-rich layer appeared to limit the vertical migration of dissolved phase PCP in the groundwater beneath the studied area. Undulations in the top of the clay-rich layer could influence the migration of dissolved-phase PCP in the water table aquifer, possibly providing migration pathways that might deviated from those expected based solely on hydraulic gradients. Stratigraphic information gather from direct push macro core sampling was used to map approximate elevations of the top of clay-rich layer, which was found to exhibit varying topography, as depicted in **Figure 5**. Two noteworthy low points in the top of the clay-rich layer were discovered. One in the vicinity of monitoring well MW-1 at the Green Chain Area and the other in the vicinity of monitoring well MW-13A.

The working conceptual site model considered that the distribution of groundwater PCP concentrations may corroborate the existence of a preferential flow path associated with the slope of the top of the clay-rich layer. For example, typical groundwater gradients observed would infer migration from the Green Chain Area, generally westward toward the unnamed tributary to Big Swamp Branch. Deviating from this were the relatively higher PCP concentrations observed in the vicinity of monitoring well MW-14/MW-14A, located somewhat cross-gradient of anticipate groundwater flow based on observed piezometric heads.

3.3 Occurrence and Movement of Groundwater

During each groundwater monitoring event, depth to groundwater data was collected. The depth to groundwater and top of casing elevation data were used to calculate the groundwater elevations at the monitoring wells**.** **Table 1** provides groundwater elevation data for the March 2020 monitoring event. **Figure 6** depicts the groundwater surface contour map prepared using data collected in March 2020. The groundwater contours suggest that groundwater flow in the water table aquifer would generally migrate toward the west. This flow direction is generally consistent most prior monitoring events. Groundwater elevation contour drawings prepared for the numerous monitoring events have shown some variations in estimated flow directions, but none are considered significant.

In situ hydraulic conductivity tests were performed on wells MW-1, MW-3A, MW-10, MW-17, MW-22, and MW-23. These rising head slug test results were analyzed using the Bouwer and Rice (1976) method, used to calculate hydraulic conductivity values for water table aquifer at these locations. The data from these tests yielded hydraulic conductivity values summarized in **Table 2**. The hydraulic conductivity values obtained ranging from 0.245 feet/day at monitoring well MW-3A to 3.183 feet/day at monitoring well MW-13.

The groundwater elevations calculated for the March 14, 2018; monitoring event were utilized to assess local groundwater gradients in the vicinity of monitoring wells assessed for hydraulic conductivity. This monitoring event was selected, given that it involved gauging depths to groundwater at most monitoring wells with hydraulic conductivity estimates. Groundwater gradients estimates are summarized in **Table 2**.

Calculated hydraulic conductivity, gradient values, and estimates of effective porosity were used to calculate seepage velocity estimates. A 30 percent effective porosity value was selected for these calculations. It is recognized that effective porosity values will vary with the various sediments that make up the water table aquifer. As summarized in **Table 2**, the calculated groundwater velocities ranged from 0.009 feet/day to 0.132 feet/day.

4.0 Nature and Extent of Wood Preservative Chemicals

The occurrence of wood preservative chemicals in soil, groundwater, and surface water at the site has been assessed through numerous investigations (see Section 2.2). The results of these investigations are summarized below.

4.1 Chemical of Concern

Based on the results of previous investigations, the chemical of concern at the site for this feasibility study is the PCP historically used as a wood preservative chemical at the site.

4.1.1 Physical and Chemical Properties

The physical and chemical properties of PCP provide useful information for determining fate and transport. PCP has a very low vapor pressure and water solubility but is highly soluble in fatty substances (lipophilic) and has high octanol-water partition and soil adsorption coefficients. As a result, PCP is likely to be present only at trace concentrations in the atmosphere or dissolved in water.

4.1.2 Fate and Transport

Based on its physical and chemical properties, PCP tends to bind to organic materials and particulate matter. Consequently, this compound exhibits limited partitioning to water that contacts impacted soil, sediments, or woody material, and thus exhibit limited mobility as aqueous constituents in the subsurface. These compounds can, however, be mobilized by surface water and groundwater flow while bound to entrained sediments and particulate matter.

4.2 Soil

Soil assessment activities were conducted by Law Engineering in 1992 and 1993. During January 1992, Law Engineering completed four hollow-stem auger borings and four shallow hand-auger boring to initiate an investigation into potential soil impacts. The collected soil samples were submitted for analysis by Method 8270 for the detection of SVOCs. During October 1993, Law Engineering completed four additional hand-auger borings in the Green Chain Area to aid in the delineation of source area soil impacts. At each of the four soil boring locations, a soil sample collected one foot below the ground surface was submitted for laboratory analyses according to Method 8270 for SVOCs and for the eight RCRA metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury).

Law Engineering data summarized in **Table 3** and **Table 4** documents analytical results of soil samples analyzed for SVOCs. PCP was not detected in the samples collected.

In 2016, SCDHEC requested that the VCC assessment include the collection of a limited number of soil samples to further assess soil impacts in the former Green Chain area. Following termination of sawmill operations in 2007, the sawmill building and Green Chain concrete pad were removed. These site changes made it practical to obtain soil samples from areas previously beneath the Green Chain and conclude assessment of source area soils as a secondary source of PCP to the underlying groundwater.

During September 2016 eight soil samples were collected in the Green Chain area. **Table 5** provides a summary of 2016 analytical results for SVOCs by Method 8270 and provides corresponding RSLs for comparison.

- PCP was detected in sample GC-2-1, representing the 0.5 to one foot bls interval at probe location GC-2. The detected concentration was less than the corresponding Industrial Soil screening level and greater than the corresponding Residential Soil screening level. PCP was not detected in the deeper sample (GC-2-6) representing 5.5 feet to six feet bls.
- 2, 3, 4, 6-Tetrachlorophenol was detected in sample GC-1-1, representing the 0.5 to one foot bls interval at probe location GC-1. The detected concentration was greater than the corresponding Residential Soil screening level but less than the Industrial Soil screening level. 2, 3, 4, 6-Tetrachlorophenol was not detected in the deeper sample (GC-2-6) representing 5.5 feet to six feet bls. This compound is a probable first-order PCP degradation daughter compound.
- No other SVOCs were detected in the remaining soil samples.

Probe location GC-1 was at the former PCP dip tank and probe location GC-2 was approximately 68 feet northwest of the former dip tank, down the alignment of the former Green Chain drip pad. Based on the sampling conducted, the extent of soil impacted by SVOCs at concentrations greater than corresponding Residential Soil screening levels but less than the Industrial Soil screening levels is limited. Given the paucity of SVOC detections in soil samples, the industrial land use of the site, and the absence of a SVOC concentration greater than the corresponding EPA RSL for Industrial Soil, a drawing depicting the SVOC detections was not prepared. Soil sample locations are depicted on **Figure 4**.

4.3 Groundwater

Assessment of the extent of groundwater impacts included collection of samples using direct push discrete interval sampling tools and samples obtained from permanent monitoring wells. Considering the potential for PCP to sink in groundwater, the groundwater quality sampling strategies employed targeted collection of groundwater samples just above the clay-rich layer underlying the water table aquifer, with fewer samples collected below the clay-rich layer to assess the vertical extent. The VCC assessment primarily focused on delineation of PCP in groundwater. The locations of monitoring wells are depicted on **Figure 6**, whereas historic direct-push groundwater sample locations are provided on **Figure 4**.

The vast majority of groundwater samples collected were analyzed for SVOCs by Method 8270, with PCP as the primary consistent of concern. Method 8270 was historically considered appropriate for assessing the extent of PCP and potential PCP breakdown compounds; therefore, it was specified in each approved VCC Work Plan. It is documented that Method 8270 cannot achieve the Maximum Contaminant Level (MCL) for PCP established at 1 µg/L. Method 8151 can achieve a reporting limit of 1 µg/L or less for PCP; however, this test method does not report other potential PCP breakdown compounds.

Recognizing that prior to selection of the final remedy, delineation of the extent of the PCP plume to the level of the PCP MCL, groundwater monitoring events conducted in 2019 and 2020 incorporated groundwater samples analyzed by Method 8151.

Table 6 provides a summary of the SVOC groundwater analytical results obtained from direct push grab samples obtained during 1999. They provided a solid basis for the preliminary vertical and horizontal delineation of the PCP plume. **Table 7** provides a summary of the SVOC groundwater analytical results for the most recent sampling event completed during March 2020 and includes some historic analytical results for select monitoring wells. The S&ME's *Remedial Investigation* report dated February 25, 2020 provides a comprehensive look at historic groundwater data dating back into 1992.

Groundwater analytical data for the March 2020 monitoring event defined the horizontal extent of PCP, with PCP was reported as less than 1 µg/L at monitoring wells MW-3A, MW-11, MW-13A, MW-14A, MW-15, MW-16, MW-18B, MW-19, MW-20, MW-21, MW-23, MW-24, and MW-26. The water table aquifer impacts are delimited on-site and are not known to reach on-site surface water receptor, Big Swamp Branch, as indicated by analytical results for monitoring well MW-18B. **Figure 7** depicts a conservative estimate of a 1 µg/L PCP isoconcentration line for the PCP plume. **Figure 8** and **Figure 9** provides cross-sections A-A' and B-B' depicting subsurface stratigraphy and recent groundwater PCP concentrations at each monitoring well shown.

The vertical extent of PCP in groundwater was previously defined by analytical data for monitoring well MW-8, and historic grab groundwater samples obtained from direct push tools at sample locations GP-1-30, GP-2-24, DS-1, DS-2, and DS-3D. The laterally continuous clay-rich layer at depth is thought to reasonably restrict the vertical migration of PCP below this layer.

Based on trends of PCP concentrations over time, the plume appears to be generally stable if not naturally attenuating before it reaches surface waters of the unnamed tributary to Big Swamp Branch.

4.4 Surface Water

The assessment of surface water quality began in December 2005, with the collection of surface water samples at points along the unnamed tributary of the Big Swamp Branch, located along the southern and western portions of the site. One segment of the stream flows within a storm drain conduit, which originates up stream of the PCP plume. Another segment of the stream exists as open channel flow down-gradient of the PCP plume, in an area of expected shallow groundwater discharge. Surface water sample location SW-1 represents water quality up-gradient of the PCP contaminant plume. Surface water sample location SW-2 represent surface water quality near the expected discharge area for the shallow groundwater PCP plume. Sample location SW-3 is approximately 400 feet down stream of location SW-2, just prior to the stream leaving the site. A fourth surface water sample location, referred to as SW-4, was involved in the assessment between June 30, 2013 and February 18, 2019. Sample location SW-4 represents surface water quality at the point water leaves the piped stream segment, down-stream of sample location SW-1. The surface water sample locations are shown in **Figure 6**.

Table 8 provides a summary of historic surface water analytical results. Analytical results from the March 2020 monitoring event reported PCP concentrations less than 1 µg/L at surface water sample locations SW-1, SW-2, and SW-3. Based on the anomalous detection of an estimated concentration of PCP at upstream sample location SW-1, a verification sampling event was conducted on April 9, 2020. Analytical results for the verification sampling event did not detected PCP in the record sample or duplicate sample obtained at sample location SW-1.

5.0 Water Well Receptor Survey

A complete discussion of methods, means, and findings of the most recent water well receptors survey were summarized in S&ME's *Water Well Receptor Update*, dated March 27, 2019. The water table aquifer at the subject site is not known to be used as an underground source of drinking water (USDW). In general, the deeper Black Creek unit is more commonly used as a USDW in the Pamplico area. A clay-rich layer found to underlie the study area has limited vertical migration of PCP, with the upper most portion of the surficial aquifer being the only impacted aquifer unit.

MARSH used an on-site water well solely to provide water for the facility's boiler and to provide water used to spray on stored logs to maintain moisture prior to processing logs in the saw mill. The well is located topographically upgradient of the PCP plume, adjacent to the boiler room. The on-site water supply well was tested numerous times, with analytical results consistently reporting no detectable concentrations of compounds on the Method 8270, acid extractable, Priority Pollutant List. Closure of the saw-mill operations eliminated the need to spray stored logs. MARSH operations no longer include operation of the boiler; therefore, the on-site well has been out of use for several years, and the well pump is currently inoperable.

The Town of Pamplico provides water to residents and businesses in the Town. The Town of Pamplico utilizes three wells for the potable water system. Well No.1 is located at River Road and Lewis Road, approximately 0.85 mile to the east southeast of the site, Well No. 2 is located at Highway 51 in Hyman, approximately 1.75 miles to the west of the subject site, and Well No. 3 is located at the corner of Trade Street and First Avenue approximately 0.46 mile to the southeast of the site. Well No. 1 and Well No. 2 are the primary wells used and the system rotates these wells off and on for rest time. Well No. 3 is reportedly active but only used as a backup. The Town's wells draw water from the deeper aquifer units. Given that potable water is provided by the Town of Pamplico, the potential future use of the shallow aquifer in the immediate vicinity of Marsh Lumber as a drinking water source is presumed to be low.

Figure 10 depicts the approximate location of water wells identified during 2019. The well identification numbers shown on **Figure 10** are keyed to information presented in **Table 9**. Water wells with MAP ID# FLO-1 through FLO-6 are located north of the subject site along Marsh Road represent rural residential properties that are located outside of the Pamplico Town limits. Wells FLO-2 through FLO-6 are located on the opposite side of the unnamed tributary to Big Swamp Branch.

Based on groundwater samples obtained from monitoring wells, PCP impacts are limited to the surficial aquifer, with horizontal extents delimited to the Marsh Lumber site.

6.0 Preliminary Risk Assessment

A preliminary risk assessment was summarized in S&ME's *Investigation Report – Marsh Lumber VCC*, dated February 25, 2020. In developing the preliminary risk assessment, it was assumed that the future use of the site will remain industrial. As previously presented, PCP was identified as the constituent of concern. Media with confirmed PCP impacts are limited to soil and groundwater. The following summarizes documented impacts to these media.

- No SVOCs were detected at concentrations that exceeded the corresponding EPA RSL for industrial soils. Detected SVOC concentrations were generally 50% or more below the industrial soil RSLs. Surficial soil impacts were limited and only detected in the area of the former dip-tank in the Green Chain Area
- PCP has been detected in groundwater at concentrations that exceed the corresponding MCL. Surface water analytical results provide no confirmed PCP impacts. This finding is consistent with the delineation of groundwater PCP impacts on-site, with PCP not detected in monitoring wells at the shallow groundwater discharge point.

Figure 11 provides a chart depicting a preliminary conceptual model. Considering the limited extent of soil PCP impacts and the industrial usage of the site, site worker exposure scenarios are unlikely; and if warranted, could be managed with institutional controls. Considering the PCP concentrations, relatively flat site topography and sandy soils, surface runoff from PCP impacted soils is an unlikely transport mechanism. Human ingestion or dermal exposure to PCP in groundwater as a drinking water source is an exposure route. Considering that the PCP plume is contained within the subject site and the nearest known active water supply wells are approximately 0.5 mile away, the human receptor pathway is currently incomplete.

7.0 Interim Remedial Measures

Two bio-sparge pilot tests were performed at the site to examine the potential effectiveness of the methodology for the reduction of PCP in shallow groundwater, with the added benefit of reduced PCP concentrations within the test areas. The following provide a brief summary of each pilot test. Prior assessment reports provided greater detail and discussion of data received.

Bio-sparge Pilot Test #1

During 2009, the first pilot test was initiated in the area down-gradient of the Green Chain Area and up-gradient of monitoring well MW-3, in what was the core of the shallow groundwater PCP plume. For the baseline start-up sampling event and subsequent monitoring events, groundwater analytical results for monitoring well BSW-2, located approximately 18 feet from injection well BSW-1, reported PCP as not detected. The non-detection of PCP prevented an assessment of potential PCP concentration reductions close to the injection well, although the data verified non-detection of PCP immediately down-gradient of the Green Chain.

It was noteworthy that since 2009, PCP concentrations declined by 98% (268 µg/L down to 5 µg/L) at monitoring well MW-3, located approximately 40 feet down-gradient of injection well BSW-1. Groundwater analytical results for monitoring well MW-3 provided evidence of sustained PCP reductions, which persist to date, approximately seven years following termination of the pilot test in 2013.

Bio-Sparge Pilot Test #2

With the success of the first pilot test, a second bio-sparge pilot test was conducted in the region up-gradient of monitoring well MW-14, which represented a known core of the dissolved-phase PCP plume. The goal was to collect data from a long-term pilot test that could be utilized in the ensuing analysis of remedial alternatives.

Bio-sparging Pilot Test #2 was initiated on October 24, 2016. With well BSW-3 as the injection well, monitoring wells MW-10, MW-14/MW-14A, MW-15, MW-21, MW-22 and MW-23 represented the network utilized to assess changes in groundwater PCP concentrations.

During 2017, additional monitoring wells were installed to refine delineation of the extent of PCP in groundwater in the vicinity of monitoring wells MW-14/MW-14A and MW-22 located within the core of the pilot test area. The additional assessment improved delineation of PCP within the pilot test study area, which in turn guided the decision to add five bio-sparge injection wells and revise the pilot test groundwater monitoring plan.

Based on a Work Plan approved by SCDHEC, the pilot test program was expanded to include five additional bio-sparge wells to enhance the area of groundwater treatments. On May 25, 2018, operation of the expanded bio-sparge pilot test wells system was commenced and bio-sparge operations continue to date.

Based on groundwater analytical data for monitoring well MW-14A, PCP concentrations were reduced from 214 µg/L prior to the pilot test, down to less than 0.5 µg/L. PCP has not been detected at monitoring well MW-14A for the last three monitoring events, which span approximately a year. Observed changes in PCP concentrations over time at monitoring wells MW-22, MW-25, and MW-27 demonstrate generally consistent reductions in PCP concentrations during pilot testing.

8.0 Remedial Action Objectives

The remedial goals for the site are to comply with appropriate SCDHEC requirements to protect human health and the environment and implement a final remedy that does not have a detrimental impact on the surrounding community and surface water. To accomplish this goal, a preferred remedial alternative will be recommended for implementation at the site based on an evaluation of remedial action alternatives. The remedial action objectives for the site are to reduce the mass of chemicals of concern in groundwater and to reduce the potential for off-site migration of chemicals of concern in groundwater to adjacent surface water.

8.1 Remedial Cleanup Goals

The following provides a summary of the remedial cleanup goals for media with known impacts:

Groundwater

- Pentachlorophenol: 1 µg/L or as closely thereto as is technologically feasible, and

Surface water

- Pentachlorophenol: 1 µg/L or as closely thereto as is technologically feasible,

Soil

- Pentachlorophenol 4,000, µg/kg and 2,3,4,6-Tetrachlorophenol 25,000 µg/kg.*

*These soil remedial cleanup goals are the EPA Regional Screening Levels, for Industrial Soil, which have been achieved.

9.0 Evaluation of Remedial Action Alternatives

9.1 Evaluation Criteria

The remedial action alternatives evaluation was based on the following criteria:

1. Effectiveness: Ability of the remedial action alternative to meet the remedial action objectives, protect human health and the environment, comply with regulatory requirements, be effective in the long and short term, and reduce toxicity and mobility of chemicals of concern at the site.
2. Implementability: Technical and administrative feasibility, including the availability of the selected technologies; the availability of materials, equipment, and labor necessary to implement the technologies; level of disruption to site activities; regulatory requirements and permitting considerations; community acceptance; and the potential effects on human health during construction and implementation.
3. Cost: The total project cost of the alternatives will be considered, including capital and operations and maintenance costs incurred during the project duration.

Descriptions and detailed evaluations of the remedial action alternatives developed are presented below (Sections 9.2 through 9.6).

9.2 Alternative A: No Action

The No Action alternative is a remediation response for site groundwater that would not employ an engineered treatment of the associated contaminants of concern (COCs). The remedial option relies on natural attenuation mechanisms to reduce contaminant concentrations. Groundwater concentration migration or reduction is not tracked by sampling and analysis.

Effectiveness

For the No Action Alternative, groundwater contaminant reductions can be reasonably expected due to naturally occurring processes, including non-destructive (e.g. dilution, dispersion) and destructive (e.g. biodegradation) attenuation. The persistence in PCP and its degradation products in groundwater indicates that contaminant concentration reductions may be protracted. Therefore, the short-term effectiveness is expected to be low, but long-term effectiveness is expected to be moderate. Should No Action be implemented as the selected alternative, the risk to human health and the environment is considered moderate due to the potential of the contaminants reaching the unnamed creek on the western portion of the site.

Implementability

The No Action alternative doesn't include design, permitting, equipment purchase, or construction activities. Therefore, the No Action alternative is implementable.

Cost

Costs associated with the No Action alternative include abandonment and removal of all monitoring wells, remediation wells, and equipment associated with the existing remediation pilot system, and preparation of a site closure report. The cost of this alternative is approximately $25,000.

9.3 Alternative B: Monitoring Natural Attenuation (MNA)

MNA relies on natural attenuation processes to achieve site-specific goals within a reasonable time. These include physical, chemical, and/or biological processes. Under favorable conditions, contaminant mass and concentration in the groundwater are reduced. *In-situ* groundwater processes may include contaminant biodegradation, dilution, volatilization, or transformation. Groundwater concentrations and certain physical/geochemical parameters are monitored to determine the effectiveness of natural attenuation. In some site-specific cases, microbiological sampling may be employed to determine if populations are available and/or thriving. In a favorable environment, the *in-situ* processes resulting in destructive and nondestructive attenuation may result in the reduction of contaminant concentrations below target levels at a cost significantly less than an active remediation alternative.

Effectiveness

PCP has been shown to aerobically degrade but may do so at lower rates than other widely-encountered volatile and semi-volatile contaminants. Dissolved oxygen (DO) and oxidation reduction potential (ORP) measurements collected at the site during regular monitoring intervals revealed that anaerobic conditions are present downgradient, in front of the leading edge of the estimated contaminant plume in certain wells (MW-15, MW-20, MW-23, MW-24, MW-30). Monitoring wells located within the highest concentration and upgradient areas exhibit potentially aerobic conditions as evidenced by highly positive ORP readings. Even though DO measurements are relatively low (MW-10, MW-16, MW-21, MW-22, MW-27, MW-28, MW-29), MNA may be occurring aerobically. Chlorine is a strong oxidizer, with ORP ranging from 650 mV – 750. Positive ORP values within the influence of the sparging system likely indicate that aerobic degradation is occurring through the release of chlorine ions causing the positive ORP values. As in Alternative A, persistence in PCP and its degradation products in groundwater indicates that contaminant concentration reductions may be protracted. Therefore, the short-term effectiveness is expected to be low, but long-term effectiveness is expected to be moderate.

Implementability

MNA could be implemented immediately. Currently, standard analytical methods and equipment are used to monitor the existing monitoring wells. The monitoring well network is sufficient to implement MNA without the need for additional monitoring points. In addition to field measurements during sampling events, additional MNA parameters would be added to the list of analytes to monitor *in-situ* processes that result in contaminate degradation. This alternative is implementable.

Cost

MNA costs are relatively low when compared to other more active/aggressive remedial alternatives. The current monitoring well network will be reduced to an appropriate level for MNA. MNA effectiveness evaluation parameters increase analytical costs. The annual cost to implement the MNA alternative would be approximately

$25k. Project duration is anticipated to be 30 to 40 years, during which a monitoring well sampling and reporting schedule will be maintained. The cost of this alternative includes sampling and reporting cost of $25k per year for 40 years and monitoring well abandonment of $25k at the project termination, for a total cost of $1025k.

9.4 Alternative C: Groundwater Extraction and Pre-treatment by Granular Activated Carbon (GAC)

The groundwater extraction and *ex-situ* treatment involves extraction/recovery wells equipped with submersible pumps used to withdraw contaminated groundwater. The location of these wells is dependent on anticipated capture zone. Vertical extraction wells are normally used to accomplish the recovery. The recovered groundwater is conveyed through a piping network and routed to a pre-treatment compound. At the pre-treatment compound, the recovered groundwater passes through GAC causing mass transfer of contaminants from water to the filter media.

The contaminants are not destroyed by the GAC, but are captured and suspended in the media, requiring periodic replacement of the GAC media. The effluent is then discharged to a publicly-owned treatment works (POTW), re-injected into the aquifer, or discharged to surface water under a NPDES permit. Because the water table is shallow, the soil is of relatively low permeability, and because there is no appropriate surface water feature to receive the pre-treated effluent, discharge to the local POTW is the only scenario considered in this alternative.

Effectiveness

Groundwater extraction and pre-treatment is an appropriate alternative for the mass reduction and hydraulic containment of PCP. However, due to physical and chemical properties of the contaminant and geologic formation, extraction and pre-treatment of dissolved contaminants is often unsuccessful in restoring groundwater concentrations to established target concentrations. Because chlorinated phenols preferentially sorb to solids, desorption of chemicals of concern to the dissolved phase would be very slow, resulting a protracted project duration. Additionally, impacted groundwater appears to be stable and not impacting the downgradient surface water above MCLs. Consequently, hydraulic control is not required at the site. Therefore, the short-term and long-term effectiveness is expected to be moderate.

Implementability

Implementing a groundwater recovery and pre-treatment system includes installation of recovery wells, conveyance piping, and the construction of a pre-treatment compound. The pre-treatment system would require permits from the industrial wastewater group at the SCDHEC. The local POTW must be willing to accept the effluent, and the new recovery wells must be permitted prior to installation. These permits may have specific on-going sampling and inspection requirements. Groundwater recovery and pre-treatment is an implementable alternative.

Cost

Capital costs for the groundwater recovery and pre-treatment system would be high. Costs would be contingent on the number of wells, system construction, and installation. O&M costs for this alternative would also be high, and would include equipment maintenance, periodic replacement of GAC, permit compliance and POTW fees. The cost of the alternative includes capital cost of $200k, sampling and reporting cost of $25k per year, operating costs of $100k per year for 30 years, with $30k for system and well abandonment at the project termination, for a total cost of $3980k.

9.5 Alternative D: Air Sparging

Air sparing involves the injection of air into the groundwater aquifer for the purpose of stripping contaminants from the groundwater. It also serves to provide an oxygen source to promote aerobic biodegradation. Compressed air is forced into the aquifer using a system of screened injection wells. The contaminants are typically volatized into the vapor phase and transported from the saturated zone to the vadose zone.

An air sparging system is installed as a series of vertical or horizontal injection points. The injection points are located based on the expected area of influence of each well and the groundwater flow direction. The area of influence is determined by many factors including subsurface geology and depth of groundwater contamination.

Effectiveness

Air sparging can be used for boundary control and reduction of dissolved-phase contaminants of concern. Air sparging can also stimulate aerobic biodegradation with the sparge system area of influence. The effectiveness of air sparging can be limited by site-specific geology as the air may take preferential pathways which may not be in the targeted zone. The Henry's law constant, K_H, for PCP is 2.8×10^{-7} atm-m^3/mol (Montgomery, 2000) which is lower than the generally accepted range of contaminants considered for air sparging. However, by introducing oxygen into the subsurface to volatilize contaminants, a secondary and potentially greater remedial effect of this alternative is that it can stimulate naturally occurring micro-organisms in the subsurface allowing for the breakdown of the contaminant through biological processes. Air sparging pilot tests have been conducted at this site, reducing PCP concentrations from low 100s μg/L PCP to <1 μg/L. Air sparging has been shown to arrest migration of contaminants, acting as a barrier to downgradient migration. The positive results from the pilot test, the potential of the air sparging system to volatilize contaminants and provide supplemental oxygen to stimulate aerobic biodegradation, demonstrates that this technology is effective. Pilot results indicate that short term effectiveness is expected to be high, and long-term effectiveness is expected to be very high.

Implementability

Implementing an air sparging system at this site would be achievable as the framework already exists from previous pilot testing. The air sparging system would be expanded from six wells that are currently on site. Expansion of the system would require the installation of additional air sparging wells, horizontal conveyance piping, and the expansion of the existing air distribution manifold. New sparging wells would need to be permitted and the current underground injection control permit would be amended to include the additional wells. As pilot studies have already been completed using this alternative at the site, design information is known. As such, this is an implementable alternative.

Cost

Capital costs for the air sparging system would be moderate. Costs would be contingent on the number of wells, system construction, and installation on-site. O&M costs would include power and maintaining/adjusting the equipment. Based on pilot results, project duration is anticipated to be three to five years, during which system operation and a monitoring well sampling and reporting schedule will be maintained. System expansion costs include capital cost of $150k, sampling and reporting cost of $25k per year, operating costs of $20k per year for ten years, with $30k for system and well abandonment at the project termination, for a total cost of $630k.

9.6 Alternative E: Bioenhancement

The remediation of groundwater contamination using bioenhancement techniques involves injecting either microbes that are known to metabolize the contaminant of concern, or nutrients to increase the population of naturally-occurring microbes in the subsurface. Known PCP degrading microbes (*Burkholderia cepacian*, *Flavobacterium (Sphingobium) chlorophenolicum, and S.chlorophenolicum*) (Stokes, 2011) and various nutrients (sulfate, nitrate, phosphorus) are commonly used. Selection of a particular microbe or nutrient depends on the current site conditions. Existing microbial population and nutrient concentrations must be determined when designing the injection process.

Effectiveness

Bioenhancement would be useful for source area mass reduction or as a polishing treatment in persistent areas where contaminant mass reduction is not occurring. The contaminant degradation rate is highly dependent on the ability to deliver the nutrient to the area of contamination. As low permeability lenses are known to exist at the site, delivery points will need to be closely spaced. Multiple injection events may be necessary to supplement initial nutrient/microbe injections. Limited microbial analysis has been performed at the site (MW-14A, MW-22) and indicated that dechlorinating microbes were present. This alternative may be effective in achieving site goals, but additional microbiological and nutrient analysis must be performed prior to implementation. Because microbial populations generally require time to acclimate to subsurface conditions, system effectiveness is expected to be low in the short-term, but high in the long-term.

Implementability

The microbe/nutrient would be injected through temporary injection points using a direct-push drilling rig. As the depth to groundwater is relatively shallow, injection rates will have to be slow to prevent daylighting of the nutrient/microbes or create preferential pathways preventing a uniform application.

An underground injection control permit would be required for bioenhancement implementation. In order to complete the permit application, additional site information and analyses will be needed to determine microbial populations, nutrient demands, injection rates, and injection spacing. Additional groundwater sampling events in nearby wells may be required to monitor bioenhancement effectiveness and to determine if subsequent injections will be necessary. This technology is implementable.

Cost

The primary cost of bioenhancement as a remedial alternative is the cost of the nutrients/microbes. Approximately 40-60% of the total cost of this alternative is anticipated to be the cost of the injectant. Other costs associated with the bioenhancement include the delivery into the subsurface and follow-up analysis confirming adequate injection. A limited-scale event would be recommended prior to full-scale implementation. Estimated costs of the limited-scale injection event is approximately $60k. Full-scale injection in the high concentration area is anticipated to cost approximately $240k. Two follow-up limited scale injection events may be required and are included in the cost of the alternative. There would be no ongoing O&M costs as the injections would be one-time events and no additional site equipment would be necessary. Project duration is anticipated to be five to ten years, during which a monitoring well sampling and reporting schedule will be maintained. The cost of the alternative includes capital cost of $420k, sampling and reporting cost of $25k per year for 20 years, with $25k for well abandonment at the project termination, for a total cost of $945k.

10.0 Comparative Analysis

The Evaluation Criteria were applied to each option, including relative effectiveness, implementability, and cost. Scoring of the Alternatives is shown in **Table 10**.

1. Alternative A (No Action): This alternative does not allow for demonstration of contaminant concentration reduction, and therefore does not meet the criteria for effectiveness.
2. Alternative B (Monitored Natural Attenuation) meets all effectiveness and implementability criteria and is the least intrusive option. The air sparging pilot has significantly reduced PCP concentrations, and continued attenuation is anticipated. The total cost of this alternative is $1025k.
3. Alternative C (Groundwater Extraction and Pre-Treatment by Granular Activated Carbon) does not meet the effectiveness or cost criterion. While this alternative may create a hydraulic barrier, organic compounds are not consistently removed by this technology. The system is implementable, but installation and operating costs are high. The total cost of this alternative is $3980k.
4. Alternative D (Air Sparging) meets the effectiveness, implementability, and cost criteria. The air sparging pilot tests have proven that the technology effectively reduces PCP concentrations within the system's area of influence. The majority of a full-scale system is already in place. The total cost of this alternative is $630k.
5. Alternative E: (Bioenhancement) meets the effectiveness, implementability, and cost criteria. Adequacy of microbial population and nutrient concentration must be determined prior to system design and implementation. The total cost of this alternative is $945k.

11.0 References

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Stokes, C., *Effects of In-Situ Biosparging on Pentachlorophenol (PCP) Degradation and Bacterial Communities in PCP*, PhD dissertation, Mississippi State University, 2011, 82 p.

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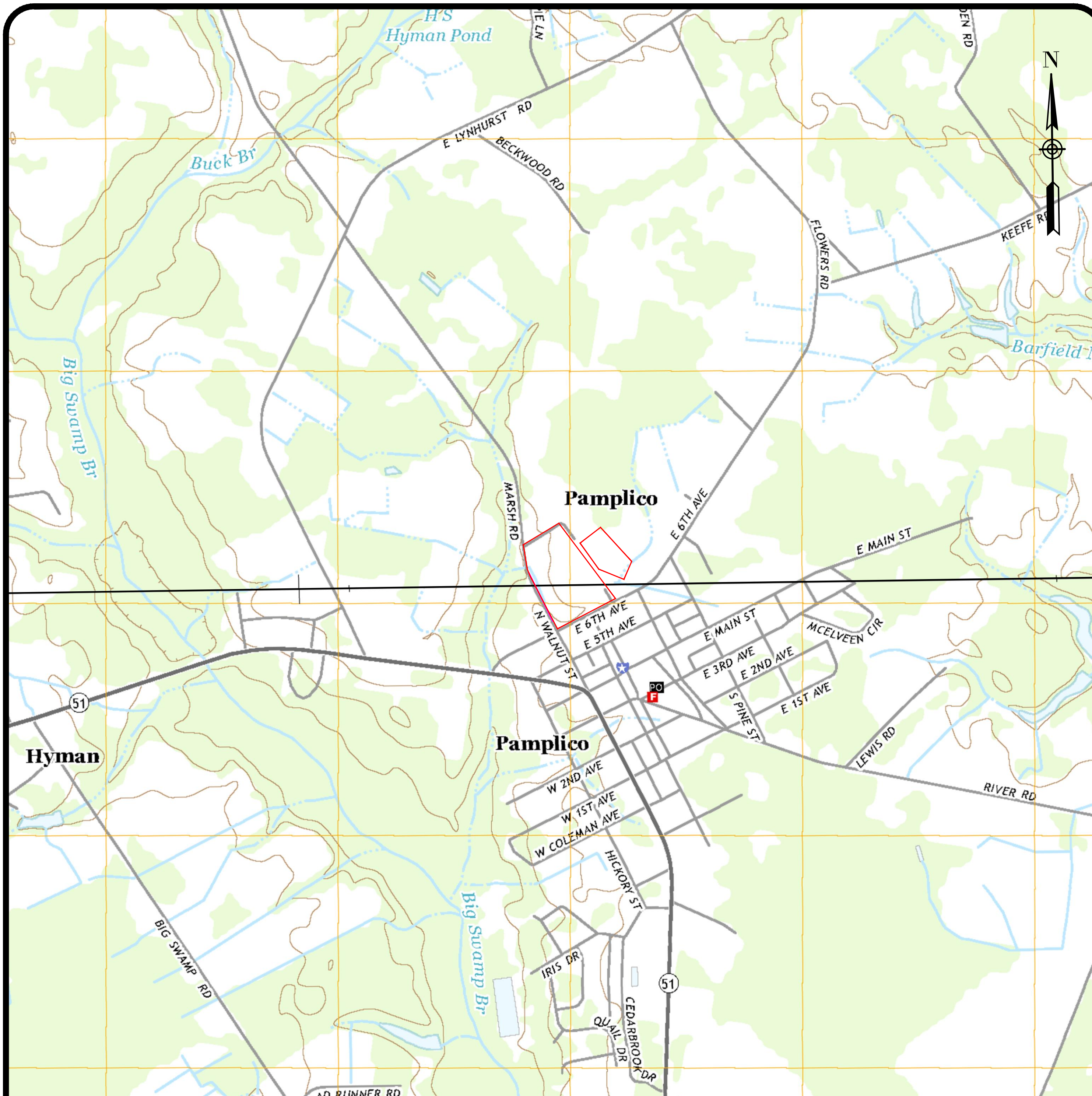
S&ME, Inc., *Water Well Receptor Update, Marsh Lumber VCC, Pamplico, South Caroline,* March 27, 2019

Appendices

Appendix I –Figures



SOURCE: PAMPLICO NORTH, SC AND PAMPLICO SOUTH, SC, 7.5-MINUTE SERIES, USGS TOPOGRAPHIC MAPS (2014).

0 2000 4000

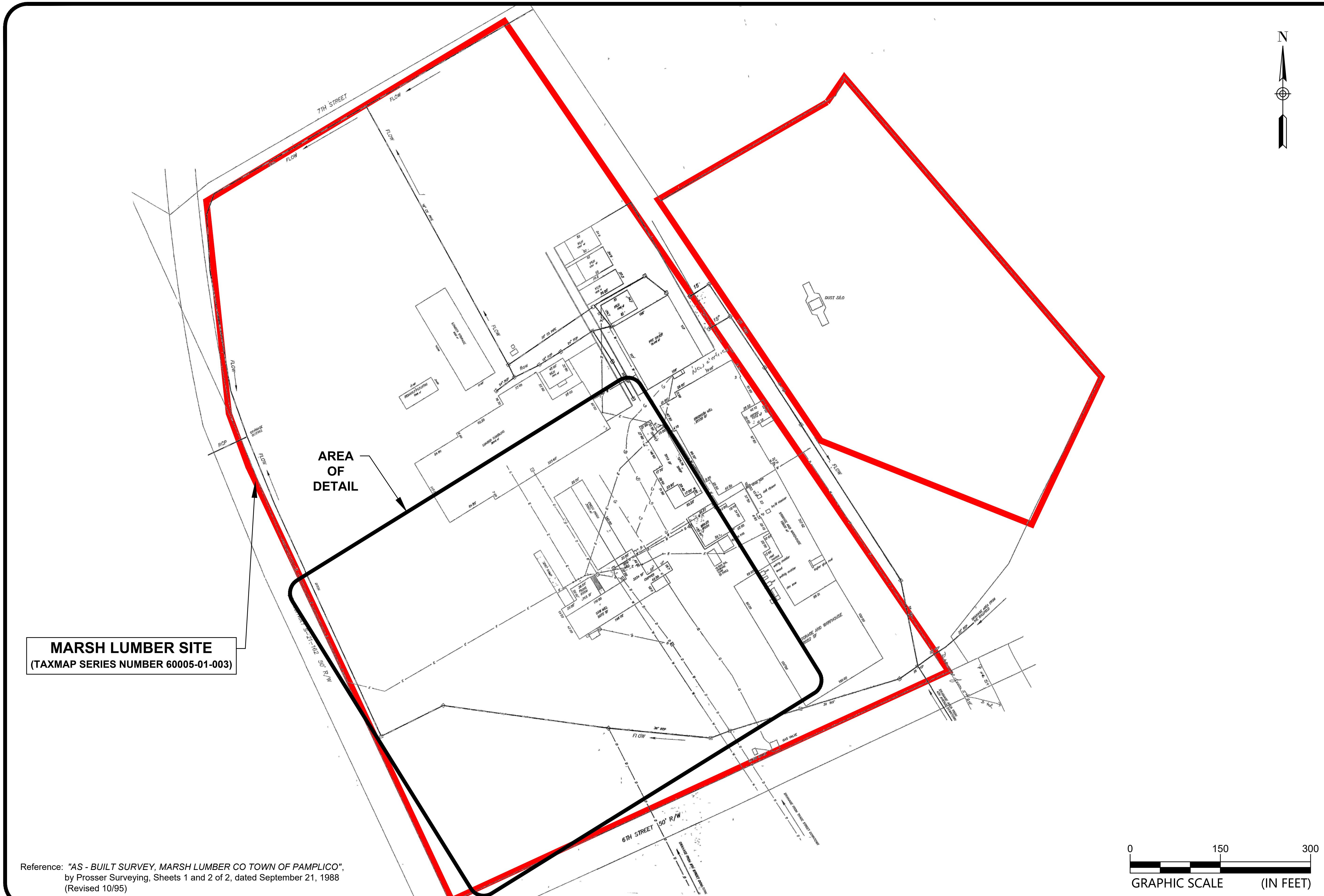
GRAPHIC SCALE (IN FEET)

AREA TOPOGRAPHIC MAP

MARSH LUMBER
PAMPLICO, SOUTH CAROLINA

SCALE:	FIGURE NO.
AS SHOWN	1
DATE:	
FEB. 2020	
PROJECT NUMBER	
1584-98-146C	

Drawing Path: Q:\1584\98\98-146 - MARSH LUMBER\C\2-20 Summary Report\Figures 1 & 11.dwg



Reference: *"AS - BUILT SURVEY, MARSH LUMBER CO TOWN OF PAMPLICO"*, by Prosser Surveying, Sheets 1 and 2 of 2, dated September 21, 1988 (Revised 10/95)

Drawing path: Q:\1584\98\98-146 - MARSH LUMBER\C\2-20 Summary Report\Figure 2.dwg

S&ME

HISTORIC SITE SURVEY

MARSH LUMBER COMPANY
PAMPLICO, SOUTH CAROLINA

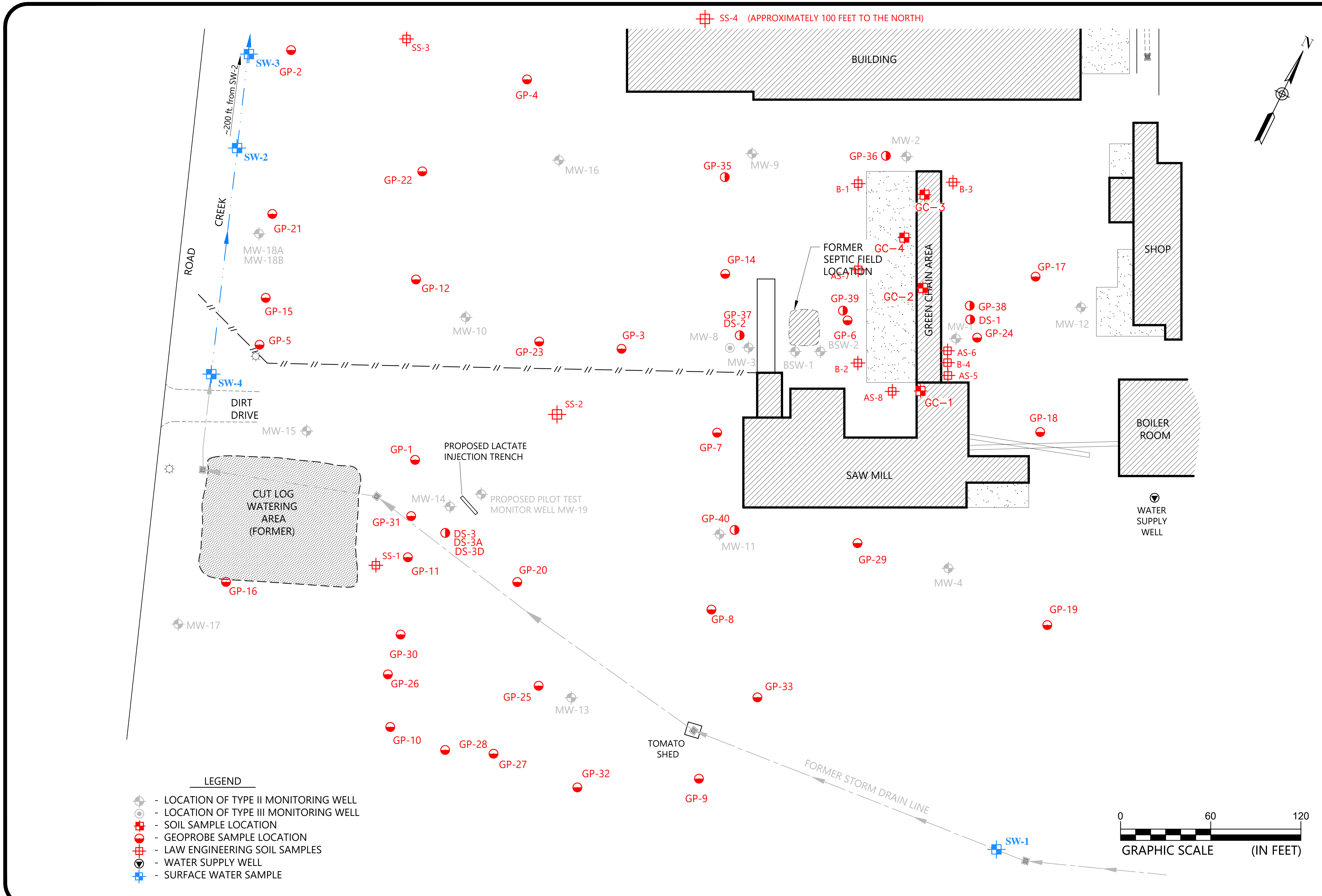
SCALE:	AS SHOWN
DATE:	FEB. 2020
PROJECT NUMBER	1584-98-146C
FIGURE NO.	2

Drawing path: Q:\1584\98\98-146 - MARSH LUMBER\C\2-20 Summary Report\Figure 3.dwg

VICINITY MAP

MARSH LUMBER COMPANY
PAMPLICO, SOUTH CAROLINA

SCALE:	AS SHOWN
DATE:	FEB. 2020
PROJECT NUMBER	1584-98-146C
FIGURE NO.	3



Drawing path: Q:\1584\98\98-146 - MARSH LUMBER\C\2-20 Summary Report\Figure 5 & 6.dwg

SOIL SAMPLE LOCATION MAP

MARSH LUMBER COMPANY
PAMPLICO, SOUTH CAROLINA

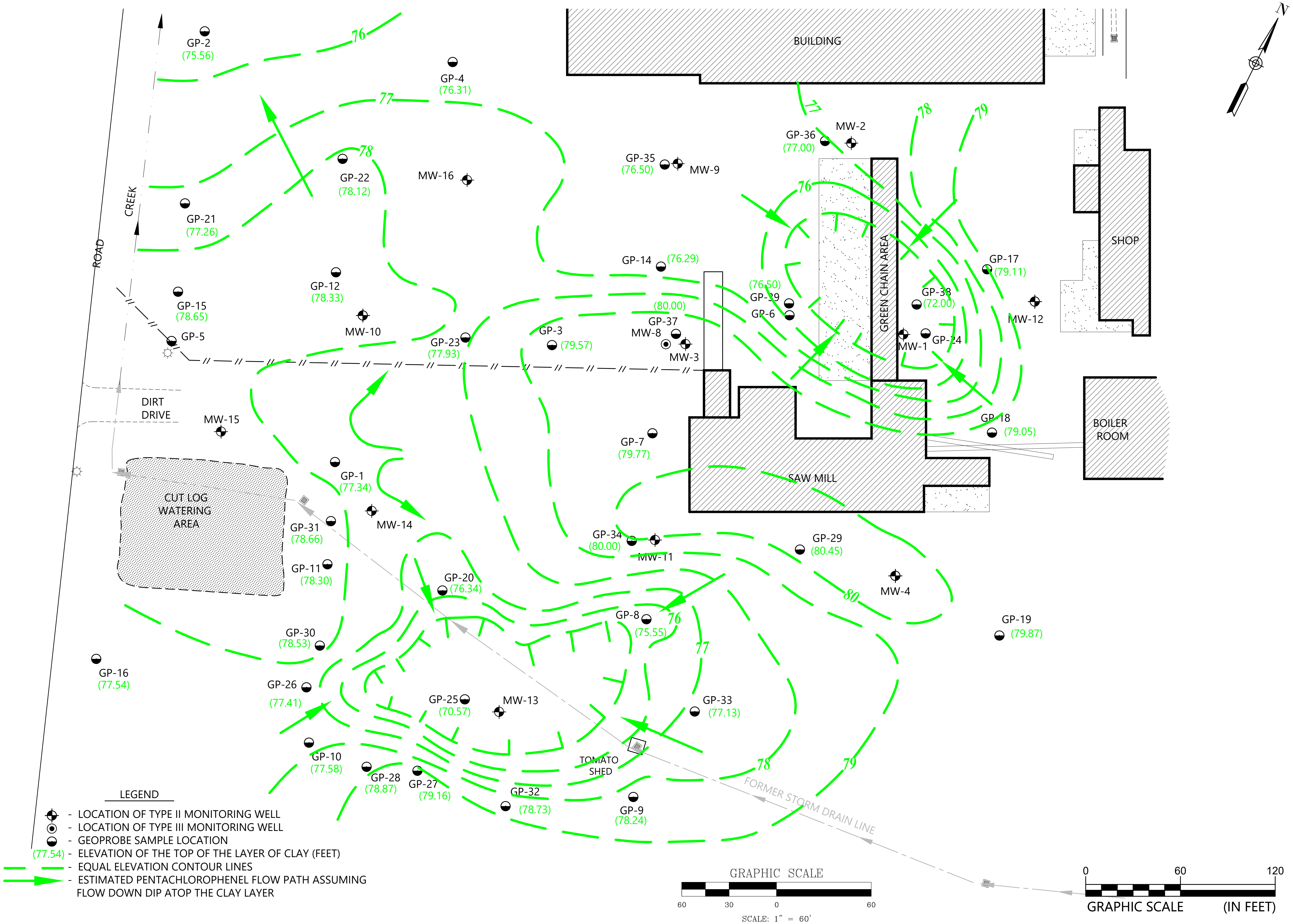
SCALE:
AS SHOWN

DATE:
FEB. 2020

PROJECT NUMBER
1584-98-146C

FIGURE NO.
4

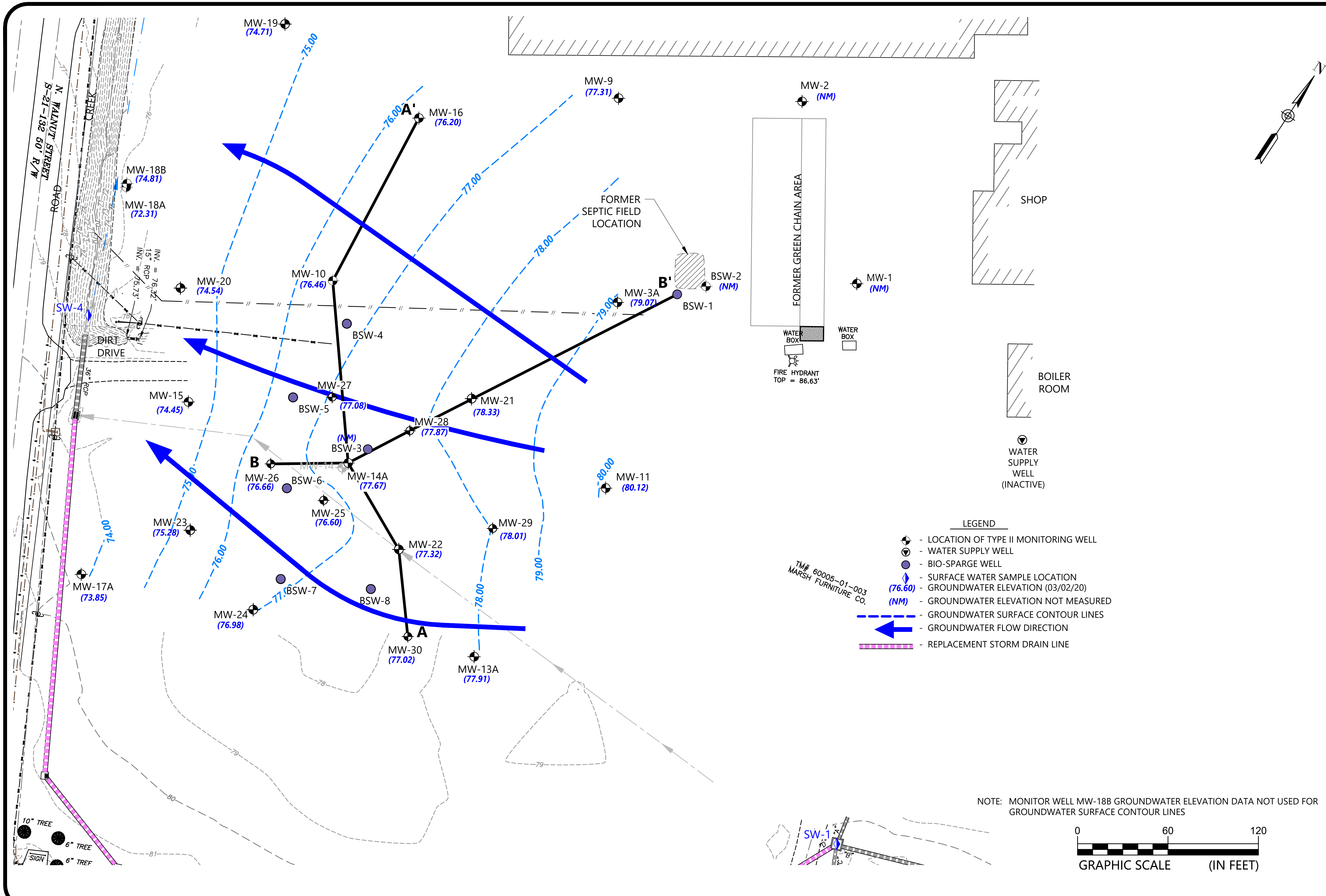
Drawing path: Q:\1584\98\98-146 - MARSH LUMBER\C\2-20 Summary Report\Figure 5.dwg



TOP OF CLAY CONTOUR MAP

MARSH LUMBER COMPANY
PAMPLICO, SOUTH CAROLINA

SCALE:	AS SHOWN
DATE:	FEB. 2020
PROJECT NUMBER	1584-98-146C
FIGURE NO.	5



Drawing path: Q:\1584\98\98-146 - MARSH LUMBER\C\4-20\Pamplico Figures.dwg

GROUNDWATER ELEVATION DATA - MARCH 2020

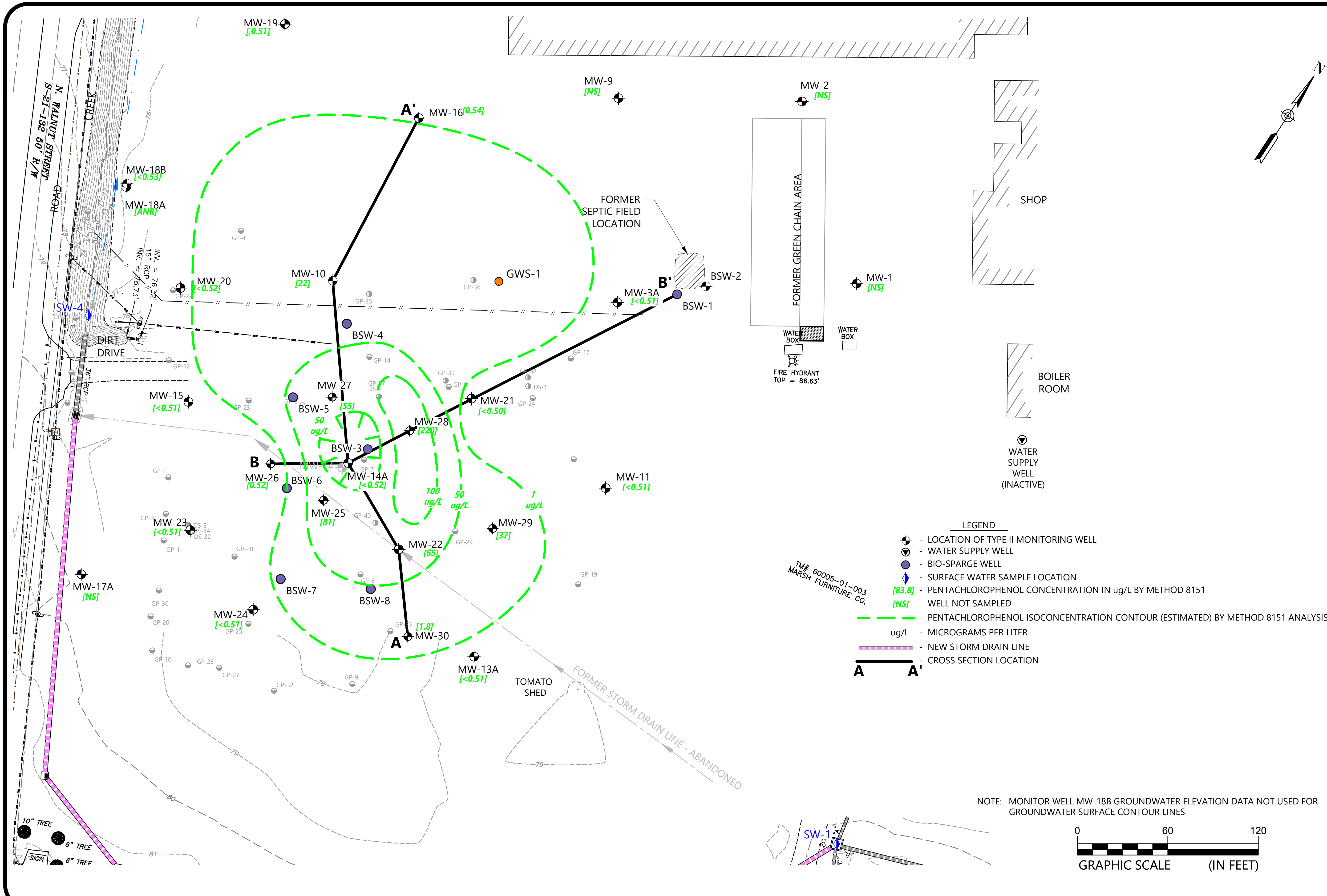
MARSH LUMBER
PAMPLICO, SOUTH CAROLINA

SCALE: AS SHOWN

DATE: APRIL 2020

PROJECT NUMBER: 1584-98-146C

FIGURE NO. 6



EXTENT OF PCP IN GROUNDWATER - MARCH 2020

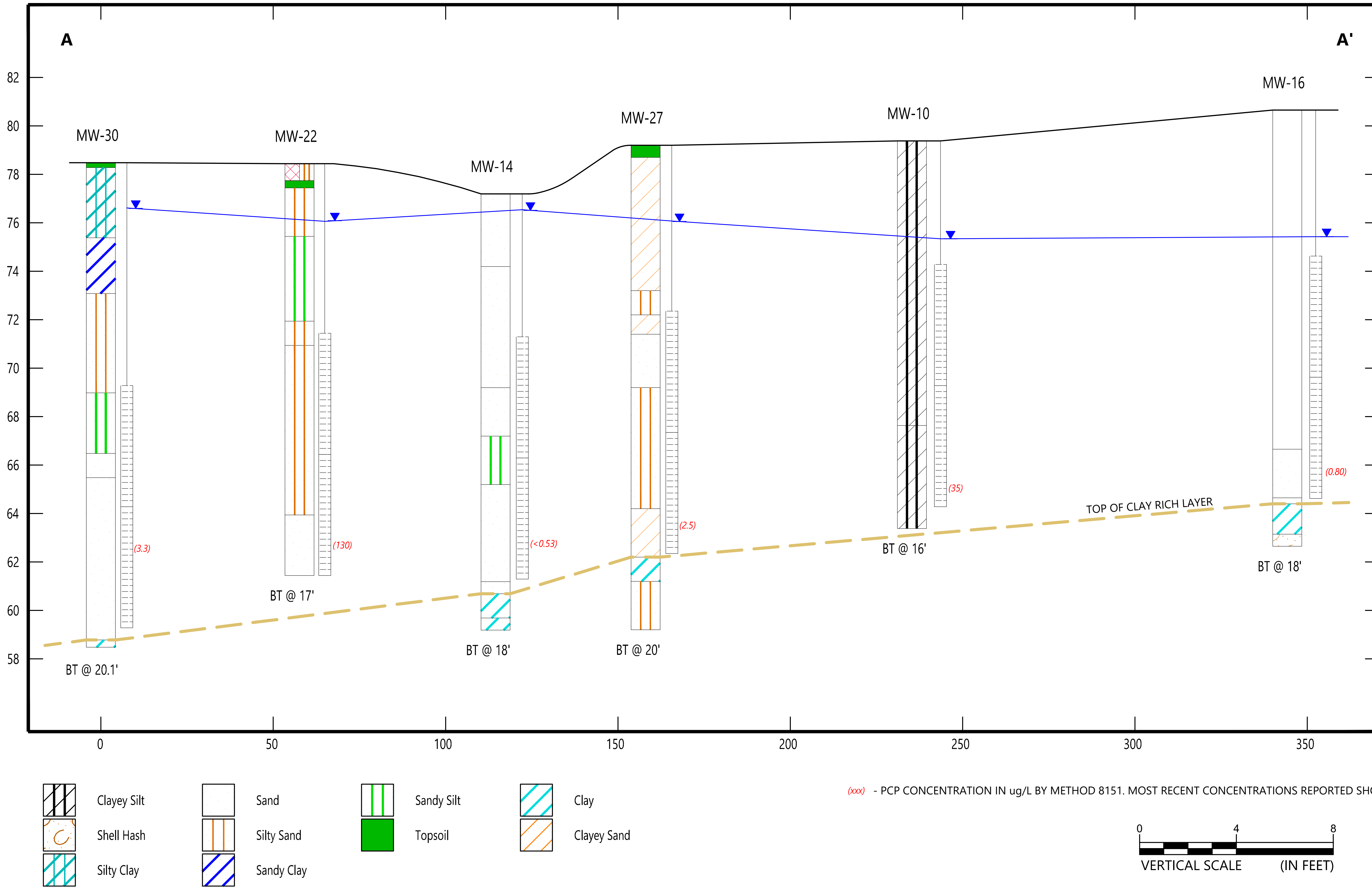
MARSH LUMBER
PAMPLICO, SOUTH CAROLINA

SCALE: AS SHOWN

DATE: APRIL 2020

PROJECT NUMBER: 1584-98-146C

FIGURE NO. 7



Drawing path: Q:\1584\98\98-146 - MARSH LUMBER\C\2-20 Summary Report\Figure 9 &10.dwg

CROSS-SECTION A - A'

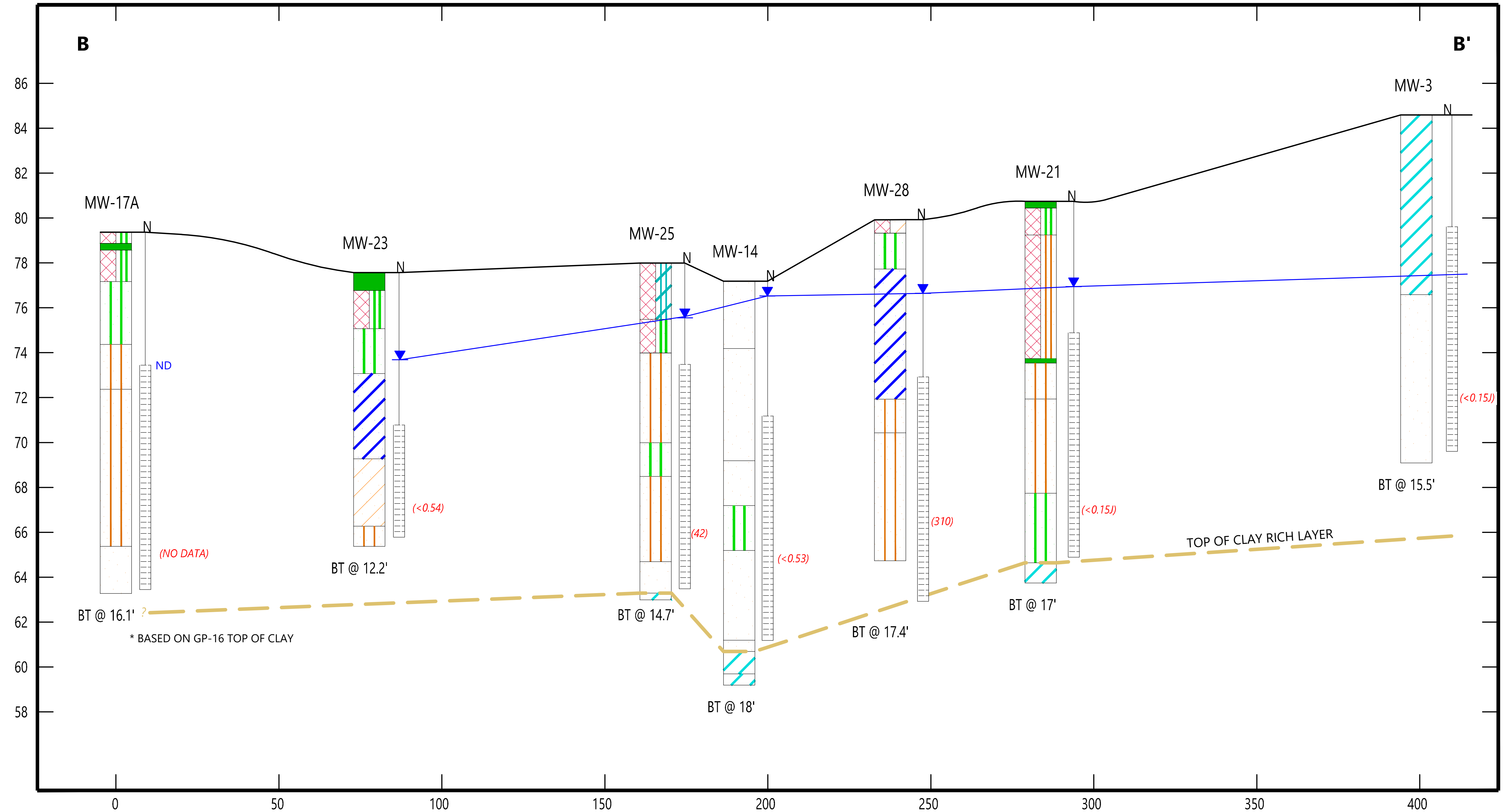
MARCH LUMBER
PAMPLICO, SOUTH CAROLINA

SCALE: AS SHOWN

DATE: FEB. 2020

PROJECT NUMBER: 1584-98-146C

FIGURE NO. 8



(xxx) - PCP CONCENTRATION IN ug/L BY METHOD 8151. MOST RECENT CONCENTRATIONS REPORTED SHOWN.

Sand
Topsoil
Silty Clay
Sandy Silt
Silty Sand
Clay
Sandy Clay
Silt
Clayey Sand

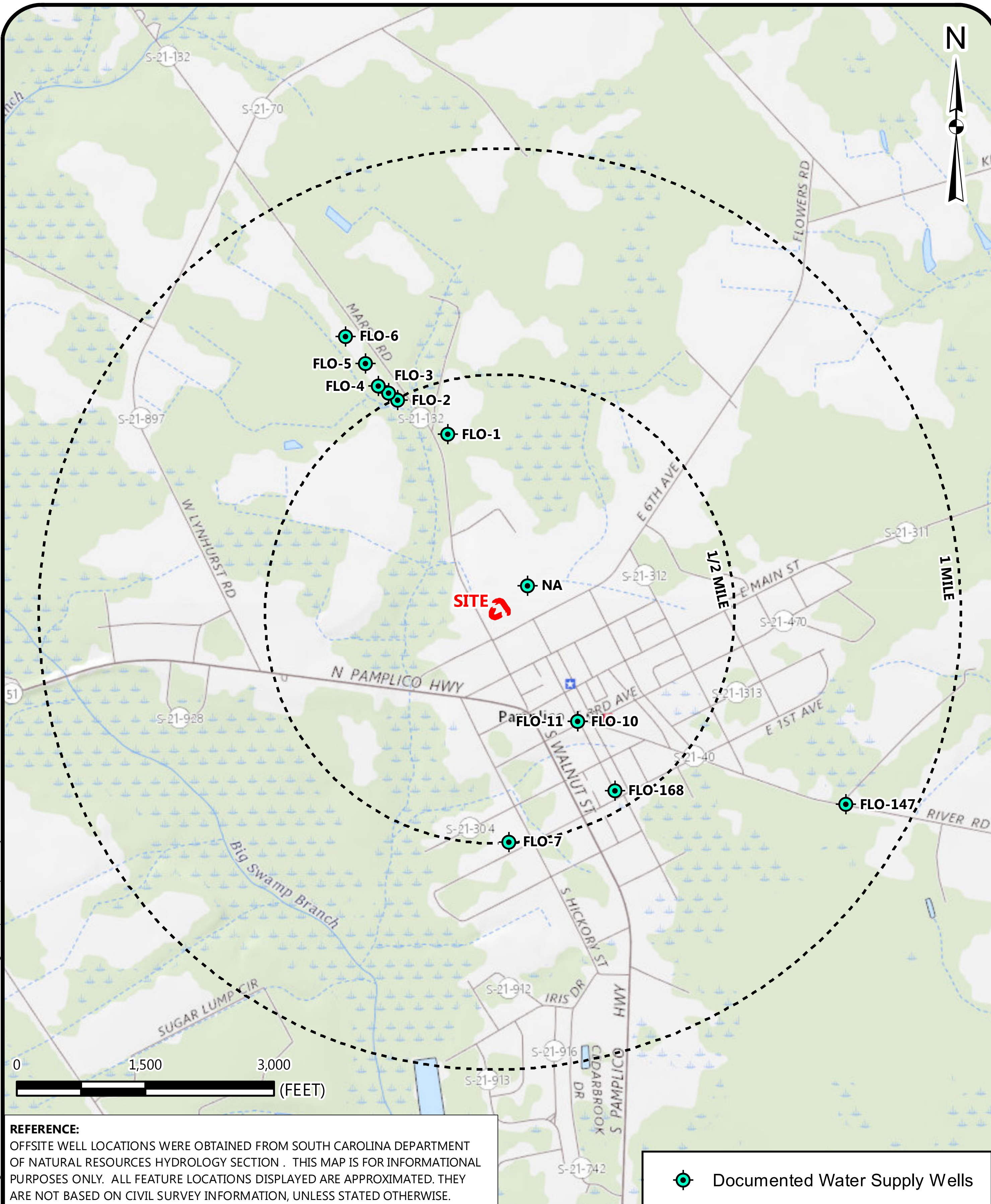
0 5 10
VERTICAL SCALE (IN FEET)

Drawing path: Q:\1584\98\98-146 - MARSH LUMBER\C\2-20 Summary Report\Figure 9 &10.dwg

CROSS-SECTION B - B'

MARCH LUMBER
PAMPLICO, SOUTH CAROLINA

SCALE: AS SHOWN
DATE: FEB. 2020
PROJECT NUMBER: 1584-98-146C
FIGURE NO. 9



REFERENCE:
OFFSITE WELL LOCATIONS WERE OBTAINED FROM SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES HYDROLOGY SECTION . THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

Documented Water Supply Wells

Drawing Path: Q:\1584\1584-98-146 Marsh Lumber\fig2_receptor.mxd plotted by DHomans 03-26-2019

WATER WELL RECEPTOR SURVEY

MARSH LUMBER COMPANY
PAMPLICO, SOUTH CAROLINA

SCALE: 1 " = 1,500 '	FIGURE NO. 10
DATE: 3-26-19	
PROJECT NUMBER 1584-98-146C	

Figure 11
Conceptual Site Model for Human Receptors
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

						Potential Receptor Populations		
Primary Source	**Primary Release Mechanism**	**Secondary Source**	**Secondary Release Mechanism**	**Exposure Media**	**Exposure Route**	**On-Site Facility Worker**	**On-Site Construction Worker/Utility Worker**	**Off-Site Resident (as water well user)**
PCP Solution For Wood Treatment*	Historic leaks or losses from dip tank and/or along drip pad	Soil	Leaching to Soil	Soil	Incidental Ingestion	YES	YES	NA
					Dermal Contact	YES	YES	NA
			Leaching to Groundwater	Groundwater	Incidental Ingestion	NO	NO	NO
					Dermal Contact	NO	NO	NO

* PCP use at the site ceased in 1986
YES = Potentially complete exposure pathway (see Note1)
NO = Pathway evaluated and found to be incomplete or insignificant, no further evaluation recommended (see Note 2)
Note 1: The potential exposure pathways evaluated for site soils concludes that the pathways were potentially complete. Further analysis involves a review of site soil contaminant concentrations; which were documented to be less than corresponding EPA Regional Screening Levels, for Industrial Soil. Current site use is industrial and expected to remain industrial for the foreseeable future.
Note 2: The groundwater scenarios indicated the pathway to be incomplete or insignificant. Delineation of the PCP plume to the subject site makes the off-site resident, water well user scenario pathway incomplete. With depths to groundwater generally 3 feet or greater below grade, site construction/utility worker scenarios should not involve excavation into groundwater.

Appendix II –Tables

Table 1
Groundwater Elevation Data - March 2, 2020
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Well ID	Total Depth (feet bls.)	Well Diameter (inches)	Screen Interval (feet bls.)		Top of Casing Elevation[1] (mean sea level)	Depth to Groundwater 3/2/2020 (feet below TOC)	Groundwater Elevation 3/2/2020 (mean sea level)
MW-1	15.3	2	5.3	15.3	85.55	not measured	not measured
MW-3A	15.0	2	5.0	15	88.59	9.52	79.07
MW-9	18.0	2	8.0	18	83.50	6.19	77.31
MW-10	15.0	2	5.0	15	83.30	6.84	76.46
MW-11	15.0	2	5.0	15	85.61	5.49	80.12
MW-13A	22.0	2	7.0	22	83.52	5.61	77.91
MW-14A	16.0	2	6.0	16	81.11	3.44	77.67
MW-15	15.0	2	5.0	15	82.32	7.87	74.45
MW-16	16.0	2	6.0	16	83.65	7.45	76.20
MW-17A	15.9	2	5.9	15.9	82.37	8.52	73.85
MW-18A	15.2	2	13.2	15.2	80.27	7.96	72.31
MW-18B	6.7	2	4.7	6.7	80.17	5.36	74.81
MW-19	17.6	2	7.4	17.4	79.56	4.85	74.71
MW-20	13.9	2	3.9	13.9	80.59	6.05	74.54
MW-21	15.8	2	5.8	15.8	84.04	5.71	78.33
MW-22	17.1	2	7.1	17.1	81.74	4.42	77.32
MW-23	11.8	2	6.8	11.8	81.37	6.09	75.28
MW-24	14.0	2	4.0	14.0	81.23	4.25	76.98
MW-25	14.6	1	4.5	14.5	80.49	3.89	76.60
MW-26	14.3	1	9.2	14.2	81.21	4.55	76.66
MW-27	17.1	1	7.0	17.0	82.20	5.12	77.08
MW-28	17.1	1	7.0	17.0	83.03	5.16	77.87
MW-29	20.1	1	10.0	20.0	82.90	4.89	78.01
MW-30	19.4	1	9.3	19.3	81.58	3.86	77.72
BSW-2	20.0	2	10.0	20.0	no data	not measured	not measured
BSW-3	16.9	2	15.0	16.8	no data	not measured	not measured

Top of Casing Elevations[1] = Based data provided by Nesbitt Surveying Company, Inc. on 10/27/2016
feet bls. = feet below land surface
feet below TOC = feet below top of well casing
Riser* = relative to top of casing

Table 2
Shallow Aquifer Parameters
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Well ID	TOC Elevation	DTW (feet)	GWE (feet)	K (feet/day)	I (feet/feet)	n (estimated)	v (feet/day)	b (feet)	T ($feet^2$/day)
MW-1	85.55	5.65	79.90	0.305	0.010	0.3	0.010	12	3.7
MW-3A	88.59	11.37	77.22	0.245	0.011	0.3	0.009	10	2.5
MW-10	83.30	8.35	74.95	2.164	0.018	0.3	0.132	8	17.3
MW-13	83.52	6.90	76.62	3.183	0.004	0.3	0.039	17	54.1
MW-17	82.37	9.70	72.67	0.426	0.025	0.3	0.035	9	3.8
MW-22	81.74	5.73	76.01	0.683	0.012	0.3	0.027	10	6.8
MW-23	81.37	7.30	74.07	0.370	0.035	0.3	0.043	10	3.7
			Average =	**1.054**			**0.042**		**13.128**

Legend

n = effective porosity
I = hydraulic gradient (3/14/2018)
v = Cacluated Groundwater Velocity
K = hydraulic conductivity
TOC = top of casing

DTW = depth to water (3/14/2018)
GWE = water elevation (3/14/2018)
v = (K*I)/n
T = calculated Transmissivity (T=K*b)

b = aquifer thickness
n = effective porosity

Table 3
Summary of Soil Sample Analytical Data - 1993
Law Engineering Soil Sampling Assessment
Marsh Lumber Site
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

		Sample ID	AS-5	AS-6	AS-7	AS-8	MW-8	MW-9	MW-10	MW-11	Regional Screening Levels-November 2019 (Target Cancer Risk = 1E-06, Hazard Quotient 1.0)	
		Sample Date	10/7/1993	10/7/1993	10/7/1993	10/7/1993	10/7/1993	10/8/1993	10/8/1993	10/11/1993		
		Sample Depth	Depth = 0.5-1.0 Feet	Depth = 0.5-1.0 Feet	Depth = 0.5-1.0 Feet	Depth = 0.5-1.0 Feet	Depth 49.5 -50 feet	Depth 6.0-7.5 feet	Depth 3.5-7.5 feet	Depth 6.0-7.5 feet		
Parameter	**Analytical Method**	**Units**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	**Residential Soil**	**Industrial Soil**
Barium	6010	mg/kg	160	280	36	44	22	8	3.4	4	15,000	220,000
Chromium	6010	mg/kg	7.8	17	82	17	43	25	6.5	5.9	not listed	not listed
Lead	6010	mg/kg	28	20	9.4	17	9.5	7	4.1	5.2	400	800
Mercury	6010	mg/kg	3.1	ND	ND	ND	ND	ND	ND	ND	11.0	46.0
Silver	6010	mg/kg	ND	ND	ND	ND	ND	ND	ND	16	390	5,800
Semi-Volatile Organics	8270	mg/kg	All BQL	All BQL	All BQL	All BQL	All BQL	All BQL	All BQL	All BQL	**	**

mg/kg = milligrams per kilogram
ND = not detected
All BQL = all target semi-volatile organic compounds reported to have concentrations below quantitation limits.
Regional Screening Levels = USEPA Regional Screening Levels
** = Regional Screen Levels are compound specific. No semi-volatile organic compounds detected for comparison
only detected parameters are listed

Table 4
Summary of Soil Sample Analytical Data - 1992
Law Engineering Soil Assessment
Marsh Lumber Site
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample ID	Sample Collection Date	Sample Depth (feet below grade)	Semi-Volatile Organics Method 8270 (µg/kg)	Tentatively Identified Compounds (TICs)	Reported TIC Concentration (µg/kg)
B-1	01/09/92	1 to 2.5	all BQL	unknown aromatic hydrocarbon	**710**
				9-octadecenamid	**1,200**
B-1	01/09/92	3.5 to 5	all BQL	9-octadecenamid	**800**
B-2	01/09/92	1 to 2.5	all BQL	none	
B-2	01/09/92	3.5 to 5	all BQL	none	
B-3	01/09/92	4 to 6	all BQL	pentatriaconate	**1,900**
				tritetraconate	**1,000**
				octadecane	**920**
				2,6,10,15-trimethylheptacecane	**2,100**
B-3	01/09/92	8.5-10	all BQL	none	
B-4	01/09/92	1 to 2.5	all BQL	none	
B-4	01/09/92	6 to 7.5	all BQL	pentadecane	**740**
				tetradecane	**700**
SS-1	01/09/92	0.5	all BQL	none	
SS-2	01/09/92	0.5	all BQL	none	
SS-3	01/09/92	0.5	all BQL	pentanamide	**350**
SS-4	01/09/92	0.5	all BQL	none	

all BQL = all target compounds below quantitation limits
ug/kg = micrograms per kilogram

Table 5
Summary of Soil Sample Analytical Data - 2016
Semi-Volatile Organics Compounds
Marsh Lumber Site
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

			Soil Samples																
Sample ID			**GC-1-1**		**GC-1-6**		**GC-2-1**		**GC-2-6**		**GC-3-1**		**GC-3-6**		**GC-4-1**		**GC-4-6**		**Regional Screening Levels November 2019 (Target Cancer Risk = 1E-06, Hazard Quotient 1.0)**
Sample Depth (feet below ground surface)			0.5-1 foot		5.5-6 foot		0.5-1 foot		5.5-6 foot		0.5-1 foot		5.5-6 foot		0.5-1 foot		5.5-6 foot		
Sample Collection Date			9/7/2016		9/7/2016		9/9/2016		9/9/2016		9/7/2016		9/9/2016		9/7/2016		9/9/2016		
Parameter	**Method**	**Units**	**Value**	**Qual**	**Value**	**Qual**	**Value**	**Qual**	**Value**	**Qual**	**Value**	**Qual**	**Value**	**Qual**	**Value**	**Qual**	**Value**	**Qual**	**Residential Soil**	**Industrial Soil**	**Groundwater SSL**
Pentachlorophenol	8270	µg/kg	<192,000		<19,100		**1,980**		<2,000		<2,020		<2,000		<2,070		<2,070		1,000	4,000	**1.4**
2,3,4,6-Tetrachlorophenol	8270	µg/kg	**5,010**		<3,820		<369		<401		<403		<401		<413		<414		1,900	25,000	180

Bold value indicates a detection above the reporting detection limit (RDL)
Groundwater soil screening level (SSL) is based on risk-based data (black font) or maximum contaminant level (MCL) data (red font)
Yellow shaded cell indicates detected concentration exceeds the cooresponding Residential Soil Screening Level
Orange shaded cell indicates detected concentration exceeds the cooresponding Industrial Soil Screening level
Qual = laboratory data qualifier. Blank in no qualifier noted

Table 6
1999 Direct Push Grab Sample Groundwater Analytical Data Summary
Marsh Lumber Site
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample Location	Date Collected	Analytical Results Pentachlorophenol (µg/L)	Sampled Interval feet below grade	Stratigraphic Position Relative to Base Of Clay-Rich Layer
GP-1-15	01/05/99	**696**	11 to 15	at and above the clay
*GP-1-15	01/28/99	**270**	11 to 15	at and above the clay
GP-1-30	01/05/99	<25	26 to 30	below the clay
GP-2-16	01/05/99	<25	12 to 16	at and above the clay
GP-2-24	01/05/99	<28	20 to 24	at and above the clay
GP-3-19	01/05/99	**74**	15 to 19	at and above the clay
GP-4-17	01/05/99	<25	13 to 17	at and above the clay
GP-5-15	01/05/99	<25	11 to 15	at and above the clay
GP-6-17	01/05/99	<25	13 to 17	at and above the clay
*GP-6-17	01/28/99	**100**	13 to 17	at and above the clay
GP-8-20	04/27/99	<25	16 to 20	at and above the clay
GP-9-15	04/27/99	<25	11 to 15	at and above the clay
GP-16-16	04/13/99	<25	12 to 16	at and above the clay
GP-20-16	04/13/99	**246**	12 to 16	at and above the clay
GP-21-14	04/26/99	<25	10 to 14	at and above the clay
GP-22-16	04/26/99	<25	12 to 16	at and above the clay
GP-23-14	04/26/99	**690**	10 to 14	at and above the clay
GP-24-20	04/26/99	<25	16 to 20	at and above the clay
GP-25-22	04/27/99	<28	18 to 22	at and above the clay
GP-28-12	04/27/99	<25	8 to 12	at and above the clay
GP-30-12	04/27/99	<25	8 to 12	at and above the clay
Tentatively Identified Compounds				
GP-8-20	4/27/1999	15 µg/l 2,3-dichlorobenzoic acid		

Laboratory Analysis by Method 8270 (acid extractables only)
all concentrations reported in micrograms per liter (ug/L)
< 25 = Concentration less than numeric values shown
* = 1/28/99 confirmation samples analytical results obtained from select location. Sample ID ML-A = same as GP-10-16. Sample ID ML-B = same as GP-6-17. The "ML" prefix sample ID's were used during the resampling event for quality control (conceal prior sample IDs)

Table 7
Groundwater Data Summary
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample ID	Position Relative to Bio-Sparge Well(s)	Distance To Bio-sparge Well (Feet)	Date Sample Collected	Method 8270 (BNA)				Method 8151	General Chemistry			Field Parameters							
				Pentachlorophenol		2,3,4,6 Tetrachlorophenol		PCP	Alkalinity	Chloride	TOC	DTGW	GWE	Temp	pH	Cond.	D.O.	ORP	Turbidity
				Result (µg/L)	MDL (µg/L)	Result (µg/L)	MDL (µg/L)	Result (µg/L)	(mg/L)	(mg/L)	(mg/L)	(feet)	(feet)	(Celsius)	(s.u...)	(µs/cm^2)	(mg/L)	(millivolts)	(NTU)
MW-3A	Up-Gradient of Current Pilot Test	192	3/13/2018	<50	3.5	not detected	**	not requested	9.2	4.1	2.3	11.37	77.22	16.2	5.0	122	0.9	228	20.8
			2/18/2019	<24.8	3.5	<9.9	2.9	not requested	not requested	not requested	not requested	11.35	77.24	18.3	5.4	130	0.5	243	48.3
			7/22/2019	not requested	not requested	not requested	not requested	**0.15 J**	not requested	not requested	not requested	11.69	76.90	25.6	4.9	146	0.4	264	7.21
			3/3/2020	not requested	not requested	not requested	not requested	<0.51	not requested	not requested	not requested	9.52	79.07	16.8	5.6	114	3.4	218	29.5
	DUPLICATE 2 Sample		3/3/2020	not requested	not requested	not requested	not requested	<0.52	not requested	not requested	not requested								
MW-9	Up-Gradient		10/30/2019	<24.5	3.5	not requested	not requested	**1.8**	not requested	not requested	not requested	8.21	75.29	25.5	6.6	510	0.2	122	14.9
MW-11	Up-Gradient		10/30/2019	<24.0	3.4	not requested	not requested	<0.54	not requested	not requested	not requested	9.95	75.66	23.8	5.2	100	0.9	277	19.0
			3/2/2020	not requested	not requested	not requested	not requested	<0.51	not requested	not requested	not requested	5.49	80.12	data lost	data lost	data lost	data lost	data lost	data lost
MW-16	Cross-Gradient	122	3/13/2018	<51	3.6	not detected	**	not requested	66.3	15.7	2.9	8.26	75.39	16.1	5.6	216	0.4	201	12.6
			2/19/2019	<25.0	3.5	<10.0	2.9	not requested	not requested	not requested	not requested	8.22	75.43	14.9	6.6	353	1.1	292	55.2
			7/22/2019	not requested	not requested	not requested	not requested	**0.80**	not requested	not requested	not requested	7.45	76.20						
			3/2/2020	not requested	not requested	not requested	not requested	**0.54**	not requested	not requested	not requested	7.45	76.20	16.9	6.4	351	1.5	190	10.3
MW-18B	Down-gradient	170	3/13/2018	<51	3.6	not detected	**	not requested	382	11.9	1.4	7.07	73.10	15.3	6.7	616	0.8	34	0.3
			2/19/2019	<25.0	3.5	<10.0	2.9	<0.50	not requested	not requested	not requested	6.73	73.44	13.2	7.1	704	1.4	2	8.7
			3/2/2020	not requested	not requested	not requested	not requested	<0.53	not requested	not requested	not requested	5.36	74.81	17.0	6.9	743	0.9	-5	7.0
MW-19	Cross-Gradient	202	3/13/2018	<51	3.6	not detected	**	not requested	314	25.2	7.5	5.89	73.67	16.5	6.2	586	0.2	6	7.6
			2/19/2019	<25.0	3.5	<10.0	2.9	<0.49	not requested	not requested	not requested	5.46	74.10	16.2	6.5	750	0.3	-61	19.4
			3/2/2020	not requested	not requested	not requested	not requested	<0.51	not requested	not requested	not requested	4.85	74.71	18.5	6.4	731	0.3	-38	4.3
MW-20	Down-gradient of BSW-4	112	3/13/2018	<49	3.5	not detected	**	not requested	201	10.6	<1.0	7.17	73.42	16.7	7.0	335	0.2	-64	0.3
			9/19/2018	<27.2	3.8	<10.9	3.2	not requested	223	10.2	<1.0	6.63	73.42	24.1	7.0	432	0.2	-78	3.6
			2/20/2019	<25.0	3.5	<10.0	2.9	not requested	not requested	not requested	not requested	6.87	73.72	14.5	7.3	377	0.2	-98	7.4
			7/24/2019	<25.0	3.5	<10.0	2.9	<0.54	not requested	not requested	not requested	7.85	72.74	24.1	6.6	474	0.1	-83	2.7
			3/2/2020	not requested	not requested	not requested	not requested	<0.52	not requested	not requested	not requested	6.05	74.54	17.5	7.3	404	0.2	-20	8.0
MW-10	Down Gradient of BSW-4	31	9/14/2016	<50	4.6	not requested	not requested	not requested	302	12.0	1.9	6.77	76.53	25.2	6.7	546	0.0	-8	8.8
			12/8/2016	<50	4.6	not requested	not requested	not requested	235	18.2	1.9	8.22	75.08	19.9	6.4	664	1.6	15	8.2
			2/21/2017	**16.0 J**	4.6	<10	2.3	not requested	207	19.8	4.0	8.47	74.83	17.4	6.2	57	2.1	107	7.7
			5/24/2017	<25.0	2.4	<10	2.3	not requested	193	19.8	3.8	8.70	74.60	21.8	6.4	446	0.2	-149	6.3
			8/30/2017	<50	3.5	not requested	not requested	not requested	141	20.4	3.1	8.84	74.46	24.0	6.5	460	1.2	77	2.9
			3/14/2018	<52.1	3.7	not detected	**	not requested	114	18.3	3.4	8.35	74.95	15.8	5.5	390	0.4	130	6.8
			6/26/2018	**30.4**	3.5	<9.8	2.9	not requested	115	17.3	4.4	9.34	73.96	23.1	5.9	390	0.3	162	17.1
			9/19/2018	<25.5	3.6	<10.2	3.0	not requested	142	14.9	9.3	7.45	74.95	24.0	6.1	375	0.4	76	6.5
			2/19/2019	<25.0	3.5	<10.0	2.9	not requested	not requested	not requested	not requested	8.07	75.23	14.8	6.3	313	0.2	113	4.0
			7/23/2019	<25.0	3.5	<10.0	2.9	**59**	96	11.6	3.8	9.25	74.05	24.2	5.7	235	0.2	98	4.3
			10/29/2019	<24.0	3.4	not requested	not requested	**35**	not requested	not requested	not requested	9.94	73.36	23.1	5.9	206	0.4	105	7.0
			3/2/2020	not requested	not requested	not requested	not requested	**22**	not requested	not requested	not requested	6.84	76.46	17.3	6.2	317	0.2	60	4.1
RSL - Tapwater				0.041		240		0.041	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Maximum Contaminant Level (MCL)				1		no standard		1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

J =concentration shown is estimated

Bold value indicates a detection above the method reporting detection limit (MDL)

Yellow shaded cell indicates detected concentration is greater than the corresponding MCL

Table 7
Groundwater Data Summary
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample ID	Position Relative to Bio-Sparge Well	Distance To Bio-sparge Well (Feet)	Date Sample Collected	Method 8270 (BNA)				Method 8151	General Chemistry			Field Parameters							
				Pentachlorophenol		2,3,4,6 Tetrachlorophenol		PCP	Alkalinity	Chloride	TOC	DTGW	GWE	Temp	pH	Cond.	D.O.	ORP	Turbidity
				Result (µg/L)	MDL (µg/L)	Result (µg/L)	MDL (µg/L)	Result (µg/L)	(mg/L)	(mg/L)	(mg/L)	(feet)	(feet)	(Celsius)	(s.u...)	(µs/cm²)	(mg/L)	(millivolts)	(NTU)
MW-14	Down	15	9/14/2016	**214**	4.6	not requested	not requested	not requested	35.7	8.4	4.7	5.51	75.6	26.5	5.1	13	0.0	77	4.9
"	Gradient		12/13/2016	<250	23.2	not requested	not requested	not requested	<5.0	12.6	9.6	5.97	75.14	17.6	5.0	142	6.7	225	489
"	of BSW-3		2/21/2017	<250	23.2	<100	22.6	not requested	3.2 J	16.3	12.7	7.05	74.06	41.4	5.8	81	2.4	272	228
MW-14A			6/7/2017	**122**	4.6	<10.0	22.6	not requested	6.0	7.4	1.9	5.19	75.92	21.4	5.5	74	6.2	40	3.3
"			8/30/2017	<50	3.5	not requested	not requested	not requested	9.2	8.4	1.4	5.88	75.23	24.9	6.0	83	6.7	103	2.0
"			3/14/2018	<50	3.5	not detected	**	not requested	<5.0	8.5	1.5	4.55	76.56	15.6	5.5	65	8.6	381	7.6
"			6/26/2018	<24.5	3.5	<9.8	2.9	not requested	<5.0	9.2	1.4	5.52	75.59	23.4	5.0	79	5.9	194	16.0
"			9/21/2018	<26.6	3.7	<10.6	3.1	not requested	5.3	8.8	2.5	4.21	76.56	23.2	5.3	90	6.6	233	12.1
			2/20/2019	<25.0	3.5	<10.0	2.9	<0.51	26.2	8.9	2.5	4.59	76.52	13.4	6.2	111	8.3	337	8.9
			7/23/2019	<25.0	3.5	<10.0	2.9	<0.53	14.2	9.5	2.5	5.13	75.98	24.4	5.7	104	6.4	309	5.0
			3/2/2020	not requested	not requested	not requested	not requested	<0.52	not requested	not requested	not requested	3.44	77.67	data lost	data lost	data lost	data lost	data lost	data lost
MW-15	Down	70	9/14/2016	<50	4.6	not requested	not requested	not requested	346	25.2	9.1	8.34	73.98	26.0	6.1	663	0.3	-64	14.9
	Gradient		12/8/2016	<50	4.6	not requested	not requested	not requested	322	24.1	10.4	8.64	73.68	18.5	6.2	843	4.5	-65	6.1
	of BSW-5		2/21/2017	<25	2.3	<10	2.3	not requested	312	23.8	7.3	9.34	72.98	16.5	6.6	627	0.0	-16	5.5
			5/23/2017	<31.2	2.9	<12.5	1.2	not requested	306	21.4	6.4	9.14	73.18	20.6	6.3	612	0.2	-46	10.2
			8/30/2017	<50	3.5	not requested	not requested	not requested	318	20.6	8.6	9.31	73.01	25.5	6.5	658	0.7	-32	4.4
			3/13/2018	<52.1	3.7	not detected	**	not requested	352	18.1	7.4	8.37	73.59	16.7	6.1	570	0.2	-24	8.6
			9/19/2018	<24.8	3.5	<9.9	2.9	not requested	331	15.7	12.1	8.91	73.59	25.6	6.2	680	0.2	-52	9.6
			2/20/2019	<25.0	3.5	<10.0	2.9	<0.48	not requested	not requested	not requested	8.89	73.43	13.6	6.4	713	0.2	-40	10.4
			7/22/2019	**46.6**	3.5	<10.0	2.9	<0.51	not requested	not requested	not requested	9.41	72.91	25.3	6.0	717	0.1	-47	5.0
			10/29/2019	<24.5	3.5	not requested	not requested	<0.53	not requested	not requested	not requested	10.38	71.94	23.3	6.2	741	2.4	-39	8.3
			10/29/2019	<24.8	3.5	not requested	not requested	<0.49	not requested	not requested	not requested	duplicate	duplicate	duplicate	duplicate	duplicate	duplicate	duplicate	duplicate
			3/2/2020	not requested	not requested	not requested	not requested	<0.51	not requested	not requested	not requested	7.87	74.45	data lost	data lost	data lost	data lost	data lost	data lost
RSL - Tapwater				0.041		240		0.041	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Maximum Contaminant Level (MCL)				1		no standard		1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

J =concentration shown is estimated

Bold value indicates a detection above the method reporting detection limit (MDL)

Yellow shaded cell indicates detected concentration is greater than the corresponding MCL

Biosparge Pilot Test #2 began 2009 at BSW-3 only, near MW-14A

Table 7
Groundwater Data Summary
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample ID	Position Relative to Bio-Sparge Well	Distance To Bio-sparge Well (Feet)	Date Sample Collected	Method 8270 (BNA) Pentachlorophenol Result (µg/L)	Method 8270 (BNA) Pentachlorophenol MDL (µg/L)	Method 8270 (BNA) 2,3,4,6 Tetrachlorophenol Result (µg/L)	Method 8270 (BNA) 2,3,4,6 Tetrachlorophenol MDL (µg/L)	Method 8151 PCP Result (µg/L)	General Chemistry Alkalinity (mg/L)	General Chemistry Chloride (mg/L)	General Chemistry TOC (mg/L)	Field Parameters DTGW (feet)	GWE (feet)	Temp (Celsius)	pH (s.u...)	Cond. (µs/cm³)	D.O. (mg/L)	ORP (millivolts)	Turbidity (NTU)
MW-21	Up	76	9/15/2016	**16.5 J**	4.6	not requested	not requested	not requested	26.7	8.9	2.1	7.94	76.1	28.8	5.5	161	0.0	189	19.0
	Gradient		12/14/2016	<50	4.6	not requested	not requested	not requested	18.3	9.1	1.0	6.10	77.94	19.5	5.4	148	2.1	146	0.2
	of BSW-3		2/21/2017	**6.5 J**	2.3	not requested	not requested	not requested	15.9	9.1	1.5	7.66	76.38	17.3	5.8	102	0.1	214	4.0
			5/24/2017	<31.2	2.9	<12.5	1.2	not requested	8.4	9.0	1.8	7.67	76.37	21.2	5.0	79	0.3	109	7.2
			8/30/2017	<50	3.5	not requested	not requested	not requested	8.9	9.1	1.5	8.11	75.93	25.7	5.3	85	0.8	117	4.3
			3/14/2018	<52.1	3.7	not detected	**	not requested	7.1	7.9	1.8	7.13	76.91	16.1	4.7	92	1.3	212	8.0
			2/21/2019	<24.8	3.5	<9.9	2.9	not requested	58.5	7.3	4.1	7.20	76.84	16.5	6.1	148	0.6	255	26.3
			7/24/2019	<25.0	3.5	<10.0	2.9	**0.15 J**	not requested	not requested	not requested	7.70	76.34	23.9	6.0	162	0.2	177	34.6
			3/2/2020	not requested	not requested	not requested	not requested	<0.50	not requested	not requested	not requested	5.71	78.33	data lost	data lost	data lost	data lost	data lost	data lost
MW-22	Cross	32	9/15/2016	<50	4.6	not requested	not requested	not requested	178	5.7	<1.0	5.79	75.95	29.0	6.5	308	0.0	-56	13.0
	Gradient		12/8/2016	**294**	4.6	not requested	not requested	not requested	153	8.5	<1.0	5.56	76.18	18.4	6.5	369	1.8	33	1.5
	of BSW-8		2/21/2017	**472**	11.6	**5.3 J**	2.3	not requested	93.9	9.8	1.2	5.87	75.87	18.5	6.0	144	0.0	198	2.5
			5/24/2017	**358**	125	<10	1.2	not requested	31.3	10.6	1.7	6.21	75.53	20.8	5.4	120	0.2	-165	2.6
			8/30/2017	**339**	7.0	not requested	not requested	not requested	27.3	11.4	1.6	6.39	75.35	24.3	5.6	121	1.0	132	1.7
			3/14/2018	**271**	3.4	not detected	**	not requested	31.4	10	2.1	5.73	76.01	14.0	5.1	116	0.2	256	0.0
			6/26/2018	**150**	17.3	<9.8	2.9	not requested	29.8	9.6	1.2	6.84	74.90	24.3	4.8	131	0.2	161	0.6
			9/20/2018	**186**	18.0	<10.2	3.0	not requested	27.8	8.8	3.5	4.76	76.09	24.6	5.2	123	0.2	201	1.6
			2/18/2019	**128**	3.5	<9.8	2.9	**83**	47.8	7.3	1.7	5.67	76.07	16.5	5.5	131	0.3	190	0.1
			7/24/2019	**83.8**	3.5	<10.0	2.9	**130**	24.4	8.8	2.3	6.85	74.89	25.4	5.2	113	0.2	218	1.0
			3/2/2020	not requested	not requested	not requested	not requested	**65**	not requested	not requested	not requested	4.42	77.32	17.4	5.6	132	1.3	187	2.4
	DUPLICATE 1 sample		3/2/2020	not requested	not requested	not requested	not requested	**73**	not requested	not requested	not requested								
MW-23	Down	70	9/15/2016	<50	4.6	not requested	not requested	not requested	297	7.1	11.8	7.57	73.80	27.0	6.2	558	0.0	-36	11.9
	Gradient		12/13/2016	<50	4.6	not requested	not requested	not requested	403	11.0	14.4	7.20	74.17	17.4	6.4	934	2.5	-74	1.0
	of BSW-6		2/21/2017	<25	2.3	<10	2.3	not requested	368	14.4	12.2	7.62	73.75	15.8	6.9	686	0.0	-43	7.1
			5/23/2017	<31.2	2.9	<12.5	1.2	not requested	400	14.6	13	7.79	73.58	20.7	6.4	807	0.2	-55	1.1
			8/30/2017	<50	3.5	not requested	not requested	not requested	404	15.8	12.1	8.03	73.34	25.6	6.7	799	0.6	-59	3.2
			3/14/2018	<52.1	3.7	not detected	**	not requested	640	17.4	15	7.30	74.07	14.8	6.4	969	0.1	-64	4.1
			9/21/2018	<25.0	3.5	<10.0	2.9	not requested	454	18.6	15.5	7.79	74.07	23.9	6.6	873	0.2	-93	2.3
			2/18/2019	<24.5	3.5	<9.8	3.5	<0.50	680	21.9	3.9	7.39	73.98	16.6	6.6	1,148	0.3	-87	24.7
			7/25/2019	<25.0	3.5	<10.0	2.9	<0.54	not requested	not requested	not requested	8.09	73.28	25.3	6.4	1,216	0.1	-88	3.8
			3/2/2020	not requested	not requested	not requested	not requested	<0.51	not requested	not requested	not requested	6.09	75.28	data lost	data lost	data lost	data lost	data lost	data lost
			RSL - Tapwater	0.041		240		0.041	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Maximum Contaminant Level (MCL)	1		no standard		1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

J =concentration shown is estimated
Bold value indicates a detection above the method reporting detection limit (MDL)
Yellow shaded cell indicates detected concentration is greater than the corresponding MCL
QA/QC samples: "Duplicate" collected on 9/15/2016 at MW-21 , "Dup-1" collected on 12/13/2016 at MW-23, and "Duplicate" collected on 2/21/2017 at MW-14

Expanded Biosparge Pilot Test #2 startup on May 29, 2018

Table 7
Groundwater Data Summary
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample ID	Position Relative to Bio-Sparge Well	Distance To Bio-sparge Well (Feet)	Date Sample Collected	Method 8270 (BNA) Pentachlorophenol Result (µg/L)	Method 8270 (BNA) Pentachlorophenol MDL (µg/L)	Method 8270 (BNA) 2,3,4,6 Tetrachlorophenol Result (µg/L)	Method 8270 (BNA) 2,3,4,6 Tetrachlorophenol MDL (µg/L)	Method 8151 PCP Result (µg/L)	General Chemistry Alkalinity (mg/L)	General Chemistry Chloride (mg/L)	General Chemistry TOC (mg/L)	Field Parameters DTGW (feet)	GWE (feet)	Temp (Celsius)	pH (s.u...)	Cond. (µs/cm²)	D.O. (mg/L)	ORP (millivolts)	Turbidity (NTU)
MW-13A	Up Gradient of BSW-6	82	11/3/2017	<25	3.5	not requested	not requested	not requested	not requested	not requested	not requested	8.35	75.17	28.5	7.2	779	0.7	-150	3.5
			3/13/2018	<50	3.5	not detected	**	not requested	267	40.6	1.8	6.90	76.62	15.3	7.0	780	0.5	-57	121.0
			9/20/2018	<25.0	3.5	<10.0	2.9	not requested	323	92.1	9.6	6.19	76.62	25.2	6.8	719	0.1	-105	36.6
			2/21/2019	<24.5	3.5	<9.8	2.9	not requested	286	48.1	1.2	6.75	76.77	19.8	7.0	774	0.1	-103	23.9
			7/25/2019	<25.0	3.5	<10.0	2.9	<0.54	not requested	not requested	not requested	7.75	75.77	25.1	6.8	618	0.1	-99	3.4
			3/2/2020	not requested	not requested	not requested	not requested	<0.51	not requested	not requested	not requested	5.61	77.91	17.5	7.0	745	0.2	-93	15.0
	DUPLICATE 3 samples		3/2/2020	not requested	not requested	not requested	not requested	<0.51	not requested	not requested	not requested								
MW-24	Cross Gradient of BSW-7	28	5/24/2017	<31.2	31.2	<12.5	1.2	not requested	1390	16.6	38.4	5.89	75.34	22.8	6.8	2,335	0.2	-176	21.5
			8/30/2017	<50	3.5	not requested	not requested	not requested	1300	16.4	38.0	6.53	74.70	24.5	7.0	2,113	0.5	-93	7.8
			3/14/2018	<50	3.5	not detected	**	not requested	1480	15.3	36.1	5.56	75.67	15.4	6.7	2,088	0.1	-134	2.6
			6/27/2018	<24.5	3.5	<9.8	2.9	not requested	1550	16.1	43.3	6.44	74.79	23.5	6.7	2,567	0.2	-133	11.4
			9/21/2018	<24.5	3.5	<9.8	2.9	not requested	1020	16.4	40.9	6.48	75.67	25.4	6.9	1,753	0.1	-144	12.8
			2/18/2019	<24.5	3.5	<9.8	2.9	<0.54	1310	16.2	37.2	5.58	75.65	15.8	7.0	2,037	0.4	-155	38.7
			7/25/2019	<25.0	3.5	<10.0	2.9	<0.55	1380	22.0	39.0	6.04	75.19	25.3	6.8	208	0.1	-145	8.1
			3/2/2020	not requested	not requested	not requested	not requested	<0.51	1380	22.0	39.0	4.25	76.98	data lost	data lost	data lost	data lost	data lost	data lost
MW-25	Up Gradient of BSW-6	25	11/2/2017	**151**	3.5	not requested	not requested	not requested	not requested	not requested	not requested	6.30	74.19	29.3	6.4	57	0.5	-19	112.0
			3/14/2018	**114**	3.7	not detected	**	not requested	121	10	4..2	5.02	75.47	14.9	5.3	287	0.3	43	21.0
			6/26/2018	**72.5**	3.5	<9.8	2.9	not requested	117	9.2	4.1	5.89	74.60	24.6	5.5	309	0.3	-2	7.6
			9/20/2018	**55.8**	3.5	<9.8	2.9	not requested	106	8	4.2	5.02	75.47	26.8	5.8	280	0.2	6	8.2
			2/20/2019	**47.4**	3.5	<10.0	2.9	not requested	84.7	9.2	3.6	5.01	75.48	13.5	6.0	208	0.2	31	12.0
			7/23/2019	**40.2**	3.5	<10.0	2.9	**42**	89.2	9.0	5.0	5.52	74.97	27.0	5.7	251	0.1	2	9.2
			3/2/2020	not requested	not requested	not requested	not requested	**81**	89.2	9.0	5.0	3.89	76.60	18.1	6.1	230	0.2	36	12.0
MW-26	Cross Gradient of BSW-6	18	11/2/2017	<25	3.5	not requested	not requested	not requested	not requested	not requested	not requested	7.08	74.13	28.4	6.4	285	0.6	17	6.9
			3/14/2018	<55.6	3.9	not detected	**	not requested	170	11.2	2.3	5.75	75.46	16.3	5.8	345	0.2	-27	241
			6/27/2018	<24.5	3.5	<9.8	2.9	not requested	174	10.6	1.5	6.54	74.67	22.0	5.8	369	0.1	4	14
			9/20/2018	<25.0	3.5	<10.0	2.9	not requested	151	10.2	1.6	5.84	75.46	23.9	6	325	0.2	-4	13.4
			2/21/2019	<24.5	3.5	<9.8	2.9	not requested	166	11.2	1.5	5.7	75.51	15.5	6.4	319	0.3	35	19
			7/23/2019	<25.0	3.5	<10.0	2.9	<0.55	127	11.8	2.4	6.18	75.03	24.1	5.9	278	0.1	1	8.7
			3/2/2020	not requested	not requested	not requested	not requested	<0.52	127	11.8	2.4	4.55	76.66	18.9	6.3	308	0.4	-16	12.9
			RSL - Tapwater	0.041		240		0.041	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Maximum Contaminant Level (MCL)	1		no standard		1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

J =concentration shown is estimated
Bold value indicates a detection above the method reporting detection limit (MDL)
Yellow shaded cell indicates detected concentration is greater than the corresponding MCL
** Not detected as a Tentatively Identified Compound (TIC) by the analytical laboratory

(Shaded) Expanded Biosparge Pilot Test #2 startup on May 29, 2018

Table 7
Groundwater Data Summary
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample ID	Position Relative to Bio-Sparge Well	Distance To Bio-sparge Well (Feet)	Date Sample Collected	Method 8270 (BNA)				Method 8151	General Chemistry			Field Parameters							
				Pentachlorophenol		2,3,4,6 Tetrachlorophenol		PCP	Alkalinity	Chloride	TOC	DTGW	GWE	Temp	pH	Cond.	D.O.	ORP	Turbidity
				Result (µg/L)	MDL (µg/L)	Result (µg/L)	MDL (µg/L)	Result (µg/L)	(mg/L)	(mg/L)	(mg/L)	(feet)	(feet)	(Celsius)	(s.u...)	(µs/cm³)	(mg/L)	(millivolts)	(NTU)
MW-27	Up	25	11/2/2017	**323**	3.5	not requested	not requested	not requested	not requested	not requested	not requested	7.60	74.57	26.4	6.0	181	1.1	-24	2.2
	Gradient		3/14/2018	<56.8	4.0	not detected	**	not requested	35	8.7	1.8	6.29	75.91	17.5	5.1	140	0.4	81	10.6
	of BSW-5		6/26/2018	<24.5	3.5	<9.8	2.9	not requested	32.9	7.6	1.5	7.07	75.13	22.1	5.1	140	0.4	20	6.7
			9/19/2018	<25.5	3.6	<10.2	3.0	not requested	22.4	6.9	1.7	5.49	75.91	24.6	5.2	116	0.6	-9	8.8
			2/20/2019	<25.0	3.5	<10.0	2.9	**2.0**	24.9	7.6	1.9	6.16	76.04	14.2	5.5	107	0.5	144	8.9
			7/24/2019	<25.0	3.5	<10.0	2.9	**2.5**	12.0	8.3	2.1	6.65	75.55	24.2	4.8	103	0.3	150	5.1
			3/2/2020	not requested	not requested	not requested	not requested	**55**	12.0	8.3	2.1	5.12	77.08	data lost	data lost	data lost	data lost	data lost	data lost
MW-28	Up	30	11/3/2017	**351**	3.5	not requested	not requested	not requested	not requested	not requested	not requested	7.95	75.03	23.9	5.7	153	1.1	-50	0.3
	Gradient		3/14/2018	**262**	3.5	not detected	**	not requested	13.8	8.1	1.5	6.31	76.72	14.3	5.0	95	0.4	246	0.3
	of BSW-3		6/27/2018	**128**	6.9	<9.8	2.9	not requested	12.6	7.9	1.5	7.39	75.64	22.5	4.2	110	0.3	131	3.4
			9/20/2018	**252**	18.7	<10.6	3.1	not requested	13.7	7.6	1.7	5.29	76.72	25.5	4.9	116	0.3	220	5.5
			2/21/2019	**151**	17.3	<9.8	2.9	not requested	15.5	8.4	2.1	6.46	76.57	15.7	5.2	109	0.4	203	5.0
			7/24/2019	**371**	17.6	<10.0	2.9	**310**	6.8	8.9	2.3	6.91	76.12	24.6	4.7	100	0.2	303	1.1
			3/2/2020	not requested	not requested	not requested	not requested	**220**	6.8	8.9	2.3	5.16	77.87	18.2	5.3	114	0.4	72	6.2
MW-29	Up	90	11/3/2017	**51.7**	3.5	not requested	not requested	not requested	not requested	not requested	not requested	7.76	75.15	27.1	7.0	487	0.5	-141	4.6
	Gradient		3/14/2018	<51	3.6	not detected	**	not requested	220	6.1	1.4	6.23	76.67	17.3	6.5	383	0.1	55	6.3
			9/20/2018	**41.4**	3.5	<10.0	2.9	not requested	228	5.6	1.4	5.29	76.67	24.0	6.5	435	0.2	134	13.8
			2/21/2019	<24.5	3.5	<9.8	2.9	not requested	160	5.8	1.4	6.11	76.79	19.5	6.5	309	0.2	142	15.6
			7/22/2019	<25.0	3.5	<10.0	2.9	**29**	not requested	not requested	not requested	7.24	75.66	24.5	6.2	350	0.2	140	8.2
	of BSW-8		3/2/2020	not requested	not requested	not requested	not requested	**37**	not requested	not requested	not requested	4.89	78.01	data lost	data lost	data lost	data lost	data lost	data lost
MW-30	Cross	38	11/3/2017	<25	3.5	not requested	not requested	not requested	not requested	not requested	not requested	6.25	75.13	29.2	7.1	740	0.5	-156	8.2
	Gradient		3/13/2018	<52.1	3.7	not detected	**	not requested	340	19.7	3.6	5.06	76.52	16.4	6.5	723	0.3	-47	47.8
	of BSW-8		6/27/2018	<24.5	3.5	<9.8	2.9	not requested	346	19.8	3.3	5.98	75.60	21.9	6.5	749	0.2	-45	24.5
			9/20/2018	<25.0	3.5	<10.0	2.9	not requested	325	16.9	3.8	4.51	76.52	25.7	6.7	691	0.2	-83	24.6
			2/19/2019	<25.0	3.5	<10.0	2.9	**2.4**	295	18.8	2.8	4.98	76.60	14.4	7.0	603	0.2	-43	39.5
			7/25/2019	<25.0	3.5	<10.0	2.9	**3.3**	284	17.3	3.4	5.69	75.89	24.7	6.7	568	0.1	-82	2.6
			3/2/2020	not requested	not requested	not requested	not requested	**1.8**	284	17.3	3.4	3.86	77.72	16.7	6.9	602	0.2	-63	6.0
RSL - Tapwater				0.041		240		0.041	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Maximum Contaminant Level (MCL)				1		no standard		1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

J =concentration shown is estimated
Bold value indicates a detection above the method reporting detection limit (MDL)
Yellow shaded cell indicates detected concentration is greater than the corresponding MCL
** Not detected as a Tentatively Identified Compound (TIC) by the analytical laboratory

Expanded Biosparge Pilot Test #2 startup on May 29, 2018

Table 8
Summary of Surface Water Analytical Results
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample Location	Date Collected	Method 8270 Acid Extractables	
		Pentachlorophenol (µg/L)	Remaining Target Compounds (µg/L)
SW-1	12/19/2005	<20	BQL
up-gradient	7/22/2006	<20	BQL
#	8/22/2006	<20	BQL
	1/24/2007	<20	BQL
	10/3/2007	<20	BQL
	7/24/2008	<20	BQL
	1/8/2009	<20	BQL
	1/7/2010	<20	BQL
	6/24/2010	<20	BQL
	5/25/2011	<50	BQL
	5/16/2013	<50	BQL
	6/20/2013	<20	BQL
	2/5/2016	<20	BQL
	2/21/2017	<25	BQL
	3/14/2018	<49	BQL
	2/18/2019	<24.5	BQL
		Pentachlorophenol By Method 8151 Herbicides	
	3/4/2020	**0.16 J**	Not Applicable
	4/9/2020	<0.51	Not Applicable
SW-ID*	4/9/2020	<0.04	Not Applicable

SW-1D* = Duplicate sample analyzed by Research & Analytical Laboratories for comparison with Pace Analytical record sample

Table 8
Summary of Surface Water Analytical Results
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample Location	Date Collected	Method 8270 Acid Extractables	
		Pentachlorophenol (µg/L)	Remaining Target Compounds (µg/L)
SW-2	12/19/2005	<20	BQL
down-gradient	7/22/2006	**2.3 J**	BQL
#	8/22/2006	<20	BQL
	1/24/2007	<20	BQL
	10/3/2007	<20	BQL
	7/24/2008	<20	BQL
	1/8/2009	<20	BQL
	1/7/2010	<20	BQL
	6/24/2010	<20	BQL
	5/25/2011	<50	BQL
	5/16/2013	<50	BQL
	6/20/2013	<20	BQL
	2/5/2016	<20	BQL
	2/21/2017	<25	BQL
	3/14/2018	<49	BQL
	2/18/2019	<24.8	BQL
		Pentachlorophenol By Method 8151 Herbicides	
	3/4/2020	<0.51	Not Applicable
	4/9/2020	**0.84**	Not Applicable

Table 8
Summary of Surface Water Analytical Results
Marsh Lumber Company
Pamplico, South Carolina
S&ME Project No. 1584-98-146C

Sample Location	Date Collected	Method 8270 Acid Extractables	
		Pentachlorophenol (µg/L)	Remaining Target Compounds (µg/L)
SW-3	12/19/2005	<20	BQL
down-gradient	7/22/2006	**3.3 J**	BQL
#	8/22/2006	<20	BQL
	1/24/2007	<20	BQL
	10/3/2007	<20	BQL
	7/24/2008	<20	BQL
	1/8/2009	<20	BQL
	1/7/2010	<20	BQL
	6/24/2010	<50	BQL
	5/25/2011	<50	BQL
	5/16/2013	**10 J**	BQL
	6/20/2013	<20	BQL
	2/5/2016	<20	BQL
	2/21/2017	< 25	BQL
	3/14/2018	<51	BQL
	2/18/2019	<24.5	BQL
		Pentachlorophenol By Method 8151 Herbicides	
	3/4/2020	**0.13 J**	Not Applicable
	4/9/2020	**0.64**	Not Applicable
SW-4	6/20/2013	<20	BQL
at discharge	2/5/2016	<20	BQL
end of original	2/21/2017	<25	BQL
stormwater	3/14/2018	<49	BQL
line	2/18/2019	<24.5	BQL

BQL = Below Quantitation Limit or Method Detection Limit
all concentrations reported in micrograms per liter (µg/l)
Confirmation sampling event. Samples analyzed by PACE Analytical (Research & Analytical Laboratories)

Table 9
Updated Water Well Receptor Survey - 2019
SCDHEC Database, Florence County GIS, & Site Reconnaissance
Marsh Lumber Company VCC Site
S&ME Project No. 1584-98-146C

Map ID	Latitude	Longitude	Owner	Address	City/State	Well Use	Approximate Distance From PCP Plume (miles)	Information Source	Well Depth (feet bgs)	Top of Screen (feet bgs)
FLO-1			Creel, Austin	420 Marsh Road	Pamplico/SC	Domestic	0.37	FOI - 1, 2, 3	170	2
FLO-2			Evans, Anthony	429 Marsh Road	Pamplico/SC		0.50	1, 3		
FLO-3			Smith, John	437 Marsh Road	Pamplico/SC		0.53	1, 3		
FLO-4			Smith, John	445 Marsh Road	Pamplico/SC		0.58	1, 3		
FLO-5			Isgett, Bobby	503 Marsh Road	Pamplico/SC		0.63	1, 2, 3		
FLO-6	34 00 50 N*	79 34 61 W*	Sutton, Mike	513 Marsh Road	Pamplico/SC	Irrigation	0.75	FOI - 2, 3	170	4
FLO-7	33 59 31*	79 34 15*	Munn, Ollie Mae	311 S Hickory Street	Pamplico/SC	Cooling	0.50	FOI	240	2
NA	339999	795698	Marsh Lumber		Pamplico/SC	Unused$_1$	On-site	4		
FLO-10	335944	793405	Town of Pamplico		Pamplico/SC	Unused	0.28	5	192	182
FLO-11	335944	793405	Town of Pamplico		Pamplico/SC	Unused	0.28	5	157	147
FLO-147	335934	793328	Town of Pamplico (Well#1)		Pamplico/SC	Public Supply	0.85	5	300	210
FLO-317	335940	793605	Town of Pamplico (Well#2)		Pamplico/SC	Public Supply	1.75	5		270
FLO-168	335936	793400	Town of Pamplico (Well#3)		Pamplico/SC	Public Supply	0.46	5	203	-

FOI = Data obtained as a results of a Freedom of Information request submitted to SCDHEC
1 = Water well assumed present because parcel was located outside of Pamplico Town limits
2 = Suspect Well Structure Visual Observation
3 = Florence County GIS records
4 = Marsh Lumber
5 = Town of Pamplico
* =Well location Longitude and Latitude data present as reported in the SCDHEC database. Others as estimated from Florence County GIS
Blank cells = no information reported or obtained

Table 10
Comparison of Remedial Alternatives to Evaluation Criteria
Marsh Lumber
Pamplico, South Carolina

Criterion	Remedial Alternatives				
	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
	No Action	Monitored Natural Attenuation	Groundwater Extraction and Pretreatment by GAC	Air Sparging	Bio-enhancement
Protection of human health and the environment	2	3	3	4	3
Compliance with ARARs	2	2	3	4	3
Short-term effectiveness	2	2	3	4	2
Long-term effectiveness	3	3	3	5	4
Implimentability	5	5	1	3	4
Cost	5	3	1	4	3
Reduction of toxicity mass and volume	2	2	3	4	3
Total Score	21	20	17	28	22
Cost -$k	$25k	$1,025k	$ 3,980k	$ 630k	$ 945k

Notes:
I = Does not meet the minimum requirements
2 = Alternative has a low probablility of meeting the alternative criteria
3 = Alternative has a moderate probablility of meeting the alternative criteria
4 = Alternative has a high probablility of meeting the alternative criteria
5 = Alternative has a very high probablility of meeting the alternative criteria

GAC = Granular Activated Carbon
MNA - Monitored Natural Attenuation