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April 28, 2017

Mr. Greg Cassidy
South Carolina Department of Health and Environmental Control
State Remediation Section
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

RECEIVED

MAY 01 2017

SITE ASSESSMENT,
REMEDIATION &
REVITALIZATION

Subject: Focused Feasibility Study Work Plan
Bramlette Road Site (VCC16-5857-RP)
400 East Bramlette Road, Greenville, SC

Dear Mr. Cassidy:

In accordance with your agency's correspondence dated February 23, 2016, Duke Energy Carolinas, LLC (Duke Energy) is submitting this Focused Feasibility Study (FFS) Work Plan for your review and approval.

If you have any questions, please feel free to contact me at 704.497.3627 or at Richard.powell2@duke-energy.com.

Sincerely,

Richard E. Powell

Richard E. Powell, P.G.
Senior Environmental Specialist

cc: Brett Engard, Anchor QEA of North Carolina, PLLC

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AECOM **Environment**

Submitted to
Duke Energy Co
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Submitted by
AECOM
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Focused Feasibility Study Work Plan

Former Pine Street MGP Site
Site No. 56553
684 North Pine Street
Spartanburg, SC

Prepared for:

DUKE ENERGY® CAROLINAS

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List of Acronyms

μg/L	Micrograms per liter
ARAR	Applicable or relevant and appropriate requirements
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, xylenes
COCs	Constituents of concern
CSM	Conceptual site model
Duke	Duke Energy
EPA	United States Environmental Protection Agency
FFS	Focused Feasibility Study
FFSWP	Focused Feasibility Study Work Plan
foc	Fraction of organic carbon
ISCO	In situ chemical oxidation
LIF	Laser-induced fluorescence
LUC	Land use control
MAROS	Monitoring and Remediation Optimization System
MCL	Maximum contaminant level
MGP	Manufactured gas plant
MNA	Monitored natural attenuation
PNG	Piedmont Natural Gas Company
PWR	Partially weathered rock
RAO	Remedial action objectives
RBSL	Risk-based screening level
SCDHEC	South Carolina Department of Health and Environmental Control
Site	Former Pine Street Manufactured gas plant
SVOC	Semi-volatile organic compound
TLM	Tar-like material
VOC	Volatile organic compound
Work Plan	Feasibility Study Investigation Work Plan

Executive Summary

This *Focused Feasibility Study Work Plan* has been developed for the Former Pine Street manufactured gas plant (MGP) facility located in Spartanburg, SC (the Site). The Site has been subjected to numerous assessment and remedial action activities since 2000, which have significantly decreased the overall site risk. Important aspects of the historical assessment and remedial activities have included the following:

- Various site assessment activities investigating soil, groundwater, and surface water have been performed since 2000.
- An extensive excavation event was performed between February 2003 and March 2004 which removed a total of 67,596 tons of soil and debris.
- Human health and ecological risk assessments were performed and approved by South Carolina Department of Health and Environmental Control (SCDHEC).
- In 2006, a Declaration of Covenants and Restrictions was recorded that limited property use and prohibited use of groundwater for drinking or irrigation purposes.
- The onsite creek has shown no impacts from on-site constituents of concern (COCs), most likely due to the low groundwater velocity and biodegradation of dissolved phase contaminants.
- The historical groundwater monitoring indicates that groundwater COC concentrations are decreasing, with the exception of three localized areas in which the groundwater concentration trends are stable.

As outlined in the February 2016 *Feasibility Study Investigation Work Plan*, a supplemental investigation was performed at the Site. The primary objectives of this work were to:

1. Investigate the distribution of residual COCs in the subsurface.
2. Collect data related to biological degradation processes to better evaluate the role of natural attenuation as part of a final remedy.
3. Use this new information to enhance the conceptual site model (CSM) and support a remedial alternatives analysis to be performed in a Focused Feasibility Study (FFS).

To accomplish these goals, the investigation included:

- Delineation of residual mass from historical MGP activities using TarGOST® technology supplemented by soil sample collection and analysis at selected locations.
- Semi-annual groundwater monitoring and an evaluation of COC trends in individual wells (using the SourceDK program tool), as well as an evaluation of the overall groundwater plume dynamics (performed using the Monitoring and Remediation Optimization System (MAROS) software).
- A subsurface microbial organisms study using Bio-Trap® samplers to quantify microbial populations actively contributing to the biodegradation of target COCs.

Based on evaluations of the data collected, the following conclusions were developed:

- Tar-like material (TLM) is present within a narrow horizon below the water table. The zones are generally between 1-3 feet thick and located just above or into the uppermost zone of partially weathered rock (PWR). There are up to three individual areas of remaining TLM over an estimated areal extent of 1,000 square feet with an estimated volume of 1,150 cubic yards.

- Biodegradation of benzene and naphthalene, the primary COCs in groundwater, is occurring. This conclusion is confirmed through evaluating the overall Site wide decreasing COC trends in monitoring wells, geochemical data, and microbial activity and stable isotope analyses.
- The benzene and naphthalene plumes are shrinking and the risk of COC migration is minimal. The overall decreasing trend of the plumes can be linked to microbial degradation. The areas where COCs have been most persistent in groundwater correlate with the areas where TLM was identified using TarGOST®.

It is recommended to evaluate the following remediation alternatives in a Focused Feasibility Study:

1. No action
2. Monitored Natural Attenuation (MNA) and Land Use Controls (LUCs)
3. Targeted excavation with MNA/LUCs
4. In situ encapsulation/stabilization with MNA/LUCs

1 Introduction

1.1 Scope and Objectives

This Focused Feasibility Study Work Plan (FFSWP) has been prepared on behalf of Duke Energy (Duke) by AECOM to present the results of recent data collection activities and to propose remedial alternatives to be evaluated as part of a Focused Feasibility Study (FFS). The investigation activities were aimed at supplementing existing Site data regarding the efficacy of monitored natural attenuation (MNA) and to evaluate potential remaining source material related to historical manufactured gas plant (MGP) operations. The data gathered and updated conceptual site model (CSM), as described herein, enables the FFS and remedy selection process to move forward for the Site.

1.2 Report Organization

The report is organized as follows:

- **Section 1** describes the scope and objectives, the report organization, and the regulatory setting.
- **Section 2** summarizes the Site background.
- **Section 3** describes the investigation activities and results.
- **Section 4** describes the FFS process.
- **Section 5** identifies and summarizes the potential Remedial Alternatives that are proposed to be evaluated further.
- **Section 6** provides a schedule.
- **Section 7** provides references.

1.3 Regulatory Setting

Remediation efforts for the Site are regulated by SCDHEC under the Voluntary Cleanup Program. During a meeting with SCDHEC on October 22, 2015, Duke and SCDHEC agreed that additional data collection was necessary to properly conduct a FFS. A Feasibility Study Investigation Work Plan was therefore developed and submitted to SCDHEC on February 23, 2016 (AECOM, 2016a). As an approval condition for the Work Plan, SCDHEC stipulated an FFSWP be included as part of the reporting effort. This correspondence is presented as **Appendix A**.

2 Site Background

The Site is a former MGP facility that has been the subject of numerous assessment and remediation activities. These include:

- Removal via excavation of a large extent of source material (approximately 67,596 tons) in the unsaturated and saturated zones.
- Extensive groundwater monitoring since 2004 that has demonstrated decreasing COC concentration trends in most monitoring wells.
- An extensive in-situ chemical oxidation pilot test featuring activated sodium persulfate
- Institution of deed restrictions to prevent development of the Site for uses that would put sensitive receptors at unacceptable risk and prevent use of groundwater for drinking or irrigation purposes.

The Site is located in a predominately commercial and industrial section of Spartanburg, South Carolina, consisting of approximately 7.4 acres that are bounded by North Pine Street (US Highway 176) to the west, Southern Railway System mainline tracks to the north, additional commercial/industrial property to the east, and Linder Road to the south. The site location and general site plan are depicted on **Figures 1** and **2**, respectively. MGP operations were conducted on portions of the Site from the early 1900s to the mid-1950s. All MGP-related equipment was removed from the Site by the early 1960s (AMEC, 2012). Piedmont Natural Gas Company (PNG) presently owns the majority of the former MGP property, and Duke owns an electrical substation situated near the center of the property. Chinquapin Creek originates off-site and generally flows west to east through the center of the Site, eventually converging with Lawson Fork Creek approximately 3,600 feet east of the Site.

Naphthalene and benzene are the primary constituents of concern (COCs) in groundwater. The COCs are present at varying concentrations above the United States Environmental Protection Agency (EPA) maximum contaminant level (MCL), or the SCDHEC risk-based screening level (RBSL) in the absence of an established MCL, in localized areas of the Site. The primary risk associated with the Site is the exposure of humans to these localized areas of groundwater and associated soil material. This risk is administratively mitigated through a Declaration of Covenants and Restrictions that was executed by PNG in 2006, prohibiting the use of groundwater for drinking or irrigation without the approval of SCDHEC and restricting property use against residential, agricultural, recreational, child care and elderly care facilities, and schools (AMEC, 2012). The potential for human receptors to be in contact with COCs is unlikely based on the depth at which groundwater and impacted soil material are present (i.e., greater than 8 feet below ground surface). There are no occupied structures within the footprint of known impacts to groundwater, and a screening level ecological risk assessment concluded there were no unacceptable risks associated with the surface water from Chinquapin Creek. Vapor intrusion and groundwater-surface water interaction pose no unacceptable risks or represent incomplete pathways (ENSR, 2008).

Extensive source area remediation was performed by Duke in 2003 and 2004. A total of 67,596 tons of impacted soil and debris were excavated and properly disposed. A groundwater monitoring program was implemented to evaluate post-remediation groundwater quality. The well network has been sampled more than 30 times since 2004, which provides a statistically relevant dataset to evaluate groundwater conditions. A pilot study testing in situ chemical oxidation (ISCO) technology to address COCs in groundwater in the area of monitoring wells MW-13ISOC and MW-13S/D was performed in 2012 and 2013. The pilot study consisted of injecting approximately 12,360 gallons of activated persulfate compound into the subsurface in this area (AMEC, 2014).

A supplemental investigation work plan describing field activities to identify residual MGP-related material was performed under the Feasibility Study Investigation Work Plan in 2016 (AECOM, 2016a). The investigation results and their relevance for preparing a FFS are discussed below.

3 Supplemental Investigation

The Feasibility Study Investigation Work Plan (Work Plan) proposed a multiple lines of evidence approach for evaluating MNA and its suitability as a remedial alternative (AECOM, 2016a). The Work Plan activities focused on answering the following questions to help in this evaluation:

- Are there sufficient and correct microorganism populations present?
- Are microorganisms biodegrading the target COCs?
- Are the groundwater plumes stable or shrinking?

The Work Plan activities were also designed to investigate if residual MGP-related source materials remain on Site, and their nature and extent, if present. A description of the work involved is provided below.

3.1 Groundwater Monitoring

Site groundwater is monitored on a semi-annual basis for volatile organic compounds (VOCs) and semi- volatile organic compounds (SVOCs). As part of the Work Plan activities, semi-annual groundwater monitoring was continued with the addition of select geochemical parameters, and the results were presented in groundwater monitoring reports delivered to SCDHEC (AECOM, 2016b; AECOM, 2016c). The results of the 2016 semi-annual monitoring events are also summarized in this report, as the data are important to the groundwater trend analyses and the understanding of current groundwater conditions. The monitoring wells sampled and analyses performed are presented on **Table 1**. Groundwater potentiometric surface contour maps are provided as **Figures 3** and **4**, and COC plume interpretation maps are provided as **Figures 5** and **6.**

3.2 Investigation Activities

In addition to groundwater monitoring, the main data collection and analysis activities performed were:

- The use of Bio-Trap® samplers to quantitatively assess microbial activity in the subsurface and specifically to evaluate if the biological degradation of benzene and naphthalene is naturally occurring.
- The use of the TarGOST® high resolution profiling system to identify and delineate tar-like material (TLM) that may be affecting the timeframe for groundwater remediation by natural attenuation.
- The collection of natural organic carbon and VOC data in saturated soil.
- Trend analysis on individual wells and calculations of bulk plume parameters that allow for the evaluation of mass decay, transport, and migration of groundwater COCs. An analysis of geochemical parameters to evaluate microbial respiration processes was also performed.

3.3 Investigation Results

A summary of the work results is provided below. The methodology and rationale for these activities is presented in the Work Plan (AECOM, 2016a) and is not reproduced herein.

3.3.1 Bio-Trap® Analysis Results

Bio-Trap® samplers were installed in five wells at the conclusion of the April 2016 groundwater monitoring event and were left in place for approximately 6 weeks in accordance with the manufacturer's instructions. Upon removal from the wells, the traps were sent to the Microbial Insights, Inc. laboratory for analysis. The functional gene analysis (QuantArray®) identified the presence of genes responsible for aerobic and anaerobic benzene and naphthalene biodegradation in all tested samples. In addition, the Microbial Insights, Inc. laboratory compared the functional gene results against their internal database containing over 40,000 samples. This comparison indicated that Site concentrations of functional genes responsible for biodegradation

fell within the 'High' range for many of the analyses. These results demonstrate the presence of active aerobic and anaerobic bacteria capable of biodegrading benzene and naphthalene. The functional gene results are provided in **Appendix B.**

In addition to the functional gene analysis, the Bio-Trap® devices were baited with either the stable isotopes ^{13}C benzene (in wells MW-13S and MW-13D) or ^{13}C naphthalene (in wells MW-18S and ISOC-MW-15D) to allow for positive identification of biodegradation of these target compounds. This analysis demonstrated that ^{13}C was detected in both an inorganic form (i.e., carbon dioxide) and an organic form (i.e., biomass) in each sample. This is important because it demonstrates that both benzene and naphthalene are being completely biodegraded to either carbon dioxide or microbial biomass. **Figure 7** provides a graphical presentation of the percentage of stable ^{13}C benzene/naphthalene isotopes present in biomass. **Figure 8** provides a graphical presentation of the percentage of ^{13}C benzene/naphthalene isotopes present in inorganic carbon. The data presented in each figure are also compared against data in the laboratory's database (several hundred samples) for similar analyses to provide a semi-quantitative (e.g., 'high', 'medium' and 'low') framework of the results. The complete stable isotope analysis results from the Microbial Insights, Inc. laboratory are presented in **Appendix B.**

3.3.2 TarGOST® Results

TarGOST® is a laser-induced fluorescence (LIF) technology specifically developed to evaluate sites impacted with TLM and was selected for use in areas of the Site exhibiting persistent elevated COC concentrations in groundwater. These areas are indicated on **Figures 5** and **6** by COC iso-concentration contours, which are inferred from the most recent groundwater sampling data (AECOM, 2016c).

In July 2016, TarGOST® borings were advanced in the 38 locations shown on **Figure 9**. The initial TarGOST® borings were advanced within central portions of the interpreted groundwater plume. Based on the field-generated responses from these initial borings, subsequent boring locations were selected to identify and delineate potential TLM. TarGOST® points were typically advanced to a depth of 5-feet below zones of apparent TLM (i.e., a positive LIF response) or until refusal, whichever was first. Most points that were advanced to refusal are consistent with the depths historically interpreted as partially weathered rock (PWR), generally around 15 feet below ground surface (bgs).

TarGOST® boring/response logs are presented in **Appendix C**. A relative response for each TarGOST® boring using a green (signal not consistent with TLM), yellow (low range of the limit of detection for TLM), red (TLM) color scheme is shown for each boring on **Figure 9**. TLM was identified within a narrow horizon below the water table in six borings.

The investigation indicated 3 individual areas of remaining TLM over an approximate areal extent of 1,000 square feet with an estimated volume of 1,150 cubic yards. These zones are generally between 1-3 feet thick and located just above or into the uppermost zone of partially weathered rock. Fill or apparent unimpacted material is located above these relatively narrow horizons.

Figures 10 and **11** present cross sections of the Site showing TarGOST® responses at select borings and other relevant data.

3.3.3 Soil Sampling Results

Six saturated soil samples were collected using a Geoprobe® immediately following the TarGOST® data collection event. The soil borings were advanced adjacent to select TarGOST® points, and the soil borings were assigned the same name as the adjacent TarGOST® boring. Four soil samples were collected from discrete locations where TarGOST® data indicated the presence of TLM. These samples (identified as TG01, TG03, TG17, and TG29) were sent to the TestAmerica Nashville laboratory for analysis of benzene, toluene, ethylbenzene, xylenes (BTEX) and naphthalene by EPA SW-846 Method 8260B. The purpose of these samples was to evaluate the concentration of COCs and corroborate the TarGOST® data with the analytical results. Two samples were also collected from one boring (identified as TG19) located upgradient and outside of the areas where potential TLM was identified by TarGOST®. These samples were sent to the TestAmerica Nashville laboratory and analyzed by ASTM Method D2974 to evaluate the natural fraction of organic carbon (foc) present in saturated soil. The soil data can be used to evaluate the potential effect of remedial alternatives on the longevity of the groundwater plume. The soil sampling locations are shown on **Figure 9** and corresponding analytical results are presented in **Table 3**. Laboratory reports are included in **Appendix D**.

Investigation derived waste (e.g., soil cuttings and decontamination fluids) were contained onsite in sealed and labeled drums until transported offsite for appropriate disposal by a licensed waste disposal contractor. A copy of the waste manifest waste manifest was provided in Appendix C of the October 2016 Report of Groundwater Monitoring (AECOM, 2016c). All TarGOST®

and soil borings were properly sealed with bentonite grout delivered through a tremie pipe from the bottom of the borehole to the ground surface, in accordance with SCDHEC Regulation 61-71, Well Standards.

3.3.4 Groundwater Plume Analyses

Available groundwater data from October 2004 through October 2016 (i.e., benzene and naphthalene concentrations) were imported into the MAROS software program. MAROS was developed as a data evaluation tool to assess overall groundwater plume dynamics such as plume mass, movement, and expansion (bulk plume metrics). The software also provides evaluations of individual well trends using Mann-Kendall trend analysis (GSI Environmental, 2012).

Since historical monitoring events were sometimes inconsistent in the wells sampled over the period of record, the 16 most consistently sampled wells were identified and the data set was used to provide a consistent plume metric calculation. Wells selected for incorporation into the MAROS software are listed in **Table 4**. Bulk plume metric analysis in MAROS includes the calculation of the following parameters:

- Zeroth Moment – Represents the sum of concentrations of all monitoring wells and is an estimate of the total dissolved mass of the plume. The trend of this parameter is also calculated using Mann-Kendall analysis. Decreasing trends of the Zeroth Moment indicate that the overall plume mass is decreasing.
- First Moment – Estimates the location of the plume center of mass. The trend in the change in location of the center of mass is calculated using Mann-Kendall analysis. Decreasing trends of the First Moment indicate that the center of mass is moving closer to the source area location.
- Second Moment – Indicates the distribution of COCs around the center of mass. Two parameters are calculated, which represent spreading parallel (x-direction) and perpendicular (y-direction) to the prevailing groundwater flow direction. Decreasing trends of the Second Moment indicate that the plume extent is shrinking.

Bulk plume metrics were calculated using either saprolite or PWR wells, and the results are summarized in **Table 4**. These results indicate that the plume mass of both benzene and naphthalene are decreasing (Zeroth Moment, **Table 4**). In addition, both the benzene and naphthalene plumes are not moving (First Moment) or spreading (Second X Moment, **Table 4**) in a direction parallel with groundwater flow. Benzene and naphthalene are spreading in the vertical direction (Second Y Moment, **Table 4**) in saprolite wells. The individual well metrics indicate that all of the wells analyzed exhibit stable or decreasing trends for both benzene and naphthalene. The entirety of the MAROS evaluation results are presented in **Appendix E**.

The MAROS results allow for the observation of groundwater/plume trends, but do not yield information regarding relative decay rates for COCs. Therefore, historical groundwater analytical data for benzene and naphthalene were also evaluated from eight saprolite wells and four PWR wells using the SourceDK software, which can calculate first order decay rates from existing data (GSI Environmental, 2004). Wells selected for SourceDK analysis and the results are presented in **Table 5**. The first order decay rates were used to calculate the half-life for benzene and naphthalene in each well. The average half-life for benzene and naphthalene in saprolite wells was 2.2 years and 1.3 years, respectively. The average half-life for benzene and naphthalene in PWR wells was 3.4 years and 26.2 years, respectively. Analysis spreadsheets from the SourceDK software are presented in **Appendix F**.

Inorganic geochemical data collected from eight wells during the October 2016 groundwater monitoring event are presented in **Table 6**. Mann-Kendall trend analysis was performed on geochemical data to investigate trends between changes in geochemical parameters and the extent of dissolved benzene and naphthalene concentrations (as opposed to time). Total iron and alkalinity displayed positive trend correlation to total benzene and naphthalene concentrations, while sulfate displayed a negative correlation. Ferrous iron, ferric iron, and sulfide displayed stable or no discernable trend; a quantitative trend could not be established for nitrate due to a lack of detectable concentrations. Trend analysis worksheets are provided as **Appendix G**.

The trend analysis of the inorganic geochemical data demonstrates the presence and activity of microbial respiration processes, specifically iron reduction and sulfate reduction. Iron reduction respiration processes have been demonstrated to be linked to both benzene (Anderson and Lovley, 1999) and naphthalene biodegradation (Kleeman and Meckenstock, 2011). This process utilizes oxidized iron (ferric; Fe[III]) as the electron acceptor, and creates reduced iron (ferrous; Fe[II]) as a byproduct. Sulfate reduction processes have also been linked to the biodegradation of both benzene (Lovley et al., 1995) and naphthalene (Meckenstock et al., 2000). During this process, sulfate anions are reduced to produce sulfide as a byproduct. The results of the trend analysis are indicative of ongoing natural attenuation processes.

3.4 Data Summary

Key conclusions from the investigation include the following:

- TLM was identified by the TarGOST® system within a confined area west of the substation. The area coincides with monitoring wells that have exhibited lingering groundwater impacts. The material is generally located within a relatively narrow zone (1-3 feet thick) just above or into the uppermost zone of partially weathered rock.
- Saturated soils samples were collected from areas identified as potential TLM and analyzed for COCs. These data indicate the presence of benzene, ethylbenzene, toluene and xylene above EPA regional screening levels in three of the four analyzed samples (Table 3). The distribution and associated COC concentration of the identified material has been defined sufficiently to conduct a FFS.
- Microbial data collected using Bio-Trap® samplers indicate that microorganisms and functional genes known to be responsible for aerobic and anaerobic biodegradation of benzene and naphthalene are present in high range quantities in the subsurface. Thus indicating the Site exhibits favorable conditions to support microbial growth.
- Stable isotope probing performed as part of the Bio-Trap® analysis definitively shows the biodegradation of benzene and naphthalene is occurring.
- The bulk plume mass of benzene and naphthalene is decreasing. The center of mass is not traveling downgradient and horizontal spreading of the plume is minimal.
- Trends of benzene and naphthalene in individual wells are either decreasing or stable.
- Geochemical data are indicative of the presence of iron and sulfate reducing microbial respiration processes.

4 Focused Feasibility Study Approach

Upon the approval of the FFSWP, a FFS will be performed in general accordance with EPA guidance (EPA, 1988; EPA,1989). The EPA guidance prescribes a step-wise approach to evaluate solutions for site restoration. These include identifying COCs, defining remedial action objectives and remediation goals, the development and screening of different remedial alternatives, and evaluating those alternatives.

4.1 Constituents of Concern

COCs are media-specific chemicals that are present at concentrations that either exceed an established promulgated standard or present an unacceptable risk of exposure to receptors. COCs for soil, groundwater, and surface water are summarized below:

- **Soil COCs:** Impacted soil in the unsaturated zone has been removed from the Site. Existing data indicates there are no soil COCs at the Site.
- **Groundwater COCs:** COCs for groundwater are benzene and naphthalene. Benzene and naphthalene are present in several Site wells and are the only constituents historically detected above promulgated standards. The promulgated standard for benzene is the EPA-established MCL. While there is no MCL for naphthalene, the SCDHEC consistently uses the RBSL as its target for naphthalene; therefore, naphthalene is considered a COC. While the FFS investigation detected ethylbenzene, toluene, and xylenes within zones of saturated soil, these analytes have historically been detected infrequently in groundwater and have never been detected above a promulgated standard. Therefore, they are not considered as COCs.
- **Surface Water COCs:** The evaluation of trends and plume dynamics performed using MAROS and SourceDK indicate COCs in groundwater degrade to concentrations below risk-based remediation goals before reaching Chinquapin Creek. Additionally, historical surface water sampling performed in conjunction with groundwater monitoring events has demonstrated there no COCs in surface water. While there have been trace concentrations of chlorinated VOCs detected in surface water, these analytes were detected upstream of the Site and originate offsite.

4.2 Remedial Action Objectives

Remedial action objectives (RAOs) are the end points which, when obtained, will result in appropriate protection of human health and the environment. A list of proposed RAOs for the Site is provided below:

- **RAO 1:** Prevent ingestion of groundwater containing COCs in excess of applicable drinking water standards.
- **RAO 2:** Restore groundwater concentrations to applicable remediation goals.
- **RAO 3:** Prevent or confirm that groundwater containing COCs do not impact on-site surface water above South Carolina surface water standards

4.3 Remediation Goals

Remediation goals are components of RAOs that are medium and constituent specific numerical values meant to provide an objective metric for when the RAO has been attained. The following remediation goals are proposed:

- Benzene in groundwater – MCL of 5 micrograms per liter (μg/L)
- Naphthalene in groundwater – RBSL of 25 μg/L

4.4 Evaluation Criteria for Focused Feasibility Study

The EPA guidance prescribes a nine criteria evaluation approach for the screening of remedial alternatives. These are divided into three categories known as Threshold, Balancing, and Modifying criteria.

4.4.1 Threshold Criteria

Threshold criteria are minimum requirements that each remedial alternative must meet. If the alternative cannot meet the threshold criteria then it is not further evaluated as a viable remedy. The threshold criteria and their definition are as follows:

- Overall Protection of Human Health and the Environment – Describes how the alternative achieves and maintains protection of human health and the environment.
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) – Describes how the alternative complies with ARARs, which are any federal or state standards, requirements, criteria, or limitations that are determined to be applicable to remedial activities.

4.4.2 Balancing Criteria

Balancing criteria are evaluation methods to determine which alternatives meeting threshold criteria are best suited to meet the remedial action objectives. Balancing criteria include the following:

- Long-term Effectiveness and Permanence – Evaluates long-term effectiveness of protection of human health and the environment.
- Reduction of Toxicity, Mobility, and Volume through Treatment – Evaluates the extent to which COCs are removed and/or destroyed by the alternative.
- Short-term Effectiveness – Evaluates the effectiveness of the alternative in protecting human health and the environment during alternative implementation.
- Implementability – Evaluates feasibility of implementing the alternatives based on technical, administrative, and availability of necessary services.
- Cost – Evaluates the capital and operational costs of each alternative.

4.4.3 Modifying Criteria

Modifying criteria are considered during evaluation of remedial alternatives. Modifying criteria include:

- State Acceptance – Includes SCDHEC’s assessment and overall preferences regarding remedial alternatives.
- Community Acceptance – Includes the community’s assessment and preference regarding remedial alternatives.

The modifying criteria are evaluated following development of the FFS, thus an evaluation of these criteria will not be included within the forthcoming FFS document, and any further steps such as public comment periods will be identified.

5 Identification of Potential Remediation Alternatives

The following remedial alternatives will be subjected to detailed analysis within the FFS. In situ chemical oxidation and in situ biological remediation technologies will be discussed within the FFS, but will not be subjected to detailed analysis.

5.1 No Action

Leave the site media “as is” with no provision for monitoring or control. Typically this option is used as a baseline to compare to other remediation alternatives.

5.2 Monitored Natural Attenuation and Land Use Controls

It is assumed that, because COC concentrations exceed standards in monitoring wells, a combination of land use controls (LUCs) and groundwater monitoring will be required under each alternative. MNA is a passive approach that monitors the natural degradation or reductions of COCs in groundwater. A typical MNA approach centers on monitoring the geochemistry of the underlying site, and the COC concentrations, to continually evaluate and confirm that the site conditions are supportive of COC degradation. During the implementation phase, a groundwater sampling plan would be developed to monitor remedy performance and to confirm that COC concentrations remain stable or decrease following the implementation of the remedy. Additionally this would also include any implementation of LUCs necessary to protect human health and the environment. Typical LUCs include development restrictions and/or groundwater use restrictions, which are already in place for the Site.

5.3 Targeted Excavation with Monitored Natural Attenuation

Under this scenario, a targeted excavation of TLM would be performed. Then, once the presumed residual source material was removed, non-impacted material would be used for backfilling. MNA with LUCs would then be initiated to evaluate anticipated reductions in groundwater concentrations.

5.4 Encapsulation/Stabilization with Monitored Natural Attenuation

Under this scenario the identified remaining mass would be encapsulated or stabilized using a soil amendment. An amendment would be selected such that it locks the residual source material within the soil matrix and prohibits or limits the ability to be released into the groundwater. Once the stabilization or solidification was completed, MNA with LUCs would be initiated to evaluate anticipated reductions in groundwater concentrations.

6 Schedule

Task Description	Start	Finish
SCDHEC Review and Approval of FFSWP	05/01/2017	07/01/2017
Draft FFS	07/01/2017	08/25/2017
SCDHEC Review of FFS	08/25/2017	09/30/2017
SCDHEC and Duke discussion and selection of remedy	10/01/2017	10/15/2017
Selection of Final Remedy	10/20/2017	10/20/2017

7 References

AECOM, 2016a. Feasibility Study Investigation Work Plan, Former Pine Street Manufactured Gas Plant Site, Spartanburg, South Carolina. Prepared for: Duke Energy, AECOM, February 2016.

AECOM, 2016b. Report of Groundwater Monitoring, Pine Street MGP Site, 684 North Pine Street, Spartanburg, South Carolina. Prepared for Duke Energy, AECOM, August 11, 2016.

AECOM, 2016c. Report of Groundwater Monitoring, Pine Street MGP Site, 684 North Pine Street, Spartanburg, South Carolina. Prepared for Duke Energy, AECOM, December 30, 2016.

AMEC, 2012. *Chemical Oxidation Pilot Test Work Plan, Pine Street Manufactured Gas Plant Site, Spartanburg, South Carolina*. Prepared for: Duke Energy, AMEC Environment & Infrastructure, Inc. Project No. 6228120021. May 29, 2012.

AMEC, 2014. Chemical Oxidation Pilot Test Report, Pine Street Manufactured Gas Plant Site, Spartanburg, South Carolina. Prepared for: Duke Energy, AMEC Foster Wheeler, Project No. 6228-12-0021. September 30, 2014.

AMEC, 2015a. *Report of Groundwater Monitoring, Pine Street MGP Site*. Prepared for: Duke Energy, AMEC Foster Wheeler, Project No. 6228-14-0195. November 13, 2015.

AMEC, 2015b. Work Plan for Additional Investigation, Pine Street Manufactured Gas Plant Site, Spartanburg, South Carolina. Prepared for: Duke Energy, AMEC Foster Wheeler, Project No. 6228-14-0195. January 8, 2015.

Anderson, R.T. and D.R. Lovley, 1999. Naphthalene and benzene degradation under Fe(III)-reducing conditions in petroleum contaminated aquifers. Bioremediation Journal. 3: 121-135

ENSR, 2008. Remedial Alternatives Focused Feasibility Study, Spartanburg Former Manufactured Gas Plant Site. ENSR Corporation, Document No. 02355180-400. May 22, 2008.

EPA, 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. EPA/540/G-89/004. October 1988.

EPA, 1989. Risk Assessment Guidance for Superfund Volume I. EPA/540/1-89/002. December 1989.

EPA, 2013. Operating Procedure: Groundwater Sampling. SESDPROC-301-R3. Effective March 6, 2013. <http://www.epa.gov/sites/production/files/2015-06/documents/Groundwater-Sampling.pdf>

GSI Environmental, 2004. SourceDK Remediation Timeframe Decision Support System. User's Manual. Version 1.0. April 2004.

GSI Environmental, 2012. Monitoring and Remediation Optimization System (MAROS) Software Version 3.0. User's Guide and Technical Manual. September 2012.

Kleeman, R. and R.U. Meckenstock, 2011. Anaerobic naphthalene degradation by Gram-positive, iron-reducing bacteria.

Lovley, D.R., Coates, J.D., Woodward, J.C. and E. Phillips, 1995. Benzene Oxidation Coupled to Sulfate Reduction. Applied and Environmental Microbiology. 61(3): 953-958.

Meckenstock, R.U., Annweiler, E., Michaelis, W., Richnow, H.H. and B. Schink, 2000. Anaerobic naphthalene degradation by a sulfate-reducing enrichment culture. Applied and Environmental Microbiology. 66 (7): 2743-2747.

S&ME, 2005. Site Assessment Report, Duke Power, Pine Street Manufactured Gas Plant Site, Spartanburg, South Carolina. Prepared for: Duke Power, S&ME Project No. 1264-02-146. April 2005.

S&ME, 2008. Groundwater Summary Report, Pine Street MGP Site, Spartanburg, South Carolina. Prepared by S&ME. January 30, 2008.

S&ME, 2011a. *Soil Data Review Summary, Duke Energy Pine Street MGP Site, Spartanburg, South Carolina*. Prepared for: Duke Energy, S&ME Project No. 1264-02-146. February 28, 2011.

S&ME, 2011b. Chemical Oxidation Work Plan, Duke Energy Pine Street MGP Site, Spartanburg, South Carolina. Prepared for: Duke Energy, S&ME Project No. 1264-02-146. August 10, 2011.

Tables

Table 1
Summary of Semi-Annual Groundwater Sampling and Laboratory Analyses
Duke Energy Pine Street MGP Site, Spartanburg, South Carolina

Well ID		VOCs	SVOCs	Methane	Nitrogen/ Nitrate	Nitrogen/ Nitrite	Alkalinity	CO_2	Ferrous Iron	Ferric Iron	H_2S / Sulfide	Sulfate
		Laboratory Analyses						HACH® Field Analyses				
Saprolite Wells	MW-1SS	X	X									
	MW-2SS	X	X									
	MW-3SS	X	X									
	MW-10S	X	X									
	MW-11S	X	X									
	MW-12S	X	X									
	MW-13S	X	X	X	X	X	X	X	X	X	X	X
	MW-13 ISOC	X	X									
	MW-14S	X	X									
	MW-15S	X	X									
	MW-16S	X	X									
	MW-17S	X	X	X	X	X	X	X	X	X	X	X
	MW-18S	X	X	X	X	X	X	X	X	X	X	X
	MW-19S	X	X									
	ISOC-4S	X	X									
	ISOC-8S	X	X									
	ISOC-15S	X	X	X	X	X	X	X	X	X	X	X
	ISOC-18S	X	X									
Partially Weathered / Fractured Rock Wells	MW-10D	X	X									
	MW-11D	X	X									
	MW-12D	X	X									
	MW-13D	X	X	X	X	X	X	X	X	X	X	X
	MW-14D	X	X									
	MW-15D	X	X									
	MW-16D	X	X									
	MW-18D	X	X	X	X	X	X	X	X	X	X	X
	ISOC-4D	X	X	X	X	X	X	X	X	X	X	X
	ISOC-15D	X	X	X	X	X	X	X	X	X	X	X
	ISOC-18D	X	X									
Deep Rock	MW-1DR	X	X									

Notes:
•Table excepted from the Feasibility Study Investigation Work Plan (AECOM, 2016a)
CO_2 - Carbon dioxide
EPA - Environmental Protection Agency
H_2S - Hydrogen sulfide
VOCs - Volatile Organic Compounds
SVOCs - Semi-Volatile Organic Compounds

Table 2
Historically Detected Volatile Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	5	--	--	--	--	700	--	40	--	25	--	--	--	--	5	1,000	10,000	--
MW-1SS	3/21/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/27/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/16/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/10/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/29/15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	09/14/15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
MW-1DR	03/20/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/29/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**182**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/18/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/17/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-2SS	03/19/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/02/12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	02/25/13	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	07/31/13	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	01/14/14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	07/08/14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	01/29/15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	09/14/15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/20/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-3SS	03/21/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/02/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	08/01/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/10/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/30/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/16/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/21/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-10S	03/19/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	08/01/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/08/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/27/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/16/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/20/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA

Table 2
Historically Detected Volatle Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	**5**	--	--	--	--	**700**	--	**40**	--	**25**	--	--	--	--	**5**	**1,000**	**10,000**	--
MW-10D	03/19/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	08/01/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/08/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/29/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/14/15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	09/14/15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	04/20/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-11S	03/21/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/02/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	08/01/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/30/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/17/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/21/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/19/16	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<250	<125	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<25.0	<25.0	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<15.0	NA
MW-11D	03/21/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**15.6**	<1.00	<1.00	<1.00	<1.00	<1.00	**1.3**	<3.00	NA
	10/02/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	08/01/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/30/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	**1.33**	<2.00	NA
	09/16/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/21/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-12S	03/21/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/02/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/27/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/28/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/20/16	<1.00	<1.00	<1.00	<1.00	0.29	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**1.7**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/18/16	<1.00	<1.00	<1.00	<1.00	**1.03**	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-12D	03/21/12	<1.00	<1.00	**1.05**	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	**1.25**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/02/12	<1.00	<1.00	**1.21**	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/27/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	**1.99**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	**1.15**	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/28/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**22.1**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/20/16	<1.00	0.56	0.7	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.27	<5.00	<5.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/17/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA

Table 2
Historically Detected Volatile Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	5	--	--	--	--	700	--	40	--	25	--	--	--	--	5	1,000	10,000	--
MW-13S	03/20/12	<5.00	<5.00	<5.00	6.75	83.3	<5.00	29.9	<250	<250	340	<5.00	<5.00	<5.00	<5.00	115	14	<5.00	<25	510	<5.00	5.45	<5.00	<5.00	<1.00	41.4	100	NA
	10/03/12	<1.00	<1.00	<5.00	<1.00	118	<1.00	41.9	<50.0	<50.0	247	<1.00	<1.00	<1.00	<1.00	116	15.9	<1.00	<5.00	714	9.07	7.58	4.15	<1.00	<1.00	32.1	99.9	1,510
	02/27/13	<20.0	<20.0	<20.0	<20.0	143	<20.0	36.1	<1000	<1000	25.7	<20.0	<20.0	<20	<20.0	88.3	<20.0	<20.0	<100	2,290	<20.0	<20.0	<20.0	<20.0	<1.00	<20.0	<60.0	1,450
	03/28/13	<20.0	<20.0	<20.0	<20.0	437	<20.0	142	<1000	<1000	34.5	<20.0	<20.0	<20	<20.0	124	34.9	<20.0	<100	3,040	44.5	<20.0	21.9	<20.0	<1.00	77.5	277	2,220
	07/30/13	<1.00	<1.00	<1.00	<1.00	105	<1.00	39.8	<50.0	10	557	<1.00	<1.00	<1.00	<1.00	124	7.88	<1.00	<5.00	2,400	3.12	<1.00	2.22	51.6	<1.00	155	259	4,730
	01/17/14	<1.00	<1.00	<1.00	<1.00	26.3	<1.00	10.4	<50.0	<5.00	17.1	<1.00	1.38	<1.00	<1.00	25.5	3.5	<1.00	<5.00	231	1.84	1.39	<1.00	<1.00	<1.00	2.89	23.3	313
	07/10/14	<1.00	<1.00	<1.00	<1.00	53.3	<1.00	20.2	<50.0	<25.0	24.1	<1.00	<1.00	<1.00	<1.00	52.2	7.8	<1.00	<5.00	529	2.93	3.00	1.06	<1.00	<1.00	4.94	51.4	1,020
	01/30/15	<1.00	<1.00	<1.00	<1.00	38.6	<1.00	15.8	<50.0	<25.0	8.77	<1.00	<1.00	<1.00	<1.00	17.0	5.65	<1.00	<5.00	296	3.36	2.56	1.38	<1.00	<1.00	1.64	18.8	580
	09/16/15	<1.00	<1.00	<1.00	<1.00	75.6	<1.00	29.4	<50.0	<25.0	30.1	<1.00	<1.00	<1.00	<1.00	57.7	13.4	<1.00	<5.00	494	<1.00	6.00	2.41	<1.00	<1.00	5.11	50.7	1,450
	04/19/16	<1.00	<1.00	<1.00	<1.00	36.6	<1.00	6.5	<5.00	<25.0	8.2	<1.00	<1.00	<1.00	<1.00	16.2	4.9	<1.00	<5.00	432	0.43	2.20	0.76	0.27	<1.00	1.6	14.7	NA
	10/20/16	<1.00	<1.00	<1.00	<1.00	59.7	<1.00	18.1	<5.00	<25.0	29.3	<1.00	<1.00	<1.00	<1.00	43.4	10.9	<1.00	<5.00	189	5.36	4.46	1.97	1.5	<1.00	2.99	35	NA
MW-13D	03/21/12	<1.00	1.61	3.94	<1.00	28	<1.00	2.84	<50.0	<50.0	175	<1.00	<1.00	<1.00	<1.00	75	7.21	<1.00	<5.00	1,420	1.56	8.72	<1.00	29.5	<1.00	263	282	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	618
	02/27/13	<1.00	1.09	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	5.62	<1.00	<1.00	<1.00	<1.00	1.17	<1.00	<1.00	<5.00	9.46	<1.00	<1.00	<1.00	<1.00	<1.00	3.96	<3.00	<100
	07/30/13	<1.00	1.19	1.07	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/17/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/10/14	<1.00	1.18	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	1.70	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/30/15	<1.00	<1.00	1.92	<1.00	12.9	<1.00	<1.00	<50.0	<25.0	73.3	<1.00	<1.00	<1.00	<1.00	34.6	3.92	<1.00	<5.00	757	1.13	5.16	<1.00	9.03	<1.00	22.8	123	1,060
	09/16/15	<1.00	1.93	3.92	<1.00	13.7	<1.00	1.71	<50.0	<25.0	137	<1.00	<1.00	<1.00	<1.00	50.3	4.05	<1.00	<5.00	964	<1.00	4.32	<1.00	15.5	1.35	65.9	180	989
	04/19/16	<1.00	1.9	2.2	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00
	10/20/16	<1.00	1.51	1.88	12.6	1.3	<1.00	<1.00	<50.0	<25.0	353	<1.00	<1.00	<1.00	<1.00	5.25	<1.00	<1.00	<5.00	96.4	<1.00	<1.00	<1.00	1.47	<1.00	8.28	22.7	NA
MW-13 ISOC	03/21/12	<1.00	<1.00	<1.00	<1.00	98.9	<1.00	30.5	<50.0	<50.0	618	<1.00	<1.00	<1.00	<1.00	63.8	8.68	<1.00	<5.00	1,350	2.76	2.15	<1.00	19.6	<1.00	102	237	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	110	<1.00	43.7	<50.0	<50.0	667	<1.00	<1.00	<1.00	<1.00	328	15.2	<1.00	<5.00	736	3.66	6.64	1.59	<1.00	<1.00	45.4	225	2,180
	01/23/13	<1.00	<1.00	<1.00	<1.00	27.4	<1.00	7.22	<50.0	261	457	<1.00	<1.00	<1.00	3.32	77.7	1.7	<1.00	<5.00	336	<1.00	<1.00	<1.00	6.07	<1.00	255	258	2,060
	02/04/13	<1.00	<1.00	<1.00	<1.00	108	<1.00	33.4	<50.0	209	714	3.14	1.09	<1.00	2.81	127	3.67	<1.00	<5.00	1,420	<1.00	1.69	3.45	<1.00	<1.00	453	542	3,520
	02/27/13	<1.00	<1.00	<1.00	12.0	110	<1.00	35.6	<50.0	81.4	495	<1.00	<1.00	<1.00	<1.00	129	3.21	<1.00	<5.00	1,430	1.38	2.25	1.28	58.2	<1.00	476	446	4,700
	03/27/13	<1.00	<1.00	<1.00	<1.00	136	<1.00	46.9	<50.0	97.3	720	<1.00	1.66	<1.00	<1.00	143	3.35	<1.00	<5.00	1,130	<1.00	1.86	1.9	50.2	<1.00	567	672	4,500
	07/31/13	<1.00	<1.00	<1.00	<1.00	34.5	<1.00	9.77	<50.0	13.9	114	<1.00	<1.00	<1.00	<1.00	37.6	4.64	<1.00	<5.00	404	<1.00	1.97	1.03	1.71	<1.00	16.6	41.4	629
	09/12/13	<1.00	<1.00	<1.00	<1.00	5.73	<1.00	3.19	<50.0	<5.00	6.62	<1.00	4.26	2.84	<1.00	8.97	<1.00	<1.00	<5.00	45.2	<1.00	<1.00	<1.00	<1.00	<1.00	3.31	10.9	<100
	10/03/13	<1.00	<1.00	<1.00	<1.00	5.92	<1.00	2.34	<50.0	<5.00	13.6	<1.00	<1.00	1.98	<1.00	6.26	<1.00	<1.00	<5.00	70.6	<1.00	<1.00	<1.00	<1.00	<1.00	2.19	10.2	108
	01/17/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	11.9	<1.00	<1.00	<1.00	<1.00	1.05	<1.00	<1.00	<5.00	5.43	<1.00	<1.00	<1.00	<1.00	<1.00	1.14	9.10	<100
	07/10/14	<1.00	<1.00	<1.00	<1.00	5.33	<1.00	1.41	<50.0	<25.0	12.2	<1.00	<1.00	<1.00	<1.00	2.28	<1.00	<1.00	<5.00	36.8	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	6.16	146
	01/30/15	<1.00	<1.00	<1.00	<1.00	3.01	<1.00	1.11	<50.0	<25.0	17.1	<1.00	<1.00	<1.00	<1.00	2.28	<1.00	<1.00	<5.00	17.4	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	12.9	<100
	09/16/15	<1.00	<1.00	<1.00	<1.00	1.75	<1.00	<1.00	<50.0	<25.0	2.04	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	10.9	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	04/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/19/16	<1.00	<1.00	<1.00	<1.00	1.12	<1.00	<1.00	<5.00	<25.0	1.01	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-14S	03/20/12	<5.00	<5.00	<5.00	<5.00	60.0	<5.00	20.2	<250	<250	14.4	<5.00	<5.00	<5.00	<5.00	54.8	13.8	<5.00	<25	1,740	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	42	NA
	10/02/12	<5.00	<5.00	<5.00	<5.00	<1.00	<5.00	<1.00	<50.0	<50.0	<1.00	<5.00	<5.00	<5.00	<5.00	<1.00	<1.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/10/14	<1.00	<1.00	<1.00	<1.00	57.5	<1.00	20.5	<50.0	<25.0	13.8	<1.00	<1.00	<1.00	<1.00	58.6	13.7	<1.00	<5.00	1,250	3.52	4.01	1.78	<1.00	<1.00	1.32	43.5	NA
	01/29/15	<1.00	<1.00	<1.00	<1.00	2.25	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	3.08	<1.00	<1.00	<5.00	40.7	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	52.5	<1.00	17.9	<50.0	<25.0	9.61	<1.00	<1.00	<1.00	<1.00	47.7	14.4	<1.00	<5.00	1,030	<1.00	4.83	2.32	<1.00	<1.00	1.51	38.4	NA
	04/20/16	<1.00	0.54	0.28	<1.00	61.8	<1.00	15.3	<5.00	<25.0	11.3	<1.00	<1.00	<1.00	<1.00	54.7	11.8	<1.00	<5.00	1,310	0.54	3.4	1.4	<1.00	<1.00	1.5	38.1	NA
	10/17/16	<1.00	<1.00	<1.00	<1.00	71.5	<1.00	23.1	<5.00	<25.0	10.9	<1.00	<1.00	<1.00	<1.00	60.6	16.6	<1.00	<5.00	1,580	<1.00	6.82	3.31	<1.00	<1.00	1.63	43.8	NA

Table 2
Historically Detected Volatle Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	5	--	--	--	--	700	--	40	--	25	--	--	--	--	5	1,000	10,000	--
MW-14D	03/21/12	<1.00	<1.00	<1.00	<1.00	3.90	<1.00	1.46	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	1.39	<1.00	<1.00	<5.00	32.6	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/10/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/28/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/20/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	1.3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/17/16	<1.00	<1.00	<1.00	<1.00	1.9	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	1.81	<1.00	<1.00	<5.00	25.1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-15S	03/20/12	<5.00	<5.00	<5.00	<5.00	131	<5.00	24.2	<250	<250	<5.00	<5.00	<5.00	<5.00	<5.00	36.6	20.6	<5.00	<25	1,280	<5.00	7.95	<5.00	<5.00	<5.00	<5.00	24.2	NA
	10/03/12	<5.00	<5.00	<5.00	<5.00	50.8	<5.00	14.1	<50.0	<50.0	1.72	<5.00	<5.00	<5.00	<5.00	17.2	7.65	<5.00	<25	364	3.4	3.36	2.09	<5.00	<5.00	<5.00	11.4	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	15.0	<1.00	5.52	<50.0	<50.0	1.01	<1.00	<1.00	<1.00	<1.00	7.66	2.75	<1.00	<5.00	137	1.6	1.01	<1.00	<1.00	<1.00	<1.00	3.17	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	10.8	<1.00	2.62	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	4.44	1.8	<1.00	<1.00	121	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.0	<1.00	<1.0	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.00	<1.00	<5.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/08/14	<1.00	<1.00	<1.00	<1.00	35.0	<1.00	14.0	<50.0	<25.0	2.88	<1.00	<1.00	<1.00	<1.00	17.8	6.69	<1.00	<1.00	236	4.87	2.56	2.38	<1.00	<1.00	<1.00	11.0	NA
	01/29/15	<1.00	<1.00	<1.00	<1.00	21.9	<1.00	8.61	<50.0	<25.0	1.59	<1.00	<1.00	<1.00	<1.00	7.94	4.04	<1.00	<1.00	167	<1.00	1.64	1.67	<1.00	<1.00	<1.00	3.81	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	32.0	<1.00	13.3	<50.0	<25.0	2.61	<1.00	<1.00	<1.00	<1.00	14.6	7.62	<1.00	<1.00	229	<1.00	3.42	2.51	<1.00	<1.00	<1.00	9.24	NA
	04/20/16	<1.00	<1.00	<1.00	<1.00	19.3	<1.00	5.8	<5.00	<25.0	1.4	<1.00	<1.00	<1.00	<1.00	5.2	1.8	<1.00	<1.00	75.4	<1.00	0.66	0.68	<1.00	<1.00	0.35	3.20	NA
	10/17/16	<1.00	<1.00	<1.00	<1.00	30.4	<1.00	11.5	<5.00	<25.0	2.09	<1.00	<1.00	<1.00	<1.00	11	6.6	<1.00	<1.00	223	5.25	3.55	2.83	<1.00	<1.00	<1.00	6.89	NA
MW-15D	03/20/12	<10.0	<10.0	<10.0	<10.0	158	<10.0	51.9	<50.00	<50.00	<1.00	<10.0	<10.0	<10.0	<10.0	126	21	<10.0	<50.0.0	3,840	<10.0	<10.0	<10.0	<10.0	<10.0	19.1	206	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	118	<1.00	41.6	<50.0	<50.0	1.27	<1.00	<1.00	<1.00	<1.00	92.4	14.3	<1.00	<5.00	1,760	5.47	4.96	4.09	<1.00	<1.00	15.7	161	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	16.8	<1.00	4.49	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	11	2.36	<1.00	<5.00	166	1.00	<1.00	<1.00	<1.00	<1.00	1.15	22.8	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	22.5	<1.00	5.14	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	15.8	3.17	<1.00	<5.00	332	<1.00	<1.00	<1.00	<1.00	<1.00	1.7	26.2	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	14.2	<1.00	1.67	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	13.7	2.6	<1.00	<5.00	41.3	<1.00	<1.00	<1.00	<1.00	<1.00	1.54	21.0	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	23.7	<1.00	7.32	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	24.2	3.39	<1.00	<5.00	360	<1.00	<1.00	<1.00	<1.00	<1.00	3.35	37.8	NA
	01/29/15	<1.00	<1.00	<1.00	<1.00	13.7	<1.00	4.46	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	12.8	2.83	<1.00	<5.00	175	<1.00	<1.00	<1.00	<1.00	<1.00	1.38	19.6	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	170	<1.00	58.8	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	141	25.1	<1.00	<5.00	2,600	<1.00	8.60	6.13	6.68	<1.00	18.0	255	NA
	04/20/16	<1.00	<1.00	<1.00	<1.00	85.5	<1.00	36	3.8	<25.0	0.57	<1.00	<1.00	<1.00	<1.00	53.1	6.9	<1.00	<5.00	1,790	<1.00	1.80	3.3	1	<1.00	9.1	146	NA
	10/17/16	<1.00	<1.00	<1.00	<1.00	183	<1.00	66.4	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	146	23.3	<1.00	<5.00	3,190	<1.00	9.65	6.52	<1.00	<1.00	14.2	234	NA
MW-16S	03/19/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	08/01/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/08/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/27/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/14/15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	04/20/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	10/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
MW-16D	03/19/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	08/01/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/08/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/27/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/14/15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	04/20/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	10/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	6.81	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA

Table 2
Historically Detected Volatile Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	5	--	--	--	--	700	--	40	--	25	--	--	--	--	5	1,000	10,000	--
MW-17S	03/21/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/02/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/27/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/29/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/14/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/18/16	0.2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**8.7**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/20/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-18S	03/20/12	<1.00	<1.00	<1.00	<1.00	**2.11**	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**55.7**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/02/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**13.6**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	**9.77**	<1.00	**3.5**	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	**4.5**	**1.48**	<1.00	<5.00	**86.0**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**3.07**	NA
	01/29/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	**36.9**	<1.00	**15.5**	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	**11.2**	**5.44**	<1.00	<5.00	**2,610**	<1.00	**2.98**	**2.19**	<1.00	<1.00	<1.00	**13.1**	NA
	04/18/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/19/16	<1.00	<1.00	<1.00	<1.00	**34.8**	<1.00	**12.5**	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	**9.28**	**4.45**	<1.00	<5.00	**317**	<1.00	**2.4**	**1.71**	<1.00	<1.00	<1.00	**11.2**	NA
MW-18D	03/20/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/02/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/29/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/18/16	<1.00	0.69	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.27	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
MW-19S	03/21/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	02/27/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/31/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	07/09/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	01/30/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
	09/15/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/18/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
OS-5N	10/05/12	<1.00	<1.00	<1.00	<1.00	**28.1**	<1.00	**8.89**	<50.0	<50.0	**3.41**	<1.00	<1.00	<1.00	<1.00	**18.7**	**4.62**	<1.00	<5.00	**258**	<1.00	**2.01**	**1.26**	<1.00	<1.00	<1.00	**13.4**	**246**
	02/28/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	**1.0**	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**11.9**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/16/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/08/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/28/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/17/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA

Table 2
Historically Detected Volatile Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	5	--	--	--	--	700	--	40	--	25	--	--	--	--	5	1,000	10,000	--
OS-5S	10/05/12	<1.00	<1.00	<1.00	<1.00	147	<1.00	43.6	<50.0	<50.0	8.80	<1.00	<1.00	<1.00	<1.00	105	21.7	<1.00	<5.00	2,660	<1.00	10.1	6.59	<1.00	<1.00	1.74	80.6	1,600
	01/23/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	285	2,830	1.27	44	1.79	<1.00	40.6	4.17	1.26	<1.00	<5.00	52.8	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<500
	02/04/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	239	2,060	<1.00	120	2.86	<1.00	133	2.94	<1.00	<1.00	<5.00	32.2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<500
	02/28/13	<1.00	<1.00	<1.00	<1.00	3.09	<1.00	1.13	<50.0	519	<1.00	29.8	1.91	<1.00	42.8	4.92	2.5	<1.00	<5.00	43	1.05	1.22	1.19	<1.00	<1.00	<1.00	<3.00	<100
	03/28/13	<1.00	<1.00	<1.00	<1.00	1.14	<1.00	<1.00	73.2	881	1.59	51.4	2.8	<1.00	75.3	5.3	2.31	<1.00	<5.00	226	<1.00	1.1	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	37.4	<1.00	2.4	<1.00	<1.00	3.5	<1.00	<1.00	<1.00	<5.00	12.8	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	62.2	<1.00	7.07	1.31	<1.00	8.53	<1.00	<1.00	<1.00	<5.00	20.3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/16/14	<1.00	<1.00	<1.00	<1.00	13.1	<1.00	3.65	<50.0	<5.00	13.6	<1.00	<1.00	<1.00	<1.00	4.60	1.84	<1.00	<5.00	198	<1.00	1.13	<1.00	<1.00	<1.00	<1.00	3.18	<100
	07/08/14	<1.00	<1.00	<1.00	<1.00	53.0	<1.00	15.8	<50.0	<25.0	36.3	<1.00	<1.00	<1.00	<1.00	10.8	6.20	<1.00	<5.00	706	5.06	3.83	2.7	<1.00	<1.00	<1.00	13.3	628
	01/28/15	<1.00	<1.00	<1.00	<1.00	11.0	<1.00	3.18	<50.0	<25.0	13.8	<1.00	<1.00	<1.00	<1.00	3.67	1.50	<1.00	<5.00	156	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	3.24	<100
	09/18/15	<1.00	<1.00	<1.00	<1.00	51.0	<1.00	15.3	<50.0	<25.0	24.2	<1.00	<1.00	<1.00	<1.00	12.7	7.30	<1.00	<5.00	708	<1.00	4.29	2.84	<1.00	<1.00	<1.00	14.1	340 H
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
OS-5E	10/05/12	<1.00	<1.00	<1.00	<1.00	8.93	<1.00	2.36	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	3.2	1.21	<1.00	<5.00	166	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	01/23/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	146	<1.00	11.1	<1.00	<1.00	7.88	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	02/04/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	91.3	<1.00	7.2	<1.00	<1.00	11.7	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	02/28/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	1.73	<1.00	<1.00	2.48	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	03/28/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	9.8	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/08/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/28/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/16/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	1.75	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	418	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
OS-10S	10/05/12	<1.00	<1.00	<1.00	<1.00	114	<1.00	37.6	<50.0	<50.0	4.33	<1.00	<1.00	<1.00	<1.00	66.8	16.6	<1.00	<5.00	1,760	<1.00	7.61	5.96	<1.00	<1.00	1.03	50.7	1,200
	01/23/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	317	1.73	21.3	3.73	<1.00	29	64.2	8.33	<1.00	<5.00	171	<1.00	2.16	1.9	<1.00	<1.00	<1.00	35.3	398
	02/04/13	<1.00	<1.00	<1.00	<1.00	1.07	<1.00	<1.00	69.6	803	<1.00	59.8	5.52	<1.00	58.3	6.08	1.68	<1.00	<5.00	178	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	02/28/13	<1.00	<1.00	<1.00	<1.00	22.3	<1.00	1.48	<50.0	210	<1.00	26.2	3.03	<1.00	26.9	8.19	3.11	<1.00	<5.00	309	<1.00	1.73	2.6	<1.00	<1.00	<1.00	5.79	120
	03/27/13	<1.00	<1.00	<1.00	<1.00	3.41	<1.00	<1.00	<1.00	130	<1.00	30.5	1.97	<1.00	36.9	4.12	1.8	<1.00	<5.00	208	<1.00	1.00	1.25	<1.00	<1.00	<1.00	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	22	<1.00	2.4	<50.0	28.8	1.48	<1.00	1.63	<1.00	2.61	6.39	3.27	<1.00	<5.00	263	<1.00	1.85	<1.00	<1.00	<1.00	<1.00	<2.00	105
	09/12/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	23.4	<1.00	<1.00	1.15	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	48.9	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	10/03/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	12.7	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/16/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/08/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	15.8	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/28/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/18/15	<1.00	<1.00	<1.00	<1.00	12.6	<1.00	3.66	<50.0	<25.0	7.45	<1.00	<1.00	<1.00	<1.00	5.63	1.95	<1.00	<5.00	100	<1.00	1.32	<1.00	<1.00	<1.00	<1.00	<3.00	<100 H
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA

Table 2
Historically Detected Volatile Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	5	--	--	--	--	700	--	40	--	25	--	--	--	--	5	1,000	10,000	--
OS-10E	10/05/12	<1.00	<1.00	<1.00	<1.00	**8.73**	<1.00	**2.23**	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	**3.33**	**1.21**	<1.00	<5.00	**213**	<1.00	**1.04**	**1.3**	<1.00	<1.00	<1.00	<3.00	<100
	01/23/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	**2.57**	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	02/04/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	**3.65**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	02/28/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	03/28/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	**23.2**	<1.00	**8.44**	<50.0	<5.00	**15.5**	<1.00	<1.00	<1.00	<1.00	**41.7**	**5.7**	<1.00	<5.00	**351**	<1.00	**3.18**	<1.00	<1.00	<1.00	<1.00	**14.3**	**272**
	10/03/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**9.87**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/15/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/08/14	<1.00	<1.00	<1.00	<1.00	**25.9**	<1.00	**7.3**	<50.0	<25.0	**42.7**	<1.00	<1.00	<1.00	<1.00	**52.5**	**7.19**	<1.00	<5.00	**393**	3.18	**4.24**	**1.29**	<1.00	<1.00	<1.00	**16.8**	**703**
	01/28/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/16/15	<1.00	<1.00	<1.00	<1.00	**29.4**	<1.00	**9.97**	<50.0	<25.0	**41.0**	<1.00	<1.00	<1.00	<1.00	**35.6**	**7.22**	<1.00	<5.00	**576**	<1.00	**4.92**	**1.70**	<1.00	<1.00	<1.00	**16.0**	**843**
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
OS-15S	10/05/12	<1.00	<1.00	<1.00	<1.00	**66.9**	<1.00	**25.4**	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	**18.2**	**8.12**	<1.00	<5.00	**756**	<1.00	**5.22**	**4.83**	<1.00	<1.00	<1.00	**12.4**	**364**
	01/23/13	<1.00	<1.00	<1.00	<1.00	**17.3**	<1.00	**6.5**	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.00	<5.00	**69.4**	<1.00	<1.00	<1.0	<1.00	<1.00	<1.00	<3.00	<100
	02/04/13	<1.00	<1.00	<1.00	<1.00	**11.2**	<1.00	**4.11**	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.00	<5.00	**69.8**	<1.00	**1.9**	<1.0	<1.00	<1.00	<1.00	<3.00	<100
	02/28/13	<1.00	<1.00	<1.00	<1.00	**3.65**	<1.00	**1.84**	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.00	<5.00	**15.1**	<1.00	<1.00	<1.0	<1.00	<1.00	<1.00	<3.00	<100
	03/27/13	<1.00	<1.00	<1.00	<1.00	**9.08**	<1.00	**3.61**	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**65.1**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	**1.84**	<1.00	<1.00	<50.0	**23.0**	<1.00	<1.00	**4.58**	**2.43**	<1.00	**1.61**	<1.00	<1.00	<5.00	**46.4**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	**834**
	10/03/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	**1.23**	**2.21**	<1.00	<1.00	<1.00	<1.00	<5.00	**8.74**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/16/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/08/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/29/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/18/15	<1.00	<1.00	<1.00	<1.00	**1.49**	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100 H
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
OS-20S	01/15/12	<1.00	<1.00	<1.00	<1.00	**105**	<1.00	**34.5**	<50.0	<50.0	**27.7**	<1.00	<1.00	<1.00	<1.00	**60**	**16.2**	<1.00	<5.00	**2,430**	<1.00	**9.75**	**7.35**	<1.00	<1.00	**2.53**	**49.5**	**1,170**
	01/23/13	<1.00	<1.00	<1.00	<1.00	**1.31**	<1.00	<1.00	<50.0	**198**	**2.38**	**2.06**	**19**	<1.00	**1.86**	**3.28**	**1.44**	<1.00	<5.00	**423**	<1.00	**1.05**	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	02/04/13	<1.00	<1.00	<1.00	<1.00	**2.30**	<1.00	<1.00	<50.0	<50.0	**9.12**	**3.19**	**9.81**	<1.00	<1.00	**3.29**	**1.1**	<1.00	<5.00	**236**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	02/28/13	<1.00	<1.00	<1.00	<1.00	**26.9**	<1.00	**4.17**	<50.0	**53.2**	**2.07**	<1.00	**10.2**	<1.00	<1.00	**21.1**	**6.69**	<1.00	<5.00	**671**	**2.35**	**3.91**	**2.07**	<1.00	<1.00	<1.00	**12.2**	**193**
	03/27/13	<1.00	<1.00	<1.00	<1.00	**31.0**	<1.00	**7.33**	<50.0	<50.0	**7.04**	<1.00	**4.49**	<1.00	<1.00	**15.6**	**5.27**	<1.00	<5.00	**464**	**2.35**	**2.51**	**1.00**	<1.00	<1.00	<1.00	**12.7**	**165**
	07/30/13	<1.00	<1.00	<1.00	<1.00	**6.38**	<1.00	**1.85**	<50.0	<5.00	**2.15**	<1.00	<1.00	<1.00	<1.00	**3.12**	<1.00	<1.00	<5.00	**89.8**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**2.66**	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	**155**	<1.00	**70.1**	<50.0	<5.00	**12.6**	<1.00	**17.4**	<1.00	<1.00	**98.1**	**22.2**	<1.00	<5.00	**1,550**	<1.00	**9.83**	**4.85**	<1.00	<1.00	**6.43**	**100**	**1,150**
	01/16/14	<1.00	<1.00	<1.00	<1.00	**13.1**	<1.00	**5.01**	<50.0	<5.00	**4.79**	<1.00	<1.00	<1.00	<1.00	**5.11**	**1.64**	<1.00	<5.00	**154**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**9.49**	<100
	07/09/14	<1.00	<1.00	<1.00	<1.00	**115**	<1.00	**42.4**	<50.0	<25.0	**37.7**	<1.00	<1.00	<1.00	<1.00	**64.2**	**18.7**	<1.00	<5.00	**1,530**	<1.00	**10.1**	**2.19**	<1.00	<1.00	**2.90**	**53.1**	**1,760**
	01/30/15	<1.00	<1.00	<1.00	<1.00	**23.1**	<1.00	**7.33**	<50.0	<25.0	**10.7**	<1.00	<1.00	<1.00	<1.00	**9.64**	**3.34**	<1.00	<5.00	**199**	**1.28**	**1.65**	<1.00	<1.00	<1.00	<1.00	**9.87**	**455**
	09/17/15	<1.00	<1.00	<1.00	<1.00	**173**	<1.00	**72.9**	<50.0	<25.0	**34.1**	<1.00	<1.00	<1.00	<1.00	**84.2**	**31.6**	<1.00	<5.00	**1,890**	**15.8**	**17.1**	**4.37**	<1.00	<1.00	**3.71**	**60.5**	**1,120**
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA

Table 2
Historically Detected Volatile Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	5	--	--	--	--	700	--	40	--	25	--	--	--	--	5	1,000	10,000	--
OS-25S	10/05/12	<1.00	<1.00	<1.00	<1.00	48.9	<1.00	24.8	<50.0	<50.0	19.8	<1.00	<1.00	<1.00	<1.00	35.6	10.1	<1.00	<5.00	754	<1.00	6.52	2.94	1.24	<1.00	1.32	28.7	796
	01/23/13	<1.00	<1.00	<1.00	<1.00	43.2	<1.00	21.7	<50.0	<50.0	17.2	2.21	9.82	<1.00	1.95	29.6	6.96	<1.00	<5.00	656	5.32	4.66	2.35	<1.00	<1.00	2.03	20	457
	02/04/13	<1.00	<1.00	<1.00	<1.00	21.0	<1.00	7.85	<50.0	62.9	23.9	3.36	21.4	<1.00	<1.00	11.9	3.79	<1.00	<5.00	377	<1.00	2.76	1.3	<1.00	<1.00	2.1	8.04	221
	02/28/13	<1.00	<1.00	<1.00	<1.00	21.1	<1.00	2.73	<50.0	<50.0	27.4	<1.00	11.7	<1.00	<1.00	26.6	7.44	<1.00	<5.00	732	2.69	4.8	1.84	<1.00	<1.00	<1.00	10.1	276
	07/31/13	<1.00	<1.00	<1.00	<1.00	41.6	<1.00	20.3	<50.0	<5.00	30.4	<1.00	<1.00	<1.00	<1.00	35.1	9.03	<1.00	<5.00	548	<1.00	5.68	2.07	<1.00	<1.00	<1.00	12.9	523
	09/12/13	<1.00	<1.00	<1.00	<1.00	60.5	<1.00	29.1	<50.0	<5.00	29.6	<1.00	1.32	<1.00	<1.00	53.0	13.2	<1.00	<5.00	8.50	<1.00	7.13	2.77	<1.00	<1.00	1.06	25.5	581
	01/15/14	<1.00	<1.00	<1.00	<1.00	47.5	<1.00	26.0	<50.0	<5.00	34.6	<1.00	<1.00	<1.00	<1.00	35.3	10.9	<1.00	<5.00	461	<1.00	5.81	2.69	<1.00	<1.00	<1.00	16.3	297
	07/09/14	<1.00	<1.00	<1.00	<1.00	52.9	<1.00	26.2	<50.0	<25.0	61.3	<1.00	<1.00	<1.00	<1.00	47.6	14.5	<1.00	<5.00	669	<1.00	8.34	2.25	<1.00	<1.00	<1.00	16.4	1,460
	01/30/15	<1.00	<1.00	<1.00	<1.00	79.6	<1.00	40.4	<50.0	<25.0	33.8	<1.00	<1.00	<1.00	<1.00	49.2	16.7	<1.00	<5.00	850	9.48	10.1	3.94	<1.00	<1.00	<1.00	21.8	1,930
	09/17/15	<1.00	<1.00	<1.00	<1.00	65.0	<1.00	31.2	<50.0	<25.0	42.4	<1.00	<1.00	<1.00	<1.00	35.2	16.4	<1.00	<5.00	636	10.0	8.71	3.35	<1.00	<1.00	<1.00	13.7	552
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
OR-3S	10/04/12	<1.00	<1.00	<1.00	<1.00	152	<1.00	47.7	<50.0	<50.0	5.06	<1.00	<1.00	<1.00	<1.00	43.7	20.3	<1.00	<5.00	1,670	<1.00	10.9	6.81	<1.00	<1.00	<1.00	28.5	690
	02/27/13	<1.00	<1.00	<1.00	<1.00	3.92	<1.00	<1.00	<50.0	<50.0	1.69	<1.00	<1.00	<1.00	<1.00	<1.00	1.19	<1.00	<5.00	78.9	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	03/27/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	82.6	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	10.5	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	7.86	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	10/03/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/16/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/10/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	5.4	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	02/05/15	<1.00	<1.00	<1.00	<1.00	1.73	<1.00	<1.00	<50.0	<25.0	1.11	<1.00	<1.00	<1.00	<1.00	<1.00	1.01	<1.00	<5.00	27.0	1.32	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/17/15	<1.00	<1.00	<1.00	<1.00	1.54	<1.00	<1.00	<50.0	<25.0	1.83	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.38	<5.00	18.5	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
OR-3W	10/04/12	<1.00	<1.00	<1.00	<1.00	62.1	<1.00	22.9	<50.0	<50.0	9.34	<1.00	<1.00	<1.00	<1.00	42.8	9.59	<1.00	<5.00	532	<1.00	3.33	2.86	<1.00	<1.00	3.94	36.4	509
	02/28/13	<1.00	<1.00	<1.00	<1.00	19.1	<1.00	3.91	<50.0	<50.0	1.54	<1.00	1.31	<1.00	<1.00	3.75	2.75	<1.00	<1.00	4.52	1.77	1.18	1.11	<1.00	<1.00	<1.00	<1.00	108
	03/27/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	146	<1.0	<1.00	4.94	1.78	12.1	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	67.8	<1.00	<1.00	1.05	<1.00	2.53	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	86.3	<1.00	<1.00	1.78	<1.00	2.29	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	10/03/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	179	<1.00	<1.00	2.8	<1.00	1.46	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/16/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/10/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/30/15	<1.00	<1.00	<1.00	<1.00	5.14	<1.00	1.64	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.69	<1.00	<5.00	104	1.28	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/17/15	<1.00	<1.00	<1.00	<1.00	5.27	<1.00	2.01	<50.0	<25.0	3.33	<1.00	<1.00	<1.00	<1.00	<1.00	1.41	<1.00	<5.00	88.6	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
OR-5S	10/04/12	<1.00	1.01	1.11	<1.00	36.2	<1.00	16.3	<50.0	<50.0	2.14	<1.00	<1.00	<1.00	<1.00	24.1	6.27	<1.00	<5.00	420	<1.00	2.29	1.88	<1.00	<1.00	<1.00	16.0	275
	02/27/13	<1.00	<1.00	<1.00	<1.00	14.6	<1.00	4.17	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	5.47	2.18	<1.00	39.4	96.6	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	111
	03/27/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	5.85	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	6.71	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	1.77	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.07	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	10/03/13	<1.00	<1.00	<1.00	<1.00	3.22	<1.00	1.4	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.86	<1.00	<1.00	<5.00	5.98	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/17/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.1	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/10/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.77	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	02/05/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.86	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.10	<1.00	<5.00	<5.00	1.17	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/17/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.79	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.40	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA

Table 2
Historically Detected Volatile Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	5	--	--	--	--	700	--	40	--	25	--	--	--	--	5	1,000	10,000	--
OR-5W	10/04/12	<1.00	1.05	<1.00	<1.00	52.5	<1.00	25.6	<50.0	<50.0	3.11	<1.00	<1.00	<1.00	<1.00	19.5	6.83	<1.00	<5.00	722	<1.00	2.76	3.54	<1.00	<1.00	1.3	19.9	383
	02/28/13	<1.00	<1.00	<1.00	<1.00	29.1	<1.00	6.98	<50.0	<50.0	1.35	<1.00	1.01	<1.00	<1.00	3.76	2.76	<1.00	<5.00	657	2.68	1.1	1.6	<1.00	<1.00	<1.00	<1.00	133
	03/27/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	1.81	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	6.68	<1.00	<1.00	<1.00	<1.00	<1.00	1.5	<3.00	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	155	<1.00	3.79	1.85	<1.00	14.3	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	91.5	<1.00	<1.00	1.92	<1.00	11.4	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	10/03/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	143	<1.00	<1.00	1.63	<1.00	7.59	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/16/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	52.5	<1.00	6.59	<1.00	<1.00	5.3	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	07/10/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	58.0	<1.00	<1.00	<1.00	<1.00	1.64	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/30/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/17/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
OR-10S	10/04/12	<1.00	1.05	<1.00	<1.00	71.8	<1.00	27.3	<50.0	<50.0	24.3	<1.00	1.13	<1.00	<1.00	46.8	10.7	<1.00	<5.00	1,040	<1.00	4.62	3.25	<1.00	<1.00	4.50	62.1	619
	02/28/13	<1.00	<1.00	<1.00	<1.00	10.5	<1.00	<1.00	<50.0	210	20.6	1.89	27.7	<1.00	4.76	56.8	9.98	<1.00	<5.00	1,580	<1.00	3.33	1.06	<1.00	<1.00	3.45	29.2	<500
	03/27/13	<1.00	<1.00	<1.00	<1.00	36.5	<1.00	7.02	<50.0	174	12.8	1.30	16.4	<1.00	4.19	42.5	7.34	<1.00	<5.00	1,480	<1.00	2.38	1.26	<1.00	<1.00	2.43	44.0	<500
	07/30/13	<1.00	<1.00	<1.00	<1.00	18.2	<1.00	2.33	<50.0	202	5.51	4.10	17.5	<1.00	6.64	11.5	4.12	<1.00	<5.00	1,780	<1.00	1.57	<1.00	<1.00	<1.00	<1.00	11.1	194
	09/12/13	<1.00	<1.00	<1.00	<1.00	25.5	<1.00	4.80	<50.0	132	5.74	<1.00	15.1	<1.00	6.06	10.3	3.58	<1.00	<5.00	1,640	<1.00	1.26	<1.00	<1.00	<1.00	<1.00	13.2	201
	10/03/13	<1.00	<1.00	<1.00	<1.00	18.4	<1.00	4.51	<50.0	194	10.1	<1.00	9.69	<1.00	5.46	12.5	3.00	<1.00	<5.00	938	<1.00	<1.00	<1.00	<1.00	<1.00	1.07	16.3	264
	01/17/14	<1.00	<1.00	<1.00	<1.00	63.1	<1.00	22.2	<50.0	38.8	28.6	<1.00	1.08	<1.00	1.67	74.1	11.1	<1.00	<5.00	1,200	2.55	3.04	1.90	<1.00	<1.00	6.11	102	882
	07/09/14	<1.00	<1.00	<1.00	<1.00	168	<1.00	63.3	<50.0	<25.00	56.2	<1.00	<1.00	<1.00	<1.00	156	27.9	<1.00	<5.00	2,950	7.40	9.90	5.47	<1.00	<1.00	13.1	217	3,090
	01/29/15	<1.00	<1.00	<1.00	<1.00	135	<1.00	46.0	<50.0	<25.00	45.7	<1.00	<1.00	<1.00	<1.00	147	20.3	<1.00	<5.00	2,360	<1.00	6.45	4.17	<1.00	<1.00	14.0	194	1,210
	09/17/15	<1.00	<1.00	<1.00	<1.00	157	<1.00	58.5	<50.0	<25.00	38.0	<1.00	<1.00	<1.00	<1.00	161	24.6	<1.00	<5.00	2,880	8.43	8.00	4.96	<1.00	<1.00	13.4	172	1,270
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
OR-10W	10/04/12	<1.00	<1.00	<1.00	<1.00	120	<1.00	38.6	<50.0	<50.0	8.27	<1.00	<1.00	<1.00	<1.00	59.9	15.0	<1.00	<5.00	944	<1.00	6.76	<1.00	<1.00	<1.00	<1.00	42.3	723
	02/28/13	<1.00	<1.00	<1.00	<1.00	1.32	<1.00	<1.00	<50.0	50.8	1.32	2.79	8.36	<1.00	3.99	<1.00	<1.00	<1.00	14.6	189	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<100
	03/27/13	<1.00	<1.00	<1.00	<1.00	1.36	<1.00	<1.00	<50.0	59.8	4.32	5.16	10.1	<1.00	9.43	<1.00	<1.00	<1.00	<5.00	167	<1.00	<1.00	<1.00	<1.00	<1.00	3.06	3.11	<100
	07/30/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	75.0	<1.00	1.36	1.67	<1.00	9.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/12/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	41.9	<1.00	<1.00	1.68	<1.00	4.86	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/16/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	14.5	<1.00	<1.00	1.18	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	03/20/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	07/10/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	1.60	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	01/30/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<100
	09/16/15	<1.00	<1.00	<1.00	<1.00	1.60	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	20.8	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	04/18/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
	10/17/16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA
ISOC-4S	05/13/15	<1.00	<1.00	<1.00	<1.00	35.3	<1.00	9.78	<50.0	<25.0	4.60	<1.00	<1.00	<1.00	<1.00	7.14	5.06	<1.00	<5.00	227	<1.00	2.01	1.52	<1.00	<1.00	<1.00	5.02	213
	09/14/15	<1.00	<1.00	<1.00	<1.00	14.4	<1.00	4.25	<50.0	<25.0	14.3	<1.00	<1.00	<1.00	<1.00	6.75	6.94	<1.00	<5.00	86.6	<1.00	2.56	1.24	<1.00	<1.00	<1.00	3.88	NA
	04/19/16	0.33	0.31	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	0.41	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.0	NA
	10/18/16	<1.00	<1.00	<1.00	<1.00	6.92	<1.00	2.52	<5.00	<25.0	9.69	<1.00	<1.00	<1.00	<1.00	3.4	3.77		<5.00	20.8	2.18	1.52	<1.00	<1.00	<1.00	<1.00	<3.00	NA
ISOC-4D	05/13/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	1.12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	09/14/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/19/16	0.26	0.63	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	0.41	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/18/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
ISOC-8S	05/13/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	16.4	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	09/14/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	3.15	1.08	<1.00	<5.00	34.7	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/19/16	<1.00	0.38	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	0.74	<1.0	<1.00	<5.00	9	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/18/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA

Table 2
Historically Detected Volatle Organics - Method 8260B Analytical Results Summary
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Date Sampled	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	1,2,4-Trimethylbenzene	1,2-Dichlorobenzene	1,3,5-Trimethylbenzene	2-Butanone (MEK)	Acetone	Benzene	Bromomethane	Carbon Disulfide	Chloroform	Chloromethane	Ethylbenzene	Isopropylbenzene	Methyl t-butyl ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	p-Isopropyltoluene	Styrene	Tetrachloroethene	Toluene	Xylenes, total	Gasoline Range Organics*
RBSL		--	--	--	--	--	--	--	--	--	5	--	--	--	--	700	--	40	--	25	--	--	--	--	5	1,000	10,000	--
ISOC-15S	05/14/15	<1.00	<1.00	<1.00	<1.00	**30.4**	<1.00	**11.9**	<50.0	<25.0	**8.93**	<1.00	<1.00	<1.00	<1.00	**27.4**	**7.94**	<1.00	<5.00	**366**	<1.00	**2.22**	1.47	<1.00	<1.00	**4.28**	**31.6**	**497**
	09/14/15	<1.00	<1.00	<1.00	<1.00	**16.3**	<1.00	**9.53**	<50.0	<25.0	**8.59**	<1.00	<1.00	<1.00	<1.00	**21.7**	**6.71**	<1.00	<5.00	**96.3**	<1.00	**1.85**	<1.00	<1.00	<1.00	**2.69**	**19.5**	NA
	04/19/16	<1.00	0.3	0.49	<1.00	**26.8**	<1.00	**10.7**	<5.00	<25.0	**8**	<1.00	<1.00	<1.00	<1.00	**34.1**	**8.6**	<1.00	<5.00	**754**	**1.5**	**2**	0.78	<1.00	<1.00	**3.3**	**38.7**	NA
	10/18/16	<1.00	<1.00	<1.00	<1.00	**20.8**	<1.00	**13.7**	<5.00	<25.0	**7.66**	<1.00	<1.00	<1.00	<1.00	**27.7**	**7**	<1.00	<5.00	**176**	**4.57**	**2.29**	**1.39**	<1.00	<1.00	**2.82**	**24.7**	NA
ISOC-15D	05/14/15	<1.00	<1.00	<1.00	<1.00	**237**	<1.00	**75.0**	<50.0	<25.0	**24.5**	<1.00	<1.00	<1.00	<1.00	**170**	**35.6**	<1.00	<5.00	**4,420**	<1.00	**9.79**	**9.35**	<1.00	<1.00	**59.2**	**312**	**3,740**
	09/14/15	<1.00	<1.00	<1.00	<1.00	**170**	<1.00	**63.0**	<50.0	<25.0	**16.4**	<1.00	<1.00	<1.00	<1.00	**203**	**29.7**	<1.00	<5.00	**3,590**	<1.00	**6.99**	**5.12**	<1.00	<1.00	**69.9**	**413**	NA
	04/19/16	<1.00	0.45	0.71	<1.00	**211**	<1.00	**90.8**	<5.00	<25.0	**14.8**	<1.00	<1.00	<1.00	<1.00	**197**	**42.6**	<1.00	<5.00	**8,970**	**1.1**	**9.1**	**5**	**2.2**	<1.00	**69.1**	**356**	NA
	10/19/16	<10.0	<10.0	<10.0	<10.0	**335**	<10.0	**128.0**	<500	<250	**15**	<10.0	<10.0	<10.0	<10.0	**235**	**41.9**	<10.0	<50.0	**6,850**	<10.0	**12.3**	**10.4**	<10.0	<10.0	**60.2**	**452**	NA
ISOC-18S	05/14/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**7.66**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
	09/14/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**143**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	04/19/16	<1.00	0.34	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
	10/17/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
ISOC-18D	05/14/15	<1.00	<1.00	<1.00	<1.00	**2.81**	<1.00	**1.03**	<50.0	<25.0	**10.3**	<1.00	<1.00	<1.00	<1.00	**1.49**	**<1.00**	<1.00	<5.00	**53.2**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	**106**
	09/14/15	<1.00	<1.00	**1.18**	<1.00	<1.00	<1.00	**1.82**	<50.0	<25.0	**40.4**	<1.00	<1.00	<1.00	<1.00	**8.98**	**1.44**	<1.00	<5.00	**111**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**9.75**	NA
	04/19/16	<1.00	0.85	0.89	<1.00	0.34	<1.00	<1.00	<5.00	<25.0	**8.3**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.23	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.28	NA
	10/17/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<25.00	**4.13**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
DUP-1 (MW-12S)	10/02/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
DUP-1 (MW-18S)	02/25/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<50.0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	**14.8**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
DUP-1 (MW-13S)	07/30/13	<1.00	<1.00	<1.00	<1.00	**103**	<1.00	**40.2**	<50.0	**6.29**	**558**	<1.00	<1.00	<1.00	<1.00	**108**	**7.93**	<1.00	<5.00	**2,170**	**3.10**	<1.00	**2.28**	**47.5**	<1.00	**140**	**235**	**4,770**
DUP-1 (MW-14S)	01/14/14	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
DUP-A	09/14/15	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	**3.23**	**1.09**	<1.00	<5.00	**37.2**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
DUP-1 (ISOC MW-4S)	04/19/16	0.3	0.26	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	0.45	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	NA
DUP-1 (MW-13-ISOC)	10/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
DUP-2 (OR-3W)	10/04/12	<1.00	<1.00	<1.00	<1.00	**82.4**	<1.00	**28.8**	<50.0	<50.0	**9.68**	<1.00	<1.00	<1.00	<1.00	**51.6**	**11.5**	<1.00	<5.00	**891**	<1.00	**3.87**	**3.56**	<1.00	<1.00	**4.19**	**42.7**	**511**
DUP-2 (OS-5S)	02/28/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	**530**	<1.00	**29.9**	**2.01**	<1.00	**47.5**	**3.30**	**1.90**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<100
DUP-2 (MW-11S)	08/01/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<50.0	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
DUP-2 (MW-13S)	01/17/14	<1.00	<1.00	<1.00	<1.00	**27.3**	<1.00	**10.5**	<50.0	<5.00	**16.5**	<1.00	**1.39**	<1.00	<1.00	**26.9**	**3.77**	<1.00	<5.00	**235**	**1.89**	**1.55**	<1.00	<1.00	<1.00	**3.18**	**24.7**	**299**
DUP-B	09/16/15	<1.00	<1.00	<1.00	<1.00	**31.3**	<1.00	**10.1**	<50.0	**68.9**	**44.2**	<1.00	<1.00	<1.00	<1.00	**35.4**	**7.12**	<1.00	<5.00	**442**	**3.78**	**5.07**	**1.89**	<1.00	<1.00	**1.01**	**16.5**	**867**
DUP-2 (MW-16D)	04/20/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA
DUP-2 (MW-11D)	10/19/16	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	NA

Notes:
Concentrations shown in micrograms per liter (µg/L)
-- = Risk Based Screening Level (RBSL) not established for this compound
Bold values indicate concentration exceeds respective laboratory reporting level
Shaded values indicate concentration exceeds repective RBSL
NS = Not sampled, well could not be located at time of sampling
NA = Not applicable to well location
H = Sample was prepped or analyzed beyond the specified holding time
* = Gasoline Range Organics (TPH GRO) by EPA Method 8015B

Prepared By/Date: MM 10/31/16
Checked By/Date: AC 12/9/2016

Table 3
Analytical Summary of Saturated Soil Samples
Pine Street MGP Site, Spartanburg, South Carolina

Boring Number	Depth Interval (ft bgs)	Date Collected	Benzene Concentration (mg/kg)	Ethylbenzene Concentration (mg/kg)	Naphthalene Concentration (mg/kg)	Toluene Concentration (mg/kg)	Xylene Concentration (mg/kg)	Fraction Oganic Carbon
RSL* (mg/kg) Protective of Groundwater [MCL Based]			0.0026	0.78	No RSL [No MCL]	0.69	9.90	--
TG01	14-15	07/15/16	ND	0.298	10.1	0.352	0.898	NA
TG03	11-12	07/15/16	0.144	121	2390	10.6	191	NA
TG17	10-11	07/15/16	1.22	3.63	107	0.209	3.86	NA
TG29	13-14	07/15/16	0.108	8.59	220	3.16	14.5	NA
TG19	15	07/15/16	NA	NA	NA	NA	NA	4.2
TG19	20	07/15/16	NA	NA	NA	NA	NA	1.2

Notes:
* Source May 2016 EPA published Regional Screening Guidelines
blue highlights indicate detected concentration exceeds the EPA's RSL protective of groundwater
NA - Not Analyzied
ND - Analyte not detected
mg/kg - milligrams per kilogram
bgs - below ground surface

Prepared By/Date: JJK 2/28/2017
Checked By/Date: PFF 3/27/17

Table 4
MAROS Analysis Results
Duke Energy Pine Street MGP Site, Spartanburg, South Carolina

INDIVIDUAL WELL METRICS

Well ID		Mann-Kendall Trend	
		Benzene	Naphthalene
Saprolite Wells	MW-3SS	ND	NT
	MW-10S	D	NT
	MW-11S	D	D
	MW-12S	D	D
	MW-13S	D	D
	MW-13 ISOC	D	D
	MW-14S	D	D
	MW-15S	D	D
	MW-16S	ND	S
Partially Weathered / Fractured Rock Wells	MW-10D	S	PD
	MW-11D	D	D
	MW-12D	S	S
	MW-13D	D	D
	MW-14D	D	D
	MW-15D	D	NT
	MW-16D	S	S

BULK PLUME METRICS

Moment	Mann-Kendall Trend			
	Saprolite Wells		PWR Wells	
	Benzene	Naphthalene	Benzene	Naphthalene
Zeroth	D	D	D	D
First	NT	NT	D	PD
Second X	S	S	NT	D
Second Y	I	I	NT	S

Notes:
ND - all samples were below detection limit
D - decreasing
S - stable
NT - no trend
PD - probably decreasing
I - Increasing
PWR - partially weathered rock

Table 5
SourceDK Analysis Results
Duke Energy Pine Street MGP Site, Spartanburg, South Carolina

Well ID		First-Order Decay Rate (yr^{-1})		Half-life (yr)	
		Benzene	Naphthalene	Benzene	Naphthalene
Saprolite Wells	MW-13S	0.351	0.234	2.0	3.0
	MW-13 ISOC	1.74	1.57	0.4	0.4
	MW-14S	0.357	0.435	1.9	1.6
	MW-15S	0.351	0.349	2.0	2.0
	MW-18S	0.843	0.563	0.8	1.2
	ISOC-4S	0.367	2.18	1.9	0.3
	ISOC-8S	NA	1.51	NA	0.5
	ISOC-15S	0.109	S	6.4	S
	AVERAGE	**0.59**	**0.97**	**2.2**	**1.3**
PWR Wells	MW-13D	0.284	0.394	2.4	1.8
	MW-14D	S	0.0647	S	10.7
	MW-15D	0.114	0.0105	6.1	66.0
	ISOC-15D	0.434	S	1.6	S
	AVERAGE	**0.28**	**0.16**	**3.4**	**26.2**

Notes:
PWR - partially weathered rock
yr - year
NA - analyte is below laboratory detection limit
S - unable to calculate decay rate due to stable trend in well

Table 6
Inorganic Analytical Results Summary October 2016
Pine Street MGP Site, Spartanburg, South Carolina

Monitoring Well	Iron (total) [1]*	Ferrous Iron [2] (Fe2+)*	Ferric Iron [3] (Fe3+)*	CO_2*	Nitrate-Nitrogen	Sulfate*	Sulfide*	Alkalinity, Total (CaCO3)
MW-13S	0.38	0.38	0.00	0.00	<1.00	27	0.45	211
MW-13D	0	0.00	0.00	6.25	0.29	0	0.15	138
MW-17S	0.12	0.08	0.04	0.00	<1.00	48	0.2	85.6
MW-18S	1.31	1.12	0.19	0.00	<0.100	6	0.15	110
MW-18D	0.33	0.12	0.21	0.00	<0.100	50	0.2	85.9
ISOC-4D	0.00	0.00	0.00	0.00	3.05	39	0.1	59.9
ISOC-15S	0.33	0.07	0.26	0.00	<0.100	15	0.55	94.8
ISOC-15D	3.40	0.19	3.21	0.00	<0.100	2	0.15	110

Notes:

Concentrations shown in milligrams per liter (mg/L)

* = Denotes analysis was performed in the field during sampling

[1] = Total iron measured in field using Hach analyzer to perform USEPA-approved FerroVer Method 8008 adapted from Standard Methods for Examination of Water and Wastewater, 15th ed.

[2] = Ferrous iron measured in field using Hach analyzer to perform Method 8146 adapted from Standard Methods for Examination of Water and Wastewater, 15th ed.

[3] = Ferric iron calculated as difference between field-measured FerroVer and Ferrous iron results

MW-13S, MW-18S, ISOC-15S, MW-13D and ISOC-15D Iron concentrations diluted at 1:25

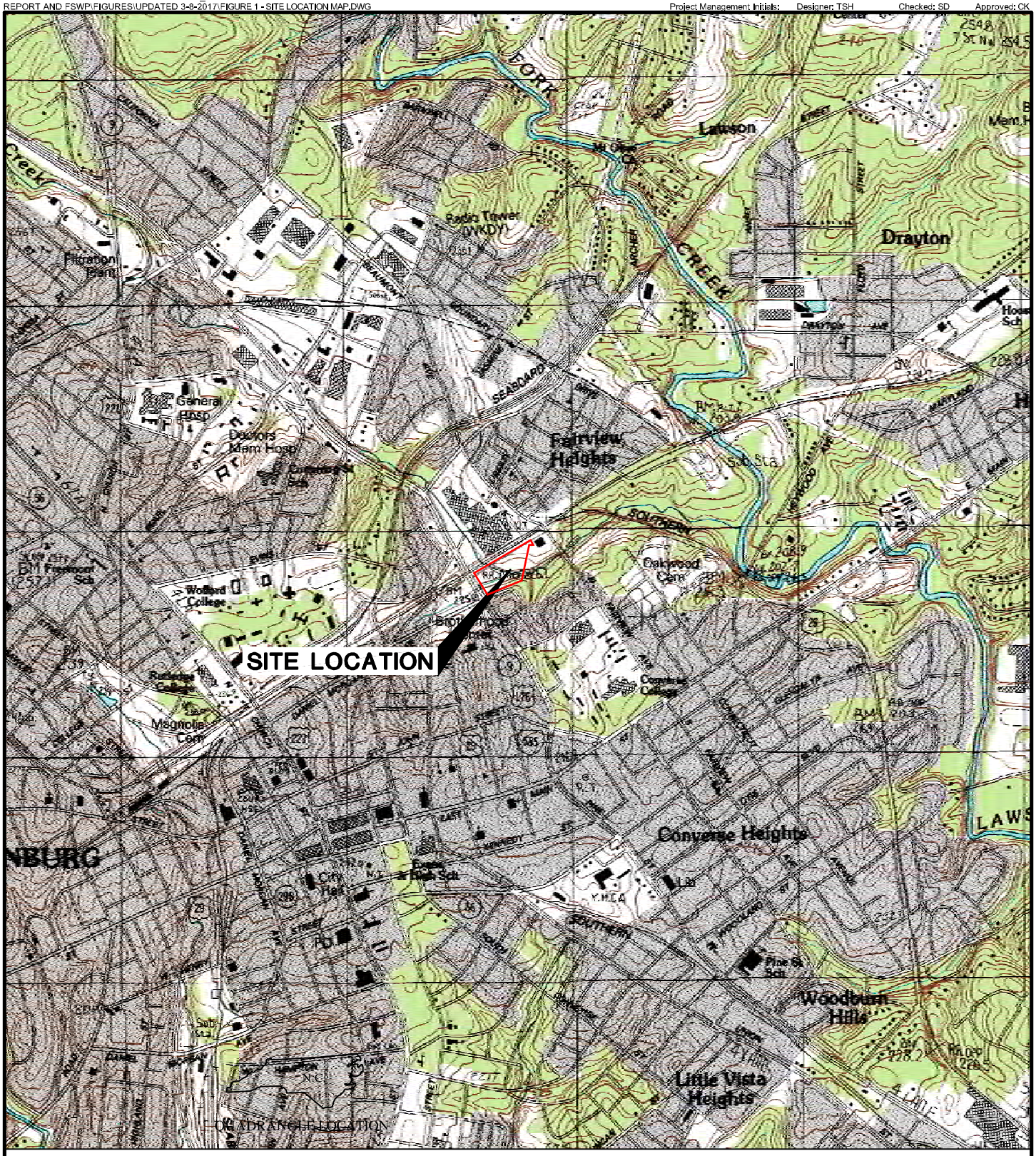
Prepared By/Date: MM 10/28/2016

Checked By/Date: AC 12/9/2016

Figures

Filename: M:\DCS\PROJECTS\L-URS\COMMON_PROJECTS\DUKE ENERGY\60493834 - SPARTANBURG MGP\4.0 DELIVERABLES\4.4 INVESTIGATION REPORT AND FSWP\FIGURES\UPDATED 3-8-2017\FIGURE 1 - SITE LOCATION MAP.DWG

Project Management Initials: Designer: TSH Checked: SD Approved: CK



SPARTANBURG, SC – USGS TOPOGRAPHIC QUADRANGLE

QUADRANGLE LOCATION

SCALE IN FEET

0 2000

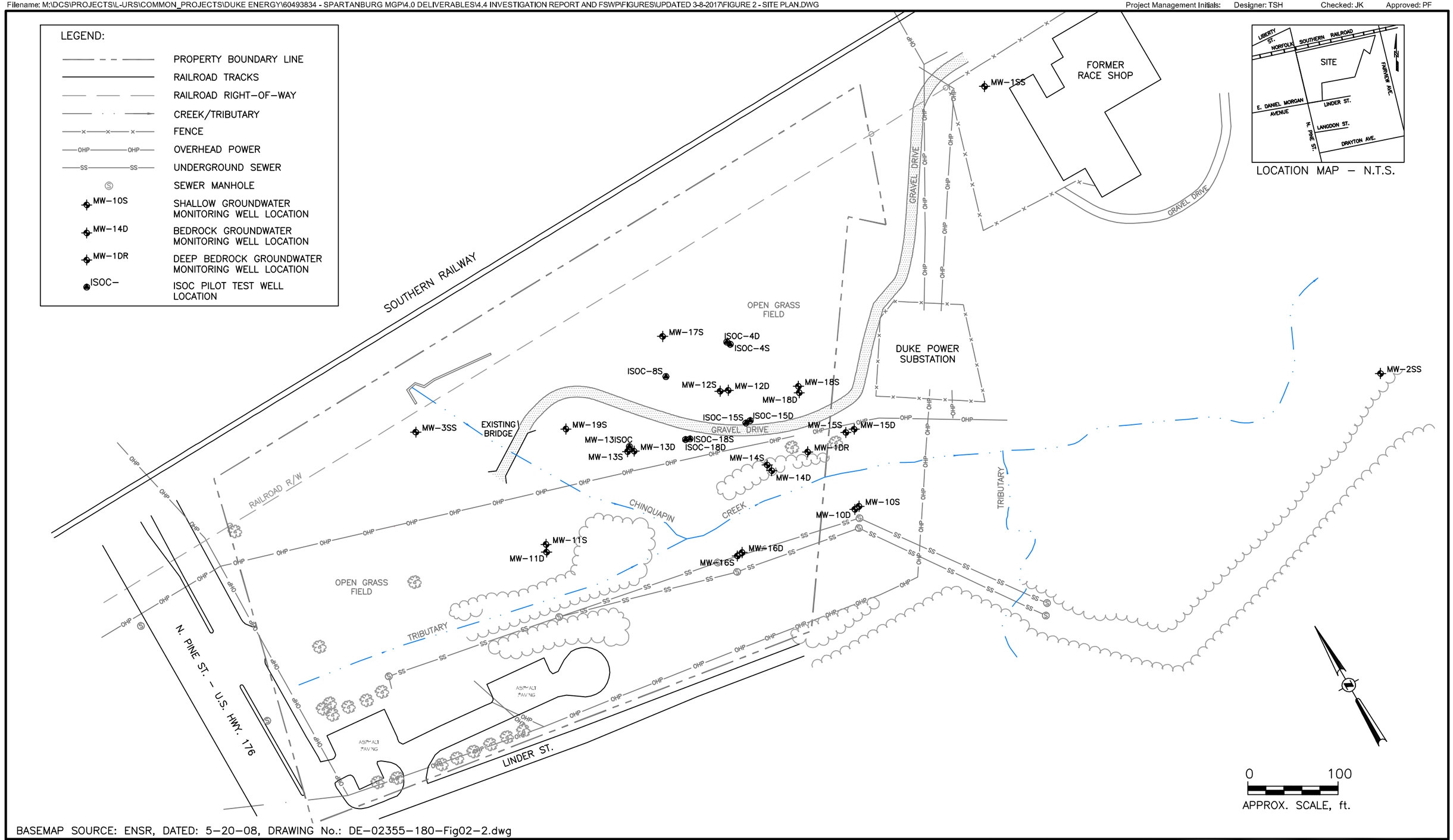
N

DATA GAP INVESTIGATION RESULTS AND FOCUSED FEASIBILITY STUDY WORK PLAN
DUKE ENERGY CORPORATION-FORMER MGP SITE
SPARTANBURG, SOUTH CAROLINA
Project No.: 60493834 Date: 2016-07-11

SITE LOCATION MAP

AECOM

Figure: 1



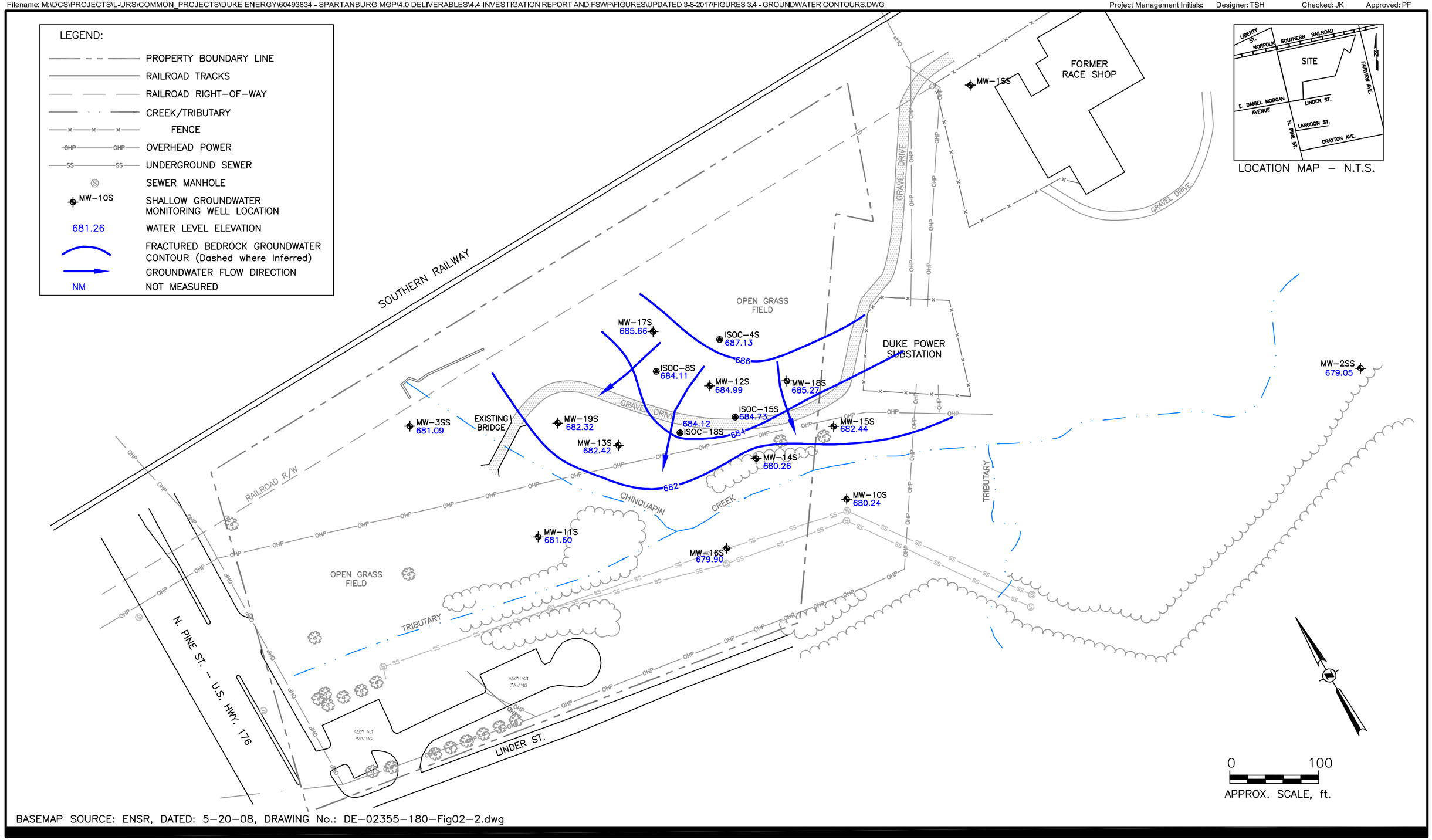
BASEMAP SOURCE: ENSR, DATED: 5-20-08, DRAWING No.: DE-02355-180-Fig02-2.dwg

DATA GAP INVESTIGATION RESULTS AND
FOCUSED FEASIBILITY STUDY WORK PLAN
DUKE ENERGY CORPORATION-FORMER MGP SITE
SPARTANBURG, SOUTH CAROLINA
Project No.: 60493834 Date: 2016-11-28

SITE PLAN

AECOM

Figure: 2



BASEMAP SOURCE: ENSR, DATED: 5-20-08, DRAWING No.: DE-02355-180-Fig02-2.dwg

DATA GAP INVESTIGATION RESULTS AND
FOCUSED FEASIBILITY STUDY WORK PLAN
DUKE ENERGY CORPORATION-FORMER MGP SITE
SPARTANBURG, SOUTH CAROLINA
Project No.: 60493834 Date: 2016-11-28

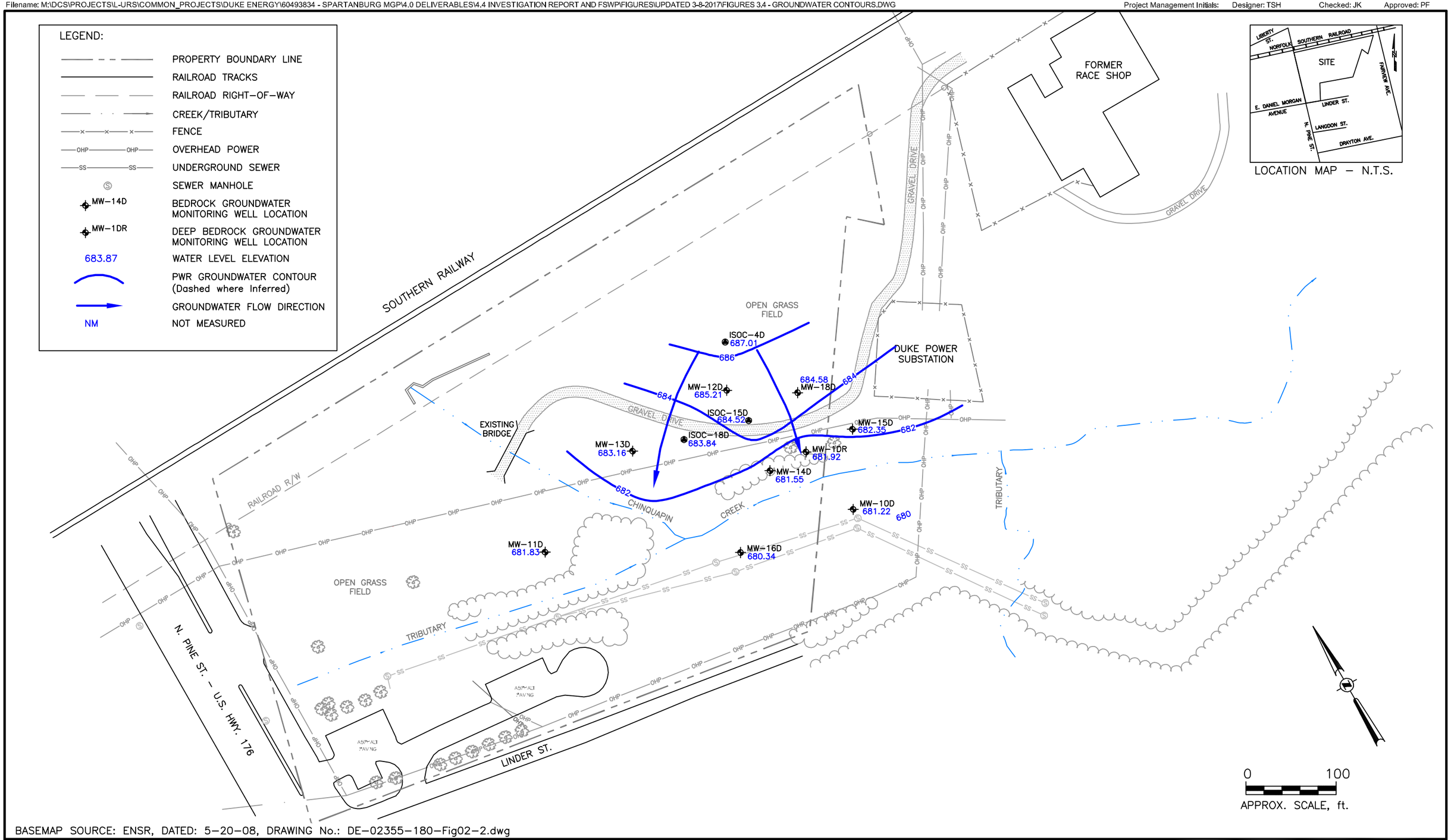
GROUNDWATER ELEVATIONS IN SAPROLITE WELLS - 10/17/2016

AECOM

Figure: 3

Filename: M:\DCS\PROJECTS\L-URS\COMMON_PROJECTS\DUKE ENERGY\60493834 - SPARTANBURG MGP\4.0 DELIVERABLES\4.4 INVESTIGATION REPORT AND FSWP\FIGURES\UPDATED 3-8-2017\FIGURES 3.4 - GROUNDWATER CONTOURS.DWG

Project Management Initials: Designer: TSH Checked: JK Approved: PF



BASEMAP SOURCE: ENSR, DATED: 5-20-08, DRAWING No.: DE-02355-180-Fig02-2.dwg

DATA GAP INVESTIGATION RESULTS AND
FOCUSED FEASIBILITY STUDY WORK PLAN
DUKE ENERGY CORPORATION-FORMER MGP SITE
SPARTANBURG, SOUTH CAROLINA
Project No.: 60493834 Date: 2016-11-28

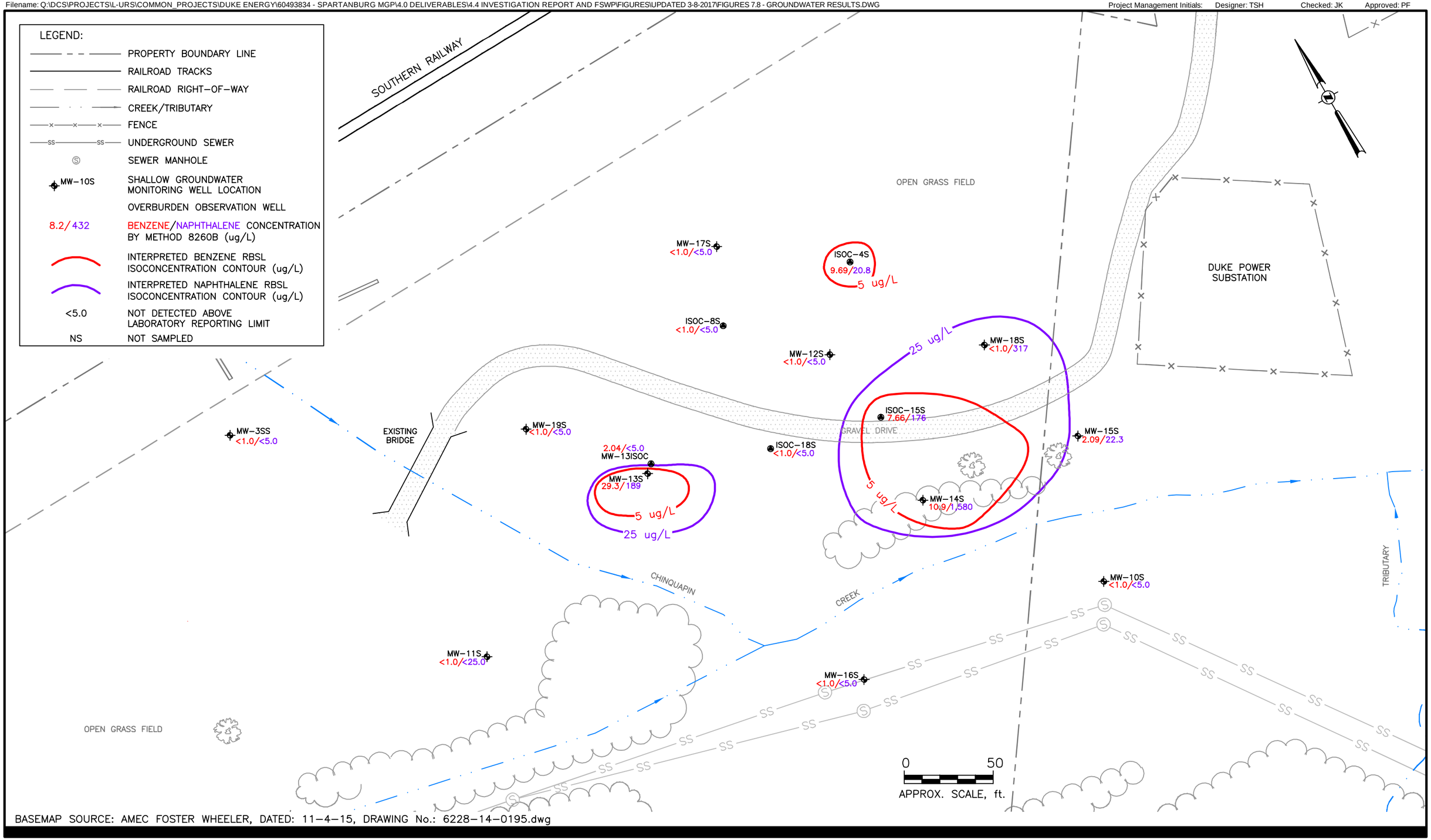
GROUNDWATER ELEVATIONS IN PWR AND FRACTURED ROCK WELLS - 10/17/2016

AECOM

Figure: 4

Filename: Q:\DCS\PROJECTS\L-URS\COMMON_PROJECTS\DUKE ENERGY\60493834 - SPARTANBURG MGP\4.0 DELIVERABLES\4.4 INVESTIGATION REPORT AND FSWP\FIGURES\UPDATED 3-8-2017\FIGURES 7.8 - GROUNDWATER RESULTS.DWG

Project Management Initials: Designer: TSH Checked: JK Approved: PF

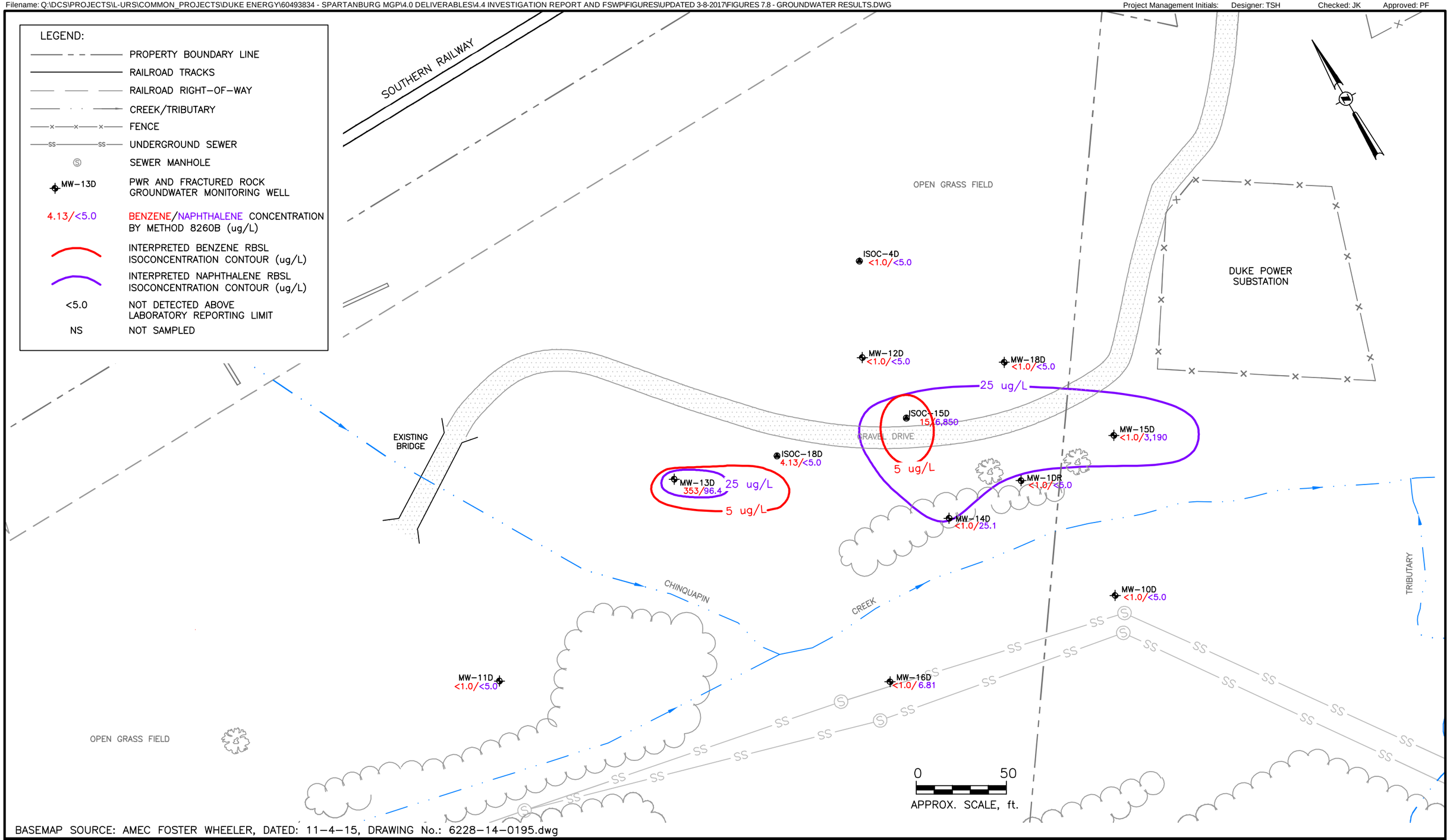


DATA GAP INVESTIGATION RESULTS AND
FOCUSED FEASIBILITY STUDY WORK PLAN
DUKE ENERGY CORPORATION-FORMER MGP SITE
SPARTANBURG, SOUTH CAROLINA
Project No.: 60493834 Date: 2016-11-28

BENZENE/NAPHTHALENE CONCENTRATIONS IN SAPROLITE WELLS - OCTOBER 2016

AECOM

Figure: 5

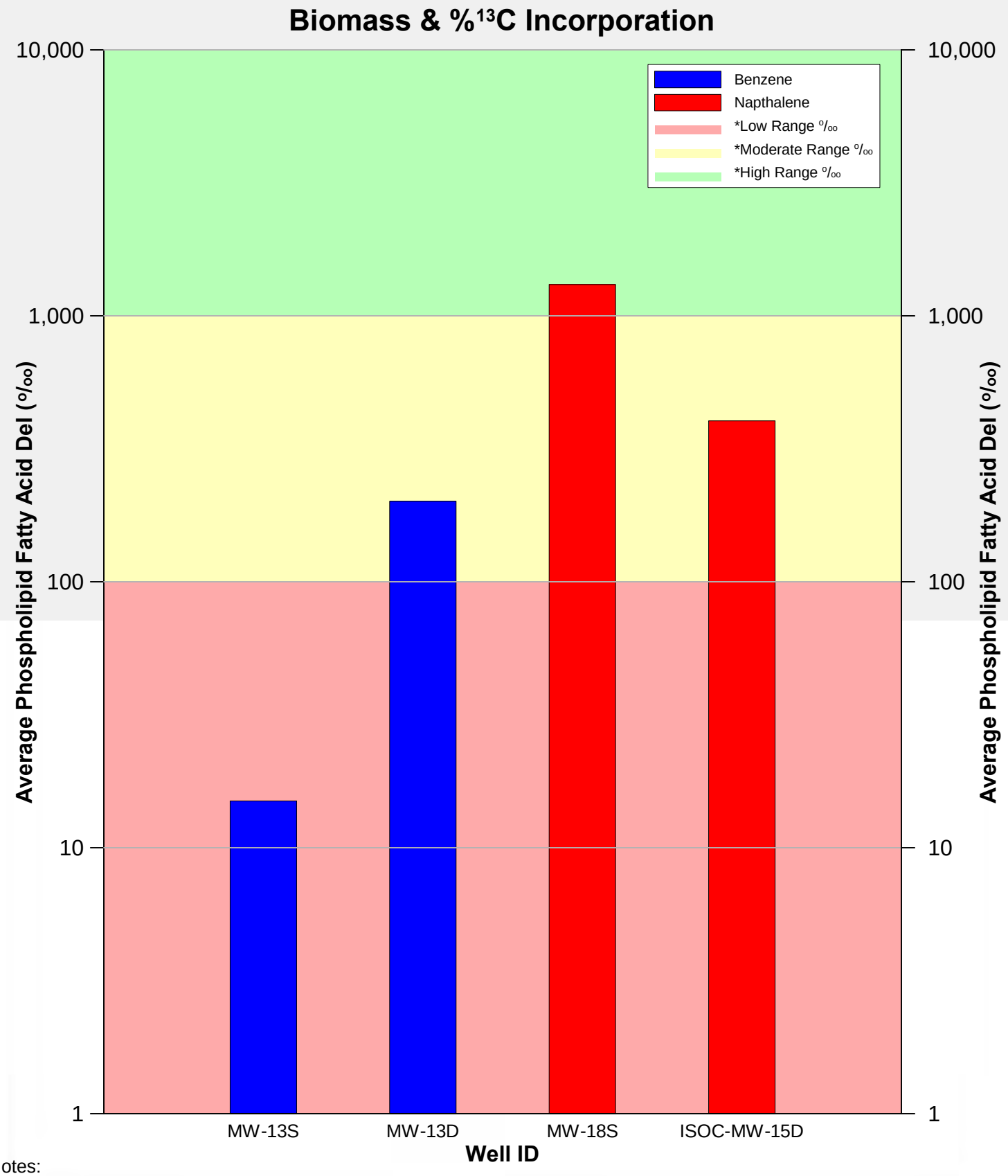


DATA GAP INVESTIGATION RESULTS AND
FOCUSED FEASIBILITY STUDY WORK PLAN
DUKE ENERGY CORPORATION-FORMER MGP SITE
SPARTANBURG, SOUTH CAROLINA
Project No.: 60493834 Date: 2016-11-28

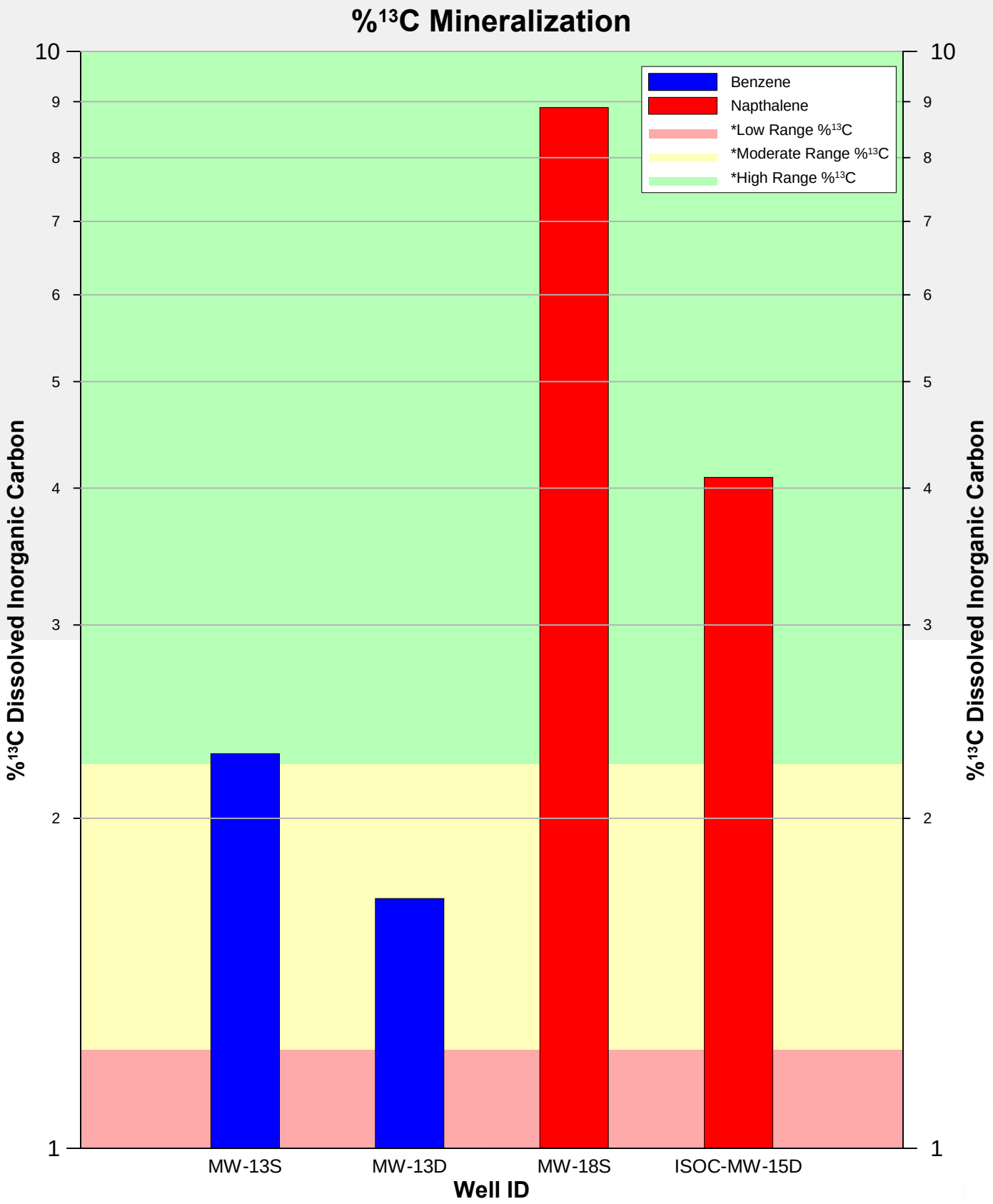
BENZENE/NAPHTHALENE CONCENTRATIONS IN PWR & FRACTURED ROCK WELLS - OCTOBER 2016

AECOM

Figure: 6

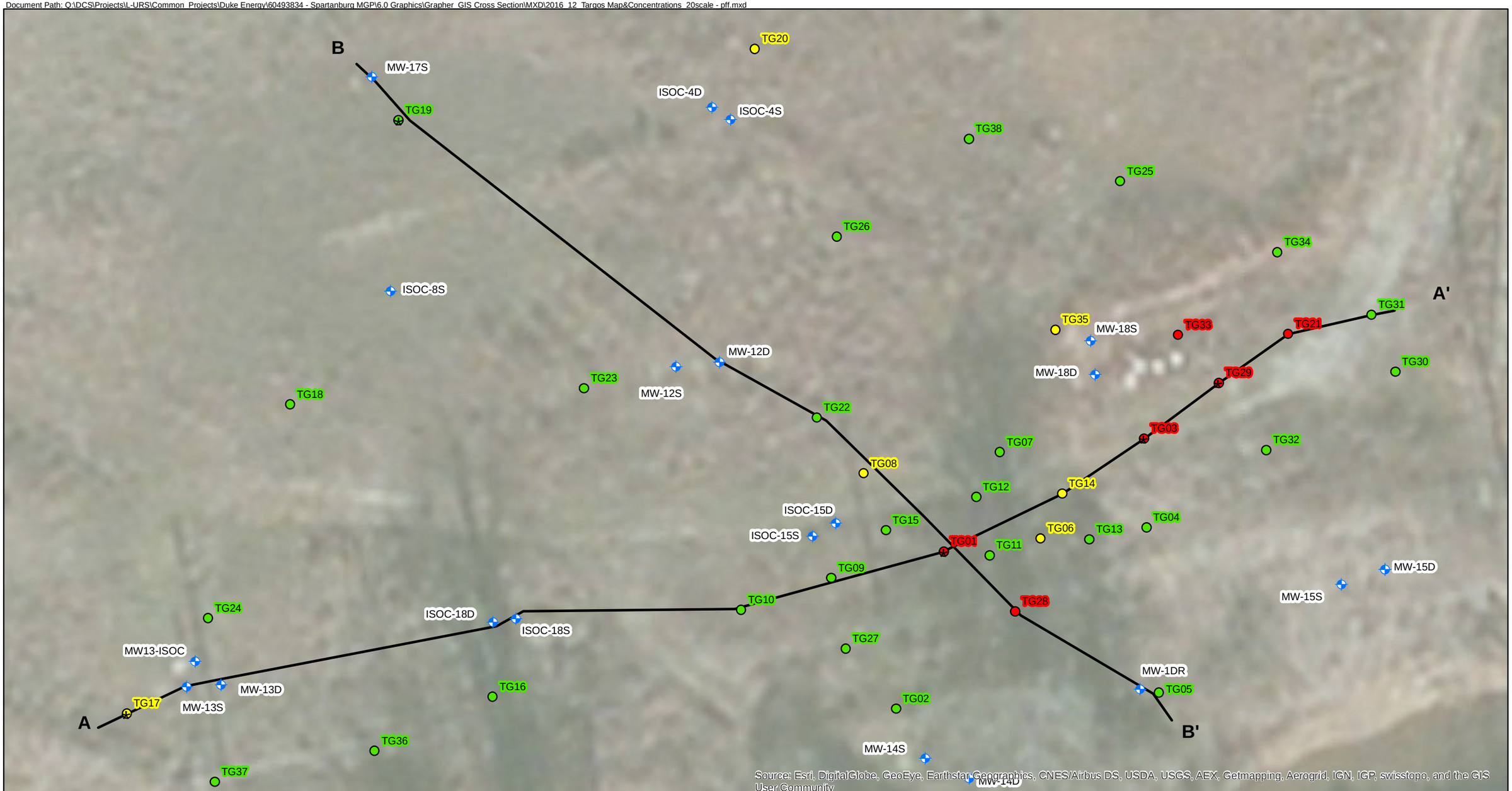


Notes:
*Ranges are based on comparison to Microbial Insights, Inc. database
‰ - Parts Per Thousand



Notes:
*Ranges are based on comparison to Microbial Insights, Inc. database

Document Path: Q:\DCS\Projects\L-URS\Common_Projects\Duke Energy\60493834 - Spartanburg MGP\6.0 Graphics\Grapher_GIS Cross Section\MXD\2016_12_Targos Map&Concentrations_20scale - pff.mxd



Legend

- Monitoring Well
- TarGOST Boring (TLM identified)
- TarGOST Boring (low fluorescent response)
- TarGOST Boring (fluorescent resopnse not consistent with TLM)
- Soil Sample Collected
- Cross-Section Location

TarGOST Boring Location Map

Duke Energy Corporation- Former MGP Site
Spartanburg, South Carolina

1 inch = 20 feet

0 25 50 100 Feet

N

January 2017
60493834

Figure 9

AECOM

1600 Perimeter Park Drive, Suite 400
Morrisville, NC 27560
tel: (919) 461-1100
fax: (919) 461-1415
web: www.AECOM.com

Legend

- FILL
- ALLUVIUM/SAPROLITE/SILT
- PARTIALLY WEATHERED ROCK
- BEDROCK- GNEISS
- Groundwater Phreatic Surface (ft amsl) (Dashed where inferred)
- TarGOST %RE (TLM identified)
- TarGOST %RE (low fluoresence for TLM)
- TarGOST %RE (no TLM indication)

- Monitoring Well
- Monitoring Well Screen
- Total Boring Depth

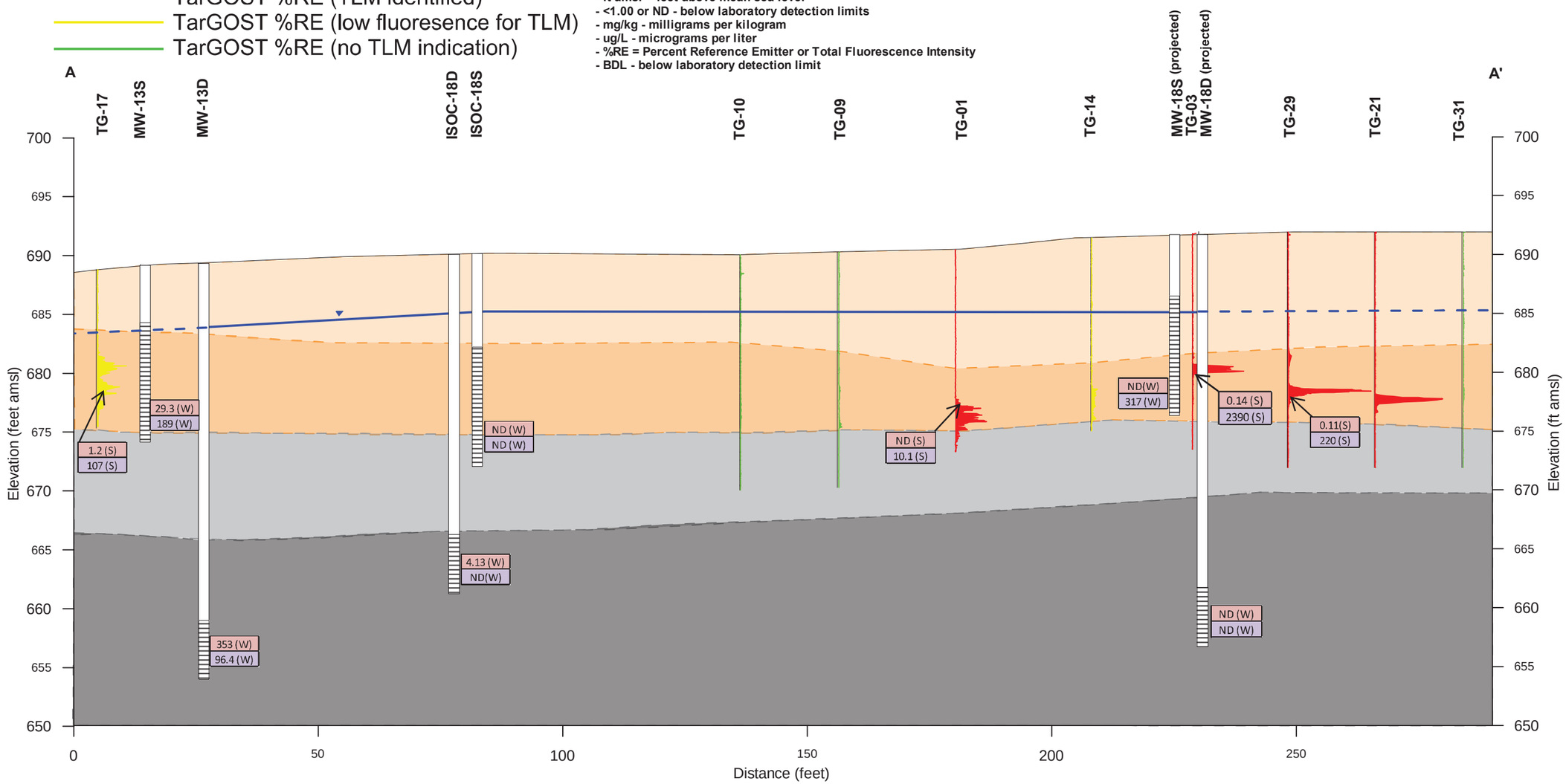
Groundwater COC Concentrations (ug/l)

Benzene	353 (W)
Naphthalene	96.4 (W)

Aquifer Soil COC Concentrations (mg/kg)

Benzene	ND (S)
Naphthalene	10.1 (S)

Notes:
- Groundwater levels and samples were collected in October 2016
- Soil samples and TarGOST data collected July 2016
- ft amsl - feet above mean sea level
- <1.00 or ND - below laboratory detection limits
- mg/kg - milligrams per kilogram
- ug/L - micrograms per liter
- %RE = Percent Reference Emitter or Total Fluorescence Intensity
- BDL - below laboratory detection limit



AECOM

Figure 10

Cross-Section A-A'

Data Gap Investigation Results and Focused Feasibility Study Work Plan
Spartanburg MGP
Spartanburg, SC
Project No.: 60493834 Date: 2017-03-08

Legend

- FILL
- ALLUVIUM/SAPROLITE/SILT
- PARTIALLY WEATHERED ROCK
- BEDROCK- GNEISS
- Groundwater Phreatic Surface (ft amsl) (Dashed where inferred)
- TarGOST %RE (TLM identified)
- TarGOST %RE (low fluoresence for TLM)
- TarGOST %RE (no TLM indication)

- Monitoring Well
- Monitoring Well Screen
- Total Boring Depth

Groundwater COC Concentrations (ug/l)

Benzene	ND (W)
Naphthalene	ND (W)

Aquifer Soil COC Concentrations (mg/kg)

Benzene	ND (S)
Naphthalene	10.1 (S)

Notes:
- Groundwater levels and samples were collected in October 2016
- Soil samples and TarGOST data collected July 2016
- ft amsl - feet above mean sea level
- <1.00 or ND - below laboratory detection limits
- mg/kg - milligrams per kilogram
- ug/L - micrograms per liter
- %RE = Percent Reference Emitter or Total Fluorescence Intensity
- BDL - below laboratory detection limit

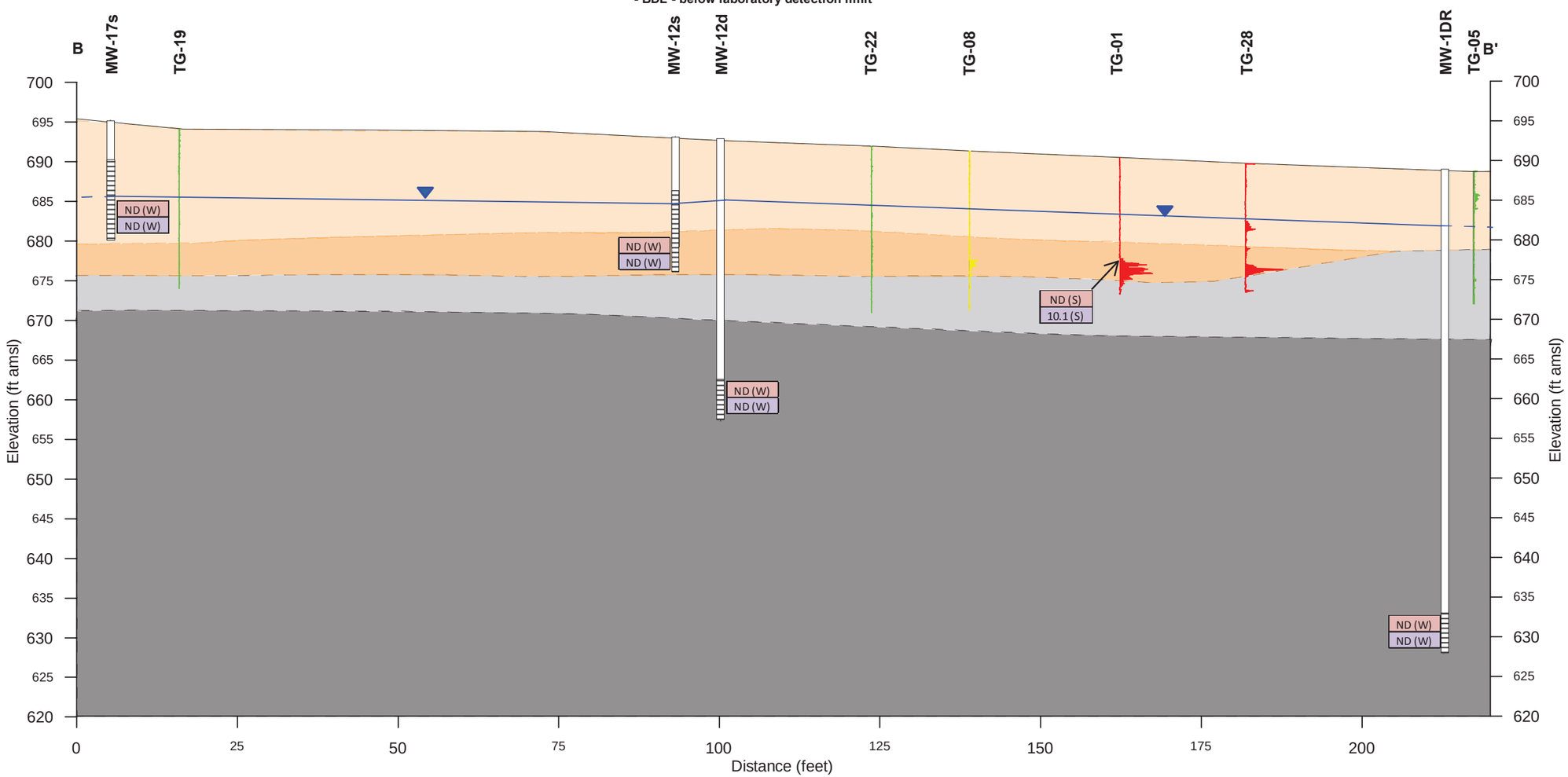


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Figure 11

Cross-Section B-B'

Data Gap Investigation Results and Focused Feasibility Study Work Plan
Spartanburg MGP
Spartanburg, SC
Project No.: 60493834 Date: 2017-03-08

Appendix A.
South Carolina Department of Health and Environmental Control Feasibility Study Investigation Work Plan Approval

Rec'd 3/10/16

D H E C

PROMOTE PROTECT PROSPER

Catherine E. Heigel, Director

Promoting and protecting the health of the public and the environment

February 23, 2016

Mr. Andrew Shull, P.E.
Duke Energy
PO Box 1006
Mail Code EC13K
Charlotte NC 28201

RE: Spartanburg Pine Street MGP Site
Feasibility Study Investigation Work Plan
Spartanburg County, File 56553

Dear Mr. Shull,

The Department has reviewed the Feasibility Study Investigation Work for the Pine Street Manufactured Gas Plant Site in Spartanburg, South Carolina received on February 12, 2016. The Department has the following comments on the Work Plan:

1. A detailed FS work plan should be submitted upon completion of the investigation. This should include a discussion of remedial action objectives, remedies for evaluation, and evaluation criteria.

2. Remedies in the FS should be evaluated for the 9 criteria outlined in the EPA RI FS guidance. The FFS may focus on a narrowed scope of applicable remedies but must use all the evaluation criteria.

The Department approves the work plan with the above referenced revisions. Please contact the Department at least 5 days prior to the start of field work. If you have any questions or concerns please contact me at (803)898-0747.

Sincerely,

Lucas Berresford
State Remediation Section
Bureau of Land and Waste Management

CC: File 56553
Stephanie Garrett, Region 2 District Office
Gary Stewart

Appendix B.
Bio-Trap® Evaluation

REPORT TO:
Reports will be provided to the contact(s) listed below. Parties other than the contact(s) listed below will require prior approval.

Name: Duke Spartanburg
Company: AECOM
Address: 10 Patewood Dr. Bldg. 6, Ste. 500
Greenville, SC 29615

email: aaron.council@aecom.com
Phone: 864-234-3032
Fax: 864-234-3069

Project Manager: Aaron Council
Project Name: Duke Spartanburg
Project No.: 60493834

INVOICE TO:
For Invoices **paid by a third party** it is imperative that contact information & corresponding reference No. be provided.

Name:
Company:
Address: as same Report
email:
Phone:
Fax:

Purchase Order No.
Subcontract No.
MI Quote No. Q2016331.0002

microbialinsights

10515 Research Dr
Knoxville, TN 37932

865-573-8188
www.microbe.com

Please Check One:
☐ More samples to follow
☒ No Additional Samples

Saturday Delivery
Please see sampling protocol for instructions

Please contact us prior to submitting samples regarding questions about the analyses you are requesting at (865) 573-8188 (8:00 am to 4:00 pm M-F). After these hours please email customerservice@microbe.com.

Sample Information					A					CENSUS: Please select the target organism/gene																							
MI ID (Laboratory Use Only)	Sample Name	13C Compound	Date Sampled	Matrix	PLFA + SIP	DIC	13C Compound Concentration		QuantArray-Petro	EBAC (Total)	APS (Sulfate Reducing Bacteria)	MGN (Methanogens)	MOB (Methanotrophs)	SMMO	DNF (Dentrifiers-nirS and nirK)	AOB (ammonia oxidizing bacteria)	PM1 (MTBE aerobic)	RMO (Toluene Monooxygenase)	RDEG (Toluene Monooxygenase)	PHE (Phenol Hydroxylase)	NAH (Napthalene-aerobic)	BSSA (Benzyl Succinate Synthase)	abcA (Benzene Carboxylase)	BCR (Benzoyl coenzyme A reductase)	TBA (TBA monooxygenase)	ETHB (ETBE monooxygenase)	HCMA	add qPCR:	add qPCR:	RNA (Expression Option)*	Other:	Other:	Other:
043NF1	MW-13S	Benzene	6-7-16	SIP	X	X	X																										
2	MW-13D	Benzene	↓	SIP	X	X	X																										
3	MW-14S								X																								
4	MW-18S	Naphthalene	↓	SIP	X	X	X																										
5	ISOC-MW-15D	Naphthalene	↓	SIP	X	X	X																										

Relinquished by: [signature] Received by: [signature] Date 6/8/16 11:30

In order for analysis to be completed correctly, it is vital that chain of custody is filled out correctly & that all relative information is provided. Failure to provide sufficient and/or correct information regarding reporting, invoicing & analyses requested information may result in delays for which MI will not be liable. *** additional cost and sample preservation are associated with RNA samples.**

10515 Research Drive
Knoxville, TN 37932
Phone: 865.573.8188
Fax: 865.573.8133
Web: www.microbe.com

SITE LOGIC Report

QuantArray® Petroleum Study

Contact: Aaron Council
Address: AECOM
10 Patewood Drive
Bldg VI, Suite 500
Greenville, SC 29615

Phone: 864-234-3032

Email: aaron.council@aecom.com

MI Identifier: 043NF

Report Date: 07/29/2016

Project: Duke Spartanburg/60493834

Comments:

The QuantArray® Approach

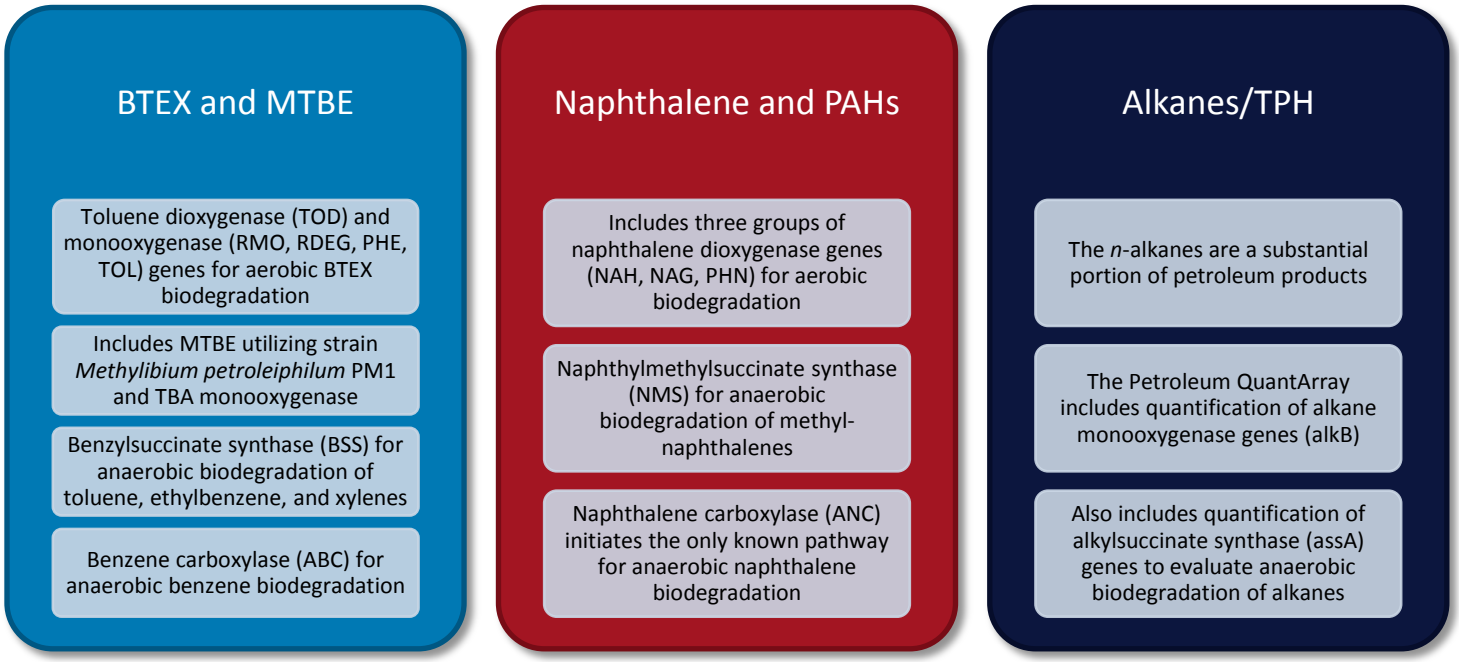
Comprehensive evaluation of biodegradation potential at petroleum impacted sites is inherently problematic due to two factors:

(1) Petroleum products are complex mixtures of hundreds of aliphatic, aromatic, cyclic and heterocyclic compounds
(2) Even for common classes of contaminants like benzene, toluene, ethylbenzene, and xylenes (BTEX), biodegradation can proceed by a multitude of pathways.

The Petroleum QuantArray has been designed to address both of these issues by providing the simultaneous quantification of the specific functional genes responsible for both aerobic and anaerobic biodegradation of BTEX, PAHs, and a variety of short and long chain alkanes.

Thus, when combined with chemical and geochemical groundwater monitoring programs, the QuantArray allows site managers to simultaneously yet economically evaluate the potential for biodegradation of a spectrum of petroleum hydrocarbons through a multitude of aerobic and anaerobic pathways to give a much more clear and comprehensive view of contaminant biodegradation.

The Petroleum QuantArray is used to quantify specific microorganisms and functional genes to evaluate aerobic and anaerobic biodegradation of the following classes of compounds present in petroleum products:



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How do QuantArrays® work?

The QuantArray in many respects is a hybrid technology combining the highly parallel detection of microarrays with the accurate and precise quantification provided by qPCR into a single platform. The key to highly parallel qPCR reactions is the nanoliter fluidics platform for low volume, solution phase qPCR reactions.

How are QuantArray® results reported?

One of the primary advantages of the Petroleum QuantArray is the simultaneous quantification of a broad spectrum of different microorganisms and key functional genes involved in a variety of pathways for chlorinated hydrocarbon biodegradation. However, highly parallel quantification combined with the various metabolic and cometabolic capabilities of different target organisms can complicate data presentation. Therefore, in addition to Summary Tables, QuantArray results will be presented as Microbial Population Summary and Comparison Figures to aid in data interpretation and subsequent evaluation of site management activities.

Types of Tables and Figures:

Microbial Population Summary	• Figure presenting the concentrations of QuantArray target gene concentrations (e.g. toluene dioxygenase) relative to typically observed values.
Summary Tables	• Tables of target population concentrations grouped by biodegradation pathway and contaminant type.
Comparison Figures	• Depending on the project, sample results can be presented to compare changes over time or examine differences in microbial populations for along a transect of the dissolved plume.

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Results

Table 1. Summary of the QuantArray® results obtained for monitoring wells.

Sample Name	MW-14S	MW-13S	MW-13D	MW-18S	ISOC-MW-15D
Aerobic BTEX and MTBE	(cells/bead)	(cells/bead)	(cells/bead)	(cells/bead)	(cells/bead)
Toluene/Benzene Dioxygenase (TOD)	**1.54E+03**	**4.84E+02**	**1.31E+02 (J)**	**6.08E+02**	**8.47E+02**
Phenol Hydroxylase (PHE)	**3.28E+04**	**1.01E+05**	**1.50E+05**	**5.31E+05**	**2.03E+04**
Toluene 2 Monooxygenase/Phenol Hydroxylase (RDEG)	**3.84E+04**	**5.63E+04**	**3.14E+04**	**6.97E+05**	**1.38E+04**
Toluene Ring Hydroxylating Monooxygenases (RMO)	**2.10E+03**	**9.00E+03**	**9.05E+04**	**2.36E+04**	<2.50E+02
Xylene/Toluene Monooxygenase (TOL)	<2.50E+02	**1.78E+03**	<2.50E+02	<2.50E+02	<2.50E+02
Ethylbenzene/Isopropylbenzene Dioxygenase (EDO)	<2.50E+02	**4.87E+01 (J)**	<2.50E+02	<2.50E+02	<2.50E+02
Biphenyl/Isopropylbenzene Dioxygenase (BPH4)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02
Methylibium petroleiphilum PM1 (PM1)	**2.87E+05**	**6.30E+05**	**1.03E+06**	**2.87E+05**	**5.51E+05**
TBA Monooxygenase (TBA)	<2.50E+02	**4.58E+03**	<2.50E+02	<2.50E+02	<2.50E+02
Aerobic PAHs and Alkanes					
Naphthalene Dioxygenase (NAH)	**1.82E+04**	**4.59E+03**	**2.76E+05**	**5.31E+04**	**7.48E+02**
Naphthalene-inducible Dioxygenase (NidA)	**2.14E+03**	<2.50E+02	**1.24E+04**	<2.50E+02	<2.50E+02
Phenanthrene Dioxygenase (PHN)	<2.50E+02	<2.50E+02	**1.97E+03**	**1.95E+04**	<2.50E+02
Alkane Monooxygenase (ALK)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02
Alkane Monooxygenase (ALMA)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02
Anaerobic BTEX					
Benzoyl Coenzyme A Reductase (BCR)	**4.72E+03**	**9.83E+05**	**6.13E+05**	**5.55E+05**	**5.48E+05**
Benzylsuccinate synthase (BSS)	<2.50E+02	**1.42E+04**	**1.04E+02 (J)**	**2.00E+03**	**1.24E+04**
Benzene Carboxylase (ABC)	<2.50E+02	<2.50E+02	**8.88E+02**	<2.50E+02	<2.50E+02
Anaerobic PAHs and Alkanes					
Naphthylmethylsuccinate Synthase (MNSSA)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02
Naphthalene Carboxylase (ANC)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02
Alkylsuccinate Synthase (ASSA)	**8.24E+02**	**1.06E+05**	**6.15E+04**	**1.01E+04**	**3.98E+05**
Other					
Total Eubacteria (EBAC)	**5.07E+05**	**1.23E+06**	**3.66E+06**	**1.84E+06**	**1.10E+06**
Sulfate Reducing Bacteria (APS)	**1.97E+01 (J)**	**9.46E+05**	**1.98E+06**	**1.41E+03**	**9.57E+05**

Legend: NA = Not Analyzed NS = Not Sampled J = Estimated gene copies below PQL but above LQL I = Inhibited< = Result not detected

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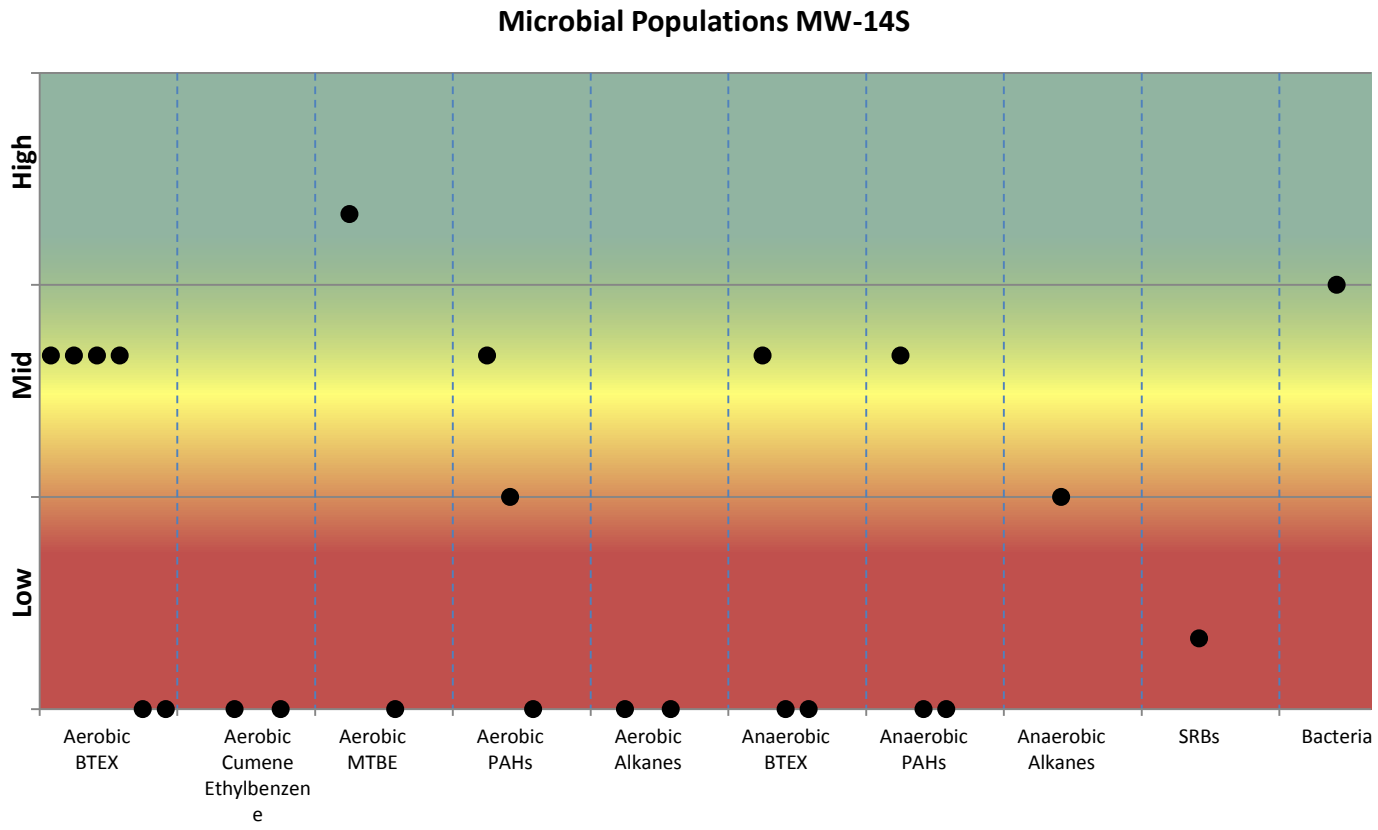
Figure 1. Microbial population summary to aid in evaluating potential pathways and biodegradation of specific contaminants.



Aerobic		Anaerobic	
BTEX	TOD, PHE, RDEG, RMO, TOL, EDO	BTEX	BCR, BSS, ABC
Cumene, Ethylbenzene	EDO, BPH4	Naphthalene/Methylnaphthalene	BCR, MNSSA, ANC
MTBE/TBA	PM1, TBA	Alkanes	assA
Naphthalene	NAH, NidA		
Phenanthrene	PHN		
Alkanes	ALK, ALMA		

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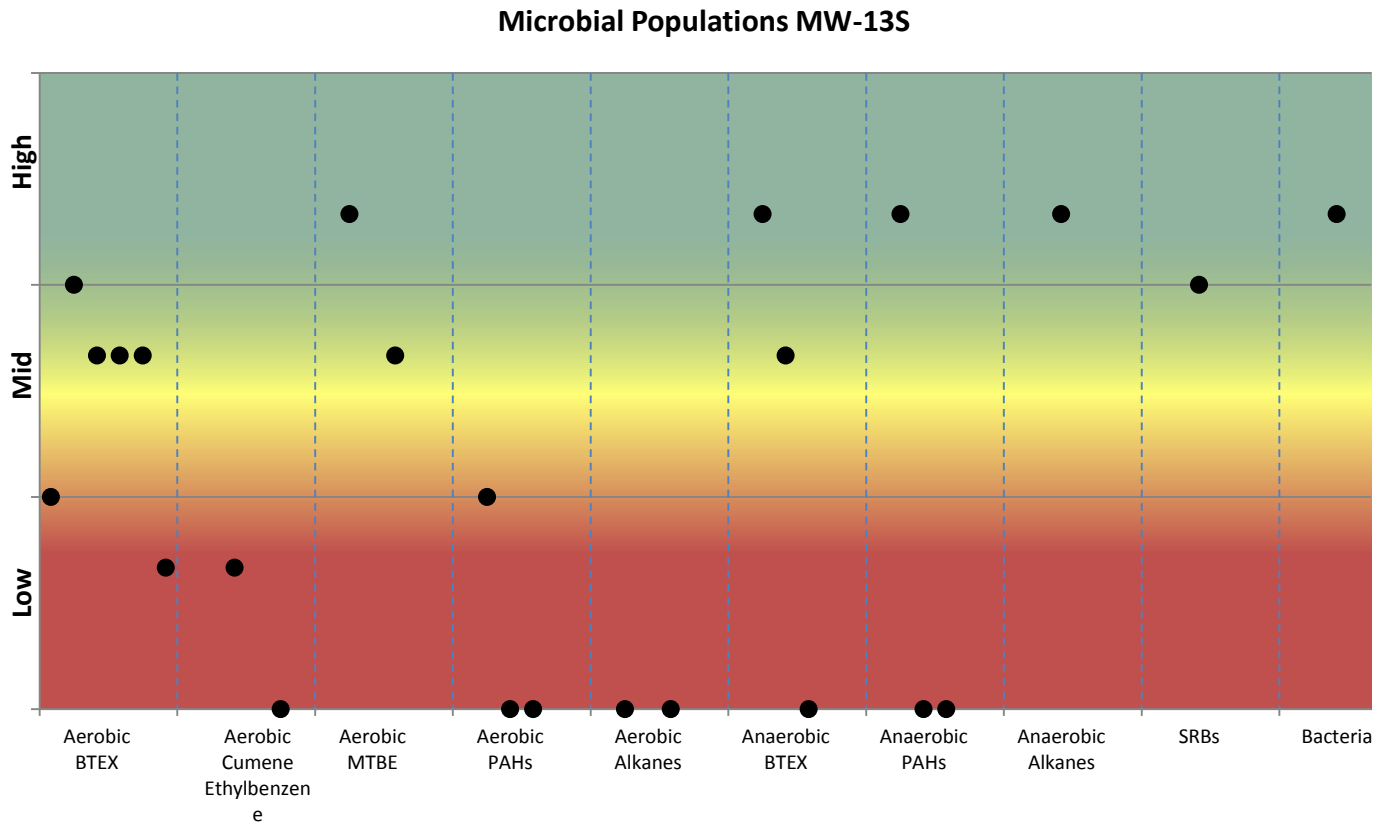
Figure 2. Microbial population summary to aid in evaluating potential pathways and biodegradation of specific contaminants.



Aerobic		Anaerobic	
BTEX	TOD, PHE, RDEG, RMO, TOL, EDO	BTEX	BCR, BSS, ABC
Cumene, Ethylbenzene	EDO, BPH4	Naphthalene/Methylnaphthalene	BCR, MNSSA, ANC
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Phenanthrene	PHN		
Alkanes	ALK, ALMA		

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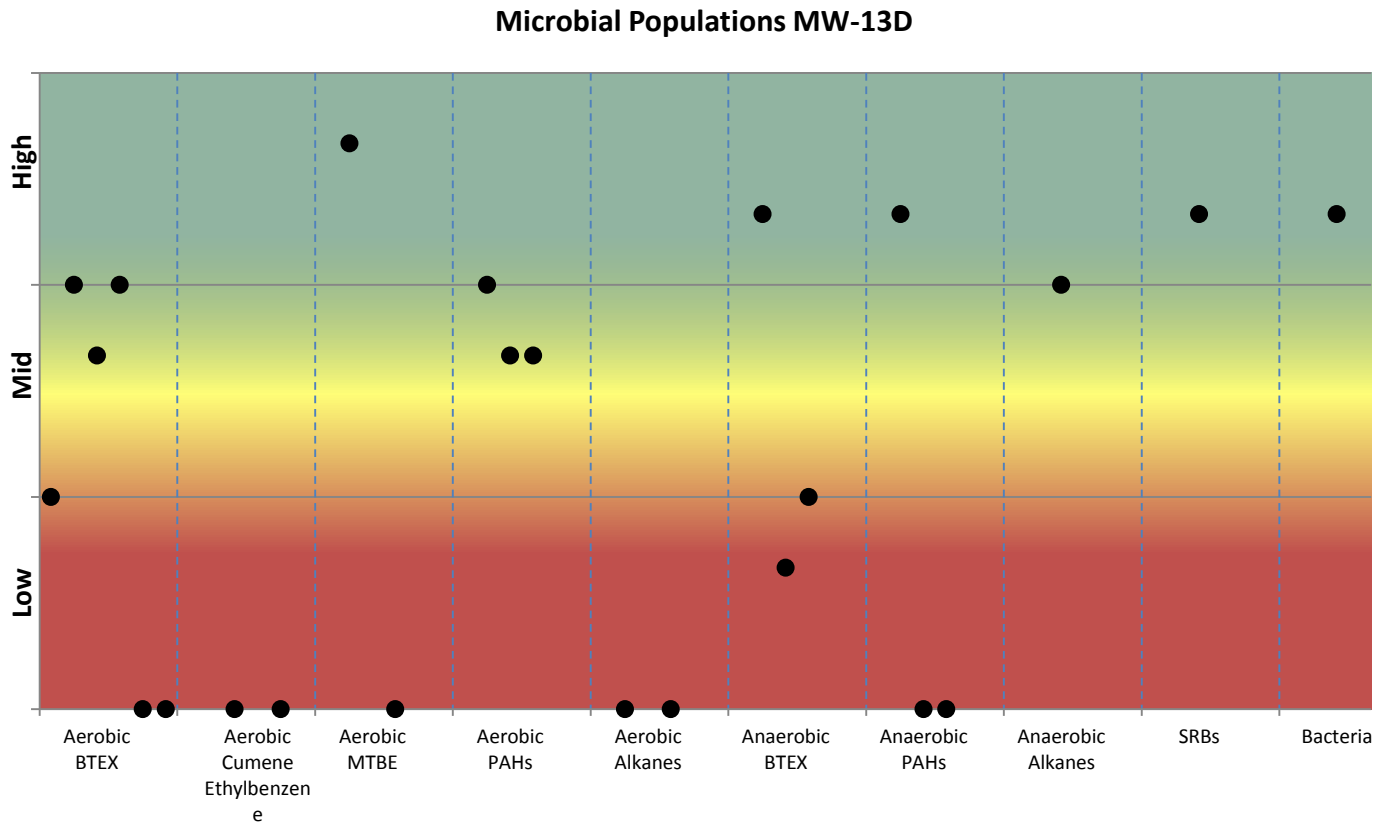
Figure 3. Microbial population summary to aid in evaluating potential pathways and biodegradation of specific contaminants.



Aerobic		Anaerobic	
BTEX	TOD, PHE, RDEG, RMO, TOL, EDO	BTEX	BCR, BSS, ABC
Cumene, Ethylbenzene	EDO, BPH4	Naphthalene/Methylnaphthalene	BCR, MNSSA, ANC
MTBE/TBA	PM1, TBA	Alkanes	assA
Naphthalene	NAH, NidA		
Phenanthrene	PHN		
Alkanes	ALK, ALMA		

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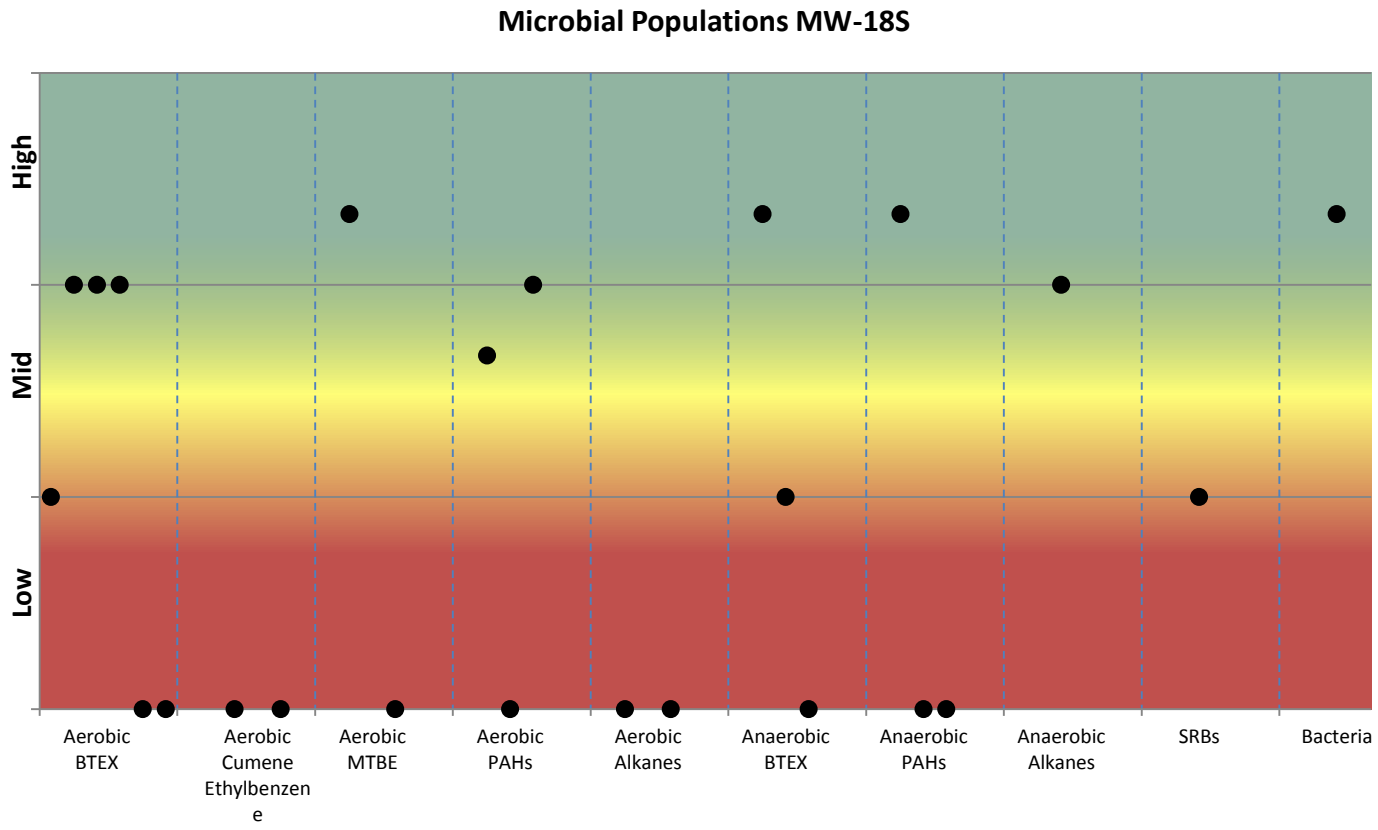
Figure 4. Microbial population summary to aid in evaluating potential pathways and biodegradation of specific contaminants.



Aerobic		Anaerobic	
BTEX	TOD, PHE, RDEG, RMO, TOL, EDO	BTEX	BCR, BSS, ABC
Cumene, Ethylbenzene	EDO, BPH4	Naphthalene/Methylnaphthalene	BCR, MNSSA, ANC
MTBE/TBA	PM1, TBA	Alkanes	assA
Naphthalene	NAH, NidA		
Phenanthrene	PHN		
Alkanes	ALK, ALMA		

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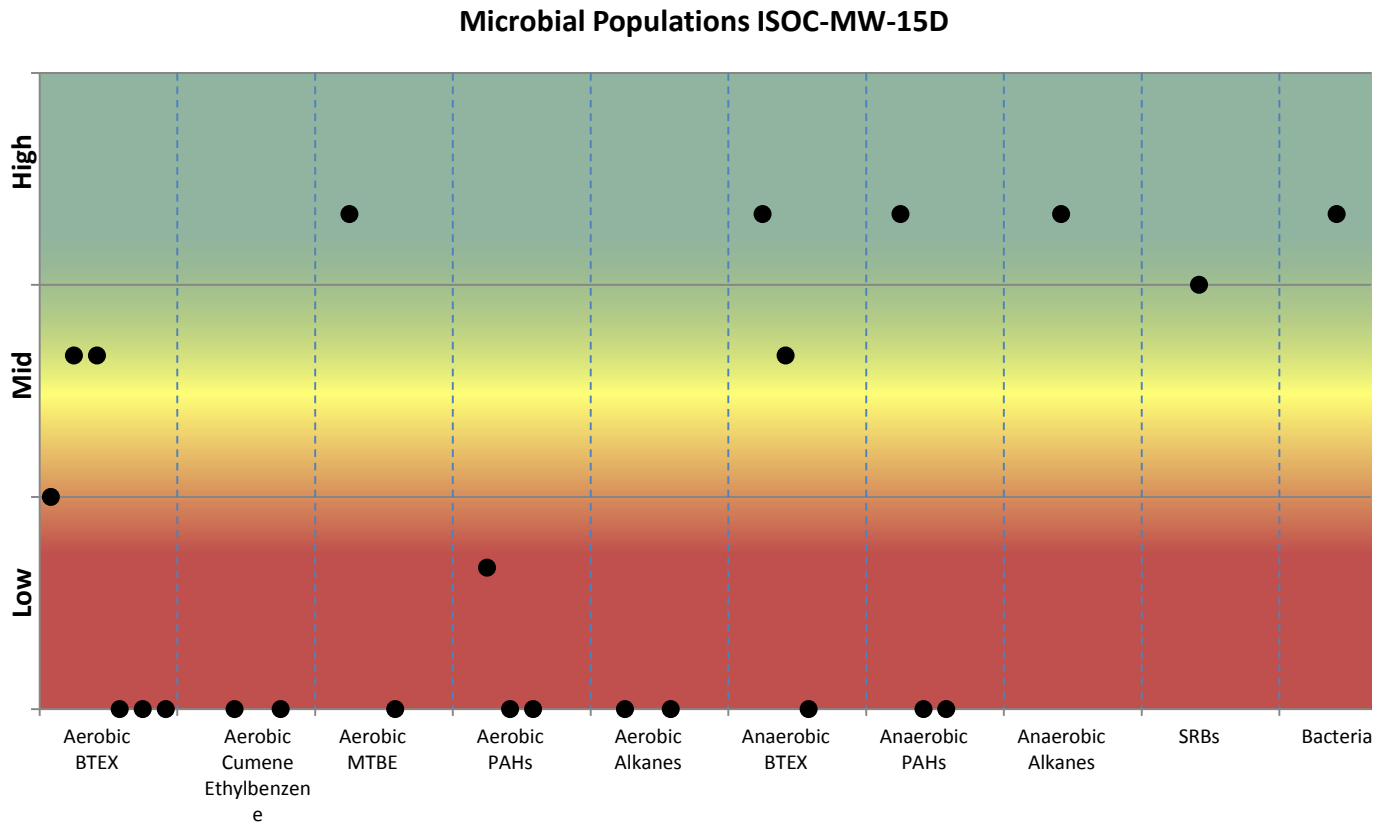
Figure 5. Microbial population summary to aid in evaluating potential pathways and biodegradation of specific contaminants.



Aerobic		Anaerobic	
BTEX	TOD, PHE, RDEG, RMO, TOL, EDO	BTEX	BCR, BSS, ABC
Cumene, Ethylbenzene	EDO, BPH4	Naphthalene/Methylnaphthalene	BCR, MNSSA, ANC
MTBE/TBA	PM1, TBA	Alkanes	assA
Naphthalene	NAH, NidA		
Phenanthrene	PHN		
Alkanes	ALK, ALMA		

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Table 2. Summary of the QuantArray® results for microorganisms responsible for aerobic BTEX and MTBE biodegradation.

Sample Name	MW-14S	MW-13S	MW-13D	MW-18S	ISOC-MW-15D
Aerobic BTEX and MTBE	**(cells/bead)**	**(cells/bead)**	**(cells/bead)**	**(cells/bead)**	**(cells/bead)**
Toluene/Benzene Dioxygenase (TOD)	**1.54E+03**	**4.84E+02**	**1.31E+02 (J)**	**6.08E+02**	**8.47E+02**
Phenol Hydroxylase (PHE)	**3.28E+04**	**1.01E+05**	**1.50E+05**	**5.31E+05**	**2.03E+04**
Toluene 2 Monooxygenase/Phenol Hydroxylase (RDEG)	**3.84E+04**	**5.63E+04**	**3.14E+04**	**6.97E+05**	**1.38E+04**
Toluene Ring Hydroxylating Monooxygenases (RMO)	**2.10E+03**	**9.00E+03**	**9.05E+04**	**2.36E+04**	<2.50E+02
Xylene/Toluene Monooxygenase (TOL)	<2.50E+02	**1.78E+03**	<2.50E+02	<2.50E+02	<2.50E+02
Ethylbenzene/Isopropylbenzene Dioxygenase (EDO)	<2.50E+02	**4.87E+01 (J)**	<2.50E+02	<2.50E+02	<2.50E+02
Biphenyl/Isopropylbenzene Dioxygenase (BPH4)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02
Methylibium petroleiphilum PM1 (PM1)	**2.87E+05**	**6.30E+05**	**1.03E+06**	**2.87E+05**	**5.51E+05**
TBA Monooxygenase (TBA)	<2.50E+02	**4.58E+03**	<2.50E+02	<2.50E+02	<2.50E+02

Figure 6. Comparison - Microbial populations involved in aerobic biodegradation of BTEX and MTBE.

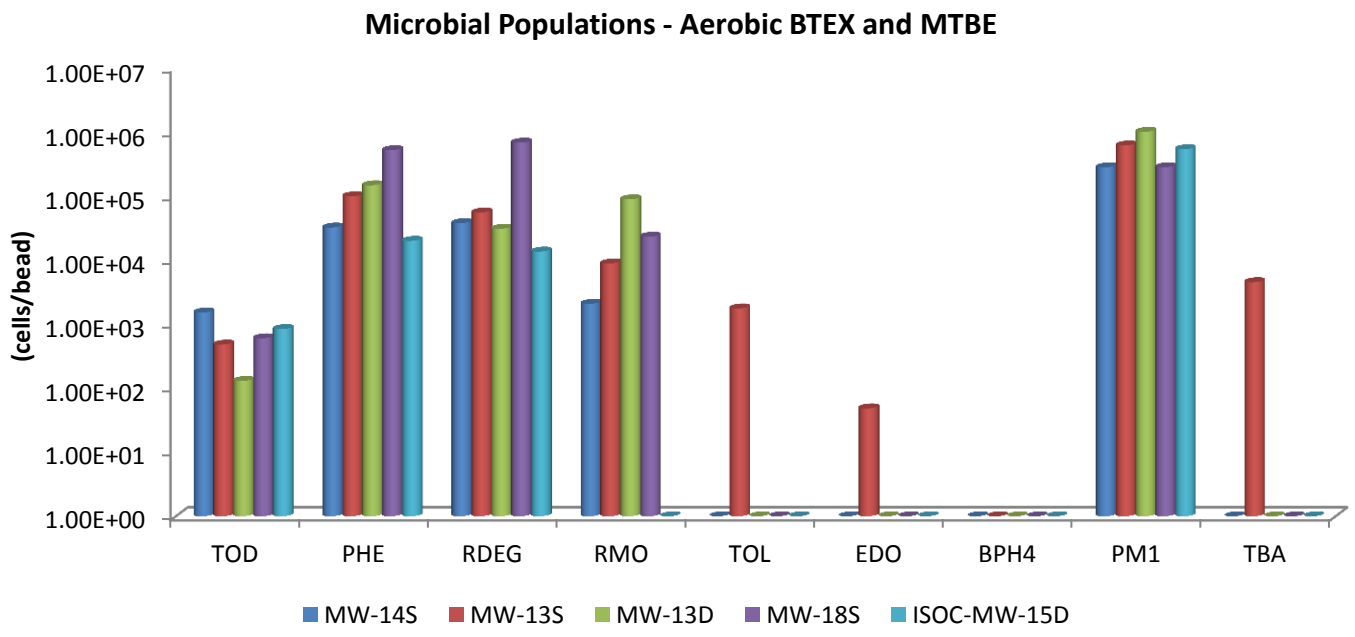

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Table 3. Summary of the QuantArray® results for microorganisms responsible for aerobic biodegradation of PAHs and alkanes.

Sample Name	MW-14S	MW-13S	MW-13D	MW-18S	ISOC-MW-15D
Aerobic PAHs and Alkanes	(cells/bead)	(cells/bead)	(cells/bead)	(cells/bead)	(cells/bead)
Naphthalene Dioxygenase (NAH)	**1.82E+04**	**4.59E+03**	**2.76E+05**	**5.31E+04**	**7.48E+02**
Naphthalene-inducible Dioxygenase (NidA)	**2.14E+03**	<2.50E+02	**1.24E+04**	<2.50E+02	<2.50E+02
Phenanthrene Dioxygenase (PHN)	<2.50E+02	<2.50E+02	**1.97E+03**	**1.95E+04**	<2.50E+02
Alkane Monooxygenase (ALK)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02
Alkane Monooxygenase (ALMA)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02

Figure 7. Comparison - Microbial populations involved in aerobic biodegradation of BTEX and MTBE.

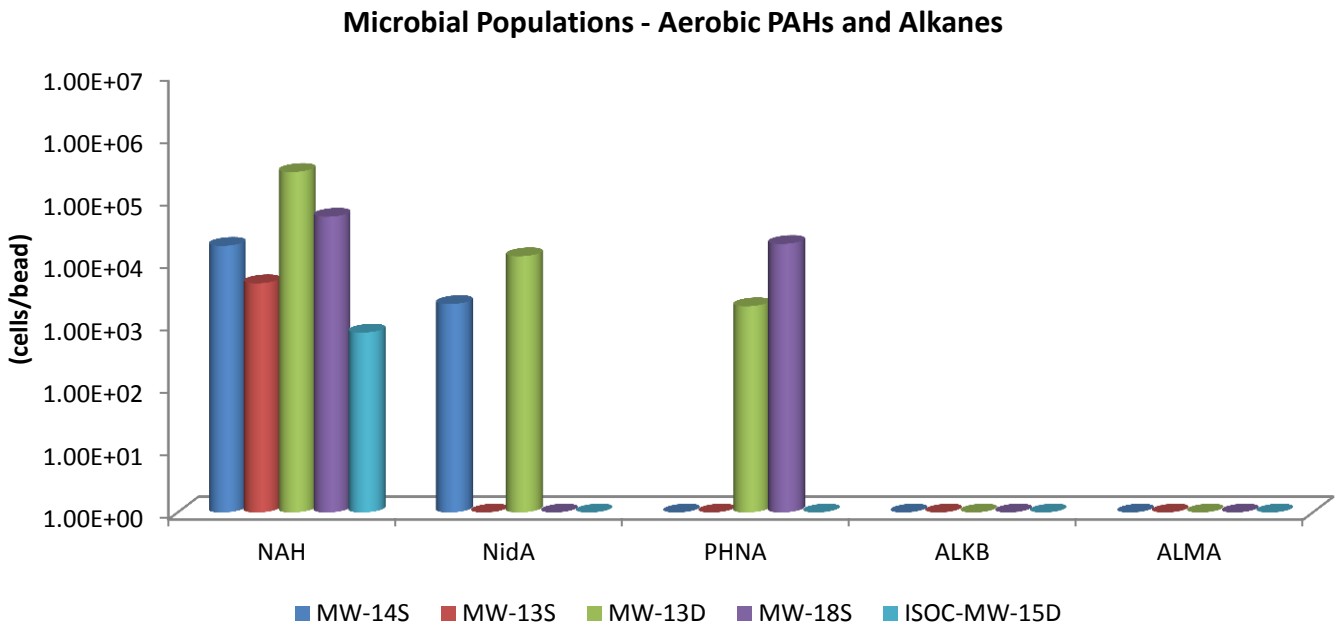

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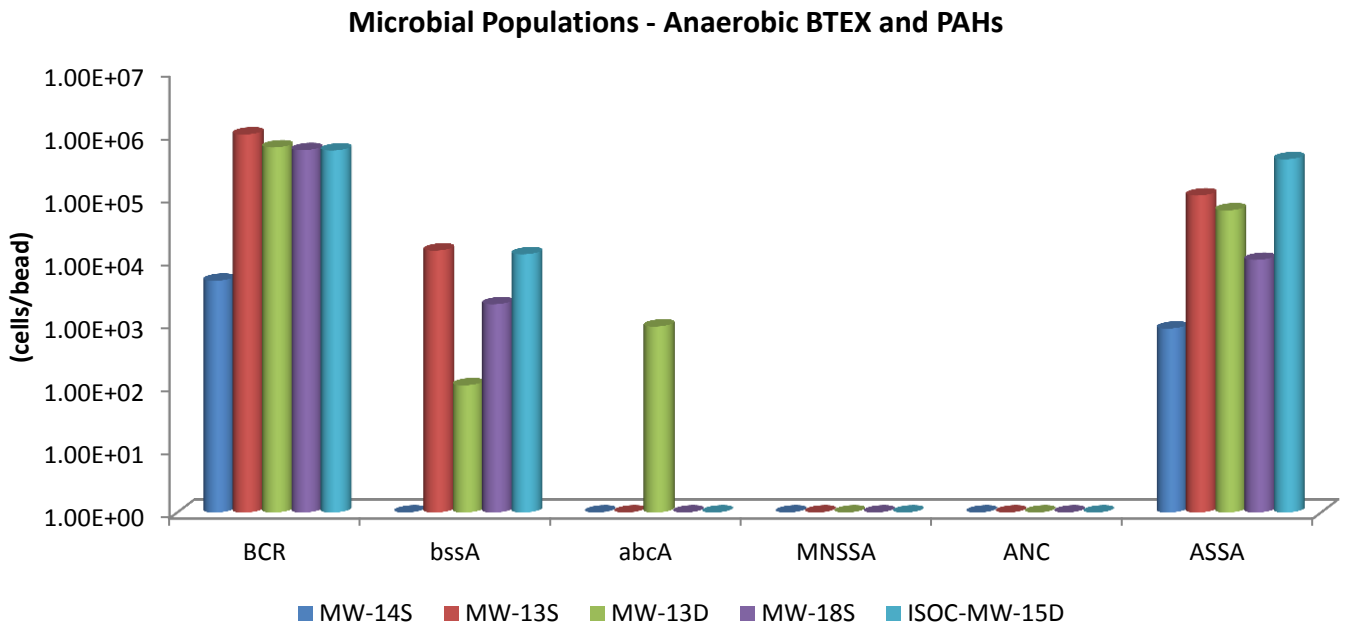
Table 4. Summary of the QuantArray® results for microorganisms responsible for anaerobic biodegradation of BTEX, PAHs, and alkanes.

Sample Name	MW-14S	MW-13S	MW-13D	MW-18S	ISOC-MW-15D
Anaerobic BTEX	(cells/bead)	(cells/bead)	(cells/bead)	(cells/bead)	(cells/bead)
Benzoyl Coenzyme A Reductase (BCR)	**4.72E+03**	**9.83E+05**	**6.13E+05**	**5.55E+05**	**5.48E+05**
Benzylsuccinate synthase (BSS)	<2.50E+02	**1.42E+04**	**1.04E+02 (J)**	**2.00E+03**	**1.24E+04**
Benzene Carboxylase (ABC)	<2.50E+02	<2.50E+02	**8.88E+02**	<2.50E+02	<2.50E+02
Anaerobic PAHs and Alkanes					
Naphthylmethylsuccinate Synthase (MNSSA)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02
Naphthalene Carboxylase (ANC)	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02	<2.50E+02
Alkylsuccinate Synthase (ASSA)	**8.24E+02**	**1.06E+05**	**6.15E+04**	**1.01E+04**	**3.98E+05**

Figure 8. Comparison - Microbial populations involved in anaerobic biodegradation of BTEX and MTBE.



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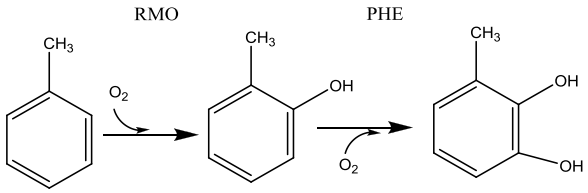
Interpretation

The overall purpose of the Petroleum QuantArray® is to give site managers the ability to simultaneously yet economically evaluate the potential for biodegradation of a spectrum of contaminants found in petroleum products through a multitude of aerobic and anaerobic pathways to give a much more clear and comprehensive view of contaminant biodegradation. The following discussion describes interpretation of results in general terms and is meant to serve as a guide.

Aerobic Biodegradation – Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX): At sites impacted by petroleum products, aromatic hydrocarbons including BTEX are often contaminants of concern. Aerobic biodegradation of aromatic hydrocarbons has been intensively studied and multiple catabolic pathways have been well characterized. The substrate specificity of each pathway (range of compounds biodegraded via each pathway) is largely determined by the specificity of the initial oxygenase enzyme. The Petro QuantArray® includes a suite of assays targeting the initial oxygenase genes of the known pathways for aerobic BTEX biodegradation.

Toluene/Benzene Dioxygenase (TOD): Toluene/benzene dioxygenase (TOD) incorporates both atoms of molecular oxygen directly into the aromatic ring. Although commonly called toluene dioxygenase, the substrate specificity of this enzyme is relaxed allowing growth on toluene and benzene along with co-oxidation of a variety of compounds including ethylbenzene, *o*-xylene, *m*-xylene and trichloroethene (TCE) when expressed.

Toluene/Benzene Monooxygenases (RMO/RDEG) and Phenol Hydroxylases (PHE): The next three known pathways for aerobic biodegradation of toluene (as well as benzene and xylenes) involve two steps: (1) an initial oxidation mediated by a toluene monooxygenase and (2) a second oxidation step catalyzed by a phenol hydroxylase. In these pathways, the toluene monooxygenases have been referred to as "ring hydroxylating monooxygenases" because they initiate biodegradation of toluene by incorporating oxygen directly into the aromatic ring rather than at the methyl group. The ring hydroxylating monooxygenases (RMOs) can be further described as toluene-2-monooxygenases, toluene-3-monooxygenases, or toluene-4-monooxygenases based upon where they attack the aromatic ring.



In general, phenol hydroxylases (PHE) catalyze the continued oxidation of phenols produced by RMOs. However, the difference between toluene monooxygenases (RMOs) and phenol hydroxylases (PHEs) is not absolute in terms of substrate specificity and catabolic function. For example, the TbmD toluene/benzene-2-monooxygenase (Johnson and Olsen 1995) may be responsible for both the initial and second oxidation step (Kahng et al. 2001).

The RMO, RDEG, and PHE assays target groups of genes encoding enzymes which perform the critical first and/or second steps in the aerobic biodegradation of BTX compounds. In general terms, the RMO assay quantifies families of toluene-3-monooxygenase and toluene-4-monooxygenase genes. The RDEG assay is used to quantify groups of toluene-2-monooxygenase and phenol hydroxylase genes. Similarly, the PHE assay targets phenol hydroxylase genes and several benzene monooxygenase genes which catalyze both oxidation steps.

Toluene/Xylene Monooxygenase (TOL): The final known pathway for aerobic toluene biodegradation involves initial monooxygenase attack at the methyl group by a toluene/xylene monooxygenase.

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Ethylbenzene Dioxygenase (EDO): Similar to TOD, this group of aromatic oxygenases exhibits relatively broad specificity and is responsible for aerobic biodegradation of alkylbenzenes including ethylbenzene and isopropylbenzene or cumene (Pflugmacher et al. 1996).

Biphenyl Dioxygenase (BPH4): In environmental restoration, biphenyl dioxygenases are best known for cometabolism of polychlorinated biphenyls (PCBs). However, this subfamily includes benzene (Na et al. 2005) and isopropylbenzene (Dabrock et al. 1994) dioxygenases from *Rhodococcus* spp.

Aerobic Biodegradation – MTBE and TBA: With increased use in the 1990's, the fuel oxygenate methyl *tert*-butyl ether (MTBE) has become one of the most commonly detected groundwater contaminants at gasoline contaminated sites. Pure cultures capable of utilizing MTBE as a growth supporting substrate have been isolated (Hanson et al. 1999) and aerobic biodegradation of MTBE and the intermediate *tert*-butyl alcohol (TBA) has been reasonably well characterized. The Petro QuantArray® includes quantification of two gene targets to assess the potential for aerobic biodegradation of MTBE and TBA.

Methylibium petroleiphilum PM1 (PM1): One of the few organisms isolated to date which is capable of utilizing MTBE and TBA as growth supporting substrates (Hanson et al. 1999).

TBA Monooxygenase (BPH4): Targets the TBA monooxygenase gene responsible for oxidation of TBA by *Methylibium petroleiphilum* PM1 (Hristova et al. 2007).

Aerobic Biodegradation – Naphthalene and other PAHs:

Naphthalene Dioxygenase (NAH): Naphthalene dioxygenase incorporates both atoms of molecular oxygen into naphthalene to initiate aerobic metabolism of the compound. However, the broad substrate specificity of naphthalene dioxygenase has been widely noted. When expressed, naphthalene dioxygenase is capable of catalyzing the oxidation of larger PAHs like anthracene, phenanthrene, acenaphthylene, fluorene, and acenaphthene. For a more comprehensive list of reactions mediated by naphthalene dioxygenases, see the University of Minnesota Biocatalysis/Biodegradation Database (http://umbbd.ethz.ch/).

Dinitrotoluene/Naphthalene Dioxygenase (DNT/NAG): The DNT/NAG assay quantifies a distinct subfamily of naphthalene dioxygenase genes that includes the *nagA*-like naphthalene dioxygenases from *Ralstonia* and *Burkholderia* spp. and *dntA*-like dinitrotoluene dioxygenases from *Burkholderia* spp. In addition to the NAH subfamily described above, the *nagA*-like (DNT/NAG) subfamily of naphthalene dioxygenase genes are commonly detected at PAH contaminated sites and have been correlated to naphthalene concentrations (Dionisi et al. 2004) and ^{14}C naphthalene mineralization (Tuomi et al. 2004).

Phenanthrene Dioxygenases (PHN): The PHN assays quantify phenanthrene/naphthalene dioxygenase genes from a diverse collection of microorganisms including *Pseudomonas*, *Burkholderia*, *Sphingomonas*, and *Acidovorax* spp. As with other naphthalene dioxygenases, substrate specificity is relatively broad and phenanthrene dioxygenases have been implicated in the biodegradation of naphthalene, phenanthrene, and anthracene and the co-oxidation of larger PAHs. Moreover, at least one research group has suggested that the PHN group of phenanthrene/naphthalene dioxygenases may be more environmentally relevant than the classical nah-like naphthalene dioxygenase (Laurie and Lloyd-Jones 2000).

Aerobic Biodegradation – *n*-alkanes: The *n*-alkanes are a substantial portion of petroleum products and are a component of TPH concentrations. The Petroleum QuantArray® includes quantification of alkane monooxygenase genes (AlkB) which allow a wide range of *Proteobacteria* and *Actinomycetals* to grow on n-alkanes with carbon lengths from C_5 to C_{16} (Wentzel et al. 2007). The QuantArray also includes a second type of alkane hydroxylase (almA) which catalyzes the aerobic biodegradation of longer chain alkanes (C_{20} – C_{32}) by some *Alcanivorax* spp. considered dominant in marine systems (Liu et al. 2011).

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Anaerobic Biodegradation – Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX): BTEX compounds are also susceptible to biodegradation under anoxic and anaerobic conditions although biodegradation pathways for each compound are not as well characterized as aerobic pathways. The Petro QuantArray® includes sets of assays targeting a number of upper and lower pathway functional genes involved in the anaerobic catabolism of BTEX compounds for better evaluation of anaerobic biodegradation at petroleum contaminated sites.

Benzylsuccinate Synthase (BSS): Of the BTEX compounds, toluene biodegradation under anaerobic conditions is the most extensively studied and best characterized. The first step in this pathway, mediated by benzylsuccinate synthase (*bss*A) is the addition of fumarate onto the toluene methyl group to form benzylsuccinate. While additional pathways are possible, some bacterial isolates capable of anaerobic biodegradation of ethylbenzene and xylenes follow the same metabolic approach where the first step is the addition of fumarate.

Anaerobic Benzene Carboxylase (ABC): Although additional pathways are possible, the only pathway for anaerobic biodegradation of benzene elucidated to date is initiated by a benzene carboxylase enzyme.

Benzoyl Coenzyme A reductase (BCR): Benzyl-CoA is the central intermediate in the anaerobic biodegradation of many aromatic hydrocarbons. Benzoyl-CoA Reductase (BCR) is the essential enzyme for reducing the benzene ring structure.

Anaerobic Biodegradation – PAHs: The anaerobic biodegradation of PAHs involves analogous mechanisms to those described for anaerobic biodegradation of BTEX compounds. For example, the anaerobic biodegradation of methyl-substituted PAHs like 2-methylnaphthalene is initiated by fumarate addition to the methyl group while the only characterized pathway for anaerobic naphthalene biodegradation is initiated by a carboxylase.

Naphthylmethylsuccinate Synthase (NMS): NMS is analogous to the benzylsuccinate synthase described above for anaerobic biodegradation of toluene. Naphthylmethylsuccinate synthase catalyzes the addition of fumarate onto the methyl group of 2-methylnaphthalene (Selesi et al. 2010).

Anaerobic Naphthalene Carboxylase (ANC): To date, the only pathway that has been characterized for anaerobic biodegradation of naphthalene is initiated by a naphthalene carboxylase enzyme (Mouttaki et al. 2012).

Anaerobic Biodegradation – *n*-alkanes: As mentioned previously, the *n*-alkanes are a substantial portion of petroleum products and should be considered particularly when site cleanup goals include TPH reduction. The addition of fumarate is a common mechanism for activating and initiating biodegradation a variety of petroleum hydrocarbons under anaerobic conditions including n-alkanes. The Petroleum QuantArray® includes quantification of alkane succinate synthase genes (assA) which have been characterized in nitrate reducing and sulfate reducing isolates utilizing n-alkanes from C_6 to at least C_{18} (Callaghan et al. 2010).

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References

Callaghan AV, Davidova IA, Savage-Ashlock K, Parisi VA, Gieg LM, Suflita JM, Kukor JJ, Wawrik B (2010) Diversity of Benzyl- and Alkylsuccinate Synthase Genes in Hydrocarbon-Impacted Environments and Enrichment Cultures. Environmental Science & Technology 44 (19):7287-7294. doi:10.1021/es1002023

Dabrock B, Kesseler M, Averhoff B, Gottschalk G (1994) Identification and characterization of a transmissible linear plasmid from *Rhodococcus erythropolis* BD2 that encodes isopropylbenzene and trichloroethene catabolism. Applied and Environmental Microbiology 60 (3):853-860

Dionisi HM, Chewning CS, Morgan KH, Menn F-M, Easter JP, Sayler GS (2004) Abundance of Dioxygenase Genes Similar to *Ralstonia* sp. Strain U2 *nagAc* Is Correlated with Naphthalene Concentrations in Coal Tar-Contaminated Freshwater Sediments. Applied and Environmental Microbiology 70 (7):3988-3995. doi:10.1128/aem.70.7.3988-3995.2004

Hanson JR, Ackerman CE, Scow KM (1999) Biodegradation of Methyl *tert*-Butyl Ether by a Bacterial Pure Culture. Applied and Environmental Microbiology 65 (11):4788-4792

Hristova KR, Schmidt R, Chakicherla AY, Legler TC, Wu J, Chain PS, Scow KM, Kane SR (2007) Comparative Transcriptome Analysis of *Methylibium petroleiphilum* PM1 Exposed to the Fuel Oxygenates Methyl *tert*-Butyl Ether and Ethanol. Applied and Environmental Microbiology 73 (22):7347-7357. doi:10.1128/aem.01604-07

Johnson GR, Olsen RH (1995) Nucleotide sequence analysis of genes encoding a toluene/benzene-2-monooxygenase from *Pseudomonas* sp. strain JS150. Applied and Environmental Microbiology 61 (9):3336-3346

Kahng H-Y, Malinverni JC, Majko MM, Kukor JJ (2001) Genetic and Functional Analysis of the *tbc* Operons for Catabolism of Alkyl- and Chloroaromatic Compounds in *Burkholderia* sp. Strain JS150. Applied and Environmental Microbiology 67 (10):4805-4816. doi:10.1128/aem.67.10.4805-4816.2001

Laurie AD, Lloyd-Jones G (2000) Quantification of *phnAc* and *nahAc* in Contaminated New Zealand Soils by Competitive PCR. Applied and Environmental Microbiology 66 (5):1814-1817. doi:10.1128/aem.66.5.1814-1817.2000

Liu C, Wang W, Wu Y, Zhou Z, Lai Q, Shao Z (2011) Multiple alkane hydroxylase systems in a marine alkane degrader, *Alcanivorax dieselolei* B-5. Environmental Microbiology 13 (5):1168-1178. doi:10.1111/j.1462-2920.2010.02416.x

Mouttaki H, Johannes J, Meckenstock RU (2012) Identification of naphthalene carboxylase as a prototype for the anaerobic activation of non-substituted aromatic hydrocarbons. Environmental Microbiology:no-no. doi:10.1111/j.1462-2920.2012.02768.x

Na K-S, Kuroda A, Takiguchi N, Ikeda T, Ohtake H, Kato J (2005) Isolation and characterization of benzene-tolerant *Rhodococcus opacus* strains. Journal of Bioscience and Bioengineering 99 (4):378-382. doi:http://dx.doi.org/10.1263/jbb.99.378

Pflugmacher U, Averhoff B, Gottschalk G (1996) Cloning, sequencing, and expression of isopropylbenzene degradation genes from Pseudomonas sp. strain JR1: identification of isopropylbenzene dioxygenase that mediates trichloroethene oxidation. Applied and Environmental Microbiology 62 (11):3967-3977

Selesi D, Jehmlich N, von Bergen M, Schmidt F, Rattei T, Tischler P, Lueders T, Meckenstock RU (2010) Combined Genomic and Proteomic Approaches Identify Gene Clusters Involved in Anaerobic 2-Methylnaphthalene Degradation in the Sulfate-Reducing Enrichment Culture N47. Journal of Bacteriology 192 (1):295-306. doi:10.1128/jb.00874-09

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Tuomi PM, Salminen JM, Jørgensen KS (2004) The abundance of *nahAc* genes correlates with the ^{14}C-naphthalene mineralization potential in petroleum hydrocarbon-contaminated oxic soil layers. FEMS Microbiology Ecology 51 (1):99-107. doi:10.1016/j.femsec.2004.07.011

Wentzel A, Ellingsen TE, Kotlar H-K, Zotchev SB, Throne-Holst M (2007) Bacterial metabolism of long-chain n-alkanes. Applied Microbiology & Biotechnology 76 (6):1209-1221. doi:10.1007/s00253-007-1119-1

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SITE LOGIC Report

Stable Isotope Probing (SIP) Study

Contact: Aaron Council
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Phone: (864) 234-3005

Email: Aaron.Council@aecom.com

MI Identifier: 043NF

Report Date: October 25, 2016

Project: Duke Spartanburg, #60493834

Comments:

Executive Summary

A Stable Isotope Probing (SIP) study was performed to determine whether biodegradation of benzene and naphthalene is occurring under existing site conditions. Two Bio-Trap® samplers baited with ^{13}C-labeled benzene were deployed in monitoring wells MW-13S and MW-13D, and two Bio-Trap® samplers baited with ^{13}C-labeled naphthalene were deployed in MW-18S and ISOC-MW-15D. Following a 47-day deployment period, the Bio-Traps were recovered to quantify ^{13}C incorporation into biomass and dissolved inorganic carbon (DIC). A complete summary of the SIP results is provided in Table 1 and Figures 1 through 5. Following are the key observations from the results obtained for the monitoring wells.

MW-13S and MW-13D Stable Isotope Probing Results

- Quantification of ^{13}C-enriched biomass and DIC conclusively demonstrated that benzene was biodegraded under existing site conditions in MW-13S and MW-13D.
- For samples MW-13S and MW-13D, the average PLFA δ^{13}C values were 15‰ and 201‰, respectively, indicating that indigenous microorganisms had metabolized the ^{13}C-labeled benzene under current site conditions.
- The average DIC δ^{13}C value was greater than 1,000‰ in MW-13S and fell in the moderate range in MW-13D. These results indicate that substantial benzene mineralization occurred during the deployment period.
- Total PLFA biomass concentrations in MW-13S and MW-13D were on the order of 10^6 cells/bead and were within the moderate range.
- The PLFA community structures in MW-13S and MW-13D were primarily composed of monoenoic fatty acids, which are indicators of proteobacteria. The remaining PLFA structural groups made up less than 20% of the total PLFA.

MW-18S and ISOC-MW-15D Stable Isotope Probing Results

- Quantification of ^{13}C-enriched biomass and DIC conclusively demonstrated that naphthalene was metabolized and mineralized during the deployment period in MW-18S and ISOC-MW-15D.
- For samples MW-13S and MW-13D, the average PLFA δ^{13}C values were 1,310‰ and 403‰, respectively, indicating that the ^{13}C-labeled naphthalene had been metabolized and incorporated into microbial biomass during the deployment period.
- The average DIC δ^{13}C value was 7,727‰ for MW-18S and 2,817‰ for ISOC-MW-15D, confirming that indigenous microorganisms mineralized the naphthalene under current site conditions.
- Total PLFA biomass concentrations in MW-18S and ISOC-MW-15D were on the order of 10^5 cells/bead, indicating a moderate biomass population.
- The PLFA community structures in MW-18S and ISOC-MW-15D were composed of a large portion of monoenoics followed by normal saturates. Indicators of firmicutes, actinomycetes, eukaryotes, and anaerobic metal reducers were also detected.

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Overview of Approach

Stable Isotope Probing (SIP)

Stable isotope probing (SIP) is an innovative method to track the environmental fate of a "labeled" contaminant of concern to unambiguously demonstrate biodegradation. Two stable carbon isotopes exist in nature – carbon 12 (^{12}C) which accounts for 99% of carbon and carbon 13 (^{13}C) which is considerably less abundant (~1%). With the SIP method, the Bio-Trap® sampler is baited with a specially synthesized form of the contaminant containing ^{13}C labeled carbon. Since ^{13}C is rare, the labeled compound can be readily differentiated from the contaminants present at the site. Following deployment, the Bio-Trap® is recovered and three approaches are used to conclusively demonstrate biodegradation of the contaminant of concern.

- The loss of the labeled compound provides an estimate of the degradation rate (% loss of ^{13}C).
- Quantification of ^{13}C enriched phospholipid fatty acids (PLFA) indicates incorporation into microbial biomass.
- Quantification of ^{13}C enriched dissolved inorganic carbon (DIC) indicates contaminant mineralization.

Phospholipid Fatty Acids (PLFA)

PLFA are a primary component of the membrane of all living cells including bacteria. PLFA decomposes rapidly upon cell death (1, 2), so the total amount of PLFA present in a sample is indicative of the viable biomass. When combined with stable isotope probing (SIP), incorporation of ^{13}C into PLFA is a conclusive indicator of biodegradation.

Some organisms produce "signature" types of PLFA allowing quantification of important microbial functional groups (e.g. iron reducers, sulfate reducers, or fermenters). The relative proportions of the groups of PLFA provide a "fingerprint" of the microbial community. In addition, *Proteobacteria* modify specific PLFA during periods of slow growth or in response to environmental stress providing an index of their health and metabolic activity.

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Results

Table 1. Summary of the results obtained from the Bio-Trap® Units. Interpretation guidelines and definitions are found later in the document.

Sample Name	MW-13S	MW-13D	MW-18S	ISOC-MW-15D
^{13}C Contaminant Loss				
^{13}C Benzene Pre-deployment (µg/bead)	236 ± 37	236 ± 37	---	---
^{13}C Benzene Post-deployment (µg/bead)	211 ± 11	190 ± 18	---	---
^{13}C Naphthalene Pre-deployment (µg/bead)	---	---	194 ± 84	194 ± 84
^{13}C Naphthalene Post-deployment (µg/bead)	---	---	133 ± 12	166 ± 28
Biomass & ^{13}C Incorporation				
Total Biomass (Cells/bead)	1.39E+06	3.19E+06	4.43E+05	3.44E+05
^{13}C Enriched Biomass (Cells/bead)	1.30E+04	5.85E+03	6.93E+03	3.35E+03
Average PLFA Del (‰)	15	201	1,310	403
Maximum PLFA Del (‰)	35	438	6,816	1,277
^{13}C Mineralization				
DIC Del (‰)	1,097	541	7,727	2,817
% 13C	2.29	1.69	8.89	4.09
Community Structure (% total PLFA)				
Firmicutes (TerBrSats)	1.40	1.82	6.20	13.32
Proteobacteria (Monos)	83.97	84.61	73.72	58.22
Anaerobic metal reducers (BrMonos)	5.81	4.07	2.36	2.23
Actinomycetes (MidBrSats)	0.45	0.29	2.55	5.61
General (Nsats)	7.58	8.58	12.53	16.99
Eukaryotes (Polyenoics)	0.79	0.62	2.63	3.65
Physiological Status (Proteobacteria only)				
Slowed Growth	0.23	0.25	0.49	0.53
Decreased Permeability	0.29	0.31	0.13	0.34

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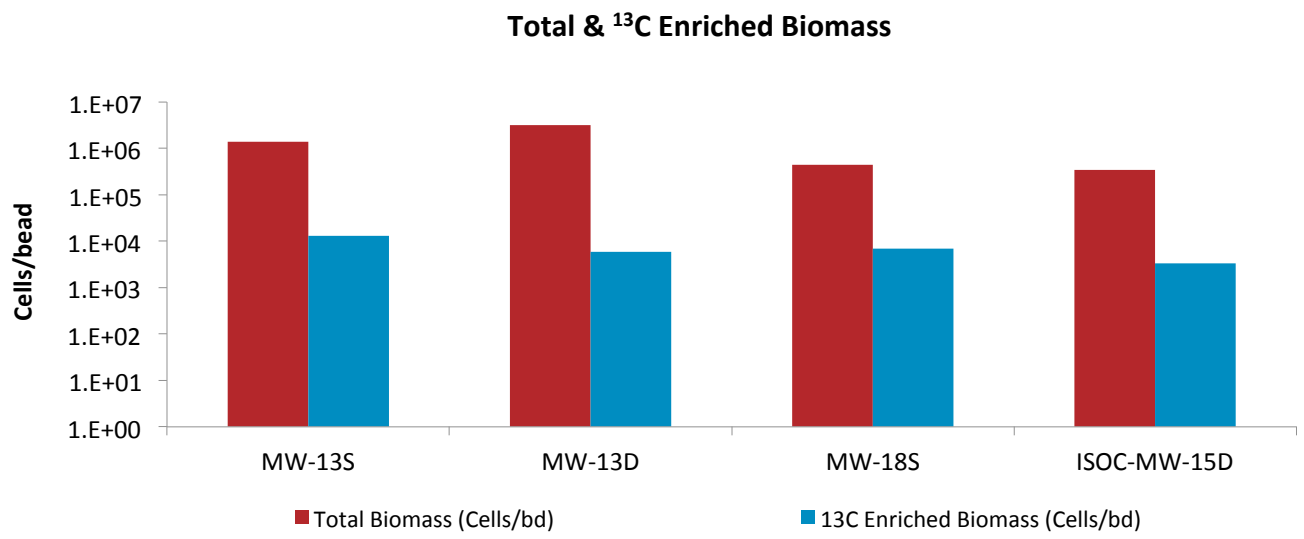

Figure 1. Biomass content is presented as a cell equivalent based on the total amount of phospholipid fatty acids (PLFA) extracted from a given sample. Total biomass is calculated based upon PLFA attributed to bacterial and eukaryotic biomass (associated with higher organisms).

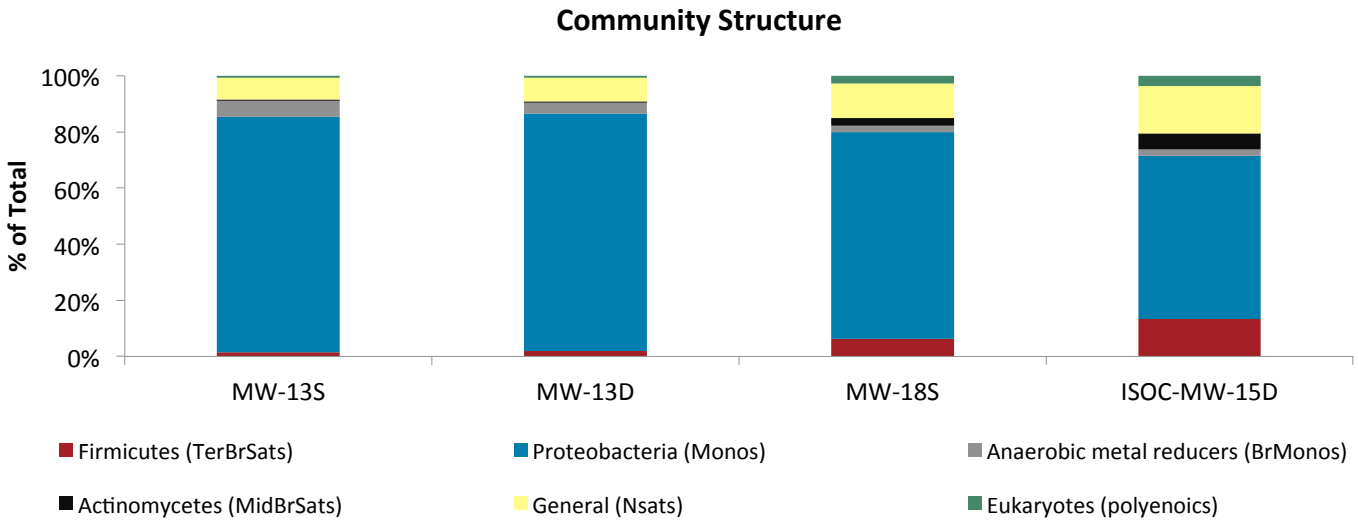

Figure 2. Relative percentages of total PLFA structural groups in the samples analyzed. Structural groups are assigned according to PLFA chemical structure, which is related to fatty acid biosynthesis. See the table in the interpretation section for detailed descriptions of the structural groups.

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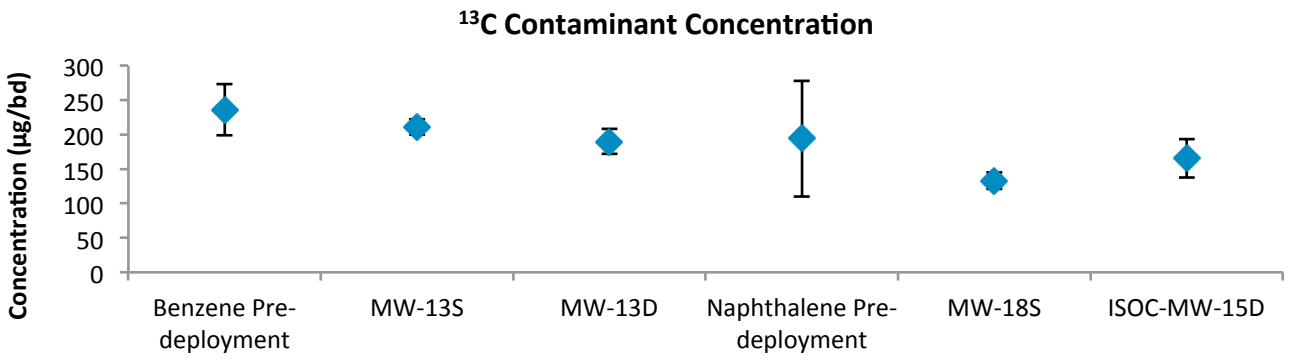

Figure 3. Comparison of Pre-deployment concentrations loaded on Bio-Sep beads to the concentrations detected after incubation.

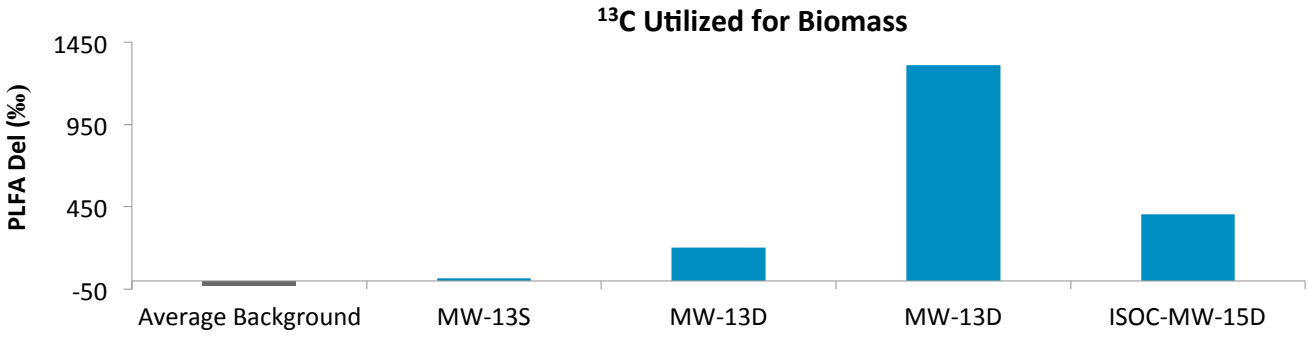

Figure 4. Comparison of the average Del value obtained from PLFA biomarkers from each Bio-Trap® unit to the average background Del observed in samples not exposed to ^{13}C enriched compounds.

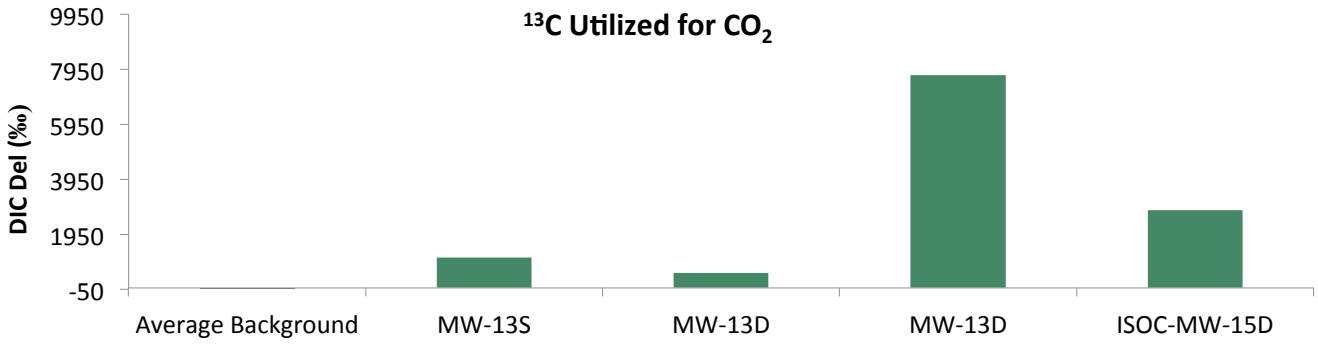

Figure 5. Comparison of the Del value obtained from DIC from each Bio-Trap® unit to the average background Del observed in samples not exposed to ^{13}C enriched compounds.

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Interpretation

Interpretation of the results of the SIP Bio-Trap® study must be performed with due consideration of site conditions, site activities, and the desired treatment mechanism. The following discussion describes interpretation of results in general terms and is meant to serve as a guide.

Contaminant Concentration: Bio-Traps® are baited with a ^{13}C labeled contaminant of concern and a pre-deployment concentration is determined prior to shipping. Following deployment, Bio-Traps® are recovered for analysis including measurement of the concentration of the ^{13}C labeled contaminant remaining. Pre- and post-deployment concentrations are used to calculate percent loss.

Biomass Concentrations: PLFA analysis is one of the most reliable and accurate methods available for the determination of viable (live) biomass. Phospholipids break down rapidly upon cell death, so biomass calculations based on PLFA content do not include "fossil" lipids from dead cells. Total biomass (cells/bead) is calculated from total PLFA using a conversion factor of 20,000 cells/pmole of PLFA. When making comparisons between wells, treatments, or over time, differences of one order of magnitude or more are considered significant.

	Total Biomass	
Low	**Moderate**	**High**
10^3 to 10^4 cells	10^5 to 10^6 cells	10^7 to 10^8 cells

For SIP studies, the ^{13}C enriched PLFA is also determined to conclusively demonstrate contaminant biodegradation and quantify incorporation into biomass as a result of the ^{13}C being used for cellular growth. The % ^{13}C incorporation (^{13}C enriched biomass/total biomass) is also provided in the data summary table, but the value must be interpreted carefully especially when comparing wells or treatments. Typically, biodegradation of a contaminant of concern is performed by a small subset of the total microbial community. For Bio-Traps® with large total biomass, the % ^{13}C incorporation value could be low despite significant ^{13}C labeled biomass and loss of the compound. The % ^{13}C incorporation should be viewed in light of total biomass, percent loss, and dissolved inorganic carbon (DIC) results.

^{13}C enrichment data is often reported as a del value. The del value is the difference between the isotopic ratio ($^{13}C/^{12}C$) of the sample (R_x) and a standard (R_{std}) normalized to the isotopic ratio of the standard (R_{std}) and multiplied by 1,000 (units are parts per thousand, denoted ‰).

R_{std} is the naturally occurring isotopic ratio and is approximately 0.011180 (roughly 1% of naturally occurring carbon is ^{13}C). The isotopic ratio, R_x, of PLFA is typically less than the R_{std} under natural conditions, resulting in a del value between -20 and -30‰. For a SIP Bio-Trap® study, biodegradation and incorporation of the ^{13}C labeled compound into PLFA results in a larger $^{13}C/^{12}C$ ratio (R_x) and thus del values greater than under natural conditions. Typical PLFA del values are provided below.

	PLFA Del (‰)	
Low	**Moderate**	**High**
0 to 100	100 to 1,000	>1,000

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Dissolved Inorganic Carbon (DIC): Often, bacteria can utilize the ^{13}C labeled compound as both a carbon and energy source. The ^{13}C portion used as a carbon source for growth can be incorporated into PLFA as discussed above, while the ^{13}C used for energy is oxidized to $^{13}CO_2$ (mineralized).

^{13}C enriched CO_2 data is often reported as a del value as described above for PLFA. Under natural conditions, the R_x of CO_2 is approximately the same as R_{std} (0.01118 or about 1.1% ^{13}C). For an SIP Bio-Trap® study, mineralization of the ^{13}C labeled contaminant of concern would lead to a greater value of R_x (increased $^{13}CO_2$ production) and thus a positive del value. As with PLFA, del values between 0 and 100‰ are considered low, values between 100 and 1,000‰ are considered moderate, and values greater than 1,000‰ are considered high. Thus DIC %^{13}C are considered low if the value is less than 1.23%, moderate if between 1.23 and 2.24%, and high if greater than 2.24%.

Dissolved Inorganic Carbon (DIC) Del and %^{13}C		
Low	**Moderate**	**High**
0 to 100	100 to 1,000	>1,000
1.11 to 1.23%	1.23 to 2.24%	>2.24%

Community Structure (% total PLFA): Community structure data is presented as a percentage of PLFA structural groups normalized to the total PLFA biomass. The relative proportions of the PLFA structural groups provide a "fingerprint" of the types of microbial groups (e.g. anaerobes, sulfate reducers, etc.) present and therefore offer insight into the dominant metabolic processes occurring at the sample location. Thorough interpretation of the PLFA structural groups depends in part on an understanding of site conditions and the desired microbial biodegradation pathways. For example, an increase in mid chain branched saturated PLFA (MidBrSats), indicative of sulfate reducing bacteria (SRB) and *Actinomycetes*, may be desirable at a site where anaerobic BTEX biodegradation is the treatment mechanism, but would not be desirable for a corrective action promoting aerobic BTEX or MTBE biodegradation. The following table provides a brief summary of each PLFA structural group and its potential relevance to bioremediation.

Table 2. Description of PLFA structural groups.

PLFA Structural Group	General classification	Potential Relevance to Bioremediation Studies
Monoenoic (Monos)	Abundant in Proteobacteria (Gram negative bacteria), typically fast growing, utilize many carbon sources, and adapt quickly to a variety of environments.	Proteobacteria is one of the largest groups of bacteria and represents a wide variety of both aerobes and anaerobes. The majority of Hydrocarbon utilizing bacteria fall within the Proteobacteria
Terminally Branched Saturated (TerBrSats)	Characteristic of Firmicutes (Low G+C Gram-positive bacteria), and also found in Bacteriodes, and some Gram-negative bacteria (especially anaerobes).	Firmicutes are indicative of presence of anaerobic fermenting bacteria (mainly *Clostridia/Bacteriodes*-like), which produce the H_2 necessary for reductive dechlorination
Branched Monoenoic (BrMonos)	Found in the cell membranes of micro-aerophiles and anaerobes, such as sulfate- or iron-reducing bacteria	In contaminated environments high proportions are often associated with anaerobic sulfate and iron reducing bacteria
Mid-Chain Branched Saturated (MidBrSats)	Common in sulfate reducing bacteria and also Actinobacteria (High G+C Gram-positive bacteria).	In contaminated environments high proportions are often associated with anaerobic sulfate and iron reducing bacteria
Normal Saturated (Nsats)	Found in all organisms.	High proportions often indicate less diverse populations.
Polyenoic	Found in eukaryotes such as fungi, protozoa, algae, higher plants, and animals.	Eukaryotic scavengers will often rise up and prey on contaminant utilizing bacteria

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Physiological Status (*Proteobacteria*): Some *Proteobacteria* modify specific PLFA as a strategy to adapt to stressful environmental conditions (3, 4). For example, *cis* monounsaturated fatty acids may be modified to cyclopropyl fatty acids during periods of slowed growth or modified to *trans* monounsaturated fatty acids to decrease membrane permeability in response to environmental stress. The ratio of product to substrate fatty acid thus provides an index of their health and metabolic activity. In general, status ratios greater than 0.25 indicate a response to unfavorable environmental conditions.

Glossary

Del: A Del value is the difference between the isotopic ratio ($^{13}C/^{12}C$) of the sample (R_x) and a standard (R_{std}) normalized to the isotopic ratio of the standard (R_{std}) and multiplied by 1,000 (units are parts per thousand denoted ‰).

$$Del = (R_x - R_{std})/R_{std} \times 1000$$

References

1. White, D.C., W.M. Davis, J.S. Nickels, J.D. King, and R.J. Bobbie. 1979. Determination of the sedimentary microbial biomass by extractable lipid phosphate. Oecologia 40:51-62.
2. White, D.C. and D.B. Ringelberg. 1995. Utility of signature lipid biomarker analysis in determining in situ viable biomass. In P.S. Amy and D.L. Halderman (eds.) The microbiology of the terrestrial surface. CRC Press, Boca Raton.
3. Guckert, J.B., M.A. Hood, and D.C. White. 1986. Phospholipid ester-linked fatty acid profile changes during nutrient deprivation of *Vibrio chloerae*: increases in the trans/cis ratio and proportions of cyclopropyl fatty acids. Applied and Environmental Microbiology. 52:794-801.
4. Tsitko, I.V., G. M. Zaitsev, A. G. Lobanok, and M.S. Salkinoja-Salonen. 1999. Effect of aromatic compounds on cellular fatty acid composition of *Rhodococcus opacus*. Applied and Environmental Microbiology. 65:853-855.

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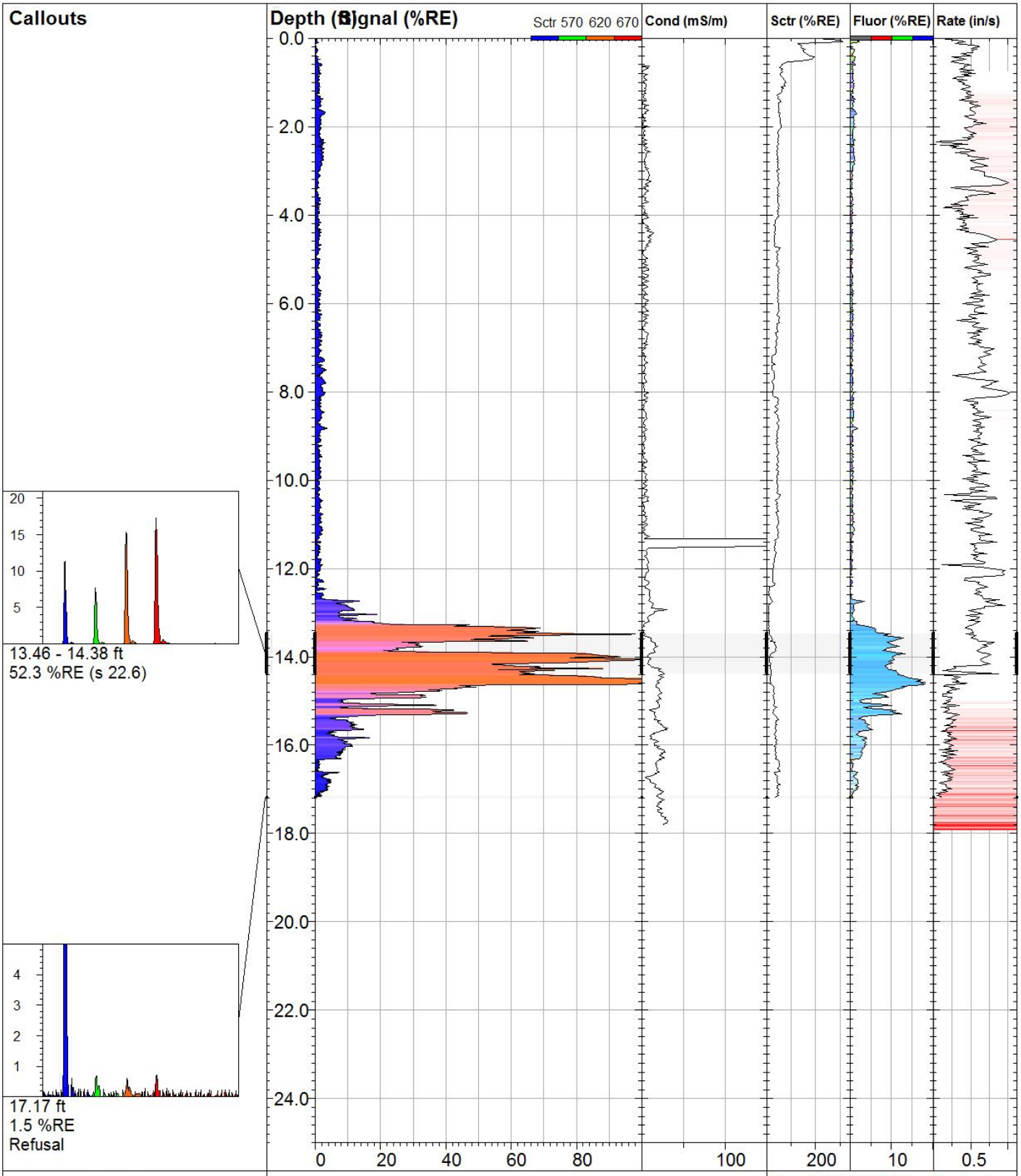
Appendix C.
TarGOST® Logs



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TG-01

TarGOST® By Dakota
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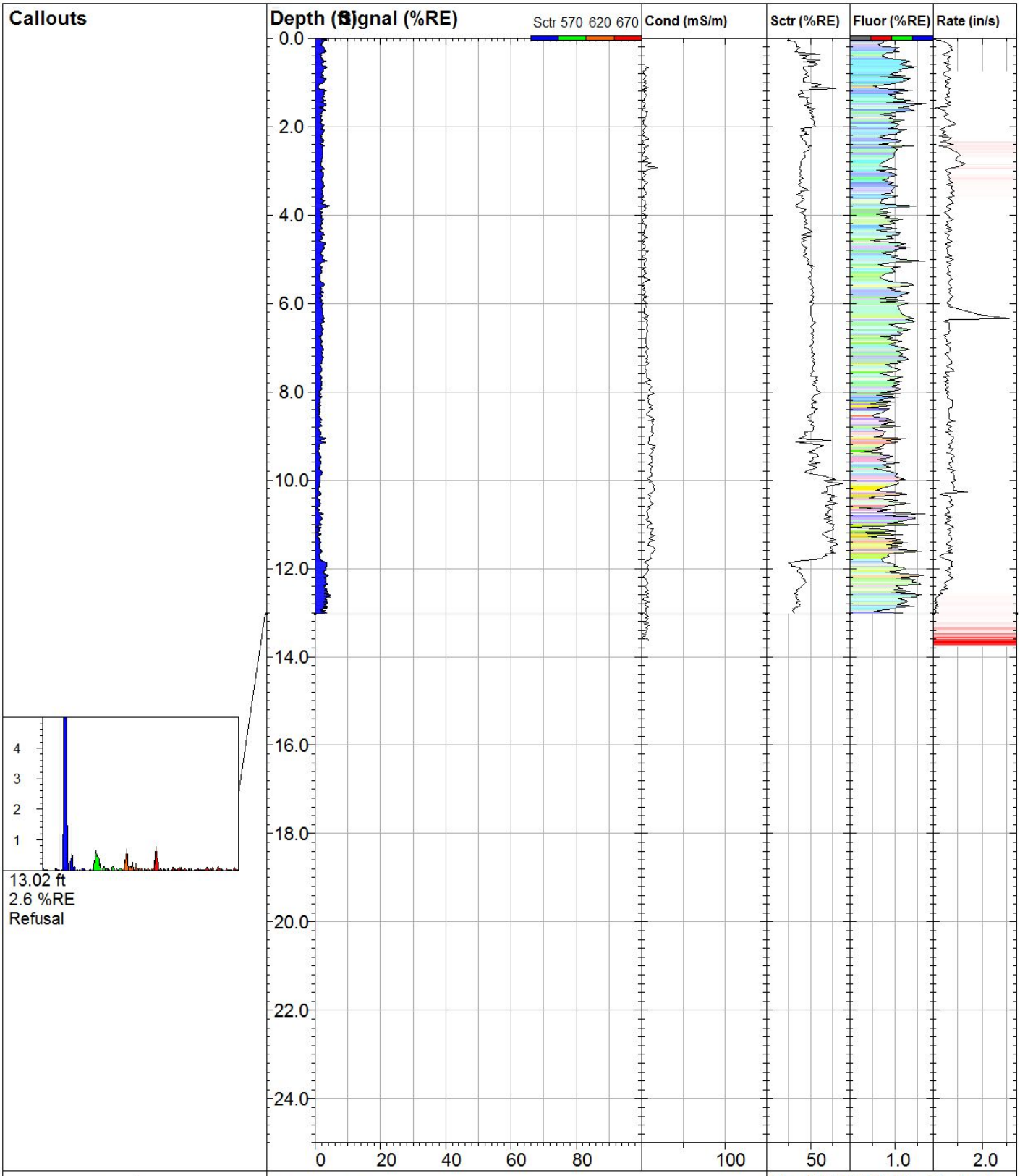
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **17.17 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **120.7 %RE @ 14.60 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-11 16:28 EDT**



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TG-02

TarGOST® By Dakota
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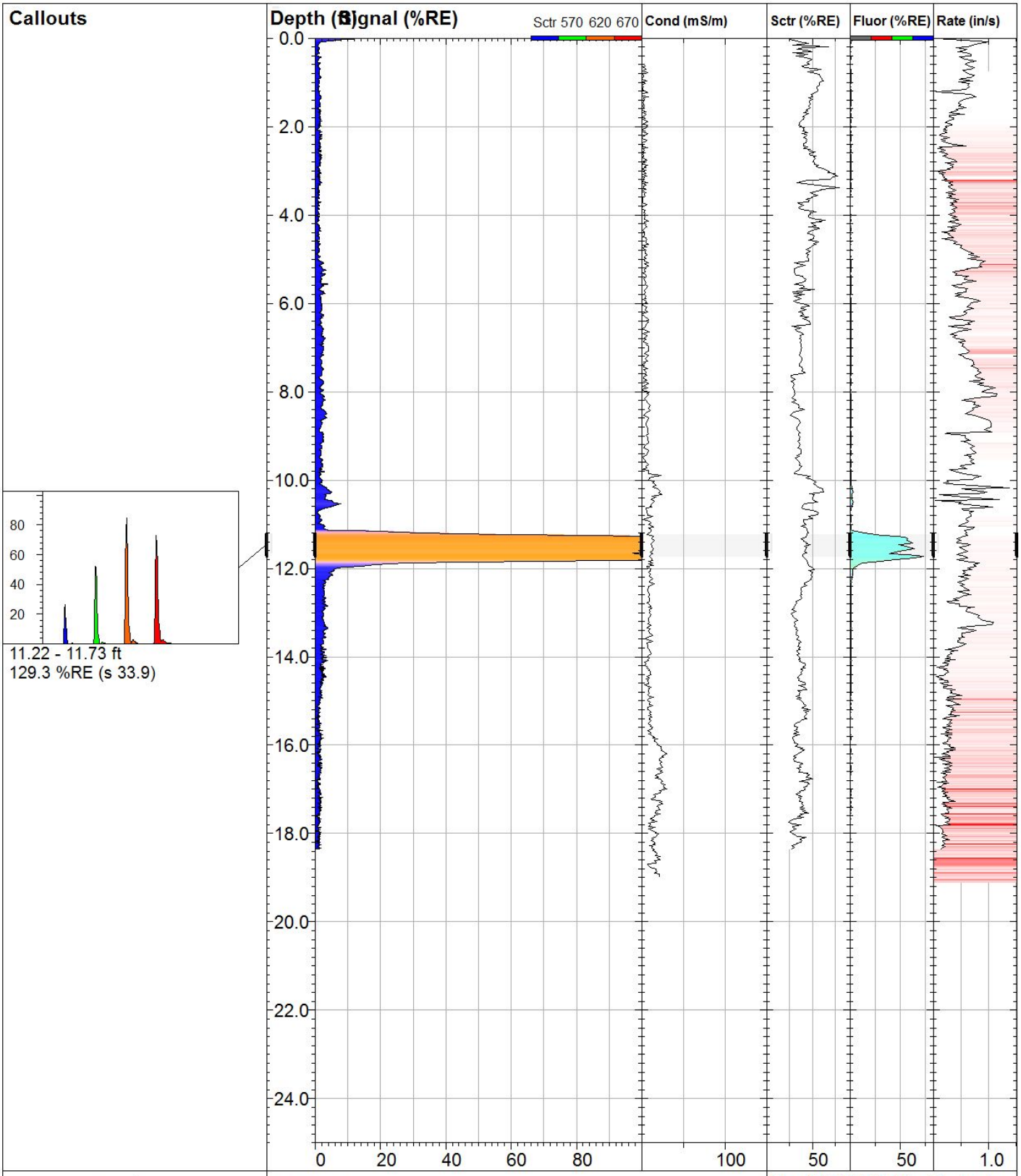
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **13.02 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **4.5 %RE @ 12.60 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-11 17:07 EDT**



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TG-03

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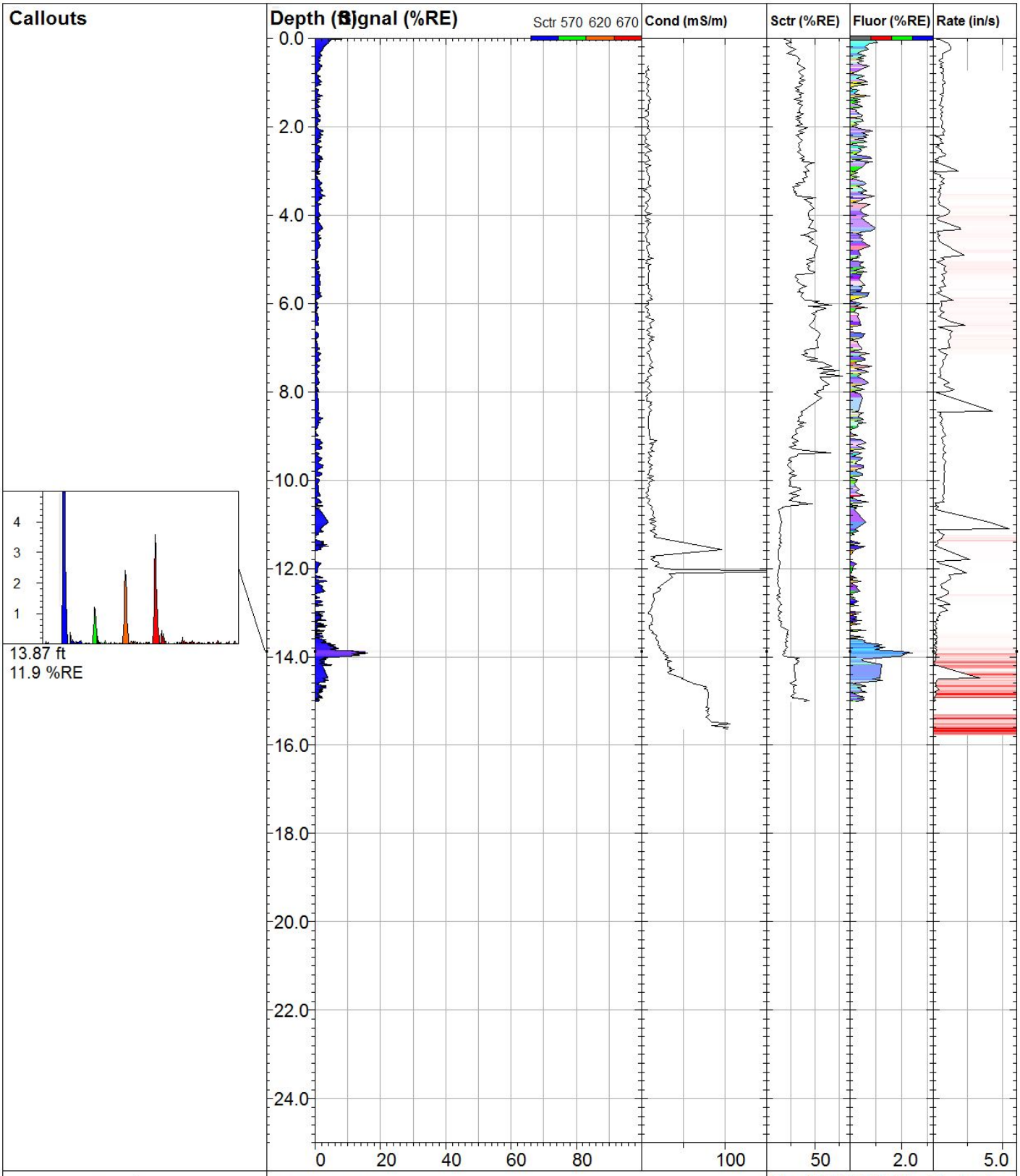
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **18.36 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **198.3 %RE @ 11.73 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-12 08:13 EDT**



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TG-04B

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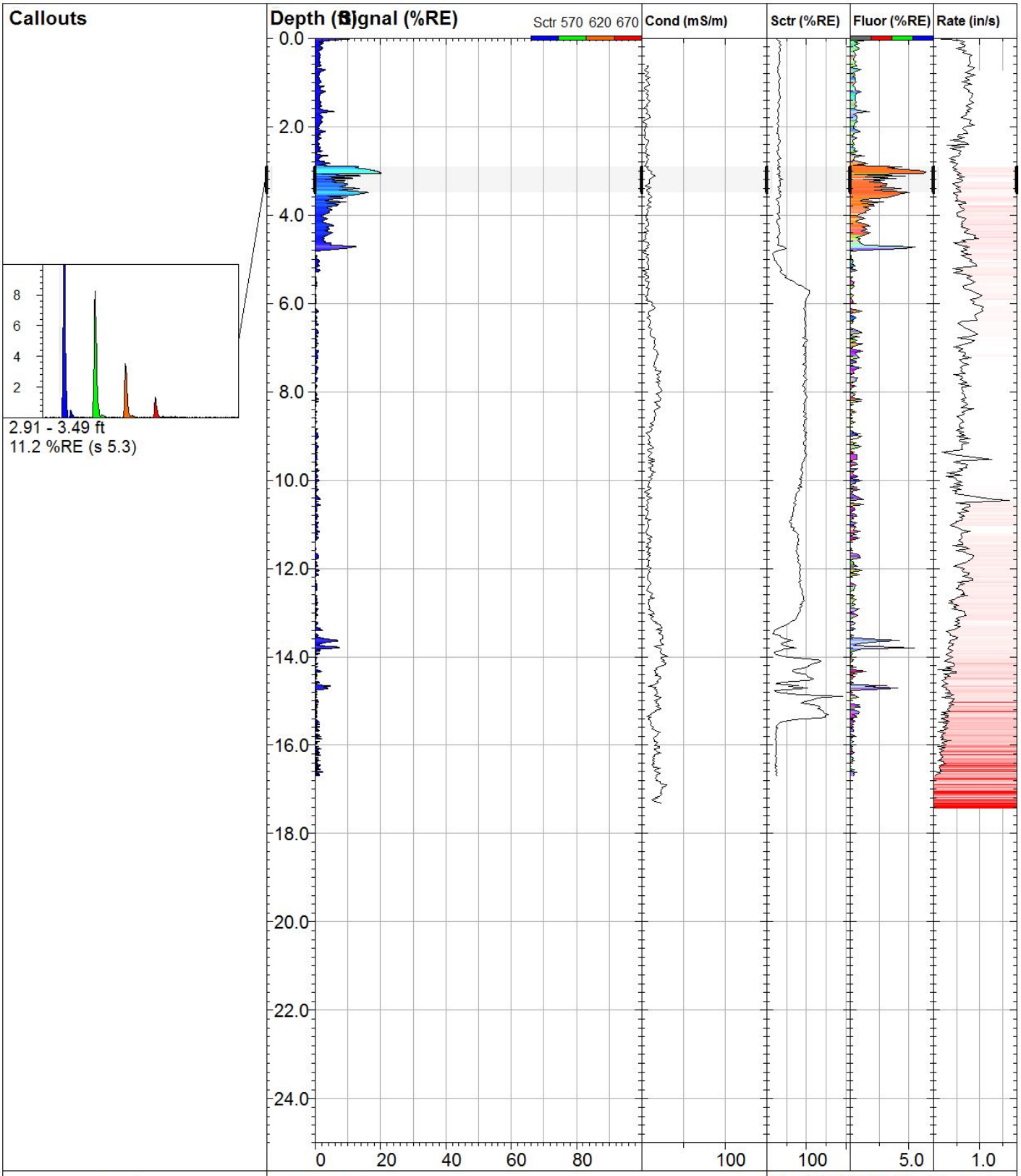
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **15.01 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **16.2 %RE @ 13.92 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-12 10:58 EDT**



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TG-05

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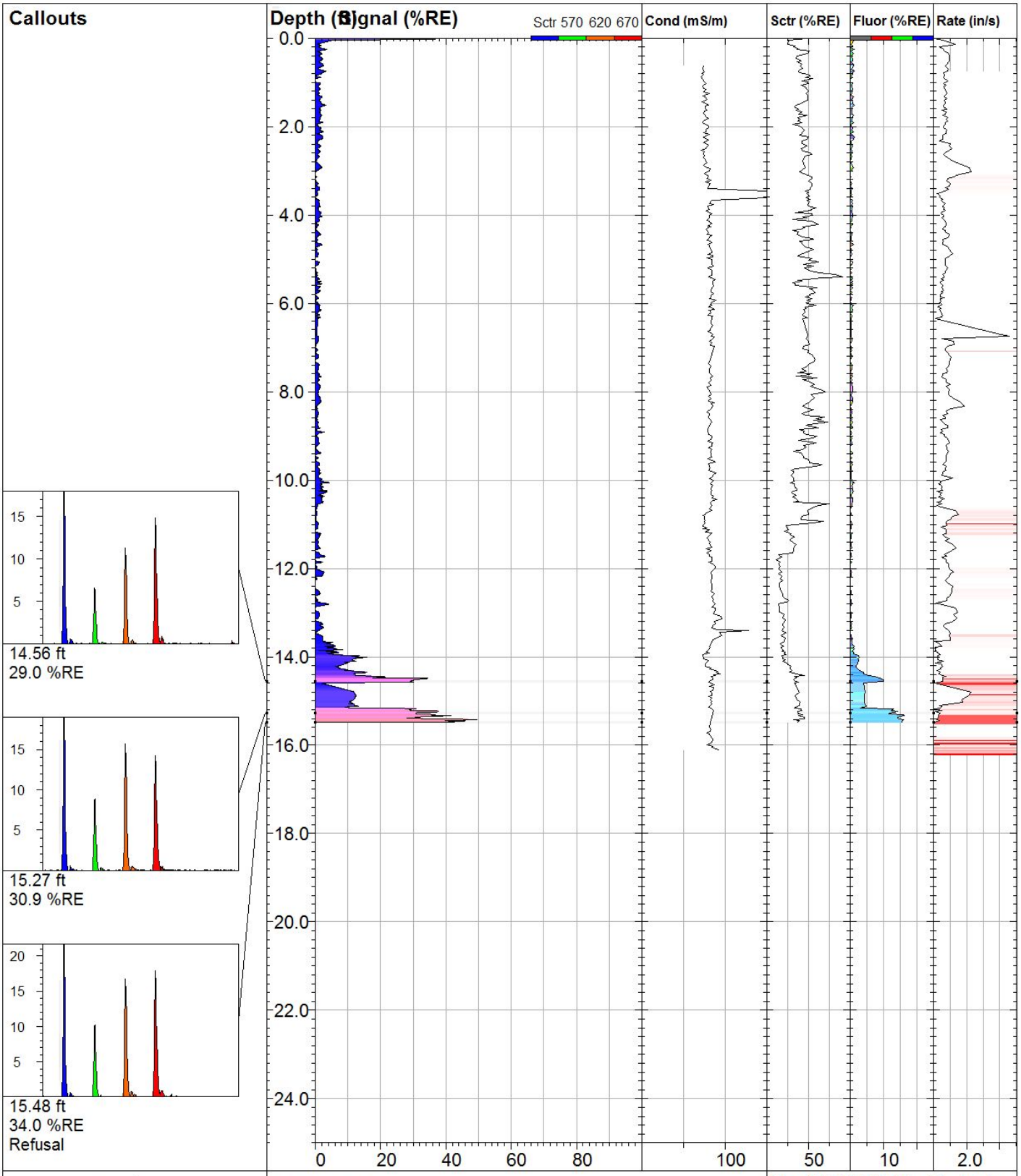
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **16.69 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **20.2 %RE @ 3.06 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-12 09:54 EDT**



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TG-06

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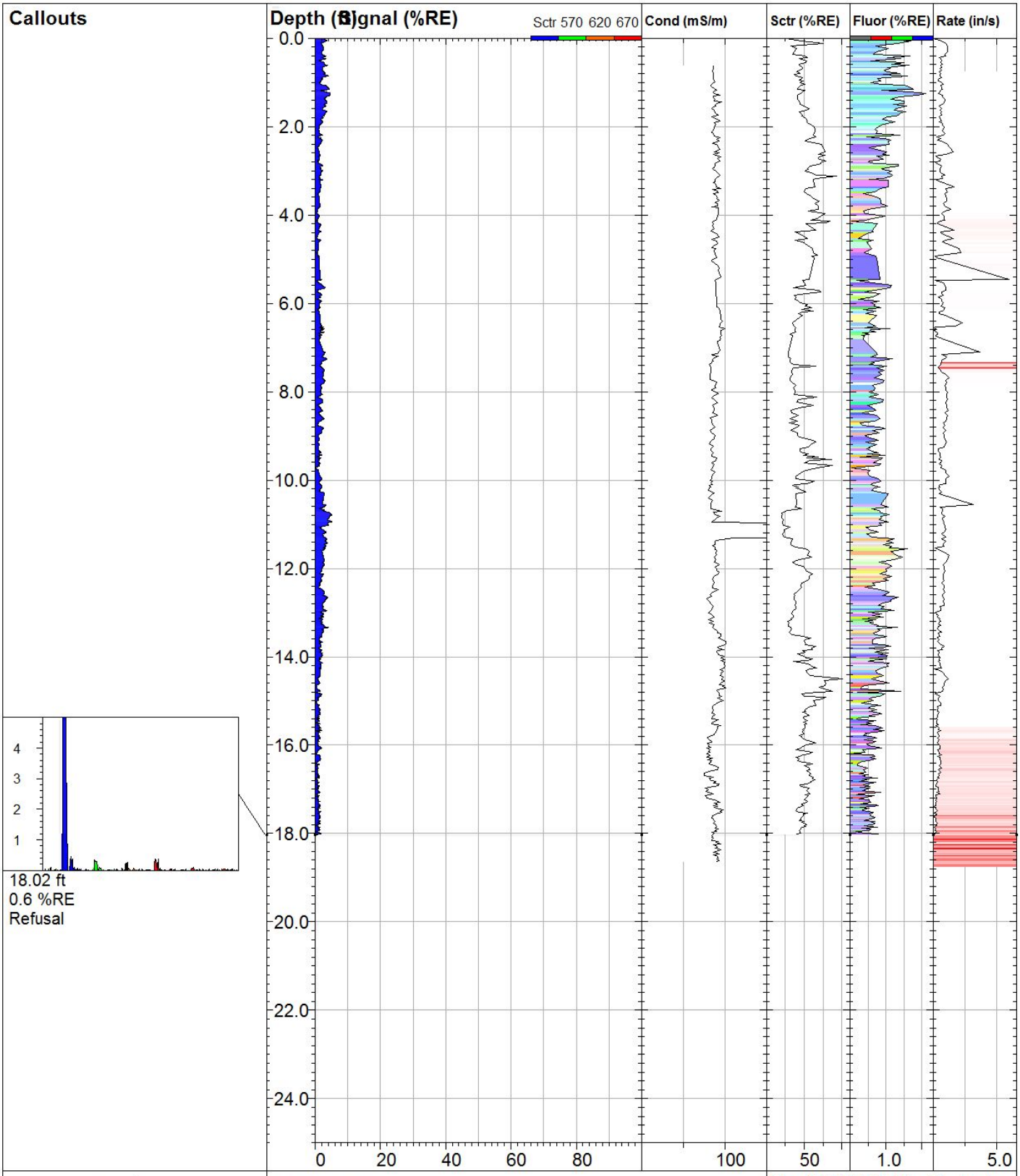
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **15.48 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **49.6 %RE @ 15.42 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-12 11:28 EDT**



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TG-07

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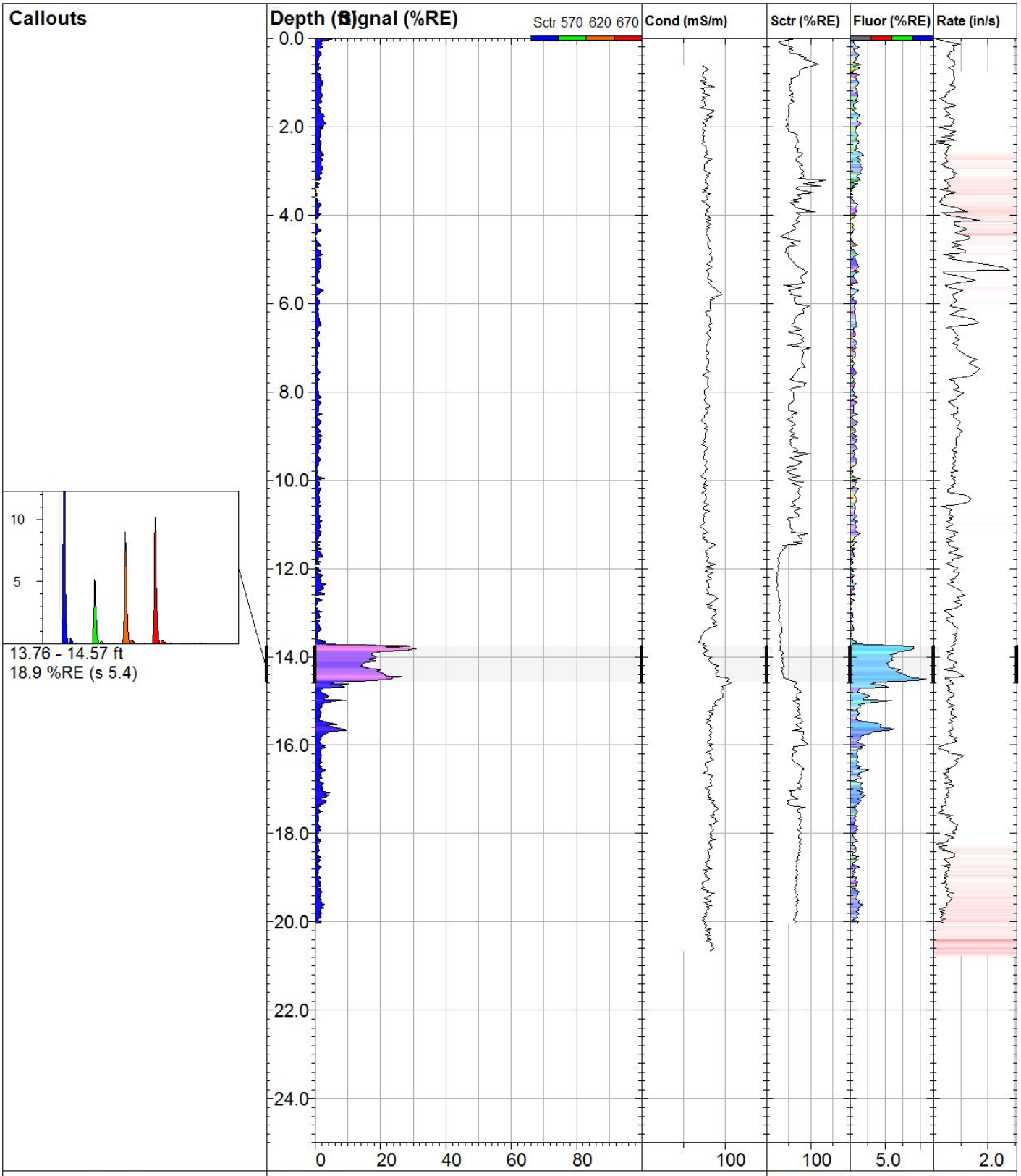
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **18.02 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.1 %RE @ 10.95 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-12 13:04 EDT**



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TG-08B

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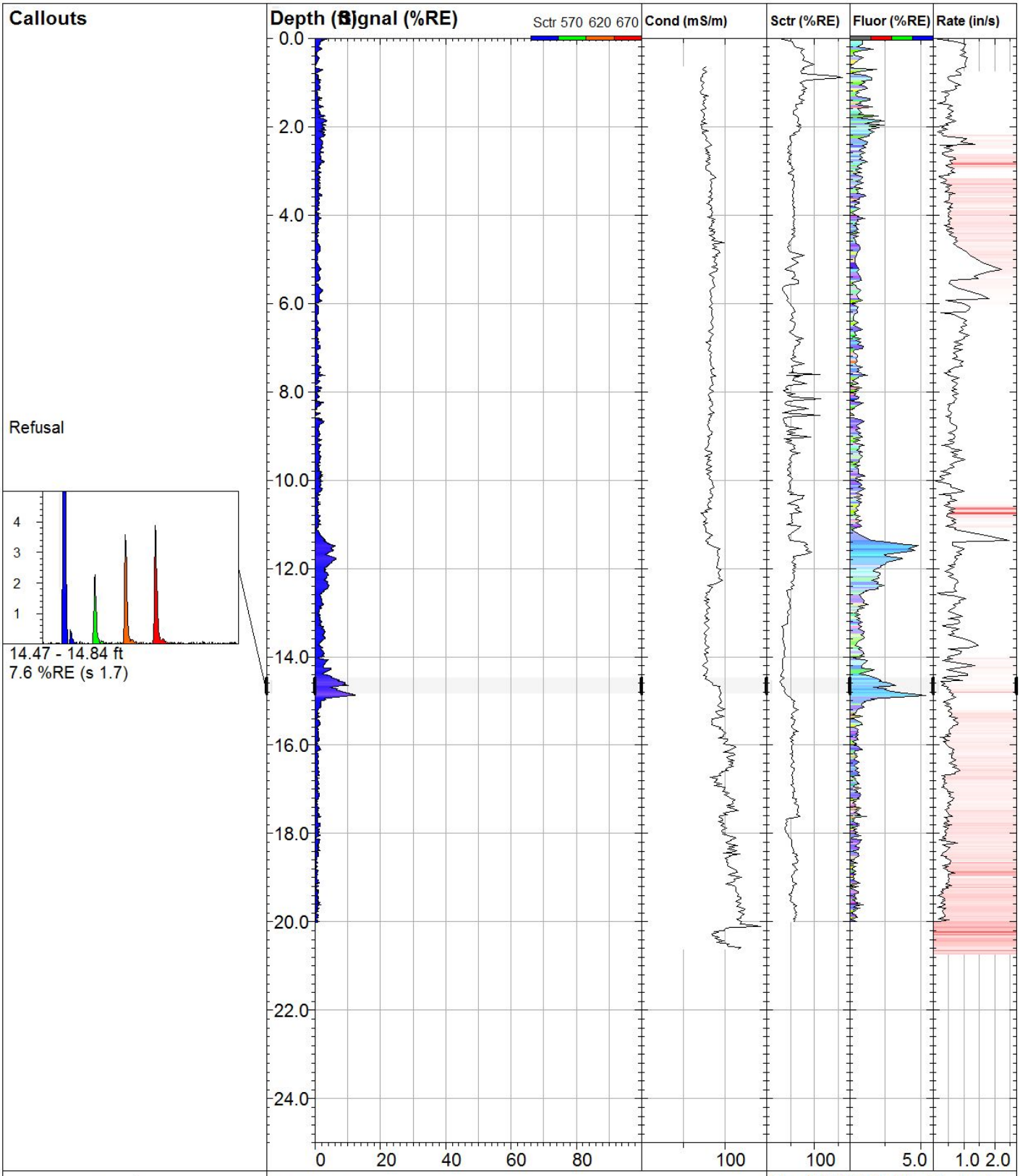
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.02 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **30.8 %RE @ 13.81 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-12 13:51 EDT**



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TG-09

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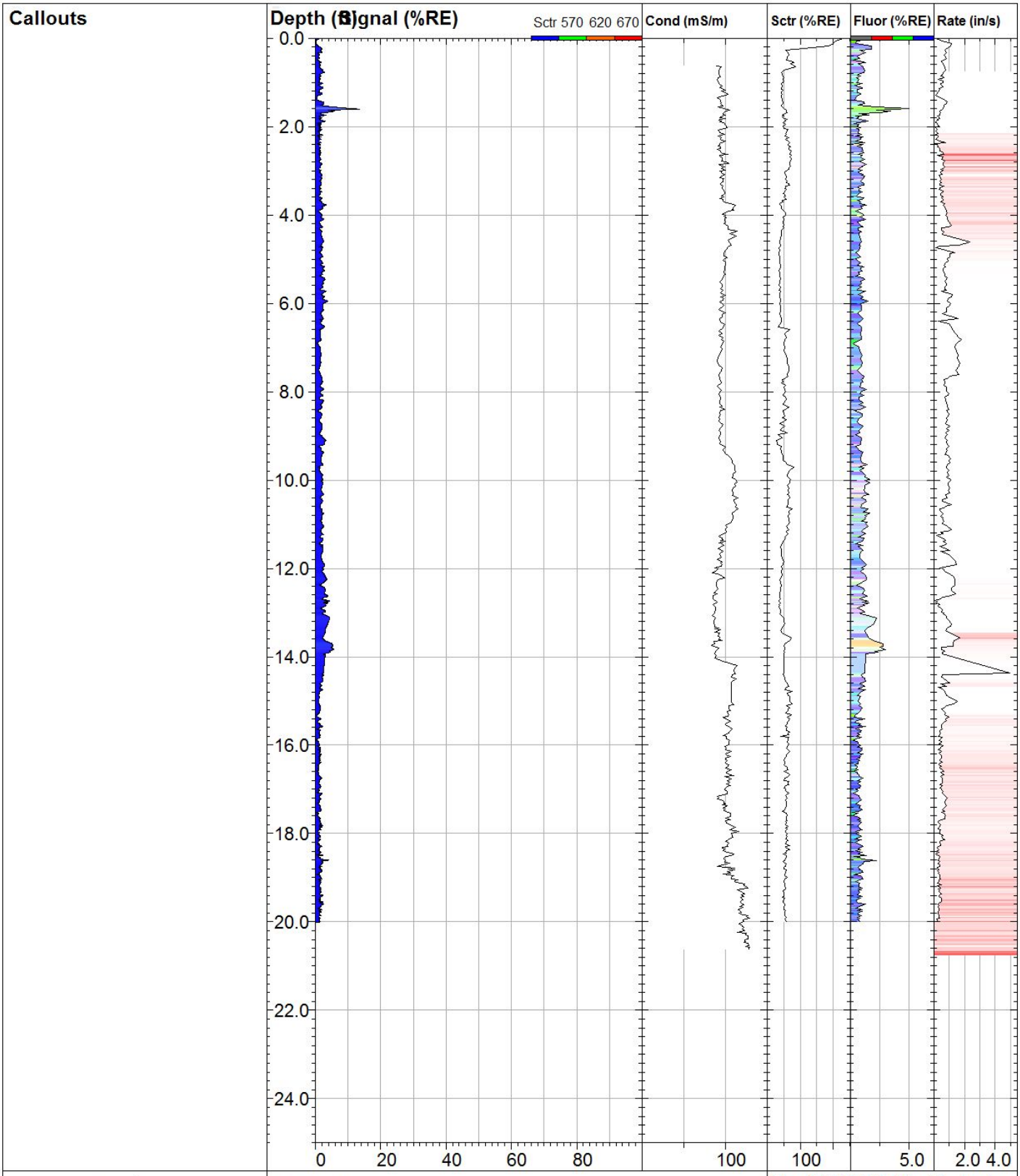
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.00 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **12.4 %RE @ 14.87 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-12 14:29 EDT**



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TG-10

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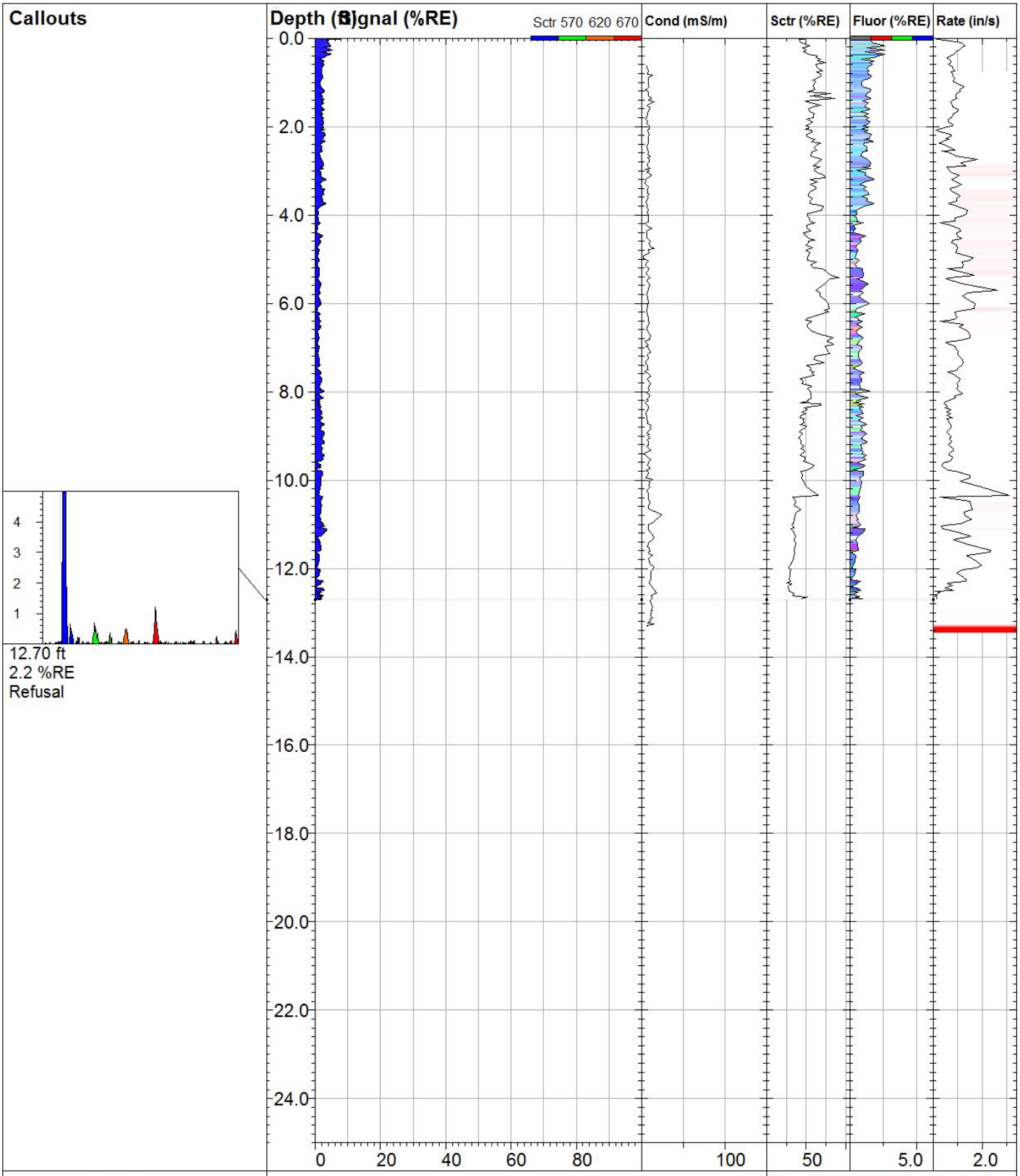
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.01 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **13.4 %RE @ 1.61 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-12 15:28 EDT**



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TG-11

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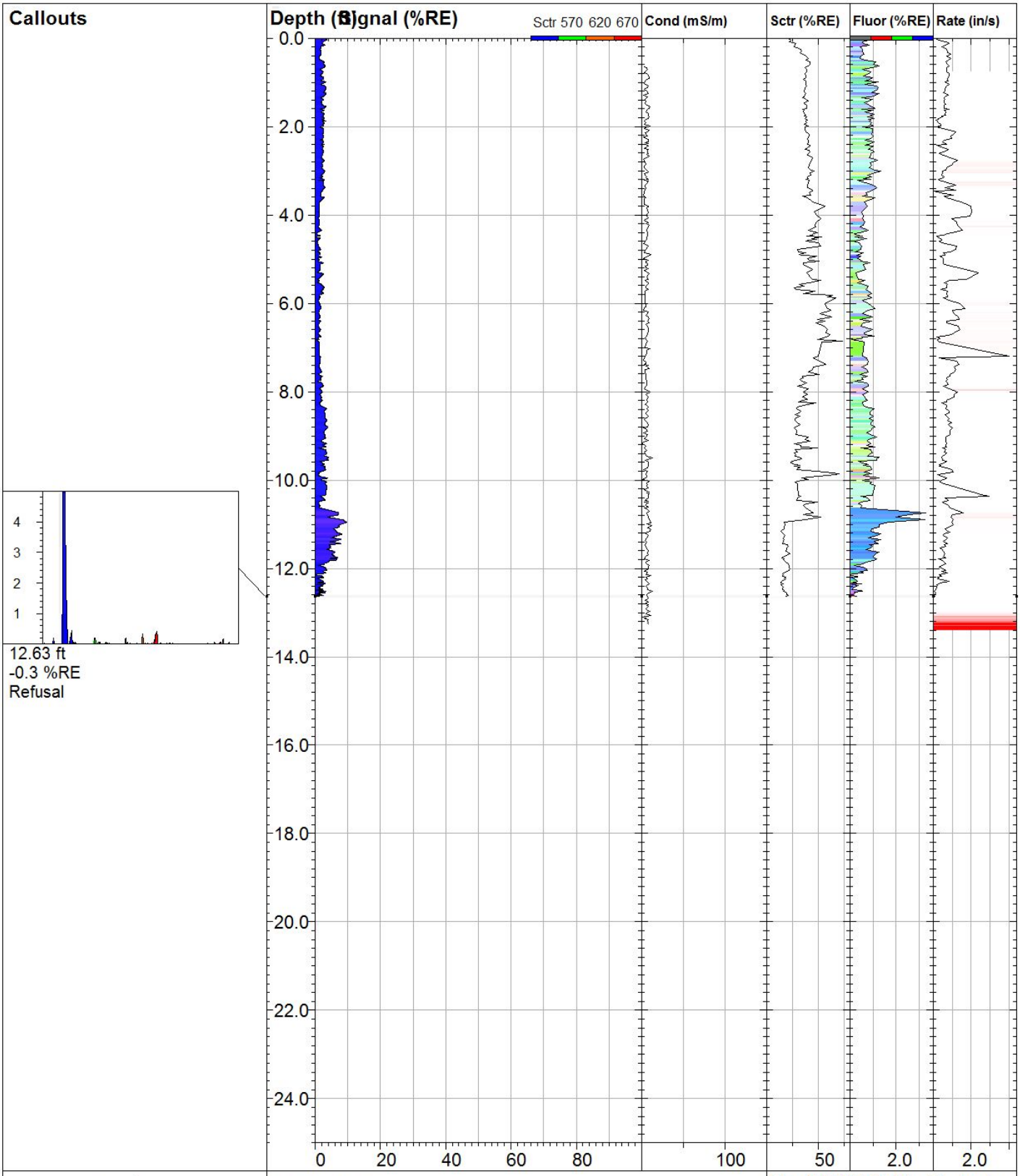
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **12.70 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **10.2 %RE @ 0.01 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-12 16:02 EDT**



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TG-11B

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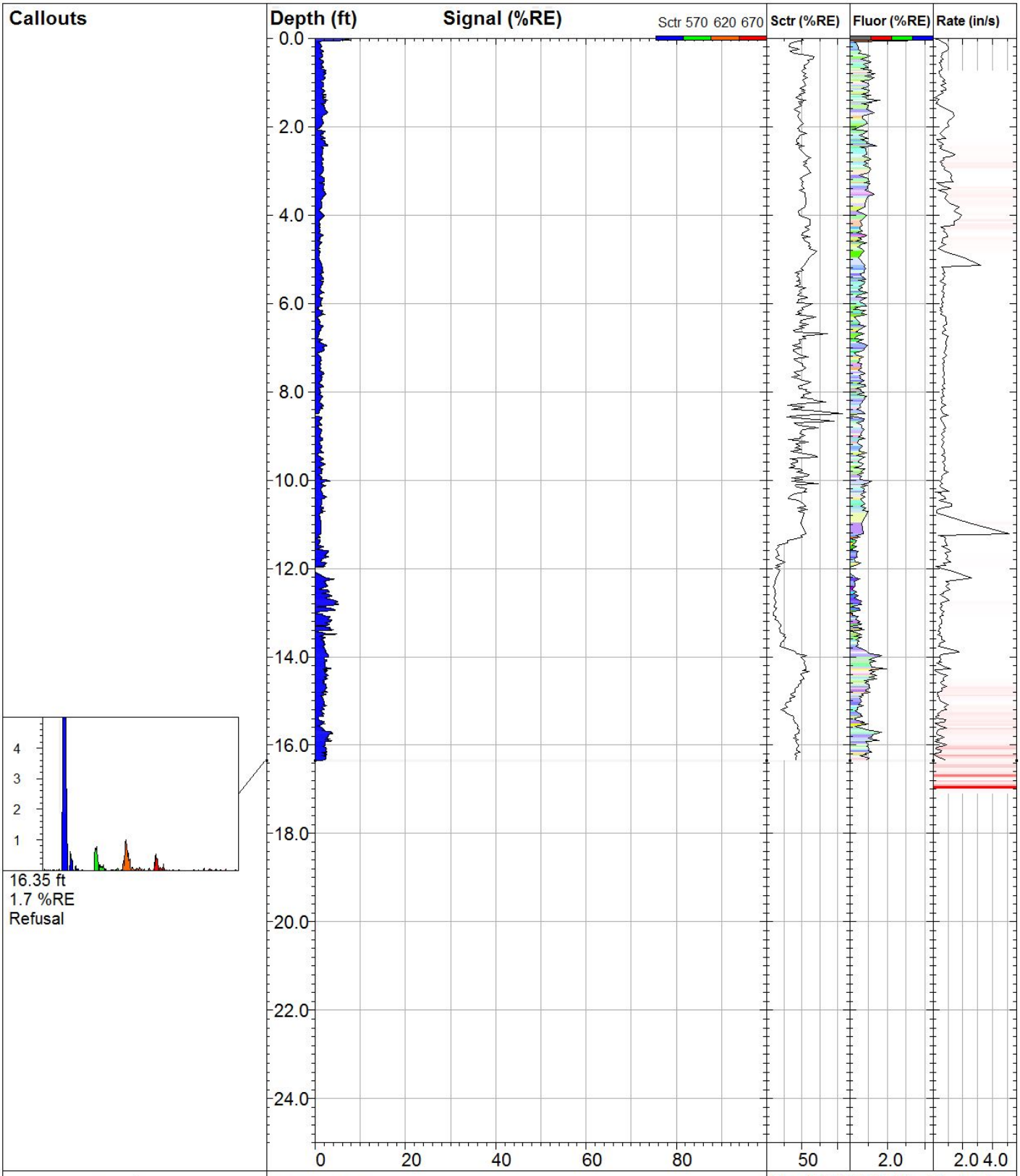
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **12.63 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **9.6 %RE @ 10.96 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 08:10 EDT**



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TG-12

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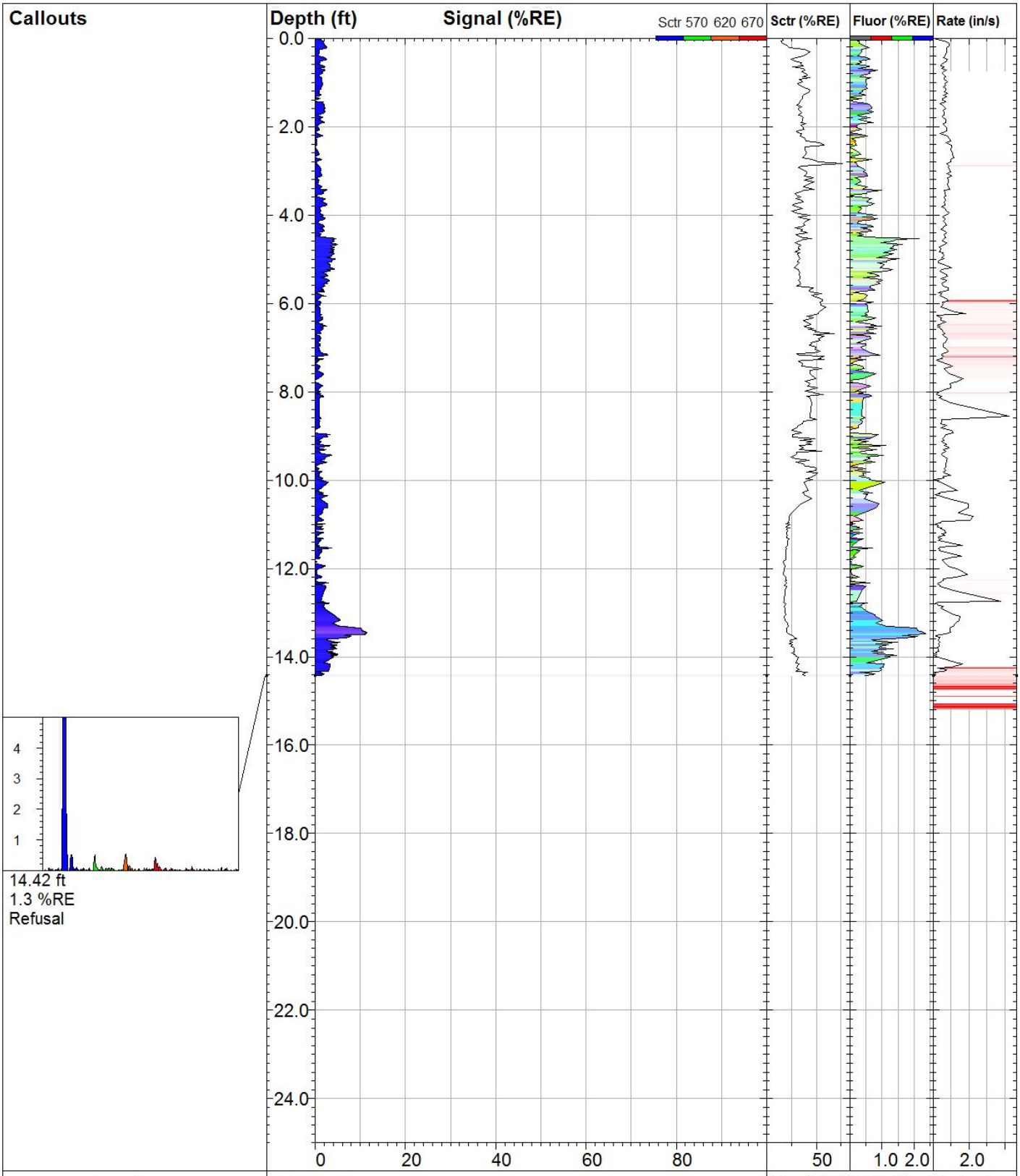
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **16.35 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **7.9 %RE @ 0.05 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 08:28 EDT**



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TG-13

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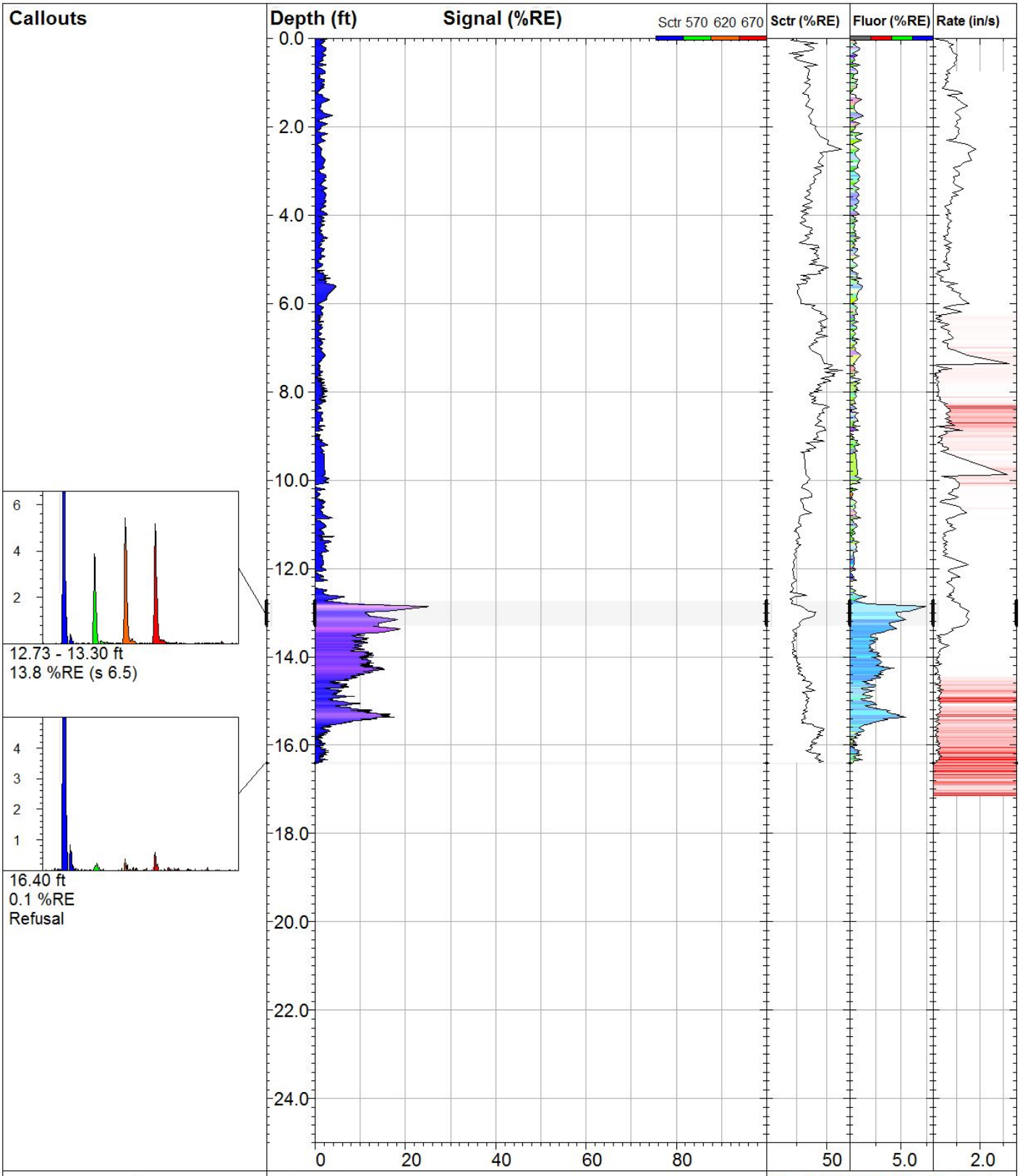
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **14.42 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **11.5 %RE @ 13.45 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 08:50 EDT**



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TG-14

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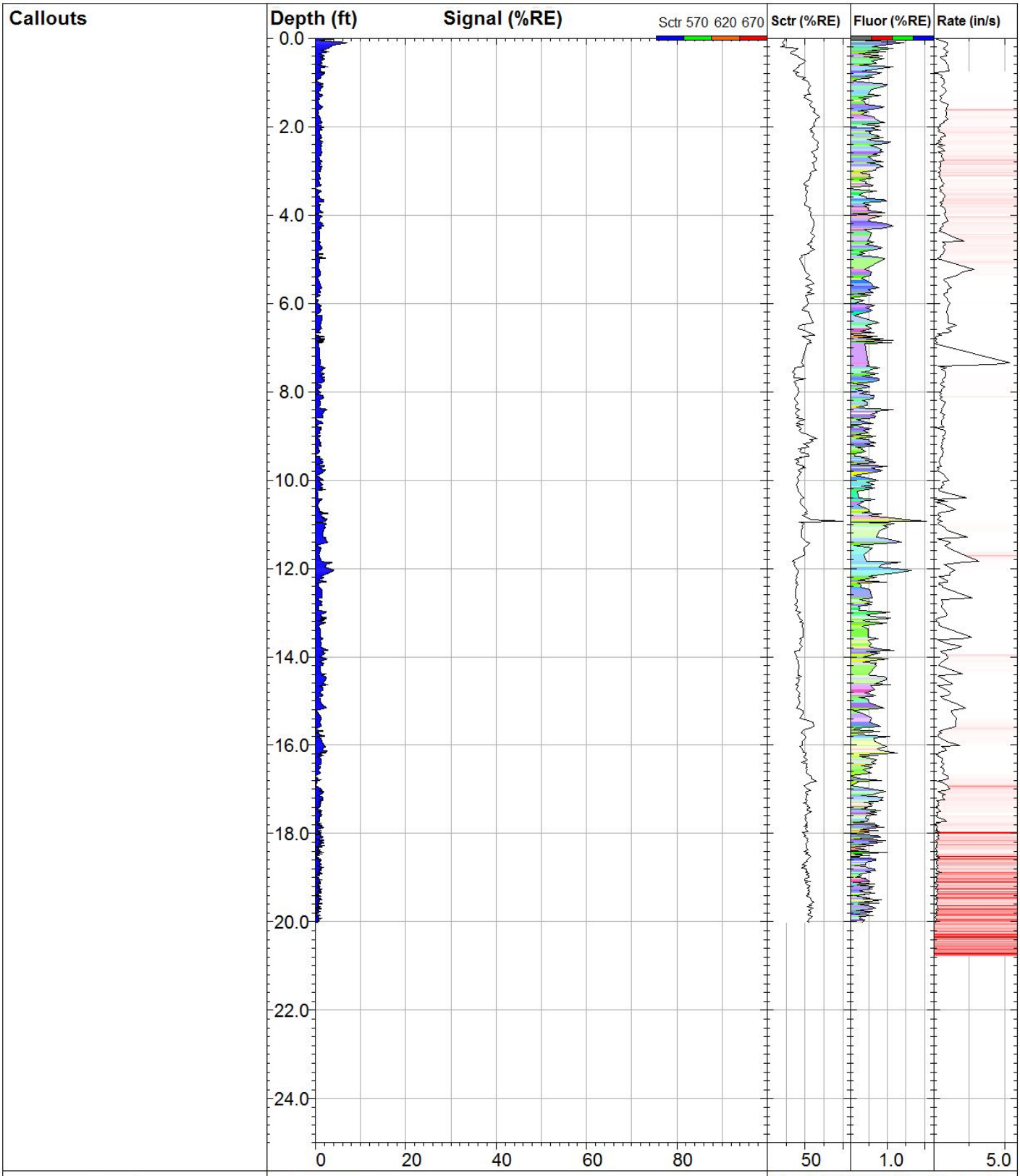
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **16.40 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **25.2 %RE @ 12.86 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 09:15 EDT**



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TG-15

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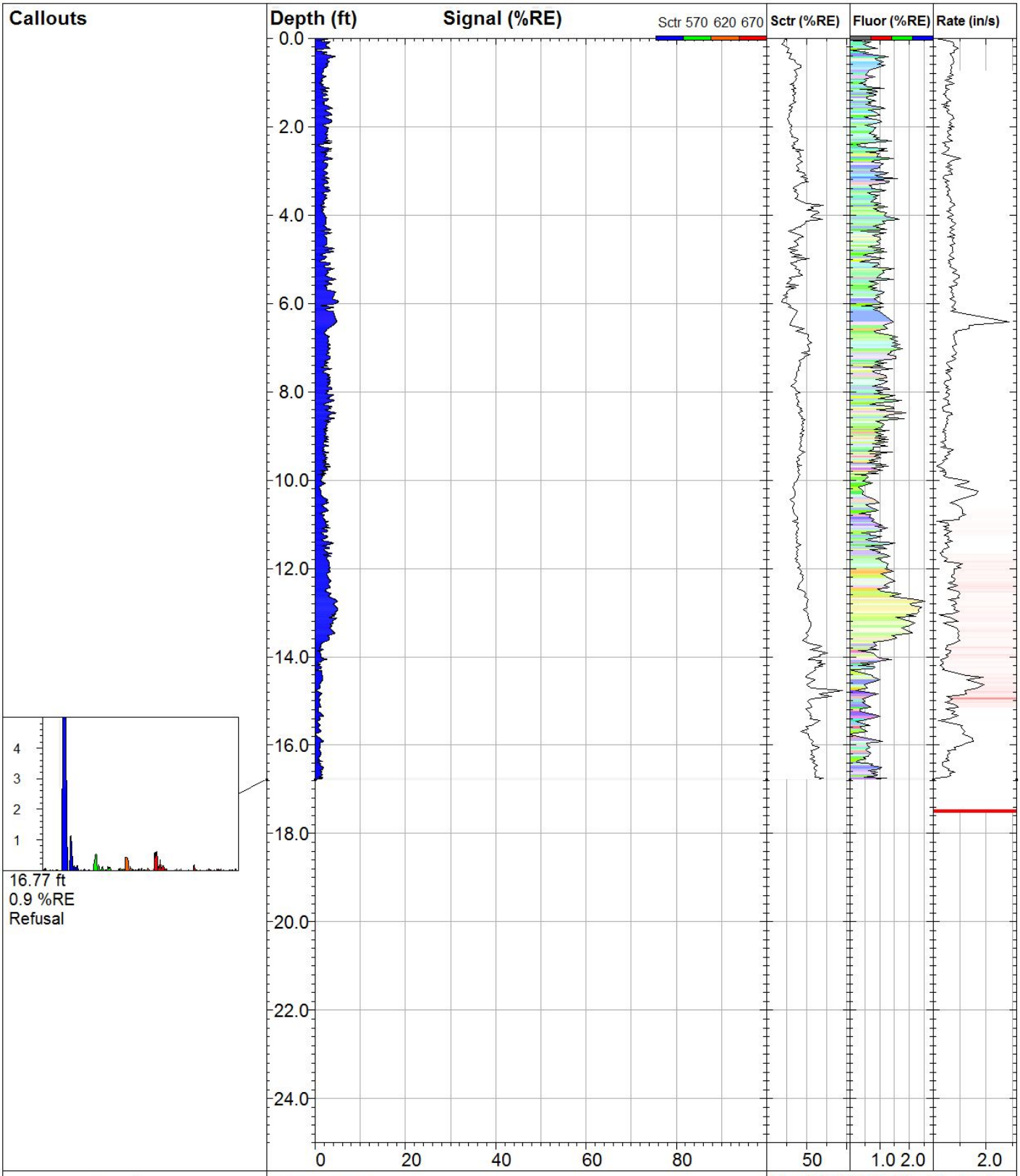
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.01 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **7.2 %RE @ 0.10 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 09:53 EDT**



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TG-16

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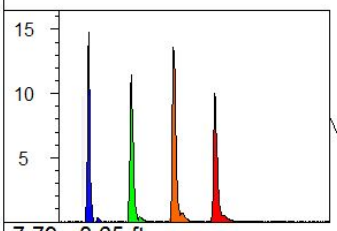
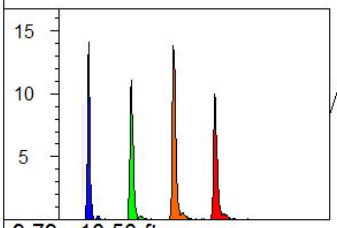
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **16.77 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.1 %RE @ 5.95 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 10:29 EDT**

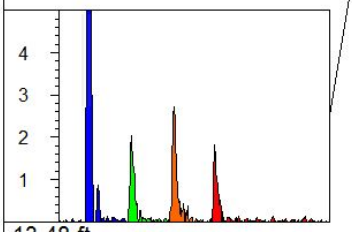
Callouts



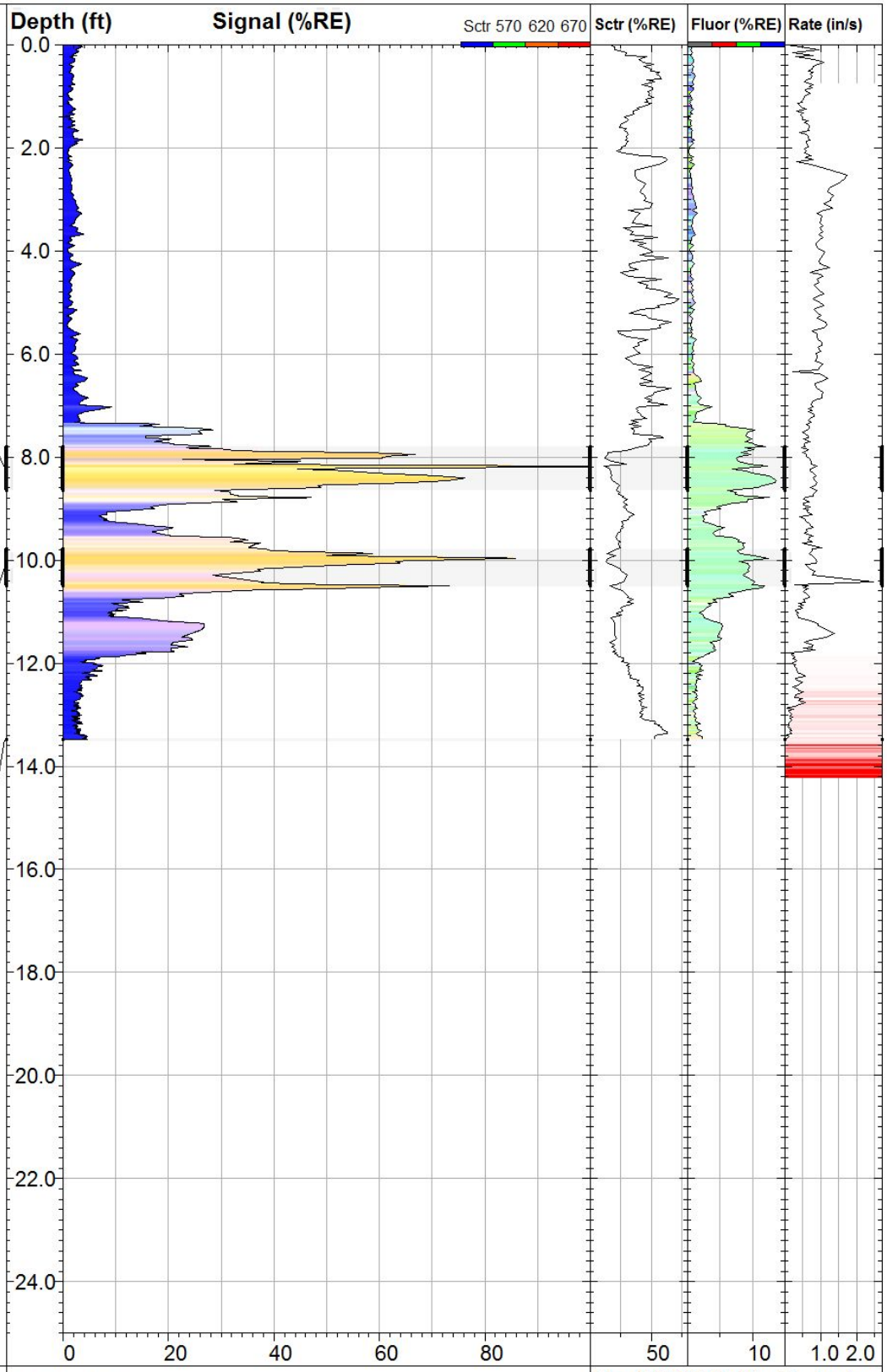
7.79 - 8.65 ft
45.7 %RE (s 21.5)



9.79 - 10.50 ft
46.7 %RE (s 15.7)



13.48 ft
4.6 %RE
Refusal



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TG-17

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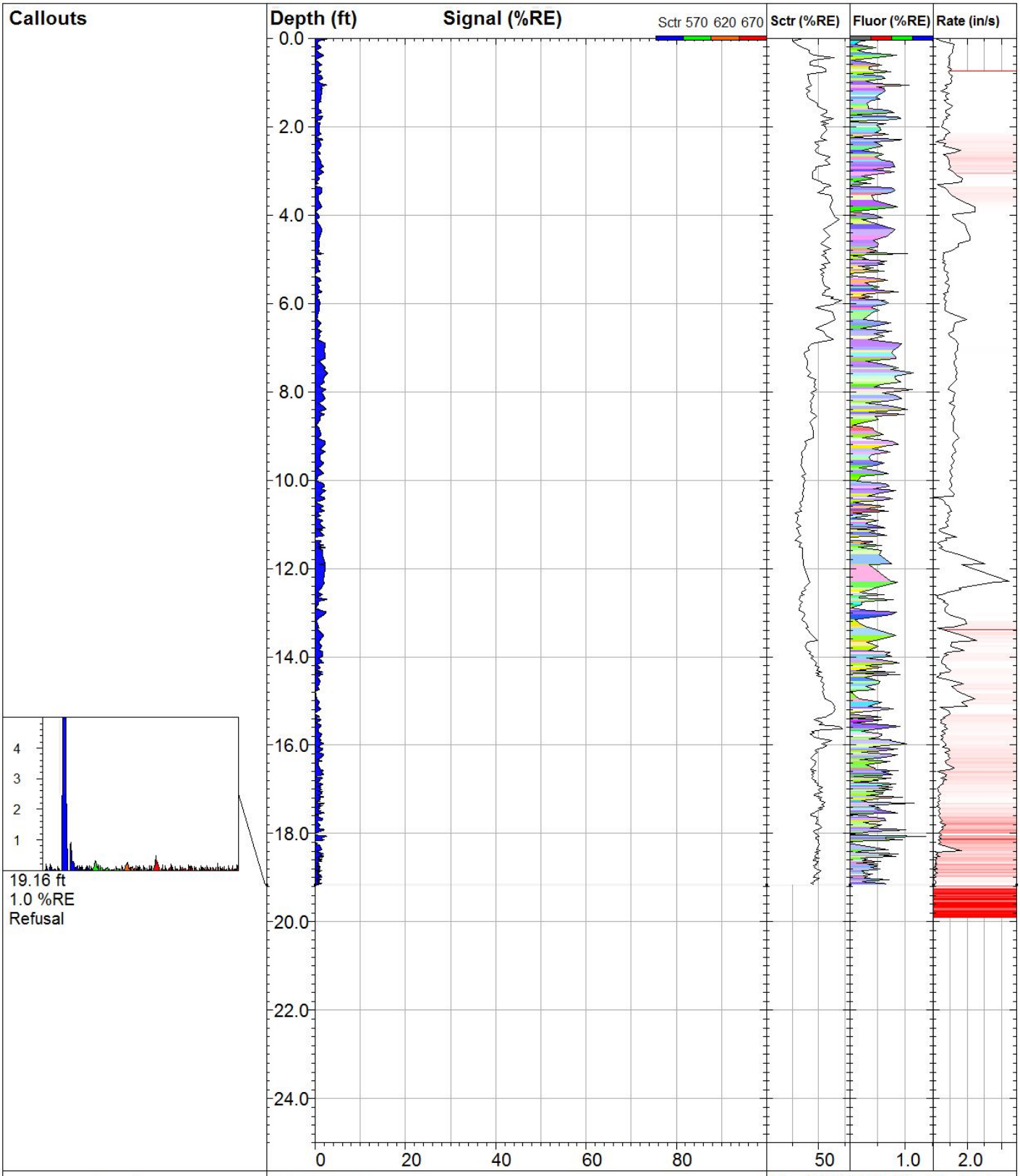
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **13.48 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **112.0 %RE @ 8.18 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 10:59 EDT**



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TG-18

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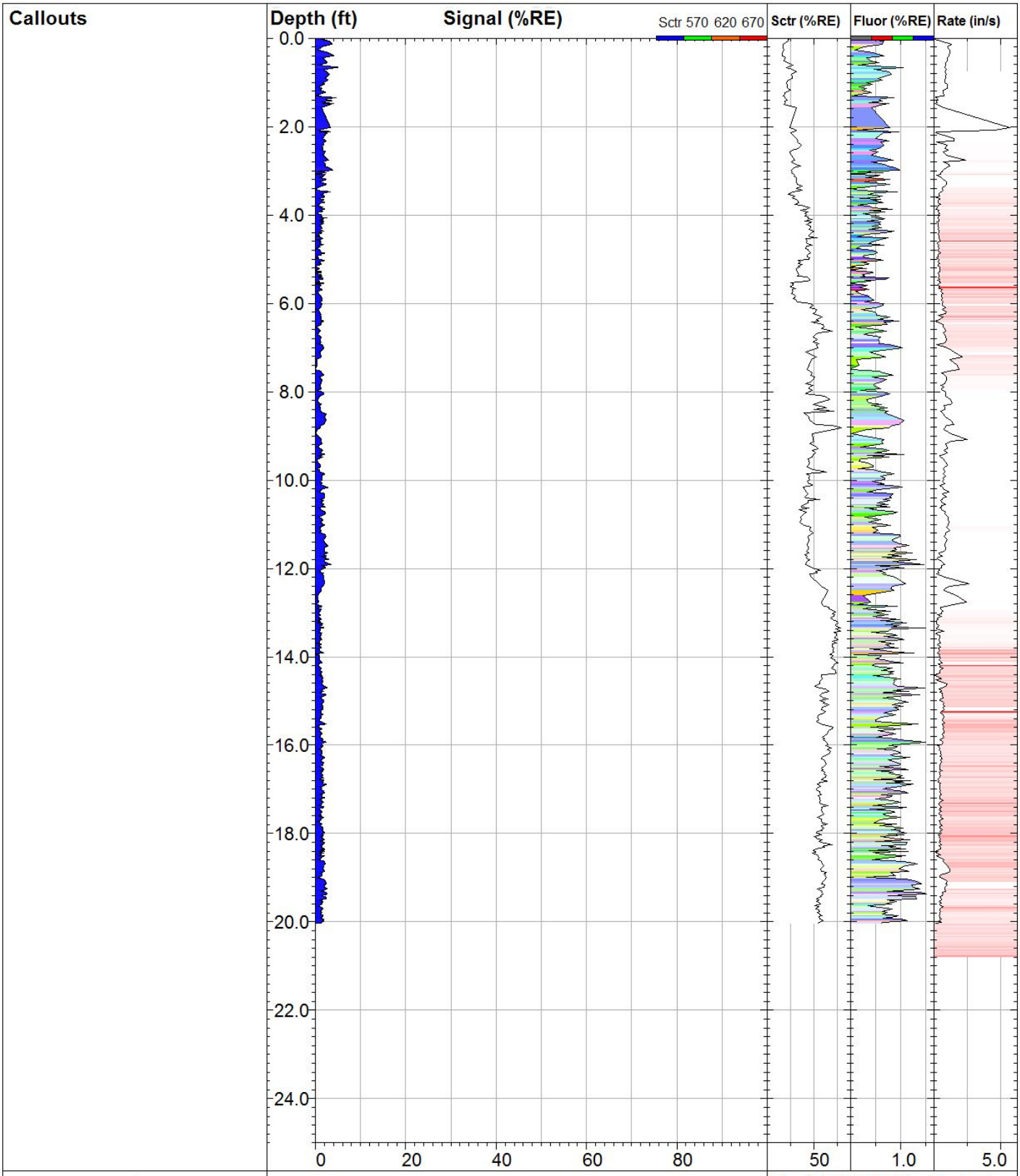
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **19.16 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **2.8 %RE @ 0.00 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 11:30 EDT**



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TG-19

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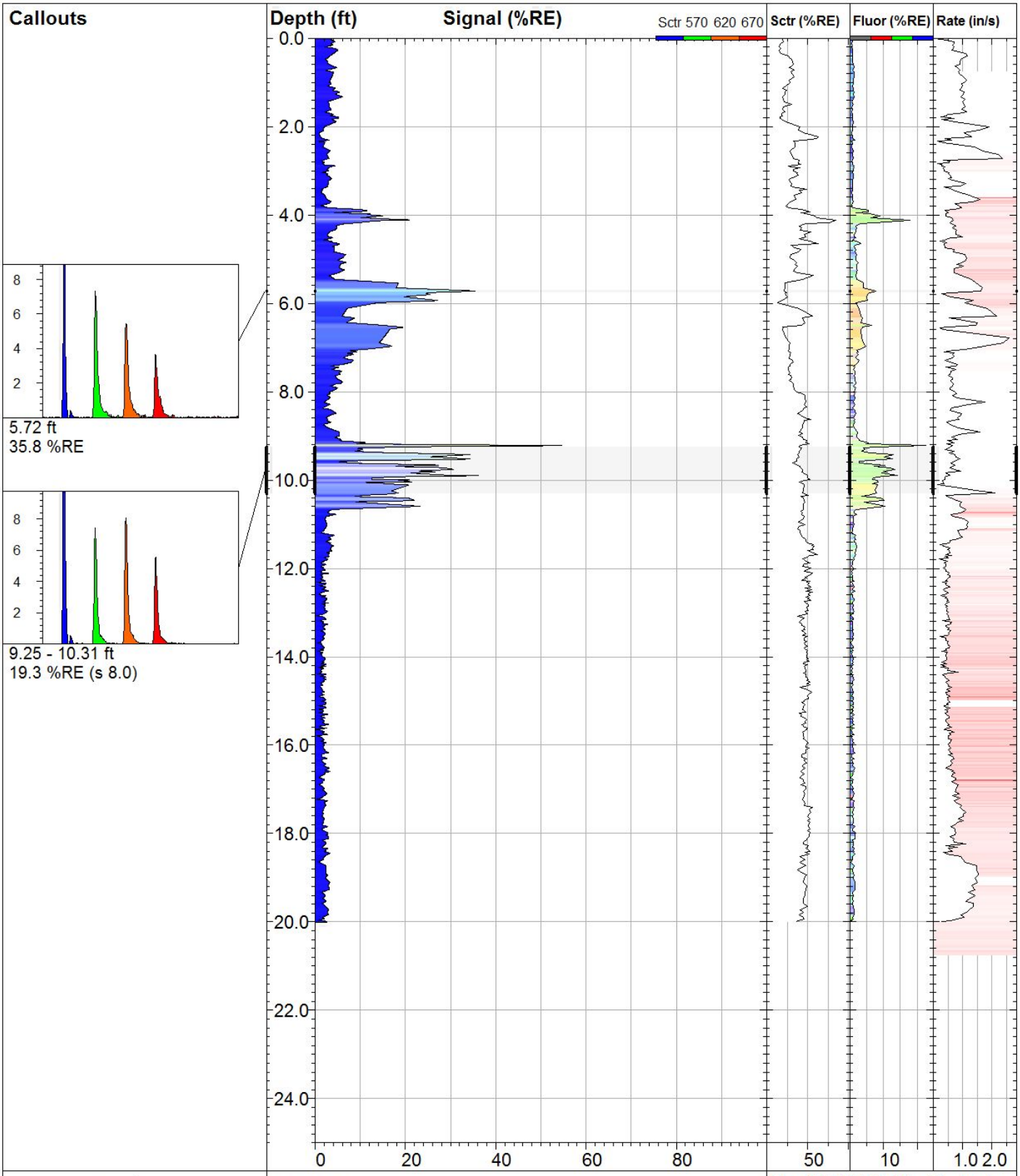
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.03 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.1 %RE @ 0.66 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 13:02 EDT**



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TG-20B

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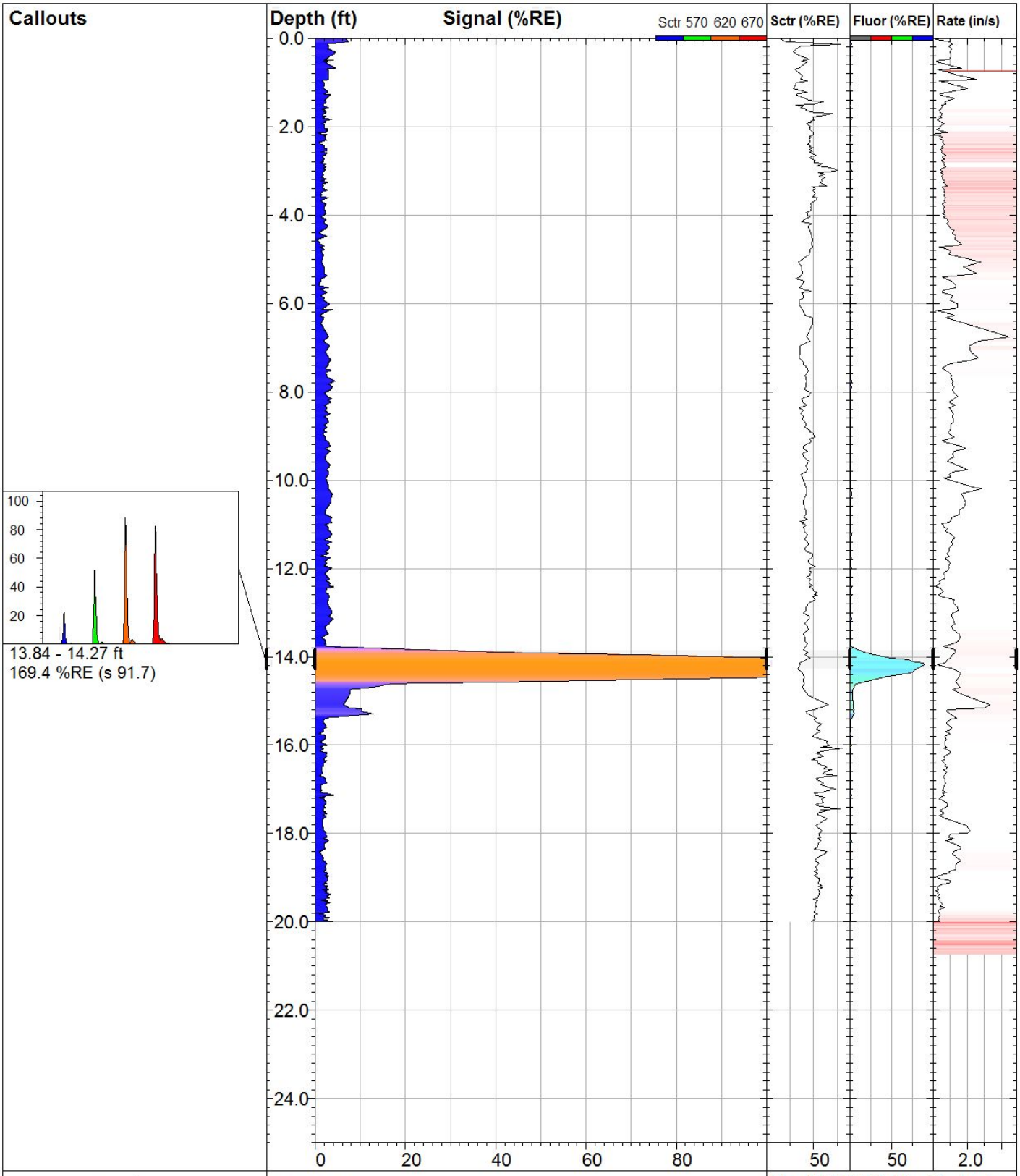
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.01 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **55.6 %RE @ 9.22 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 13:42 EDT**



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TG-21

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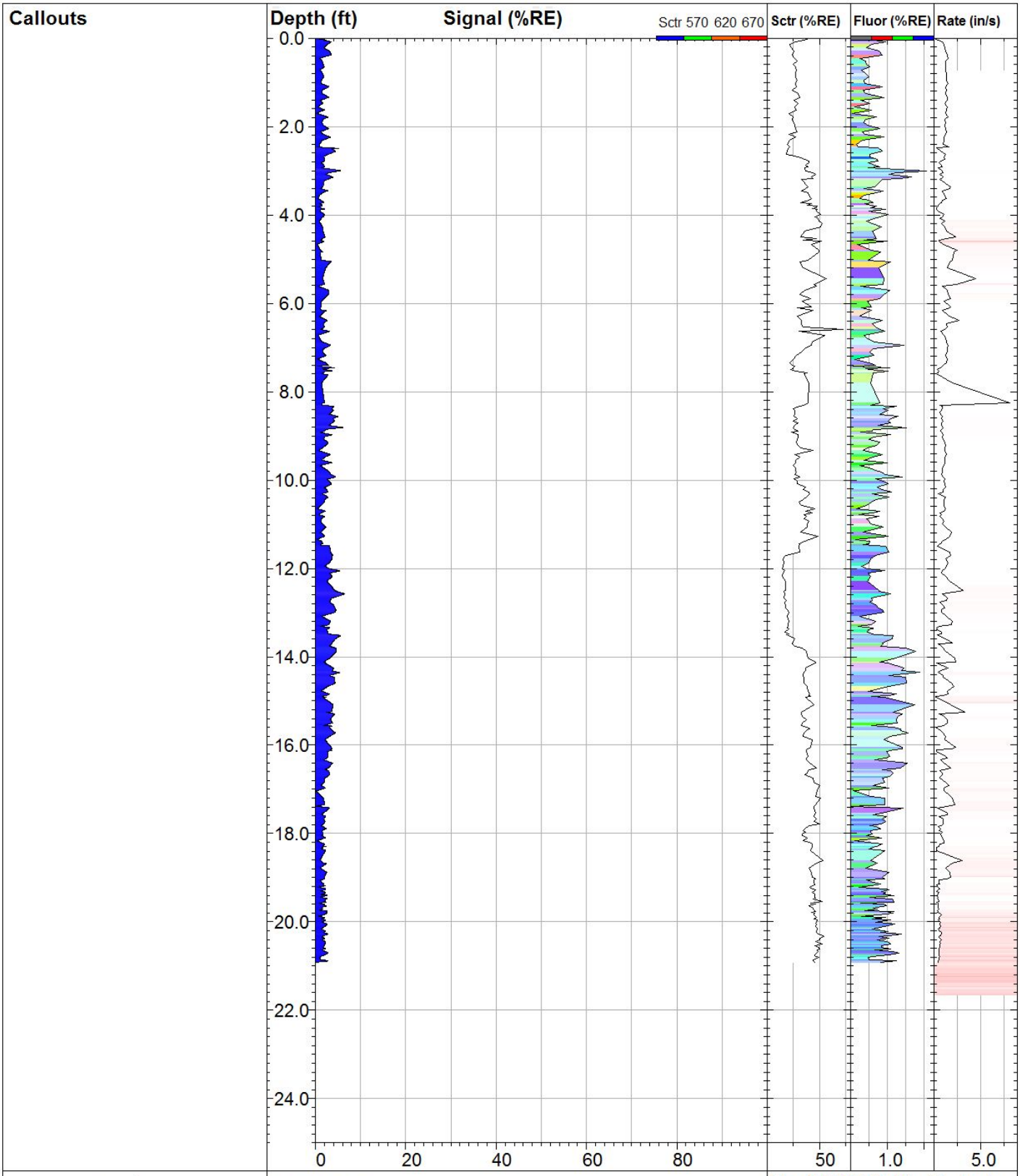
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.00 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **262.5 %RE @ 14.18 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 14:09 EDT**



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TG-22

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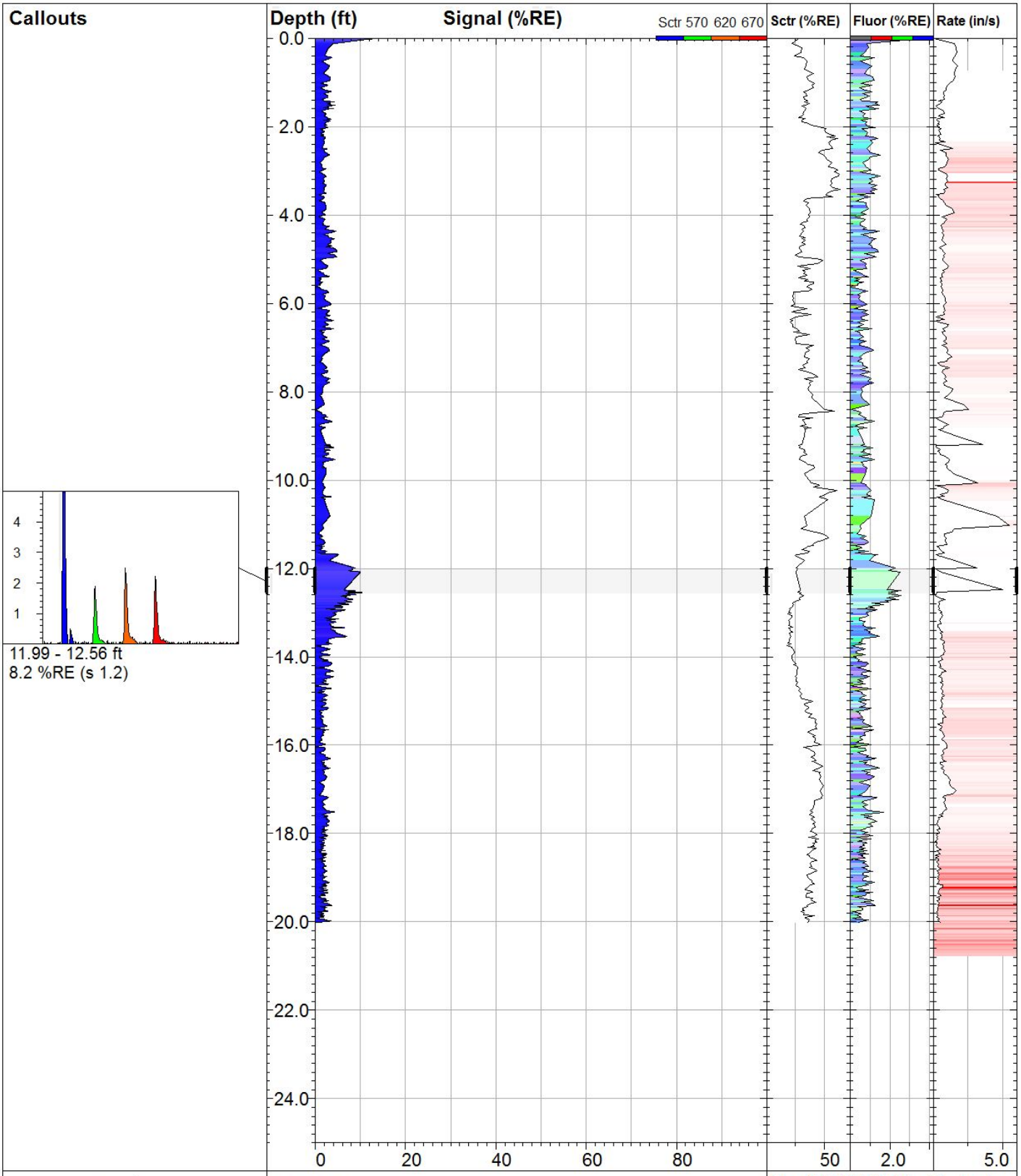
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.91 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **6.5 %RE @ 12.58 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 14:39 EDT**



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TG-23

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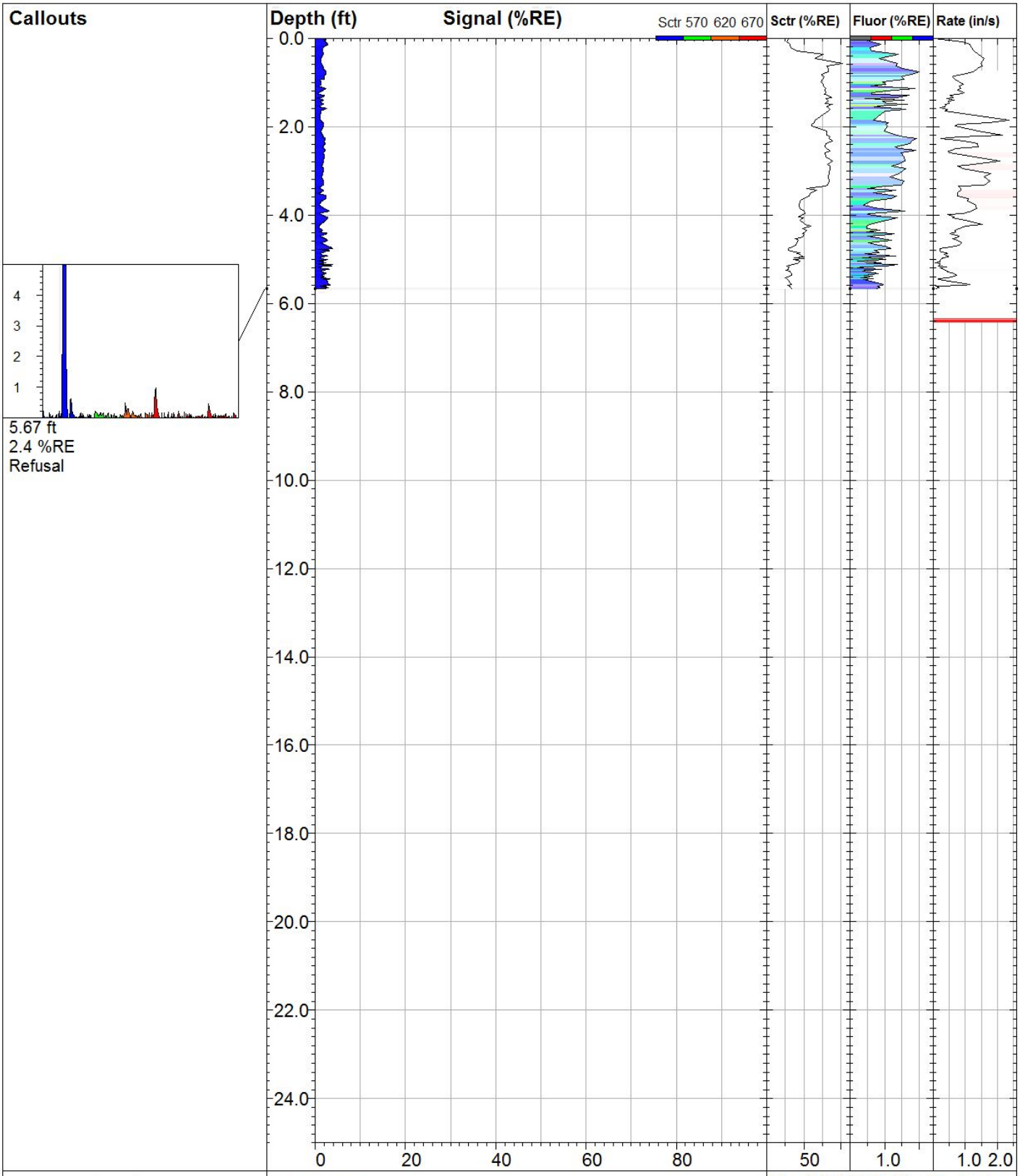
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.01 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **15.0 %RE @ 0.00 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 15:35 EDT**



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TG-24

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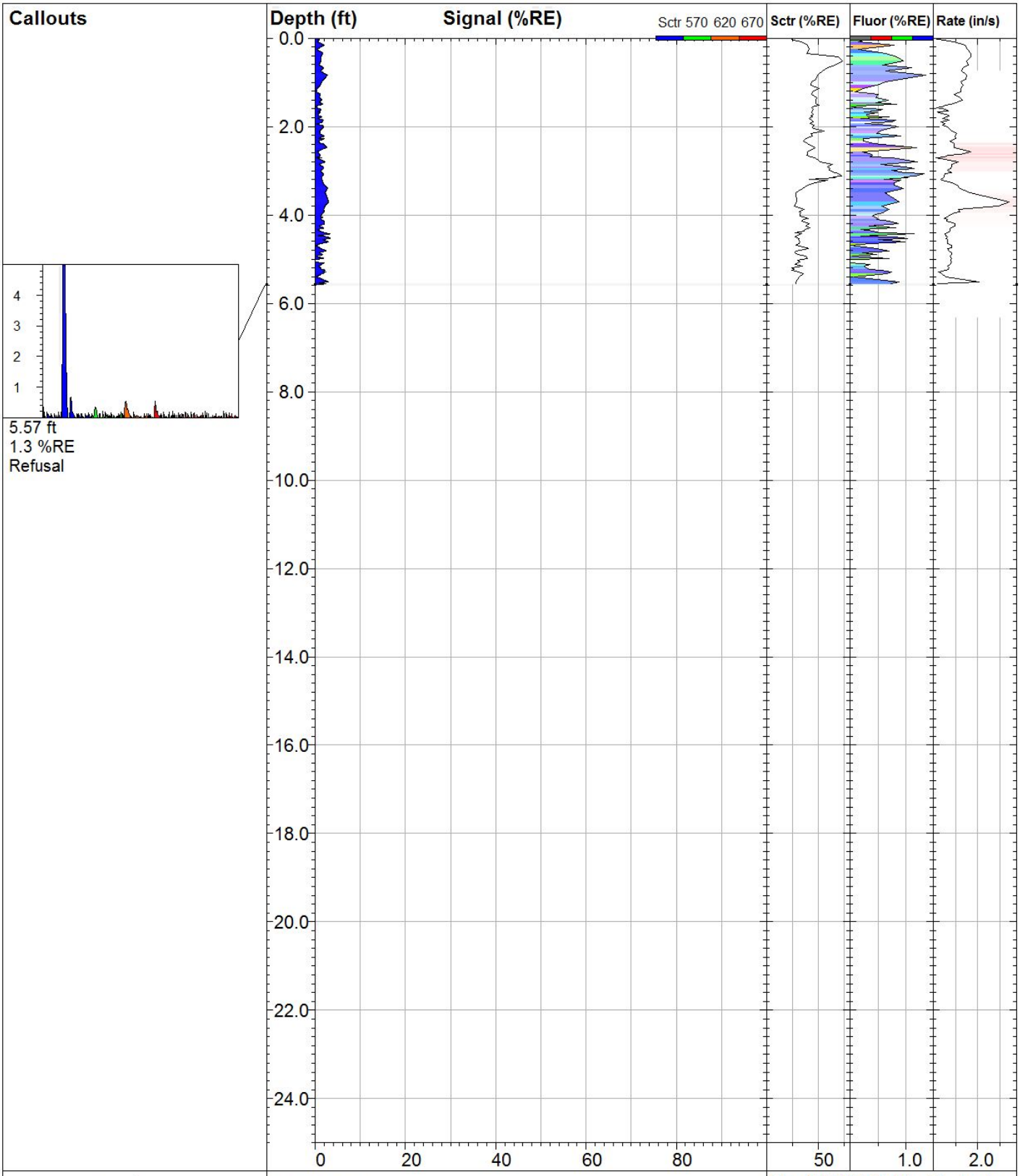
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.67 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **4.0 %RE @ 4.77 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 16:02 EDT**



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FARGO, ND 701.237.4908
WWW.DAKOTATECHNOLOGIES.COM

TG-24B

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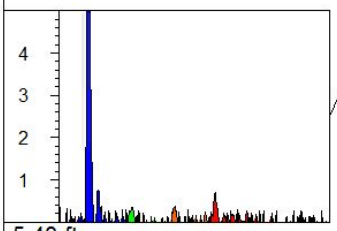
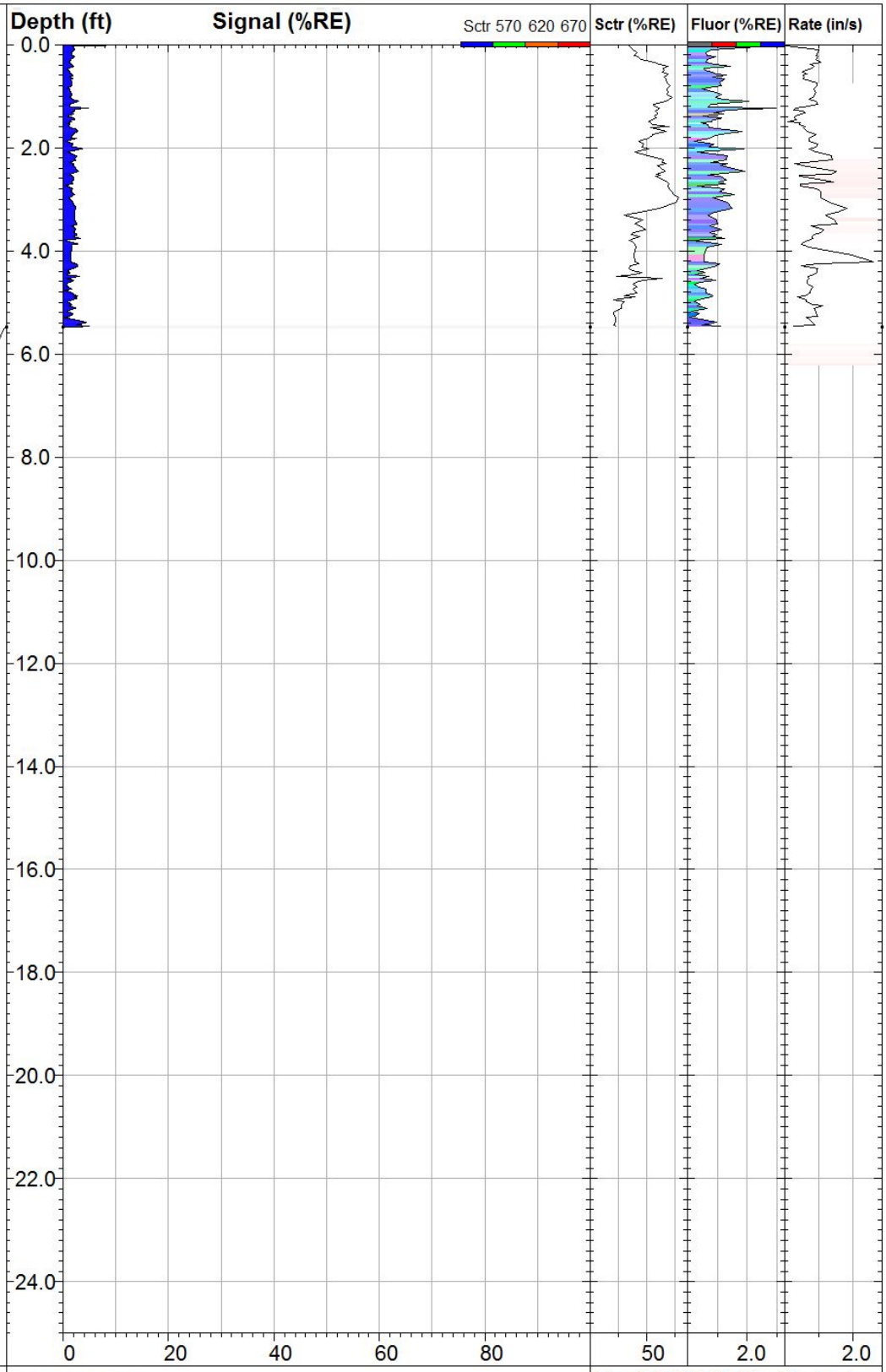
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.57 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **3.3 %RE @ 4.43 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 16:15 EDT**

Callouts



5.48 ft
1.8 %RE
Refusal



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TG-24C

TarGOST® By Dakota
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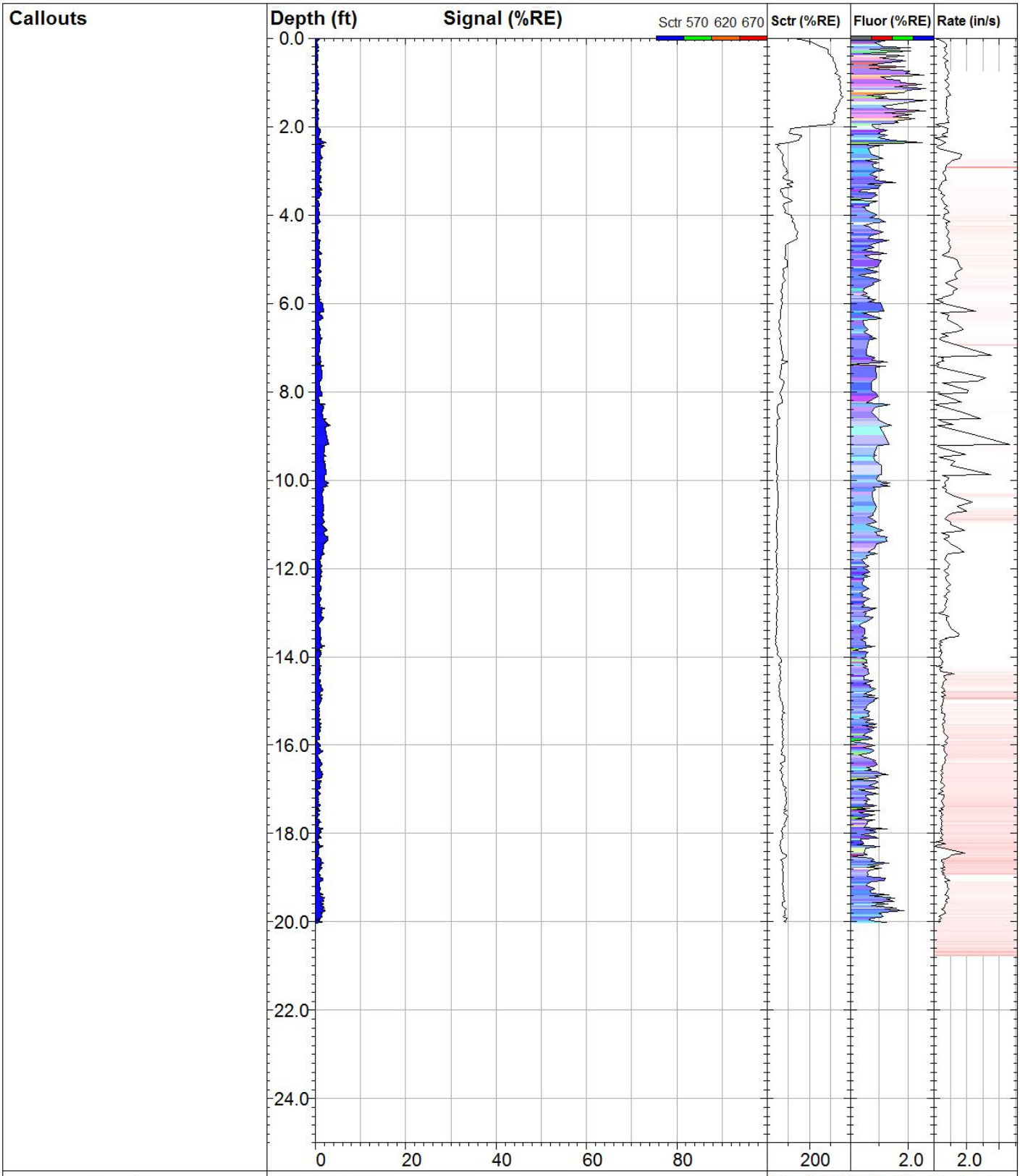
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.48 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **8.4 %RE @ 0.02 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-13 16:23 EDT**



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TG-25

TarGOST® By Dakota
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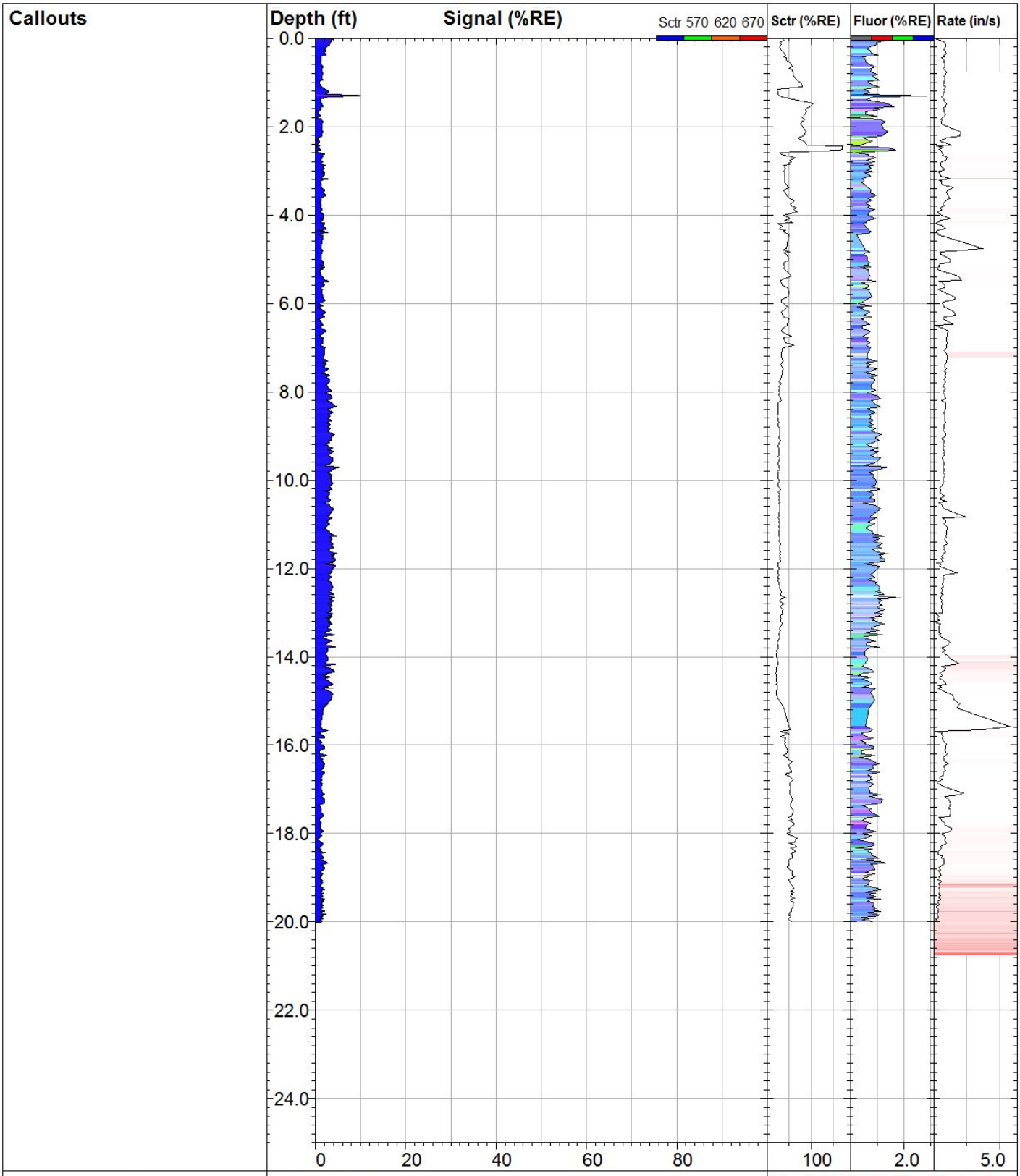
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.02 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **3.3 %RE @ 8.76 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 07:47 EDT**



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TG-26

TarGOST® By Dakota
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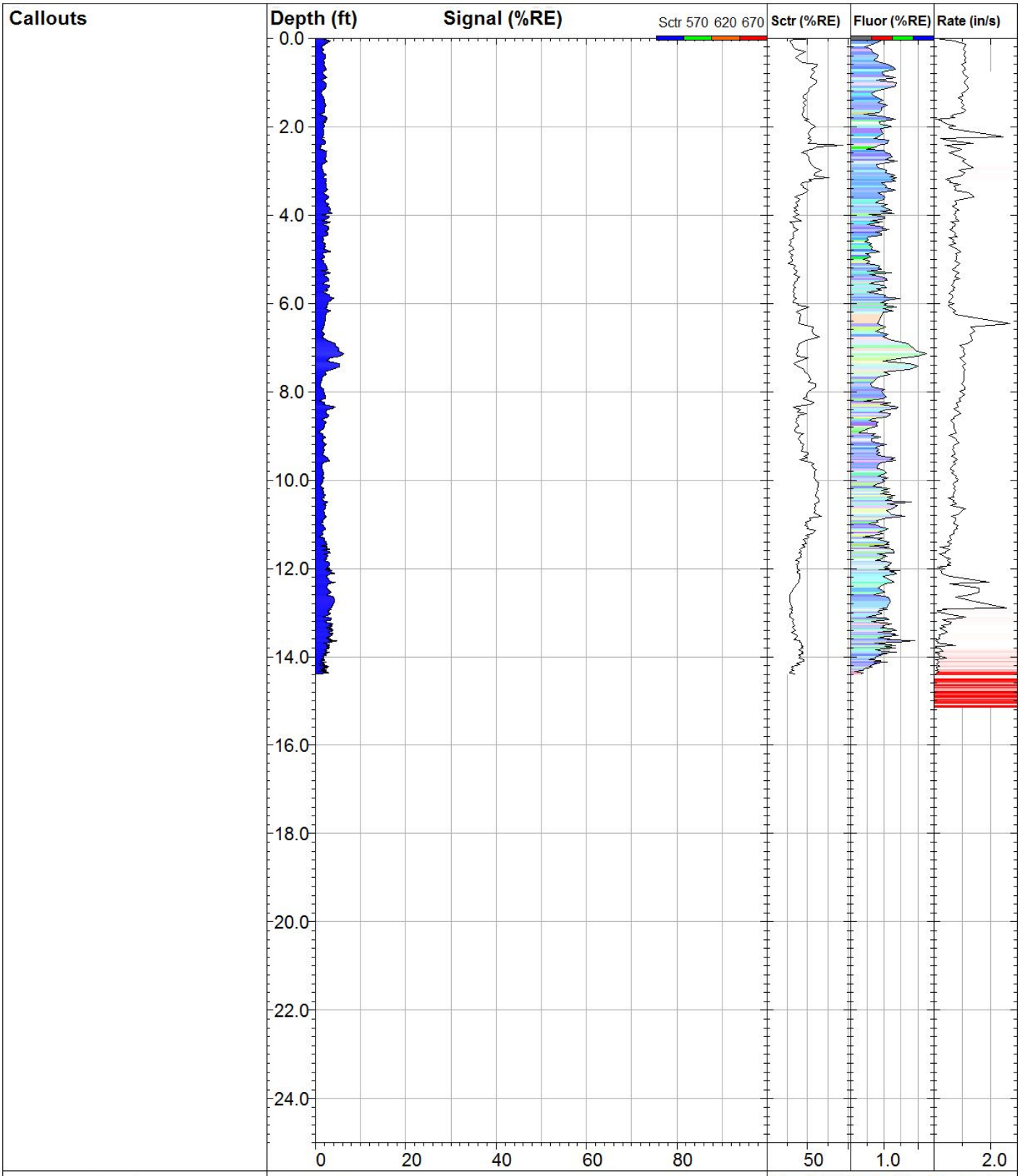
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.00 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **10.0 %RE @ 1.30 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 08:19 EDT**



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TG-27

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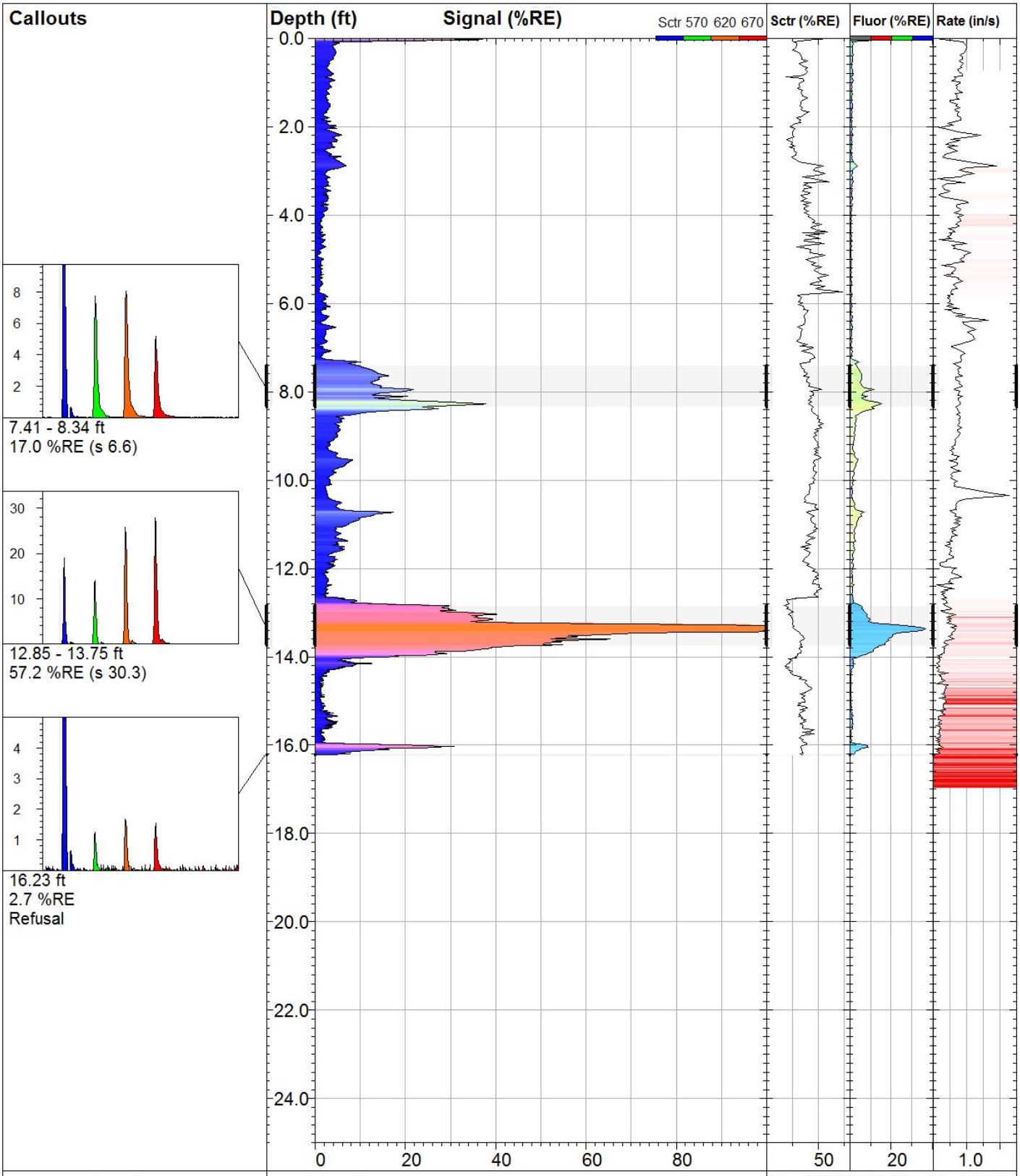
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **14.38 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **6.3 %RE @ 7.14 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 08:54 EDT**



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TG-28

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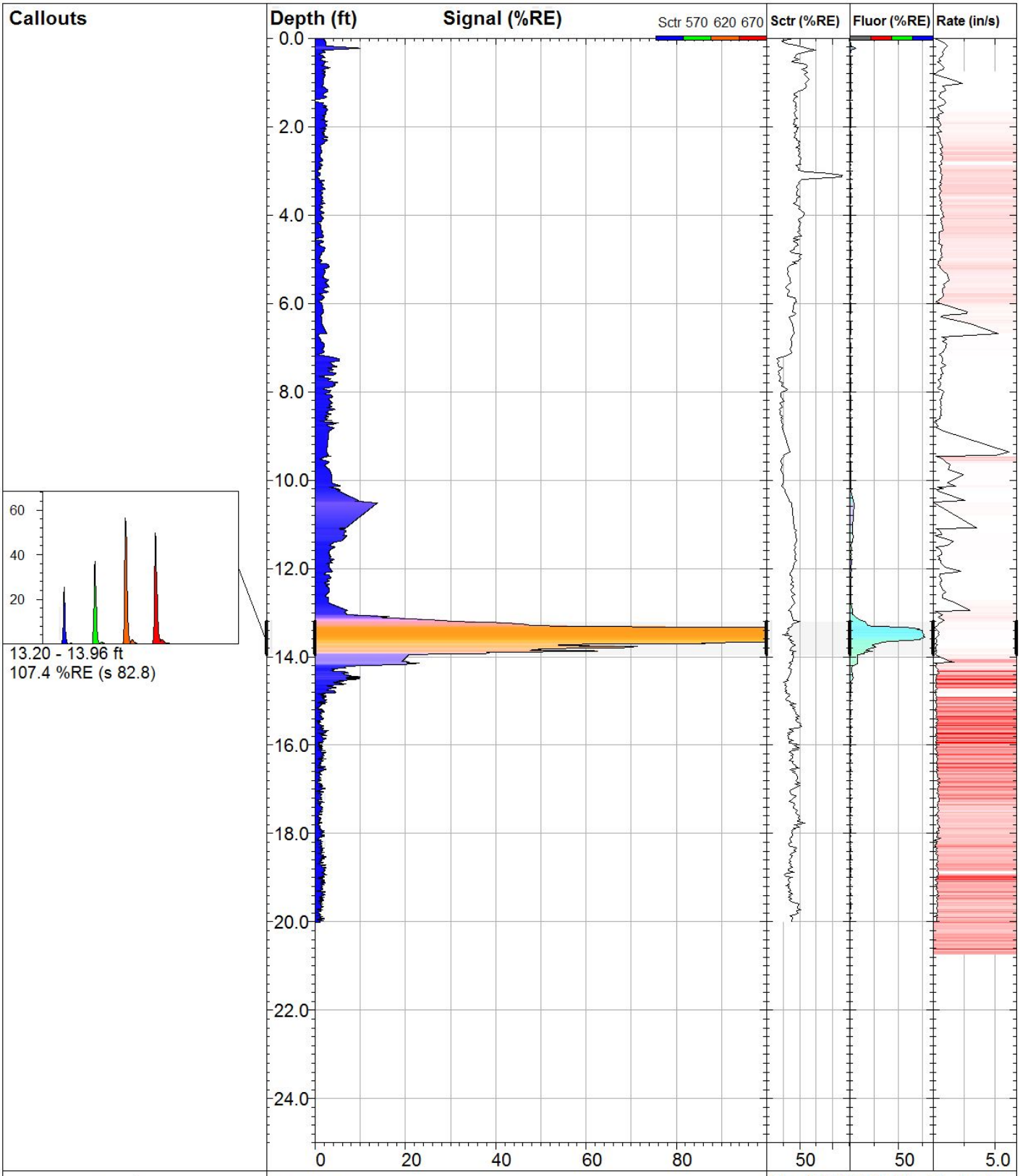
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **16.23 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **138.8 %RE @ 13.37 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 09:25 EDT**



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TG-29

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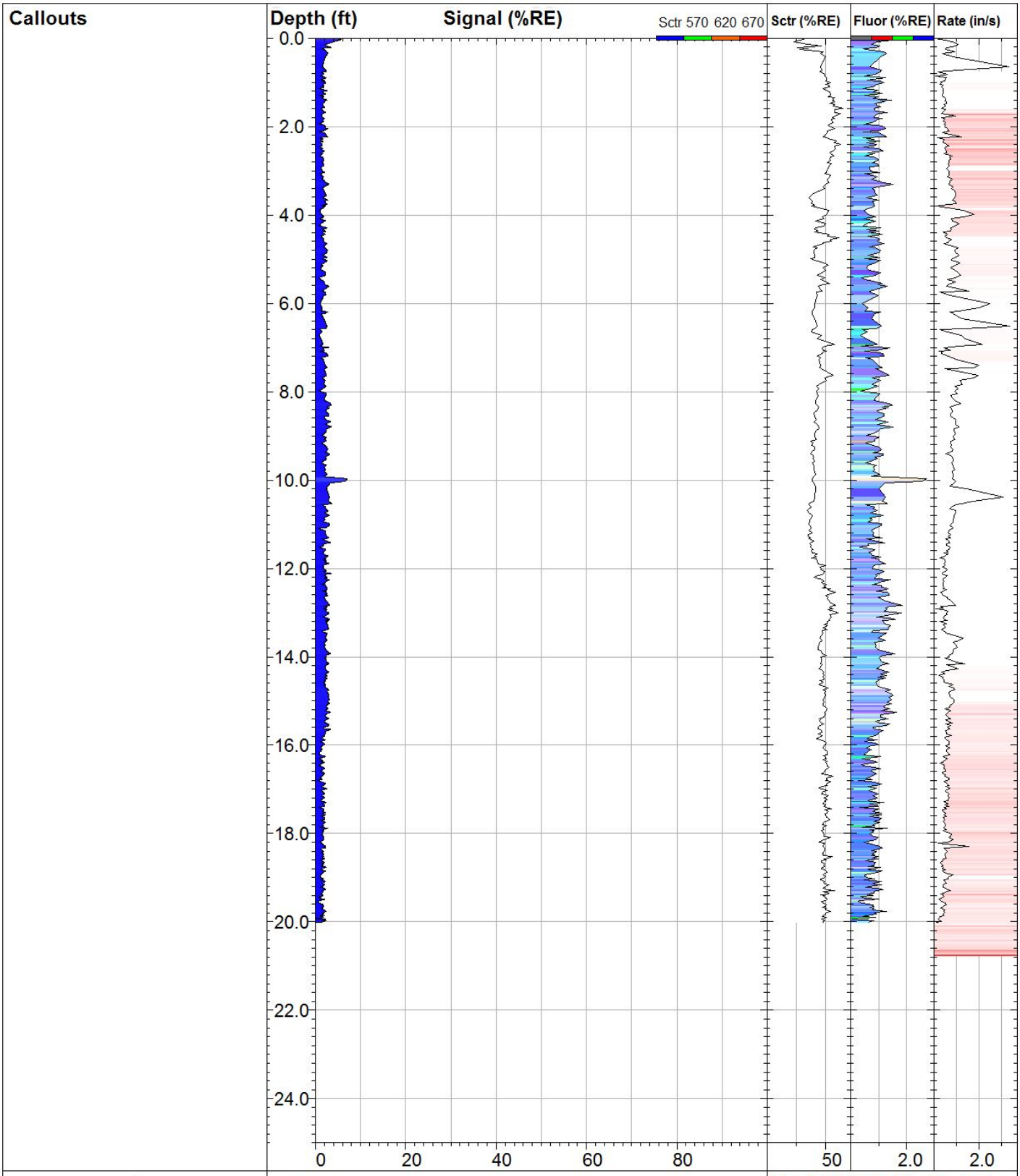
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.00 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **320.4 %RE @ 13.50 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 09:48 EDT**



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TG-30

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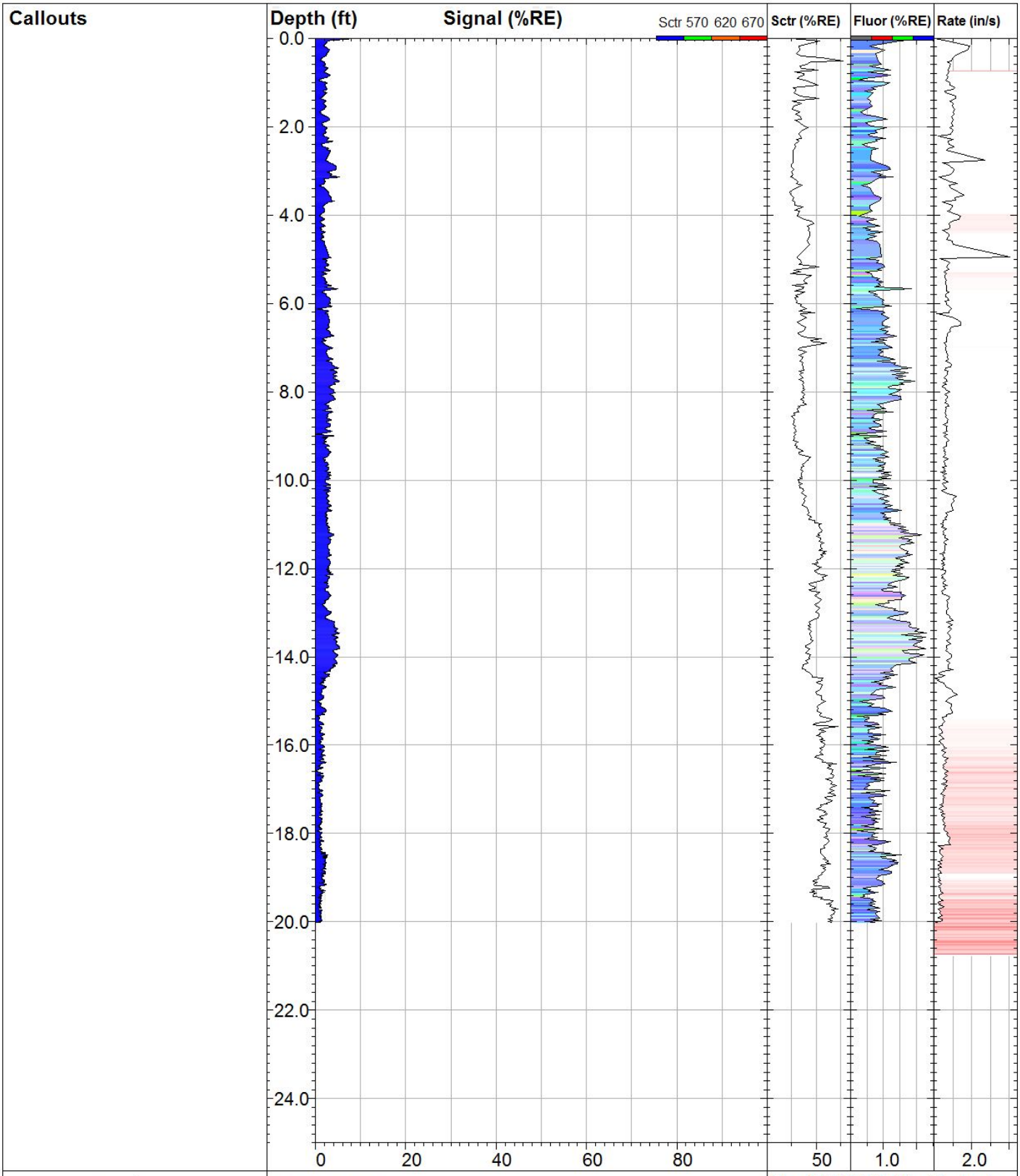
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.01 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **7.0 %RE @ 9.97 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 10:33 EDT**



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TG-31D

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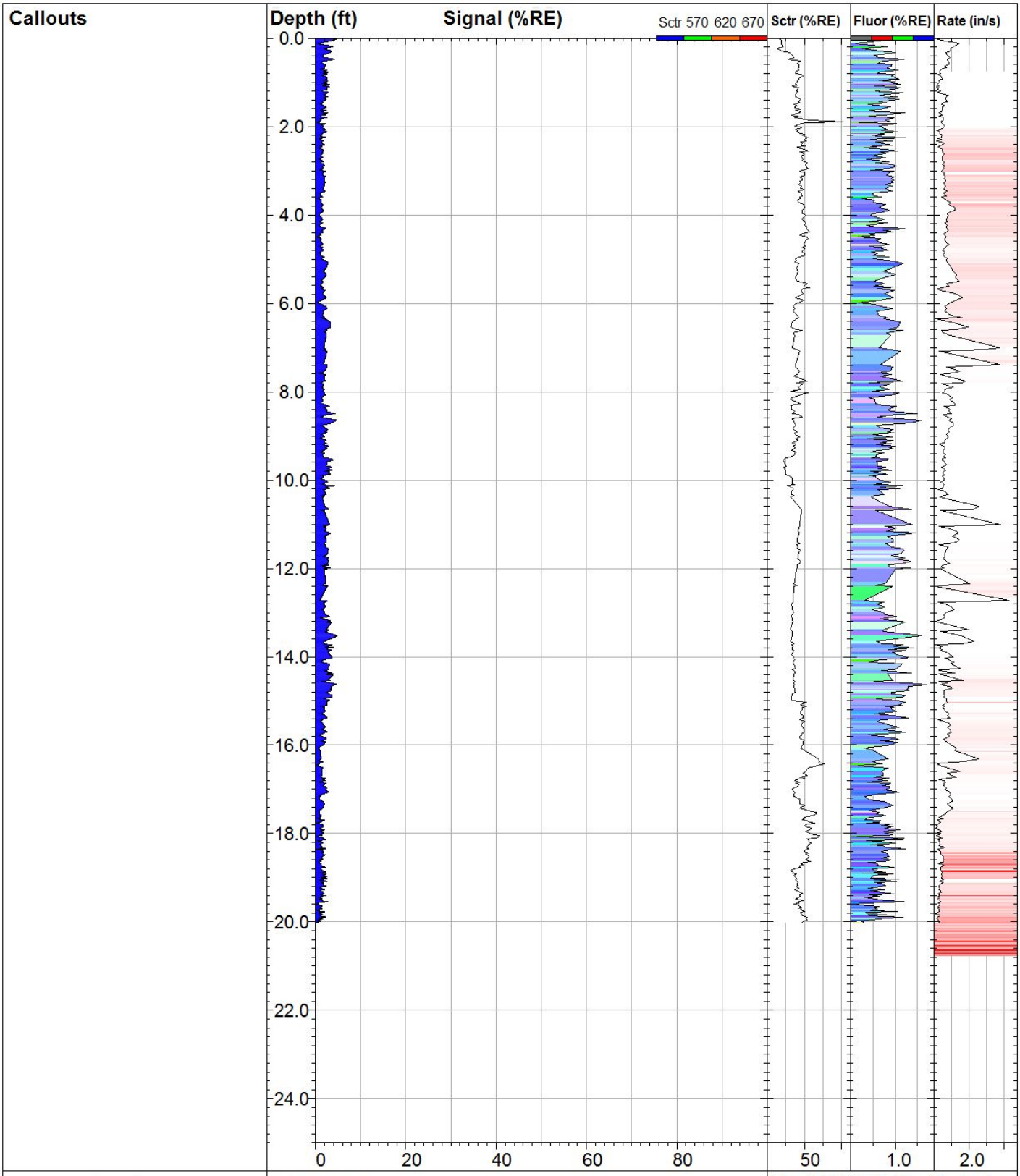
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.01 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **9.4 %RE @ 0.00 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 12:29 EDT**



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TG-32

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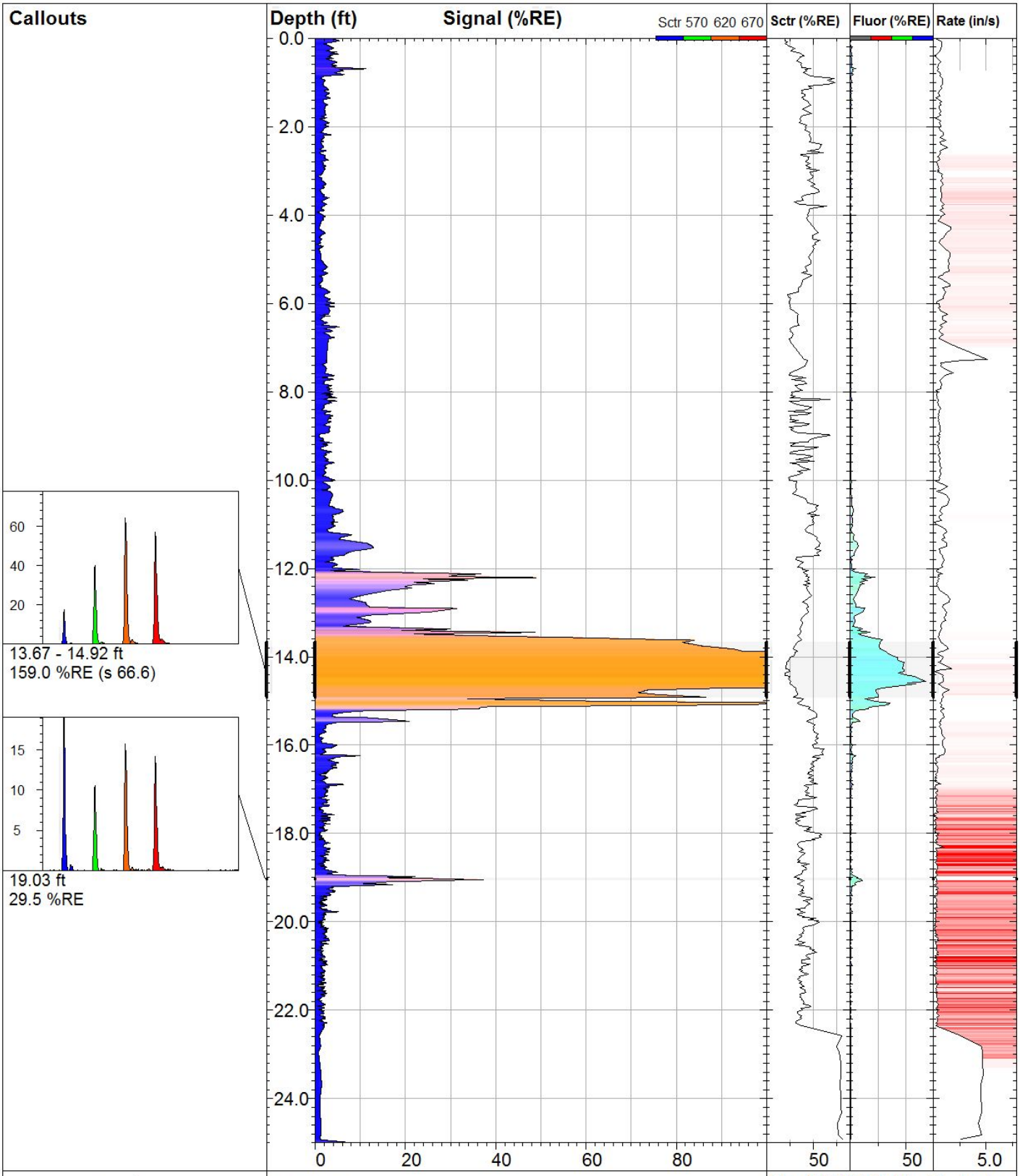
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.02 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.0 %RE @ 0.00 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 12:59 EDT**



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TG-33

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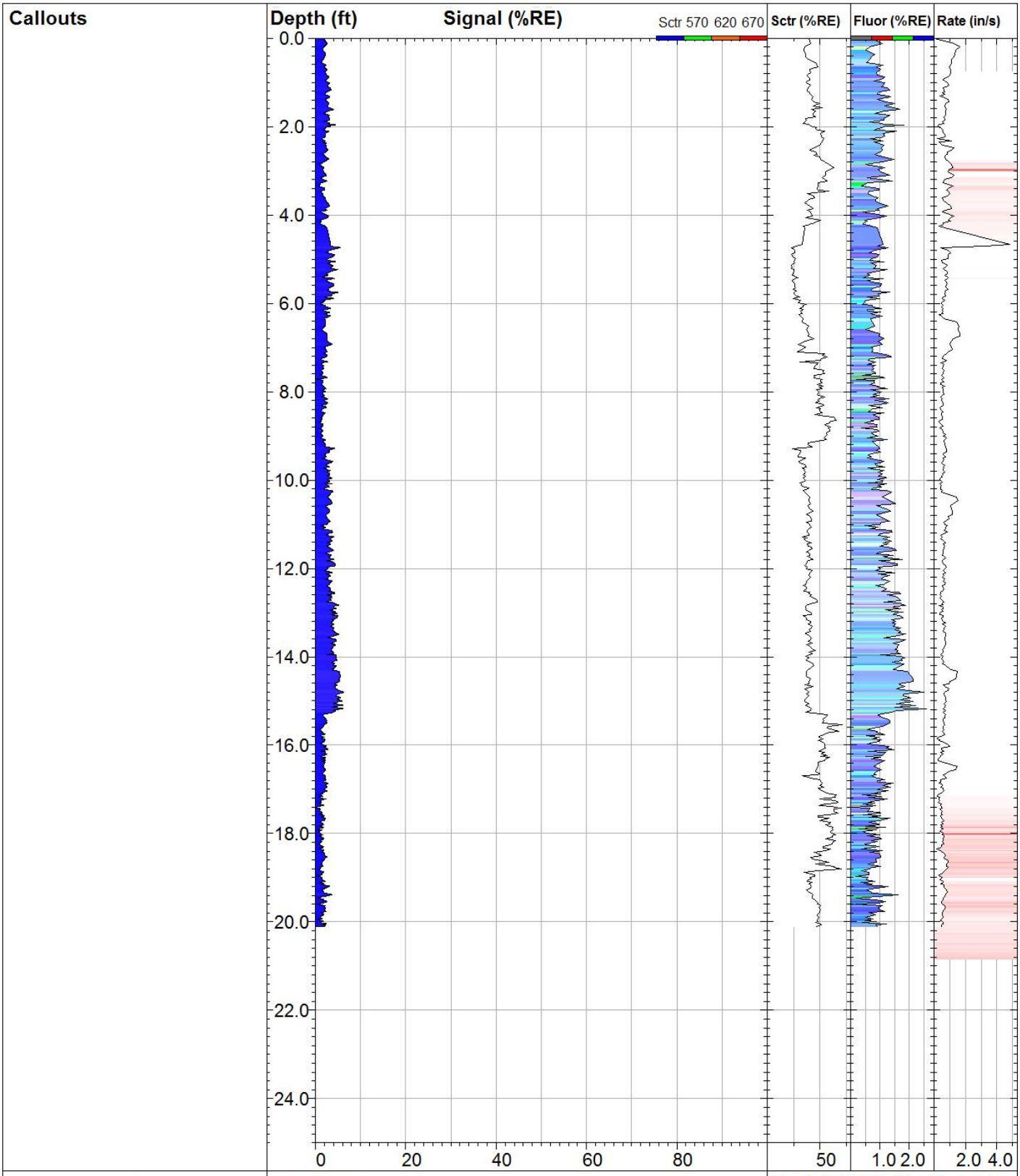
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **30.04 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **270.8 %RE @ 14.42 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 13:25 EDT**



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TG-34

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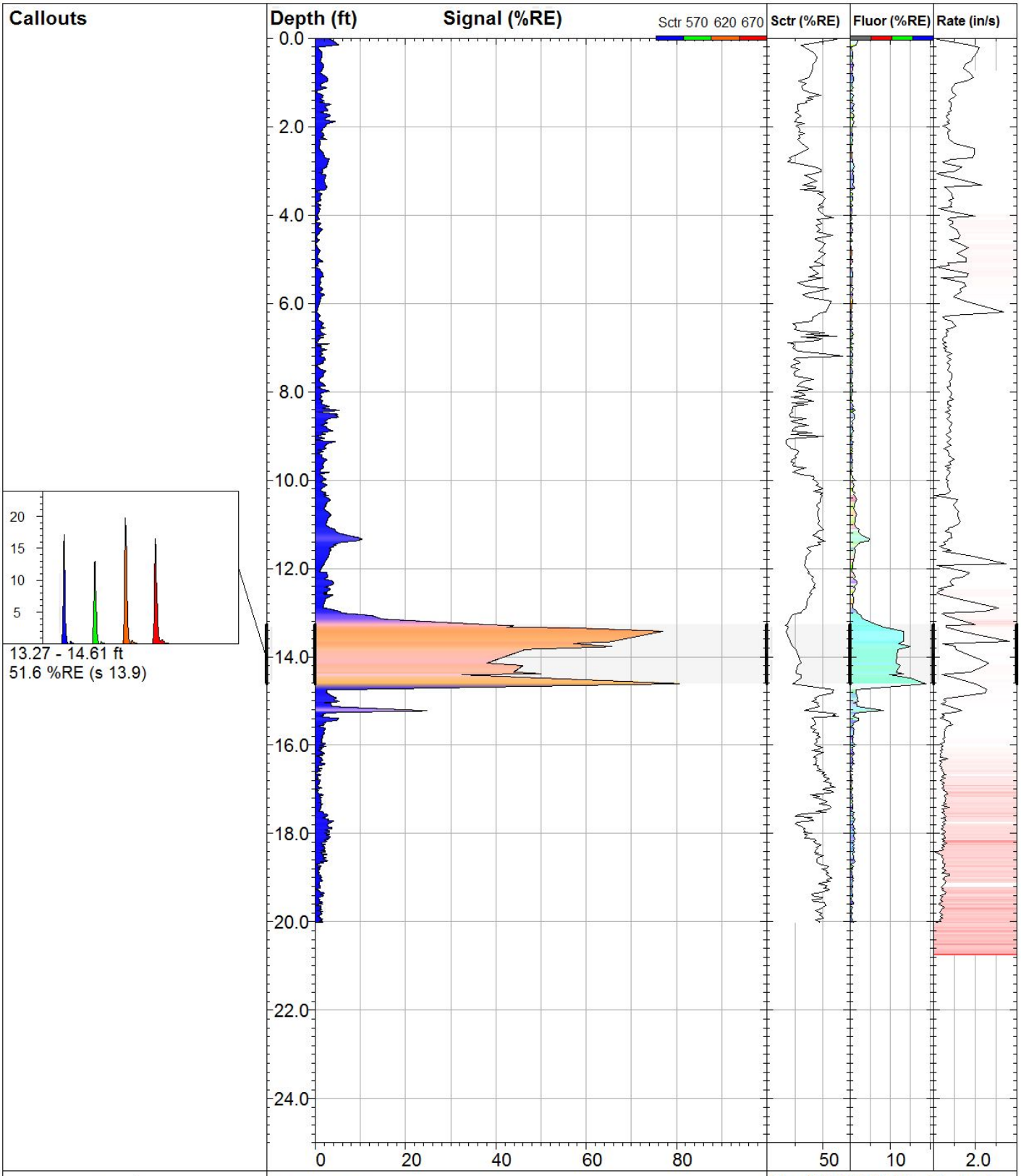
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **22.35 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **6.4 %RE @ 14.80 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 14:02 EDT**



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TG-35

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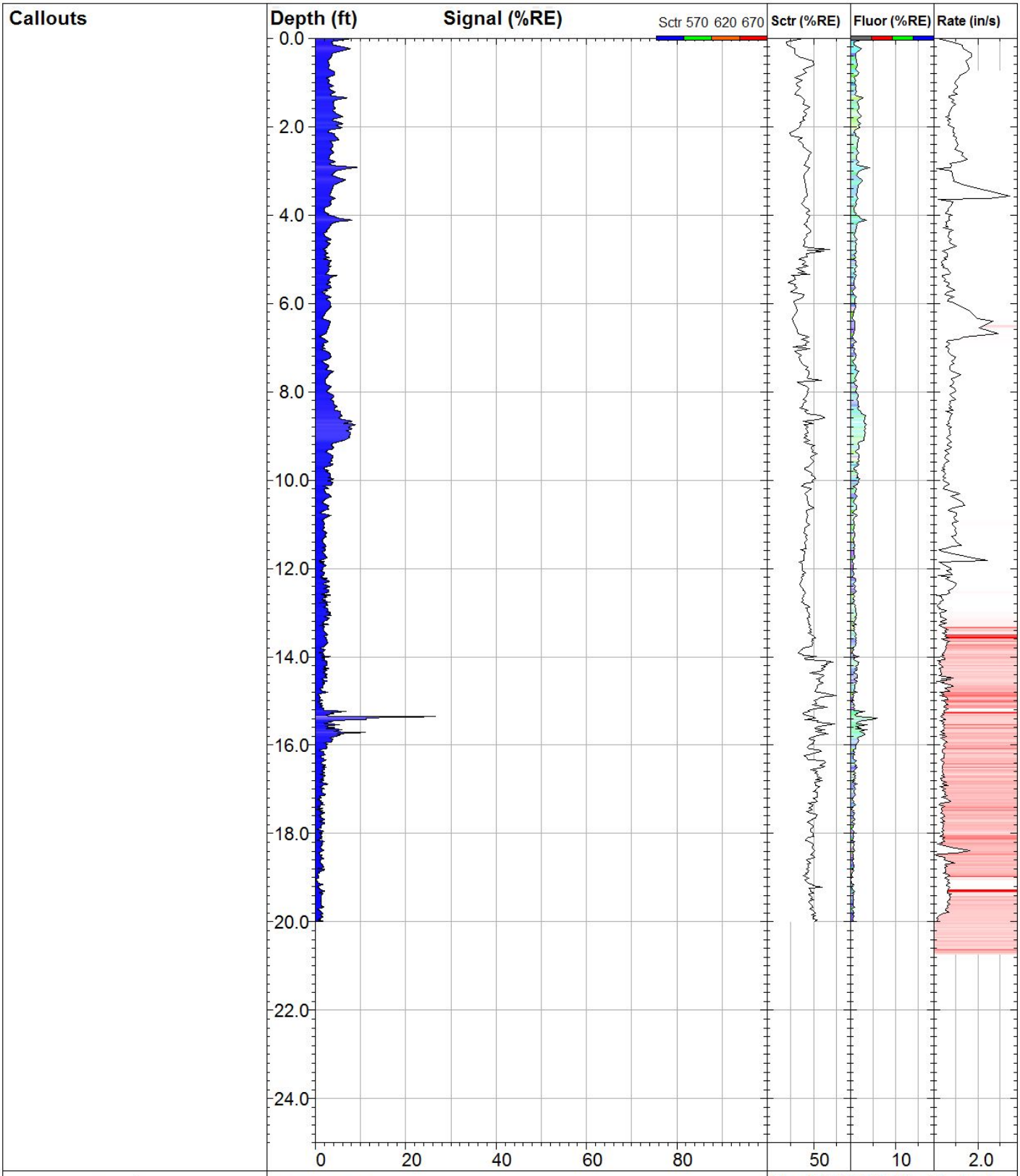
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **22.35 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **81.1 %RE @ 14.61 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 14:34 EDT**



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TG-36

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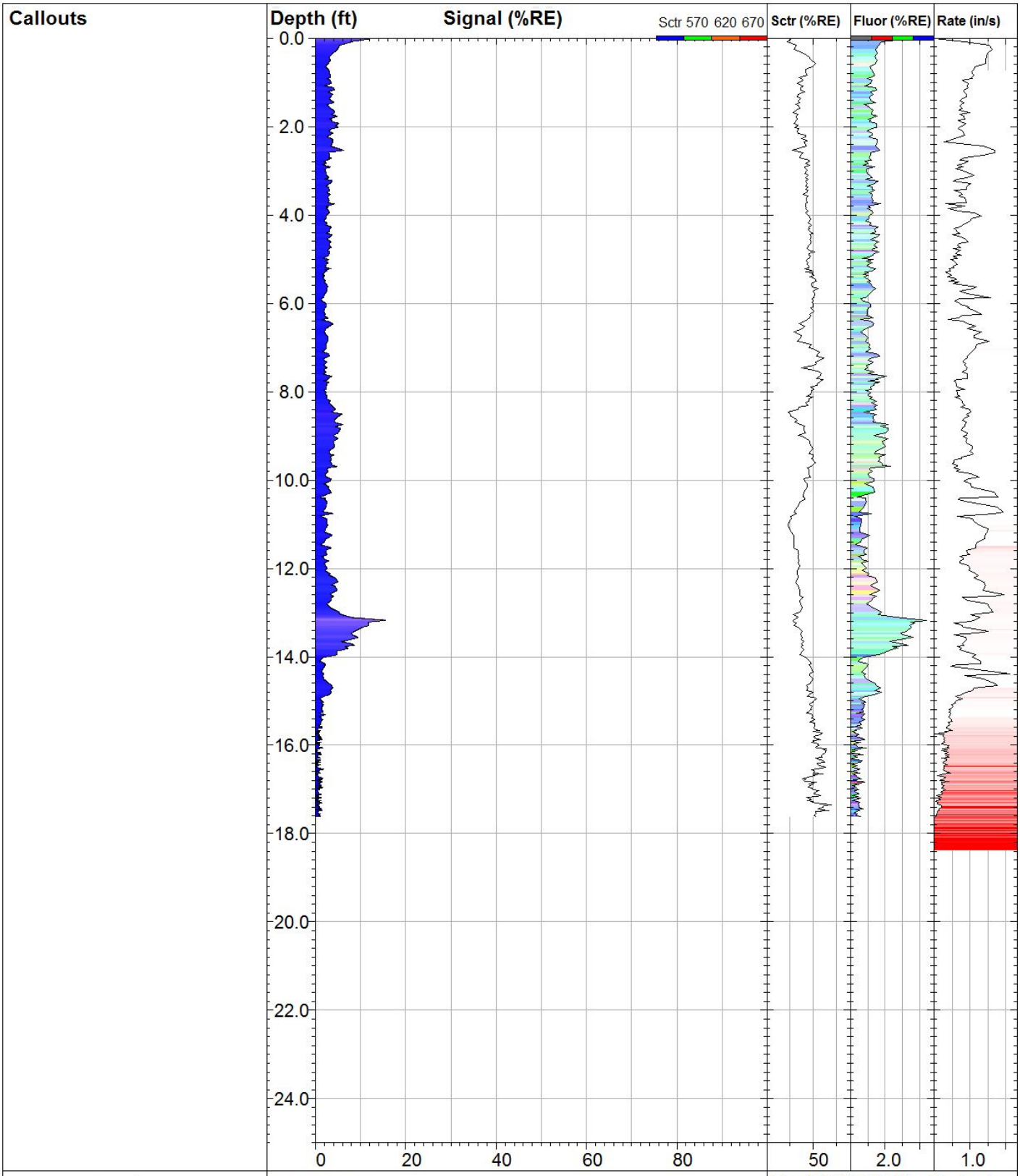
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **22.35 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **27.2 %RE @ 15.35 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 15:00 EDT**



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TG-37

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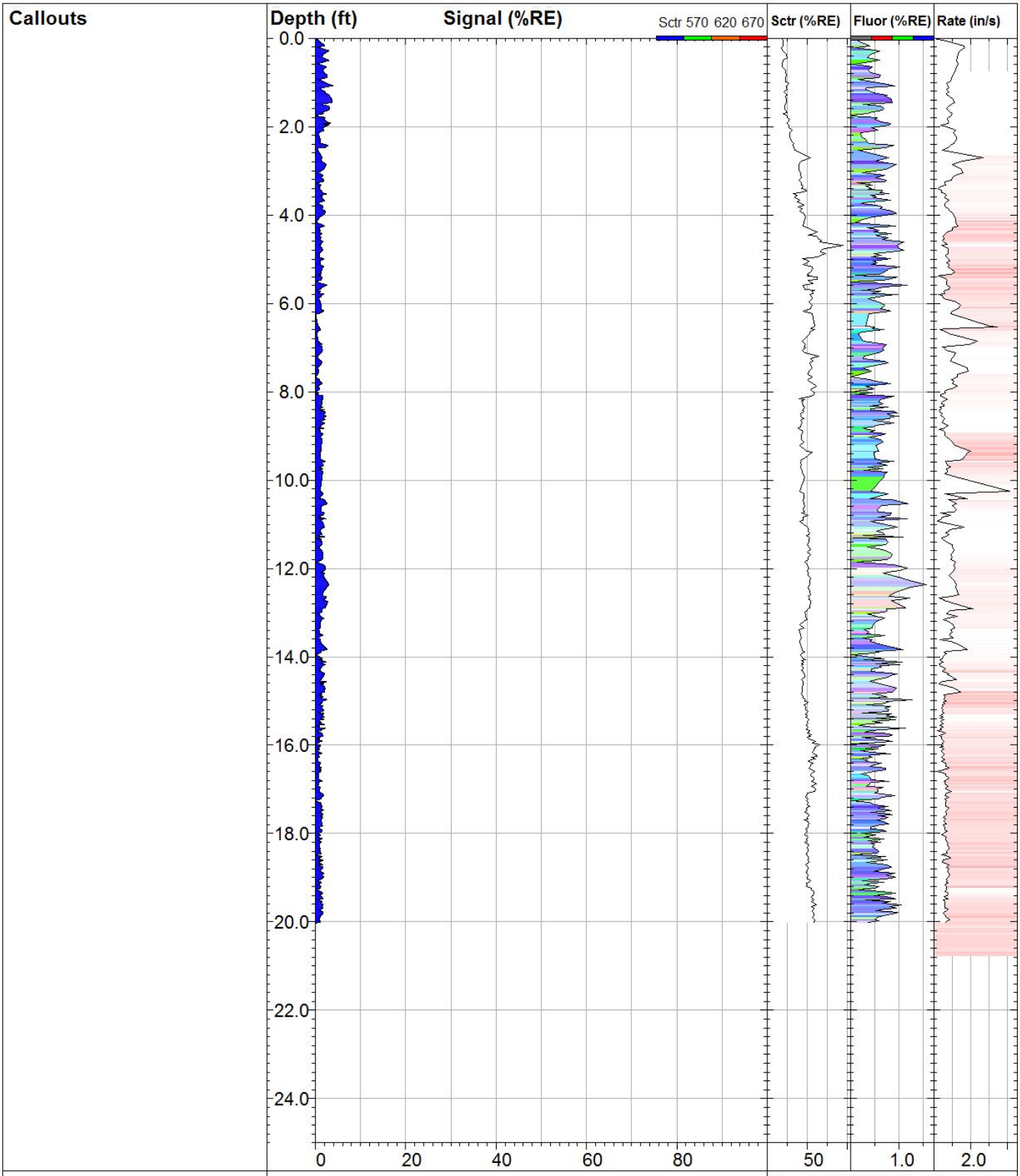
Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **22.35 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **15.6 %RE @ 13.17 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 15:27 EDT**



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TG-38

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Site: **Spartanburg MGP Site**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.02 ft**
Client / Job: **AECOM / 60493834**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **3.8 %RE @ 1.08 ft**
Operator / Unit: **DT/GES / TG1000**	*Elevation:* **Unavailable**	*Date & Time:* **2016-07-14 15:59 EDT**

Appendix D.
Laboratory Analytical Data

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Nashville
2960 Foster Creighton Drive
Nashville, TN 37204
Tel: (615)726-0177

TestAmerica Job ID: 490-107852-1
Client Project/Site: Spartanburg MGP J16070519

For:
Duke Energy Corporation
13339 Hagers Ferry Road
Huntersville, North Carolina 28078

Attn: Lab Customer

Authorized for release by:
7/28/2016 3:06:59 PM

Shali Brown, Project Manager II
(615)301-5031
shali.brown@testamericainc.com

The test results in this report meet all 2003 NELAC and 2009 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Sample Summary

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
490-107852-1	TG01-14-15	Solid	07/15/16 08:15	07/16/16 09:45
490-107852-2	TG03-11-12	Solid	07/15/16 08:45	07/16/16 09:45
490-107852-3	TG29-13-14	Solid	07/15/16 09:15	07/16/16 09:45
490-107852-4	TG17-10-11	Solid	07/15/16 09:45	07/16/16 09:45
490-107852-5	TG19-15	Solid	07/15/16 10:10	07/16/16 09:45
490-107852-6	TG19-20	Solid	07/15/16 10:15	07/16/16 09:45

Job ID: 490-107852-1

Laboratory: TestAmerica Nashville

Narrative

CASE NARRATIVE

Client: Duke Energy Corporation

Project: Spartanburg MGP J16070519

Report Number: 490-107852-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica Nashville attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header.

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT
The samples were received on 07/16/2016; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 0.7 C.

VOLATILE ORGANIC COMPOUNDS (GC-MS)
Samples TG01-14-15 (490-107852-1), TG03-11-12 (490-107852-2), TG29-13-14 (490-107852-3) and TG17-10-11 (490-107852-4) were analyzed for volatile organic compounds (GC-MS) in accordance with EPA SW-846 Method 8260B. The samples were prepared on 07/15/2016 and analyzed on 07/22/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

PERCENT SOLIDS
Samples TG01-14-15 (490-107852-1), TG03-11-12 (490-107852-2), TG29-13-14 (490-107852-3) and TG17-10-11 (490-107852-4) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 07/18/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

MOISTURE, ASH AND ORGANIC MATTER OF PEAT AND OTHER ORGANIC SOILS

Job ID: 490-107852-1 (Continued)

Laboratory: TestAmerica Nashville (Continued)

Samples TG19-15 (490-107852-5) and TG19-20 (490-107852-6) were analyzed for Moisture, Ash and Organic Matter of Peat and Other Organic Soils in accordance with ASTM Method D_2974. The samples were analyzed on 07/25/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Qualifiers

GC/MS VOA

Qualifier	Qualifier Description
F1	MS and/or MSD Recovery is outside acceptance limits.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Client Sample Results

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Client Sample ID: TG01-14-15

Date Collected: 07/15/16 08:15
Date Received: 07/16/16 09:45

Lab Sample ID: 490-107852-1

Matrix: Solid
Percent Solids: 81.8

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		0.110		mg/Kg	☼	07/15/16 08:15	07/22/16 04:18	1
Ethylbenzene	**0.298**		0.110		mg/Kg	☼	07/15/16 08:15	07/22/16 04:18	1
Naphthalene	**10.1**		0.274		mg/Kg	☼	07/15/16 08:15	07/22/16 04:18	1
Toluene	**0.352**		0.110		mg/Kg	☼	07/15/16 08:15	07/22/16 04:18	1
Xylenes, Total	**0.898**		0.164		mg/Kg	☼	07/15/16 08:15	07/22/16 04:18	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*101*		*70 - 130*	*07/15/16 08:15*	*07/22/16 04:18*	*1*
4-Bromofluorobenzene (Surr)	*96*		*70 - 130*	*07/15/16 08:15*	*07/22/16 04:18*	*1*
Dibromofluoromethane (Surr)	*98*		*70 - 130*	*07/15/16 08:15*	*07/22/16 04:18*	*1*
Toluene-d8 (Surr)	*107*		*70 - 130*	*07/15/16 08:15*	*07/22/16 04:18*	*1*

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	**81.8**		0.1		%			07/18/16 14:48	1

Client Sample Results

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Client Sample ID: TG03-11-12

Date Collected: 07/15/16 08:45
Date Received: 07/16/16 09:45

Lab Sample ID: 490-107852-2

Matrix: Solid
Percent Solids: 76.4

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	0.144		0.135	mg/Kg	☼	07/15/16 08:45	07/22/16 07:22	1
Ethylbenzene	121		1.35	mg/Kg	☼	07/15/16 08:45	07/22/16 07:51	10
Naphthalene	2390		33.8	mg/Kg	☼	07/15/16 08:45	07/22/16 18:38	100
Toluene	10.6		0.135	mg/Kg	☼	07/15/16 08:45	07/22/16 07:22	1
Xylenes, Total	191		2.03	mg/Kg	☼	07/15/16 08:45	07/22/16 07:51	10

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*104*		*70 - 130*	*07/15/16 08:45*	*07/22/16 07:22*	*1*
1,2-Dichloroethane-d4 (Surr)	*107*		*70 - 130*	*07/15/16 08:45*	*07/22/16 07:51*	*10*
1,2-Dichloroethane-d4 (Surr)	*108*		*70 - 130*	*07/15/16 08:45*	*07/22/16 18:38*	*100*
4-Bromofluorobenzene (Surr)	*102*		*70 - 130*	*07/15/16 08:45*	*07/22/16 07:22*	*1*
4-Bromofluorobenzene (Surr)	*91*		*70 - 130*	*07/15/16 08:45*	*07/22/16 07:51*	*10*
4-Bromofluorobenzene (Surr)	*100*		*70 - 130*	*07/15/16 08:45*	*07/22/16 18:38*	*100*
Dibromofluoromethane (Surr)	*100*		*70 - 130*	*07/15/16 08:45*	*07/22/16 07:22*	*1*
Dibromofluoromethane (Surr)	*106*		*70 - 130*	*07/15/16 08:45*	*07/22/16 07:51*	*10*
Dibromofluoromethane (Surr)	*106*		*70 - 130*	*07/15/16 08:45*	*07/22/16 18:38*	*100*
Toluene-d8 (Surr)	*105*		*70 - 130*	*07/15/16 08:45*	*07/22/16 07:22*	*1*
Toluene-d8 (Surr)	*104*		*70 - 130*	*07/15/16 08:45*	*07/22/16 07:51*	*10*
Toluene-d8 (Surr)	*101*		*70 - 130*	*07/15/16 08:45*	*07/22/16 18:38*	*100*

General Chemistry

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	76.4		0.1	%			07/18/16 14:48	1

Client Sample Results

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Client Sample ID: TG29-13-14

Date Collected: 07/15/16 09:15
Date Received: 07/16/16 09:45

Lab Sample ID: 490-107852-3

Matrix: Solid
Percent Solids: 85.4

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Benzene	0.108		0.0921		mg/Kg	☼	07/15/16 09:15	07/22/16 06:21	1
Ethylbenzene	8.59		0.0921		mg/Kg	☼	07/15/16 09:15	07/22/16 06:21	1
Naphthalene	220		4.60		mg/Kg	☼	07/15/16 09:15	07/22/16 17:43	20
Toluene	3.16		0.0921		mg/Kg	☼	07/15/16 09:15	07/22/16 06:21	1
Xylenes, Total	14.5		0.138		mg/Kg	☼	07/15/16 09:15	07/22/16 06:21	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*102*		*70 - 130*	*07/15/16 09:15*	*07/22/16 06:21*	*1*
1,2-Dichloroethane-d4 (Surr)	*106*		*70 - 130*	*07/15/16 09:15*	*07/22/16 17:43*	*20*
4-Bromofluorobenzene (Surr)	*95*		*70 - 130*	*07/15/16 09:15*	*07/22/16 06:21*	*1*
4-Bromofluorobenzene (Surr)	*102*		*70 - 130*	*07/15/16 09:15*	*07/22/16 17:43*	*20*
Dibromofluoromethane (Surr)	*100*		*70 - 130*	*07/15/16 09:15*	*07/22/16 06:21*	*1*
Dibromofluoromethane (Surr)	*108*		*70 - 130*	*07/15/16 09:15*	*07/22/16 17:43*	*20*
Toluene-d8 (Surr)	*103*		*70 - 130*	*07/15/16 09:15*	*07/22/16 06:21*	*1*
Toluene-d8 (Surr)	*102*		*70 - 130*	*07/15/16 09:15*	*07/22/16 17:43*	*20*

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	85.4		0.1		%			07/18/16 14:48	1

Client Sample Results

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Client Sample ID: TG17-10-11

Date Collected: 07/15/16 09:45
Date Received: 07/16/16 09:45

Lab Sample ID: 490-107852-4

Matrix: Solid
Percent Solids: 78.4

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Benzene	1.22		0.118		mg/Kg	☼	07/15/16 09:45	07/22/16 05:20	1
Ethylbenzene	3.63		0.118		mg/Kg	☼	07/15/16 09:45	07/22/16 05:20	1
Naphthalene	107		2.95		mg/Kg	☼	07/15/16 09:45	07/22/16 05:51	10
Toluene	0.209		0.118		mg/Kg	☼	07/15/16 09:45	07/22/16 05:20	1
Xylenes, Total	3.86		0.177		mg/Kg	☼	07/15/16 09:45	07/22/16 05:20	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*107*		*70 - 130*	*07/15/16 09:45*	*07/22/16 05:20*	*1*
1,2-Dichloroethane-d4 (Surr)	*107*		*70 - 130*	*07/15/16 09:45*	*07/22/16 05:51*	*10*
4-Bromofluorobenzene (Surr)	*94*		*70 - 130*	*07/15/16 09:45*	*07/22/16 05:20*	*1*
4-Bromofluorobenzene (Surr)	*92*		*70 - 130*	*07/15/16 09:45*	*07/22/16 05:51*	*10*
Dibromofluoromethane (Surr)	*103*		*70 - 130*	*07/15/16 09:45*	*07/22/16 05:20*	*1*
Dibromofluoromethane (Surr)	*101*		*70 - 130*	*07/15/16 09:45*	*07/22/16 05:51*	*10*
Toluene-d8 (Surr)	*102*		*70 - 130*	*07/15/16 09:45*	*07/22/16 05:20*	*1*
Toluene-d8 (Surr)	*105*		*70 - 130*	*07/15/16 09:45*	*07/22/16 05:51*	*10*

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	78.4		0.1		%			07/18/16 14:48	1

Client Sample Results

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Client Sample ID: TG19-15

Lab Sample ID: 490-107852-5

Date Collected: 07/15/16 10:10

Matrix: Solid

Date Received: 07/16/16 09:45

Method: D2974 - Moisture, Ash and Organic Matter

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Fractional Organic Carbon	4.2		0.6		%			07/25/16 08:00	1

Client Sample Results

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Client Sample ID: TG19-20

Lab Sample ID: 490-107852-6

Date Collected: 07/15/16 10:15

Matrix: Solid

Date Received: 07/16/16 09:45

Method: D2974 - Moisture, Ash and Organic Matter

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Fractional Organic Carbon	1.2		0.6		%			07/25/16 08:00	1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Lab Sample ID: 490-107521-C-12-A MS — **Client Sample ID: Matrix Spike**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 357135 — **Prep Batch: 355645**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Benzene	ND		2.90	2.999		mg/Kg	☼	103	21 - 150
Ethylbenzene	ND		2.90	3.001		mg/Kg	☼	103	10 - 150
Naphthalene	0.339		2.90	3.175		mg/Kg	☼	98	10 - 150
Toluene	ND		2.90	2.992		mg/Kg	☼	103	17 - 150
Xylenes, Total	ND		5.80	5.975		mg/Kg	☼	103	10 - 150

Surrogate	*MS %Recovery*	*MS Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*101*		*70 - 130*
4-Bromofluorobenzene (Surr)	*102*		*70 - 130*
Dibromofluoromethane (Surr)	*103*		*70 - 130*
Toluene-d8 (Surr)	*103*		*70 - 130*

Lab Sample ID: 490-107521-C-12-A MSD — **Client Sample ID: Matrix Spike Duplicate**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 357135 — **Prep Batch: 355645**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Benzene	ND		2.90	3.115		mg/Kg	☼	107	21 - 150	4	50
Ethylbenzene	ND		2.90	3.095		mg/Kg	☼	107	10 - 150	3	50
Naphthalene	0.339		2.90	3.970		mg/Kg	☼	125	10 - 150	22	50
Toluene	ND		2.90	3.082		mg/Kg	☼	106	17 - 150	3	50
Xylenes, Total	ND		5.80	6.125		mg/Kg	☼	106	10 - 150	2	50

Surrogate	*MSD %Recovery*	*MSD Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*101*		*70 - 130*
4-Bromofluorobenzene (Surr)	*104*		*70 - 130*
Dibromofluoromethane (Surr)	*103*		*70 - 130*
Toluene-d8 (Surr)	*102*		*70 - 130*

Lab Sample ID: 490-107724-A-6-A MS — **Client Sample ID: Matrix Spike**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 357005 — **Prep Batch: 355662**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Benzene	0.281		3.21	2.567		mg/Kg	☼	71	21 - 150
Ethylbenzene	4.66		3.21	5.583		mg/Kg	☼	29	10 - 150
Naphthalene	8.09	F1	3.21	14.70	F1	mg/Kg	☼	206	10 - 150
Toluene	1.09		3.21	3.208		mg/Kg	☼	66	17 - 150
Xylenes, Total	8.32		6.42	10.33		mg/Kg	☼	31	10 - 150

Surrogate	*MS %Recovery*	*MS Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*100*		*70 - 130*
4-Bromofluorobenzene (Surr)	*94*		*70 - 130*
Dibromofluoromethane (Surr)	*97*		*70 - 130*
Toluene-d8 (Surr)	*116*		*70 - 130*

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: 490-107724-A-6-A MSD — **Client Sample ID: Matrix Spike Duplicate**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 357005 — **Prep Batch: 355662**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Benzene	0.281		3.21	2.737		mg/Kg	☼	76	21 - 150	6	50
Ethylbenzene	4.66		3.21	6.868		mg/Kg	☼	69	10 - 150	21	50
Naphthalene	8.09	F1	3.21	13.17	F1	mg/Kg	☼	158	10 - 150	11	50
Toluene	1.09		3.21	3.646		mg/Kg	☼	80	17 - 150	13	50
Xylenes, Total	8.32		6.42	12.74		mg/Kg	☼	69	10 - 150	21	50

Surrogate	*MSD %Recovery*	*MSD Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*101*		*70 - 130*
4-Bromofluorobenzene (Surr)	*88*		*70 - 130*
Dibromofluoromethane (Surr)	*100*		*70 - 130*
Toluene-d8 (Surr)	*110*		*70 - 130*

Lab Sample ID: MB 490-357005/6 — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 357005

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		0.100	mg/Kg			07/22/16 00:44	1
Ethylbenzene	ND		0.100	mg/Kg			07/22/16 00:44	1
Naphthalene	ND		0.250	mg/Kg			07/22/16 00:44	1
Toluene	ND		0.100	mg/Kg			07/22/16 00:44	1
Xylenes, Total	ND		0.150	mg/Kg			07/22/16 00:44	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*103*		*70 - 130*		*07/22/16 00:44*	*1*
4-Bromofluorobenzene (Surr)	*102*		*70 - 130*		*07/22/16 00:44*	*1*
Dibromofluoromethane (Surr)	*99*		*70 - 130*		*07/22/16 00:44*	*1*
Toluene-d8 (Surr)	*99*		*70 - 130*		*07/22/16 00:44*	*1*

Lab Sample ID: LCS 490-357005/3 — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 357005

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Benzene	2.50	2.086		mg/Kg		83	70 - 130
Ethylbenzene	2.50	2.190		mg/Kg		88	70 - 130
Naphthalene	2.50	1.907		mg/Kg		76	55 - 149
Toluene	2.50	2.166		mg/Kg		87	70 - 130
Xylenes, Total	5.00	4.317		mg/Kg		86	70 - 130

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*101*		*70 - 130*
4-Bromofluorobenzene (Surr)	*97*		*70 - 130*
Dibromofluoromethane (Surr)	*96*		*70 - 130*
Toluene-d8 (Surr)	*102*		*70 - 130*

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCSD 490-357005/4 — **Client Sample ID: Lab Control Sample Dup**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 357005

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Benzene	2.50	1.989		mg/Kg		80	70 - 130	5	37
Ethylbenzene	2.50	1.968		mg/Kg		79	70 - 130	11	38
Naphthalene	2.50	1.875		mg/Kg		75	55 - 149	2	37
Toluene	2.50	2.024		mg/Kg		81	70 - 130	7	40
Xylenes, Total	5.00	3.772		mg/Kg		75	70 - 130	13	38

Surrogate	*LCSD %Recovery*	*LCSD Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*98*		*70 - 130*
4-Bromofluorobenzene (Surr)	*98*		*70 - 130*
Dibromofluoromethane (Surr)	*95*		*70 - 130*
Toluene-d8 (Surr)	*105*		*70 - 130*

Lab Sample ID: MB 490-357135/6 — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 357135

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		0.100	mg/Kg			07/22/16 13:05	1
Ethylbenzene	ND		0.100	mg/Kg			07/22/16 13:05	1
Naphthalene	ND		0.250	mg/Kg			07/22/16 13:05	1
Toluene	ND		0.100	mg/Kg			07/22/16 13:05	1
Xylenes, Total	ND		0.150	mg/Kg			07/22/16 13:05	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
1,2-Dichloroethane-d4 (Surr)	*124*		*70 - 130*		*07/22/16 13:05*	*1*
4-Bromofluorobenzene (Surr)	*106*		*70 - 130*		*07/22/16 13:05*	*1*
Dibromofluoromethane (Surr)	*109*		*70 - 130*		*07/22/16 13:05*	*1*
Toluene-d8 (Surr)	*104*		*70 - 130*		*07/22/16 13:05*	*1*

Lab Sample ID: LCS 490-357135/3 — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 357135

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Benzene	2.50	2.700		mg/Kg		108	70 - 130
Ethylbenzene	2.50	2.574		mg/Kg		103	70 - 130
Naphthalene	2.50	2.551		mg/Kg		102	55 - 149
Toluene	2.50	2.624		mg/Kg		105	70 - 130
Xylenes, Total	5.00	5.111		mg/Kg		102	70 - 130

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*115*		*70 - 130*
4-Bromofluorobenzene (Surr)	*102*		*70 - 130*
Dibromofluoromethane (Surr)	*109*		*70 - 130*
Toluene-d8 (Surr)	*103*		*70 - 130*

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCSD 490-357135/4
Matrix: Solid
Analysis Batch: 357135

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Benzene			2.50	2.695		mg/Kg		108	70 - 130	0	37
Ethylbenzene			2.50	2.569		mg/Kg		103	70 - 130	0	38
Naphthalene			2.50	2.595		mg/Kg		104	55 - 149	2	37
Toluene			2.50	2.567		mg/Kg		103	70 - 130	2	40
Xylenes, Total			5.00	5.045		mg/Kg		101	70 - 130	1	38

Surrogate	*LCSD %Recovery*	*LCSD Qualifier*	*Limits*
1,2-Dichloroethane-d4 (Surr)	*116*		*70 - 130*
4-Bromofluorobenzene (Surr)	*101*		*70 - 130*
Dibromofluoromethane (Surr)	*108*		*70 - 130*
Toluene-d8 (Surr)	*102*		*70 - 130*

Method: Moisture - Percent Moisture

Lab Sample ID: 490-107852-1 DU
Matrix: Solid
Analysis Batch: 356026

Client Sample ID: TG01-14-15
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Percent Solids	81.8			79.8		%				2	20

Method: D2974 - Moisture, Ash and Organic Matter

Lab Sample ID: MB 490-358714/1
Matrix: Solid
Analysis Batch: 358714

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Fractional Organic Carbon	ND		0.6		%			07/25/16 08:00	1

Lab Sample ID: 490-107852-5 DU
Matrix: Solid
Analysis Batch: 358714

Client Sample ID: TG19-15
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Fractional Organic Carbon	4.2			4.4		%				5	46

QC Association Summary

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

GC/MS VOA

Prep Batch: 355645

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-107521-C-12-A MS	Matrix Spike	Total/NA	Solid	5030B	
490-107521-C-12-A MSD	Matrix Spike Duplicate	Total/NA	Solid	5030B	

Prep Batch: 355662

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-107724-A-6-A MS	Matrix Spike	Total/NA	Solid	5030B	
490-107724-A-6-A MSD	Matrix Spike Duplicate	Total/NA	Solid	5030B	

Prep Batch: 355991

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-107852-1	TG01-14-15	Total/NA	Solid	5035	
490-107852-2	TG03-11-12	Total/NA	Solid	5035	
490-107852-3	TG29-13-14	Total/NA	Solid	5035	
490-107852-4	TG17-10-11	Total/NA	Solid	5035	

Analysis Batch: 357005

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-107852-1	TG01-14-15	Total/NA	Solid	8260B	355991
490-107852-2	TG03-11-12	Total/NA	Solid	8260B	355991
490-107852-2	TG03-11-12	Total/NA	Solid	8260B	355991
490-107852-3	TG29-13-14	Total/NA	Solid	8260B	355991
490-107852-4	TG17-10-11	Total/NA	Solid	8260B	355991
490-107852-4	TG17-10-11	Total/NA	Solid	8260B	355991
MB 490-357005/6	Method Blank	Total/NA	Solid	8260B	
LCS 490-357005/3	Lab Control Sample	Total/NA	Solid	8260B	
LCSD 490-357005/4	Lab Control Sample Dup	Total/NA	Solid	8260B	
490-107724-A-6-A MS	Matrix Spike	Total/NA	Solid	8260B	355662
490-107724-A-6-A MSD	Matrix Spike Duplicate	Total/NA	Solid	8260B	355662

Analysis Batch: 357135

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-107852-2	TG03-11-12	Total/NA	Solid	8260B	355991
490-107852-3	TG29-13-14	Total/NA	Solid	8260B	355991
MB 490-357135/6	Method Blank	Total/NA	Solid	8260B	
LCS 490-357135/3	Lab Control Sample	Total/NA	Solid	8260B	
LCSD 490-357135/4	Lab Control Sample Dup	Total/NA	Solid	8260B	
490-107521-C-12-A MS	Matrix Spike	Total/NA	Solid	8260B	355645
490-107521-C-12-A MSD	Matrix Spike Duplicate	Total/NA	Solid	8260B	355645

General Chemistry

Analysis Batch: 356026

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-107852-1	TG01-14-15	Total/NA	Solid	Moisture	
490-107852-2	TG03-11-12	Total/NA	Solid	Moisture	
490-107852-3	TG29-13-14	Total/NA	Solid	Moisture	
490-107852-4	TG17-10-11	Total/NA	Solid	Moisture	
490-107852-1 DU	TG01-14-15	Total/NA	Solid	Moisture	

QC Association Summary

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Geotechnical

Analysis Batch: 358714

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-107852-5	TG19-15	Total/NA	Solid	D2974	
490-107852-6	TG19-20	Total/NA	Solid	D2974	
MB 490-358714/1	Method Blank	Total/NA	Solid	D2974	
490-107852-5 DU	TG19-15	Total/NA	Solid	D2974	

Lab Chronicle

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Client Sample ID: TG01-14-15 — Lab Sample ID: 490-107852-1

Date Collected: 07/15/16 08:15 — **Matrix: Solid**
Date Received: 07/16/16 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	356026	07/18/16 14:48	AAB	TAL NSH

Client Sample ID: TG01-14-15 — Lab Sample ID: 490-107852-1

Date Collected: 07/15/16 08:15 — **Matrix: Solid**
Date Received: 07/16/16 09:45 — **Percent Solids: 81.8**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			355991	07/15/16 08:15	JLP	TAL NSH
Total/NA	Analysis	8260B		1	357005	07/22/16 04:18	EML	TAL NSH

Client Sample ID: TG03-11-12 — Lab Sample ID: 490-107852-2

Date Collected: 07/15/16 08:45 — **Matrix: Solid**
Date Received: 07/16/16 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	356026	07/18/16 14:48	AAB	TAL NSH

Client Sample ID: TG03-11-12 — Lab Sample ID: 490-107852-2

Date Collected: 07/15/16 08:45 — **Matrix: Solid**
Date Received: 07/16/16 09:45 — **Percent Solids: 76.4**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			355991	07/15/16 08:45	JLP	TAL NSH
Total/NA	Analysis	8260B		1	357005	07/22/16 07:22	EML	TAL NSH
Total/NA	Prep	5035			355991	07/15/16 08:45	JLP	TAL NSH
Total/NA	Analysis	8260B		10	357005	07/22/16 07:51	EML	TAL NSH
Total/NA	Prep	5035			355991	07/15/16 08:45	JLP	TAL NSH
Total/NA	Analysis	8260B		100	357135	07/22/16 18:38	EML	TAL NSH

Client Sample ID: TG29-13-14 — Lab Sample ID: 490-107852-3

Date Collected: 07/15/16 09:15 — **Matrix: Solid**
Date Received: 07/16/16 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	356026	07/18/16 14:48	AAB	TAL NSH

Client Sample ID: TG29-13-14 — Lab Sample ID: 490-107852-3

Date Collected: 07/15/16 09:15 — **Matrix: Solid**
Date Received: 07/16/16 09:45 — **Percent Solids: 85.4**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			355991	07/15/16 09:15	JLP	TAL NSH

Lab Chronicle

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Client Sample ID: TG29-13-14 — Lab Sample ID: 490-107852-3

Date Collected: 07/15/16 09:15 — **Matrix: Solid**
Date Received: 07/16/16 09:45 — **Percent Solids: 85.4**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	357005	07/22/16 06:21	EML	TAL NSH
Total/NA	Prep	5035			355991	07/15/16 09:15	JLP	TAL NSH
Total/NA	Analysis	8260B		20	357135	07/22/16 17:43	EML	TAL NSH

Client Sample ID: TG17-10-11 — Lab Sample ID: 490-107852-4

Date Collected: 07/15/16 09:45 — **Matrix: Solid**
Date Received: 07/16/16 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	356026	07/18/16 14:48	AAB	TAL NSH

Client Sample ID: TG17-10-11 — Lab Sample ID: 490-107852-4

Date Collected: 07/15/16 09:45 — **Matrix: Solid**
Date Received: 07/16/16 09:45 — **Percent Solids: 78.4**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			355991	07/15/16 09:45	JLP	TAL NSH
Total/NA	Analysis	8260B		1	357005	07/22/16 05:20	EML	TAL NSH
Total/NA	Prep	5035			355991	07/15/16 09:45	JLP	TAL NSH
Total/NA	Analysis	8260B		10	357005	07/22/16 05:51	EML	TAL NSH

Client Sample ID: TG19-15 — Lab Sample ID: 490-107852-5

Date Collected: 07/15/16 10:10 — **Matrix: Solid**
Date Received: 07/16/16 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D2974		1	358714	07/25/16 08:00	CLJ	TAL NSH

Client Sample ID: TG19-20 — Lab Sample ID: 490-107852-6

Date Collected: 07/15/16 10:15 — **Matrix: Solid**
Date Received: 07/16/16 09:45

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D2974		1	358714	07/25/16 08:00	CLJ	TAL NSH

Laboratory References:

TAL NSH = TestAmerica Nashville, 2960 Foster Creighton Drive, Nashville, TN 37204, TEL (615)726-0177

Method Summary

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Method	Method Description	Protocol	Laboratory
8260B	Volatile Organic Compounds (GC/MS)	SW846	TAL NSH
Moisture	Percent Moisture	EPA	TAL NSH
D2974	Moisture, Ash and Organic Matter	ASTM	TAL NSH

Protocol References:

ASTM = ASTM International

EPA = US Environmental Protection Agency

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL NSH = TestAmerica Nashville, 2960 Foster Creighton Drive, Nashville, TN 37204, TEL (615)726-0177

Certification Summary

Client: Duke Energy Corporation
Project/Site: Spartanburg MGP J16070519

TestAmerica Job ID: 490-107852-1

Laboratory: TestAmerica Nashville

Unless otherwise noted, all analytes for this laboratory were covered under each certification below.

Authority	Program	EPA Region	Certification ID	Expiration Date
South Carolina	State Program	4	84009 (001)	02-28-16 *

The following analytes are included in this report, but certification is not offered by the governing authority:

Analysis Method	Prep Method	Matrix	Analyte
D2974		Solid	Fractional Organic Carbon
Moisture		Solid	Percent Solids

South Carolina (Do Not Use - DW)	State Program	4	84009 (002)	12-16-17

The following analytes are included in this report, but certification is not offered by the governing authority:

Analysis Method	Prep Method	Matrix	Analyte
8260B	5035	Solid	Benzene
8260B	5035	Solid	Ethylbenzene
8260B	5035	Solid	Naphthalene
8260B	5035	Solid	Toluene
8260B	5035	Solid	Xylenes, Total
D2974		Solid	Fractional Organic Carbon
Moisture		Solid	Percent Solids

* Certification renewal pending - certification considered valid.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
Nashville, TN

COOLER RECEIPT FORM

490-107852 Chain of Custody

Cooler Received/Opened On 7/16/2016 @ 0945

Time Samples Removed From Cooler 1600 Time Samples Placed In Storage 1641 (2 Hour Window)

1. Tracking # 8063 (last 4 digits, FedEx) Courier: FedeX Ground

IR Gun ID 17960353 pH Strip Lot HC574756 Chlorine Strip Lot 041416F

2. Temperature of rep. sample or temp blank when opened: 0.7 *Degrees Celsius*

3. If Item #2 temperature is 0°C or less, was the representative sample or temp blank frozen? YES NO...NA

4. Were custody seals on outside of cooler? YES...NO...NA

If yes, how many and where: one front

5. Were the seals intact, signed, and dated correctly? YES...NO...NA

6. Were custody papers inside cooler? YES...NO...NA

I certify that I opened the cooler and answered questions 1-6 (intial) DA

7. Were custody seals on containers: YES NO and Intact YES...NO...NA

Were these signed and dated correctly? YES...NO...NA

8. Packing mat'l used? Bubblewrap Plastic bag Peanuts Vermiculite Foam Insert Paper Other None

9. Cooling process: Ice Ice-pack Ice (direct contact) Dry ice Other None

10. Did all containers arrive in good condition (unbroken)? YES...NO...NA

11. Were all container labels complete (#, date, signed, pres., etc)? YES...NO...NA

12. Did all container labels and tags agree with custody papers? YES...NO...NA

13a. Were VOA vials received? YES...NO...NA

b. Was there any observable headspace present in any VOA vial? YES...NO...NA

14. Was there a Trip Blank in this cooler? YES...NO...NA If multiple coolers, sequence # N/A

I certify that I unloaded the cooler and answered questions 7-14 (intial) ACOS

15a. On pres'd bottles, did pH test strips suggest preservation reached the correct pH level? YES...NO...NA ACOS 7/16/16

b. Did the bottle labels indicate that the correct preservatives were used YES...NO...NA

16. Was residual chlorine present? YES...NO...NA

I certify that I checked for chlorine and pH as per SOP and answered questions 15-16 (intial) ACOS

17. Were custody papers properly filled out (ink, signed, etc)? YES...NO...NA

18. Did you sign the custody papers in the appropriate place? YES...NO...NA

19. Were correct containers used for the analysis requested? YES...NO...NA

20. Was sufficient amount of sample sent in each container? YES...NO...NA

I certify that I entered this project into LIMS and answered questions 17-20 (intial) ACOS

I certify that I attached a label with the unique LIMS number to each container (intial) ACOS

21. Were there Non-Conformance issues at login? YES...NO Was a NCM generated? YES...NO...# NA

BIS = Broken in shipment
Cooler Receipt Form.doc

LF-1
End of Form

Revised 12/15/15

[redacted]

Chain of Custody Record

Charlotte Service Center

Temperature on Receipt _____

Drinking Water? Yes☐ No☐

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124 (1007)

Client	Project Manager	Date	Chain of Custody Number
AECOM	Paul Farris		287869
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page 1 of 1**
1600 Perimeter Park Drive Suite 400	919-461-1468 paul.farris@AECOM.com		
City / State / Zip Code	**Site Contact / Lab Contact**	**Analysis (Attach list if more space is needed)**	
Morrisville / NC / 27560			Loc: 490 107852
Project Name and Location (State)	**Carrier/Waybill Number**		
Duke MGP 60493834	FEDEX 8091 6017 8063		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	MeOH Soil	BTEX/Naph 8260B	FOC ASTM 2974
TG01-14-15	7/15/16	0815				X	X						X	X	
TG03-11-12	7/15/16	0845				X	X						X	X	
TG29-13-14	7/15/16	0915				X	X						X	X	
TG17-10-11	7/15/16	0945				X	X						X	X	
TG19-15	7/15/16	1010				X	X								X
TG19-20	7/15/16	1015				X	X								X

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other Standard

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	7/15/16	1130	1. Received By TAN	7/16/16	0945
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

ANALYTICAL LABORATORY REQUEST FORM (ARF)

(1) Complete all yellow sections of this form. Move through by striking the "TAB" key.

(2) Save the file & e-mail to:	labcustomer@duke-energy.com
Questions / Problems Call:	704-875-5245

Duke Energy Completes and sends ARF to the engineering firm

Customer Information

Your Name	Office Phone	Cell Phone
Andrew Shull	919-546-2104	919-946-5835

Project Name(Use Remediation/Decommissioning/MGP site name)	Your e-Mail Address
Spartanburg MGP	Andrew.Shull@duke-energy.com

Duke Vendor Labs & Contact	Accounting Fields	
Test America: ***Candace.Bonham@testamericainc.com***	Accounting Type	Specific Accounting
Pace: ***Kevin.Herring@pacelabs.com***	Operating Unit	0193
Accutest: ***Andreac@accutest.com***	Project ID	MGPSPTPST
Prism: ***Aovercash@prismlabs.com***	Activity ID	ALLACTV
	Account	0228280
Also send copy to - labcustomer@duke-energy.com		

Engineering Firm Completes these sections and sends ARF to one of the Duke Vendor Lab Contacts listed above

Sampling Information

Sampling Personnel / Contractor	Scheduled Sampling Date	Date Sample Kit Needed
AECOM	7/15/2016	7/14/2016

Shipping Address for Kit

Name	Phone	Mail Code
Aaron Council	864 234 3032	
Street Address - street address and town needed	State	Zip Code
10 Patewood Drive, Bldg. 6, Ste 500, Greenville	SC	29615

Reporting

Report Due Date	Additional Reports - .pdf file w/ Basic QC and EDD (spreadsheet) is Standard	
standard	EDD spreadsheet of all results	
Report To (e-Mail Address 1)	Report To (e-Mail Address 2)	Report to (e-Mail Address 3)
Andrew.Shull@duke-energy.com	paul.farris@aecom.com	jon.kucera@aecom.com

Project Specifics

Project Name	Program Type
Spartanburg MGP	

Site, Location or Station	State	Approximate Number of Days Sampling is Scheduled
684 North Pine Street	SC	1

Notes, Special Requests, Required Contract Lab to use, etc.

Up to 4 soil samples may be collected depending on results of TarGOST field screening investigation (possibility for no sample collection).

Bottles	Matrix	Variables, Methods
4	soil	BTEX / Naphthalene - 8260B
2	soil	Fraction of Organic Carbon - ASTM 2974
		IMPORTANT: Vendor lab indicate above Project Name on COC

Login Sample Receipt Checklist

Client: Duke Energy Corporation

Job Number: 490-107852-1

Login Number: 107852

List Source: TestAmerica Nashville

List Number: 1

Creator: Stvartak, Anthony Q

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Appendix E.
MAROS Output

MAROS Mann-Kendall Statistics Summary

Project: Duke Spartanburg MGP
User Name: Elizabeth Morgan
Location: Spartanburg
State: North Carolina

Time Period: 10/21/2004 to 10/20/2016
Consolidation Period: Yearly
Consolidation Type: Geometric Mean
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value

Well	Source/ Tail	Number of Samples	Number of Detects	Coefficient of Variation	Mann-Kendall Statistic	Confidence in Trend	All Samples "ND" ?	Concentration Trend
BENZENE								
MW-10D	T	10	1	0.00	-9	75.8%	No	S
MW-10S	T	13	5	1.17	-42	99.5%	No	D
MW-11D	T	13	7	0.96	-45	99.8%	No	D
MW-11S	T	13	6	0.83	-43	99.6%	No	D
MW-12D	T	13	5	0.39	-10	70.5%	No	S
MW-12S	S	13	8	1.99	-64	100.0%	No	D
MW-13D	S	13	13	0.78	-42	99.5%	No	D
MW-13ISOC	S	11	11	1.11	-29	98.7%	No	D
MW-13S	S	13	13	0.94	-62	100.0%	No	D
MW-14D	T	13	4	0.56	-42	99.5%	No	D
MW-14S	T	13	12	1.28	-48	99.9%	No	D
MW-15D	T	13	10	0.75	-47	99.9%	No	D
MW-15S	T	13	13	1.09	-60	100.0%	No	D
MW-16D	S	10	1	0.00	-9	75.8%	No	S
MW-16S	S	13	0	0.00	0	47.6%	Yes	ND
MW-3SS	S	7	0	0.00	0	43.7%	Yes	ND
NAPHTHALENE								
MW-10D	T	10	2	1.22	-17	92.2%	No	PD
MW-10S	T	13	6	3.07	-19	86.1%	No	NT
MW-11D	T	13	9	1.16	-66	100.0%	No	D
MW-11S	T	13	6	1.89	-45	99.8%	No	D
MW-12D	T	13	6	0.49	-21	88.6%	No	S
MW-12S	S	13	8	2.32	-54	100.0%	No	D
MW-13D	S	13	12	0.82	-28	95.0%	No	D
MW-13ISOC	S	11	10	1.05	-33	99.5%	No	D
MW-13S	S	13	13	0.84	-62	100.0%	No	D

MAROS Mann-Kendall Statistics Summary

Project: Duke Spartanburg MGP
User Name: Elizabeth Morgan
Location: Spartanburg
State: North Carolina

NAPHTHALENE

Well	Source/ Tail	Number of Samples	Number of Detects	Coefficient of Variation	Mann-Kendall Statistic	Confidence in Trend	All Samples "ND" ?	Concentration Trend
MW-14D	T	13	10	1.23	-45	99.8%	No	D
MW-14S	T	13	12	0.94	-42	99.5%	No	D
MW-15D	T	13	13	0.68	10	70.5%	No	NT
MW-15S	T	13	13	0.79	-54	100.0%	No	D
MW-16D	S	10	3	0.61	-8	72.9%	No	S
MW-16S	S	13	1	0.02	-8	66.2%	No	S
MW-3SS	S	7	1	2.42	4	66.7%	No	NT

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A)-Due to insufficient Data (< 4 sampling events); Source/Tail (S/T)

The Number of Samples and Number of Detects shown above are post-consolidation values.

MAROS Spatial Moment Analysis Summary

Project: Duke Spartanburg MGP
User Name: Elizabeth Morgan
Location: Spartanburg
State: North Carolina

	0th Moment	1st Moment (Center of Mass)			2nd Moment (Spread)		
Effective Date	Estimated Mass (Kg)	Xc (ft)	Yc (ft)	Source Distance	Sigma XX (sq ft)	Sigma YY (sq ft)	Number of Wells
BENZENE							
7/1/2004	2.1E-01	1,723,464	1,139,032	76	6,938	1,025	8
7/1/2005	2.9E-01	1,723,470	1,139,037	70	5,904	822	8
7/1/2006	1.8E-01	1,723,472	1,139,029	69	6,169	1,018	9
7/1/2007	1.0E-01	1,723,462	1,139,028	79	6,741	1,100	9
7/1/2008	5.8E-02	1,723,462	1,139,023	80	8,629	1,239	9
7/1/2009	5.9E-02	1,723,444	1,139,024	97	7,737	1,183	9
7/1/2010	3.7E-02	1,723,484	1,139,010	63	2,185	1,215	8
7/1/2011	3.3E-02	1,723,491	1,139,012	55	2,675	1,244	8
7/1/2012	2.5E-02	1,723,472	1,139,005	76	2,397	1,258	8
7/1/2013	9.9E-03	1,723,465	1,138,995	87	2,885	1,331	8
7/1/2014	8.8E-03	1,723,487	1,138,998	67	3,636	1,286	8
7/1/2015	7.8E-03	1,723,490	1,138,997	65	4,072	1,276	8
7/1/2016	1.5E-02	1,723,449	1,138,998	100	10,397	1,004	9
NAPHTHALENE							
7/1/2004	5.0E+00	1,723,509	1,139,037	31	5,829	703	8
7/1/2005	4.0E+00	1,723,510	1,139,038	30	5,182	697	8
7/1/2006	2.3E+00	1,723,503	1,139,037	37	5,039	768	9
7/1/2007	1.3E+00	1,723,506	1,139,027	36	5,848	1,002	9
7/1/2008	1.1E+00	1,723,515	1,139,026	29	6,309	1,011	9
7/1/2009	7.6E-01	1,723,431	1,139,024	110	12,107	954	9
7/1/2010	5.5E-01	1,723,523	1,139,018	27	3,668	958	8
7/1/2011	4.5E-01	1,723,524	1,139,023	22	3,399	994	8
7/1/2012	1.7E-01	1,723,507	1,139,014	42	3,987	1,171	8
7/1/2013	8.3E-02	1,723,467	1,138,990	88	3,656	1,149	8
7/1/2014	8.1E-02	1,723,496	1,138,996	61	3,744	1,071	8
7/1/2015	1.4E-01	1,723,517	1,139,005	41	4,019	1,107	8
7/1/2016	2.4E-01	1,723,499	1,139,005	53	8,175	959	9

MAROS Spatial Moment Analysis Summary

Project: Duke Spartanburg MGP
User Name: Elizabeth Morgan
Location: Spartanburg
State: North Carolina

Spatial Moment Analysis Summary:

Moment Type	Constituent	Coefficient of Variation	Mann-Kendall S Statistic	Confidence in Trend	Moment Trend
0th Moment	BENZENE	1.13	-68	100.0%	D
0th Moment	NAPHTHALENE	1.28	-66	100.0%	D
First Moment	BENZENE	0.17	2	52.4%	NT
First Moment	NAPHTHALENE	0.55	18	84.7%	NT
Second Moment X	BENZENE	0.49	-4	57.1%	S
Second Moment X	NAPHTHALENE	0.44	-10	70.5%	S
Second Moment Y	BENZENE	0.13	42	99.5%	I
Second Moment Y	NAPHTHALENE	0.16	40	99.3%	I

Note: The following assumptions were applied for the calculation of the Zeroth Moment:

Porosity: 0.40 Saturated Thickness: Uniform: 10 ft

Mann-Kendall Trend test performed on all sample events for each constituent. Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A)-Due to insufficient Data (< 4 sampling events); (ND) Non Detect.

Note: The Sigma XX and Sigma YY components are estimated using the given field coordinate system and then rotated to align with the estimated groundwater flow direction. Moments are not calculated for sample events with less than 6 wells.

MAROS Spatial Moment Analysis Summary

Project: Duke Spartanburg MGP-PWR
User Name: Elizabeth Morgan
Location: Spartanburg
State: North Carolina

	0th Moment	1st Moment (Center of Mass)			2nd Moment (Spread)		
Effective Date	Estimated Mass (Kg)	Xc (ft)	Yc (ft)	Source Distance	Sigma XX (sq ft)	Sigma YY (sq ft)	Number of Wells
BENZENE							
7/1/2007	7.4E-03	1,723,458	1,138,981	100	3,163	1,244	7
7/1/2008	5.8E-03	1,723,465	1,138,984	92	3,554	1,331	7
7/1/2009	6.8E-03	1,723,461	1,138,983	97	3,159	1,286	7
7/1/2010	4.0E-03	1,723,471	1,138,989	85	3,618	1,475	7
7/1/2011	5.7E-03	1,723,476	1,138,995	77	3,075	1,538	7
7/1/2012	2.5E-03	1,723,485	1,138,994	70	4,004	1,497	7
7/1/2013	1.5E-03	1,723,495	1,138,993	64	4,734	1,450	7
7/1/2014	1.7E-03	1,723,490	1,138,993	68	4,475	1,436	7
7/1/2015	4.7E-03	1,723,471	1,138,989	85	2,898	1,360	7
7/1/2016	2.6E-03	1,723,480	1,138,991	77	3,759	1,401	7
NAPHTHALENE							
7/1/2007	2.2E-01	1,723,508	1,138,996	53	5,995	1,322	7
7/1/2008	1.3E-01	1,723,504	1,139,000	53	5,598	1,525	7
7/1/2009	1.0E-01	1,723,482	1,138,991	75	5,355	1,536	7
7/1/2010	9.4E-02	1,723,531	1,139,011	29	5,639	1,467	7
7/1/2011	1.2E-01	1,723,518	1,139,012	35	4,573	1,459	7
7/1/2012	3.7E-02	1,723,540	1,139,014	25	5,347	1,398	7
7/1/2013	1.1E-02	1,723,540	1,139,011	27	5,411	1,460	7
7/1/2014	9.1E-03	1,723,541	1,139,011	28	5,352	1,469	7
7/1/2015	3.9E-02	1,723,500	1,139,005	53	4,672	1,627	7
7/1/2016	2.6E-02	1,723,552	1,139,016	26	4,842	1,297	7

MAROS Spatial Moment Analysis Summary

Project: Duke Spartanburg MGP-PWR
User Name: Elizabeth Morgan
Location: Spartanburg
State: North Carolina

Spatial Moment Analysis Summary:

Moment Type	Constituent	Coefficient of Variation	Mann-Kendall S Statistic	Confidence in Trend	Moment Trend
0th Moment	BENZENE	0.50	-25	98.6%	D
0th Moment	NAPHTHALENE	0.86	-31	99.8%	D
First Moment	BENZENE	0.15	-25	98.6%	D
First Moment	NAPHTHALENE	0.42	-19	94.6%	PD
Second Moment X	BENZENE	0.17	9	75.8%	NT
Second Moment X	NAPHTHALENE	0.09	-23	97.7%	D
Second Moment Y	BENZENE	0.07	7	70.0%	NT
Second Moment Y	NAPHTHALENE	0.07	-1	50.0%	S

Note: The following assumptions were applied for the calculation of the Zeroth Moment:

Porosity: 0.40 Saturated Thickness: Uniform: 5 ft

Mann-Kendall Trend test performed on all sample events for each constituent. Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A)-Due to insufficient Data (< 4 sampling events); (ND) Non Detect.

Note: The Sigma XX and Sigma YY components are estimated using the given field coordinate system and then rotated to align with the estimated groundwater flow direction. Moments are not calculated for sample events with less than 6 wells.

Appendix F.
SourceDK Output

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - ISOC-4S

Constituent of Interest: Benzene and Naphthalene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	5/13/2015	227	4.6		
2	9/14/2015	86.6	14.3		
3	4/19/2016	2.5	0.41		
4	10/18/2016	20.8	9.69		
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

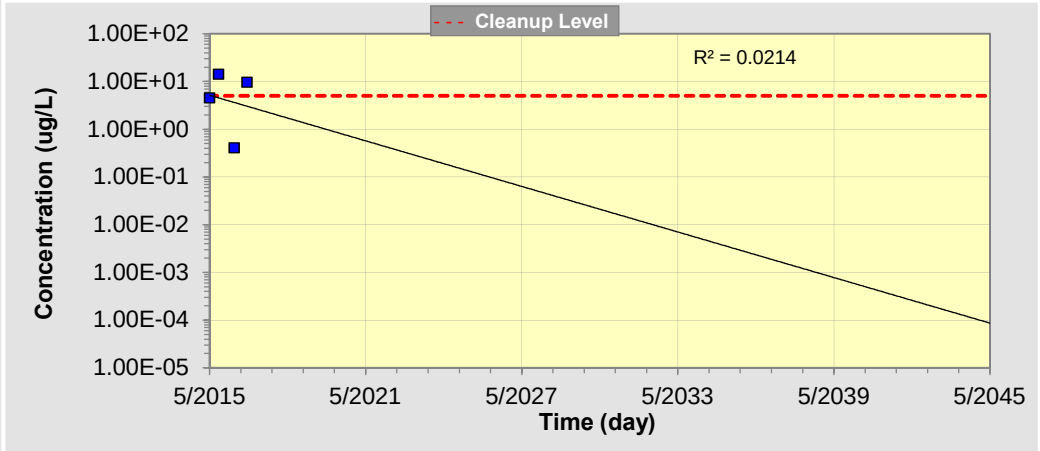
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25 (ug/L)
◉	**Benzene**	5 (ug/L)
○	Constituent C	(ug/L)
○	Constituent D	(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2015**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2015 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **3.67E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - ISOC-4S

Constituent of Interest: Benzene and Naphthalene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	5/13/2015	227	4.6		
2	9/14/2015	86.6	14.3		
3	4/19/2016	2.5	0.41		
4	10/18/2016	20.8	9.69		
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

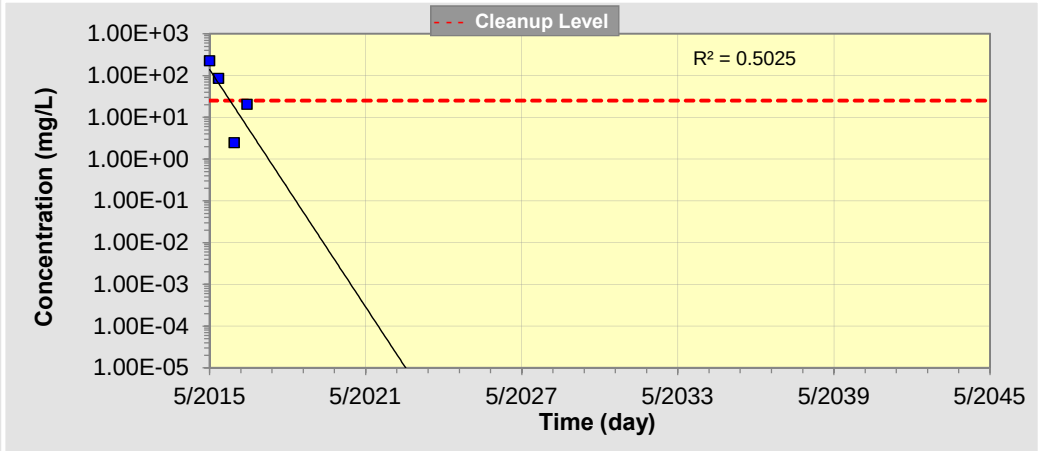
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

◉	**Naphthalene**	25 (ug/L)
○	Benzene	5 (ug/L)
○	Constituent C	(ug/L)
○	Constituent D	(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2016**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2015 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **2.18E+00**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

Site Location and I.D.:	Former Pine Street MGP - ISOC-8S
Constituent of Interest:	Benzene and Naphthalene

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A	Constituent B	Constituent C	Constituent D
		Naphthalene	***Benzene***		
1	*5/13/2015*	*16.4*	*0.5*		
2	*9/14/2015*	*34.7*	*0.5*		
3	*4/19/2016*	*9*	*0.5*		
4	*10/18/2016*	*2.5*	*0.5*		
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Print Historical Data

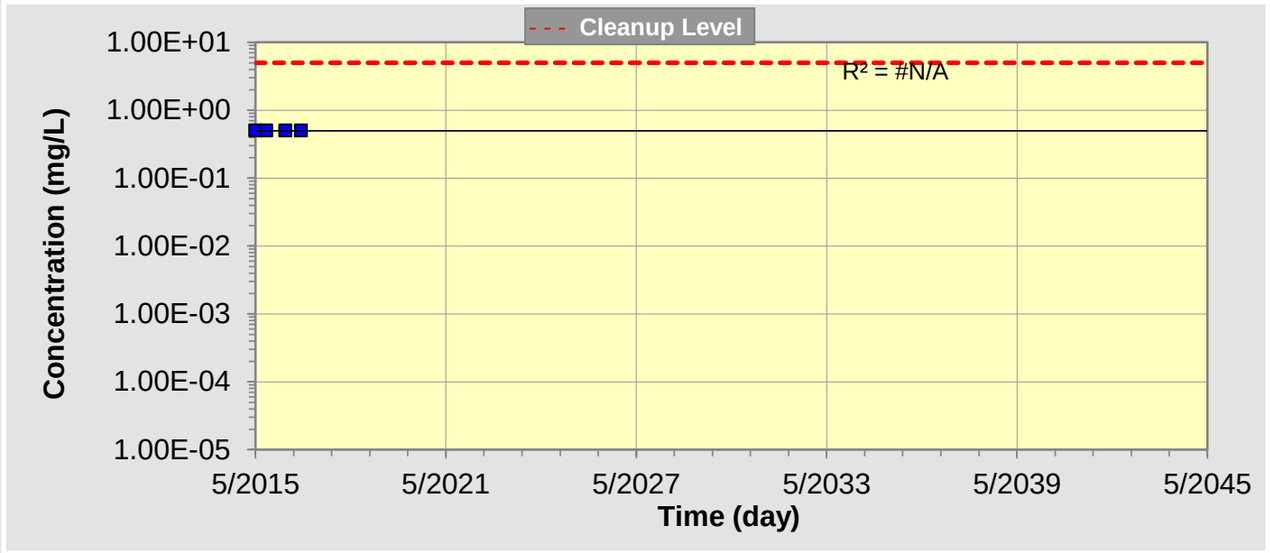
2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- ○ Naphthalene — 25 (ug/L)
- ◉ **Benzene** — 5 (ug/L)
- ○ Constituent C — (ug/L)
- ○ Constituent D — (ug/L)

3. OUTPUT GRAPH

DISSOLVED BENZENE CONCENTRATION (ug/L)



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: [redacted]

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

[redacted] (Lower Limit on Confidence Interval) to [redacted] (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): 0.00E+00
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | ***New Site/Clear*** | ***Paste Example Data*** | ***HELP***

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

Site Location and I.D.: Former Pine Street MGP - ISOC-8S

Constituent of Interest: Benzene and Naphthalene

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	5/13/2015	16.4	0.5		
2	9/14/2015	34.7	0.5		
3	4/19/2016	9	0.5		
4	10/18/2016	2.5	0.5		
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Print Historical Data

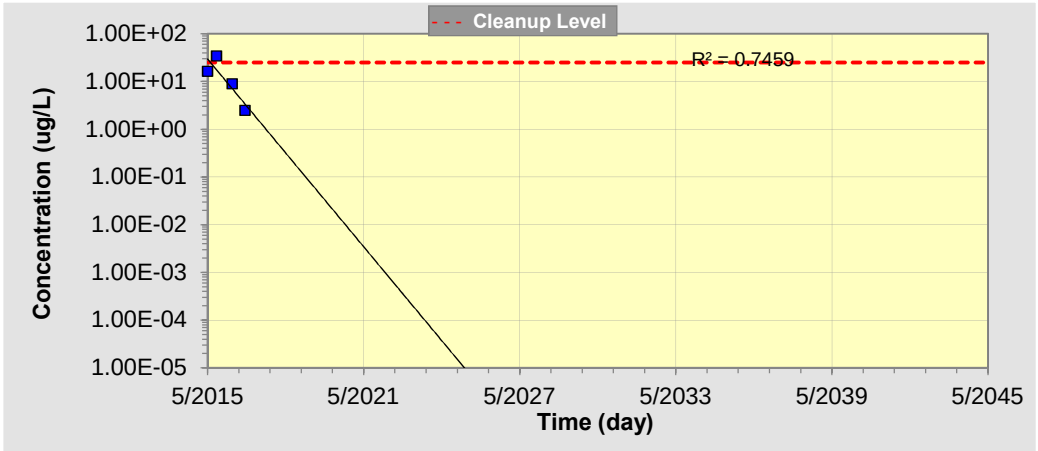
2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH

DISSOLVED NAPHTHALENE CONCENTRATION (ug/L)



Number of Years Over Which to Plot Graph 30 (yr) Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2015**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

- ( ) 90 % Confidence Interval
- (●) 95 % Confidence Interval

2015 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **1.51E+00**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - ISOC-15D

Constituent of Interest: Benzene and Naphthalene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A	Constituent B	Constituent C	Constituent D
		Naphthalene	Benzene		
1	5/13/2015	4420	24.5		
2	9/14/2015	3590	26.4		
3	4/19/2016	8970	14.8		
4	10/18/2016	6850	15		
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

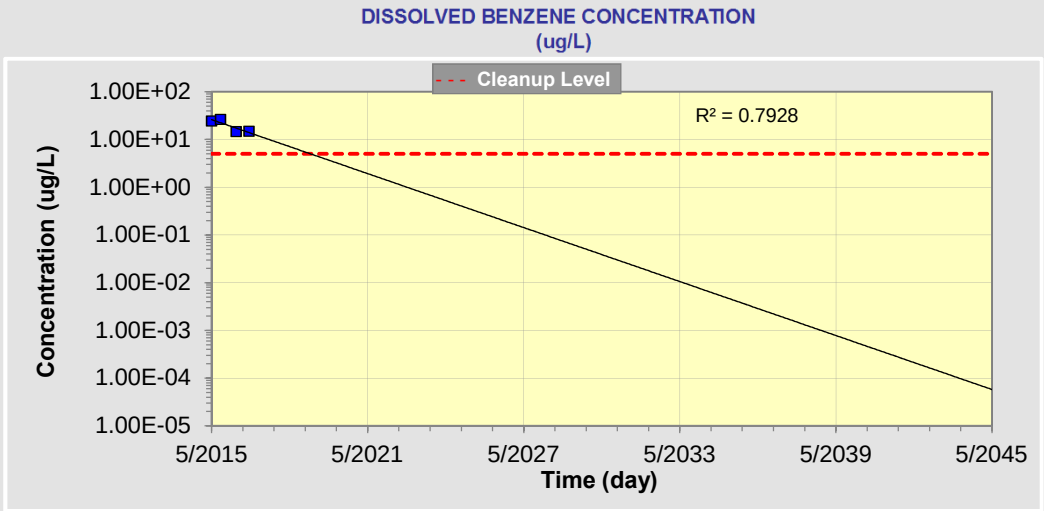
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25	(ug/L)
◉	**Benzene**	5	(ug/L)
○	Constituent C		(ug/L)
○	Constituent D		(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2019**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2016 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **4.34E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - ISOC-15D

Constituent of Interest: Benzene and Naphthalene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	5/13/2015	4420	24.5		
2	9/14/2015	3590	26.4		
3	4/19/2016	8970	14.8		
4	10/18/2016	6850	15		
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

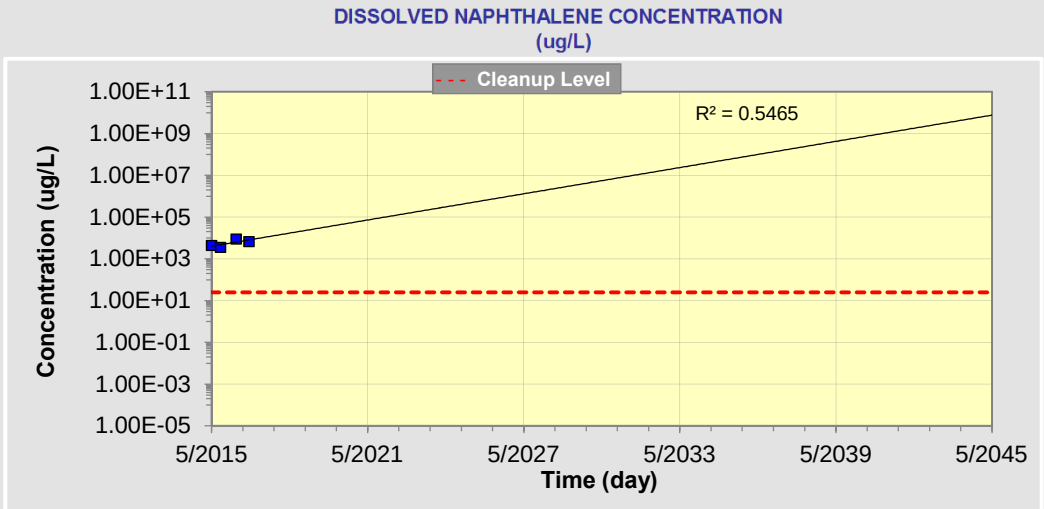
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **Can't Calc (+ve Trend)**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

- ( ) 90 % Confidence Interval
- (●) 95 % Confidence Interval

2019 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **-4.82E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

Site Location and I.D.:	Former Pine Street MGP - ISOC-15S
Constituent of Interest:	Benzene and Naphthalene

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A	Constituent B	Constituent C	Constituent D
		Naphthalene	***Benzene***		
1	5/13/2015	366	8.93		
2	9/14/2015	96.3	8.59		
3	4/19/2016	754	8		
4	10/18/2016	176	7.65		
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

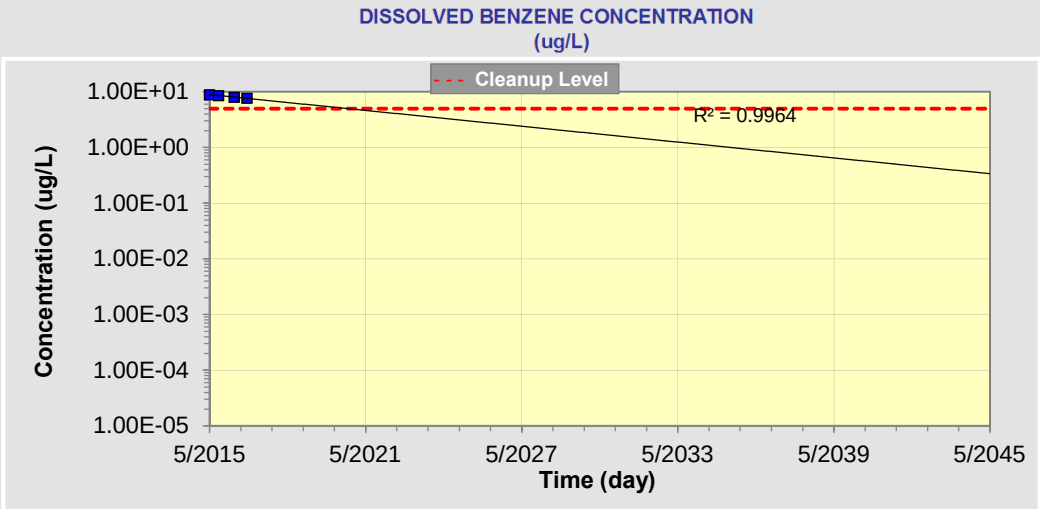
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25	(ug/L)
◉	**Benzene**	5	(ug/L)
○	Constituent C		(ug/L)
○	Constituent D		(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2020**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2019 (Lower Limit on Confidence Interval) to **2022** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **1.09E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | *New Site/Clear* | *Paste Example Data* | ***HELP***

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - ISOC-15S

Constituent of Interest: Benzene and Naphthalene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	5/13/2015	366	8.93		
2	9/14/2015	96.3	8.59		
3	4/19/2016	754	8		
4	10/18/2016	176	7.65		
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

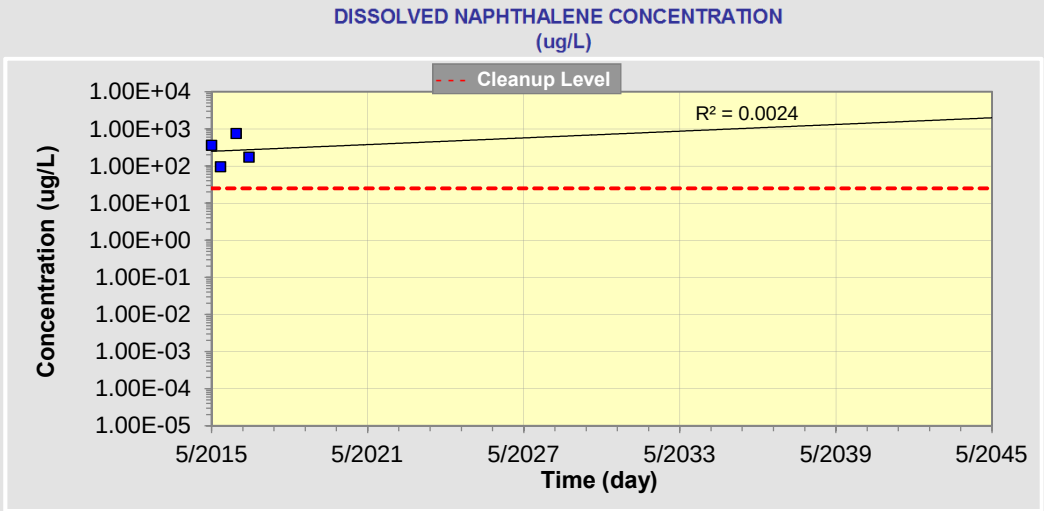
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **Can't Calc (+ve Trend)**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

- ( ) 90 % Confidence Interval
- (●) 95 % Confidence Interval

2015 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **-6.94E-02**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | *New Site/Clear* | *Paste Example Data* | *HELP*

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

Site Location and I.D.:	Former Pine Street MGP - MW-13-ISOC
Constituent of Interest:	Naphthalene and Benzene

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	3/21/2012	1320	618		
2	10/3/2012	736	667		
3	1/23/2013	336	457		
4	2/4/2013	1420	714		
5	2/27/2013	1430	495		
6	3/27/2013	1130	720		
7	7/31/2013	404	114		
8	9/12/2013	45.2	6.62		
9	10/3/2013	70.6	13.6		
10	1/17/2014	5.43	11.9		
11	7/10/2014	36.8	12.2		
12	1/30/2015	17.4	17.1		
13	9/16/2015	10.9	2.04		
14	4/19/2016	2.5	0.5		
15	10/19/2016	2.5	1.01		

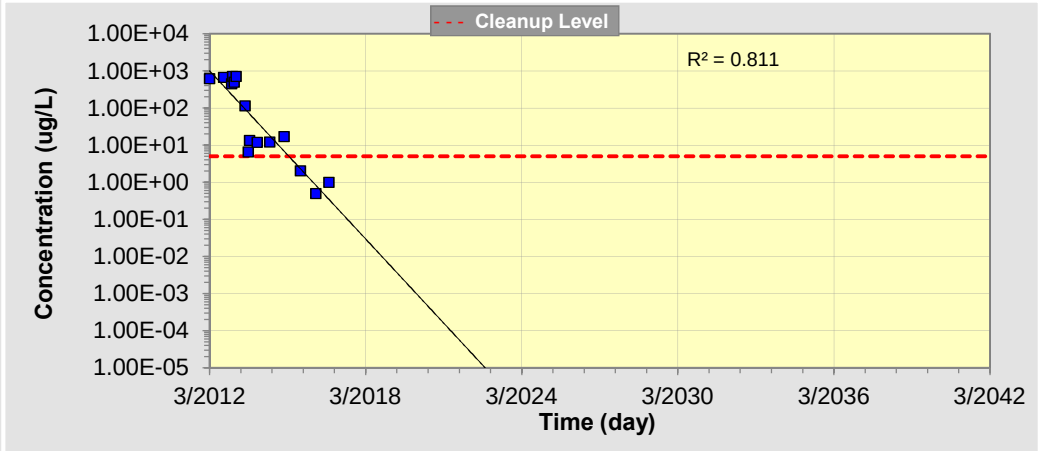
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25 (ug/L)
◉	**Benzene**	5 (ug/L)
○	Constituent C	(ug/L)
○	Constituent D	(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2015**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2014 (Lower Limit on Confidence Interval) to **2017** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **1.74E+00**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | *New Site/Clear* | *Paste Example Data* | *HELP*

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-13-ISOC

Constituent of Interest: Naphthalene and Benzene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	3/21/2012	1320	618		
2	10/3/2012	736	667		
3	1/23/2013	336	457		
4	2/4/2013	1420	714		
5	2/27/2013	1430	495		
6	3/27/2013	1130	720		
7	7/31/2013	404	114		
8	9/12/2013	45.2	6.62		
9	10/3/2013	70.6	13.6		
10	1/17/2014	5.43	11.9		
11	7/10/2014	36.8	12.2		
12	1/30/2015	17.4	17.1		
13	9/16/2015	10.9	2.04		
14	4/19/2016	2.5	0.5		
15	10/19/2016	2.5	1.01		

Print Historical Data

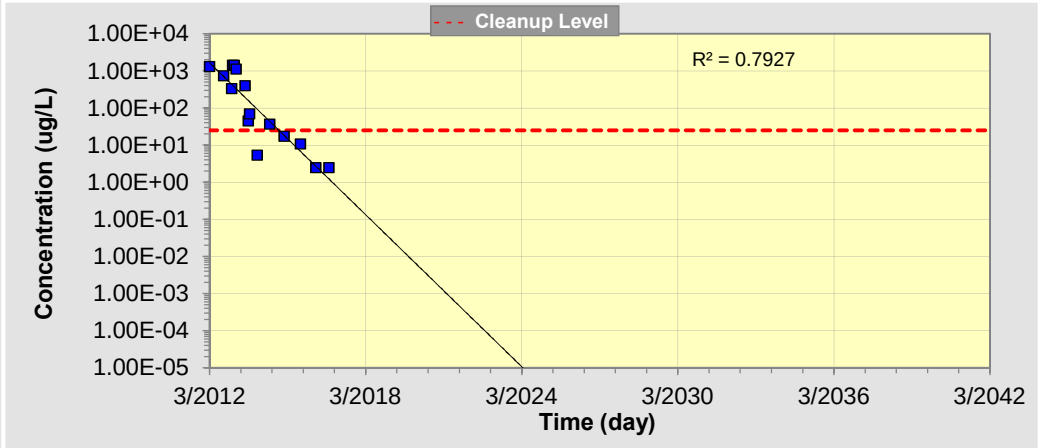
2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH

DISSOLVED NAPHTHALENE CONCENTRATION (ug/L)



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2014**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

( ) 90 % Confidence Interval
(●) 95 % Confidence Interval

2013 (Lower Limit on Confidence Interval) to **2017** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **1.57E+00**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-13D

Constituent of Interest: Benzene and Naphthalene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	1200	140		
2	12/7/2004	750	150		
3	3/13/2005	440	120		
4	6/12/2005	1800	170		
5	9/27/2005	1000	170		
6	12/6/2005	1100	160		
7	3/7/2006	1200	160		
8	6/20/2006	1200	200		
9	9/16/2006	1500	200		
10	9/27/2006	1400	190		
11	10/19/2006	1200	160		
12	11/20/2006	1000	160		
13	12/19/2006	910	150		
14	3/27/2007	730	130		
15	6/19/2007	440	140		

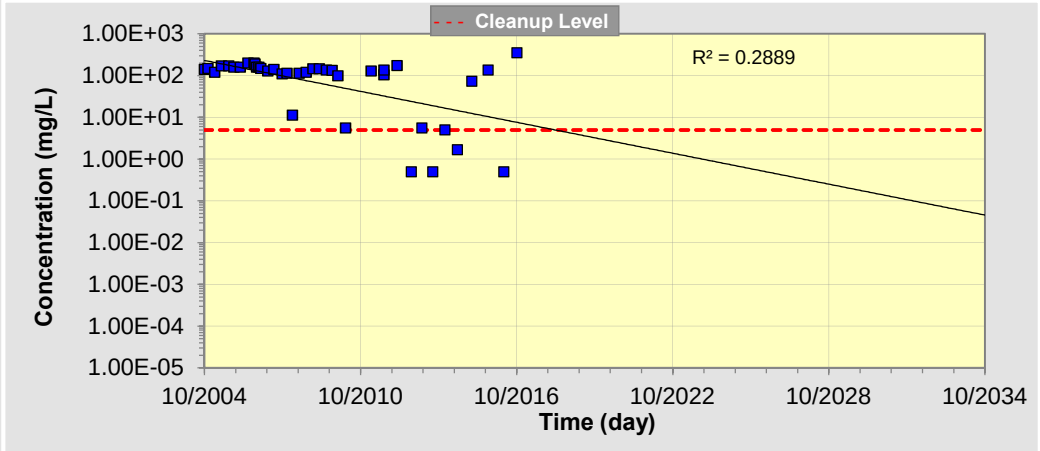
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25 (ug/L)
◉	**Benzene**	5 (ug/L)
○	Constituent C	(ug/L)
○	Constituent D	(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2018**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2011 (Lower Limit on Confidence Interval) to **2039** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **2.84E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-13D

Constituent of Interest: Benzene and Naphthalene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	1200	140		
2	12/7/2004	750	150		
3	3/13/2005	440	120		
4	6/12/2005	1800	170		
5	9/27/2005	1000	170		
6	12/6/2005	1100	160		
7	3/7/2006	1200	160		
8	6/20/2006	1200	200		
9	9/16/2006	1500	200		
10	9/27/2006	1400	190		
11	10/19/2006	1200	160		
12	11/20/2006	1000	160		
13	12/19/2006	910	150		
14	3/27/2007	730	130		
15	6/19/2007	440	140		

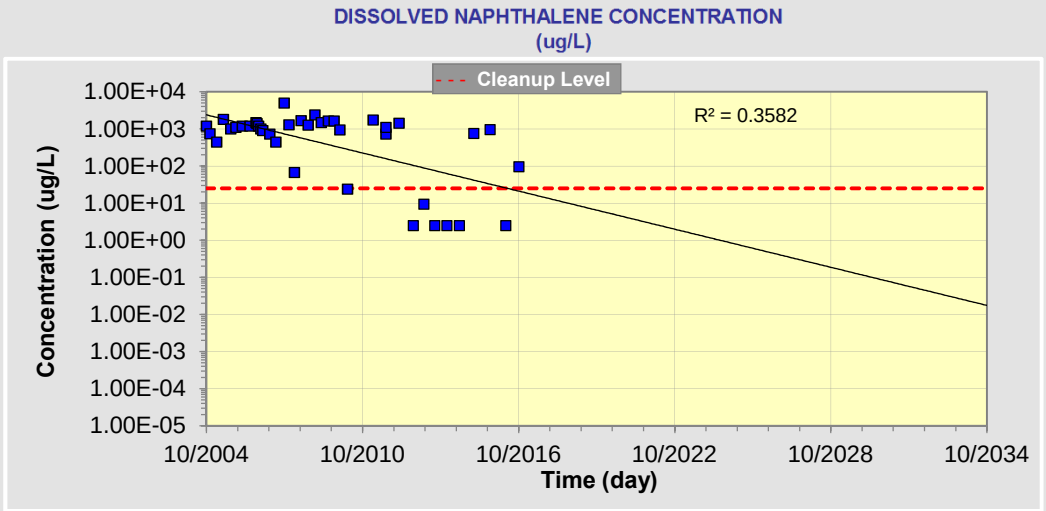
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2016**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

( ) 90 % Confidence Interval
(●) 95 % Confidence Interval

2011 (Lower Limit on Confidence Interval) to **2030** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **3.94E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK Tier 1

Constituent Historical Data

Site Location and I.D.: Former Pine Street MGP - MW-13D
Constituent of Interest: Benzene and Naphthalene
Page 1 of 1

	Date	Naphthalene Concentration (ug/L)	Benzene Concentration (ug/L)		
1	10/21/2004	1200.000	140.000		
2	12/7/2004	750.000	150.000		
3	3/13/2005	440.000	120.000		
4	6/12/2005	1800.000	170.000		
5	9/27/2005	1000.000	170.000		
6	12/6/2005	1100.000	160.000		
7	3/7/2006	1200.000	160.000		
8	6/20/2006	1200.000	200.000		
9	9/16/2006	1500.000	200.000		
10	9/27/2006	1400.000	190.000		
11	10/19/2006	1200.000	160.000		
12	11/20/2006	1000.000	160.000		
13	12/19/2006	910.000	150.000		
14	3/27/2007	730.000	130.000		
15	6/19/2007	440.000	140.000		
16	10/15/2007	5040.000	110.000		
17	12/19/2007	1300.000	115.000		
18	3/8/2008	66.800	11.400		
19	6/8/2008	1680.000	115.000		
20	9/17/2008	1260.000	120.000		
21	12/19/2008	2410.000	146.000		
22	3/17/2009	1480.000	146.000		
23	6/23/2009	1640.000	137.000		
24	9/15/2009	1650.000	133.000		
25	12/3/2009	950.000	98.700		
26	3/23/2010	24.000	5.550		
27	9/10/2011	726.000	105.000		
28	3/15/2011	1760.000	130.000		
29	9/11/2011	1110.000	136.000		
30	3/12/2012	1420.000	175.000		
31	10/3/2012	2.500	0.500		
32	2/27/2013	9.460	5.620		
33	7/30/2013	2.500	0.500		
34	1/16/2014	2.500	5.000		
35	7/10/2014	2.500	1.700		
36	1/29/2015	757.000	73.300		
37	9/15/2015	964.000	137.000		
38	4/19/2016	2.500	0.500		
39	10/20/2016	96.400	353.000		

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-13S

Constituent of Interest:

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	5300	910		
2	12/7/2004	4700	780		
3	3/13/2005	4700	970		
4	6/5/2005	6700	1200		
5	9/27/2005	6200	850		
6	12/6/2005	3000	510		
7	3/7/2006	2000	1000		
8	6/20/2006	3700	750		
9	9/16/2006	4000	390		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	4700	320		
14	3/27/2007	3000	760		
15	6/19/2007	2500	500		

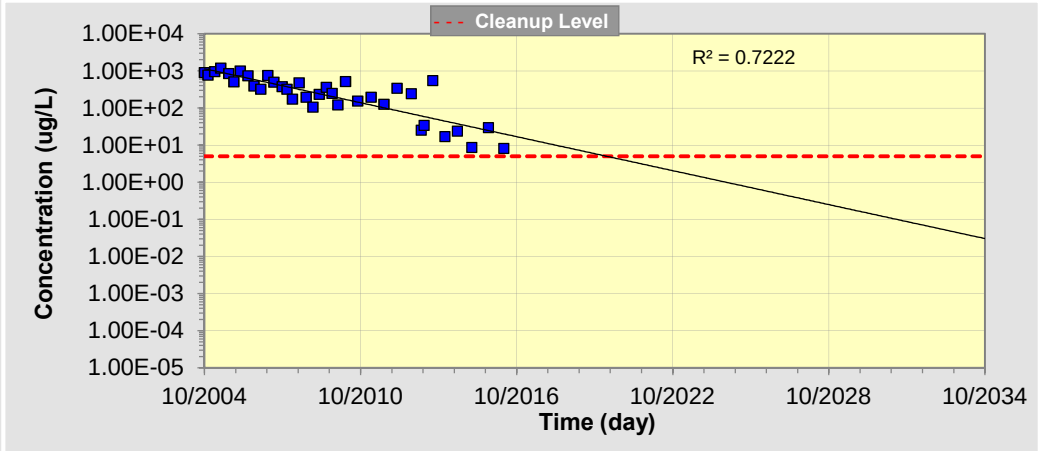
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25 (ug/L)
◉	**Benzene**	5 (ug/L)
○	Constituent C	(ug/L)
○	Constituent D	(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2020**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2016 (Lower Limit on Confidence Interval) to **2026** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **3.51E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-13S

Constituent of Interest:

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	5300	910		
2	12/7/2004	4700	780		
3	3/13/2005	4700	970		
4	6/5/2005	6700	1200		
5	9/27/2005	6200	850		
6	12/6/2005	3000	510		
7	3/7/2006	2000	1000		
8	6/20/2006	3700	750		
9	9/16/2006	4000	390		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	4700	320		
14	3/27/2007	3000	760		
15	6/19/2007	2500	500		

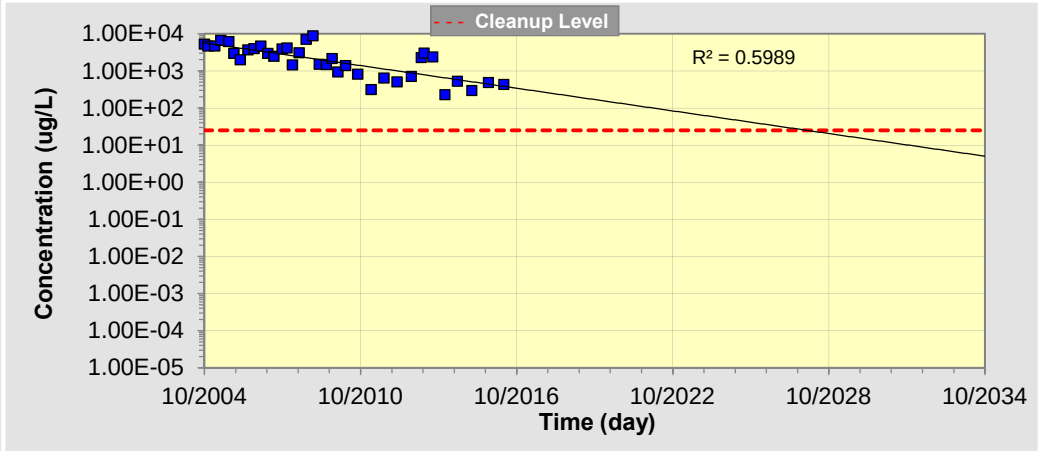
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2027**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

( ) 90 % Confidence Interval
(●) 95 % Confidence Interval

2021 (Lower Limit on Confidence Interval) to **2039** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **2.34E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK Tier 1

Constituent Historical Data

Site Location and I.D.: Former Pine Street MGP - MW-13S
Constituent of Interest:

	Date	Naphthalene Concentration (ug/L)	Benzene Concentration (ug/L)		
1	10/21/2004	5300.000	910.000		
2	12/7/2004	4700.000	780.000		
3	3/13/2005	4700.000	970.000		
4	6/5/2005	6700.000	1200.000		
5	9/27/2005	6200.000	850.000		
6	12/6/2005	3000.000	510.000		
7	3/7/2006	2000.000	1000.000		
8	6/20/2006	3700.000	750.000		
9	9/16/2006	4000.000	390.000		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	4700.000	320.000		
14	3/27/2007	3000.000	760.000		
15	6/19/2007	2500.000	500.000		
16	10/15/2007	3920.000	376.000		
17	12/19/2007	4150.000	323.000		
18	3/8/2008	1450.000	176.000		
19	6/8/2008	3110.000	482.000		
20	9/17/2008	7100.000	196.000		
21	12/19/2008	8840.000	107.000		
22	3/17/2009	1530.000	237.000		
23	6/23/2009	1500.000	366.000		
24	9/15/2009	2190.000	251.000		
25	12/3/2009	946.000	123.000		
26	3/23/2010	1390.000	520.000		
27	9/10/2010	815.000	155.000		
28	3/15/2011	319.000	197.000		
29	9/11/2011	647.000	127.000		
30	3/12/2012	510.000	340.000		
31	10/3/2012	714.000	247.000		
32	2/17/2013	2290.000	25.700		
33	3/28/2013	3040.000	34.500		
34	7/31/2013	2400.000	557.000		
35	1/16/2014	231.000	17.100		
36	7/10/2014	529.000	24.100		
37	1/29/2015	296.000	8.770		
38	9/16/2015	494.000	30.100		
39	4/19/2016	432.000	8.200		

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

Site Location and I.D.:	Former Pine Street MGP - MW-14D
Constituent of Interest:	Naphthalene and Benzene

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A	Constituent B	Constituent C	Constituent D
		Naphthalene	*Benzene*		
1	3/21/2012	32.6	2.5		
2	10/3/2012	2.5	1.72		
3	2/25/2013	2.5	1.01		
4	7/31/2013	2.5	0.5		
5	1/14/2014	2.5	0.5		
6	7/10/2014	2.5	2.88		
7	1/28/2015	2.5	1.59		
8	9/15/2015	2.5	2.61		
9	4/20/2016	1.3	1.4		
10	10/17/2016	25.1	2.09		
11					
12					
13					
14					
15					

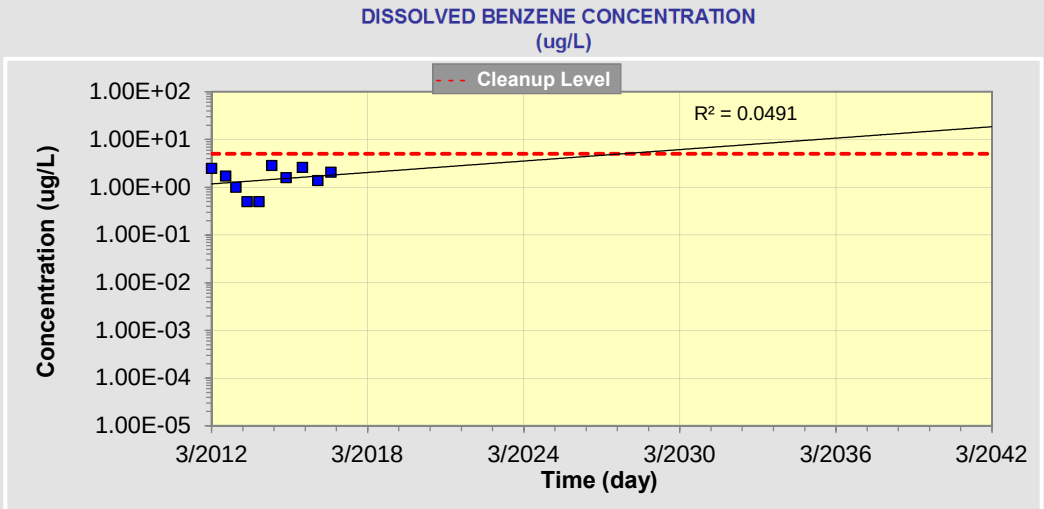
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25 (ug/L)
◉	**Benzene**	5 (ug/L)
○	Constituent C	(ug/L)
○	Constituent D	(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **Can't Calc (+ve Trend)**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2012 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **-9.21E-02**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | *New Site/Clear* | *Paste Example Data* | *HELP*

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-14D

Constituent of Interest: Naphthalene and Benzene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	3/21/2012	32.6	2.5		
2	10/3/2012	2.5	1.72		
3	2/25/2013	2.5	1.01		
4	7/31/2013	2.5	0.5		
5	1/14/2014	2.5	0.5		
6	7/10/2014	2.5	2.88		
7	1/28/2015	2.5	1.59		
8	9/15/2015	2.5	2.61		
9	4/20/2016	1.3	1.4		
10	10/17/2016	25.1	2.09		
11					
12					
13					
14					
15					

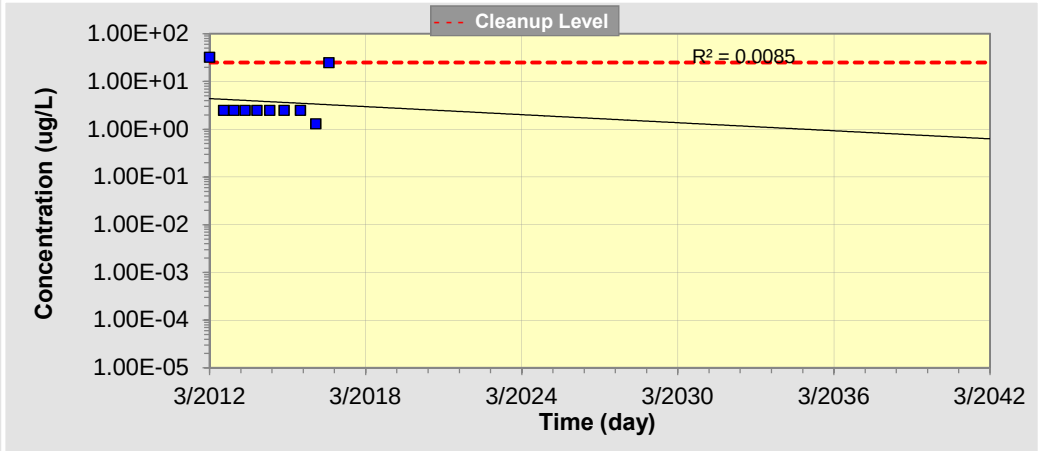
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2012**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

( ) 90 % Confidence Interval
(●) 95 % Confidence Interval

2012 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **6.47E-02**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-14S

Constituent of Interest:

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	3600	50		
2	12/7/2004	2500	25		
3	3/13/2005	3000	25		
4	6/1/2005	8200	72		
5	9/27/2005	4200	65		
6	12/6/2005	4100	69		
7	3/7/2006	2500	1100		
8	6/20/2006	3400	52		
9	9/16/2006	3600	42		
10	12/19/2006	3100	43		
11	3/27/2007	1900	34		
12	6/19/2007	1700	41		
13	10/15/2007	16700	22.6		
14	12/19/2007	2180	27.7		
15	3/8/2008	2730	28.8		

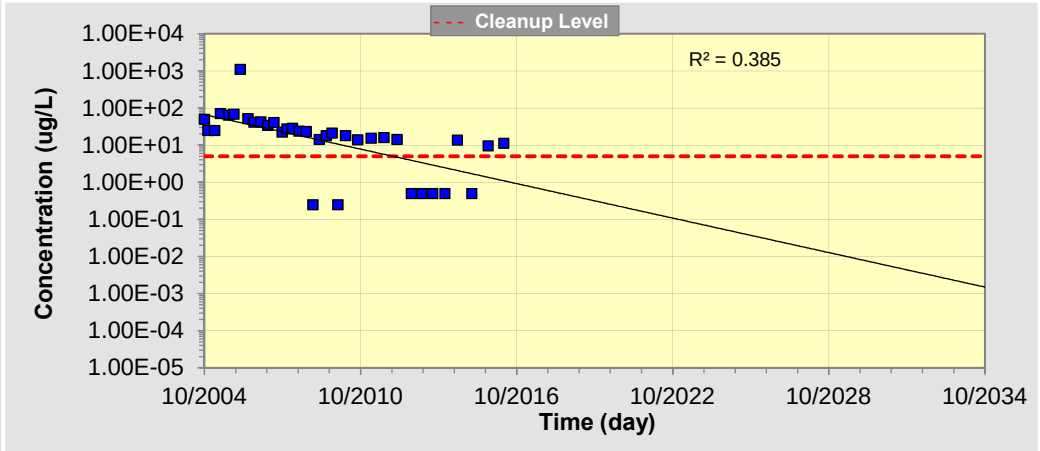
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25 (ug/L)
◉	**Benzene**	5 (ug/L)
○	Constituent C	(ug/L)
○	Constituent D	(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2012**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2008 (Lower Limit on Confidence Interval) to **2022** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **3.57E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | *New Site/Clear* | *Paste Example Data* | *HELP*

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-14S

Constituent of Interest:

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	3600	50		
2	12/7/2004	2500	25		
3	3/13/2005	3000	25		
4	6/1/2005	8200	72		
5	9/27/2005	4200	65		
6	12/6/2005	4100	69		
7	3/7/2006	2500	1100		
8	6/20/2006	3400	52		
9	9/16/2006	3600	42		
10	12/19/2006	3100	43		
11	3/27/2007	1900	34		
12	6/19/2007	1700	41		
13	10/15/2007	16700	22.6		
14	12/19/2007	2180	27.7		
15	3/8/2008	2730	28.8		

Print Historical Data

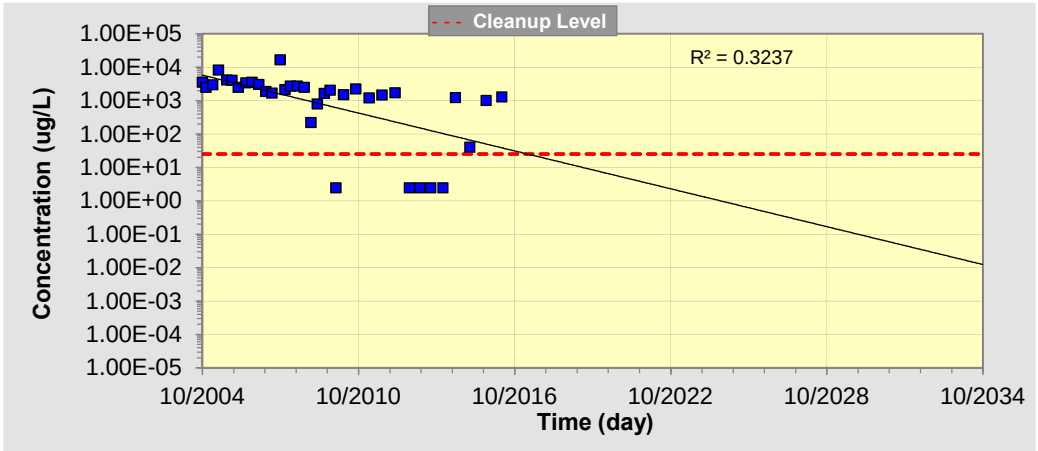
2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH

DISSOLVED NAPHTHALENE CONCENTRATION (ug/L)



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2017**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

( ) 90 % Confidence Interval
(●) 95 % Confidence Interval

2011 (Lower Limit on Confidence Interval) to **2036** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **4.35E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK Tier 1

Constituent Historical Data

Site Location and I.D.: Former Pine Street MGP - MW-14S
Constituent of Interest:
Page 1 of 1

	Date	Naphthalene Concentration (ug/L)	Benzene Concentration (ug/L)		
1	10/21/2004	3600.000	50.000		
2	12/7/2004	2500.000	25.000		
3	3/13/2005	3000.000	25.000		
4	6/1/2005	8200.000	72.000		
5	9/27/2005	4200.000	65.000		
6	12/6/2005	4100.000	69.000		
7	3/7/2006	2500.000	1100.000		
8	6/20/2006	3400.000	52.000		
9	9/16/2006	3600.000	42.000		
10	12/19/2006	3100.000	43.000		
11	3/27/2007	1900.000	34.000		
12	6/19/2007	1700.000	41.000		
13	10/15/2007	16700.000	22.600		
14	12/19/2007	2180.000	27.700		
15	3/8/2008	2730.000	28.800		
16	6/8/2008	2740.000	23.800		
17	9/17/2008	2530.000	23.400		
18	12/19/2008	224.000	0.250		
19	3/17/2009	801.000	14.200		
20	6/23/2009	1670.000	18.200		
21	9/15/2009	2070.000	21.200		
22	12/3/2009	2.500	0.250		
23	3/23/2010	1520.000	18.000		
24	9/10/2010	2250.000	14.000		
25	3/15/2011	1220.000	15.400		
26	9/11/2011	1470.000	16.000		
27	3/12/2012	1740.000	14.400		
28	10/3/2012	2.500	0.500		
29	2/27/2013	2.500	0.500		
30	3/28/2013				
31	7/31/2013	2.500	0.500		
32	1/16/2014	2.500	0.500		
33	7/10/2014	1250.000	13.800		
34	1/29/2015	40.700	0.500		
35	9/15/2015	1030.000	9.610		
36	4/19/2016	1310.000	11.300		

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-15D

Constituent of Interest:

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	84	0.57		
2	12/7/2004	180	2.5		
3	3/13/2005	810	2.5		
4	6/5/2005	92	1.7		
5	9/27/2005	1400	4.8		
6	12/6/2005	1200	4.2		
7	3/7/2006	1300	2.5		
8	6/20/2006	780	5.6		
9	9/16/2006	2200	4.5		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	2100	4		
14	3/27/2007	1600	3.8		
15	6/19/2007	2000	4.1		

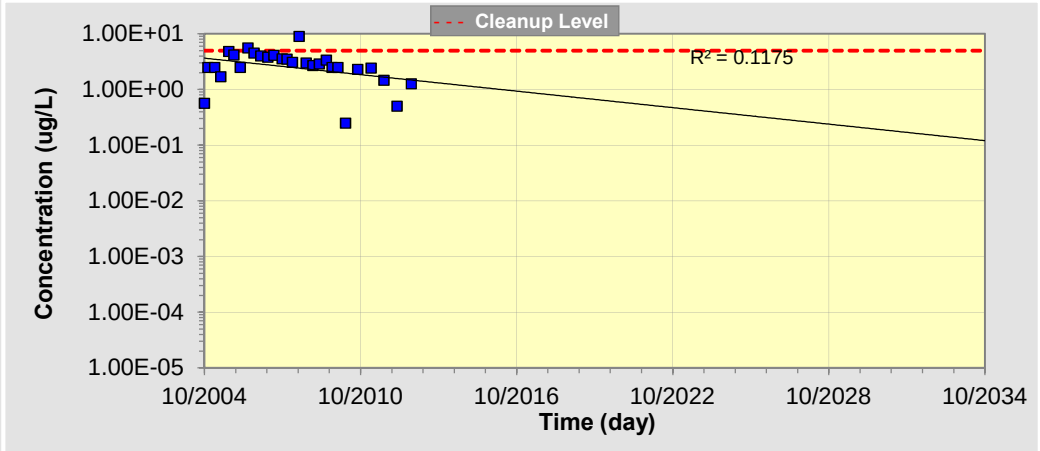
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- ○ Naphthalene — 25 (ug/L)
- ◉ **Benzene** — 5 (ug/L)
- ○ Constituent C — (ug/L)
- ○ Constituent D — (ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2004**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2004 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **1.14E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-15D

Constituent of Interest:

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	84	0.57		
2	12/7/2004	180	2.5		
3	3/13/2005	810	2.5		
4	6/5/2005	92	1.7		
5	9/27/2005	1400	4.8		
6	12/6/2005	1200	4.2		
7	3/7/2006	1300	2.5		
8	6/20/2006	780	5.6		
9	9/16/2006	2200	4.5		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	2100	4		
14	3/27/2007	1600	3.8		
15	6/19/2007	2000	4.1		

Print Historical Data

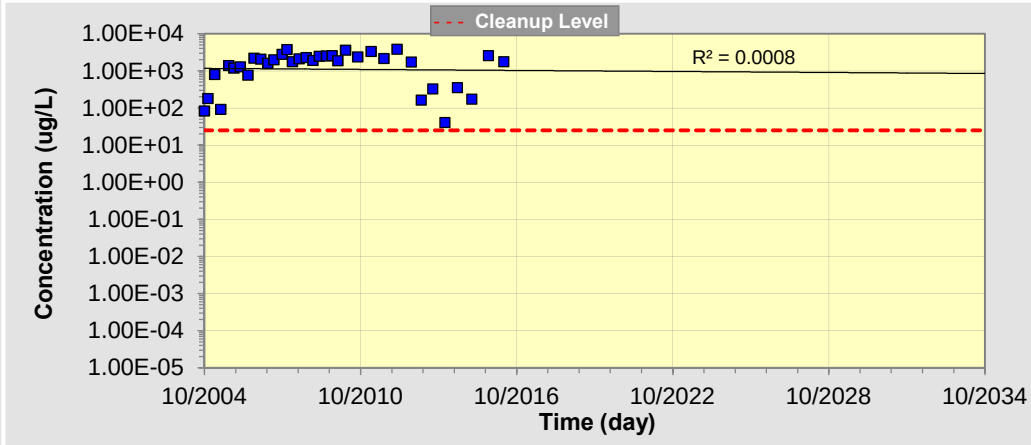
2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH

DISSOLVED NAPHTHALENE CONCENTRATION (ug/L)



Number of Years Over Which to Plot Graph 30 (yr) Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2369**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

( ) 90 % Confidence Interval
(●) 95 % Confidence Interval

2026 (Lower Limit on Confidence Interval) to **Can't Calc (+ve Trend)** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **1.05E-02**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK Tier 1

Constituent Historical Data

Site Location and I.D.: Former Pine Street MGP - MW-15D
Constituent of Interest:

	Date	Naphthalene Concentration (ug/L)	Benzene Concentration (ug/L)		
1	10/21/2004	84.000	0.570		
2	12/7/2004	180.000	2.500		
3	3/13/2005	810.000	2.500		
4	6/5/2005	92.000	1.700		
5	9/27/2005	1400.000	4.800		
6	12/6/2005	1200.000	4.200		
7	3/7/2006	1300.000	2.500		
8	6/20/2006	780.000	5.600		
9	9/16/2006	2200.000	4.500		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	2100.000	4.000		
14	3/27/2007	1600.000	3.800		
15	6/19/2007	2000.000	4.100		
16	10/15/2007	2790.000	3.550		
17	12/19/2007	3790.000	3.500		
18	3/8/2008	1770.000	3.100		
19	6/8/2008	2130.000	9.000		
20	9/17/2008	2300.000	3.000		
21	12/19/2008	1940.000	2.700		
22	3/17/2009	2480.000	2.900		
23	6/23/2009	2550.000	3.370		
24	9/15/2009	2590.000	2.490		
25	12/3/2009	1880.000	2.500		
26	3/23/2010	3640.000	0.250		
27	9/10/2010	2390.000	2.300		
28	3/15/2011	3360.000	2.430		
29	9/11/2011	2160.000	1.470		
30	3/12/2012	3840.000	0.500		
31	10/3/2012	1760.000	1.270		
32	2/17/2013	166.000			
33	7/31/2013	332.000			
34	1/16/2014	41.300			
35	7/10/2014	360.000			
36	1/29/2015	175.000			
37	9/16/2015	2600.000			
38	4/19/2016	1790.000			

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-15S

Constituent of Interest:

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

	Date (mm/dd/yy)	Concentration ug/L			
		Constituent A	*Constituent B*	*Constituent C*	*Constituent D*
		Naphthalene	***Benzene***		
1	10/21/2004	1900	50		
2	12/7/2004	2100	25		
3	3/13/2005	3000	10		
4	6/5/2005	3300	42		
5	9/27/2005	3300	41		
6	12/6/2005	4400	33		
7	3/7/2006	810	26		
8	6/20/2006	3400	30		
9	9/16/2006	3900	30		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	3500	25		
14	3/27/2007	1700	21		
15	6/19/2007	1700	16		

Print Historical Data

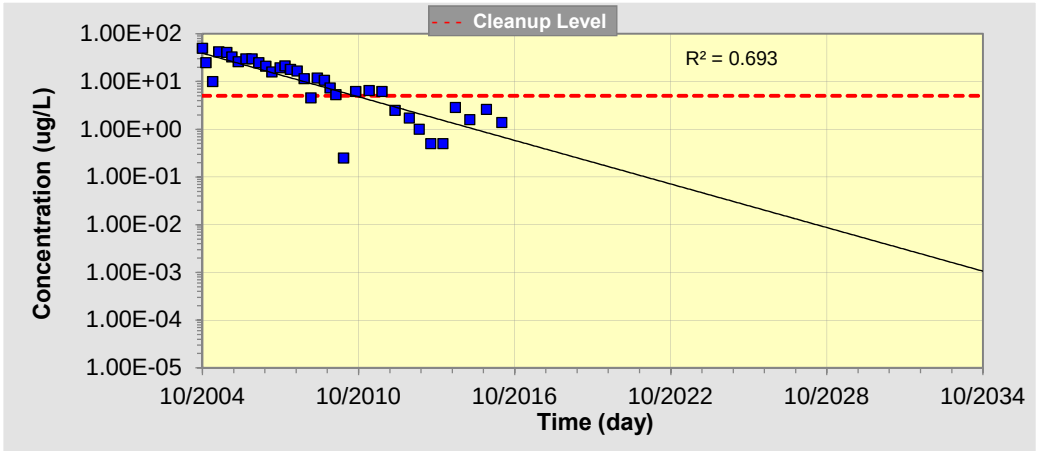
2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25	(ug/L)
◉	**Benzene**	5	(ug/L)
○	Constituent C		(ug/L)
○	Constituent D		(ug/L)

3. OUTPUT GRAPH

DISSOLVED BENZENE CONCENTRATION (ug/L)



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2010**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2008 (Lower Limit on Confidence Interval) to **2014** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **3.51E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | *New Site/Clear* | *Paste Example Data* | *HELP*

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-15S

Constituent of Interest:

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	1900	50		
2	12/7/2004	2100	25		
3	3/13/2005	3000	10		
4	6/5/2005	3300	42		
5	9/27/2005	3300	41		
6	12/6/2005	4400	33		
7	3/7/2006	810	26		
8	6/20/2006	3400	30		
9	9/16/2006	3900	30		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	3500	25		
14	3/27/2007	1700	21		
15	6/19/2007	1700	16		

Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH

Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2020**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

( ) 90 % Confidence Interval
(●) 95 % Confidence Interval

2015 (Lower Limit on Confidence Interval) to **2029** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **3.49E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK Tier 1

Constituent Historical Data

Site Location and I.D.: Former Pine Street MGP - MW-15S
Constituent of Interest:

	Date	Naphthalene Concentration (ug/L)	Benzene Concentration (ug/L)		
1	10/21/2004	1900.000	50.000		
2	12/7/2004	2100.000	25.000		
3	3/13/2005	3000.000	10.000		
4	6/5/2005	3300.000	42.000		
5	9/27/2005	3300.000	41.000		
6	12/6/2005	4400.000	33.000		
7	3/7/2006	810.000	26.000		
8	6/20/2006	3400.000	30.000		
9	9/16/2006	3900.000	30.000		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	3500.000	25.000		
14	3/27/2007	1700.000	21.000		
15	6/19/2007	1700.000	16.000		
16	10/15/2007	2170.000	19.400		
17	12/19/2007	1930.000	21.400		
18	3/8/2008	2770.000	18.000		
19	6/8/2008	2300.000	16.800		
20	9/17/2008	3180.000	11.600		
21	12/19/2008	786.000	4.600		
22	3/17/2009	2490.000	11.800		
23	6/23/2009	2300.000	10.600		
24	9/15/2009	1470.000	7.360		
25	12/3/2009	976.000	5.320		
26	3/23/2010	3110.000	0.250		
27	9/10/2010	1560.000	6.260		
28	3/15/2011	1630.000	6.480		
29	9/11/2011	775.000	6.230		
30	3/12/2012	1280.000	2.500		
31	10/3/2012	364.000	1.720		
32	2/17/2013	137.000	1.010		
33	7/31/2013	121.000	0.500		
34	1/16/2014	2.500	0.500		
35	7/10/2014	236.000	2.880		
36	1/29/2015	167.000	1.590		
37	9/16/2015	229.000	2.610		
38	4/19/2016	75.400	1.400		

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

Site Location and I.D.: Former Pine Street MGP - MW-18S

Constituent of Interest: Benzene and Naphthalene

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	6600	50		
2	12/7/2004	5100	25		
3	3/13/2005	4200	25		
4	6/5/2005	8500	2.2		
5	9/27/2005	7200	2.3		
6	12/6/2005	8500	2		
7	3/7/2006	1100	2.5		
8	6/20/2006	4200	2.2		
9	9/16/2006	4800	2.2		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	3400	1.6		
14	3/27/2007	320	0.25		
15	6/19/2007	2200	1.9		

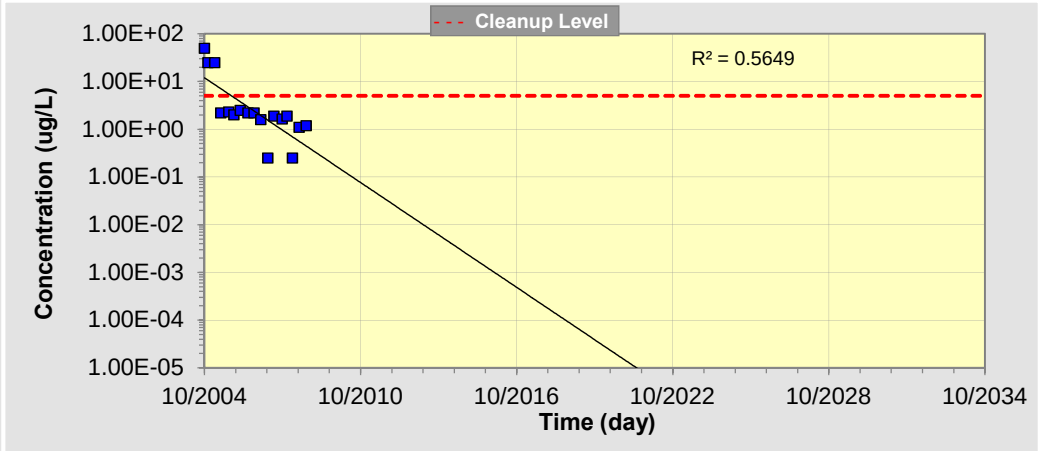
Print Historical Data

2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

○	Naphthalene	25 (ug/L)
◉	**Benzene**	5 (ug/L)
○	Constituent C	(ug/L)
○	Constituent D	(ug/L)

3. OUTPUT GRAPH



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2005**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

○ 90 % Confidence Interval
◉ 95 % Confidence Interval

2004 (Lower Limit on Confidence Interval) to **2008** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **8.43E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | *New Site/Clear* | *Paste Example Data* | *HELP*

SourceDK TIER 1 Empirical Data

Remediation Timeframe Decision Support System

Air Force Center for Engineering and Environment *Version 2.0*

Site Location and I.D.: Former Pine Street MGP - MW-18S

Constituent of Interest: Benzene and Naphthalene

Data Input Instructions:

10.80 → *Enter value directly.*

10.80 → *Value calculated by model. (Don't enter any data).*

1. ENTER CONSTITUENT NAME AND HISTORICAL DATA

Concentration ug/L

	Date (mm/dd/yy)	Constituent A Naphthalene	Constituent B Benzene	Constituent C	Constituent D
1	10/21/2004	6600	50		
2	12/7/2004	5100	25		
3	3/13/2005	4200	25		
4	6/5/2005	8500	2.2		
5	9/27/2005	7200	2.3		
6	12/6/2005	8500	2		
7	3/7/2006	1100	2.5		
8	6/20/2006	4200	2.2		
9	9/16/2006	4800	2.2		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	3400	1.6		
14	3/27/2007	320	0.25		
15	6/19/2007	2200	1.9		

Print Historical Data

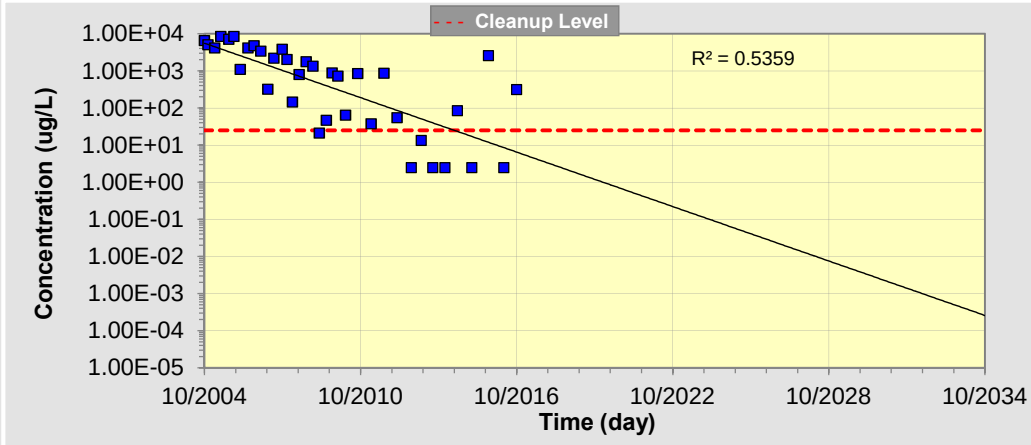
2. WHICH CONSTITUENT TO PLOT?

What is the cleanup level?

- (●) **Naphthalene** 25 (ug/L)
- ( ) Benzene 5 (ug/L)
- ( ) Constituent C (ug/L)
- ( ) Constituent D (ug/L)

3. OUTPUT GRAPH

DISSOLVED NAPHTHALENE CONCENTRATION (ug/L)



Number of Years Over Which to Plot Graph 30 *(yr)* Update Graph

4. RESULTS

Predicted Date to Achieve Cleanup: **2014**

Confidence Interval on Predicted Cleanup Date:
(at least 3 data points needed to calculate confidence intervals)

( ) 90 % Confidence Interval
(●) 95 % Confidence Interval

2010 (Lower Limit on Confidence Interval) to **2021** (Upper Limit on Confidence Interval)

Source Decay Rate Constant (1/year): **5.63E-01**
(positive numbers represent shrinking plumes while negative numbers represent expanding plumes)

Return To Main Screen | New Site/Clear | Paste Example Data | HELP

SourceDK Tier 1

Constituent Historical Data

Site Location and I.D.: Former Pine Street MGP - MW-18S
Constituent of Interest: Benzene and Naphthalene

	Date	Naphthalene Concentration (ug/L)	Benzene Concentration (ug/L)		
1	10/21/2004	6600.000	50.000		
2	12/7/2004	5100.000	25.000		
3	3/13/2005	4200.000	25.000		
4	6/5/2005	8500.000	2.200		
5	9/27/2005	7200.000	2.300		
6	12/6/2005	8500.000	2.000		
7	3/7/2006	1100.000	2.500		
8	6/20/2006	4200.000	2.200		
9	9/16/2006	4800.000	2.200		
10	9/27/2006				
11	10/19/2006				
12	11/20/2006				
13	12/19/2006	3400.000	1.600		
14	3/27/2007	320.000	0.250		
15	6/19/2007	2200.000	1.900		
16	10/15/2007	3890.000	1.650		
17	12/19/2007	2040.000	1.890		
18	3/8/2008	146.000	0.250		
19	6/8/2008	811.000	1.100		
20	9/17/2008	1770.000	1.200		
21	12/19/2008	1360.000			
22	3/17/2009	21.200			
23	6/23/2009	47.300			
24	9/15/2009	887.000			
25	12/3/2009	728.000			
26	3/23/2010	65.000			
27	9/10/2010	846.000			
28	3/15/2011	37.800			
29	9/11/2011	870.000			
30	3/12/2012	55.700			
31	10/3/2012	2.500			
32	2/17/2013	13.600			
33	7/31/2013	2.500			
34	1/16/2014	2.500			
35	7/10/2014	86.000			
36	1/29/2015	2.500			
37	9/16/2015	2610.000			
38	4/19/2016	2.500			
39	10/19/2016	317.000			

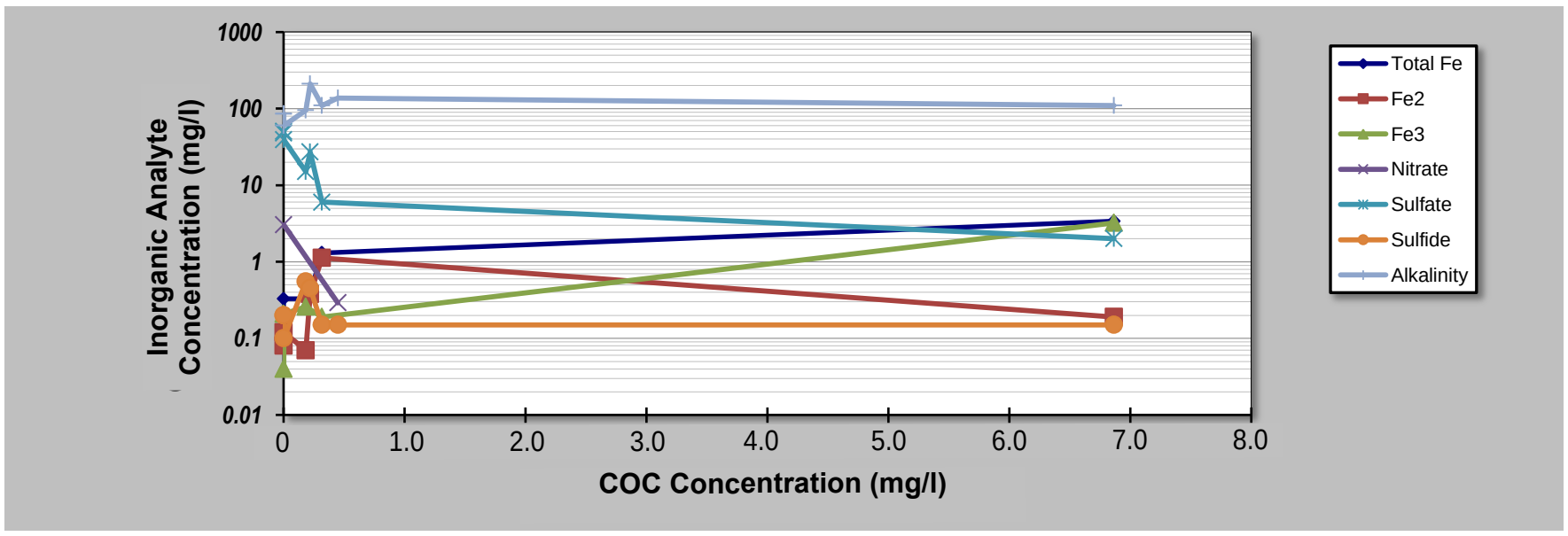
Appendix G.
Geochemical Trend Analysis

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: October 2016 Groundwater Data
Facility Name: Duke Spartanburg MGP
Conducted By: M. Zenker (AECOM)

Job ID: 60493834
Constituent: Various inorganics
Concentration Units: mg/l

Sampling Point ID:		Total Fe	Fe2	Fe3	Nitrate	Sulfate	Sulfide	Alkalinity
Monitoring Well Sampled	COC Concentration (mg/l)	VARIOUS INORGANICS CONCENTRATION (mg/l)						
MW-17S	0	0.12	0.08	0.04		48	0.2	85.6
MW-18D	0	0.33	0.12	0.21		50	0.2	85.9
ISOC-4D	0				3.05	39	0.1	59.9
ISOC-15S	0.184	0.33	0.07	0.26		15	0.55	94.8
MW-13S	0.218	0.38	0.38			27	0.45	211
MW-18S	0.317	1.31	1.12	0.19		6	0.15	110
MW-13D	0.449				0.29	0	0.15	138
ISOC-15D	6.865	3.4	0.19	3.21		2	0.15	110
Coefficient of Variation:		1.29	1.24	1.74	1.17	0.88	0.67	0.41
Mann-Kendall Statistic (S):		14	7	6	-1	-22	-6	15
Confidence Factor:		99.6%	86.4%	88.3%		99.8%	72.6%	95.8%
Concentration Trend:		Increasing	No Trend	No Trend		Decreasing	Stable	Increasing



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.
4. COC Concentration is the sum of the benzene and naphthalene concentrations measured for each well listed during the Oct. 2016 monitoring event