APPENDIX 6

GROUNDWATER MONITORING PLAN

Alabama Power

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March 8, 2021

Received: 3/8/21

Via email to SSS@adem.alabama.gov

Mr. S. Scott Story, Chief
Solid Waste Branch
Land Division
Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2400

Re: ADEM Letter of January 20, 2021
Response to Groundwater Monitoring Plans Submitted to the Department
William C. Gorgas Electric Generating Plant

Dear Mr. Story:

The following provides responses to comments received in a letter from the Alabama Department of Environmental Management (ADEM) Land Division dated January 20, 2021. The letter pertains to the revised groundwater monitoring plans (GWMPs) submitted to the Department on August 24, 2020, for the (1) Ash Pond, (2) Bottom Ash Landfill, (3) CCR and Gypsum Landfill, and (4) Gypsum Pond at the Alabama Power Company (APC) William C. Gorgas Electric Generating Plant. The following presents the full text of the comments provided by ADEM in italics followed by our response indented in plain text.

As discussed in telephone call with ADEM on February 22, 2021, in lieu of providing responses in a revised GWMP as requested in the Department's letter, many of the responses are provided as a *Supplemental Site Hydrogeologic Characterization Report*, attached to this letter. A revised GWMP will be submitted to the Department under separate cover no later than March 15, 2021.

General Comments:

A table of all historical ground water, pore water, and surface water data is needed to aid in the review of statistical background. In addition to the GWMP a historical groundwater data table should be included in all groundwater monitoring reports.

> The GWMP will be amended to identify this information as an item that will be included in semi-annual Groundwater Monitoring Reports (GWMR). Currently, historical

groundwater quality data is tabulated and included in routine GWMRs and the requested historical data table will be included in all subsequent groundwater monitoring reports.

<u>Plant Gorgas Ash Pond:</u>

1. *The GWMP describes a process for using intrawell analysis. Because no compliance monitoring wells were installed prior to the placement of waste at the facility, it does not appear that intrawell analysis will accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit required by ADEM Admin. Code r. 335-13-15-.06 (2)(a)1. It is recommended that intrawell analysis procedures be removed from the GWMP and SAP.*

   Section 8 of the GWMP and Section 5 of the site-specific statistical analysis plan (SAP) provide details regarding statistical methods used during detection and assessment monitoring. These sections explicitly describe the interwell approach used at the site and the rationale for the approach. Intrawell methods are not mentioned in the GWMP and are only mentioned in the SAP for 2 reasons: (1) to describe the other statistical approach provided for in the CCR rules and USEPA guidance as a means of supporting the interwell statistical method selected for use at the site, and (2) to outline when it may be appropriate to propose for the use of intrawell methods at the site due to a change in site conditions. Both the GWMP and the SAP note that any change to the statistical method requires Department approval.

2. *Figure 7 indicates that monitoring wells GS-AP-MW-5, GS-AP-MW-9, GS-AP-MW-10, GS-AP- MW-11, GS-AP-MW-13, and GS-AP-MW-14 have been abandoned. Section 4.3 of the GWMP indicates that a plan for replacing downgradient monitoring wells GS-AP-MW-9, GS-AP-MW-11, and GS-AP-MW-14 will be submitted to the department in the future. Section 4.3 lists GS-AP-MW-13 as a downgradient location. Please clarify the designation of monitoring well GS-AP-MW-13. The replacement of monitoring wells GS-AP-MW-5 and GS-AP-MW-10, and GS-AP-MW-13 should be addressed. The GWMP should specify that an adequate set of replacement wells will be installed to monitor the site.*

   GS-AP-MW-13 was abandoned in July 2019 as shown on Figure 7. It was erroneously listed in Section 4.3 as a downgradient location when in fact it is an upgradient background well as identified on Table 2 of the GWMP and in the SAP. Although the well was abandoned, the data from the well remains in the database for statistical analysis.

As requested by the Department, the figures and tables of the GWMP will identify current and planned wells so the monitoring network is sufficiently described for permitting purposes. The figures and tables in the GWMP will be updated to clearly identify (1) existing upgradient and downgradient locations, (2) anticipated additional or replacement wells, (3) current and anticipated well abandonments, and (4) a general description of the timing of future proposed well installation and removal sequencing.

3. *It appears that monitoring wells should be installed to monitor the (deep) Pratt Aquifer downgradient of the waste management unit between GS-AP-MW-15 and GS-AP-MW-25H in topographic low areas of the drainage feature depicted west of the site on Figure 6A.*

As requested by the Department, the figures and tables of the GWMP will be updated to identify current and planned wells so the monitoring network is sufficiently described for permitting purposes. Since submission of the GWMP to the Department, additional wells have been installed within the (deep) Pratt Aquifer. As presented on Figure 5 in the *2020 Annual Groundwater Monitoring and Corrective Action Report*, dated January 31, 2021, wells GS-AP-MW-37H and GS-AP-MW-39H were installed as part of delineation efforts at the site. However, as often occurs in the Pratt Aquifer, significant groundwater-bearing zones were not encountered, and the wells yielded insufficient groundwater for sampling. Also shown on Figure 5 are the locations of 4 wells that were abandoned pursuant to Department approval to facilitate pond closure work. These 4 wells are to be reinstalled when construction permits. A workplan and proposed replacement locations will be submitted to the Department by March 31, 2021. Well GS-AP-MW-12 remains in that area and is sampled semi-annually. Arsenic concentrations have steadily decreased in well GS-AP-MW-12 from 0.11 milligram per liter in August 2016 (mg/L) to 0.00616 mg/L during the most recent sampling event in September 2020. Concentrations have been below the GWPS during the last two sampling events. This steady decrease from the initial sampling event fits the description of chemical equilibrium restoring after the initial disturbance generated from the boring and well installation process.

4. *The screened interval for proposed background monitoring well GS-AP-MW-8 is located from 370.02 to 390.02 feet MSL. The screened interval for proposed background well GS-AP-MW-13 is located from 350.63 to 370.63 feet MSL. The elevation of the ash pond appears to be approximately 380 feet MSL. It appears that there may be potential for impacts to proposed background monitoring wells GS-AP-MW-8 and GS-AP-MW-13 from the waste management unit because a portion of the screened interval/the screened interval of these wells were installed*

below the elevation of the ash pond unit. It is recommended that the GWMP justify that these wells will produce background that meets the requirement s of ADEM Admin Code R. 335-13-15-.06(2)(a)1.

Section 4.2.1 of the GWMP describes the rationale for including wells GS-AP-MW-8 and GS-AP-MW-13 as upgradient wells. Although the well screens for these wells are lower than the ash pond, groundwater elevations within these wells are typically at least 7 feet greater than the pond elevation, resulting in a hydraulic gradient toward the ash pond. The geology and hydrogeology at the site are complex; however, the hydraulic pressure within different stratigraphic zones and surface water will govern water flow potential. Despite stratigraphic complexity, groundwater will migrate from zones of higher pressure (higher elevation) to those of lower pressure (elevation). Therefore, we are confident that that wells GS-AP-MW-8 and GS-AP-MW-13 represent background water quality that is present at a greater pressure and migrates toward the former ash pond, which occurs at a lower pressure potential. We note that well GS-AP-MW-13 has been abandoned and will be reinstalled when feasible in the near future. This replacement will be addressed in the forthcoming revised GWMP.

5. *Two cross sections are included as Figures 5A and 5B to characterize the site. Additional detailed geologic cross sections across the Northern and Eastern portions of the site are requested to be included as part of the pending assessment of corrective measures plan to thoroughly characterize site conditions.*

The requested cross sections are included in the attached *Supplemental Site Hydrogeologic Characterization Report*. In addition, these cross sections presenting site stratigraphy and groundwater quality data were provided in the report titled *Semi-Annual Progress and Groundwater Delineation Report*, dated September 30, 2020. Figure 4D in the report presents a cross section along the eastern portion of the site. Figures 4F and 4H provide additional geologic interpretations along the northern and north-central parts of the site, respectively. Slight variability in groundwater quality is expected between monitoring events. These cross sections depicting groundwater quality data will be updated in subsequent semi-annual reports if groundwater quality changes and substantively alters interpretations of delineation.

6. *The faults depicted on figures 5A and 5b should be indicated on Figure 4.*

A revised figure including the faults is included in the attached *Supplemental Site Hydrogeologic Characterization Report*. Fault locations are included on Figures 3a and 3b of this report.

7. *It is recommended that Table 1 in the GWMP, Groundwater Monitoring Well Network Details and Table 1 in the SAP, Groundwater Monitoring Well Network Details identify the same monitoring well network. It is recommended that the GWMP clearly note the designation of monitoring well GS-AP-MW-l7V.*

   The figures and tables of the GWMP will be updated to identify current and planned wells so the monitoring network is sufficiently described for permitting purposes. Well GS-AP-MW- l7V was originally installed as a vertical delineation well, but groundwater elevations at GS-AP-MW-17V indicate that this location is upgradient of the ash pond. Data from the well is being evaluated for a period to support a recommendation regarding inclusion of the well in the compliance monitoring network. The GWMP and SAP will be updated to assure that tables identifying the groundwater monitoring network details are consistent and the designation of well GS-AP-MW- l7V clearly identified.

<u>Plant Gorgas Bottom Ash Landfill:</u>

1. *The GWMP describes a process for using intrawell analysis. Because no compliance monitoring wells were installed prior to the placement of waste at the facility, it does not appear that intrawell analysis will accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit required by ADEM Admin. Code r. 335-13-15-.06 (2)(a)1. It is recommended that intrawell analysis procedures be removed from the GWMP and SAP.*

   Section 8 of the GWMP and Section 5 of the SAP provide details regarding statistical methods used during detection and assessment monitoring. These sections explicitly describe the interwell approach used at the site and the rationale for the approach. Intrawell methods are not mentioned in the GWMP and are only mentioned in the SAP for 2 reasons: (1) to describe the other statistical approach provided for in the CCR rules and USEPA guidance as a means of supporting the interwell statistical method selected for use at the site, and (2) to outline when it may be appropriate to propose for the use of intrawell methods at the site due to a change in site conditions. Both the GWMP and SAP note that any change to the statistical method requires Department approval.

2. *Monitoring wells MW-10, MW-11, and MW-12 appear to be located approximately 400 feet downgradient of the waste unit boundary. ADEM Admin. Code r. 335-13-15-(2)(a)2 requires that the downgradient monitoring system be installed at the waste boundary that ensures detection of groundwater contamination in the*

uppermost aquifer. It is recommended that justification for the locations of these site wells be included in the GWMP.

These wells were installed downgradient of the Bottom Ash Landfill in 2012 and 2014 prior to publication of the CCR rule and in accordance with ADEM Admin. Code r. 335-13-4-.27(2)(a)3 identifying the compliance boundary as no more than 150 meters (492 feet) of the waste boundary. The hydrogeology at the site is complex and groundwater producing zones are often unable to be located: several wells have been installed at the site that cannot be used for groundwater monitoring because of insufficient yield and recharge. These wells have been installed at locations that yield sufficient water for sampling and have a substantial background data set for statistical analysis. Attempts to install additional wells may not be successful and will forfeit the use of data trends established in the current monitoring wells. In addition, these wells are located at least 1,500 feet from the downgradient property boundary, providing sufficient room for future delineation if necessary. Therefore, these wells were installed in accordance with Department regulations at the time, are representative of groundwater migrating from the Bottom Ash Landfill area that will detect impacts, and have substantial buffer from the downgradient property line should exceedances require further investigation.

Plant Gorgas CCR and Gypsum Landfill:

1. *Monitoring wells MW-6, MW-7, and MW- 17R appear to be located approximately 400 feet downgradient of respective waste unit boundaries. ADEM Admin. Code r. 335-13-15-(2)(a)2 requires that the downgradient monitoring system be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. It is recommended that justification for the locations of these site wells be included in the GWMP.*

   Due to the steep downward slopes at the site and construction activities, wells MW-6 and MW-7 were installed as close as practical to the CCR Landfill. In addition, they were installed in 2014 prior to publication of the CCR rule and at Department-approved locations. Since construction has been completed, it may be feasible to install a replacement well closer to the unit between wells MW-5 and MW-7. The GWMP will be updated to reflect the proposed addition but will account for the possibility that a replacement location may provide insufficient water for monitoring.

   Well MW-17 was originally located near the Gypsum Landfill waste boundary; however, the well yielded insufficient water for monitoring. Replacement well MW-17R was installed at the present location and it yields sufficient water for sampling.

Plant Gorgas Gypsum Pond:

1. *The background monitoring wells proposed for the Gorgas Gypsum pond are the same background monitoring wells proposed for the CCR landfill. Tables 1 and 2 in the GWMP and Table 1 in the SAP should note that proposed background monitoring wells MW-1 through MW-4 are located at the CCR landfill site because wells with the same names were installed at the Plant Gorgas Gypsum Pond.*

   The background monitoring wells proposed for the Gorgas Gypsum Pond are the same background monitoring wells that are proposed for the CCR Landfill. The report titled *Semi-Annual Progress and Groundwater Delineation Report*, dated September 30, 2020, includes all current well designations for the Gorgas Gypsum Pond. Tables 1 and 2 in the revised GWMP and Table 1 in the revised SAP will include a note clarifying that the background wells for the Gypsum Pond are the same as those for the CCR Landfill.

2. *One cross section is included as Figure 5 to characterize the site. Additional detailed geologic cross sections across the Southern and Eastern portions of the site are requested to be included to thoroughly characterize site conditions.*

   Additional cross sections are included in the attached *Supplemental Site Hydrogeologic Characterization Report*. In addition, these 5 cross sections presenting site stratigraphy and groundwater quality data were provided in the report titled *Semi-Annual Progress and Groundwater Delineation Report*, dated September 30, 2020. Reliable geologic data is not available on the east side of the site because boreholes conducted in that area for wells were dry and thus, not surveyed. Therefore, a geologic profile was not produced for that area.

We appreciate the opportunity to provide these clarifications. I will be pleased to discuss these items if that is helpful to you. If you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

Dustin Brooks

Dustin G. Brooks
Environmental Affairs Supervisor

Cc: Eric Wallis – Southern Company Services

Attachment

Alabama Power

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August 24, 2020

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Re: Response to ADEM Letter of August 14, 2020 -- Groundwater Monitoring Plan Comments

Dear Mr. Story:

The following provides responses to comments received in a letter received from the Alabama Department of Environmental Management (ADEM or Department) Land Division dated August 14, 2020. The following presents the full text of the letter provided by ADEM followed by our response in italics.

General Comments

1) Additional information is requested to be included as part of the pending Assessment of Corrective Measures Plan to thoroughly characterize site conditions. The information should include the following:
   a) Additional historical potentiometric figures. This is requested to aid in the assessment of the groundwater flow at the site.
   b) Additional detailed geologic cross sections. Cross sections aid the hydrogeologic interpretation of groundwater flow direction and are crucial for assessing the monitoring well network.
   c) A table of all historical groundwater, pore water, and surface water data is needed to aid in the review of statistical background. In addition to the GWMP, a historical groundwater data table should be included in all groundwater monitoring repo1ts.
   d) Please provide the data associated with the advanced geophysical methods that were used for the Plant Gaston Ash Pond Monitoring Wells.

This information will be provided for each plant in the subsequent Delineation Reports to be submitted to the Department on or before September 30, 2020.

2) Section 4.5 of the Groundwater Monitoring Plan (GWMP) states "If an upgradient well is abandoned due to pond closure activities or by an unforeseen circumstance, the historical data from that well will remain in the upgradient data pool and, therefore, the well remains part of the upgradient network by legacy." Data from a background well that is abandoned may remain relevant for use as statistical background. However, it is recommended that background data for each background well proposed for abandonment be evaluated and included in statistical background upon Department approval prior to submiss ion of the monitoring well abandonment plan.

This has been addressed by modifications to Section 2.2.2 of the SAP and Section 4.5 of the monitoring plans consistent with this request. Background data for each upgradient well proposed for abandonment (or otherwise removed from the background network) will be statistically evaluated with respect to the background data pool. Based on the evaluation, a proposal will be submitted to the Department for approval detailing the evaluation of the data and proposing the continued use (or disuse) of the data in the background data set. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

3) Section 2.2.2 of the Statistical Analysis Plan (SAP) should clearly specify how background will be evaluated, and eliminated or included. lt is recommended that Section 2.2.2 of the SAP indicate that modifications to background will occur with Department approval.

This has been addressed by modifications to Section 2.2.2 of the SAP. Language has been added to Sections 1.0, 2.0, and 2.2 that clearly state that any changes to the statistical analysis plan (including background wells and the background data set) require Department approval. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

4) Section 6.3 of the GWMP states that the analytical "method used will be able to reach a suitable practical quantification limit to detect natural background conditions at the facility." It is recommended that the GWMP be revised to reflect the requirements of ADEM Admin. Code r. 335-13-15-.06(4)(g)5.

Section 6.3 of the GWMPs have been modified consistent with this request using language consistent with ADEM Admin. Code r. 335-13-15-.06(4)(g)5. The plans clearly state "that any practical quantitation limit that is used will be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility." See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

5) The GWMPs for Plant Barry, Plant Gadsden, Plant Greene, and Plant Miller describe a process for using intrawell analysis. Because no compliance monitoring wells were installed prior to the placement of waste at the facility, it does not appear that intrawell analysis will accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit as require d by ADEM Admin. code r. 335-13-15-.06(2)(a)1. Intrawell analysis procedures should be removed from all Ash Pond GWMPs and SAPs. Intrawell analysis may be justifiable for the lined Barry Gypsum and Gaston Gypsum ponds.

Intrawell analysis has been used on a very limited basis for select few parameters during detection monitoring. Each of these sites is in assessment monitoring and proceeding with groundwater remedy selection. Nonetheless, intrawell statistical analysis of Appendix III detection constituents will be discontinued. Section 8.1 of the GWMPs for Plant Barry, Plant Gadsden, Plant Greene, and Plant Miller have been amended to remove the option of intrawell statistical analysis for Appendix III detection monitoring constituents. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

6) The proposed use of tolerance intervals to set Groundwater Protection Standard s (GWPSs) using pooled data from multiple wells screened in different hydrostratigraphic positions, without explicit checks for spatial variation, does not comply with requirements listed in Section 17.2 .1 of the March 2009 Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance (Unified Guidance) to set adequate tolerance limits. It is recommended that the GWMP comply with recommendations stated in the Unified Guidance.

Section 5.2 of the SAP has been modified to address this request. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

7) Sections 7.5 and 21.0 of the Unified Guidance present GWPS testing as an either/or decision using either a multi-sample approach (using detection monitoring tests listed in Part III of the Unified Guidance), or a single-sample approach (using assessment and corrective action tests listed in Part IV of the Unified Guidance). The GWMP includes a combined approach using both tolerance limits to set an elevated GWPS and confidence intervals that require the entire interval to exceed the GWPS before corrective action is indicated. Section 7.5 and Example 7-1 of the Unified Guidance couch multi-sample tests to provide a reasonable GWPS for concentrations of constituents that "are occasionally found at uncontaminated background well concentrations exceeding the irrespective MCLs. The regulations then provide that a GWPS based on background levels is appropriate. "It appears that the multi- sample approach should only be applied to constituents with observed concentrations that

occasionally exceed relative MCLs and health-based standards in uncontaminated background rather than applied universally to all Appendix IV constituents.

Section 5.2 of the SAP has been modified to address this request. Additional documentation provided by Dr. Kirk Cameron, primary author of the Unified Guidance, explains the intended use of interwell tolerance limits (a detection monitoring test) when applied to Assessment Monitoring programs to establish an alternate GWPS when concentrations upgradient naturally exceed MCLs. The documentation supports the use of parametric and nonparametric tolerance limits (depending on the distribution of a given constituent) using pooled upgradient well data regardless of the presence of spatial variation. The resulting statistical limit establishes the threshold of all anticipated unimpacted average concentrations at downgradient wells when compared to a GWPS through the use of confidence intervals. Parametric tolerance limits will be used with Department approval when data sets follow a normal distribution. In the event that a data transformation or high degree of variability establishes a background limit that is less than conservative from a regulatory perspective, a nonparametric tolerance limit will be constructed. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

8) Section 4.1 of the SAP indicates that parametric confidence intervals will be constructed at the 99% confidence level, which is the highest confidence level in the guidance. Because statistical confidence is not the same as power, Section 7.4.1 of " the Unified Guidance recommends reversing the usual sequence: first select the desired level of power for the test, (I-B), and then compute the associated (maximum) false positive rate (a). In this way a pre-specified power can be maintained even if the sample size is too low to simultaneously minimize the risks of both Type I and Type II errors (i.e., false positives and false negatives)." Section 7.4.1 of the Unified Guidance indicates "statistical confidence is not the same as power. The confidence level merely indicates how often - in repeated applications - the population will contain the true population parameter (0); not how often the test will indicate an exceedance of a fixed standard. "It appears that parametric confidence intervals should be constructed at a confidence level based on power to minimize the risk of missing contamination above the GWPS. Justification for the use of confidence intervals set at the 99% confidence level should include calculations demonstrating that the true population coefficient of variation is no greater than 0.5.

Section 4.1 of the SAP has been modified to address this request. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

9) Section 4.2 of the SAP states that "In Corrective Action, a well/parameter pair is declared to no longer be an SSI over the GWPS when the entire interval falls below a specified limit (i.e., the Upper Confidence Limit [UCL] falls below the limit), or when the LCL of the Append ix IV parameters does not exceed the GWPS for a period of three consecutive years." Section 7.5 of the Unified Guidance indicates that the proposed combined single-sample and multi-sample approach "based on both background sample size and sample variability is recommended for identifying the background GWPS at a suitably high enough level above current background to allow for reversal of the test hypotheses. ... a GWPS based on this method allows for a variety of confidence interval tests (e.g., a one-way normal mean confidence interval identified in [7.3] and [7.4])." The statistical methods referenced in ADEM Adm in. code r. 335-13- l 5-.06(9)(d)2 are applicable to detection monitoring tests referenced in ADEM Adm in. code r. 335-13- 15-.06(4)(f) and (g). Confidence intervals require justification for use under ADEM Admin. code r. 335- 13-15-.06(4)(f)5. Hypothesis test structures using confidence intervals should be consistent with equations [7.1] and [7.2] of the Unified Guidance when us in g the proposed method. It is recommended that the portion of the GWMP stating "or when the LCL of the Appendix IV parameters does not exceed the GWPS for a period of three consecutive years." be removed.

Section 4.2 of the SAP has been modified to address this request by striking the phrase "or when the LCL of the Appendix IV parameters does not exceed the GWPS for a period of three consecutive years." The removed language does not appear in the GWMPs. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

10) The term "statistical limit " appears to be used twice in Section 5.2 of the SAP to describe the GWPS in assessment monitoring comparisons described in ADEM Admin. Code r. 335-13-15-.06(e), (f), and (g). It is recommended that the terminology used in the SAP be consistent with terminology used in Solid Waste regulations.

We presume that the intended reference in this comment was to ADEM Admin. Code r. 335-13-15-.06(6)(e), (f), and (g). *Section 5.2 of the SAP has been modified to address this request by using terminology consistent with Solid Waste regulations (i.e. groundwater protection standard or GWPS). See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

Individual CCR Unit Comments

Plant Barry Ash Pond

1) Table 2 provides a comparison of constituents between background and downgradient wells to demonstrate that proposed background wells are not impacted. Boron is listed as ND, however time series graphs included in the background update indicate that there are detections (not J values for boron) in proposed background monitoring wells at the Plant Barry Ash Pond. The footnote indicates that the detection was below the MDL, and thus considered ND. However, Table 3 shows the RL for boron as 0.05 mg/L, the detections are at minimum greater than 0.1 mg/L. Time series graphs are not included for other key indicator parameters (time series graphs were not constructed for this purpose, but they provide the only reference to historical data in the GWMP). It is recommended that the GWMP be revise d to accurately represent monitoring data.

Table 2 has been updated to use average boron concentrations, using ½ the reporting limit where not detected. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

Plant Barry Gypsum Pond

1) Table 2 provides a comparison of constituents between background and downgradient wells to demonstrate that proposed background wells are not impacted. Boron is listed as ND, however time series graphs included in the background update indicate that there are detections (not J values for boron) in proposed background monitoring wells at the Plant Barry Gypsum Pond. The footnote indicates that the detection was below the MDL, and thus considered ND. However, Table 3 shows the RL for boron as 0.05 mg/L, the detections are at minimum greater than 0.1 mg/L. Time series graphs are not included for other key indicator parameters (time series graphs were not constructed for this purpose, but they provide the only reference to historical data in the GWMP). It is recommended that the GWMP be revise d to accurately represent monitoring data.

Table 2 has been updated to use average boron concentrations, using ½ the reporting limit where not detected. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

Plant Gadsden Ash Pond

1) The Table of contents in the SAP indicates that Appendix A is "Background Screening and Compliance Evaluation" however no such document is attached, as was provided for the other CCR units. Please provide this in formation.

Appendix A was inadvertently omitted from the SAP and is now included. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

Plant Miller Ash Pond

1) Section 5 .2 of the GWMP states that " Screen length will not exceed 10 feet without justification as to why a longer screen is necessary (e.g. significant variation in groundwater level)." Table 1 indicates that monitoring wells GS-AP-MW-8, GS-AP-MW-13, GS-AP-MW- 17V, MR-AP-MW- 19 HA, MR-AP-M W-28H, MR-AP-MW-30H, MR-AP-MW-31H, MR-AP-MW-33H, MR-AP- MW -36 H, and MR-AP-MW-2V were installed with 20 feet of well screen. It is recommended that the GWMP include information to explain the reason these wells were installed with longer screens.

Section 5.2 of the GWMPs for Plants Miller and Gorgas have been modified to explain the reasoning for installing certain wells with screen lengths greater than 10 feet. As previously discussed with the Department, because of the nature of the geology at Plants Miller and Gorgas locating water-bearing fractures and zones is difficult, as evidenced by numerous dry holes drilled at the site. Additional well screen length is often necessary at fractured rock sites such as Plant Miller and Gorgas: groundwater yield is so low that wells are not able to be developed or sampled using conventional methods. The additional footage of well screen assists well development and sampling by providing a greater volume of groundwater and can provide more fracture and groundwater flow zone intersection. See the updated Groundwater Monitoring Plan submitted to the Department on August 24, 2020.

2) Monitoring wells MR-AP-MW-21 and MR-AP-MW-23 are screened 95 feet in elevation apart. Groundwater elevations appear to indicate that these wells are screened in an unconfined aquifer. Additional information should be provided to identify the geology at MR-AP-MW-23 and provide rationale for installing the well screens such a distance apart. Figure 6C should identify the aquifer in which these wells are screened.

A revised Figure 6C including the requested information has been included in the updated Groundwater Monitoring Plan submitted to the Department on August 21, 2020. Additional geologic information will be submitted in the upcoming Plant Miller groundwater delineation report due on or before September 30th, 2020.

At Plant Miller compliance wells vary in depth from approximately 40 feet below ground surface (ft BGS) to 291 ft BGS and are screened across multiple discrete flow zones. This variability in well screen depth and flow zone(s) can lead to natural variability in groundwater quality. These proposed upgradient locations were chosen based upon similar position on the Sequatchie Anticline and APC land ownership. These locations sit on the opposite limb of the Sequatchie Anticline, but at similar elevation, structural, and stratigraphic setting. Staggered depth *intervals are an attempt to capture depth dependent variation in groundwater quality which can differ based upon age of groundwater and groundwater-rock interactions along heterogenous Pottsville Strata.*

3) The boring log for monitoring well MR-AP-MW-21 indicates that at 175 feet BGS the "Driller lost all water circulation at the beginning of Run 19 and never got it back. Mud tub drained out." It appears that the drilling fluid may have been los t down the borehole. Please clarify what occurred during the installation of proposed background monitoring well MR-AP-MW-21.

As evidenced by the caliper log provided in the GWMP, the bore intersected a fracture between 174.5 ft BGS and 175.3 ft BGS. The loss of water circulation occurred across this interval indicating relatively high permeability and ability for the fracture to take drilling water. The use of the description "Mud tub" was not meant to imply that drilling mud was utilized in the boring advancement process. Sonic drilling relies on water as drilling lubricant and only water was utilized at this location. Groundwater quality samples collected from this location do not exhibit unusual physical appearance or a geochemical signature indicating drilling-induced bias.

4) The monitoring well installation process described in Section 5.2 of the GWMP does not adequately describe the process indicated on provided boring logs. In many cases monitoring wells constructed at the site were installed after boring hundreds of feet to bedrock, conducting geophysical methods on the borehole, and abandoning the boring below the interval selected for monitoring with bentonite chips. The process of inserting bentonite chips into the borehole requires a specific process to ensure that bridging does not occur, resulting in an inadequate seal. It is recommended that the process used to install monitoring wells above abandoned bore holes be thoroughly described in the GWMP.

Section 5.2 of the revised GWMP has been updated to include the requested information, including the use of bentonite and the process used to install monitoring wells over abandoned boreholes. See the updated Groundwater Monitoring Plan submitted to the Department on August 24, 2020.

5) The elevation of the screened interval for monito ring well MR-AP-PZ-5 is incorrectly listed in Table 1. It is recommended that the table be corrected.

Table 1 has been corrected and included in the updated Groundwater Monitoring Plan submitted to the Department on August 24, 2020.

We appreciate the opportunity to provide these clarifications. I will be pleased to discuss these items if that is helpful to you. If you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

Dustin Brooks

Dustin G. Brooks
Environmental Affairs Supervisor

cc: Eric Wallis – Southern Company Services

PLANT GORGAS CCR LANDFILL
GROUNDWATER MONITORING PLAN

Revision 2: March 11, 2021

Revision 1: August 21, 2020

Submittal: April 20, 2020

PREPARED FOR:

Alabama Power

Southern Company Services
Earth Sciences and Environmental Engineering

REVISED GROUNDWATER MONITORING PLAN

ALABAMA POWER COMPANY - PLANT GORGAS

This *Revised Groundwater Monitoring Plan, Alabama Power Company - Plant Gorgas CCR Landfill*, has been prepared to document that the Site groundwater monitoring network and monitoring plan meets the requirements described by ADEM Admin Code r. 335-13-15-.06(2). It has been completed under the supervision of a licensed Professional Geologist with Southern Company Services.

Report Prepared by:

Gregory B. Dyer

Gregory B. Dyer, P.G.
Alabama Professional Geologist No. 1471

3/11/2021
Date

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1. INTRODUCTION

The Gorgas CCR Landfill Groundwater Monitoring Plan (GMP or plan) has been updated to include additional information regarding the hydrogeological evaluation for the site, the background groundwater monitoring network, procedures for updating the background data set, and statistical methods used to evaluate groundwater quality data.

Groundwater monitoring at the Plant Gorgas CCR Landfill is required by the Alabama Department of Environmental Management (ADEM or the Department), ADEM Admin Code r. 335-13-15-.06, to detect potential downgradient changes in groundwater quality. This GMP meets the requirements set forth for groundwater monitoring networks as described by ADEM Admin Code r. 335-13-15-.06(2). The plan describes the groundwater monitoring program for the site, including the following key components: description of subsurface hydrogeology and uppermost aquifer, monitoring well network design, sampling and analyses program, and statistical analyses program.

Prior to the promulgation of the Federal and State coal combustion residuals (CCR) regulations, the CCR Landfill was permitted under Industrial Waste Landfill Permit #64-10 (ADEM Admin Code Ch. 335-13-4) effective January 8, 2016. Accordingly, the GMP was developed and groundwater monitoring activities, under ADEM Admin Code Ch. 335-13-4, began in 2014. The first groundwater monitoring report was submitted to the Department in 2016.

Groundwater monitoring has occurred since 2016 in accordance with the United States Environmental Protection Agency (EPA) CCR rule (40 CFR Part 257, Subpart D) and the State of Alabama's CCR Regulations (ADEM Admin Code Ch. 335-13-15) and results reported to ADEM. Upon initiating detection groundwater monitoring at the site in 2017, statistically significant increases (SSIs) of Appendix III monitoring parameters were detected above background levels. Pursuant to State and Federal regulations assessment monitoring was implemented. During assessment monitoring, Appendix IV constituents were detected at statistically significant levels (SSLs) above groundwater protection standards (GWPS). Consequently, Assessment of Corrective Measures (ACM) was prepared and submitted to ADEM in February 2020. The site performs semi-annual assessment monitoring as additional site investigation is performed and a final remedy is developed. However, during the most recent sampling events of 2019, no GWPS exceedances were noted in downgradient wells.

The purpose of this plan is to present the groundwater monitoring network, field and lab procedures, and site-specific statistical analysis plan for Departmental review and approval. This plan also includes procedures for managing changes to the monitoring network, background, and statistical analyses.

2. SITE LOCATION AND DESCRIPTION

Alabama Power Company's (APC) Plant Gorgas is located in southeastern Walker County, Alabama, approximately fifteen miles south of Jasper, at 460 Gorgas Road, Parrish, Alabama 35580. Plant Gorgas lies in portions of Sections 7, 8, 9, 16, 17, 18, 19, 20, 21, 28, and 29, Township 16 South, Range 6 West and Section 12, 13, and 24, Township 16 South, Range 7 West. Section/Township/Range data are based on visual inspection of USGS topographic quadrangle maps and GIS maps (USGS, 1975; USGS, 1983).

The Plant Gorgas CCR Landfill is located east and northeast of the main power generation facility and is bordered to the north by Highway 269 and to the south by the Mulberry Fork of the Black Warrior River. **Figure 1, Site Location Map**, depicts the location of the site referenced to roadways and geographic features. **Figure 2, Site Plan Map**, depicts the general configuration of the CCR unit and the site monitoring well network. **Figure 3, Site Topographic Map**, depicts the topography of the site.

3. GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Plant Gorgas lies in the Warrior Basin physiographic region (Sapp and Emplaincourt, 1975), a late Paleozoic basin formed as a result of flexure and sediment loading associated with Appalachian and Ouachita orogenies. The bedrock geology is dominated by clastic sedimentary rocks of the Lower Pottsville Formation (GSA, 2010b). Deeper stratigraphy is marked by carbonates, shales, chert, and sandstones of Mississippian to Cambrian in age (Raymond et al., 1988). Plant Gorgas is directly underlain by rocks belonging to the Pratt Coal Group (Ward II et al., 1989). In general, the Pratt Group consists of mudstone, shale, fine-grained sandstone, and interbedded coal. **Figure 4, Site Geologic Map**, illustrates the surface geology at the site and neighboring areas.

Strip mining was conducted over a large portion of the area down to the American Seam. As a result, the overburden beneath the CCR units is dominated by backfilled mine overburden and is characterized by weathered shale and sandstone boulders with lenses of fine sediments and small amounts of coal fragments and coarse sediments. Geologic logs generated during various on-site investigations indicate that the depth to rock varies significantly, ranging from as little as five feet (un-mined areas) to as much as 155 feet below ground surface (BGS). **Figures 5A & 5B, Geologic Cross-Sections**, illustrates the geologic layering beneath the site. Borehole geophysical logs, boring logs, and well construction data is presented in **Appendix A, Boring and Well Construction Logs.**

Two water-bearing zones are present beneath the site: (1) the mine overburden/top-of-rock interface, and (2) the underlying Pottsville Aquifer. The first saturated zone beneath the site generally corresponds to the mine overburden/top of rock interface zone at which the mine-spoil overburden transitions to bedrock (Pottsville Formation). The average depth of the first saturated zone beneath the site is approximately 107 feet (BGS). The depth of the first saturated zone is generally between 105 and 115 feet (BGS) near the CCR Landfill with an average piezometric surface rising to 18 feet above the base of the screen.

The saturated thickness of the first saturated zone ranges between 3 and 8 feet. Hydraulic conductivity (K) in this zone varies widely, but is generally between 10-1 to 10-4 cm/sec. Well developments generally indicate low groundwater yields (quantity) between 0.05 and 1.0 gallons per minute (gpm).

The principal aquifer system from a local and regional perspective is the Pottsville Formation. The Pottsville Formation is also the uppermost aquifer beneath the site. In the Pottsville, two types of secondary porosity were observed to yield groundwater: (1) fractured intervals and (2) bedding plane weaknesses associated with fissile, siderite-banded, iron-claystone sequences. Fractured intervals are sporadic across the site and tend to occur with greater density in the upper 100 feet of rock. The upper portions of the Pottsville Aquifer beneath the proposed disposal facilities indicate unconfined to semi-confined, fractured, and extremely anisotropic conditions. The Pottsville Aquifer functions as a series of confined to semi-confined water producing zones (aquifers) since large permeability contrasts exist within the strata (Stricklin, 1989). Depth to groundwater varies significantly across the site and is wholly dependent upon encountering a fractured interval or zone of fissile, iron-claystone. Based on published data, groundwater quality produced from the Pottsville Formation can be characterized by high concentrations of sulfate, iron, and other trace metals (Jennings and Cook, 2010). Trace metals in Pottsville Formation groundwater are associated with sulfide minerals contained in organic-rich strata (e.g., Mudstones and Coal Seams) and siliceous/carbonate healed fractures and joints. Trace element enrichment is likely the result of migrating hydrothermal fluids generated during the late Paleozoic Allegheny orogeny (Diehl et al., 2005). Arsenic, antimony, molybdenum, selenium, copper, thallium, and mercury are elevated in Warrior Basin coal strata (Goldhaber et al., 2002).

The topography of the site creates a localized flow system where groundwater flow direction is south and south-southeast across the site, paralleling trends in topography, structural dip, and historic strip pit floors. Groundwater discharge in this local flow system is to the Mulberry Fork of the Warrior River. Mine spoil layering and complex Pottsville Formation lithofacies contribute to the vertical and horizontal heterogeneity present within the aquifer system and overlying saturated mine spoils. The potentiometric surface presented in **Figure 6, Potentiometric Surface Contour Map (October 7, 2019)**, indicate that groundwater flow direction is consistent despite seasonal fluctuations. This heterogeneity focuses groundwater flow along more permeable pathways, such as parallel to coal seams and bedding plains, or along vertical or sub-vertical discontinuities in the rock fabric. Thus, groundwater flow paths across the site may be tortuous.

4. SELECTION OF WELL LOCATIONS

According to ADEM Admin. Code r. 335-13-15-.06(2)(a), the groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

1. Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit; and
2. Accurately represent the quality of groundwater passing the waste boundary of the CCR unit.

ADEM Admin. Code r. 335-13-15-.06(2)(b) states that the number, spacing, and depths of groundwater monitoring system wells must be determined based upon site-specific technical information that must include a characterization of:

1. Aquifer thickness, groundwater flow rate, groundwater flow direction, including seasonal and temporal fluctuations in groundwater flow; and
2. Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

ADEM Admin. Code r. 335-13-15-.06(2)(c) requires the groundwater monitoring system to include the number of monitoring wells necessary to meet the performance standard set forth in the rules. The monitoring system must contain a minimum of one upgradient and three downgradient monitoring wells but consist of additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

This groundwater monitoring network was previously approved by the Department under a minor modification to existing industrial waste landfill permit #64-10 operating under state solid waste rules (ADEM Admin Code Ch. 335-13-4).

4.1 Compliance Monitoring Network

Groundwater monitoring wells are installed to monitor the uppermost occurrence of groundwater beneath the site which accurately represent the quality of groundwater passing the waste boundary of the CCR unit. Locations are selected based on facility layout and site geologic and hydrogeologic considerations. The proposed groundwater monitoring network at Plant Gorgas CCR Landfill is subdivided into background and compliance locations as based upon potentiometric contours and interpretations by a qualified groundwater scientist.

Background wells represent the quality of background water that has not been or would not be affected by the CCR unit. Compliance wells are screened within the uppermost aquifer and are used to assess potential impacts to the first "aquifer" in the event of a release. Groundwater monitoring wells are designed and constructed using "Design and Installation of Groundwater Monitoring Wells in Aquifers", ASTM Subcommittee D18.21 on Groundwater Monitoring, as a guide. **Table 1, Groundwater Monitoring Well Network Details**, and **Figure 7, Monitoring Well Location Map**, present the designed purpose and locations of monitoring wells with respect to the facility. Groundwater monitoring wells are screened across the mine spoil overburden – top of rock interface as this corresponds to the first zone of saturation beneath the site. If groundwater saturation is not present, deeper Pottsville intervals are targeted for well screens.

4.2 Background Monitoring Wells

Background groundwater is the baseline quality of groundwater that is representative of the aquifer being monitored, and that has not been affected by disposed CCR material. A background groundwater monitoring network has been identified at the Site based on groundwater flow conditions, groundwater quality, and statistical screening of the data in accordance with the Unified Guidance (Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance, March 2009, USEPA 530/R-09-007). The following describes the selected background network based on these criteria.

To evaluate upgradient well locations at the Site, groundwater elevations and CCR indicator parameters were reviewed. As presented on **Table 1** and **Figure 7**, 4 monitoring wells (MW-1, MW-2, MW-3, and MW-4) located upgradient of the CCR Landfill serve as background monitoring wells.

The following subsections describe in detail the results of this upgradient well evaluation process.

4.2.1 Groundwater Elevations and Flow

Groundwater elevations and potentiometric surfaces constructed for the Site since 2012 (pre-CCR LF construction) demonstrate a consistent groundwater flow direction and establish areas hydraulically upgradient of the CCR landfill. Because the CCR Landfill is a lined facility complete with a leachate collection system there is no mounding of groundwater and subsequent radial flow emanating away from the facility. As shown on **Figure 6**, groundwater flow at the Site is towards the south with only a slight 3 to 5-degree bend towards the east. Groundwater flow direction is driven by gravity and closely mimics site topography which has a north to south slope toward the Mulberry Fork of the Warrior River. Potentiometric surface contours and groundwater flow direction demonstrate that wells located to the north or northwest of the CCR Landfill are hydraulically upgradient and well locations to the west are lateral to groundwater flow direction. Therefore, monitoring well locations MW-1, MW-2, and MW-3 are hydraulically upgradient of the CCR Landfill, and MW-4, is lateral to flow but not in a downgradient flow path away from the CCR Landfill.

4.2.2 Groundwater Geochemistry

A comparison of the concentrations of key Appendix III and IV indicator parameters is useful in determining if a well is impacted by the CCR unit. At the CCR Landfill, groundwater quality data in upgradient wells was compared to downgradient wells. The results from these comparisons show similar overall concentrations for key indicator parameters, which is expected, given that the CCR Landfill is a relatively new landfill, the CCR Landfill was constructed with a liner and leachate collection system. The comparison is summarized on **Table 2, Upgradient Comparisons – Key Indicator Parameters**.

To summarize findings on **Table 2**, boron is a strong indicator of a CCR impact to groundwater. Upgradient concentrations were slightly lower than downgradient wells. Boron concentrations observed in both upgradient and downgradient wells were low-level trace detections and occur at concentrations that indicate that a CCR impact has not occurred. This supports the conclusion that the upgradient wells fairly represent background and have not been affected by CCR material.

Similarly, chloride is very low (<4 mg/L) in upgradient locations. These very low concentrations in-and-of-themselves indicate that groundwater has not likely been impacted by an outside source. Although still low, slightly higher concentrations are observed in downgradient wells. This further supports the conclusion that the upgradient wells fairly represent background and have not been affected by CCR material.

Finally, the data comparison shows that upgradient wells generally displayed lower calcium, and TDS concentrations than downgradient locations. The concentration of sulfate in the downgradient wells falls within the upgradient sulfate concentration range. These concentrations are expected given the geology of the area and confirms that calcium and sulfate are naturally occurring. This too supports the conclusion that the upgradient wells represent background.

Comparison of Field Data

Comparing field parameters can often be useful for evaluating potential upgradient locations. In upgradient locations, it is more likely to find higher dissolved oxygen (DO), positive oxidation-reduction potential (ORP), lower conductivity, and lower pH. This because upgradient locations are more likely to be screened across younger, recharging groundwater. Recharging water generally carries higher DO (closer connection/more recent interaction with atmosphere) and have lower pH values more like meteoric water which is slightly acidic due to interactions with carbon dioxide in the atmosphere. Lower conductivity is expected due to a shorter residence time and consequently, less time for groundwater-rock interaction which naturally contributes to higher total dissolved solids. Conversely, downgradient and impacted wells are more likely to show reducing conditions (low DO, more strongly negative ORP), higher pH values, and higher conductivity (indicates higher total dissolved solids). The CCR Landfill is underlain by mine spoils, as described in **Section 3,** and the high degree of geologic heterogeneity may not fit this classic model as well as some Sites or to the degree, but as presented in **Table 2,** a comparison between upgradient wells and the average of downgradient wells generally do show these patterns.

As presented in **Table 2,** well locations MW-1, MW-2, MW-3, and MW-4 generally do show lower pH, higher DO, and positive ORP values when compared to downgradient wells. The most notable difference is the comparison of ORP data in which 3 of the 4 upgradient locations (MW-1, MW-3, and MW-4) average greater than 150 millivolts and indicate strongly oxidizing conditions. Conversely the average from downgradient wells was just below 7 millivolts and indicates largely neutral ORP. DO and pH generally fit the model as well where upgradient locations have pH values closer to 5 SU and downgradient wells average around 6.2 SU and the DO in upgradient locations averages slightly higher than downgradient wells (0.75 mg/L vs 0.38 mg/L). These comparisons provide additional assurance that these are upgradient of the CCR Landfill.

Upgradient well, MW-3, represents the potential variability that can be observed in mine spoil and Pottsville rocks as pH values can range from 3.77 to 5.69 SU, ORP from 66.4 to 353.4 millivolts, and DO from 0.52 to 1.07 mg/L. These variations are reflective of wetter than normal rainy seasons over the past couple of seasons combined with a recovery from the summer drought of 2016. The infiltration of weakly acidic rainwater and interactions with pyritic intervals (oxidization) decreases pH and can lead to the release of naturally occurring trace elements within pyritic and iron hydroxide/oxyhydroxide rich zones.

Based on review of data presented in Section 4.2.1 and 4.2.2, the wells identified for use as background groundwater monitoring points satisfy the requisite criteria: the wells are located hydraulically upgradient of the CCR Landfill and do not show evidence of having been impacted by a release from the CCR Landfill. The wells are screened in the same groundwater flow system as the downgradient compliance wells and thus represent background groundwater quality migrating toward the CCR Landfill

4.2.3 Statistical Screening

Details regarding screening of the background is presented in **Appendix B, Statistical Analysis Plan**. Groundwater quality was determined to be representative of a statistical background following screening in accordance with the Unified Guidance (*Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance*, March 2009, USEPA 530/R-09-007).

4.3 Downgradient Compliance Wells

Adequately locating and screening downgradient monitoring wells are essential to being able to detect potential impacts to groundwater from the CCR Landfill. Well locations, MW-5, MW-6, MW-7, and MW-8, as shown on **Table 1** and **Figure 7** are designated as downgradient compliance monitoring wells. These wells are screened at or near the mine spoil – top of rock interface which represents the first saturated zone and water-table flow system beneath the Site and are installed in the downgradient direction of flow away from the CCR Landfill as shown on the potentiometric surface contour map (**Figure 6**). Water levels in these wells are generally equal to or within a few feet of the screen length indicating water table conditions.

The base elevation of CCR Landfill cells 1 and 2 are 504 feet above MSL. Groundwater elevation data from piezometers proximal to these facilities (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, and MW-8) indicate that groundwater elevations are between 415 and 334 feet above MSL from north to south, respectively. Therefore, data suggests a vertical separation greater than 85-feet between the base of CCR Landfill cells and the water-table at the Site. Recharging meteoric water, or leachate, in the unlikely event of a release from the facility, would migrate vertically through the vadose zone until reaching the sharp permeability contrast encountered at the top of rock interface before flowing horizontally along the top of rock and also slowly migrating vertically into deeper Pottsville strata at preferred locations. Hydrogeologic cross-sections through these facilities are presented as **Figure 5.**

Based upon a review of the data discussed above, downgradient compliance wells are adequately installed to detect downgradient and vertical migration to deeper Pottsville flow systems in the unlikely event of a release from the facility. An additional downgradient well location (MW-22) not possible during the construction of the CCR Landfill may now be possible. The spatial areas under consideration are included in **Amendment 1** – Locations for Evaluation – Potential Additional Downgradient Well of this plan. These areas must be evaluated for underground conflicts and additionally, as documented for the Site, groundwater saturation and yield is highly variable and attempts to install may be unsuccessful.

Additionally, although not part of the immediate downgradient network for the CCR Landfill, other wells downgradient of the Bottom Ash Landfill and those surrounding the Gypsum Landfill further downgradient of the CCR Landfill could be utilized for detection or delineation if necessary.

4.4 Delineation Wells

Pursuant to ADEM Admin. Code r. 335-13-15-.06(6)(g)2., if assessment monitoring is implemented and exceedances of GWPS are observed, wells may be required to delineate the nature and extent of exceedances. A site-specific well delineation plan will be submitted to the Department for approval. Any newly-installed delineation well(s) will be sampled for Appendix III and IV constituents as part of the assessment groundwater monitoring program until the Department approves a change to the monitoring program.

4.5 Updating the Background Well Network

The intention of this groundwater monitoring plan is to present the final groundwater monitoring network and designation of monitoring wells for permitting. However, in the future and over time the upgradient or background well network may be updated by adding or removing wells, updating background periods, re-designating existing wells, or modifying the background data set.

Changes to the background well network and data set will be made after receipt of Departmental approval.

If an update or modification to the permitted background network is recommended in the future, APC will complete the following:

- A notice will be submitted to the Department describing the proposed change(s) and the rationale for the change. The notice will contain statistical screening of the background data set and include sufficient information to evaluate and approve the request.
- Upon approval by the Department, the background network and data set will be adjusted pursuant to the proposal and used for future analyses.
- A revised groundwater monitoring plan and minor modification will be submitted to the Department.

The Statistical Analysis Plan in Appendix B provides details regarding requesting Department approval for updates and changes to the background well network and data set.

When well re-designations are approved by the Department, new statistical limits will be calculated based upon the resulting monitoring well network. When background data is updated, historical reports and exceedance lists will not be updated unless approved by the Department. Changes will apply to future analysis unless an immediate change is warranted. If delineation or groundwater corrective action is underway, the new background may be applied to those actions as appropriate with Department approval.

When background data is updated changes will apply to future analysis unless an immediate change is warranted. If delineation or groundwater corrective action is underway, the new background will be applied to those actions as appropriate with Department approval.

5. MONITORING WELL DRILLING, CONSTRUCTION, ABANDONMENT & REPORTING

The following describes monitoring system performance standards that have been applied to monitoring well activities subsequent to this monitoring plan and that will be applicable to all work performed in the future.

5.1 Drilling

Drilling methodology may include, but not be limited to: hollow stem augers, direct push, air rotary, mud rotary, or rotosonic techniques. The drilling method will minimize the disturbance of subsurface materials and will not cause impact to the groundwater. Borings will be advanced using an appropriate drilling technology capable of drilling and installing a well in site-specific geology. Drilling equipment will be decontaminated before use and between borehole locations using the procedures described in the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Field Equipment Cleaning and Decontamination as a guide.

Sampling or coring may be used to help determine the stratigraphy and geology. Samples will be logged by a qualified groundwater scientist. Screen depths will be chosen based on the depth of the uppermost aquifer. Logging will be performed by a geologist or geotechnical engineer registered in the State of Alabama or working under the direction of a geologist or engineer registered in Alabama.

5.2 Design and Construction

Well construction materials will be sufficiently durable to resist chemical and physical degradation and will not interfere with the quality of groundwater samples. Groundwater monitoring wells are designed and constructed in accordance with ADEM Admin Code r. 335-13-15-.06(2)(e) using “Design and Installation of Groundwater Monitoring Wells in Aquifers”, ASTM Subcommittee D18.21 on Groundwater Monitoring as a guide. Well installations will generally follow the procedures outlined below.

The minimum boring diameter will be four inches larger than the outside diameter of the well casing, and a minimum well casing diameter of two inches will be used. Up to ten feet of ASTM NSF-rated Schedule 40 PVC with 0.010- in. slots will be set at an approximate depth of 10-20 ft below the typical water table depth. ASTM NSF-rated Schedule 40 PVC flush-threaded riser casing with will be used to finish the well approximately 3 feet of above-ground surface. A filter pack consisting of well-rounded and chemically inert materials (e.g., clean quartz) will be packed around the screen from the bottom of the borehole to a minimum 2 feet above the top of the screen. Sodium bentonite pellets will be placed to create a seal above the screen in the annulus for a minimum of 2-ft above the filter pack by dropping or washing down with potable water, or by tremie method. The annular space above the seal will be filled via tremie injection with a high-solids bentonite slurry, neat cement, or cement-bentonite grout mixture to the ground surface.

The design and construction of the intake of the groundwater wells will: (1) allow sufficient groundwater flow to the well for sampling; (2) minimize the passage of formation materials (turbidity) into the well; and (3) ensure sufficient structural integrity to prevent the collapse of the intake structure.

Each groundwater monitoring well will include a well screen designed to limit the amount of formation material passing into the well when it is purged and sampled. Screens with 0.010-inch slots have proven effective for the earth materials at the site and will be used unless geologic conditions discovered at the time of installation dictate a different size. Screen lengths are site and conditions dependent but are typically 10 feet. In some cases, screen lengths of 20 feet are utilized if the water table may undergo large fluctuations in elevation, particularly seasonally, or to capture a sufficient volume of water to adequately sample the groundwater well.

Additional well screen length is a tool utilized at fractured rock sites such as Plant Miller and Gorgas where groundwater yield is low and often is below the threshold for development and subsequent low-flow sampling. The additional footage of well screen assists well development and sampling by providing a greater volume of groundwater and can offer a technical advantage by providing more fracture/discrete flow zone intersection with the screened interval. Successful wells, that do not intersect groundwater yielding coal seams or well-connected fracture zones, are often predicated on encountering numerous, discrete low-yield fractures or bedding planes (where individual contributions may be sub 25 mL/min). In these instances, additional screen length can be a deciding factor in the success of a monitoring well installation.

If the above prove ineffective for developing a well with sufficient yield or acceptable turbidity, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

The placement of well screens at fractured rock sites such as Plant Miller and Gorgas is dependent upon sound borehole characterization to identify fracture networks and water bearing units. Groundwater is found chiefly in fractures and coal seams and is commonly confined by sharp permeability contrasts within the aquifer. Previously conducted conceptual site models are utilized to select target depths of well screen intervals during installation of monitor wells. In some instances, rising head tests are conducted at field dependent intervals while the borehole is being advanced to provide a preliminary characterization of borehole yield across intervals. Borehole geophysics and hydrophysical logging suites are utilized upon completion of the borehole. These logs will be utilized to determine borehole lithology and potential groundwater yielding zones. A combination of gamma, 3-arm, caliper, acoustic/optical televiewer combined with fluid resistivity/temperature logging will provide the principal points of comparison. Upon completion of the borehole geophysics, it may be necessary to backfill the boring to the well design depth. Boring are backfilled with bentonite chips to the design depth by slowly pouring the chips down the drill casing at a target pour rate of 3 minutes per 50-pound bag to prevent bridging. Additionally, periodically a weighted tape is used to check for bridging and the depth of the backfill. A target thickness of 5-ft of filter pack sand will separate the base of sand from bentonite chip backfill and to complete the backfill process.

Pre-packed dual-wall well screens may be used for well construction. Pre-packed well screens combine a centralized inner well screen, a developed filter sand pack, and an outer conductor screen in one integrated unit composed of inert materials. Pre-packed well screens will be installed following general industry standards and using the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Design and Installation of Monitoring Wells as a general guide. If the dual-wall pre-packed-screened wells do not yield sufficient water or are excessively turbid after development, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

The monitoring wells will be completed with concrete pads approximately 6-inches thick extending approximately 3 feet around the well and sloping away from the well. Each well will be capped and enclosed in a lockable above-ground protective cover with weep holes to prevent build-up of water within the protective casing. Wells located in areas with potential traffic will require a minimum of three surface protection bumper guards (bollards). All wells will have proper identification including the well identification number, total depth, and installation date.

5.3 Wells with Inconsistent Water Levels

The following procedures should be followed when field observations suggest that saturated conditions may exist at the target borehole depth at temporary and permanent well locations, but only minor amounts of free water (i.e., water capable of being sampled from a well casing) are observed in the well boreholes during drilling. These procedures should not be followed when “dry” (i.e., no free water) conditions are observed in the well boreholes at the target borehole depth. The field geologist will communicate with the project manager to determine if the boring should then be properly abandoned.

The decision to install a permanent well will be based on measurement of a target water column length. The target water column length for permanent wells is five (5) feet based on placement of the pump intake at least one (1) foot above the base of the screen and the well yielding sufficient sample volume to collect a complete sample set with quality assurance/quality control samples within one (1) day.

The following summarizes the procedure that will be followed:

  - Prepare a workplan describing, at a minimum, well location(s), purpose, drilling method, target depth, and water level performance standards outlined below and submit to the Department per ADEM Admin Code r. 35-13-15-.06(2)(e).
  - Drill the monitoring well borehole to the target depth.
  - If sonic or core drilling, and a significant volume of drilling lubricant (drilling water) is used in tight formations (low permeability), the purging of 1 borehole volume and subsequent monitoring of water level recovery may be utilized to evaluate recharge rate.
  - If the target water column length is not observed in the borehole after drilling, allow the water level in the borehole to equilibrate for 24 hours. The area around the borehole will be prepared to prevent surface water infiltration into the borehole.
  - If a minimum of 5 feet of water is present in the borehole (or 4 feet of water will be present above the planned pump intake depth) after 24 hours, install the monitoring well at the target depth.
  - If the above water column criteria are not present in the borehole after 24 hours, then terminate drilling at the location and grout the borehole following the appropriate Department standards.
  - If a well is not installed, the Department will be notified, and an alternative well installation plan developed if necessary, to meet Department requirements.

5.4 Well Development

Upon completion of well construction, the monitoring wells will be developed using a combination of surging and purging to remove excess fines and sediments and to promote good hydraulic communication with the aquifer. Development will continue until the purged water is free of visible fines, and water quality field parameters (turbidity, pH, temperature, and conductivity) have stabilized. In cases of slow recharge and slow turbidity reduction, potable water may be injected and purged as needed to remove fines. If this approach is used, a minimum of three times the volume of water introduced must be purged from the well.

5.5 Abandonment

If a permitted monitoring well should be abandoned, procedures will be followed in accordance with ADEM Admin Code r. 335-13-15-.06(2)(g). If practical, the entire well casing and screen will be removed. Removal can be accomplished by over-drilling the well with hollow stem augers and removing the grout and filter pack material from the well, followed by removal of the casing and the well screen. The clean borehole will then be backfilled with neat Portland cement from bottom to top by pressure grouting using the positive displacement (tremie) method. If the casing cannot be removed the well will be tremie grouted from the bottom of the well upwards with a neat cement. Additionally, a concrete seal will be placed at the ground surface. In either case, the top two feet of the borehole will be poured with concrete to insure a secure surface seal (plug).

Records of well abandonment activities will be kept for each well abandoned. The records will include the depth of emplacement and volume of all abandonment materials, methods of casing removal, and depth to water and well bottom prior to abandonment. A copy of these records will be provided to ADEM and a copy placed in the operating record.

If a replacement well is required, a plan and justification will be submitted to support replacement location(s) and screened intervals along with the proposal to abandon wells.

5.6 Documentation

Pursuant to ADEM Admin. Code r. 335-13-15-.06(2)(e)4., APC will document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices, as well as the name of the drilling contractor and type of drill rig.

6. GROUNDWATER SAMPLING AND ANALYSIS PLAN

Pursuant to ADEM Admin. Code r. 335-13-15-.06(4), the following section describes groundwater sampling requirements with respect to parameters for analysis, sampling frequency, sample preservation and shipment, analytical methods, chain of custody control, and quality assurance and quality control. Groundwater samples used to provide compliance monitoring data will not be filtered prior to collection.

6.1 Sample Collection

Groundwater samples will be collected from the monitoring well network as part of the Detection Monitoring Program, and potentially as part of the Assessment Monitoring Program, in accordance with the APC Low-Flow Groundwater Sampling Technical Standard Operating Procedures (TSOP) included as **Appendix C**. Samples will be collected using low-volume purge, or “low-flow” sampling methods with peristaltic or bladder pumps. Depth to water readings at each well location will be taken prior to sampling. Water quality parameters (pH, redox potential, conductivity, etc.) will be measured during purging and recorded on a field sampling form. Samples will be collected after field parameter stabilization criteria are met.

Low-flow (minimal drawdown) groundwater sampling procedures will be used for purging and sampling monitoring wells that will sustain a pumping rate of at least 100 milliliters per minute (mL/min) without significant water-level drawdown. Flow rates should not exceed 500 mL/min. Field water quality parameters recorded during purging will be used as criteria to determine when purging has been completed.

Where non-dedicated pumps are used, the sampling equipment must be slowly lowered into the well so as to avoid agitation of the water column. Sampling equipment and pump intakes must not extend below the midpoint of any well screen unless the well is known to drawdown and is a threat to go dry even with low flow rates or the water level in the well does not extend above the screened interval.

Most wells are screened with the top-of-screen below the static water level in the well. In these wells (1) the water level in the well must not be drawn down below the top of screen, and (2) stabilization of the water column will be considered achieved when three consecutive water level measurements vary by 0.33 feet or less at a pumping rate of no less than 100 mL/min.

If the static (pre-pumping) water level is below the top-of-screen, the water level must not be drawn down below the top of pump where it can be accurately measured.

Field water quality parameters (temperature, pH, turbidity, conductivity, dissolved oxygen and oxidation-reduction potential) will be measured but not all will be used for determining stabilization. Stabilization will be considered achieved and purging will be considered complete when three consecutive measurements of each field parameter vary within the following limits:

- 0.2 standard units for pH,
- 5% for specific conductance,
- 0.2 mg/L or 10% for DO > 0.5 mg/L (whichever is greater),
- IF DO < 0.5 mg/L there is no stabilization criteria for DO,
- Turbidity (see the following section for more detail), and
- Temperature and ORP – record only, no stabilization criteria.

The goal when sampling is to attain a turbidity of less than 5 nephelometric turbidity units (NTU); however, samples may be collected where turbidity is less than 10 NTU and the stabilization criteria described above are met. If sample turbidity is greater than 10 NTU and all other stabilization criteria have been met, samplers must take reasonable steps (i.e., Additional purging) to reduce the turbidity to 10 NTU or less.

- If turbidity is less than 10 NTU, and all other parameters are stabilized, the well should be sampled.
- Where turbidity remains above 10 NTU and turbidity has stabilized within 10% for 3 consecutive readings, the well has been pumped for at least 2 hours and the water quality indicator parameters have stabilized, a complete sample set using the appropriate, pre-preserved containers will be collected followed by an additional sample set using unpreserved containers to be lab filtered and analyzed for the dissolved portion of target constituents.

If necessary, and pursuant to industry-accepted guidance, stabilization criteria may be adjusted to accommodate site-specific or well-specific conditions (USEPA, 1996).

6.2 Sample Preservation and Shipment

Groundwater samples will be collected in the designated size and type of containers required for specific parameters and laboratory methods. Sample bottles will be pre-preserved and do not require field preservation. Where temperature control is required, field personnel will place samples in a cooler with ice immediately after sample collection. Dry ice, blue ice, and other cooling packs may not be used. Samples will be cooled to less than 6°C and maintained until receipt by the analytical laboratory.

Samples will be delivered to the APC General Testing Laboratory within 48 hours of collection following appropriate temperature control and chain-of-custody procedures. At no time will samples be analyzed after the method-prescribed hold time has expired. If using commercial shipping methods and relinquishing control of the samples to a third-party courier, the shipping cooler will be sealed using a custody seal to identify samples which may have been tampered with during transport to the laboratory. The seal must be labeled with instructions for the laboratory to notify the shipper if the seal is broken when the samples arrive at the laboratory.

6.3 Analytical Methods

As shown on **Table 3, Monitoring Parameters and Reporting Limits**, the groundwater samples will be analyzed using methods specified in USEPA Manual SW-846, EPA 600/4-79-020, Standard Methods for the Examination of Water and Wastewater (SM18-20), USEPA Methods for the Chemical Analysis of Water and Wastes (MCAWW), American Society for Testing and Materials (ASTM), or other suitable analytical methods approved by ADEM. Any practical quantitation limit (reporting limit) that is used will be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility. Field instruments used to measure pH must be accurate and reproducible to within 0.2 Standard Units (S.U.).

6.4 Chain of Custody Control

The COC record is required for tracing sample possession from time of collection to time of receipt at the laboratory. The National Enforcement Investigations Center (NEIC) of USEPA considers a sample to be in custody under any of the following conditions:

- It is in the individual’s possession
- It is in the individual’s view after being in his/her possession
- It was in the individual’s possession and (s)he locked it up (e.g. locked in a vehicle)
- It is in a designated secure area

All samples will be handled under strict COC procedures beginning in the field. The field team leader will be the field sample custodian and will be responsible for ensuring that COC procedures are followed. The use of electronic COCs are encouraged and utilized by APC Water Field Services. The record will contain the following information:

- Sample destination and transporter
- Sample identification numbers
- Signature of collector
- Date and time of collection
- Sample type
- Identification of monitoring well
- Number of sample containers
- Parameters requested for analysis
- Signature of person(s) involved in the chain of possession
- Inclusive dates of possession

The samples must be in the custody of assigned personnel, an assigned agent, or the laboratory. If the samples are transferred to other employees for delivery or transport, the sampler or possessor must relinquish possession and the samples must be received by the new owner.

If the samples are being shipped, a hard copy COC must be signed and enclosed within the shipping container in a watertight bag. Shipping agents such as Federal Express do not sign the chain-of-custody form. The shipping receipt must be retained by the samplers as part of the record documenting sample transfer.

6.5 Sampling Parameters and Frequency

Table 4, Groundwater Monitoring Parameters and Frequency presents the groundwater monitoring parameters and sampling frequency. A minimum of eight independent samples from each groundwater well will be collected and analyzed for 40 CFR 257, Subpart D, Appendix III and Appendix IV test parameters to establish a background statistical dataset.

DETECTION MONITORING

After background has been established, detection monitoring will be performed in accordance with ADEM Admin. Code r. 335-13-15-.06(5)(b). The detection monitoring frequency for the Appendix III parameters will be at least semi-annual during the active life of the facility and the post-closure care period.

ASSESSMENT MONITORING

If required, assessment monitoring will be performed per ADEM Admin. Code r. 335-13-15-.06(6). Assessment monitoring is required whenever an SSI over background levels has been detected for one or more of the constituents listed in 40 CFR 257, Subpart D, Appendix III test parameters.

For assessment sampling at the Site, two semi-annual sampling events will be performed. As shown on **Table 4**, the full suite of Appendix III and IV constituents will be sampled and statistically analyzed semiannually. During these events all compliance monitoring wells and any newly-installed delineation well(s) will be sampled for Appendix III and IV constituents.

A proposal may be made to the Department to modify the subset of delineation wells sampled during assessment monitoring, or the sampling frequency. Proposed changes will be implemented following Department approval.

6.6 Quality Assurance and Quality Control

All field quality control samples will be prepared the same as compliance samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected during each sampling event.

FIELD EQUIPMENT RINSATE BLANKS

In cases where sampling equipment is not new or dedicated, an equipment rinsate blank will be collected at a rate of one blank per 10 samples. The equipment rinsate blanks are prepared in the field using the same distilled or deionized water used for decontamination. The water is poured over and through each type of sampling equipment and submitted to the laboratory for analysis of target constituents. If the equipment is dedicated or new for each monitoring well, equipment rinsate blanks will be collected at a rate of 1 blank per CCR unit. If a plant has multiple CCR storage units, an equipment rinsate blank should be collected at each unit (e.g. ash pond, gypsum storage, etc.)

FIELD DUPLICATES

Field duplicates are collected by filling additional containers at the same location, and the field duplicate is assigned a unique sample identification number. One field duplicate will be collected for every group of 10 samples.

FIELD BLANKS

Field blanks are collected in the field using the same distilled or deionized water source that is used for decontamination. The water is poured directly into the supplied sample containers in the field and submitted to the laboratory for analysis of target constituents. One field blank will be collected for every group of 10 samples.

The groundwater samples will be analyzed by licensed and accredited laboratories through the National Environmental Laboratory Accreditation Program (NELAP). Lab data reports will include the records of standard laboratory QA/QC reports.

7. REPORTING RESULTS

The following subsections outline reportable results and delivery.

7.1 14-Day Notification

Pursuant to ADEM Admin. Code r. 335-13-15-.06(4)(h)3., the Department will be notified of any new statistical exceedances identified during detection or assessment monitoring within 14 days. Since the exceedance will also be described in subsequent monitoring reports and addressed pursuant to the rules, the initial notification will not be repeated for the same exceedance in subsequent monitoring events.

7.2 Semi-Annual Groundwater Monitoring Reports

Pursuant to ADEM Admin. Code R. 335-13-15-.06(1)(f), an annual groundwater monitoring and corrective action report documenting the results of sampling and analysis will be submitted to ADEM by January 31st of each year. Pursuant to ADEM Admin. Code r. 335-13-15-.06(5)(g), a semi-annual report to coincide with the semi-annual groundwater sampling will also be submitted. The semi-annual report will be submitted to ADEM by July 31st of each year. At a minimum, semi-annual and annual reports will include:

1. A narrative describing sampling activities and findings including a summary of the number of samples collected, the dates the samples were collected and whether the samples were required by the detection or assessment monitoring programs.
2. A brief overview of purging/sampling methodologies.
3. If applicable, analytical results for samples collected from each delineation well during the semi-annual period.
4. Discussion of results.
5. Recommendations for future monitoring consistent with ADEM's CCR rules.
6. Potentiometric surface contour map for the aquifer(s) being monitored, signed and sealed by an Alabama-registered P.G. or P.E.
7. Table of as-built information for groundwater monitoring wells including top of casing elevations, ground elevations, screened elevations, current groundwater elevations and depth to water measurements.
8. Groundwater flow rate and direction calculations.
9. Identification of any groundwater wells that were installed or decommissioned during the preceding year, along with a narrative description of why these actions were taken.

10. A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels.

11. If applicable, assessment monitoring results.

12. Any alternate source demonstration completed during the previous monitoring period, if applicable.

13. Laboratory Reports and COC documentation.

14. Field sampling logs including field instrument calibration, indicator parameters and parameter stabilization data.

15. Documentation of non-functioning wells, dry surface water and underdrain sampling locations.

16. Table of current analytical results for each well, highlighting statistically significant increases and concentrations above maximum contaminant level (MCL).

17. Statistical analyses.

18. Certification by a qualified groundwater scientist.

8. STATISTICAL ANALYSIS

Groundwater quality data from each sampling event will be statistically evaluated to determine if there has been a statistically significant change in groundwater chemistry. Historical background data will be used to determine statistical limits.

According to ADEM Admin Code r. 335-13-15-.06(4)(f), which incorporates the statistical analysis requirements of 40 CFR 257.93, the site must specify in the operating record the statistical methods to be used in evaluating groundwater monitoring data for each hazardous constituent.

A site-specific statistical analysis plan that provides details regarding the statistical methods to be used will be placed in the site's operating record pursuant to ADEM Admin Code r. 335-13-15-.06(4)(f). **Appendix B, Statistical Analysis Plan**, provides the site-specific plan.

The Sanitas Groundwater statistical software is used to perform the statistical analyses. Sanitas is a decision support software package that incorporates the statistical tests required of RCRA Subtitle C and D facilities by EPA regulations. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities as well as with the USEPA Unified Guidance (2009).

The following subsections provide a high-level summary of the statistical analyses plan as broken down by monitoring program status.

8.1 Detection Monitoring

As discussed in **Appendix B**, Intrawell prediction limits, combined with a 1-of-2 verification resample plan, are used to evaluate boron, calcium, fluoride, sulfate, and total dissolved solids (TDS). Interwell prediction limits, combined with a 1-of-2 verification resample plan, are used for chloride and pH to determine whether there has been a SSI over background groundwater quality. Intrawell prediction limits use screened historical data within a given well to establish limits for parameters at that well. The most recent sample from the same well is compared to its respective background to identify statistically SSIs over background. Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. The most recent sample from each downgradient well is compared to the background limit to identify SSIs.

Groundwater Stats Consulting demonstrated that these test methods were appropriate in the October 2017 Statistical Analysis Plan, which was updated in the September 2019 data screening evaluation. Time series plots were used to screen proposed background data for suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective. Suspected outliers at all wells for Appendix III parameters are formally tested using Tukey's box plot method and, when identified, flagged in the computer database.

The following adjustments are also applicable to the statistical analysis per the Unified Guidance:

- No statistical analyses are required on wells and analytes containing 100% non-detects (EPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in the background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the practical quantitation limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects the Kaplan-Meier non-detect adjustment is applied to the background data.
- Non-parametric prediction limits are used on data containing greater than 50% non-detects.

8.2 Assessment Monitoring

When in assessment monitoring, Appendix IV constituent concentrations are compared to a GWPS. Appendix IV analysis uses the pooled results from the individual downgradient well to develop a well-specific Confidence Interval that is compared to the statistical limit (GWPS). The statistical limit is either the Inter-well Tolerance Limit (i.e. background) calculated using the pool of all available upgradient well data (see Chapter 7 of the Unified Guidance), or an applicable GWPS published in the regulations such as the Maximum Contaminant Level (MCL). As discussed in the Statistical Analysis Plan, Appendix IV background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Interwell Tolerance Limits (background) were calculated using pooled upgradient well data for Appendix IV parameters. When the Lower Confidence Limit (LCL), or the entire interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSL.

As described in 40 CFR § 257.95(h)(1)-(3) and specified by ADEM Variance dated April 15, 2019, the GWPS is:

(1) The maximum contaminant level (MCL) established under 40 CFR §141.62 and 141.66.
(2) Where an MCL has not been established:
    (i) Cobalt 0.006 mg/L;
    (ii) Lead 0.015 mg/L;
    (iii) Lithium 0.040 mg/L; and
    (iv) Molybdenum 0.100 mg/L.
(3) Background levels for constituents where the background level is higher than the MCL or rule-specified GWPS.

Details regarding the statistical analysis of assessment monitoring results are included in the Statistical Analysis Plan in **Appendix B**.

8.2.1 Delineation Wells

During assessment monitoring, any newly-installed delineation wells will be sampled for Appendix III and IV constituents on the same schedule as the compliance monitoring well network. A proposal may be made to the Department to modify the subset of delineation wells sampled during assessment monitoring, or the sampling frequency. Data obtained from delineation wells will be compared to the GWPS numerically until sufficient data is obtained to prepare well-specific Confidence Intervals.

9. REFERENCES

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Tables

Table 1.
Groundwater Monitoring Well Network Details

Well Name	Purpose	Northing [1]	Easting [1]	Ground Elevation [2]	Top of Casing Elevation [2]	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation [2]	Bottom of Screen Elevation [2]	Screen Length (ft.)
MW-1	Upgradient	1330794.064	594082.361	499.19	502.25	107.56	405.09	395.09	10
MW-2	Upgradient	1331053.309	593548.802	498.54	502.12	94.58	417.94	407.94	10
MW-3	Upgradient	1330842.402	593025.397	522.23	525.9	119.07	417.23	407.23	10
MW-4	Upgradient	1330289.727	592896.414	516.67	518.63	128.66	400.37	390.37	10
MW-5	Downgradient	1328645.982	592436.538	471.55	474.55	137	351.95	341.95	10
MW-6	Downgradient	1327877.972	592829.837	409.99	412.99	129	294.39	284.39	10
MW-7	Downgradient	1328515.235	593408.341	391.59	394.59	74	330.99	320.99	10
MW-8	Downgradient	1329140.729	593813.964	413.15	416.1	72.25	354.25	344.25	10

1. Northing and easting are in feet relative to the State Plane Alabama West North America Datum of 1983.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. Top of screen and bottom of screen depths are calculated relative Top of Casing elevation and less the well sump length of 0.4’.

Table 2. Plant Gorgas CCR Upgradient Comparisons – Key Indicator Parameters

Well Designation	**Well ID**	**DO** (mg/L)	**pH** (SU)	**ORP** (mV)	**Conductivity** (uS/cm)	**Boron** (mg/L)	**Calcium** (mg/L)	**Sulfate** (mg/L)	**Chloride** (mg/L)
Upgradient	MW-1	0.50	5.17	197.3	2326.3	0.022	149.23	1500.00	2.31
Upgradient	MW-2	0.20	5.93	59.4	1957.8	0.028	171.85	1039.00	3.39
Upgradient	MW-3	0.68	5.08	159.5	3600.5	0.040	301.38	2490.77	1.61
Upgradient	MW-4	1.62	6.15	151.8	3791.5	0.043	301.38	2597.69	1.95
Downgradient Compliance [1]	Average Concentrations	0.38	6.44	6.87	3010.0	0.067	344.63	1811.73	31.26

Notes:

1. Downgradient compliance wells included MW-5, MW-6, MW-7, and MW-8

Table 3.
Monitoring Parameters and Reporting Limits

Appendix III Parameters		
Parameter	**Analytical Method**	**Reporting Limit (mg/L) [1]**
Boron	EPA 200.7/200.8	0.05
Calcium	EPA 200.7/200.8	0.25
Chloride	EPA 300.0	2
Fluoride	EPA 300.0	0.1
pH	None	None
Sulfate	EPA 300.0	5
Total Dissolved Solids (TDS)	SM 2540C	5
Appendix IV Parameters		
Parameter	**Analytical Method**	**Reporting Limit (mg/L)**
Antimony	EPA 200.7/200.8	0.0025
Arsenic	EPA 200.7/200.8	0.00125
Barium	EPA 200.7/200.8	0.0025
Beryllium	EPA 200.7/200.8	0.0025
Cadmium	EPA 200.7/200.8	0.0025
Chromium	EPA 200.7/200.8	0.0025
Cobalt	EPA 200.7/200.8	0.0025
Fluoride	EPA 300.0	0.1
Lead	EPA 200.7/200.8	0.00125
Lithium	EPA 200.7/200.8	0.0025
Mercury	EPA 7470A	0.0002
Molybdenum	EPA 200.7/200.8	0.015
Selenium	EPA 200.7/200.8	0.00125
Thallium	EPA 200.7/200.8	0.0005
Radium 226 & 228 combined [2]	EPA 9315/9320	1 pCi/L

Notes:

1. mg/L - Milligrams per liter

2. Combined Radium 226 + 228 reported in pCi/L - Picocuries per liter

Table 4. Groundwater Monitoring Parameters and Frequency

Monitoring Parameters		Groundwater Sampling Schedule	
		Semi-Annual Event 1	**Semi-Annual Event 2**
		(Jan-June)	**(July-Dec)**
Field Parameters	Temperature	X	X
	pH	X	X
	Specific Conductance	X	X
	Dissolved Oxygen	X	X
Appendix III (Detection)	Boron	X	X
	Calcium	X	X
	Chloride	X	X
	Fluoride	X	X
	pH	X	X
	Sulfate	X	X
	Total Dissolved Solids	X	X
Appendix IV (Assessment)	Antimony	X	X
	Arsenic	X	X
	Barium	X	X
	Beryllium	X	X
	Cadmium	X	X
	Chromium	X	X
	Cobalt	X	X
	Fluoride	X	X
	Lead	X	X
	Lithium	X	X
	Mercury	X	X
	Molybdenum	X	X
	Selenium	X	X
	Thallium	X	X
	Radium 226 & 228	X	X

Figures

Legend

🟥 Property Boundary (Approximate)

🟩 CCR Landfill Boundary (Approximate)

SCALE 1:9000

DATE 3/23/2020

DRAWN BY KWR

CHECKED BY GBD

DRAWING TITLE

SITE LOCATION MAP
PLANT GORGAS CCR LANDFILL

FIGURE NO

FIGURE 1

Southern Company

Legend

- 🟩 Gorgas CCR Landfill
- 🟥 Property Boundary (Approximate)
- 〰 20-Foot Topographic Contour
- ⊕ Downgradient Monitoring Well
- ▣ Upgradient Monitoring Well

N

0 500 1,000 2,000 Feet

SCALE	1:8,400
DATE	4/14/2020
DRAWN BY	KAR
CHECKED BY	GBD

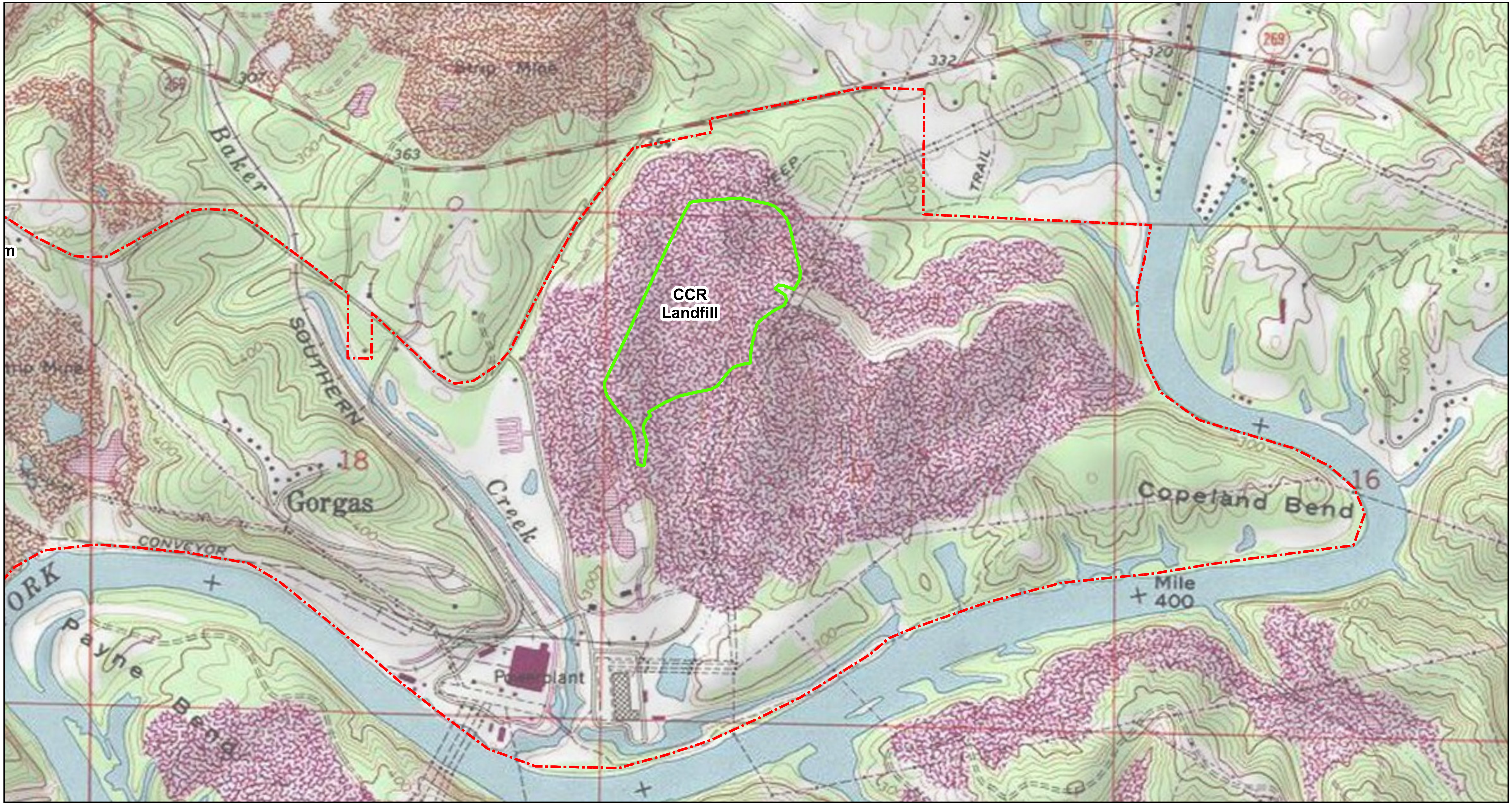
DRAWING TITLE

SITE PLAN MAP
PLANT GORGAS CCR LANDFILL

FIGURE NO

FIGURE 2

Southern Company



Legend

🟩 Gorgas CCR Landfill

🟥 Property Boundary (Approximate)

N

0 1,000 2,000 4,000 Feet

SCALE	1:12,000
DATE	3/23/2020
DRAWN BY	KAR
CHECKED BY	GBD

DRAWING TITLE

SITE TOPOGRAPHIC MAP
PLANT GORGAS CCR LANDFILL

FIGURE NO

FIGURE 3

Southern Company

Legend

▭ Property Boundary (Approximate)

▭ CCR Landfill Boundary (Approximate)

Geologic Units

▭ Pottsville Formation (upper part), Appalachian Plateaus (Ppv1u)

N

0 500 1,000 2,000 3,000 Feet

SCALE 1:9000

DATE 3/23/2020

DRAWN BY KWR

CHECKED BY GBD

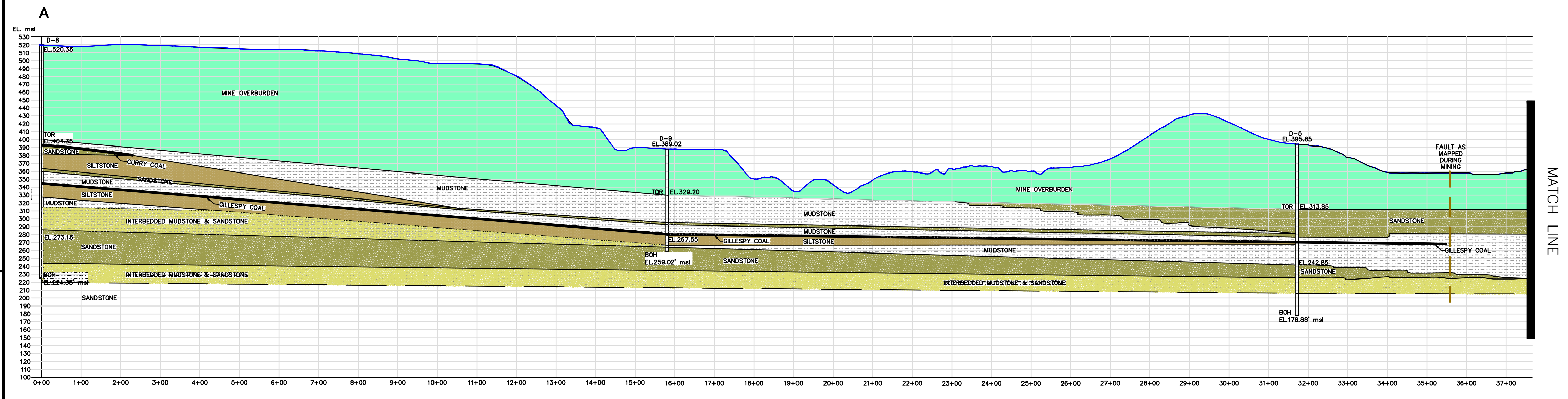
DRAWING TITLE

SITE GEOLOGIC MAP
PLANT GORGAS CCR LANDFILL

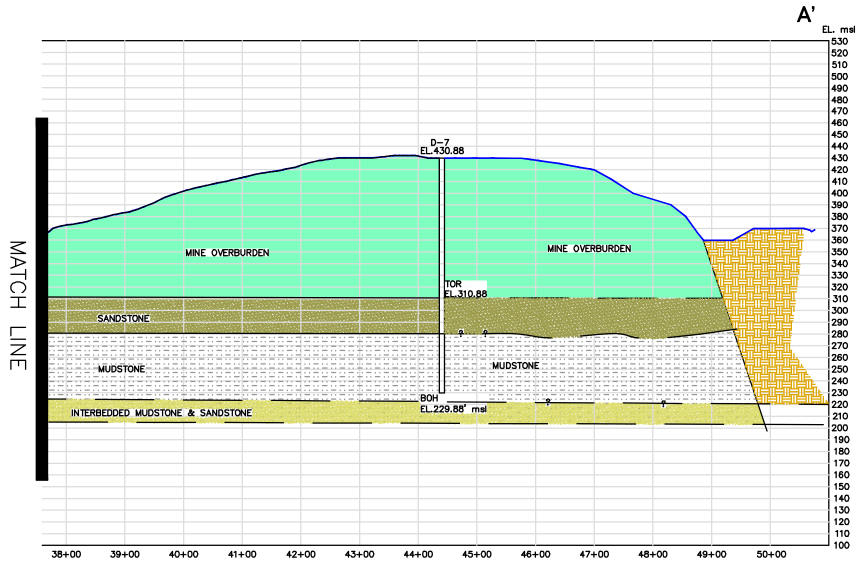
FIGURE NO

FIGURE 4

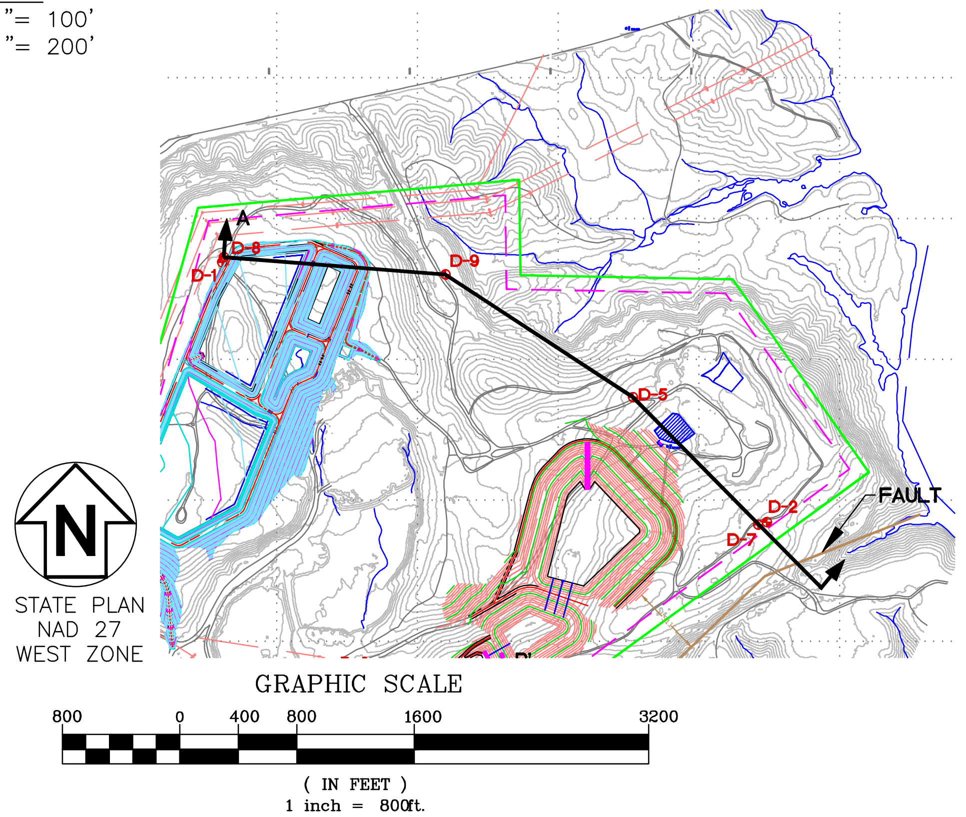
Southern Company



SECTION A–A'
SCALE: VERT: 1"= 100'
HORIZ: 1"= 200'



SECTION A–A'
SCALE: VERT: 1"= 100'
HORIZ: 1"= 200'



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Southern Company Services
Engineering and Construction Services
FOR
Alabama Power Company

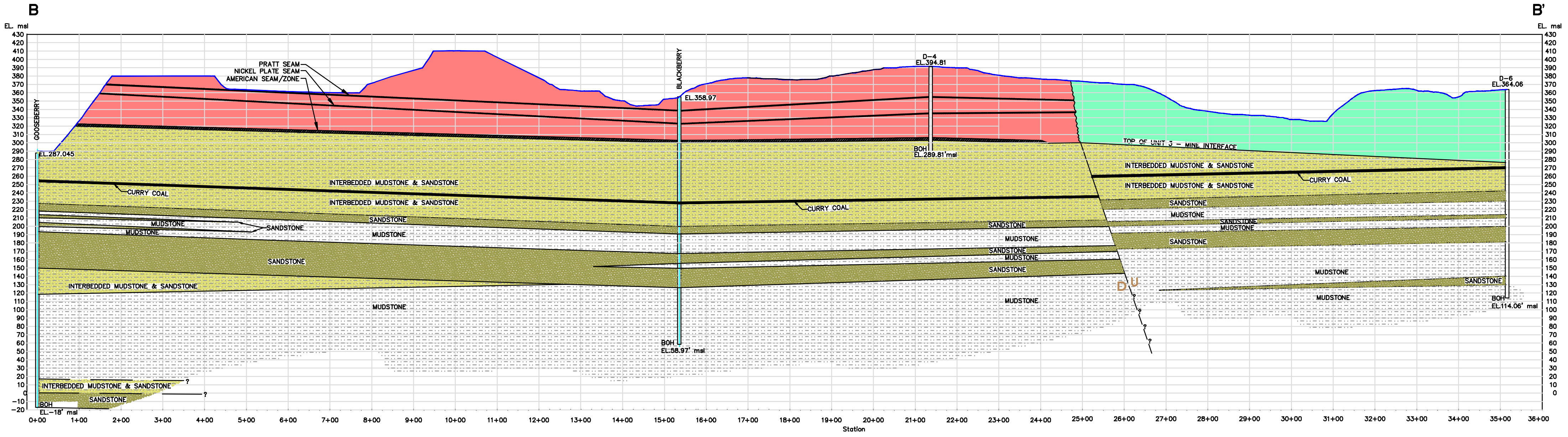
PLANT GORGAS
UNIT 8, UNIT 9 AND UNIT 10
CCB STORAGE FACILITY
GEOLOGIC CROSS
SECTION A–A'

REVISION	DATE	REVISION	DATE	REVISION	DATE
				0	07/07/2017
				ISSUED FOR REPORT	

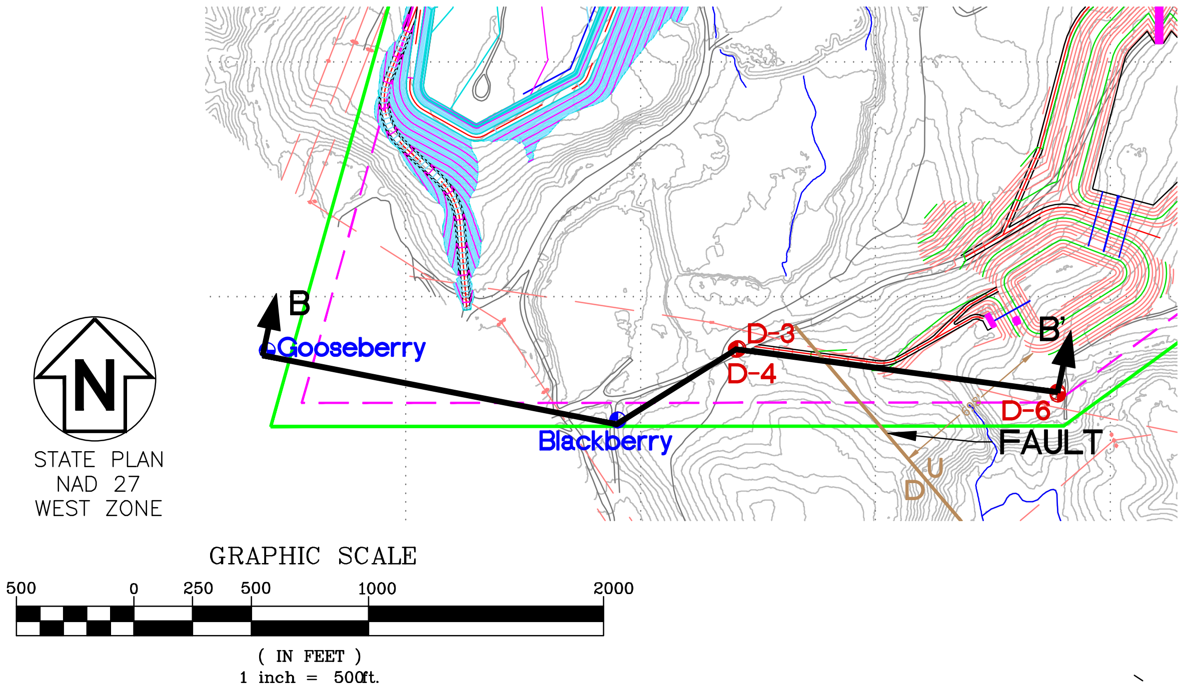
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
														GBD	GBD	SCB	XXX	XXX	XXX	XXX

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
AS SHOWN	**FIGURE 5A**	1	FINAL	0

ANSI C: 22x17 Acad2013



SECTION B–B'
SCALE: VERT: 1"= 100'
HORIZ: 1"= 200'



REVISION	DATE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR

REVISION	DATE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR

REVISION 0
DATE 07/07/2017
ISSUED FOR REPORT

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
GBD	GBD	SCB	XXX	XXX	XXX	XXX

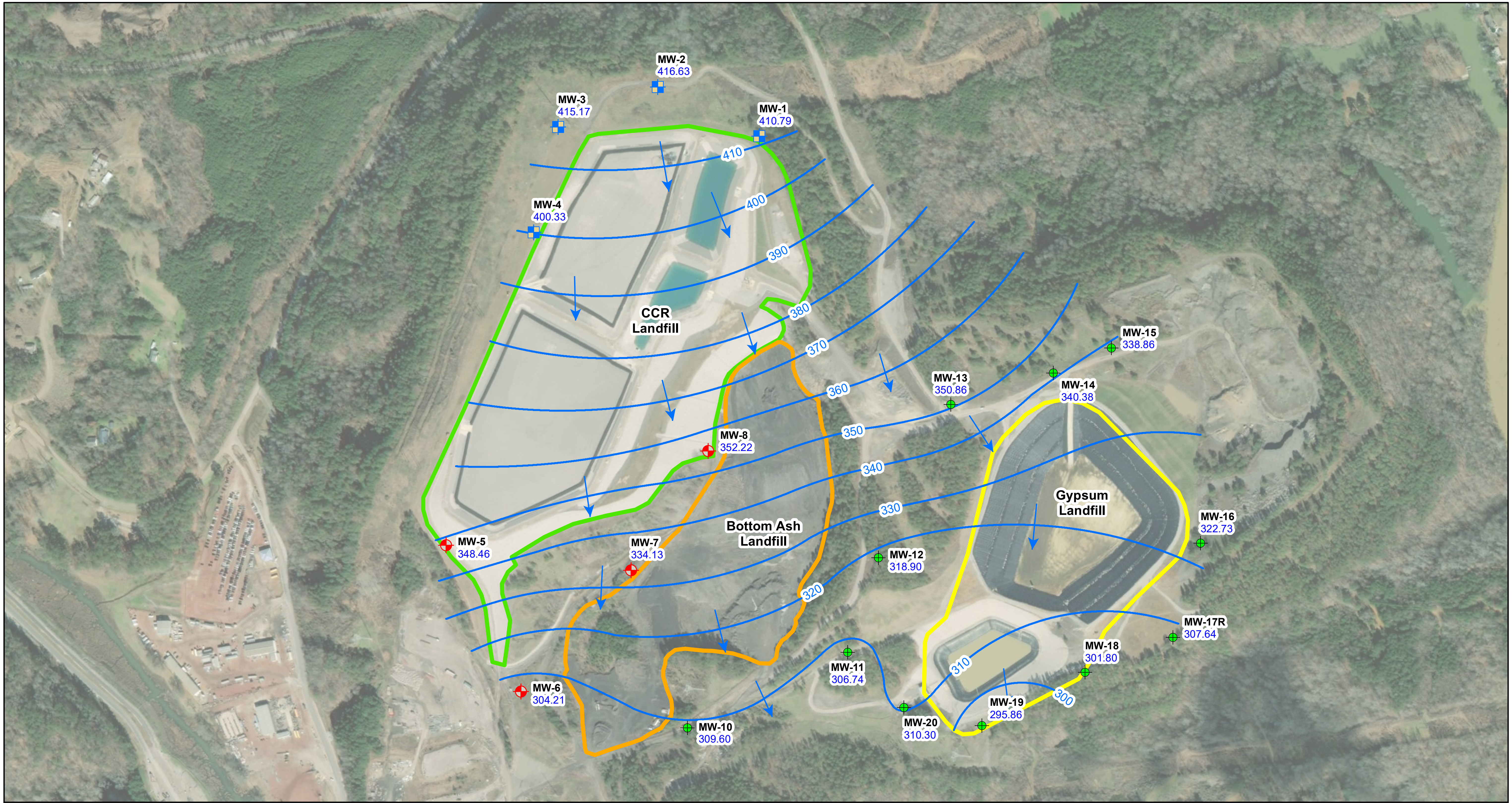
Southern Company Services
Engineering and Construction Services
FOR

Alabama Power Company

PLANT GORGAS
UNIT 8, UNIT 9 AND UNIT 10
CCB STORAGE FACILITY
GEOLOGIC CROSS
SECTION B–B'

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
AS SHOWN	**FIGURE 5b**	1	FINAL	0

ANSI C: 22x17
Acad2013



Legend

- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Monitoring Well
- Potentiometric Surface Contour (ft NAVD88)
- Approximate Groundwater Flow Direction
- Bottom Ash Landfill Boundary (Approximate)
- CCR Landfill Boundary (Approximate)
- Gypsum Landfill Boundary (Approximate)

MW-1	Well ID
410.79	Groundwater Elevation

N

0 500 1,000 2,000 Feet

NOTES: 1. NAVD88 indicates North American Vertical Datum of 1988.
2. NM indicates not measured.

SCALE 1:6000

DATE 4/3/2020

DRAWN BY KAR

CHECKED BY GBD

DRAWING TITLE

POTENTIOMETRIC SURFACE CONTOUR MAP
OCTOBER 7, 2019
PLANT GORGAS CCR LANDFILL

FIGURE NO

FIGURE 6

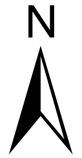
Southern Company

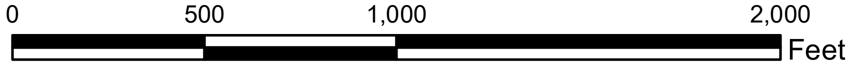
Legend

🟥 Downgradient Monitoring Well

🟦 Upgradient Monitoring Well

🟩 CCR Landfill Boundary (Approximate)





SCALE	1:6000
DATE	12/18/2019
DRAWN BY	KWR
CHECKED BY	GBD

DRAWING TITLE

MONITORING WELL LOCATION MAP
PLANT GORGAS CCR LANDFILL

FIGURE NO

FIGURE 7

Southern Company

Amendment 1

Legend

- ▣ Target Downgradient Monitoring Well Location
- ⊕ Downgradient Monitoring Well
- ✚ Upgradient Monitoring Well
- ▨ Area of Review/Exploration for Additional Downgradient Compliance Location MW-22
- 🟩 Gorgas CCR Landfill Boundary (Approximate)

Notes: 1. Proposed location has not yet been screened for suitability. Limitations such as facility construction (liner, piping, etc.), topography, and access may prevent installation in these areas.
2. Groundwater saturation and yield is highly variable at the site, and therefore, any installation attempts may yield unsuccessful.

SCALE	1:6000
DATE	3/10/2021
DRAWN BY	KWR
CHECKED BY	GBD

DRAWING TITLE

PROPOSED LOCATION FOR EVALUATING
SUITABILITY OF ADDITIONAL
DOWNGRADIENT WELL
PLANT GORGAS CCR LANDFILL

FIGURE NO

FIGURE 1

Southern Company

Appendix A

BORING MW-1
PAGE 1 OF 3

BORING LOG

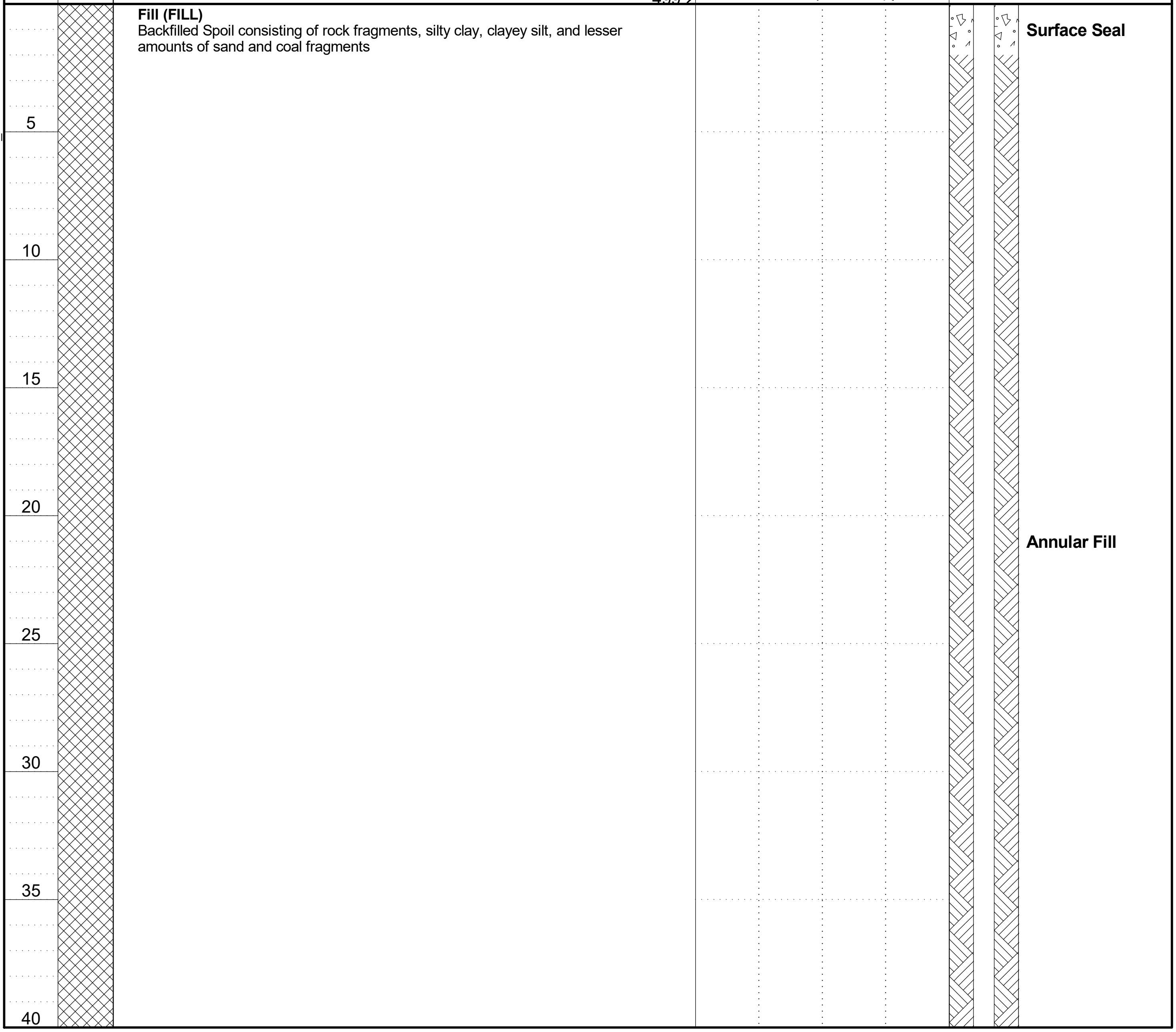
SOUTHERN COMPANY

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 1/13/2014 **COMPLETED** 1/15/2014 **SURF. ELEV.** 499.2 **COORDINATES:** N:1,330,794.06 E:594,082.36
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 104.7 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 88.92 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma	WELL DATA Top of casing Elev. = 502.25
		Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	499.2		**Surface Seal** **Annular Fill**



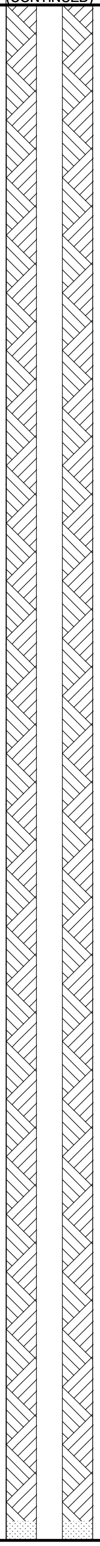
(Continued Next Page)

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 502.25 (CONTINUED)
		Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*	499.2		
45					
50					
55					
60					
65					**Annular Fill**
70					
75					
80					
85					**Annular Seal**



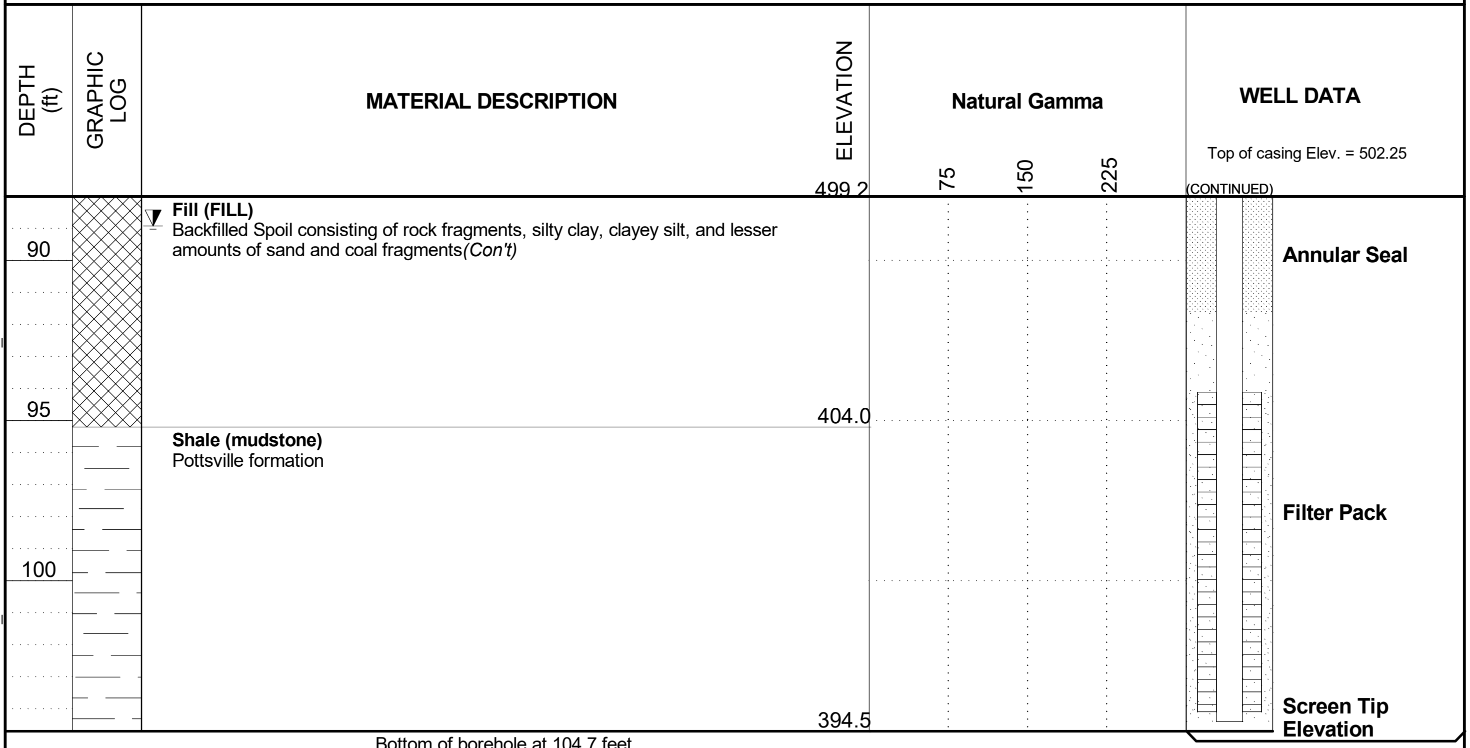
(Continued Next Page)

BORING MW-1

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION



DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION
	Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*	499.2
90		
95		404.0
	Shale (mudstone) Pottsville formation	
100		
		394.5

Bottom of borehole at 104.7 feet.

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/13/17 15:16 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

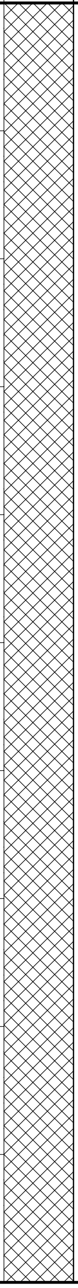
BORING LOG

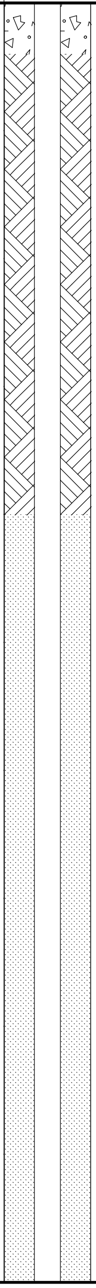
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 498.5 **COORDINATES:** N:1,331,053.31 E:593,548.80
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 91 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 81.7 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 501.54
		Fill (FILL) dark gray to medium gray mudstone/siltstone with trace sandstone, coarse sand to coarse gravel sized angular rock fragments within a dark gray to brownish gray to orangish brown sandy silt	498.5		**Surface Seal**
5					
		trace cobble sized rock fragments			
10					**Annular Fill**
15					
		trace reddish brown staining on some rock fragments			
20					
25					
		upper coarse sand to bolder sized (limited core recovered) dark gray to medium gray rock fragments within a dark gray silty matrix with trace layers of orangish brown clay/silt			
30					
35					**Annular Seal**
		trace weathered sandstone fragments with orangish brown staining			
40					
45					
50					





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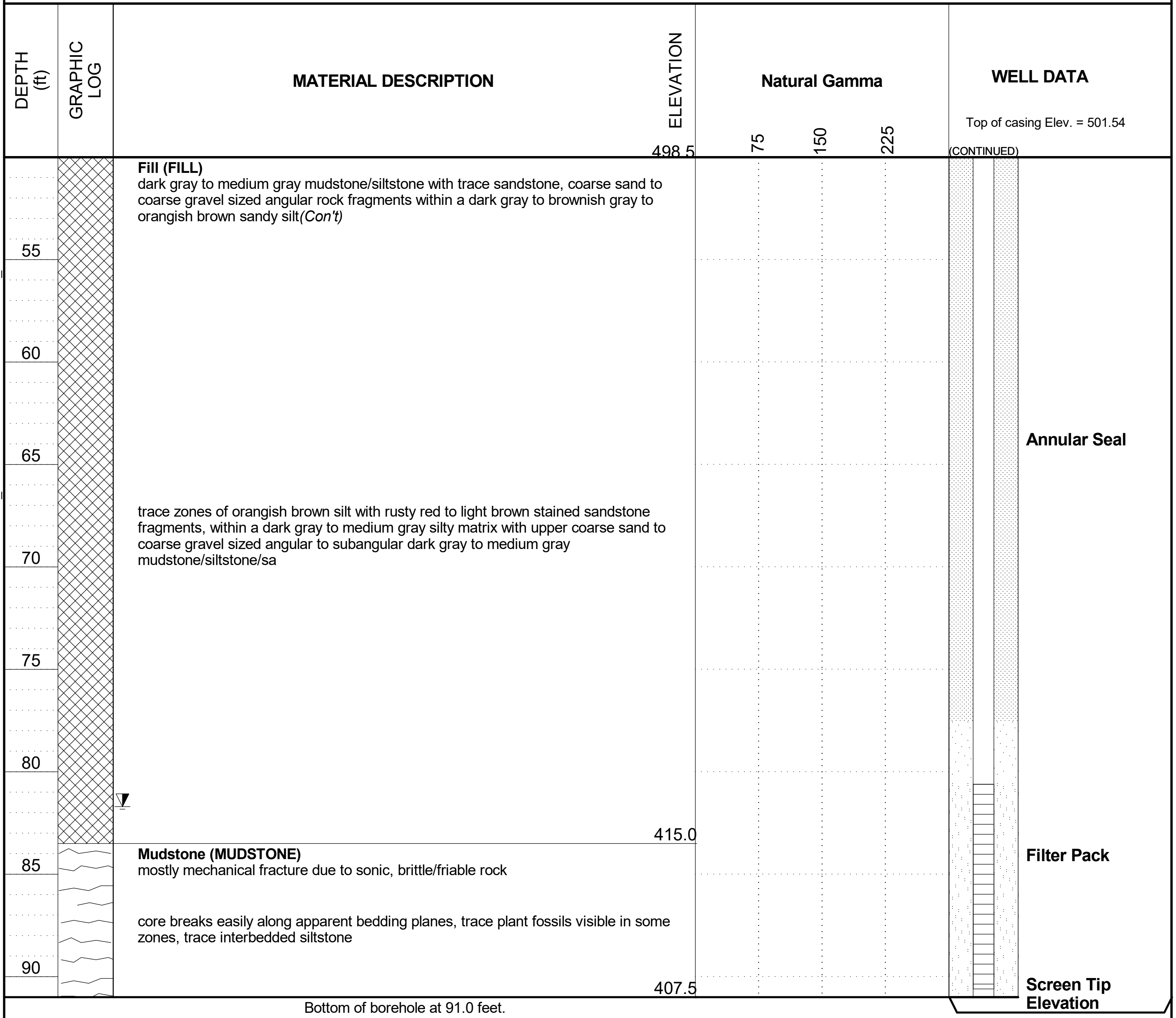
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION



Fill (FILL)
dark gray to medium gray mudstone/siltstone with trace sandstone, coarse sand to coarse gravel sized angular rock fragments within a dark gray to brownish gray to orangish brown sandy silt*(Con't)*

trace zones of orangish brown silt with rusty red to light brown stained sandstone fragments, within a dark gray to medium gray silty matrix with upper coarse sand to coarse gravel sized angular to subangular dark gray to medium gray mudstone/siltstone/sa

Mudstone (MUDSTONE)
mostly mechanical fracture due to sonic, brittle/friable rock

core breaks easily along apparent bedding planes, trace plant fossils visible in some zones, trace interbedded siltstone

Bottom of borehole at 91.0 feet.

BORING MW-3
PAGE 1 OF 2

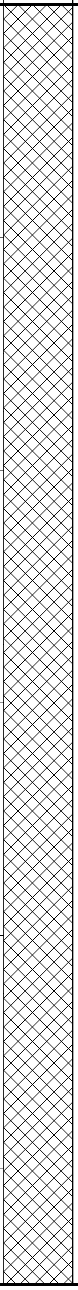
BORING LOG

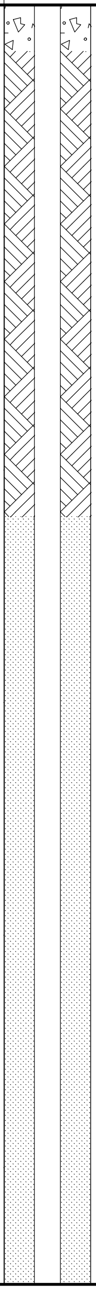
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 522.2 **COORDINATES:** N:1,330,842.40 E:593,025.40
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 115.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 106.91 ft.
NOTES

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 525.23
	Fill (FILL) dark gray to medium gray mudstone/siltstone fragments within dark gray silty soil matrix.	522.2		Surface Seal
	trace rock fragments with orangish brown to rusty red staining			
10				Annular Fill
20				
	zone of subangular rock fragments within a dark gray to orangish brown silty to clayey sand, trace light brown to reddish brown siltstone/sandstone fragments			
30				
				Annular Seal
40				
	fine gravel to cobble sized angular to subangular mudstone/siltstone fragments			
50				





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BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft) | GRAPHIC LOG | **MATERIAL DESCRIPTION** | ELEVATION

522.2

Fill (FILL)
dark gray to medium gray mudstone/siltstone fragments within dark gray silty soil matrix.*(Con't)*

60

increasing dark brown to orangish brown sandy silt to sandy clay matrix with dark gray to medium gray upper coarse sand to cobble sized mudstone/siltstone fragments with trace sandstone fragments

decrease in clayey matrix, dark gray to medium gray rock fragments/matrix

70

80

@ approx. 90' change from dark gray to light brown (overburden) siltstone/sandstone angular fine gravel to coarse gravel sized rock fragments

90

increasing dark gray brittle/friable rock fragments

100

▽

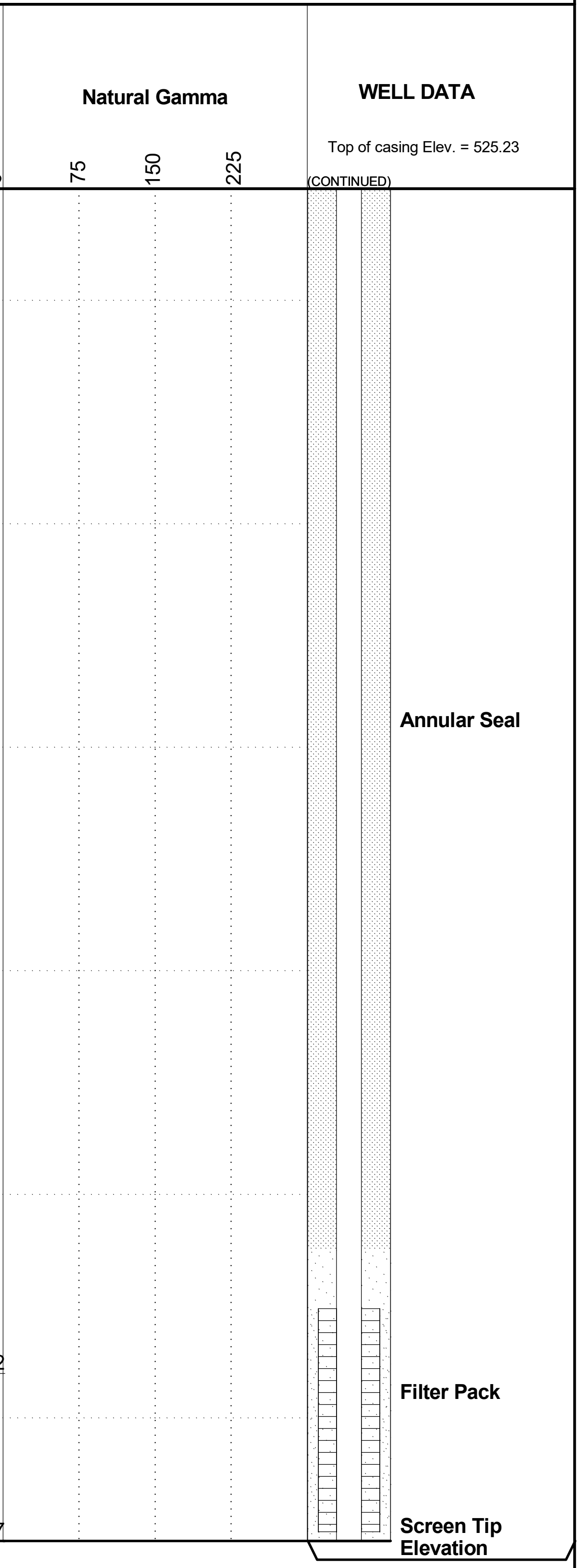
414.2

Sandstone (SANDSTONE)
trace dark gray nodular inclusions

110

406.7

Bottom of borehole at 115.5 feet.



BORING LOG

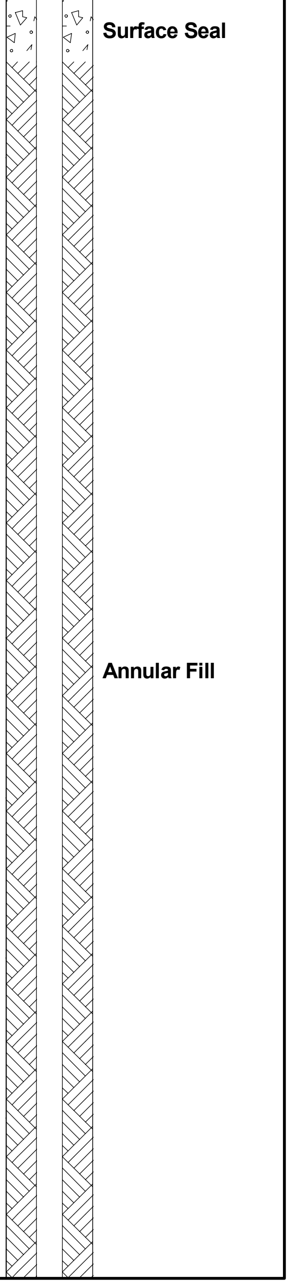
SOUTHERN COMPANY

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 2/12/2014 **COMPLETED** 2/19/2012 **SURF. ELEV.** 516.7 **COORDINATES:** N:1,330,289.73 E:592,896.41
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 129.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 116.59 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 518.63
	▨	**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	516.7		Surface Seal
5	▨				
10	▨				
15	▨				
20	▨				Annular Fill
25	▨				
30	▨				
35	▨				
40	▨				



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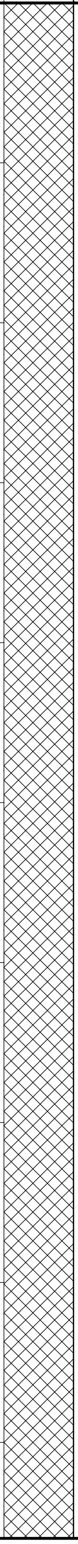
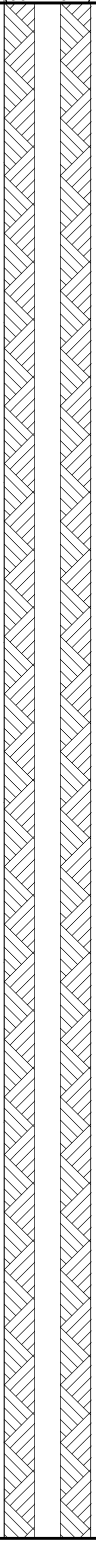
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 518.63 (CONTINUED)
		Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*	516.7		
45					
50					
55					
60					
65					**Annular Fill**
70					
75					
80					
85					





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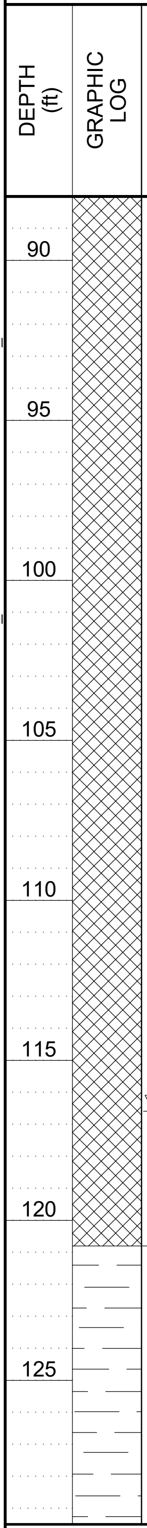
SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/13/17 15:16 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

BORING MW-4
PAGE 3 OF 3

BORING LOG

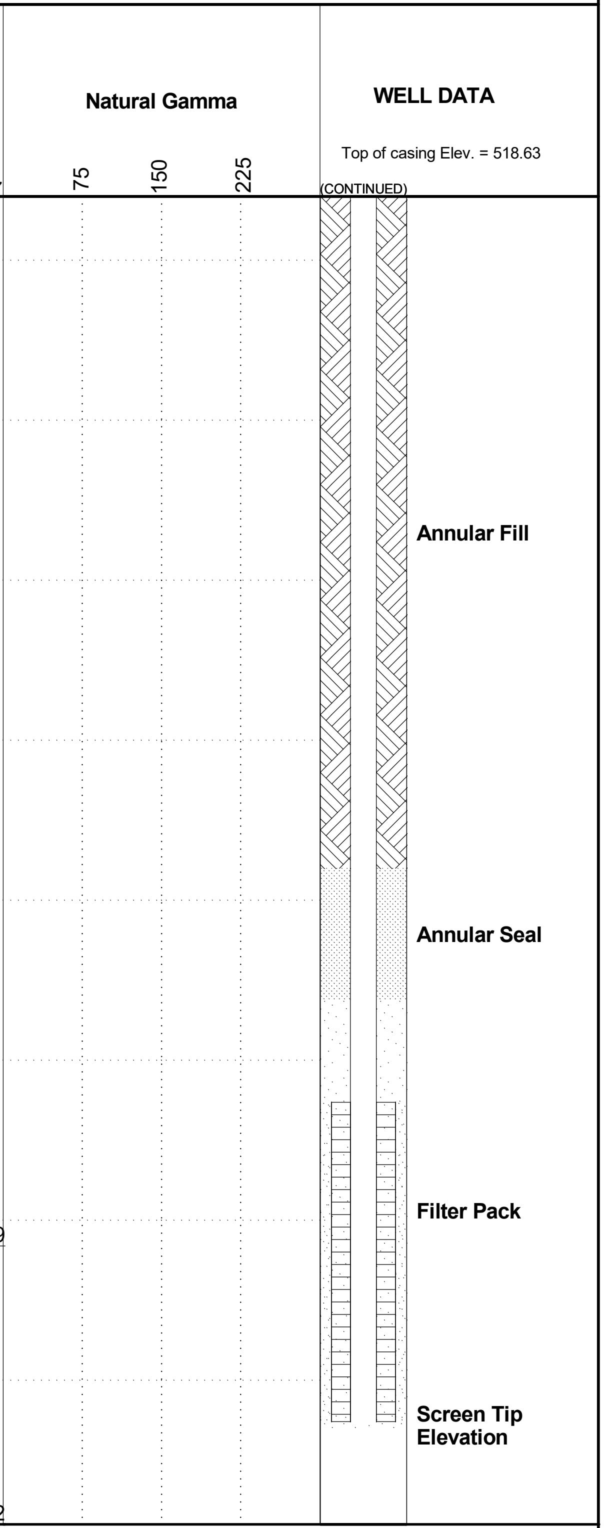
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION



MATERIAL DESCRIPTION	ELEVATION
	516.7
Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*	
	395.9
Shale (SHALE) Pottsville formation, lenticular bedding	
	387.2

Bottom of borehole at 129.5 feet.



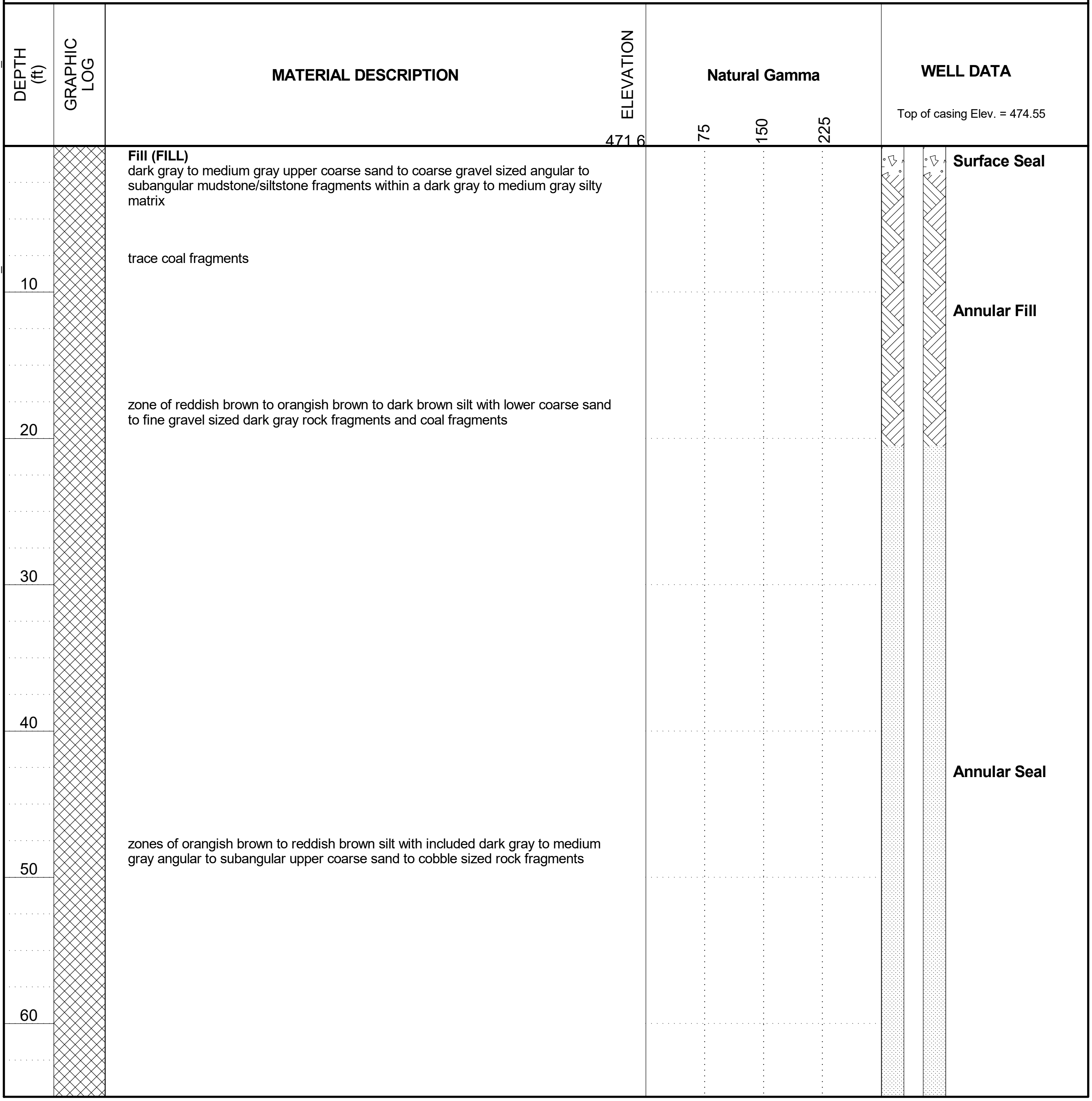
SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/28/2014 **COMPLETED** **SURF. ELEV.** 471.6 **COORDINATES:** N:1,328,645.98 E:592,436.54
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 136 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 122.97 ft.
NOTES



Fill (FILL)
dark gray to medium gray upper coarse sand to coarse gravel sized angular to subangular mudstone/siltstone fragments within a dark gray to medium gray silty matrix

trace coal fragments

zone of reddish brown to orangish brown to dark brown silt with lower coarse sand to fine gravel sized dark gray rock fragments and coal fragments

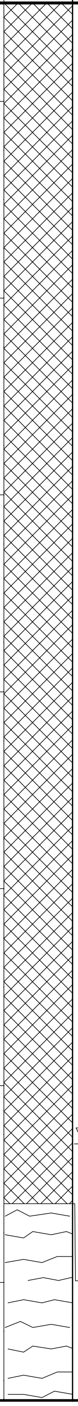
zones of orangish brown to reddish brown silt with included dark gray to medium gray angular to subangular upper coarse sand to cobble sized rock fragments

(Continued Next Page)

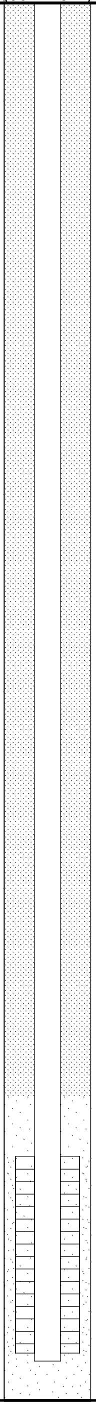
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION



DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 474.55 (CONTINUED)
	Fill (FILL) dark gray to medium gray upper coarse sand to coarse gravel sized angular to subangular mudstone/siltstone fragments within a dark gray to medium gray silty matrix*(Con't)*	471.6		
70				
80				
	bolder sized rock fragments indicated by trace core recovered and light gray pulverized rock powder			
90				**Annular Seal**
100				
	dark gray to medium gray upper coarse sand to coarse gravel sized with trace bolder sized angular rock fragments, trace reddish brown to rusty red staining, medium gray to light gray pulverized rock powder matrix			
110				
120				
	▽ very dark gray to black intermixed mudstone and coal fragments			
	zone of light brown sandy silt (overburden soils) with included grayish brown to orangish brown sandstone fragments	345.6		**Filter Pack**
130	black, very fine to fine gravel sized coal fragments and coal dust			
	Mudstone (MUDSTONE) trace unidentifiable fossils, limited recovery (4.5' of 8'), core fractures along horizontal planes when struck with hammer, predominate mechanical fracture			**Screen Tip Elevation**
		335.6		



Bottom of borehole at 136.0 feet.

BORING MW-6
PAGE 1 OF 2

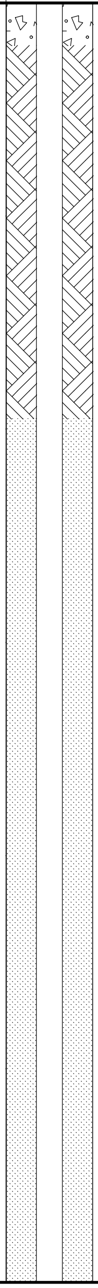
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/29/2014 **COMPLETED** **SURF. ELEV.** 410.0 **COORDINATES:** N:1,327,877.97 E:592,829.84
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 126 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 103.27 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma	WELL DATA
			410.0	75 150 225	Top of casing Elev. = 412.99
		Fill (FILL) light gray to medium gray sandstone fragments with trace dark gray too grayish brown mudstone/siltstone fragments within a light gray to medium gray pulverized rock powder matrix, upper coarse sand to cobble sized with trace bolder sized rock fragments			**Surface Seal**
10		dark gray to medium gray mudstone siltstone rock fragments, interlayered zones of orangish brown to brownish gray sandy silt with dark gray to grayish brown upper coarse sand to fine gravel sized angular to subangular rock fragments			**Annular Fill**
20					
30		zones of orangish brown to reddish brown silty to clayey matrix with dark gray mottling within an overall dark gray silty matrix			
40		dark gray to medium gray silty soil matrix with dark gray to medium gray angular to subangular mudstone/siltstone fragments			**Annular Seal**
50		zones of grayish brown silt with included upper course to fine gravel sized angular rock fragments			
60					



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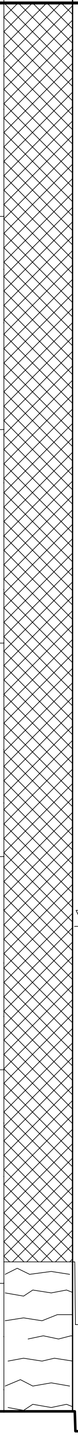
SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/13/17 15:16 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma	WELL DATA
			410.0	75 150 225	Top of casing Elev. = 412.99 (CONTINUED)



Fill (FILL)
light gray to medium gray sandstone fragments with trace dark gray too grayish brown mudstone/siltstone fragments within a light gray to medium gray pulverized rock powder matrix, upper coarse sand to cobble sized with trace bolder sized rock fragments*(Con't)*

decrease in size of rock fragments to upper medium sand to fine gravel within a dark gray to medium gray with orangish brown mottling silty to clayey matrix

70

80

bolder sized rock fragments encountered @ approx. 92', trace core recovered

90

100

dark gray to medium gray upper coarse sand to coarse gravel with trace cobble sized mudstone/siltstone fragments within a light gray to medium gray silty matrix grading to grayish brown to medium brown, @ approx. 115.5' -116' black very fine to fine grain

110

black, lower coarse sand to fine gravel sized coal fragments within black very fine grained coal dust — 291.0

120

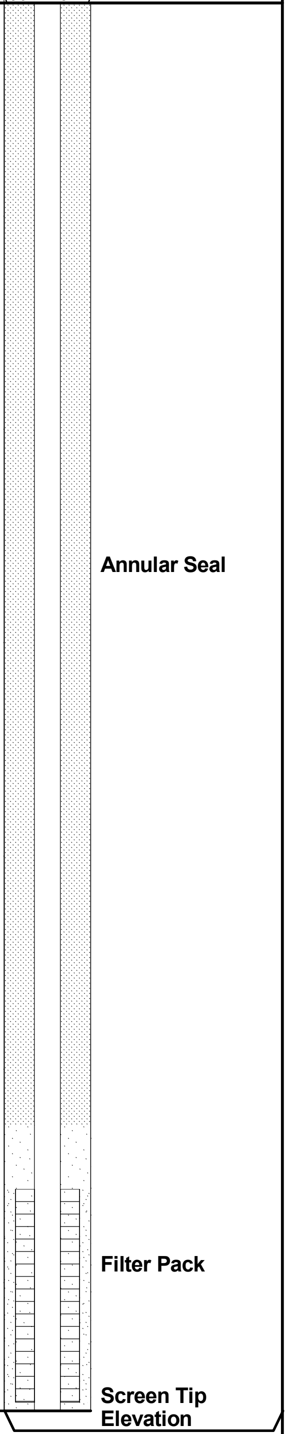
medium gray to dark gray upper coarse sand to fine gravel sized mudstone/siltstone fragments, with layers of medium gray sandy clay with orangish brown mottling

Mudstone (MUDSTONE)
sonic method broke up sample into upper coarse to fine gravel sized fragments, recovered sample brittle/friable can be broken by hand

284.0

core pieces recovered can be broken along horizontal planes when hit with hammer

Bottom of borehole at 126.0 feet.



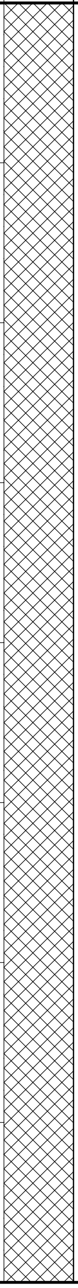
BORING LOG

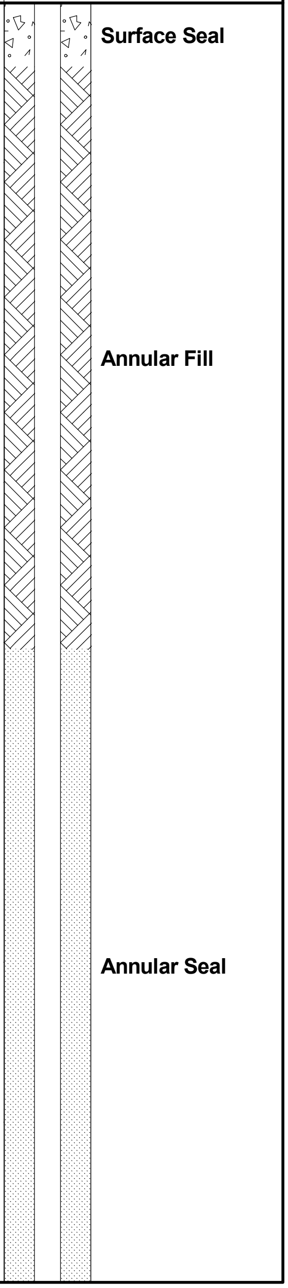
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/29/2014 **COMPLETED** **SURF. ELEV.** 391.6 **COORDINATES:** N:1,328,515.24 E:593,408.34
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 71 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 58 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 394.59
		Fill (FILL) dark gray to medium gray fine gravel to coarse gravel sized angular to subangular mudstone/siltstone within a medium gray silty matrix	391.6		Surface Seal
5					
		trace cobble sized fragments			
10					Annular Fill
15					
		trace sandstone fragments			
20					
25					
		trace reddish brown to rusty red staining on trace rock fragments			
30					Annular Seal
35					
40					





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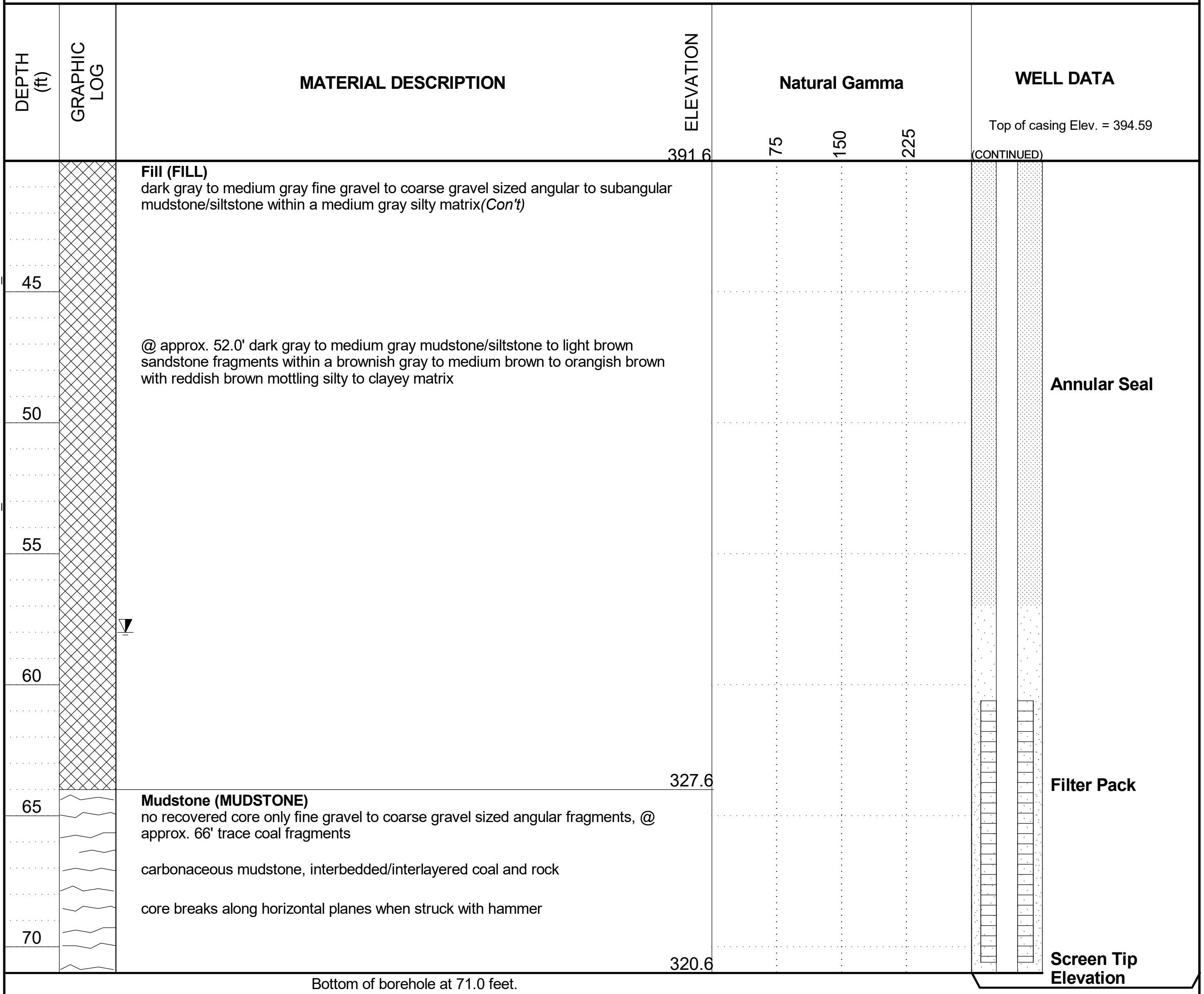
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION



MATERIAL DESCRIPTION	ELEVATION
Fill (FILL) dark gray to medium gray fine gravel to coarse gravel sized angular to subangular mudstone/siltstone within a medium gray silty matrix*(Con't)*	391.6
@ approx. 52.0' dark gray to medium gray mudstone/siltstone to light brown sandstone fragments within a brownish gray to medium brown to orangish brown with reddish brown mottling silty to clayey matrix	
Mudstone (MUDSTONE) no recovered core only fine gravel to coarse gravel sized angular fragments, @ approx. 66' trace coal fragments carbonaceous mudstone, interbedded/interlayered coal and rock core breaks along horizontal planes when struck with hammer	327.6
	320.6

Bottom of borehole at 71.0 feet.

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SOUTHERN COMPANY

BORING LOG

BORING MW-8
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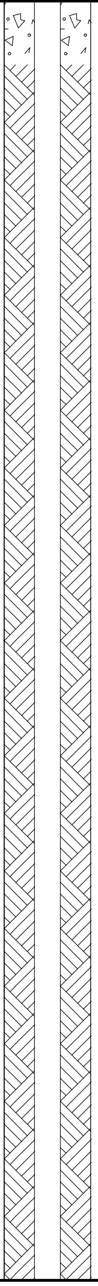
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 1/15/2014 **COMPLETED** 1/16/2014 **SURF. ELEV.** 413.2 **COORDINATES:** N:1,329,140.73 E:593,813.96
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 69.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 61.02 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 415.68
	▨	**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	413.2		**Surface Seal**
5	▨				
10	▨				
15	▨				
20	▨				**Annular Fill**
25	▨				
30	▨				
35	▨				
40	▨				



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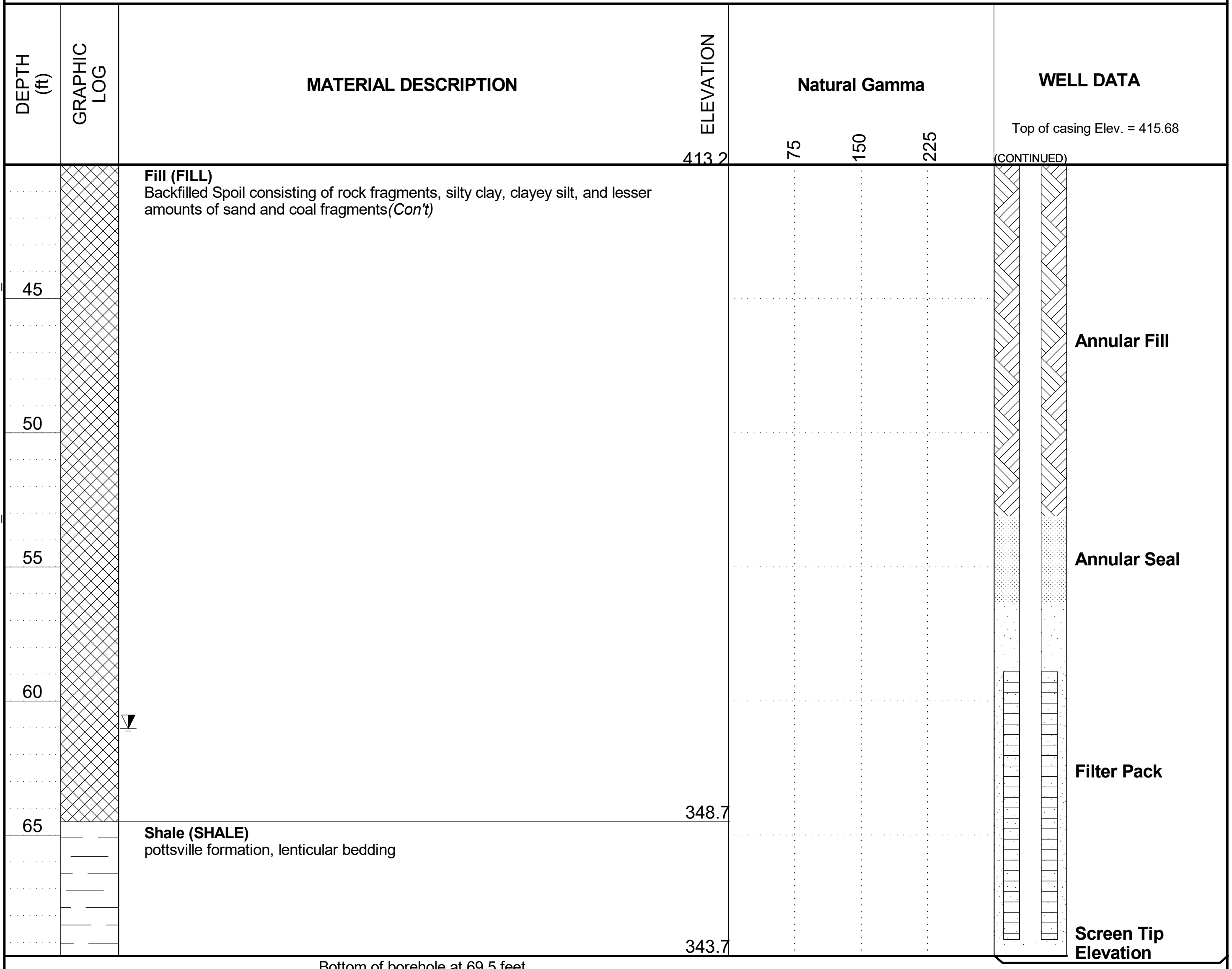
SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/13/17 15:16 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION



Fill (FILL)
Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*

Shale (SHALE)
pottsville formation, lenticular bedding

Bottom of borehole at 69.5 feet.

SOUTHERN COMPANY

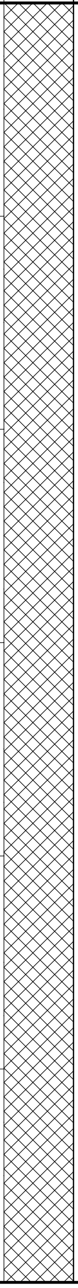
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/27/2014 **COMPLETED** **SURF. ELEV.** 487.2 **COORDINATES:** N:1,329,976.53 E:594,124.62
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 121 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 110.41 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma	WELL DATA
			487.2	75 150 225	Top of casing Elev. = 490.15



Fill (FILL)
dark gray to medium gray mudstone/siltstone and trace sandstone with trace reddish brown staining, angular to subangular upper coarse sand to coarse gravel sized rock fragments within a light brown to grayish brown to light gray sandy silt matrix

trace bolder sized rock fragments (trace core returned) within a light gray powder/pulverized rock

10

trace zones of medium brown to reddish brown gravelly silt to gravelly clay matrix containing upper coarse sand to fine gravel sized rock fragments

20

30

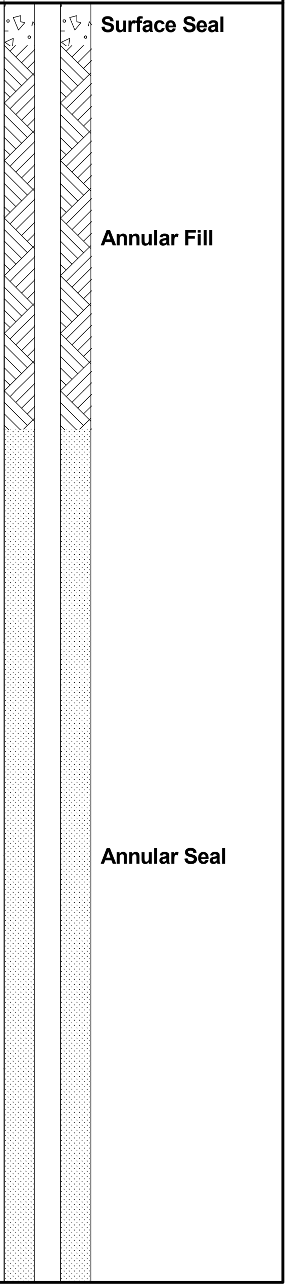
orangish brown to reddish brown to grayish brown gravelly silt, upper coarse sand to coarse gravel sized dark gray to medium gray angular to subangular mudstone/siltstone fragments

40

50

dark gray to medium gray upper coarse sand to coarse gravel to trace bolder sized mudstone/siltstone fragments within a dark gray to med gray silt to light gray pulverized rock powder with trace light brown (overburden) soils

60



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BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225
			487.2	
		Fill (FILL) dark gray to medium gray mudstone/siltstone and trace sandstone with trace reddish brown staining, angular to subangular upper coarse sand to coarse gravel sized rock fragments within a light brown to grayish brown to light gray sandy silt matrix*(Con't)*		
		dark gray to medium gray silty matrix with dark gray to medium gray rock fragments		
70				
80				
90				
		trace rock fragments with rusty red to reddish brown staining, dark gray to medium gray mudstone/siltstone angular to subangular upper coarse sand to coarse gravel sized rock fragments within a dark gray to medium gray silty matrix with trace orangish bro		
100				
		dark gray to medium gray mudstone/siltstone upper coarse to cobble with trace bolder sized rock fragments		
110		▼		
			372.2	
		Mudstone (MUDSTONE) trace plant fossils visible, predominately mechanical fracture due to sonic drilling		
120				
			366.2	

Bottom of borehole at 121.0 feet.

WELL DATA

Top of casing Elev. = 490.15

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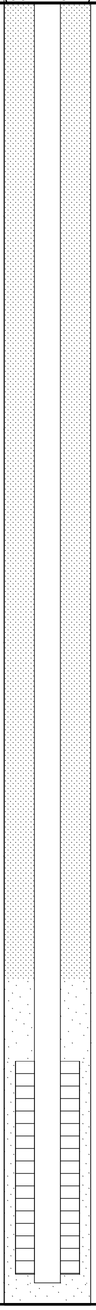


Annular Seal

Filter Pack

Screen Tip Elevation

SOUTHERN COMPANY

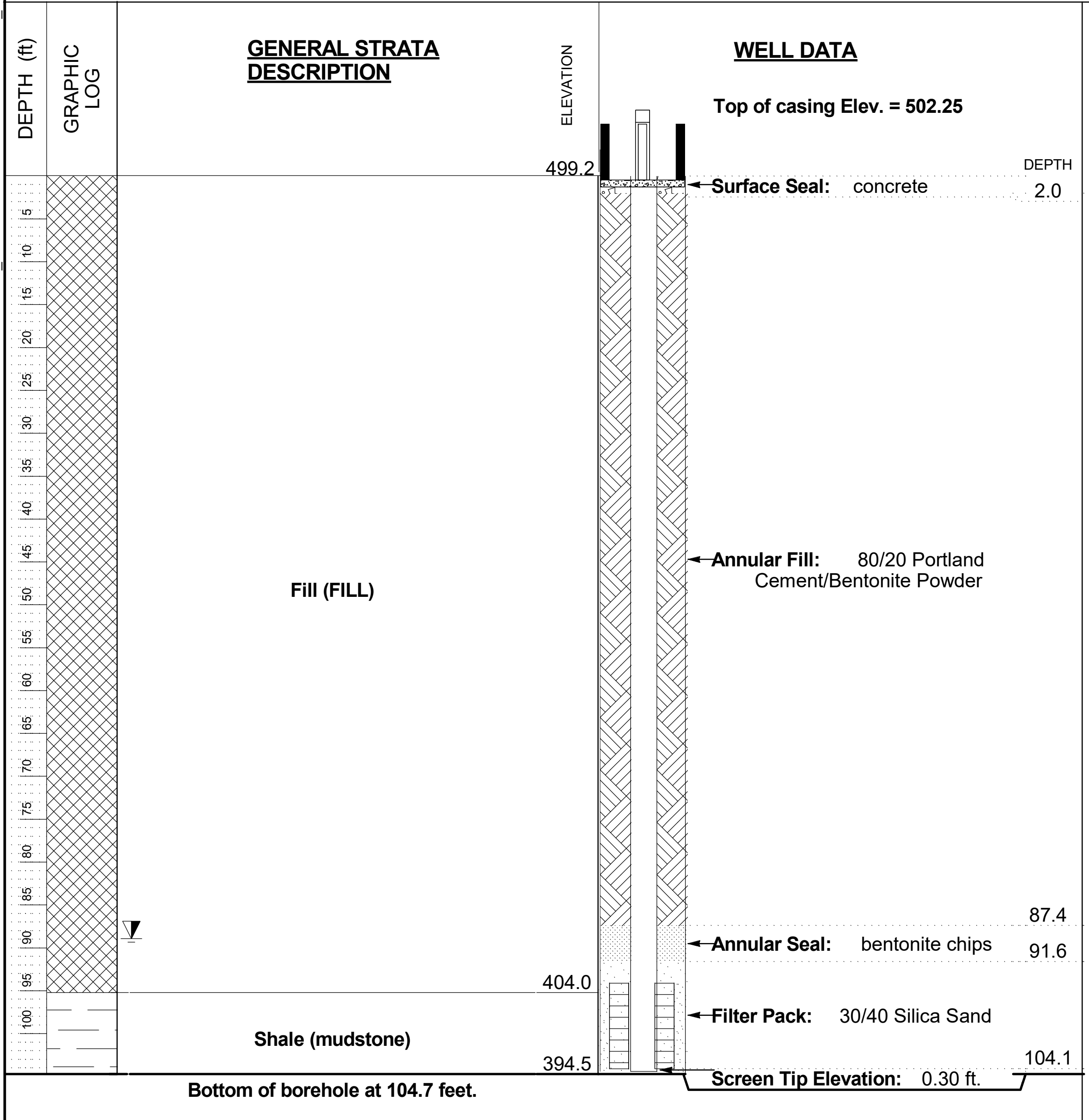
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 1/13/2014 **COMPLETED** 1/15/2014 **SURF. ELEV.** 499.2 **COORDINATES:** N:1,330,794.06 E:594,082.36
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 104.7 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 88.92 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION	WELL DATA	NOTES:



Top of casing Elev. = 502.25

Elevation	Strata	Well Data	Depth
499.2	Fill (FILL)	**Surface Seal:** concrete	2.0
		Annular Fill: 80/20 Portland Cement/Bentonite Powder	87.4
		Annular Seal: bentonite chips	91.6
404.0	Shale (mudstone)	**Filter Pack:** 30/40 Silica Sand	104.1
394.5		**Screen Tip Elevation:** 0.30 ft.	

Bottom of borehole at 104.7 feet.

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

SOUTHERN COMPANY

LOG OF WELL INSTALLATION

BORING MW-2
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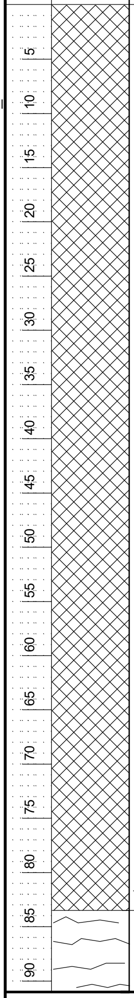
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 498.5 **COORDINATES:** N:1,331,053.31 E:593,548.80
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 91 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 81.7 ft.
NOTES

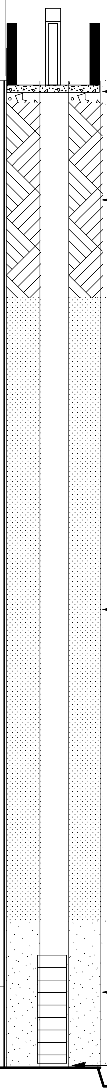
DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION
0			498.5
		Fill (FILL)	
		▼	
			415.0
		Mudstone (MUDSTONE)	
91			407.5

Bottom of borehole at 91.0 feet.



WELL DATA

Top of casing Elev. = 501.54



	DEPTH
Surface Seal: concrete	2.0
Annular Fill: 80/20 Portland Cement/Bentonite Powder	20.0
Annular Seal: bentonite chips	77.5
Filter Pack: 30/40 Silica Sand	90.6

Screen Tip Elevation: 0.40 ft.

NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

BORING MW-3
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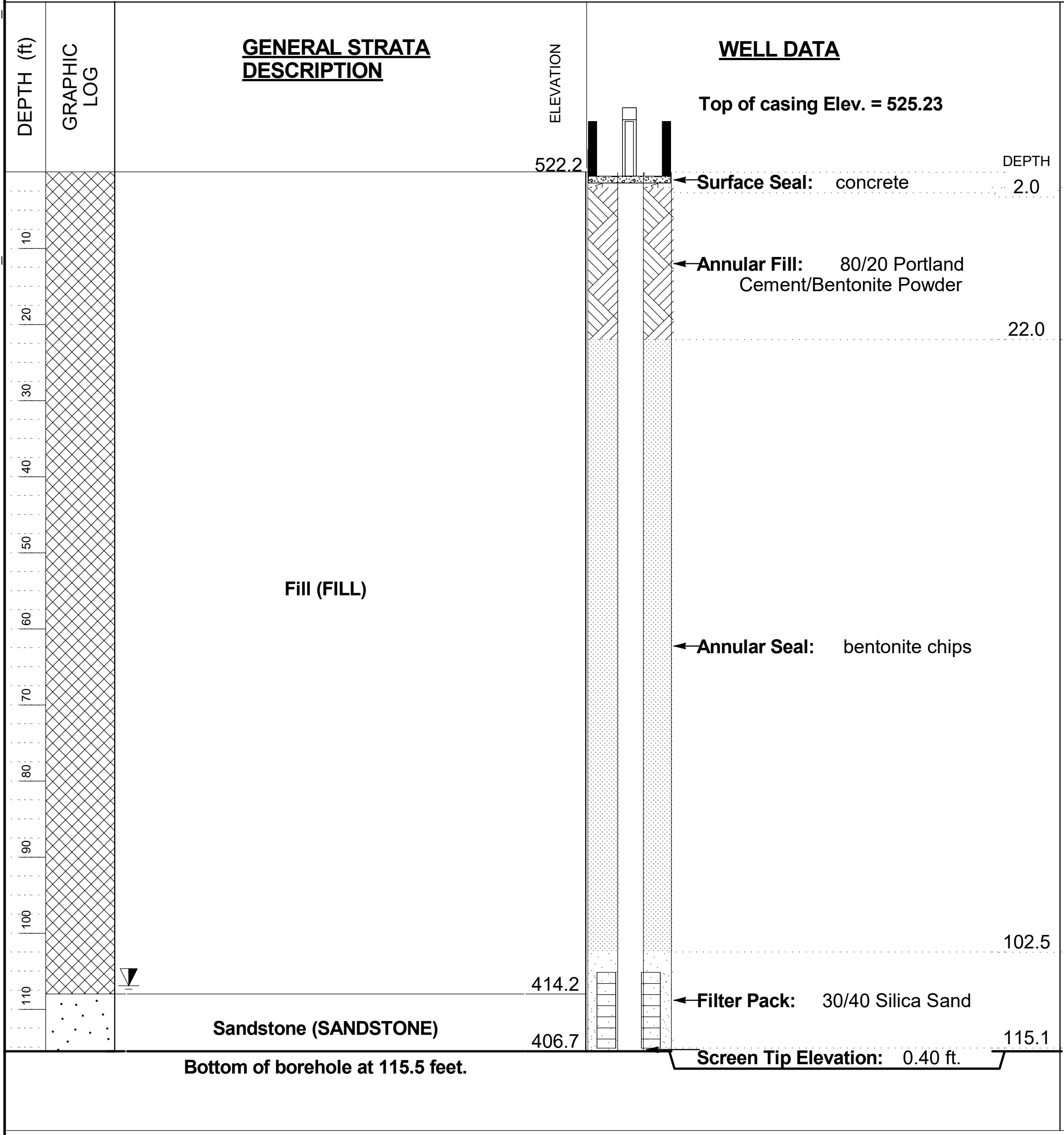
SOUTHERN COMPANY

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 522.2 **COORDINATES:** N:1,330,842.40 E:593,025.40
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 115.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 106.91 ft.
NOTES



GENERAL STRATA DESCRIPTION

ELEVATION	
522.2	Fill (FILL)
414.2	Sandstone (SANDSTONE)
406.7	

Bottom of borehole at 115.5 feet.

WELL DATA

Top of casing Elev. = 525.23

	DEPTH
Surface Seal: concrete	2.0
Annular Fill: 80/20 Portland Cement/Bentonite Powder	22.0
Annular Seal: bentonite chips	102.5
Filter Pack: 30/40 Silica Sand	115.1

Screen Tip Elevation: 0.40 ft.

NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/13/17 15:18 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

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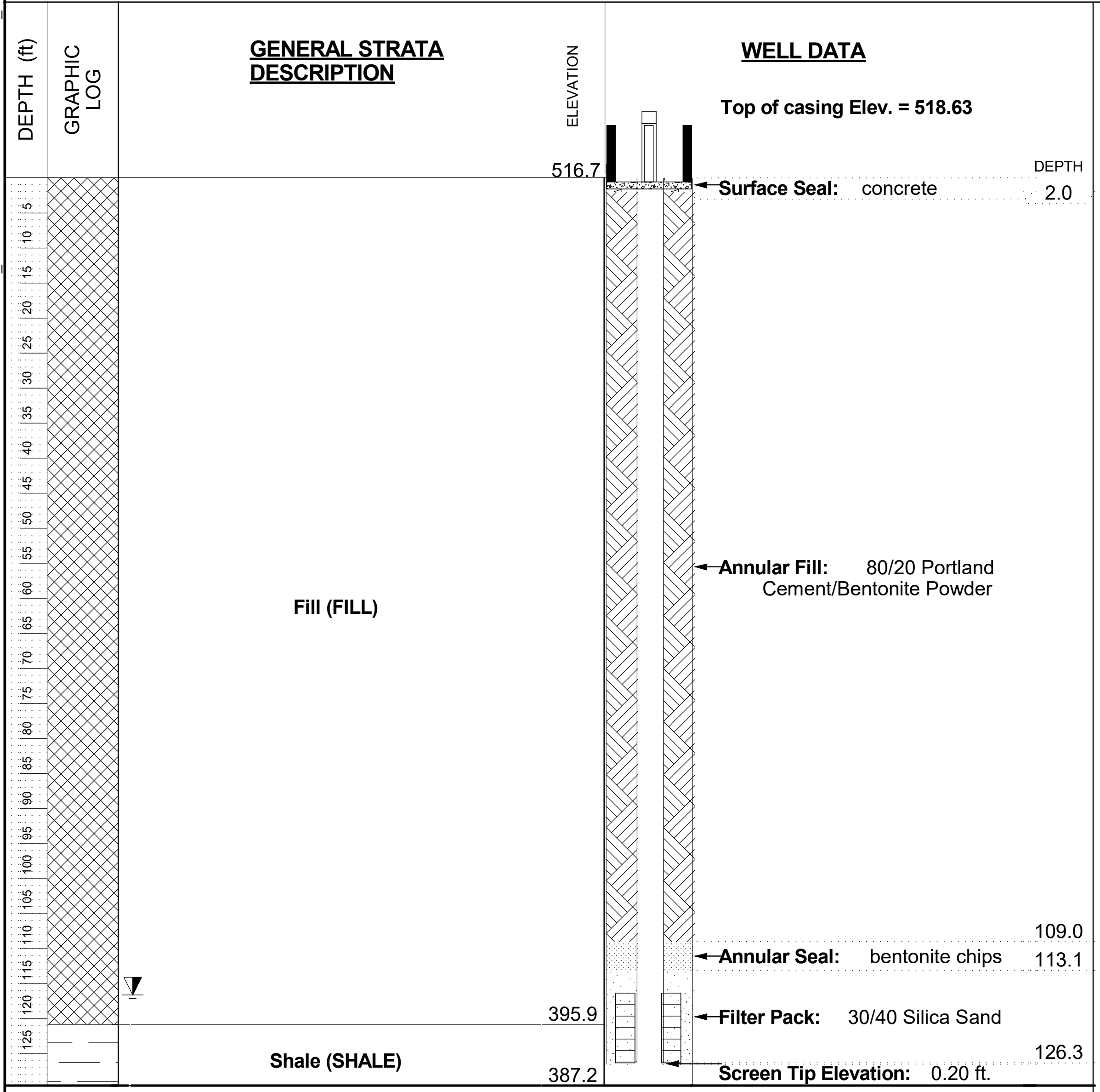
SOUTHERN COMPANY

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 2/12/2014 **COMPLETED** 2/19/2012 **SURF. ELEV.** 516.7 **COORDINATES:** N:1,330,289.73 E:592,896.41
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 129.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 116.59 ft.
NOTES



Bottom of borehole at 129.5 feet.

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/13/17 15:18 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

SOUTHERN COMPANY

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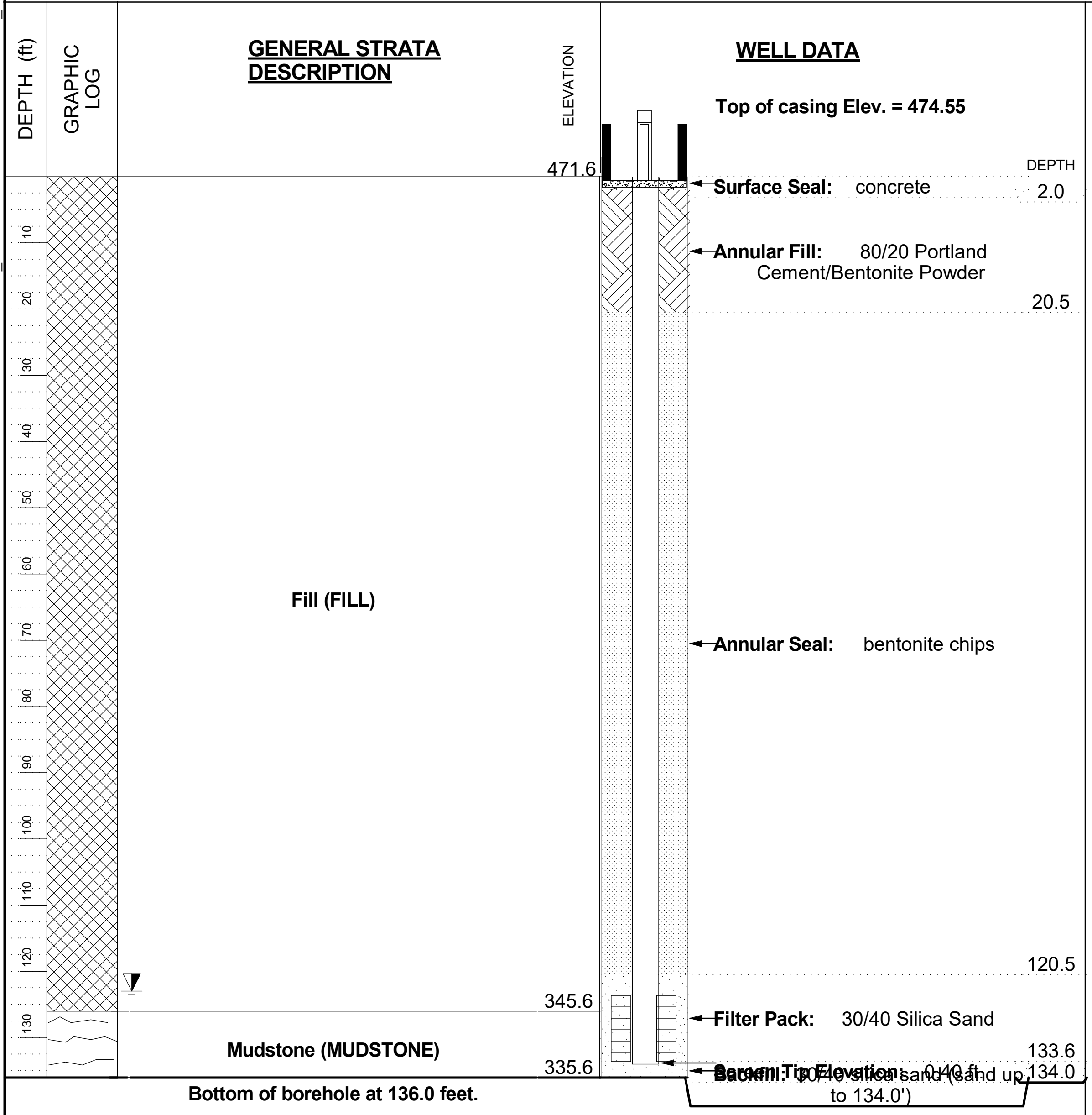
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/28/2014 **COMPLETED** **SURF. ELEV.** 471.6 **COORDINATES:** N:1,328,645.98 E:592,436.54
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 136 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 122.97 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION	WELL DATA	NOTES:



Top of casing Elev. = 474.55

471.6

Fill (FILL)

345.6

Mudstone (MUDSTONE)

335.6

Bottom of borehole at 136.0 feet.

Surface Seal: concrete — 2.0

Annular Fill: 80/20 Portland Cement/Bentonite Powder — 20.5

Annular Seal: bentonite chips — 120.5

Filter Pack: 30/40 Silica Sand — 133.6

Screen Tip Elevation: 0.40 ft. — 134.0

Backfill: 30/40 silica sand (sand up to 134.0')

WELL SPECIFICATIONS

Casing Diameter: 2 inches **Screen Diameter:** 2 inches
Casing Material: Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
Casing Length: feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/13/17 15:18 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

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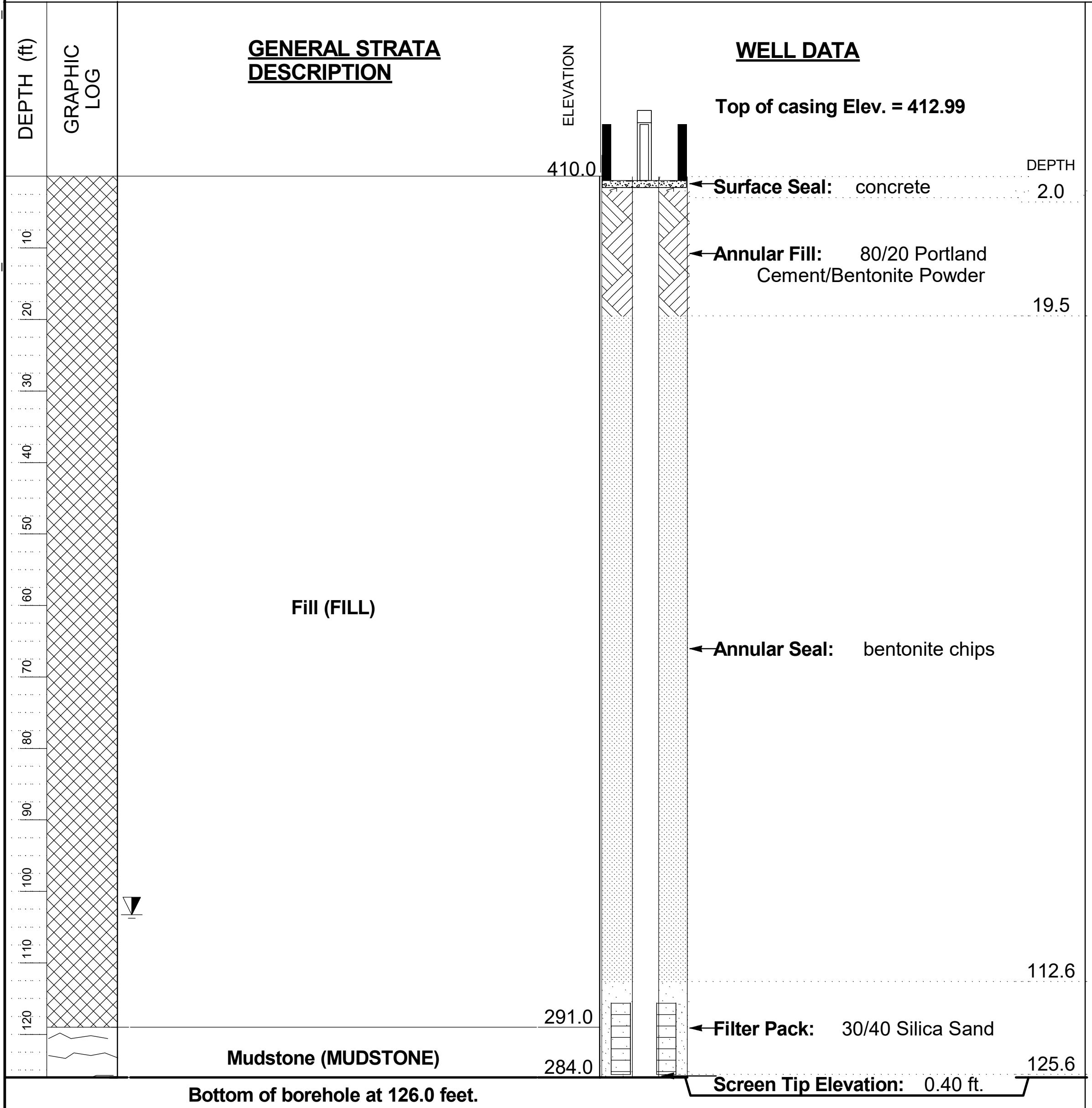
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/29/2014 **COMPLETED** **SURF. ELEV.** 410.0 **COORDINATES:** N:1,327,877.97 E:592,829.84
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 126 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 103.27 ft.
NOTES



DEPTH (ft)	GENERAL STRATA DESCRIPTION	ELEVATION
0–119	Fill (FILL)	410.0
119–126	Mudstone (MUDSTONE)	291.0
126	Bottom of borehole at 126.0 feet.	284.0

WELL DATA

Top of casing Elev. = 412.99

Surface Seal: concrete — 2.0

Annular Fill: 80/20 Portland Cement/Bentonite Powder — 19.5

Annular Seal: bentonite chips — 112.6

Filter Pack: 30/40 Silica Sand — 125.6

Screen Tip Elevation: 0.40 ft.

NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/13/17 15:18 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

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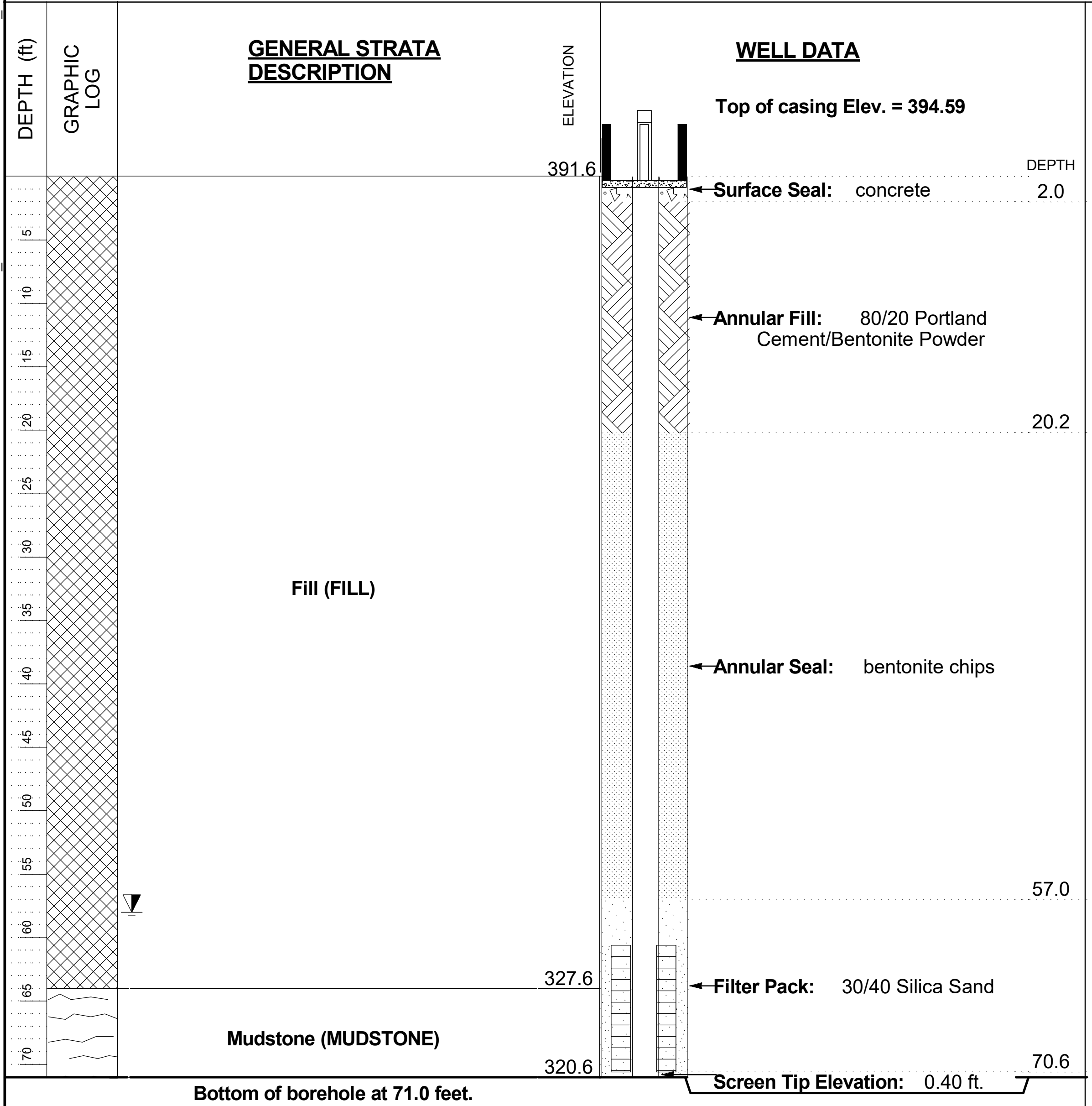
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/29/2014 **COMPLETED** **SURF. ELEV.** 391.6 **COORDINATES:** N:1,328,515.24 E:593,408.34
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 71 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 58 ft.
NOTES



Bottom of borehole at 71.0 feet.

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/13/17 15:18 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

BORING MW-8
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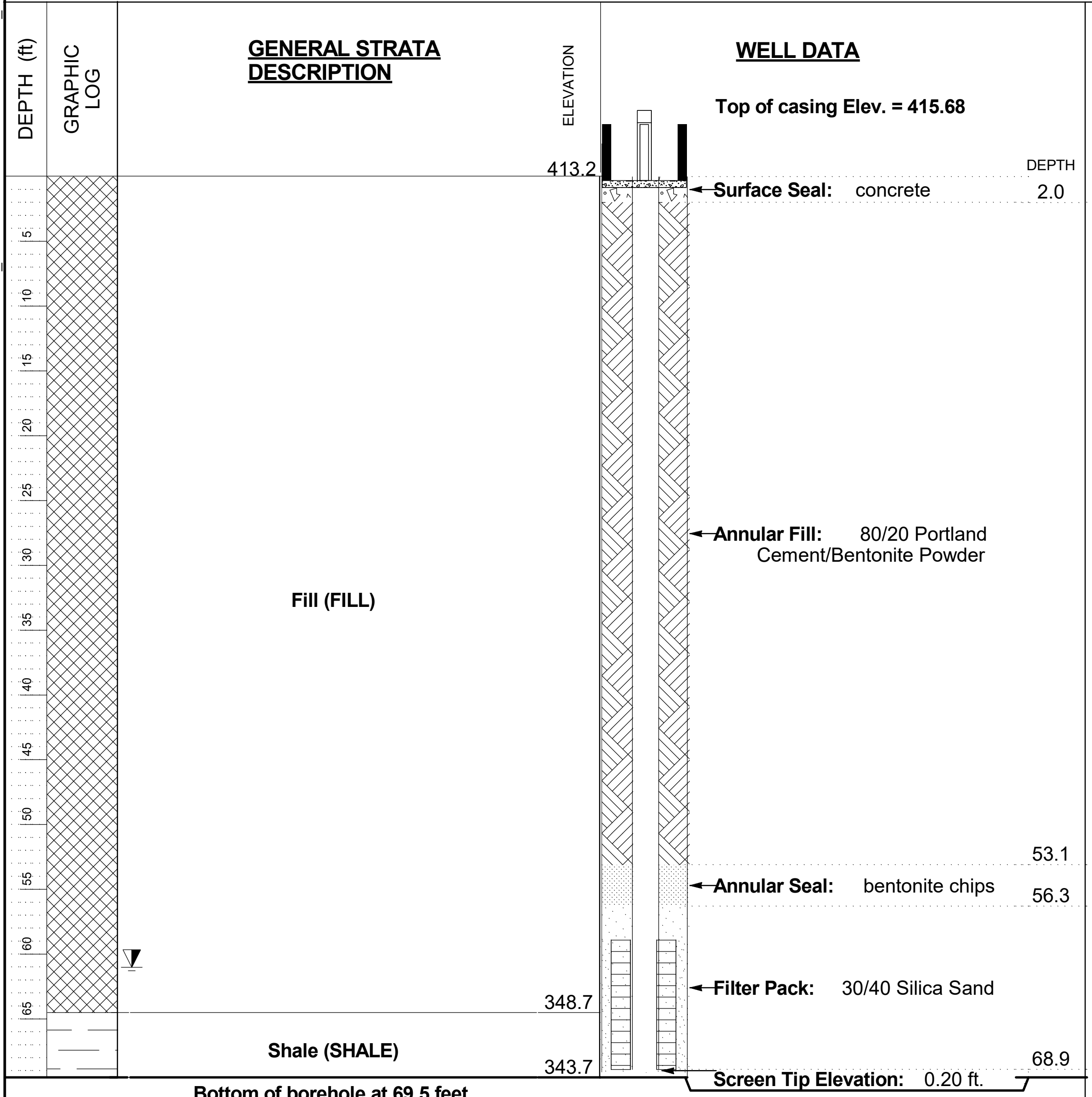
SOUTHERN COMPANY

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 1/15/2014 **COMPLETED** 1/16/2014 **SURF. ELEV.** 413.2 **COORDINATES:** N:1,329,140.73 E:593,813.96
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 69.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 61.02 ft.
NOTES



Bottom of borehole at 69.5 feet.

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/13/17 15:19 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

BORING MW-9
PAGE 1 OF 1

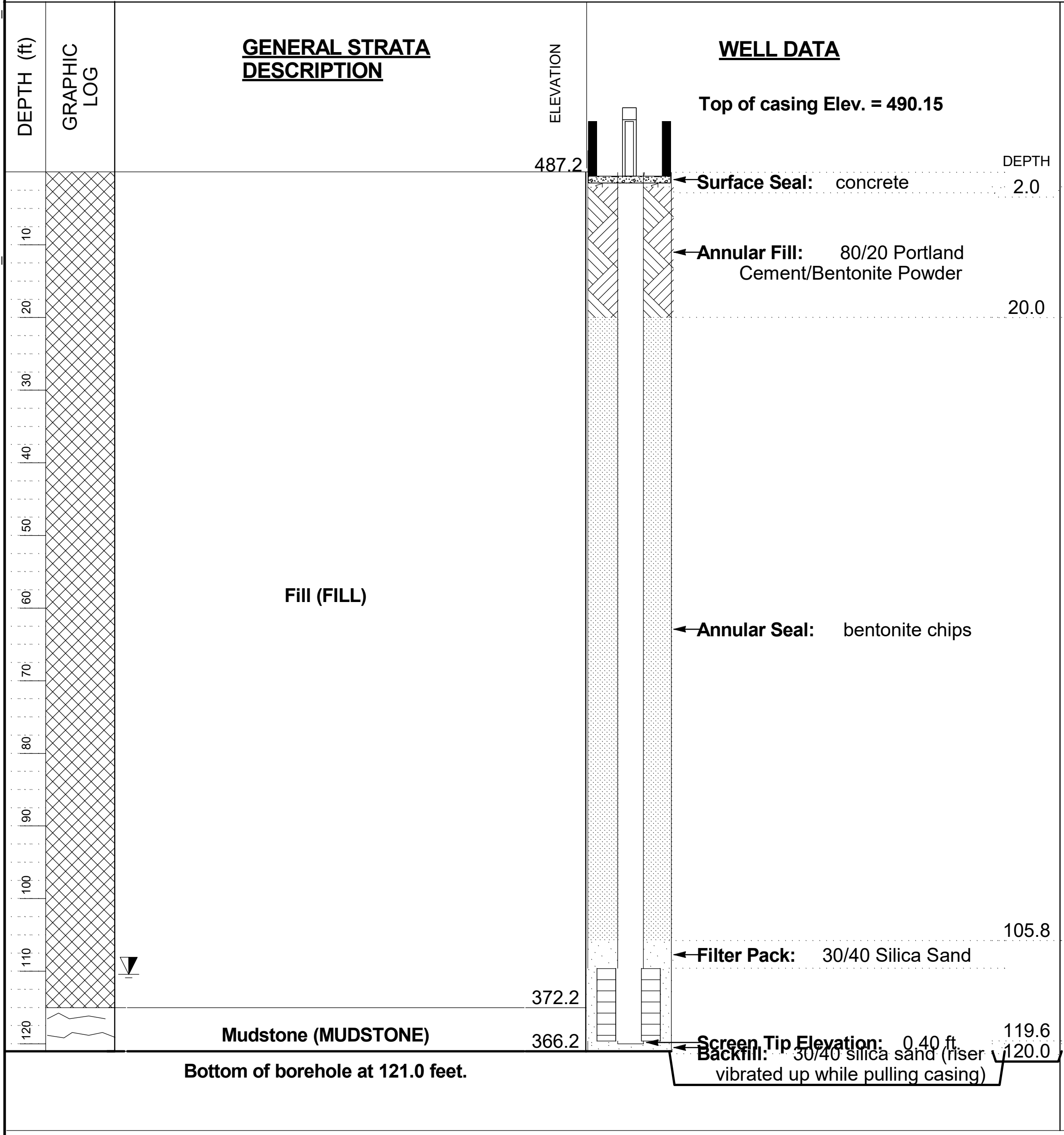
LOG OF WELL INSTALLATION

SOUTHERN COMPANY

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/27/2014 **COMPLETED** **SURF. ELEV.** 487.2 **COORDINATES:** N:1,329,976.53 E:594,124.62
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 121 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 110.41 ft.
NOTES



GENERAL STRATA DESCRIPTION

ELEVATION	
487.2	Fill (FILL)
372.2	Mudstone (MUDSTONE)
366.2	

Bottom of borehole at 121.0 feet.

WELL DATA

Top of casing Elev. = 490.15

	DEPTH
Surface Seal: concrete	2.0
Annular Fill: 80/20 Portland Cement/Bentonite Powder	20.0
Annular Seal: bentonite chips	105.8
Filter Pack: 30/40 Silica Sand	119.6
Screen Tip Elevation: 0.40 ft.	
Backfill: 30/40 silica sand (riser vibrated up while pulling casing)	120.0

NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

Appendix B

ALABAMA POWER COMPANY
PLANT GORGAS
CCR LANDFILL
STATISTICAL ANALYSIS PLAN

Prepared for

Alabama Power Company
Birmingham, Alabama

Prepared by

Groundwater Stats Consulting
Mobile, Alabama

Revised August 2020

ALABAMA POWER COMPANY
PLANT GORGAS
CCR LANDFILL
STATISTICAL ANALYSIS PLAN

Kristina L. Rayner
Groundwater Stats Consulting, LLC
Originator

Gregory T. Whetstone, P.E.
Southern Company Services, Inc.
Reviewer

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

This updated Statistical Analysis Plan (SAP) describes the site-specific statistical analysis approach that will be used to evaluate groundwater at Alabama Power Company's Plant Gorgas CCR Landfill pursuant to ADEM Admin. Code r. 335-13-15-.06 and 40 CFR Part 257. 90 through 95 under detection and assessment monitoring programs.

A compliance groundwater monitoring well system was installed pursuant to requirements of 40 CFR 257.91(e)(1). A background well network is installed upgradient of the CCR unit. Downgradient monitoring wells were installed along the downgradient waste boundary pursuant to 40 CFR 257.91(a)(2). The compliance monitoring well network is described in the site-specific groundwater monitoring plan and summarized in the attached Table 1.

Alabama Power Company conducted 8 background monitoring sample events beginning in 2016. Samples were collected from the compliance monitoring wells and analyzed for CCR Appendix III and IV parameters pursuant to 40 CFR 257.91 Appendix III and IV parameters are as follows:

1) Appendix III (Detection Monitoring) - boron, calcium, chloride, fluoride, pH, sulfate, and TDS
2) Appendix IV (Assessment Monitoring) – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

This updated SAP has been developed based upon the characteristics of the groundwater quality data collected since groundwater monitoring was implemented in 2016 following the requirements in 40 CFR 257.91[1], and the United States Environmental Protection Agency (USEPA) Unified Guidance (March 2009)[2]. The plan describes:

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[1] Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities, 2015.

[2] U.S. EPA, March 2009. *Unified Guidance*, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

1) Background data collection, management, and updates;
2) Statistical concepts applicable to detection and assessment monitoring programs;
3) Site-specific statistical analysis methods for Detection Monitoring; and
4) Statistical approach for Assessment Monitoring and Corrective Action.

As part of ongoing site activities, installation of additional wells may be necessary to characterize site conditions or supplement the assessment monitoring well network. The disposition of these additional wells will be described in the site groundwater monitoring plan. Procedures for statistically evaluating additional wells are described in this SAP.

Any change to the statistical analysis plan (e.g. statistical analysis method, background period, background data set, well network, screening method, etc.) will only be implemented upon receipt of approval from the Alabama Department of Environmental Management (Department).

2.0 BACKGROUND

This section describes the establishment, screening, update, and management of the background data sets used for detection, assessment and corrective action phases of groundwater monitoring. Included are descriptions of the tests that are used to determine whether the potential background data represent site-specific conditions and the procedures used to update (expand or truncate) the background data set. Also described are procedures that will be used to update the data set with more current monitoring data or as new background monitoring wells are installed.

Changes or updates to background updates will only be made after Department approval.

2.1 Background Screening

Background is determined based on site-specific conditions such upgradient wells, wells not in the groundwater flow path of the unit, or wells determined to not be affected by the disposal unit. Once background wells are selected based on site-specific conditions, the data are screened as follows:

2.1.1 Outlier Testing

An outlier is defined as an observation that is unlikely to have come from the same distribution as the rest of the data. A statistical outlier test, such as the 1989 EPA Outlier Test [3]or Tukey's Outlier Test as discussed in the USEPA Guidance, will be performed on the monitoring well data when time series plots or box and whiskers plots indicate the presence of extreme observations relative to other observations. The outlier test will serve as a data quality check to help identify errors from data entry and other sources.

Statistical outliers in the background data will be deselected unless it can be proven that the data point is not an anomalous value and does represent naturally occurring variation. This is conservative from a regulatory perspective in that it ensures that the background limits are not artificially elevated. When outliers are identified, they are flagged in the data set and the values excluded from background limit calculations. Re-testing for outliers will be performed when background updates are proposed.

2.1.2 Testing and Adjusting for Seasonal Effects

Testing and adjusting data for seasonal factors ensures that seasonal effects will not affect the test results. When seasonal effects are suspected, the Kruskal-Wallis seasonality test will be used to determine whether the seasonal effects are statistically significant when there are sufficient data to test for seasonality. When seasonal effects are confirmed, the data will be de-seasonalized prior to calculating a statistical limit. Data are de-seasonalized by subtracting the seasonal mean and adding back the grand mean to each observation. Background data will be re-tested when there are at least four new values available and a background update is proposed.

2.1.3 Temporal Trend Testing

The Sen's Slope/Mann-Kendall statistical analysis will be performed on all well/constituent pairs to evaluate concentrations over time. The Sen's Slope Estimator will be used to estimate the rate of change (increasing, no change, or decreasing) for each constituent at each well. The Mann Kendall statistic will be used to determine whether each of those trends is statistically significant. The Sen's Slope/Mann Kendall analysis requires at least five observations.

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[3] 1953, "Processing data for outliers", *Biometrics*, Vol. 9, pp.74-89.

When a significant trend is present, older historical values may be deselected from the background data prior to computing background limits in cases where groundwater is presumed not to be impacted by the unit. The resulting limits will reflect more current conditions and will not be influenced by older, historical conditions that are no longer relevant. If upgradient concentration levels are changing over time (i.e. trending upward or downward), the prospective background data set may need to be truncated, removing older data to ensure that the resulting limits continue to represent current natural conditions.

For instance, when background concentration levels are increasing over time due to upgradient water quality changes, if the background data sets are not adjusted, the established PLs could result in increased false positive or false negative risk. In some cases, including older historical data in the background data set may result in overly sensitive limits and an increased chance of false positive readings. In other cases, using all background data when there are temporal changes in background levels may artificially elevate limits. This scenario may occur even when there is a decreasing trend in background concentration levels. An elevated limit under these circumstances is a direct result of an inflated standard deviation that is used in the computation of the parametric limit, which in turn will increase the risk of false negative test outcomes.

Well/constituent pairs that have increasing or decreasing concentration levels over time will be evaluated to determine if earlier data are no longer representative of present-day groundwater quality. In those cases, earlier data may be deselected prior to construction of limits to reduce variation as well as to provide limits that are conservative from a regulatory perspective that will detect future changes in groundwater quality.

Background limits also need to allow for random variation in groundwater concentration levels that are naturally present at a site. The availability of multiple background wells can give an indication of the natural variability in groundwater constituent levels across a site.

2.1.4 Sample Size

While a parametric prediction limit may be constructed with as little as four samples per well, the CCR Rule and the EPA Unified Guidance recommend that a minimum of at least 8 independent background observations be collected for constructing statistical limits. The reliability of the statistical results is greatly enhanced by increasing the sample size to eight or more. An increased sample size tends to more accurately characterize the variation and typically reduce the probability of erroneous conclusions. Furthermore, if a nonparametric prediction limit is required, the confidence level associated with the test will be dependent on the number of background data available as well as the number of comparisons to the statistical limit.

2.1.5 Non-Detect Data

When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit (RL) utilized for nondetects is the practical quantification limit (PQL) used by the laboratory.

When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit. Trace (or estimated) values which are reported above the method detection limit (MDL) and below the PQL/RL are used in the statistical analysis as reported by the laboratory. These values are flagged with "J" to distinguish between estimated values and values reported above the PQL.

If detection limits change over a period of analysis, then a statistically significant trend could be the result of increasing or decreasing laboratory precision and not an actual change in water quality. Under those circumstances, an appropriate substitution of the detection limit will be considered, such as the median or most recent detection limit.

2.2 Updating Interwell Background

The following describes the process that will be used to update interwell background data sets. Background updates described below will only be performed after Department approval.

Interwell statistical methods are constructed by pooling upgradient well data from 2 or more upgradient wells. For the Detection Monitoring program, background-derived Prediction Limits will be updated during each semi-annual event by incorporating the most recent sampling results from the existing background well network into the background data set. New background data will be screened for any new outliers as described above.

For the Assessment and Corrective Action program, background-derived tolerance limits are used to construct background limits using pooled upgradient well data for comparison against established standards. The tolerance limits will be updated every 2 years after screening as described above.

Once background has been established, the background well network may be updated by (1) adding wells to the background well network, or (2) removing wells and data from the background well network. The following describes the additional statistical screening steps that will be taken to update the background after a site-specific determination is made that the wells meet the hydraulic and geochemical requirements of a background location.

2.2.1 Adding to the Background Well Network

The background data set may be updated or adjusted by incorporating new wells into the network or installing new background monitoring wells. When new wells are installed, the following process will be used to statistically evaluate the results and incorporate them into the background data set upon receipt of ADEM approval.

Prior to incorporating new upgradient well data for construction of statistical limits, Tukey's outlier test and visual screening are used to evaluate data. Any confirmed outliers are flagged as such in the database and deselected prior to construction of interwell prediction limits. Any flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. A summary of Tukey's test results and flagged values will be provided with the report.

Upgradient well data will be further tested for trends as described earlier. When no statistically significant trends are identified, all new well data will be incorporated into the background. Any records with trending data will be evaluated on a case by case basis, and records may require deselection if historical data are no longer representative of present-day groundwater quality conditions. Interwell prediction limits using all upgradient well data are re-calculated as a result of this screening.

2.2.2 Removing Wells and Data from Background

As additional background data are collected, or site conditions change, a recommendation may be made to remove a well from the background network for any number of reasons (e.g. removal, change in groundwater flow conditions, change in chemistry, vandalism, etc.). If an upgradient well will no longer be part of the background network, the historical data from that well will no longer be included in the construction of interwell limits (which pool upgradient well data) without Department approval.

When wells are proposed for removal from the network, a site-specific statistical and geochemical evaluation will be made to identify the population(s) of data that may not represent background conditions. A proposal will be submitted to the Department for approval identifying the recommended use or disuse of historical data from the well(s) proposed for removal. The proposal will include statistical data screening and will explain the rationale for the proposed use of the data.

In the case where an upgradient well is no longer sampled (i.e. due to well damage, etc.), but historical data are still representative of upgradient water quality, an evaluation will be conducted as described below to determine whether data are still representative of background and should continue to be included in the background data set. When demonstration shows that groundwater quality from a well is still representative of naturally occurring groundwater quality upgradient of the facility, this data will be used in construction of statistical limits with ADEM approval. In cases where data from upgradient wells removed from the network do not represent upgradient groundwater quality, a proposal will be made for ADEM approval whereby interwell prediction limits will be re-calculated using data from only those upgradient wells in the network.

When preparing a background data evaluation for Department approval, the statistical portion of the evaluation will be accomplished by:

i. Using the ANOVA to determine whether significant variation exists among upgradient wells which would prevent the well's data from being included in construction of interwell prediction limits;
ii. Visual screening using Time Series and Box Plots to determine whether measurements are similar to neighboring upgradient wells;
iii. Screening the background data set for outliers as described above; and

iv. Performing trend tests to identify statistically significant increasing or decreasing trends which may require adjustment of the record to eliminate trending data and reduce variation.

2.3 Updating Intrawell Background

Intrawell statistical methods may be used at well locations that have not been impacted by a release from the unit being monitored. When using intrawell methods, once the background limits are established, data will not be evaluated again for updating until a minimum of 4 new samples are available, or every 2 years[4]. Data will be screened for outliers and trends as described above.

When updating an intra-well background, data are tested for suitability of updating by consolidating new sampling observations with the screened background data. Before updating the data for intrawell testing, it is necessary to verify that the most recent observations represent an unimpacted state as compared with the existing background. Data are first screened for outliers and, when confirmed, flagged as such in the database and deselected prior to constructing statistical limits. This step results in statistical limits that are conservative from a regulatory perspective.

The Mann-Whitney (Wilcoxon Rank Sum) two-sample test is then used to compare the median of the first group of background observations to the median of the more recent 4 or more observations. If the most recent data group is not found to be statistically different than the older data, the background data set may be updated and the prediction limits will be reconstructed to include the more recent background samples. When statistical differences are identified by the Mann Whitney test, statistical limits may not be eligible for updating. When more samples are available, data will be tested again for suitability of updating background data sets. In the event it is determined that the historical data are no longer representative of present-day groundwater quality in the absence of suspected impacts, only the more recent 8 or more measurements will be used to update the prediction limits.

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[4] US EPA Unified Guidance, March 2009. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities – Section 5.3*. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

3.0 STATISTICAL APPROACH FOR DETECTION MONITORING

The following sections describe the concepts related to developing a site-specific SAP for detection monitoring. The statistical evaluation includes screening upgradient well data to characterize groundwater upgradient of the facility and determine whether intrawell or interwell methods are recommended as the most appropriate statistical method for each Appendix III constituent.

3.1 Statistical Method

When data from multiple upgradient wells are available, a determination will be made as to whether the upgradient well data appear to come from the same population or whether there is evidence of spatial variation upgradient of the facility. Data for each constituent are plotted using box and whisker plots to assist in making this determination, providing visual representation of concentrations within and across wells. Analysis of Variance (ANOVA) may be used initially to statistically evaluate whether significant spatial variation exists at each unit.

Interwell prediction limits (PLs) pool upgradient well data to construct statistical limits which are used to evaluate data at downgradient wells. These tests are appropriate when the ANOVA determines that no significant spatial variation exists among the background wells.

In the event the ANOVA determines:

1) evidence of significant spatial variation upgradient of the facility, or
2) that there are insufficient upgradient well data, or
3) that interwell methods will not adequately address the question of a change in groundwater quality at any of the downgradient wells,

the USEPA Unified Guidance recommends switching from interwell methods to intrawell methods when it can be reasonably demonstrated that no impact from the CCR unit is present for well/constituent pairs in detection monitoring.

Intrawell PLs, which compare the most recent sample from a given well to statistical limits constructed from historical measurements at the same well, are extremely useful for rapidly detecting changes over time at a given location. Intrawell methods remove the influence of on-site spatial variation in well-to-well concentration levels. Site monitoring data are evaluated for the appropriateness of intrawell methods, including screening of background data from within each well for trends, seasonality when sufficient data are available, and outliers.

3.2 Prediction Limits

The use of PL tests is restricted to Appendix III parameters recently sampled at groundwater monitoring wells to represent *current* conditions. Background stability will be tested using temporal and seasonal trend tests, utilizing de-seasonalizing adjustments when seasonal trends are present. Moreover, statistical conditions including background sample size requirements as specified in USEPA guidance and regulations will be verified prior to the use of each statistical approach.

3.3 Criteria for Using the Interwell Statistical Methodology

There are a number of conditions that need to be met before an interwell statistical analysis can be considered appropriate for a specific site. These conditions are described in this section.

1. Ensuring that the aquifer underlying the site is continuous and that all monitoring wells are screened in the same level;
2. Ensuring that limits will be adequately sensitive in detecting a facility release;
3. Ensuring that limits reflect current background conditions; and
4. Ensuring that confounding factors will not confuse the results.

3.3.1 Aquifer Designation and Monitoring Wells

Where the uppermost aquifer underlying a site is discontinuous, where downgradient monitoring wells are screened in differing levels, or where the upgradient monitoring well network is limited, EPA recommends performing intrawell analyses, to avoid confusing an impact caused by a release from the facility with a difference between wells caused by heterogeneous hydrogeology.

The statistical approach for constituents of concern will be based on interwell or intrawell PLs, and in some cases a combination of both methods, as a result of evaluation of spatial variation at the site. Box and whisker plots may be provided to demonstrate concentration levels within each well and across wells. When significant differences exist in concentration levels, particularly between upgradient wells, this indicates spatial variation in the groundwater quality. Spatial variation and/or limited upgradient well data would tend to create statistical limits that are:

1) not conservative from a regulatory perspective; or
2) not representative of background water quality.

3.4 Criteria for Using an Intrawell Statistical Methodology

The following is a description of the criteria that a site must meet to use an intrawell statistical methodology if it is determined that interwell methods are not appropriate.

3.4.1 Screening of Prospective Historical Background Data

Prior to using an intrawell analysis, it will be necessary to demonstrate that there have been no potential prior impacts at downgradient wells on the prospective historical background data as a result of the current practices at the Site. In addition to an independent investigation for prior impacts, prospective background data for intrawell tests will be screened for trends, seasonality and outliers as described above. If intrawell analyses are not feasible due to elevated concentrations in downgradient wells relative to concentrations upgradient of the facility, as determined during the screening process, interwell analyses will initially be utilized until further evidence supports the use of intrawell testing.

3.4.2 Stable Naturally Occurring Concentrations

The background data screening procedure described here is designed to check for stable background conditions, and account for existing groundwater quality from past or present activities in the area. While having pre-waste data is ideal for characterization of groundwater quality prior to waste placement, these facilities do not have pre-waste data.

The Sen's Slope/Mann-Kendall test for increasing or decreasing temporal trends will be used to test prospective background data when time series plots indicate the possibility of either increasing or decreasing trends over time. In the case where significant trends are found, unrepresentative values will be deselected only when it is clear that the trend is not the result of contamination. Assuming no alternative source, if similar trends and/or concentration levels are noted upgradient of the unit for the same parameters, it will be assumed that concentration levels represent natural variation in groundwater, and thus, earlier data will be removed so that compliance limits reflect current groundwater conditions upgradient of the unit.

3.5 Site-Wide False Positive Rates (SWFPR) and Statistical Power

The USEPA Unified Guidance recommends an annual site-wide false positive rate of 10%, which is distributed equally among the total number of sampling events. A site-wide false positive rate of 5% is targeted for each semi-annual sampling event. USEPA also requires demonstration that the statistical methodology selected for a facility will provide adequate statistical power, as discussed in Section 3.7 to detect a release, should one occur.

3.6 Determination of Future Compliance Observations Falling Within Background Limits

Intrawell or interwell upper PL are constructed with a test-specific alpha based on the overall site-wide false positive rate (SWFPR) of 5% for each sampling event. Any compliance observation that exceeds the background prediction limit will be followed with one or two independent resamples, depending on the resample plan, to determine whether the initial exceedance is verified.

The following pretests are used to ensure that the statistical test criteria are met:

1) *Data Distribution*. The distribution of the data will be tested using either the Shapiro-Wilk test (for background sample sizes of 50 or less) or the Shapiro-Francia test (for background sample sizes greater than 50). Non-normally distributed data will be transformed using the ladder of powers[5] to normalize the data prior to construction of background limits. When background data cannot be normalized, nonparametric PL will be calculated.

2) *Handling Non-Detects*. Simple substitution per USEPA Guidance[6] will be used when non-detects comprise less than or equal to 15% of the individual well data. Simple substitution refers to the practice of substituting one-half the reporting or

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[5] 1992, *Statistical Methods In Water Resources,* Elsevier, Helsel, D. R., & Hirsch, R. M.

[6] June 1992, *Addendum to Interim Final Guidance, Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities.* Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

detection limit for non-detects. When the proportion of non-detects (NDs) in background falls between 16 and 50%, a non-detect adjustment such as the Kaplan-Meier or Regression on Order Statistics (ROS) method for adjustment of the mean and standard deviation will be used prior to constructing a parametric prediction limit. When the proportion of non-detects exceeds 50%, or when the data cannot be normalized, a nonparametric prediction limit will be used.

3.7 Statistical Power

The USEPA Unified Guidance also requires that facilities achieve adequate statistical power to detect a release, even if only at one facility well and involving a single constituent. More specifically, EPA recommends power of approximately 55% when concentration levels are 3 standard deviations above the background mean, or approximately 80% power at 4 standard deviations above the background mean.

The performance of a given testing strategy is displayed in Power Curves which are based on the particular statistical method chosen combined with the resampling plan, the false positive rate associated with the statistical test, as well as the number of background samples available and the size and configuration of the monitoring network.

Power Curves for the PLs following this report demonstrate that the specified plan has the power to detect a release in downgradient wells and meet or exceed at least one of the power recommendations. As more data are collected during routine semi-annual sampling events and the background sets are expanded, the power requirements will exceed recommended power requirements.

4.0 STATISTICAL APPROACH FOR ASSESSMENT MONITORING & CORRECTIVE ACTION

The following describes the general statistical procedures that will be used if a facility enters Assessment or Corrective Action monitoring because of SSIs in the Detection monitoring program. Site-specific and event-specific SAPs may be developed at that time according to permit or regulatory requirements.

4.1 Assessment Monitoring

Assessment Monitoring may be initiated when there is a confirmed SSI over background in one or more wells for any of the Appendix III parameters. Wells are sampled for Appendix IV parameters semiannually concurrent with Appendix III constituents.

When in assessment monitoring, Appendix IV constituent concentrations are compared to Groundwater Protection Standards (GWPS), or other applicable standards, using Confidence Intervals. Upgradient well data are screened for outliers and trends as described above and tolerance limits are used to develop background limits. GWPS may be based on background limits when background concentrations are higher than the established Maximum Contaminant Levels (MCLs) or other rule-specified GWPS.

Parametric confidence intervals around the population mean will be constructed at the 99% confidence level when data follow a normal distribution, and around the geometric mean (or population median) when data follow a transformed-normal distribution.

Non-parametric confidence intervals will be constructed when data do not pass a normality test and cannot be normalized via a transformation. The confidence level associated with the non-parametric tests is dependent on the number of values used to construct the interval. Confidence intervals require a minimum of four samples; however, a minimum of eight samples are recommended. When non-parametric confidence intervals are constructed, a maximum of eight of the most recent samples will be used in the comparison. When a well/constituent pair does not have the minimum sample requirement, the well/constituent pair will continue to be reported and tracked using time series plots and/or trend tests until such time that enough data are available.

In Assessment Monitoring, when the Lower Confidence Limit (LCL), or the entire interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSI.

4.2 Corrective Action

If groundwater corrective action is triggered, semi-annual sampling of the assessment monitoring wells will continue and Confidence Intervals will monitor the progress of remediation efforts. Confidence Intervals are compared to GWPS and the entire interval must fall below a specified limit (i.e. the Upper Confidence Limit [UCL] must be below the limit) to demonstrate compliance. A site-specific monitoring program will be developed based on the final corrective action plan and points-of-compliance.

5.0 SITE-SPECIFIC STATISTICAL ANALYSIS METHODS

A site-specific statistical analysis approach was developed after applying the screening criteria described previously. Results of the site-specific screening are presented in Appendix A, Background Screening and Compliance Evaluation. The following is a detailed description of the statistical analysis methodology that will be used for groundwater quality analysis at the site when monitored constituents are present in any of the downgradient wells.

Background sampling began in February 2016. The monitoring well network is described on Table 1.

For the statistical analysis of analytical results obtained from the existing monitoring well network, (1) the number of samples collected will be consistent with the appropriate statistical procedures as recommended by the CCR Rule and the USEPA Unified Guidance; (2) the statistical method will comply with the EPA-recommended performance standards; and (3) determination of whether or not there is a statistically significant increase (SSI) over background values in the future will be completed per the above-mentioned regulations.

5.1 Detection Monitoring Program

Based on the background screening that was conducted by Groundwater Stats Consulting in the Fall 2017 and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting, interwell methods combined with a 1-of-2 resampling strategy will be used to evaluate chloride and pH. Intrawell methods combined with a 1-of-2 resampling strategy will be used to evaluate boron, calcium, fluoride, sulfate and TDS. If a statistical exceedance is found, one independent resample will be collected to determine whether the initial exceedance is verified.

If the initial finding is not verified by resampling, the resampled value will replace the initial finding. When the resample confirms the initial finding, the exceedance will be reported. The Sen's Slope/Mann Kendall trend test will be used, in addition to PL, to statistically evaluate concentration levels over time and determine whether concentrations are increasing, decreasing, or stabilizing.

The chance of false positive results increases with increasing numbers of statistical tests. The total number of statistical tests for a facility is the number of parameters tested multiplied by the number of monitoring wells. In an effort to reduce the overall number of statistical tests performed at each semi-annual sampling event, thereby lowering the chance of a false exceedance while maintaining a high degree of statistical confidence that a release will be detected, Plant Gorgas CCR Landfill will:

1) Monitor constituents in wells with detections (i.e. excluding well/constituent pairs with 100% nondetects); and
2) Incorporate a 1-of-2 retesting strategy

The following statistical methods will be used:

5.1.1 Parametric Prediction Limits

These limits will be computed per USEPA Unified Guidance when data can be normalized, possibly via transformation. The test alpha will be calculated based on the following configuration:

Annual SWFPR = 0.10
1-of-2 resampling plan with a minimum of 8 background samples for interwell tests
1-of-2 resampling plan with a minimum of 8 background samples for intrawell tests
w= 4 (number of compliance wells)
c= 7 constituents

5.1.2 Nonparametric Prediction Limits

The highest background value will be used to set the upper nonparametric prediction limit. The associated confidence level takes into account the prospect of additional future compliance values (retests) when there is an initial exceedance. The achieved confidence level is determined based on the background sample size, the number of monitoring wells in the network, and the number of proposed retests, using tables provided in the USEPA Unified Guidance[7].

5.1.3 Retesting Strategy

When the prediction limit analyses indicate initial exceedances, discrete verification resamples from the indicating well(s) will be collected within 90 days and prior to the next regularly scheduled sampling event. If the initial exceedance is verified, a confirmed SSI will be reported. For the test to be valid, the resample needs to be statistically independent which requires that sufficient time elapse between the initial sample and resample. A minimum time interval between samples will be established to ensure that separate volumes of groundwater are being sampled.

5.1.4 Background Data Set

Interwell tests, which compare downgradient well data to statistical limits constructed from all pooled upgradient well data after careful screening, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter. Because upgradient well data represent natural groundwater quality upgradient of the facility, intrawell prediction limits are also constructed on these wells. A minimum of 8 background samples are required for both interwell and intrawell tests.

The background data set will be managed, screened and updated as described previously after receipt of Department approval.

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[7] USEPA Unified Guidance, March 2009. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

5.2 Assessment Monitoring Program

Assessment monitoring will be performed following the procedures described in Section 4.0. When assessment monitoring is initiated, Appendix IV constituents are sampled semi-annually, and concentrations in downgradient wells are statistically compared as described below to GWPS. Following the Unified Guidance, the Maximum Contaminant Level (MCL) is used as the GWPS. When reported concentrations in upgradient wells are higher than the established MCLs, background limits may be developed as described below from an interwell tolerance limit using the pool of all approved upgradient well data (see Chapter 7 of the Unified Guidance).

Parametric tolerance limits, which are used when pooled upgradient well data follow a normal or transformed-normal distribution, may be constructed on upgradient well or wells with the highest average concentrations with Department approval. This step serves to reduce the effect of spatial variation on the standard deviation in the parametric case when calculating a GWPS. Non-parametric tolerance limits will be constructed when data do not follow a normal or transformed-normal distribution or when a parametric tolerance limit is not approved.

For constituents without established MCLs, the CCR-rule specified limits will be used as the GWPS unless Department-approved background is higher as calculated from interwell tolerance limit as described above. Appendix IV background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Confidence Intervals are then constructed using a maximum of 8 of the most recent assessment measurements from a given downgradient well for comparison to the GWPS to determine compliance.

Parametric tolerance limits (i.e. UTLs) are calculated when data follow a normal or transformed-normal distribution using pooled upgradient well data as described above for Appendix IV parameters with a target of 95% confidence and 95% coverage. When data sets contain greater than 50% nondetects or do not follow a normal or transformed-normal distribution, the confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. The UTLs are then used as background levels for establishing the GWPS under case 3 below.

As described in 40 CFR § 257.95(h)(1)-(3) the GWPS is:

1. The maximum contaminant level (MCL) established under 40 CFR § 141.62 and 141.66.
2. Where an MCL has not been established:
   (i) Cobalt 0.006 mg/L;
   (ii) Lead 0.015 mg/L;
   (iii) Lithium 0.040 mg/L; and
   (iv) Molybdenum 0.100 mg/L.
3. Background levels for constituents where the background level is higher than the MCL or rule-specified GWPS.

In assessment monitoring, when the Lower Confidence Limit (LCL), or the entire confidence interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSL.

With Department approval, the background limits will be updated and compared to the MCLs and CCR-rule specified limits for Appendix IV constituents every two years to determine whether the established limit or background will be used as the GWPS in the confidence interval comparisons, as discussed above.

5.3 Corrective Action Monitoring Program

When implemented, groundwater corrective action will include a remedy monitoring program. The remedy monitoring program will be prepared under separate cover and include details regarding statistical analysis of results.

6.0 BIBLIOGRAPHY

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Zar, Jerrold H., 1996. *Biostatistical Analysis*. 3rd edition (p112) Prentice Hall

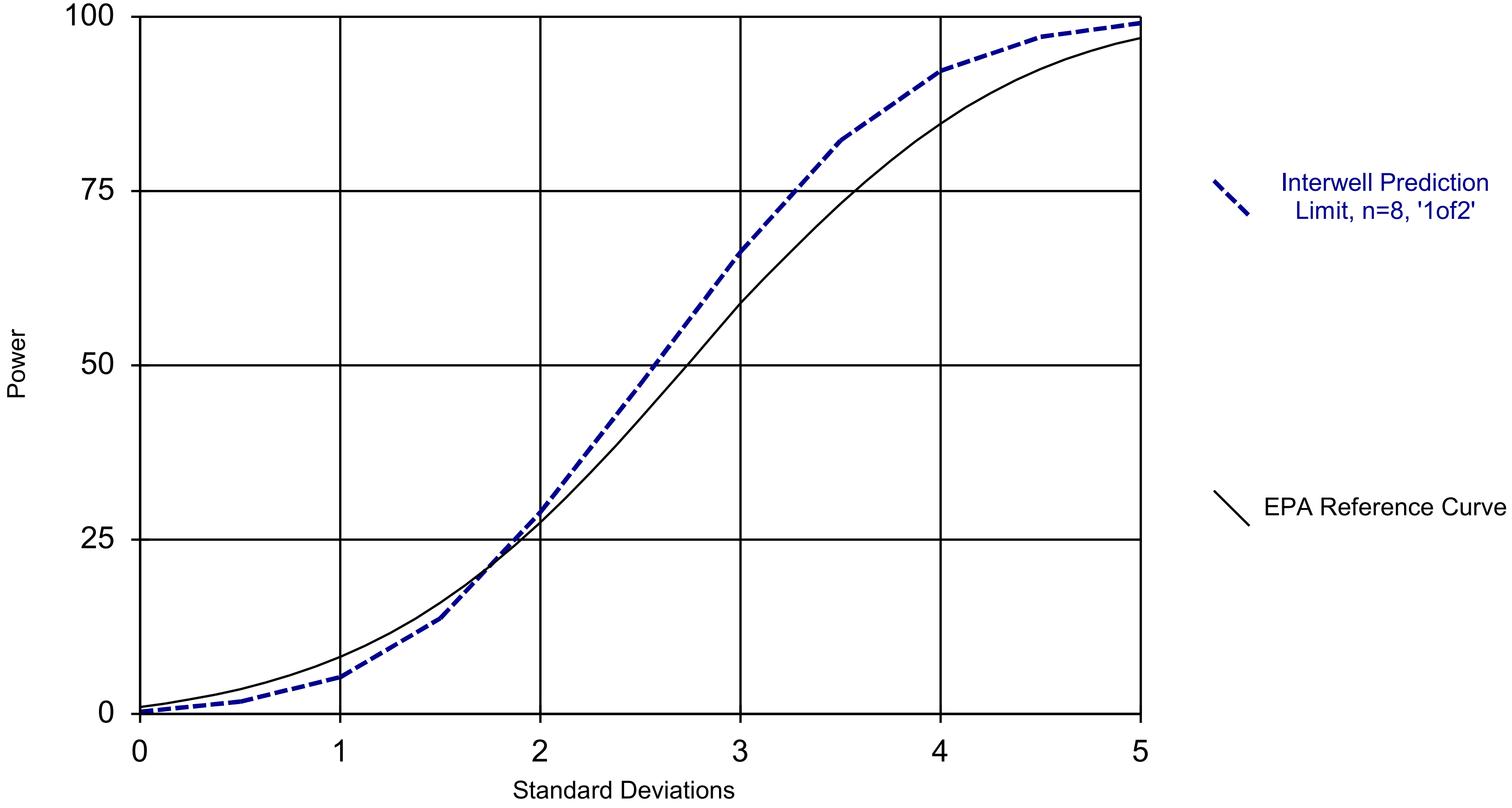
Figures

Table 1.
Groundwater Monitoring Well Network Details

Well Name	Purpose	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation (ft.) below TOC	Bottom of Screen Elevation (ft.) below TOC	Screen Length (ft.)
MW-1	Upgradient	1330794.064	594082.361	499.19	502.25	107.56	405.09	395.09	10
MW-2	Upgradient	1331053.309	593548.802	498.54	502.12	94.58	417.94	407.94	10
MW-3	Upgradient	1330842.402	593025.397	522.23	525.9	119.07	417.23	407.23	10
MW-4	Upgradient	1330289.727	592896.414	516.67	518.63	128.66	400.37	390.37	10
MW-5	Downgradient	1328645.982	592436.538	471.55	474.55	137	351.95	341.95	10
MW-6	Downgradient	1327877.972	592829.837	409.99	412.99	129	294.39	284.39	10
MW-7	Downgradient	1328515.235	593408.341	391.59	394.59	74	330.99	320.99	10
MW-8	Downgradient	1329140.729	593813.964	413.15	416.1	72.25	354.25	344.25	10

1. Northing and easting are in feet relative to the State Plane Alabama West North America Datum of 1983.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. Top of screen and bottom of screen depths are calculated relative Top of Casing elevation and less the well sump length of 0.4’.

Power Curve

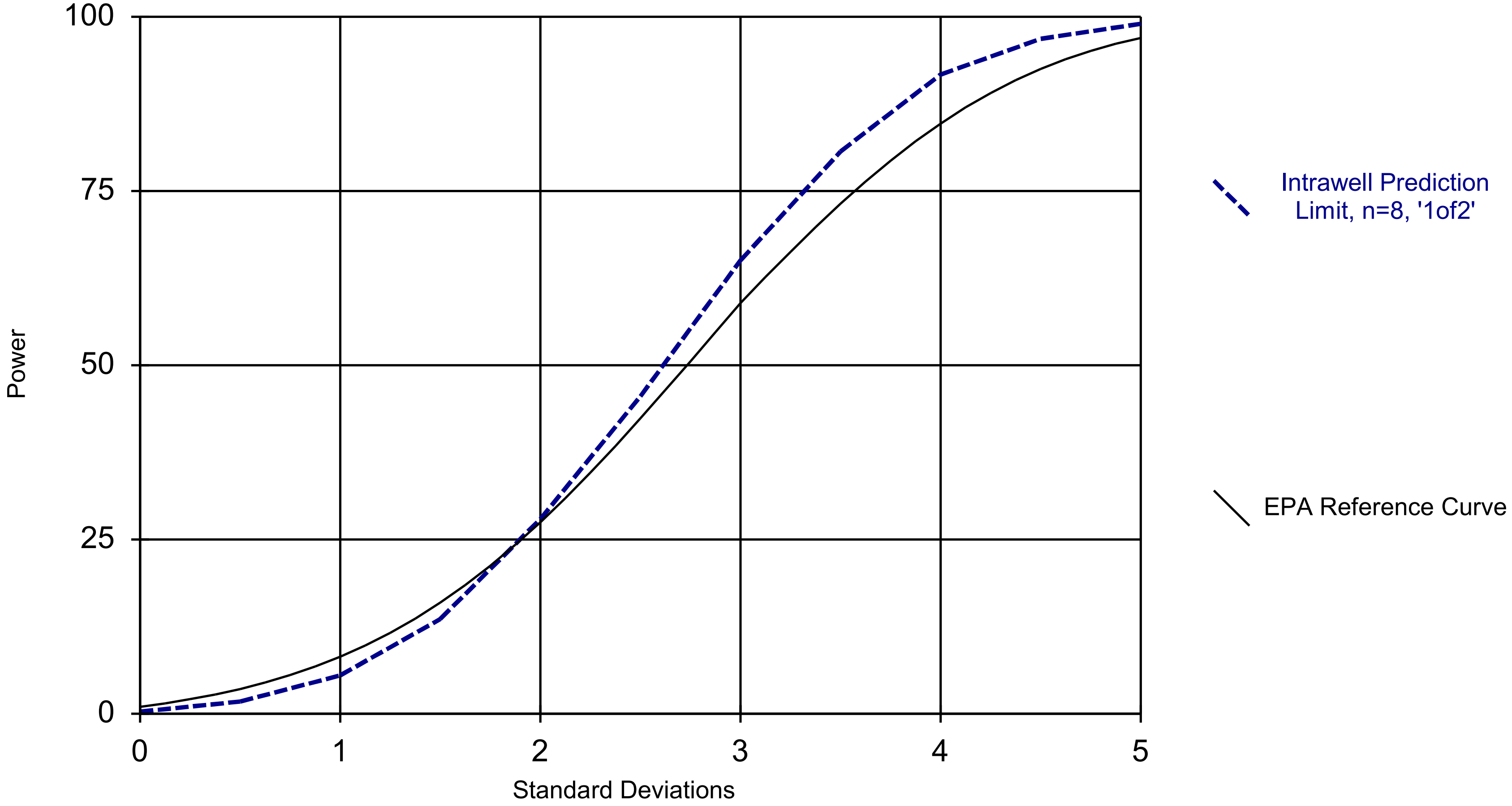


Kappa = 2.556, based on 4 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/9/2020 5:16 PM

Plant William C Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Power Curve



Kappa = 2.616, based on 4 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/9/2020 5:16 PM

Plant William C Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Appendix A
Background Screening and Compliance Evaluation

GROUNDWATER STATS
CONSULTING

September 30, 2019

Southern Company Services
Attn: Mr. Greg Dyer
3535 Colonnade Parkway
Birmingham, AL 35243

Re: Plant Gorgas CCR Landfill
Background Update – 2019

Dear Mr. Dyer,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening for the proposed background update of the prediction limits with data through May 2019 for Alabama Power Company's Plant Gorgas CCR Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at site for the CCR program in 2016. The monitoring well network, as provided by Southern Company Services, consists of the following:

- **Upgradient wells:** MW-1, MW-2, MW-3, and MW-4;
- **Downgradient wells:** MW-5, MW-6, MW-7, and MW-8.

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was prepared according to the Statistical Analysis Plan approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting. The analysis was reviewed by Dr. Jim Loftis, Civil & Environmental Engineering professor emeritus at Colorado State University and Senior Advisor to Groundwater Stats Consulting.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS;

Time series and box plots for these parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record for the purpose of updating statistical limits (Figures A and B, respectively). Values in background which have been flagged as outliers may be seen in a lighter font and as a disconnected symbol on the graphs.

Background Update Summary

Intrawell prediction limits, which compare the most recent compliance sample from a given well to historical data from the same well, are updated by testing for the appropriateness of consolidating new sampling observations with the screened background data. This process is described below and requires a minimum of four new data points. Historical data were evaluated for updating with newer data through May 2019 through the use of time series graphs to identify potential outliers when necessary, as well as the Mann-Whitney test for equality of medians. As discussed in the Statistical Analysis Plan (October 2018), intrawell prediction limits are used to evaluate boron, calcium, fluoride, sulfate, and TDS at all wells due to natural spatial variation for this parameter.

Interwell prediction limits, which compare the most recent sample from each downgradient well to statistical limits constructed from pooled upgradient well data, are updated during each sample event. Data from upgradient wells are periodically re-screened for newly developing trends, which may require adjustment of the background period to eliminate the trend, as well as for outliers over the entire record. Interwell prediction limits are used to evaluate chloride and pH.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. While the false positive rate associated with the parametric limits is based on an annual 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with the nonparametric limits is dependent upon the available background sample size, number of future comparisons, and verification resample plan. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Prior to performing prediction limits, proposed background data through May 2019 were reviewed to identify any newly suspected outliers at all wells for boron, calcium, fluoride, sulfate, and TDS, and at upgradient wells for chloride and pH (Figure C). Both Tukey's Test and visual screening are used to identify potential outliers. When identified, values were flagged with "o" and excluded to reduce variation, better represent background conditions, and provide limits that are conservative from a regulatory perspective. Potential outliers that are identified by Tukey's test but are not greatly different from the rest of the data are not flagged. Also, outliers that are not identified as important by Tukey's test may be identified visually. As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. Summaries of both Tukey's test results and of flagged values follow this letter.

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through May 2017 for upgradient wells MW-1, MW-2, MW-3, and MW-4 and historical data through October 2017 for downgradient wells MW-5, MW-6, MW-7, and MW-8 to compliance data through May 2019 to evaluate whether the groups are statistically similar at the 99% confidence level, in which case background data may be updated with compliance data (Figure D). Statistically significant differences were found between the two groups for calcium in wells MW-1 and MW-8; fluoride in wells MW-2 and MW-4; and TDS in well MW-1.

Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data but will be reconsidered in the future. Because the differences for calcium, fluoride and TDS occurred in upgradient wells and more recent data are fairly similar to background and better represent the groundwater quality upgradient of the facility, these background data sets were updated.

In the case of calcium at downgradient well MW-8, because the upgradient well data indicate groundwater quality is changing naturally over time and reported concentrations are lower than those reported in at least one upgradient well, background data were updated to include newer reported measurements. A summary of these results follows this letter and the test results are included with the Mann Whitney test section at the end of this report. Additionally, a summary of well/constituent pairs using a truncated portion of their records follows this letter.

The Sen's Slope/Mann Kendall trend test was used to evaluate the entire record of data from upgradient wells for parameters utilizing interwell prediction limits (Figure E). When statistically significant increasing trends are identified in upgradient wells, the earlier portion of data is deselected prior to construction of interwell statistical limits if the trending data would result in statistical limits that are not conservative from a regulatory perspective. No statistically significant trends were noted in upgradient wells and results may be seen on the Trend Test Summary Table.

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 verification strategy were constructed for chloride and pH; and intrawell prediction limits combined with a 1-of-2 verification strategy were constructed for boron, calcium, fluoride, sulfate and TDS (Figures F and G, respectively). Future samples will be compared against these prediction limits. In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary. A summary of the updated prediction limits may be found in the Prediction Limit Summary tables following this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for Gorgas CCR Landfill. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

ACollins

Andrew T. Collins

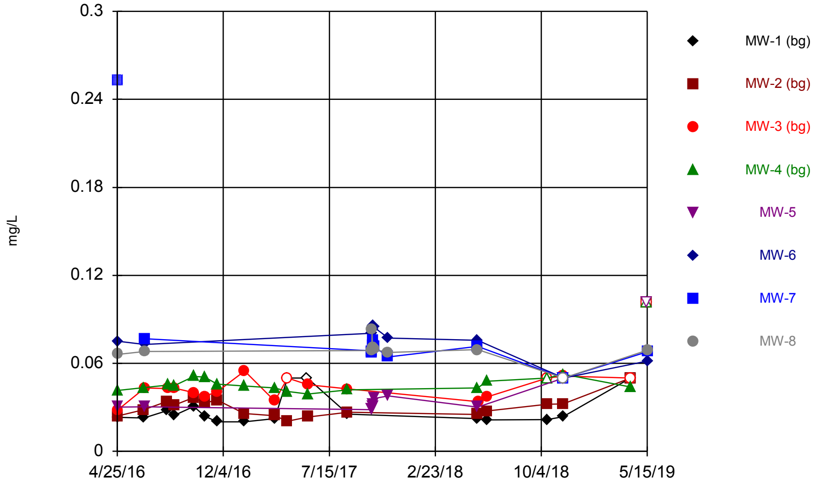
Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

FIGURE A.

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

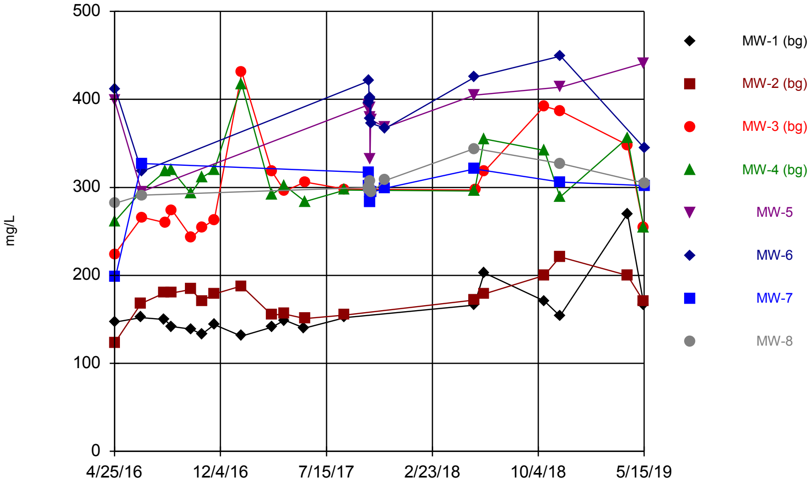
Time Series



Constituent: Boron   Analysis Run 9/26/2019 2:55 PM
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

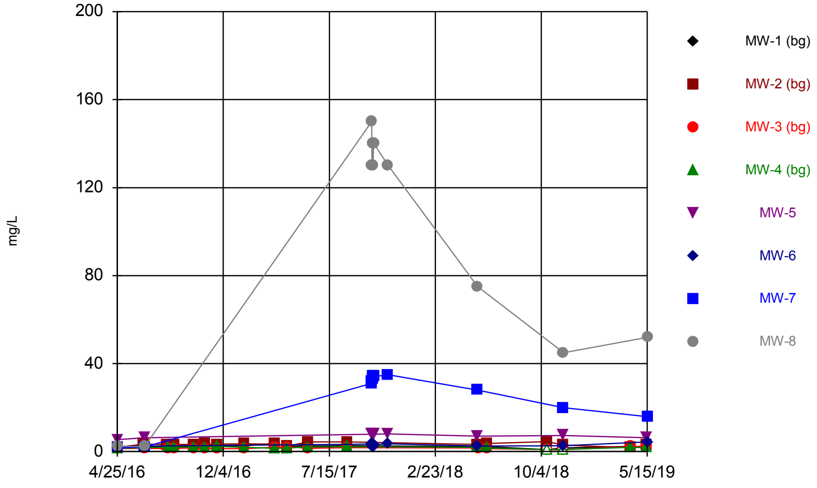
Time Series



Constituent: Calcium   Analysis Run 9/26/2019 2:55 PM
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

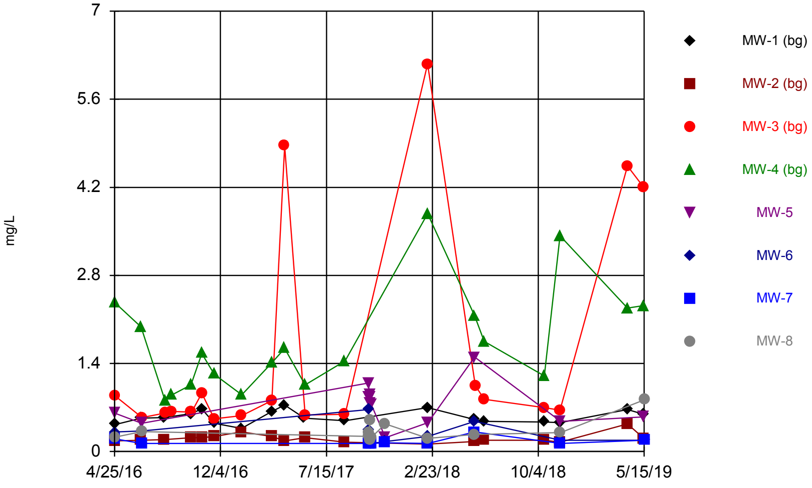
Time Series



Constituent: Chloride   Analysis Run 9/26/2019 2:55 PM
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Time Series



Constituent: Dissolved Oxygen   Analysis Run 9/26/2019 2:55 PM
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Time Series

Constituent: Boron (mg/L) Analysis Run 9/26/2019 2:55 PM

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-1 (bg)	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-5	MW-6	MW-7	MW-8
4/25/2016		0.0241 (J)	0.028 (J)	0.0414 (J)	0.0301 (J)			
4/26/2016	0.0231 (J)							
4/27/2016						0.075 (J)	0.253 (o)	0.0662 (J)
6/20/2016	0.0227 (J)	0.0284 (J)		0.0434 (J)				
6/21/2016					0.0304 (J)	0.0729 (J)	0.0768 (J)	0.0681 (J)
6/22/2016			0.0433 (J)					
8/8/2016	0.0278 (J)	0.034 (J)						
8/9/2016			0.0429 (J)	0.0453 (J)				
8/24/2016	0.0247 (J)	0.0316 (J)	0.0431 (J)	0.0451 (J)				
10/3/2016	0.0307 (J)	0.0367 (J)		0.0511 (J)				
10/4/2016			0.04 (J)					
10/26/2016	0.0241 (J)	0.0331 (J)	0.0375 (J)	0.0507 (J)				
11/21/2016	0.0202 (J)	0.035 (J)	0.0406 (J)	0.0458 (J)				
1/17/2017	0.0201 (J)	0.0259 (J)						
1/18/2017			0.0548 (J)	0.0445 (J)				
3/22/2017	0.0224 (J)	0.0243 (J)	0.0344 (J)	0.0432 (J)				
4/18/2017	<0.1	0.0206 (J)	<0.1	0.0409 (J)				
5/30/2017	<0.1							
5/31/2017		0.0234 (J)	0.0454 (J)	0.0392 (J)				
8/23/2017	0.0253 (J)	0.0267 (J)	0.0425 (J)	0.042 (J)				
10/12/2017					0.0285 (J)	0.0806 (J)	0.0685 (J)	0.0687 (J)
10/13/2017					0.0287 (J)	0.0803 (J)	0.0674 (J)	0.0831 (J)
10/14/2017					0.0305 (J)	0.0828 (J)	0.0756 (J)	0.0702 (J)
10/15/2017					0.0319 (J)	0.0852 (J)	0.0719 (J)	0.0702 (J)
10/16/2017					0.0304 (J)	0.0858 (J)	0.0726 (J)	0.0707 (J)
10/17/2017					0.036 (J)	0.0846 (J)	0.0716 (J)	0.0695 (J)
11/16/2017					0.0377 (J)	0.0772 (J)	0.0644 (J)	0.0675 (J)
5/22/2018	0.0224 (J)	0.0251 (J)						
5/23/2018				0.0433 (J)	0.0301 (J)	0.0757 (J)	0.0715 (J)	0.0693 (J)
5/24/2018			0.0339 (J)					
6/12/2018	0.0214 (J)	0.0275 (J)	0.0371 (J)	0.0478 (J)				
10/17/2018	0.0216 (J)	0.0321 (J)	<0.1 (J)	<0.1 (J)				
11/19/2018	0.0237 (J)	0.0324 (J)	0.0514 (J)	0.0526 (J)				
11/20/2018					<0.1 (J)	<0.1 (J)	<0.1 (J)	<0.1 (J)
4/10/2019	<0.1	<0.1	<0.1	0.0438 (J)				
5/14/2019	<0.203 (o)	<0.203 (o)	<0.203 (o)	<0.203 (o)	<0.203 (o)			
5/15/2019						0.0616 (J)	0.0678 (J)	0.0689 (J)

Time Series

Constituent: Calcium (mg/L) Analysis Run 9/26/2019 2:55 PM

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-1 (bg)	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-5	MW-6	MW-7	MW-8
4/25/2016		123	224	261	399			
4/26/2016	147							
4/27/2016						411	198	282
6/20/2016	152	168		295				
6/21/2016					295	318	327	291
6/22/2016			266					
8/8/2016	150	180						
8/9/2016			260	318				
8/24/2016	142	180	274	319				
10/3/2016	139	184		293				
10/4/2016			243					
10/26/2016	133	171	254	311				
11/21/2016	144	179	263	320				
1/17/2017	131	188						
1/18/2017			431	417				
3/22/2017	141	155	318	292				
4/18/2017	149	156	296	302				
5/30/2017	140							
5/31/2017		151	306	284				
8/23/2017	152	155	298	297				
10/12/2017					394	421	317	300
10/13/2017					389	396	302	298
10/14/2017					391	400	283	299
10/15/2017					332	378	294	307
10/16/2017					380	402	284	299
10/17/2017					377	373	294	294
11/16/2017					368	367	299	308
5/22/2018	166	172						
5/23/2018				296	405	425	321	344
5/24/2018			297					
6/12/2018	203	179	318	355				
10/17/2018	171	200	392	342				
11/19/2018	154	221	387	289				
11/20/2018					414	449	306	327
4/10/2019	270	200	348	356				
5/14/2019	167	170	254	254	441			
5/15/2019						345	302	305

Time Series

Constituent: Chloride (mg/L) Analysis Run 9/26/2019 2:55 PM

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-1 (bg)	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-5	MW-6	MW-7	MW-8
4/25/2016		1.9	1.32	1.53	5.44			
4/26/2016	1.94							
4/27/2016						2.19	1.71	2.34
6/20/2016	2.09	3.43		1.85				
6/21/2016					6.32	2.56	2.04	2.29
6/22/2016			1.46					
8/8/2016	2.18	3.31						
8/9/2016			1.35	1.95				
8/24/2016	2.22	3.23	1.47	2.07				
10/3/2016	2.34	3.21		2.02				
10/4/2016			1.59					
10/26/2016	2.34	3.35	1.27	2.07				
11/21/2016	2.5	3.34	1.38	2.39				
1/17/2017	2.68	3.58						
1/18/2017			1.34	1.9				
3/22/2017	3.7	3.4	2	1.5 (J)				
4/18/2017	2.4	2.6	2.2	1.6 (J)				
5/30/2017	2.6							
5/31/2017		4.4	1.5 (J)	2.1				
8/23/2017	2.7	4.4	1.8 (J)	2.3				
10/12/2017					7.9	3.4	31	150
10/13/2017					8 (B)	3 (B)	32 (B)	130 (B)
10/14/2017					7.4	2.8	33	140
10/15/2017					7.2	1.9 (J)	34	130
10/16/2017					8.1	1.8 (J)	34	140
10/17/2017					7.9	3.1	34	140
11/16/2017					8.1	3.5	35	130
5/22/2018	2.3	3.2						
5/23/2018				2	7	2.6	28	75
5/24/2018			1.6 (J)					
6/12/2018	2.3	3.7	1.4 (J)	1.7 (J)				
10/17/2018	<2 (J)	4.6	<2	<2 (J)				
11/19/2018	1.7 (J)	3	<2	<2				
11/20/2018					7.4	2.7	20	45
4/10/2019	2.35	1.76	2.25	1.88				
5/14/2019	2.28	2.87	2.28	1.82	6.24			
5/15/2019						4.45	15.9	52

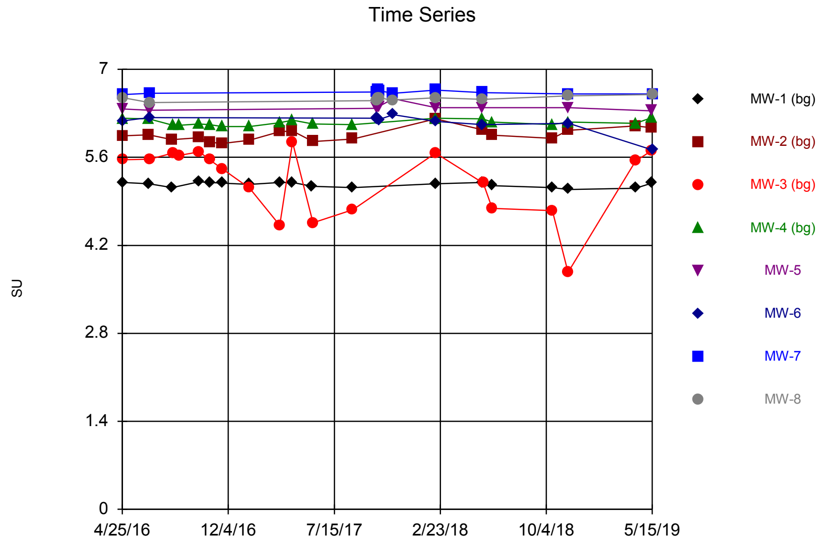
Time Series

Constituent: Dissolved Oxygen (mg/L) Analysis Run 9/26/2019 2:55 PM

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-1 (bg)	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-5	MW-6	MW-7	MW-8
4/25/2016		0.17	0.89	2.37	0.61			
4/26/2016	0.43							
4/27/2016						0.31	0.2	0.23
6/20/2016	0.53	0.18		1.98				
6/21/2016					0.45	0.33	0.13	0.32
6/22/2016			0.54					
8/8/2016	0.54	0.19						
8/9/2016			0.61	0.81				
8/24/2016			0.64	0.9				
10/3/2016	0.6 (D)	0.22 (D)		1.06 (D)				
10/4/2016			0.63 (D)					
10/26/2016	0.68	0.22	0.93	1.56				
11/21/2016	0.45 (D)	0.24 (D)	0.52 (D)	1.23 (D)				
1/17/2017	0.37 (D)	0.31 (D)						
1/18/2017			0.57 (D)	0.9 (D)				
3/22/2017	0.64 (D)	0.24 (D)	0.81 (D)	1.41 (D)				
4/18/2017	0.74	0.17	4.86	1.64				
5/30/2017	0.53 (D)							
5/31/2017		0.22 (D)	0.58 (D)	1.06 (D)				
8/23/2017	0.49 (D)	0.15 (D)	0.59 (D)	1.44 (D)				
10/12/2017					1.09	0.67	0.13	0.24
10/13/2017					0.87	0.35	0.13	0.31
10/14/2017					0.86	0.23	0.12	0.5
10/15/2017					0.9	0.2	0.13	0.19
10/16/2017					0.77	0.13	0.12	0.19
10/17/2017					0.76	0.13	0.13	0.22
11/16/2017					0.22	0.16	0.14	0.44
2/13/2018	0.7	0.12	6.16	3.78				
2/14/2018					0.46	0.24	0.13	0.21
5/22/2018	0.51	0.16						
5/23/2018				2.16	1.5	0.48	0.31	0.27
5/24/2018			1.05					
6/12/2018	0.48	0.18	0.83	1.75				
10/17/2018	0.47	0.18	0.7	1.2				
11/19/2018	0.46 (D)	0.15 (D)	0.66 (D)	3.43 (D)				
11/20/2018					0.48	0.18	0.13	0.3
4/10/2019	0.67	0.44	4.54	2.28				
5/14/2019	0.59	0.21	4.2	2.32	0.55			
5/15/2019						0.18	0.18	0.82

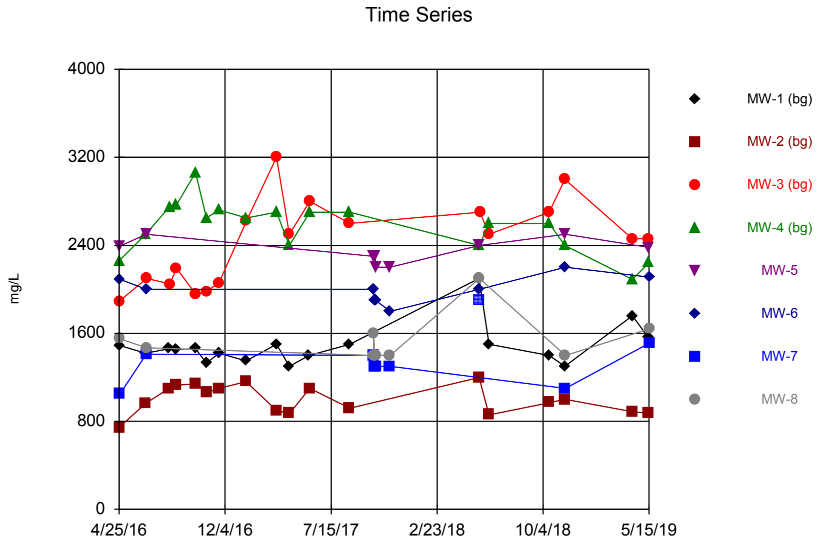
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: pH   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

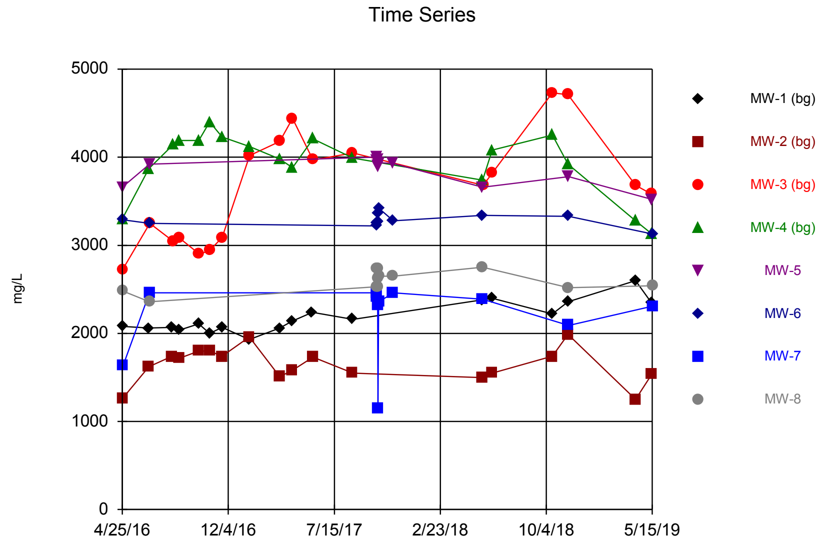
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Sulfate   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Time Series

Constituent: pH (SU)   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-1 (bg)	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-5	MW-6	MW-7	MW-8
4/25/2016		5.94	5.56	6.22	6.37			
4/26/2016	5.2							
4/27/2016						6.18	6.6	6.55
6/20/2016	5.18	5.96		6.21				
6/21/2016					6.35	6.23	6.62	6.47
6/22/2016			5.57					
8/8/2016	5.12	5.88						
8/9/2016			5.67	6.11				
8/24/2016			5.63	6.11				
10/3/2016	5.21 (D)	5.91 (D)		6.13 (D)				
10/4/2016			5.69 (D)					
10/26/2016	5.2	5.84	5.56	6.12				
11/21/2016	5.19 (D)	5.82 (D)	5.42 (D)	6.09 (D)				
1/17/2017	5.17 (D)	5.87 (D)						
1/18/2017			5.11 (D)	6.09 (D)				
3/22/2017	5.2 (D)	6.01 (D)	4.52 (D)	6.15 (D)				
4/18/2017	5.2	6.02	5.84	6.19				
5/30/2017	5.14 (D)							
5/31/2017		5.85 (D)	4.56 (D)	6.13 (D)				
8/23/2017	5.12 (D)	5.89 (D)	4.77 (D)	6.12 (D)				
10/12/2017					6.38	6.22	6.64	6.5
10/13/2017					6.43	6.23	6.64	6.51
10/14/2017					6.41	6.22	6.66	6.53
10/15/2017					6.42	6.22	6.67	6.53
10/16/2017					6.42	6.21	6.67	6.54
10/17/2017					6.41	6.2	6.66	6.54
11/16/2017					6.53	6.28	6.62	6.51
2/13/2018	5.18	6.21	5.67	6.22				
2/14/2018					6.39	6.17	6.67	6.55
5/22/2018	5.2	6.04						
5/23/2018				6.21	6.39	6.12	6.63	6.52
5/24/2018			5.19					
6/12/2018	5.15	5.95	4.79	6.16				
10/17/2018	5.12	5.9	4.75	6.12				
11/19/2018	5.09 (D)	6.03 (D)	3.77 (D)	6.16 (D)				
11/20/2018					6.39	6.14	6.61	6.58
4/10/2019	5.11	6.1	5.54	6.14				
5/14/2019	5.19	6.07	5.71	6.23	6.34			
5/15/2019						5.72	6.61	6.6

Time Series

Constituent: Sulfate (mg/L)   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-1 (bg)	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-5	MW-6	MW-7	MW-8
4/25/2016		745	1890	2260	2390			
4/26/2016	1490							
4/27/2016						2090	1050	1550
6/20/2016	1420	964		2500				
6/21/2016					2500	2000	1410	1470
6/22/2016			2100					
8/8/2016	1460	1100						
8/9/2016			2050	2750				
8/24/2016	1450	1130	2190	2770				
10/3/2016	1460	1140		3060				
10/4/2016			1950					
10/26/2016	1330	1060	1980	2650				
11/21/2016	1420	1100	2060	2720				
1/17/2017	1350	1160						
1/18/2017			2620	2650				
3/22/2017	1500	900	3200	2700				
4/18/2017	1300	870	2500	2400				
5/30/2017	1400							
5/31/2017		1100	2800	2700				
8/23/2017	1500	920	2600	2700				
10/12/2017					2300	2000	1400	1400
10/13/2017					2300	2000	1400	1600
10/14/2017					2300	1900	1300	1400
10/15/2017					2300	1900	1300	1400
10/16/2017					2300	1900	1300	1400
10/17/2017					2200	1900	1300	1400
11/16/2017					2200	1800	1300	1400
5/22/2018	2100	1200						
5/23/2018				2400	2400	2000	1900 (o)	2100
5/24/2018			2700					
6/12/2018	1500	860	2500	2600				
10/17/2018	1400	970	2700	2600				
11/19/2018	1300	1000	3000	2400				
11/20/2018					2500	2200	1100	1400
4/10/2019	1760	889	2460	2090				
5/14/2019	1560	873	2460	2240	2380			
5/15/2019						2110	1510	1640

Time Series

Constituent: Total Dissolved Solids (mg/L)   Analysis Run 9/26/2019 2:55 PM

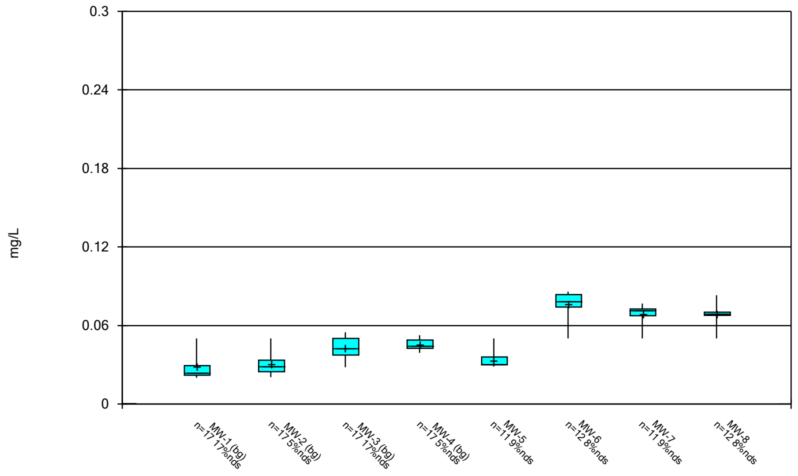
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-1 (bg)	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-5	MW-6	MW-7	MW-8
4/25/2016		1260 (D)	2720 (D)	3300 (D)	3660			
4/26/2016	2080 (D)							
4/27/2016						3290	1640	2480
6/20/2016	2060 (D)	1620 (D)		3870 (D)				
6/21/2016					3920	3250	2460	2360
6/22/2016			3250 (D)					
8/8/2016	2070 (D)	1740 (D)						
8/9/2016			3050 (D)	4140 (D)				
8/24/2016	2040	1720	3080	4190				
10/3/2016	2110 (D)	1800 (D)		4190 (D)				
10/4/2016			2900 (D)					
10/26/2016	2000	1800	2940	4400				
11/21/2016	2070 (D)	1740 (D)	3090 (D)	4230 (D)				
1/17/2017	1930 (D)	1960 (D)						
1/18/2017			4020 (D)	4120 (D)				
3/22/2017	2060 (D)	1510 (D)	4180 (D)	3980 (D)				
4/18/2017	2140	1580	4440	3880				
5/30/2017	2240 (D)							
5/31/2017		1730 (D)	3970 (D)	4210 (D)				
8/23/2017	2160 (D)	1550 (D)	4050 (D)	3990 (D)				
10/12/2017					4000	3220	2460	2530
10/13/2017					3960	3250	2420	2740
10/14/2017					3910	3260	2320	2630
10/15/2017					3890	3260	1150	2530
10/16/2017					3980	3360	2320	2740
10/17/2017					3940	3420	2360	2650
11/16/2017					3930	3280	2460	2650
5/22/2018	2380 (D)	1500 (D)						
5/23/2018				3740 (D)	3660	3340	2390	2750
5/24/2018			3680 (D)					
6/12/2018	2400	1550	3820	4080				
10/17/2018	2220	1740	4730	4250				
11/19/2018	2360 (D)	1990 (D)	4710 (D)	3920 (D)				
11/20/2018					3780	3330	2090	2520
4/10/2019	2600	1250	3680	3280				
5/14/2019	2340 (D)	1540 (D)	3580 (D)	3130 (D)	3520			
5/15/2019						3130	2310	2540

FIGURE B.

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

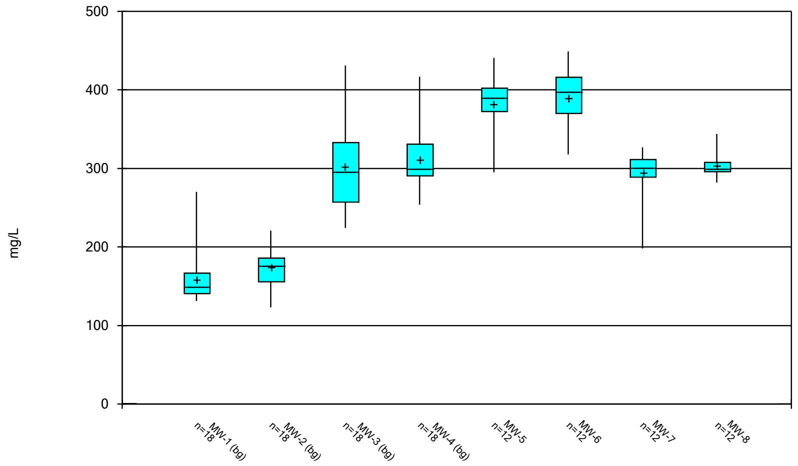


Constituent: Boron   Analysis Run 9/26/2019 2:54 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

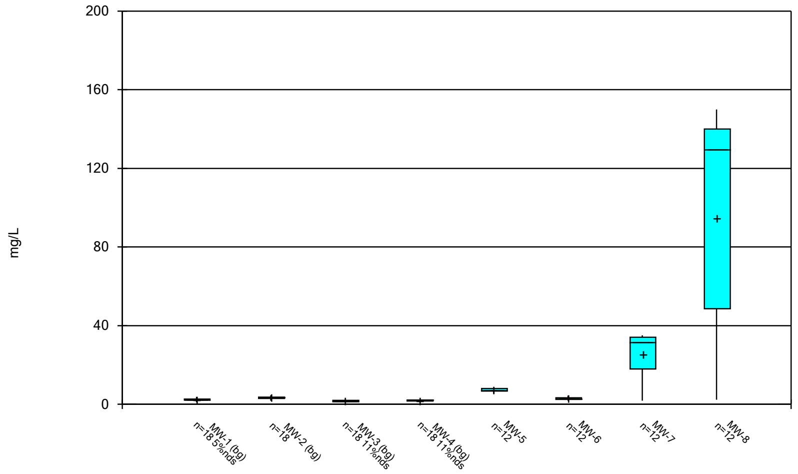


Constituent: Calcium   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

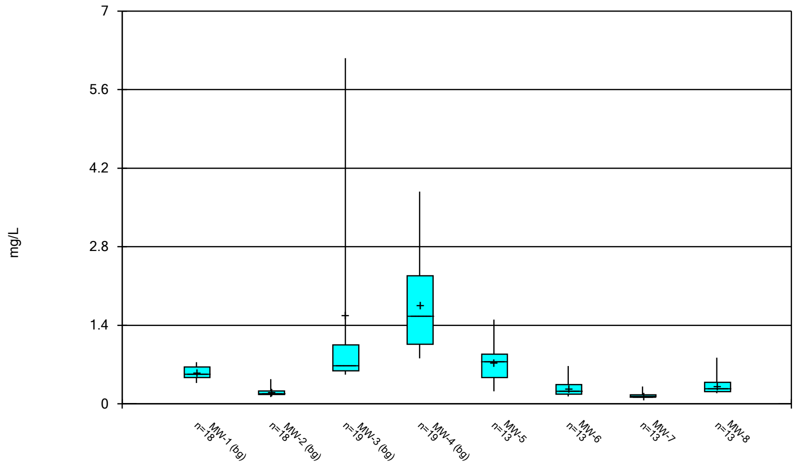


Constituent: Chloride   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

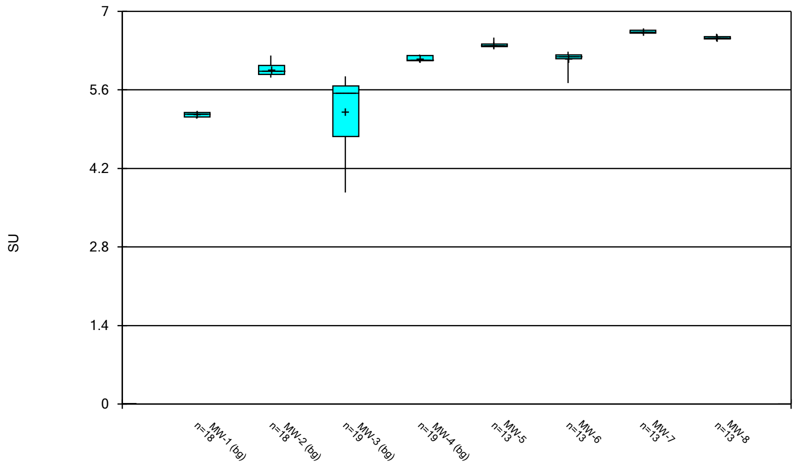


Constituent: Dissolved Oxygen   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

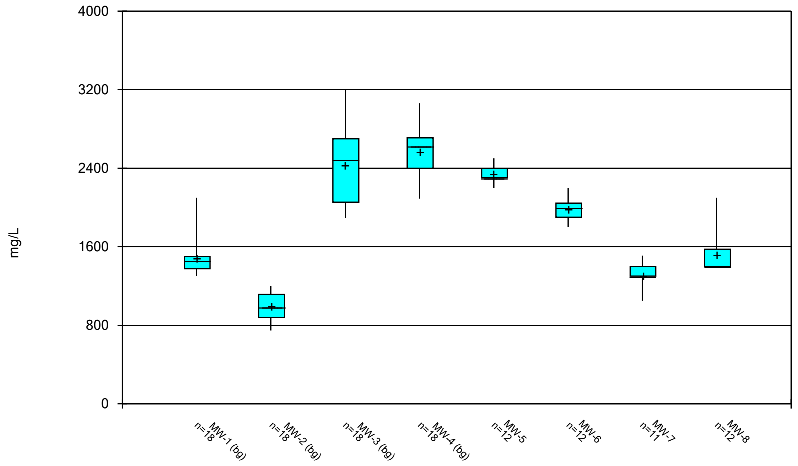


Constituent: pH   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

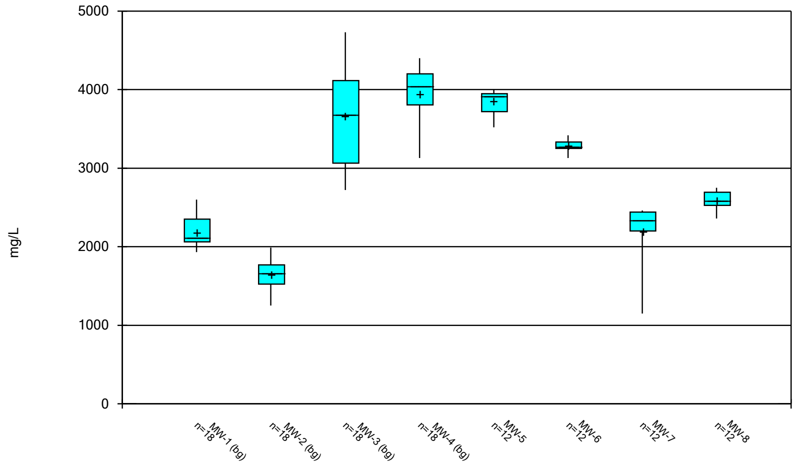


Constituent: Sulfate   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids   Analysis Run 9/26/2019 2:55 PM

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

FIGURE C.

Outlier Summary

	MW-1 Boron (mg/L)	MW-2 Boron (mg/L)	MW-3 Boron (mg/L)	MW-4 Boron (mg/L)	MW-5 Boron (mg/L)	MW-7 Boron (mg/L)	MW-7 Sulfate (mg/L)
4/27/2016						0.253 (o)	
5/23/2018							1900 (o)
5/14/2019	<0.203 (o)	<0.203 (o)	<0.203 (o)	<0.203 (o)	<0.203 (o)		

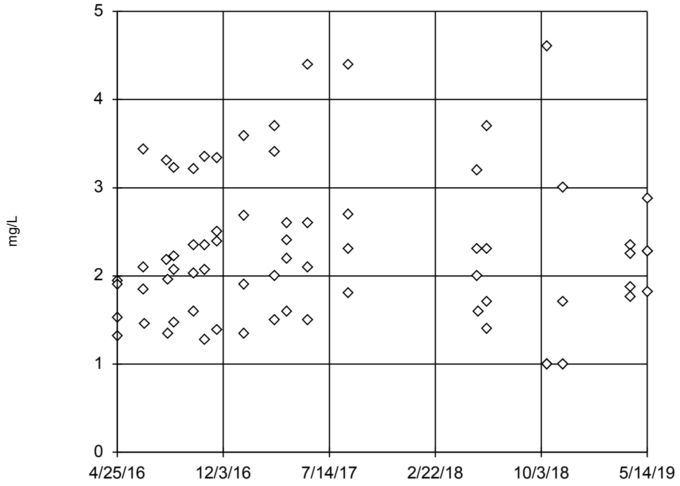
Upgradient Outlier Analysis - All Results

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF Printed 9/26/2019, 10:42 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Chloride (mg/L)	MW-1,MW-2,MW-3,MW-4	No	n/a	n/a w/combined bg	NP	NaN	72	2.247	0.8446	ln(x)	ShapiroFrancia
pH (SU)	MW-1,MW-2,MW-3,MW-4	No	n/a	n/a w/combined bg	NP	NaN	74	5.628	0.5228	x^6	ShapiroFrancia

Tukey's Outlier Screening, Pooled Background

MW-1,MW-2,MW-3,MW-4



n = 72

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

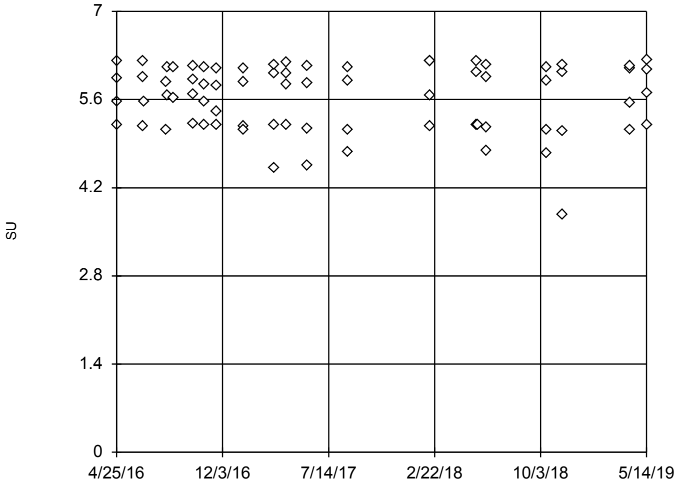
High cutoff = 11.85, low cutoff = 0.3563, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/26/2019 10:41 AM View: Interwell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Tukey's Outlier Screening, Pooled Background

MW-1,MW-2,MW-3,MW-4



n = 74

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 7.277, low cutoff = -6.525, based on IQR multiplier of 3.

Constituent: pH Analysis Run 9/26/2019 10:41 AM View: Interwell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Outlier Analysis - Significant Results

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF   Printed 9/26/2019, 10:44 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	**MW-2 (bg)**	**Yes**	**0.1015**	**5/14/2019**	**NP**	**NaN**	**18**	**0.03402**	**0.01813**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	**MW-4 (bg)**	**Yes**	**0.1015**	**5/14/2019**	**NP**	**NaN**	**18**	**0.04842**	**0.01377**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	**MW-5**	**Yes**	**0.1015**	**5/14/2019**	**NP**	**NaN**	**12**	**0.03882**	**0.02063**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	**MW-7**	**Yes**	**0.253,0.05**	**4/27/2016,11/20/2018**	**NP**	**NaN**	**12**	**0.08426**	**0.05359**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	**MW-8**	**Yes**	**0.0831,0.05**	**10/13/2017,11/20/2018**	**NP**	**NaN**	**12**	**0.06853**	**0.007226**	**x^2**	**ShapiroWilk**
Sulfate (mg/L)	**MW-1 (bg)**	**Yes**	**2100**	**5/22/2018**	**NP**	**NaN**	**18**	**1483**	**187.3**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	**MW-7**	**Yes**	**1900**	**5/23/2018**	**NP**	**NaN**	**12**	**1356**	**213.5**	**ln(x)**	**ShapiroWilk**

Outlier Analysis - All Results

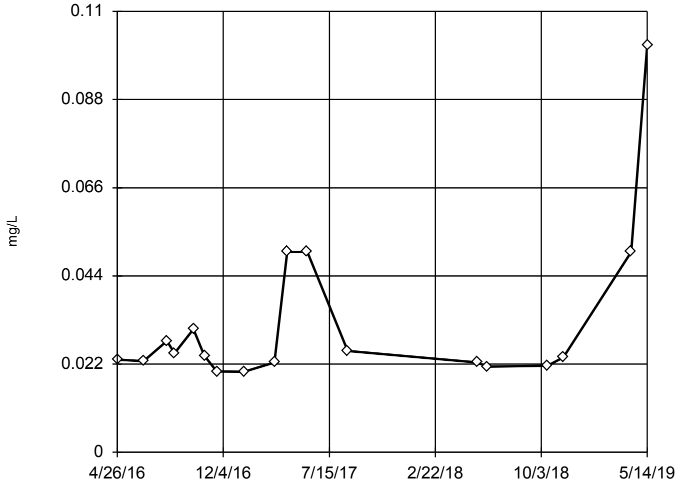
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF   Printed 9/26/2019, 10:44 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	NaN	18	0.03232	0.02015	ln(x)	ShapiroWilk
Boron (mg/L)	**MW-2 (bg)**	**Yes**	**0.1015**	**5/14/2019**	**NP**	**NaN**	**18**	**0.03402**	**0.01813**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	MW-3 (bg)	No	n/a	n/a	NP	NaN	18	0.04591	0.01552	ln(x)	ShapiroWilk
Boron (mg/L)	**MW-4 (bg)**	**Yes**	**0.1015**	**5/14/2019**	**NP**	**NaN**	**18**	**0.04842**	**0.01377**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	**MW-5**	**Yes**	**0.1015**	**5/14/2019**	**NP**	**NaN**	**12**	**0.03882**	**0.02063**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	MW-6	No	n/a	n/a	NP	NaN	12	0.07598	0.0106	x^6	ShapiroWilk
Boron (mg/L)	**MW-7**	**Yes**	**0.253,0.05**	**4/27/2016,11/20/2018**	**NP**	**NaN**	**12**	**0.08426**	**0.05359**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	**MW-8**	**Yes**	**0.0831,0.05**	**10/13/2017,11/20/2018**	**NP**	**NaN**	**12**	**0.06853**	**0.007226**	**x^2**	**ShapiroWilk**
Calcium (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	NaN	18	158.4	32.55	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-2 (bg)	No	n/a	n/a	NP	NaN	18	174	21.99	normal	ShapiroWilk
Calcium (mg/L)	MW-3 (bg)	No	n/a	n/a	NP	NaN	18	301.6	56.48	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-4 (bg)	No	n/a	n/a	NP	NaN	18	311.2	38.16	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-5	No	n/a	n/a	NP	NaN	12	382.1	38.01	x^4	ShapiroWilk
Calcium (mg/L)	MW-6	No	n/a	n/a	NP	NaN	12	390.4	36.38	x^3	ShapiroWilk
Calcium (mg/L)	MW-7	No	n/a	n/a	NP	NaN	12	293.9	33.14	x^6	ShapiroWilk
Calcium (mg/L)	MW-8	No	n/a	n/a	NP	NaN	12	304.5	16.53	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	NaN	19	0.1262	0.03546	x^2	ShapiroWilk
Fluoride (mg/L)	MW-2 (bg)	No	n/a	n/a	NP	NaN	19	0.1401	0.05792	normal	ShapiroWilk
Fluoride (mg/L)	MW-3 (bg)	No	n/a	n/a	NP	NaN	19	0.3629	0.125	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-4 (bg)	No	n/a	n/a	NP	NaN	19	0.3281	0.06353	x^5	ShapiroWilk
Fluoride (mg/L)	MW-5	No	n/a	n/a	NP	NaN	13	0.3334	0.04245	x^6	ShapiroWilk
Fluoride (mg/L)	MW-6	No	n/a	n/a	NP	NaN	13	0.1398	0.007628	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-7	No	n/a	n/a	NP	NaN	13	0.1855	0.01295	normal	ShapiroWilk
Fluoride (mg/L)	MW-8	No	n/a	n/a	NP	NaN	13	0.2142	0.009112	x^6	ShapiroWilk
Sulfate (mg/L)	**MW-1 (bg)**	**Yes**	**2100**	**5/22/2018**	**NP**	**NaN**	**18**	**1483**	**187.3**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	MW-2 (bg)	No	n/a	n/a	NP	NaN	18	998.9	129.3	normal	ShapiroWilk
Sulfate (mg/L)	MW-3 (bg)	No	n/a	n/a	NP	NaN	18	2431	379.6	sqrt(x)	ShapiroWilk
Sulfate (mg/L)	MW-4 (bg)	No	n/a	n/a	NP	NaN	18	2566	233.5	normal	ShapiroWilk
Sulfate (mg/L)	MW-5	No	n/a	n/a	NP	NaN	12	2339	98.21	ln(x)	ShapiroWilk
Sulfate (mg/L)	MW-6	No	n/a	n/a	NP	NaN	12	1983	111.5	ln(x)	ShapiroWilk
Sulfate (mg/L)	**MW-7**	**Yes**	**1900**	**5/23/2018**	**NP**	**NaN**	**12**	**1356**	**213.5**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	MW-8	No	n/a	n/a	NP	NaN	12	1513	204.7	ln(x)	ShapiroWilk
Total Dissolved Solids...	MW-1 (bg)	No	n/a	n/a	NP	NaN	18	2181	173.6	ln(x)	ShapiroWilk
Total Dissolved Solids...	MW-2 (bg)	No	n/a	n/a	NP	NaN	18	1643	200.5	x^2	ShapiroWilk
Total Dissolved Solids...	MW-3 (bg)	No	n/a	n/a	NP	NaN	18	3661	628.6	ln(x)	ShapiroWilk
Total Dissolved Solids...	MW-4 (bg)	No	n/a	n/a	NP	NaN	18	3939	362.7	x^6	ShapiroWilk
Total Dissolved Solids...	MW-5	No	n/a	n/a	NP	NaN	12	3846	154.3	x^6	ShapiroWilk
Total Dissolved Solids...	MW-6	No	n/a	n/a	NP	NaN	12	3283	74.36	x^3	ShapiroWilk
Total Dissolved Solids...	MW-7	No	n/a	n/a	NP	NaN	12	2198	402.5	x^6	ShapiroWilk
Total Dissolved Solids...	MW-8	No	n/a	n/a	NP	NaN	12	2593	120.2	x^2	ShapiroWilk

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-1 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

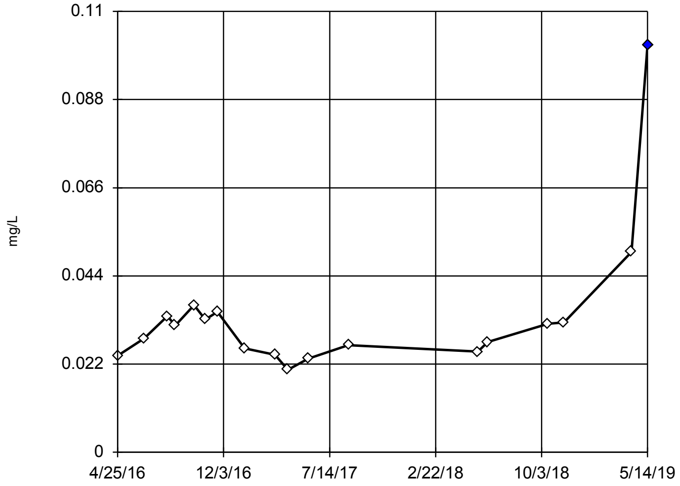
High cutoff = 0.2214, low cutoff = 0.003893, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-2 (bg)



n = 18

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

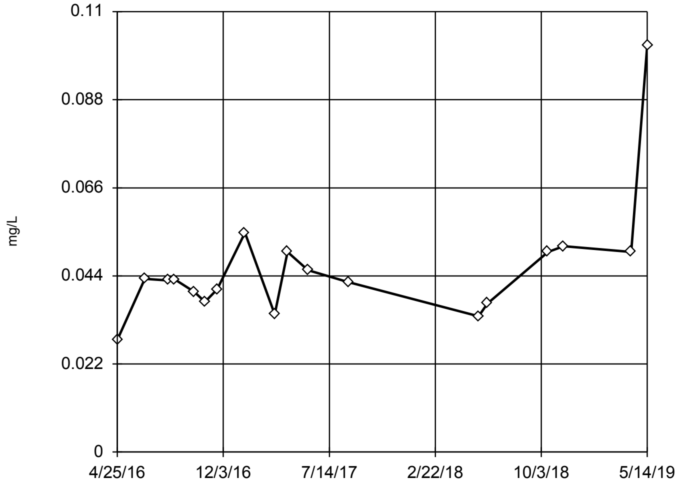
High cutoff = 0.09401, low cutoff = 0.009062, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-3 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

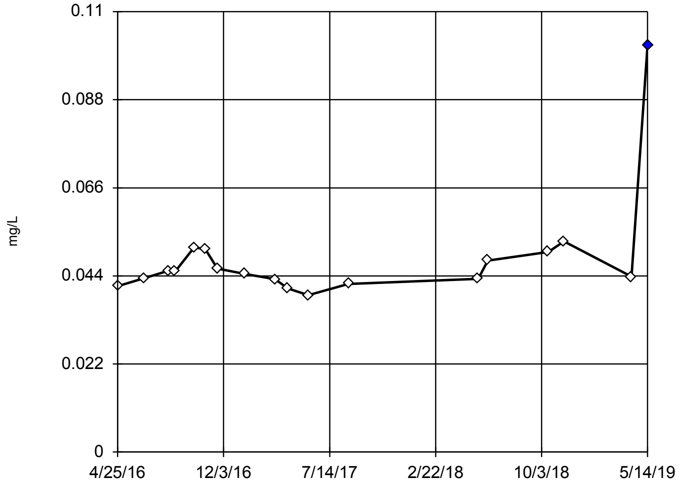
High cutoff = 0.1204, low cutoff = 0.01548, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4 (bg)



n = 18

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

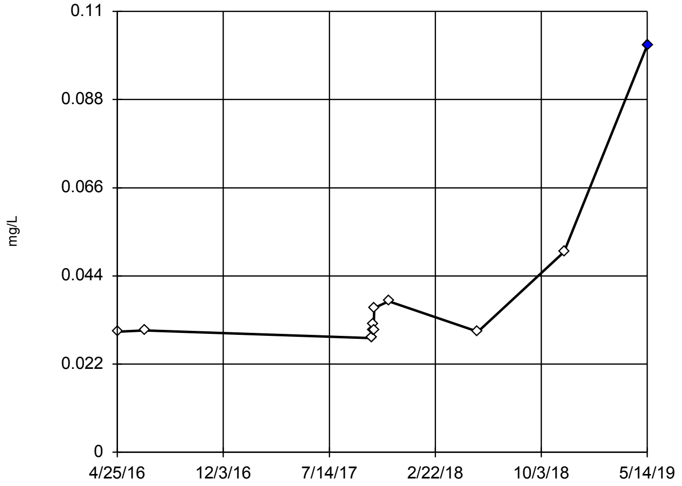
High cutoff = 0.08315, low cutoff = 0.02579, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-5



n = 12

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

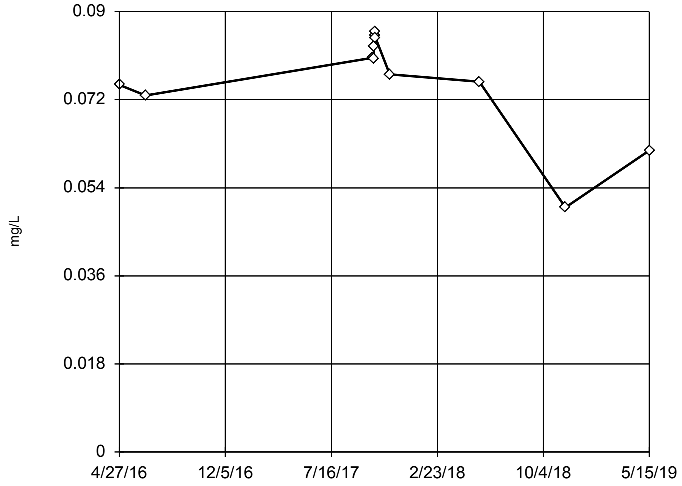
High cutoff = 0.06754, low cutoff = 0.01642, based on IQR multiplier of 3.

Constituent: Boron   Analysis Run 9/26/2019 10:43 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-6



n = 12

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

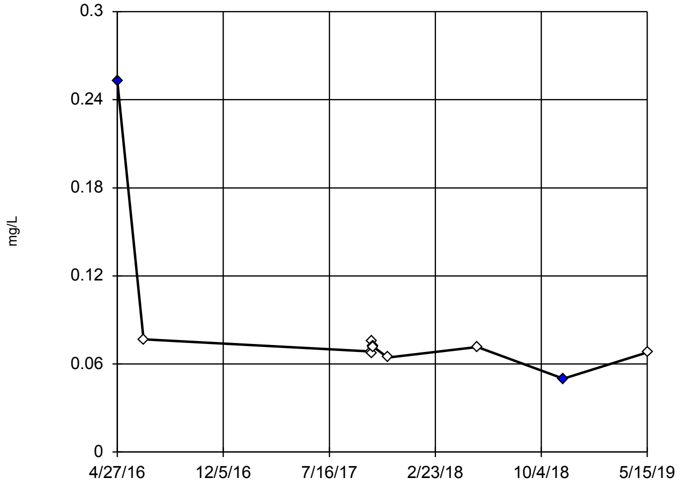
High cutoff = 0.098, low cutoff = -0.085, based on IQR multiplier of 3.

Constituent: Boron   Analysis Run 9/26/2019 10:43 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-7



n = 12

Outliers are drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

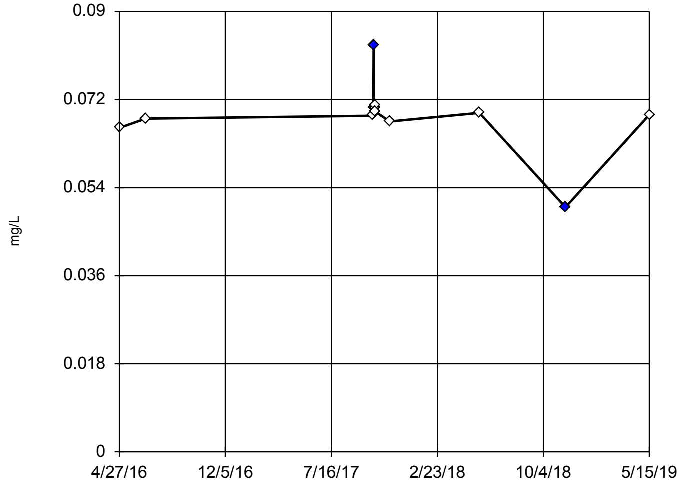
High cutoff = 0.09752, low cutoff = 0.05136, based on IQR multiplier of 3.

Constituent: Boron   Analysis Run 9/26/2019 10:43 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-8



n = 12

Outliers are drawn as solid. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

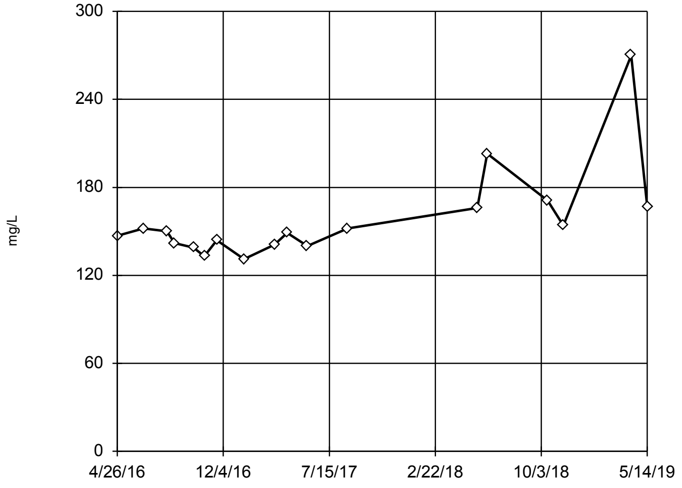
High cutoff = 0.07695, low cutoff = 0.06003, based on IQR multiplier of 3.

Constituent: Boron   Analysis Run 9/26/2019 10:43 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-1 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

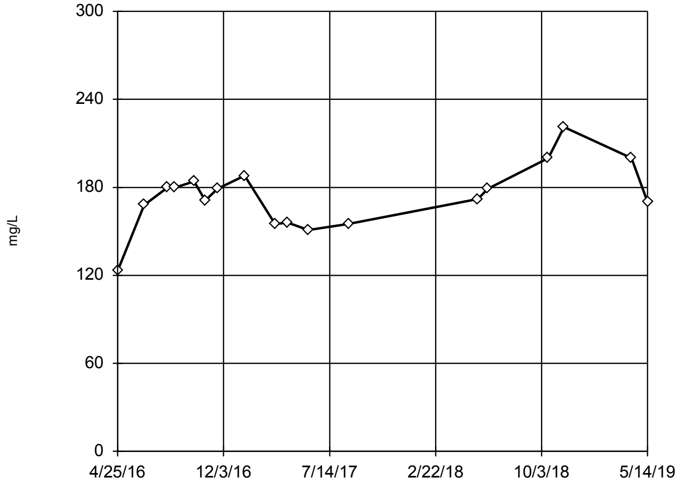
High cutoff = 277.1, low cutoff = 84.42, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-2 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

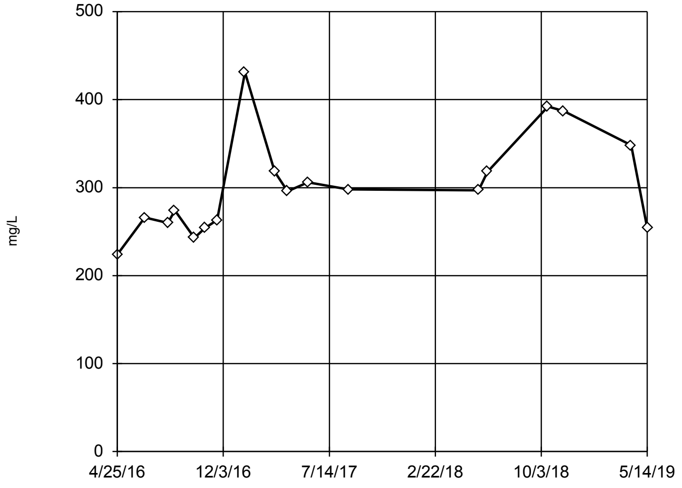
High cutoff = 277.5, low cutoff = 64, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-3 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

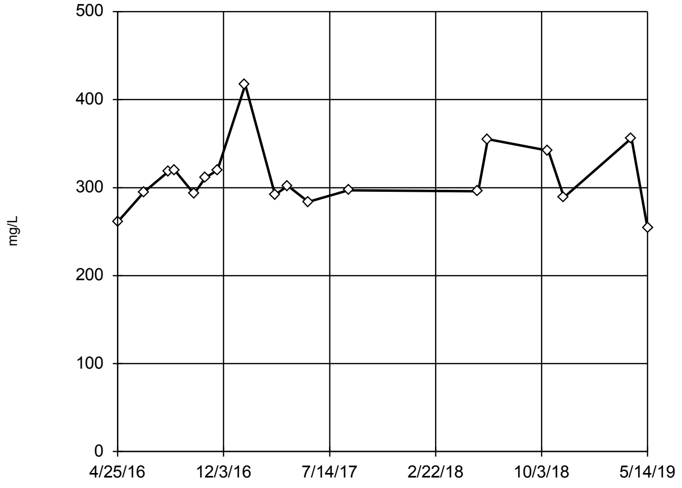
High cutoff = 721.6, low cutoff = 118.5, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

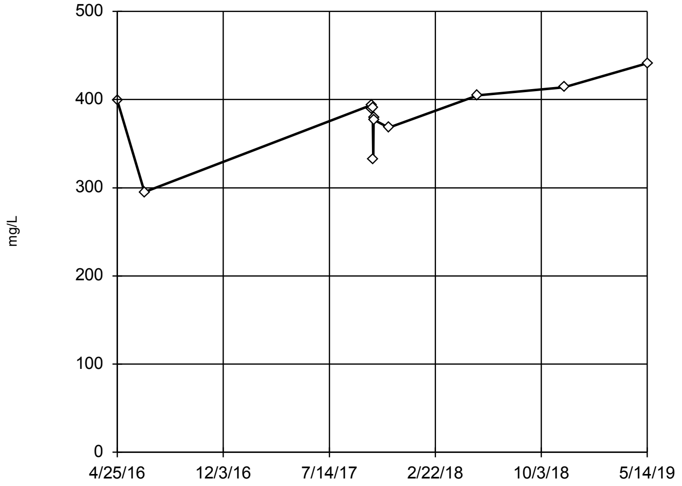
High cutoff = 488.6, low cutoff = 196.7, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-5



n = 12

No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 464.8, low cutoff = -189.6, based on IQR multiplier of 3.

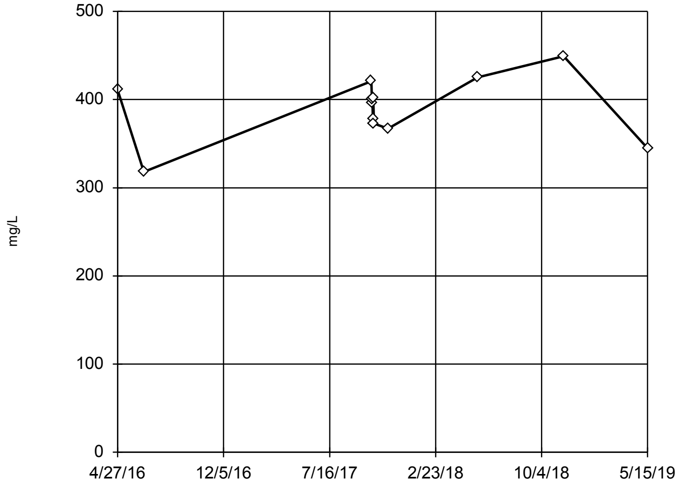
Constituent: Calcium Analysis Run 9/26/2019 10:43 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-6



n = 12

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 514.4, low cutoff = -237.6, based on IQR multiplier of 3.

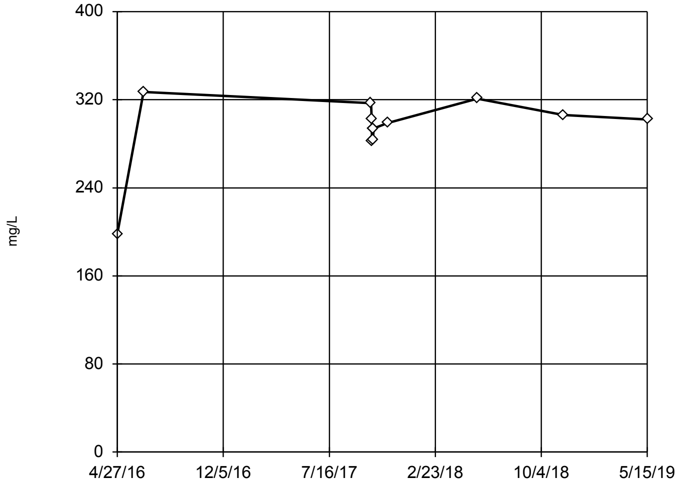
Constituent: Calcium Analysis Run 9/26/2019 10:43 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-7



n = 12

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 352.4, low cutoff = -272.9, based on IQR multiplier of 3.

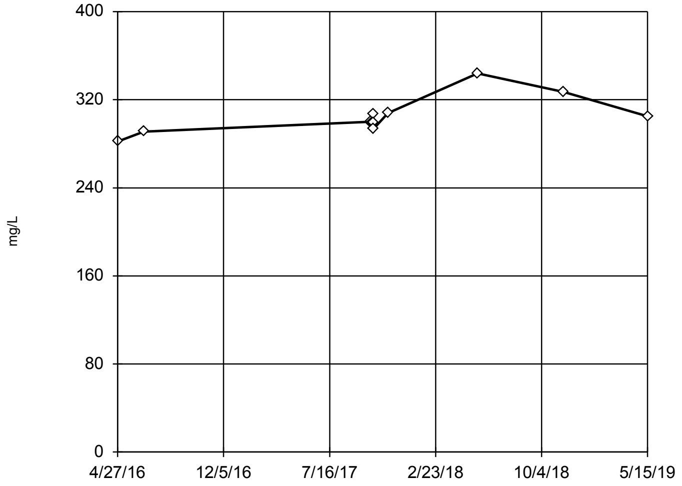
Constituent: Calcium Analysis Run 9/26/2019 10:43 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-8



n = 12

No outliers found. Tukey's method selected by user.

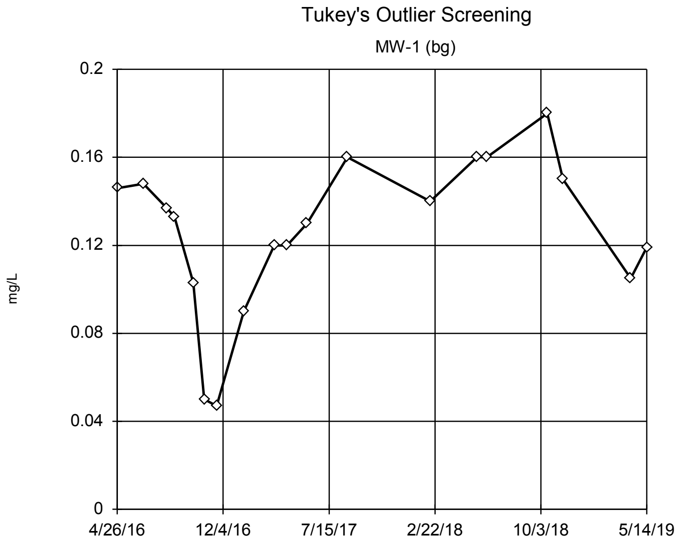
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 344.8, low cutoff = 264, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 9/26/2019 10:43 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 19

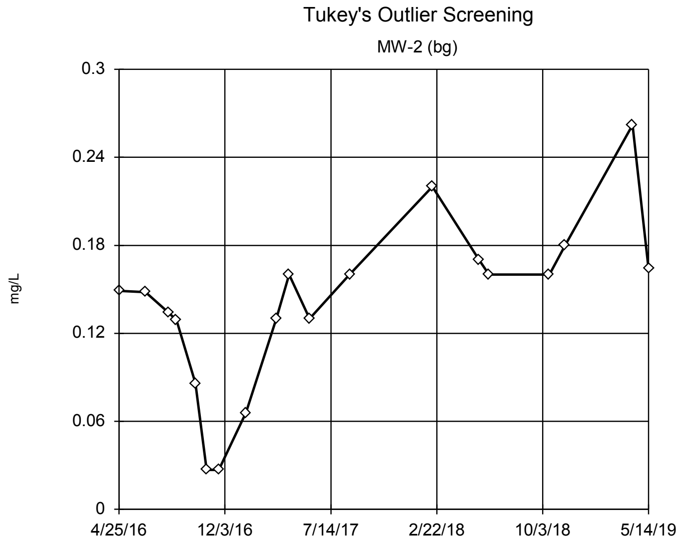
No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.2386, low cutoff = -0.153, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 19

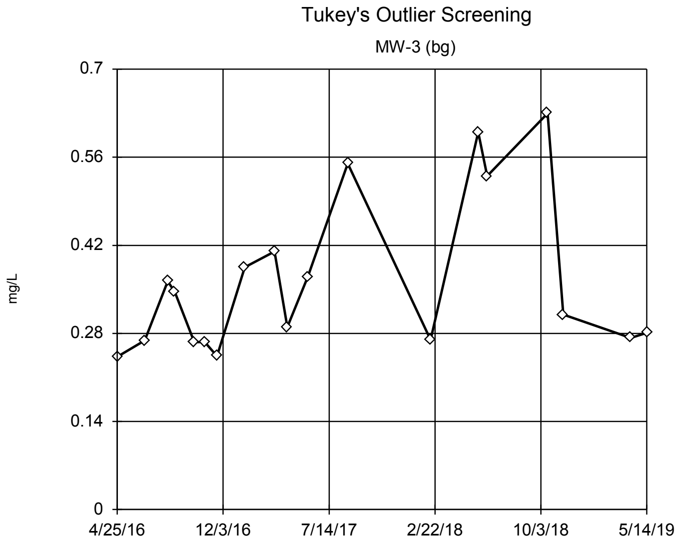
No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.269, low cutoff = 0.024, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 19

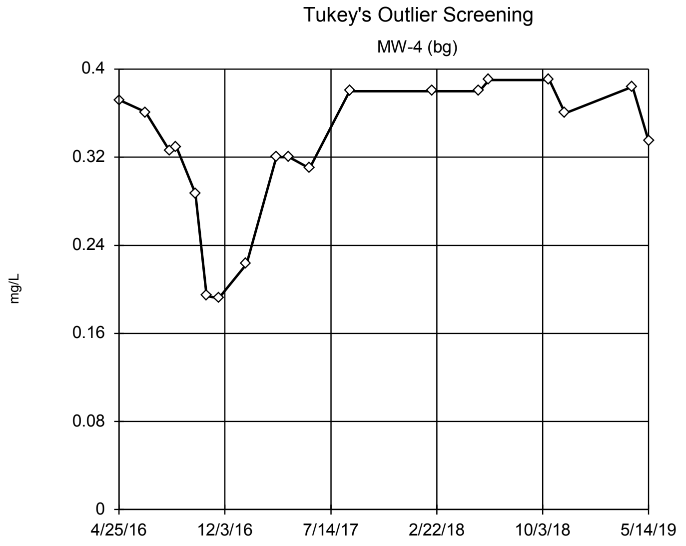
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.452, low cutoff = 0.07597, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 19

No outliers found. Tukey's method selected by user.

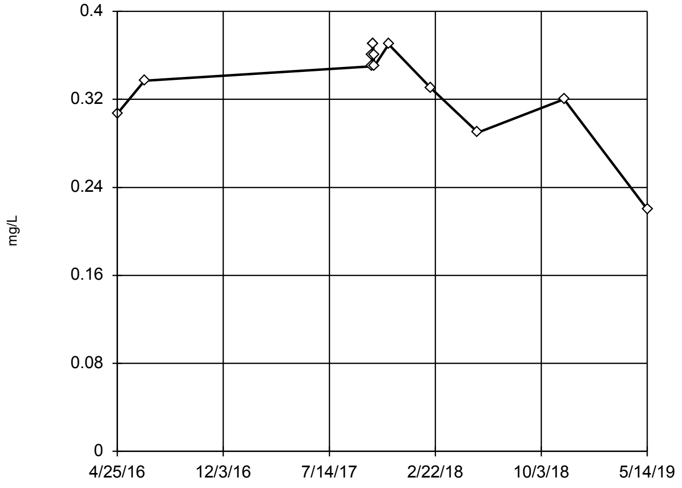
Data were x^5 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.4707, low cutoff = -0.4151, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Tukey's Outlier Screening

MW-5



n = 13

No outliers found. Tukey's method selected by user.

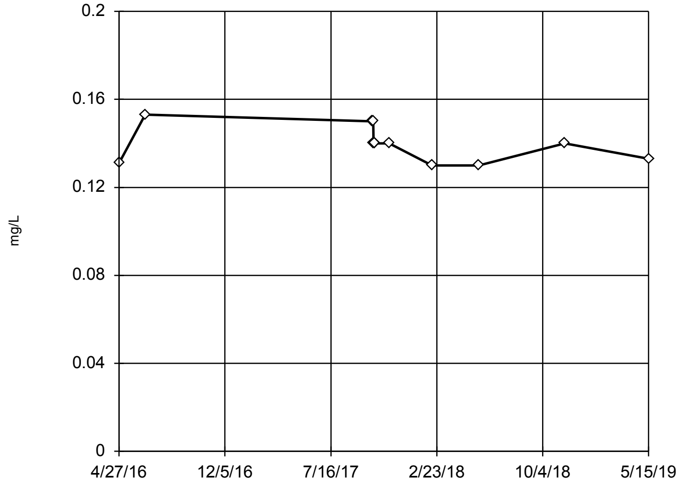
Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.4333, low cutoff = -0.3857, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Tukey's Outlier Screening

MW-6



n = 13

No outliers found. Tukey's method selected by user.

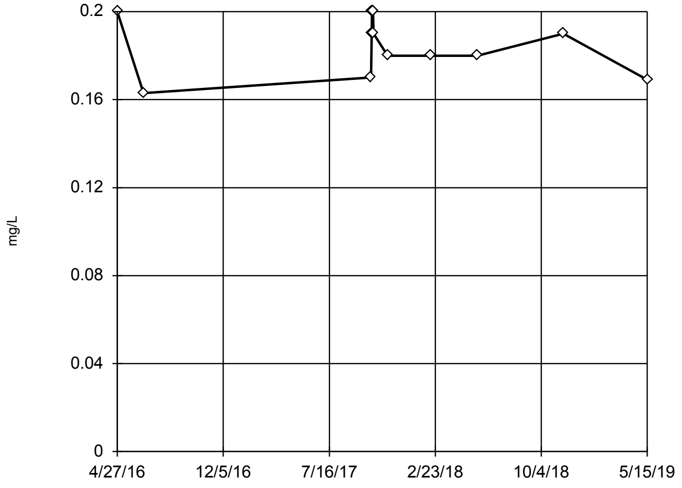
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1918, low cutoff = 0.09975, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Tukey's Outlier Screening

MW-7



n = 13

No outliers found. Tukey's method selected by user.

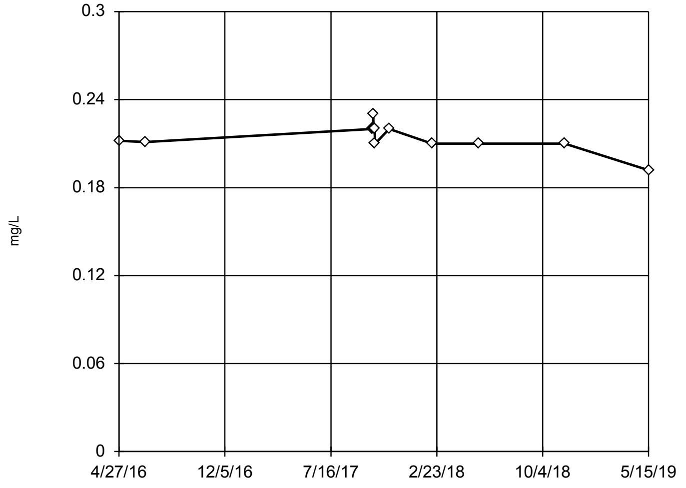
Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.275, low cutoff = 0.1, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Tukey's Outlier Screening

MW-8



n = 13

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

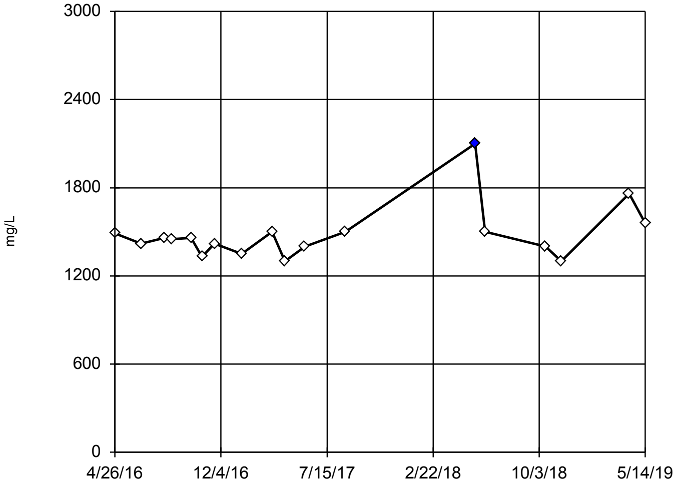
High cutoff = 0.2411, low cutoff = 0.1196, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-1 (bg)



n = 18

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

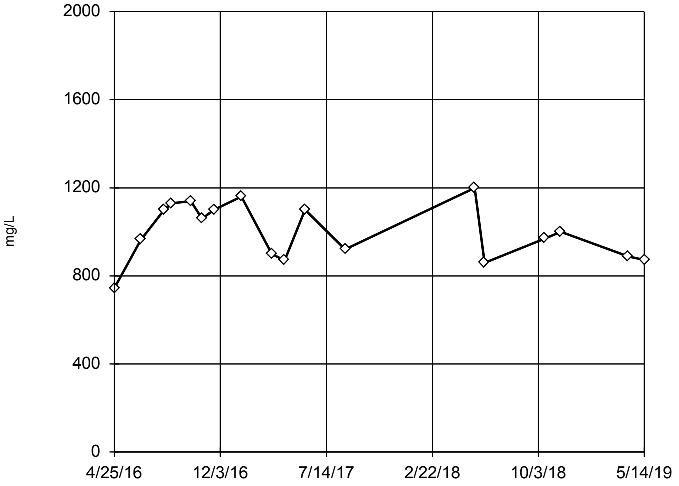
High cutoff = 1948, low cutoff = 1058, based on IQR multiplier of 3.

Constituent: Sulfate   Analysis Run 9/26/2019 10:43 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-2 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

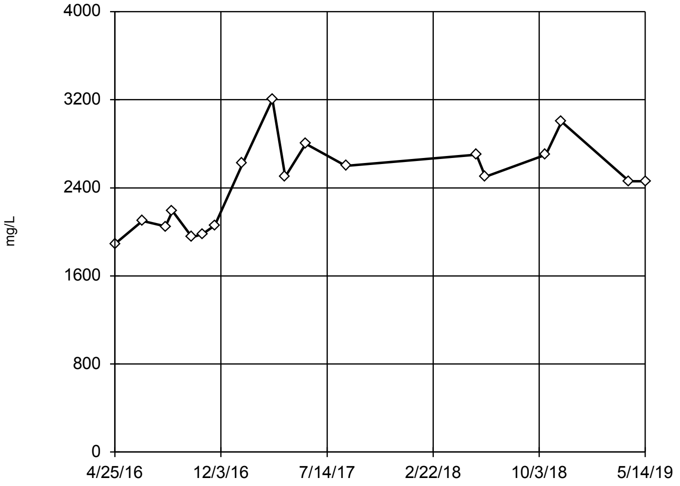
High cutoff = 1817, low cutoff = 179, based on IQR multiplier of 3.

Constituent: Sulfate   Analysis Run 9/26/2019 10:43 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-3 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

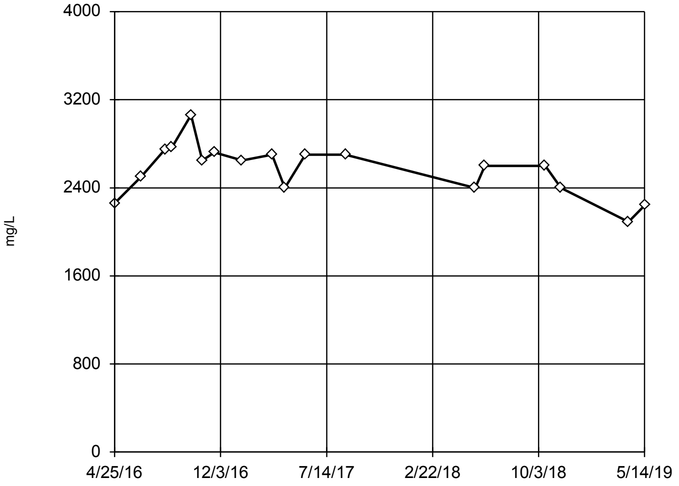
High cutoff = 5162, low cutoff = 647.4, based on IQR multiplier of 3.

Constituent: Sulfate   Analysis Run 9/26/2019 10:43 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4 (bg)



n = 18

No outliers found. Tukey's method selected by user.

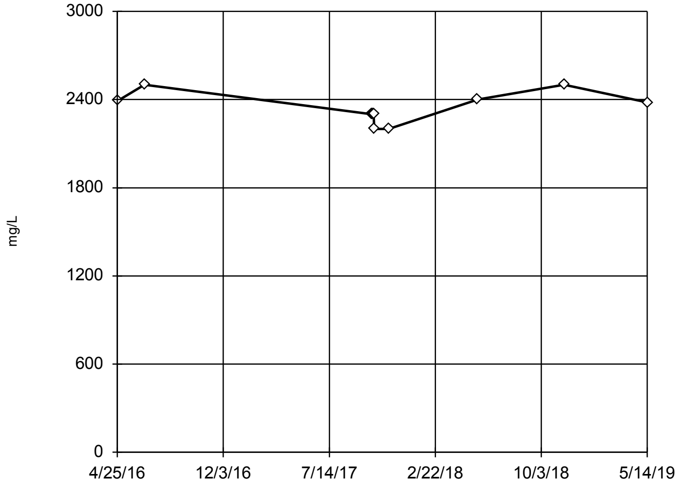
Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 3640, low cutoff = 1470, based on IQR multiplier of 3.

Constituent: Sulfate   Analysis Run 9/26/2019 10:43 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Tukey's Outlier Screening

MW-5



n = 12

No outliers found. Tukey's method selected by user.

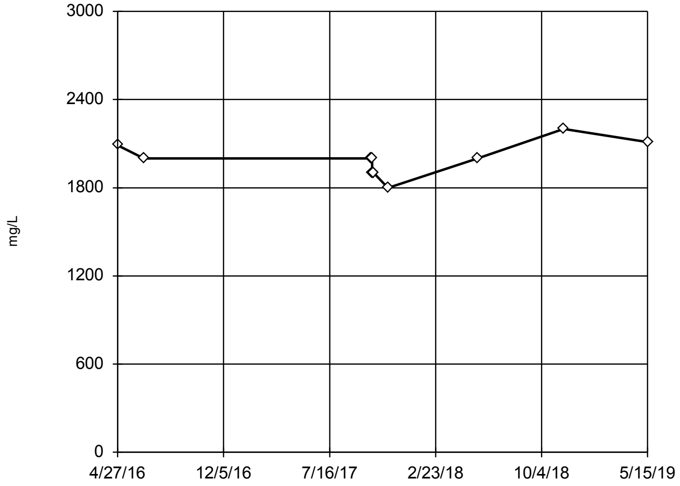
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2704, low cutoff = 2037, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Tukey's Outlier Screening

MW-6



n = 12

No outliers found. Tukey's method selected by user.

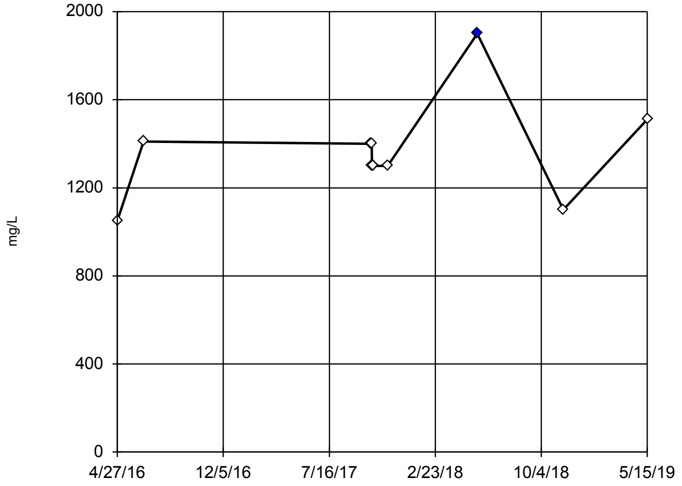
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2547, low cutoff = 1525, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Tukey's Outlier Screening

MW-7



n = 12

Outlier is drawn as solid. Tukey's method selected by user.

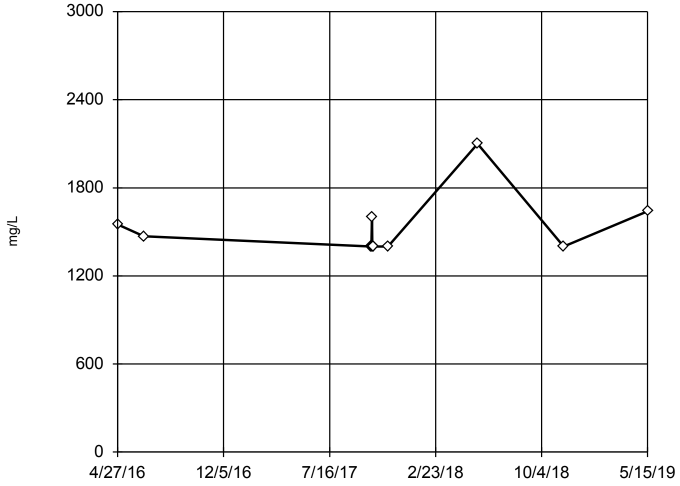
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1774, low cutoff = 1030, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Tukey's Outlier Screening

MW-8



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

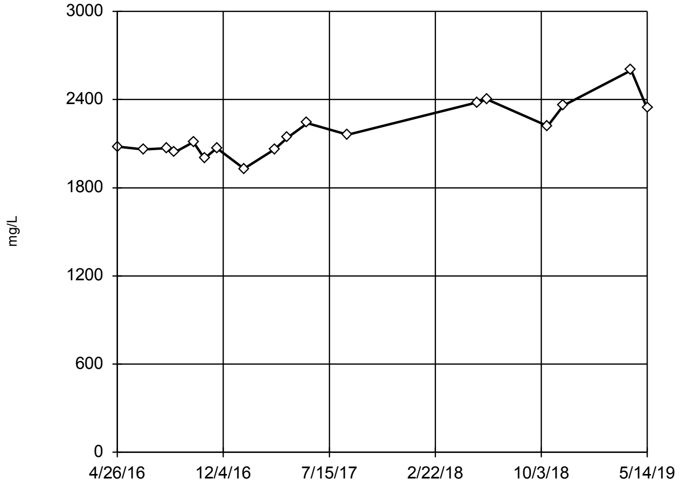
High cutoff = 2241, low cutoff = 983.6, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-1 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

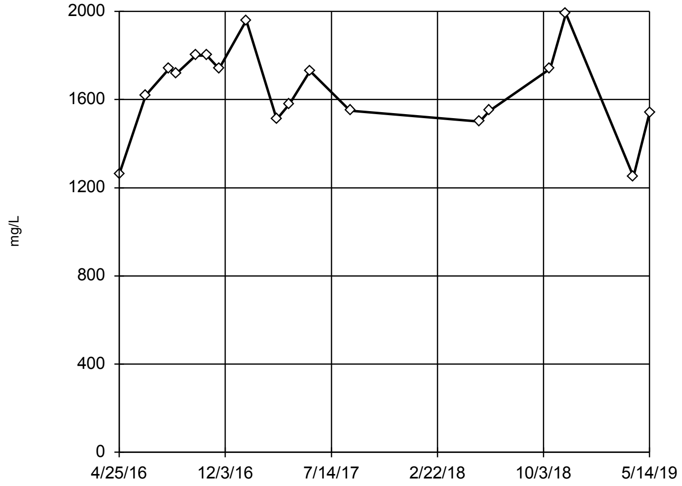
High cutoff = 3489, low cutoff = 1388, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-2 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

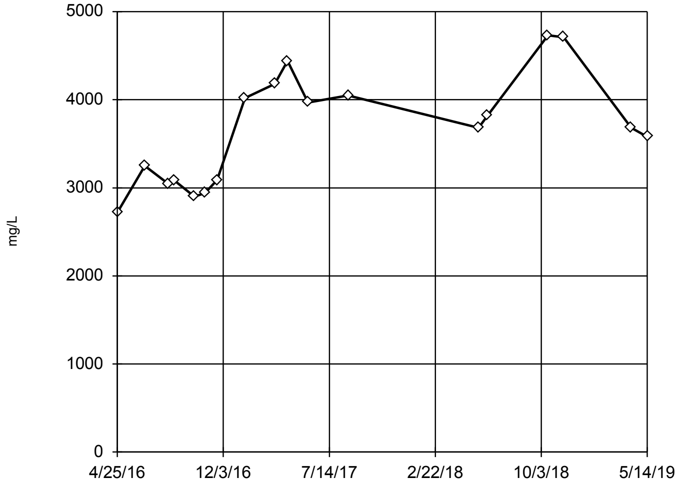
High cutoff = 2357, low cutoff = -313, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-3 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

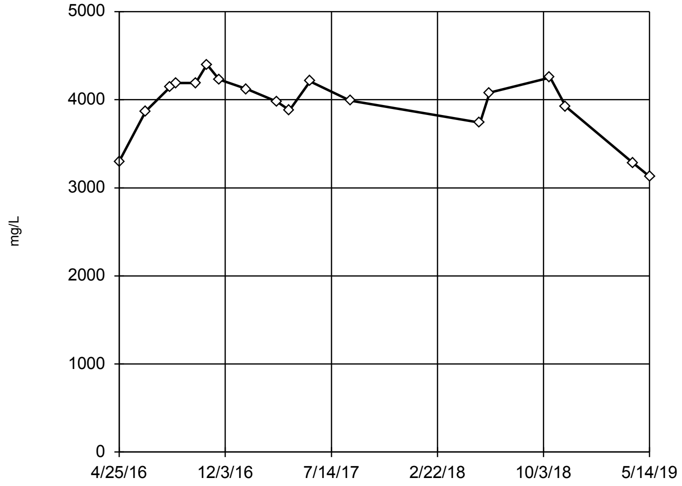
High cutoff = 9954, low cutoff = 1267, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4 (bg)



n = 18

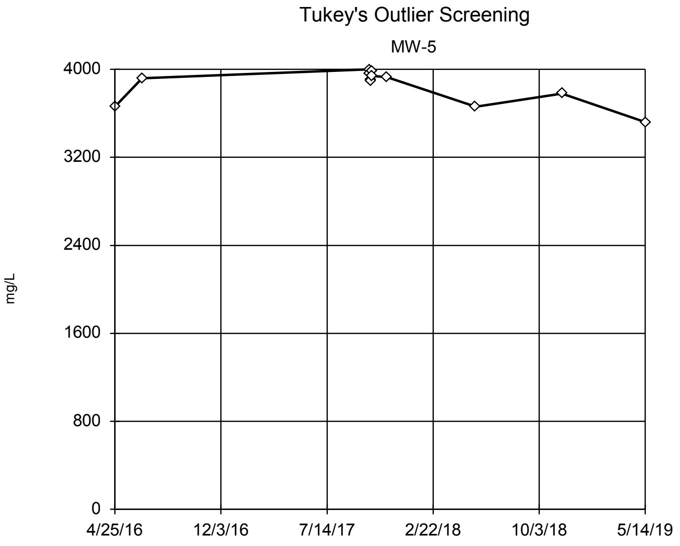
No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 4837, low cutoff = -4029, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

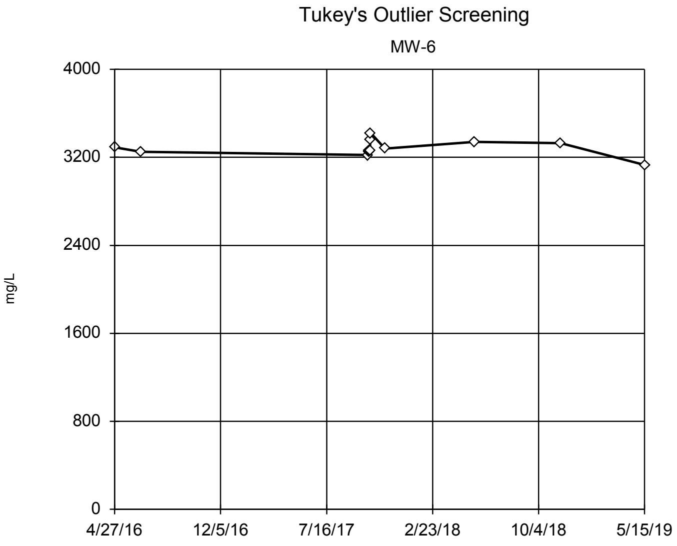
No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 4396, low cutoff = -3017, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

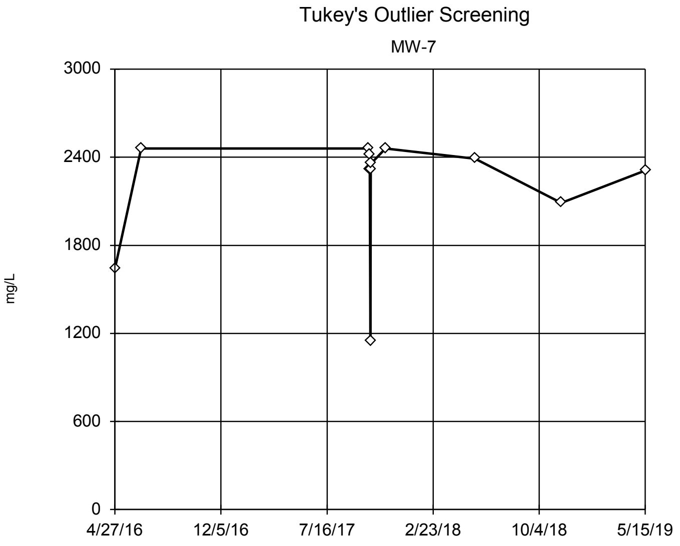
No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3567, low cutoff = 2964, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

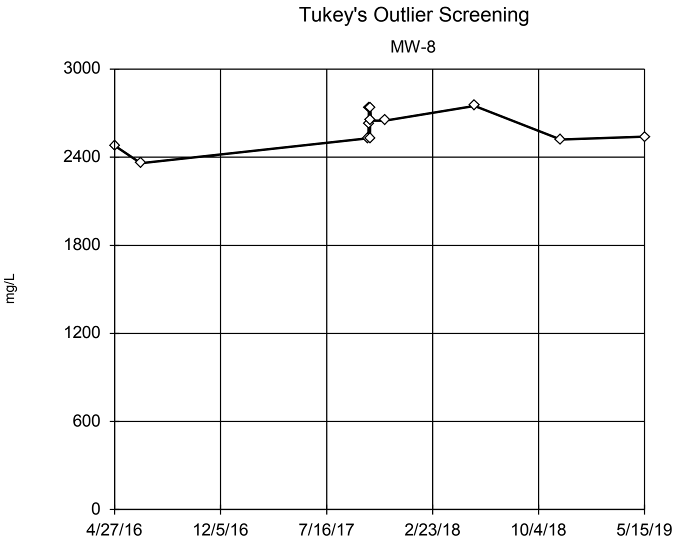
No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2810, low cutoff = -2338, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3152, low cutoff = 1925, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 10:43 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

FIGURE D.

Welch's t-test/Mann-Whitney - Significant Results

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF Printed 9/26/2019, 3:08 PM

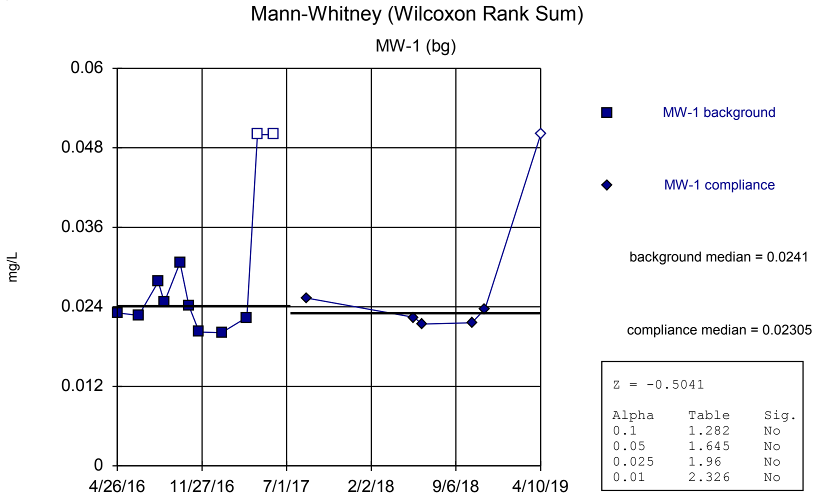
Constituent	Well	Calc.	0.01	Method
Calcium (mg/L)	**MW-1 (bg)**	**3.398**	**Yes**	**Mann-W**
Calcium (mg/L)	**MW-8**	**2.467**	**Yes**	**Mann-W**
Fluoride (mg/L)	**MW-2 (bg)**	**3.486**	**Yes**	**Mann-W**
Fluoride (mg/L)	**MW-4 (bg)**	**3.27**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	**MW-1 (bg)**	**3.264**	**Yes**	**Mann-W**

Welch's t-test/Mann-Whitney - All Results

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF   Printed 9/26/2019, 3:08 PM

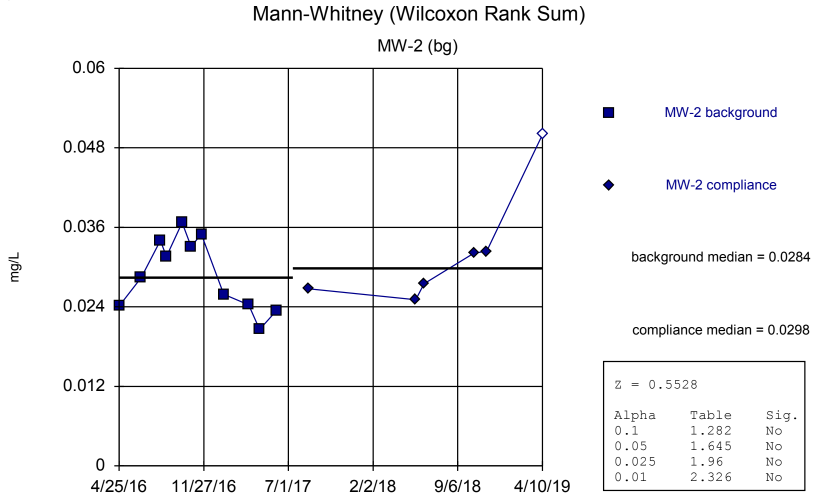
Constituent	Well	Calc.	0.01	Method
Boron (mg/L)	MW-1 (bg)	-0.5041	No	Mann-W
Boron (mg/L)	MW-2 (bg)	0.5528	No	Mann-W
Boron (mg/L)	MW-3 (bg)	0.3526	No	Mann-W
Boron (mg/L)	MW-4 (bg)	0.7538	No	Mann-W
Boron (mg/L)	MW-5	1.23	No	Mann-W
Boron (mg/L)	MW-6	-2.123	No	Mann-W
Boron (mg/L)	MW-7	-2.173	No	Mann-W
Boron (mg/L)	MW-8	-1.616	No	Mann-W
Calcium (mg/L)	**MW-1 (bg)**	**3.398**	**Yes**	**Mann-W**
Calcium (mg/L)	MW-2 (bg)	1.271	No	Mann-W
Calcium (mg/L)	MW-3 (bg)	1.723	No	Mann-W
Calcium (mg/L)	MW-4 (bg)	0.2717	No	Mann-W
Calcium (mg/L)	MW-5	1.613	No	Mann-W
Calcium (mg/L)	MW-6	0.2548	No	Mann-W
Calcium (mg/L)	MW-7	1.193	No	Mann-W
Calcium (mg/L)	**MW-8**	**2.467**	**Yes**	**Mann-W**
Fluoride (mg/L)	MW-1 (bg)	2.276	No	Mann-W
Fluoride (mg/L)	**MW-2 (bg)**	**3.486**	**Yes**	**Mann-W**
Fluoride (mg/L)	MW-3 (bg)	1.693	No	Mann-W
Fluoride (mg/L)	**MW-4 (bg)**	**3.27**	**Yes**	**Mann-W**
Fluoride (mg/L)	MW-5	-1.697	No	Mann-W
Fluoride (mg/L)	MW-6	-2.085	No	Mann-W
Fluoride (mg/L)	MW-7	-1.577	No	Mann-W
Fluoride (mg/L)	MW-8	-2.139	No	Mann-W
Sulfate (mg/L)	MW-1 (bg)	1.728	No	Mann-W
Sulfate (mg/L)	MW-2 (bg)	-1.089	No	Mann-W
Sulfate (mg/L)	MW-3 (bg)	1.678	No	Mann-W
Sulfate (mg/L)	MW-4 (bg)	-2.185	No	Mann-W
Sulfate (mg/L)	MW-5	0.7955	No	Mann-W
Sulfate (mg/L)	MW-6	0.8806	No	Mann-W
Sulfate (mg/L)	MW-7	-0.1073	No	Mann-W
Sulfate (mg/L)	MW-8	0.8523	No	Mann-W
Total Dissolved Solids (mg/L)	**MW-1 (bg)**	**3.264**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	MW-2 (bg)	-1.272	No	Mann-W
Total Dissolved Solids (mg/L)	MW-3 (bg)	1.812	No	Mann-W
Total Dissolved Solids (mg/L)	MW-4 (bg)	-1.54	No	Mann-W
Total Dissolved Solids (mg/L)	MW-5	-1.872	No	Mann-W
Total Dissolved Solids (mg/L)	MW-6	0.08522	No	Mann-W
Total Dissolved Solids (mg/L)	MW-7	-0.08567	No	Mann-W
Total Dissolved Solids (mg/L)	MW-8	0.5122	No	Mann-W

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



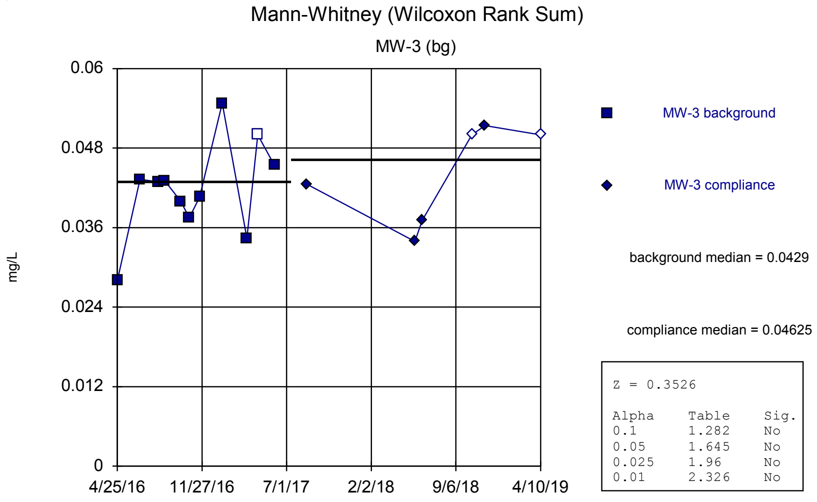
Constituent: Boron Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



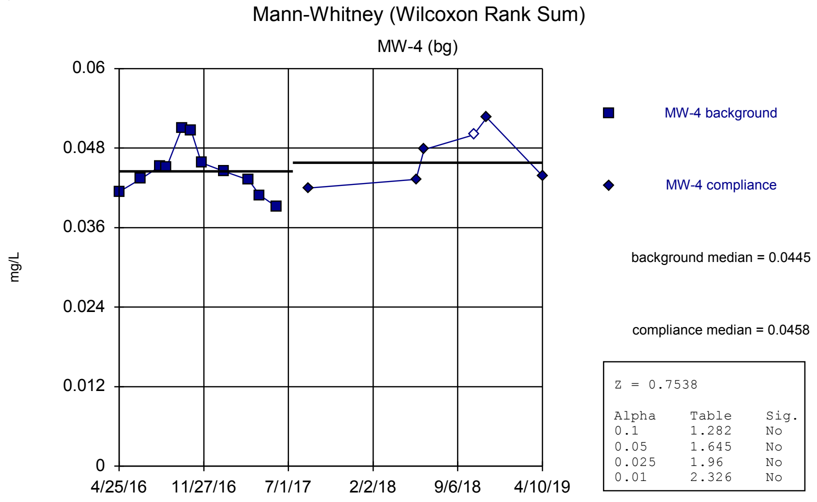
Constituent: Boron Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Boron Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

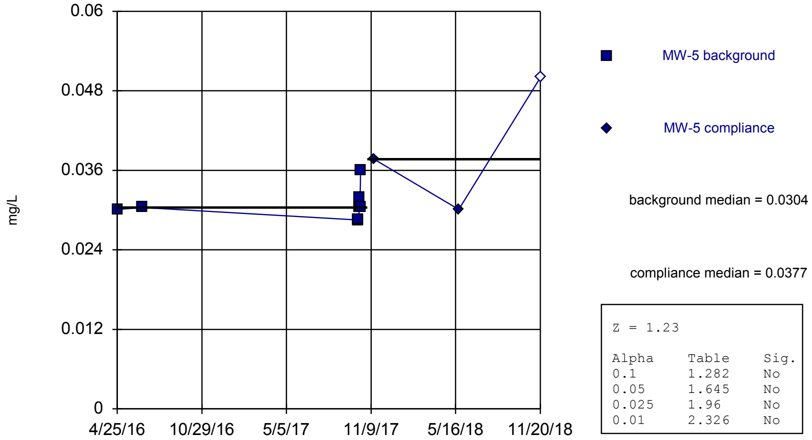


Constituent: Boron Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-5



background median = 0.0304

compliance median = 0.0377

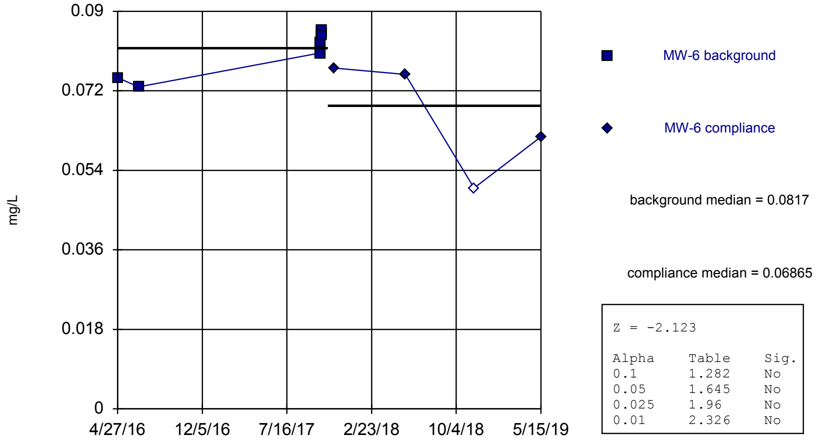
```
Z = 1.23

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Boron   Analysis Run 9/26/2019 3:06 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-6



background median = 0.0817

compliance median = 0.06865

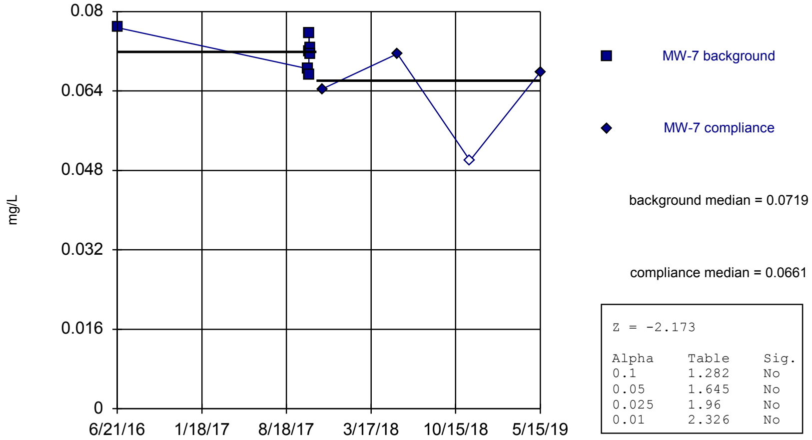
```
Z = -2.123

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Boron   Analysis Run 9/26/2019 3:06 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-7



background median = 0.0719

compliance median = 0.0661

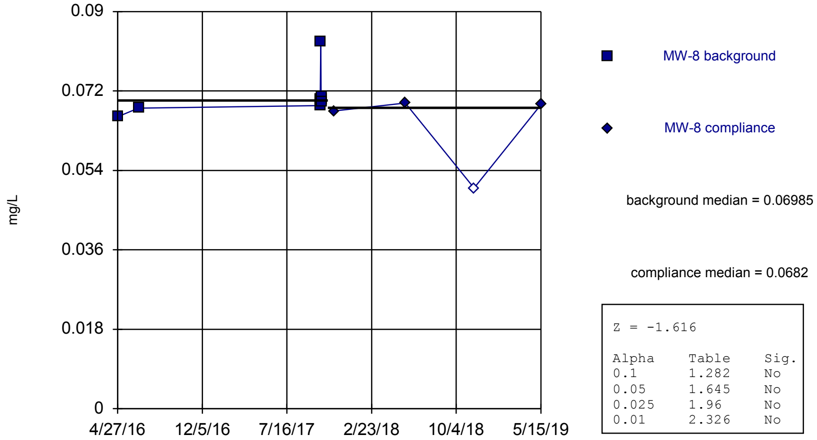
```
Z = -2.173

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Boron   Analysis Run 9/26/2019 3:06 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-8



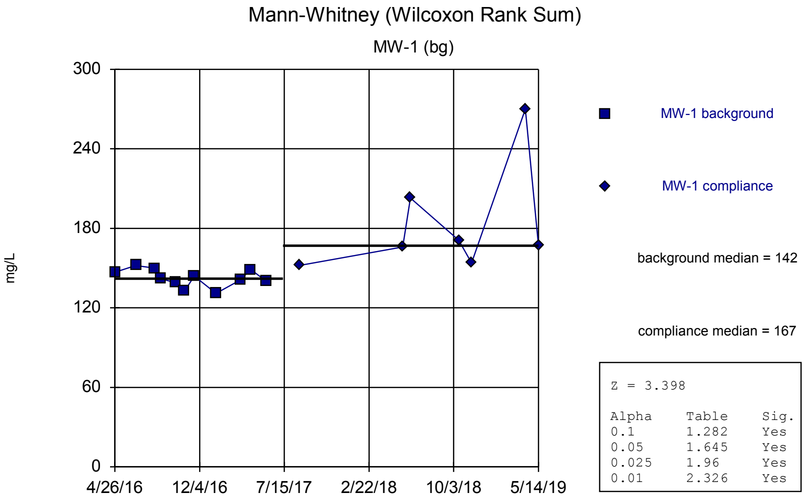
background median = 0.06985

compliance median = 0.0682

```
Z = -1.616

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Boron   Analysis Run 9/26/2019 3:06 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

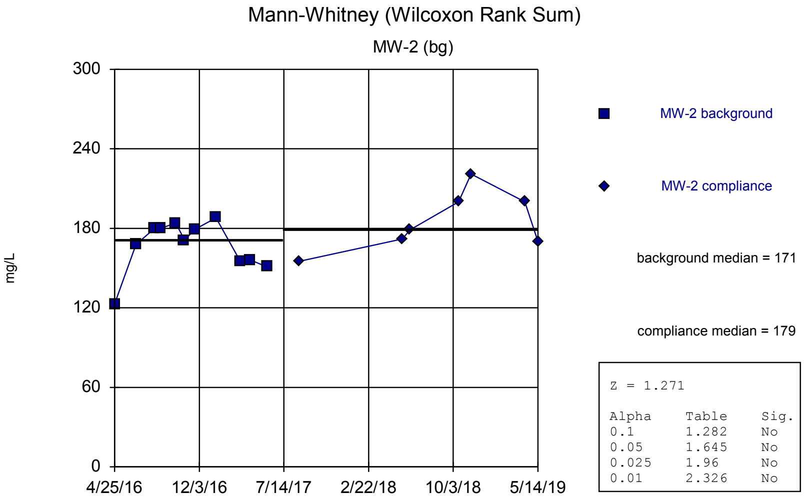


Z = 3.398

Alpha	Table	Sig.
0.1	1.282	Yes
0.05	1.645	Yes
0.025	1.96	Yes
0.01	2.326	Yes

Constituent: Calcium Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

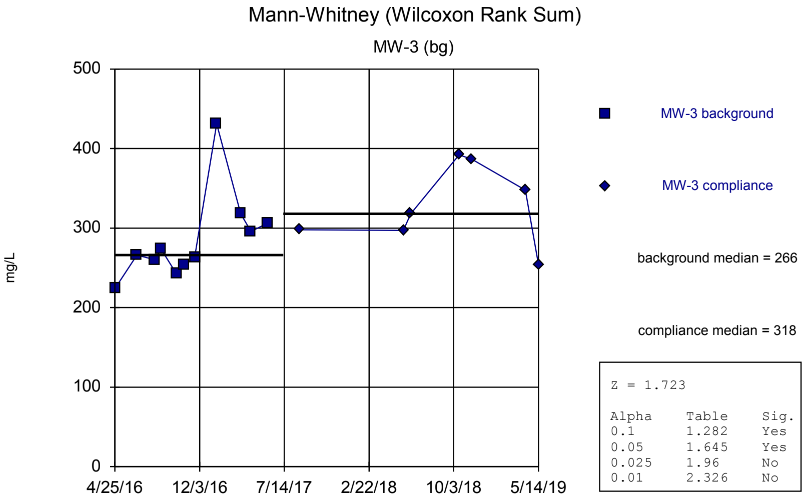


Z = 1.271

Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Calcium Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

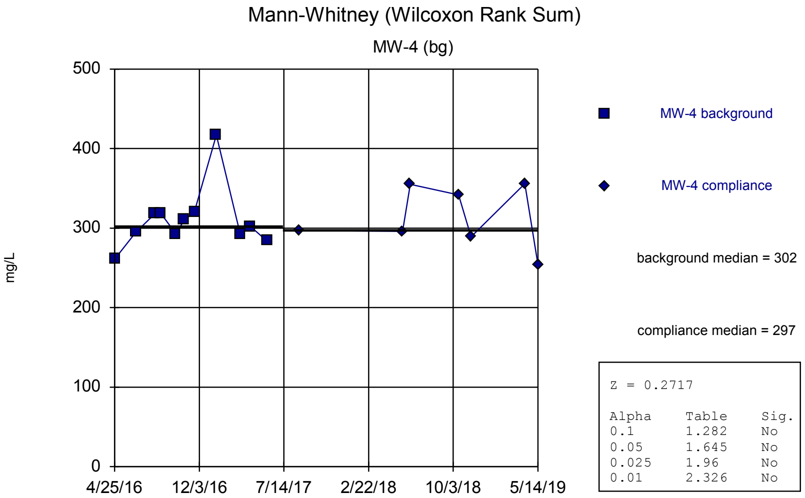


Z = 1.723

Alpha	Table	Sig.
0.1	1.282	Yes
0.05	1.645	Yes
0.025	1.96	No
0.01	2.326	No

Constituent: Calcium Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Z = 0.2717

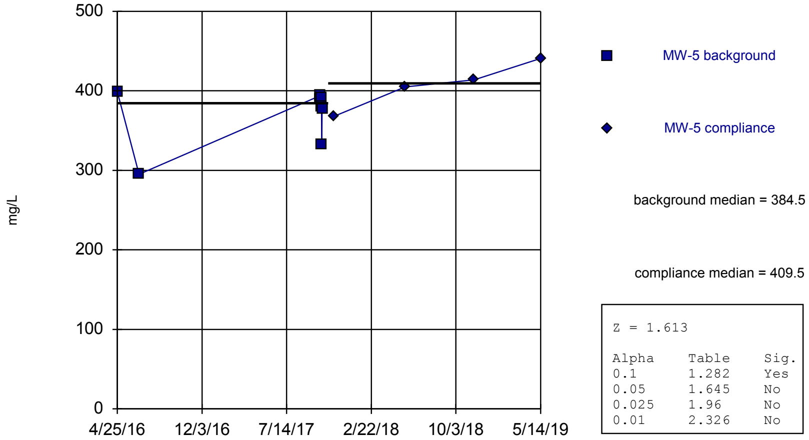
Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Calcium Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-5



background median = 384.5

compliance median = 409.5

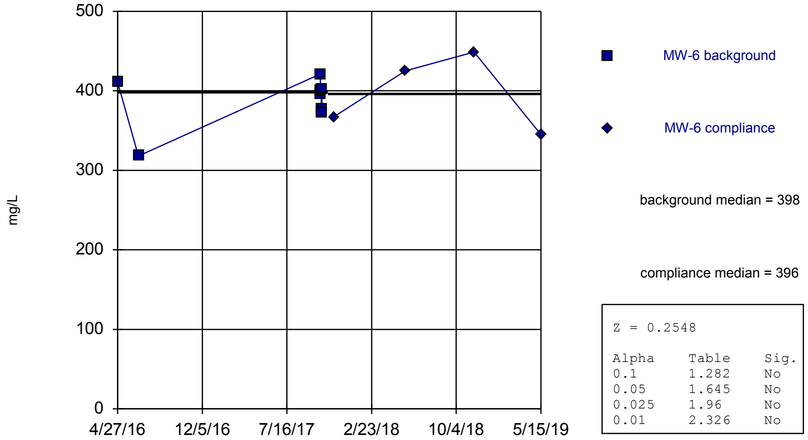
```
Z = 1.613

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-6



background median = 398

compliance median = 396

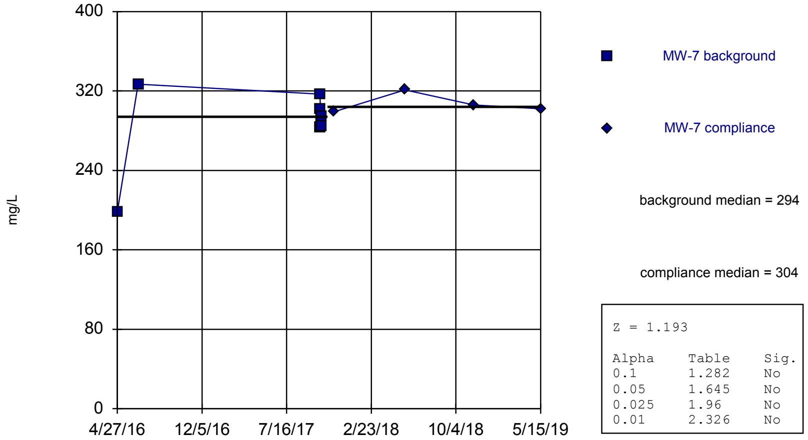
```
Z = 0.2548

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-7



background median = 294

compliance median = 304

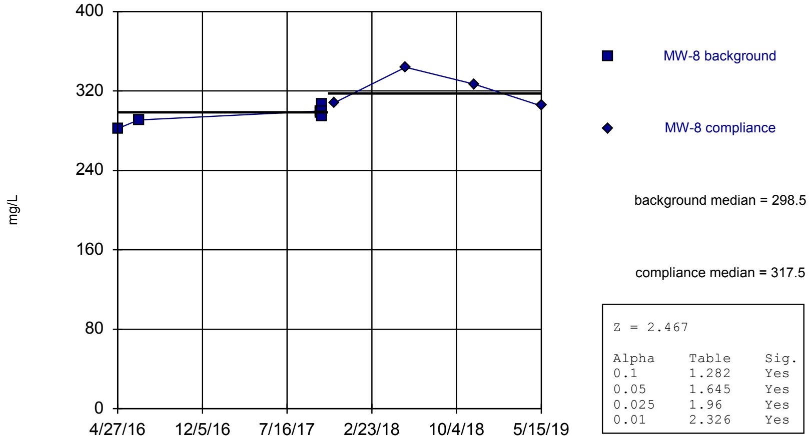
```
Z = 1.193

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-8



background median = 298.5

compliance median = 317.5

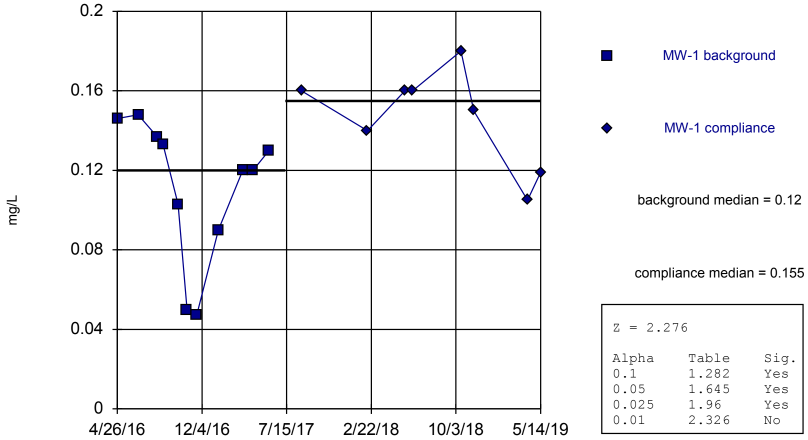
```
Z = 2.467

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     Yes
```

Constituent: Calcium Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1 (bg)



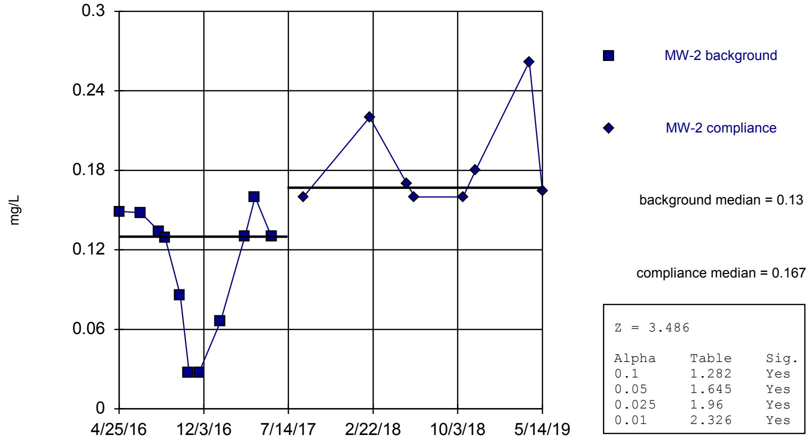
```
Z = 2.276

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     No
```

Constituent: Fluoride Analysis Run 9/26/2019 3:06 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-2 (bg)



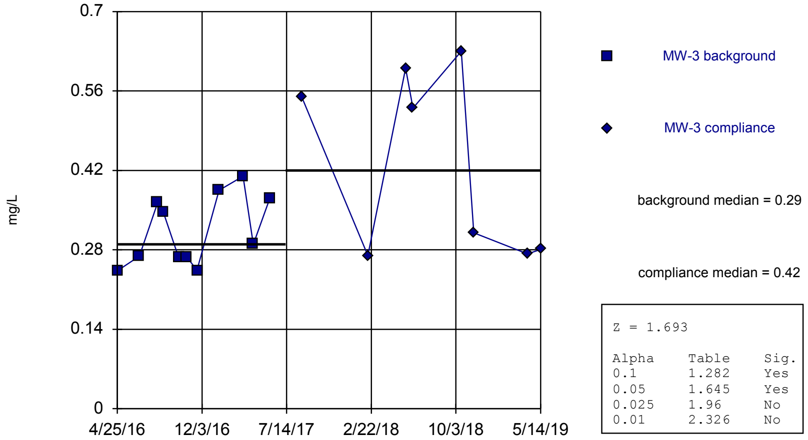
```
Z = 3.486

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     Yes
```

Constituent: Fluoride Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-3 (bg)



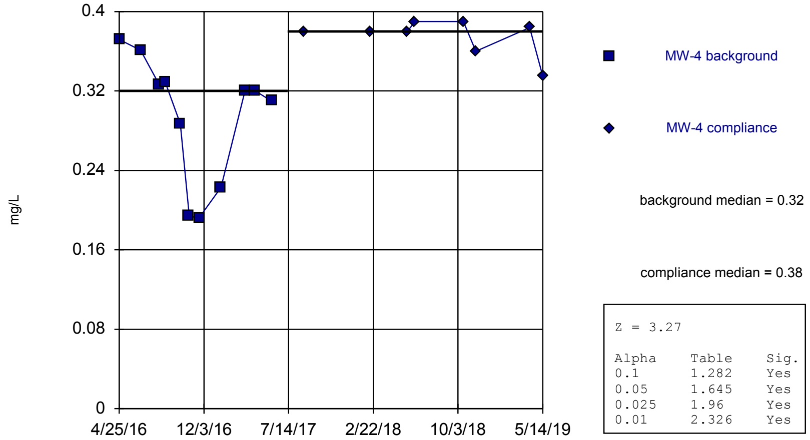
```
Z = 1.693

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      No
0.01      2.326     No
```

Constituent: Fluoride Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4 (bg)



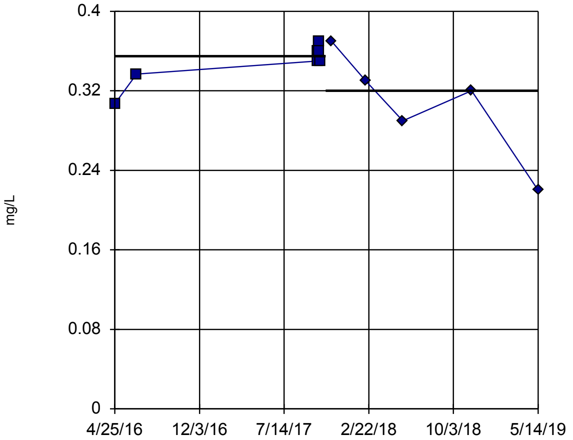
```
Z = 3.27

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     Yes
```

Constituent: Fluoride Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-5



background median = 0.355

compliance median = 0.32

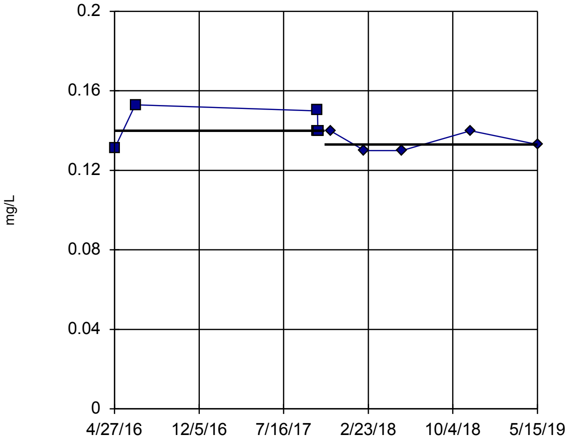
```
Z = -1.697

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Fluoride   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-6



background median = 0.14

compliance median = 0.133

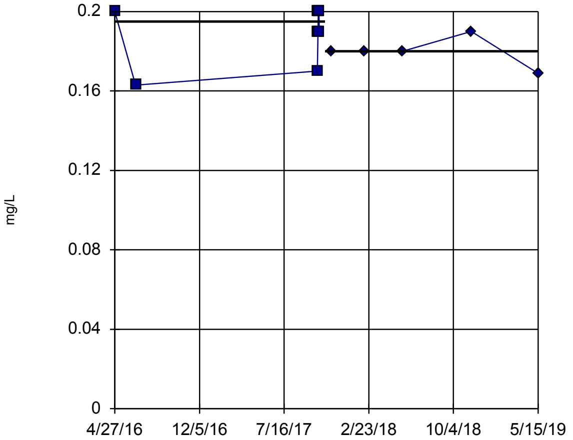
```
Z = -2.085

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Fluoride   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-7



background median = 0.195

compliance median = 0.18

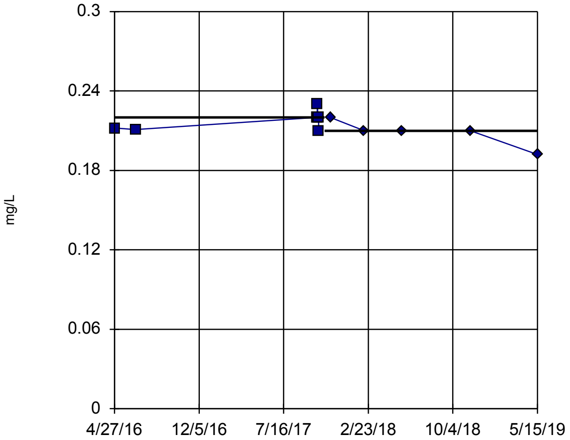
```
Z = -1.577

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Fluoride   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-8



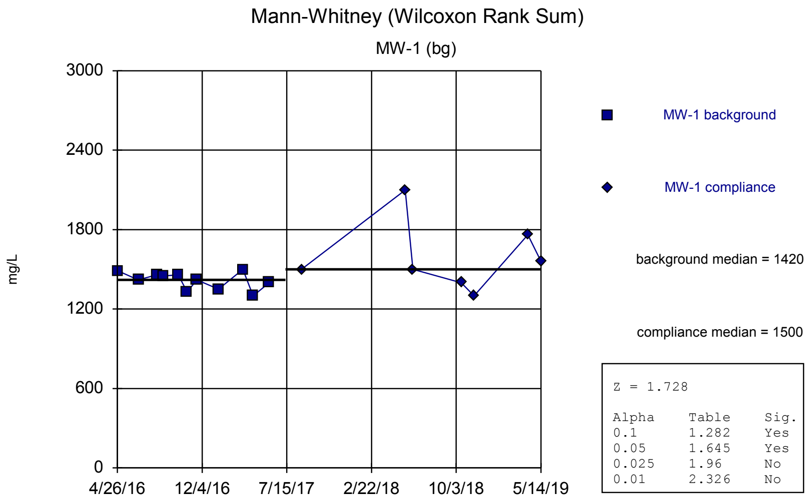
background median = 0.22

compliance median = 0.21

```
Z = -2.139

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

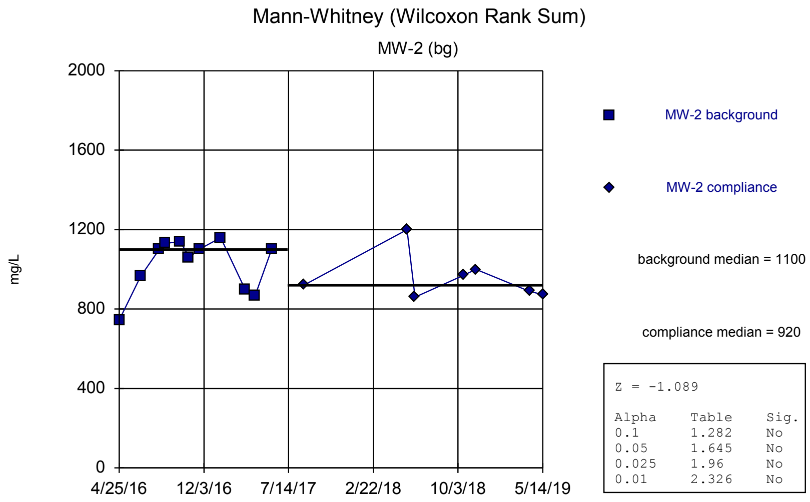
Constituent: Fluoride   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



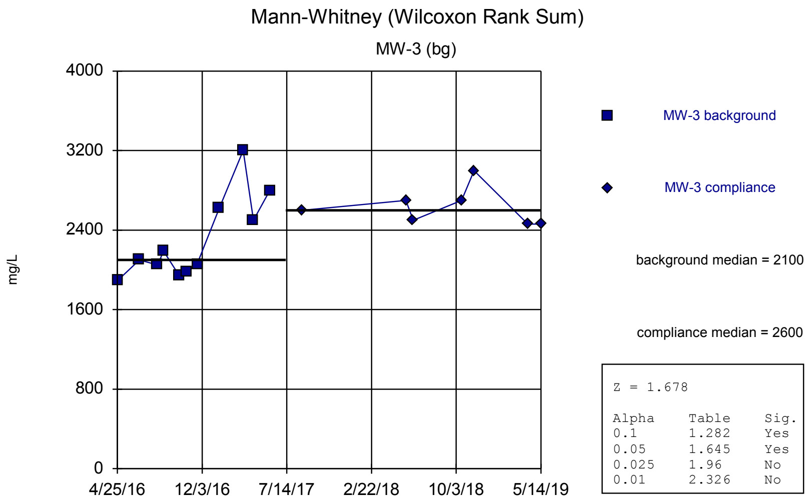
Constituent: Sulfate Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



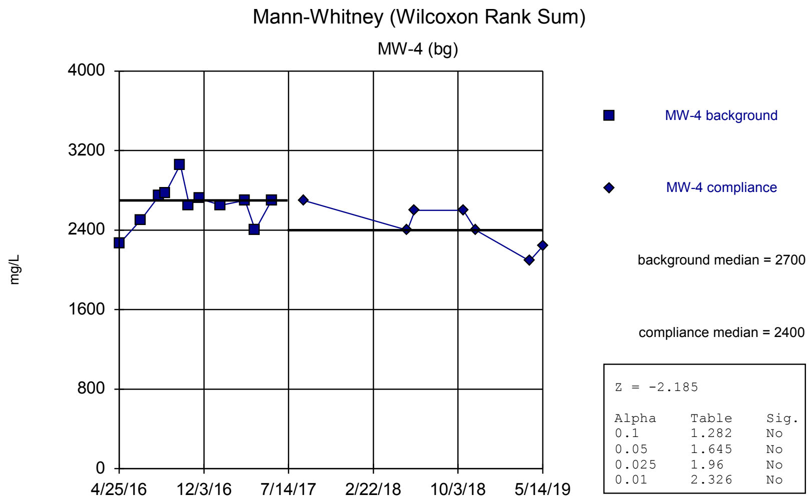
Constituent: Sulfate Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Sulfate Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

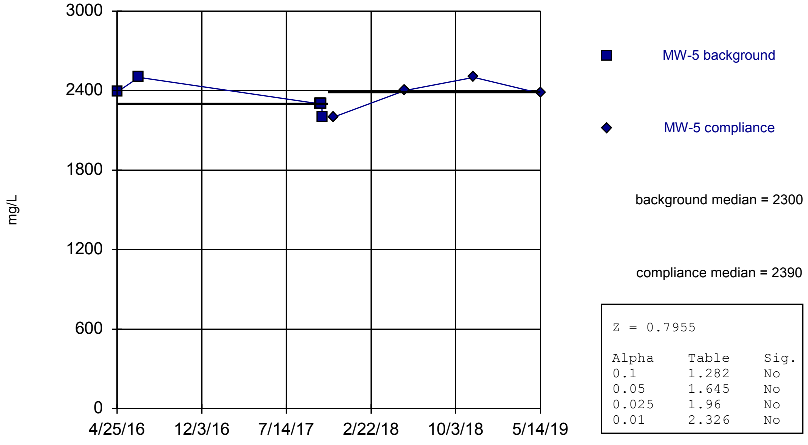


Constituent: Sulfate Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-5



background median = 2300

compliance median = 2390

Z = 0.7955

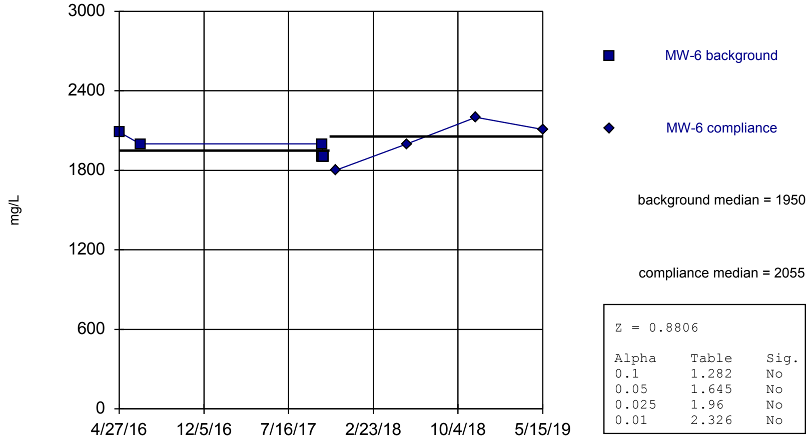
Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Sulfate   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-6



background median = 1950

compliance median = 2055

Z = 0.8806

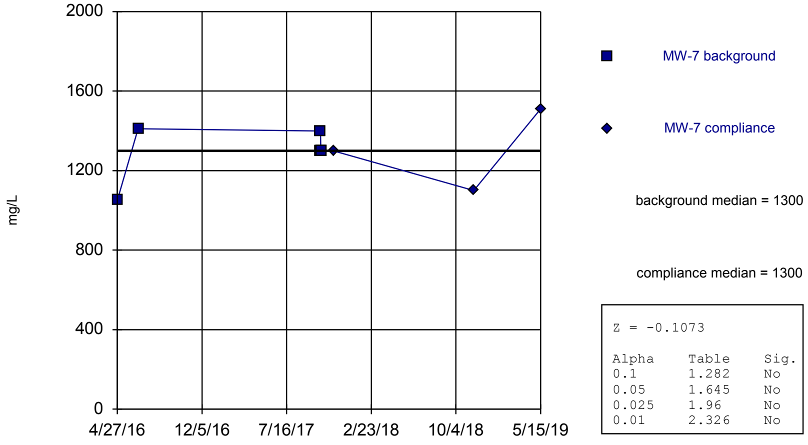
Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Sulfate   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-7



background median = 1300

compliance median = 1300

Z = -0.1073

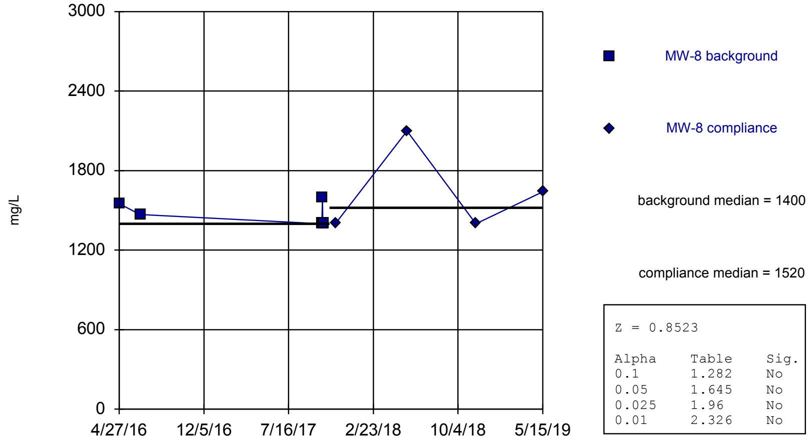
Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Sulfate   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-8



background median = 1400

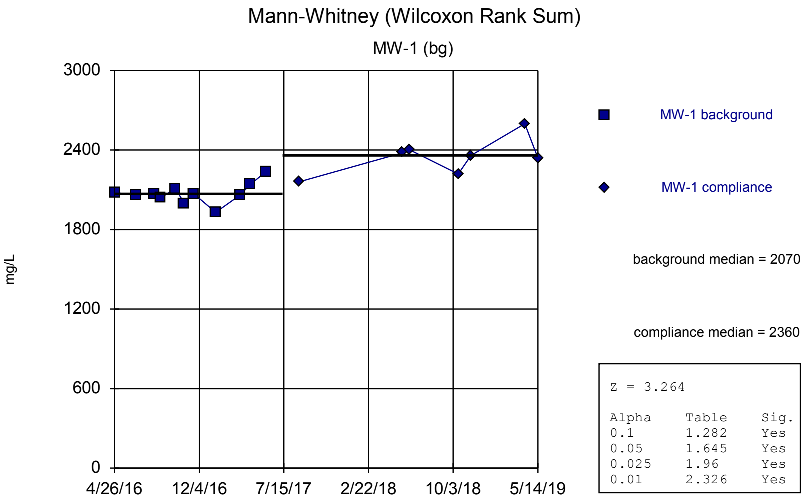
compliance median = 1520

Z = 0.8523

Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Sulfate   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

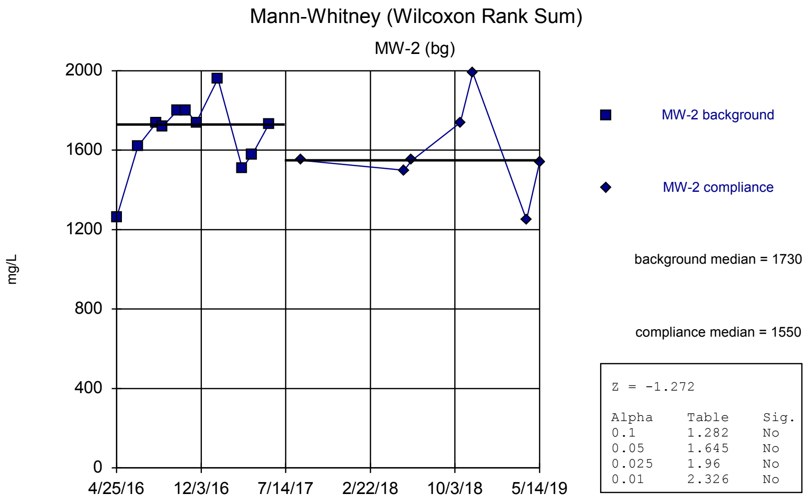
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = 3.264

Alpha     Table    Sig.
0.1       1.282    Yes
0.05      1.645    Yes
0.025     1.96     Yes
0.01      2.326    Yes
```

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

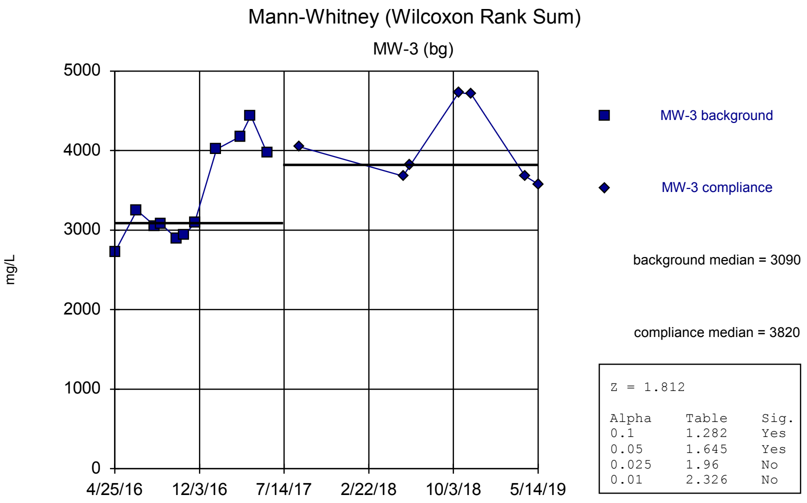
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = -1.272

Alpha     Table    Sig.
0.1       1.282    No
0.05      1.645    No
0.025     1.96     No
0.01      2.326    No
```

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

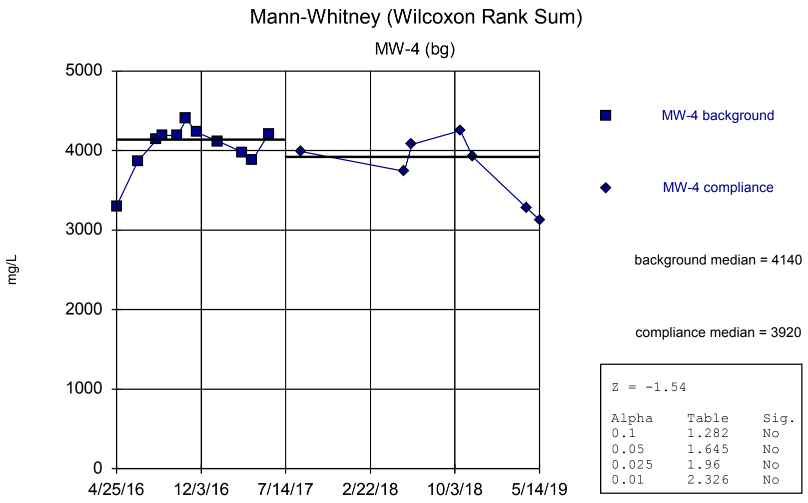
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = 1.812

Alpha     Table    Sig.
0.1       1.282    Yes
0.05      1.645    Yes
0.025     1.96     No
0.01      2.326    No
```

Constituent: Total Dissolved Solids Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

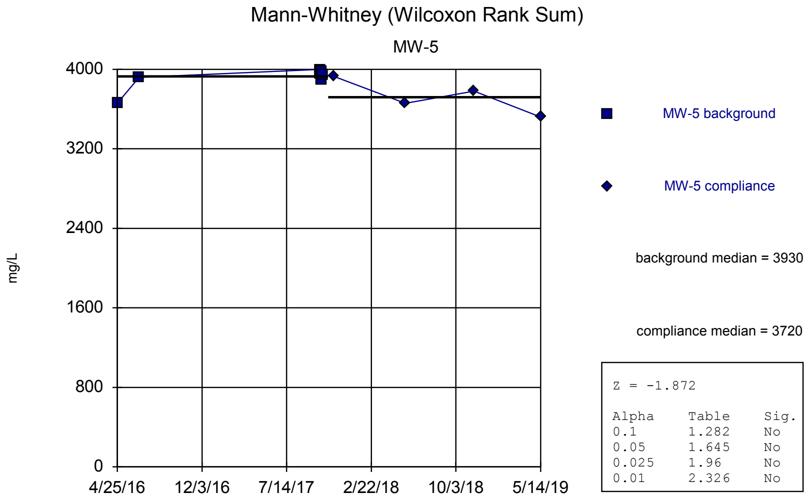
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = -1.54

Alpha     Table    Sig.
0.1       1.282    No
0.05      1.645    No
0.025     1.96     No
0.01      2.326    No
```

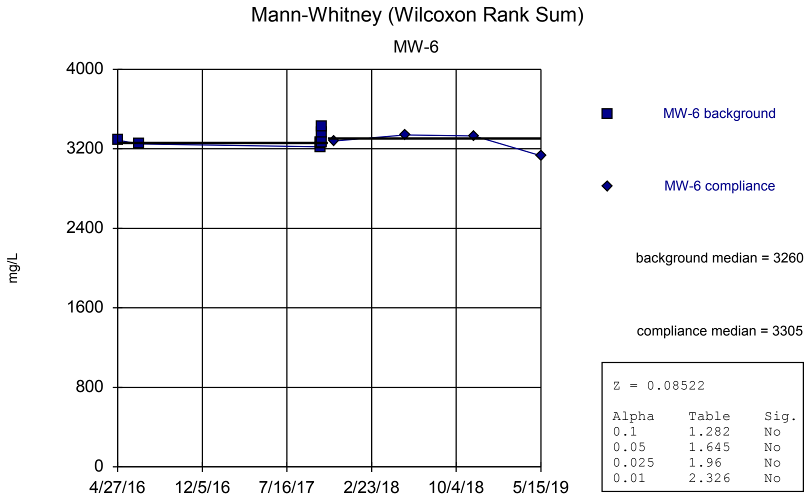
Constituent: Total Dissolved Solids Analysis Run 9/26/2019 3:07 PM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



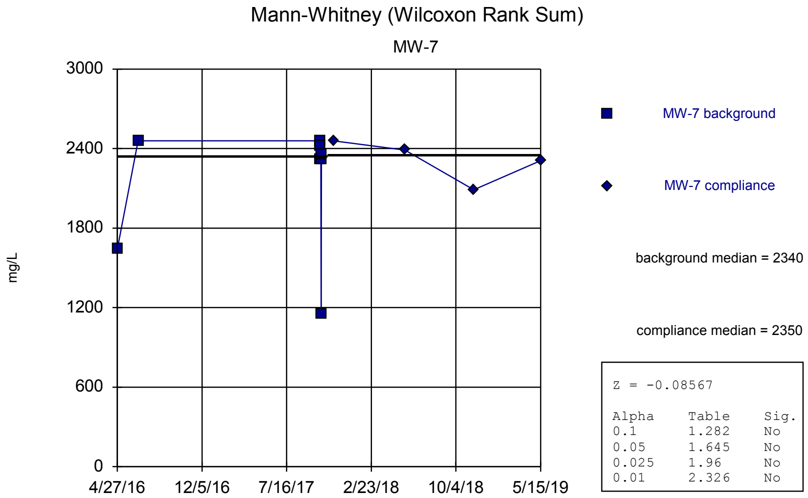
Constituent: Total Dissolved Solids   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



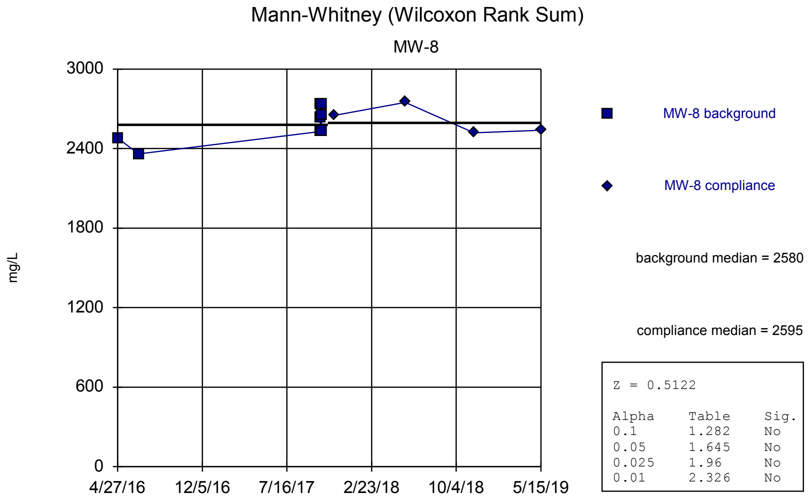
Constituent: Total Dissolved Solids   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids   Analysis Run 9/26/2019 3:07 PM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

FIGURE E.

Trend Tests Summary Table - All Results

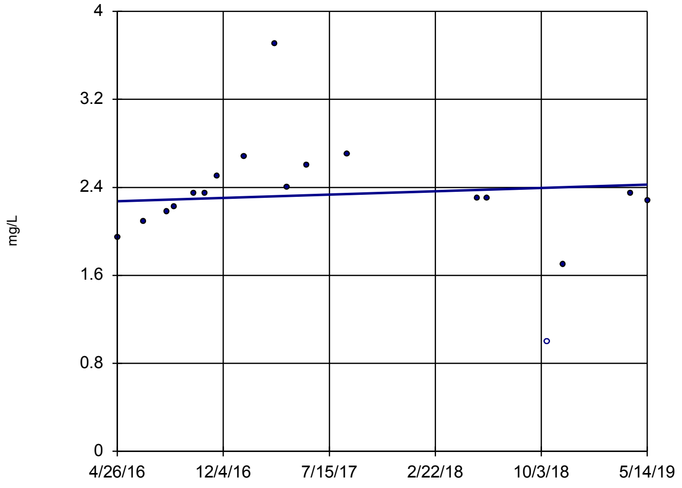
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF   Printed 9/26/2019, 2:57 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Chloride (mg/L)	MW-1 (bg)	0.04948	17	63	No	18	5.556	n/a	n/a	0.02	NP
Chloride (mg/L)	MW-2 (bg)	0.1043	4	63	No	18	0	n/a	n/a	0.02	NP
Chloride (mg/L)	MW-3 (bg)	0.1053	36	63	No	18	11.11	n/a	n/a	0.02	NP
Chloride (mg/L)	MW-4 (bg)	-0.07231	-23	-63	No	18	11.11	n/a	n/a	0.02	NP
pH (SU)	MW-1 (bg)	-0.01853	-54	-63	No	18	0	n/a	n/a	0.02	NP
pH (SU)	MW-2 (bg)	0.05407	57	63	No	18	0	n/a	n/a	0.02	NP
pH (SU)	MW-3 (bg)	-0.229	-39	-68	No	19	0	n/a	n/a	0.02	NP
pH (SU)	MW-4 (bg)	0.009631	32	68	No	19	0	n/a	n/a	0.02	NP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-1 (bg)



n = 18

Slope = 0.04948 units per year.

Mann-Kendall statistic = 17 critical = 63

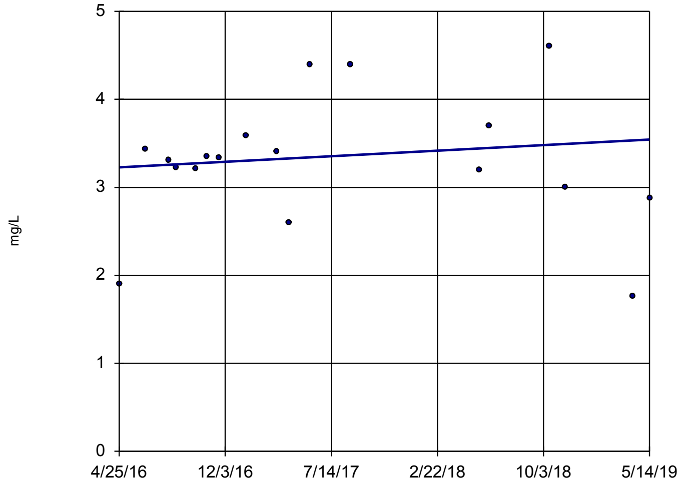
Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: Chloride Analysis Run 9/26/2019 2:56 PM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-2 (bg)



n = 18

Slope = 0.1043 units per year.

Mann-Kendall statistic = 4 critical = 63

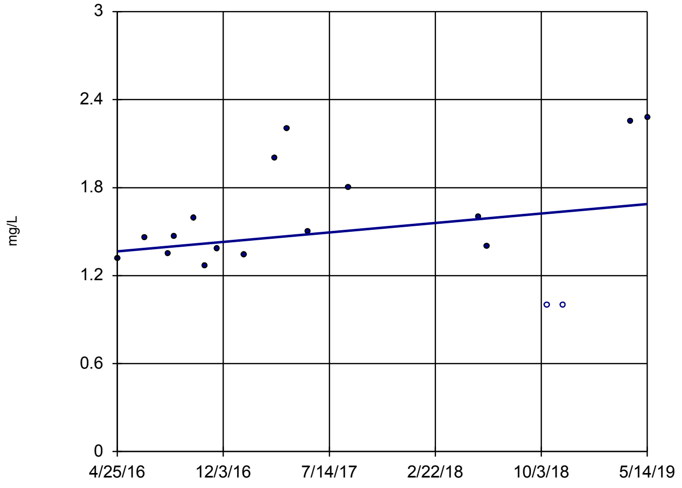
Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: Chloride Analysis Run 9/26/2019 2:56 PM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-3 (bg)



n = 18

Slope = 0.1053 units per year.

Mann-Kendall statistic = 36 critical = 63

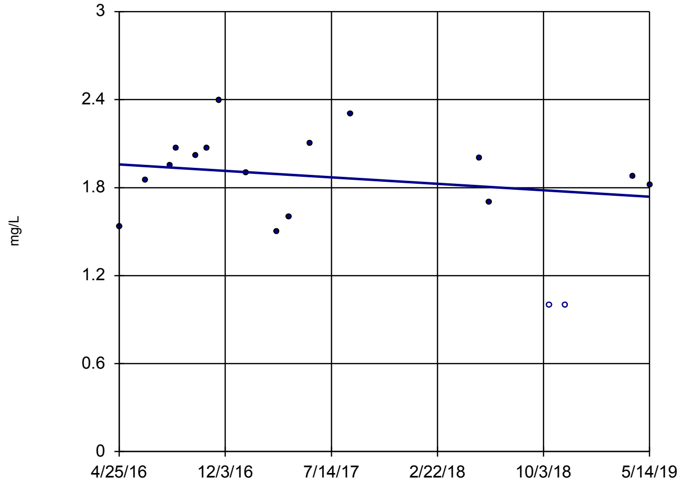
Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: Chloride Analysis Run 9/26/2019 2:56 PM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-4 (bg)



n = 18

Slope = -0.07231 units per year.

Mann-Kendall statistic = -23 critical = -63

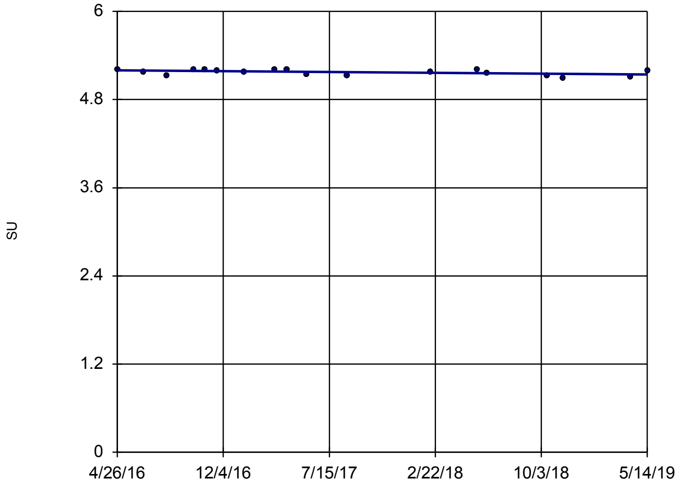
Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: Chloride Analysis Run 9/26/2019 2:56 PM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-1 (bg)



n = 18

Slope = -0.01853 units per year.

Mann-Kendall statistic = -54 critical = -63

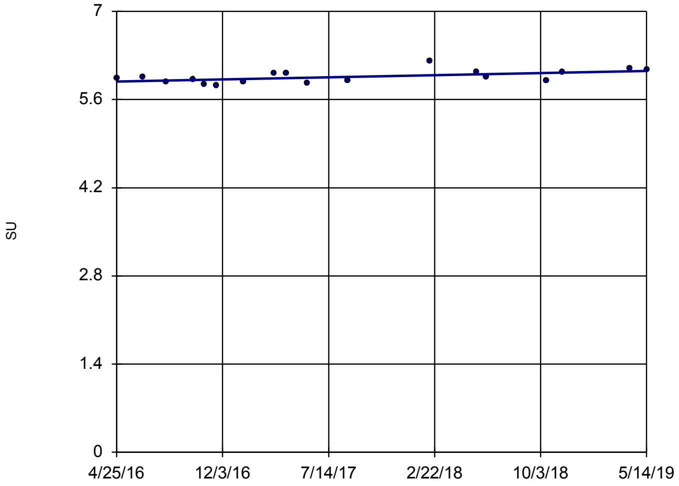
Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: pH Analysis Run 9/26/2019 2:56 PM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-2 (bg)



n = 18

Slope = 0.05407 units per year.

Mann-Kendall statistic = 57 critical = 63

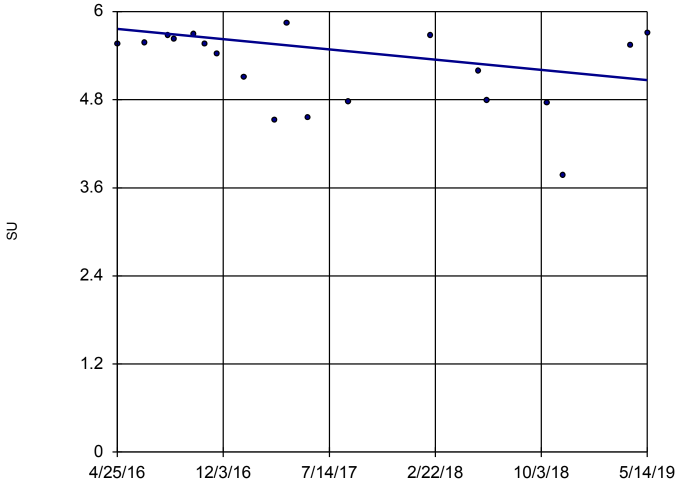
Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: pH Analysis Run 9/26/2019 2:56 PM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-3 (bg)



n = 19

Slope = -0.229 units per year.

Mann-Kendall statistic = -39 critical = -68

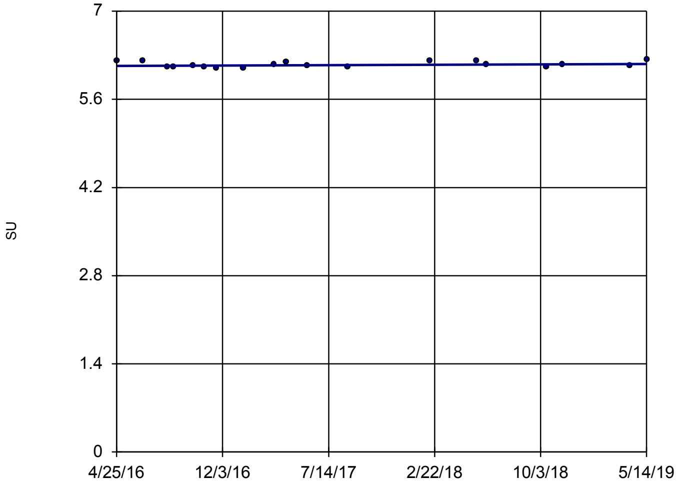
Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: pH Analysis Run 9/26/2019 2:57 PM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-4 (bg)



n = 19

Slope = 0.009631 units per year.

Mann-Kendall statistic = 32 critical = 68

Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: pH Analysis Run 9/26/2019 2:57 PM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

FIGURE F.

Interwell Prediction Limit Summary Table - All Results

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF   Printed 9/26/2019, 3:00 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Chloride (mg/L)	n/a	3.844	n/a	n/a	4 future	n/a	72	1.474	0.2749	6.944	None	sqrt(x)	0.00188	Param Inter 1 of 2
pH (SU)	n/a	6.23	3.77	n/a	4 future	n/a	74	n/a	n/a	0	n/a	n/a	0.0007063	NP Inter (normality) 1 of 2

FIGURE G.

Intrawell Prediction Limit Summary Table - All Results

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF Printed 9/27/2019, 11:56 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	MW-1	0.1015	n/a	n/a	1 future	n/a	18	n/a	n/a	22.22	n/a	n/a	0.005373	NP Intra (normality) 1 of 2
Boron (mg/L)	MW-2	0.1015	n/a	n/a	1 future	n/a	18	n/a	n/a	11.11	n/a	n/a	0.005373	NP Intra (normality) 1 of 2
Boron (mg/L)	MW-3	0.05671	n/a	n/a	1 future	n/a	18	-3.206	0.1655	22.22	Kaplan-Meier	ln(x)	0.00188	Param Intra 1 of 2
Boron (mg/L)	MW-4	0.1015	n/a	n/a	1 future	n/a	18	n/a	n/a	11.11	n/a	n/a	0.005373	NP Intra (normality) 1 of 2
Boron (mg/L)	MW-5	0.1015	n/a	n/a	1 future	n/a	12	n/a	n/a	16.67	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Boron (mg/L)	MW-6	0.09963	n/a	n/a	1 future	n/a	12	0.07598	0.0106	8.333	None	No	0.00188	Param Intra 1 of 2
Boron (mg/L)	MW-7	0.253	n/a	n/a	1 future	n/a	12	n/a	n/a	8.333	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Boron (mg/L)	MW-8	0.0831	n/a	n/a	1 future	n/a	12	n/a	n/a	8.333	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Calcium (mg/L)	MW-1	270	n/a	n/a	1 future	n/a	18	n/a	n/a	0	n/a	n/a	0.005373	NP Intra (normality) 1 of 2
Calcium (mg/L)	MW-2	218.7	n/a	n/a	1 future	n/a	18	174	21.99	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-3	416.4	n/a	n/a	1 future	n/a	18	301.6	56.48	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-4	388.7	n/a	n/a	1 future	n/a	18	311.2	38.16	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-5	466.9	n/a	n/a	1 future	n/a	12	382.1	38.01	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-6	471.6	n/a	n/a	1 future	n/a	12	390.4	36.38	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-7	346.8	n/a	n/a	1 future	n/a	12	2.6e7	6944823	0	None	x^3	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-8	341.4	n/a	n/a	1 future	n/a	12	304.5	16.53	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-1	0.1975	n/a	n/a	1 future	n/a	19	0.1262	0.03546	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-2	0.2565	n/a	n/a	1 future	n/a	19	0.1401	0.05792	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-3	0.6475	n/a	n/a	1 future	n/a	19	-1.063	0.3126	0	None	ln(x)	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-4	0.4323	n/a	n/a	1 future	n/a	19	0.1114	0.03754	0	None	x^2	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-5	0.4265	n/a	n/a	1 future	n/a	13	0.3334	0.04245	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-6	0.1565	n/a	n/a	1 future	n/a	13	0.1398	0.007628	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-7	0.2139	n/a	n/a	1 future	n/a	13	0.1855	0.01295	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-8	0.2342	n/a	n/a	1 future	n/a	13	0.2142	0.009112	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-1	2100	n/a	n/a	1 future	n/a	18	n/a	n/a	0	n/a	n/a	0.005373	NP Intra (normality) 1 of 2
Sulfate (mg/L)	MW-2	1262	n/a	n/a	1 future	n/a	18	998.9	129.3	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-3	3202	n/a	n/a	1 future	n/a	18	2431	379.6	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-4	3041	n/a	n/a	1 future	n/a	18	2566	233.5	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-5	2558	n/a	n/a	1 future	n/a	12	2339	98.21	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-6	2232	n/a	n/a	1 future	n/a	12	1983	111.5	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-7	1832	n/a	n/a	1 future	n/a	12	1356	213.5	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-8	2100	n/a	n/a	1 future	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Total Dissolved Solids (mg/L)	MW-1	2534	n/a	n/a	1 future	n/a	18	2181	173.6	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-2	2051	n/a	n/a	1 future	n/a	18	1643	200.5	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-3	4938	n/a	n/a	1 future	n/a	18	3661	628.6	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-4	4601	n/a	n/a	1 future	n/a	18	1.6e7	2719774	0	None	x^2	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-5	4190	n/a	n/a	1 future	n/a	12	3846	154.3	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-6	3448	n/a	n/a	1 future	n/a	12	3283	74.36	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-7	2647	n/a	n/a	1 future	n/a	12	6.3e16	3.0e16	0	None	x^5	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-8	2862	n/a	n/a	1 future	n/a	12	2593	120.2	0	None	No	0.00188	Param Intra 1 of 2

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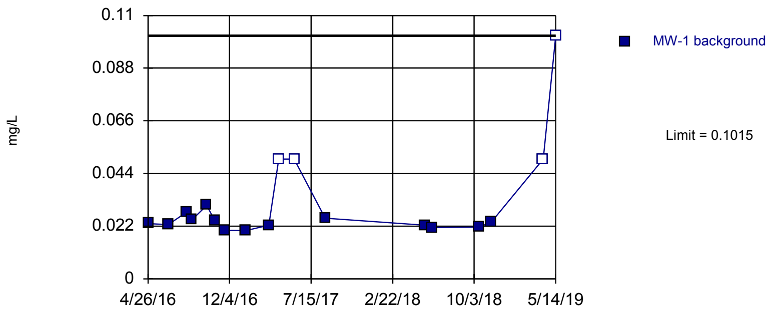
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, MW-1 (bg)



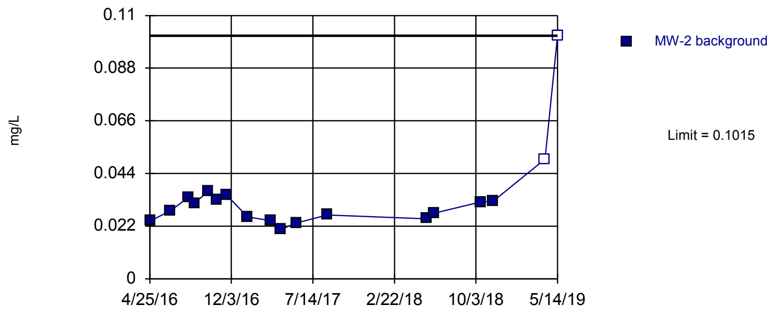
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. 22.22% NDs. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, MW-2 (bg)



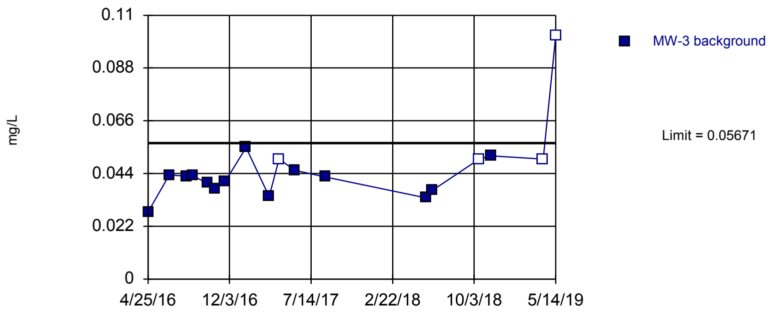
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. 11.11% NDs. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-3 (bg)



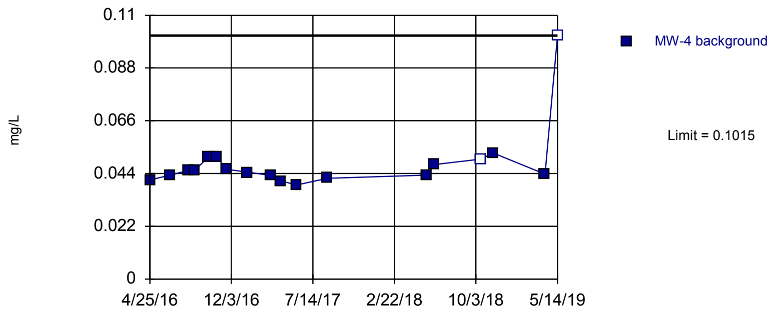
Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-3.206, Std. Dev.=0.1655, n=18, 22.22% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8671, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, MW-4 (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. 11.11% NDs. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Boron (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-1
4/26/2016	0.0231 (J)
6/20/2016	0.0227 (J)
8/8/2016	0.0278 (J)
8/24/2016	0.0247 (J)
10/3/2016	0.0307 (J)
10/26/2016	0.0241 (J)
11/21/2016	0.0202 (J)
1/17/2017	0.0201 (J)
3/22/2017	0.0224 (J)
4/18/2017	<0.1
5/30/2017	<0.1
8/23/2017	0.0253 (J)
5/22/2018	0.0224 (J)
6/12/2018	0.0214 (J)
10/17/2018	0.0216 (J)
11/19/2018	0.0237 (J)
4/10/2019	<0.1
5/14/2019	<0.203 (o)

Prediction Limit

Constituent: Boron (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-2
4/25/2016	0.0241 (J)
6/20/2016	0.0284 (J)
8/8/2016	0.034 (J)
8/24/2016	0.0316 (J)
10/3/2016	0.0367 (J)
10/26/2016	0.0331 (J)
11/21/2016	0.035 (J)
1/17/2017	0.0259 (J)
3/22/2017	0.0243 (J)
4/18/2017	0.0206 (J)
5/31/2017	0.0234 (J)
8/23/2017	0.0267 (J)
5/22/2018	0.0251 (J)
6/12/2018	0.0275 (J)
10/17/2018	0.0321 (J)
11/19/2018	0.0324 (J)
4/10/2019	<0.1
5/14/2019	<0.203 (o)

Prediction Limit

Constituent: Boron (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-3
4/25/2016	0.028 (J)
6/22/2016	0.0433 (J)
8/9/2016	0.0429 (J)
8/24/2016	0.0431 (J)
10/4/2016	0.04 (J)
10/26/2016	0.0375 (J)
11/21/2016	0.0406 (J)
1/18/2017	0.0548 (J)
3/22/2017	0.0344 (J)
4/18/2017	<0.1
5/31/2017	0.0454 (J)
8/23/2017	0.0425 (J)
5/24/2018	0.0339 (J)
6/12/2018	0.0371 (J)
10/17/2018	<0.1 (J)
11/19/2018	0.0514 (J)
4/10/2019	<0.1
5/14/2019	<0.203 (o)

Prediction Limit

Constituent: Boron (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-4
4/25/2016	0.0414 (J)
6/20/2016	0.0434 (J)
8/9/2016	0.0453 (J)
8/24/2016	0.0451 (J)
10/3/2016	0.0511 (J)
10/26/2016	0.0507 (J)
11/21/2016	0.0458 (J)
1/18/2017	0.0445 (J)
3/22/2017	0.0432 (J)
4/18/2017	0.0409 (J)
5/31/2017	0.0392 (J)
8/23/2017	0.042 (J)
5/23/2018	0.0433 (J)
6/12/2018	0.0478 (J)
10/17/2018	<0.1 (J)
11/19/2018	0.0526 (J)
4/10/2019	0.0438 (J)
5/14/2019	<0.203 (o)

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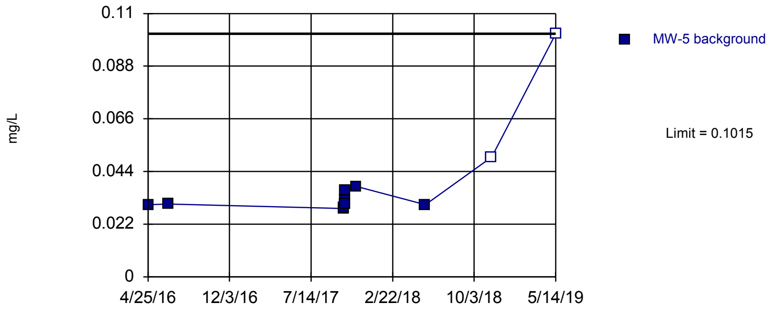
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, MW-5



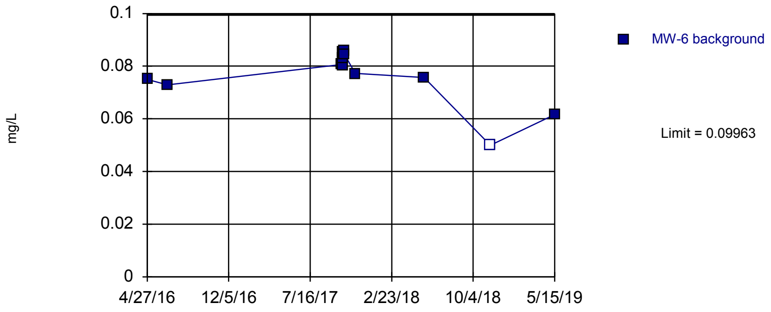
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. 16.67% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-6



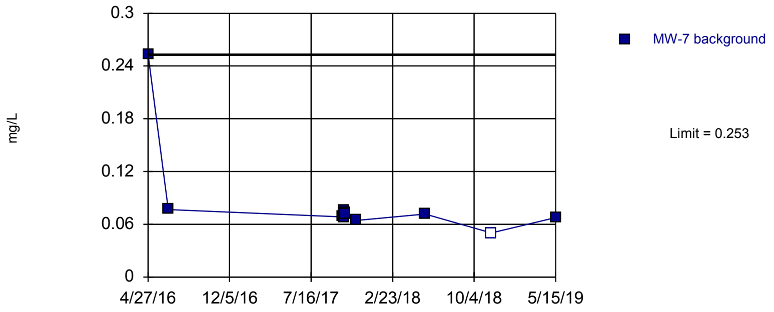
Background Data Summary: Mean=0.07598, Std. Dev.=0.0106, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8272, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, MW-7



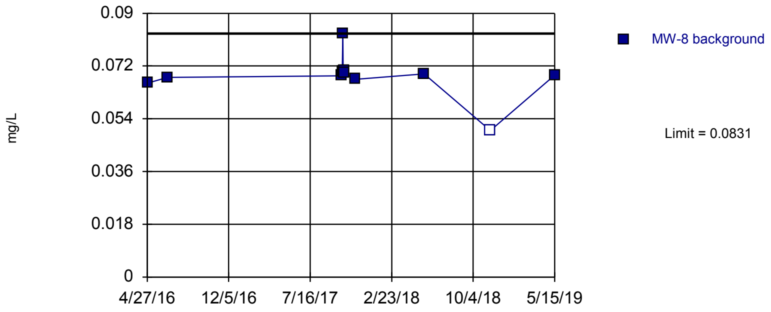
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. 8.333% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, MW-8



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. 8.333% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Boron (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-5
4/25/2016	0.0301 (J)
6/21/2016	0.0304 (J)
10/12/2017	0.0285 (J)
10/13/2017	0.0287 (J)
10/14/2017	0.0305 (J)
10/15/2017	0.0319 (J)
10/16/2017	0.0304 (J)
10/17/2017	0.036 (J)
11/16/2017	0.0377 (J)
5/23/2018	0.0301 (J)
11/20/2018	<0.1 (J)
5/14/2019	<0.203 (o)

Prediction Limit

Constituent: Boron (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-6
4/27/2016	0.075 (J)
6/21/2016	0.0729 (J)
10/12/2017	0.0806 (J)
10/13/2017	0.0803 (J)
10/14/2017	0.0828 (J)
10/15/2017	0.0852 (J)
10/16/2017	0.0858 (J)
10/17/2017	0.0846 (J)
11/16/2017	0.0772 (J)
5/23/2018	0.0757 (J)
11/20/2018	<0.1 (J)
5/15/2019	0.0616 (J)

Prediction Limit

Constituent: Boron (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-7
4/27/2016	0.253 (o)
6/21/2016	0.0768 (J)
10/12/2017	0.0685 (J)
10/13/2017	0.0674 (J)
10/14/2017	0.0756 (J)
10/15/2017	0.0719 (J)
10/16/2017	0.0726 (J)
10/17/2017	0.0716 (J)
11/16/2017	0.0644 (J)
5/23/2018	0.0715 (J)
11/20/2018	<0.1 (J)
5/15/2019	0.0678 (J)

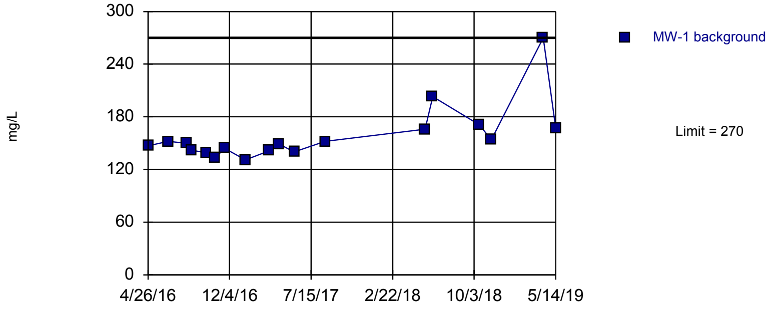
Prediction Limit

Constituent: Boron (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-8
4/27/2016	0.0662 (J)
6/21/2016	0.0681 (J)
10/12/2017	0.0687 (J)
10/13/2017	0.0831 (J)
10/14/2017	0.0702 (J)
10/15/2017	0.0702 (J)
10/16/2017	0.0707 (J)
10/17/2017	0.0695 (J)
11/16/2017	0.0675 (J)
5/23/2018	0.0693 (J)
11/20/2018	<0.1 (J)
5/15/2019	0.0689 (J)

Prediction Limit

Intrawell Non-parametric, MW-1 (bg)

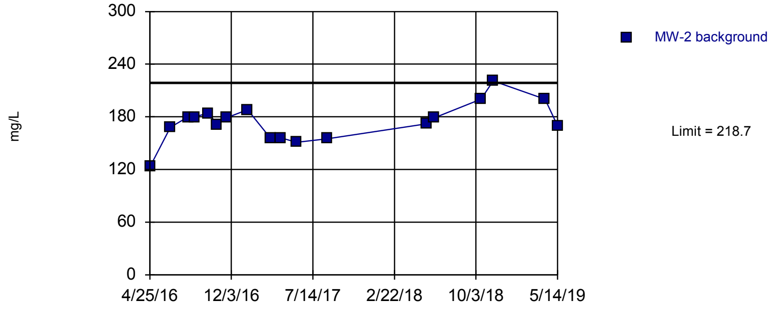


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Intrawell Parametric, MW-2 (bg)

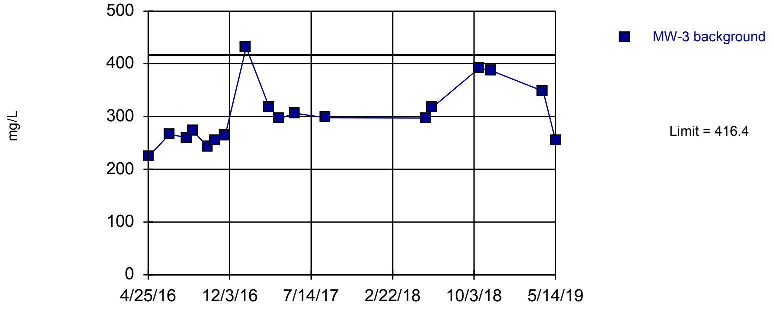


Background Data Summary: Mean=174, Std. Dev.=21.99, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9686, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Intrawell Parametric, MW-3 (bg)

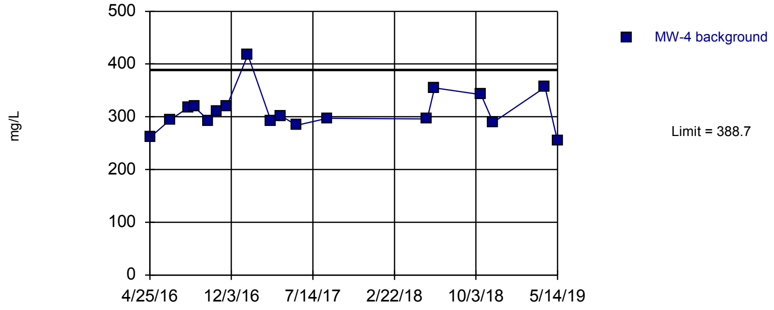


Background Data Summary: Mean=301.6, Std. Dev.=56.48, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9168, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary: Mean=311.2, Std. Dev.=38.16, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9055, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Calcium (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-1
4/26/2016	147
6/20/2016	152
8/8/2016	150
8/24/2016	142
10/3/2016	139
10/26/2016	133
11/21/2016	144
1/17/2017	131
3/22/2017	141
4/18/2017	149
5/30/2017	140
8/23/2017	152
5/22/2018	166
6/12/2018	203
10/17/2018	171
11/19/2018	154
4/10/2019	270
5/14/2019	167

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-2
4/25/2016	123
6/20/2016	168
8/8/2016	180
8/24/2016	180
10/3/2016	184
10/26/2016	171
11/21/2016	179
1/17/2017	188
3/22/2017	155
4/18/2017	156
5/31/2017	151
8/23/2017	155
5/22/2018	172
6/12/2018	179
10/17/2018	200
11/19/2018	221
4/10/2019	200
5/14/2019	170

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-3
4/25/2016	224
6/22/2016	266
8/9/2016	260
8/24/2016	274
10/4/2016	243
10/26/2016	254
11/21/2016	263
1/18/2017	431
3/22/2017	318
4/18/2017	296
5/31/2017	306
8/23/2017	298
5/24/2018	297
6/12/2018	318
10/17/2018	392
11/19/2018	387
4/10/2019	348
5/14/2019	254

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

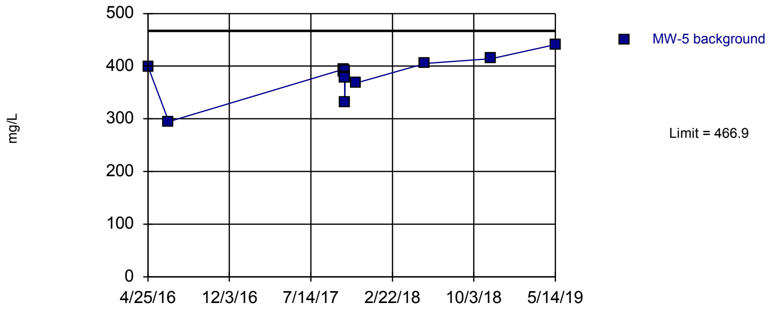
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-4
4/25/2016	261
6/20/2016	295
8/9/2016	318
8/24/2016	319
10/3/2016	293
10/26/2016	311
11/21/2016	320
1/18/2017	417
3/22/2017	292
4/18/2017	302
5/31/2017	284
8/23/2017	297
5/23/2018	296
6/12/2018	355
10/17/2018	342
11/19/2018	289
4/10/2019	356
5/14/2019	254

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-5



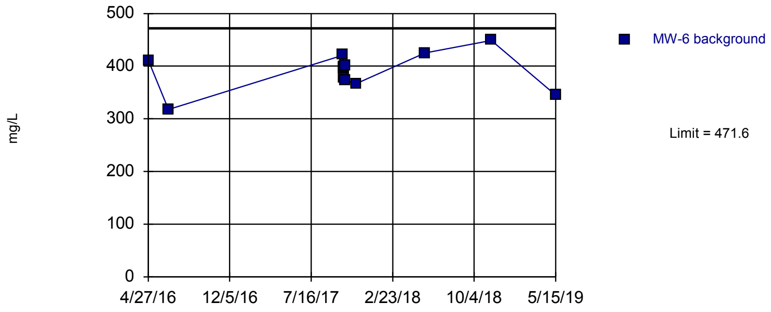
Background Data Summary: Mean=382.1, Std. Dev.=38.01, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9172, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-6



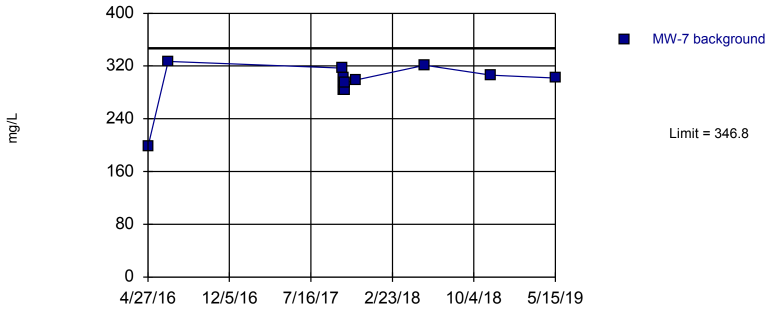
Background Data Summary: Mean=390.4, Std. Dev.=36.38, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9786, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-7



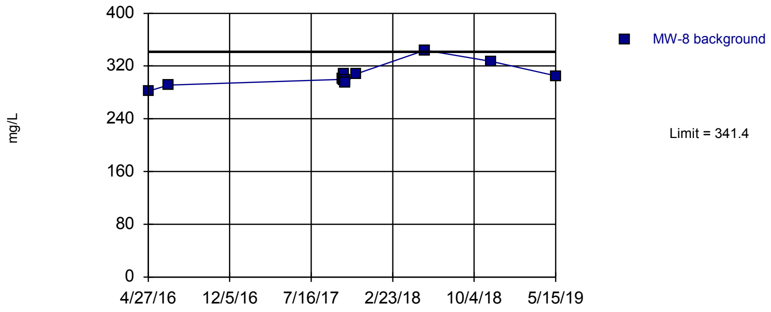
Background Data Summary (based on cube transformation): Mean=2.6e7, Std. Dev.=6944823, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8464, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-8



Background Data Summary: Mean=304.5, Std. Dev.=16.53, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8722, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-5
4/25/2016	399
6/21/2016	295
10/12/2017	394
10/13/2017	389
10/14/2017	391
10/15/2017	332
10/16/2017	380
10/17/2017	377
11/16/2017	368
5/23/2018	405
11/20/2018	414
5/14/2019	441

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-6
4/27/2016	411
6/21/2016	318
10/12/2017	421
10/13/2017	396
10/14/2017	400
10/15/2017	378
10/16/2017	402
10/17/2017	373
11/16/2017	367
5/23/2018	425
11/20/2018	449
5/15/2019	345

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-7
4/27/2016	198
6/21/2016	327
10/12/2017	317
10/13/2017	302
10/14/2017	283
10/15/2017	294
10/16/2017	284
10/17/2017	294
11/16/2017	299
5/23/2018	321
11/20/2018	306
5/15/2019	302

Prediction Limit

Constituent: Calcium (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

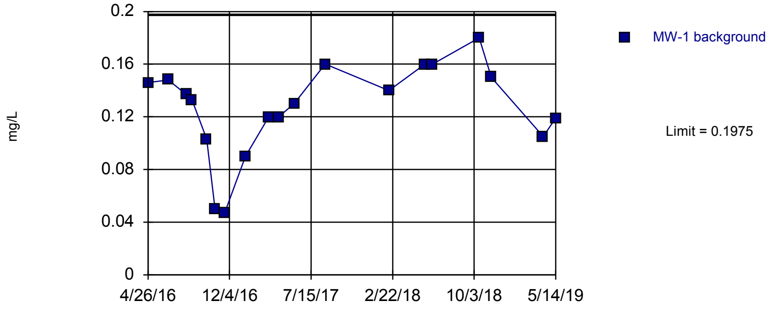
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-8
4/27/2016	282
6/21/2016	291
10/12/2017	300
10/13/2017	298
10/14/2017	299
10/15/2017	307
10/16/2017	299
10/17/2017	294
11/16/2017	308
5/23/2018	344
11/20/2018	327
5/15/2019	305

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1 (bg)



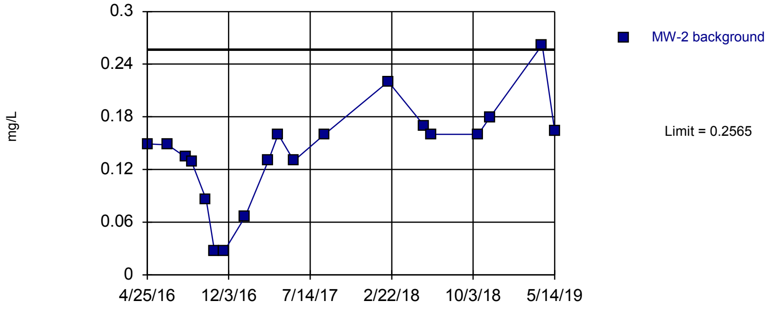
Background Data Summary: Mean=0.1262, Std. Dev.=0.03546, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9175, critical = 0.863. Kappa = 2.01 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-2 (bg)



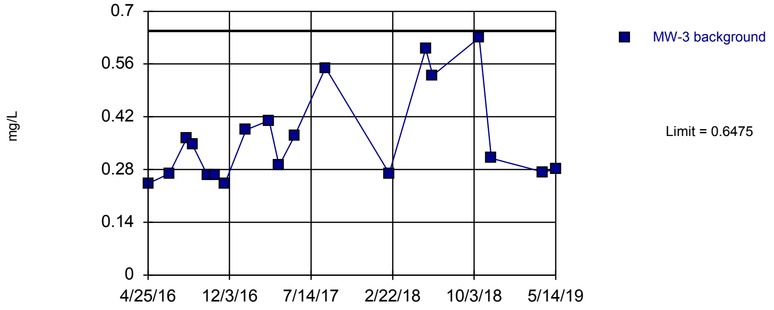
Background Data Summary: Mean=0.1401, Std. Dev.=0.05792, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9235, critical = 0.863. Kappa = 2.01 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-3 (bg)



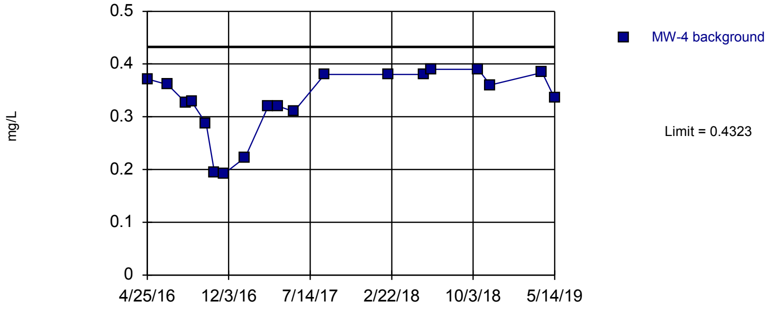
Background Data Summary (based on natural log transformation): Mean=-1.063, Std. Dev.=0.3126, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.875, critical = 0.863. Kappa = 2.01 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary (based on square transformation): Mean=0.1114, Std. Dev.=0.03754, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8742, critical = 0.863. Kappa = 2.01 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-1
4/26/2016	0.146 (J)
6/20/2016	0.148 (J)
8/8/2016	0.137 (J)
8/24/2016	0.133 (J)
10/3/2016	0.103 (J)
10/26/2016	0.05 (J)
11/21/2016	0.047 (J)
1/17/2017	0.09 (J)
3/22/2017	0.12
4/18/2017	0.12
5/30/2017	0.13
8/23/2017	0.16
2/13/2018	0.14 (D)
5/22/2018	0.16
6/12/2018	0.16
10/17/2018	0.18
11/19/2018	0.15
4/10/2019	0.105
5/14/2019	0.119

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-2
4/25/2016	0.149 (J)
6/20/2016	0.148 (J)
8/8/2016	0.134 (J)
8/24/2016	0.129 (J)
10/3/2016	0.086 (J)
10/26/2016	0.027 (J)
11/21/2016	0.027 (J)
1/17/2017	0.066 (J)
3/22/2017	0.13
4/18/2017	0.16
5/31/2017	0.13
8/23/2017	0.16
2/13/2018	0.22 (D)
5/22/2018	0.17
6/12/2018	0.16
10/17/2018	0.16
11/19/2018	0.18
4/10/2019	0.262
5/14/2019	0.164

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-3
4/25/2016	0.243 (J)
6/22/2016	0.269 (J)
8/9/2016	0.363
8/24/2016	0.346
10/4/2016	0.266 (J)
10/26/2016	0.266 (J)
11/21/2016	0.244 (J)
1/18/2017	0.385
3/22/2017	0.41
4/18/2017	0.29
5/31/2017	0.37
8/23/2017	0.55
2/13/2018	0.27 (D)
5/24/2018	0.6
6/12/2018	0.53
10/17/2018	0.63
11/19/2018	0.31
4/10/2019	0.273
5/14/2019	0.281

Prediction Limit

Constituent: Fluoride (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-4
4/25/2016	0.372
6/20/2016	0.361
8/9/2016	0.326
8/24/2016	0.329
10/3/2016	0.287 (J)
10/26/2016	0.194 (J)
11/21/2016	0.192 (J)
1/18/2017	0.223 (J)
3/22/2017	0.32
4/18/2017	0.32
5/31/2017	0.31
8/23/2017	0.38
2/13/2018	0.38 (D)
5/23/2018	0.38
6/12/2018	0.39
10/17/2018	0.39
11/19/2018	0.36
4/10/2019	0.384
5/14/2019	0.335

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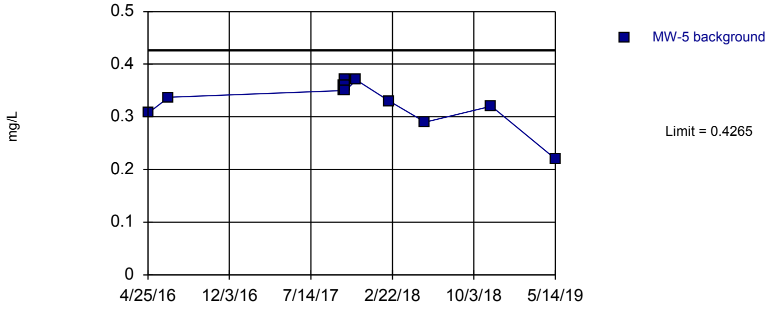
Prediction Limit

Intrawell Parametric, MW-5



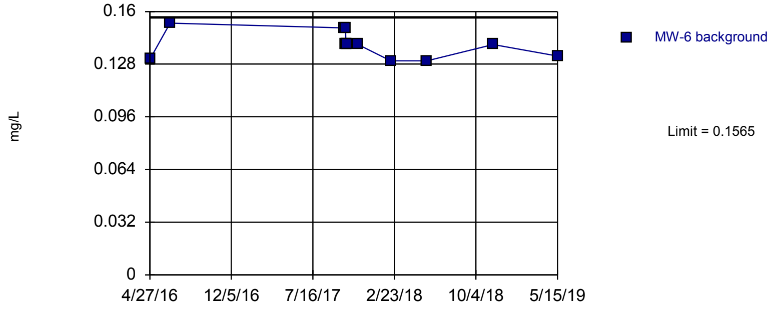
Background Data Summary: Mean=0.3334, Std. Dev.=0.04245, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8179, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:55 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-6



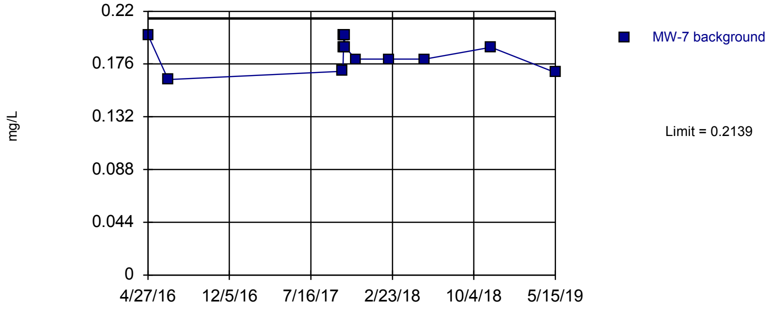
Background Data Summary: Mean=0.1398, Std. Dev.=0.007628, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8775, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-7



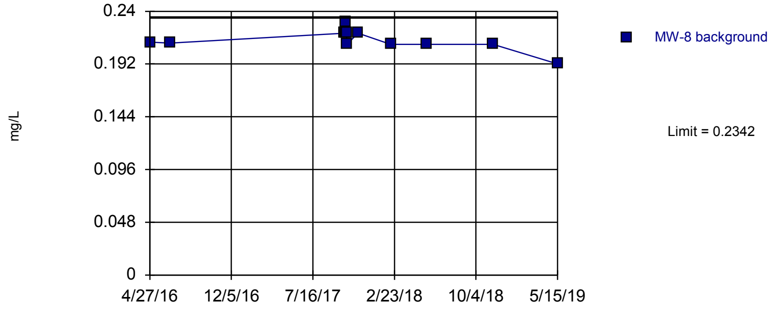
Background Data Summary: Mean=0.1855, Std. Dev.=0.01295, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8949, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-8



Background Data Summary: Mean=0.2142, Std. Dev.=0.009112, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8671, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-5
4/25/2016	0.307
6/21/2016	0.337
10/12/2017	0.35
10/13/2017	0.36
10/14/2017	0.37
10/15/2017	0.37
10/16/2017	0.36
10/17/2017	0.35
11/16/2017	0.37
2/14/2018	0.33 (D)
5/23/2018	0.29
11/20/2018	0.32
5/14/2019	0.22

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-6
4/27/2016	0.131 (J)
6/21/2016	0.153 (J)
10/12/2017	0.15
10/13/2017	0.15
10/14/2017	0.14
10/15/2017	0.14
10/16/2017	0.14
10/17/2017	0.14
11/16/2017	0.14
2/14/2018	0.13 (D)
5/23/2018	0.13
11/20/2018	0.14
5/15/2019	0.133

Prediction Limit

Constituent: Fluoride (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-7
4/27/2016	0.2 (J)
6/21/2016	0.163 (J)
10/12/2017	0.17
10/13/2017	0.19
10/14/2017	0.2
10/15/2017	0.2
10/16/2017	0.2
10/17/2017	0.19
11/16/2017	0.18
2/14/2018	0.18 (D)
5/23/2018	0.18
11/20/2018	0.19
5/15/2019	0.169

Prediction Limit

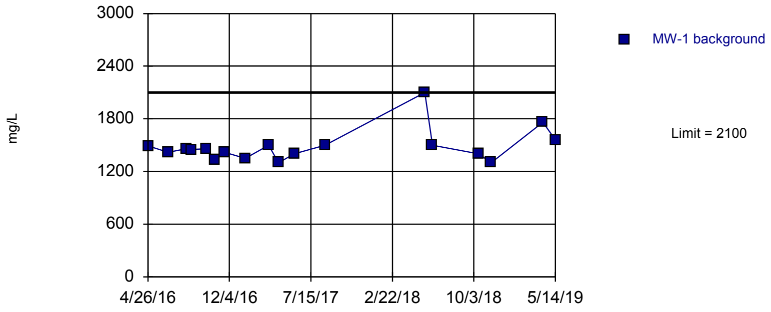
Constituent: Fluoride (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-8
4/27/2016	0.212 (J)
6/21/2016	0.211 (J)
10/12/2017	0.22
10/13/2017	0.23
10/14/2017	0.22
10/15/2017	0.22
10/16/2017	0.22
10/17/2017	0.21
11/16/2017	0.22
2/14/2018	0.21 (D)
5/23/2018	0.21
11/20/2018	0.21
5/15/2019	0.192

Prediction Limit

Intrawell Non-parametric, MW-1 (bg)

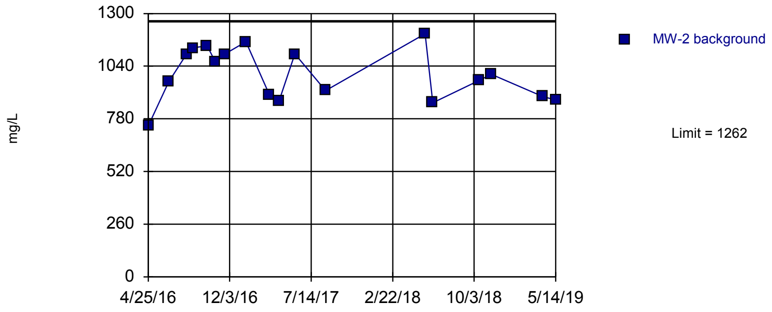


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Intrawell Parametric, MW-2 (bg)

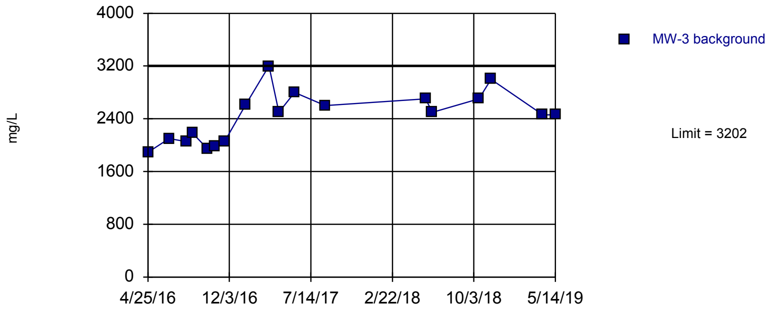


Background Data Summary: Mean=998.9, Std. Dev.=129.3, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9464, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Intrawell Parametric, MW-3 (bg)

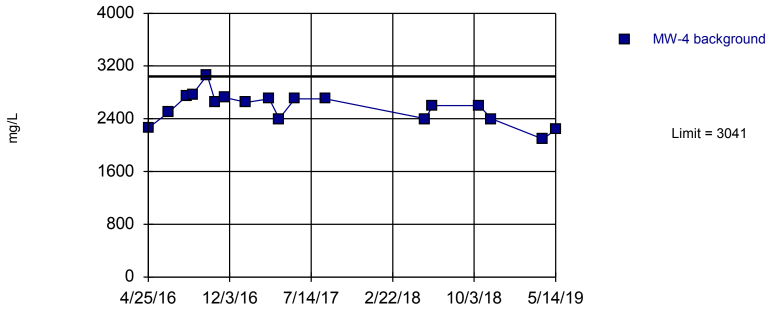


Background Data Summary: Mean=2431, Std. Dev.=379.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9476, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary: Mean=2566, Std. Dev.=233.5, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9529, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-1
4/26/2016	1490
6/20/2016	1420
8/8/2016	1460
8/24/2016	1450
10/3/2016	1460
10/26/2016	1330
11/21/2016	1420
1/17/2017	1350
3/22/2017	1500
4/18/2017	1300
5/30/2017	1400
8/23/2017	1500
5/22/2018	2100
6/12/2018	1500
10/17/2018	1400
11/19/2018	1300
4/10/2019	1760
5/14/2019	1560

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-2
4/25/2016	745
6/20/2016	964
8/8/2016	1100
8/24/2016	1130
10/3/2016	1140
10/26/2016	1060
11/21/2016	1100
1/17/2017	1160
3/22/2017	900
4/18/2017	870
5/31/2017	1100
8/23/2017	920
5/22/2018	1200
6/12/2018	860
10/17/2018	970
11/19/2018	1000
4/10/2019	889
5/14/2019	873

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-3
4/25/2016	1890
6/22/2016	2100
8/9/2016	2050
8/24/2016	2190
10/4/2016	1950
10/26/2016	1980
11/21/2016	2060
1/18/2017	2620
3/22/2017	3200
4/18/2017	2500
5/31/2017	2800
8/23/2017	2600
5/24/2018	2700
6/12/2018	2500
10/17/2018	2700
11/19/2018	3000
4/10/2019	2460
5/14/2019	2460

Prediction Limit

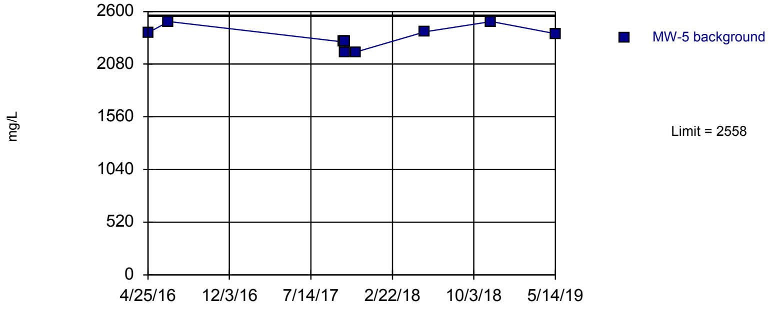
Constituent: Sulfate (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-4
4/25/2016	2260
6/20/2016	2500
8/9/2016	2750
8/24/2016	2770
10/3/2016	3060
10/26/2016	2650
11/21/2016	2720
1/18/2017	2650
3/22/2017	2700
4/18/2017	2400
5/31/2017	2700
8/23/2017	2700
5/23/2018	2400
6/12/2018	2600
10/17/2018	2600
11/19/2018	2400
4/10/2019	2090
5/14/2019	2240

Prediction Limit

Intrawell Parametric, MW-5

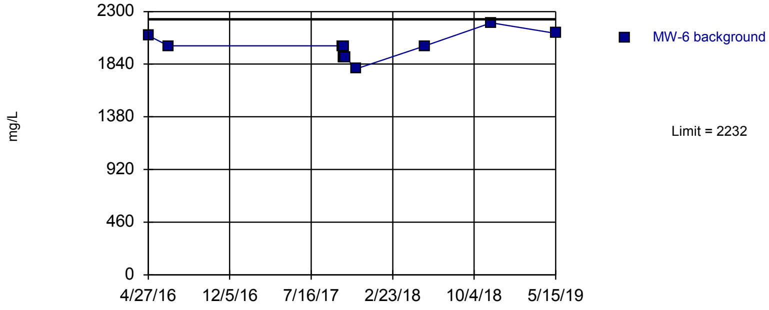


Background Data Summary: Mean=2339, Std. Dev.=98.21, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9007, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Intrawell Parametric, MW-6

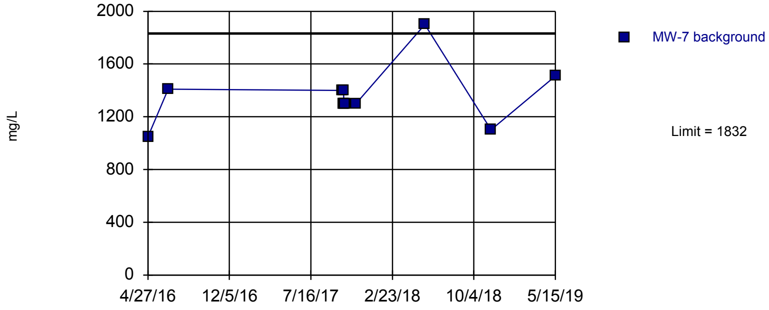


Background Data Summary: Mean=1983, Std. Dev.=111.5, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.939, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Intrawell Parametric, MW-7

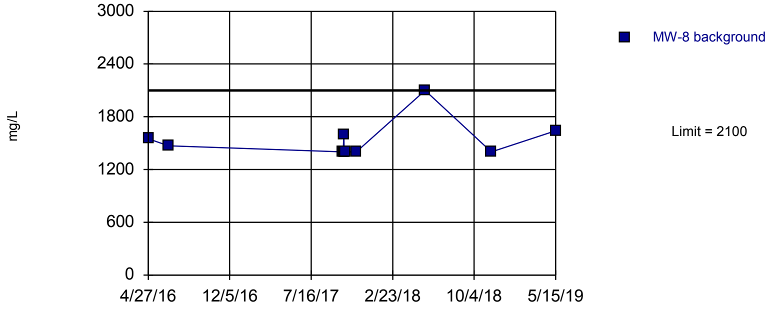


Background Data Summary: Mean=1356, Std. Dev.=213.5, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8496, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Intrawell Non-parametric, MW-8



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-5
4/25/2016	2390
6/21/2016	2500
10/12/2017	2300
10/13/2017	2300
10/14/2017	2300
10/15/2017	2300
10/16/2017	2300
10/17/2017	2200
11/16/2017	2200
5/23/2018	2400
11/20/2018	2500
5/14/2019	2380

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-6
4/27/2016	2090
6/21/2016	2000
10/12/2017	2000
10/13/2017	2000
10/14/2017	1900
10/15/2017	1900
10/16/2017	1900
10/17/2017	1900
11/16/2017	1800
5/23/2018	2000
11/20/2018	2200
5/15/2019	2110

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-7
4/27/2016	1050
6/21/2016	1410
10/12/2017	1400
10/13/2017	1400
10/14/2017	1300
10/15/2017	1300
10/16/2017	1300
10/17/2017	1300
11/16/2017	1300
5/23/2018	1900
11/20/2018	1100
5/15/2019	1510

Prediction Limit

Constituent: Sulfate (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-8
4/27/2016	1550
6/21/2016	1470
10/12/2017	1400
10/13/2017	1600
10/14/2017	1400
10/15/2017	1400
10/16/2017	1400
10/17/2017	1400
11/16/2017	1400
5/23/2018	2100
11/20/2018	1400
5/15/2019	1640

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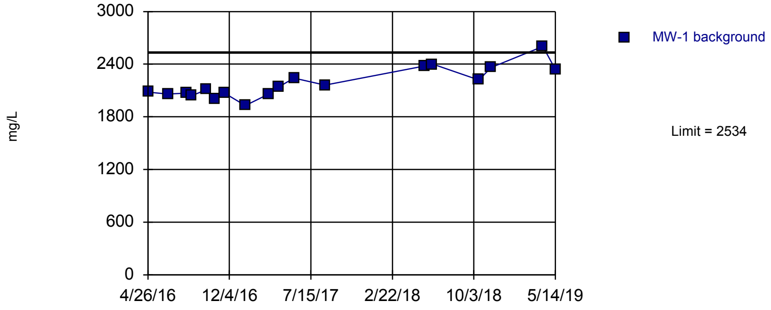
Prediction Limit

Intrawell Parametric, MW-1 (bg)



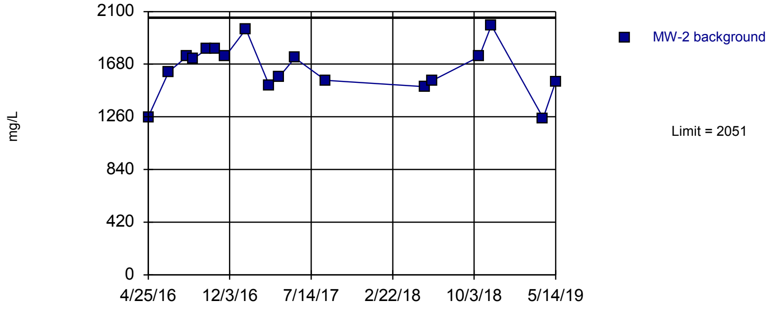
Background Data Summary: Mean=2181, Std. Dev.=173.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9208, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-2 (bg)



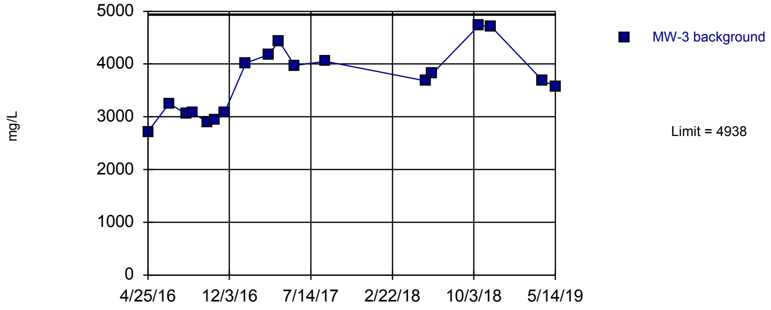
Background Data Summary: Mean=1643, Std. Dev.=200.5, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9458, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-3 (bg)



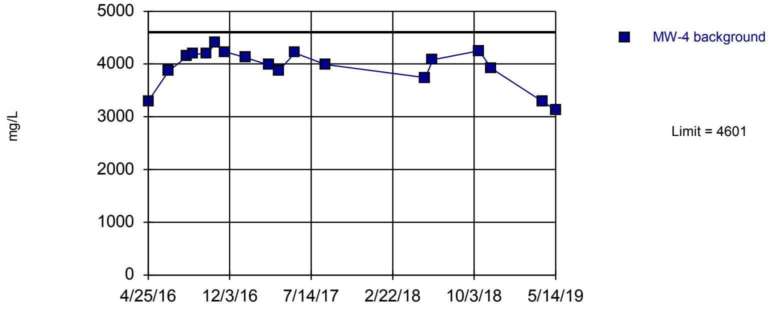
Background Data Summary: Mean=3661, Std. Dev.=628.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9455, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary (based on square transformation): Mean=1.6e7, Std. Dev.=2719774, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8799, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Total Dissolved Solids (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-1
4/26/2016	2080 (D)
6/20/2016	2060 (D)
8/8/2016	2070 (D)
8/24/2016	2040
10/3/2016	2110 (D)
10/26/2016	2000
11/21/2016	2070 (D)
1/17/2017	1930 (D)
3/22/2017	2060 (D)
4/18/2017	2140
5/30/2017	2240 (D)
8/23/2017	2160 (D)
5/22/2018	2380 (D)
6/12/2018	2400
10/17/2018	2220
11/19/2018	2360 (D)
4/10/2019	2600
5/14/2019	2340 (D)

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-2
4/25/2016	1260 (D)
6/20/2016	1620 (D)
8/8/2016	1740 (D)
8/24/2016	1720
10/3/2016	1800 (D)
10/26/2016	1800
11/21/2016	1740 (D)
1/17/2017	1960 (D)
3/22/2017	1510 (D)
4/18/2017	1580
5/31/2017	1730 (D)
8/23/2017	1550 (D)
5/22/2018	1500 (D)
6/12/2018	1550
10/17/2018	1740
11/19/2018	1990 (D)
4/10/2019	1250
5/14/2019	1540 (D)

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-3
4/25/2016	2720 (D)
6/22/2016	3250 (D)
8/9/2016	3050 (D)
8/24/2016	3080
10/4/2016	2900 (D)
10/26/2016	2940
11/21/2016	3090 (D)
1/18/2017	4020 (D)
3/22/2017	4180 (D)
4/18/2017	4440
5/31/2017	3970 (D)
8/23/2017	4050 (D)
5/24/2018	3680 (D)
6/12/2018	3820
10/17/2018	4730
11/19/2018	4710 (D)
4/10/2019	3680
5/14/2019	3580 (D)

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-4
4/25/2016	3300 (D)
6/20/2016	3870 (D)
8/9/2016	4140 (D)
8/24/2016	4190
10/3/2016	4190 (D)
10/26/2016	4400
11/21/2016	4230 (D)
1/18/2017	4120 (D)
3/22/2017	3980 (D)
4/18/2017	3880
5/31/2017	4210 (D)
8/23/2017	3990 (D)
5/23/2018	3740 (D)
6/12/2018	4080
10/17/2018	4250
11/19/2018	3920 (D)
4/10/2019	3280
5/14/2019	3130 (D)

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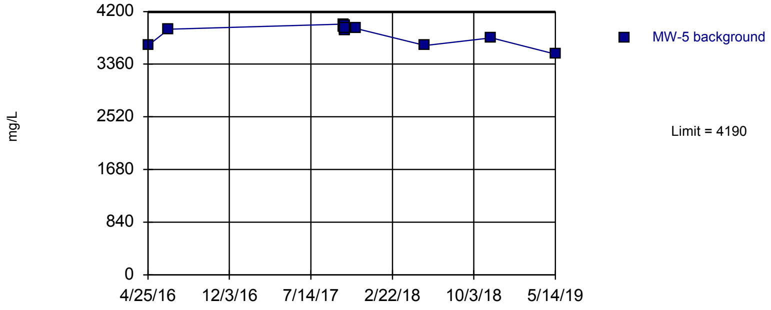
Prediction Limit

Intrawell Parametric, MW-5



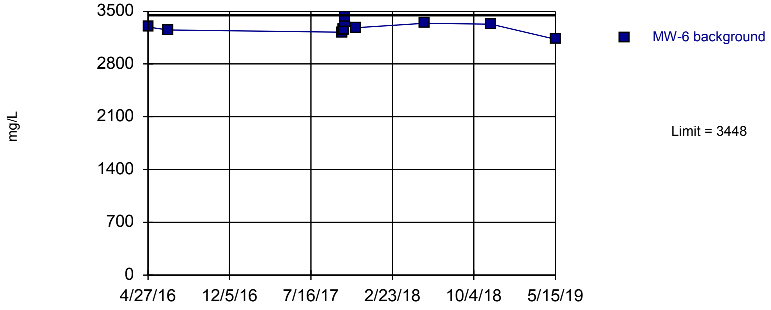
Background Data Summary: Mean=3846, Std. Dev.=154.3, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8398, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-6



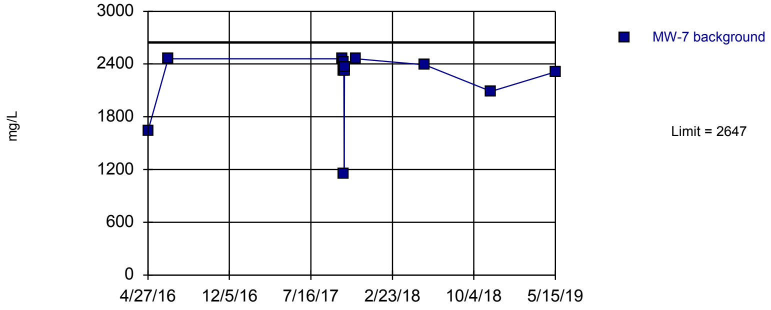
Background Data Summary: Mean=3283, Std. Dev.=74.36, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9669, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-7



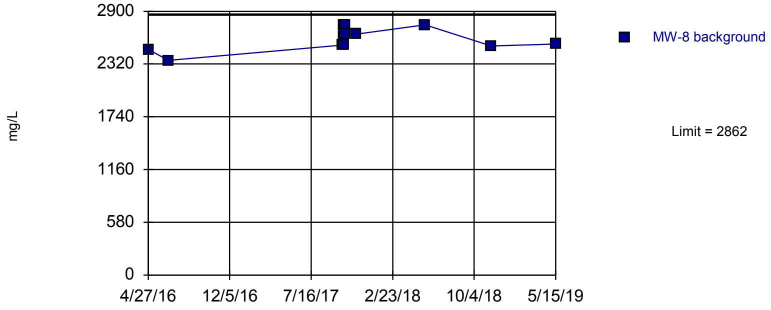
Background Data Summary (based on x^5 transformation): Mean=6.3e16, Std. Dev.=3.0e16, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8216, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-8



Background Data Summary: Mean=2593, Std. Dev.=120.2, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9303, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:56 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-5
4/25/2016	3660
6/21/2016	3920
10/12/2017	4000
10/13/2017	3960
10/14/2017	3910
10/15/2017	3890
10/16/2017	3980
10/17/2017	3940
11/16/2017	3930
5/23/2018	3660
11/20/2018	3780
5/14/2019	3520

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-6
4/27/2016	3290
6/21/2016	3250
10/12/2017	3220
10/13/2017	3250
10/14/2017	3260
10/15/2017	3260
10/16/2017	3360
10/17/2017	3420
11/16/2017	3280
5/23/2018	3340
11/20/2018	3330
5/15/2019	3130

Prediction Limit

Constituent: Total Dissolved Solids (mg/L)   Analysis Run 9/27/2019 11:56 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas CCR LF

	MW-7
4/27/2016	1640
6/21/2016	2460
10/12/2017	2460
10/13/2017	2420
10/14/2017	2320
10/15/2017	1150
10/16/2017	2320
10/17/2017	2360
11/16/2017	2460
5/23/2018	2390
11/20/2018	2090
5/15/2019	2310

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 9/27/2019 11:56 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas CCR LF

	MW-8
4/27/2016	2480
6/21/2016	2360
10/12/2017	2530
10/13/2017	2740
10/14/2017	2630
10/15/2017	2530
10/16/2017	2740
10/17/2017	2650
11/16/2017	2650
5/23/2018	2750
11/20/2018	2520
5/15/2019	2540

Appendix C

WFG Low-Flow Groundwater Sampling TSOP

1. Purpose

1.1. The purpose of this Technical SOP (TSOP) is to discuss the process and requirements associated with conducting Low-Flow groundwater sampling.

1.2. This TSOP specifically describes using bladder pumps and peristaltic pumps to obtain groundwater samples collected for laboratory analysis by the Alabama Power Company (APC) Environmental Affairs (EA), Water Field Group (WFG).

2. Scope

2.1. This procedure is to be used by field personnel when collecting and handling groundwater samples using the Low-Flow groundwater collection method in the field.

2.2. The sampling equipment covered in this TSOP may be portable (well-to-well) or well-dedicated.

2.3. The sampling of SVOCs and VOCs should not be collected with the use of peristaltic pumps unless prior written customer approval is attained.

2.4. The procedure is designed to ensure that the samples collected are representative of the aquifer or target formation and that sample cross-contamination is eliminated during the sampling and handling process.

2.5. This procedure cannot replace education and experience. Professional judgment should be used in conjunction with this procedure.

3. Definitions/Abbreviations

3.1. Low-Flow (or micropurge) - Refers to the velocity with which water is withdrawn from the well. The objective of low-flow sampling is to extract fresh samples of the ambient groundwater from within the screened interval of the well with minimal impact to the zone of influence of the well.

3.2. Drawdown - Lowering of the water column within a well due to pumping. Typically associated with high-flow purging of a well for water sampling.

3.3. DI water – De-ionized water. Water that has been passed through a standard deionizing resin column. Water used for decontamination of field equipment.

3.4. Ultra-pure DI water- Water that is filtered and treated to the highest levels of purity. This water is used for the filling of blanks.

3.5. Phosphate-free soap or cleaner – A cleaner which contains, by weight, 0.5% or less of phosphates or derivatives of phosphates (Liquinox® or Luminox®).

3.6. Potable water- Water that is safe to consume. Can be used in detergent solution and first rinse during decontamination. Can be replaced by DI water.

3.7. PPE - Personal Protective Equipment.

3.8. NTU - Nephelometeric Turbidity Units. The unit of measure used when measuring the turbidity of water.

3.9. COC - Chain of Custody. A controlled document used to record sample information and transfer the samples to the laboratory after collection.

3.10. SVOCs and VOCs- Semi-volatile organic compounds and volatile organic compounds.

3.11. DO - Dissolved Oxygen

3.12. ORP - Oxidation Reduction Potential

3.13. SAP - Sampling and Analysis Plan

3.14. EDAS- Environmental Data Acquisition System

3.15. Artesian well- A well in which water rises under pressure from a permeable stratum overlaid by impermeable rock.

4. References

4.1. Internal Documents

4.1.1. WFG Groundwater Equipment Decontamination TSOP
4.1.2. WFG Groundwater Water Level and Total Depth Measurements TSOP
4.1.3. WFG General Water Sampling and Field Measurement TSOP
4.1.4. WFG Deployment and Maintenance of Dedicated Groundwater Equipment TSOP
4.1.5. WFG Turbidity TSOP
4.1.6. WFG Temperature TSOP
4.1.7. WFG Conductivity TSOP
4.1.8. WFG Luminescent Dissolved Oxygen (LDO) TSOP
4.1.9. WFG Oxidation-Reduction Potential (ORP) TSOP
4.1.10. WFG pH (TSOP-SM-4500H) TSOP
4.1.11. WFG Electronic Calibration Form
4.1.12. Groundwater Electronic Chain of Custody

4.1.13. Site specific SAP

4.2. External Documents

4.2.1. United States Environmental Protection Agency (U.S. EPA). Region 4, Groundwater Sampling. Document # SESDPROC-301-R4.

4.2.2. Florida Department of Environmental Protection (DEP). FS 2200 Groundwater Sampling. Document # DEP-SOP-001/01.

4.2.3. United States Environmental Protection Agency (U.S. EPA). Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. Document # EPA/540/S-95/504.

4.2.4. ASTM Standard D6771-18- Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations

5. Method Overview

5.1. Low flow sampling of groundwater from within the screened interval is accomplished by maintaining a low pump rate that minimizes drawdown of the water column while leaving the more stagnant water above the screened interval undisturbed.

5.2. Indicator parameters and water levels are measured at the beginning of and while micro-purging the well. Stabilization acceptance criteria for turbidity, pH, specific conductance and DO are found in the site specific SAP. Stabilization of these parameters indicates that the water is representative of ambient conditions and sample collection can begin. ORP and temperature measurements should also be collected but will not be used as indicators of stability.

5.3. Non-dedicated sampling equipment must be decontaminated prior to next use in a well to avoid cross contamination. Refer to and understand the Groundwater Equipment Decontamination TSOP prior to performing groundwater sampling.

6. Detection Limit

6.1. Some of the indicator parameter methods used to show equilibrium of the well water have minimum detection limits or other quality control requirements. Refer to the latest version of the TSOPs associated with these procedures (turbidity, pH, specific conductance, and DO).

6.2. Users of this procedure must study and be familiar with the applicable data acceptance criteria and required field measurements. Refer to the SAP for information on these parameters and other information.

7. Safety

7.1. Appropriate PPE should be worn and utilized when sampling groundwater wells in accordance with APC policies. Generally this includes safety glasses, hard hats, gloves and safety-toed boots. Plant-specific requirements may also apply and should be determined/known prior to arriving at the work location.

7.2. Refer to the WFG General Water Sampling and Field Measurement TSOP procedure for general safety requirements.

7.3. If using compressed Nitrogen gas for deep wells, always secure tanks when transporting and ensure protective cap is secured over valve. Take care to avoid exceeding the max pressure rating of the controller, air hose and pump.

8. Equipment and Materials

The following is a basic listing of the necessary reusable and expendable items that are required to complete this procedure.

8.1. Reusable Items

- 8.1.1. Field Book
- 8.1.2. Appropriate installation diagram and/or well construction data
- 8.1.3. Keys for well locks
- 8.1.4. Water level meter
- 8.1.5. Pump with parts (tubing grab plates, bladders, O-rings, etc.)
- 8.1.6. Pump controller
- 8.1.7. Peristaltic pump
- 8.1.8. Flow-through cell
- 8.1.9. iPad
- 8.1.10. InSitu™ multi-parameter probe
- 8.1.11. Handheld turbidity meter
- 8.1.12. Generator (min. 2,000 kW)
- 8.1.13. Air compressor and hose
- 8.1.14. Graduated cylinder
- 8.1.15. Tubing Weight (for peristaltic application)
- 8.1.16. Tubing caddy with counter unit or other measurement device
- 8.1.17. Decon/wash containers w/ lids (3)
- 8.1.18. Coolers for samples
- 8.1.19. Procedures & SAPs

8.2. Consumable/Disposable Items

8.2.1. Tubing (estimated for number of wells x well depths with extra)
8.2.2. Silicone tubing for peristaltic pump head
8.2.3. COCs (if electronic format is not suitable)
8.2.4. Plastic sheeting
8.2.5. Gasoline (in approved container)
8.2.6. Ice for samples
8.2.7. Sample Bottles
8.2.8. DI water (For decon)
8.2.9. Ultra-Pure DI water (For blanks collection)
8.2.10. Potable water (for decon)
8.2.11. Phosphate free detergent (e.g. Liquinox or Luminox®)
8.2.12. Support rope or coated safety cable
8.2.13. Calibration Standards
8.2.14. Disposal sample bags & trash bags
8.2.15. Paper towels

9. Reagents & Standards

9.1. This document describes the Low-Flow purging and sampling procedure and does not include method calibration procedures. Calibration procedures may be found in the associated method TSOP on the APC Qualtrax site. The instrument(s) used to measure indicator parameters must be verified daily using the below appropriate calibration standards (or equivalent).

9.1.1. ORP- ZoBell's ORP Solution
9.1.2. pH- 3-point calibration

    9.1.2.1. 2.00 buffer standard for pH
    9.1.2.2. 4.00 buffer standard for pH
    9.1.2.3. 7.00 buffer standard for pH
    9.1.2.4. 10.00 buffer standard for pH
    9.1.2.5. 12.00 buffer standard for pH

9.1.3. DO - NA
9.1.4. Specific Conductance - 1,412 µS/cm, or appropriate conductivity standard
9.1.5. Turbidity – Zeroed with 0.00 standard and calibrated with 10.00 NTU standard

10. Calibration

10.1. Calibration and/or verification of water quality measurement equipment shall be performed at the start of each day and should be specific to the manufacturer's calibration instructions. A verification check of the instrument calibration will be performed after the calibration and at the end of each day with a standard of the same value but different lot number or manufacturer.

10.2. All calibration data, and initial and final LCS data, should be recorded electronically in the calibration log on EDAS.

10.3. Refer to the APC TSOP for each method to complete the instrument calibration (TSOPs: turbidity, pH, temperature, specific conductance, DO and ORP).

11. Procedure

General Note

At the start of each sampling event, a round of water levels from each well should be collected for use in generating a potentiometric surface map. This should be completed on the first day of the sampling event. Refer to the Groundwater Water Level and Total Depth Measurement TSOP for guidance.

11.1. Well lock keys are maintained by the plant compliance contact and must be obtained from the compliance office, if not already assigned a key, prior to beginning work

11.2. Inspect the well for any damage or tampering. If there is evidence of damage or tampering, immediately notify the Technical Manager or the Water Field Services Supervisor. Take photos of the site as documentation and make sure not to disturb the well. The damage/tampering and any discussions about a response should also be documented in the field logbook or electronically in the iPad.

11.3. If the well is in good condition, open the well head and if the well is non-dedicated and non-vented, remove the inner casing cap to allow for atmospheric equilibration. Begin setting up to sample by arranging/organizing the work zone.

11.4. Designate a clean work space or work surface used to provide a contaminant-free area to place sampling equipment during assembly.

11.5. Calibrate or verify all field parameter measurement equipment at the start of each day (this typically includes an InSitu multi-meter probe and a handheld turbidity meter if an inline turbidity sensor is not used). Refer to the appropriate method TSOP and calibration procedure for each instrument used.

11.6. All non-dedicated equipment that will, or could come into contact with groundwater (e.g. pump and water level meter) in the well must be decontaminated prior to each use. Refer to the Groundwater Equipment Decontamination TSOP for more details.

11.7. Using a properly functioning water level indicator, lower the probe into the well and obtain an initial water level measurement for the well (Refer to WFG Groundwater Water Level and Total Depth Measurements TSOP).

11.8. Measure and record all water levels to the nearest hundredth (0.01) foot at the reference point or survey mark on the well casing.

11.9. Refer to the WFG Deployment and Maintenance of Dedicated Groundwater Equipment TSOP for initial or re-deployment of dedicated pumps and for performing maintenance activities.

11.10. Dedicated Low-Flow – Bladder Pump

11.10.1. Connect the external compressor hose to the pump controller intake port using the quick-connect.

11.10.2. Connect the pump air supply line to the “Air Out” quick connect on the control box. Connect the other end of the air supply line to the air connection on the dedicated well cap.

11.10.3. Connect a short piece of tubing to the existing sample line on the dedicated well cap and then connect to the bottom of the flow-through cell for the InSitu multi-probe. Use care to ensure proper connection of the tubing.

11.10.4. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth. Ensure that the dedicated pump is still located below the water table, and at a suitable sampling depth.

11.10.5. Insert the InSitu multi-parameter probe into the flow-through cell and press the power button

11.10.6. Turn on the iPad and open the InSitu Low-Flow application (iSitu® or VuSitu® app). Enter the initial data needed to initiate the program or if a template is available, open the well specific template. Refer to the manufacturer’s instructions for a step-by-step explanation of the Low-Flow app and the data input required.

11.10.7. Continue to fill in all appropriate information in the InSitu program using the parameter stabilization criteria set forth in the site-specific SAP. Always confirm with the Technical Manager that the current SAP is being used.

11.10.8. Place the generator as far away as possible from the well, preferable downwind. Start the generator and the air compressor to begin pumping. If the well is too deep for a traditional air compressor, use of compressed Nitrogen gas, high pressure controller and pressure regulator may be required.

11.10.9. Monitor the water level and adjust the flow rate on the pump controller to provide a constant water level in the well. Pump rates should not exceed three tenths of a foot (0.3) water level drawdown when sampling. During initial pump start-up, drawdown may exceed three tenths of a foot (0.3) while flow rate adjustments are being made or while water level stabilization occurs.

11.10.10. Use a graduated cylinder (or similar) to measure the flow rate in milliliters per minute (ml/min). Purge rates must fall between 100 and 500 ml/min or meet the specific requirements provided in the project SAP. If the minimum flow rate requirement of 100 ml/min cannot be achieved without water level drawdown exceeding three tenths of a foot (0.3), refer to section 16.1.

11.10.10.1. If the well has been previously purged and sampled, refer back to the most recent well record and make an effort to target that purge rate for consistency.

11.10.11. When a stable purge rate is attained, enter that flow rate in the InSitu program and set the measurement frequency to every 5 minutes. The Low-Flow application (iSitu® or VuSitu® app) will now be used to determine when groundwater samples can be taken. The Low-Flow app uses the previously entered SAP acceptance criteria and applies them to each measurement. When the criteria are met, the indicator parameter will be highlighted in green on the iPad screen, indicating equilibration.

11.10.12. Note the start time and other well information in the field log book and start the program.

11.10.13. Turbidity measurements may be taken with an inline turbidity sensor or with an external handheld unit. If using an external turbidity meter, readings must collected as close as possible to the time as the readings acquired from the InSitu meter.

11.10.14. Continue to measure water level and turbidity at the same measurement frequency as the indicator parameters, entering the values in the iPad InSitu application.

11.10.15. Once the water level and all field parameters have stabilized and turbidity is less than 10 NTU according to the criteria in the SAP, the well is considered equilibrated and sampling may take place. Refer to the site-specific SAP and Sections 16.2 and 16.3 of this procedure for direction on wells where 10 NTU are unattainable.

11.10.16. Tap the “**Finish Test**” button on the iPad and enter any relevant notes such as time sampled in the comment section. Email the data file to a secure company email address for storage and use. In the event that there is no data service to email the file and the iPad is damaged or lost before the field report can be sent, the well will be re-sampled.

11.10.17. **DO NOT** turn off the pump. Complete the labeling for all sample bottles and also record the same information for each sample in the field log book, and all electronic forms.

11.10.18. Put on nitrile or latex gloves and make sure that all bottles are preserved with the appropriate acid.

11.10.19. Carefully remove the sample line from the bottom of the flow-through cell. Cut the end off of the sample tubing and begin filling up the sample containers.

11.10.20. Do not adjust the flow rate when sampling.

11.10.21. Fill up the containers by placing the tubing in the mouth of the bottle, using care not to touch the mouth or sides of the container. Do not overfill sample bottles. Bottle should be filled to the top leaving a small amount of headspace, unless otherwise directed by the customer or lab.

11.10.22. Upon filling and capping all sample containers, place the samples in the sample cooler and ensure that the samples with temperature requirements are placed on ice.

11.10.23. Turn off the controller, air compressor and generator.

11.10.24. Remove the water level indicator from the well, making sure to decontaminate the wetted tape and probe portion.

11.10.25. Disconnect the airline tubing from the controller and make sure the sample line tubing is disconnected. Secure the dedicated tubing within the wellhead in such manner that the tubing stays clean and does not fall into the well. Close and secure the well.

11.11. Non- Dedicated Low Flow- Bladder Pump

11.11.1. Complete Steps 11.1 – 11.9 from the above procedure.

11.11.2. Assemble a clean pump system with a bladder, and connect the support rope or cable, sample line, and air line to the top of the pump assembly. Use care to ensure proper connection and positioning. Never lower a pump in a well without a support rope attached.

11.11.3. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth.

11.11.4. Slowly lower the pump assembly into the well, using care to minimize disturbance once the groundwater interface is reached. The tubing counter or other depth measurement devices can be used to aid in determining appropriate depth.
11.11.5. Recharge characteristics may dictate the need to place the pump intake slightly lower than the mid-screen depth if drawdown historically is unavoidable.
11.11.6. With the pump intake lowered to approximately mid-screen depth, secure the support rope or cable so that the pump is fixed and stationary in the well.
11.11.7. Cut the air line to an appropriate length and attach to the air hose on the pump controller. Next, cut the water line to an appropriate length and attach to the bottom of the flow-through cell.
11.11.8. Re-lower the water level meter into the well.
11.11.9. Follow above Steps 11.10.5 – 11.10.23.
11.11.10. Remove the pump and tubing from the well. Discard the used tubing and pump bladder. Never re-use disposable sampling equipment or tubing.
11.11.11. Place the well cap back on the well and close and lock the well lid.

11.12. Low Flow –Peristaltic Pumps

11.12.1. Complete steps 11.1 – 11.9 from the above procedures.
11.12.2. Peristaltic- Dedicated Well Tubing

11.12.2.1. Prepare an adequate length of clean silicon tubing that has the correct outside and inside dimensions to allow proper fit in the pump head. Insert into the pump head rollers and secure (refer to pump user manual for additional information).
11.12.2.2. Connect the vacuum end of the silicone tubing to the barb fitting on the dedicated well cap.
11.12.2.3. Attach the discharge end of the silicone tubing to the bottom of the flow through cell.

11.12.3. Peristaltic- Non-Dedicated Well Tubing

11.12.3.1. Attach the tubing weight to the end of clean polyethylene tubing.
11.12.3.2. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth.

11.12.3.3. Using the tubing caddy or another tubing depth measurement device, slowly lower the tubing and weight to the mid-screen depth.

11.12.3.4. Once the tubing intake is at the correct depth, allow for excess tubing at the surface and insert into the pump head rollers and secure.

11.12.3.5. Allow for a short section (one to three feet) of tubing from the discharge side of the pump head. This may be used for both the purge discharge and to fill sample bottles upon stabilization.

11.12.3.6. Attach the discharge tubing to the intake (lower) port of the flow-through cell.

11.12.4. Insert the InSitu multi-parameter probe into the flow-through cell and press the power button on the battery pack.

11.12.5. Turn on the iPad and open the InSitu Low-Flow application (iSitu® or VuSitu® app). Enter the initial data needed to initiate the program or if a template is available, open the well-specific template. Refer to the manufacturer's instructions for a step-by-step explanation of the Low-Flow app and the data input required.

11.12.6. Make the necessary preparations to provide power to the pump. Turn on the peristaltic pump to produce a vacuum on the well side of the pump head and begin purging. Observe pump direction to ensure that the pump operation is applying a vacuum to the sample line (down-hole) tubing.

11.12.7. Monitor the water level and adjust the flow rate to provide a constant water level in the well. The pump rate will initially require adjustment based on the site and well properties. Pump rates should not exceed three tenths of a foot (0.3) water level drawdown when sampling. During initial pump start-up, drawdown may exceed three tenths of a foot (0.3) while flow rate adjustments are being made or while water level stabilization occurs. If the minimum flow rate requirement of 100 ml/min cannot be achieved without water level drawdown exceeding three tenths of a foot (0.3), refer to section 16.1.

11.12.8. Continue to fill in all appropriate information in the InSitu program using the parameter stabilization criteria set forth in the site-specific SAP. Always confirm with the Technical Manager that the current SAP data are being used.

11.12.9. Use a graduated cylinder (or similar) to measure the flow rate in milliliters per minute (ml/min). Purge rates must fall between 100 and 500 ml/min or meet the specific requirements provided in the project SAP.

11.12.9.1. If the well has been previously purged and sampled, refer back to the most recent well record and make an effort to match the purge rate for consistency.

11.12.10. When a stable purge rate is attained, enter that flow rate in the InSitu program and set the measurement frequency to 5 minutes. The Low-Flow application (iSitu® or VuSitu® app) will now be used to determine when groundwater samples can be taken. The Low-Flow app uses the previously entered SAP acceptance criteria and compares them to each measurement. When the criteria are met, the indicator parameter will be highlighted in green on the iPad screen, indicating equilibration.

11.12.11. Note the start time and other well information in the field log book and start the program.

11.12.12. Turbidity measurements may be taken with an inline turbidity sensor or with an external handheld unit. If using an external turbidity meter, readings must be collected as close as possible to the time as the readings acquired from the InSitu meter.

11.12.13. Continue to measure water level and turbidity at the same measurement frequency as the indicator parameters, entering the values in the iPad SmarTROLL™ application.

11.12.14. Once the water level and all field parameters have stabilized and turbidity is less than 10 NTU according to the criteria in the SAP, the well is considered equilibrated and sampling may take place. Refer to the site-specific SAP and Sections 16.2 and 16.3 of this procedure for wells where 10 NTU is unattainable.

11.12.15. Tap the "**Finish Test**" button on the iPad and enter any relevant notes such as time sampled in the comment section. Email the data file to a secure company email address for storage and use. In the event that there is no data service to email the file and the iPad is damaged or lost before the field report can be sent, the well will be re-sampled.

11.12.16. **DO NOT** turn off the pump. Complete the labeling for all sample bottles and also record the same information for each sample in the field log book and associated electronic forms.

11.12.17. Make sure that all bottles are preserved with the appropriate acid.

11.12.18. Carefully remove the sample line from the bottom of the flow-through cell. Cut the end off of the sample tubing and begin filling up the sample containers.

11.12.19. Do not adjust the flow rate when sampling.

11.12.20. Fill up the containers by placing the tubing in the mouth of the bottle, using care not to touch the mouth or sides of the container. Do not overfill sample bottles. Bottles should be filled to the top leaving a small amount of headspace unless otherwise directed by the customer or lab.

11.12.21. Upon filling and capping all sample containers, place the samples in the sample cooler and ensure that the samples with temperature requirements are placed on ice.

11.12.22. Stop the pump and reverse the flow direction so that the sample line is emptied of water.

11.12.23. Turn off the peristaltic pump and generator.

11.12.24. Remove the water level indicator from the well, making sure to decontaminate the wetted tape and probe.

11.12.25. For dedicated tubing, disconnect the silicone tubing piece from the pump and dedicated well cap and throw away. Close and secure the well. For non-dedicated tubing, disconnect the tubing from the pump and throw away.

11.13. Decontamination and Clean-Up – For all Reusable Components

11.13.1. Decontamination of any reusable components can be completed as a separate task at a later time but must not be re-used until decontaminated according to the WFG Groundwater Equipment Decontamination TSOP.

11.13.2. Do not re-use any disposable sampling equipment and throw away all non-dedicated tubing and bladders after use.

11.13.3. Pack up and secure all equipment and complete all sample information on the COC.

11.13.4. Reattach well cap (as appropriate) and close and lock the wellhead.

12. Calculations and Reports

12.1. Sample reports should be emailed in the field using the InSitu iPad application to a secure company email address.

13. Data Interpretation, Recording and Reporting

13.1. Data interpretation and reporting will be completed by personnel with Southern Company Services (SCS) and will subsequently be used to produce the compliance report per the Coal Combustion Residuals Rule [80 FR 21301] and respective state agency requirements.

13.2. Recording of field data used to support the interpretation and reporting process will be completed using field log books and/or sample reports that will be filled out each time groundwater monitoring activities are conducted. The field log book or sample report should contain the following information:

13.2.1. Well identification number
13.2.2. Well depth
13.2.3. Static water level depth, date & time
13.2.4. Pumping rate, drawdown, indicator parameter values, time at five minute intervals; calculated or measured total volume pumped
13.2.5. Time of sample collection
13.2.6. Field observations
13.2.7. Name of sample collectors
13.2.8. Weather conditions
13.2.9. QA/QC data for blanks (sample time and location)

13.3. Information on sample times, dates, analytical methods, personnel, etc. should be filled out on the COC for each sample and turned in with the samples to the proper lab.

14. Quality Control Acceptance Criteria and Corrective Actions for Failed QC

14.1. Any deviations or issues related to the well sampling process should be documented in the field log book or sample report.

14.2. One sample duplicate and one field blank shall be collected per every group of 10 wells sampled as specified in the SAP. An equipment rinsate blank should also be collected at a rate of 1 per every CCR storage unit. Refer to the site specific SAP for guidance. Ultra-pure DI water shall be used as the control water for all blanks.

14.3. Calibration acceptance criteria for field parameters may be found in the individual TSOP documents. Refer to individual TSOPs for guidance on initial and final LCS failures.

15. Diagrams

15.1. Well construction logs are maintained by SCS Earth Sciences and may be consulted to confirm total well depth and screened interval.

16. Deviations/Exceptions

16.1. The low-flow sampling method is not always feasible in some wells due to very slow recharge rates. Depending on the geology and conditions of water bearing zones, water levels may decline at rates greater than the accepted minimum drawdown limit of three tenths of a foot (0.3 ft) even with minimal flow rates. If this is the case, and the well has a dedicated pump, minimum purge sampling may be necessary. Follow the below steps for minimum purge sampling:

16.1.1. Calculate the total system volume (bladder, tubing & flow through cell) by inputting the necessary information in the InSitu program.
16.1.2. Purge 1-3 times the system volume, depending on the volume of the overhead water column.
16.1.3. Purge rates should occur at rates less than 100 ml/min.
16.1.4. Collect field readings after at least 1 system volume has been purged.
16.1.5. Commence sampling once system volume(s) have been purged.
16.1.6. Document field methodology, data, calculations and observations.

16.2. The target for monitoring turbidity is readings less than or equal to 5 NTUs, however this value is not mandatory (EPA, July 1996). In some instances, turbidity levels may exceed the recommended turbidity level due to natural aquifer conditions, changes in aquifer recharge, or other well characteristics. When these conditions are encountered, the following guidelines shall be considered:

16.2.1. If turbidity readings are greater than 5 NTU but less than 10 NTU and all other parameter criteria has been met, sampling can commence.
16.2.2. If turbidity readings are slightly above 10 NTU, but are trending downward, purging and monitoring shall continue.
16.2.3. If turbidity readings are greater than 10 NTUs and are stable within 10% for the final 3 consecutive readings and pumping has occurred for at least 2 hours, well sampling shall be based upon stabilization of critical indicator parameters (pH, Specific Conductance and DO).

16.2.3.1. In situations described in the above section, first collect a preserved sample set followed by an additional preserved sample set to be field filtered.
16.2.3.2. After the first sample set is collected, attach a 0.45 micron field filter to the end of the sample line. Allow for about 300 ml of sample water to pass through the filter prior to sample collection. Once filtered bottles have been filled, dispose of the filter. Ensure that the filtered sample set is properly denoted on the label.

16.3. Artesian Wells

16.3.1. For wells that are artesian, water may free flow out of the well casing before it reaches equilibrium. In such cases, a dedicated pump is not required. It is acceptable to collect the sample using traditional low flow criteria utilizing a special well cap fitted with control valve routed directly to the flow through cell. A minimum of 1 well volume should be purged before sample collection.

17. Client-Defined Specifications/Observations/Specialized Analysis

17.1. A project SAP is required on a groundwater sampling project and is available for review in the groundwater folder on EDAS. This document provides project-specific information regarding regulatory, sampling, containerization, chemical analysis, and data acceptance criteria requirements.

*****END OF DOCUMENT*****

PLANT GORGAS GYPSUM LANDFILL GROUNDWATER MONITORING PLAN

Revised August 21, 2020

PREPARED FOR:

Alabama Power

Southern Company Services
Earth Sciences and Environmental Engineering

REVISED GROUNDWATER MONITORING PLAN

ALABAMA POWER COMPANY - PLANT GORGAS

This *Revised Groundwater Monitoring Plan, Alabama Power Company - Plant Gorgas Gypsum Landfill*, has been prepared to document that the Site groundwater monitoring network and monitoring plan meets the requirements described by ADEM Admin Code r. 335-13-15-.06(2). It has been completed under the supervision of a licensed Professional Geologist with Southern Company Services.

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8/21/2020
Date

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1. INTRODUCTION

The Gorgas Gypsum Landfill Groundwater Monitoring Plan (GMP or plan) has been updated to include additional information regarding the hydrogeological evaluation for the site, the background groundwater monitoring network, procedures for updating the background data set, and statistical methods used to evaluate groundwater quality data.

Groundwater monitoring at the Plant Gorgas Gypsum Landfill is required by the Alabama Department of Environmental Management (ADEM or the Department), ADEM Admin. Code r. 335-13-15-.06, to detect potential downgradient changes in groundwater quality. This GMP meets the requirements set forth for groundwater monitoring networks as described by ADEM Admin. Code r. 335-13-15-.06(2). The plan describes the groundwater monitoring program for the site, including the following key components: description of subsurface hydrogeology and uppermost aquifer, monitoring well network design, sampling and analyses program, and statistical analyses program.

Prior to the promulgation of the Federal and State coal combustion residuals (CCR) regulations, the Gypsum Landfill was permitted under Industrial Waste Landfill Permit #64-10 (ADEM Admin Code Ch. 335-13-4) effective January 8, 2016. Accordingly, the GMP was developed and groundwater monitoring activities, under ADEM Admin Code Ch. 335-13-4, began in 2014. The first groundwater monitoring report submitted to the Department in 2016.

Groundwater monitoring has occurred since 2016 in accordance with the United States Environmental Protection Agency (EPA) CCR rule (40 CFR Part 257, Subpart D) and the State of Alabama's CCR Regulations (ADEM Admin Code Ch. 335-13-15) and results reported to ADEM. Upon initiating detection groundwater monitoring at the site in 2017 statistically significant increases (SSIs) of Appendix III monitoring parameters were detected above background levels. Pursuant to State and Federal regulations assessment monitoring was implemented. During assessment monitoring, Appendix IV constituents were detected at statistically significant levels (SSLs) above groundwater protection standards (GWPS). Consequently, an Assessment of Corrective Measures (ACM) was prepared and submitted to ADEM in February 2020. The site performs semi-annual assessment monitoring as additional site investigation is performed and a final remedy is developed. However, during the most recent sampling events of 2019, no GWPS exceedances were noted in downgradient wells.

The purpose of this plan is to present the groundwater monitoring network, field and lab procedures, and site-specific statistical analysis plan for Departmental review and approval. This plan also seeks to establish procedures or mechanisms for managing changes to the monitoring network and statistical analyses.

2. SITE LOCATION AND DESCRIPTION

Alabama Power Company's Plant Gorgas is located in southeastern Walker County, Alabama, approximately fifteen miles south of Jasper, at 460 Gorgas Road, Parrish, Alabama 35580. Plant Gorgas lies in portions of Sections 7, 8, 9, 16, 17, 18, 19, 20, 21, 28, and 29, Township 16 South, Range 6 West and Section 12, 13, and 24, Township 16 South, Range 7 West. Section/Township/Range data are based on visual inspection of USGS topographic quadrangle maps and GIS maps (USGS, 1975; USGS, 1983).

The Plant Gorgas Gypsum Landfill is located east of the main power generation facility and is bordered to the north by Highway 269 and to the south by the Mulberry Fork of the Black Warrior River. **Figure 1, Site Location Map,** depicts the location of the site referenced to roadways and geographic features. **Figure 2, Site Plan Map,** depicts the configuration of the Gypsum Landfill and the site monitoring well network. **Figure 3, Site Topographic Map**, depicts the topography of the site.

3. GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Plant Gorgas lies in the Warrior Basin physiographic region (Sapp and Emplaincourt, 1975), a late Paleozoic basin formed as a result of flexure and sediment loading associated with Appalachian and Ouachita orogenies. The bedrock geology is dominated by clastic sedimentary rocks of the Lower Pottsville Formation (GSA, 2010b). Deeper stratigraphy is marked by carbonates, shales, chert, and sandstones of Mississippian to Cambrian in age (Raymond et al., 1988). Plant Gorgas is directly underlain by rocks belonging to the Pratt Coal Group (Ward II et al., 1989). In general, the Pratt Group consists of mudstone, shale, fine-grained sandstone, and interbedded coal. **Figure 4, Site Geologic Map**, illustrates the surface geology at the site and neighboring areas.

Strip mining was conducted over a large portion of the area down to the American Seam. As a result, the overburden beneath the CCR units is dominated by backfilled mine overburden and is characterized by weathered shale and sandstone boulders with lenses of fine sediments and small amounts of coal fragments and coarse sediments. Geologic logs generated during various on-site investigations indicate that the depth to rock varies significantly, ranging from as little as five feet (un-mined areas) to as much as 155 feet below ground surface (BGS). **Figure 5, Geologic Cross-Sections A-A' and B-B'**, illustrate the geologic layering beneath the site. Borehole geophysical logs, boring logs, and well construction data is presented in **Appendix A, Boring and Well Construction Logs.**

Two water-bearing zones are present beneath the site: (1) the mine overburden/top-of-rock interface, and (2) the underlying Pottsville Aquifer. The first saturated zone beneath the site generally corresponds to the mine overburden/top of rock interface zone at which the mine-spoil overburden transitions to bedrock (Pottsville Formation).

The saturated thickness of the first saturated zone ranges between 3 and 8 feet. Hydraulic conductivity (K) in this zone varies widely, but is generally between 10^{-1} to 10^{-4} cm/sec. Well developments generally indicate low groundwater yields (quantity) between 0.05 and 1.0 gallons per minute (gpm).

The principal aquifer system from a local and regional perspective is the Pottsville Formation. The Pottsville Formation is also the uppermost aquifer beneath the site. In the Pottsville, two types of secondary porosity were observed to yield groundwater: (1) fractured intervals and (2) bedding plane weaknesses associated with fissile, siderite-banded, iron-claystone sequences. Fractured intervals are sporadic across the site and tend to occur with greater density in the upper 100 feet of rock. The upper portions of the Pottsville Aquifer beneath the proposed disposal facilities indicate unconfined to semi-confined, fractured, and extremely anisotropic conditions. The Pottsville Aquifer functions as a series of confined to semi-confined water producing zones (aquifers) since large permeability contrasts exist within the strata (Stricklin, 1989). Depth to groundwater varies significantly across the site and is wholly dependent upon encountering a fractured interval or zone of fissile, iron-claystone. Based on published data, groundwater quality produced from the Pottsville Formation can be characterized by high concentrations of sulfate, iron, and other trace metals (Jennings and Cook, 2010). Trace metals in Pottsville Formation groundwater are associated with sulfide minerals contained in organic-rich strata (e.g., Mudstones and Coal Seams) and siliceous/carbonate healed fractures and joints. Trace element enrichment is likely the result of migrating hydrothermal fluids generated during the late Paleozoic Allegheny orogeny (Diehl et al., 2005). Arsenic, antimony, molybdenum, selenium, copper, thallium, and mercury are elevated in Warrior Basin coal strata (Goldhaber et al., 2002).

The topography of the site creates a localized flow system where groundwater flow direction is south and south-southeast across the site, paralleling trends in topography, structural dip, and historic strip pit floors. Groundwater discharge in this local flow system is to the Mulberry Fork of the Black Warrior River. Mine spoil layering and complex Pottsville Formation lithofacies contribute to the vertical and horizontal heterogeneity present within the aquifer system and overlying saturated mine spoils. The potentiometric surface presented in **Figure 6, Potentiometric Surface Map (October 7, 2019)**, indicate that groundwater flow direction is consistent despite seasonal fluctuations. This heterogeneity focuses groundwater flow along more permeable pathways, such as parallel to coal seams and bedding plains, or along vertical or sub-vertical discontinuities in the rock fabric. Thus, groundwater flow paths across the site may be tortuous.

4. SELECTION OF WELL LOCATIONS

According to ADEM Admin Code r. 335-13-15-.06(2)(a), the groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

1. Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit; and
2. Accurately represent the quality of groundwater passing the waste boundary of the CCR unit.

ADEM Admin Code r. 335-13-15-.06(2)(b) states that the number, spacing, and depths of groundwater monitoring system wells must be determined based upon site-specific technical information that must include a characterization of:

1. Aquifer thickness, groundwater flow rate, groundwater flow direction, including seasonal and temporal fluctuations in groundwater flow; and
2. Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

ADEM Admin Code r. 335-13-15-.06(2)(c) requires the groundwater monitoring system to include the number of monitoring wells necessary to meet the performance standard set forth in the rules. The monitoring system must contain a minimum of one upgradient and three downgradient monitoring wells but consist of additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

This groundwater monitoring network was previously approved by the Department under a minor modification to existing industrial waste landfill permit #64-10 operating under state solid waste rules (ADEM Admin Code Ch. 335-13-4).

4.1 Compliance Monitoring Network

Groundwater monitoring wells are installed to monitor the uppermost occurrence of groundwater beneath the site which accurately represent the quality of groundwater passing the waste boundary of the CCR unit. Locations are selected based on facility layout and site geologic and hydrogeologic considerations. The proposed groundwater monitoring network at Plant Gorgas Gypsum Landfill is subdivided into background and compliance locations as based upon potentiometric contours and interpretations by a qualified groundwater scientist.

Background wells represent the quality of background water that has not been or would not be affected by the CCR unit. Compliance wells are screened within the uppermost aquifer and are used to assess potential impacts to the first “aquifer” in the event of a release. Groundwater monitoring wells are designed and constructed using “Design and Installation of Groundwater Monitoring Wells in Aquifers”, ASTM Subcommittee D18.21 on Groundwater Monitoring, as a guide. **Table 1, Groundwater Monitoring Well Network Details**, and **Figure 7, Groundwater Monitoring Well Location Map**, present the designed purpose and locations of monitoring wells with respect to the facility. Groundwater monitoring wells generally are screened across the mine spoil overburden – top of rock interface as this corresponds to the first zone of saturation beneath the site. If groundwater saturation is not present, deeper Pottsville intervals are targeted for well screens.

4.2 Background Monitoring Wells

Background groundwater is the baseline quality of groundwater that is representative of the aquifer being monitored, and that has not been affected by disposed CCR material. A background groundwater monitoring network has been identified at the Site based on groundwater flow conditions, groundwater quality, and statistical screening of the data in accordance with the Unified Guidance (Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance, March 2009, USEPA 530/R-09-007). The following describes the selected background network based on these criteria.

To evaluate upgradient well locations at the Site, groundwater elevations and CCR indicator parameters were reviewed. As presented on **Table 1** and **Figure 7**, 7 monitoring wells (MW-1, MW-2, MW-3, MW-4, MW-13, MW-14, and MW-15) located upgradient of the Gypsum Landfill serve as background monitoring wells.

The following subsections describe in detail the results of this upgradient well evaluation process.

4.2.1 Groundwater Elevations and Flow

Groundwater elevations and potentiometric surfaces constructed for the Site since 2012 (pre-Gypsum LF construction) demonstrate a consistent groundwater flow direction and establish areas hydraulically upgradient of the Gypsum Landfill. Because the Gypsum Landfill is a lined facility complete with a leachate collection system there is no mounding of groundwater and subsequent radial flow emanating away from the facility. As shown on **Figure 6**, groundwater flow at the Site is towards the south with only a slight 3 to 5-degree bend towards the east. Groundwater flow direction is driven by gravity and closely mimics site topography which has a north to south slope toward the Mulberry Fork of the Black Warrior River. Potentiometric surface contours and groundwater flow direction demonstrate that wells located to the north or northwest of the Gypsum Landfill are hydraulically upgradient and well locations to the west are lateral to groundwater flow direction. Therefore, monitoring well locations MW-1, MW-2, MW-3, MW-4, MW-13, MW-14, and MW-15 are hydraulically upgradient of the Gypsum Landfill.

The potentiometric surface contour map shown on **Figure 6** also clearly demonstrates that upgradient wells MW-13, MW-14, and MW-15 are not in the downgradient flow path away from the Bottom Ash Landfill and therefore, are suitable as unimpacted, upgradient wells for the Gypsum Landfill.

4.2.2 Groundwater Geochemistry

A comparison of the concentrations of key Appendix III and IV indicator parameters is useful in determining if a well is impacted by leakage from the CCR unit. At the Gypsum Landfill, groundwater quality data in upgradient wells was compared to downgradient wells. The results from these comparisons show similar overall concentrations for key indicator parameters, which isn't unexpected, given that the Gypsum Landfill is a relatively new landfill, the Gypsum Landfill was constructed with a liner and leachate collection system, and no impacts to groundwater from the Gypsum Landfill are suspected.

To summarize findings, boron concentrations, likely the strongest indicator of a CCR impact to groundwater were non-detect in upgradient wells MW-13, MW-14, and MW-15 and detected at low-level, trace concentrations in upgradient wells, MW-1, MW-2, MW-3, and MW-4. Downgradient wells also generally displaced low concentrations of boron. The results are presented in **Table 2, Upgradient Comparisons – Key Indicator Parameters**.

Comparison of Field Data

Comparing field parameters can often be useful for evaluating potential upgradient locations. In upgradient locations, it is more likely to find higher dissolved oxygen (DO), positive oxidation-reduction potential (ORP), lower conductivity, and lower pH. This because upgradient locations are more likely to be screened across younger, recharging groundwater. Recharging water generally carries higher DO (closer connection/more recent interaction with atmosphere) and have lower pH values more like meteoric water which is slightly acidic due to interactions with carbon dioxide in the atmosphere. Lower conductivity is expected due to a shorter residence time and consequently, less time for groundwater-rock interaction which naturally contributes to higher total dissolved solids. Conversely, downgradient and impacted wells are more likely to show reducing conditions (low DO, more strongly negative ORP), higher pH values, and higher conductivity (indicates higher total dissolved solids). The Gypsum Landfill is constructed with a liner and leachate collection system, and as presented in **Table 2,** a comparison of field parameters between upgradient wells and the average of downgradient wells demonstrates that downgradient wells have not been impacted by leakage from the CCR unit.

As presented in **Table 2,** well locations MW-1, MW-2, MW-3, MW-4, MW-13, MW-14, and MW-15 generally do show similar pH, DO, conductivity, and positive ORP values when compared to downgradient wells. The most notable difference is the comparison of pH data in which 3 of the upgradient locations (MW-1, MW-2, and MW-3) have an average of 5.4 SU. The pH values for these upgradient locations represents the potential variability that can be observed in mine spoil and Pottsville rocks as pH values can range from 3.77 to 5.69 SU, ORP from 66.4 to 353.4 millivolts, and DO from 0.52 to 1.07 mg/L. These variations are reflective of wetter than normal rainy seasons over the past couple of seasons combined with a recovery from the summer drought of 2016. The infiltration of weakly acidic rainwater and interactions with pyritic intervals (oxidization) decreases pH and can lead to the release of naturally occurring trace elements within pyritic and iron hydroxide/oxyhydroxide rich zones.

Based on review of data presented in Section 4.2.1 and 4.2.2, the wells identified for use as background groundwater monitoring points satisfy the requisite criteria: the wells are located hydraulically upgradient of the Gypsum Landfill and do not show evidence of having been impacted by a release from the Gypsum Landfill or the Bottom Ash Landfill. The wells are screened in the same groundwater flow system as the downgradient compliance wells and thus represent background groundwater quality migrating toward the Gypsum Landfill.

4.2.3 Statistical Screening

Details regarding screening of the background is presented in the attached Statistical Analysis Plan (**Appendix B**). Groundwater quality was determined to be representative of a statistical background following screening in accordance with the Unified Guidance (*Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance*, March 2009, USEPA 530/R-09-007).

4.3 Downgradient Compliance Wells

Adequately locating and screening downgradient monitoring wells are essential to being able to detect potential impacts to groundwater from the Gypsum Landfill. Well locations, MW-16, MW-17R, MW-18, MW-19, and MW-20, as shown on **Table 1** and **Figure 7** are designated as downgradient compliance monitoring wells. These wells are screened at or near the mine spoil – top of rock interface which represents the first saturated zone and water-table flow system beneath the Site and are installed in the downgradient direction of flow away from the Gypsum Landfill as shown on the potentiometric surface contour map (**Figure 6**). Water levels in these wells are generally equal to or within a few feet of the screen length indicating water table conditions.

The base elevation of Gypsum Landfill cell is approximately 360 ft MSL and Sedimentation Pond approximately 332 feet above MSL. Potentiometric surface contours derived from Site monitoring wells (MW-13, MW-14, MW-15, MW-16, MW-17R, MW-18, MW-19 and MW-20) indicate that groundwater elevations are between 335 and 300 feet above MSL from north to south, respectively.

Therefore, data suggests a vertical separation greater than 20-feet between the base of Gypsum Landfill cells and the water-table at the Site. Recharging meteoric water, or leachate, in the unlikely event of a release from the facility, would migrate vertically through the vadose zone until reaching the sharp permeability contrast encountered at the top of rock interface before flowing horizontally along the top of rock and also slowly migrating vertically into deeper Pottsville strata at preferred locations. Hydrogeologic cross-sections through these facilities are presented as **Figure 5.**

Based upon a review of the data discussed above, downgradient compliance wells are adequately installed to detect downgradient and vertical migration of leachate to deeper Pottsville flow systems in the unlikely event of a release from the facility. Additionally, although not part of the immediate downgradient network for the Gypsum Landfill, other wells downgradient of the Bottom Ash Landfill and those surrounding the Gypsum Landfill further downgradient of the Gypsum Landfill could be utilized for detection or delineation in the event of a release from the facility.

4.4 Updating the Background Well Network

The intention of this groundwater monitoring plan is to present the final groundwater monitoring network and designation of monitoring wells for permitting. However, in the future and over time the upgradient or background well network may be updated by adding or removing wells, updating background periods, re-designating existing wells, or modifying the background data set.

Changes to the background well network and data set will be made after receipt of Departmental approval.

If an update or modification to the permitted background network is recommended in the future, APC will complete the following:

- A notice will be submitted to the Department describing the proposed change(s) and the rationale for the change. The notice will contain statistical screening of the background data set and include sufficient information to evaluate and approve the request.
- Upon approval by the Department, the background network and data set will be adjusted pursuant to the proposal and used for future analyses.
- A revised groundwater monitoring plan and minor modification will be submitted to the Department.

The Statistical Analysis Plan in Appendix B provides details regarding requesting Department approval for updates and changes to the background well network and data set.

When well re-designations are approved by the Department, new statistical limits will be calculated based upon the resulting monitoring well network. When background data is updated, historical reports and exceedance lists will not be updated unless approved by the Department. Changes will apply to future analysis unless an immediate change is warranted. If delineation or groundwater corrective action is underway, the new background may be applied to those actions as appropriate with Department approval.

When background data is updated changes will apply to future analysis unless an immediate change is warranted. If delineation or groundwater corrective action is underway, the new background will be applied to those actions as appropriate with Department approval.

5. MONITORING WELL DRILLING, CONSTRUCTION, ABANDONMENT & REPORTING

The following describes monitoring system performance standards that have been applied to monitoring well activities subsequent to this monitoring plan and that will be applicable to all work performed in the future.

5.1 DRILLING

Drilling methodology may include, but not be limited to: hollow stem augers, direct push, air rotary, mud rotary, or rotosonic techniques. The drilling method will minimize the disturbance of subsurface materials and will not cause impact to the groundwater. Borings will be advanced using an appropriate drilling technology capable of drilling and installing a well in site-specific geology. Drilling equipment will be decontaminated before use and between borehole locations using the procedures described in the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Field Equipment Cleaning and Decontamination as a guide.

Sampling or coring may be used to help determine the stratigraphy and geology. Samples will be logged by a qualified groundwater scientist. Screen depths will be chosen based on the depth of the uppermost aquifer. Logging will be performed by a geologist or geotechnical engineer registered in the State of Alabama or working under the direction of a geologist or engineer registered in Alabama.

5.2 DESIGN AND CONSTRUCTION

Well construction materials will be sufficiently durable to resist chemical and physical degradation and will not interfere with the quality of groundwater samples. Groundwater monitoring wells are designed and constructed in accordance with ADEM Admin Code r. 335-13-15-.06(2)(e) using “Design and Installation of Groundwater Monitoring Wells in Aquifers”, ASTM Subcommittee D18.21 on Groundwater Monitoring as a guide. Well installations will generally follow the procedures outlined below.

The minimum boring diameter will be four inches larger than the outside diameter of the well casing, and a minimum well casing diameter of two inches will be used. Up to ten feet of ASTM NSF-rated Schedule 40 PVC with 0.010- in. slots will be set at an approximate depth of 10-20 ft below the typical water table depth. ASTM NSF-rated Schedule 40 PVC flush-threaded riser casing with will be used to finish the well approximately 3 feet of above-ground surface. A filter pack consisting of well-rounded and chemically inert materials (e.g., clean quartz) will be packed around the screen from the bottom of the borehole to a minimum 2 feet above the top of the screen. Sodium bentonite pellets will be placed to create a seal above the screen in the annulus for a minimum of 2-ft above the filter pack by dropping or washing down with potable water, or by tremie method. The annular space above the seal will be filled via tremie injection with a high-solids bentonite slurry, neat cement, or cement-bentonite grout mixture to the ground surface.

The design and construction of the intake of the groundwater wells will: (1) allow sufficient groundwater flow to the well for sampling; (2) minimize the passage of formation materials (turbidity) into the well; and (3) ensure sufficient structural integrity to prevent the collapse of the intake structure.

Each groundwater monitoring well will include a well screen designed to limit the amount of formation material passing into the well when it is purged and sampled. Screens with 0.010-inch slots have proven effective for the earth materials at the site and will be used unless geologic conditions discovered at the time of installation dictate a different size. Screen lengths are site and conditions dependent but are typically 10 feet. In some cases, screen lengths of 20 feet are utilized if the water table may undergo large fluctuations in elevation, particularly seasonally, or to capture a sufficient volume of water to adequately sample the groundwater well.

Additional well screen length is a tool utilized at fractured rock sites such as Plant Miller and Gorgas where groundwater yield is low and often is below the threshold for development and subsequent low-flow sampling. The additional footage of well screen assists well development and sampling by providing a greater volume of groundwater and can offer a technical advantage by providing more fracture/discrete flow zone intersection with the screened interval. Successful wells, that do not intersect groundwater yielding coal seams or well-connected fracture zones, are often predicated on encountering numerous, discrete low-yield fractures or bedding planes (where individual contributions may be sub 25 mL/min). In these instances, additional screen length can be a deciding factor in the success of a monitoring well installation.

If the above prove ineffective for developing a well with sufficient yield or acceptable turbidity, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

The placement of well screens at fractured rock sites such as Plant Miller and Gorgas is dependent upon sound borehole characterization to identify fracture networks and water bearing units. Groundwater is found chiefly in fractures and coal seams and is commonly confined by sharp permeability contrasts within the aquifer. Previously conducted conceptual site models are utilized to select target depths of well screen intervals during installation of monitor wells. In some instances, rising head tests are conducted at field dependent intervals while the borehole is being advanced to provide a preliminary characterization of borehole yield across intervals. Borehole geophysics and hydrophysical logging suites are utilized upon completion of the borehole. These logs will be utilized to determine borehole lithology and potential groundwater yielding zones. A combination of gamma, 3-arm, caliper, acoustic/optical televiewer combined with fluid resistivity/temperature logging will provide the principal points of comparison. Upon completion of the borehole geophysics, it may be necessary to backfill the boring to the well design depth. Boring are backfilled with bentonite chips to the design depth by slowly pouring the chips down the drill casing at a target pour rate of 3 minutes per 50-pound bag to prevent bridging. Additionally, periodically a weighted tape is used to check for bridging and the depth of the backfill. A target thickness of 5-ft of filter pack sand will separate the base of sand from bentonite chip backfill and to complete the backfill process.

Pre-packed dual-wall well screens may be used for well construction. Pre-packed well screens combine a centralized inner well screen, a developed filter sand pack, and an outer conductor screen in one integrated unit composed of inert materials. Pre-packed well screens will be installed following general industry standards and using the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Design and Installation of Monitoring Wells as a general guide. If the dual-wall pre-packed-screened wells do not yield sufficient water or are excessively turbid after development, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

The monitoring wells will be completed with concrete pads approximately 6-inches thick extending approximately 3 feet around the well and sloping away from the well. Each well will be capped and enclosed in a lockable above-ground protective cover with weep holes to prevent build-up of water within the protective casing. Wells located in areas with potential traffic will require a minimum of three surface protection bumper guards (bollards). All wells will have proper identification including the well identification number, total depth, and installation date.

5.3 Wells with Inconsistent Water Levels

The following procedures should be followed when field observations suggest that saturated conditions may exist at the target borehole depth at temporary and permanent well locations, but only minor amounts of free water (i.e., water capable of being sampled from a well casing) are observed in the well boreholes during drilling. These procedures should not be followed when “dry” (i.e., no free water) conditions are observed in the well boreholes at the target borehole depth. The field geologist will communicate with the project manager to determine if the boring should then be properly abandoned.

The decision to install a permanent well will be based on measurement of a target water column length. The target water column length for permanent wells is five (5) feet based on placement of the pump intake at least one (1) foot above the base of the screen and the well yielding sufficient sample volume to collect a complete sample set with quality assurance/quality control samples within one (1) day.

The following summarizes the procedure that will be followed:

- Prepare a workplan describing, at a minimum, well location(s), purpose, drilling method, target depth, and water level performance standards outlined below and submit to the Department per ADEM Admin Code r. 35-13-15-.06(2)(e).
- Drill the monitoring well borehole to the target depth.
- If sonic or core drilling, and a significant volume of drilling lubricant (drilling water) is used in tight formations (low permeability), the purging of 1 borehole volume and subsequent monitoring of water level recovery may be utilized to evaluate recharge rate.
- If the target water column length is not observed in the borehole after drilling, allow the water level in the borehole to equilibrate for 24 hours. The area around the borehole will be prepared to prevent surface water infiltration into the borehole.
- If a minimum of 5 feet of water is present in the borehole (or 4 feet of water will be present above the planned pump intake depth) after 24 hours, install the monitoring well at the target depth.
- If the above water column criteria are not present in the borehole after 24 hours, then terminate drilling at the location and grout the borehole following the appropriate Department standards.
- If a well is not installed, the Department will be notified, and an alternative well installation plan developed if necessary, to meet Department requirements.

5.4 WELL DEVELOPMENT

Upon completion of well construction, the monitoring wells will be developed using a combination of surging and purging to remove excess fines and sediments and to promote good hydraulic communication with the aquifer. Development will continue until the purged water is free of visible fines, and water quality field parameters (turbidity, pH, temperature, and conductivity) have stabilized. In cases of slow recharge and slow turbidity reduction, potable water may be injected and purged as needed to remove fines. If this approach is used, a minimum of three times the volume of water introduced must be purged from the well.

5.5 ABANDONMENT

If a permitted monitoring well should be abandoned, procedures will be followed in accordance with ADEM Admin Code r. 335-13-15-.06(2)(g). If practical, the entire well casing and screen will be removed. Removal can be accomplished by over-drilling the well with hollow stem augers and removing the grout and filter pack material from the well, followed by removal of the casing and the well screen. The clean borehole will then be backfilled with neat Portland cement from bottom to top by pressure grouting using the positive displacement (tremie) method. If the casing cannot be removed the well will be tremie grouted from the bottom of the well upwards with a neat cement. Additionally, a concrete seal will be placed at the ground surface. In either case, the top two feet of the borehole will be poured with concrete to insure a secure surface seal (plug).

Records of well abandonment activities will be kept for each well abandoned. The records will include the depth of emplacement and volume of all abandonment materials, methods of casing removal, and depth to water and well bottom prior to abandonment. A copy of these records will be provided to ADEM and a copy placed in the operating record.

If a replacement well is required, a plan and justification will be submitted to support replacement location(s) and screened intervals along with the proposal to abandon wells.

5.6 DOCUMENTATION

Pursuant to ADEM Admin. Code r. 335-13-15-.06(2)(e)4., APC will document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. Name of drilling contractor and type of drill rig.

6. GROUNDWATER SAMPLING AND ANALYSIS PLAN

Pursuant to ADEM Admin. Code r. 335-13-15-.06(4), the following section describes groundwater sampling requirements with respect to parameters for analysis, sampling frequency, sample preservation and shipment, analytical methods, chain of custody control, and quality assurance and quality control. Groundwater samples used to provide compliance monitoring data will not be filtered prior to collection.

6.1 SAMPLE COLLECTION

Groundwater samples will be collected from the monitoring well network as part of the Detection Monitoring Program, and potentially as part of the Assessment Monitoring Program, in accordance with the APC Low-Flow Groundwater Sampling Technical Standard Operating Procedures (TSOP) included as **Appendix C**. Samples will be collected using low-volume purge, or “low-flow” sampling methods with peristaltic or bladder pumps. Depth to water readings at each well location will be taken prior to sampling. Water quality parameters (pH, redox potential, conductivity, etc.) will be measured during purging and recorded on a field sampling form. Samples will be collected after field parameter stabilization criteria are met.

Low-flow (minimal drawdown) groundwater sampling procedures will be used for purging and sampling monitoring wells that will sustain a pumping rate of at least 100 milliliters per minute (mL/min) without significant water-level drawdown. Flow rates should not exceed 500 mL/min. Field water quality parameters recorded during purging will be used as criteria to determine when purging has been completed.

Where non-dedicated pumps are used, the sampling equipment must be slowly lowered into the well so as to avoid agitation of the water column. Sampling equipment and pump intakes must not extend below the midpoint of any well screen unless the well is known to drawdown and is a threat to go dry even with low flow rates or the water level in the well does not extend above the screened interval.

Most wells are screened with the top-of-screen below the static water level in the well. In these wells (1) the water level in the well must not be drawn down below the top of screen, and (2) stabilization of the water column will be considered achieved when three consecutive water level measurements vary by 0.33 feet or less at a pumping rate of no less than 100 mL/min.

If the static (pre-pumping) water level is below the top-of-screen, the water level must not be drawn down below the top of pump where it can be accurately measured.

Field water quality parameters (temperature, pH, turbidity, conductivity, dissolved oxygen and oxidation-reduction potential) will be measured but not all will be used for determining stabilization. Stabilization will be considered achieved and purging will be considered complete when three consecutive measurements of each field parameter vary within the following limits:

- 0.2 standard units for pH,
- 5% for specific conductance,
- 0.2 mg/L or 10% for DO > 0.5 mg/L (whichever is greater),
- IF DO < 0.5 mg/L there is no stabilization criteria for DO,
- Turbidity (see the following section for more detail), and
- Temperature and ORP – record only, no stabilization criteria.

The goal when sampling is to attain a turbidity of less than 5 nephelometric turbidity units (NTU); however, samples may be collected where turbidity is less than 10 NTU and the stabilization criteria described above are met. If sample turbidity is greater than 10 NTU and all other stabilization criteria have been met, samplers must take reasonable steps (i.e., Additional purging) to reduce the turbidity to 10 NTU or less.

- If turbidity is less than 10 NTU, and all other parameters are stabilized, the well should be sampled.
- Where turbidity remains above 10 NTU and turbidity has stabilized within 10% for 3 consecutive readings, the well has been pumped for at least 2 hours and the water quality indicator parameters have stabilized, a complete sample set using the appropriate, pre-preserved containers will be collected followed by an additional sample set using unpreserved containers to be lab filtered and analyzed for the dissolved portion of target constituents.

Samplers must check the “Lab FILTERED” box on the chain-of-custody form and properly note on the sample label.

If necessary, and pursuant to industry-accepted guidance, stabilization criteria may be adjusted to accommodate site-specific or well-specific conditions (USEPA, 1996).

6.2 SAMPLE PRESERVATION AND SHIPMENT

Groundwater samples will be collected in the designated size and type of containers required for specific parameters and laboratory methods. Sample bottles will be pre-preserved and do not require field preservation. Where temperature control is required, field personnel will place samples in a cooler with ice immediately after sample collection. Dry ice, blue ice, and other cooling packs may not be used. Samples will be cooled to less than 6°C and maintained until receipt by the analytical laboratory.

Samples will be delivered to the APC General Testing Laboratory within 48 hours of collection following appropriate temperature control and chain-of-custody procedures. At no time will samples be analyzed after the method-prescribed hold time has expired. If using commercial shipping methods and relinquishing control of the samples to a third-party courier, the shipping cooler will be sealed using a custody seal to identify samples which may have been tampered with during transport to the laboratory. The seal must be labeled with instructions for the laboratory to notify the shipper if the seal is broken when the samples arrive at the laboratory.

6.3 ANALYTICAL METHODS

As shown on **Table 3, Monitoring Parameters and Reporting Limits**, the groundwater samples will be analyzed using methods specified in USEPA Manual SW-846, EPA 600/4-79-020, Standard Methods for the Examination of Water and Wastewater (SM18-20), USEPA Methods for the Chemical Analysis of Water and Wastes (MCAWW), American Society for Testing and Materials (ASTM), or other suitable analytical methods approved by ADEM. Any practical quantitation limit (reporting limit) that is used will be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility. Field instruments used to measure pH must be accurate and reproducible to within 0.2 Standard Units (S.U.).

6.4 CHAIN OF CUSTODY CONTROL

The COC record is required for tracing sample possession from time of collection to time of receipt at the laboratory. The National Enforcement Investigations Center (NEIC) of USEPA considers a sample to be in custody under any of the following conditions:

- It is in the individual’s possession
- It is in the individual’s view after being in his/her possession
- It was in the individual’s possession and (s)he locked it up (e.g. locked in a vehicle)
- It is in a designated secure area

All samples will be handled under strict COC procedures beginning in the field. The field team leader will be the field sample custodian and will be responsible for ensuring that COC procedures are followed. The use of electronic COCs are encouraged and utilized by APC Water Field Services. The record will contain the following information:

- Sample destination and transporter
- Sample identification numbers
- Signature of collector
- Date and time of collection
- Sample type
- Identification of monitoring well
- Number of sample containers
- Parameters requested for analysis
- Signature of person(s) involved in the chain of possession
- Inclusive dates of possession

The samples must be in the custody of assigned personnel, an assigned agent, or the laboratory. If the samples are transferred to other employees for delivery or transport, the sampler or possessor must relinquish possession and the samples must be received by the new owner.

If the samples are being shipped, a hard copy COC must be signed and enclosed within the shipping container in a watertight bag. Shipping agents such as Federal Express do not sign the chain-of-custody form. The shipping receipt must be retained by the samplers as part of the record documenting sample transfer.

6.5 SAMPLING PARAMETERS AND FREQUENCY

Table 4, Groundwater Monitoring Parameters and Frequency presents the groundwater monitoring parameters and sampling frequency. A minimum of eight independent samples from each groundwater well will be collected and analyzed for 40 CFR 257, Subpart D, Appendix III and Appendix IV test parameters to establish a background statistical dataset.

DETECTION MONITORING

After background has been established, detection monitoring will be performed in accordance with ADEM Admin Code r. 335-13-15-.06(5)(b). The detection monitoring frequency for the Appendix III parameters will be at least semi-annual during the active life of the facility and the post-closure care period.

ASSESSMENT MONITORING

If required, assessment monitoring will be performed per ADEM Admin Code r. 335-13-15-.06(6). Assessment monitoring is required whenever a SSI over background levels has been detected for one or more of the constituents listed in 40 CFR 257, Subpart D, Appendix III test parameters.

For assessment sampling at the Site, two semi-annual sampling events will be performed. As shown on **Table 4**, the full suite of Appendix III and IV constituents will be sampled and statistically analyzed semiannually. During these events all compliance monitoring wells and any newly-installed delineation well(s) will be sampled for Appendix III and IV constituents.

A proposal may be made to the Department to modify the subset of delineation wells sampled during assessment monitoring, or the sampling frequency. Proposed changes will be implemented following Department approval.

6.6 QUALITY ASSURANCE AND QUALITY CONTROL

All field quality control samples will be prepared the same as compliance samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected during each sampling event.

FIELD EQUIPMENT RINSATE BLANKS

In cases where sampling equipment is not new or dedicated, an equipment rinsate blank will be collected at a rate of one blank per 10 samples. The equipment rinsate blanks are prepared in the field using the same distilled or deionized water used for decontamination. The water is poured over and through each type of sampling equipment and submitted to the laboratory for analysis of target constituents. If the equipment is dedicated or new for each monitoring well, equipment rinsate blanks will be collected at a rate of 1 blank per CCR unit. If a plant has multiple CCR storage units, an equipment rinsate blank should be collected at each unit (e.g. ash pond, gypsum storage, etc.)

FIELD DUPLICATES

Field duplicates are collected by filling additional containers at the same location, and the field duplicate is assigned a unique sample identification number. One field duplicate will be collected for every group of 10 samples.

FIELD BLANKS

Field blanks are collected in the field using the same distilled or deionized water source that is used for decontamination. The water is poured directly into the supplied sample containers in the field and submitted to the laboratory for analysis of target constituents. One field blank will be collected for every group of 10 samples.

The groundwater samples will be analyzed by licensed and accredited laboratories through the National Environmental Laboratory Accreditation Program (NELAP). Lab data reports will include the records of standard laboratory QA/QC reports.

7. REPORTING RESULTS

The following subsections outline reportable results and delivery.

7.1 14-Day Notification

Pursuant to ADEM Admin. Code r. 335-13-15-.06(4)(h)3., the Department will be notified of any new statistical exceedances identified during detection or assessment monitoring within 14 days. Since the exceedance will also be described in subsequent monitoring reports and addressed pursuant to the rules, the initial notification will not be repeated for the same exceedance in subsequent monitoring events.

7.2 Semi-Annual Groundwater Monitoring Reports

Pursuant to ADEM Admin. Code R. 335-13-15-.06(1)(f), an annual groundwater monitoring and corrective action report documenting the results of sampling and analysis will be submitted to ADEM by January 31st of each year. Pursuant to ADEM Admin. Code r. 335-13-15-.06(5)(g), a semi-annual report to coincide with the semi-annual groundwater sampling will also be submitted. The semi-annual report will be submitted to ADEM by July 31st of each year. At a minimum, semi-annual and annual reports will include:

1. A narrative describing sampling activities and findings including a summary of the number of samples collected, the dates the samples were collected and whether the samples were required by the detection or assessment monitoring programs.
2. A brief overview of purging/sampling methodologies.
3. If applicable, analytical results for samples collected from each delineation well during the semi-annual period.
4. Discussion of results.
5. Recommendations for future monitoring consistent with ADEM's CCR rules.
6. Potentiometric surface contour map for the aquifer(s) being monitored, signed and sealed by an Alabama-registered P.G. or P.E.
7. Table of as-built information for groundwater monitoring wells including top of casing elevations, ground elevations, screened elevations, current groundwater elevations and depth to water measurements.
8. Groundwater flow rate and direction calculations.
9. Identification of any groundwater wells that were installed or decommissioned during the preceding year, along with a narrative description of why these actions were taken.

10. A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels.

11. If applicable, assessment monitoring results.

12. Any alternate source demonstration completed during the previous monitoring period, if applicable.

13. Laboratory Reports and COC documentation.

14. Field sampling logs including field instrument calibration, indicator parameters and parameter stabilization data.

15. Documentation of non-functioning wells, dry surface water and underdrain sampling locations.

16. Table of current analytical results for each well, highlighting statistically significant increases and concentrations above maximum contaminant level (MCL).

17. Statistical analyses.

18. Certification by a qualified groundwater scientist.

8. STATISTICAL ANALYSIS

Groundwater quality data from each sampling event will be statistically evaluated to determine if there has been a statistically significant change in groundwater chemistry. Historical background data will be used to determine statistical limits.

According to ADEM Admin Code r. 335-13-15-.06(4)(f), which incorporates the statistical analysis requirements of 40 CFR 257.93, the site must specify in the operating record the statistical methods to be used in evaluating groundwater monitoring data for each hazardous constituent.

A site-specific statistical analysis plan that provides details regarding the statistical methods to be used will be placed in the site's operating record pursuant to ADEM Admin Code r. 335-13-15-.06(4)(f). **Appendix B, Statistical Analysis Plan**, provides the site-specific plan.

The Sanitas Groundwater statistical software is used to perform the statistical analyses. Sanitas is a decision support software package that incorporates the statistical tests required of RCRA Subtitle C and D facilities by EPA regulations. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities as well as with the USEPA Unified Guidance (2009).

The following subsections provide a high-level summary of the statistical analyses plan as broken down by monitoring program status.

8.1 Detection Monitoring

As discussed in **Appendix B**, Intrawell prediction limits, combined with a 1-of-2 verification resample plan, are used to evaluate calcium, chloride, fluoride, sulfate, and total dissolved solids (TDS). Interwell prediction limits, combined with a 1-of-2 verification resample plan, are used for boron and pH to determine whether there has been a SSI over background groundwater quality. Intrawell prediction limits use screened historical data within a given well to establish limits for parameters at that well. The most recent sample from the same well is compared to its respective background to identify SSIs over background. Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. The most recent sample from each downgradient well is compared to the background limit to identify SSIs.

Groundwater Stats Consulting demonstrated that these test methods were appropriate in the October 2017 Statistical Analysis Plan, which was updated in the September 2019 data screening evaluation. Time series plots were used to screen proposed background data for suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective. Suspected outliers at all wells for Appendix III parameters are formally tested using Tukey's box plot method and, when identified, flagged in the computer database.

The following adjustments are also applicable to the statistical analysis per the Unified Guidance:

- No statistical analyses are required on wells and analytes containing 100% non-detects (EPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in the background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the practical quantitation limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects the Kaplan-Meier non-detect adjustment is applied to the background data.
- Non-parametric prediction limits are used on data containing greater than 50% non-detects.

8.2 Assessment Monitoring

When in assessment monitoring, Appendix IV constituent concentrations are compared to a GWPS. Appendix IV analysis uses the pooled results from the individual downgradient well to develop a well-specific Confidence Interval that is compared to the statistical limit (GWPS). The statistical limit is either the Inter-well Tolerance Limit (i.e. background) calculated using the pool of all available upgradient well data (see Chapter 7 of the Unified Guidance), or an applicable GWPS published in the regulations such as the Maximum Contaminant Level (MCL). As discussed in the Statistical Analysis Plan, Appendix IV background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Interwell Tolerance Limits (background) were calculated using pooled upgradient well data for Appendix IV parameters. When the Lower Confidence Limit (LCL), or the entire interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSL.

As described in 40 CFR § 257.95(h)(1)-(3) and specified by ADEM Variance dated April 15, 2019, the GWPS is:

(1) The maximum contaminant level (MCL) established under 40 CFR §141.62 and 141.66.
(2) Where an MCL has not been established:
    (i) Cobalt 0.006 mg/L;
    (ii) Lead 0.015 mg/L;
    (iii) Lithium 0.040 mg/L; and
    (iv) Molybdenum 0.100 mg/L.
(3) Background levels for constituents where the background level is higher than the MCL or rule-specified GWPS.

Details regarding the statistical analysis of assessment monitoring results are included in the Statistical Analysis Plan in **Appendix B**.

8.2.1 Delineation Wells

During assessment monitoring, any newly-installed delineation wells will be sampled for Appendix III and IV constituents on the same schedule as the compliance monitoring well network. A proposal may be made to the Department to modify the subset of delineation wells sampled during assessment monitoring, or the sampling frequency. Data obtained from delineation wells will be compared to the GWPS numerically until sufficient data is obtained to prepare well-specific Confidence Intervals.

9. REFERENCES

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Tables

Table 1.
Groundwater Monitoring Well Network Details

Well Name	Purpose	Northing [1]	Easting [1]	Ground Elevation [2]	Top of Casing Elevation [2]	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation [2]	Bottom of Screen Elevation [2]	Screen Length (ft.)
MW-1	Upgradient	1330794.064	594082.361	499.19	502.25	107.56	405.09	395.09	10
MW-2	Upgradient	1331053.309	593548.802	498.54	502.12	94.58	417.94	407.94	10
MW-3	Upgradient	1330842.402	593025.397	522.23	525.9	119.07	417.23	407.23	10
MW-4	Upgradient	1330289.727	592896.414	516.67	518.63	128.66	400.37	390.37	10
MW-13	Upgradient	1329383.939	595088.06	442.00	445.04	109.04	346.40	336.40	10
MW-14	Upgradient	1329549.381	595627.606	426.90	429.90	103.50	336.80	326.80	10
MW-15	Upgradient	1329680.612	595932.099	403.10	406.05	87.15	329.30	319.30	10
MW-16	Downgradient	1328655.721	596399.878	411.57	414.57	110.00	314.97	304.97	10
MW-17R	Downgradient	1328244.376	2064752.826	431.46	434.57	138.05	306.12	296.12	10
MW-18	Downgradient	1327977.419	595793.776	411.42	414.42	118.00	306.82	296.82	10
MW-19	Downgradient	1327697.305	595251.571	375.11	377.32	97.31	290.41	280.41	10
MW-20	Downgradient	1327792.527	594841.227	329.89	332.89	73.50	269.79	259.79	10

1. Northing and easting are in feet relative to the State Plane Alabama West North America Datum of 1983.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. Top of screen and bottom of screen depths are calculated relative Top of Casing elevation and less the well sump length of 0.4’.

Table 2. Plant Gorgas Gypsum Landfill Upgradient Comparisons – Key Indicator Parameters

Well Designation	**Well ID**	**DO** (mg/L)	**pH** (SU)	**ORP** (mV)	**Conductivity** (uS/cm)	**Boron** (mg/L)	**Calcium** (mg/L)	**Sulfate** (mg/L)	**Chloride** (mg/L)
Upgradient	MW-1	0.50	5.17	197.3	2326.3	0.022	149.23	1500.00	2.31
Upgradient	MW-2	0.20	5.93	59.4	1957.8	0.028	171.85	1039.00	3.39
Upgradient	MW-3	0.68	5.08	159.5	3600.5	0.040	301.38	2490.77	1.61
Upgradient	MW-4	1.62	6.15	151.8	3791.5	0.043	301.38	2597.69	1.95
Upgradient	MW-13	0.38	6.37	51.0	3143.8	non-detect [3]	306.62	1920.77	2.20
Upgradient	MW-14	0.36	6.36	33.4	3221.4	non-detect	328.62	1943.08	2.00
Upgradient	MW-15	0.28	6.07	19.5	2671.4	non-detect	271.15	1634.62	1.49
Downgradient Compliance [1]	Average Concentrations	0.70	6.45	24.55	2966.8	0.084	344.63	1811.73	6.33
BALF Ash Pore Water[2]	PW-1	0.19	6.03	15.3	1557.6	2.01	322	896	1.27

Notes:

1. Downgradient compliance wells included MW-16, MW-17R, MW-18, MW-19 and MW-20

2. BALF ash pore-water included for comparison with upgradient locations MW-13, MW-14, MW-15.

3. Non-detect indicates concentration below laboratory method detection limit

Table 3.
Monitoring Parameters and Reporting Limits

Appendix III Parameters		
Parameter	**Analytical Method**	**Reporting Limit (mg/L) [1]**
Boron	EPA 200.7/200.8	0.05
Calcium	EPA 200.7/200.8	0.25
Chloride	EPA 300.0	2
Fluoride	EPA 300.0	0.1
pH	None	None
Sulfate	EPA 300.0	5
Total Dissolved Solids (TDS)	SM 2540C	5
Appendix IV Parameters		
Parameter	**Analytical Method**	**Reporting Limit (mg/L)**
Antimony	EPA 200.7/200.8	0.0025
Arsenic	EPA 200.7/200.8	0.00125
Barium	EPA 200.7/200.8	0.0025
Beryllium	EPA 200.7/200.8	0.0025
Cadmium	EPA 200.7/200.8	0.0025
Chromium	EPA 200.7/200.8	0.0025
Cobalt	EPA 200.7/200.8	0.0025
Fluoride	EPA 300.0	0.1
Lead	EPA 200.7/200.8	0.00125
Lithium	EPA 200.7/200.8	0.0025
Mercury	EPA 7470A	0.0002
Molybdenum	EPA 200.7/200.8	0.015
Selenium	EPA 200.7/200.8	0.00125
Thallium	EPA 200.7/200.8	0.0005
Radium 226 & 228 combined [2]	EPA 9315/9320	1 pCi/L

Notes:

1. mg/L - Milligrams per liter

2. Combined Radium 226 + 228 reported in pCi/L - Picocuries per liter

Table 4. Groundwater Monitoring Parameters and Frequency

Monitoring Parameters		**Groundwater Sampling Schedule**	
		Semi-Annual Event 1	**Semi-Annual Event 2**
		(Jan-June)	**(July-Dec)**
Field Parameters	Temperature	X	X
	pH	X	X
	Specific Conductance	X	X
	Dissolved Oxygen	X	X
Appendix III (Detection)	Boron	X	X
	Calcium	X	X
	Chloride	X	X
	Fluoride	X	X
	pH	X	X
	Sulfate	X	X
	Total Dissolved Solids	X	X
Appendix IV (Assessment)	Antimony	X	X
	Arsenic	X	X
	Barium	X	X
	Beryllium	X	X
	Cadmium	X	X
	Chromium	X	X
	Cobalt	X	X
	Fluoride	X	X
	Lead	X	X
	Lithium	X	X
	Mercury	X	X
	Molybdenum	X	X
	Selenium	X	X
	Thallium	X	X
	Radium 226 & 228	X	X

Figures

Legend

🟥 Property Boundary (Approximate)

🟨 Gypsum Landfill Boundary (Approximate)

N

0 500 1,000 2,000 3,000 Feet

SCALE 1:9000

DATE 3/23/2020

DRAWN BY KAR

CHECKED BY GBD

DRAWING TITLE

SITE LOCATION MAP
PLANT GORGAS GYPSUM LANDFILL

FIGURE NO

FIGURE 1

Southern Company

Legend

🟥 Property Boundary (Approximate)
🟨 Gypsum Landfill Boundary (Approximate)
⌒ 20-Foot Topographic Contour
⊕ Downgradient Monitoring Well
▦ Upgradient Monitoring Well

N

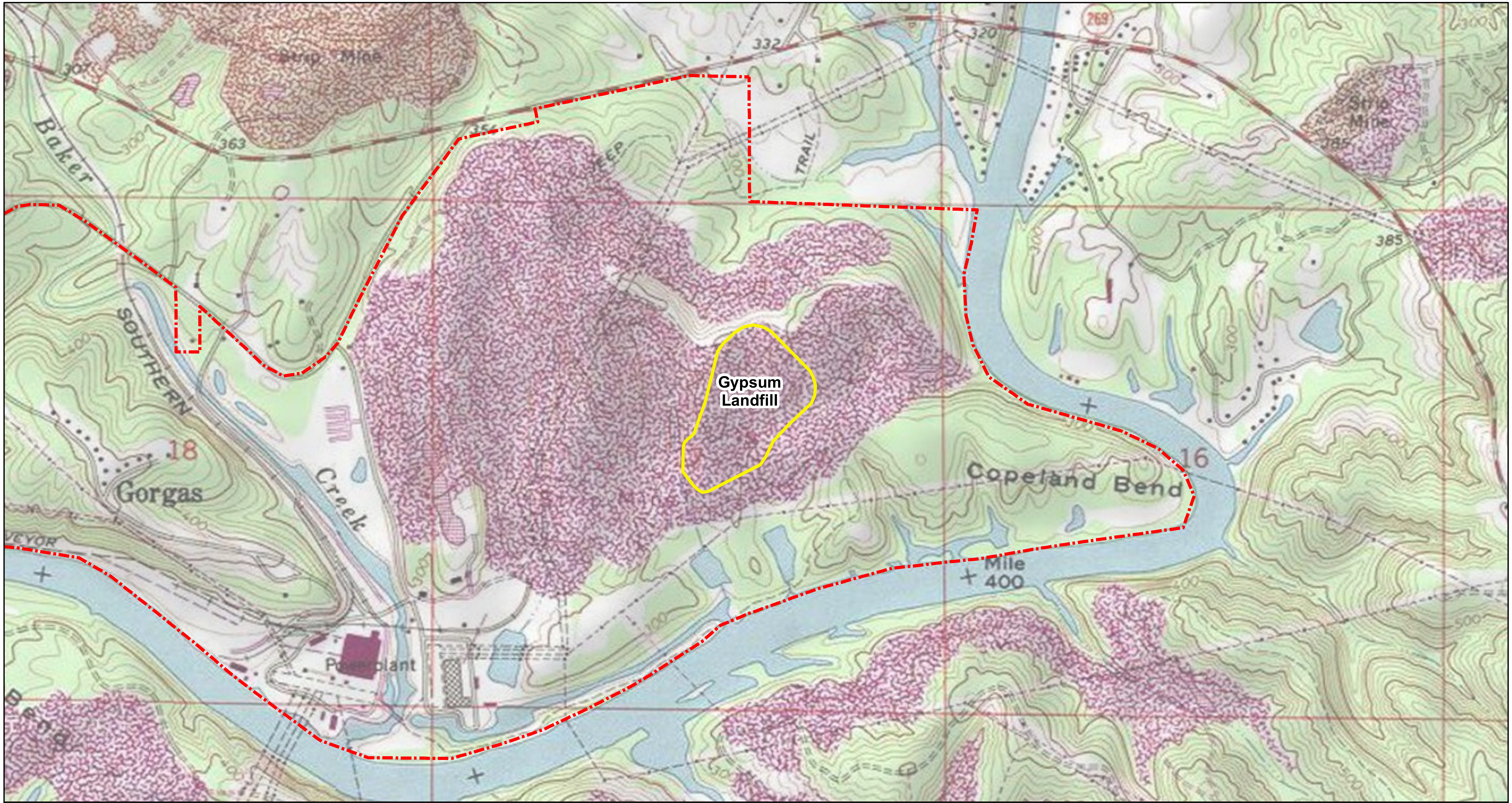
0 500 1,000 2,000 3,000 Feet

SCALE 1:9000
DATE 4/14/2020
DRAWN BY KAR
CHECKED BY GBD

DRAWING TITLE
SITE PLAN MAP
PLANT GORGAS GYPSUM LANDFILL

FIGURE NO
FIGURE 2

Southern Company



Legend

🟥 Property Boundary (Approximate)
🟨 Gypsum Landfill Boundary (Approximate)

N

0 500 1,000 2,000 3,000 4,000 Feet

SCALE	1:12000
DATE	3/23/2020
DRAWN BY	KAR
CHECKED BY	GBD

DRAWING TITLE

SITE GEOLOGIC MAP
PLANT GORGAS GYPSUM LANDFILL

FIGURE NO

FIGURE 3

Southern Company

Legend

🟥 Property Boundary (Approximate)

🟨 Gypsum Landfill Boundary (Approximate)

Geologic Units

🟦 Pottsville Formation (upper part), Appalachian Plateaus (Ppv1u)

SCALE
1:9000

DATE
3/23/2020

DRAWN BY
KAR

CHECKED BY
GBD

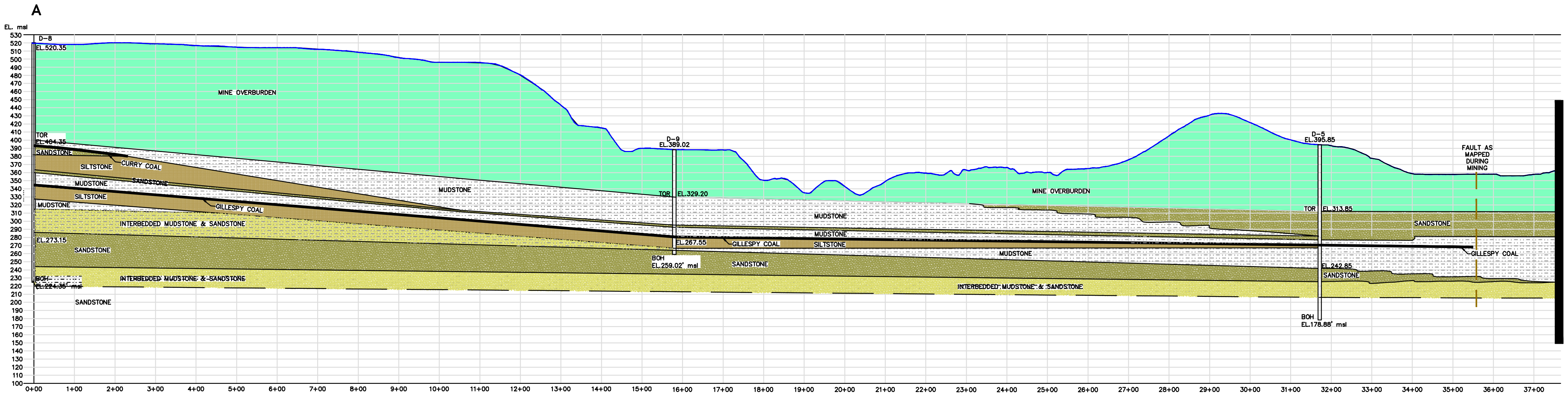
DRAWING TITLE

SITE GEOLOGIC MAP
PLANT GORGAS GYPSUM LANDFILL

FIGURE NO

FIGURE 4

Southern Company



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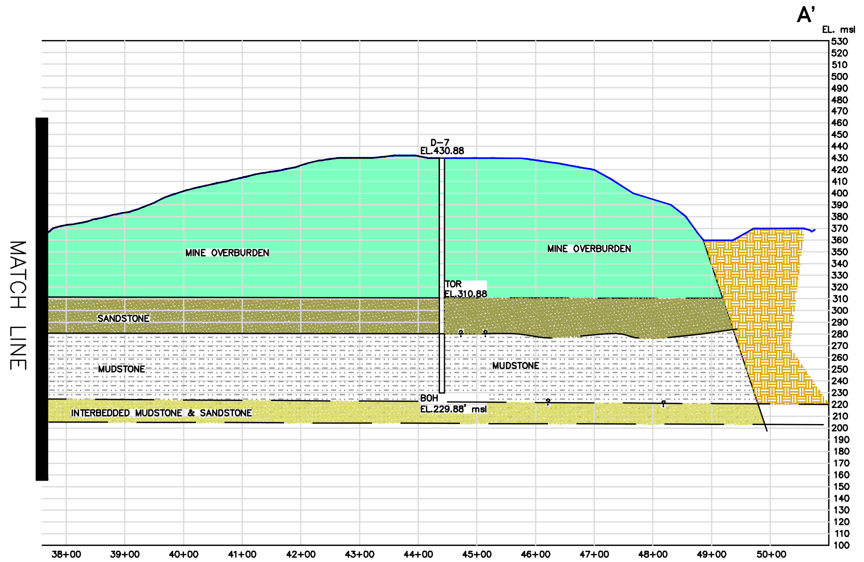
HORIZ: 1"= 200'



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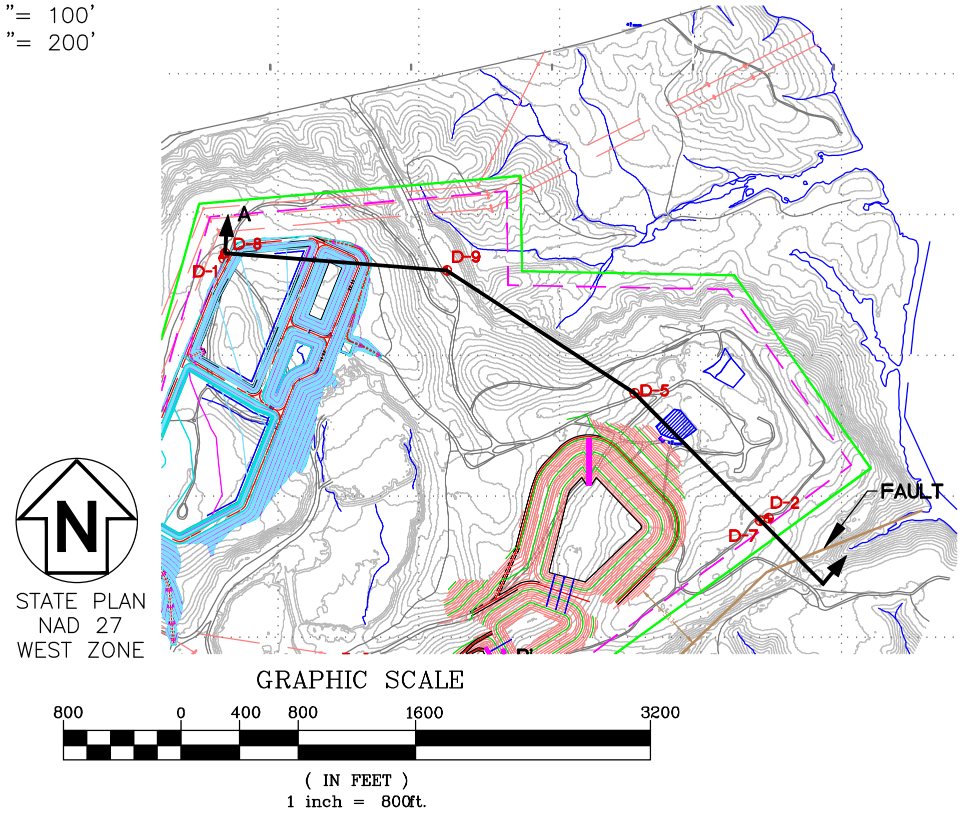
HORIZ: 1"= 200'



Southern Company Services
Engineering and Construction Services
FOR
Alabama Power Company

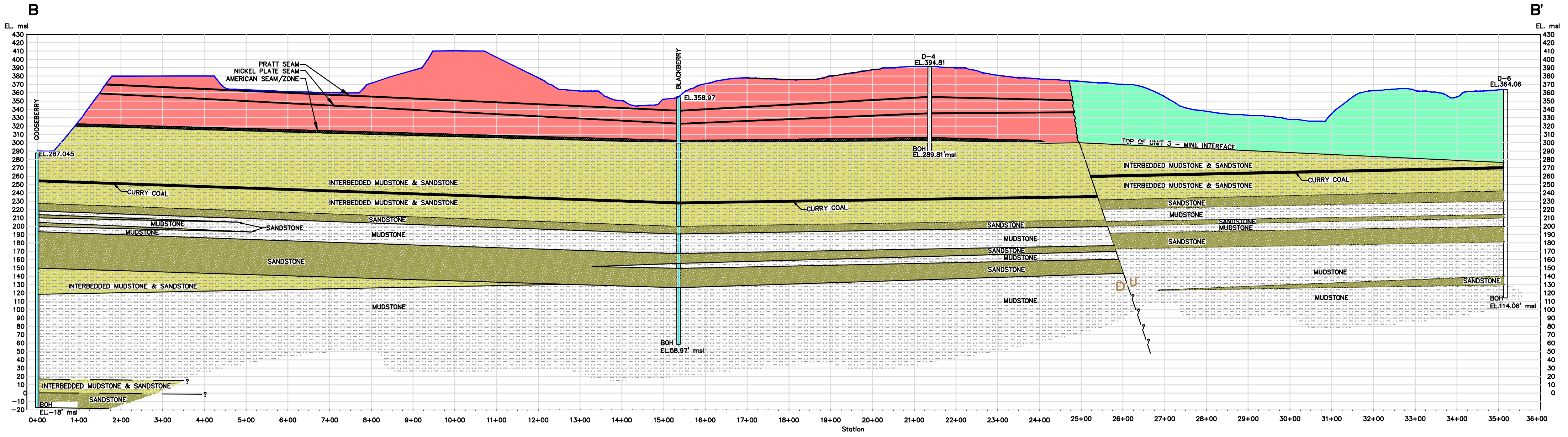
PLANT GORGAS
UNIT 8, UNIT 9 AND UNIT 10
CCB STORAGE FACILITY
GEOLOGIC CROSS SECTION A–A'

REVISION	DATE	REVISION	DATE	REVISION	DATE
				0 ISSUED FOR REPORT	07/07/2017

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
GBD	GBD	SCB	XXX	XXX	XXX	XXX

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
AS SHOWN	**FIGURE 5A**	1	FINAL	0

ANSI C: 22x17 Acad2013



SECTION B–B'
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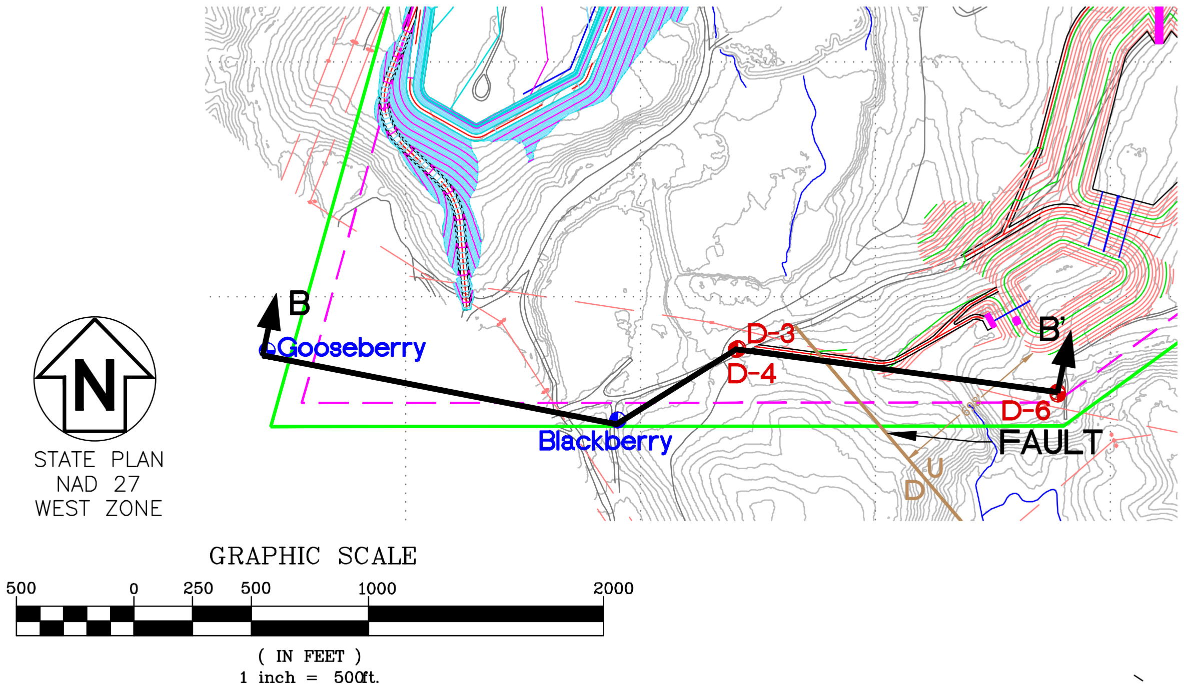
HORIZ: 1"= 200'



Southern Company Services
Engineering and Construction Services
FOR
Alabama Power Company

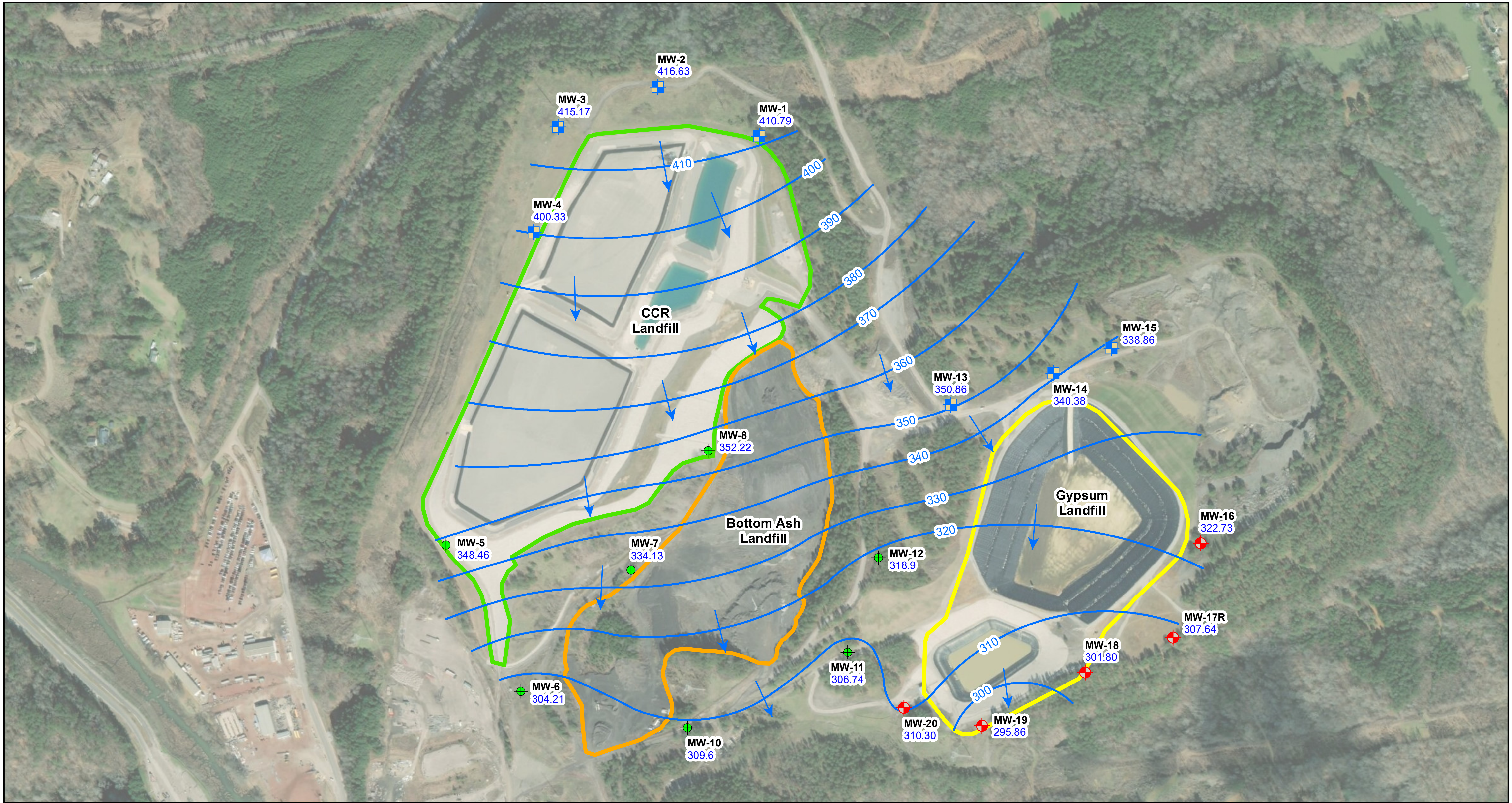
PLANT GORGAS
UNIT 8, UNIT 9 AND UNIT 10
CCB STORAGE FACILITY
GEOLOGIC CROSS
SECTION B–B'

REVISION	DATE	REVISION	DATE	REVISION 0	DATE 07/07/2017
				ISSUED FOR REPORT	

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
														GBD	GBD	SCB	XXX	XXX	XXX	XXX

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
AS SHOWN	**FIGURE 5b**	1	FINAL	0

ANSI C: 22x17 Acad2013



Legend

- ⊕ Downgradient Monitoring Well
- ▣ Upgradient Monitoring Well
- ⊕ Monitoring Well
- ↗ Approximate Groundwater Flow Direction
- ⌒ Potentiometric Surface Contour (ft NAVD88)
- 🟧 Bottom Ash Landfill Boundary (Approximate)
- 🟩 CCR Landfill Boundary (Approximate)
- 🟨 Gypsum Landfill Boundary (Approximate)

MW-1 Well ID
410.79 Groundwater Elevation

N

0 500 1,000 2,000 Feet

NOTES: 1. NAVD88 indicates North American Vertical Datum of 1988.
2. NM indicates not measured.

SCALE 1:6000

DATE 4/3/2020

DRAWN BY KAR

CHECKED BY GBD

DRAWING TITLE

POTENTIOMETRIC SURFACE CONTOUR MAP
OCTOBER 7, 2019
PLANT GORGAS GYPSUM LANDFILL

FIGURE NO

FIGURE 6

Southern Company

Legend

- ⊕ Downgradient Monitoring Well
- ⊞ Upgradient Monitoring Well
- ▭ Property Boundary (Approximate)
- ▭ Gypsum Landfill Boundary (Approximate)

N

0 500 1,000 2,000 Feet

SCALE	1:6000
DATE	4/3/2020
DRAWN BY	KAR
CHECKED BY	GBD

DRAWING TITLE

MONITORING WELL LOCATION MAP
PLANT GORGAS GYPSUM LANDFILL

FIGURE NO

FIGURE 7

Southern Company

Appendix A

SOUTHERN COMPANY

BORING LOG

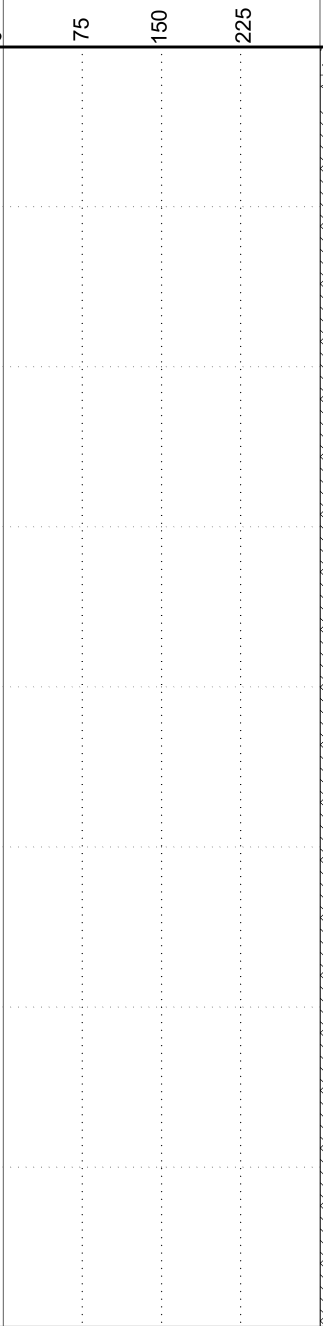
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 1/13/2014 **COMPLETED** 1/15/2014 **SURF. ELEV.** 499.2 **COORDINATES:** N:1,330,794.06 E:594,082.36
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 104.7 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 88.92 ft.
NOTES

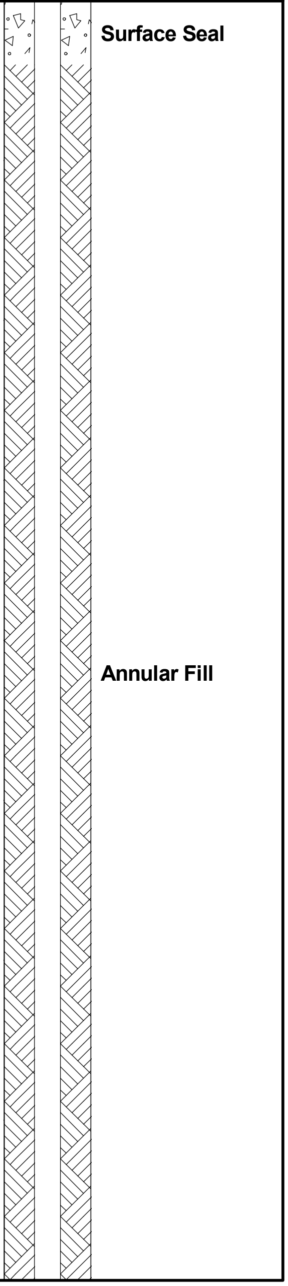
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION
			499.2
0–40	▨	**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	
5			
10			
15			
20			
25			
30			
35			
40			

Natural Gamma



WELL DATA

Top of casing Elev. = 502.25



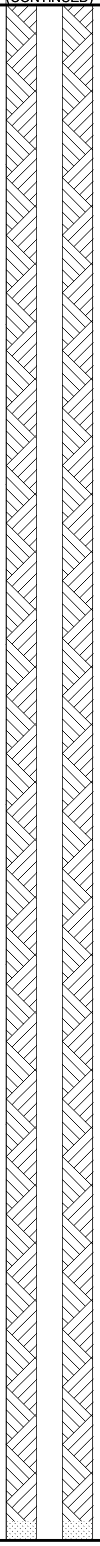
(Continued Next Page)

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 502.25
	▨	**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*	499.2		(CONTINUED)
45	▨				
50	▨				
55	▨				
60	▨				
65	▨				Annular Fill
70	▨				
75	▨				
80	▨				
85	▨				Annular Seal

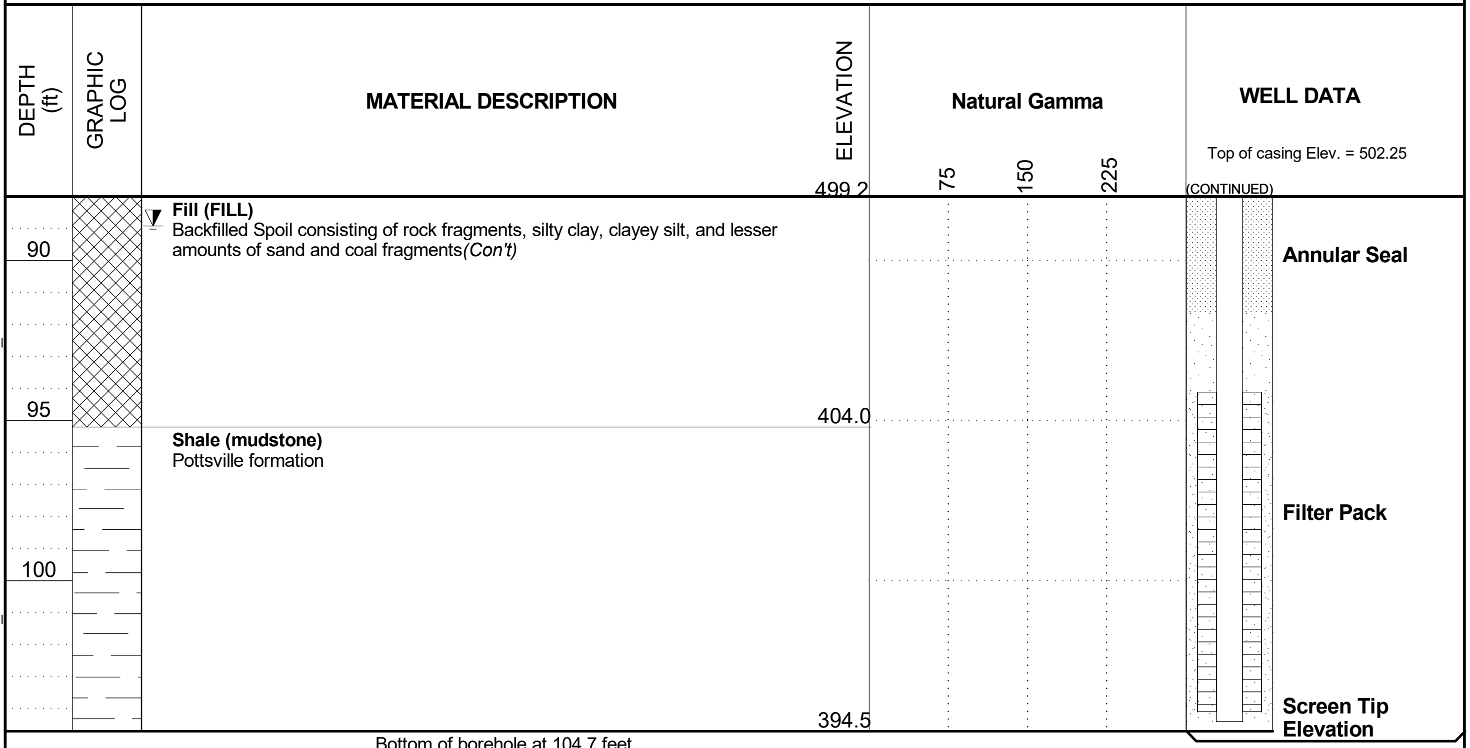


(Continued Next Page)

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION



Top of casing Elev. = 502.25

(CONTINUED)

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION
	Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*	499.2
	Shale (mudstone) Pottsville formation	404.0
		394.5

Bottom of borehole at 104.7 feet.

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/13/17 15:24 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

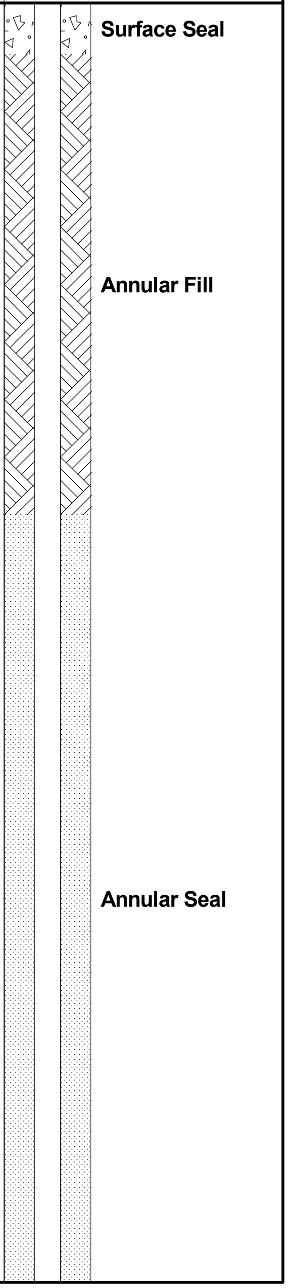
DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 498.5 **COORDINATES:** N:1,331,053.31 E:593,548.80
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 91 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 81.7 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION
	▨	**Fill (FILL)** dark gray to medium gray mudstone/siltstone with trace sandstone, coarse sand to coarse gravel sized angular rock fragments within a dark gray to brownish gray to orangish brown sandy silt	498.5
5	▨		
	▨	trace cobble sized rock fragments	
10	▨		
15	▨		
	▨	trace reddish brown staining on some rock fragments	
20	▨		
25	▨		
	▨	upper coarse sand to bolder sized (limited core recovered) dark gray to medium gray rock fragments within a dark gray silty matrix with trace layers of orangish brown clay/silt	
30	▨		
35	▨		
	▨	trace weathered sandstone fragments with orangish brown staining	
40	▨		
45	▨		
50	▨		

Natural Gamma
75 150 225

WELL DATA

Top of casing Elev. = 501.54



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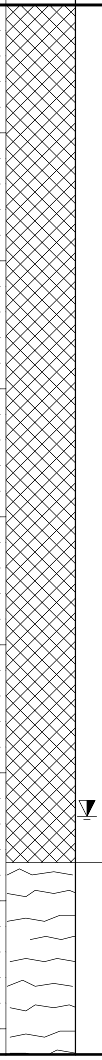
BORING LOG

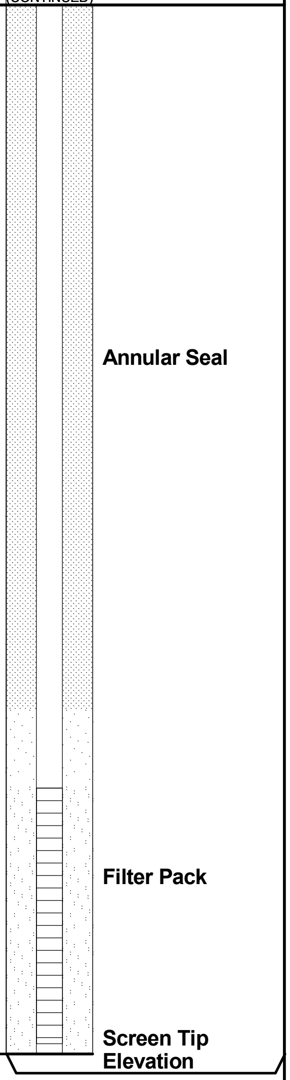
SOUTHERN COMPANY

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma	WELL DATA
			498.5	75 150 225	Top of casing Elev. = 501.54 (CONTINUED)
		Fill (FILL) dark gray to medium gray mudstone/siltstone with trace sandstone, coarse sand to coarse gravel sized angular rock fragments within a dark gray to brownish gray to orangish brown sandy silt*(Con't)*			
55					
60					
65					Annular Seal
		trace zones of orangish brown silt with rusty red to light brown stained sandstone fragments, within a dark gray to medium gray silty matrix with upper coarse sand to coarse gravel sized angular to subangular dark gray to medium gray mudstone/siltstone/sa			
70					
75					
80					
			415.0		
		Mudstone (MUDSTONE) mostly mechanical fracture due to sonic, brittle/friable rock			
85					Filter Pack
		core breaks easily along apparent bedding planes, trace plant fossils visible in some zones, trace interbedded siltstone			
90			407.5		Screen Tip Elevation





Bottom of borehole at 91.0 feet.

BORING MW-3
PAGE 1 OF 2

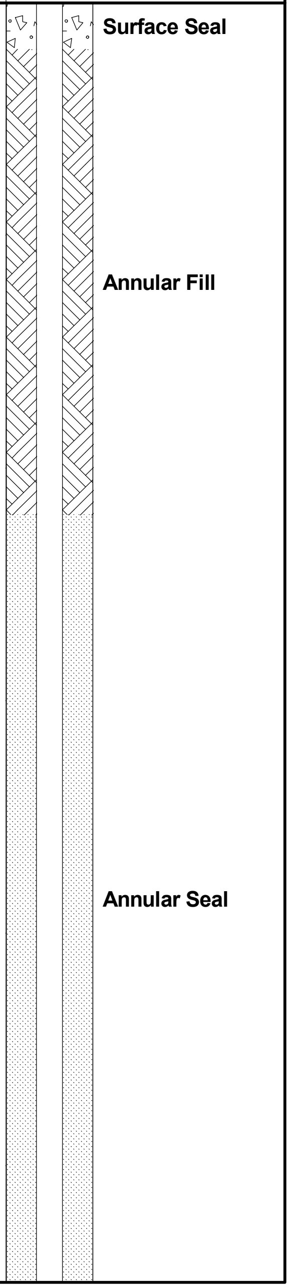
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 522.2 **COORDINATES:** N:1,330,842.40 E:593,025.40
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 115.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 106.91 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 525.23
		Fill (FILL) dark gray to medium gray mudstone/siltstone fragments within dark gray silty soil matrix.	522.2		
		trace rock fragments with orangish brown to rusty red staining			
10					
20					
		zone of subangular rock fragments within a dark gray to orangish brown silty to clayey sand, trace light brown to reddish brown siltstone/sandstone fragments			
30					
40					
		fine gravel to cobble sized angular to subangular mudstone/siltstone fragments			
50					



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BORING MW-3
PAGE 2 OF 2

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION
	Fill (FILL) dark gray to medium gray mudstone/siltstone fragments within dark gray silty soil matrix.*(Con't)*	522.2
	increasing dark brown to orangish brown sandy silt to sandy clay matrix with dark gray to medium gray upper coarse sand to cobble sized mudstone/siltstone fragments with trace sandstone fragments	
60		
	decrease in clayey matrix, dark gray to medium gray rock fragments/matrix	
70		
80		
	@ approx. 90' change from dark gray to light brown (overburden) siltstone/sandstone angular fine gravel to coarse gravel sized rock fragments	
90		
	increasing dark gray brittle/friable rock fragments	
100		
	Sandstone (SANDSTONE) trace dark gray nodular inclusions	414.2
110		
		406.7

Bottom of borehole at 115.5 feet.

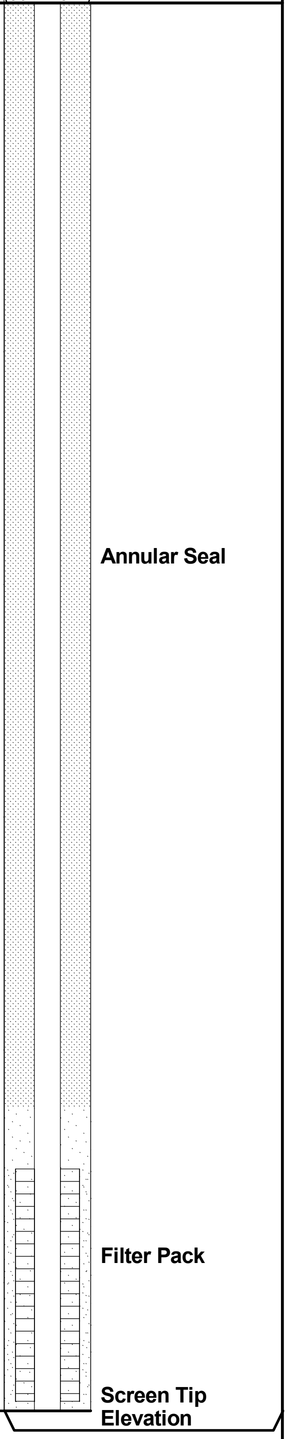
Natural Gamma

75 150 225

WELL DATA

Top of casing Elev. = 525.23

(CONTINUED)



SOUTHERN COMPANY

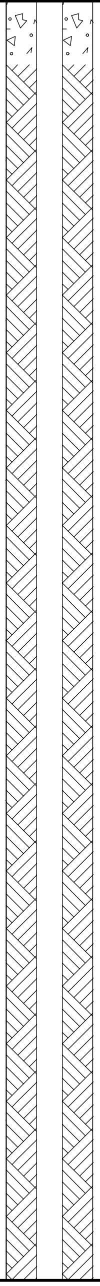
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 2/12/2014 **COMPLETED** 2/19/2012 **SURF. ELEV.** 516.7 **COORDINATES:** N:1,330,289.73 E:592,896.41
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 129.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 116.59 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 518.63
	▨	**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	516.7		**Surface Seal**
5	▨				
10	▨				
15	▨				
20	▨				**Annular Fill**
25	▨				
30	▨				
35	▨				
40	▨				



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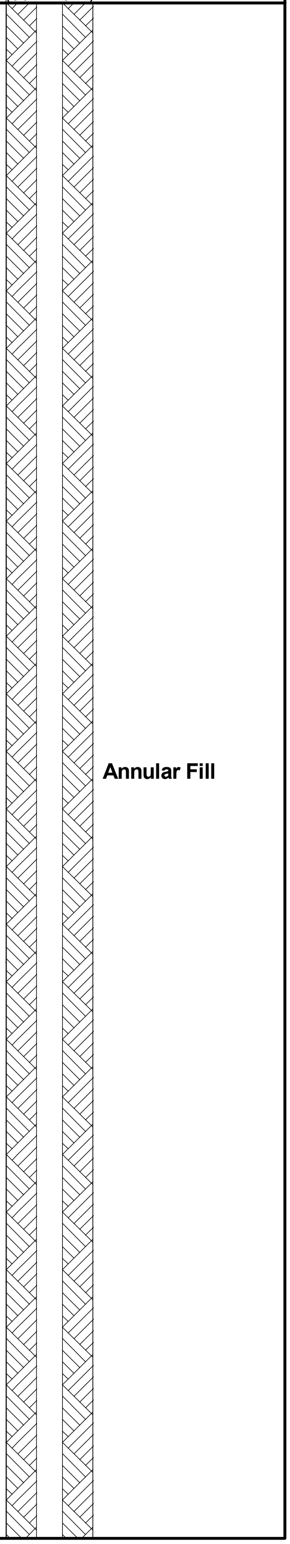
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma	WELL DATA
			516.7	75 150 225	Top of casing Elev. = 518.63 (CONTINUED)
	▨	**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*			
45	▨				
50	▨				
55	▨				
60	▨				
65	▨				**Annular Fill**
70	▨				
75	▨				
80	▨				
85	▨				



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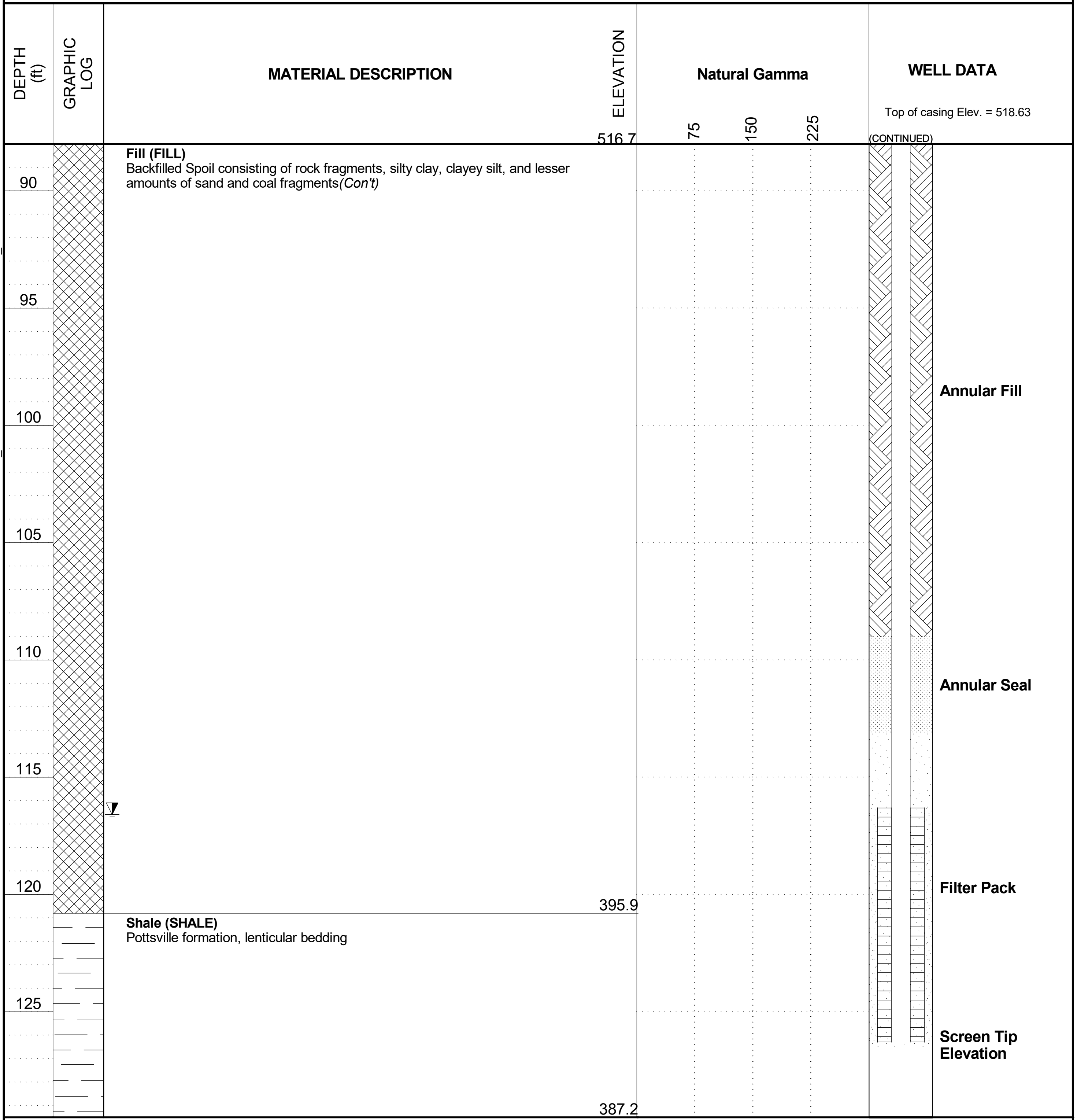
SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION



Fill (FILL)
Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*

Shale (SHALE)
Pottsville formation, lenticular bedding

Bottom of borehole at 129.5 feet.

BORING MW-13
PAGE 1 OF 2

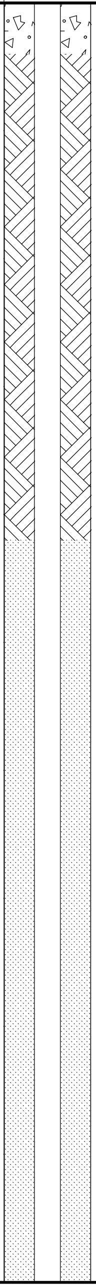
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/4/2014 **COMPLETED** **SURF. ELEV.** 442.0 **COORDINATES:** N:1,329,383.94 E:595,088.06
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 106 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 91.35 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 445.04
		Fill (FILL) dark gray to medium gray angular to subangular upper coarse sand to coarse gravel sized mudstone/siltstone with light gray sandstone with trace orangish brown staining within a dark gray to medium gray silty matrix	442.0		**Surface Seal**
5					
10					**Annular Fill**
15					
20					
25		trace zone of orangish brown silty to clayey soils with upper coarse sand to fine gravel sized dark gray to medium gray angular to subrounded rock fragments			
30					
35		trace bolder sized rock fragments, trace core and pulverized rock recovered			**Annular Seal**
40					
45		zone with trace coal fragments and coal dust			
50					



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BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION
		442.0
	Fill (FILL) dark gray to medium gray angular to subangular upper coarse sand to coarse gravel sized mudstone/siltstone with light gray sandstone with trace orangish brown staining within a dark gray to medium gray silty matrix *(Con't)*	
55		
60		
65		
	trace rusty red to orangish brown stained sandstone fragments included with dark gray to medium gray mudstone fragments, zones of orangish brown sandy silt	
70		
75		
80		
85		
90		
	▽	
	dark gray to medium gray angular upper coarse sand to fine gravel sized mudstone fragments within a orangish brown sandy silty (overburden layer) with trace lower medium to fine gravel sized coal fragments	
95		
		343.0
100	**Mudstone (MUDSTONE)** mudstone grading to a darker carbonaceous mudstone with depth, drilled dry - limited core recovery, @ approx. 104' - 105' interbedded coal (returned pulverized coal fragments and dust), @ approx. 105' grades to medium gray to dark gray mudstone - grades	
105		
		336.0

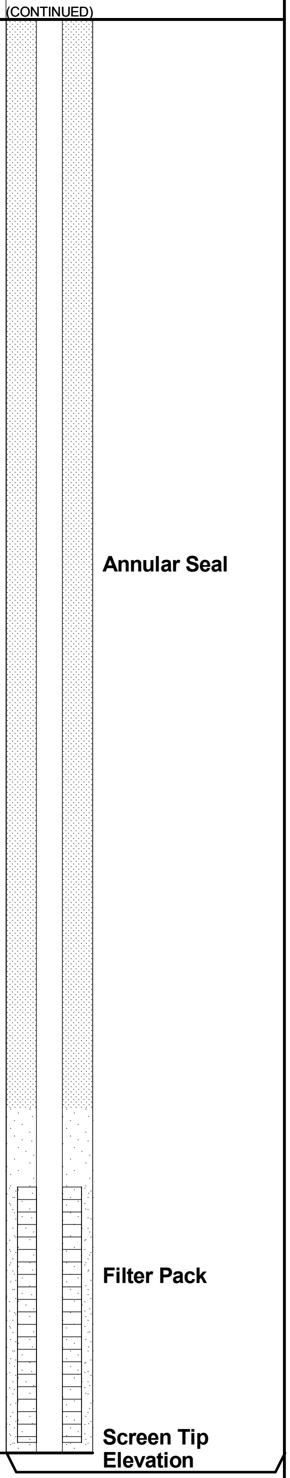
Bottom of borehole at 106.0 feet.

Natural Gamma

75 150 225

WELL DATA

Top of casing Elev. = 445.04

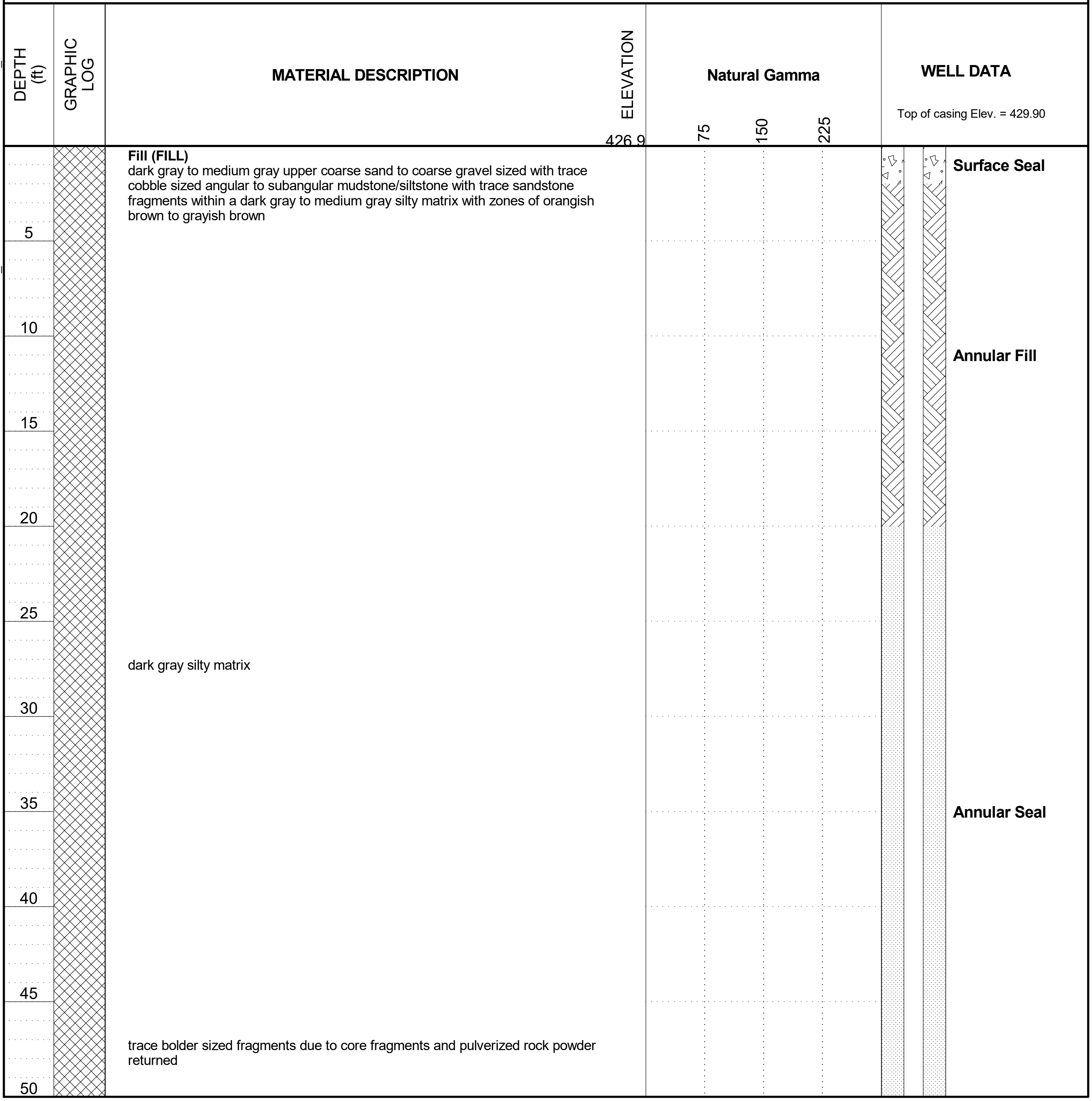


BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/5/2014 **COMPLETED** **SURF. ELEV.** 426.9 **COORDINATES:** N:1,329,549.38 E:595,627.61
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 101 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 86.17 ft.
NOTES



Fill (FILL)
dark gray to medium gray upper coarse sand to coarse gravel sized with trace cobble sized angular to subangular mudstone/siltstone with trace sandstone fragments within a dark gray to medium gray silty matrix with zones of orangish brown to grayish brown

dark gray silty matrix

trace bolder sized fragments due to core fragments and pulverized rock powder returned

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BORING MW-14
PAGE 2 OF 2

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

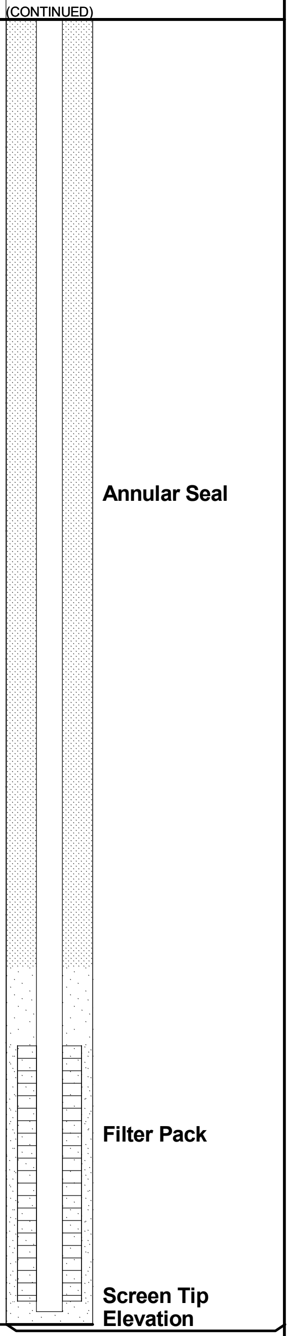
PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225
		Fill (FILL) dark gray to medium gray upper coarse sand to coarse gravel sized with trace cobble sized angular to subangular mudstone/siltstone with trace sandstone fragments within a dark gray to medium gray silty matrix with zones of orangish brown to grayish brown*(Con't)*	426.9	
55				
60				
65				
		trace fine gravel sized orangish brown to reddish brown stained sandstone fragments		
70				
75				
80				
85				
	▽			
		@ approx. 92.5' grayish brown to dark brown to medium brown silt with trace upper coarse to fine gravel sized angular rock fragments (overburden)		
90				
		Mudstone (MUDSTONE) core breaks along horizontal planes when struck by hammer, trace unknown fossils visible	332.9	
95				
100				
			325.9	

Bottom of borehole at 101.0 feet.

WELL DATA

Top of casing Elev. = 429.90



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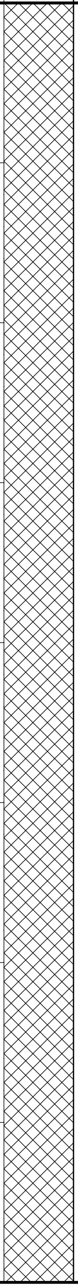
BORING LOG

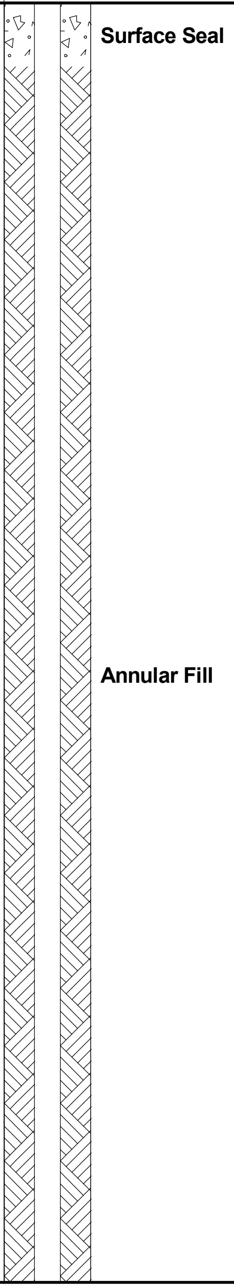
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/16/2013 **COMPLETED** 11/17/2013 **SURF. ELEV.** 403.1 **COORDINATES:** N:1,329,680.61 E:595,932.10
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 84.2 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 65.03 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA Top of casing Elev. = 405.50
0		**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	403.1		Surface Seal
5					
10					
15					
20					Annular Fill
25					
30					
35					
40					





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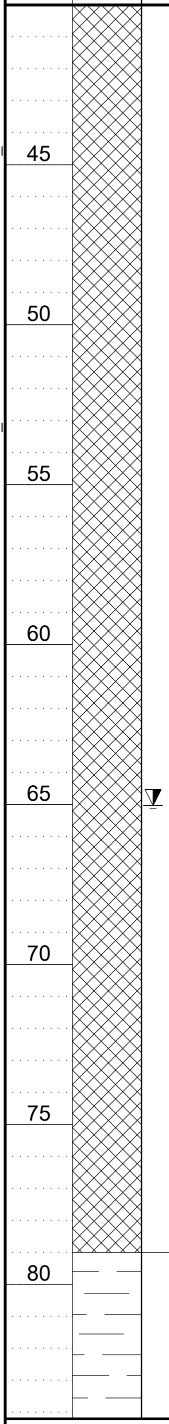
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

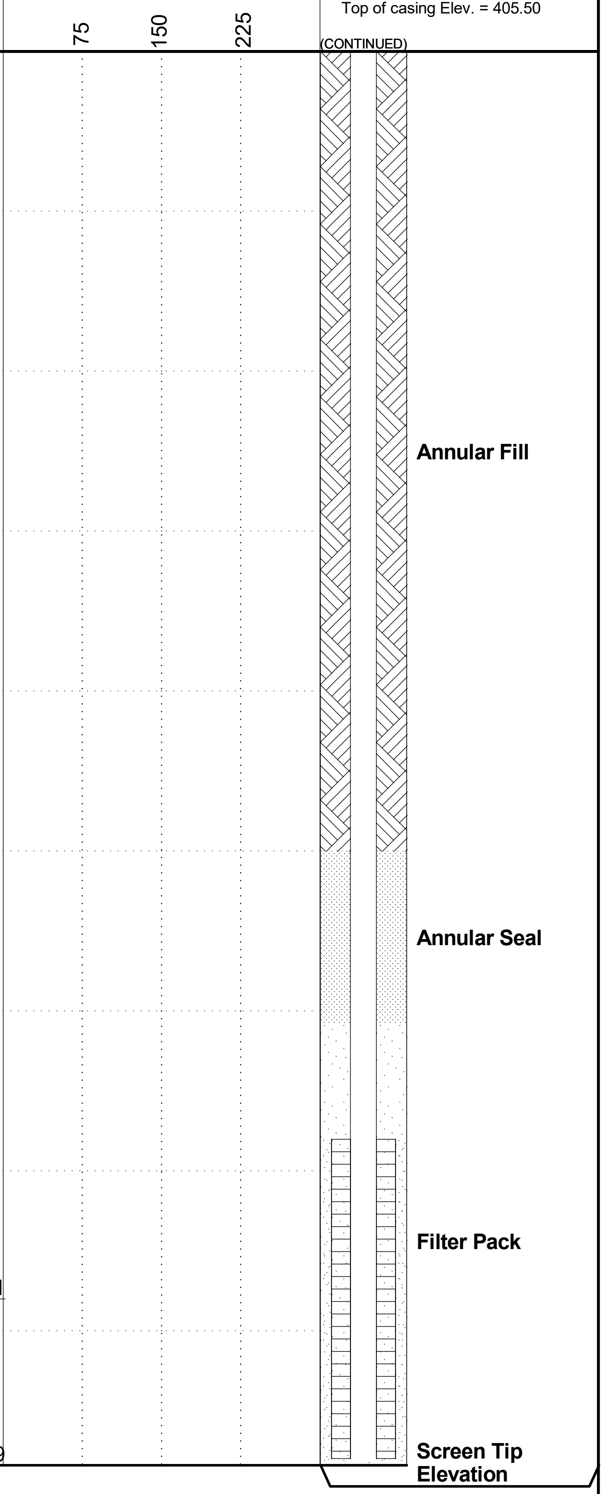
PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma	WELL DATA



MATERIAL DESCRIPTION	ELEVATION
Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*	403.1
Shale (SHALE) Pottsville formation, lenticular bedding	324.1
	318.9

Bottom of borehole at 84.2 feet.



SOUTHERN COMPANY

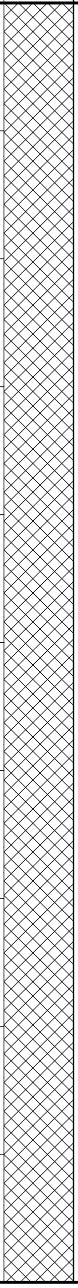
BORING LOG

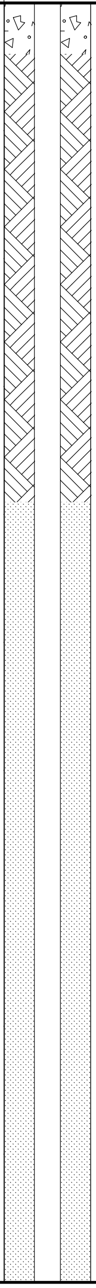
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/5/2014 **COMPLETED** **SURF. ELEV.** 411.6 **COORDINATES:** N:1,328,655.72 E:596,399.88
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 107 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 88.43 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 414.57
0		**Fill (FILL)** dark gray to medium gray upper coarse sand to coarse gravel sized angular to subangular mudstone/siltstone fragments within a dark gray to medium gray silty matrix	411.6		**Surface Seal**
5					
10					**Annular Fill**
15		trace bolder sized fragments due to limited core recovered			
20					
25					
30					
35					**Annular Seal**
40					
45		zones of dark brown to orangish brown silt/clay with fine gravel sized angular rock fragments			
50					





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BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 414.57 (CONTINUED)
		Fill (FILL) dark gray to medium gray upper coarse sand to coarse gravel sized angular to subangular mudstone/siltstone fragments within a dark gray to medium gray silty matrix*(Con't)*	411.6		
55		trace to some light gray to medium gray fine gravel to coarse gravel sized sandstone fragments			
60					
65		trace bolder sized sandstone fragments, zones of dark gray silt with upper coarse sand sized angular fragments (small fragment zone - rubble)			
70					**Annular Seal**
75		dark gray to medium gray upper coarse sand to cobble sized with trace bolder sized angular to subangular mudstone/siltstone to sandstone fragments within a dark gray to brownish gray silty matrix			
80					
85		grades to medium gray silt with med gray rock fragments with depth			
90					
95		zone of dark brown silt/clay grading to very dark gray silt with dark gray mudstone and dark brown to reddish brown sandstone fragments, black coal fragments			
100		**Mudstone (MUDSTONE)** trace unknown fossils visible, core breaks along horizontal planes when struck with hammer	311.6		**Filter Pack**
105					
			304.6		**Screen Tip Elevation**

Bottom of borehole at 107.0 feet.

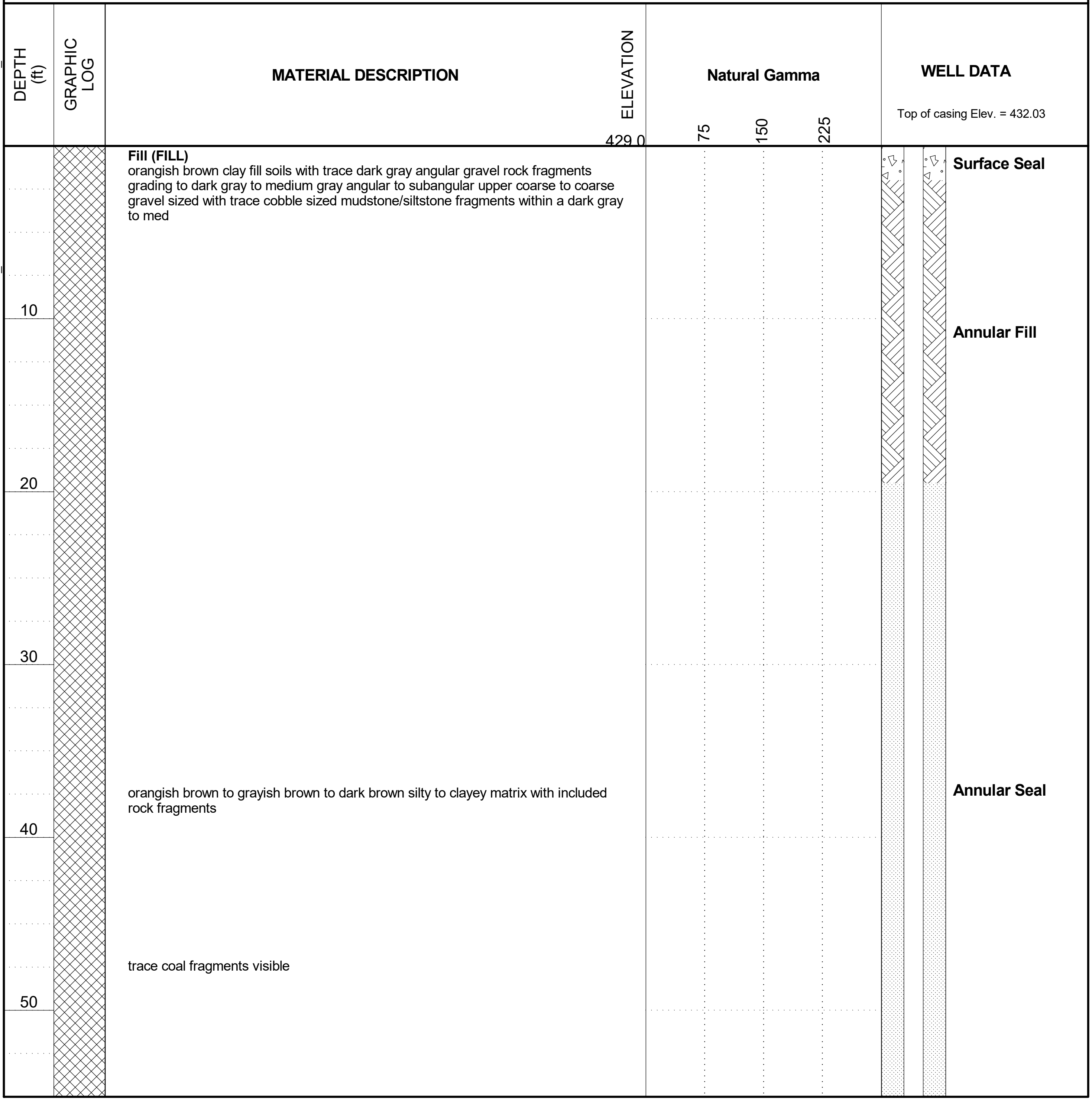
BORING MW-17
PAGE 1 OF 2

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/6/2014 **COMPLETED** **SURF. ELEV.** 429.0 **COORDINATES:** N:1,328,253.36 E:596,174.14
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 111 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
NOTES



Fill (FILL)
orangish brown clay fill soils with trace dark gray angular gravel rock fragments grading to dark gray to medium gray angular to subangular upper coarse to coarse gravel sized with trace cobble sized mudstone/siltstone fragments within a dark gray to med

orangish brown to grayish brown to dark brown silty to clayey matrix with included rock fragments

trace coal fragments visible

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BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 432.03
	▨	**Fill (FILL)** orangish brown clay fill soils with trace dark gray angular gravel rock fragments grading to dark gray to medium gray angular to subangular upper coarse to coarse gravel sized with trace cobble sized mudstone/siltstone fragments within a dark gray to med*(Con't)*	429.0		(CONTINUED)
60	▨				
	▨	bolder sized rock fragments, core pieces and pulverized rock powder recovered			
70	▨				
	▨				**Annular Seal**
	▨	@ approx. 85' - 86' zone of light brown silty (overburden soils) with fine gravel to cobble sized light brown sandstone fragments			
80	▨				
90	▨				
	▨		330.0		
100	⁖	**Sandstone (SANDSTONE)** trace mica visible, trace high to moderately angled fractures visible, rusty red staining within fractures visible			**Filter Pack**
	⁖				**Screen Tip Elevation**
	⁖	drilled down to 111' to confirm native rock and not a bolder in the spoils material			
110	⁖		318.0		

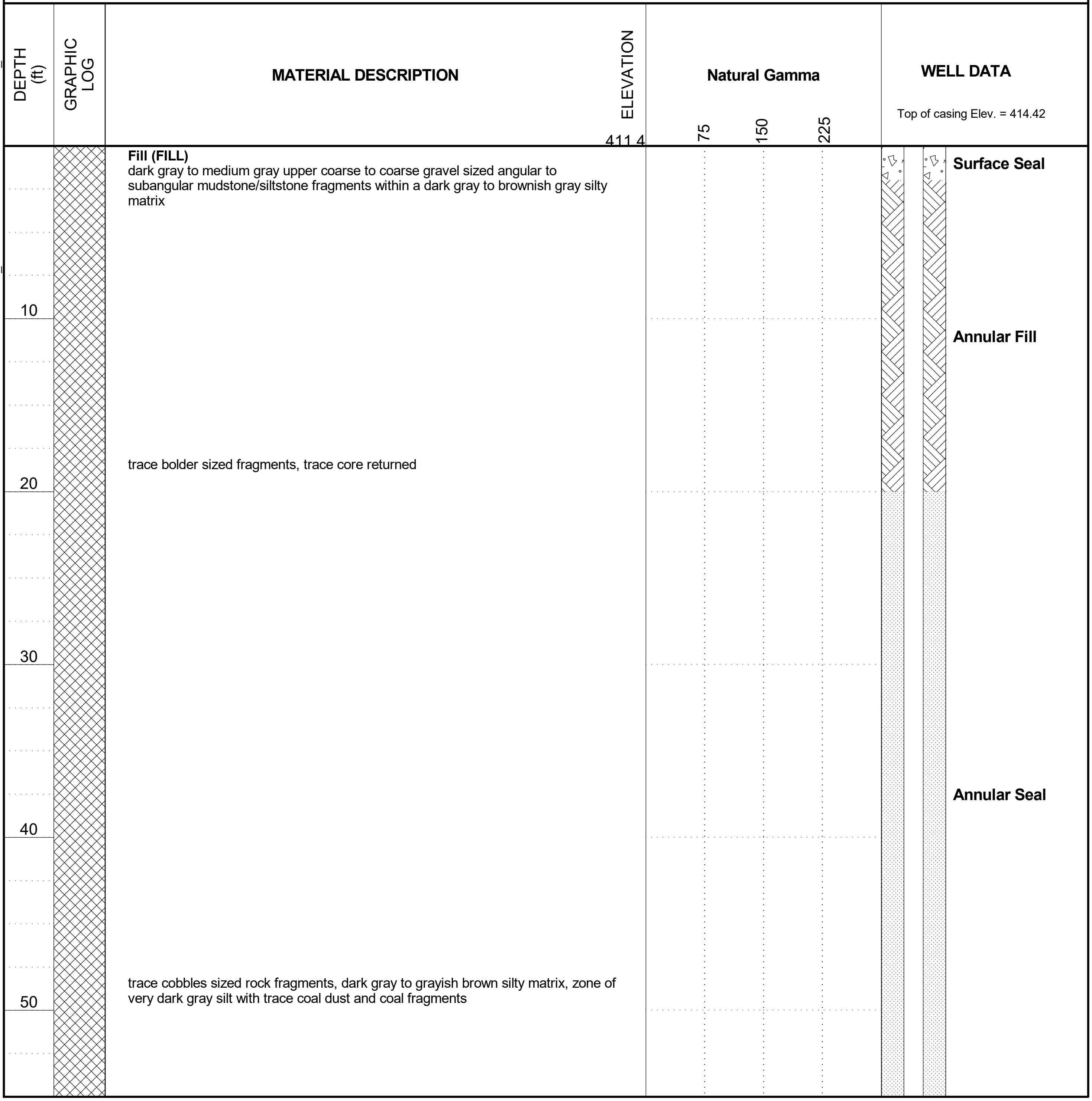
Bottom of borehole at 111.0 feet.

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/6/2014 **COMPLETED** **SURF. ELEV.** 411.4 **COORDINATES:** N:1,327,977.42 E:595,793.78
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 117 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 110.84 ft.
NOTES



Fill (FILL)
dark gray to medium gray upper coarse to coarse gravel sized angular to subangular mudstone/siltstone fragments within a dark gray to brownish gray silty matrix

trace bolder sized fragments, trace core returned

trace cobbles sized rock fragments, dark gray to grayish brown silty matrix, zone of very dark gray silt with trace coal dust and coal fragments

(Continued Next Page)

BORING LOG

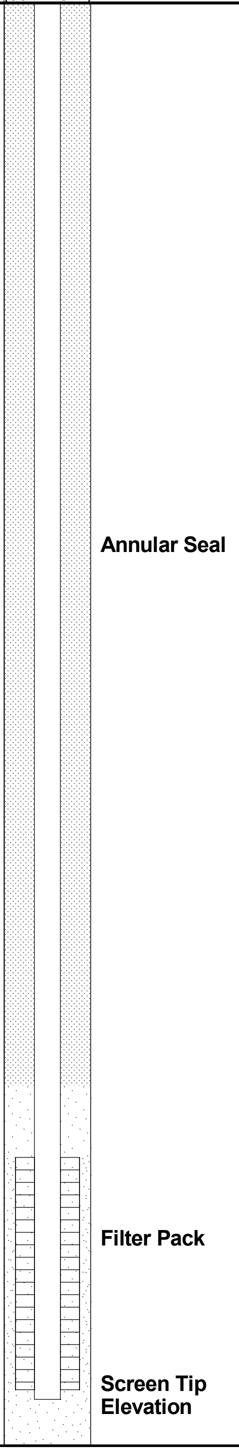
SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

Natural Gamma: 75 150 225

WELL DATA: Top of casing Elev. = 414.42 (CONTINUED)

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION
	▨	**Fill (FILL)** dark gray to medium gray upper coarse to coarse gravel sized angular to subangular mudstone/siltstone fragments within a dark gray to brownish gray silty matrix*(Con't)*	411.4
60	▨	trace light brown sandstone fragments included with dark gray mudstone/siltstone fragments, dark brown to orangish brown silty matrix	
70	▨		
80	▨		
90	▨	trace core pieces and light gray pulverized rock powder recovered, trace dark gray mudstone/siltstone fragments with rusty red staining	
100	▨	dark gray to grayish brown silty matrix grading to dark brown silt with fine gravel sized angular medium brown sandstone fragments	
	▨	dark brown to medium brown overburden soils with included rock fragments	302.4
110	⁘	**Sandstone (SANDSTONE)** ▽ trace to some mica visible, trace high to moderate angled fractures	
	⁘		294.4



Bottom of borehole at 117.0 feet.

SOUTHERN COMPANY

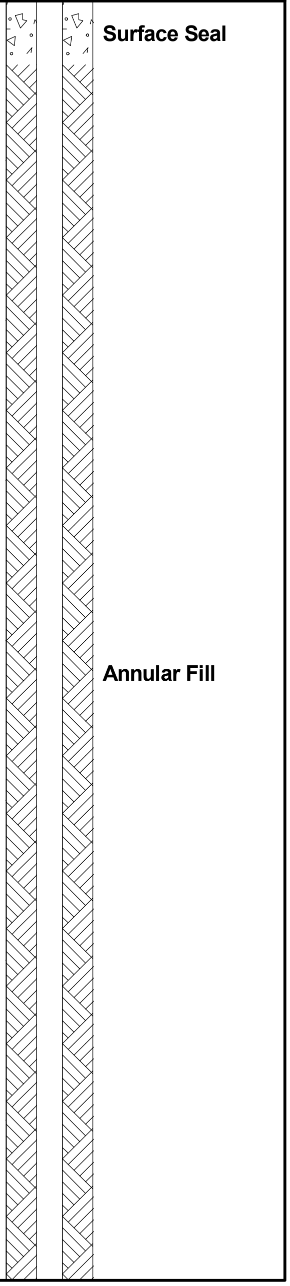
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/4/2013 **COMPLETED** 11/6/2013 **SURF. ELEV.** 375.1 **COORDINATES:** N:1,327,697.31 E:595,251.57
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 95.1 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 79.63 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 377.32
	▨	**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	375.1		**Surface Seal**
5	▨				
10	▨				
15	▨				
20	▨				**Annular Fill**
25	▨				
30	▨				
35	▨				
40	▨				



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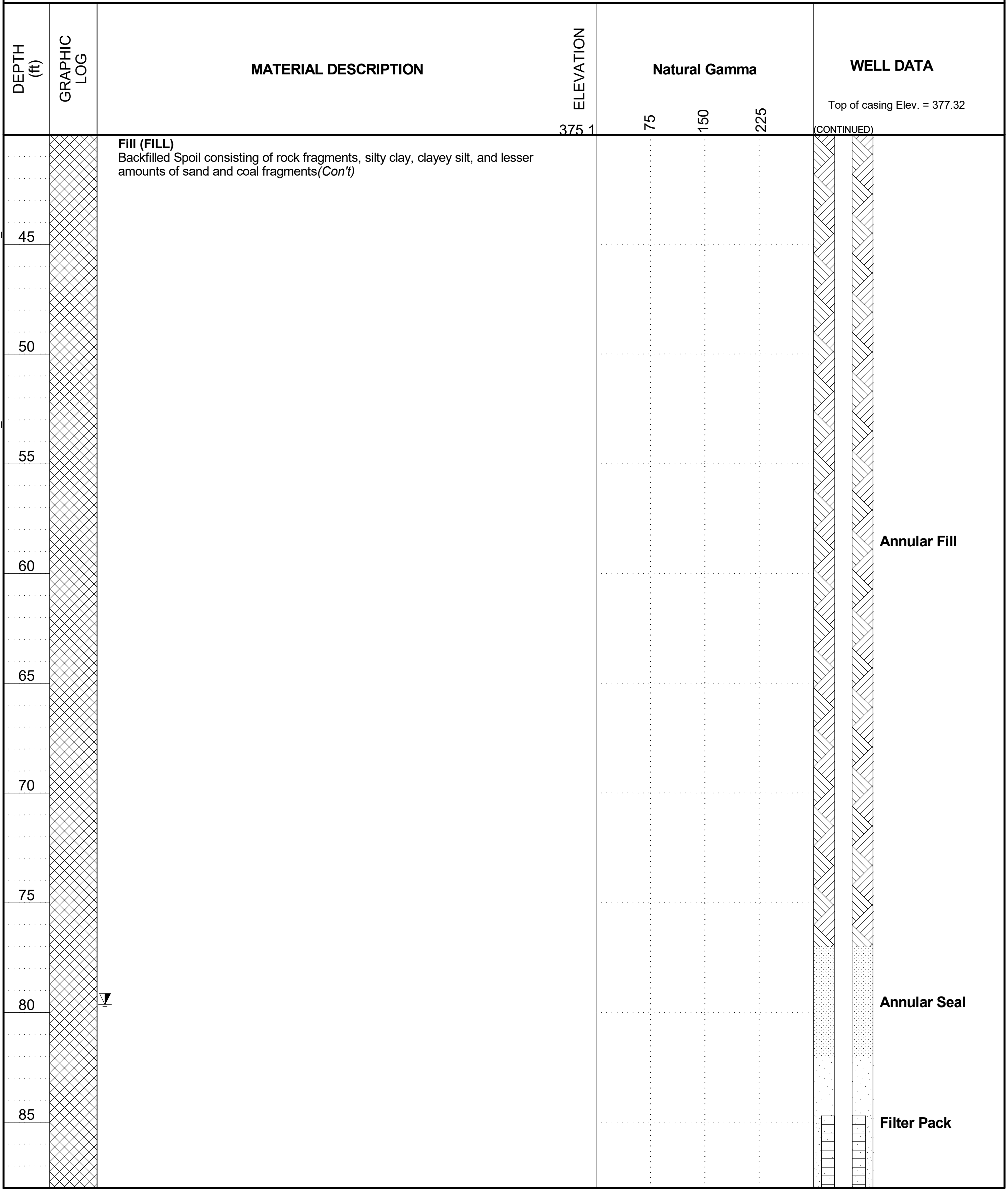
SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/13/17 15:24 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION



Fill (FILL)
Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*

(Continued Next Page)

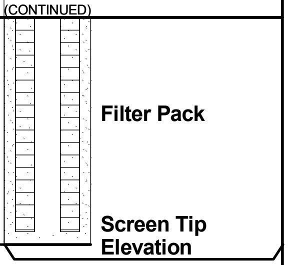
BORING MW-19
PAGE 3 OF 3

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225	WELL DATA Top of casing Elev. = 377.32
			375.1		(CONTINUED)
90	▨	**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*	284.1		Filter Pack
95		**Shale (SHALE)** Contains trace coal spars, Pottsville formation	280.0		Screen Tip Elevation



Bottom of borehole at 95.1 feet.

BORING MW-20
PAGE 1 OF 2

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

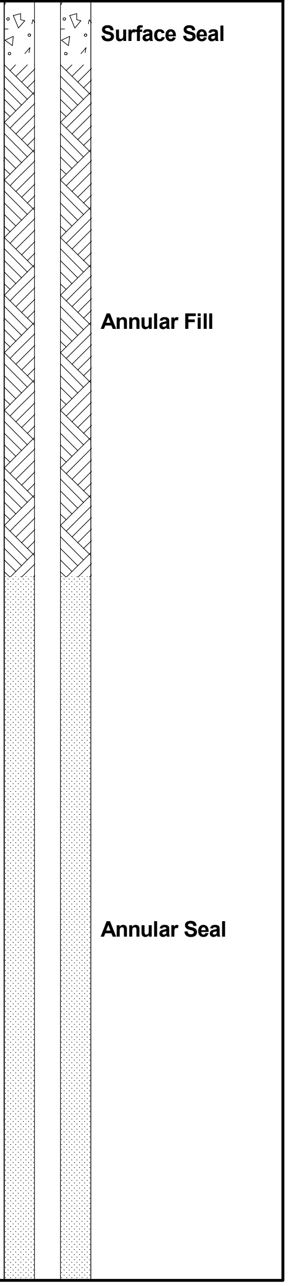
PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/10/2014 **COMPLETED** **SURF. ELEV.** 329.9 **COORDINATES:** N:1,327,792.53 E:594,841.23
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Coates **CHECKED BY**
BORING DEPTH 70.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 32.23 ft.
NOTES

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma 75 150 225
	Fill (FILL) light brown silty fill w/ rocks, tan to brown silty CLAY (5'-6')	329.9	
5			
	brown to orange brown clay w/ silt few sand, moist (14'-16' dry grey powdery rock-pulverized boulder)		
10			
15			
	light brown silty clay w/ rocks, few 3-4" cobbles		
20			
25			
	(26-29')green grey clay, (29-33' orange brown silty CL w/ sand), (33-36' green grey CL)		
30			
	▽		
35			
	brown silty CL w/ sand, few rocks, shaley in places		
40			

WELL DATA

Top of casing Elev. = 332.89



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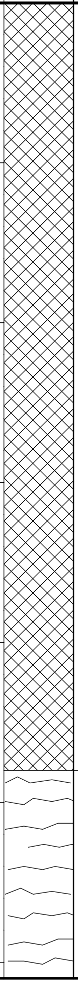
BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION
		Fill (FILL) light brown silty fill w/ rocks, tan to brown silty CLAY (5'-6')*(Con't)*	329.9
45			
50			
55			
		brown silty CL few sand, 63' small coal layer ~6-8",	
60			
			265.9
65		**Mudstone (MUDSTONE)** weathered rock mud/siltstone	
		rock, grey massive silt/fine sandstone, thinly banded	
70			259.4

Bottom of borehole at 70.5 feet.

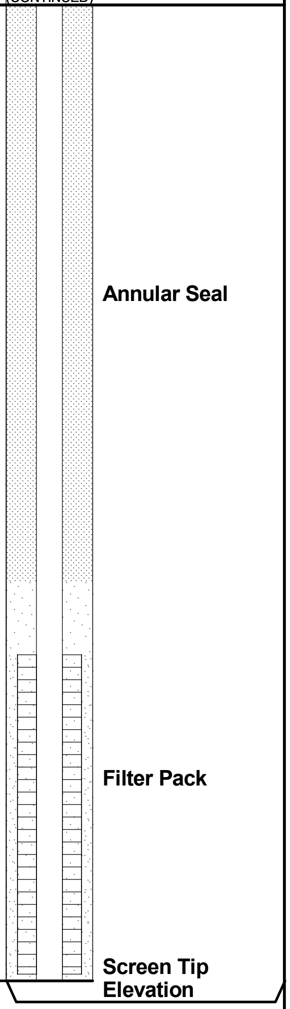


Natural Gamma: 75, 150, 225

WELL DATA

Top of casing Elev. = 332.89

(CONTINUED)



BORING MW-1
PAGE 1 OF 1

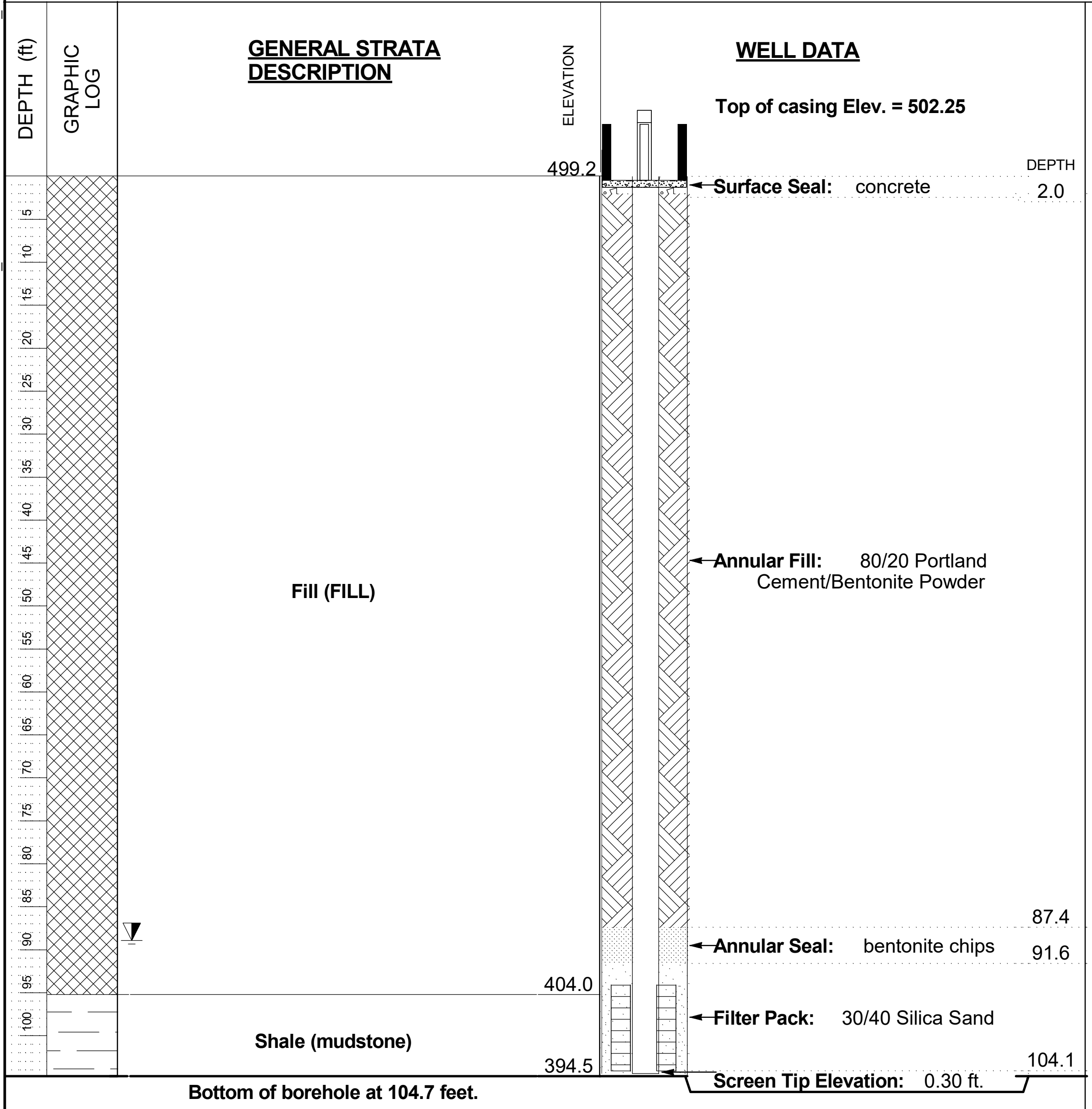
SOUTHERN COMPANY

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 1/13/2014 **COMPLETED** 1/15/2014 **SURF. ELEV.** 499.2 **COORDINATES:** N:1,330,794.06 E:594,082.36
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 104.7 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 88.92 ft.
NOTES



WELL SPECIFICATIONS

Casing Diameter: 2 inches **Screen Diameter:** 2 inches
Casing Material: Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
Casing Length: feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

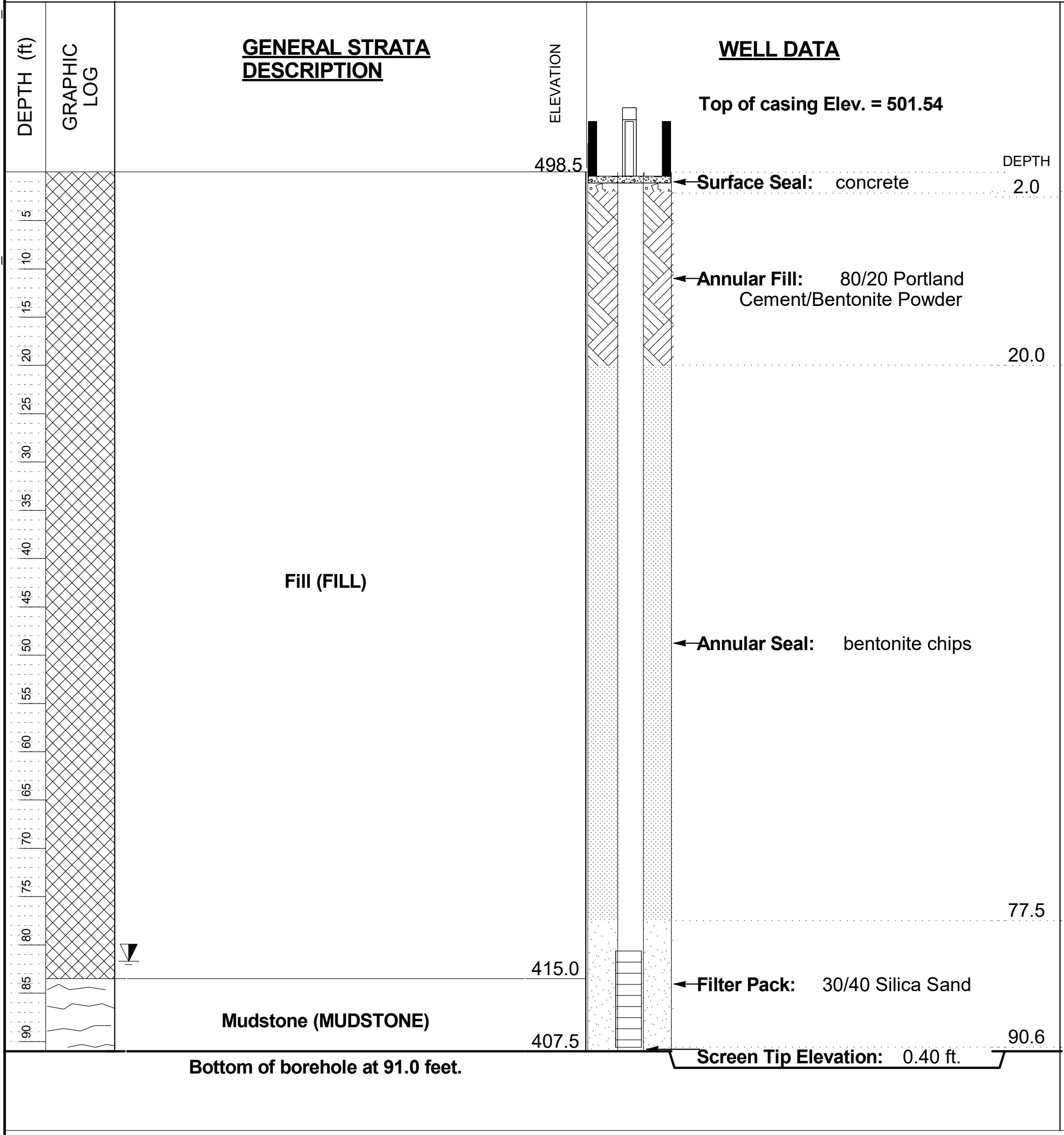
BORING MW-2
PAGE 1 OF 1

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 498.5 **COORDINATES:** N:1,331,053.31 E:593,548.80
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 91 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 81.7 ft.
NOTES



WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/13/17 15:25 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

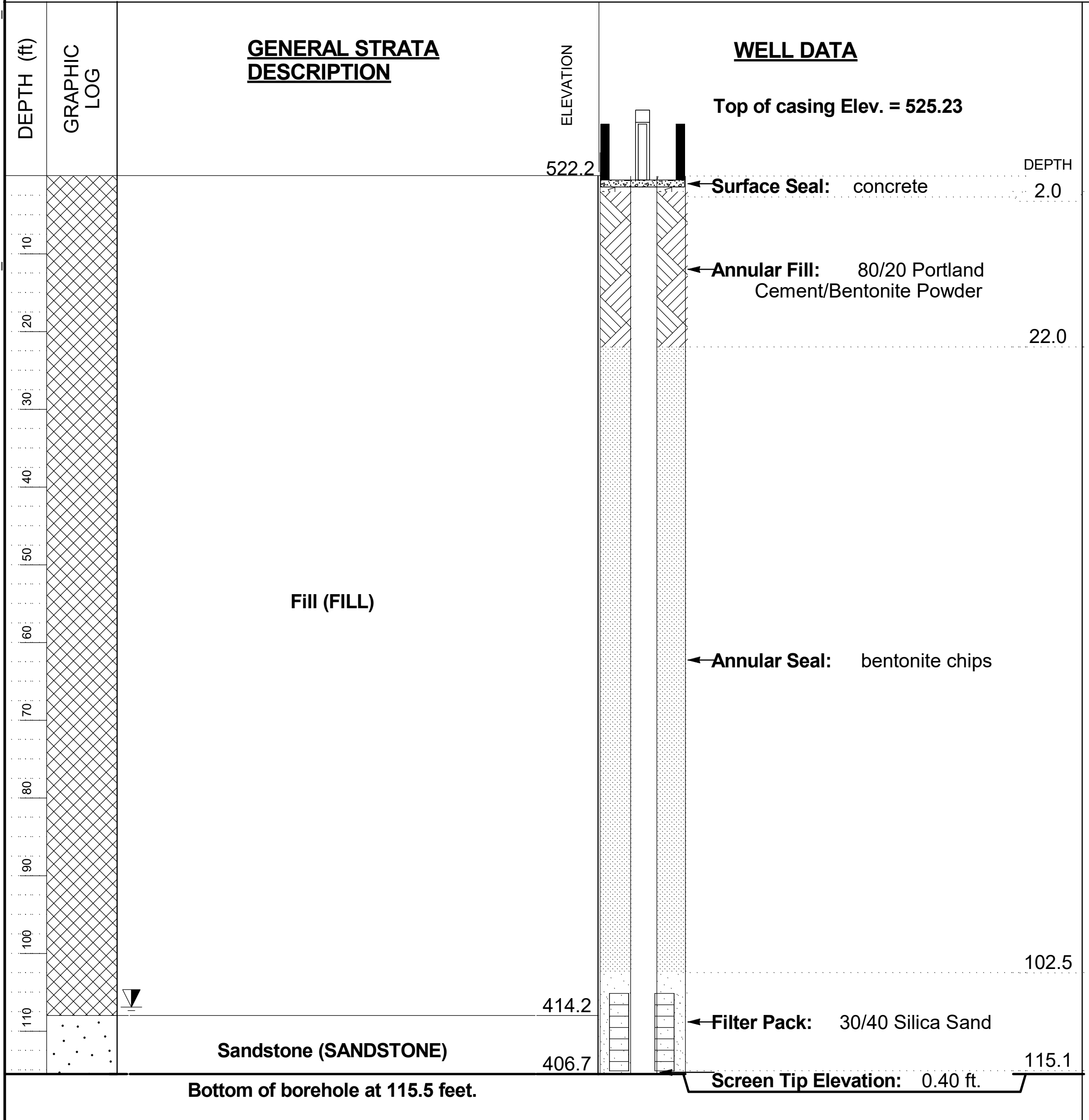
BORING MW-3
PAGE 1 OF 1

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 522.2 **COORDINATES:** N:1,330,842.40 E:593,025.40
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 115.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 106.91 ft.
NOTES



NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

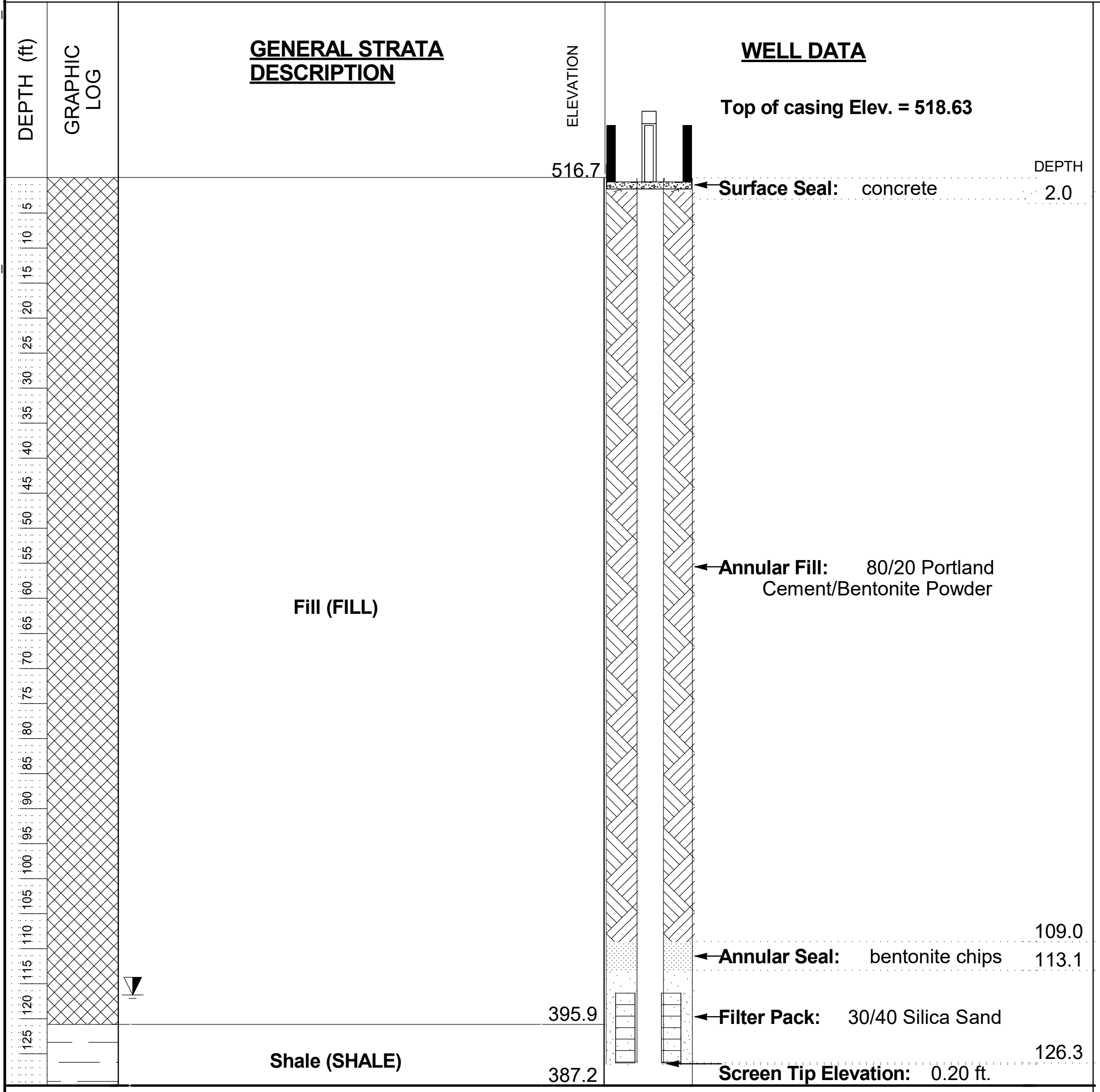
BORING MW-4
PAGE 1 OF 1

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 2/12/2014 **COMPLETED** 2/19/2012 **SURF. ELEV.** 516.7 **COORDINATES:** N:1,330,289.73 E:592,896.41
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 129.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 116.59 ft.
NOTES



NOTES:

Bottom of borehole at 129.5 feet.

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

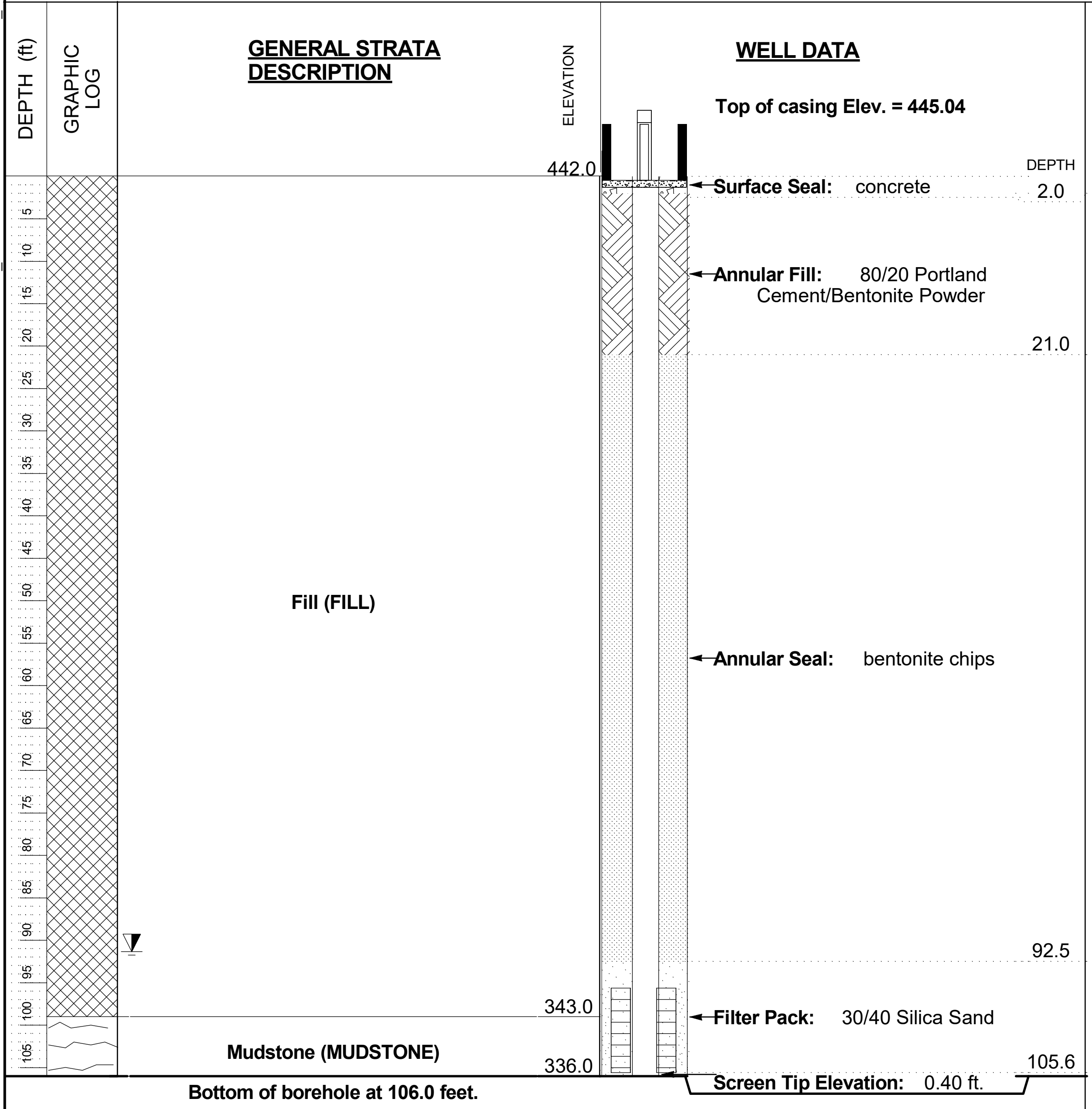
BORING MW-13
PAGE 1 OF 1

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/4/2014 **COMPLETED** **SURF. ELEV.** 442.0 **COORDINATES:** N:1,329,383.94 E:595,088.06
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 106 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 91.35 ft.
NOTES



Top of casing Elev. = 445.04

Depth	Strata	Elevation
0 – 99	Fill (FILL)	442.0 – 343.0
99 – 106	Mudstone (MUDSTONE)	343.0 – 336.0

Surface Seal: concrete

Annular Fill: 80/20 Portland Cement/Bentonite Powder

Annular Seal: bentonite chips

Filter Pack: 30/40 Silica Sand

Screen Tip Elevation: 0.40 ft.

Bottom of borehole at 106.0 feet.

WELL SPECIFICATIONS

Casing Diameter: 2 inches **Screen Diameter:** 2 inches
Casing Material: Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
Casing Length: feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

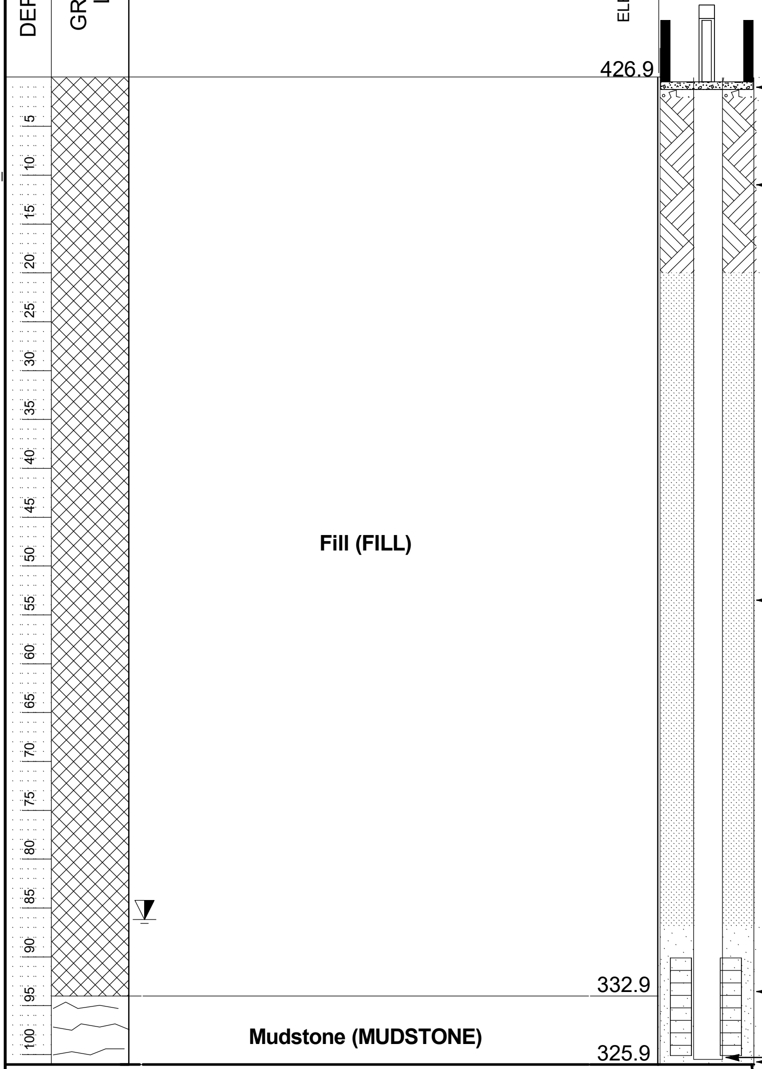
BORING MW-14
PAGE 1 OF 1

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/5/2014 **COMPLETED** **SURF. ELEV.** 426.9 **COORDINATES:** N:1,329,549.38 E:595,627.61
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 101 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 86.17 ft.
NOTES



GENERAL STRATA DESCRIPTION	ELEVATION
	426.9
Fill (FILL)	
	332.9
Mudstone (MUDSTONE)	
	325.9

Bottom of borehole at 101.0 feet.

WELL DATA

Top of casing Elev. = 429.90

	DEPTH
Surface Seal: concrete	2.0
Annular Fill: 80/20 Portland Cement/Bentonite Powder	20.0
Annular Seal: bentonite chips	87.0
Filter Pack: 30/40 Silica Sand	100.1
Screen Tip Elevation: 0.40 ft. **Backfill:** 30/40 silica sand (riser vibrated up while pulling casing)	100.5

NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

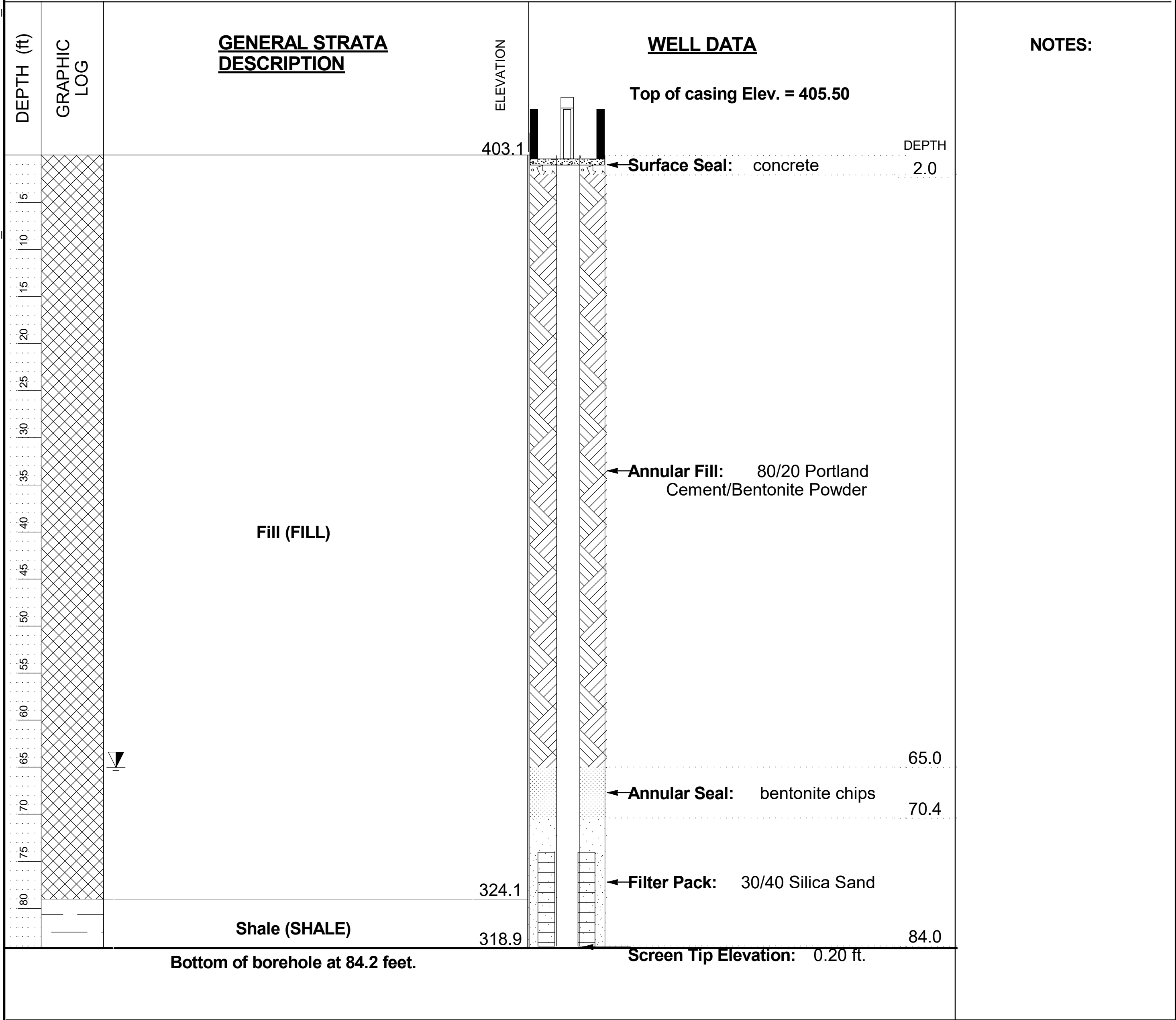
BORING MW-15
PAGE 1 OF 1

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/16/2013 **COMPLETED** 11/17/2013 **SURF. ELEV.** 403.1 **COORDINATES:** N:1,329,680.61 E:595,932.10
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 84.2 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 65.03 ft.
NOTES



WELL SPECIFICATIONS

Casing Diameter: 2 inches **Screen Diameter:** 2 inches
Casing Material: Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
Casing Length: feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

SOUTHERN COMPANY

BORING MW-16
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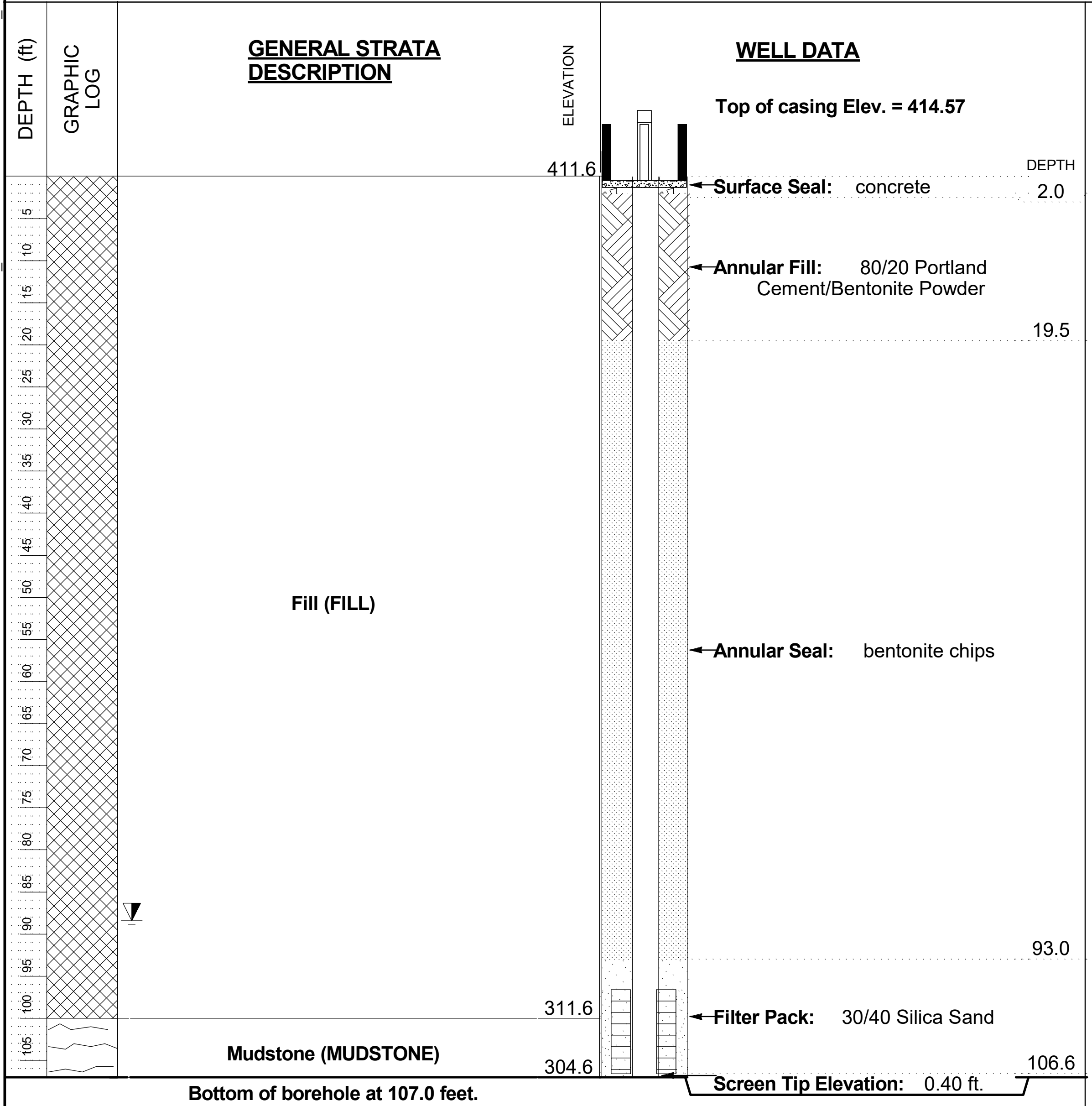
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/5/2014 **COMPLETED** **SURF. ELEV.** 411.6 **COORDINATES:** N:1,328,655.72 E:596,399.88
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 107 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 88.43 ft.
NOTES



NOTES:

Description	Elevation
Fill (FILL)	411.6
Mudstone (MUDSTONE)	311.6
	304.6

Bottom of borehole at 107.0 feet.

Top of casing Elev. = 414.57

Well Data	Depth
Surface Seal: concrete	2.0
Annular Fill: 80/20 Portland Cement/Bentonite Powder	19.5
Annular Seal: bentonite chips	93.0
Filter Pack: 30/40 Silica Sand	106.6

Screen Tip Elevation: 0.40 ft.

WELL SPECIFICATIONS

Casing Diameter: 2 inches **Screen Diameter:** 2 inches
Casing Material: Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
Casing Length: feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/13/17 15:25 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

BORING MW-17
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SOUTHERN COMPANY

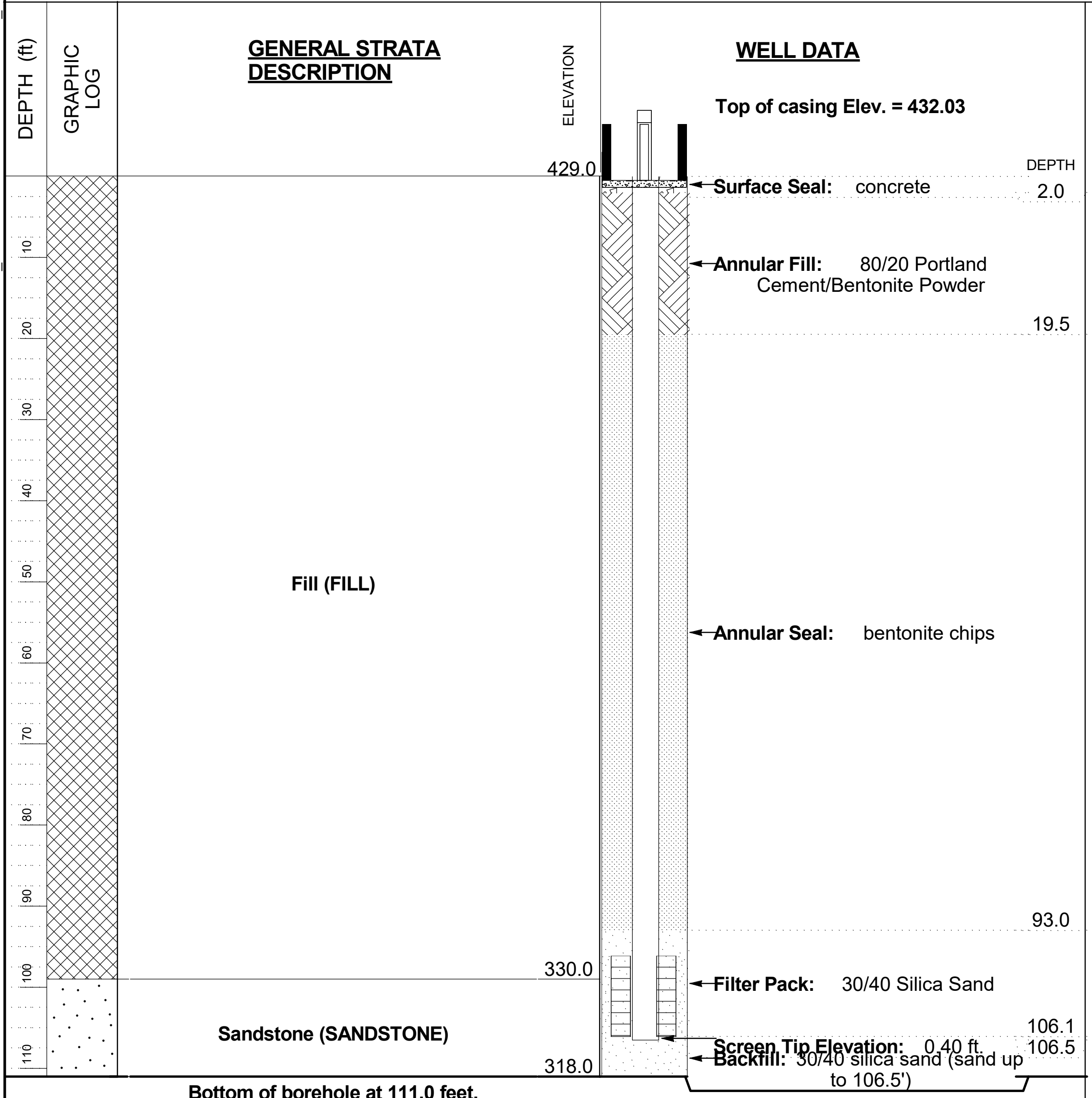
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/6/2014 **COMPLETED** **SURF. ELEV.** 429.0 **COORDINATES:** N:1,328,253.36 E:596,174.14
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 111 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED**
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION	WELL DATA	NOTES:
				Top of casing Elev. = 432.03	
0		Fill (FILL)	429.0		
101		Sandstone (SANDSTONE)	330.0		
111			318.0		



Bottom of borehole at 111.0 feet.

WELL DATA

Top of casing Elev. = 432.03

DEPTH	WELL DATA
2.0	**Surface Seal:** concrete
19.5	**Annular Fill:** 80/20 Portland Cement/Bentonite Powder
93.0	**Annular Seal:** bentonite chips
106.1	**Filter Pack:** 30/40 Silica Sand
106.5	**Screen Tip Elevation:** 0.40 ft.
	Backfill: 30/40 silica sand (sand up to 106.5')

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

2012 GEOTECH LOG WITH WELL - ESEE2012DATABASE.GDT - 10/13/17 15:25 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

BORING MW-18
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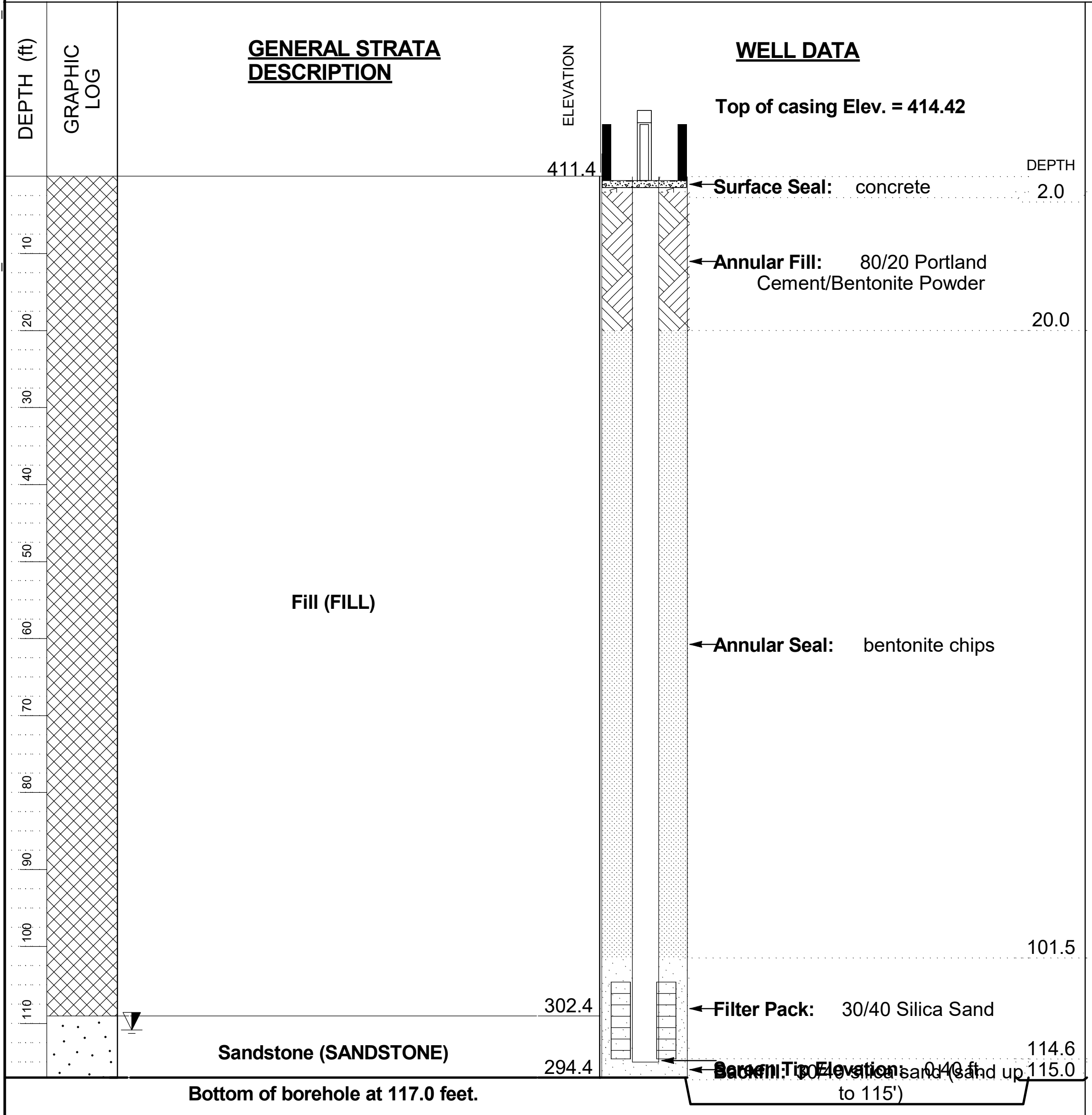
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/6/2014 **COMPLETED** **SURF. ELEV.** 411.4 **COORDINATES:** N:1,327,977.42 E:595,793.78
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 117 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 110.84 ft.
NOTES



Bottom of borehole at 117.0 feet.

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

BORING MW-19
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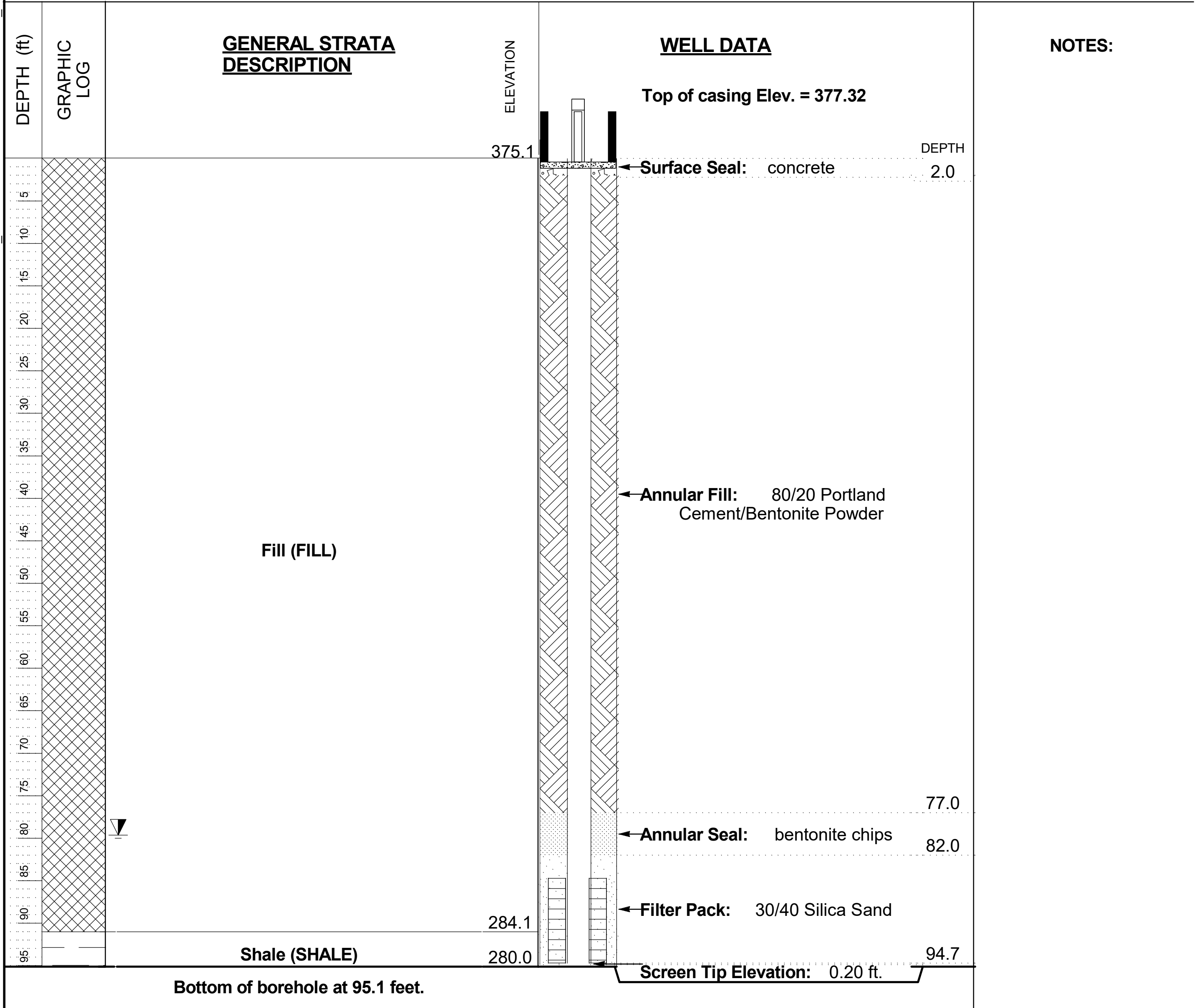
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/4/2013 **COMPLETED** 11/6/2013 **SURF. ELEV.** 375.1 **COORDINATES:** N:1,327,697.31 E:595,251.57
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 95.1 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 79.63 ft.
NOTES



WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

BORING MW-20
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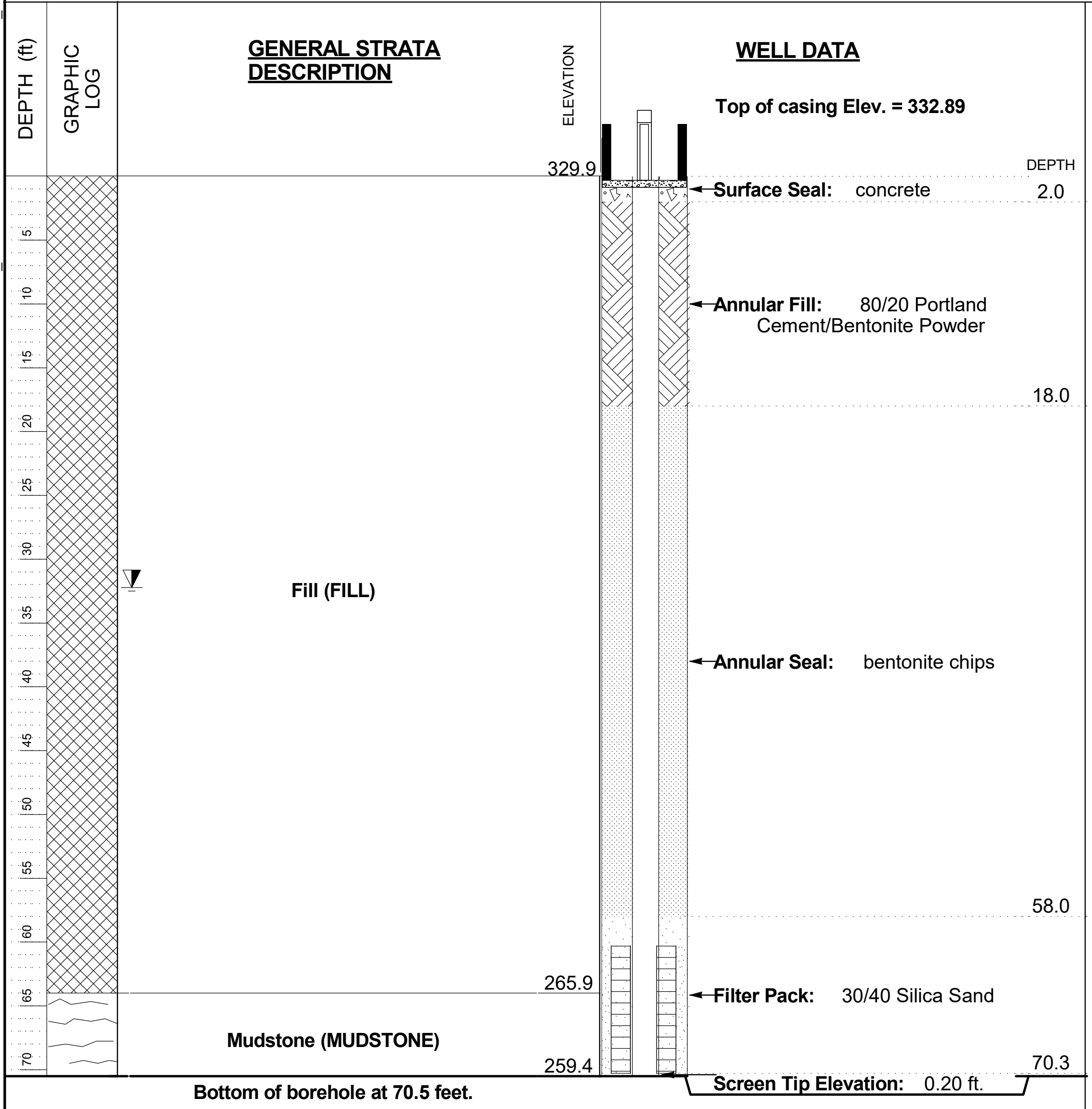
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/10/2014 **COMPLETED** **SURF. ELEV.** 329.9 **COORDINATES:** N:1,327,792.53 E:594,841.23
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Coates **CHECKED BY**
BORING DEPTH 70.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 32.23 ft.
NOTES



WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

Appendix B

ALABAMA POWER COMPANY
PLANT GORGAS
GYPSUM LANDFILL
STATISTICAL ANALYSIS PLAN

Prepared for

Alabama Power Company
Birmingham, Alabama

Prepared by

Groundwater Stats Consulting
Mobile, Alabama

Revised August 2020

ALABAMA POWER COMPANY
PLANT GORGAS
GYPSUM LANDFILL
STATISTICAL ANALYSIS PLAN

Kristina L. Rayner
Groundwater Stats Consulting, LLC
Originator

Gregory T. Whetstone, P.E.
Southern Company Services, Inc.
Reviewer

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APPENDICES

1.0 INTRODUCTION

This updated Statistical Analysis Plan (SAP) describes the site-specific statistical analysis approach that will be used to evaluate groundwater at Alabama Power Company's Plant Gorgas Gypsum Landfill pursuant to ADEM Admin. Code r. 335-13-15-.06 and 40 CFR Part 257. 90 through 95 under detection and assessment monitoring programs.

A compliance groundwater monitoring well system was installed pursuant to requirements of 40 CFR 257.91(e)(1). A background well network is installed upgradient of the CCR unit. Downgradient monitoring wells were installed along the downgradient waste boundary pursuant to 40 CFR 257.91(a)(2). The compliance monitoring well network is described in the site-specific groundwater monitoring plan and summarized in the attached Table 1.

Alabama Power Company conducted 8 background monitoring sample events beginning in 2016. Samples were collected from the compliance monitoring wells and analyzed for CCR Appendix III and IV parameters pursuant to 40 CFR 257.91 Appendix III and IV parameters are as follows:

1) Appendix III (Detection Monitoring) - boron, calcium, chloride, fluoride, pH, sulfate, and TDS
2) Appendix IV (Assessment Monitoring) – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

This updated SAP has been developed based upon the characteristics of the groundwater quality data collected since groundwater monitoring was implemented in 2016 following the requirements in 40 CFR 257.91[1], and the United States Environmental Protection Agency (USEPA) Unified Guidance (March 2009)[2]. The plan describes:

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[1] Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities, 2015.

[2] U.S. EPA, March 2009. *Unified Guidance*, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

1) Background data collection, management, and updates;
2) Statistical concepts applicable to detection and assessment monitoring programs;
3) Site-specific statistical analysis methods for Detection Monitoring; and
4) Statistical approach for Assessment Monitoring and Corrective Action.

As part of ongoing site activities, installation of additional wells may be necessary to characterize site conditions or supplement the assessment monitoring well network. The disposition of these additional wells will be described in the site groundwater monitoring plan. Procedures for statistically evaluating additional wells are described in this SAP.

Any change to the statistical analysis plan (e.g. statistical analysis method, background period, background data set, well network, screening method, etc.) will only be implemented upon receipt of approval from the Alabama Department of Environmental Management (Department).

2.0 BACKGROUND

This section describes the establishment, screening, update, and management of the background data sets used for detection, assessment and corrective action phases of groundwater monitoring. Included are descriptions of the tests that are used to determine whether the potential background data represent site-specific conditions and the procedures used to update (expand or truncate) the background data set. Also described are procedures that will be used to update the data set with more current monitoring data or as new background monitoring wells are installed.

Changes or updates to background updates will only be made after Department approval.

2.1 Background Screening

Background is determined based on site-specific conditions such upgradient wells, wells not in the groundwater flow path of the unit, or wells determined to not be affected by the disposal unit. Once background wells are selected based on site-specific conditions, the data are screened as follows:

2.1.1 Outlier Testing

An outlier is defined as an observation that is unlikely to have come from the same distribution as the rest of the data. A statistical outlier test, such as the 1989 EPA Outlier Test [3]or Tukey's Outlier Test as discussed in the USEPA Guidance, will be performed on the monitoring well data when time series plots or box and whiskers plots indicate the presence of extreme observations relative to other observations. The outlier test will serve as a data quality check to help identify errors from data entry and other sources.

Statistical outliers in the background data will be deselected unless it can be proven that the data point is not an anomalous value and does represent naturally occurring variation. This is conservative from a regulatory perspective in that it ensures that the background limits are not artificially elevated. When outliers are identified, they are flagged in the data set and the values excluded from background limit calculations. Re-testing for outliers will be performed when background updates are proposed.

2.1.2 Testing and Adjusting for Seasonal Effects

Testing and adjusting data for seasonal factors ensures that seasonal effects will not affect the test results. When seasonal effects are suspected, the Kruskal-Wallis seasonality test will be used to determine whether the seasonal effects are statistically significant when there are sufficient data to test for seasonality. When seasonal effects are confirmed, the data will be de-seasonalized prior to calculating a statistical limit. Data are de-seasonalized by subtracting the seasonal mean and adding back the grand mean to each observation. Background data will be re-tested when there are at least four new values available and a background update is proposed.

2.1.3 Temporal Trend Testing

The Sen's Slope/Mann-Kendall statistical analysis will be performed on all well/constituent pairs to evaluate concentrations over time. The Sen's Slope Estimator will be used to estimate the rate of change (increasing, no change, or decreasing) for each constituent at each well. The Mann Kendall statistic will be used to determine whether each of those trends is statistically significant. The Sen's Slope/Mann Kendall analysis requires at least five observations.

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[3] 1953, "Processing data for outliers", *Biometrics*, Vol. 9, pp.74-89.

When a significant trend is present, older historical values may be deselected from the background data prior to computing background limits in cases where groundwater is presumed not to be impacted by the unit. The resulting limits will reflect more current conditions and will not be influenced by older, historical conditions that are no longer relevant. If upgradient concentration levels are changing over time (i.e. trending upward or downward), the prospective background data set may need to be truncated, removing older data to ensure that the resulting limits continue to represent current natural conditions.

For instance, when background concentration levels are increasing over time due to upgradient water quality changes, if the background data sets are not adjusted, the established PLs could result in increased false positive or false negative risk. In some cases, including older historical data in the background data set may result in overly sensitive limits and an increased chance of false positive readings. In other cases, using all background data when there are temporal changes in background levels may artificially elevate limits. This scenario may occur even when there is a decreasing trend in background concentration levels. An elevated limit under these circumstances is a direct result of an inflated standard deviation that is used in the computation of the parametric limit, which in turn will increase the risk of false negative test outcomes.

Well/constituent pairs that have increasing or decreasing concentration levels over time will be evaluated to determine if earlier data are no longer representative of present-day groundwater quality. In those cases, earlier data may be deselected prior to construction of limits to reduce variation as well as to provide limits that are conservative from a regulatory perspective that will detect future changes in groundwater quality.

Background limits also need to allow for random variation in groundwater concentration levels that are naturally present at a site. The availability of multiple background wells can give an indication of the natural variability in groundwater constituent levels across a site.

2.1.4 Sample Size

While a parametric prediction limit may be constructed with as little as four samples per well, the CCR Rule and the EPA Unified Guidance recommend that a minimum of at least 8 independent background observations be collected for constructing statistical limits. The reliability of the statistical results is greatly enhanced by increasing the sample size to eight or more. An increased sample size tends to more accurately characterize the variation and typically reduce the probability of erroneous conclusions. Furthermore, if a nonparametric prediction limit is required, the confidence level associated with the test will be dependent on the number of background data available as well as the number of comparisons to the statistical limit.

2.1.5 Non-Detect Data

When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit (RL) utilized for nondetects is the practical quantification limit (PQL) used by the laboratory.

When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit. Trace (or estimated) values which are reported above the method detection limit (MDL) and below the PQL/RL are used in the statistical analysis as reported by the laboratory. These values are flagged with "J" to distinguish between estimated values and values reported above the PQL.

If detection limits change over a period of analysis, then a statistically significant trend could be the result of increasing or decreasing laboratory precision and not an actual change in water quality. Under those circumstances, an appropriate substitution of the detection limit will be considered, such as the median or most recent detection limit.

2.2 Updating Interwell Background

The following describes the process that will be used to update interwell background data sets. Background updates described below will only be performed after Department approval.

Interwell statistical methods are constructed by pooling upgradient well data from 2 or more upgradient wells. For the Detection Monitoring program, background-derived Prediction Limits will be updated during each semi-annual event by incorporating the most recent sampling results from the existing background well network into the background data set. New background data will be screened for any new outliers as described above.

For the Assessment and Corrective Action program, background-derived tolerance limits are used to construct background limits using pooled upgradient well data for comparison against established standards. The tolerance limits will be updated every 2 years after screening as described above.

Once background has been established, the background well network may be updated by (1) adding wells to the background well network, or (2) removing wells and data from the background well network. The following describes the additional statistical screening steps that will be taken to update the background after a site-specific determination is made that the wells meet the hydraulic and geochemical requirements of a background location.

2.2.1 Adding to the Background Well Network

The background data set may be updated or adjusted by incorporating new wells into the network or installing new background monitoring wells. When new wells are installed, the following process will be used to statistically evaluate the results and incorporate them into the background data set upon receipt of ADEM approval.

Prior to incorporating new upgradient well data for construction of statistical limits, Tukey’s outlier test and visual screening are used to evaluate data. Any confirmed outliers are flagged as such in the database and deselected prior to construction of interwell prediction limits. Any flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. A summary of Tukey’s test results and flagged values will be provided with the report.

Upgradient well data will be further tested for trends as described earlier. When no statistically significant trends are identified, all new well data will be incorporated into the background. Any records with trending data will be evaluated on a case by case basis, and records may require deselection if historical data are no longer representative of present-day groundwater quality conditions. Interwell prediction limits using all upgradient well data are re-calculated as a result of this screening.

2.2.2 Removing Wells and Data from Background

As additional background data are collected, or site conditions change, a recommendation may be made to remove a well from the background network for any number of reasons (e.g. removal, change in groundwater flow conditions, change in chemistry, vandalism, etc.). If an upgradient well will no longer be part of the background network, the historical data from that well will no longer be included in the construction of interwell limits (which pool upgradient well data) without Department approval.

When wells are proposed for removal from the network, a site-specific statistical and geochemical evaluation will be made to identify the population(s) of data that may not represent background conditions. A proposal will be submitted to the Department for approval identifying the recommended use or disuse of historical data from the well(s) proposed for removal. The proposal will include statistical data screening and will explain the rationale for the proposed use of the data.

In the case where an upgradient well is no longer sampled (i.e. due to well damage, etc.), but historical data are still representative of upgradient water quality, an evaluation will be conducted as described below to determine whether data are still representative of background and should continue to be included in the background data set. When demonstration shows that groundwater quality from a well is still representative of naturally occurring groundwater quality upgradient of the facility, this data will be used in construction of statistical limits with ADEM approval. In cases where data from upgradient wells removed from the network do not represent upgradient groundwater quality, a proposal will be made for ADEM approval whereby interwell prediction limits will be re-calculated using data from only those upgradient wells in the network.

When preparing a background data evaluation for Department approval, the statistical portion of the evaluation will be accomplished by:

i. Using the ANOVA to determine whether significant variation exists among upgradient wells which would prevent the well's data from being included in construction of interwell prediction limits;
ii. Visual screening using Time Series and Box Plots to determine whether measurements are similar to neighboring upgradient wells;
iii. Screening the background data set for outliers as described above; and

iv. Performing trend tests to identify statistically significant increasing or decreasing trends which may require adjustment of the record to eliminate trending data and reduce variation.

2.3 Updating Intrawell Background

Intrawell statistical methods may be used at well locations that have not been impacted by a release from the unit being monitored. When using intrawell methods, once the background limits are established, data will not be evaluated again for updating until a minimum of 4 new samples are available, or every 2 years[4]. Data will be screened for outliers and trends as described above.

When updating an intra-well background, data are tested for suitability of updating by consolidating new sampling observations with the screened background data. Before updating the data for intrawell testing, it is necessary to verify that the most recent observations represent an unimpacted state as compared with the existing background. Data are first screened for outliers and, when confirmed, flagged as such in the database and deselected prior to constructing statistical limits. This step results in statistical limits that are conservative from a regulatory perspective.

The Mann-Whitney (Wilcoxon Rank Sum) two-sample test is then used to compare the median of the first group of background observations to the median of the more recent 4 or more observations. If the most recent data group is not found to be statistically different than the older data, the background data set may be updated and the prediction limits will be reconstructed to include the more recent background samples. When statistical differences are identified by the Mann Whitney test, statistical limits may not be eligible for updating. When more samples are available, data will be tested again for suitability of updating background data sets. In the event it is determined that the historical data are no longer representative of present-day groundwater quality in the absence of suspected impacts, only the more recent 8 or more measurements will be used to update the prediction limits.

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[4] US EPA Unified Guidance, March 2009. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities – Section 5.3*. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

3.0 STATISTICAL APPROACH FOR DETECTION MONITORING

The following sections describe the concepts related to developing a site-specific SAP for detection monitoring. The statistical evaluation includes screening upgradient well data to characterize groundwater upgradient of the facility and determine whether intrawell or interwell methods are recommended as the most appropriate statistical method for each Appendix III constituent.

3.1 Statistical Method

When data from multiple upgradient wells are available, a determination will be made as to whether the upgradient well data appear to come from the same population or whether there is evidence of spatial variation upgradient of the facility. Data for each constituent are plotted using box and whisker plots to assist in making this determination, providing visual representation of concentrations within and across wells. Analysis of Variance (ANOVA) may be used initially to statistically evaluate whether significant spatial variation exists at each unit.

Interwell prediction limits (PLs) pool upgradient well data to construct statistical limits which are used to evaluate data at downgradient wells. These tests are appropriate when the ANOVA determines that no significant spatial variation exists among the background wells.

In the event the ANOVA determines:

1) evidence of significant spatial variation upgradient of the facility, or
2) that there are insufficient upgradient well data, or
3) that interwell methods will not adequately address the question of a change in groundwater quality at any of the downgradient wells,

the USEPA Unified Guidance recommends switching from interwell methods to intrawell methods when it can be reasonably demonstrated that no impact from the CCR unit is present for well/constituent pairs in detection monitoring.

Intrawell PLs, which compare the most recent sample from a given well to statistical limits constructed from historical measurements at the same well, are extremely useful for rapidly detecting changes over time at a given location. Intrawell methods remove the influence of on-site spatial variation in well-to-well concentration levels. Site monitoring data are evaluated for the appropriateness of intrawell methods, including screening of background data from within each well for trends, seasonality when sufficient data are available, and outliers.

3.2 Prediction Limits

The use of PL tests is restricted to Appendix III parameters recently sampled at groundwater monitoring wells to represent *current* conditions. Background stability will be tested using temporal and seasonal trend tests, utilizing de-seasonalizing adjustments when seasonal trends are present. Moreover, statistical conditions including background sample size requirements as specified in USEPA guidance and regulations will be verified prior to the use of each statistical approach.

3.3 Criteria for Using the Interwell Statistical Methodology

There are a number of conditions that need to be met before an interwell statistical analysis can be considered appropriate for a specific site. These conditions are described in this section.

1. Ensuring that the aquifer underlying the site is continuous and that all monitoring wells are screened in the same level;
2. Ensuring that limits will be adequately sensitive in detecting a facility release;
3. Ensuring that limits reflect current background conditions; and
4. Ensuring that confounding factors will not confuse the results.

3.3.1 Aquifer Designation and Monitoring Wells

Where the uppermost aquifer underlying a site is discontinuous, where downgradient monitoring wells are screened in differing levels, or where the upgradient monitoring well network is limited, EPA recommends performing intrawell analyses, to avoid confusing an impact caused by a release from the facility with a difference between wells caused by heterogeneous hydrogeology.

The statistical approach for constituents of concern will be based on interwell or intrawell PLs, and in some cases a combination of both methods, as a result of evaluation of spatial variation at the site. Box and whisker plots may be provided to demonstrate concentration levels within each well and across wells. When significant differences exist in concentration levels, particularly between upgradient wells, this indicates spatial variation in the groundwater quality. Spatial variation and/or limited upgradient well data would tend to create statistical limits that are:

1) not conservative from a regulatory perspective; or
2) not representative of background water quality.

3.4 Criteria for Using an Intrawell Statistical Methodology

The following is a description of the criteria that a site must meet to use an intrawell statistical methodology if it is determined that interwell methods are not appropriate.

3.4.1 Screening of Prospective Historical Background Data

Prior to using an intrawell analysis, it will be necessary to demonstrate that there have been no potential prior impacts at downgradient wells on the prospective historical background data as a result of the current practices at the Site. In addition to an independent investigation for prior impacts, prospective background data for intrawell tests will be screened for trends, seasonality and outliers as described above. If intrawell analyses are not feasible due to elevated concentrations in downgradient wells relative to concentrations upgradient of the facility, as determined during the screening process, interwell analyses will initially be utilized until further evidence supports the use of intrawell testing.

3.4.2 Stable Naturally Occurring Concentrations

The background data screening procedure described here is designed to check for stable background conditions, and account for existing groundwater quality from past or present activities in the area. While having pre-waste data is ideal for characterization of groundwater quality prior to waste placement, these facilities do not have pre-waste data.

The Sen’s Slope/Mann-Kendall test for increasing or decreasing temporal trends will be used to test prospective background data when time series plots indicate the possibility of either increasing or decreasing trends over time. In the case where significant trends are found, unrepresentative values will be deselected only when it is clear that the trend is not the result of contamination. Assuming no alternative source, if similar trends and/or concentration levels are noted upgradient of the unit for the same parameters, it will be assumed that concentration levels represent natural variation in groundwater, and thus, earlier data will be removed so that compliance limits reflect current groundwater conditions upgradient of the unit.

3.5 Site-Wide False Positive Rates (SWFPR) and Statistical Power

The USEPA Unified Guidance recommends an annual site-wide false positive rate of 10%, which is distributed equally among the total number of sampling events. A site-wide false positive rate of 5% is targeted for each semi-annual sampling event. USEPA also requires demonstration that the statistical methodology selected for a facility will provide adequate statistical power, as discussed in Section 3.7 to detect a release, should one occur.

3.6 Determination of Future Compliance Observations Falling Within Background Limits

Intrawell or interwell upper PL are constructed with a test-specific alpha based on the overall site-wide false positive rate (SWFPR) of 5% for each sampling event. Any compliance observation that exceeds the background prediction limit will be followed with one or two independent resamples, depending on the resample plan, to determine whether the initial exceedance is verified.

The following pretests are used to ensure that the statistical test criteria are met:

1) *Data Distribution.* The distribution of the data will be tested using either the Shapiro-Wilk test (for background sample sizes of 50 or less) or the Shapiro-Francia test (for background sample sizes greater than 50). Non-normally distributed data will be transformed using the ladder of powers[5] to normalize the data prior to construction of background limits. When background data cannot be normalized, nonparametric PL will be calculated.

2) *Handling Non-Detects.* Simple substitution per USEPA Guidance[6] will be used when non-detects comprise less than or equal to 15% of the individual well data. Simple substitution refers to the practice of substituting one-half the reporting or detection limit for non-detects. When the proportion of non-detects (NDs) in

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[5] 1992, *Statistical Methods In Water Resources,* Elsevier, Helsel, D. R., & Hirsch, R. M.

[6] June 1992, *Addendum to Interim Final Guidance, Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities.* Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

background falls between 16 and 50%, a non-detect adjustment such as the Kaplan-Meier or Regression on Order Statistics (ROS) method for adjustment of the mean and standard deviation will be used prior to constructing a parametric prediction limit. When the proportion of non-detects exceeds 50%, or when the data cannot be normalized, a nonparametric prediction limit will be used.

3.7 Statistical Power

The USEPA Unified Guidance also requires that facilities achieve adequate statistical power to detect a release, even if only at one facility well and involving a single constituent. More specifically, EPA recommends power of approximately 55% when concentration levels are 3 standard deviations above the background mean, or approximately 80% power at 4 standard deviations above the background mean.

The performance of a given testing strategy is displayed in Power Curves which are based on the particular statistical method chosen combined with the resampling plan, the false positive rate associated with the statistical test, as well as the number of background samples available and the size and configuration of the monitoring network.

Power Curves for the PLs following this report demonstrate that the specified plan has the power to detect a release in downgradient wells and meet or exceed at least one of the power recommendations. As more data are collected during routine semi-annual sampling events and the background sets are expanded, the power requirements will exceed recommended power requirements.

4.0 STATISTICAL APPROACH FOR ASSESSMENT MONITORING & CORRECTIVE ACTION

The following describes the general statistical procedures that will be used if a facility enters Assessment or Corrective Action monitoring because of SSIs in the Detection monitoring program. Site-specific and event-specific SAPs may be developed at that time according to permit or regulatory requirements.

4.1 Assessment Monitoring

Assessment Monitoring may be initiated when there is a confirmed SSI over background in one or more wells for any of the Appendix III parameters. Wells are sampled for Appendix IV parameters semiannually concurrent with Appendix III constituents.

When in assessment monitoring, Appendix IV constituent concentrations are compared to Groundwater Protection Standards (GWPS), or other applicable standards, using Confidence Intervals. Upgradient well data are screened for outliers and trends as described above and tolerance limits are used to develop background limits. GWPS may be based on background limits when background concentrations are higher than the established Maximum Contaminant Levels (MCLs) or other rule-specified GWPS.

Parametric confidence intervals around the population mean will be constructed at the 99% confidence level when data follow a normal distribution, and around the geometric mean (or population median) when data follow a transformed-normal distribution.

Non-parametric confidence intervals will be constructed when data do not pass a normality test and cannot be normalized via a transformation. The confidence level associated with the non-parametric tests is dependent on the number of values used to construct the interval. Confidence intervals require a minimum of four samples; however, a minimum of eight samples are recommended. When non-parametric confidence intervals are constructed, a maximum of eight of the most recent samples will be used in the comparison. When a well/constituent pair does not have the minimum sample requirement, the well/constituent pair will continue to be reported and tracked using time series plots and/or trend tests until such time that enough data are available.

In Assessment Monitoring, when the Lower Confidence Limit (LCL), or the entire interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSI.

4.2 Corrective Action

If groundwater corrective action is triggered, semi-annual sampling of the assessment monitoring wells will continue and Confidence Intervals will monitor the progress of remediation efforts. Confidence Intervals are compared to GWPS and the entire interval must fall below a specified limit (i.e. the Upper Confidence Limit [UCL] must be below the limit) to demonstrate compliance. A site-specific monitoring program will be developed based on the final corrective action plan and points-of-compliance.

5.0 SITE-SPECIFIC STATISTICAL ANALYSIS METHODS

A site-specific statistical analysis approach was developed after applying the screening criteria described previously. Results of the site-specific screening are presented in Appendix A, Background Screening and Compliance Evaluation. The following is a detailed description of the statistical analysis methodology that will be used for groundwater quality analysis at the site when monitored constituents are present in any of the downgradient wells.

Background sampling began in February 2016. The monitoring well network is described on Table 1.

For the statistical analysis of analytical results obtained from the existing monitoring well network, (1) the number of samples collected will be consistent with the appropriate statistical procedures as recommended by the CCR Rule and the USEPA Unified Guidance; (2) the statistical method will comply with the EPA-recommended performance standards; and (3) determination of whether or not there is a statistically significant increase (SSI) over background values in the future will be completed per the above-mentioned regulations.

5.1 Detection Monitoring Program

Based on the background screening that was conducted by Groundwater Stats Consulting in the Fall 2017 and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting, interwell methods combined with a 1-of-2 resampling strategy will be used to evaluate boron and pH. Intrawell methods combined with a 1-of-2 resampling strategy will be used to evaluate calcium, chloride, fluoride, sulfate and TDS. If a statistical exceedance is found, one independent resample will be collected to determine whether the initial exceedance is verified.

If the initial finding is not verified by resampling, the resampled value will replace the initial finding. When the resample confirms the initial finding, the exceedance will be reported. The Sen's Slope/Mann Kendall trend test will be used, in addition to PL, to statistically evaluate concentration levels over time and determine whether concentrations are increasing, decreasing, or stabilizing.

The chance of false positive results increases with increasing numbers of statistical tests. The total number of statistical tests for a facility is the number of parameters tested multiplied by the number of monitoring wells. In an effort to reduce the overall number of statistical tests performed at each semi-annual sampling event, thereby lowering the chance of a false exceedance while maintaining a high degree of statistical confidence that a release will be detected, Plant Gorgas Gypsum Landfill will:

1) Monitor constituents in wells with detections (i.e. excluding well/constituent pairs with 100% nondetects); and
2) Incorporate a 1-of-2 retesting strategy

The following statistical methods will be used:

5.1.1 Parametric Prediction Limits

These limits will be computed per USEPA Unified Guidance when data can be normalized, possibly via transformation. The test alpha will be calculated based on the following configuration:

Annual SWFPR = 0.10
1-of-2 resampling plan with a minimum of 8 background samples for interwell tests
1-of-2 resampling plan with a minimum of 8 background samples for intrawell tests
w= 5 (number of compliance wells)
c= 7 constituents

5.1.2 Nonparametric Prediction Limits

The highest background value will be used to set the upper nonparametric prediction limit. The associated confidence level takes into account the prospect of additional future compliance values (retests) when there is an initial exceedance. The achieved confidence level is determined based on the background sample size, the number of monitoring wells in the network, and the number of proposed retests, using tables provided in the USEPA Unified Guidance[7].

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[7] USEPA Unified Guidance, March 2009. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

5.1.3 Retesting Strategy

When the prediction limit analyses indicate initial exceedances, discrete verification resamples from the indicating well(s) will be collected within 90 days and prior to the next regularly scheduled sampling event. If the initial exceedance is verified, a confirmed SSI will be reported. For the test to be valid, the resample needs to be statistically independent which requires that sufficient time elapse between the initial sample and resample. A minimum time interval between samples will be established to ensure that separate volumes of groundwater are being sampled.

5.1.4 Background Data Set

Interwell tests, which compare downgradient well data to statistical limits constructed from all pooled upgradient well data after careful screening, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter. Because upgradient well data represent natural groundwater quality upgradient of the facility, intrawell prediction limits are also constructed on these wells. A minimum of 8 background samples are required for both interwell and intrawell tests.

The background data set will be managed, screened and updated as described previously after receipt of Department approval.

5.2 Assessment Monitoring Program

Assessment monitoring will be performed following the procedures described in Section 4.0. When assessment monitoring is initiated, Appendix IV constituents are sampled semi-annually, and concentrations in downgradient wells are statistically compared as described below to GWPS. Following the Unified Guidance, the Maximum Contaminant Level (MCL) is used as the GWPS. When reported concentrations in upgradient wells are higher than the established MCLs, background limits may be developed as described below from an interwell tolerance limit using the pool of all approved upgradient well data (see Chapter 7 of the Unified Guidance).

Parametric tolerance limits, which are used when pooled upgradient well data follow a normal or transformed-normal distribution, may be constructed on upgradient well or wells with the highest average concentrations with Department approval. This step serves to reduce the effect of spatial variation on the standard deviation in the parametric case when calculating a GWPS. Non-parametric tolerance limits will be constructed when data do not follow a normal or transformed-normal distribution or when a parametric tolerance limit is not approved.

For constituents without established MCLs, the CCR-rule specified limits will be used as the GWPS unless Department-approved background is higher as calculated from interwell tolerance limit as described above. Appendix IV background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Confidence Intervals are then constructed using a maximum of 8 of the most recent assessment measurements from a given downgradient well for comparison to the GWPS to determine compliance.

Parametric tolerance limits (i.e. UTLs) are calculated when data follow a normal or transformed-normal distribution using pooled upgradient well data as described above for Appendix IV parameters with a target of 95% confidence and 95% coverage. When data sets contain greater than 50% nondetects or do not follow a normal or transformed-normal distribution, the confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. The UTLs are then used as background levels for establishing the GWPS under case 3 below.

As described in 40 CFR § 257.95(h)(1)-(3) the GWPS is:

1. The maximum contaminant level (MCL) established under 40 CFR § 141.62 and 141.66.
2. Where an MCL has not been established:
   (i) Cobalt 0.006 mg/L;
   (ii) Lead 0.015 mg/L;

(iii) Lithium 0.040 mg/L; and
(iv) Molybdenum 0.100 mg/L.

3. Background levels for constituents where the background level is higher than the MCL or rule-specified GWPS.

In assessment monitoring, when the Lower Confidence Limit (LCL), or the entire confidence interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSL.

With Department approval, the background limits will be updated and compared to the MCLs and CCR-rule specified limits for Appendix IV constituents every two years to determine whether the established limit or background will be used as the GWPS in the confidence interval comparisons, as discussed above.

5.3 Corrective Action Monitoring Program

When implemented, groundwater corrective action will include a remedy monitoring program. The remedy monitoring program will be prepared under separate cover and include details regarding statistical analysis of results.

6.0 BIBLIOGRAPHY

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Zar, Jerrold H., 1996. *Biostatistical Analysis*. 3rd edition (p112) Prentice Hall

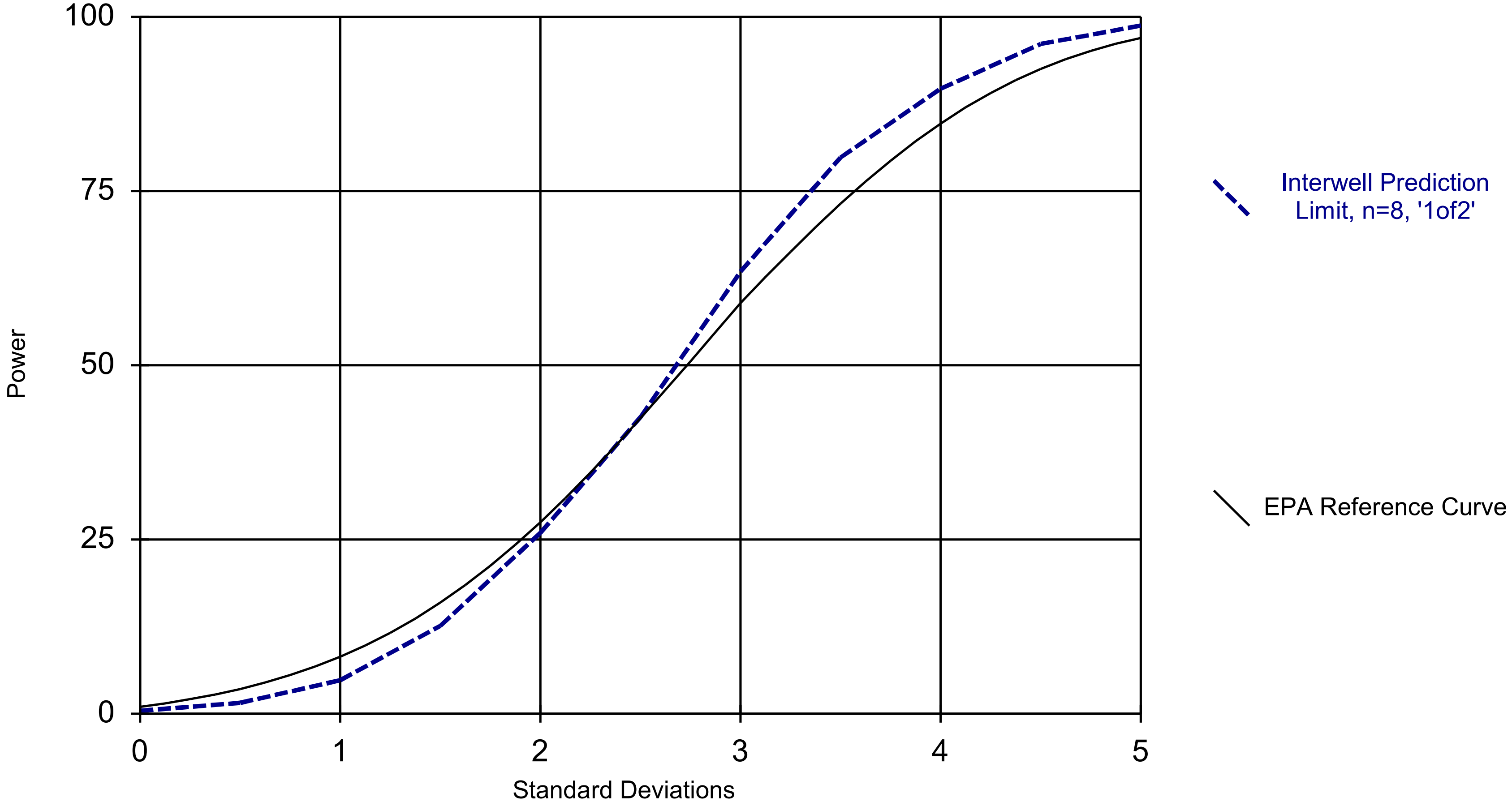
Figures

Table 1.
Groundwater Monitoring Well Network Details

Well Name	Purpose	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth (ft.) BTOC	Top of Screen Elevation (ft. MSL)	Bottom of Screen Elevation (ft. MSL)	Screen Length (ft.)
MW-1	Upgradient	1330794.064	594082.361	499.19	502.25	107.56	405.09	395.09	10
MW-2	Upgradient	1331053.309	593548.802	498.54	502.12	94.58	417.94	407.94	10
MW-3	Upgradient	1330842.402	593025.397	522.23	525.90	119.07	417.23	407.23	10
MW-4	Upgradient	1330289.727	592896.414	516.67	518.63	128.66	400.37	390.37	10
MW-13	Upgradient	1329383.939	595088.06	442.00	445.04	109.04	346.40	336.40	10
MW-14	Upgradient	1329549.381	595627.606	426.90	429.90	103.50	336.80	326.80	10
MW-15	Upgradient	1329680.612	595932.099	403.10	406.05	87.15	329.30	319.30	10
MW-16	Downgradient	1328655.721	596399.878	411.57	414.57	110.00	314.97	304.97	10
MW-17R	Downgradient	1328244.376	2064752.826	431.46	434.57	138.05	306.12	296.12	10
MW-18	Downgradient	1327977.419	595793.776	411.42	414.42	118.00	306.82	296.82	10
MW-19	Downgradient	1327697.305	595251.571	375.11	377.32	97.31	290.41	280.41	10
MW-20	Downgradient	1327792.527	594841.227	329.89	332.89	73.50	269.79	259.79	10

1. Northing and easting are in feet relative to the State Plane Alabama West North America Datum of 1983.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. Top of screen and bottom of screen depths are calculated relative Top of Casing elevation and less the well sump length of 0.4’.

Power Curve

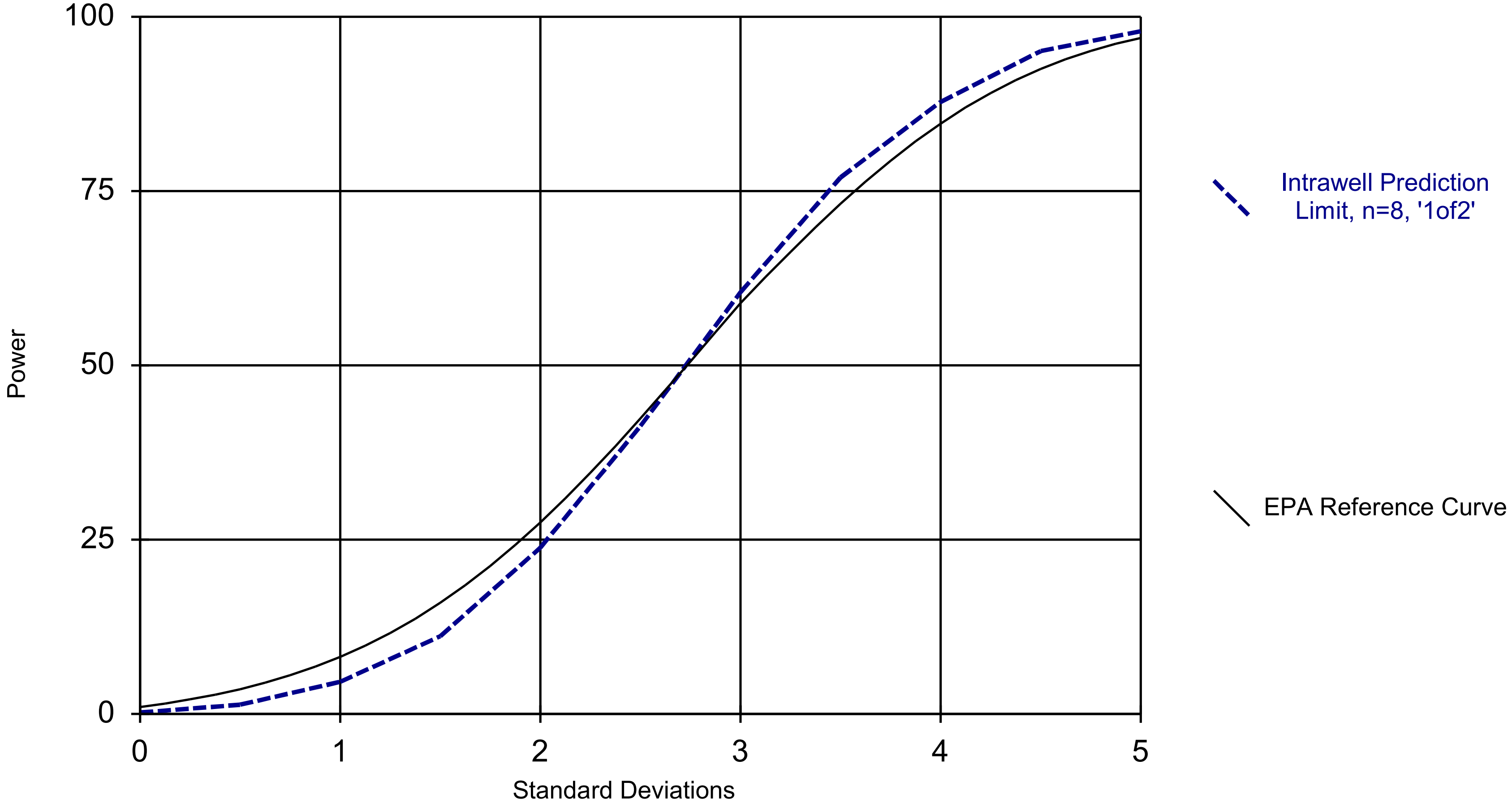


Kappa = 2.666, based on 5 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/10/2020 7:05 AM

Plant William C Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Power Curve



Kappa = 2.74, based on 5 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/10/2020 7:05 AM

Plant William C Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Appendix A
Background Screening and Compliance Evaluation

GROUNDWATER STATS
CONSULTING

September 27, 2019

Southern Company Services
Attn: Mr. Greg Dyer
3535 Colonnade Parkway
Birmingham, AL 35243

Re: Plant Gorgas Gypsum Landfill
Background Update – 2019

Dear Mr. Dyer,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening for the proposed background update of the prediction limits with data through May 2019 for Alabama Power Company's Plant Gorgas Gypsum Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at site for the CCR program in 2016. The monitoring well network, as provided by Southern Company Services, consists of the following:

- **Upgradient wells:** MW-1, MW-2, MW-3, MW-4, MW-13, MW-14 and MW-15; and
- **Downgradient wells:** MW-16, MW-18, MW-19, and MW-20.

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was prepared according to the Statistical Analysis Plan approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting. The analysis was reviewed by Dr. Jim Loftis, Civil & Environmental Engineering professor emeritus at Colorado State University and Senior Advisor to Groundwater Stats Consulting.

The CCR program consists of the following constituents:

> **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Time series and box plots for these parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record for the purpose of updating statistical limits (Figures A and B, respectively). Values in background which have been flagged as outliers may be seen in a lighter font and as a disconnected symbol on the graphs.

Background Update Summary

Intrawell prediction limits, which compare the most recent compliance sample from a given well to historical data from the same well, are updated by testing for the appropriateness of consolidating new sampling observations with the screened background data. This process is described below and requires a minimum of four new data points. Historical data were evaluated for updating with newer data through May 2019 through the use of time series graphs to identify potential outliers when necessary, as well as the Mann Whitney test for equality of medians. As discussed in the Statistical Analysis Plan (October 2018), intrawell prediction limits are used to evaluate calcium, chloride, fluoride, sulfate, and TDS at all wells due to natural spatial variation for these parameters.

Interwell prediction limits, which compare the most recent sample from each downgradient well to statistical limits constructed from pooled upgradient well data, are updated during each sample event. Data from upgradient wells are periodically re-screened for newly developing trends, which may require adjustment of the background period to eliminate the trend, as well as for outliers over the entire record. Interwell prediction limits are used to evaluate boron and pH.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. While the false positive rate associated with the parametric limits is based on an annual 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with the nonparametric limits is dependent upon the available background sample size, number of future comparisons, and verification resample plan. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Prior to performing prediction limits, proposed background data were through May 2019 reviewed to identify any newly suspected outliers at all wells for calcium, chloride, fluoride, sulfate, and TDS and at upgradient wells for boron and pH (Figure C). Both Tukey's Test and visual screening are used to identify potential outliers. When identified, values were flagged with "o" and excluded to reduce variation, better represent background conditions, and provide limits that are conservative from a regulatory perspective. Potential outliers that are identified by Tukey's test but are not greatly different from the rest of the data are not flagged. Also, outliers that are not identified as important by Tukey's test may be identified visually. As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. A summary of Tukey's test results follows this letter, but no values were flagged as outliers.

For constituents requiring intrawell prediction limits, the Mann Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through October 2017 to compliance data through May 2019 to evaluate whether the groups are statistically similar at the 99% confidence level, in which case background data may be updated with compliance data (Figure D). Statistically significant differences were found between the two groups for calcium in well MW-1; chloride in well MW-20; fluoride in wells MW-2 and MW-4; and TDS in well MW-1. Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data, but will be reconsidered in the future. Because the differences for calcium, fluoride and TDS occurred in upgradient wells and more recent data are fairly similar to background and better represent the groundwater quality upgradient of the facility, these background data sets were updated. Due to more recent observations reported at higher concentrations than those in background for chloride in downgradient well MW-20, however, the background data set could not be updated at this time (there is a large increasing trend in chloride at MW-20 starting on 5/22/18). A summary of these results follows this letter, and the test results are included with the Mann Whitney test section at the end of this report.

The Sen's Slope/Mann Kendall trend test was used to evaluate the entire record of data from upgradient wells for parameters utilizing interwell prediction limits (Figure E). When statistically significant increasing trends are identified in upgradient wells, the earlier portion of data is deselected prior to construction of interwell statistical limits if the trending data would result in statistical limits that are not conservative from a regulatory perspective. No statistically significant trends were noted in upgradient wells, and trend test results may be seen on the Trend Test Summary Table.

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 verification strategy were constructed for boron and ph; and intrawell prediction limits combined with a 1-of-2 verification strategy were constructed for calcium, chloride, fluoride, sulfate, and TDS (Figures F and G, respectively). Future samples will be compared against these prediction limits. In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified, and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If a resample falls within the statistical limit, the initial exceedance is considered to be a false positive result; therefore, no further action is necessary. A summary of the updated prediction limits may be found in the Prediction Limit Summary tables following this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for Gorgas Gypsum Landfill. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

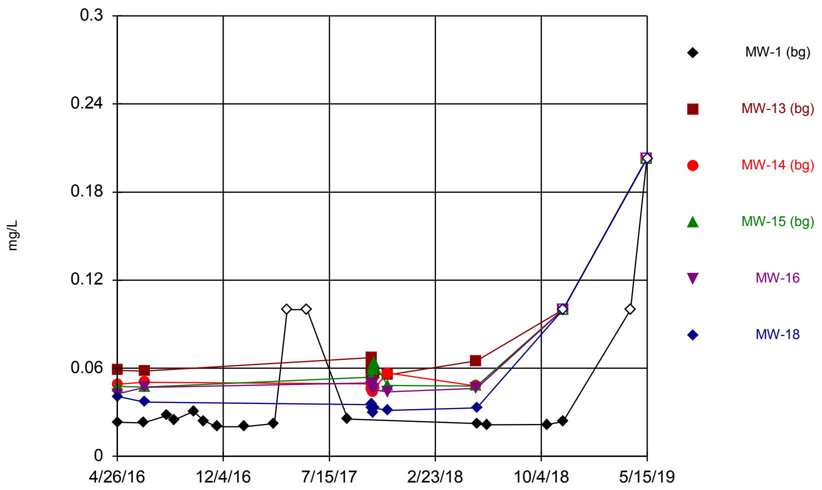
ACollins
Andrew T. Collins
Groundwater Analyst

Kristina Rayner
Kristina L. Rayner
Groundwater Statistician

FIGURE A.

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

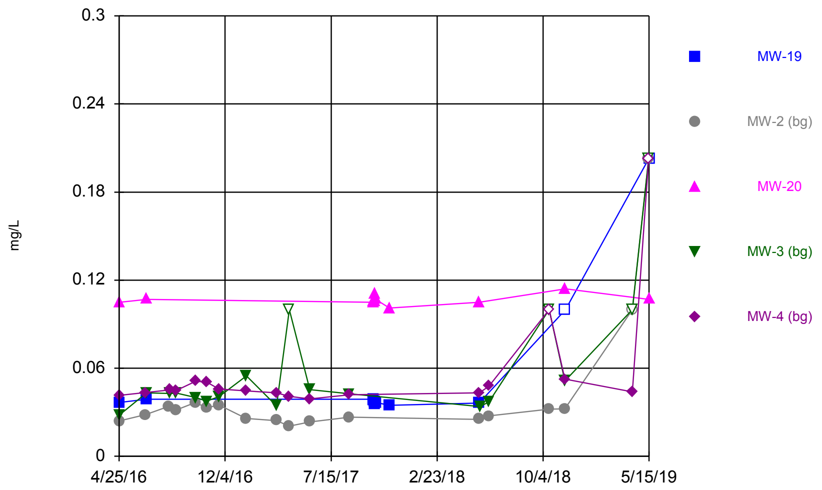
Time Series



Constituent: Boron Analysis Run 9/27/2019 11:09 AM
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

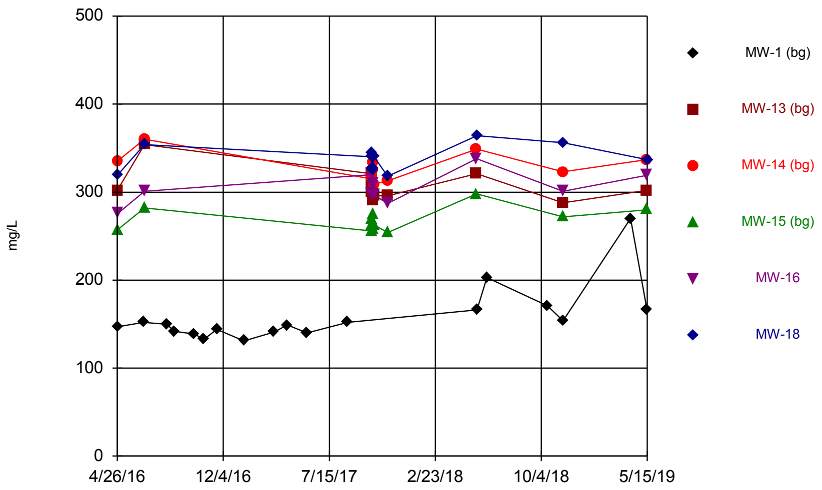
Time Series



Constituent: Boron Analysis Run 9/27/2019 11:09 AM
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

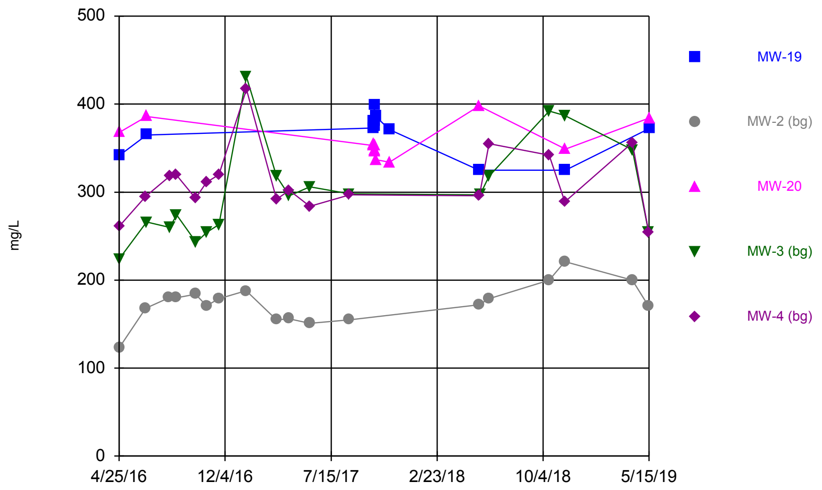
Time Series



Constituent: Calcium Analysis Run 9/27/2019 11:09 AM
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Time Series



Constituent: Calcium Analysis Run 9/27/2019 11:09 AM
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Time Series

Constituent: Boron (mg/L) Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

	MW-1 (bg)	MW-13 (bg)	MW-14 (bg)	MW-15 (bg)	MW-16	MW-18
4/26/2016	0.0231 (J)	0.0585 (J)	0.0491 (J)	0.0476 (J)		0.0408 (J)
4/27/2016					0.0425 (J)	
6/20/2016	0.0227 (J)					
6/22/2016		0.0581 (J)	0.0504 (J)	0.0472 (J)	0.0469 (J)	0.0369 (J)
8/8/2016	0.0278 (J)					
8/24/2016	0.0247 (J)					
10/3/2016	0.0307 (J)					
10/26/2016	0.0241 (J)					
11/21/2016	0.0202 (J)					
1/17/2017	0.0201 (J)					
3/22/2017	0.0224 (J)					
4/18/2017	<0.1					
5/30/2017	<0.1					
8/23/2017	0.0253 (J)					
10/12/2017		0.0673 (J)	0.0493 (J)	0.054 (J)	0.05 (J)	0.0351 (J)
10/13/2017		0.06 (J)	0.0464 (J)	0.0535 (J)	0.0468 (J)	0.0357 (J)
10/14/2017		0.0555 (J)	0.0458 (J)	0.0533 (J)	0.0471 (J)	0.0333 (J)
10/15/2017		0.0567 (J)	0.046 (J)	0.0592 (J)	0.0456 (J)	0.0325 (J)
10/16/2017		0.0576 (J)	0.0438 (J)	0.0608 (J)	0.0486 (J)	0.0295 (J)
10/17/2017		0.0561 (J)	0.046 (J)	0.0641 (J)	0.0452 (J)	0.033 (J)
11/15/2017				0.0483 (J)	0.044 (J)	0.0313 (J)
11/16/2017		0.0554 (J)	0.0568 (J)			
5/21/2018		0.0651 (J)	0.0478 (J)	0.0478 (J)	0.0463 (J)	
5/22/2018	0.0224 (J)					0.0331 (J)
6/12/2018	0.0214 (J)					
10/17/2018	0.0216 (J)					
11/19/2018	0.0237 (J)	<0.1 (J)	<0.1 (J)	<0.1 (J)	<0.1 (J)	<0.1 (J)
4/10/2019	<0.1					
5/14/2019	<0.203	<0.203	<0.203	<0.203	<0.203	
5/15/2019						<0.203

Time Series

Constituent: Boron (mg/L)   Analysis Run 9/27/2019 11:09 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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	MW-19	MW-2 (bg)	MW-20	MW-3 (bg)	MW-4 (bg)
4/25/2016		0.0241 (J)		0.028 (J)	0.0414 (J)
4/26/2016	0.0367 (J)		0.105		
6/20/2016		0.0284 (J)			0.0434 (J)
6/22/2016	0.039 (J)		0.107	0.0433 (J)	
8/8/2016		0.034 (J)			
8/9/2016				0.0429 (J)	0.0453 (J)
8/24/2016		0.0316 (J)		0.0431 (J)	0.0451 (J)
10/3/2016		0.0367 (J)			0.0511 (J)
10/4/2016				0.04 (J)	
10/26/2016		0.0331 (J)		0.0375 (J)	0.0507 (J)
11/21/2016		0.035 (J)		0.0406 (J)	0.0458 (J)
1/17/2017		0.0259 (J)			
1/18/2017				0.0548 (J)	0.0445 (J)
3/22/2017		0.0243 (J)		0.0344 (J)	0.0432 (J)
4/18/2017		0.0206 (J)		<0.1	0.0409 (J)
5/31/2017		0.0234 (J)		0.0454 (J)	0.0392 (J)
8/23/2017		0.0267 (J)		0.0425 (J)	0.042 (J)
10/12/2017	0.039 (J)		0.105		
10/13/2017	0.0384 (J)		0.106		
10/14/2017	0.0372 (J)		0.106		
10/15/2017	0.0354 (J)		0.107		
10/16/2017	0.0373 (J)		0.111		
10/17/2017	0.0367 (J)		0.107		
11/15/2017	0.0348 (J)		0.101		
5/22/2018	0.0362 (J)	0.0251 (J)	0.105		
5/23/2018					0.0433 (J)
5/24/2018				0.0339 (J)	
6/12/2018		0.0275 (J)		0.0371 (J)	0.0478 (J)
10/17/2018		0.0321 (J)		<0.1 (J)	<0.1 (J)
11/19/2018		0.0324 (J)		0.0514 (J)	0.0526 (J)
11/20/2018	<0.1 (J)		0.114		
4/10/2019		<0.1		<0.1	0.0438 (J)
5/14/2019		<0.203		<0.203	<0.203
5/15/2019	<0.203		0.107 (J)		

Time Series

Constituent: Calcium (mg/L)   Analysis Run 9/27/2019 11:09 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-1 (bg)	MW-13 (bg)	MW-14 (bg)	MW-15 (bg)	MW-16	MW-18
4/26/2016	147	302	335	257		319
4/27/2016					276	
6/20/2016	152					
6/22/2016		354	360	282	301	354
8/8/2016	150					
8/24/2016	142					
10/3/2016	139					
10/26/2016	133					
11/21/2016	144					
1/17/2017	131					
3/22/2017	141					
4/18/2017	149					
5/30/2017	140					
8/23/2017	152					
10/12/2017		321	315	256	320	340
10/13/2017		312	317	269	297	326
10/14/2017		300	315	262	299	345
10/15/2017		300	325	275	307	327
10/16/2017		290	333	258	310	325
10/17/2017		296	309	263	297	341
11/15/2017				254	287	318
11/16/2017		296	313			
5/21/2018		321	349	298	338	
5/22/2018	166					364
6/12/2018	203					
10/17/2018	171					
11/19/2018	154	288	323	272	301	356
4/10/2019	270					
5/14/2019	167	302	337	280	319	
5/15/2019						337

Time Series

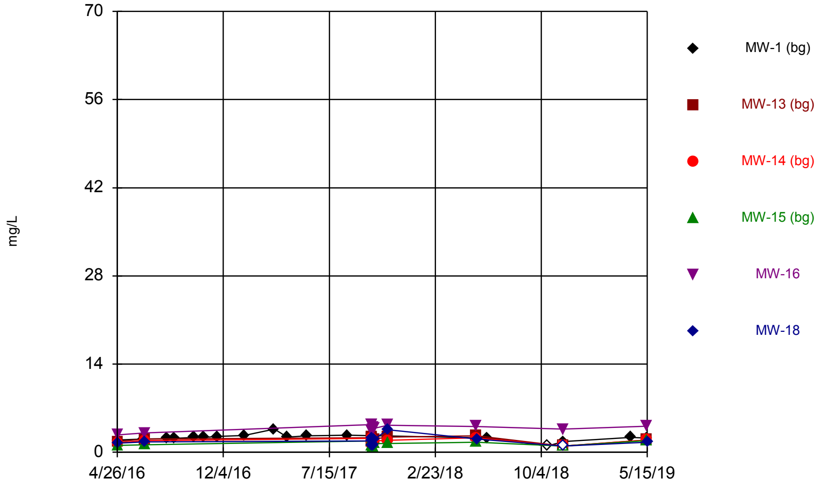
Constituent: Calcium (mg/L) Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

	MW-19	MW-2 (bg)	MW-20	MW-3 (bg)	MW-4 (bg)
4/25/2016		123		224	261
4/26/2016	342		368		
6/20/2016		168			295
6/22/2016	365		386	266	
8/8/2016		180			
8/9/2016				260	318
8/24/2016		180		274	319
10/3/2016		184			293
10/4/2016				243	
10/26/2016		171		254	311
11/21/2016		179		263	320
1/17/2017		188			
1/18/2017				431	417
3/22/2017		155		318	292
4/18/2017		156		296	302
5/31/2017		151		306	284
8/23/2017		155		298	297
10/12/2017	373		353		
10/13/2017	381		354		
10/14/2017	399		346		
10/15/2017	375		353		
10/16/2017	381		347		
10/17/2017	386		337		
11/15/2017	371		334		
5/22/2018	325	172	398		
5/23/2018					296
5/24/2018				297	
6/12/2018		179		318	355
10/17/2018		200		392	342
11/19/2018		221		387	289
11/20/2018	325		349		
4/10/2019		200		348	356
5/14/2019		170		254	254
5/15/2019	372		384		

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series

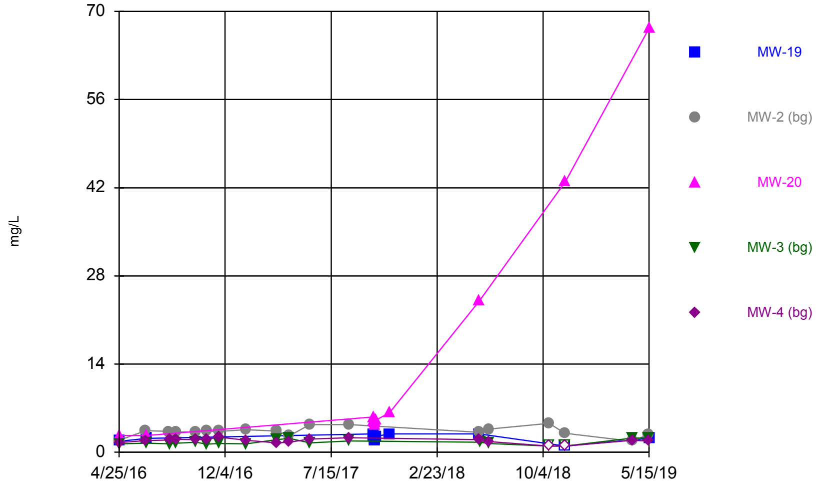


Constituent: Chloride   Analysis Run 9/27/2019 11:09 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series

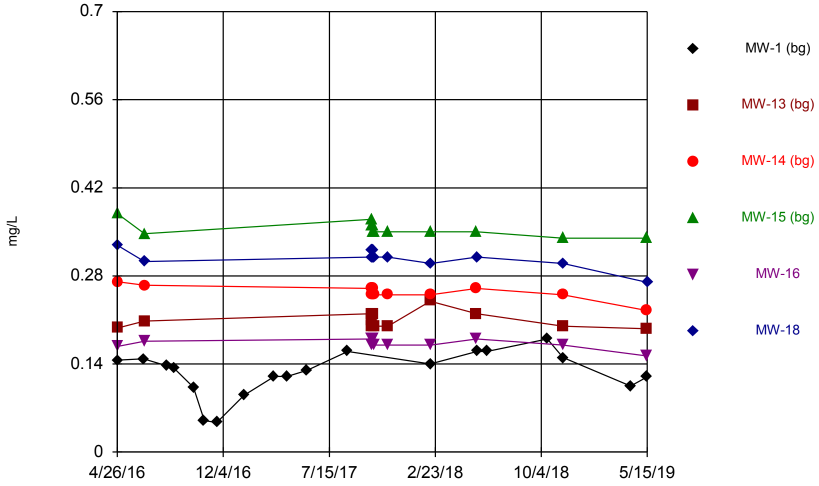


Constituent: Chloride   Analysis Run 9/27/2019 11:09 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Time Series

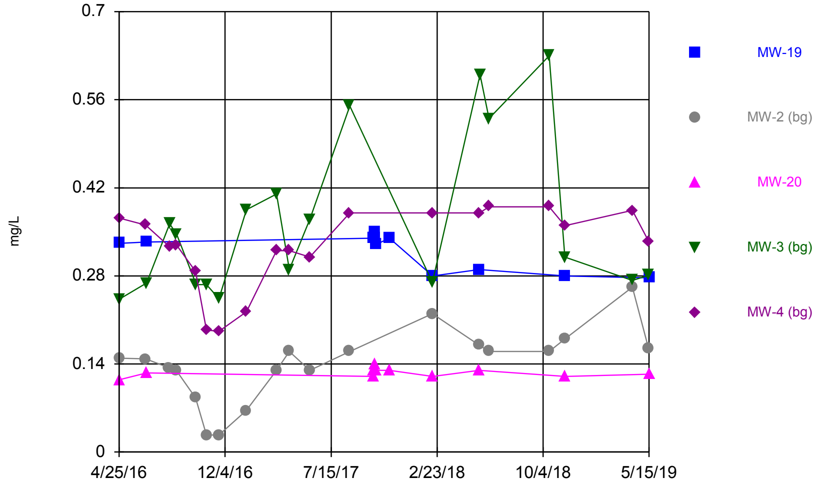


Constituent: Fluoride   Analysis Run 9/27/2019 11:09 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Time Series



Constituent: Fluoride   Analysis Run 9/27/2019 11:09 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Time Series

Constituent: Chloride (mg/L) Analysis Run 9/27/2019 11:09 AM
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

	MW-1 (bg)	MW-13 (bg)	MW-14 (bg)	MW-15 (bg)	MW-16	MW-18
4/26/2016	1.94	1.71	1.48	1.11		1.45
4/27/2016					2.76	
6/20/2016	2.09					
6/22/2016		2.1	1.83	1.19	3.08	1.64
8/8/2016	2.18					
8/24/2016	2.22					
10/3/2016	2.34					
10/26/2016	2.34					
11/21/2016	2.5					
1/17/2017	2.68					
3/22/2017	3.7					
4/18/2017	2.4					
5/30/2017	2.6					
8/23/2017	2.7					
10/12/2017		2.3	2.2	1.8 (J)	4.4	1.8 (J)
10/13/2017		2.5	2.2	1.8 (J)	4.3 (B)	2.3 (B)
10/14/2017		1.6 (J)	1.3 (J)	1.1 (J)	3.4	1 (J)
10/15/2017		1.6 (J)	1.4 (J)	0.93 (J)	3.6	1.3 (J)
10/16/2017		1.5 (J)	1.3 (J)	0.83 (J)	3.9	1 (J)
10/17/2017		2.1	1.8 (J)	1.4 (J)	3.8	2
11/15/2017				1.4 (J)	4.3	3.6
11/16/2017		2.4	1.9 (J)			
5/21/2018		2.6	2.3	1.6 (J)	4.1	
5/22/2018	2.3					2.1
6/12/2018	2.3					
10/17/2018	<2 (J)					
11/19/2018	1.7 (J)	<2 (J)	<2	<2	3.7	<2
4/10/2019	2.35					
5/14/2019	2.28	1.96	1.97	1.87	4.12	
5/15/2019						1.61

Time Series

Constituent: Chloride (mg/L)   Analysis Run 9/27/2019 11:09 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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	MW-19	MW-2 (bg)	MW-20	MW-3 (bg)	MW-4 (bg)
4/25/2016		1.9		1.32	1.53
4/26/2016	1.76		2.66		
6/20/2016		3.43			1.85
6/22/2016	2.19		2.68	1.46	
8/8/2016		3.31			
8/9/2016				1.35	1.95
8/24/2016		3.23		1.47	2.07
10/3/2016		3.21			2.02
10/4/2016				1.59	
10/26/2016		3.35		1.27	2.07
11/21/2016		3.34		1.38	2.39
1/17/2017		3.58			
1/18/2017				1.34	1.9
3/22/2017		3.4		2	1.5 (J)
4/18/2017		2.6		2.2	1.6 (J)
5/31/2017		4.4		1.5 (J)	2.1
8/23/2017		4.4		1.8 (J)	2.3
10/12/2017	2.9		5.6		
10/13/2017	2.6 (B)		5 (B)		
10/14/2017	1.8 (J)		4.4		
10/15/2017	2		4.8		
10/16/2017	2.4		4.9		
10/17/2017	2.5		5.1		
11/15/2017	2.9		6.3		
5/22/2018	2.9	3.2	24		
5/23/2018					2
5/24/2018				1.6 (J)	
6/12/2018		3.7		1.4 (J)	1.7 (J)
10/17/2018		4.6		<2	<2 (J)
11/19/2018		3		<2	<2
11/20/2018	<2 (J)		43		
4/10/2019		1.76		2.25	1.88
5/14/2019		2.87		2.28	1.82
5/15/2019	2.22		67.3		

Time Series

Constituent: Fluoride (mg/L) Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

	MW-1 (bg)	MW-13 (bg)	MW-14 (bg)	MW-15 (bg)	MW-16	MW-18
4/26/2016	0.146 (J)	0.197 (J)	0.271 (J)	0.379		0.329
4/27/2016					0.168 (J)	
6/20/2016	0.148 (J)					
6/22/2016		0.208 (J)	0.265 (J)	0.347	0.176 (J)	0.303
8/8/2016	0.137 (J)					
8/24/2016	0.133 (J)					
10/3/2016	0.103 (J)					
10/26/2016	0.05 (J)					
11/21/2016	0.047 (J)					
1/17/2017	0.09 (J)					
3/22/2017	0.12					
4/18/2017	0.12					
5/30/2017	0.13					
8/23/2017	0.16					
10/12/2017		0.22	0.26	0.37	0.18	0.31
10/13/2017		0.2	0.25	0.36	0.17	0.32
10/14/2017		0.21	0.26	0.37	0.18	0.32
10/15/2017		0.22	0.26	0.35	0.18	0.32
10/16/2017		0.22	0.25	0.36	0.18	0.31
10/17/2017		0.2	0.25	0.35	0.17	0.31
11/15/2017				0.35	0.17	0.31
11/16/2017		0.2	0.25			
2/13/2018	0.14 (D)	0.24 (D)	0.25 (D)			
2/14/2018				0.35 (D)	0.17 (D)	0.3 (D)
5/21/2018		0.22	0.26	0.35	0.18	
5/22/2018	0.16					0.31
6/12/2018	0.16					
10/17/2018	0.18					
11/19/2018	0.15	0.2	0.25	0.34	0.17	0.3
4/10/2019	0.105					
5/14/2019	0.119	0.196	0.225	0.34	0.153	
5/15/2019						0.27

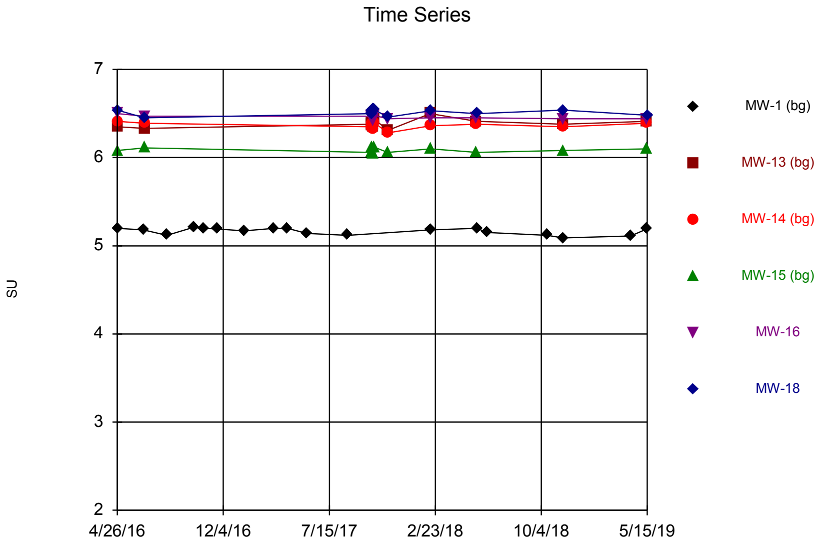
Time Series

Constituent: Fluoride (mg/L) Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

	MW-19	MW-2 (bg)	MW-20	MW-3 (bg)	MW-4 (bg)
4/25/2016		0.149 (J)		0.243 (J)	0.372
4/26/2016	0.332		0.115 (J)		
6/20/2016		0.148 (J)			0.361
6/22/2016	0.334		0.126 (J)	0.269 (J)	
8/8/2016		0.134 (J)			
8/9/2016				0.363	0.326
8/24/2016		0.129 (J)		0.346	0.329
10/3/2016		0.086 (J)			0.287 (J)
10/4/2016				0.266 (J)	
10/26/2016		0.027 (J)		0.266 (J)	0.194 (J)
11/21/2016		0.027 (J)		0.244 (J)	0.192 (J)
1/17/2017		0.066 (J)			
1/18/2017				0.385	0.223 (J)
3/22/2017		0.13		0.41	0.32
4/18/2017		0.16		0.29	0.32
5/31/2017		0.13		0.37	0.31
8/23/2017		0.16		0.55	0.38
10/12/2017	0.34		0.12		
10/13/2017	0.34		0.13		
10/14/2017	0.34		0.13		
10/15/2017	0.34		0.14		
10/16/2017	0.35		0.13		
10/17/2017	0.33		0.13		
11/15/2017	0.34		0.13		
2/13/2018		0.22 (D)		0.27 (D)	0.38 (D)
2/14/2018	0.28 (D)		0.12 (D)		
5/22/2018	0.29	0.17	0.13		
5/23/2018					0.38
5/24/2018				0.6	
6/12/2018		0.16		0.53	0.39
10/17/2018		0.16		0.63	0.39
11/19/2018		0.18		0.31	0.36
11/20/2018	0.28		0.12		
4/10/2019		0.262		0.273	0.384
5/14/2019		0.164		0.281	0.335
5/15/2019	0.277		0.124		

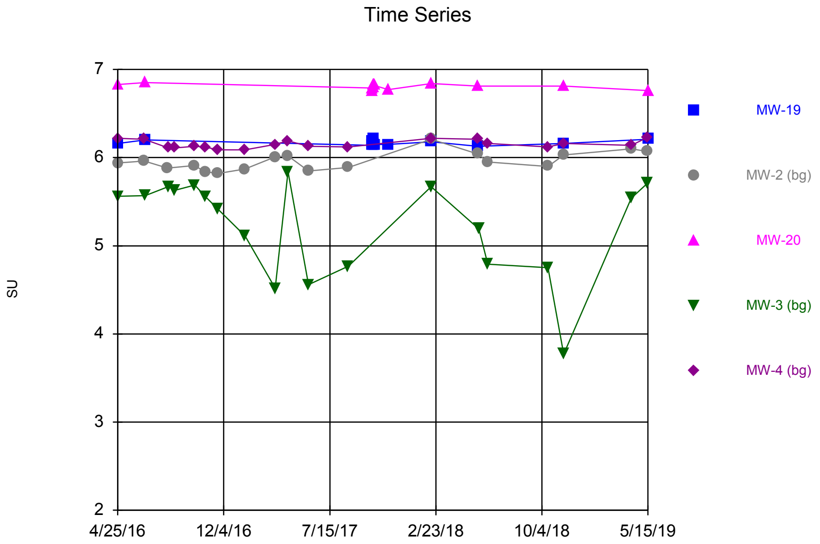
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: pH Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

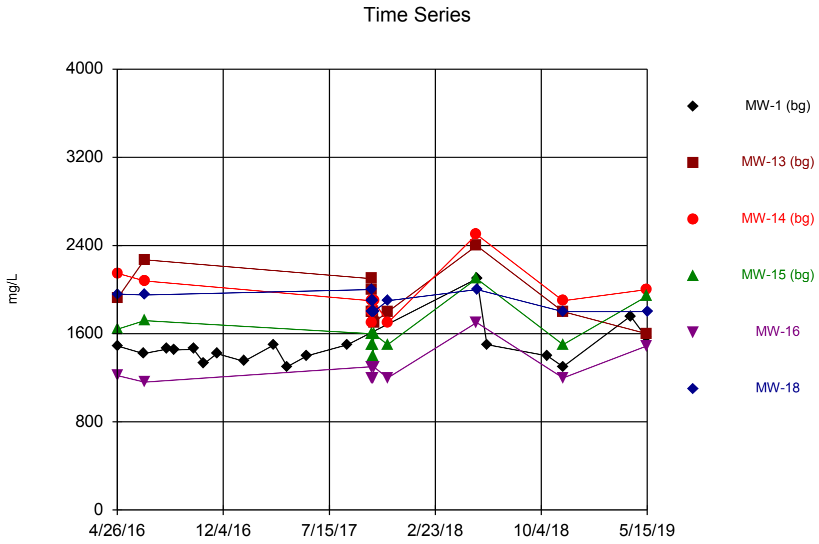
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: pH Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

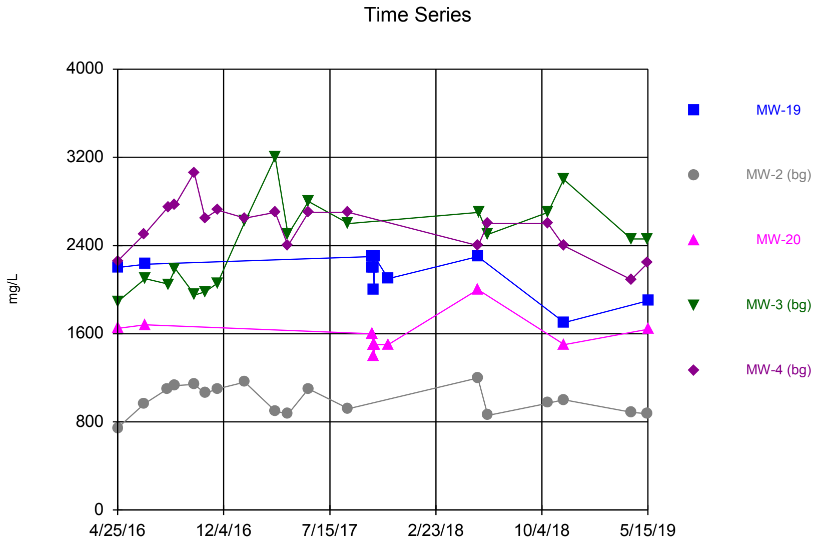
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Sulfate Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Sulfate Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Time Series

Constituent: pH (SU)   Analysis Run 9/27/2019 11:09 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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	MW-1 (bg)	MW-13 (bg)	MW-14 (bg)	MW-15 (bg)	MW-16	MW-18
4/26/2016	5.2	6.35	6.41	6.08		6.54
4/27/2016					6.5	
6/20/2016	5.18					
6/22/2016		6.33	6.39	6.11	6.47	6.45
8/8/2016	5.12					
10/3/2016	5.21 (D)					
10/26/2016	5.2					
11/21/2016	5.19 (D)					
1/17/2017	5.17 (D)					
3/22/2017	5.2 (D)					
4/18/2017	5.2					
5/30/2017	5.14 (D)					
8/23/2017	5.12 (D)					
10/12/2017		6.38	6.35	6.06	6.47	6.5
10/13/2017		6.37	6.34	6.06	6.45	6.49
10/14/2017		6.4	6.38	6.12	6.48	6.54
10/15/2017		6.35	6.32	6.05	6.43	6.55
10/16/2017		6.37	6.33	6.05	6.42	6.55
10/17/2017		6.44	6.4	6.12	6.48	6.55
11/15/2017				6.06	6.44	6.46
11/16/2017		6.31	6.28			
2/13/2018	5.18	6.5	6.36			
2/14/2018				6.1	6.45	6.53
5/21/2018		6.41	6.38	6.06	6.45	
5/22/2018	5.2					6.5
6/12/2018	5.15					
10/17/2018	5.12					
11/19/2018	5.09 (D)	6.38	6.35	6.08	6.44	6.54
4/10/2019	5.11					
5/14/2019	5.19	6.41	6.39	6.1	6.44	
5/15/2019						6.48

Time Series

Constituent: pH (SU)   Analysis Run 9/27/2019 11:09 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-19	MW-2 (bg)	MW-20	MW-3 (bg)	MW-4 (bg)
4/25/2016		5.94		5.56	6.22
4/26/2016	6.16		6.83		
6/20/2016		5.96			6.21
6/22/2016	6.2		6.85	5.57	
8/8/2016		5.88			
8/9/2016				5.67	6.11
8/24/2016				5.63	6.11
10/3/2016		5.91 (D)			6.13 (D)
10/4/2016				5.69 (D)	
10/26/2016		5.84		5.56	6.12
11/21/2016		5.82 (D)		5.42 (D)	6.09 (D)
1/17/2017		5.87 (D)			
1/18/2017				5.11 (D)	6.09 (D)
3/22/2017		6.01 (D)		4.52 (D)	6.15 (D)
4/18/2017		6.02		5.84	6.19
5/31/2017		5.85 (D)		4.56 (D)	6.13 (D)
8/23/2017		5.89 (D)		4.77 (D)	6.12 (D)
10/12/2017	6.14		6.79		
10/13/2017	6.18		6.75		
10/14/2017	6.21		6.82		
10/15/2017	6.14		6.8		
10/16/2017	6.16		6.83		
10/17/2017	6.15		6.82		
11/15/2017	6.15		6.77		
2/13/2018		6.21		5.67	6.22
2/14/2018	6.18		6.84		
5/22/2018	6.13	6.04	6.81		
5/23/2018					6.21
5/24/2018				5.19	
6/12/2018		5.95		4.79	6.16
10/17/2018		5.9		4.75	6.12
11/19/2018		6.03 (D)		3.77 (D)	6.16 (D)
11/20/2018	6.16		6.81		
4/10/2019		6.1		5.54	6.14
5/14/2019		6.07		5.71	6.23
5/15/2019	6.21		6.76		

Time Series

Constituent: Sulfate (mg/L)   Analysis Run 9/27/2019 11:09 AM

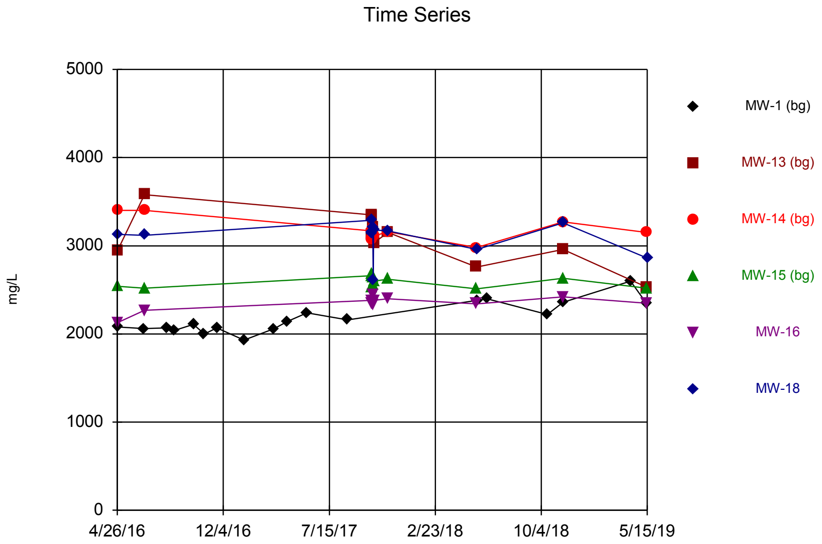
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-1 (bg)	MW-13 (bg)	MW-14 (bg)	MW-15 (bg)	MW-16	MW-18
4/26/2016	1490	1920	2150	1640		1960
4/27/2016					1220	
6/20/2016	1420					
6/22/2016		2270	2080	1720	1160	1950
8/8/2016	1460					
8/24/2016	1450					
10/3/2016	1460					
10/26/2016	1330					
11/21/2016	1420					
1/17/2017	1350					
3/22/2017	1500					
4/18/2017	1300					
5/30/2017	1400					
8/23/2017	1500					
10/12/2017		2100	1900	1600	1300	2000
10/13/2017		2000	1800	1600	1300	1900
10/14/2017		1800	1700	1500	1200	1800
10/15/2017		1800	1800	1500	1200	1800
10/16/2017		1800	1800	1400	1200	1900
10/17/2017		1700	1900	1600	1300	1800
11/15/2017				1500	1200	1900
11/16/2017		1800	1700			
5/21/2018		2400	2500	2100	1700	
5/22/2018	2100					2000
6/12/2018	1500					
10/17/2018	1400					
11/19/2018	1300	1800	1900	1500	1200	1800
4/10/2019	1760					
5/14/2019	1560	1600	2000	1940	1490	
5/15/2019						1800

Time Series

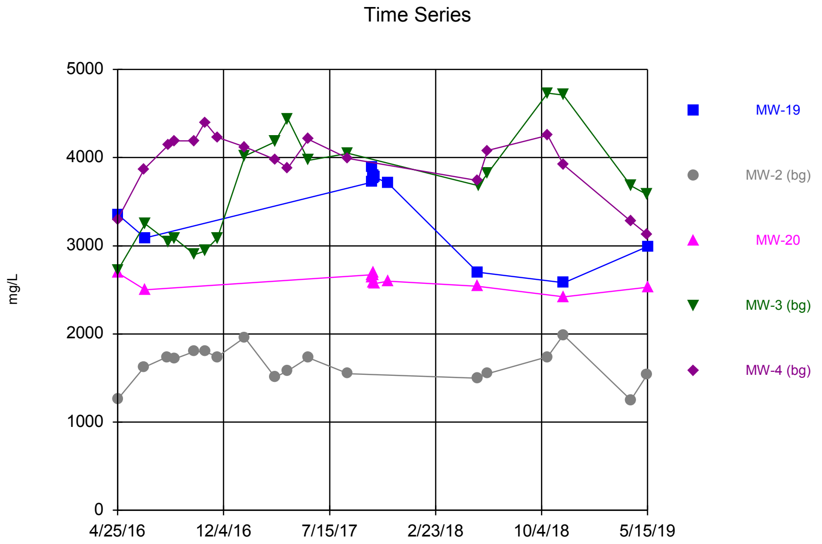
Constituent: Sulfate (mg/L)   Analysis Run 9/27/2019 11:09 AM
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-19	MW-2 (bg)	MW-20	MW-3 (bg)	MW-4 (bg)
4/25/2016		745		1890	2260
4/26/2016	2200		1650		
6/20/2016		964			2500
6/22/2016	2230		1680	2100	
8/8/2016		1100			
8/9/2016				2050	2750
8/24/2016		1130		2190	2770
10/3/2016		1140			3060
10/4/2016				1950	
10/26/2016		1060		1980	2650
11/21/2016		1100		2060	2720
1/17/2017		1160			
1/18/2017				2620	2650
3/22/2017		900		3200	2700
4/18/2017		870		2500	2400
5/31/2017		1100		2800	2700
8/23/2017		920		2600	2700
10/12/2017	2300		1600		
10/13/2017	2200		1600		
10/14/2017	2300		1500		
10/15/2017	2200		1500		
10/16/2017	2000		1400		
10/17/2017	2300		1500		
11/15/2017	2100		1500		
5/22/2018	2300	1200	2000		
5/23/2018					2400
5/24/2018				2700	
6/12/2018		860		2500	2600
10/17/2018		970		2700	2600
11/19/2018		1000		3000	2400
11/20/2018	1700		1500		
4/10/2019		889		2460	2090
5/14/2019		873		2460	2240
5/15/2019	1900		1640		



Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill



Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:09 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Time Series

Constituent: Total Dissolved Solids (mg/L)　Analysis Run 9/27/2019 11:09 AM

Plant Gorgas　Client: Southern Company　Data: Gorgas Gypsum Landfill

	MW-1 (bg)	MW-13 (bg)	MW-14 (bg)	MW-15 (bg)	MW-16	MW-18
4/26/2016	2080 (D)	2940	3400	2540		3130
4/27/2016					2130	
6/20/2016	2060 (D)					
6/22/2016		3580	3400	2520	2270	3120
8/8/2016	2070 (D)					
8/24/2016	2040					
10/3/2016	2110 (D)					
10/26/2016	2000					
11/21/2016	2070 (D)					
1/17/2017	1930 (D)					
3/22/2017	2060 (D)					
4/18/2017	2140					
5/30/2017	2240 (D)					
8/23/2017	2160 (D)					
10/12/2017		3350	3170	2660	2380	3290
10/13/2017		3340	3070	2680	2340	3140
10/14/2017		3120	3090	2530	2340	3150
10/15/2017		3210	3190	2640	2440	3210
10/16/2017		3150	3110	2550	2330	2610
10/17/2017		3030	3110	2600	2380	3180
11/15/2017				2620	2400	3170
11/16/2017		3150	3160			
5/21/2018		2760	2980	2510	2340	
5/22/2018	2380 (D)					2960
6/12/2018	2400					
10/17/2018	2220					
11/19/2018	2360 (D)	2960	3270	2630	2420	3260
4/10/2019	2600					
5/14/2019	2340 (D)	2530	3150	2520	2350	
5/15/2019						2860

Time Series

Constituent: Total Dissolved Solids (mg/L)   Analysis Run 9/27/2019 11:09 AM

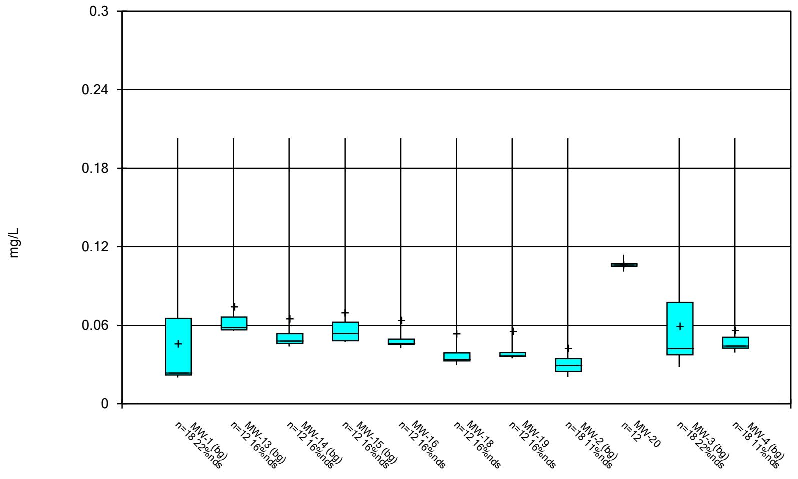
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-19	MW-2 (bg)	MW-20	MW-3 (bg)	MW-4 (bg)
4/25/2016		1260 (D)		2720 (D)	3300 (D)
4/26/2016	3350		2690		
6/20/2016		1620 (D)			3870 (D)
6/22/2016	3090		2500	3250 (D)	
8/8/2016		1740 (D)			
8/9/2016				3050 (D)	4140 (D)
8/24/2016		1720		3080	4190
10/3/2016		1800 (D)			4190 (D)
10/4/2016				2900 (D)	
10/26/2016		1800		2940	4400
11/21/2016		1740 (D)		3090 (D)	4230 (D)
1/17/2017		1960 (D)			
1/18/2017				4020 (D)	4120 (D)
3/22/2017		1510 (D)		4180 (D)	3980 (D)
4/18/2017		1580		4440	3880
5/31/2017		1730 (D)		3970 (D)	4210 (D)
8/23/2017		1550 (D)		4050 (D)	3990 (D)
10/12/2017	3720		2670		
10/13/2017	3890		2640		
10/14/2017	3800		2590		
10/15/2017	3800		2700		
10/16/2017	3770		2670		
10/17/2017	3780		2570		
11/15/2017	3710		2600		
5/22/2018	2700	1500 (D)	2540		
5/23/2018					3740 (D)
5/24/2018				3680 (D)	
6/12/2018		1550		3820	4080
10/17/2018		1740		4730	4250
11/19/2018		1990 (D)		4710 (D)	3920 (D)
11/20/2018	2580		2420		
4/10/2019		1250		3680	3280
5/14/2019		1540 (D)		3580 (D)	3130 (D)
5/15/2019	2990		2530		

FIGURE B.

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

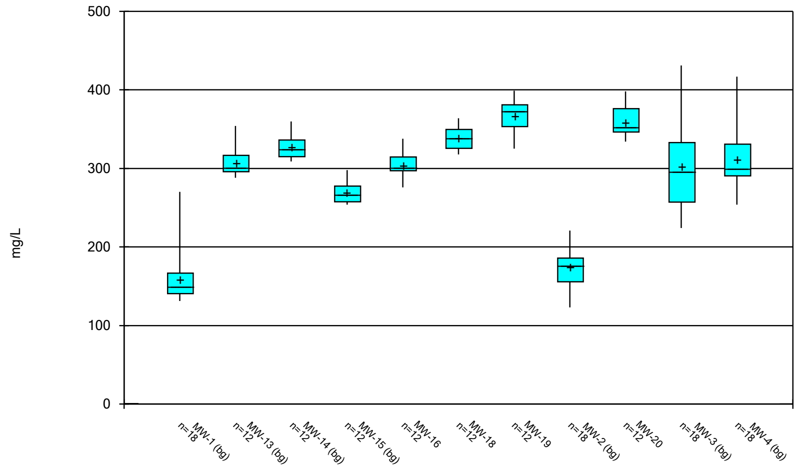


Constituent: Boron   Analysis Run 9/27/2019 11:10 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

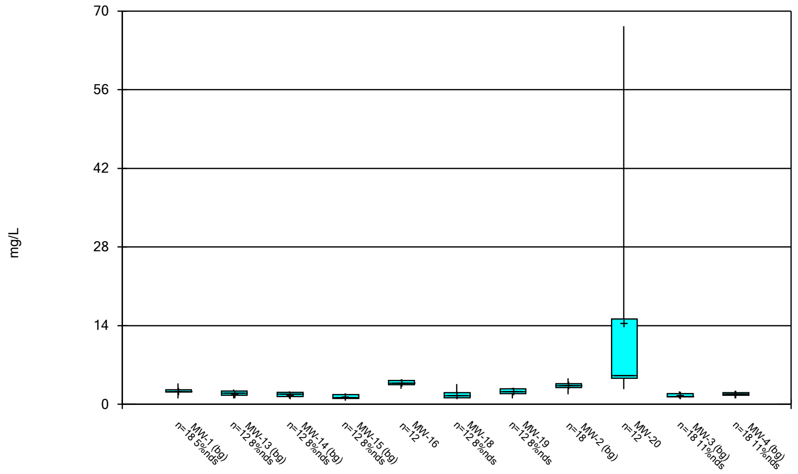


Constituent: Calcium   Analysis Run 9/27/2019 11:10 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

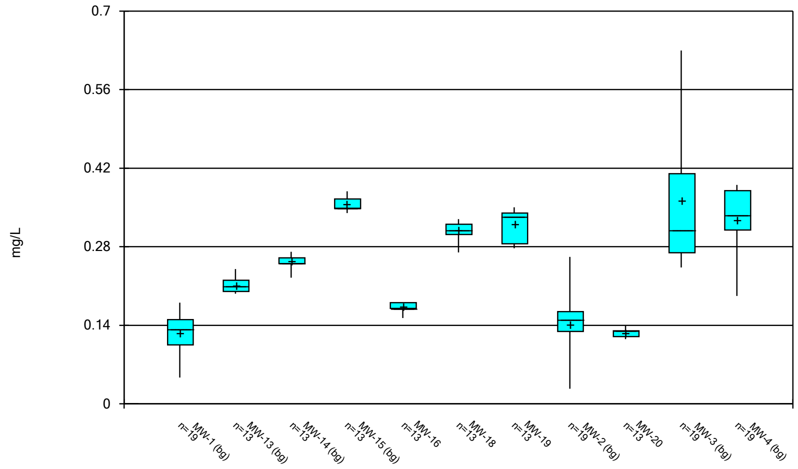


Constituent: Chloride   Analysis Run 9/27/2019 11:10 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

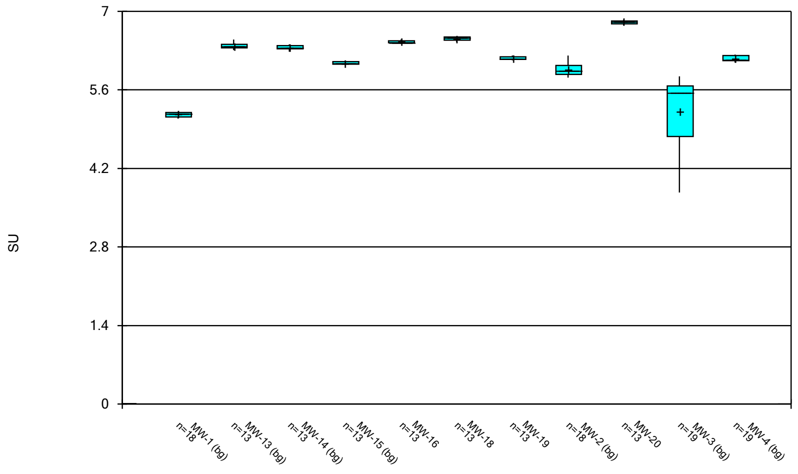


Constituent: Fluoride   Analysis Run 9/27/2019 11:10 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

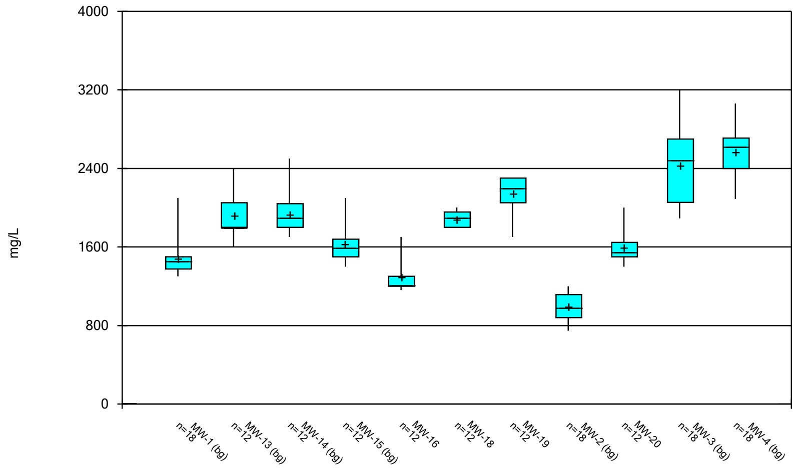


Constituent: pH Analysis Run 9/27/2019 11:10 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot

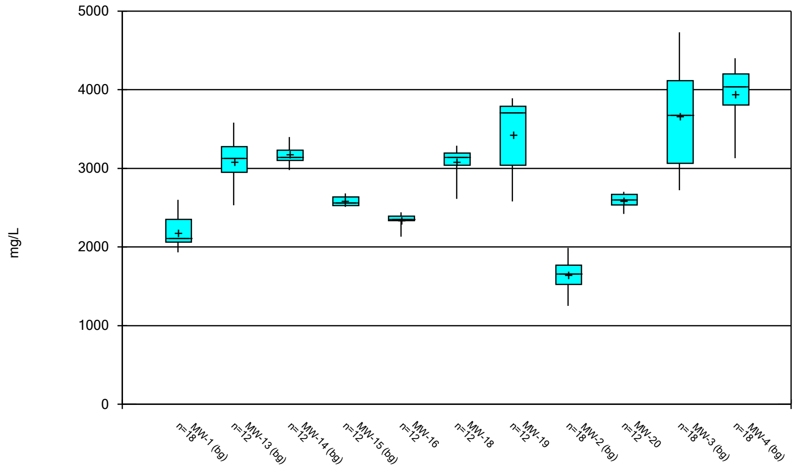


Constituent: Sulfate Analysis Run 9/27/2019 11:10 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:10 AM

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

FIGURE C.

Upgradient Outlier Analysis - Signficant Results

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill   Printed 9/27/2019, 10:49 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	**MW-1,MW-13,MW-14,...**	**Yes**	**0.1,0.1,0.1,0.1,0.1,0.203**	**n/a w/combined bg**	**NP (nrm)**	**NaN**	**108**	**0.05754**	**0.04394**	**unknown**	**ChiSquared**

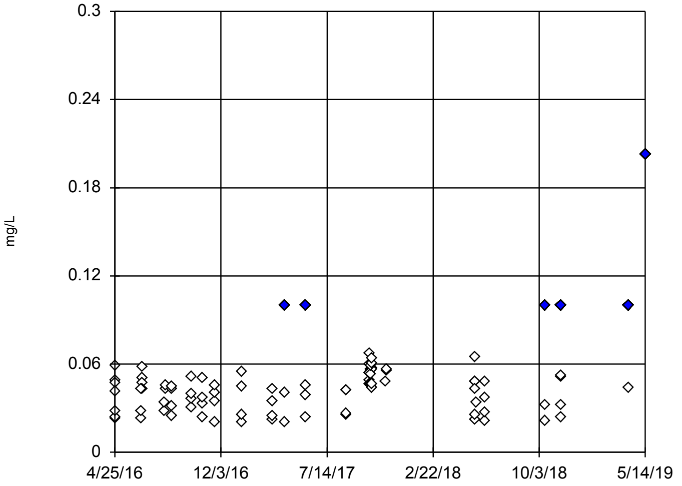
Upgradient Outlier Analysis - All Results

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill Printed 9/27/2019, 10:49 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	**MW-1,MW-13,MW-14,...**	**Yes**	**0.1,0.1,0.1,0.1,0.1,0.203**	**n/a w/combined bg**	**NP (nrm)**	**NaN**	**108**	**0.05754**	**0.04394**	**unknown**	**ChiSquared**
pH (SU)	MW-1,MW-13,MW-14,...	No	n/a	n/a w/combined bg	NP (nrm)	NaN	113	5.852	0.5298	unknown	ChiSquared

Tukey's Outlier Screening, Pooled Background

MW-1,MW-13,MW-14,MW-15,MW-2,MW-3,MW-4...



n = 108

Outliers are drawn as solid.
Tukey's method used in lieu of parametric test because the Chi Squared normality test failed at the 0.1 alpha level.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.07477, low cutoff = -0.07005, based on IQR multiplier of 3.

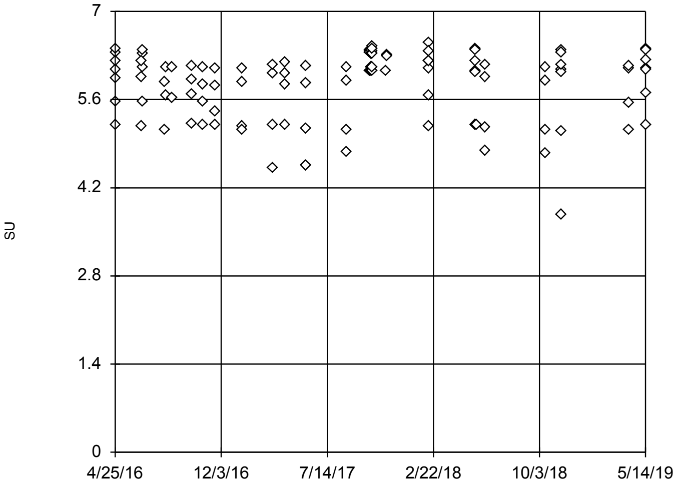
Constituent: Boron Analysis Run 9/27/2019 10:48 AM View: Interwell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

---

Tukey's Outlier Screening, Pooled Background

MW-1,MW-13,MW-14,MW-15,MW-2,MW-3,MW-4...



n = 113

No outliers found.
Tukey's method used in lieu of parametric test because the Chi Squared normality test failed at the 0.1 alpha level.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 7.661, low cutoff = -3.365, based on IQR multiplier of 3.

Constituent: pH Analysis Run 9/27/2019 10:48 AM View: Interwell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Outlier Analysis - Significant Results

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill   Printed 9/27/2019, 10:45 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Calcium (mg/L)	**MW-1 (bg)**	**Yes**	**203,270**	**6/12/2018,4/10/2019**	**Dixon`s**	**0.05**	**18**	**158.4**	**32.55**	**normal**	**ShapiroWilk**
Chloride (mg/L)	**MW-1 (bg)**	**Yes**	**3.7**	**3/22/2017**	**Dixon`s**	**0.05**	**18**	**2.312**	**0.5231**	**normal**	**ShapiroWilk**
Fluoride (mg/L)	**MW-1 (bg)**	**Yes**	**0.05,0.047**	**10/26/2016,11/21/2016**	**Dixon`s**	**0.05**	**19**	**0.1262**	**0.03546**	**normal**	**ShapiroWilk**
Fluoride (mg/L)	**MW-18**	**Yes**	**0.27**	**5/15/2019**	**Dixon`s**	**0.05**	**13**	**0.3086**	**0.01439**	**normal**	**ShapiroWilk**
Sulfate (mg/L)	**MW-1 (bg)**	**Yes**	**1760,2100**	**4/10/2019,5/22/2018**	**Dixon`s**	**0.05**	**18**	**1483**	**187.3**	**normal**	**ShapiroWilk**
Sulfate (mg/L)	**MW-16**	**Yes**	**1700**	**5/21/2018**	**NP (nrm)**	**NaN**	**12**	**1289**	**156.9**	**unknown**	**ShapiroWilk**
Sulfate (mg/L)	**MW-20**	**Yes**	**2000**	**5/22/2018**	**Dixon`s**	**0.05**	**12**	**1589**	**153.5**	**normal**	**ShapiroWilk**
Total Dissolved Solids (mg/L)	**MW-16**	**Yes**	**2130**	**4/27/2016**	**Dixon`s**	**0.05**	**12**	**2343**	**81.05**	**normal**	**ShapiroWilk**

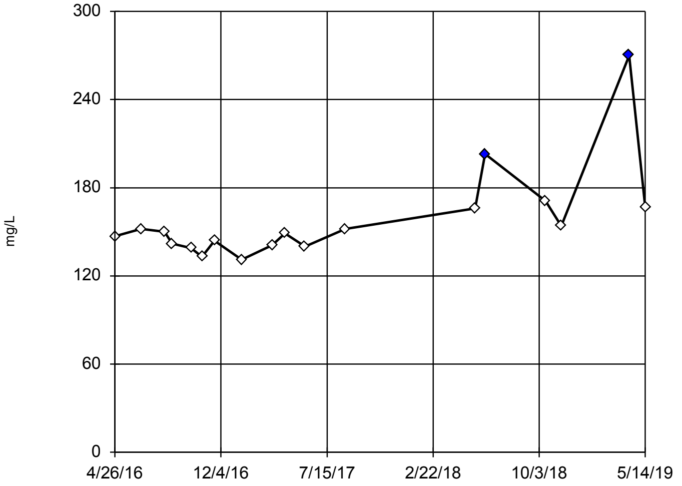
Outlier Analysis - All Results

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill   Printed 9/27/2019, 10:45 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Calcium (mg/L)	**MW-1 (bg)**	**Yes**	**203,270**	**6/12/2018,4/10/2019**	**Dixon`s**	**0.05**	**18**	**158.4**	**32.55**	**normal**	**ShapiroWilk**
Calcium (mg/L)	MW-13 (bg)	No	n/a	n/a	Dixon`s	0.05	12	306.8	18.25	normal	ShapiroWilk
Calcium (mg/L)	MW-14 (bg)	No	n/a	n/a	EPA 1989	0.05	12	327.6	15.66	normal	ShapiroWilk
Calcium (mg/L)	MW-15 (bg)	No	n/a	n/a	EPA 1989	0.05	12	268.8	13.21	normal	ShapiroWilk
Calcium (mg/L)	MW-16	No	n/a	n/a	EPA 1989	0.05	12	304.3	16.22	normal	ShapiroWilk
Calcium (mg/L)	MW-18	No	n/a	n/a	EPA 1989	0.05	12	337.7	15.11	normal	ShapiroWilk
Calcium (mg/L)	MW-19	No	n/a	n/a	NP (nrm)	NaN	12	366.3	23.49	unknown	ShapiroWilk
Calcium (mg/L)	MW-2 (bg)	No	n/a	n/a	Dixon`s	0.05	18	174	21.99	normal	ShapiroWilk
Calcium (mg/L)	MW-20	No	n/a	n/a	EPA 1989	0.05	12	359.1	20.39	normal	ShapiroWilk
Calcium (mg/L)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	18	301.6	56.48	normal	ShapiroWilk
Calcium (mg/L)	MW-4 (bg)	No	n/a	n/a	Dixon`s	0.05	18	311.2	38.16	normal	ShapiroWilk
Chloride (mg/L)	**MW-1 (bg)**	**Yes**	**3.7**	**3/22/2017**	**Dixon`s**	**0.05**	**18**	**2.312**	**0.5231**	**normal**	**ShapiroWilk**
Chloride (mg/L)	MW-13 (bg)	No	n/a	n/a	Dixon`s	0.05	12	1.948	0.477	normal	ShapiroWilk
Chloride (mg/L)	MW-14 (bg)	No	n/a	n/a	EPA 1989	0.05	12	1.723	0.4201	normal	ShapiroWilk
Chloride (mg/L)	MW-15 (bg)	No	n/a	n/a	EPA 1989	0.05	12	1.336	0.3638	normal	ShapiroWilk
Chloride (mg/L)	MW-16	No	n/a	n/a	EPA 1989	0.05	12	3.788	0.5109	normal	ShapiroWilk
Chloride (mg/L)	MW-18	No	n/a	n/a	EPA 1989	0.05	12	1.733	0.7337	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-19	No	n/a	n/a	Dixon`s	0.05	12	2.264	0.5677	normal	ShapiroWilk
Chloride (mg/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	18	3.293	0.7475	normal	ShapiroWilk
Chloride (mg/L)	MW-20	No	n/a	n/a	NP (nrm)	NaN	12	14.65	20.41	unknown	ShapiroWilk
Chloride (mg/L)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	18	1.567	0.3909	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-4 (bg)	No	n/a	n/a	EPA 1989	0.05	18	1.816	0.3798	normal	ShapiroWilk
Fluoride (mg/L)	**MW-1 (bg)**	**Yes**	**0.05,0.047**	**10/26/2016,11/21/2016**	**Dixon`s**	**0.05**	**19**	**0.1262**	**0.03546**	**normal**	**ShapiroWilk**
Fluoride (mg/L)	MW-13 (bg)	No	n/a	n/a	NP (nrm)	NaN	13	0.2101	0.01313	unknown	ShapiroWilk
Fluoride (mg/L)	MW-14 (bg)	No	n/a	n/a	NP (nrm)	NaN	13	0.2539	0.01115	unknown	ShapiroWilk
Fluoride (mg/L)	MW-15 (bg)	No	n/a	n/a	EPA 1989	0.05	13	0.3551	0.01195	normal	ShapiroWilk
Fluoride (mg/L)	MW-16	No	n/a	n/a	NP (nrm)	NaN	13	0.1728	0.007766	unknown	ShapiroWilk
Fluoride (mg/L)	**MW-18**	**Yes**	**0.27**	**5/15/2019**	**Dixon`s**	**0.05**	**13**	**0.3086**	**0.01439**	**normal**	**ShapiroWilk**
Fluoride (mg/L)	MW-19	No	n/a	n/a	NP (nrm)	NaN	13	0.321	0.0278	unknown	ShapiroWilk
Fluoride (mg/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	19	0.1401	0.05792	normal	ShapiroWilk
Fluoride (mg/L)	MW-20	No	n/a	n/a	EPA 1989	0.05	13	0.1265	0.006591	normal	ShapiroWilk
Fluoride (mg/L)	MW-3 (bg)	No	n/a	n/a	NP (nrm)	NaN	19	0.3629	0.125	unknown	ShapiroWilk
Fluoride (mg/L)	MW-4 (bg)	No	n/a	n/a	NP (nrm)	NaN	19	0.3281	0.06353	unknown	ShapiroWilk
Sulfate (mg/L)	**MW-1 (bg)**	**Yes**	**1760,2100**	**4/10/2019,5/22/2018**	**Dixon`s**	**0.05**	**18**	**1483**	**187.3**	**normal**	**ShapiroWilk**
Sulfate (mg/L)	MW-13 (bg)	No	n/a	n/a	EPA 1989	0.05	12	1916	236.3	normal	ShapiroWilk
Sulfate (mg/L)	MW-14 (bg)	No	n/a	n/a	Dixon`s	0.05	12	1936	225.5	normal	ShapiroWilk
Sulfate (mg/L)	MW-15 (bg)	No	n/a	n/a	NP (nrm)	NaN	12	1633	201.9	unknown	ShapiroWilk
Sulfate (mg/L)	**MW-16**	**Yes**	**1700**	**5/21/2018**	**NP (nrm)**	**NaN**	**12**	**1289**	**156.9**	**unknown**	**ShapiroWilk**
Sulfate (mg/L)	MW-18	No	n/a	n/a	NP (nrm)	NaN	12	1884	81.52	unknown	ShapiroWilk
Sulfate (mg/L)	MW-19	No	n/a	n/a	NP (nrm)	NaN	12	2144	189.1	unknown	ShapiroWilk
Sulfate (mg/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	18	998.9	129.3	normal	ShapiroWilk
Sulfate (mg/L)	**MW-20**	**Yes**	**2000**	**5/22/2018**	**Dixon`s**	**0.05**	**12**	**1589**	**153.5**	**normal**	**ShapiroWilk**
Sulfate (mg/L)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	18	2431	379.6	normal	ShapiroWilk
Sulfate (mg/L)	MW-4 (bg)	No	n/a	n/a	EPA 1989	0.05	18	2566	233.5	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-1 (bg)	No	n/a	n/a	EPA 1989	0.05	18	2181	173.6	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-13 (bg)	No	n/a	n/a	EPA 1989	0.05	12	3093	279.3	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-14 (bg)	No	n/a	n/a	EPA 1989	0.05	12	3175	126.5	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-15 (bg)	No	n/a	n/a	EPA 1989	0.05	12	2583	61.4	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	**MW-16**	**Yes**	**2130**	**4/27/2016**	**Dixon`s**	**0.05**	**12**	**2343**	**81.05**	**normal**	**ShapiroWilk**
Total Dissolved Solids (mg/L)	MW-18	No	n/a	n/a	Dixon`s	0.05	12	3090	192.3	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-19	No	n/a	n/a	NP (nrm)	NaN	12	3432	472.6	unknown	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	18	1643	200.5	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-20	No	n/a	n/a	EPA 1989	0.05	12	2593	85.74	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	18	3661	628.6	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-4 (bg)	No	n/a	n/a	NP (nrm)	NaN	18	3939	362.7	unknown	ShapiroWilk

Dixon's Outlier Test

MW-1 (bg)



n = 18

Statistical outliers are
drawn as solid.
Testing for 2 high outliers.
Mean = 158.4.
Std. Dev. = 32.55.
203: c = 0.5625
tabl = 0.475.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9449
Critical = 0.906
The distribution, after
removal of suspect values, was found to be normally distributed.

Constituent: Calcium Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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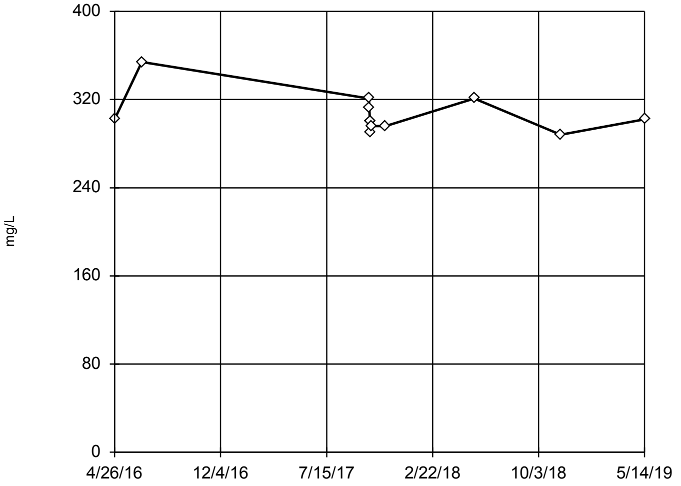
Dixon's Outlier Test

MW-13 (bg)



n = 12

No statistical outliers.
Testing for 1 high outlier.
Mean = 306.8.
Std. Dev. = 18.25.
354: c = 0.5156
tabl = 0.546.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8991
Critical = 0.876
The distribution was found
to be normally distributed.

Constituent: Calcium Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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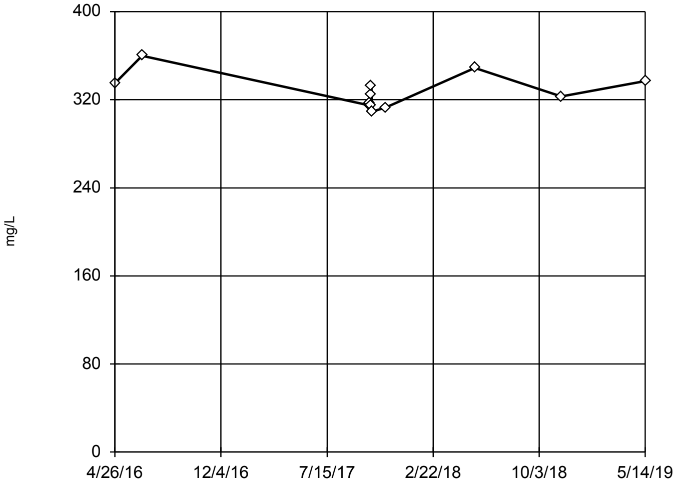
EPA Screening (suspected outliers for Dixon's Test)

MW-14 (bg)



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 327.6, std. dev.
15.66, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9182
Critical = 0.883
The distribution was found
to be normally distributed.

Constituent: Calcium Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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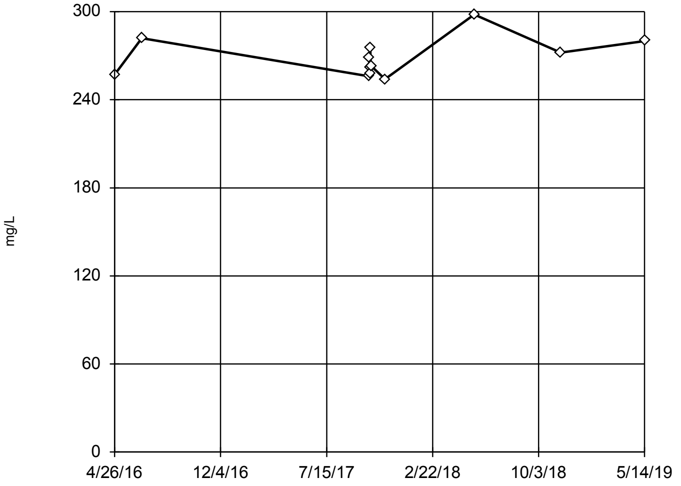
EPA Screening (suspected outliers for Dixon's Test)

MW-15 (bg)



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 268.8, std. dev.
13.21, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.916
Critical = 0.883
The distribution was found
to be normally distributed.

Constituent: Calcium Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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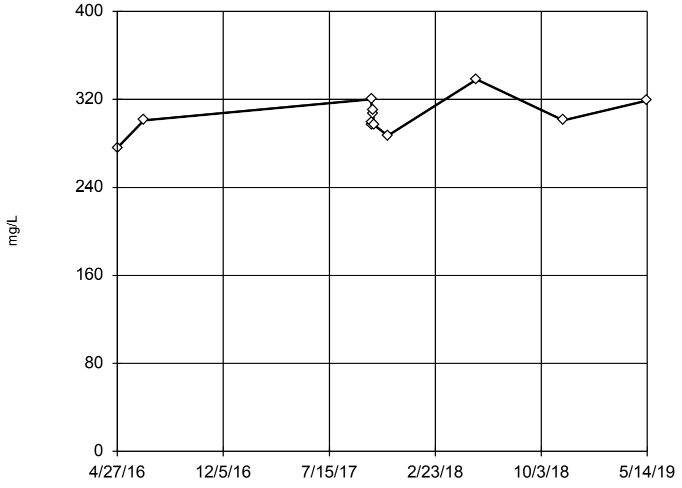
EPA Screening (suspected outliers for Dixon's Test)

MW-16



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 304.3, std. dev.
16.22, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.966
Critical = 0.883
The distribution was found
to be normally distributed.

Constituent: Calcium   Analysis Run 9/27/2019 10:44 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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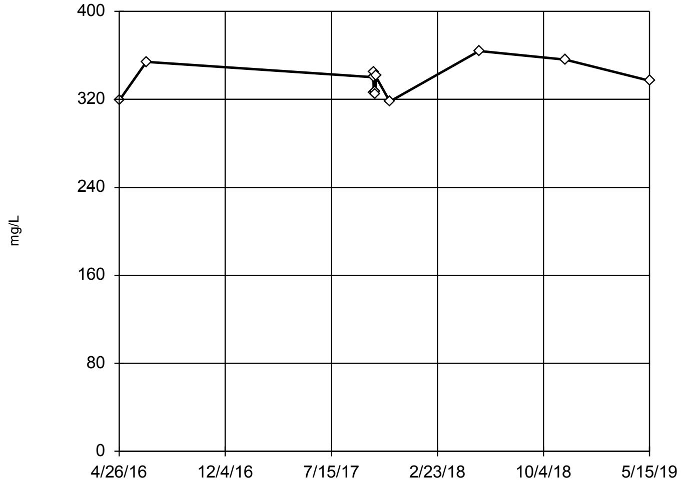
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-18



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 337.7, std. dev.
15.11, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9435
Critical = 0.883
The distribution was found
to be normally distributed.

Constituent: Calcium   Analysis Run 9/27/2019 10:44 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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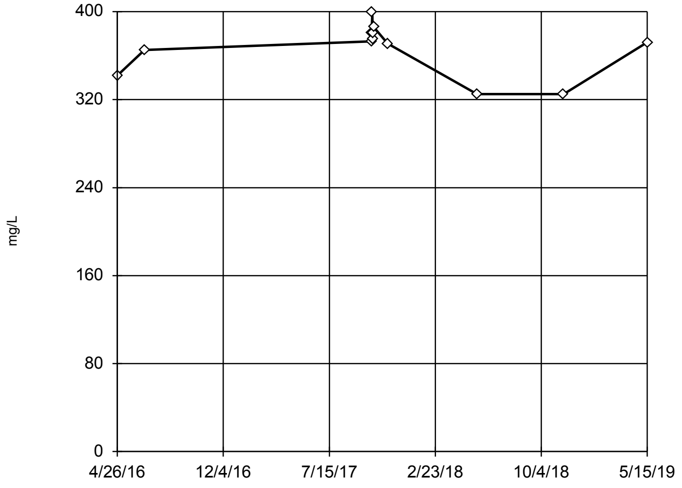
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-19



n = 12

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 429.6, low
cutoff = -328.1, based
on IQR multiplier of 3.

Constituent: Calcium   Analysis Run 9/27/2019 10:44 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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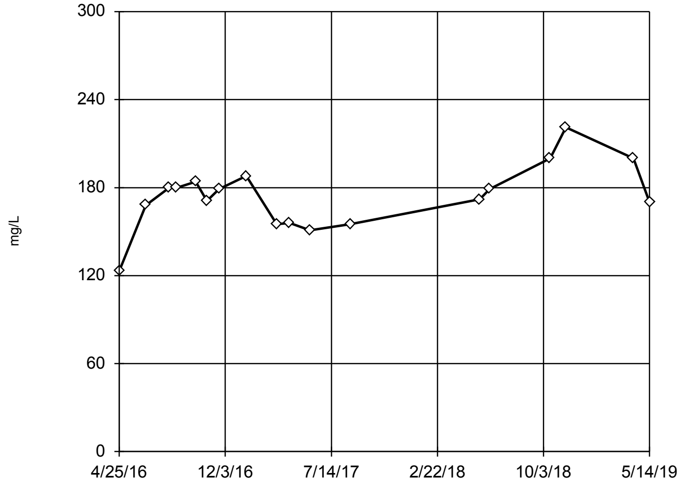
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Dixon's Outlier Test

MW-2 (bg)



n = 18

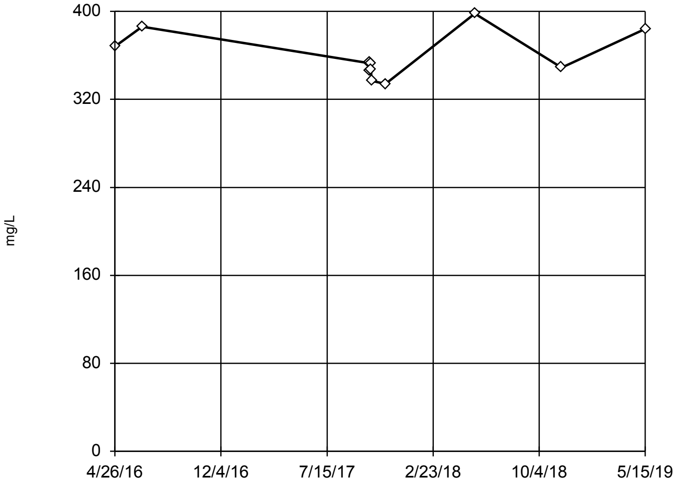
No statistical outliers.
Testing for 1 low outlier.
Mean = 174.
Std. Dev. = 21.99.
123: c = 0.4156
tabl = 0.475.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9418
Critical = 0.91
The distribution was found
to be normally distributed.

Constituent: Calcium   Analysis Run 9/27/2019 10:44 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

EPA Screening (suspected outliers for Dixon's Test)

MW-20



n = 12

Dixon's will not be run. No suspect values identified or unable to establish suspect values. Mean 359.1, std. dev. 20.39, critical Tn 2.285

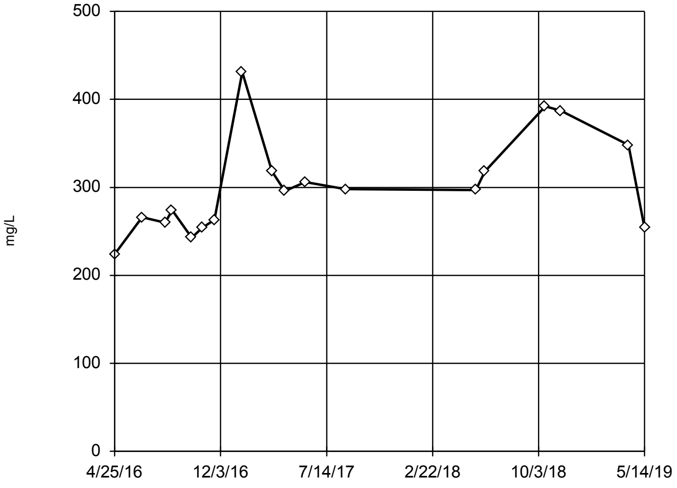
Normality test used: Shapiro Wilk@alpha = 0.1 Calculated = 0.8965 Critical = 0.883 The distribution was found to be normally distributed.

Constituent: Calcium Analysis Run 9/27/2019 10:44 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

EPA Screening (suspected outliers for Dixon's Test)

MW-3 (bg)



n = 18

Dixon's will not be run. No suspect values identified or unable to establish suspect values. Mean 301.6, std. dev. 56.48, critical Tn 2.504

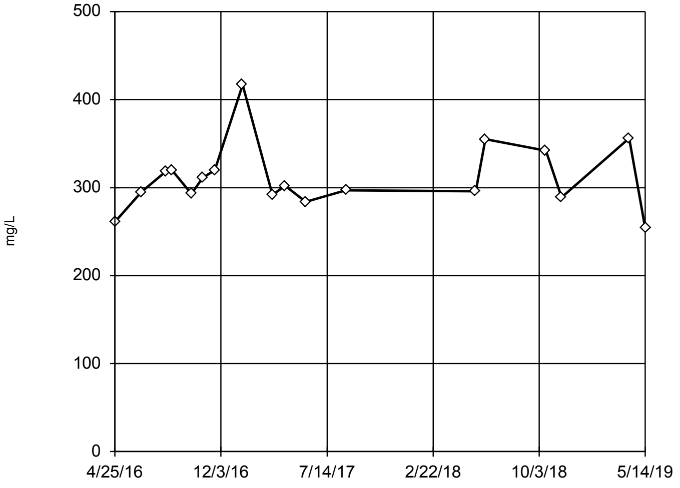
Normality test used: Shapiro Wilk@alpha = 0.1 Calculated = 0.9168 Critical = 0.914 The distribution was found to be normally distributed.

Constituent: Calcium Analysis Run 9/27/2019 10:44 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Dixon's Outlier Test

MW-4 (bg)



n = 18

No statistical outliers. Testing for 1 high outlier. Mean = 311.2. Std. Dev. = 38.16. 417: c = 0.4662 tabl = 0.475. Alpha = 0.05.

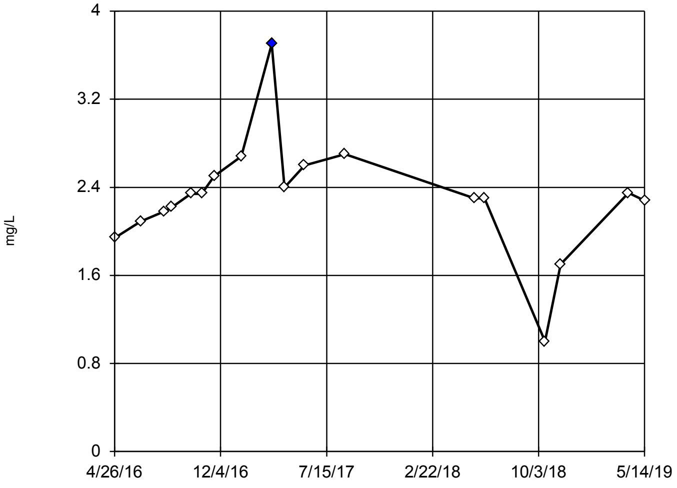
Normality test used: Shapiro Wilk@alpha = 0.1 Calculated = 0.9484 Critical = 0.91 The distribution was found to be normally distributed.

Constituent: Calcium Analysis Run 9/27/2019 10:44 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Dixon's Outlier Test

MW-1 (bg)



n = 18

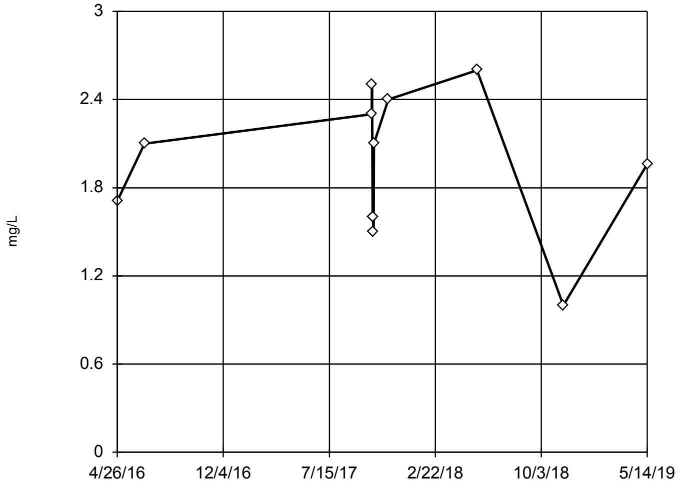
Statistical outlier is drawn as solid. Testing for 1 high and 2 low outliers. Mean = 2.312. Std. Dev. = 0.5231. 2.7: c = 0.6335 tabl = 0.475. 1.7 (J): c = 0.398 tabl = 0.475. Alpha = 0.05.

Normality test used: Shapiro Wilk@alpha = 0.1 Calculated = 0.9617 Critical = 0.901 The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Dixon's Outlier Test

MW-13 (bg)

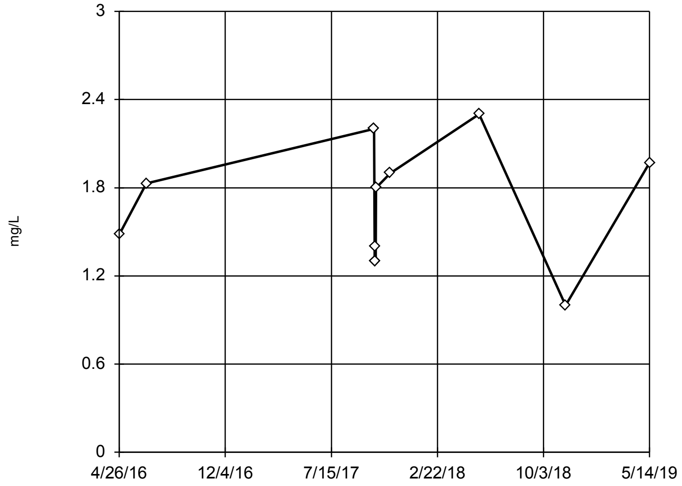
n = 12

No statistical outliers.
Testing for 1 low outlier.
Mean = 1.948.
Std. Dev. = 0.477.
<2 (J): c = 0.4
tabl = 0.546.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9286
Critical = 0.876
The distribution was found to be normally distributed.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



EPA Screening (suspected outliers for Dixon's Test)

MW-14 (bg)

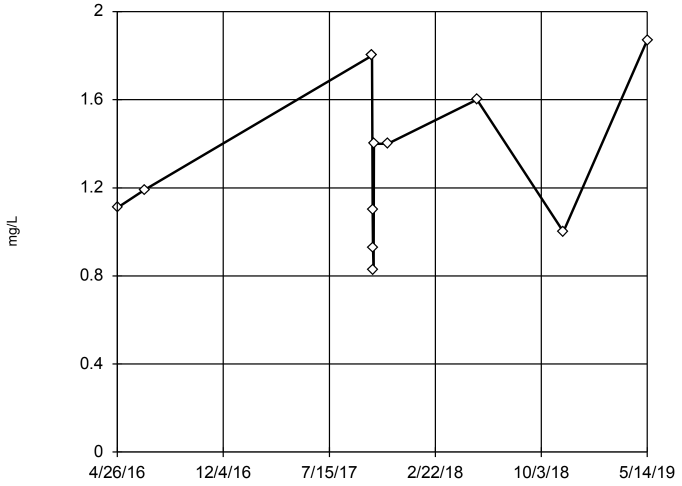
n = 12

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 1.723, std. dev. 0.4201, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9418
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



EPA Screening (suspected outliers for Dixon's Test)

MW-15 (bg)

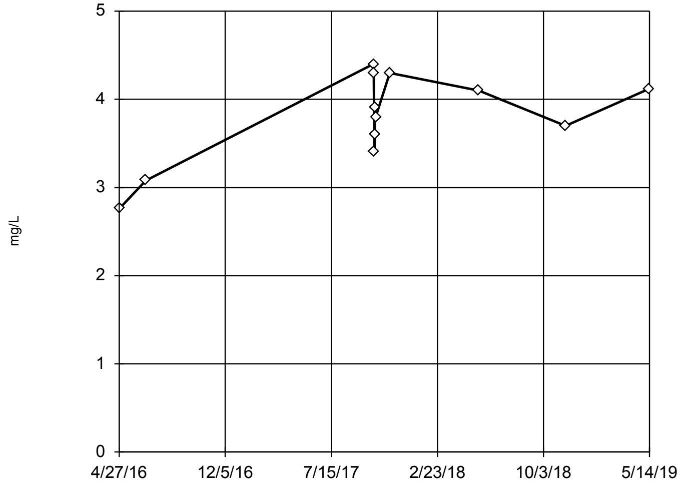
n = 12

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 1.336, std. dev. 0.3638, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9226
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



EPA Screening (suspected outliers for Dixon's Test)

MW-16

n = 12

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 3.788, std. dev. 0.5109, critical Tn 2.285

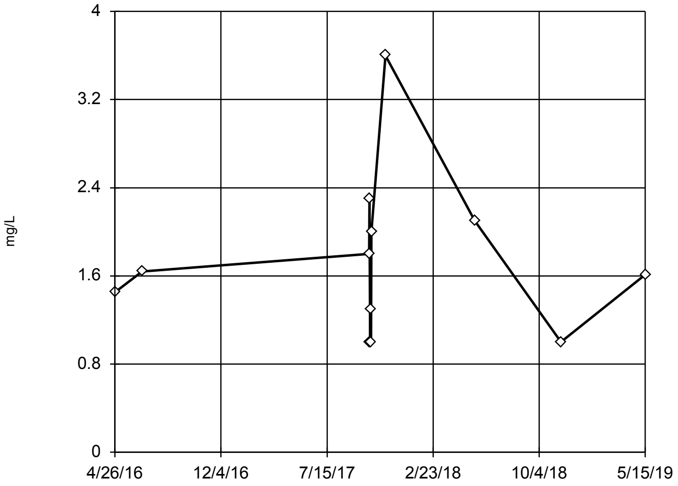
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9337
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-18



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 1.733, std. dev.
0.7337, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9381
Critical = 0.883 (after
natural log transformation)
The distribution was found
to be log-normal.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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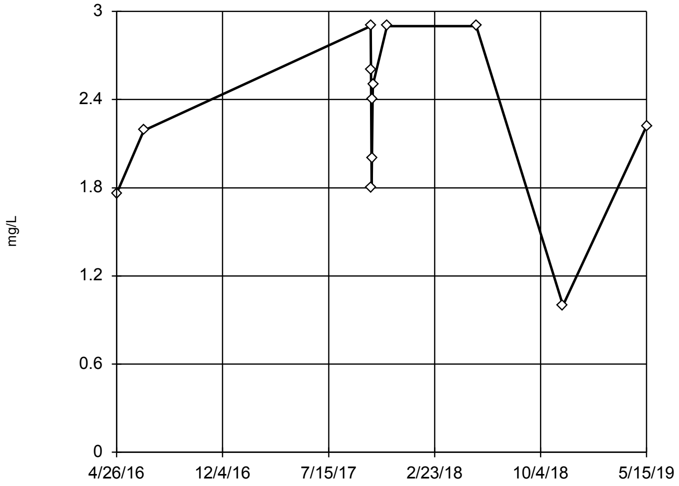
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Dixon's Outlier Test

MW-19



n = 12

No statistical outliers.
Testing for 1 low outlier.
Mean = 2.264.
Std. Dev. = 0.5677.
<2 (J): c = 0.4211
tabl = 0.546.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9161
Critical = 0.876
The distribution was found
to be normally distributed.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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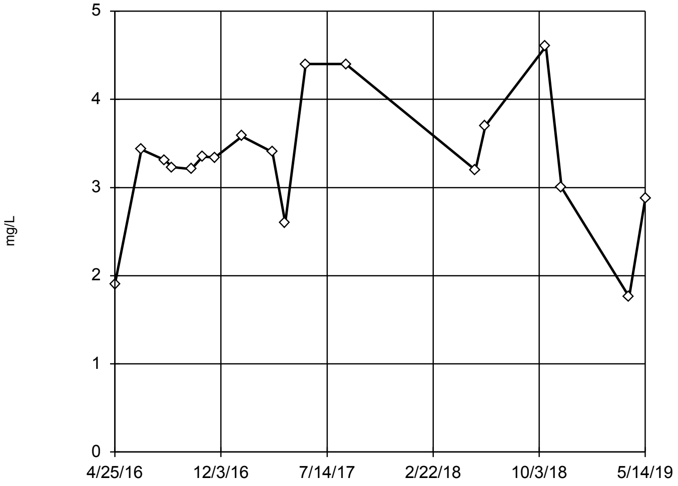
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-2 (bg)



n = 18

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 3.293, std. dev.
0.7475, critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9291
Critical = 0.914
The distribution was found
to be normally distributed.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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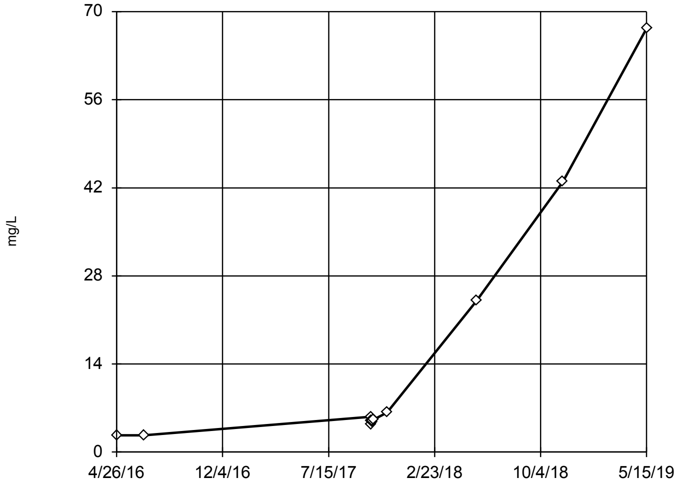
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-20



n = 12

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

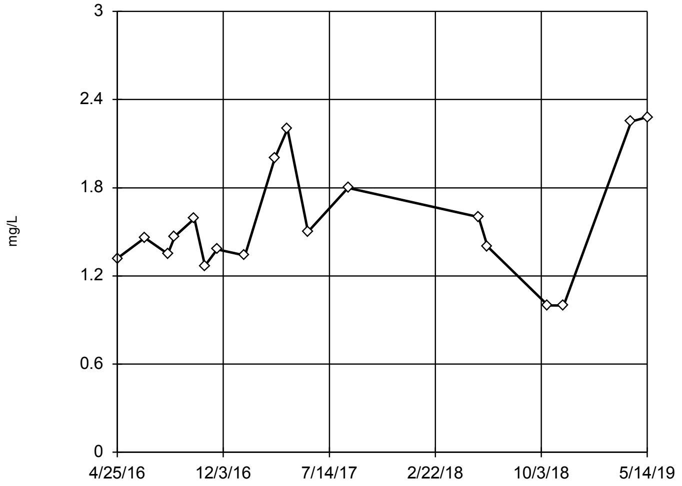
High cutoff = 235.5, low
cutoff = 0.2399, based
on IQR multiplier of 3.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-3 (bg)



n = 18

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 1.567, std. dev.
0.3909, critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9336
Critical = 0.914 (after
natural log transforma-
tion)
The distribution was found
to be log-normal.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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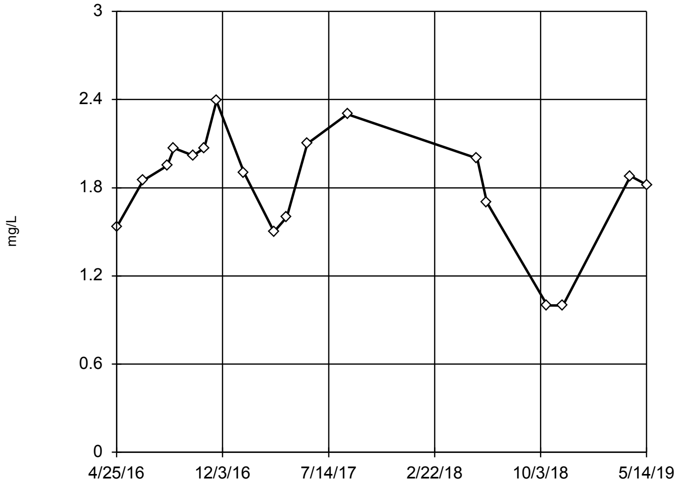
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-4 (bg)



n = 18

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 1.816, std. dev.
0.3798, critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9148
Critical = 0.914
The distribution was found
to be normally distrib-
uted.

Constituent: Chloride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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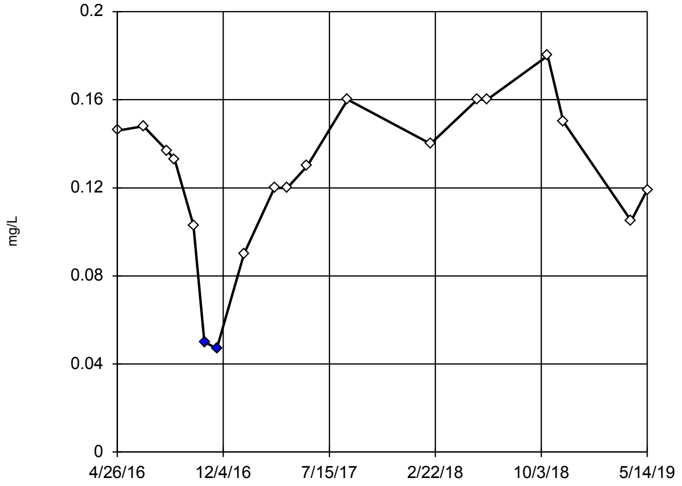
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Dixon's Outlier Test

MW-1 (bg)



n = 19

Statistical outliers are
drawn as solid.
Testing for 2 low outliers.
Mean = 0.1262.
Std. Dev. = 0.03546.
0.05 (J): c = 0.4818
tabl = 0.462.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9802
Critical = 0.91
The distribution, after
removal of suspect val-
ues, was found to be nor-
mally distributed.

Constituent: Fluoride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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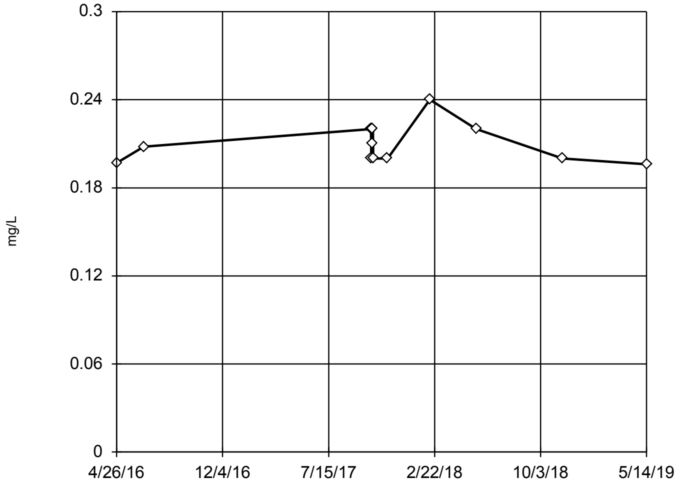
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-13 (bg)



n = 13

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

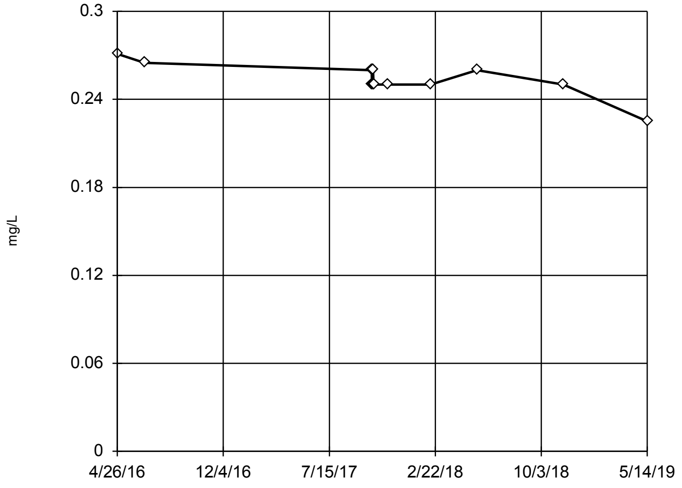
High cutoff = 0.2928,
low cutoff = 0.1503, based
on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-14 (bg)



n = 13

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.282, low cutoff = 0.1918, based on IQR multiplier of 3.

Constituent: Fluoride   Analysis Run 9/27/2019 10:44 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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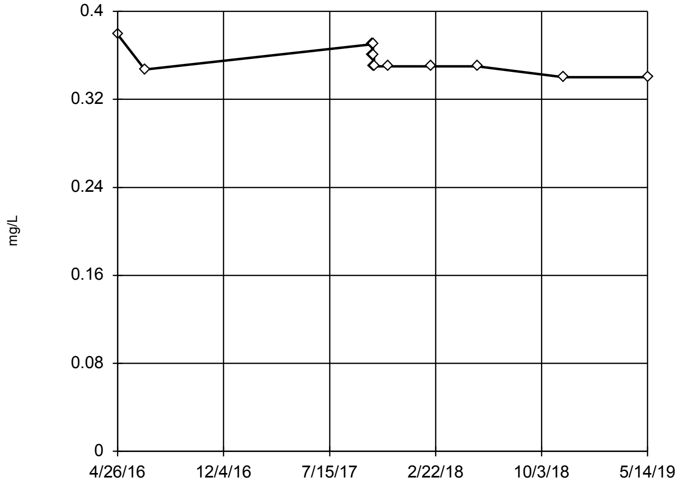
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-15 (bg)



n = 13

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 0.3551, std. dev.
0.01195, critical Tn 2.331

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8974
Critical = 0.889
The distribution was found to be normally distributed.

Constituent: Fluoride   Analysis Run 9/27/2019 10:44 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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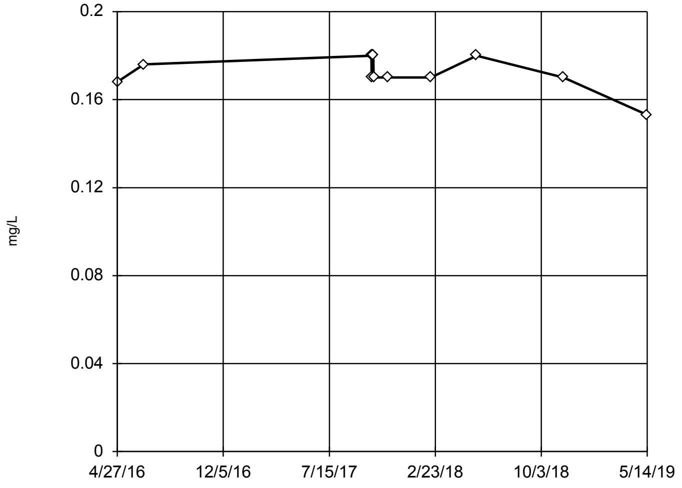
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-16



n = 13

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1998, low cutoff = -0.1328, based on IQR multiplier of 3.

Constituent: Fluoride   Analysis Run 9/27/2019 10:44 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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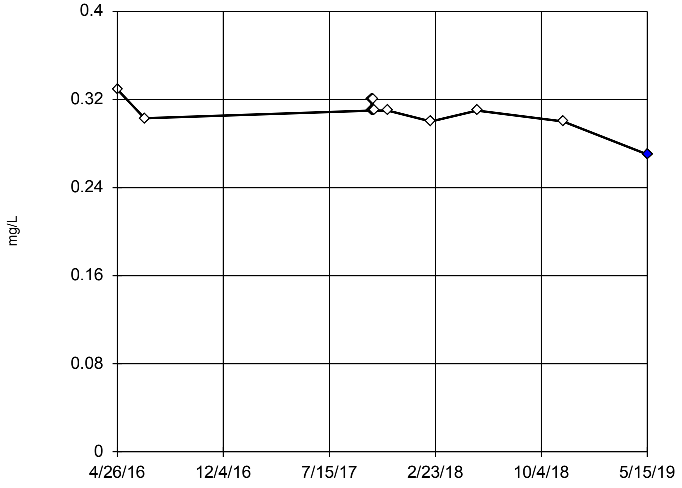
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Dixon's Outlier Test

MW-18



n = 13

Statistical outlier is
drawn as solid.
Testing for 1 low outlier.
Mean = 0.3086.
Std. Dev. = 0.01439.
0.27: c = 0.6
tabl = 0.521.
Alpha = 0.05.

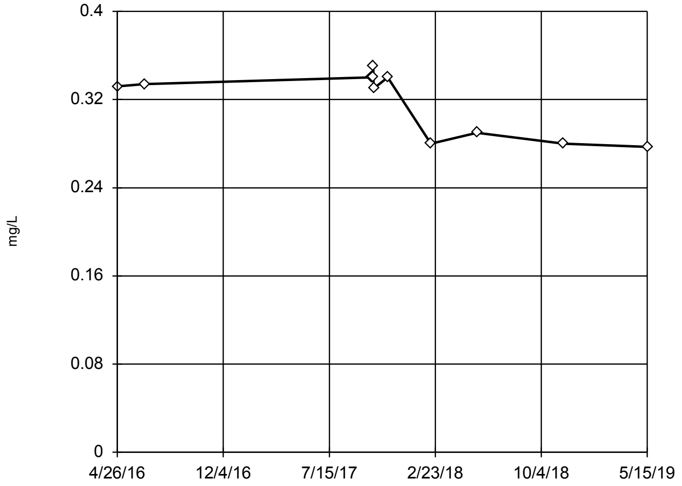
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9082
Critical = 0.883
The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Fluoride   Analysis Run 9/27/2019 10:44 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Tukey's Outlier Screening

MW-19



n = 13

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.4073,
low cutoff = -0.3679,
based on IQR multiplier
of 3.

Constituent: Fluoride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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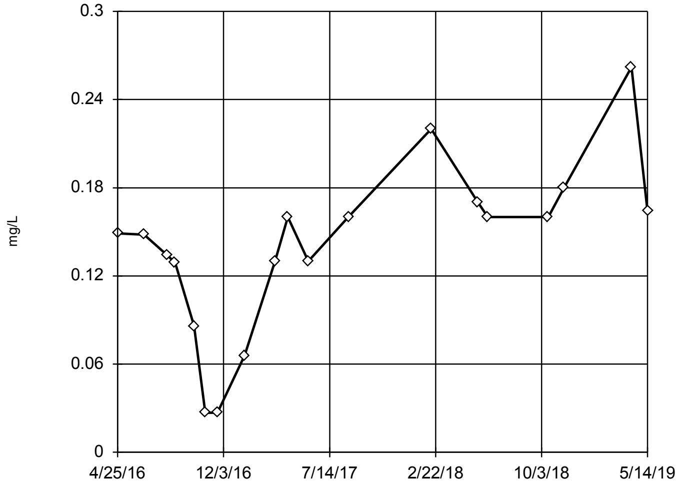
EPA Screening (suspected outliers for Dixon's Test)

MW-2 (bg)



n = 19

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 0.1401, std. dev.
0.05792, critical Tn 2.532

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9235
Critical = 0.917
The distribution was found
to be normally distributed.

Constituent: Fluoride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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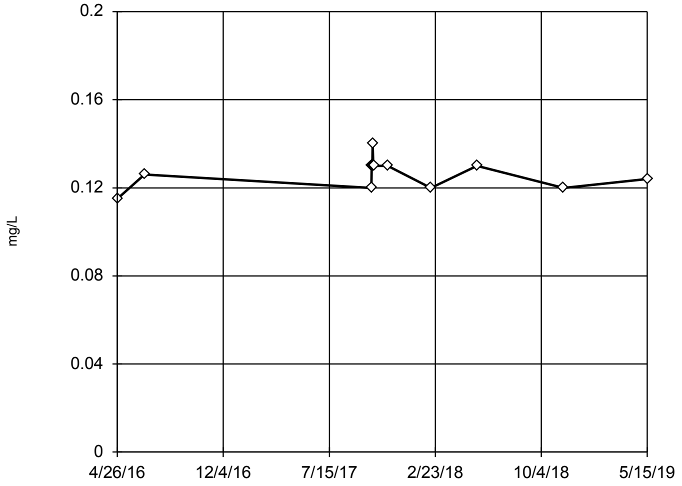
EPA Screening (suspected outliers for Dixon's Test)

MW-20



n = 13

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 0.1265, std. dev.
0.006591, critical Tn
2.331

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9048
Critical = 0.889
The distribution was found
to be normally distributed.

Constituent: Fluoride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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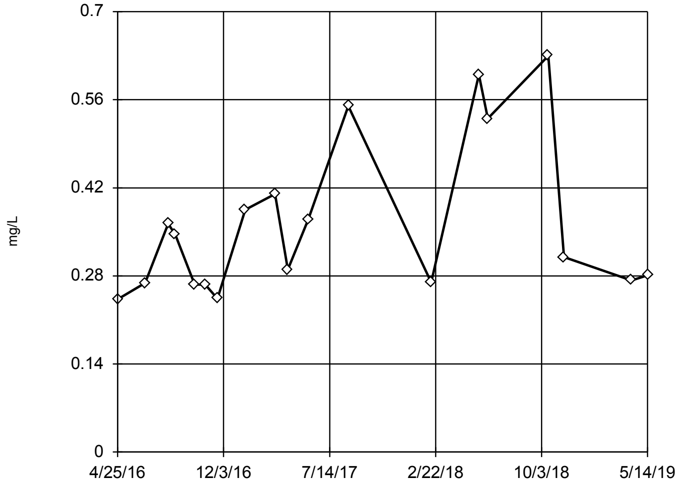
Tukey's Outlier Screening

MW-3 (bg)



n = 19

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

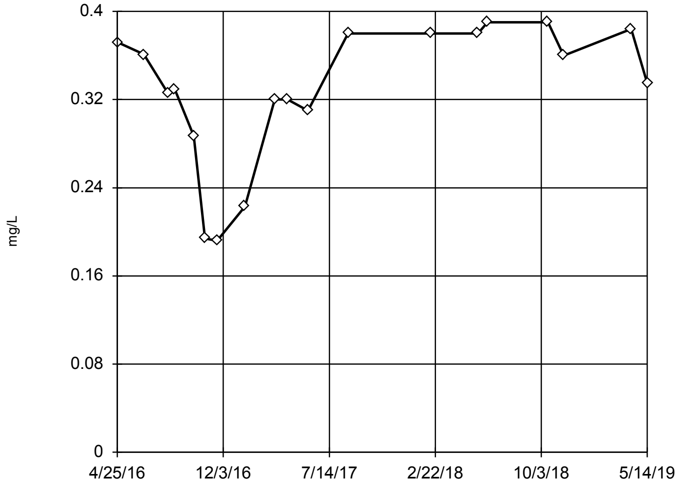
Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

High cutoff = 1.452, low
cutoff = 0.07597, based
on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Tukey's Outlier Screening

MW-4 (bg)



n = 19

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were x^5 transformed
to achieve best W statistic
(graph shown in
original units).

High cutoff = 0.4707,
low cutoff = -0.4151,
based on IQR multiplier
of 3.

Constituent: Fluoride Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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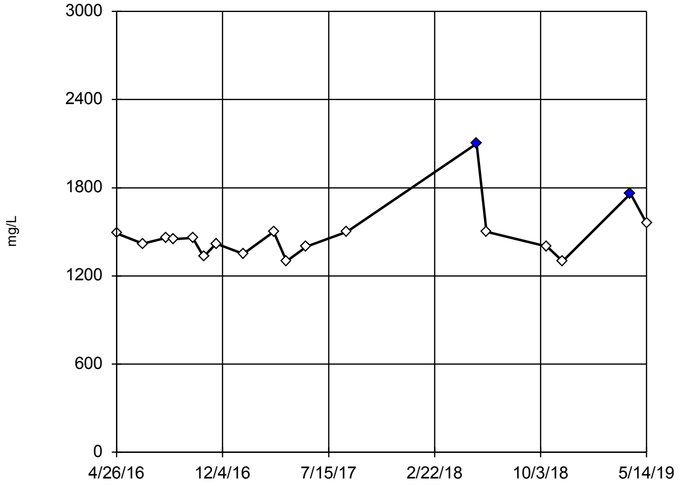
Dixon's Outlier Test

MW-1 (bg)



n = 18

Statistical outliers are
drawn as solid.
Testing for 2 high outliers.
Mean = 1483.
Std. Dev. = 187.3.
1760: c = 0.6047
tabl = 0.475.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9475
Critical = 0.906
The distribution, after
removal of suspect values,
was found to be normally distributed.

Constituent: Sulfate Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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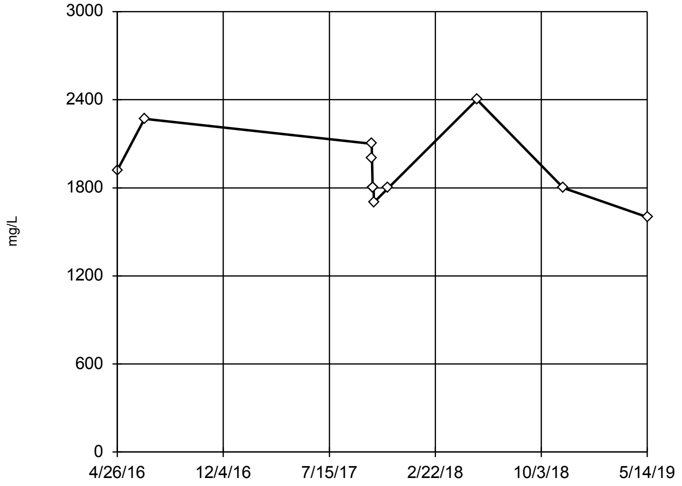
EPA Screening (suspected outliers for Dixon's Test)

MW-13 (bg)



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 1916, std. dev. 236.3,
critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8932
Critical = 0.883
The distribution was found
to be normally distributed.

Constituent: Sulfate Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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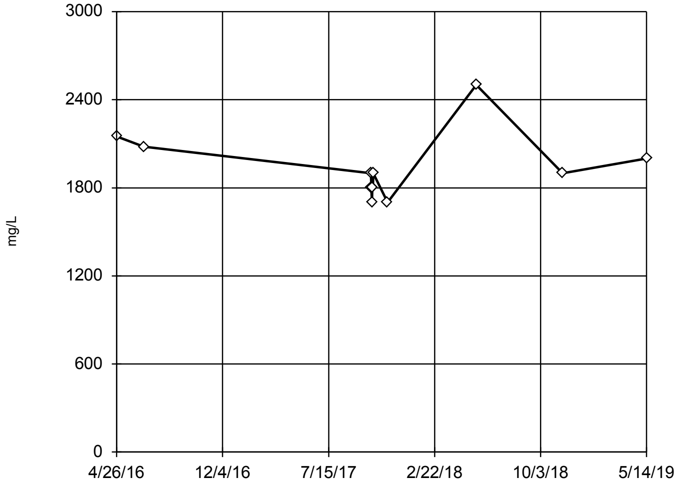
Dixon's Outlier Test

MW-14 (bg)



n = 12

No statistical outliers.
Testing for 1 high outlier.
Mean = 1936.
Std. Dev. = 225.5.
2500: c = 0.525
tabl = 0.546.
Alpha = 0.05.

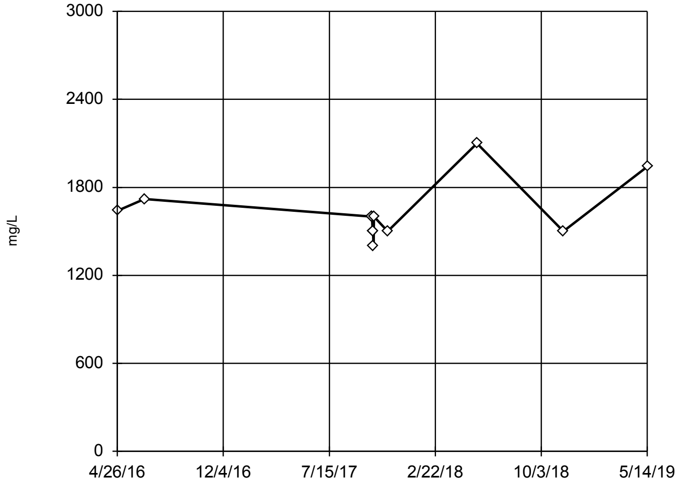
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9306
Critical = 0.876
The distribution was found
to be normally distributed.

Constituent: Sulfate Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-15 (bg)



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2358, low cutoff = 1069, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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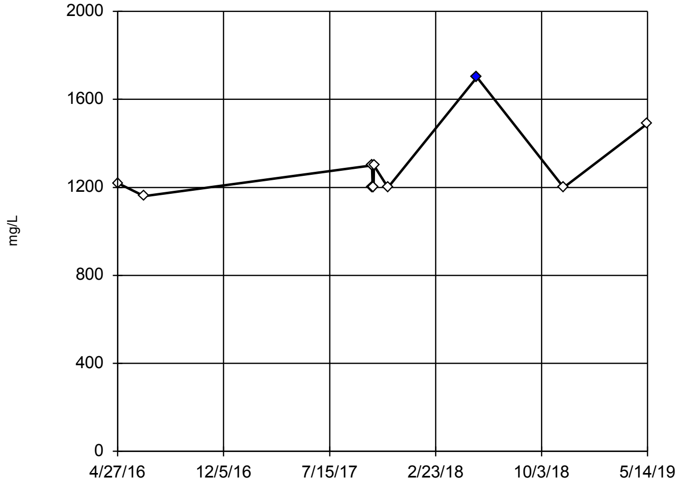
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-16



n = 12

Outlier is drawn as solid. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1653, low cutoff = 943.8, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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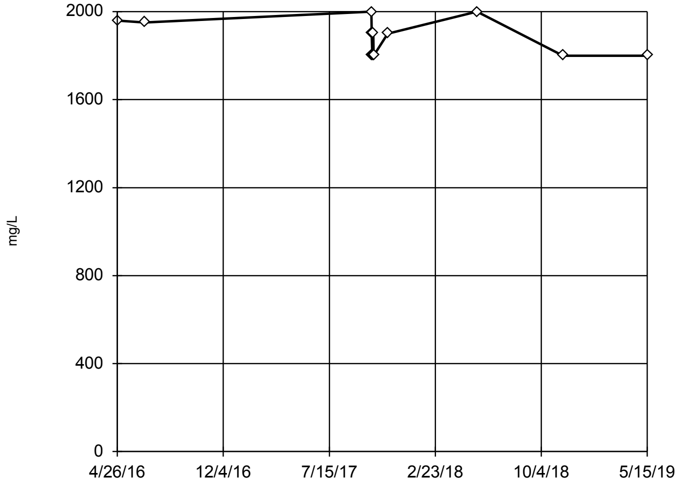
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-18



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2225, low cutoff = -1777, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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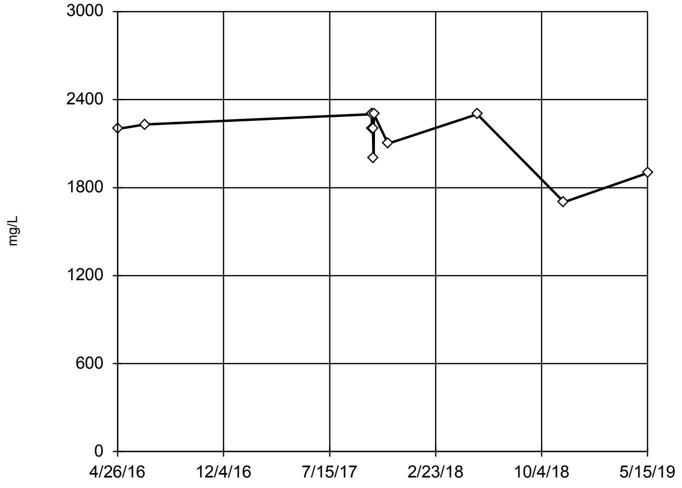
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-19



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

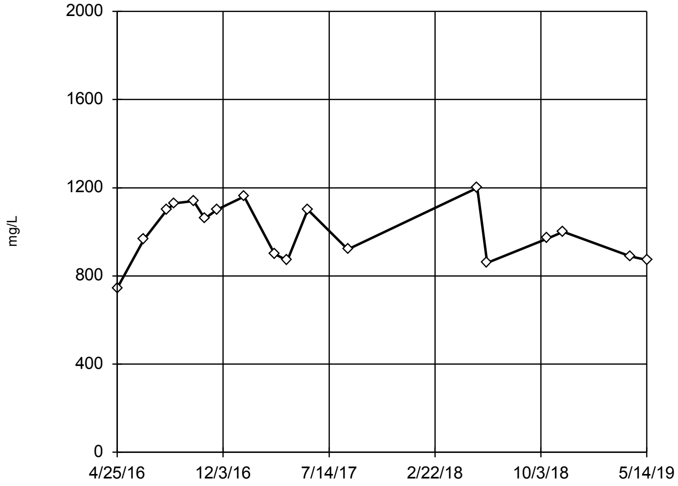
High cutoff = 2676, low cutoff = -2291, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-2 (bg)



n = 18

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 998.9, std. dev. 129.3, critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9464
Critical = 0.914
The distribution was found to be normally distributed.

Constituent: Sulfate   Analysis Run 9/27/2019 10:44 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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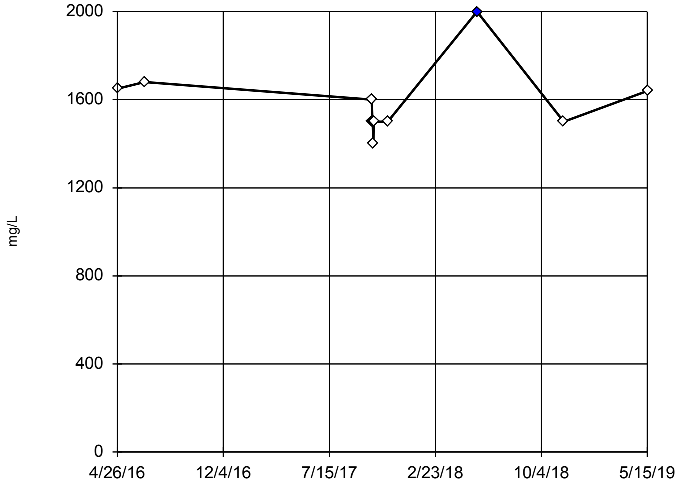
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Dixon's Outlier Test

MW-20



n = 12

Statistical outlier is drawn as solid.
Testing for 1 high outlier.
Mean = 1589.
Std. Dev. = 153.5.
2000: c = 0.7
tabl = 0.546.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8978
Critical = 0.876
The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Sulfate   Analysis Run 9/27/2019 10:44 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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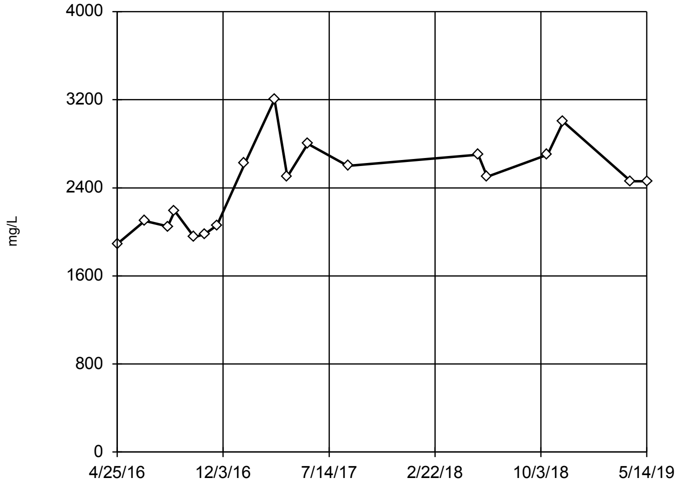
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-3 (bg)



n = 18

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 2431, std. dev. 379.6, critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9476
Critical = 0.914
The distribution was found to be normally distributed.

Constituent: Sulfate   Analysis Run 9/27/2019 10:44 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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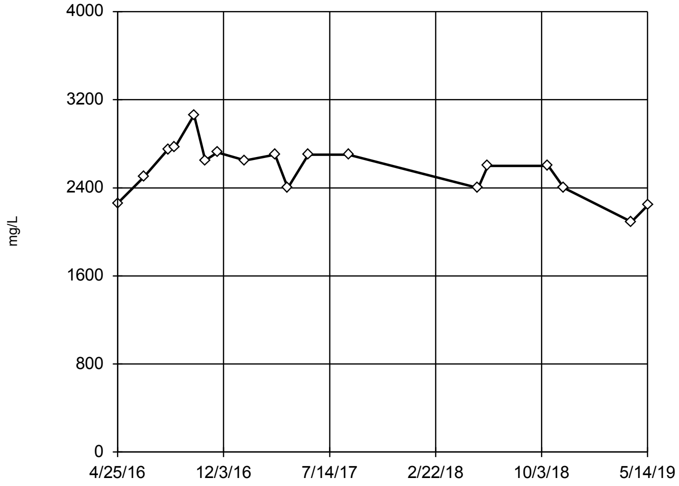
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-4 (bg)



n = 18

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 2566, std. dev. 233.5, critical Tn 2.504

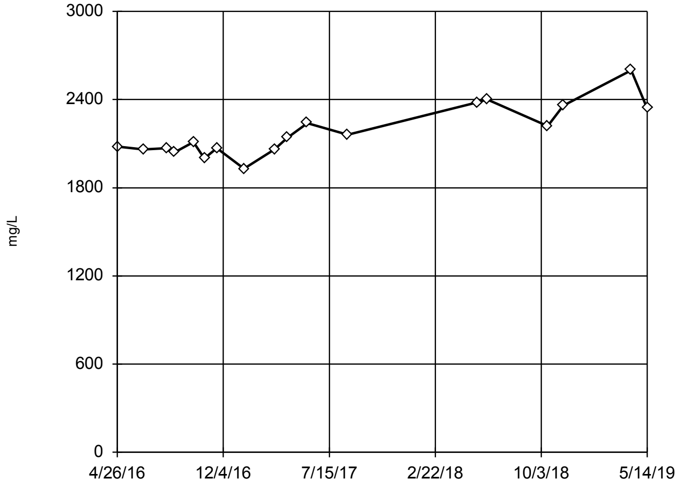
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9529
Critical = 0.914
The distribution was found to be normally distributed.

Constituent: Sulfate   Analysis Run 9/27/2019 10:44 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-1 (bg)



n = 18

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 2181, std. dev. 173.6,
critical Tn 2.504

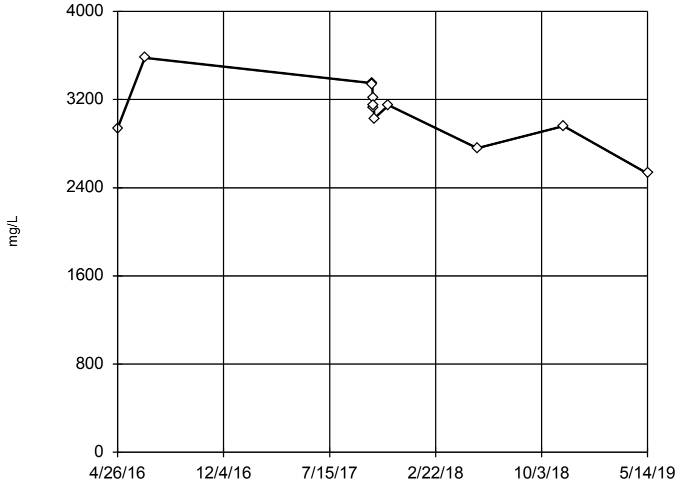
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9208
Critical = 0.914
The distribution was found
to be normally distributed.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-13 (bg)



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 3093, std. dev. 279.3,
critical Tn 2.285

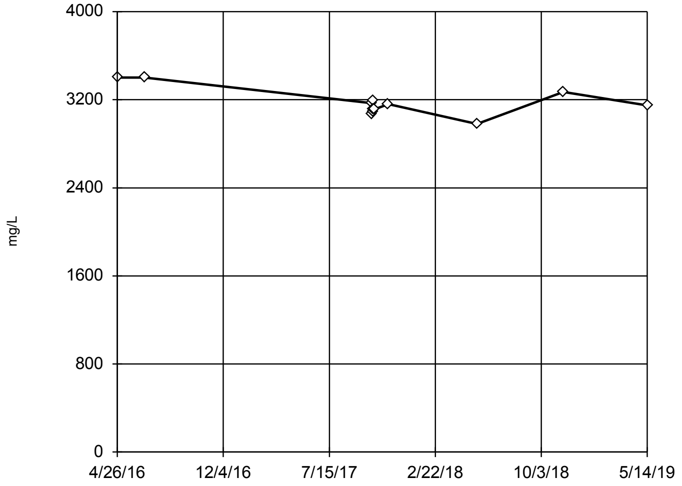
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.979
Critical = 0.883
The distribution was found
to be normally distributed.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-14 (bg)



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 3175, std. dev. 126.5,
critical Tn 2.285

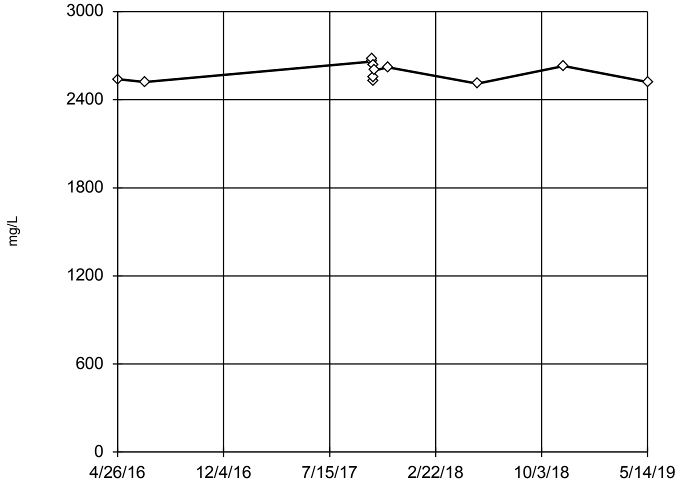
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9106
Critical = 0.883
The distribution was found
to be normally distributed.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-15 (bg)



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 2583, std. dev. 61.4,
critical Tn 2.285

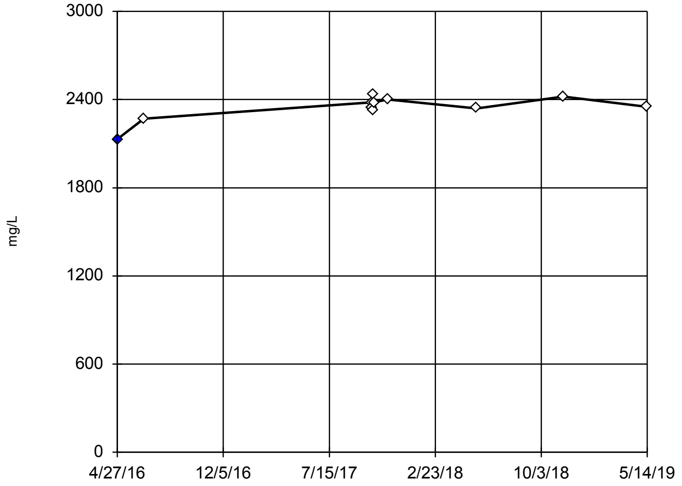
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.894
Critical = 0.883
The distribution was found
to be normally distributed.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Dixon's Outlier Test

MW-16



n = 12

Statistical outlier is drawn as solid. Testing for 1 low outlier. Mean = 2343. Std. Dev. = 81.05. 2130: c = 0.6897 tabl = 0.546. Alpha = 0.05.

Normality test used: Shapiro Wilk@alpha = 0.1 Calculated = 0.9568 Critical = 0.876 The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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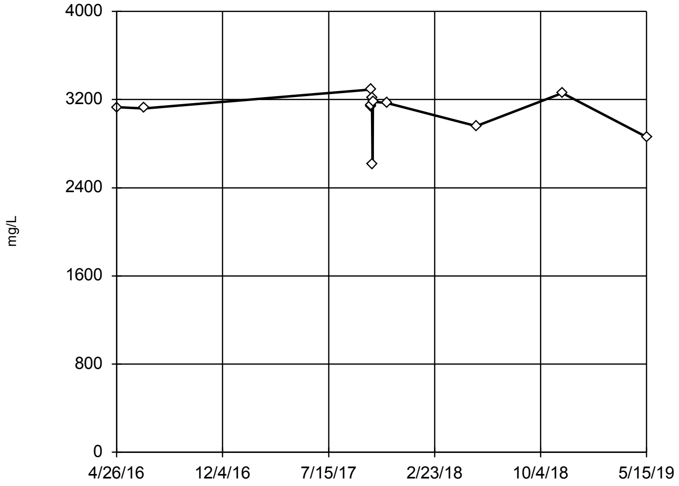
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Dixon's Outlier Test

MW-18



n = 12

No statistical outliers. Testing for 1 low outlier. Mean = 3090. Std. Dev. = 192.3. 2610: c = 0.5385 tabl = 0.546. Alpha = 0.05.

Normality test used: Shapiro Wilk@alpha = 0.1 Calculated = 0.8811 Critical = 0.876 The distribution was found to be normally distributed.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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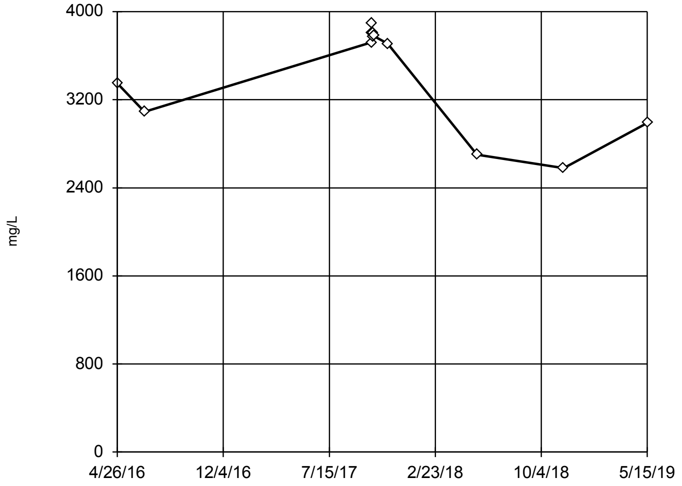
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-19



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 4600, low cutoff = -4229, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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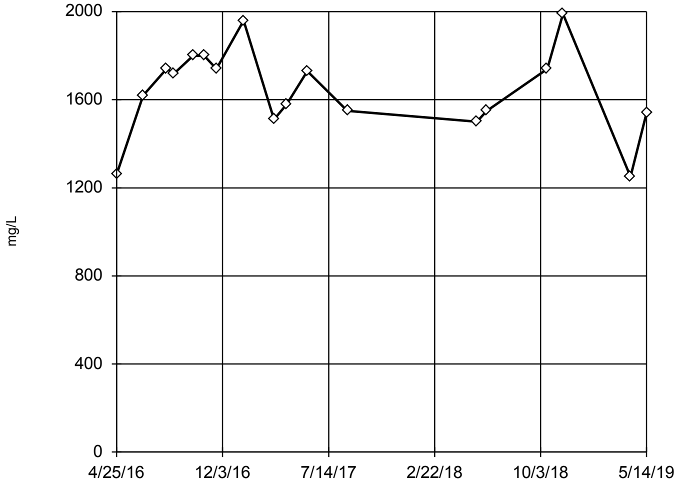
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-2 (bg)



n = 18

Dixon's will not be run. No suspect values identified or unable to establish suspect values. Mean 1643, std. dev. 200.5, critical Tn 2.504

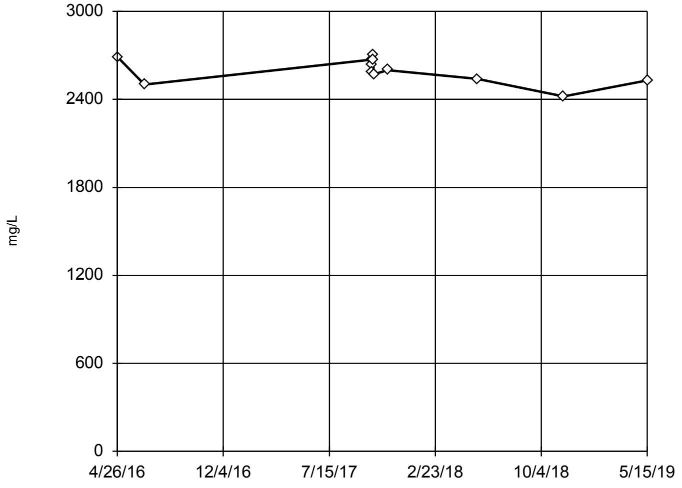
Normality test used: Shapiro Wilk@alpha = 0.1 Calculated = 0.9458 Critical = 0.914 The distribution was found to be normally distributed.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-20



n = 12

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 2593, std. dev. 85.74,
critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9468
Critical = 0.883
The distribution was found
to be normally distributed.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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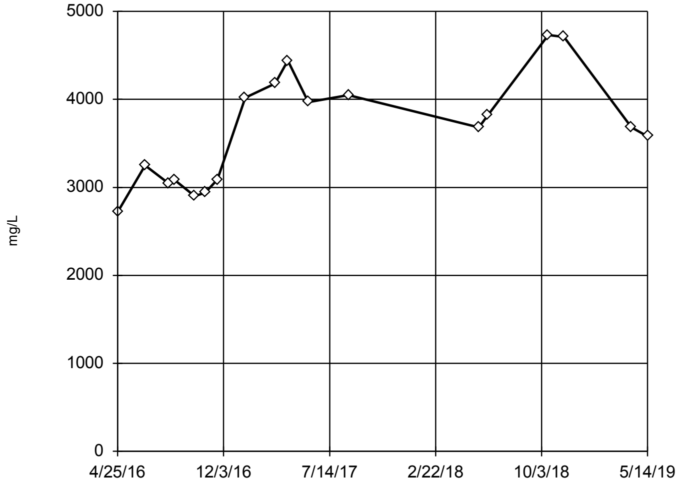
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

EPA Screening (suspected outliers for Dixon's Test)

MW-3 (bg)



n = 18

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 3661, std. dev. 628.6,
critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9455
Critical = 0.914
The distribution was found
to be normally distributed.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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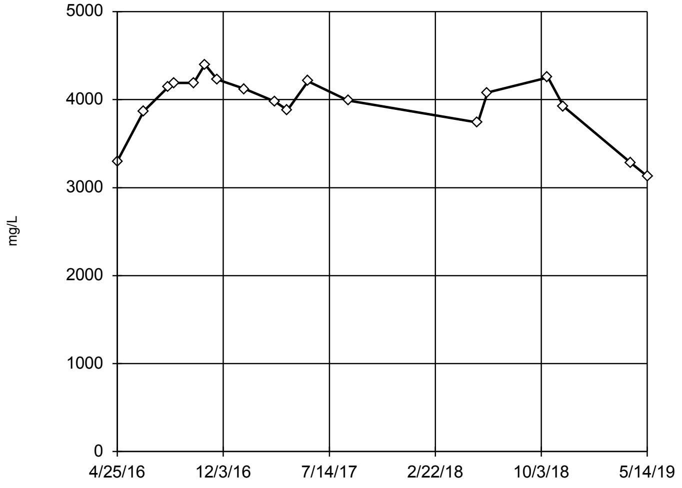
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4 (bg)



n = 18

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 4837, low
cutoff = -4029, based
on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 10:44 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

FIGURE D.

Welch's t-test/Mann-Whitney - Significant Results

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill   Printed 9/27/2019, 10:59 AM

Constituent	Well	Calc.	0.01	Method
Calcium (mg/L)	**MW-1 (bg)**	**3.327**	**Yes**	**Mann-W**
Chloride (mg/L)	**MW-20**	**2.633**	**Yes**	**Mann-W**
Fluoride (mg/L)	**MW-2 (bg)**	**3.356**	**Yes**	**Mann-W**
Fluoride (mg/L)	**MW-4 (bg)**	**2.923**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	**MW-1 (bg)**	**3.235**	**Yes**	**Mann-W**

Welch's t-test/Mann-Whitney - All Results

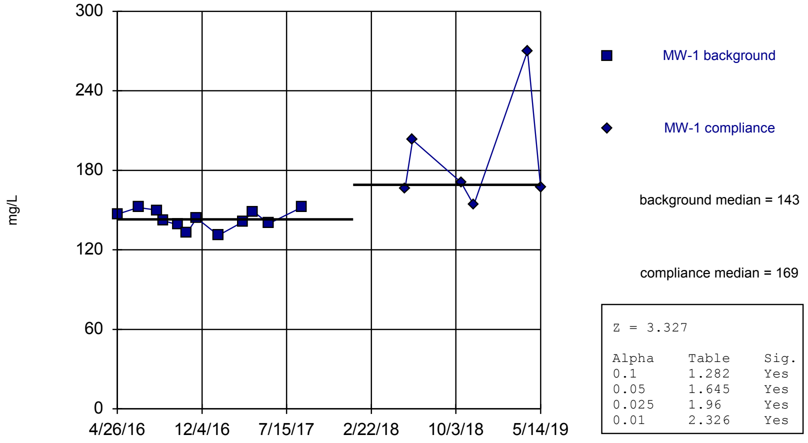
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill   Printed 9/27/2019, 10:59 AM

Constituent	Well	Calc.	0.01	Method
Calcium (mg/L)	**MW-1 (bg)**	**3.327**	**Yes**	**Mann-W**
Calcium (mg/L)	MW-13 (bg)	-0.6842	No	Mann-W
Calcium (mg/L)	MW-14 (bg)	0.4253	No	Mann-W
Calcium (mg/L)	MW-15 (bg)	0.7643	No	Mann-W
Calcium (mg/L)	MW-16	0.6818	No	Mann-W
Calcium (mg/L)	MW-18	0.5944	No	Mann-W
Calcium (mg/L)	MW-19	-2.13	No	Mann-W
Calcium (mg/L)	MW-2 (bg)	1.877	No	Mann-W
Calcium (mg/L)	MW-20	0.2552	No	Mann-W
Calcium (mg/L)	MW-3 (bg)	1.641	No	Mann-W
Calcium (mg/L)	MW-4 (bg)	0.3278	No	Mann-W
Chloride (mg/L)	MW-1 (bg)	-1.734	No	Mann-W
Chloride (mg/L)	MW-13 (bg)	0.4261	No	Mann-W
Chloride (mg/L)	MW-14 (bg)	0.5965	No	Mann-W
Chloride (mg/L)	MW-15 (bg)	0.8522	No	Mann-W
Chloride (mg/L)	MW-16	1.021	No	Mann-W
Chloride (mg/L)	MW-18	0.5986	No	Mann-W
Chloride (mg/L)	MW-19	0.4276	No	Mann-W
Chloride (mg/L)	MW-2 (bg)	-0.7965	No	Mann-W
Chloride (mg/L)	**MW-20**	**2.633**	**Yes**	**Mann-W**
Chloride (mg/L)	MW-3 (bg)	0.1406	No	Mann-W
Chloride (mg/L)	MW-4 (bg)	-1.922	No	Mann-W
Fluoride (mg/L)	MW-1 (bg)	1.736	No	Mann-W
Fluoride (mg/L)	MW-13 (bg)	-0.3012	No	Mann-W
Fluoride (mg/L)	MW-14 (bg)	-1.798	No	Mann-W
Fluoride (mg/L)	MW-15 (bg)	-2.193	No	Mann-W
Fluoride (mg/L)	MW-16	-1.319	No	Mann-W
Fluoride (mg/L)	MW-18	-2.351	No	Mann-W
Fluoride (mg/L)	MW-19	-2.337	No	Mann-W
Fluoride (mg/L)	**MW-2 (bg)**	**3.356**	**Yes**	**Mann-W**
Fluoride (mg/L)	MW-20	-0.8521	No	Mann-W
Fluoride (mg/L)	MW-3 (bg)	1.141	No	Mann-W
Fluoride (mg/L)	**MW-4 (bg)**	**2.923**	**Yes**	**Mann-W**
Sulfate (mg/L)	MW-1 (bg)	1.364	No	Mann-W
Sulfate (mg/L)	MW-13 (bg)	-0.6164	No	Mann-W
Sulfate (mg/L)	MW-14 (bg)	0.5177	No	Mann-W
Sulfate (mg/L)	MW-15 (bg)	0.6096	No	Mann-W
Sulfate (mg/L)	MW-16	0.7985	No	Mann-W
Sulfate (mg/L)	MW-18	-0.3556	No	Mann-W
Sulfate (mg/L)	MW-19	-1.567	No	Mann-W
Sulfate (mg/L)	MW-2 (bg)	-0.8916	No	Mann-W
Sulfate (mg/L)	MW-20	0.4411	No	Mann-W
Sulfate (mg/L)	MW-3 (bg)	1.501	No	Mann-W
Sulfate (mg/L)	MW-4 (bg)	-2.589	No	Mann-W
Total Dissolved Solids (mg/L)	**MW-1 (bg)**	**3.235**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	MW-13 (bg)	-2.042	No	Mann-W
Total Dissolved Solids (mg/L)	MW-14 (bg)	-0.4261	No	Mann-W
Total Dissolved Solids (mg/L)	MW-15 (bg)	-1.021	No	Mann-W
Total Dissolved Solids (mg/L)	MW-16	1.114	No	Mann-W
Total Dissolved Solids (mg/L)	MW-18	-0.4246	No	Mann-W
Total Dissolved Solids (mg/L)	MW-19	-2.467	No	Mann-W
Total Dissolved Solids (mg/L)	MW-2 (bg)	-1.033	No	Mann-W
Total Dissolved Solids (mg/L)	MW-20	-1.957	No	Mann-W
Total Dissolved Solids (mg/L)	MW-3 (bg)	1.452	No	Mann-W
Total Dissolved Solids (mg/L)	MW-4 (bg)	-1.546	No	Mann-W

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1 (bg)



background median = 143

compliance median = 169

```
Z = 3.327

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     Yes
```

Constituent: Calcium   Analysis Run 9/27/2019 10:57 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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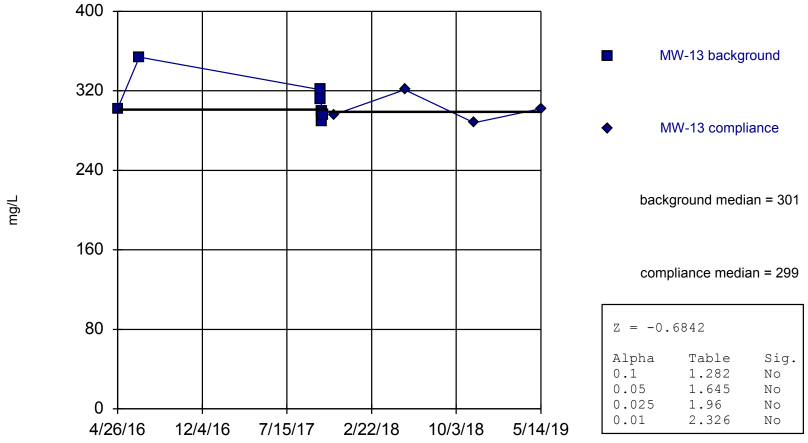
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-13 (bg)



background median = 301

compliance median = 299

```
Z = -0.6842

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium   Analysis Run 9/27/2019 10:57 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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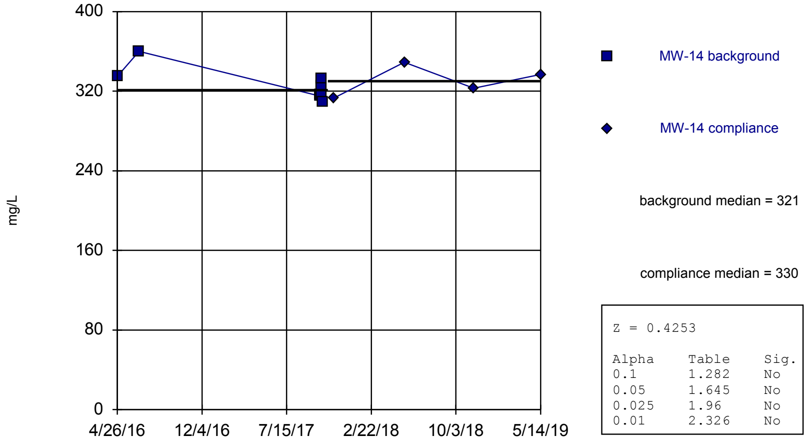
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-14 (bg)



background median = 321

compliance median = 330

```
Z = 0.4253

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium   Analysis Run 9/27/2019 10:57 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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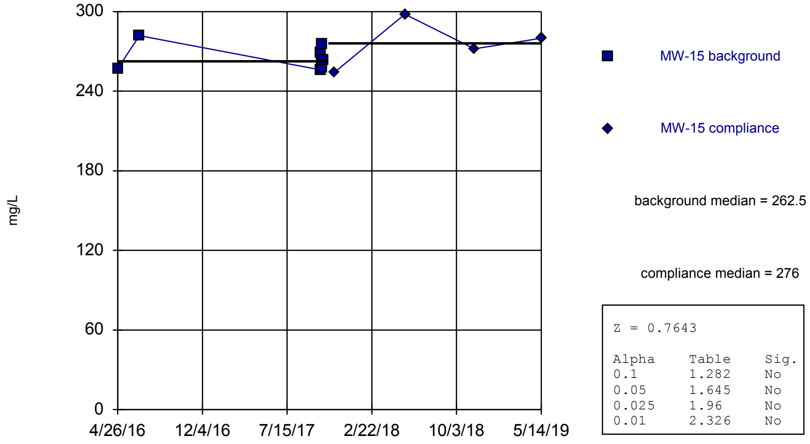
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-15 (bg)



background median = 262.5

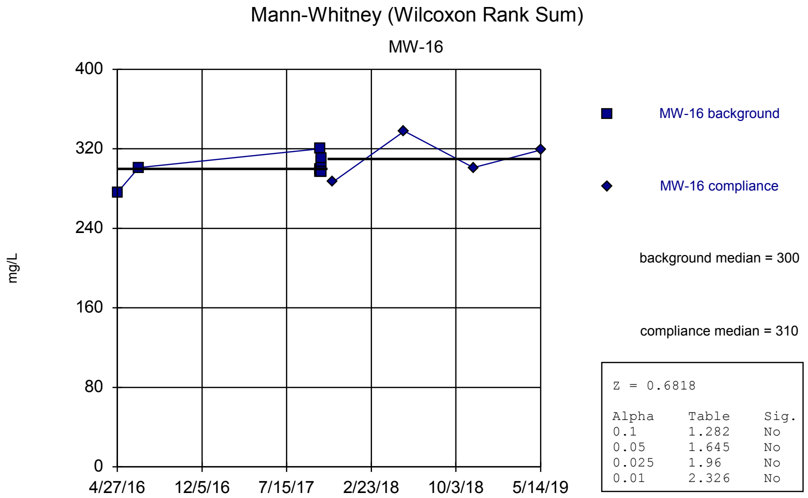
compliance median = 276

```
Z = 0.7643

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium   Analysis Run 9/27/2019 10:57 AM   View: Intrawell

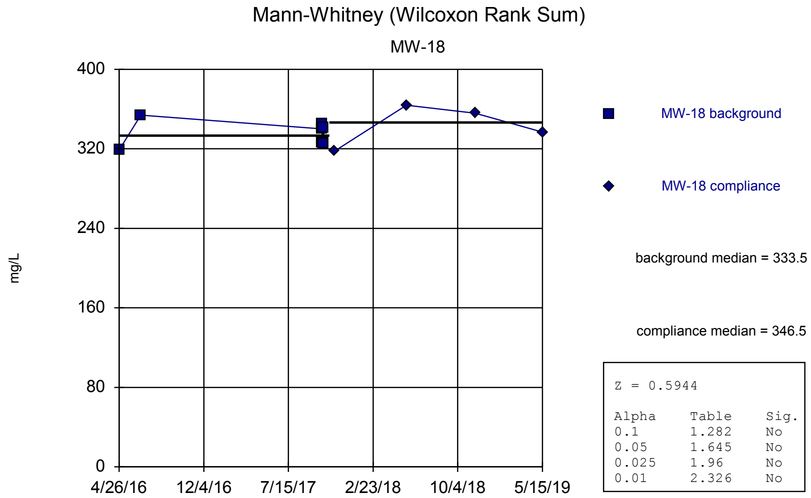
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



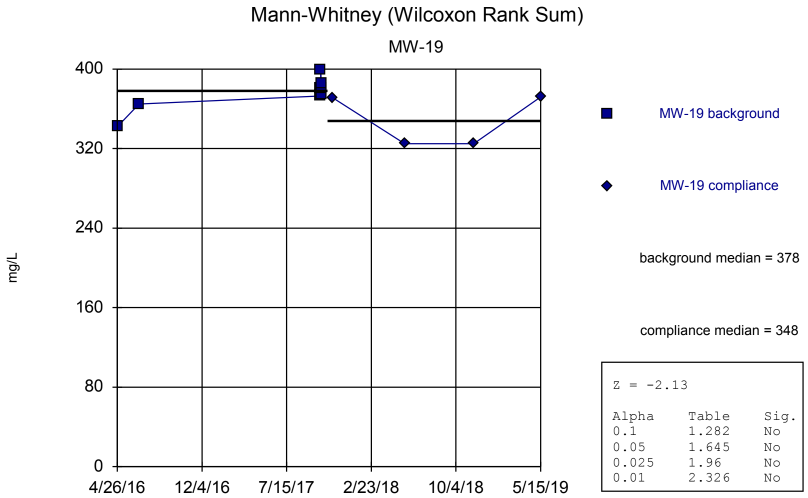
Constituent: Calcium Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



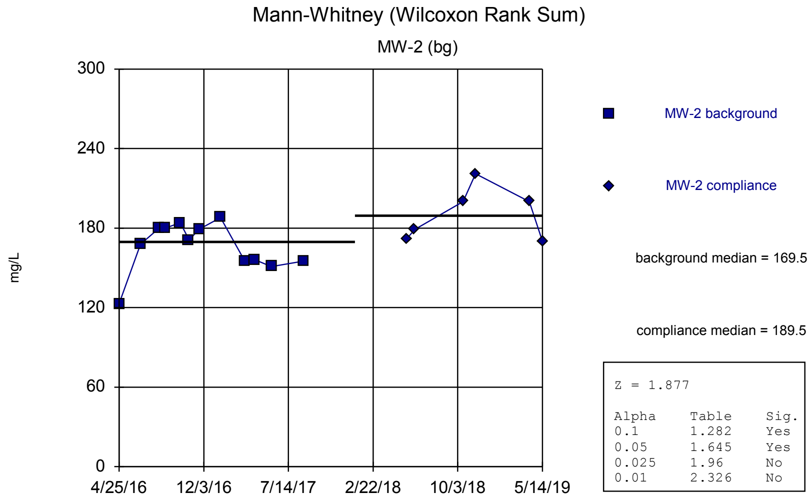
Constituent: Calcium Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



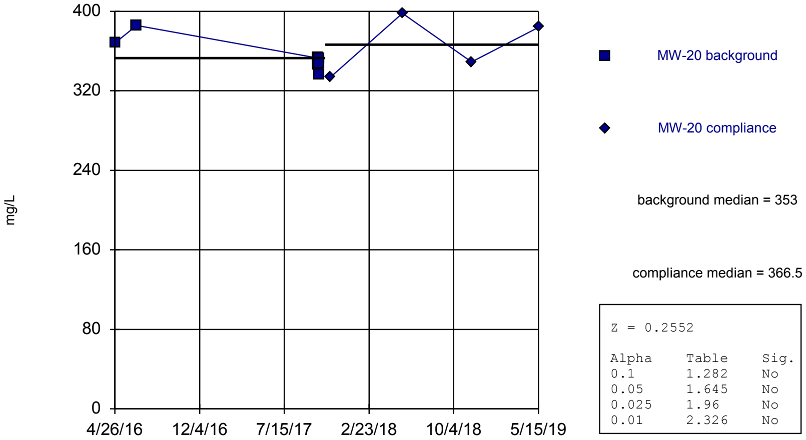
Constituent: Calcium Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Calcium Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Mann-Whitney (Wilcoxon Rank Sum)

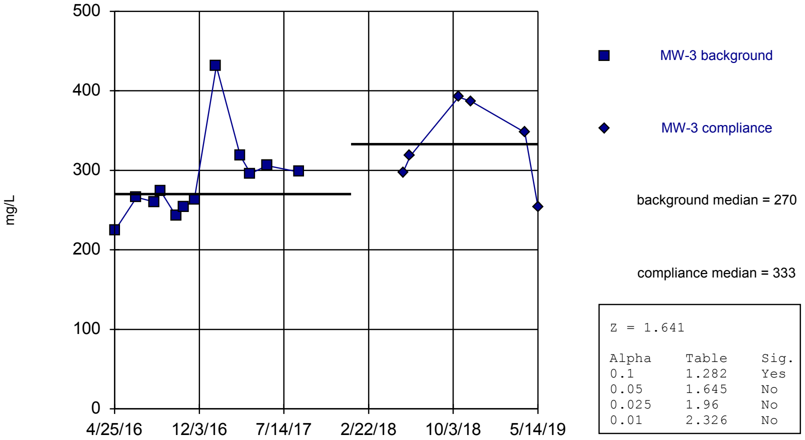
MW-20

```
Z = 0.2552

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Calcium Analysis Run 9/27/2019 10:57 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Mann-Whitney (Wilcoxon Rank Sum)

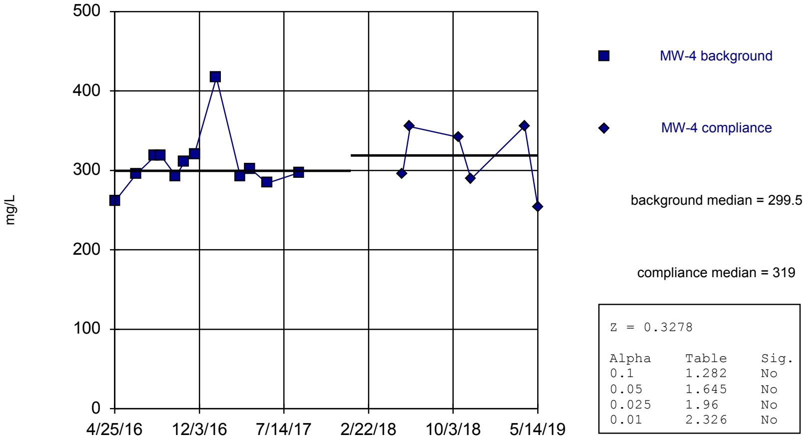
MW-3 (bg)

```
Z = 1.641

Alpha    Table    Sig.
0.1      1.282    Yes
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Calcium Analysis Run 9/27/2019 10:57 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Mann-Whitney (Wilcoxon Rank Sum)

MW-4 (bg)

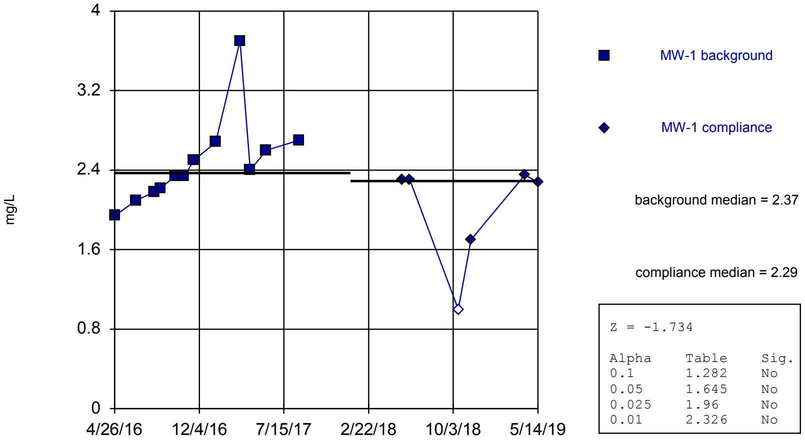
```
Z = 0.3278

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Calcium Analysis Run 9/27/2019 10:57 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.



Mann-Whitney (Wilcoxon Rank Sum)

MW-1 (bg)

```
Z = -1.734

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

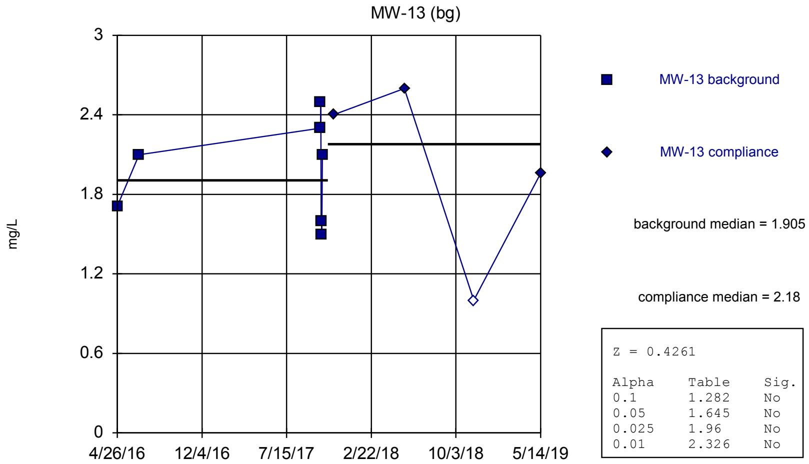
Constituent: Chloride Analysis Run 9/27/2019 10:57 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-13 (bg)



background median = 1.905

compliance median = 2.18

```
Z = 0.4261

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride   Analysis Run 9/27/2019 10:57 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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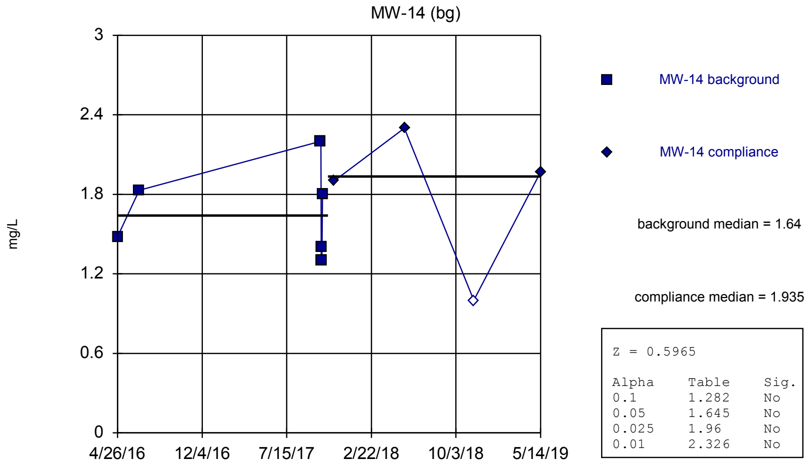
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-14 (bg)



background median = 1.64

compliance median = 1.935

```
Z = 0.5965

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride   Analysis Run 9/27/2019 10:57 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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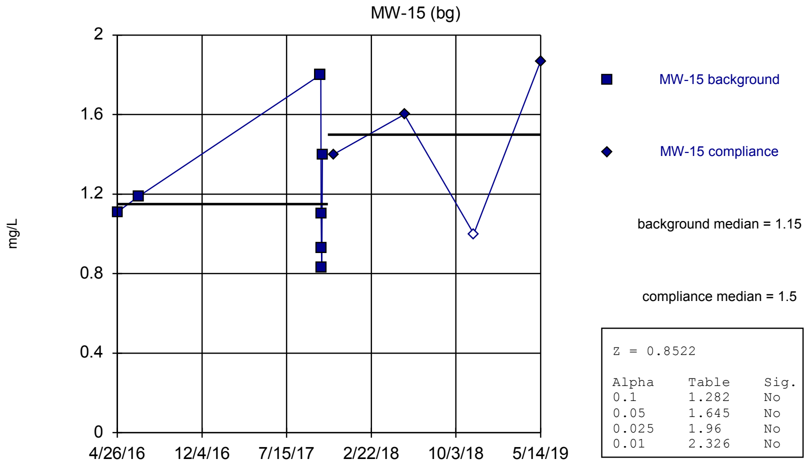
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-15 (bg)



background median = 1.15

compliance median = 1.5

```
Z = 0.8522

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride   Analysis Run 9/27/2019 10:57 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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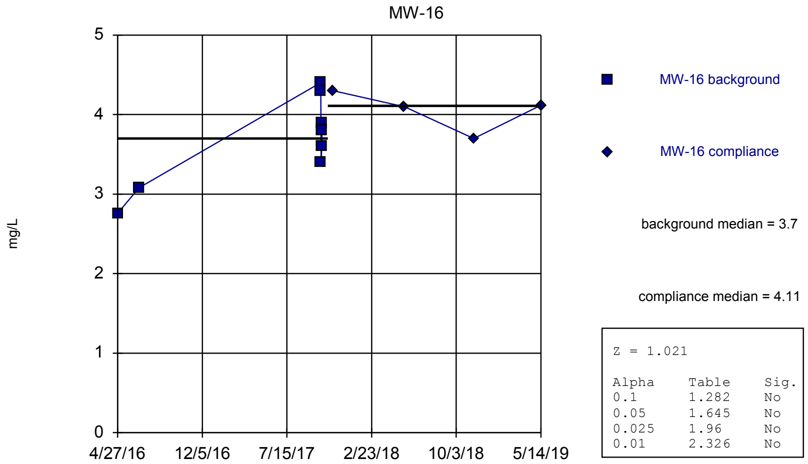
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-16



background median = 3.7

compliance median = 4.11

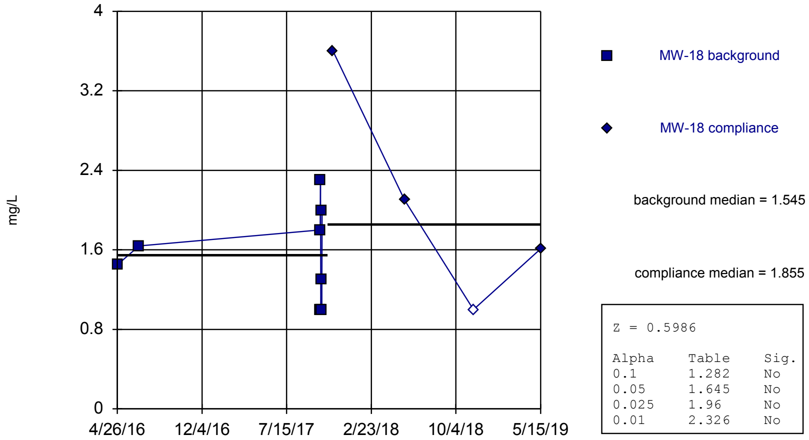
```
Z = 1.021

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride   Analysis Run 9/27/2019 10:57 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-18



background median = 1.545

compliance median = 1.855

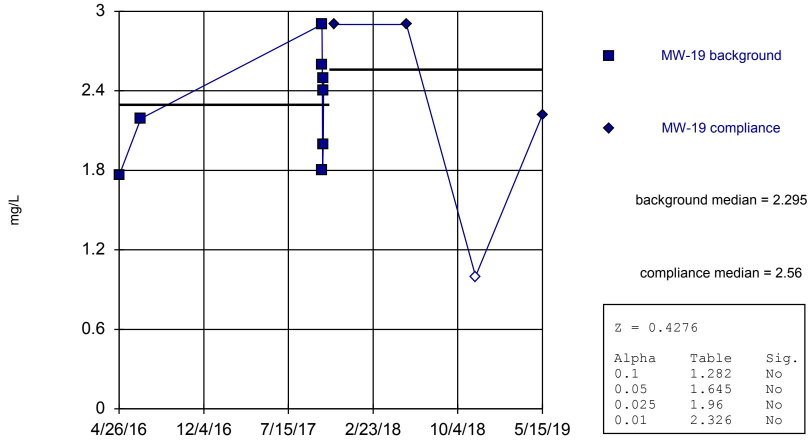
```
Z = 0.5986

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-19



background median = 2.295

compliance median = 2.56

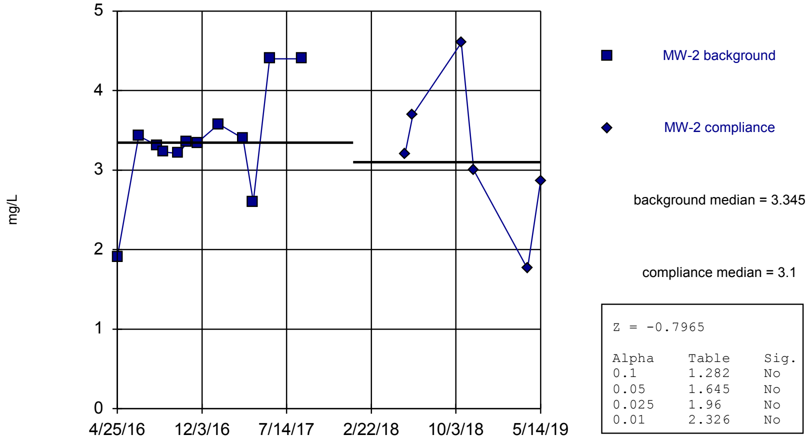
```
Z = 0.4276

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-2 (bg)



background median = 3.345

compliance median = 3.1

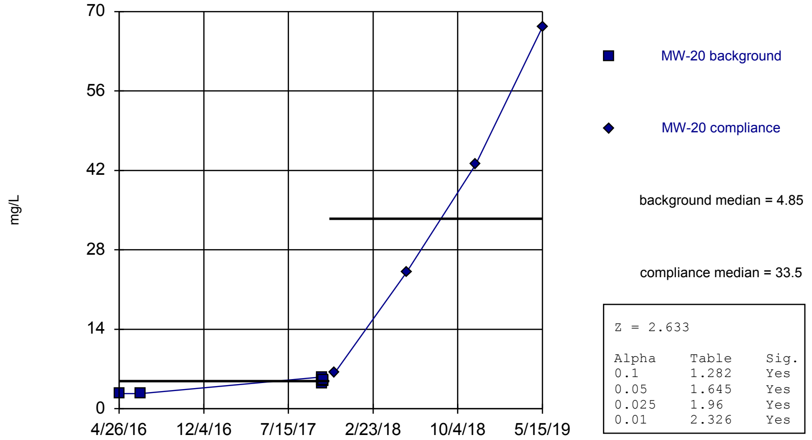
```
Z = -0.7965

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-20



background median = 4.85

compliance median = 33.5

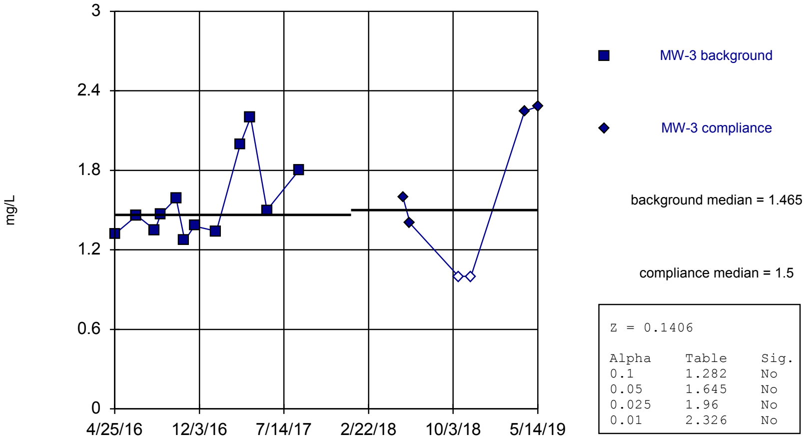
```
Z = 2.633

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     Yes
```

Constituent: Chloride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-3 (bg)



```
Z = 0.1406

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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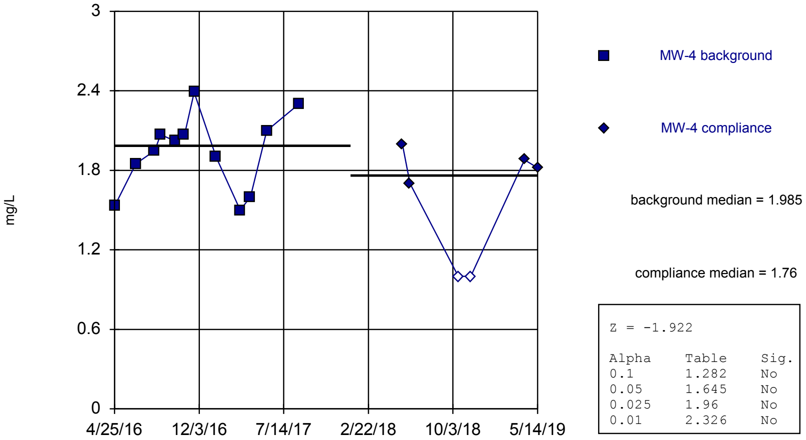
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-4 (bg)



```
Z = -1.922

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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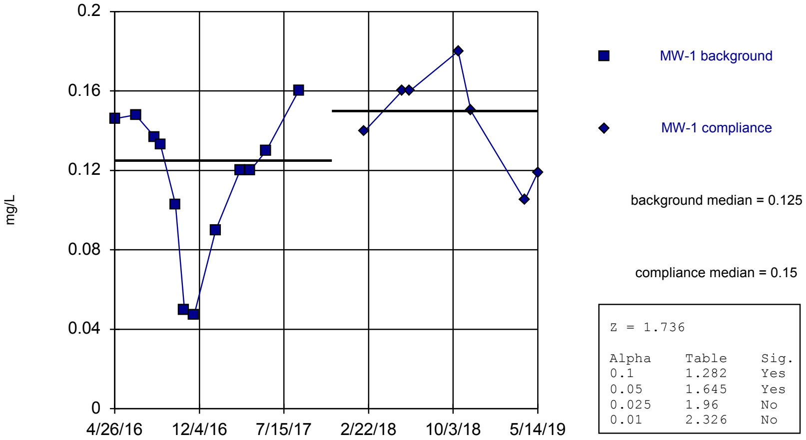
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1 (bg)



```
Z = 1.736

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      No
0.01      2.326     No
```

Constituent: Fluoride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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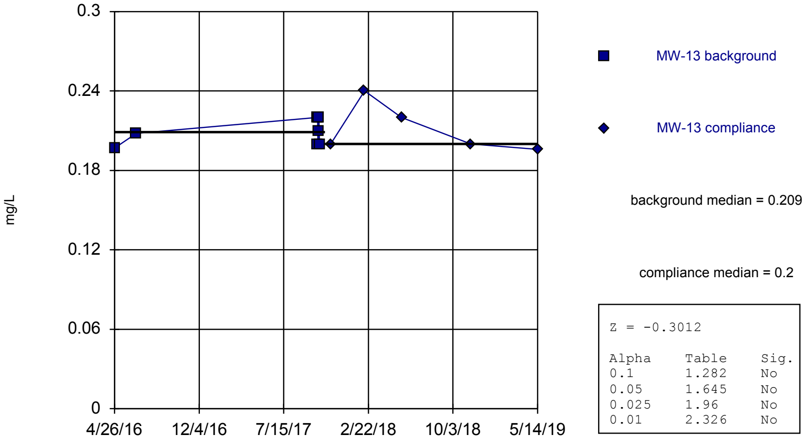
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-13 (bg)



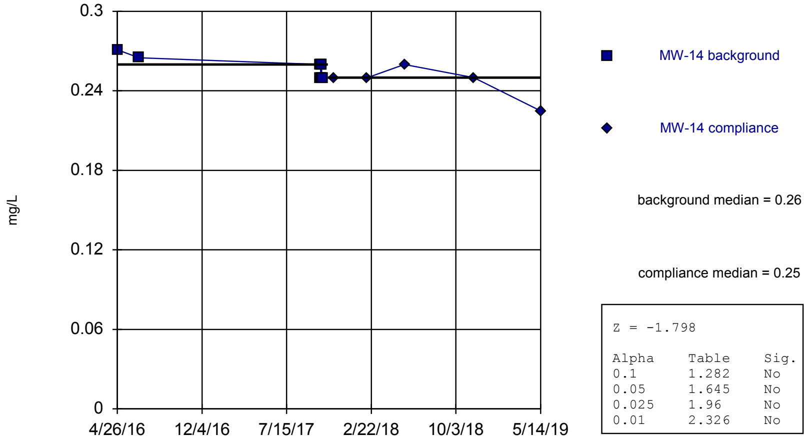
```
Z = -0.3012

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Fluoride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-14 (bg)

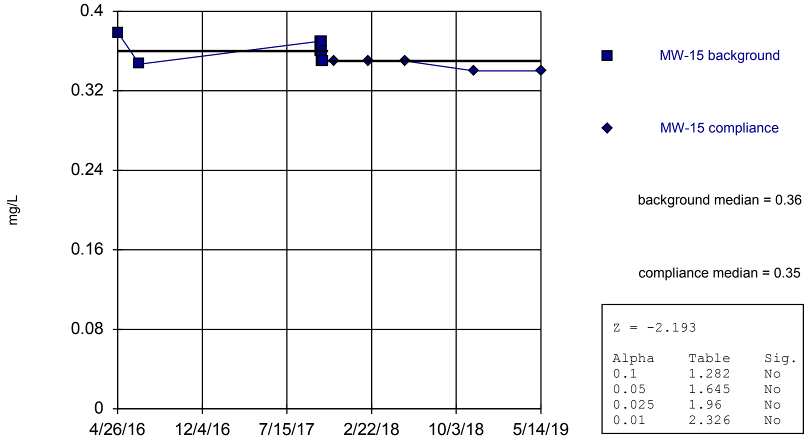


Constituent: Fluoride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-15 (bg)

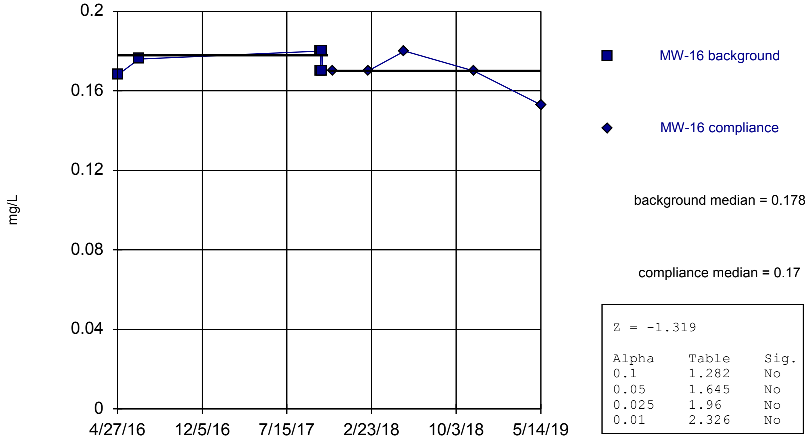


Constituent: Fluoride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-16

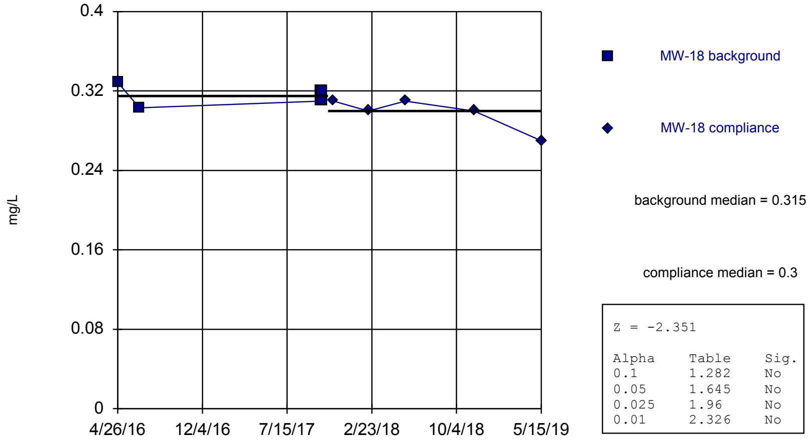


Constituent: Fluoride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

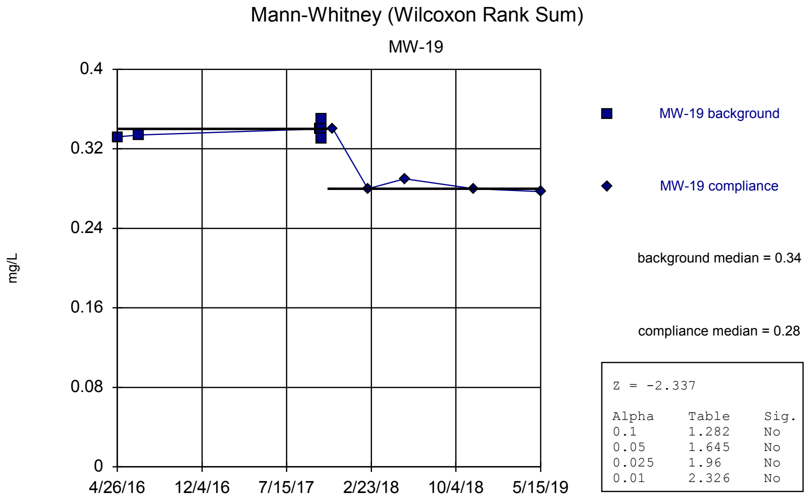
Mann-Whitney (Wilcoxon Rank Sum)

MW-18



Constituent: Fluoride Analysis Run 9/27/2019 10:57 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

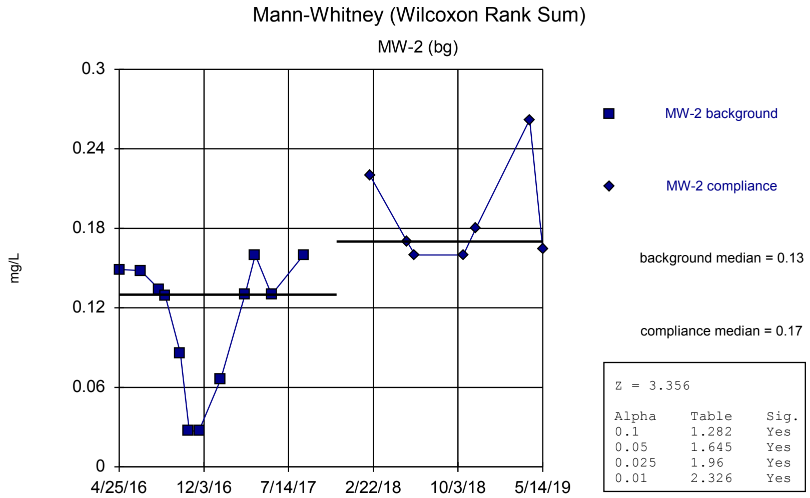
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = -2.337

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Fluoride   Analysis Run 9/27/2019 10:57 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

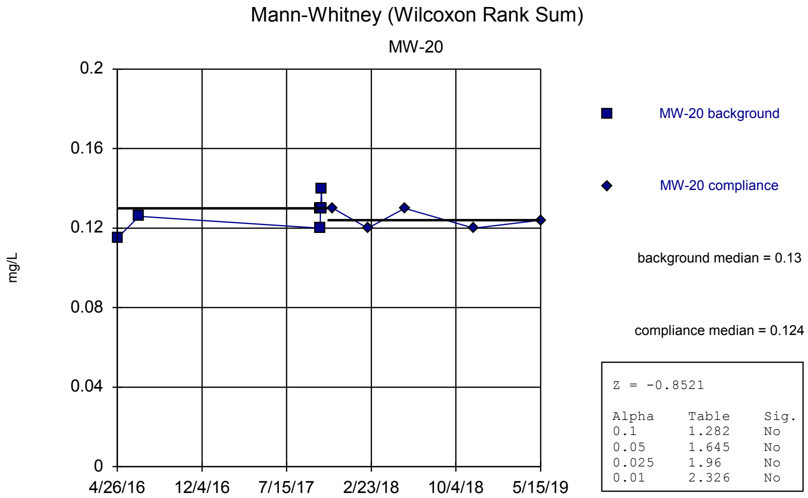
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = 3.356

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     Yes
```

Constituent: Fluoride   Analysis Run 9/27/2019 10:57 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

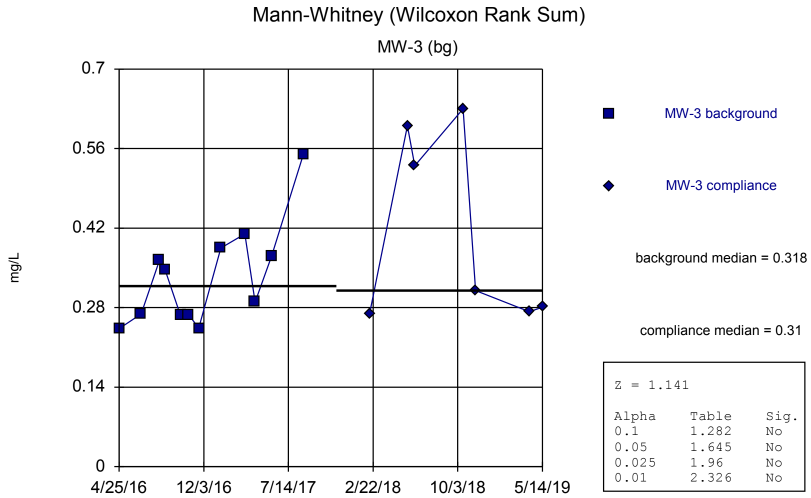
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = -0.8521

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Fluoride   Analysis Run 9/27/2019 10:57 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



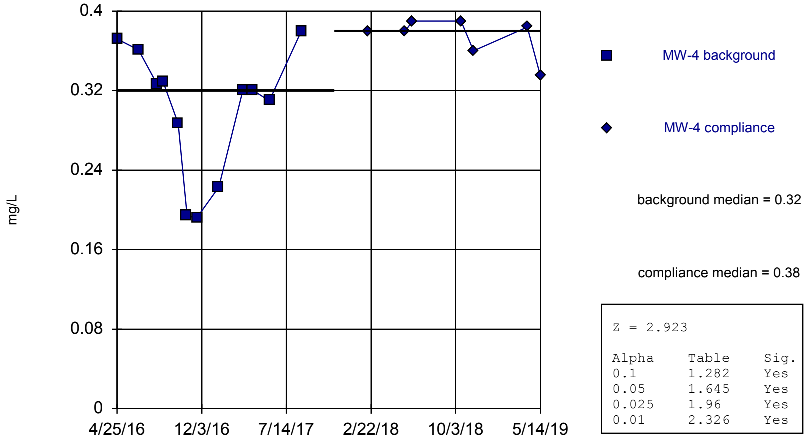
```
Z = 1.141

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Fluoride   Analysis Run 9/27/2019 10:57 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4 (bg)



```
Z = 2.923

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     Yes
```

Constituent: Fluoride   Analysis Run 9/27/2019 10:57 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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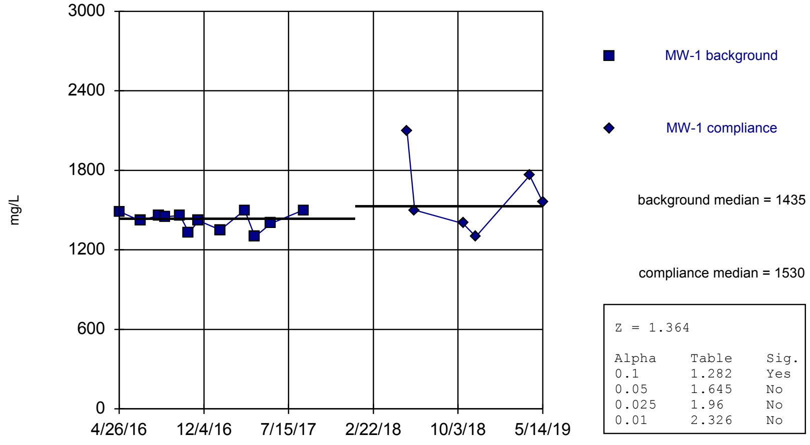
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1 (bg)



```
Z = 1.364

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Sulfate   Analysis Run 9/27/2019 10:57 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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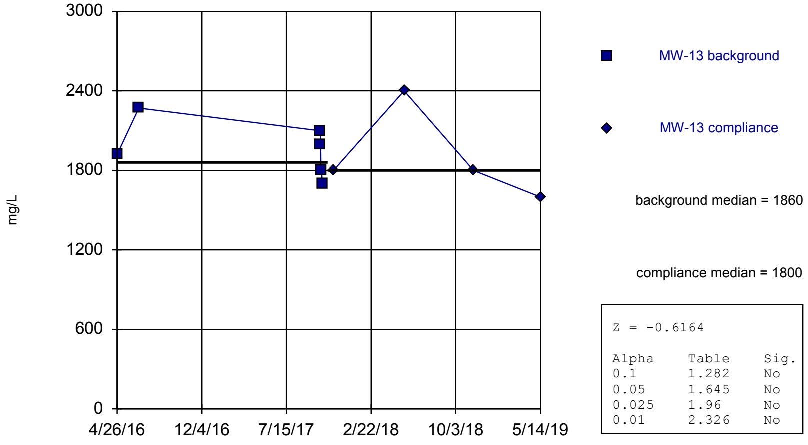
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-13 (bg)



```
Z = -0.6164

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Sulfate   Analysis Run 9/27/2019 10:58 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

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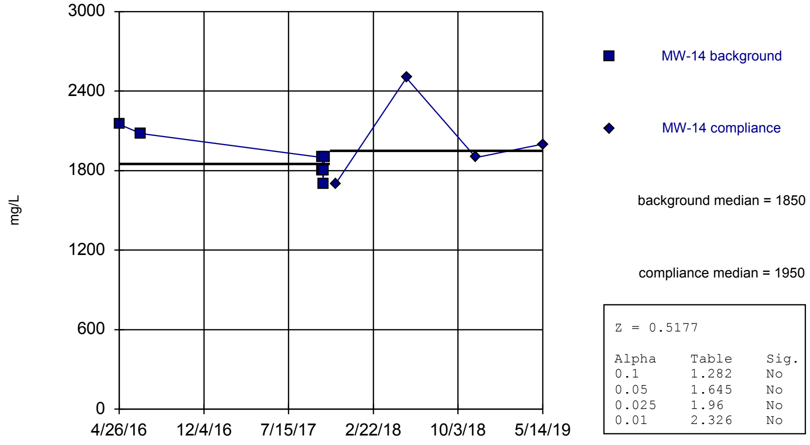
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-14 (bg)



```
Z = 0.5177

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

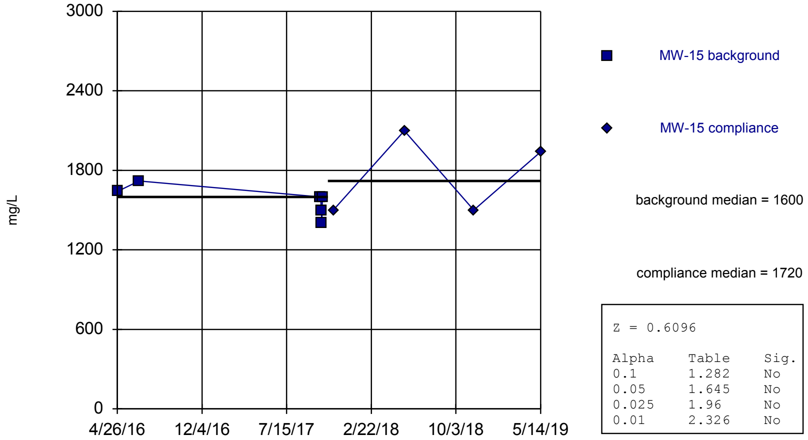
Constituent: Sulfate   Analysis Run 9/27/2019 10:58 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-15 (bg)



background median = 1600

compliance median = 1720

```
Z = 0.6096

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Sulfate Analysis Run 9/27/2019 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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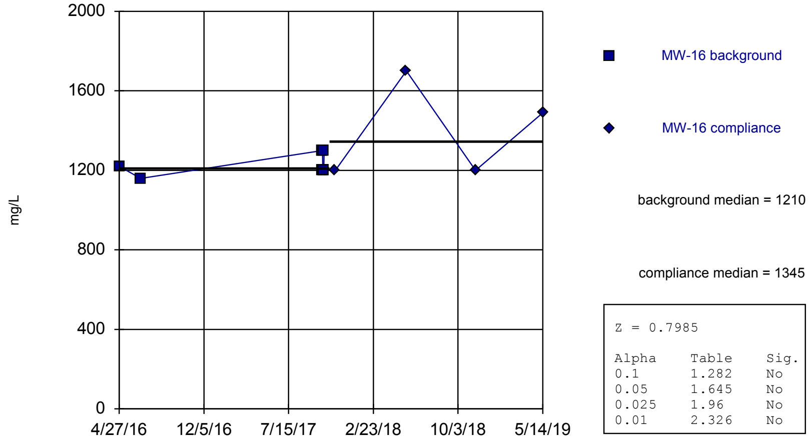
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-16



background median = 1210

compliance median = 1345

```
Z = 0.7985

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Sulfate Analysis Run 9/27/2019 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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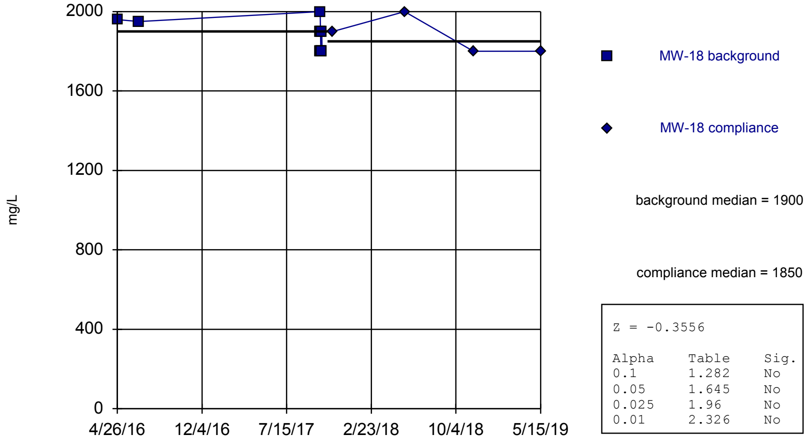
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-18



background median = 1900

compliance median = 1850

```
Z = -0.3556

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Sulfate Analysis Run 9/27/2019 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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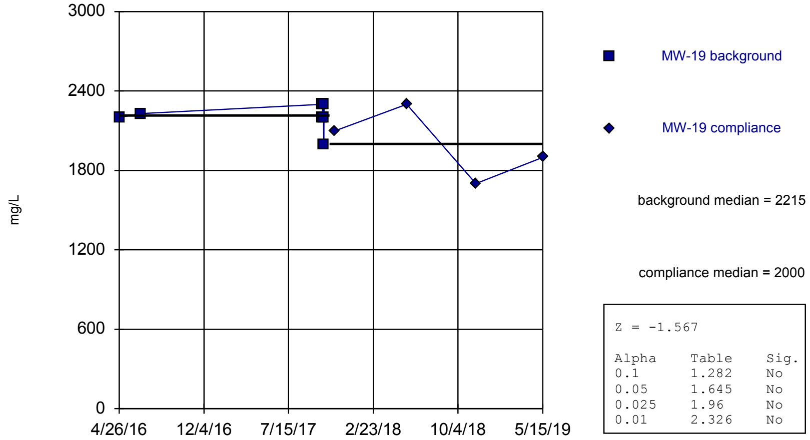
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-19



background median = 2215

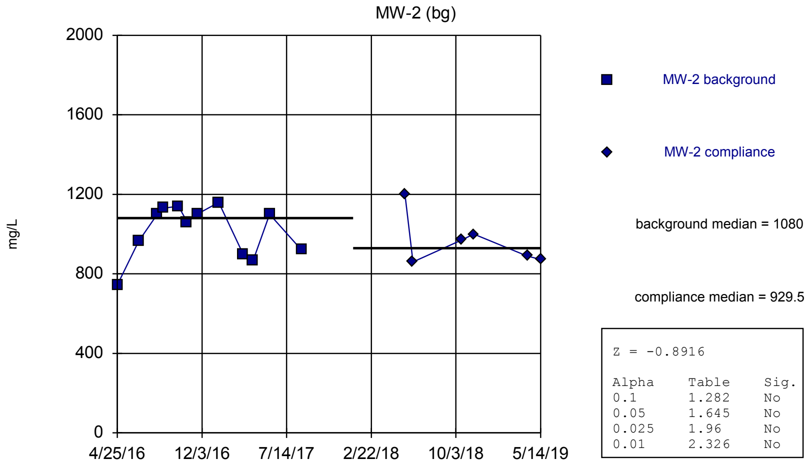
compliance median = 2000

```
Z = -1.567

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Sulfate Analysis Run 9/27/2019 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

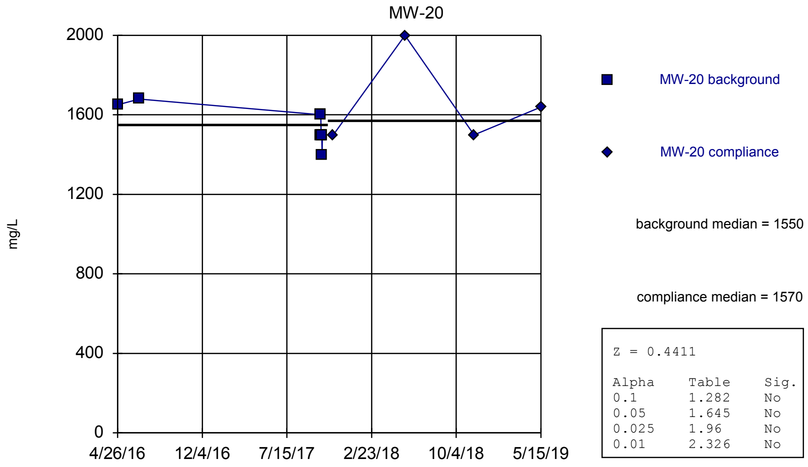


```
Z = -0.8916

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Sulfate   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

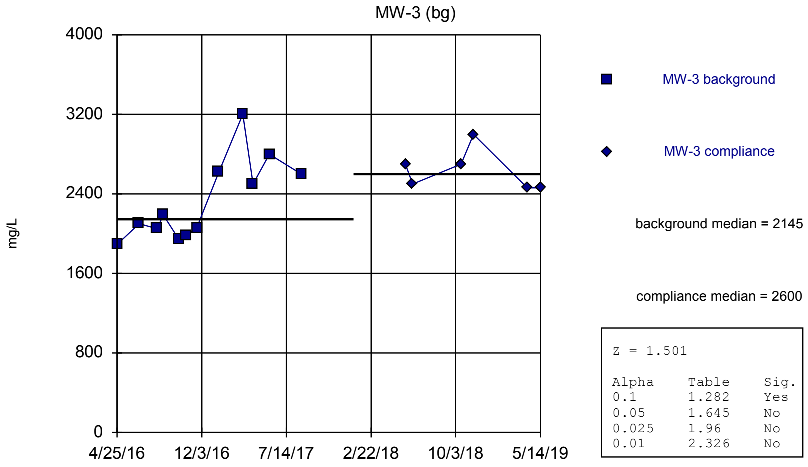


```
Z = 0.4411

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Sulfate   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

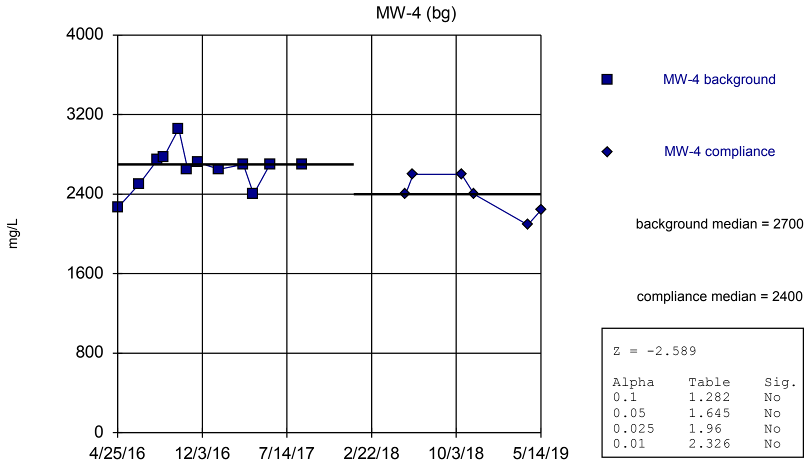


```
Z = 1.501

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Sulfate   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

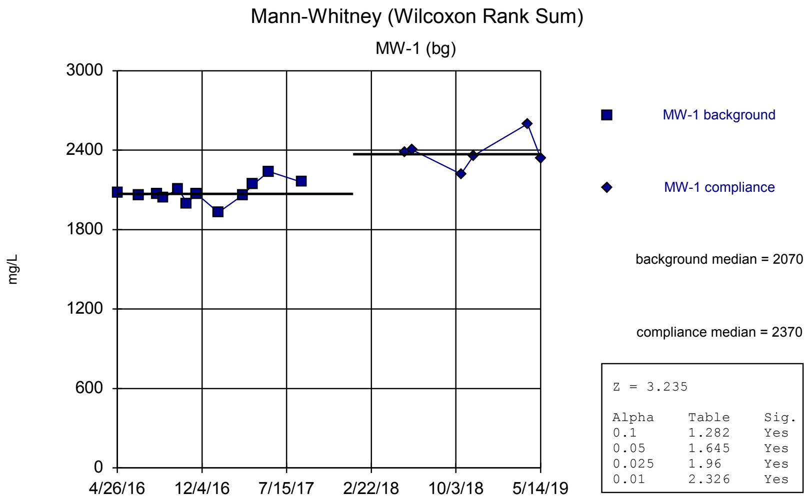
Mann-Whitney (Wilcoxon Rank Sum)



```
Z = -2.589

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Sulfate   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

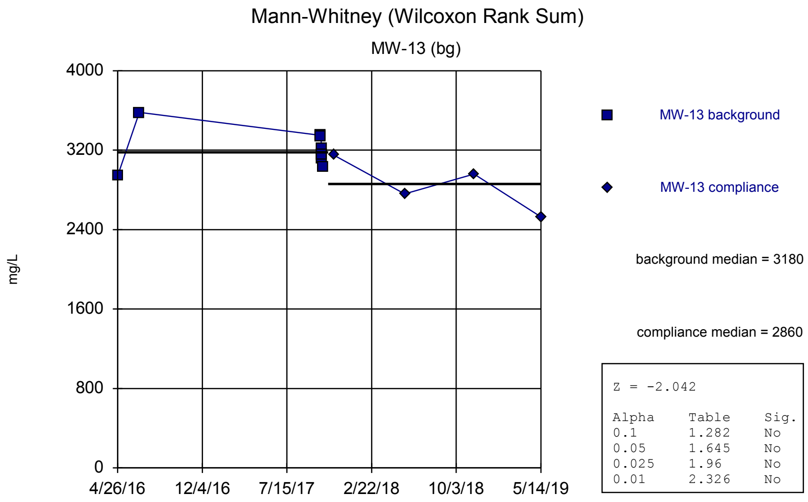
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = 3.235

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     Yes
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

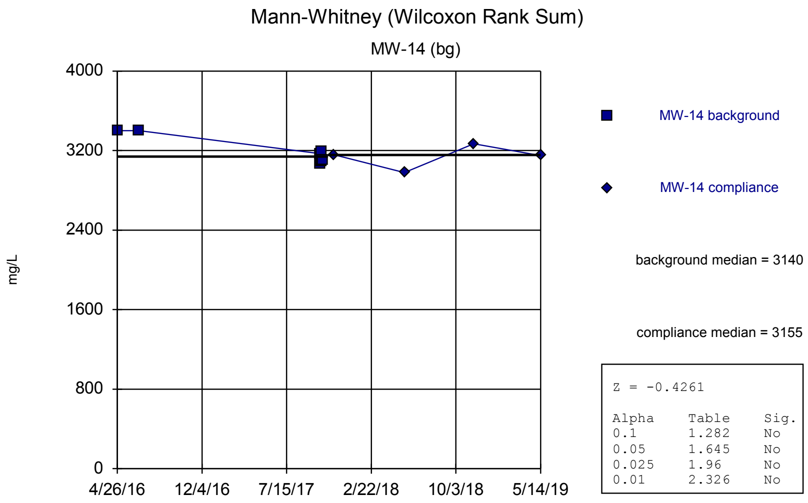
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = -2.042

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

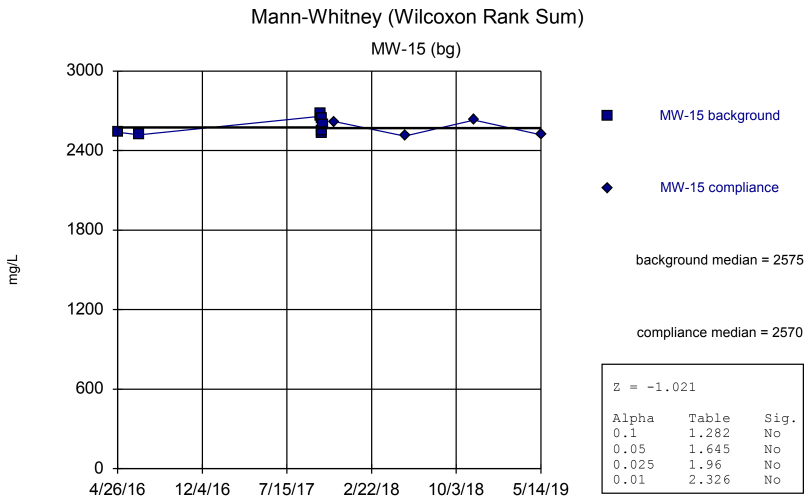
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = -0.4261

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

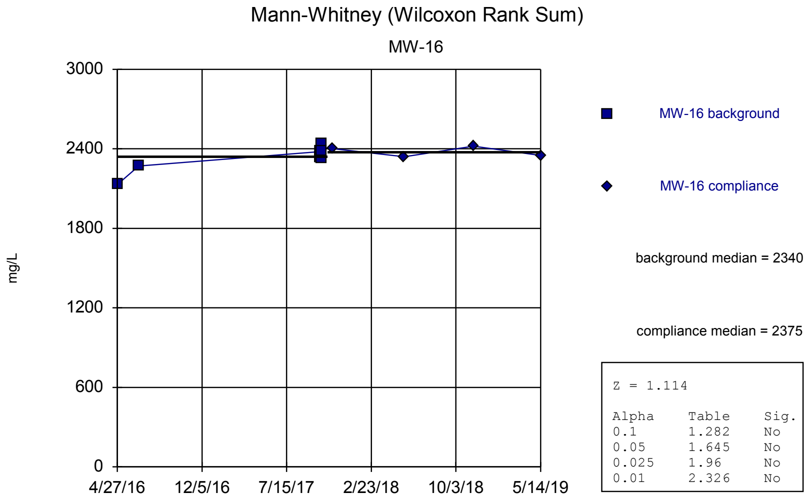
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = -1.021

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

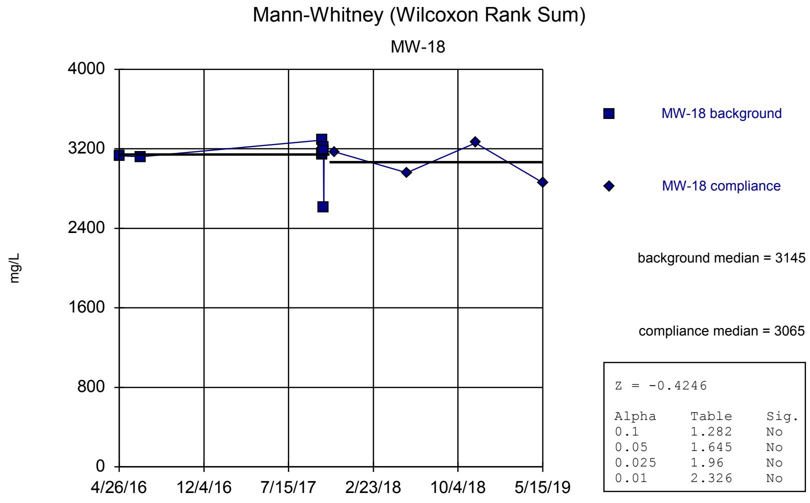
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = 1.114

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

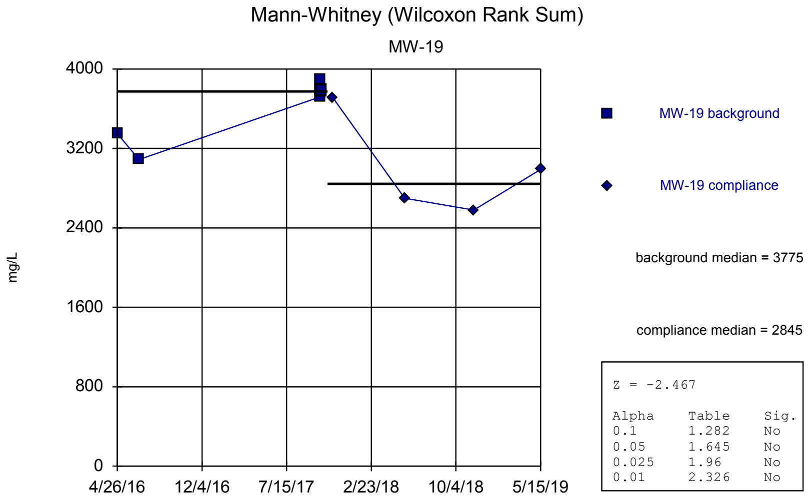
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = -0.4246

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

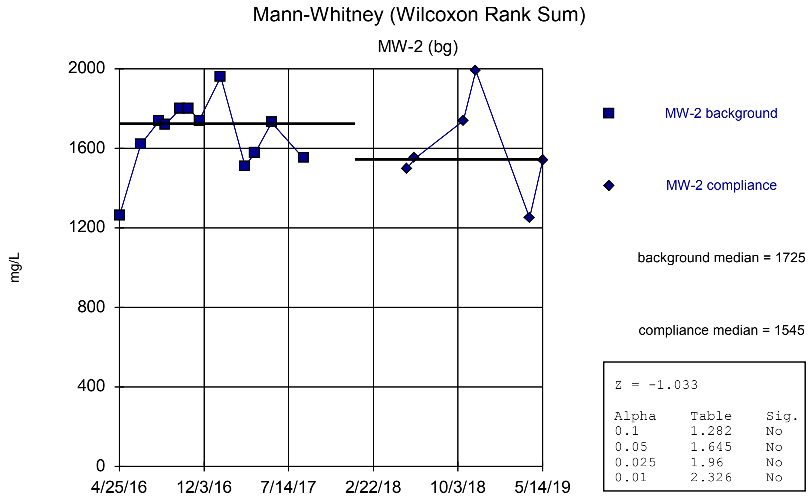
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



```
Z = -2.467

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



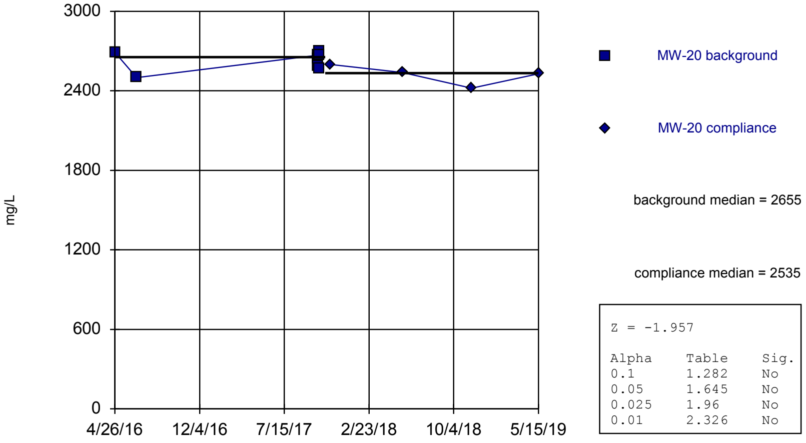
```
Z = -1.033

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-20



background median = 2655

compliance median = 2535

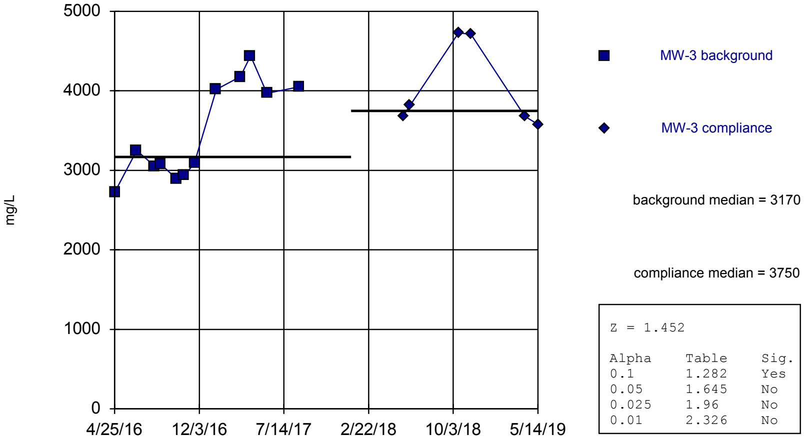
```
Z = -1.957

Alpha     Table    Sig.
0.1       1.282    No
0.05      1.645    No
0.025     1.96     No
0.01      2.326    No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-3 (bg)



background median = 3170

compliance median = 3750

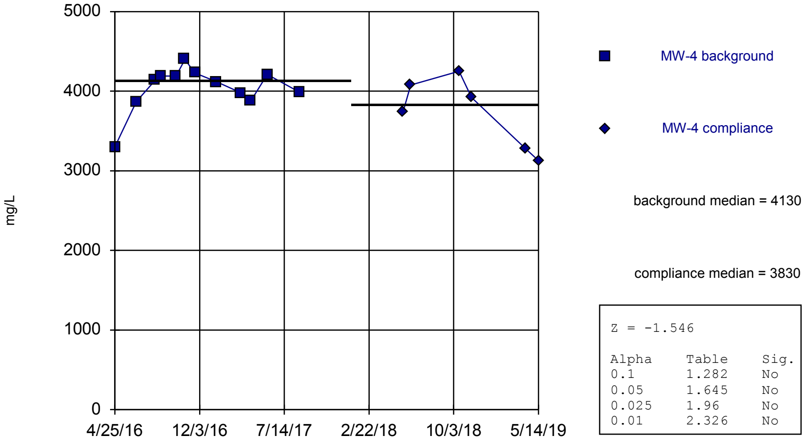
```
Z = 1.452

Alpha     Table    Sig.
0.1       1.282    Yes
0.05      1.645    No
0.025     1.96     No
0.01      2.326    No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4 (bg)



background median = 4130

compliance median = 3830

```
Z = -1.546

Alpha     Table    Sig.
0.1       1.282    No
0.05      1.645    No
0.025     1.96     No
0.01      2.326    No
```

Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 10:58 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

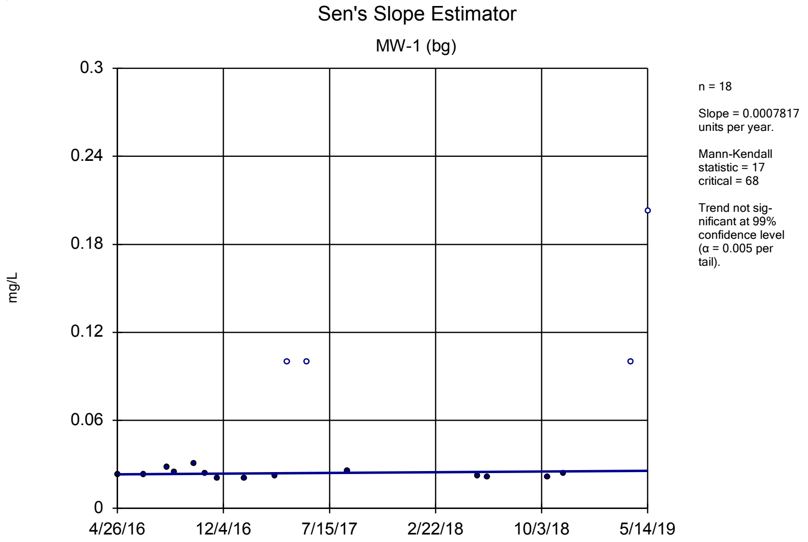
FIGURE E.

Trend Tests Summary Table - All Results

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill   Printed 9/27/2019, 11:08 AM

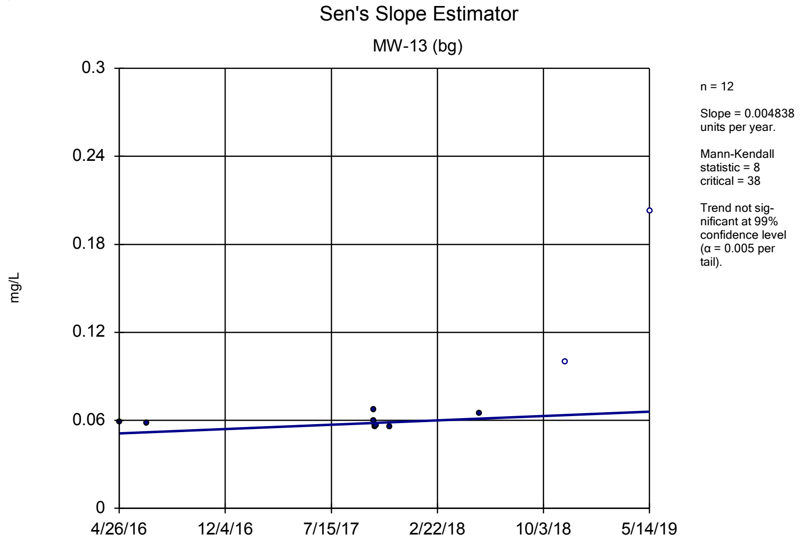
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron (mg/L)	MW-1 (bg)	0.0007817	17	68	No	18	22.22	n/a	n/a	0.01	NP
Boron (mg/L)	MW-13 (bg)	0.004838	8	38	No	12	16.67	n/a	n/a	0.01	NP
Boron (mg/L)	MW-14 (bg)	0.004751	13	38	No	12	16.67	n/a	n/a	0.01	NP
Boron (mg/L)	MW-15 (bg)	0.0166	32	38	No	12	16.67	n/a	n/a	0.01	NP
Boron (mg/L)	MW-2 (bg)	0.002461	27	68	No	18	11.11	n/a	n/a	0.01	NP
Boron (mg/L)	MW-3 (bg)	0.009173	48	68	No	18	22.22	n/a	n/a	0.01	NP
Boron (mg/L)	MW-4 (bg)	0.001738	29	68	No	18	11.11	n/a	n/a	0.01	NP
pH (SU)	MW-1 (bg)	-0.01853	-54	-68	No	18	0	n/a	n/a	0.01	NP
pH (SU)	MW-13 (bg)	0.023	28	43	No	13	0	n/a	n/a	0.01	NP
pH (SU)	MW-14 (bg)	-0.006665	-9	-43	No	13	0	n/a	n/a	0.01	NP
pH (SU)	MW-15 (bg)	0	2	43	No	13	0	n/a	n/a	0.01	NP
pH (SU)	MW-2 (bg)	0.05407	57	68	No	18	0	n/a	n/a	0.01	NP
pH (SU)	MW-3 (bg)	-0.229	-39	-74	No	19	0	n/a	n/a	0.01	NP
pH (SU)	MW-4 (bg)	0.009631	32	74	No	19	0	n/a	n/a	0.01	NP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



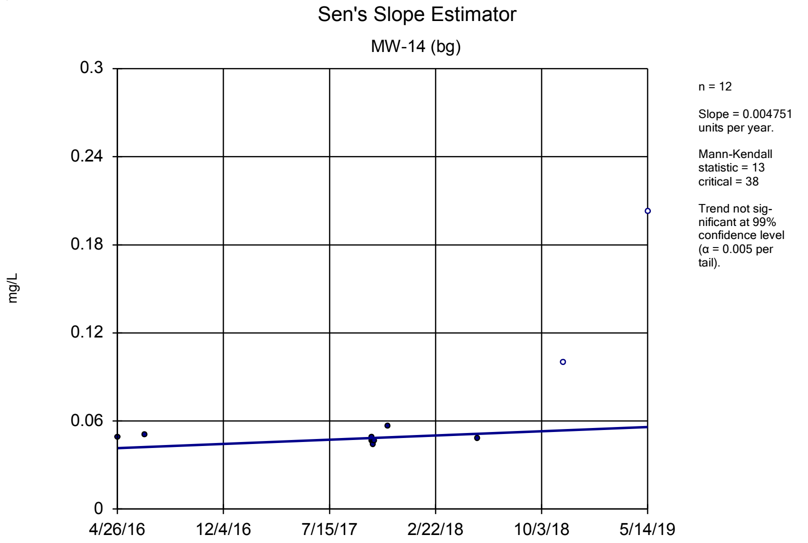
Constituent: Boron   Analysis Run 9/27/2019 11:07 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



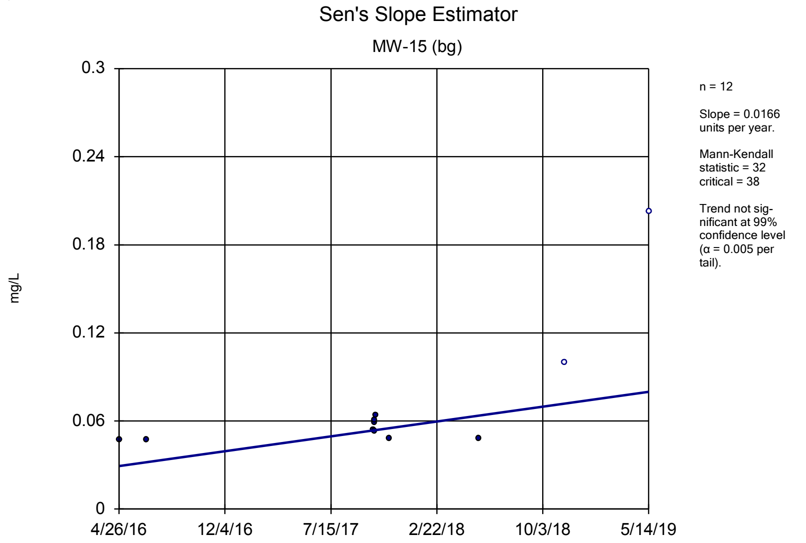
Constituent: Boron   Analysis Run 9/27/2019 11:07 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Boron   Analysis Run 9/27/2019 11:07 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

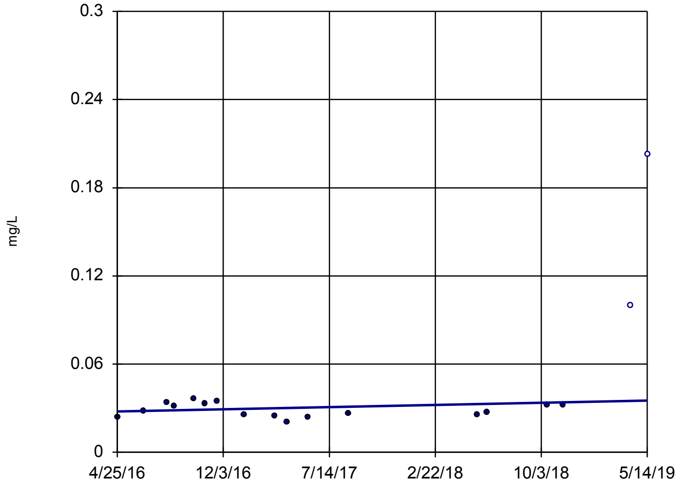


Constituent: Boron   Analysis Run 9/27/2019 11:07 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-2 (bg)



n = 18

Slope = 0.002461
units per year.

Mann-Kendall
statistic = 27
critical = 68

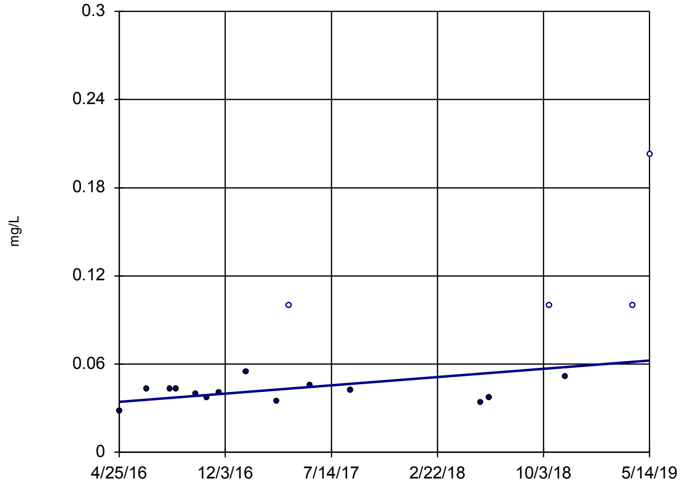
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 9/27/2019 11:07 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-3 (bg)



n = 18

Slope = 0.009173
units per year.

Mann-Kendall
statistic = 48
critical = 68

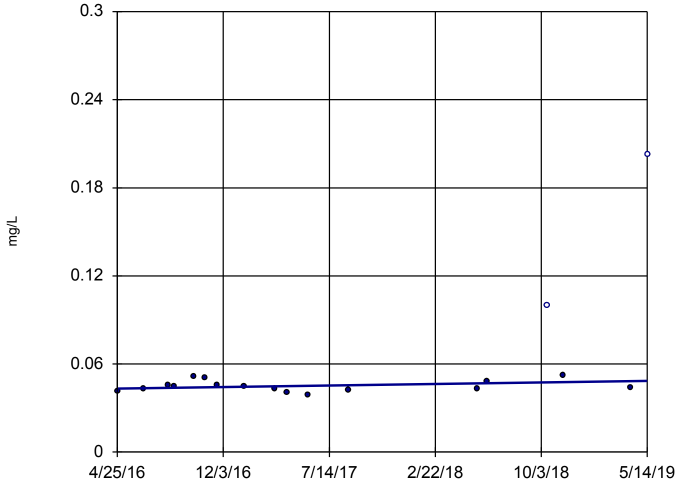
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 9/27/2019 11:07 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-4 (bg)



n = 18

Slope = 0.001738
units per year.

Mann-Kendall
statistic = 29
critical = 68

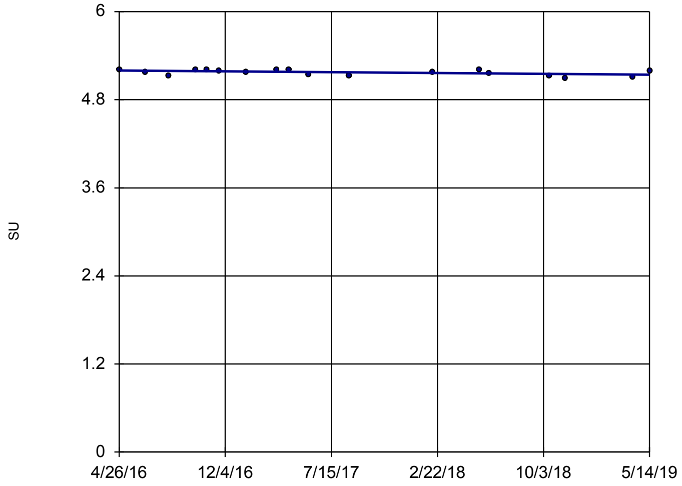
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 9/27/2019 11:07 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-1 (bg)



n = 18

Slope = -0.01853
units per year.

Mann-Kendall
statistic = -54
critical = -68

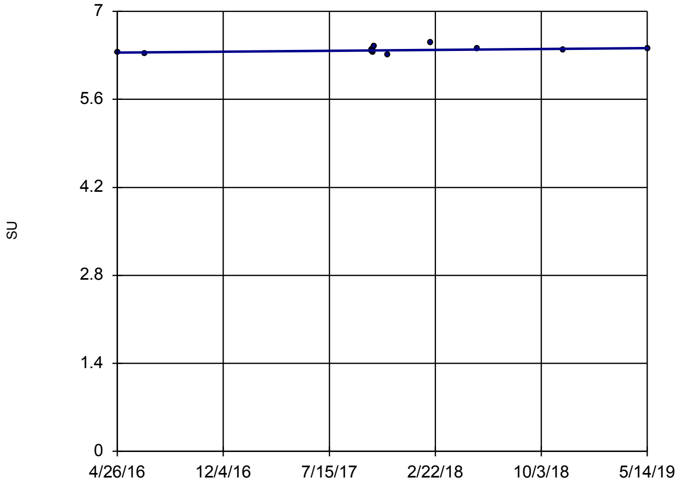
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 9/27/2019 11:07 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-13 (bg)



n = 13

Slope = 0.023
units per year.

Mann-Kendall
statistic = 28
critical = 43

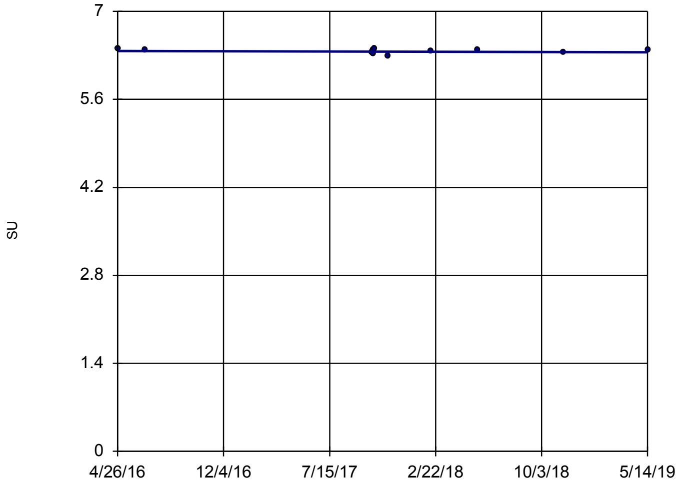
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: pH Analysis Run 9/27/2019 11:07 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-14 (bg)



n = 13

Slope = -0.006665
units per year.

Mann-Kendall
statistic = -9
critical = -43

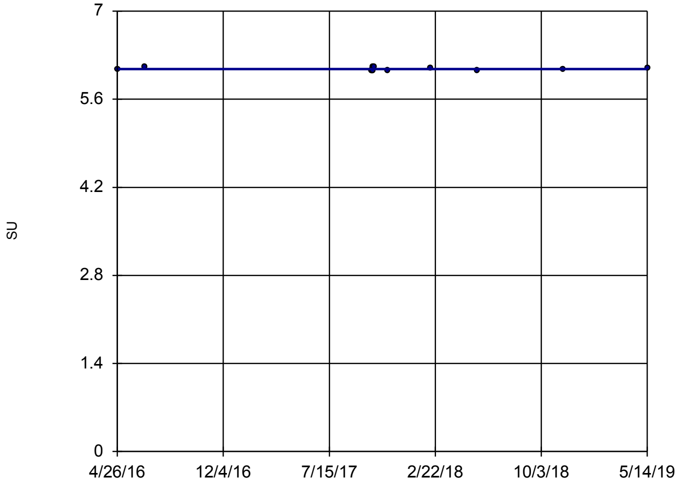
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: pH Analysis Run 9/27/2019 11:07 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-15 (bg)



n = 13

Slope = 0
units per year.

Mann-Kendall
statistic = 2
critical = 43

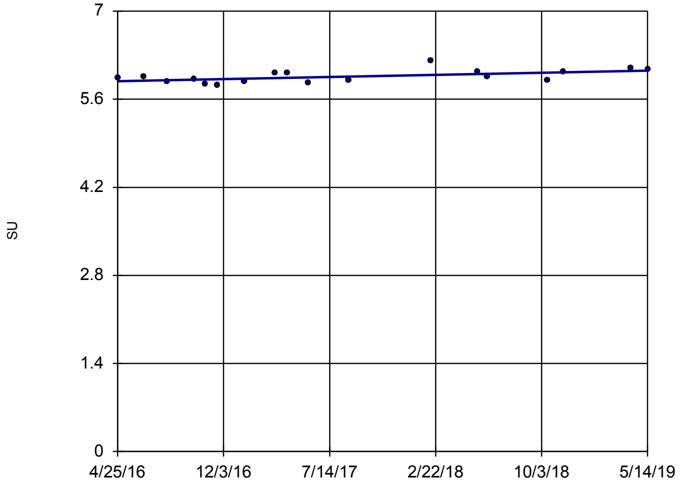
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: pH Analysis Run 9/27/2019 11:07 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW-2 (bg)



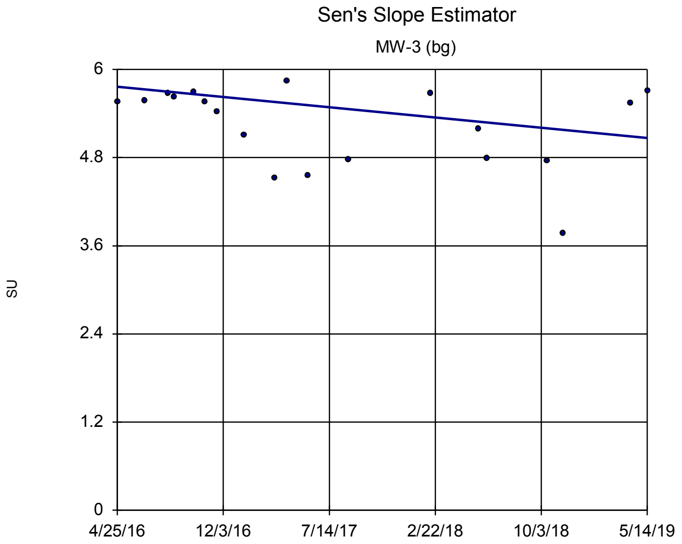
n = 18

Slope = 0.05407
units per year.

Mann-Kendall
statistic = 57
critical = 68

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: pH Analysis Run 9/27/2019 11:08 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill



n = 19

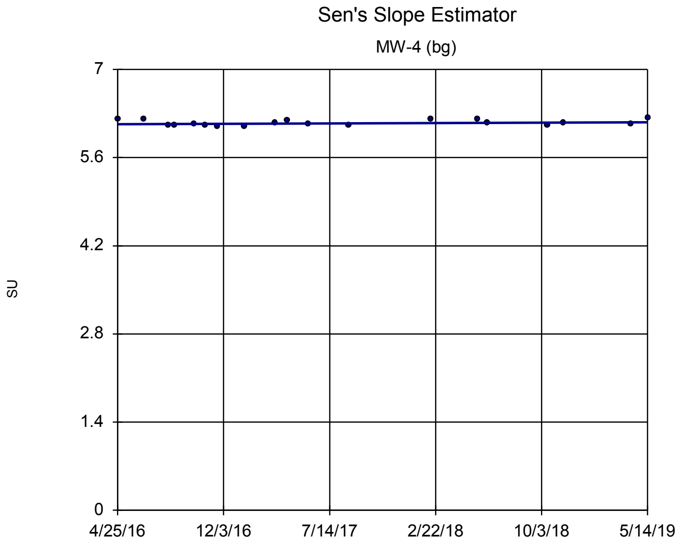
Slope = -0.229
units per year.

Mann-Kendall
statistic = -39
critical = -74

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 9/27/2019 11:08 AM View: Interwell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill



n = 19

Slope = 0.009631
units per year.

Mann-Kendall
statistic = 32
critical = 74

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 9/27/2019 11:08 AM View: Interwell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

FIGURE F.

Interwell Prediction Limit Summary Table - All Results

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill Printed 9/27/2019, 10:54 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	n/a	0.203	n/a	n/a	4 future	n/a	108	n/a	n/a	16.67	n/a	n/a	0.0001702	NP Inter (normality) 1 of 2
pH (SU)	n/a	6.5	3.77	n/a	4 future	n/a	113	n/a	n/a	0	n/a	n/a	0.0003112	NP Inter (normality) 1 of 2

FIGURE G.

Intrawell Prediction Limit Summary Table - All Results

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill   Printed 9/27/2019, 11:06 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium (mg/L)	MW-1	270	n/a	n/a	1 future	n/a	18	n/a	n/a	0	n/a	n/a	0.005373	NP Intra (normality) 1 of 2
Calcium (mg/L)	MW-13	347.6	n/a	n/a	1 future	n/a	12	306.8	18.25	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-14	362.5	n/a	n/a	1 future	n/a	12	327.6	15.66	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-15	298.3	n/a	n/a	1 future	n/a	12	268.8	13.21	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-16	340.5	n/a	n/a	1 future	n/a	12	304.3	16.22	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-18	371.4	n/a	n/a	1 future	n/a	12	337.7	15.11	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-19	418.7	n/a	n/a	1 future	n/a	12	366.3	23.49	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-2	218.7	n/a	n/a	1 future	n/a	18	174	21.99	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-20	404.6	n/a	n/a	1 future	n/a	12	359.1	20.39	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-3	416.4	n/a	n/a	1 future	n/a	18	301.6	56.48	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-4	388.7	n/a	n/a	1 future	n/a	18	311.2	38.16	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-1	3.375	n/a	n/a	1 future	n/a	18	2.312	0.5231	5.556	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-13	3.012	n/a	n/a	1 future	n/a	12	1.948	0.477	8.333	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-14	2.661	n/a	n/a	1 future	n/a	12	1.723	0.4201	8.333	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-15	2.148	n/a	n/a	1 future	n/a	12	1.336	0.3638	8.333	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-16	4.929	n/a	n/a	1 future	n/a	12	3.788	0.5109	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-18	3.371	n/a	n/a	1 future	n/a	12	1.733	0.7337	8.333	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-19	3.531	n/a	n/a	1 future	n/a	12	2.264	0.5677	8.333	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-2	4.812	n/a	n/a	1 future	n/a	18	3.293	0.7475	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-20	7.306	n/a	n/a	1 future	n/a	8	4.393	1.114	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-3	2.362	n/a	n/a	1 future	n/a	18	1.567	0.3909	11.11	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-4	2.587	n/a	n/a	1 future	n/a	18	1.816	0.3798	11.11	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-1	0.1975	n/a	n/a	1 future	n/a	19	0.1262	0.03546	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-13	0.2389	n/a	n/a	1 future	n/a	13	0.2101	0.01313	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-14	0.2784	n/a	n/a	1 future	n/a	13	0.2539	0.01115	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-15	0.3813	n/a	n/a	1 future	n/a	13	0.3551	0.01195	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-16	0.1873	n/a	n/a	1 future	n/a	13	0.0009022	0.0001503	0	None	x^4	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-18	0.3402	n/a	n/a	1 future	n/a	13	0.3086	0.01439	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-19	0.35	n/a	n/a	1 future	n/a	13	n/a	n/a	0	n/a	n/a	0.009692	NP Intra (normality) 1 of 2
Fluoride (mg/L)	MW-2	0.2565	n/a	n/a	1 future	n/a	19	0.1401	0.05792	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-20	0.141	n/a	n/a	1 future	n/a	13	0.1265	0.006591	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-3	0.6475	n/a	n/a	1 future	n/a	19	-1.063	0.3126	0	None	ln(x)	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-4	0.4323	n/a	n/a	1 future	n/a	19	0.1114	0.03754	0	None	x^2	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-1	2100	n/a	n/a	1 future	n/a	18	n/a	n/a	0	n/a	n/a	0.005373	NP Intra (normality) 1 of 2
Sulfate (mg/L)	MW-13	2443	n/a	n/a	1 future	n/a	12	1916	236.3	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-14	2439	n/a	n/a	1 future	n/a	12	1936	225.5	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-15	2084	n/a	n/a	1 future	n/a	12	1633	201.9	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-16	1700	n/a	n/a	1 future	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Sulfate (mg/L)	MW-18	2066	n/a	n/a	1 future	n/a	12	1884	81.52	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-19	2566	n/a	n/a	1 future	n/a	12	2144	189.1	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-2	1262	n/a	n/a	1 future	n/a	18	998.9	129.3	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-20	1932	n/a	n/a	1 future	n/a	12	1589	153.5	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-3	3202	n/a	n/a	1 future	n/a	18	2431	379.6	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-4	3041	n/a	n/a	1 future	n/a	18	2566	233.5	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-1	2534	n/a	n/a	1 future	n/a	18	2181	173.6	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-13	3717	n/a	n/a	1 future	n/a	12	3093	279.3	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-14	3457	n/a	n/a	1 future	n/a	12	3175	126.5	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-15	2720	n/a	n/a	1 future	n/a	12	2583	61.4	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-16	2524	n/a	n/a	1 future	n/a	12	2343	81.05	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-18	3519	n/a	n/a	1 future	n/a	12	3090	192.3	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-19	4487	n/a	n/a	1 future	n/a	12	3432	472.6	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-2	2051	n/a	n/a	1 future	n/a	18	1643	200.5	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-20	2785	n/a	n/a	1 future	n/a	12	2593	85.74	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-3	4938	n/a	n/a	1 future	n/a	18	3661	628.6	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-4	4601	n/a	n/a	1 future	n/a	18	1.6e7	2719774	0	None	x^2	0.00188	Param Intra 1 of 2

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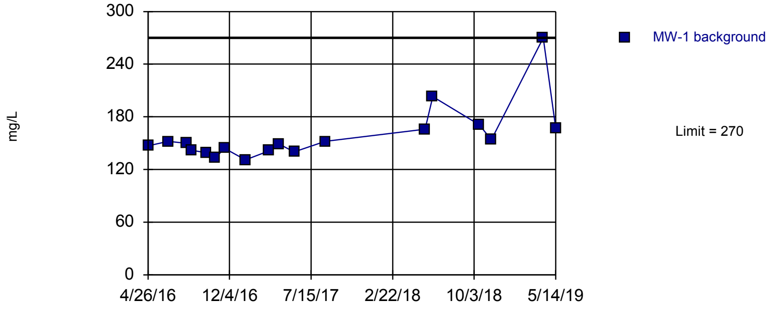
Prediction Limit

Intrawell Non-parametric, MW-1 (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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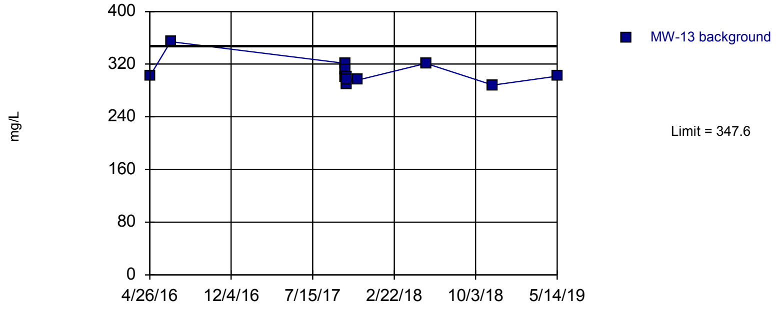
Prediction Limit

Intrawell Parametric, MW-13 (bg)



Background Data Summary: Mean=306.8, Std. Dev.=18.25, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.828, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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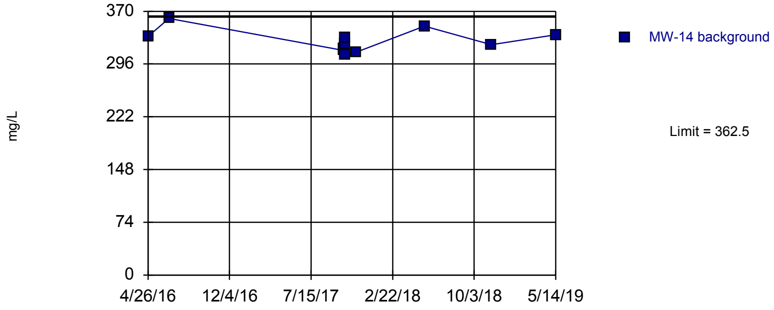
Prediction Limit

Intrawell Parametric, MW-14 (bg)



Background Data Summary: Mean=327.6, Std. Dev.=15.66, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9182, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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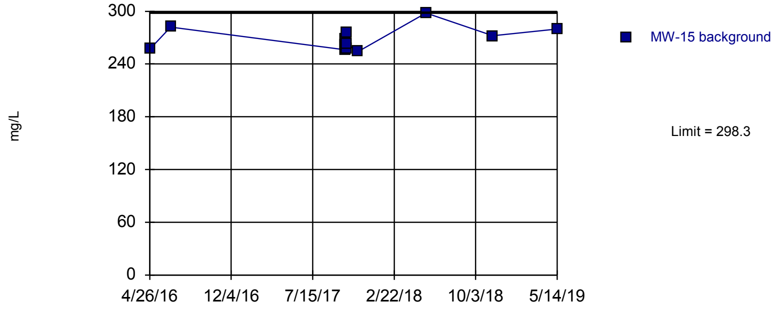
Prediction Limit

Intrawell Parametric, MW-15 (bg)



Background Data Summary: Mean=268.8, Std. Dev.=13.21, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.916, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Calcium Analysis Run 9/27/2019 11:06 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

	MW-1	MW-13	MW-14	MW-15
4/26/2016	147	302	335	257
6/20/2016	152			
6/22/2016		354	360	282
8/8/2016	150			
8/24/2016	142			
10/3/2016	139			
10/26/2016	133			
11/21/2016	144			
1/17/2017	131			
3/22/2017	141			
4/18/2017	149			
5/30/2017	140			
8/23/2017	152			
10/12/2017		321	315	256
10/13/2017		312	317	269
10/14/2017		300	315	262
10/15/2017		300	325	275
10/16/2017		290	333	258
10/17/2017		296	309	263
11/15/2017				254
11/16/2017		296	313	
5/21/2018		321	349	298
5/22/2018	166			
6/12/2018	203			
10/17/2018	171			
11/19/2018	154	288	323	272
4/10/2019	270			
5/14/2019	167	302	337	280

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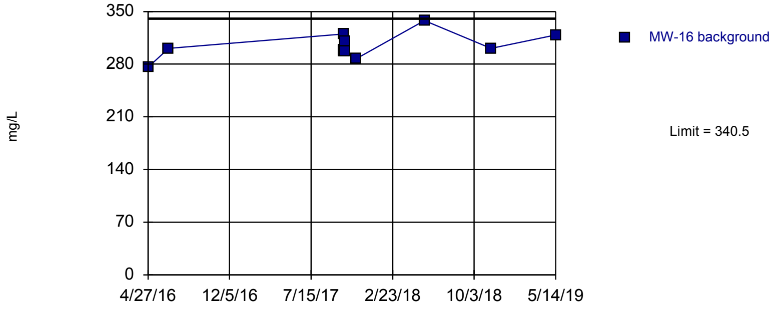
Prediction Limit

Intrawell Parametric, MW-16



Background Data Summary: Mean=304.3, Std. Dev.=16.22, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.966, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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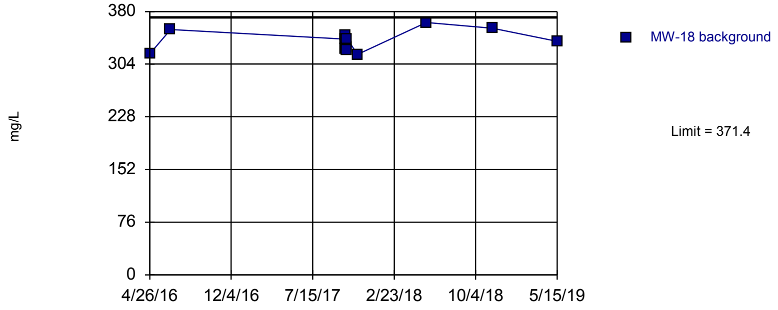
Prediction Limit

Intrawell Parametric, MW-18



Background Data Summary: Mean=337.7, Std. Dev.=15.11, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9435, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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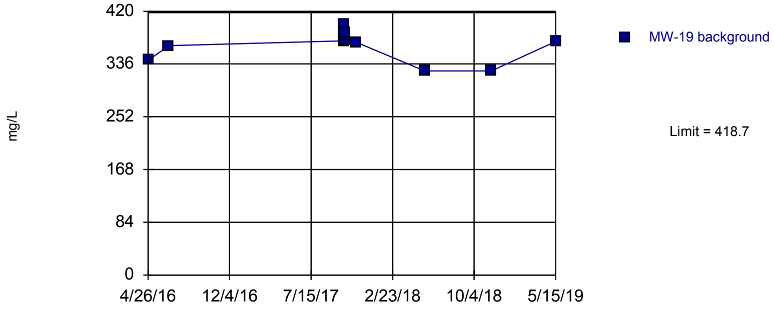
Prediction Limit

Intrawell Parametric, MW-19



Background Data Summary: Mean=366.3, Std. Dev.=23.49, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8755, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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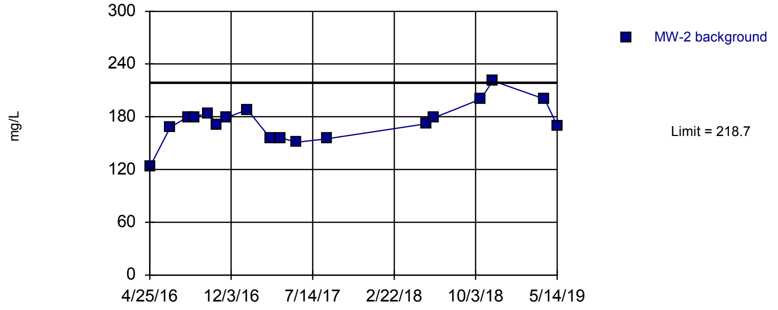
Prediction Limit

Intrawell Parametric, MW-2 (bg)



Background Data Summary: Mean=174, Std. Dev.=21.99, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9686, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Calcium   Analysis Run 9/27/2019 11:06 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-16	MW-18	MW-19	MW-2
4/25/2016				123
4/26/2016		319	342	
4/27/2016	276			
6/20/2016				168
6/22/2016	301	354	365	
8/8/2016				180
8/24/2016				180
10/3/2016				184
10/26/2016				171
11/21/2016				179
1/17/2017				188
3/22/2017				155
4/18/2017				156
5/31/2017				151
8/23/2017				155
10/12/2017	320	340	373	
10/13/2017	297	326	381	
10/14/2017	299	345	399	
10/15/2017	307	327	375	
10/16/2017	310	325	381	
10/17/2017	297	341	386	
11/15/2017	287	318	371	
5/21/2018	338			
5/22/2018		364	325	172
6/12/2018				179
10/17/2018				200
11/19/2018	301	356		221
11/20/2018			325	
4/10/2019				200
5/14/2019	319			170
5/15/2019		337	372	

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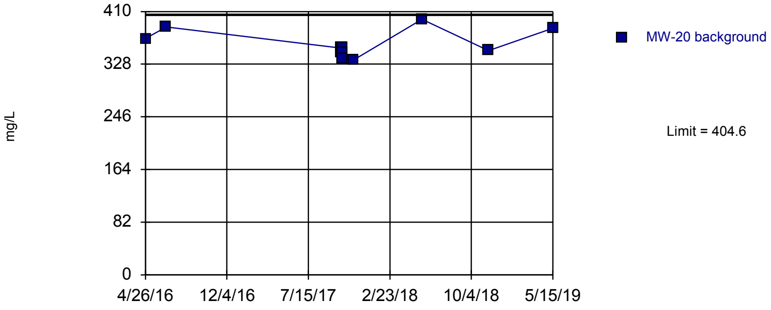
Prediction Limit

Intrawell Parametric, MW-20



Background Data Summary: Mean=359.1, Std. Dev.=20.39, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8965, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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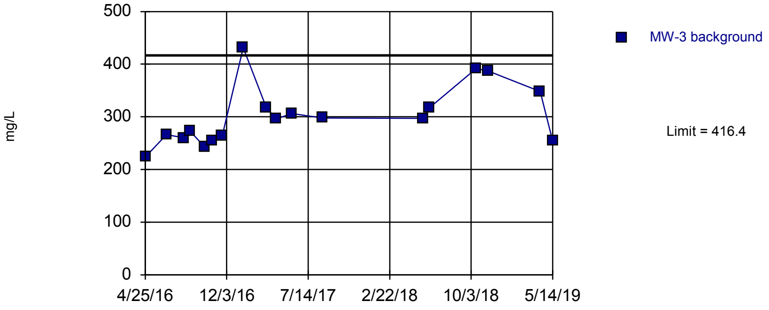
Prediction Limit

Intrawell Parametric, MW-3 (bg)



Background Data Summary: Mean=301.6, Std. Dev.=56.48, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9168, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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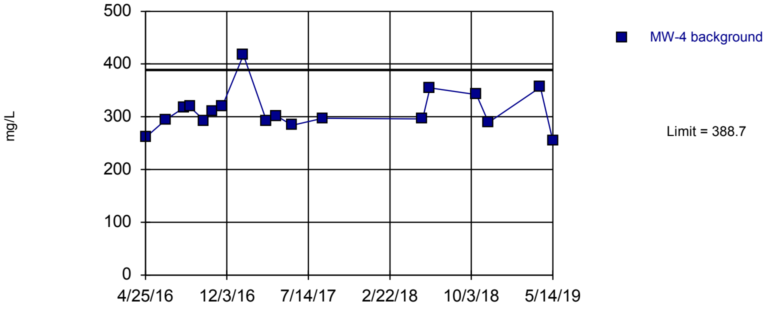
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary: Mean=311.2, Std. Dev.=38.16, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9055, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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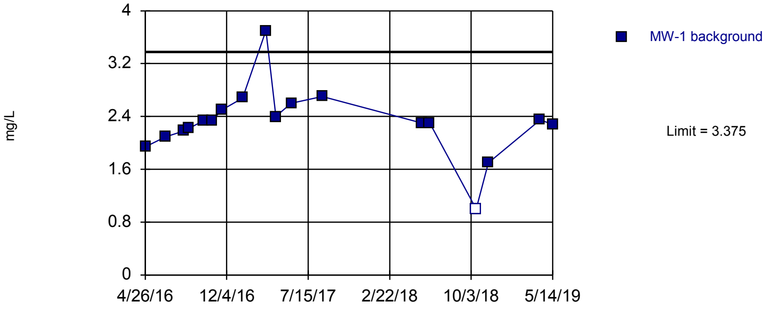
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-1 (bg)



Background Data Summary: Mean=2.312, Std. Dev.=0.5231, n=18, 5.556% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.875, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Calcium, Chloride Analysis Run 9/27/2019 11:06 AM View: Intrawell

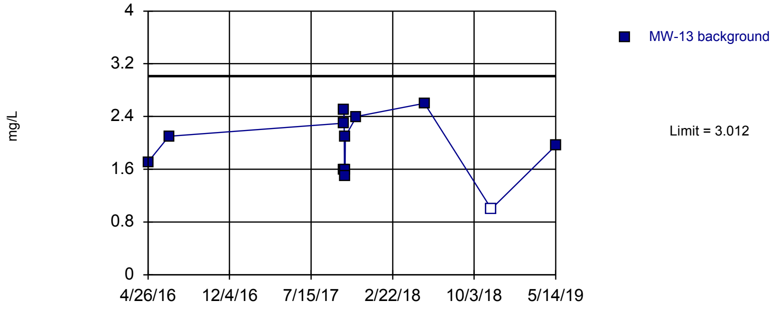
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

	MW-20	MW-3	MW-4	MW-1
4/25/2016		224	261	
4/26/2016	368			1.94
6/20/2016			295	2.09
6/22/2016	386	266		
8/8/2016				2.18
8/9/2016		260	318	
8/24/2016		274	319	2.22
10/3/2016			293	2.34
10/4/2016		243		
10/26/2016		254	311	2.34
11/21/2016		263	320	2.5
1/17/2017				2.68
1/18/2017		431	417	
3/22/2017		318	292	3.7
4/18/2017		296	302	2.4
5/30/2017				2.6
5/31/2017		306	284	
8/23/2017		298	297	2.7
10/12/2017	353			
10/13/2017	354			
10/14/2017	346			
10/15/2017	353			
10/16/2017	347			
10/17/2017	337			
11/15/2017	334			
5/22/2018	398			2.3
5/23/2018			296	
5/24/2018		297		
6/12/2018		318	355	2.3
10/17/2018		392	342	<2 (J)
11/19/2018		387	289	1.7 (J)
11/20/2018	349			
4/10/2019		348	356	2.35
5/14/2019		254	254	2.28
5/15/2019	384			

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-13 (bg)



Background Data Summary: Mean=1.948, Std. Dev.=0.477, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.805, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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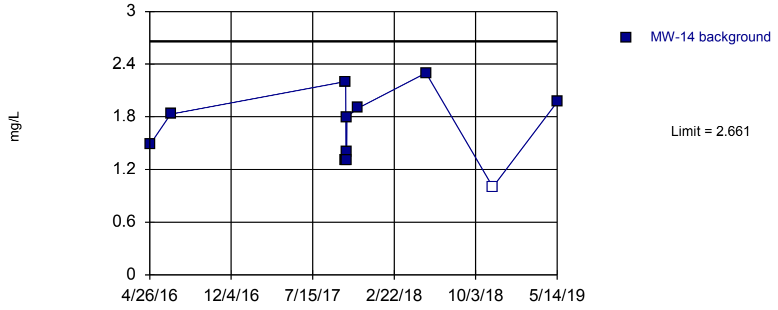
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-14 (bg)



Background Data Summary: Mean=1.723, Std. Dev.=0.4201, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9418, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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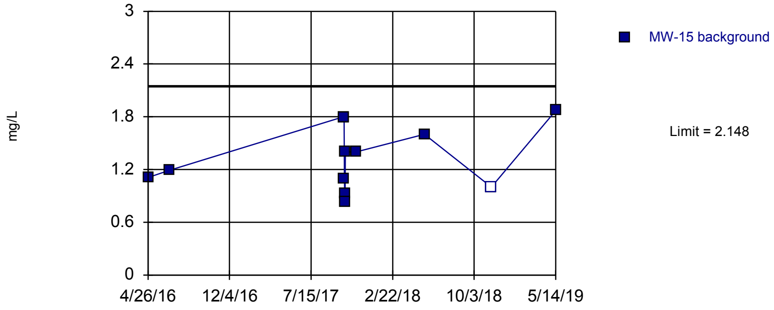
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-15 (bg)



Background Data Summary: Mean=1.336, Std. Dev.=0.3638, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9226, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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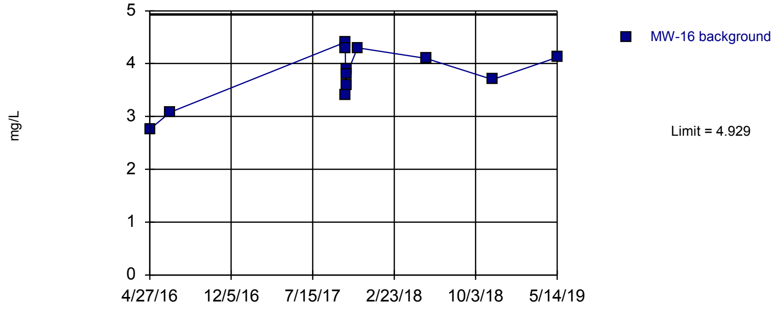
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-16



Background Data Summary: Mean=3.788, Std. Dev.=0.5109, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9337, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

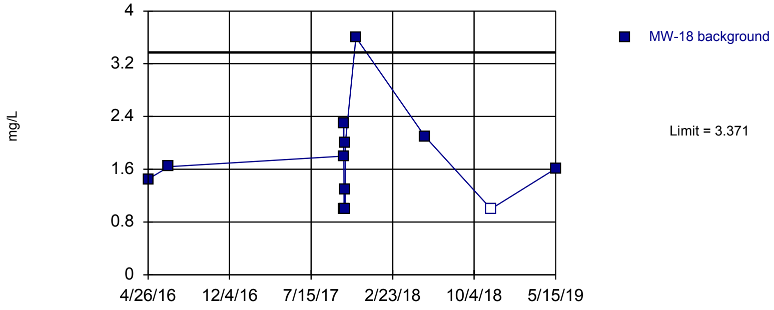
Constituent: Chloride   Analysis Run 9/27/2019 11:06 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-13	MW-14	MW-15	MW-16
4/26/2016	1.71	1.48	1.11	
4/27/2016				2.76
6/22/2016	2.1	1.83	1.19	3.08
10/12/2017	2.3	2.2	1.8 (J)	4.4
10/13/2017	2.5	2.2	1.8 (J)	4.3 (B)
10/14/2017	1.6 (J)	1.3 (J)	1.1 (J)	3.4
10/15/2017	1.6 (J)	1.4 (J)	0.93 (J)	3.6
10/16/2017	1.5 (J)	1.3 (J)	0.83 (J)	3.9
10/17/2017	2.1	1.8 (J)	1.4 (J)	3.8
11/15/2017			1.4 (J)	4.3
11/16/2017	2.4	1.9 (J)		
5/21/2018	2.6	2.3	1.6 (J)	4.1
11/19/2018	<2 (J)	<2	<2	3.7
5/14/2019	1.96	1.97	1.87	4.12

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-18



Background Data Summary: Mean=1.733, Std. Dev.=0.7337, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8612, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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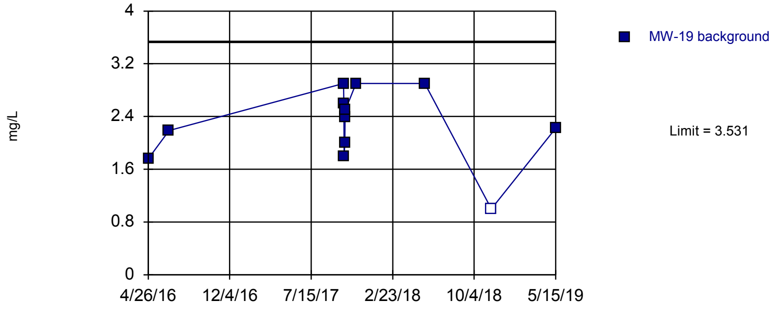
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-19



Background Data Summary: Mean=2.264, Std. Dev.=0.5677, n=12, 8.333% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9208, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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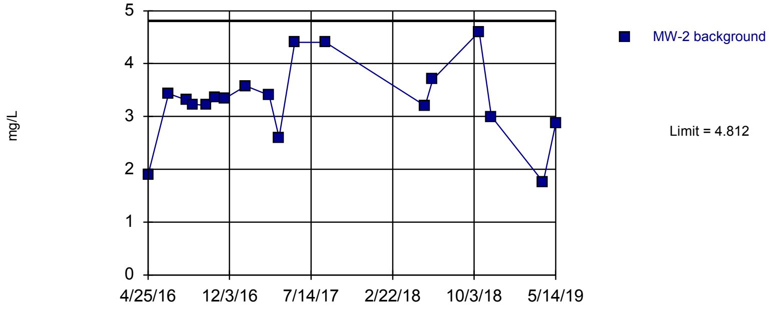
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-2 (bg)



Background Data Summary: Mean=3.293, Std. Dev.=0.7475, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9291, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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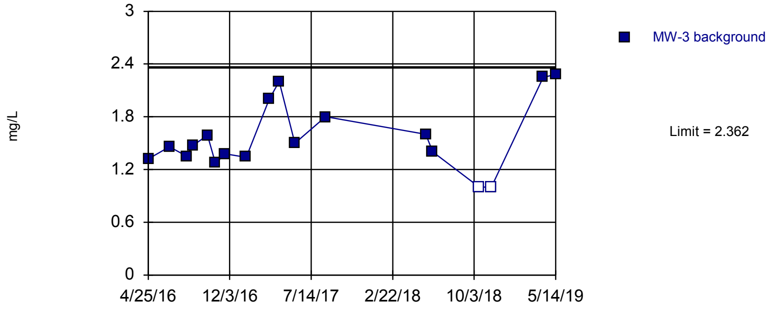
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-3 (bg)



Background Data Summary: Mean=1.567, Std. Dev.=0.3909, n=18, 11.11% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9045, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Chloride Analysis Run 9/27/2019 11:06 AM View: Intrawell

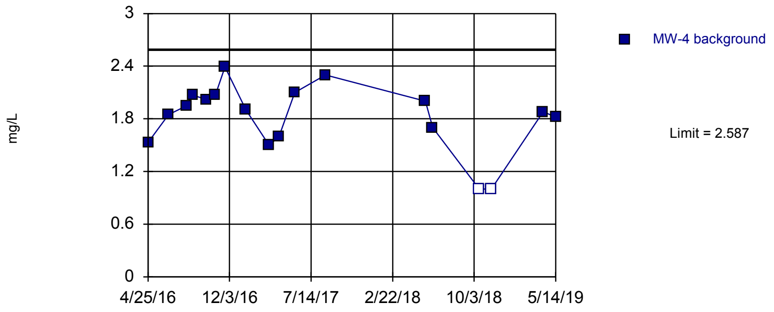
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

	MW-18	MW-19	MW-2	MW-3
4/25/2016			1.9	1.32
4/26/2016	1.45	1.76		
6/20/2016			3.43	
6/22/2016	1.64	2.19		1.46
8/8/2016			3.31	
8/9/2016				1.35
8/24/2016			3.23	1.47
10/3/2016			3.21	
10/4/2016				1.59
10/26/2016			3.35	1.27
11/21/2016			3.34	1.38
1/17/2017			3.58	
1/18/2017				1.34
3/22/2017			3.4	2
4/18/2017			2.6	2.2
5/31/2017			4.4	1.5 (J)
8/23/2017			4.4	1.8 (J)
10/12/2017	1.8 (J)	2.9		
10/13/2017	2.3 (B)	2.6 (B)		
10/14/2017	1 (J)	1.8 (J)		
10/15/2017	1.3 (J)	2		
10/16/2017	1 (J)	2.4		
10/17/2017	2	2.5		
11/15/2017	3.6	2.9		
5/22/2018	2.1	2.9	3.2	
5/24/2018				1.6 (J)
6/12/2018			3.7	1.4 (J)
10/17/2018			4.6	<2
11/19/2018	<2		3	<2
11/20/2018		<2 (J)		
4/10/2019			1.76	2.25
5/14/2019			2.87	2.28
5/15/2019	1.61	2.22		

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary: Mean=1.816, Std. Dev.=0.3798, n=18, 11.11% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9148, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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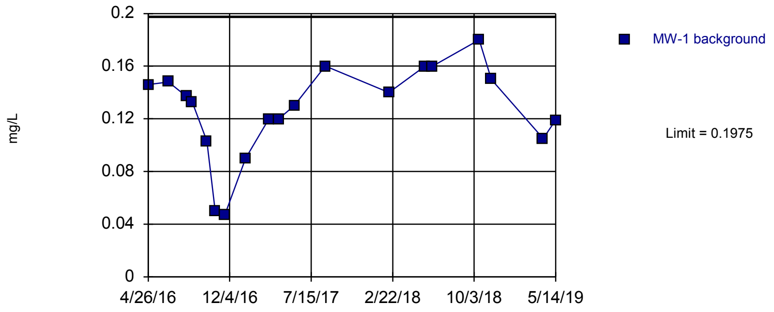
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1 (bg)



Background Data Summary: Mean=0.1262, Std. Dev.=0.03546, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9175, critical = 0.863. Kappa = 2.01 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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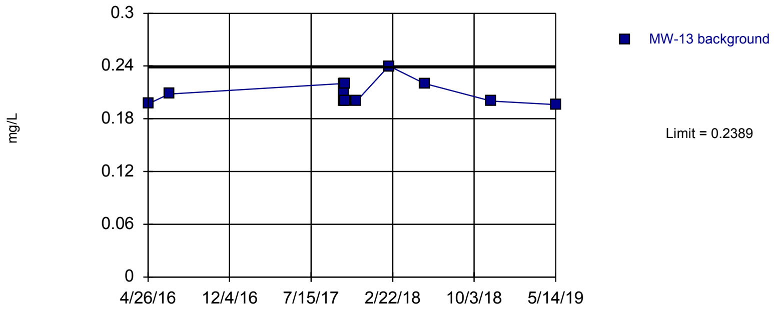
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-13 (bg)



Background Data Summary: Mean=0.2101, Std. Dev.=0.01313, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8608, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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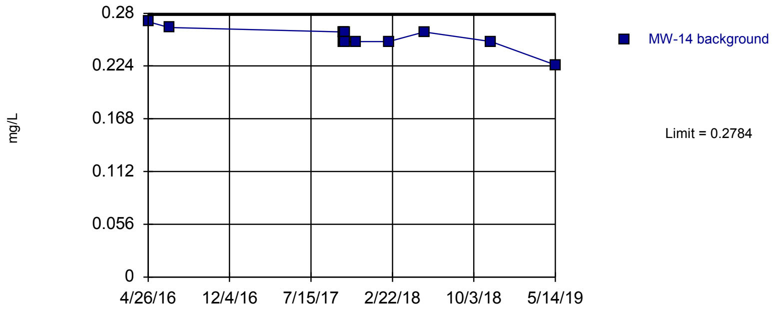
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-14 (bg)



Background Data Summary: Mean=0.2539, Std. Dev.=0.01115, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8403, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Chloride, Fluoride   Analysis Run 9/27/2019 11:06 AM   View: Intrawell

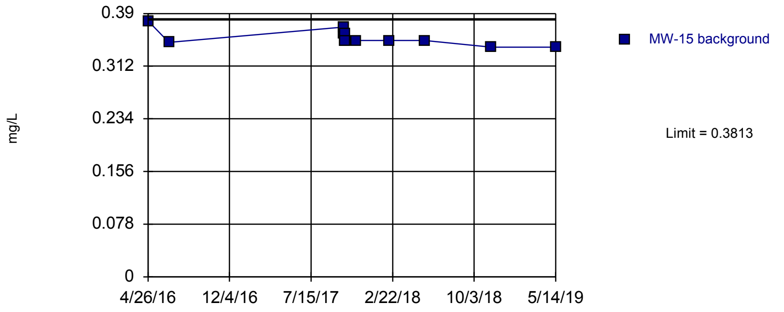
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-4	MW-1	MW-13	MW-14
4/25/2016	1.53			
4/26/2016		0.146 (J)	0.197 (J)	0.271 (J)
6/20/2016	1.85	0.148 (J)		
6/22/2016			0.208 (J)	0.265 (J)
8/8/2016		0.137 (J)		
8/9/2016	1.95			
8/24/2016	2.07	0.133 (J)		
10/3/2016	2.02	0.103 (J)		
10/26/2016	2.07	0.05 (J)		
11/21/2016	2.39	0.047 (J)		
1/17/2017		0.09 (J)		
1/18/2017	1.9			
3/22/2017	1.5 (J)	0.12		
4/18/2017	1.6 (J)	0.12		
5/30/2017		0.13		
5/31/2017	2.1			
8/23/2017	2.3	0.16		
10/12/2017			0.22	0.26
10/13/2017			0.2	0.25
10/14/2017			0.21	0.26
10/15/2017			0.22	0.26
10/16/2017			0.22	0.25
10/17/2017			0.2	0.25
11/16/2017			0.2	0.25
2/13/2018		0.14 (D)	0.24 (D)	0.25 (D)
5/21/2018			0.22	0.26
5/22/2018		0.16		
5/23/2018	2			
6/12/2018	1.7 (J)	0.16		
10/17/2018	<2 (J)	0.18		
11/19/2018	<2	0.15	0.2	0.25
4/10/2019	1.88	0.105		
5/14/2019	1.82	0.119	0.196	0.225

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-15 (bg)



Background Data Summary: Mean=0.3551, Std. Dev.=0.01195, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8974, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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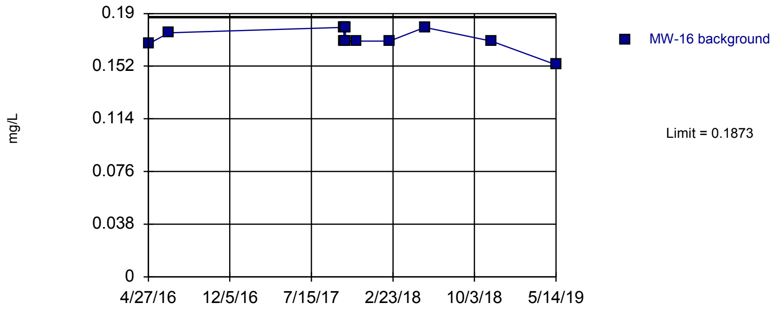
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-16



Background Data Summary (based on x^4 transformation): Mean=0.0009022, Std. Dev.=0.0001503, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8205, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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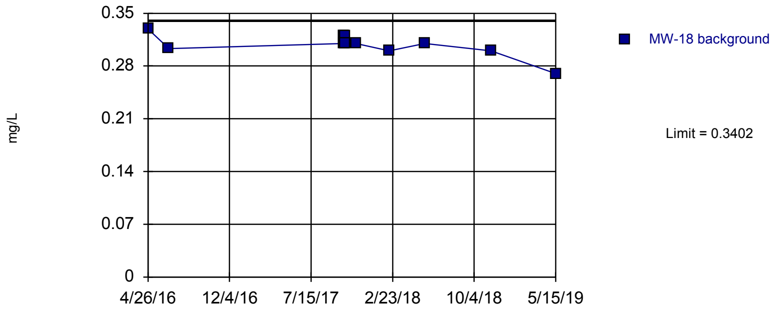
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-18



Background Data Summary: Mean=0.3086, Std. Dev.=0.01439, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8513, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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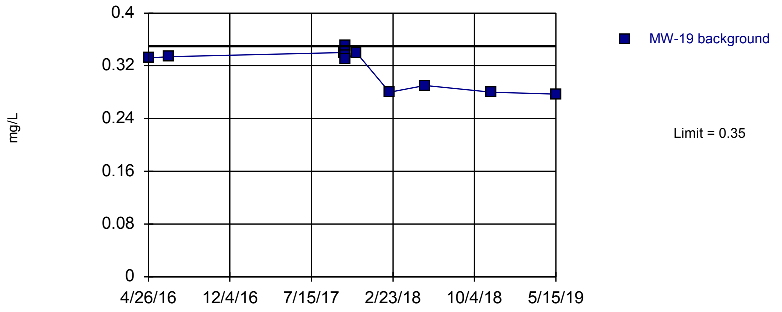
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, MW-19



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 13 background values. Well-constituent pair annual alpha = 0.01929. Individual comparison alpha = 0.009692 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Fluoride   Analysis Run 9/27/2019 11:06 AM   View: Intrawell

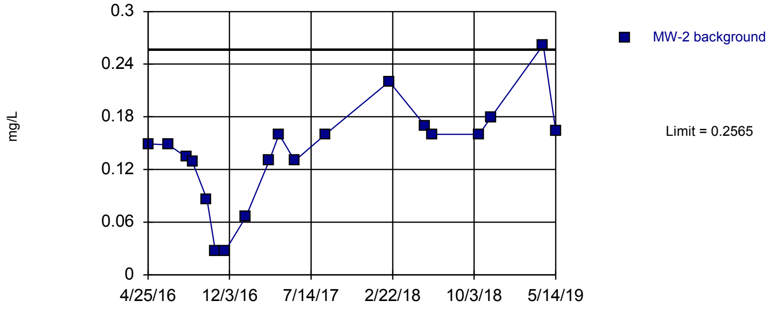
Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-15	MW-16	MW-18	MW-19
4/26/2016	0.379		0.329	0.332
4/27/2016		0.168 (J)		
6/22/2016	0.347	0.176 (J)	0.303	0.334
10/12/2017	0.37	0.18	0.31	0.34
10/13/2017	0.36	0.17	0.32	0.34
10/14/2017	0.37	0.18	0.32	0.34
10/15/2017	0.35	0.18	0.32	0.34
10/16/2017	0.36	0.18	0.31	0.35
10/17/2017	0.35	0.17	0.31	0.33
11/15/2017	0.35	0.17	0.31	0.34
2/14/2018	0.35 (D)	0.17 (D)	0.3 (D)	0.28 (D)
5/21/2018	0.35	0.18		
5/22/2018			0.31	0.29
11/19/2018	0.34	0.17	0.3	
11/20/2018				0.28
5/14/2019	0.34	0.153		
5/15/2019			0.27	0.277

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-2 (bg)



Background Data Summary: Mean=0.1401, Std. Dev.=0.05792, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9235, critical = 0.863. Kappa = 2.01 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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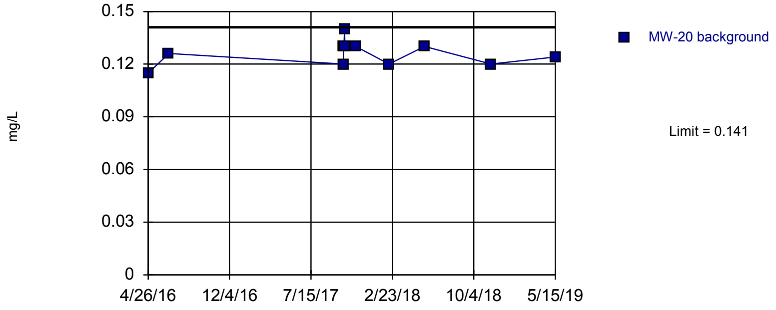
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-20



Background Data Summary: Mean=0.1265, Std. Dev.=0.006591, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9048, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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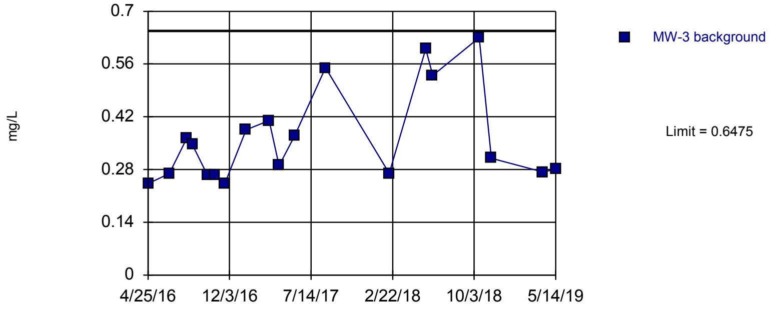
Prediction Limit

Intrawell Parametric, MW-3 (bg)



Background Data Summary (based on natural log transformation): Mean=-1.063, Std. Dev.=0.3126, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.875, critical = 0.863. Kappa = 2.01 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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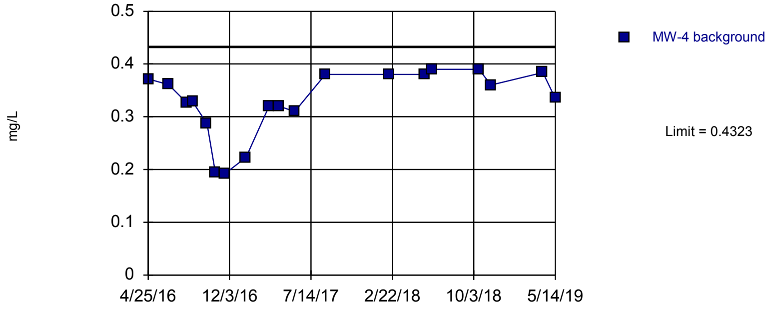
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary (based on square transformation): Mean=0.1114, Std. Dev.=0.03754, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8742, critical = 0.863. Kappa = 2.01 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Fluoride   Analysis Run 9/27/2019 11:06 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-2	MW-20	MW-3	MW-4
4/25/2016	0.149 (J)		0.243 (J)	0.372
4/26/2016		0.115 (J)		
6/20/2016	0.148 (J)			0.361
6/22/2016		0.126 (J)	0.269 (J)	
8/8/2016	0.134 (J)			
8/9/2016			0.363	0.326
8/24/2016	0.129 (J)		0.346	0.329
10/3/2016	0.086 (J)			0.287 (J)
10/4/2016			0.266 (J)	
10/26/2016	0.027 (J)		0.266 (J)	0.194 (J)
11/21/2016	0.027 (J)		0.244 (J)	0.192 (J)
1/17/2017	0.066 (J)			
1/18/2017			0.385	0.223 (J)
3/22/2017	0.13		0.41	0.32
4/18/2017	0.16		0.29	0.32
5/31/2017	0.13		0.37	0.31
8/23/2017	0.16		0.55	0.38
10/12/2017		0.12		
10/13/2017		0.13		
10/14/2017		0.13		
10/15/2017		0.14		
10/16/2017		0.13		
10/17/2017		0.13		
11/15/2017		0.13		
2/13/2018	0.22 (D)		0.27 (D)	0.38 (D)
2/14/2018		0.12 (D)		
5/22/2018	0.17	0.13		
5/23/2018				0.38
5/24/2018			0.6	
6/12/2018	0.16		0.53	0.39
10/17/2018	0.16		0.63	0.39
11/19/2018	0.18		0.31	0.36
11/20/2018		0.12		
4/10/2019	0.262		0.273	0.384
5/14/2019	0.164		0.281	0.335
5/15/2019		0.124		

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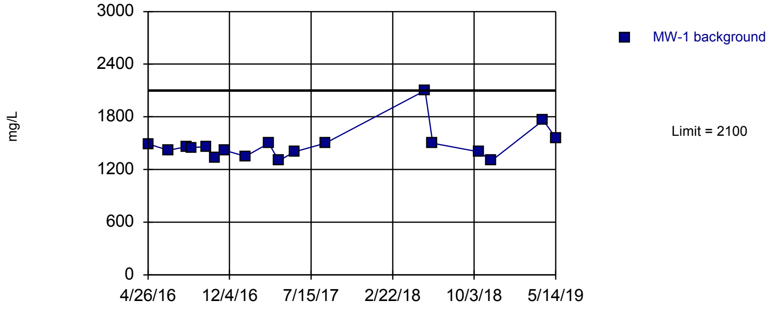
Prediction Limit

Intrawell Non-parametric, MW-1 (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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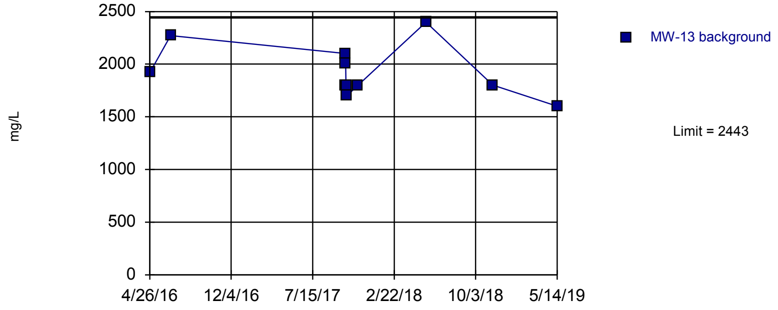
Prediction Limit

Intrawell Parametric, MW-13 (bg)



Background Data Summary: Mean=1916, Std. Dev.=236.3, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8932, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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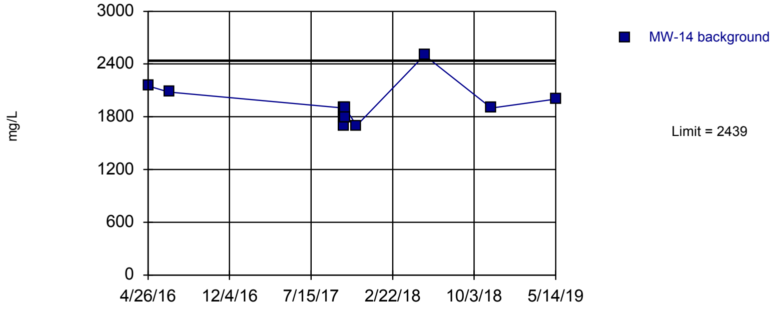
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-14 (bg)



Background Data Summary: Mean=1936, Std. Dev.=225.5, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8615, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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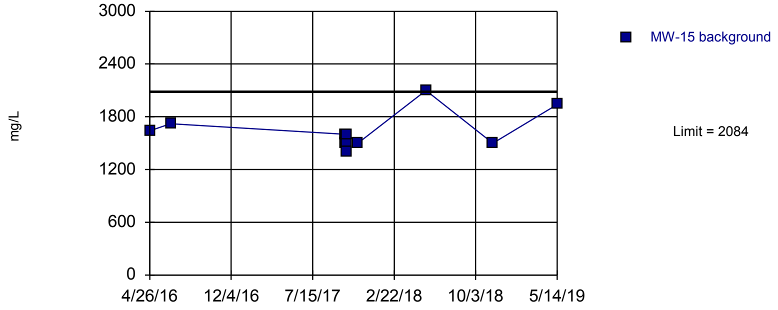
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-15 (bg)



Background Data Summary: Mean=1633, Std. Dev.=201.9, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8372, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Sulfate   Analysis Run 9/27/2019 11:06 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-1	MW-13	MW-14	MW-15
4/26/2016	1490	1920	2150	1640
6/20/2016	1420			
6/22/2016		2270	2080	1720
8/8/2016	1460			
8/24/2016	1450			
10/3/2016	1460			
10/26/2016	1330			
11/21/2016	1420			
1/17/2017	1350			
3/22/2017	1500			
4/18/2017	1300			
5/30/2017	1400			
8/23/2017	1500			
10/12/2017		2100	1900	1600
10/13/2017		2000	1800	1600
10/14/2017		1800	1700	1500
10/15/2017		1800	1800	1500
10/16/2017		1800	1800	1400
10/17/2017		1700	1900	1600
11/15/2017				1500
11/16/2017		1800	1700	
5/21/2018		2400	2500	2100
5/22/2018	2100			
6/12/2018	1500			
10/17/2018	1400			
11/19/2018	1300	1800	1900	1500
4/10/2019	1760			
5/14/2019	1560	1600	2000	1940

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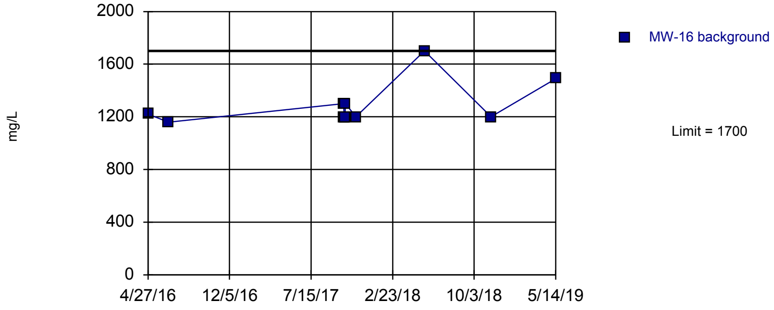
Prediction Limit

Intrawell Non-parametric, MW-16



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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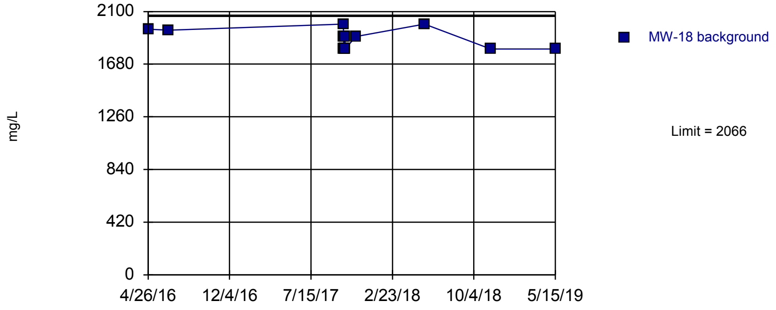
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-18



Background Data Summary: Mean=1884, Std. Dev.=81.52, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8317, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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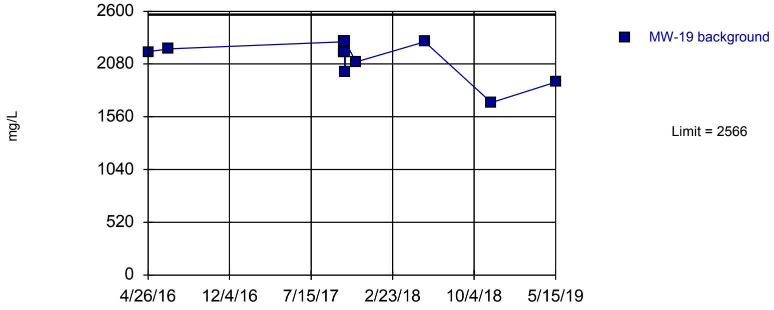
Prediction Limit

Intrawell Parametric, MW-19



Background Data Summary: Mean=2144, Std. Dev.=189.1, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8153, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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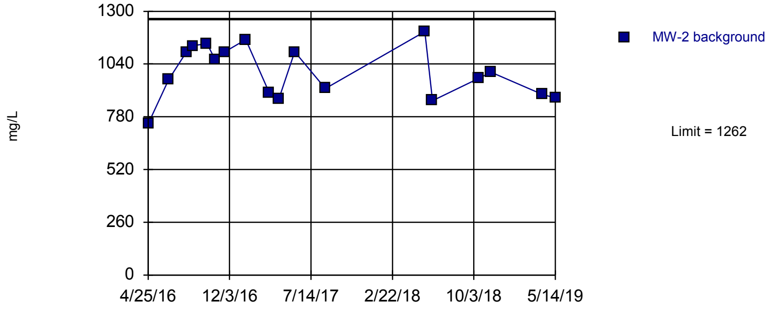
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-2 (bg)



Background Data Summary: Mean=998.9, Std. Dev.=129.3, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9464, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

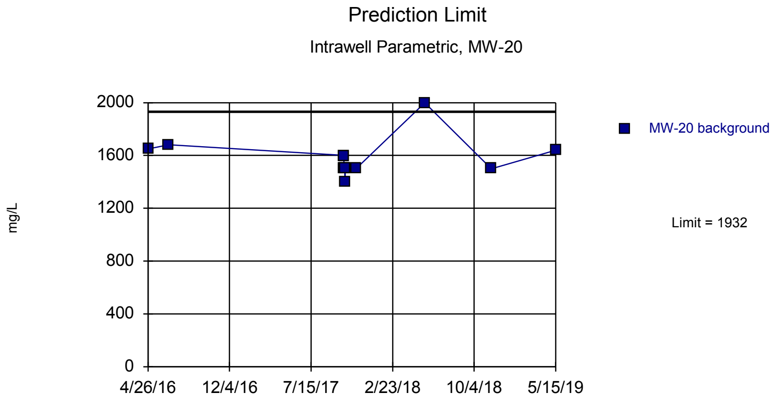
Prediction Limit

Constituent: Sulfate   Analysis Run 9/27/2019 11:06 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-16	MW-18	MW-19	MW-2
4/25/2016				745
4/26/2016		1960	2200	
4/27/2016	1220			
6/20/2016				964
6/22/2016	1160	1950	2230	
8/8/2016				1100
8/24/2016				1130
10/3/2016				1140
10/26/2016				1060
11/21/2016				1100
1/17/2017				1160
3/22/2017				900
4/18/2017				870
5/31/2017				1100
8/23/2017				920
10/12/2017	1300	2000	2300	
10/13/2017	1300	1900	2200	
10/14/2017	1200	1800	2300	
10/15/2017	1200	1800	2200	
10/16/2017	1200	1900	2000	
10/17/2017	1300	1800	2300	
11/15/2017	1200	1900	2100	
5/21/2018	1700			
5/22/2018		2000	2300	1200
6/12/2018				860
10/17/2018				970
11/19/2018	1200	1800		1000
11/20/2018			1700	
4/10/2019				889
5/14/2019	1490			873
5/15/2019		1800	1900	

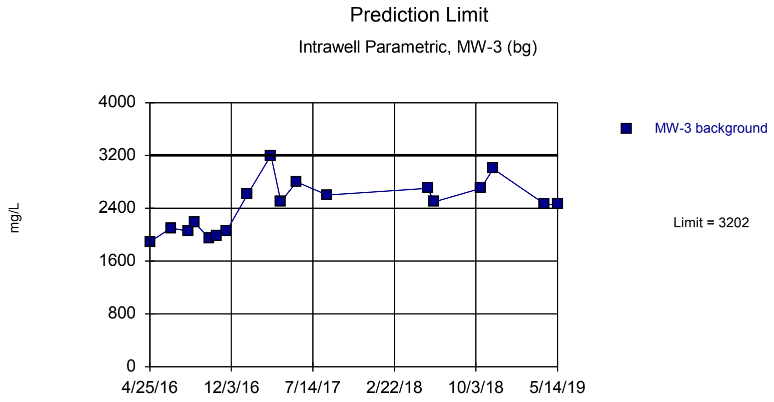
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Background Data Summary: Mean=1589, Std. Dev.=153.5, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8096, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

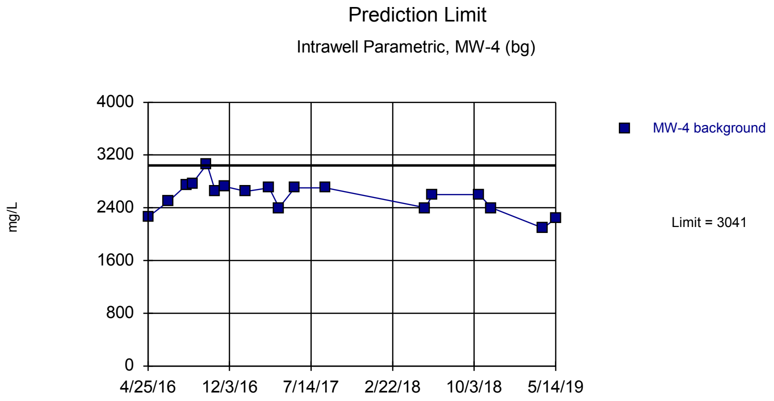
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Background Data Summary: Mean=2431, Std. Dev.=379.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9476, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

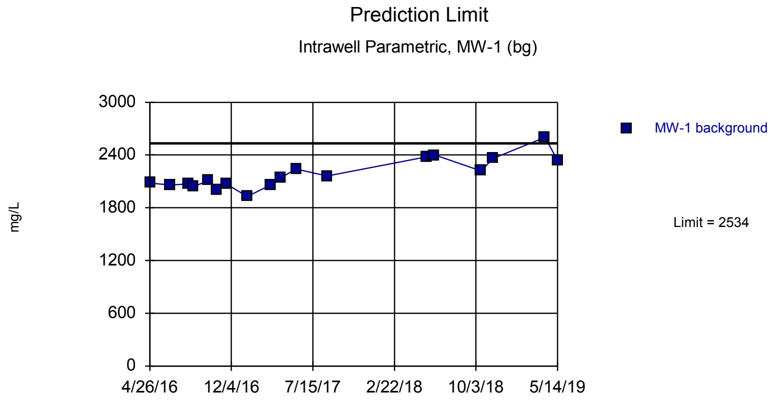
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Background Data Summary: Mean=2566, Std. Dev.=233.5, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9529, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Background Data Summary: Mean=2181, Std. Dev.=173.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9208, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Sulfate, Total Dissolved Solids   Analysis Run 9/27/2019 11:06 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-20	MW-3	MW-4	MW-1
4/25/2016		1890	2260	
4/26/2016	1650			2080 (D)
6/20/2016			2500	2060 (D)
6/22/2016	1680	2100		
8/8/2016				2070 (D)
8/9/2016		2050	2750	
8/24/2016		2190	2770	2040
10/3/2016			3060	2110 (D)
10/4/2016		1950		
10/26/2016		1980	2650	2000
11/21/2016		2060	2720	2070 (D)
1/17/2017				1930 (D)
1/18/2017		2620	2650	
3/22/2017		3200	2700	2060 (D)
4/18/2017		2500	2400	2140
5/30/2017				2240 (D)
5/31/2017		2800	2700	
8/23/2017		2600	2700	2160 (D)
10/12/2017	1600			
10/13/2017	1600			
10/14/2017	1500			
10/15/2017	1500			
10/16/2017	1400			
10/17/2017	1500			
11/15/2017	1500			
5/22/2018	2000			2380 (D)
5/23/2018			2400	
5/24/2018		2700		
6/12/2018		2500	2600	2400
10/17/2018		2700	2600	2220
11/19/2018		3000	2400	2360 (D)
11/20/2018	1500			
4/10/2019		2460	2090	2600
5/14/2019		2460	2240	2340 (D)
5/15/2019	1640			

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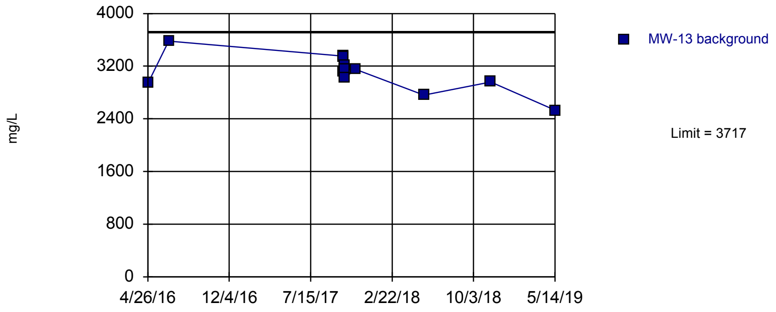
Prediction Limit

Intrawell Parametric, MW-13 (bg)



Background Data Summary: Mean=3093, Std. Dev.=279.3, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.979, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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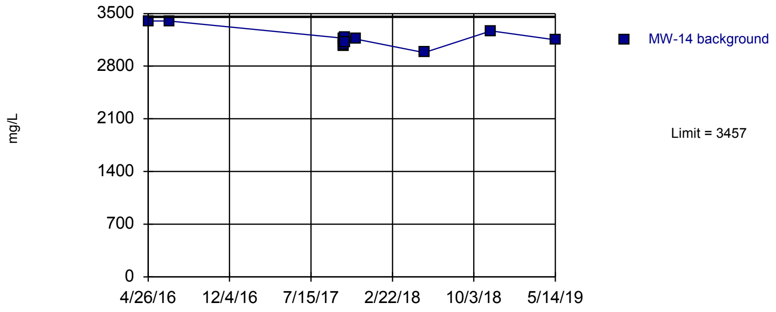
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-14 (bg)



Background Data Summary: Mean=3175, Std. Dev.=126.5, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9106, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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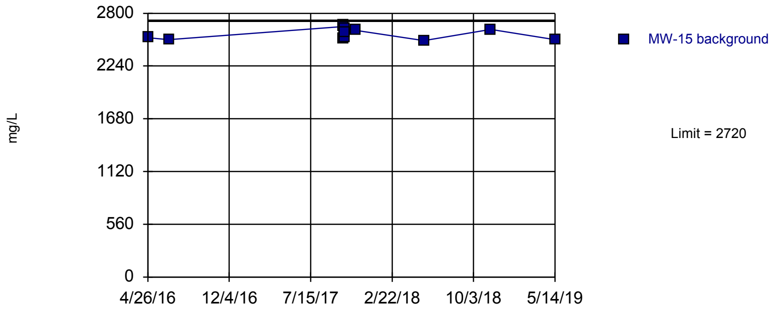
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-15 (bg)



Background Data Summary: Mean=2583, Std. Dev.=61.4, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.894, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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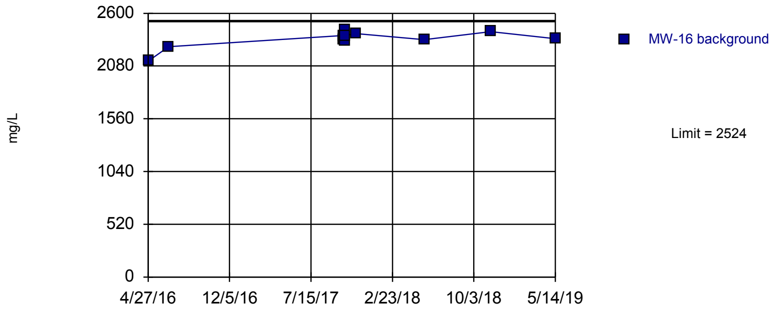
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-16



Background Data Summary: Mean=2343, Std. Dev.=81.05, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8399, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:06 AM View: Intrawell

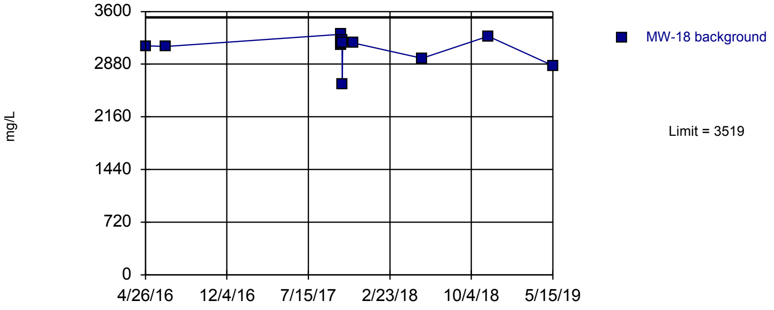
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

	MW-13	MW-14	MW-15	MW-16
4/26/2016	2940	3400	2540	
4/27/2016				2130
6/22/2016	3580	3400	2520	2270
10/12/2017	3350	3170	2660	2380
10/13/2017	3340	3070	2680	2340
10/14/2017	3120	3090	2530	2340
10/15/2017	3210	3190	2640	2440
10/16/2017	3150	3110	2550	2330
10/17/2017	3030	3110	2600	2380
11/15/2017			2620	2400
11/16/2017	3150	3160		
5/21/2018	2760	2980	2510	2340
11/19/2018	2960	3270	2630	2420
5/14/2019	2530	3150	2520	2350

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-18



Background Data Summary: Mean=3090, Std. Dev.=192.3, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8202, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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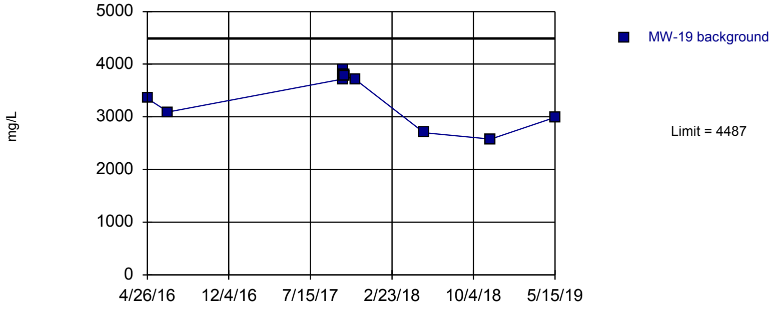
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-19



Background Data Summary: Mean=3432, Std. Dev.=472.6, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8225, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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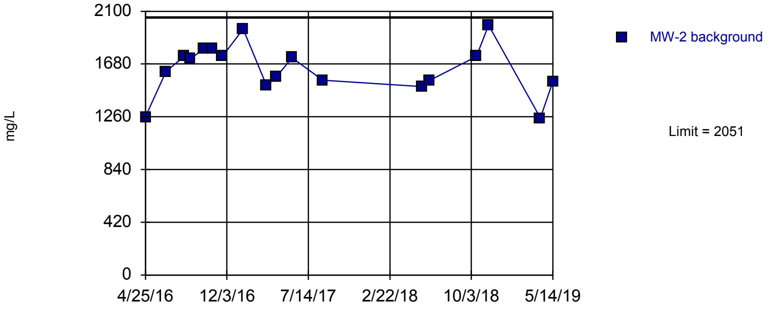
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-2 (bg)



Background Data Summary: Mean=1643, Std. Dev.=200.5, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9458, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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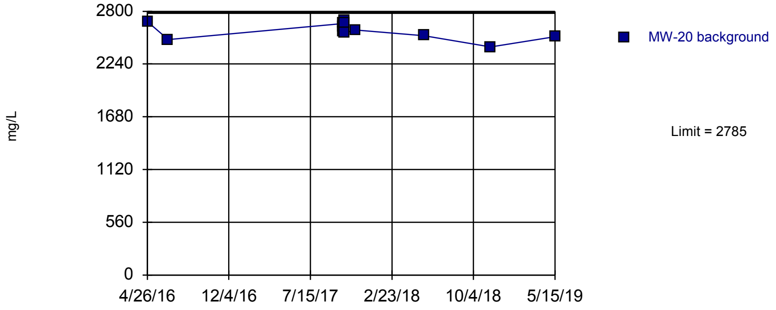
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-20



Background Data Summary: Mean=2593, Std. Dev.=85.74, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9468, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

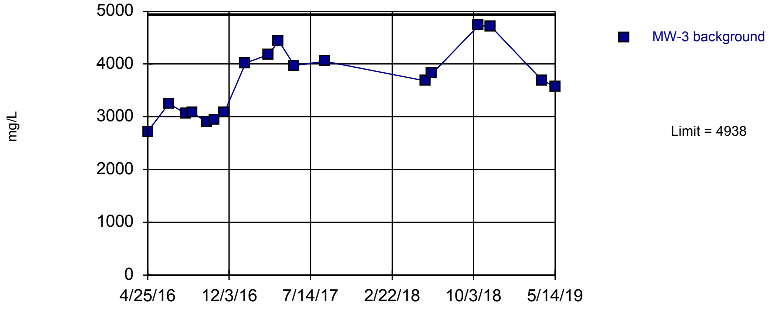
Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 11:06 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-18	MW-19	MW-2	MW-20
4/25/2016			1260 (D)	
4/26/2016	3130	3350		2690
6/20/2016			1620 (D)	
6/22/2016	3120	3090		2500
8/8/2016			1740 (D)	
8/24/2016			1720	
10/3/2016			1800 (D)	
10/26/2016			1800	
11/21/2016			1740 (D)	
1/17/2017			1960 (D)	
3/22/2017			1510 (D)	
4/18/2017			1580	
5/31/2017			1730 (D)	
8/23/2017			1550 (D)	
10/12/2017	3290	3720		2670
10/13/2017	3140	3890		2640
10/14/2017	3150	3800		2590
10/15/2017	3210	3800		2700
10/16/2017	2610	3770		2670
10/17/2017	3180	3780		2570
11/15/2017	3170	3710		2600
5/22/2018	2960	2700	1500 (D)	2540
6/12/2018			1550	
10/17/2018			1740	
11/19/2018	3260		1990 (D)	
11/20/2018		2580		2420
4/10/2019			1250	
5/14/2019			1540 (D)	
5/15/2019	2860	2990		2530

Prediction Limit

Intrawell Parametric, MW-3 (bg)



Background Data Summary: Mean=3661, Std. Dev.=628.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9455, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

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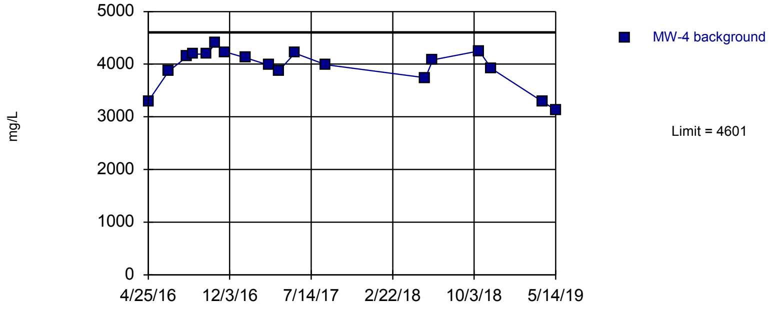
Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary (based on square transformation): Mean=1.6e7, Std. Dev.=2719774, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8799, critical = 0.858. Kappa = 2.032 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 9/27/2019 11:04 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

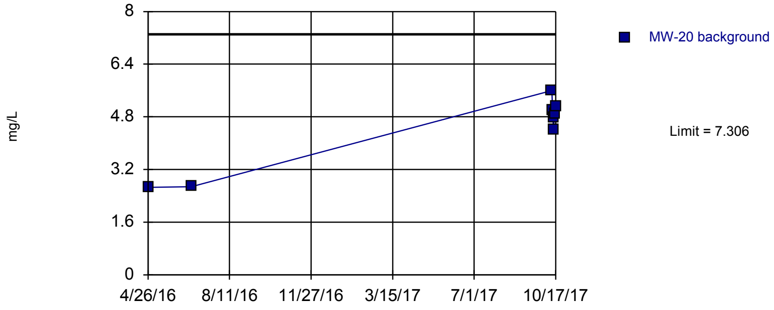
Constituent: Total Dissolved Solids   Analysis Run 9/27/2019 11:06 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-3	MW-4
4/25/2016	2720 (D)	3300 (D)
6/20/2016		3870 (D)
6/22/2016	3250 (D)	
8/9/2016	3050 (D)	4140 (D)
8/24/2016	3080	4190
10/3/2016		4190 (D)
10/4/2016	2900 (D)	
10/26/2016	2940	4400
11/21/2016	3090 (D)	4230 (D)
1/18/2017	4020 (D)	4120 (D)
3/22/2017	4180 (D)	3980 (D)
4/18/2017	4440	3880
5/31/2017	3970 (D)	4210 (D)
8/23/2017	4050 (D)	3990 (D)
5/23/2018		3740 (D)
5/24/2018	3680 (D)	
6/12/2018	3820	4080
10/17/2018	4730	4250
11/19/2018	4710 (D)	3920 (D)
4/10/2019	3680	3280
5/14/2019	3580 (D)	3130 (D)

Prediction Limit

Intrawell Parametric, MW-20



Background Data Summary: Mean=4.393, Std. Dev.=1.114, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8117, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 9/27/2019 11:05 AM View: Mann Whitney
Plant Gorgas Client: Southern Company Data: Gorgas Gypsum Landfill

Prediction Limit

Constituent: Chloride   Analysis Run 9/27/2019 11:06 AM   View: Mann Whitney

Plant Gorgas   Client: Southern Company   Data: Gorgas Gypsum Landfill

	MW-20
4/26/2016	2.66
6/22/2016	2.68
10/12/2017	5.6
10/13/2017	5 (B)
10/14/2017	4.4
10/15/2017	4.8
10/16/2017	4.9
10/17/2017	5.1

Appendix C

Alabama Power

Procedure Number	7839
Revision Number	4
Effective Date	03/23/2020
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WFG Low-Flow Groundwater Sampling TSOP

1. Purpose

1.1. The purpose of this Technical SOP (TSOP) is to discuss the process and requirements associated with conducting Low-Flow groundwater sampling.

1.2. This TSOP specifically describes using bladder pumps and peristaltic pumps to obtain groundwater samples collected for laboratory analysis by the Alabama Power Company (APC) Environmental Affairs (EA), Water Field Group (WFG).

2. Scope

2.1. This procedure is to be used by field personnel when collecting and handling groundwater samples using the Low-Flow groundwater collection method in the field.

2.2. The sampling equipment covered in this TSOP may be portable (well-to-well) or well-dedicated.

2.3. The sampling of SVOCs and VOCs should not be collected with the use of peristaltic pumps unless prior written customer approval is attained.

2.4. The procedure is designed to ensure that the samples collected are representative of the aquifer or target formation and that sample cross-contamination is eliminated during the sampling and handling process.

2.5. This procedure cannot replace education and experience. Professional judgment should be used in conjunction with this procedure.

3. Definitions/Abbreviations

3.1. Low-Flow (or micropurge) - Refers to the velocity with which water is withdrawn from the well. The objective of low-flow sampling is to extract fresh samples of the ambient groundwater from within the screened interval of the well with minimal impact to the zone of influence of the well.

3.2. Drawdown - Lowering of the water column within a well due to pumping. Typically associated with high-flow purging of a well for water sampling.

3.3. DI water – De-ionized water. Water that has been passed through a standard deionizing resin column. Water used for decontamination of field equipment.

3.4. Ultra-pure DI water- Water that is filtered and treated to the highest levels of purity. This water is used for the filling of blanks.

3.5. Phosphate-free soap or cleaner – A cleaner which contains, by weight, 0.5% or less of phosphates or derivatives of phosphates (Liquinox® or Luminox®).

3.6. Potable water- Water that is safe to consume. Can be used in detergent solution and first rinse during decontamination. Can be replaced by DI water.

3.7. PPE - Personal Protective Equipment.

3.8. NTU - Nephelometeric Turbidity Units. The unit of measure used when measuring the turbidity of water.

3.9. COC - Chain of Custody. A controlled document used to record sample information and transfer the samples to the laboratory after collection.

3.10. SVOCs and VOCs- Semi-volatile organic compounds and volatile organic compounds.

3.11. DO - Dissolved Oxygen

3.12. ORP - Oxidation Reduction Potential

3.13. SAP - Sampling and Analysis Plan

3.14. EDAS- Environmental Data Acquisition System

3.15. Artesian well- A well in which water rises under pressure from a permeable stratum overlaid by impermeable rock.

4. References

4.1. Internal Documents

4.1.1. WFG Groundwater Equipment Decontamination TSOP
4.1.2. WFG Groundwater Water Level and Total Depth Measurements TSOP
4.1.3. WFG General Water Sampling and Field Measurement TSOP
4.1.4. WFG Deployment and Maintenance of Dedicated Groundwater Equipment TSOP
4.1.5. WFG Turbidity TSOP
4.1.6. WFG Temperature TSOP
4.1.7. WFG Conductivity TSOP
4.1.8. WFG Luminescent Dissolved Oxygen (LDO) TSOP
4.1.9. WFG Oxidation-Reduction Potential (ORP) TSOP
4.1.10. WFG pH (TSOP-SM-4500H) TSOP
4.1.11. WFG Electronic Calibration Form
4.1.12. Groundwater Electronic Chain of Custody

4.1.13. Site specific SAP

4.2. External Documents

4.2.1. United States Environmental Protection Agency (U.S. EPA). Region 4, Groundwater Sampling. Document # SESDPROC-301-R4.
4.2.2. Florida Department of Environmental Protection (DEP). FS 2200 Groundwater Sampling. Document # DEP-SOP-001/01.
4.2.3. United States Environmental Protection Agency (U.S. EPA). Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. Document # EPA/540/S-95/504.
4.2.4. ASTM Standard D6771-18- Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations

5. Method Overview

5.1. Low flow sampling of groundwater from within the screened interval is accomplished by maintaining a low pump rate that minimizes drawdown of the water column while leaving the more stagnant water above the screened interval undisturbed.

5.2. Indicator parameters and water levels are measured at the beginning of and while micro-purging the well. Stabilization acceptance criteria for turbidity, pH, specific conductance and DO are found in the site specific SAP. Stabilization of these parameters indicates that the water is representative of ambient conditions and sample collection can begin. ORP and temperature measurements should also be collected but will not be used as indicators of stability.

5.3. Non-dedicated sampling equipment must be decontaminated prior to next use in a well to avoid cross contamination. Refer to and understand the Groundwater Equipment Decontamination TSOP prior to performing groundwater sampling.

6. Detection Limit

6.1. Some of the indicator parameter methods used to show equilibrium of the well water have minimum detection limits or other quality control requirements. Refer to the latest version of the TSOPs associated with these procedures (turbidity, pH, specific conductance, and DO).

6.2. Users of this procedure must study and be familiar with the applicable data acceptance criteria and required field measurements. Refer to the SAP for information on these parameters and other information.

7. Safety

7.1. Appropriate PPE should be worn and utilized when sampling groundwater wells in accordance with APC policies. Generally this includes safety glasses, hard hats, gloves and safety-toed boots. Plant-specific requirements may also apply and should be determined/known prior to arriving at the work location.

7.2. Refer to the WFG General Water Sampling and Field Measurement TSOP procedure for general safety requirements.

7.3. If using compressed Nitrogen gas for deep wells, always secure tanks when transporting and ensure protective cap is secured over valve. Take care to avoid exceeding the max pressure rating of the controller, air hose and pump.

8. Equipment and Materials

The following is a basic listing of the necessary reusable and expendable items that are required to complete this procedure.

8.1. Reusable Items

8.1.1. Field Book
8.1.2. Appropriate installation diagram and/or well construction data
8.1.3. Keys for well locks
8.1.4. Water level meter
8.1.5. Pump with parts (tubing grab plates, bladders, O-rings, etc.)
8.1.6. Pump controller
8.1.7. Peristaltic pump
8.1.8. Flow-through cell
8.1.9. iPad
8.1.10. InSitu™ multi-parameter probe
8.1.11. Handheld turbidity meter
8.1.12. Generator (min. 2,000 kW)
8.1.13. Air compressor and hose
8.1.14. Graduated cylinder
8.1.15. Tubing Weight (for peristaltic application)
8.1.16. Tubing caddy with counter unit or other measurement device
8.1.17. Decon/wash containers w/ lids (3)
8.1.18. Coolers for samples
8.1.19. Procedures & SAPs

8.2. Consumable/Disposable Items

8.2.1. Tubing (estimated for number of wells x well depths with extra)
8.2.2. Silicone tubing for peristaltic pump head
8.2.3. COCs (if electronic format is not suitable)
8.2.4. Plastic sheeting
8.2.5. Gasoline (in approved container)
8.2.6. Ice for samples
8.2.7. Sample Bottles
8.2.8. DI water (For decon)
8.2.9. Ultra-Pure DI water (For blanks collection)
8.2.10. Potable water (for decon)
8.2.11. Phosphate free detergent (e.g. Liquinox or Luminox®)
8.2.12. Support rope or coated safety cable
8.2.13. Calibration Standards
8.2.14. Disposal sample bags & trash bags
8.2.15. Paper towels

9. Reagents & Standards

9.1. This document describes the Low-Flow purging and sampling procedure and does not include method calibration procedures. Calibration procedures may be found in the associated method TSOP on the APC Qualtrax site. The instrument(s) used to measure indicator parameters must be verified daily using the below appropriate calibration standards (or equivalent).

9.1.1. ORP- ZoBell's ORP Solution
9.1.2. pH- 3-point calibration

  9.1.2.1. 2.00 buffer standard for pH
  9.1.2.2. 4.00 buffer standard for pH
  9.1.2.3. 7.00 buffer standard for pH
  9.1.2.4. 10.00 buffer standard for pH
  9.1.2.5. 12.00 buffer standard for pH

9.1.3. DO - NA
9.1.4. Specific Conductance - 1,412 µS/cm, or appropriate conductivity standard
9.1.5. Turbidity – Zeroed with 0.00 standard and calibrated with 10.00 NTU standard

10. Calibration

10.1. Calibration and/or verification of water quality measurement equipment shall be performed at the start of each day and should be specific to the manufacturer's calibration instructions. A verification check of the instrument calibration will be performed after the calibration and at the end of each day with a standard of the same value but different lot number or manufacturer.

10.2. All calibration data, and initial and final LCS data, should be recorded electronically in the calibration log on EDAS.

10.3. Refer to the APC TSOP for each method to complete the instrument calibration (TSOPs: turbidity, pH, temperature, specific conductance, DO and ORP).

11. Procedure

General Note

At the start of each sampling event, a round of water levels from each well should be collected for use in generating a potentiometric surface map. This should be completed on the first day of the sampling event. Refer to the Groundwater Water Level and Total Depth Measurement TSOP for guidance.

11.1. Well lock keys are maintained by the plant compliance contact and must be obtained from the compliance office, if not already assigned a key, prior to beginning work

11.2. Inspect the well for any damage or tampering. If there is evidence of damage or tampering, immediately notify the Technical Manager or the Water Field Services Supervisor. Take photos of the site as documentation and make sure not to disturb the well. The damage/tampering and any discussions about a response should also be documented in the field logbook or electronically in the iPad.

11.3. If the well is in good condition, open the well head and if the well is non-dedicated and non-vented, remove the inner casing cap to allow for atmospheric equilibration. Begin setting up to sample by arranging/organizing the work zone.

11.4. Designate a clean work space or work surface used to provide a contaminant-free area to place sampling equipment during assembly.

11.5. Calibrate or verify all field parameter measurement equipment at the start of each day (this typically includes an InSitu multi-meter probe and a handheld turbidity meter if an inline turbidity sensor is not used). Refer to the appropriate method TSOP and calibration procedure for each instrument used.

11.6. All non-dedicated equipment that will, or could come into contact with groundwater (e.g. pump and water level meter) in the well must be decontaminated prior to each use. Refer to the Groundwater Equipment Decontamination TSOP for more details.

11.7. Using a properly functioning water level indicator, lower the probe into the well and obtain an initial water level measurement for the well (Refer to WFG Groundwater Water Level and Total Depth Measurements TSOP).

11.8. Measure and record all water levels to the nearest hundredth (0.01) foot at the reference point or survey mark on the well casing.

11.9. Refer to the WFG Deployment and Maintenance of Dedicated Groundwater Equipment TSOP for initial or re-deployment of dedicated pumps and for performing maintenance activities.

11.10. Dedicated Low-Flow – Bladder Pump

11.10.1. Connect the external compressor hose to the pump controller intake port using the quick-connect.
11.10.2. Connect the pump air supply line to the “Air Out” quick connect on the control box. Connect the other end of the air supply line to the air connection on the dedicated well cap.
11.10.3. Connect a short piece of tubing to the existing sample line on the dedicated well cap and then connect to the bottom of the flow-through cell for the InSitu multi-probe. Use care to ensure proper connection of the tubing.
11.10.4. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth. Ensure that the dedicated pump is still located below the water table, and at a suitable sampling depth.
11.10.5. Insert the InSitu multi-parameter probe into the flow-through cell and press the power button
11.10.6. Turn on the iPad and open the InSitu Low-Flow application (iSitu® or VuSitu® app). Enter the initial data needed to initiate the program or if a template is available, open the well specific template. Refer to the manufacturer’s instructions for a step-by-step explanation of the Low-Flow app and the data input required.
11.10.7. Continue to fill in all appropriate information in the InSitu program using the parameter stabilization criteria set forth in the site-specific SAP. Always confirm with the Technical Manager that the current SAP is being used.
11.10.8. Place the generator as far away as possible from the well, preferable downwind. Start the generator and the air compressor to

begin pumping. If the well is too deep for a traditional air compressor, use of compressed Nitrogen gas, high pressure controller and pressure regulator may be required.

11.10.9. Monitor the water level and adjust the flow rate on the pump controller to provide a constant water level in the well. Pump rates should not exceed three tenths of a foot (0.3) water level drawdown when sampling. During initial pump start-up, drawdown may exceed three tenths of a foot (0.3) while flow rate adjustments are being made or while water level stabilization occurs.

11.10.10. Use a graduated cylinder (or similar) to measure the flow rate in milliliters per minute (ml/min). Purge rates must fall between 100 and 500 ml/min or meet the specific requirements provided in the project SAP. If the minimum flow rate requirement of 100 ml/min cannot be achieved without water level drawdown exceeding three tenths of a foot (0.3), refer to section 16.1.

11.10.10.1. If the well has been previously purged and sampled, refer back to the most recent well record and make an effort to target that purge rate for consistency.

11.10.11. When a stable purge rate is attained, enter that flow rate in the InSitu program and set the measurement frequency to every 5 minutes. The Low-Flow application (iSitu® or VuSitu® app) will now be used to determine when groundwater samples can be taken. The Low-Flow app uses the previously entered SAP acceptance criteria and applies them to each measurement. When the criteria are met, the indicator parameter will be highlighted in green on the iPad screen, indicating equilibration.

11.10.12. Note the start time and other well information in the field log book and start the program.

11.10.13. Turbidity measurements may be taken with an inline turbidity sensor or with an external handheld unit. If using an external turbidity meter, readings must collected as close as possible to the time as the readings acquired from the InSitu meter.

11.10.14. Continue to measure water level and turbidity at the same measurement frequency as the indicator parameters, entering the values in the iPad InSitu application.

11.10.15. Once the water level and all field parameters have stabilized and turbidity is less than 10 NTU according to the criteria in the SAP, the well is considered equilibrated and sampling may take place. Refer to the site-specific SAP and Sections 16.2 and 16.3 of this procedure for direction on wells where 10 NTU are unattainable.

11.10.16. Tap the "**Finish Test**" button on the iPad and enter any relevant notes such as time sampled in the comment section. Email the data file to a secure company email address for storage and use. In the event that there is no data service to email the file and the iPad is damaged or lost before the field report can be sent, the well will be re-sampled.

11.10.17. **DO NOT** turn off the pump. Complete the labeling for all sample bottles and also record the same information for each sample in the field log book, and all electronic forms.

11.10.18. Put on nitrile or latex gloves and make sure that all bottles are preserved with the appropriate acid.

11.10.19. Carefully remove the sample line from the bottom of the flow-through cell. Cut the end off of the sample tubing and begin filling up the sample containers.

11.10.20. Do not adjust the flow rate when sampling.

11.10.21. Fill up the containers by placing the tubing in the mouth of the bottle, using care not to touch the mouth or sides of the container. Do not overfill sample bottles. Bottle should be filled to the top leaving a small amount of headspace, unless otherwise directed by the customer or lab.

11.10.22. Upon filling and capping all sample containers, place the samples in the sample cooler and ensure that the samples with temperature requirements are placed on ice.

11.10.23. Turn off the controller, air compressor and generator.

11.10.24. Remove the water level indicator from the well, making sure to decontaminate the wetted tape and probe portion.

11.10.25. Disconnect the airline tubing from the controller and make sure the sample line tubing is disconnected. Secure the dedicated tubing within the wellhead in such manner that the tubing stays clean and does not fall into the well. Close and secure the well.

11.11. Non- Dedicated Low Flow- Bladder Pump

11.11.1. Complete Steps 11.1 – 11.9 from the above procedure.

11.11.2. Assemble a clean pump system with a bladder, and connect the support rope or cable, sample line, and air line to the top of the pump assembly. Use care to ensure proper connection and positioning. Never lower a pump in a well without a support rope attached.

11.11.3. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth.

11.11.4. Slowly lower the pump assembly into the well, using care to minimize disturbance once the groundwater interface is reached. The tubing counter or other depth measurement devices can be used to aid in determining appropriate depth.
11.11.5. Recharge characteristics may dictate the need to place the pump intake slightly lower than the mid-screen depth if drawdown historically is unavoidable.
11.11.6. With the pump intake lowered to approximately mid-screen depth, secure the support rope or cable so that the pump is fixed and stationary in the well.
11.11.7. Cut the air line to an appropriate length and attach to the air hose on the pump controller. Next, cut the water line to an appropriate length and attach to the bottom of the flow-through cell.
11.11.8. Re-lower the water level meter into the well.
11.11.9. Follow above Steps 11.10.5 – 11.10.23.
11.11.10. Remove the pump and tubing from the well. Discard the used tubing and pump bladder. Never re-use disposable sampling equipment or tubing.
11.11.11. Place the well cap back on the well and close and lock the well lid.

11.12. Low Flow –Peristaltic Pumps

11.12.1. Complete steps 11.1 – 11.9 from the above procedures.
11.12.2. Peristaltic- Dedicated Well Tubing

11.12.2.1. Prepare an adequate length of clean silicon tubing that has the correct outside and inside dimensions to allow proper fit in the pump head. Insert into the pump head rollers and secure (refer to pump user manual for additional information).
11.12.2.2. Connect the vacuum end of the silicone tubing to the barb fitting on the dedicated well cap.
11.12.2.3. Attach the discharge end of the silicone tubing to the bottom of the flow through cell.

11.12.3. Peristaltic- Non-Dedicated Well Tubing

11.12.3.1. Attach the tubing weight to the end of clean polyethylene tubing.
11.12.3.2. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth.

11.12.3.3. Using the tubing caddy or another tubing depth measurement device, slowly lower the tubing and weight to the mid-screen depth.

11.12.3.4. Once the tubing intake is at the correct depth, allow for excess tubing at the surface and insert into the pump head rollers and secure.

11.12.3.5. Allow for a short section (one to three feet) of tubing from the discharge side of the pump head. This may be used for both the purge discharge and to fill sample bottles upon stabilization.

11.12.3.6. Attach the discharge tubing to the intake (lower) port of the flow-through cell.

11.12.4. Insert the InSitu multi-parameter probe into the flow-through cell and press the power button on the battery pack.

11.12.5. Turn on the iPad and open the InSitu Low-Flow application (iSitu® or VuSitu® app). Enter the initial data needed to initiate the program or if a template is available, open the well-specific template. Refer to the manufacturer's instructions for a step-by-step explanation of the Low-Flow app and the data input required.

11.12.6. Make the necessary preparations to provide power to the pump. Turn on the peristaltic pump to produce a vacuum on the well side of the pump head and begin purging. Observe pump direction to ensure that the pump operation is applying a vacuum to the sample line (down-hole) tubing.

11.12.7. Monitor the water level and adjust the flow rate to provide a constant water level in the well. The pump rate will initially require adjustment based on the site and well properties. Pump rates should not exceed three tenths of a foot (0.3) water level drawdown when sampling. During initial pump start-up, drawdown may exceed three tenths of a foot (0.3) while flow rate adjustments are being made or while water level stabilization occurs. If the minimum flow rate requirement of 100 ml/min cannot be achieved without water level drawdown exceeding three tenths of a foot (0.3), refer to section 16.1.

11.12.8. Continue to fill in all appropriate information in the InSitu program using the parameter stabilization criteria set forth in the site-specific SAP. Always confirm with the Technical Manager that the current SAP data are being used.

11.12.9. Use a graduated cylinder (or similar) to measure the flow rate in milliliters per minute (ml/min). Purge rates must fall between 100 and 500 ml/min or meet the specific requirements provided in the project SAP.

11.12.9.1. If the well has been previously purged and sampled, refer back to the most recent well record and make an effort to match the purge rate for consistency.

11.12.10. When a stable purge rate is attained, enter that flow rate in the InSitu program and set the measurement frequency to 5 minutes. The Low-Flow application (iSitu® or VuSitu® app) will now be used to determine when groundwater samples can be taken. The Low-Flow app uses the previously entered SAP acceptance criteria and compares them to each measurement. When the criteria are met, the indicator parameter will be highlighted in green on the iPad screen, indicating equilibration.

11.12.11. Note the start time and other well information in the field log book and start the program.

11.12.12. Turbidity measurements may be taken with an inline turbidity sensor or with an external handheld unit. If using an external turbidity meter, readings must be collected as close as possible to the time as the readings acquired from the InSitu meter.

11.12.13. Continue to measure water level and turbidity at the same measurement frequency as the indicator parameters, entering the values in the iPad SmarTROLL™ application.

11.12.14. Once the water level and all field parameters have stabilized and turbidity is less than 10 NTU according to the criteria in the SAP, the well is considered equilibrated and sampling may take place. Refer to the site-specific SAP and Sections 16.2 and 16.3 of this procedure for wells where 10 NTU is unattainable.

11.12.15. Tap the "**Finish Test**" button on the iPad and enter any relevant notes such as time sampled in the comment section. Email the data file to a secure company email address for storage and use. In the event that there is no data service to email the file and the iPad is damaged or lost before the field report can be sent, the well will be re-sampled.

11.12.16. **DO NOT** turn off the pump. Complete the labeling for all sample bottles and also record the same information for each sample in the field log book and associated electronic forms.

11.12.17. Make sure that all bottles are preserved with the appropriate acid.

11.12.18. Carefully remove the sample line from the bottom of the flow-through cell. Cut the end off of the sample tubing and begin filling up the sample containers.

11.12.19. Do not adjust the flow rate when sampling.

11.12.20. Fill up the containers by placing the tubing in the mouth of the bottle, using care not to touch the mouth or sides of the container. Do not overfill sample bottles. Bottles should be filled to the top leaving a small amount of headspace unless otherwise directed by the customer or lab.

11.12.21. Upon filling and capping all sample containers, place the samples in the sample cooler and ensure that the samples with temperature requirements are placed on ice.

11.12.22. Stop the pump and reverse the flow direction so that the sample line is emptied of water.

11.12.23. Turn off the peristaltic pump and generator.

11.12.24. Remove the water level indicator from the well, making sure to decontaminate the wetted tape and probe.

11.12.25. For dedicated tubing, disconnect the silicone tubing piece from the pump and dedicated well cap and throw away. Close and secure the well. For non-dedicated tubing, disconnect the tubing from the pump and throw away.

11.13. Decontamination and Clean-Up – For all Reusable Components

11.13.1. Decontamination of any reusable components can be completed as a separate task at a later time but must not be re-used until decontaminated according to the WFG Groundwater Equipment Decontamination TSOP.

11.13.2. Do not re-use any disposable sampling equipment and throw away all non-dedicated tubing and bladders after use.

11.13.3. Pack up and secure all equipment and complete all sample information on the COC.

11.13.4. Reattach well cap (as appropriate) and close and lock the wellhead.

12. Calculations and Reports

12.1. Sample reports should be emailed in the field using the InSitu iPad application to a secure company email address.

13. Data Interpretation, Recording and Reporting

13.1. Data interpretation and reporting will be completed by personnel with Southern Company Services (SCS) and will subsequently be used to produce the compliance report per the Coal Combustion Residuals Rule [80 FR 21301] and respective state agency requirements.

13.2. Recording of field data used to support the interpretation and reporting process will be completed using field log books and/or sample reports that will be filled out each time groundwater monitoring activities are conducted. The field log book or sample report should contain the following information:

- 13.2.1. Well identification number
- 13.2.2. Well depth
- 13.2.3. Static water level depth, date & time
- 13.2.4. Pumping rate, drawdown, indicator parameter values, time at five minute intervals; calculated or measured total volume pumped
- 13.2.5. Time of sample collection
- 13.2.6. Field observations
- 13.2.7. Name of sample collectors
- 13.2.8. Weather conditions
- 13.2.9. QA/QC data for blanks (sample time and location)

13.3. Information on sample times, dates, analytical methods, personnel, etc. should be filled out on the COC for each sample and turned in with the samples to the proper lab.

14. Quality Control Acceptance Criteria and Corrective Actions for Failed QC

14.1. Any deviations or issues related to the well sampling process should be documented in the field log book or sample report.

14.2. One sample duplicate and one field blank shall be collected per every group of 10 wells sampled as specified in the SAP. An equipment rinsate blank should also be collected at a rate of 1 per every CCR storage unit. Refer to the site specific SAP for guidance. Ultra-pure DI water shall be used as the control water for all blanks.

14.3. Calibration acceptance criteria for field parameters may be found in the individual TSOP documents. Refer to individual TSOPs for guidance on initial and final LCS failures.

15. Diagrams

15.1. Well construction logs are maintained by SCS Earth Sciences and may be consulted to confirm total well depth and screened interval.

16. Deviations/Exceptions

16.1. The low-flow sampling method is not always feasible in some wells due to very slow recharge rates. Depending on the geology and conditions of water bearing zones, water levels may decline at rates greater than the accepted minimum drawdown limit of three tenths of a foot (0.3 ft) even with minimal flow rates. If this is the case, and the well has a dedicated pump, minimum purge sampling may be necessary. Follow the below steps for minimum purge sampling:

16.1.1. Calculate the total system volume (bladder, tubing & flow through cell) by inputting the necessary information in the InSitu program.
16.1.2. Purge 1-3 times the system volume, depending on the volume of the overhead water column.
16.1.3. Purge rates should occur at rates less than 100 ml/min.
16.1.4. Collect field readings after at least 1 system volume has been purged.
16.1.5. Commence sampling once system volume(s) have been purged.
16.1.6. Document field methodology, data, calculations and observations.

16.2. The target for monitoring turbidity is readings less than or equal to 5 NTUs, however this value is not mandatory (EPA, July 1996). In some instances, turbidity levels may exceed the recommended turbidity level due to natural aquifer conditions, changes in aquifer recharge, or other well characteristics. When these conditions are encountered, the following guidelines shall be considered:

16.2.1. If turbidity readings are greater than 5 NTU but less than 10 NTU and all other parameter criteria has been met, sampling can commence.
16.2.2. If turbidity readings are slightly above 10 NTU, but are trending downward, purging and monitoring shall continue.
16.2.3. If turbidity readings are greater than 10 NTUs and are stable within 10% for the final 3 consecutive readings and pumping has occurred for at least 2 hours, well sampling shall be based upon stabilization of critical indicator parameters (pH, Specific Conductance and DO).

16.2.3.1. In situations described in the above section, first collect a preserved sample set followed by an additional preserved sample set to be field filtered.
16.2.3.2. After the first sample set is collected, attach a 0.45 micron field filter to the end of the sample line. Allow for about 300 ml of sample water to pass through the filter prior to sample collection. Once filtered bottles have been filled, dispose of the filter. Ensure that the filtered sample set is properly denoted on the label.

16.3. Artesian Wells

16.3.1. For wells that are artesian, water may free flow out of the well casing before it reaches equilibrium. In such cases, a dedicated pump is not required. It is acceptable to collect the sample using traditional low flow criteria utilizing a special well cap fitted with control valve routed directly to the flow through cell. A minimum of 1 well volume should be purged before sample collection.

17. Client-Defined Specifications/Observations/Specialized Analysis

17.1. A project SAP is required on a groundwater sampling project and is available for review in the groundwater folder on EDAS. This document provides project-specific information regarding regulatory, sampling, containerization, chemical analysis, and data acceptance criteria requirements.

*****END OF DOCUMENT*****

APPENDIX 7
TECHNICAL SPECIFICATIONS

CCB DISPOSAL CELL TECHNICAL SPECIFICATIONS

SOUTHERN COMPANY GENERATION
ENGINEERING AND CONSTRUCTION SERVICES

TECHNICAL SPECIFICATIONS

FOR THE

CONSTRUCTION OF THE BAGHOUSE BYPRODUCT STORAGE FACILITY

AT

PLANT GORGAS

ALABAMA POWER COMPANY

Prepared By: James C. Pegues Date: 03/06/13

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Civil Design Supervisor
Date: 03/06/13

REVISIONS

NO.	DESCRIPTION	BY	REVIEWED	APPROVED	DATE
0	Issued for Inquiry	JCP	ECO/THH	KAM	03/06/13
1	Issued for Inquiry	JCP	ECO/THH	KAM	04/01/13
2	Issued for Construction	JCP	ECO/THH	KAM	05/31/13

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TECHNICAL SPECIFICATION
FOR THE CONSTRUCTION OF THE
BAGHOUSE BYPRODUCT STORAGE FACILITY
AT
PLANT GORGAS
ALABAMA POWER COMPANY

1.0 GENERAL

Plant Gorgas is a fossil fueled electric generating plant located in Walker County, Alabama, along the Black Warrior River near of the city of Parrish. The purpose of this work is to develop the Baghouse Byproduct storage facility.

1.1 GENERAL INFORMATION

1.1.1 These Specifications, all related attachments and associated documents cover the furnishing of all materials (unless otherwise noted), labor, supervision, equipment, and tools required for the construction of the Baghouse Byproduct Storage Facility at Plant Gaston. The technical and construction requirements, including notes, Specifications, and design data continue on the Drawings. The Drawings and Notes are an integral part of these Specifications.

1.1.2 The provisions of these Specifications shall govern unless otherwise specified in the contract documents. In case of conflicting requirements, the contract documents shall govern. Discrepancies between the Drawings and the Specifications shall be brought to the attention of the Purchaser for resolution before the performance of the work. In the case of discrepancies between the scale dimensions on the Drawings and the dimensions the written dimensions shall govern.

1.1.3 The following terms shall apply to these Technical Specifications ("Specifications"):

a) The term-"Purchaser" means Alabama Power Company (APC).
b) The term “Contractor” means the entity awarded the contract to furnish the materials and perform the work as described herein, to construct the Baghouse Byproduct Disposal Facility as specified in the contract documents.
c) The term “Project Construction Manager”, (PCM), means the on-site manager of the project or his designated representative. He is the authorized representative at the site for the Purchaser.
d) The term "Purchaser's Representative" means the representative designated by the PCM to perform certain activities under these Specifications.

e) The terms "Accepted, Acceptable, or Approved" denotes that of which must be acceptable, accepted or approved by the Project Construction Manager or his authorized representative.

1.1.4 The Contractor shall ensure that all work is performed in accordance with the Occupational Safety and Health Act of 1970 and other Standards and Codes listed herein (latest revision).

1.1.5 The Contractor shall receive, unload, haul to site, handle, store, place, and secure all materials and equipment. Any security measures taken for the protection of the Contractor's equipment shall be at his expense.

1.1.6 The Contractor shall furnish and keep in good working condition at all times sufficient equipment of the proper design and capacity to do all work described under these Specifications and in accordance with the established schedule.

1.1.7 The Contractor shall furnish appropriate equipment for minimizing fugitive dust.

1.1.8 The Contractor shall comply with all applicable state and county regulations concerning hazardous material disposal and burning operations, if allowed by the Purchaser. The Contractor shall have the responsibility for obtaining any necessary permits for these activities.

1.1.9 All earthwork, including ramps and access roads, done for the convenience of the Contractor shall be done at his expense. Such work will be restored to its original elevation at the Contractor's expense if the Purchaser so desires.

1.1.10 The Contractor shall install, at his expense, any drainage piping required because of the Contractor's mode of operation including his ramps and roads.

1.1.11 The Contractor shall provide traffic control during roadway related construction activities and material deliveries. This shall be coordinated with other activities ongoing at the plant. If within active and congested areas around the plant, traffic control shall include flag persons, barriers, and other control aids to provide for the safe routing of traffic in the affected area.

1.1.12 The Contractor shall be responsible for hiring a qualified third party quality assurance firm or firms to handle all quality assurance testing. This shall be at the Contractor's expense.

1.1.13 The Contractor shall inform the Purchaser of any existing wells encountered within the footprint of the construction or the proposed borrow area that have not been previously abandoned. If present and abandonment is necessary, these wells shall be abandoned by the Purchaser. Monitoring wells shall not be damaged or destroyed by construction activities. Any monitoring well damaged or destroyed by the Contractor and his activities shall be replaced at no cost to the Purchaser.

1.2 APPLICABLE DOCUMENTS

1.2.1 Drawings – Reference Inquiry Package for Drawing List.

1.2.2 The following Codes, Standards, Specifications, Publications, and/or Regulations shall be made part of these Specifications and will become part of the contract entered into for performance of the work covered herein. The latest edition in effect at the time of the contract shall apply. Other codes and standards shall be incorporated as referenced in this document. The omission of any Codes and/or Standards from this list does not relieve the Contractor of his responsibility to follow the latest revision of all applicable codes and standards for conducting the work.

Occupational Safety and Health Administration

- Occupational Safety and Health Act of 1970

American Society for Testing and Materials (ASTM)

- ASTM D 422 – Standard Test Method for Particle-Size Analysis of Soils
- ASTM D 698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
- ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil In - Place by the Sand Cone Method
- ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D 2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
- ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D 2488 - Description and Identification of Soils (Visual-Manual Procedure)
- ASTM D 6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil – Aggregate In Place by Nuclear Methods
- ASTM D 2937 - Standard Test Method for Density of Soil In Place by the Drive Cylinder Method
- ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method

- ASTM D 4959 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method
- ASTM D 1587 - Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
- ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D 792 – Standard Test Methods for Density and Specific Gravity (relative density) and Density of Plastics by Displacement
- ASTM D 1004 - Standard Test Method for Tear Resistance of Plastic Film and Sheeting
- ASTM D 1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- ASTM D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique
- ASTM D 1603 - Standard Test Method for Carbon Black in Olefin Plastics
- ASTM D 3895 - Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry
- ASTM D 4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- ASTM D 5084 – Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- ASTM D 5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- ASTM D 5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- ASTM D 5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- ASTM D 5721 - Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
- ASTM D 5885 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
- ASTM D 5994 - Standard Test Method for Measuring Core Thickness of Textured Geomembranes

- ASTM D 6392 – Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- ASTM D 6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- ASTM D 4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
- ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- ASTM D 4716 - Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
- ASTM D 4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile
- ASTM D 5035 - Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
- ASTM D 5084 - Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- ASTM D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- ASTM D 5321 - Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
- ASTM D 5887 - Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
- ASTM D 5890 - Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
- ASTM D 5891 - Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
- ASTM D 5993 - Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners

- ASTM D 6243 - Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method
- ASTM D 6496 - Standard Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
- ASTM D 6768 - Standard Test Method for Tensile Strength of Geosynthetic Clay Liners
- ASTM D 7005 - Determining the Bond Strength (Ply Adhesion) of Geocomposites

Geosynthetic Research Institute GRI Standards

- GM 10 - The Stress Crack Resistance of HDPE Geomembrane Sheet
- GM 11 - Accelerated Weathering of Geomembranes using a Fluorescent UVA Device
- GM 12 - Asperity Measurement of Textured Geomembranes Using a Depth Gage
- GM 13 - Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Geomembranes
- GM 19 – Seam Strength and Related Properties of thermally Bonded Polyolefin Geomembranes

Corps of Engineers EM-LST, Appendix VII, Falling-Head Permeability Test

Codes specific to the local county

Alabama Department of Environmental Management regulations

Environmental Protection Agency (EPA) regulations

2.0 EARTHWORK

2.1 SITE CONDITIONS

2.1.1 The Contractor shall visit the site and acquaint himself with site conditions, utility locations, and the proposed scope of work.

2.2 LINES AND GRADES

2.2.1 The project shall be constructed to the elevations, lines, grades and cross sections shown on applicable Drawings. The Purchaser reserves the right to increase the foundation widths, change the embankment slopes, and to make other changes in the embankment sections as conditions indicate are necessary for the construction of a safe and permanent structure. The Contractor shall be compensated for changes in plan and/or sections resulting in changes of quantities of materials.

2.2.2 The above grade soil within the proposed footprint shall be removed down to base grade. The soil may be used for fill construction material if it meets the specifications of Section 2.5 and may be used for compacted clay liner if it meets the specifications of Section 2.6.

2.3 CLEARING, GRUBBING, AND STRIPPING

2.3.1 Clearing, grubbing and stripping will be required to prepare the work area for construction.

2.3.2 Prior to any clearing or grubbing operations, adequate erosion control measures should be in place. At a minimum, all federal, state and local guidelines should be followed.

2.3.3 Vegetated areas within the construction footprint shall be cleared, grubbed, and stripped of any vegetation, organic matter and/or any other debris. Stripped topsoil shall be stockpiled at a location on the site to be designated by the Project Construction Manager.

2.3.4 The grubbed area shall be harrowed and raked with a tractor-mounted root rake to collect all small material previously overlooked. The tractor shall be of adequate size to achieve a minimum of 4 inches penetration of the root rake teeth. The root rake teeth shall not be more than 12 inches apart.

2.3.5 Trees, stumps, and brush cleared from the above areas shall be disposed of by burning, if allowed by the Purchaser, by mulching, or by removal from the site. All burning shall be performed in accordance with state and local regulations. Burn pits shall be located outside of the construction area, borrow area, outside of future cell construction, and off right-of-ways.

2.3.6 Burning operations, if permitted by the Purchaser, shall be conducted only in previously cleared areas and away from standing timber, structures, or other flammable materials. Materials to be burned shall be properly stacked, by dozers, in piles sufficiently large enough to facilitate the complete burning of all the materials in the pile. The Contractor shall be subject to all public laws governing such burning operations and shall be responsible for any damage to life or property as a result of burning either on the Purchaser’s property or the property of others. Fires shall not be started unless tractors are available in the immediate vicinity to check the spread of fire outside the cleared area. Fires shall be guarded at all times and shall be under constant attendance until they have burned out or have been extinguished.

2.3.7 Spoil material shall be disposed of only in areas to be designated by the Purchaser. The Contractor shall slope the spoil area for drainage, implement necessary erosion control measures, and provide a perennial stand of vegetation.

2.4 SUBGRADE PREPARATION

2.4.1 Erosion and sediment control measures shall be prepared and placed first, where necessary.

2.4.2 Existing overburden soils shall be excavated to the excavation limits indicated on the drawings. Material suitable for topsoil, material to be used as fill material and material suitable for use as clay liner material shall all be stockpiled separately.

2.4.3 The entire cell subgrade shall be proof-rolled utilizing loaded, off-road trucks with a gross machine weight, including payload of 40 tons of soil, that will impart approximately 7600 psf subgrade loading over a minimum tire width of 2 feet. Prior to receiving earth fill, the foundation area shall be scarified by harrowing or other suitable means.

2.4.4 Any areas failing proof roll shall be undercut and replaced with compacted structural soil fill and re-rolled.

2.4.5 No fill shall be placed on any part of the subgrade until such areas have been proof rolled and approved by the Purchaser.

2.4.6 Work flow shall be planned such that the first fill lift is placed soon after subgrade compaction to minimize subgrade exposure to inclement weather.

2.4.7 The Contractor shall be required to prepare the base and interior dike slopes, including the sedimentation pond, for installation of the liner surface as shown on the Drawings. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than ½-inch in diameter, or debris of any kind. These surfaces shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade.

2.5 FILL MATERIAL

2.5.1 <u>General</u>

2.5.1.1 On site soils consist of clay with various fractions of weathered rock. Coal mine spoils, consisting of predominantly gravel size particles, are also present. Non-organic, non-plastic soils and coal mine spoils excavated from the site are generally suitable for fill materials if they meet the specifications in Sections 2.5.2 and 2.5.3.

2.5.1.2 Quality control testing shall be performed on all earth fill in accordance with Section 2.8 of this Specification.

2.5.1.3 No earth fill layer may be placed until the Project Construction Manager has verified that the underlying layer has met the compaction and/or moisture requirements.

2.5.2 Rock

2.5.2.1 Rock at the site consists of Shale and Sandstone.

2.5.2.2 Rock materials excavated from the site may be used for fill materials under the following conditions:

- Rock fragments larger than 4 inches may not be used as structural fill (as defined in Section 2.5.3).
- Rock fill may not be placed within the upper 5 feet of any fill area.
- Rock shall at no time be placed directly beneath a liner.
- Particle sizes larger than 24 inches may not be used for fill material in any circumstances.

2.5.3 Structural Fill

2.5.3.1 Structural fill will be required for the construction of the berms for the sedimentation pond, the storage cell and other uses, if any, requiring compacted fill.

2.5.3.2 Structural fill shall consist of the soil, rock or mine spoils materials meeting the requirements stated herein and shall be placed and compacted in accordance with these Specifications.

2.5.3.3 Fill materials may be used if the total organic carbon (TOC) content is less than 5% and if approved by the Project Construction Manager. Material with greater than 5% TOC may not be used under the footprint of the dike or as structural dike fill. The Contractor must provide laboratory analysis for approval by the Project Construction Manager.

2.5.3.4 Material with greater than 5% TOC may be used as structural dike fill if it is blended with other soil to fulfill the TOC requirement.

2.5.3.5 Structural fill will contain no particle sizes greater than 4 inches in diameter.

2.5.3.6 Preparation for structural fill shall consist of the removal of any organic or deleterious materials present within the extent of the fill operation.

2.5.3.7 Structural fill shall be placed in uniform layers of eight inches, nominal thickness, loose measurement, for one foot beyond the full width of the fill on each side. Each layer shall be kept level with the necessary grading equipment. Upon completion of compaction, the slopes shall be cut back to the final slope. Particular care must be used to obtain the required compaction along the edges of the fill slopes. Slopes will require compaction after they have been cut back to minimize water infiltration and erosion.

2.5.3.8 During the dumping and spreading processes, the Contractor shall maintain at all times a force of men adequate for removal of roots and debris from all structural fill materials and all stones greater than four inch maximum dimension. Stones, roots, and debris shall be removed from the structural fill and disposed of in an approved manner.

2.5.3.9 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Project Construction Manger, before the succeeding layer is placed.

2.5.3.10 When moisture content is too low, the moisture content shall be adjusted to within the specification. Moisture adjustment shall be done by wetting and disking sufficiently to bring the moisture content within the specified range.

2.5.3.11 If the moisture content is too high, the Contractor will be permitted to stockpile and disk the fill material to promote drying to bring it back within the allowable moisture range. Scarifying of the lift and recompaction after drying shall also be permitted.

2.5.3.12 The Contractor will be required to remove any compacted material that does not comply with the compaction requirements (density or moisture) and replace the fill at his own expense.

2.5.3.13 Structural fill which cannot be compacted with roller equipment because of inadequate clearances shall be spread in 4-inch layers and compacted with power tampers to the extent required by the specifications for structural fill material.

2.5.3.14 Earth fill material that is not clay liner shall be compacted to a minimum 95% maximum dry density, as determined by the Standard Proctor compaction test (ASTM D698). The moisture content of the earth fill at the time of placement shall be between -3% and +3% of the optimum moisture obtained by Standard Proctor compaction test. The Contractor shall strive to place the earth fill material on the wet side of optimum.

2.5.3.15 The Contractor will be required to remove any compacted material that does not comply with the compaction and/or moisture requirements and replace the compacted earth fill to comply with these Specifications at his own expense.

2.5.3.16 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified in this Section.

2.5.3.17 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to insure that the correct reference Proctor curves are being used for compaction check

2.5.3.18 If the construction of the facility is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of earth fill material before placing additional layers.

2.5.3.19 Exterior dike slopes shall be grassed upon reaching final grade in accordance with the Vegetation Schedule from Section 8.

2.6 COMPACTED CLAY LINER

2.6.1 A compacted clay liner shall be installed as the upper twelve (12) inches of earth fill underlying the GCL and HDPE liner. The clay liner shall be placed and compacted in accordance with these Specifications and Drawings.

2.6.2 Compacted clay liner material shall have a in-place permeability equal to or less than 1×10^{-5} cm/sec, shall meet USCS Classification of CL, CH or SC, shall contain a minimum of 30% material passing the #200 sieve, shall have a liquid limit (LL) of greater than or equal to 30, shall have a plasticity index (PI) greater than or equal to 7, shall have a maximum clod size of 2 inches, and shall be free of organics or other debris.

2.6.3 Prior to placement of the clay liner, the borrow material shall be sampled to test its feasibility for use as a clay liner. A minimum of three soil samples of clay shall be obtained for laboratory testing from the clay portion of the borrow area. Laboratory testing on the clay samples shall include the Standard Proctor density (ASTM D 698), permeability by constant head (ASTM D 5084) or falling head test, grain size distribution and hydrometer analysis (ASTM D 422), Atterberg Limits (ASTM D 4318) and in-place moisture (ASTM D 2216).

2.6.4 Clay liner material shall be placed in uniform layers of 8 inches, nominal thickness, loose measurement. Each layer shall be kept level with the necessary grading equipment. Upon completion of compaction, fill slopes shall be cut back to the final slope.

2.6.5 Quality control testing shall be performed on the liner in accordance with Section 2.8 of this Specification. No clay liner layer may be placed until the Project Construction Manager has verified that the underlying layer has met the compaction, permeability, and/or moisture requirements.

2.6.6 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Project Construction Manger, before the succeeding layer is placed.

2.6.7 Clay liner material shall be compacted to a minimum 95% maximum dry density, as determined by the Standard Proctor compaction test (ASTM D 698), or to the percent compaction required to achieve the specified permeability, whichever is greater. The moisture content of the clay liner at the time of placement shall be +1% to +3% wet of optimum as determined by the Standard Proctor compaction test.

2.6.8 When moisture content is too low, the moisture content shall be adjusted to within the above specification prior to compaction. Moisture adjustment shall be by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and disking of the layer shall be done after deposition, but before compaction.

2.6.9 If the moisture content is too high, the Contractor will be permitted to stockpile and disk the liner material to promote drying to bring it back within the allowable moisture range. This drying must be done prior to placement.

2.6.10 Liner material which cannot be compacted with roller equipment because of inadequate clearances shall be spread in 4-inch layers and compacted with power tampers to the extent required by the specifications in this Section.

2.6.11 The Contractor will be required to remove any compacted material that does not comply with the compaction, moisture, and/or permeability requirements and replace the compacted earth fill to comply with these Specifications at his own expense.

2.6.12 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified in this Section.

2.6.13 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to insure that the correct reference Proctor curves are being used for compaction check.

2.6.14 If the construction of the clay liner is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of liner material before placing additional layers.

2.6.15 The Contractor shall be required to repair erosion features, desiccation cracks, and other defects in the clay liner. All soils and sediments that have been transported onto the active clay liner placement areas from storm runoff shall be removed or graded away from the clay liner. All repairs to the liner shall be completed prior to the subsequent lift of clay material placed.

2.7 EARTHWORK EQUIPMENT

2.7.1 The Earthwork Contractor shall be responsible for providing all earthwork equipment necessary to perform the work set forth in these Specifications. The Contractor shall be responsible for maintaining the equipment during the contract period. Any delays in work activities due to equipment maintenance must be reported to the Project Construction Manager for determination of impacts on the schedule.

2.7.2 The Contractor shall be responsible for the cleaning of haul vehicles. The Contractor shall wash down the wheels, outside body, cab, undercarriage, etc. of all haul vehicles to prevent spreading material during transit of the equipment out of the boundary of the working area.

2.7.3 All of the Contractor’s equipment shall be operated in a safe, careful manner in accordance with these Specifications.

2.8 QUALITY CONTROL TESTING

2.8.1 Field density and moisture content testing shall be performed by a third party quality assurance firm at the Contractor’s expense to verify that compaction requirements have been achieved. In-place field density testing of the compacted soil shall be performed in accordance with the procedure ASTM D 1556, the sand cone method. Test results reports should include both the moisture content and dry density, along with other data such as location, elevation, Proctor curve used for comparison, etc.

2.8.2 Testing procedures of in-place density and moisture content by nuclear methods is described in ASTM D 6938. This procedure may be used provided: 1) acceptable correlation with sand cone density test results can be obtained according to the guidelines of Section 7, “Calibration”, of ASTM D 6938, and 2) the initial correlation results are reviewed and use of the nuclear device is approved by the Project Construction Manager. In addition, it shall be required that the testing agency or representative have the necessary licenses to operate a nuclear energy source, and to take all safety precautions per Section 6 of ASTM D 6938.

2.8.3 In the event of repeated failures, or water content and density test values plotting far from the Proctor curves used for comparison in computing percent compaction, it shall be the option of the Project Construction Manager to require one or two point Proctor checks (on the dry side of optimum) to verify that the proper Proctor curve is being referenced. If not, a new Proctor curve determined by a five-point test shall be required. The Contractor shall sample and perform the five-point testing, all at the Contractor’s expense.

2.8.4 If the compaction requirements for a lift have not been achieved, the Purchaser shall direct the Contractor to either rework the lift to obtain the compaction requirements or remove and replace with a new lift for compaction, all at the Contractor’s expense.

2.8.5 The in-place water content and density testing frequency for all compacted soil, including the clay liner, shall be one test for each 20,000 square feet of lift area or portion thereof for each lift, with a minimum of one test performed for each 200 lineal feet of dike per lift as measured parallel to the dike axis.

2.8.6 Laboratory confirmation testing for the compacted clay liner material placed in the upper twelve (12) inches below the final grade shall be performed to verify that the permeability of the compacted liner is equal to or less than 1×10^{-5} cm/sec using either the falling head or back pressure permeability test. The confirmation testing shall consist of obtaining undisturbed samples of the clay liner for laboratory confirmation of field density, moisture content, and hydraulic conductivity of field compacted material. The undisturbed samples shall be obtained by pushing a thin walled drive cylinder into the compacted liner at a frequency of one (1) tube per one (1) acre of liner material per lift.

2.8.7 The drive tubes used to collect the undisturbed samples shall be cleaned and paraffin sealed to preserve the moisture content and delivered to the independent soil testing laboratory. The location, lift, and depth below the surface should be recorded with each sample. The undisturbed samples shall be stored and handled in such a manner as to prevent damage to the sample from freezing, transporting or other means. After the undisturbed samples are taken, the holes shall be filled with bentonite (powder, chips, or pellets) to maintain the integrity of the fill.

2.8.8 The results of all permeability tests by the testing laboratory shall be reported to the Owner's Engineer. If any permeability test result is higher than the minimum required value of 1 x 10^{-5} cm/sec, the Contractor shall rework or replace a section or entire lift of the clay layer being constructed, at the Contractor's expense. All reworked or replaced sections of clay liner shall be retested and meet the minimum permeability requirements.

3.0 DRAINAGE DITCHES, CHANNELS AND SLOPES

3.1 GENERAL

3.1.1 All drainage channels and perimeter drainage ditches shall be excavated to the lines, grades, cross-sections, and elevations indicated on the Drawings. The waterways shall be free of bank projections or other irregularities which will impede normal flow.

3.1.2 All earth removed and not used in construction shall be disposed of so that it will not interfere with the functioning of the waterway.

4.0 GEOSYNTHETIC CLAY LINER (GCL)

4.1 GENERAL

4.1.1 A geosynthetic clay liner (GCL) overlying the compacted clay liner shall be used as part of the composite liner system for the site. The GCL shall be placed underlying the HDPE in the following areas: a) the bottom and side slopes of Cells 1 and 2 ; b) the bottom and side slope of the sedimentation ponds .

4.1.2 The GCL shall be placed in accordance with these Specifications, the manufacturer's recommendations, and the details indicated on drawings.

4.1.3 The Contractor shall provide panel placement, placement procedures, and GCL connection details to the Purchaser fourteen (14) days prior to the start of GCL installation.

4.1.4 The Contractor shall furnish the GCL Manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the product's specifications.

4.2 GCL CONTRACTOR QUALIFICATIONS

4.2.1 The manufacturer of the geosynthetic clay liner (GCL) must have produced at least ten (10) million square feet of product, with at least eight (8) million square feet installed.

4.2.2 The GCL installer must either have installed at least one (1) million square feet of product, **or** must provide to the Purchaser's Representative satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner.

4.2.3 The Contractor shall provide a third-party inspector for construction quality control (CQC) of the GCL installation. The GCL inspector shall be an individual or company who is independent from the manufacturer and installer, who shall be responsible for monitoring and documenting activities related to the CQC of the GCL, throughout installation. The GCL inspector shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The inspector should be an engineer registered to practice in the state of Alabama or a geosynthetics installation technician certified through the Inspector Certification Program (ICP) administered by the Geosynthetics Certification Institute (GCI). The Contractor shall provide the Purchaser with a statement of qualifications (SOQ) for the inspector with the bid.

4.4.4 A Manufacturer's Representative may be on site during the initial phase of the GCL installation to provide assistance to the Contractor.

4.3 MATERIAL

4.3.1 The GCL to be used in the storage cells and associated ponds and ditches on slopes greater than 3H to 1V shall be a CETCO Continuum DN, GSE BentoLiner CAR NWL, or equal material, approved by the Purchaser.

4.3.2 The GCL to be used in the storage cells and associated ponds and ditches on slopes of 10H to 1V up to slopes of 3H to 1V shall be a CETCO Continuum ST, GSE BentoLiner CAR NWL, or equal material, approved by the Purchaser.

4.3.2 The GCL to be used on the bottom of the gypsum cells and associated ponds shall be a CETCO-Continuum 200R, GSE BentoLiner CAR EC, or equal material, approved by the Purchaser.

4.3.3 The GCL and its components shall have the following properties:

GCL (modified per GRI-GCL3)			
Material Property	**ASTM Test Method**	**Test Frequency**	**Required Values**
Clay Properties (as received)			
Swell Index	D 5890	1/100,000 lb	24 mL/2g
Fluid Loss(1)	D 5891	1/100,000 lb	18 mL
Geotextiles (as received)			
Cap fabric (non-woven) – mass/unit area	D 5261	25,000 yd^2	3.0
Carrier fabric (non-woven composite	D 5261	25,000 yd^2	3.0
GCL (as manufactured)			
Mass of GCL (2)	D 5993	5,000 yd^2	0.82 lb/ft^2
Mass of Bentonite (2)	D 5993	5,000 yd^2	0.75 lb/ft^2
Tensile Strength, MD	D 6768	25,000 yd^2	23 lb/in
Flux(1)	D 5887	30,000 yd^2	1×10^{-6} $cm^3/sec\text{-}cm^2$
Permeability(1)	D 5887	30,000 yd^2	1×10^{-8} cm/sec

Notes

(1) These values are maximum. All others are minimum.

(2) Mass of GCL and bentonite is measured after oven drying per the stated test method.

4.4 LABELING AND PACKAGING

4.4.1 Prior to shipment, the GCL manufacturer shall label each roll, identifying the product identification information (manufacturer’s name and address, brand product code), lot number, roll number, roll length, width and weight.

4.4.2 The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

4.4.3 All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

4.5 SHIPPING, HANDLING AND STORAGE

4.5.1 The manufacturer assumes responsibility for initial loading the GCL. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the GCL are the responsibility of the Contractor, installer or other designated party.

4.5.2 A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

4.5.3 The party responsible for unloading the GCL should contact the manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

4.5.4 Storage of the GCL rolls shall be the responsibility of the installer. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well-drained.

4.5.5 Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four (4) feet).

4.5.6 All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

4.5.7 The integrity and legibility of the labels shall be preserved during storage.

4.6 SURFACE PREPARATION

4.6.1 Any surface upon which the GCL is installed shall be prepared and compacted in accordance with these Specifications and the Drawings. The finished surface shall be smooth, firm, and unyielding, without abrupt elevation changes, voids, cracks, ice, or standing water and free of vegetation, sticks, debris, rocks greater than ½ inch, and any other foreign matter which could puncture or damage the overlying GCL. There shall be no rutting, tire tracks or shrinkage cracks in the prepared surface.

4.6.2 The Contractor, on a daily basis, shall approve the surface on which the GCL will be installed. After the supporting soil surface has been approved, it shall be the Contractor’s responsibility to indicate to the Purchaser any changes to its condition that may require repair work.

4.6.3 The Contractor shall certify in writing that the subgrade on which the GCL is to be installed is acceptable. This shall be done prior to commencing work. It shall be the Contractor's responsibility thereafter to indicate to the Purchaser any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this Section.

4.6.4 Immediately prior to GCL deployment, the subgrade shall be finish-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than one-half inch (12 mm) from the surface shall be removed, crushed or pushed into the surface with a smooth-drum compactor.

4.6.5 The Contractor shall submit certificates of subgrade acceptance, signed by the Contractor, QC Inspector, and the Purchaser's Representative, for each area prepared for GCL placement.

4.6.6 Along the top of slope of lined cells, ditches, and ponds, an anchor trench for the GCL, HDPE, and geocomposite shall be excavated. The trench shall be excavated and approved by the Purchaser's Representative prior to GCL placement. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench.

4.7 GCL PLACEMENT

4.7.1 The GCL shall be placed in accordance with guidelines and specifications provided by the manufacturer of the material unless otherwise noted.

4.7.2 GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL.

4.7.3 Equipment which could damage the GCL shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues. Low ground pressure ATV's (6 psi or less) will be allowed to ride over the GCL surface during installation and repair operations.

4.7.4 Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL and the subgrade.

4.7.5 The GCL panels shall be placed parallel to the direction of the slope. All GCL panels should lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels.

4.7.6 Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The Purchaser's Representative and GCL supplier should be consulted for specific guidance if premature hydration occurs.

4.7.7 As directed by the project drawings and specifications, the end of the GCL roll shall be placed in an anchor trench at the top of the slope. When utilizing an anchor trench design, the front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor and the rear trench wall.

4.7.8 There shall be a five (5)-foot overlapping transition zone between the higher strength GCL to be placed on the side slopes and the GCL to be placed on the bottom interior of the cells (if two different products are used).

4.8 SEAMING

4.8.1 The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required.

4.8.2 The minimum dimension of the longitudinal overlap should be six (6) inches (150 mm). End-of-roll overlapped seams should be similarly constructed, but the minimum overlap should measure 24 inches (600 mm).

4.8.3 Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.

4.8.4 Unless the GCL contains bentonite grooves to facilitate seaming without additional bentonite, bentonite-enhanced seams are constructed between the overlapping adjacent panels described above. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the six (6)-inch (150 mm) line. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m).

4.8.5 The granular bentonite sealing clay used for overlap seaming, penetration sealing, and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer.

4.9 DAMAGE REPAIR

4.9.1 Any GCL that is damaged during delivery or handling operations and cannot be used in the liner installation shall be replaced by the Contractor at no additional cost to the Purchaser.

4.9.2 If any GCL is damaged during installation, to include placement of the overlying HDPE liner and placement and compaction of the protection soil cover and topsoil, and the Purchaser determines the GCL will not perform for the liner system, then the affected installed GCL shall be replaced by the Contractor at no additional cost to the Purchaser.

4.9.3 If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

4.9.4 After installation, the Contractor shall submit certificates, signed by the Contractor, the Purchaser’s Representative, and the CQC Inspector, that the GCL was repaired in accordance with these Specifications.

4.10 TESTING

4.10.1 Upon request by the Purchaser, the Contractor shall provide samples of the GCL delivered to the site for testing by an independent laboratory. This testing will be the responsibility of the Purchaser.

5.0 GEOMEMBRANE (HDPE) LINER

5.1 GENERAL

5.1.1 A textured, high density polyethylene (HDPE) liner shall be placed on the bottom and inside slopes of Cells 1 and 2 and along the bottom and inside slopes of the sedimentation ponds, as shown on the Drawings.

5.1.2 The HDPE liner material shall meet the requirements of this Section and shall be installed with perimeter anchor trenches as shown on the Drawings.

5.1.3 Heavy vehicles shall not be permitted to operate directly on the liner material. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than six (6) psi.

5.1.4 In areas of heavy traffic, the geomembrane shall be protected by placing protective cover over the geomembrane.

5.1.5 If the geomembrane is damaged by vehicular traffic, it shall be replaced at the Contractor's expense.

5.1.6 In the bottom of the cell (not including the sides of the dike), the HDPE liner shall be overlain by double-sided geocomposite drainage material.

5.1.7 A Manufacturer's Representative may be on site during the initial phase of the HDPE installation to provide assistance to the Contractor.

5.2 GEOMEMBRANE CONTRACTOR QUALIFICATIONS

5.2.1 The manufacturer of the HDPE material shall have at least five (5) years continuous experience in manufacturing polyethylene geomembrane and/or experience totaling 10,000,000 square feet of manufactured polyethylene geomembrane.

5.2.2 The installation contractor shall be qualified and trained to install the manufacturer's geomembrane. Installation shall be performed under the constant direction of a field installation supervisor who shall remain on site and be responsible, throughout the liner installation, for liner layout, seaming, testing, repairs, and all other activities by the Installer. The field installation supervisor shall have installed or supervised the installation of a minimum of 2,000,000 square feet of polyethylene geomembrane. Seaming shall be performed under the direction of a master seamer (who may also be the field installation supervisor) who has seamed a minimum of 1,000,000 square feet of polyethylene geomembrane, using the same type of seaming apparatus specified for this project. The field installation supervisor and/or master seamer shall be present whenever seaming is performed.

5.2.3 The Contractor shall provide a third-party inspector for construction quality control (CQC) of the HDPE installation. The HDPE inspector shall be an individual or company who is independent from the manufacturer and installer, who shall be responsible for monitoring and documenting activities related to the CQC of the HDPE throughout installation. The inspector shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The Contractor shall provide the Purchaser with a statement of qualifications (SOQ) for the HDPE inspector prior to starting work.

5.3 GEOMEMBRANE MATERIAL

5.3.1 The geomembrane shall be 60 mil thick, textured on both sides, high density polyethylene (HDPE), a minimum 22.5 feet seamless width, as manufactured by Gundle/SLT Environmental Incorporated (GSE), or an approved equal. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.

5.3.2 The Contractor shall provide QC certificates for both the liner and the welding rods.

5.3.3 The surface of the geomembrane shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter except that, if in the opinion of the Purchaser's Representative the blemish will not adversely affect properties and use of the liner, the Purchaser's Representative may accept the liner after sufficient laboratory test data are provided to support such acceptance, and further provided all such testing is done at the sole expense of the Contractor.

5.3.4 The geomembrane shall be supplied in rolls. Labels on each roll shall identify the thickness of the material, the length and width of the roll, batch and roll numbers, and the name of the manufacturer.

5.4 GEOMEMBRANE RAW MATERIALS

5.4.1 The geomembrane shall be manufactured of polyethylene resins and shall be compounded and manufactured specifically for the intended purpose. The Contractor shall submit a certification from the manufacturer of the geomembrane that the sheeting meets the following physical property requirements.

Property	Test Method	HDPE Requirements
Density, g/cc	ASTM D 1505	0.932
Melt Index,g/10 min.	ASTM D 1238	≤1.0
OIT, min	ASTM D 3895 ASTM D 5885	100

5.5 GEOMEMBRANE ROLLS

5.5.1 The geomembrane rolls shall meet or exceed the following specifications. Certification shall be provided for each roll stating that these items have been met or exceeded. The certification shall reference the manufacturer's batch and roll number and shall indicate the name of the manufacturer.

TEXTURED HDPE GEOMEMBRANE - 60 MIL (Per GRI GM-13 and GRI GM-19)

Property	**Frequency**	**Test Method**	**Minimum Average Value**
Thickness 1. Minimum Average 2. Lowest individual of 8 of 10 readings 3. Lowest individual of 10 readings	per roll	ASTM D 5994	57 mil nom 54 mil 51 mil
Asperity Height[1]	Every 2nd Roll	GRI GM12	10 mil
Density	Once per 200,000 lbs of resin	ASTM D 1505 ASTM D 792	≥ 0.940 g/cc
Tensile Properties[2] 1. Yield Strength 2. Break Strength 3. Yield Elongation 4. Break Elongation	20,000 lbs.	ASTM D 6693, Type IV Dumbell, 2 ipm G.L.=1.3 in G.L.=2.0 in	≥ 126 lb/in ≥ 90 lb/in 12 % 100 %
Tear Resistance	45,000 lbs	ASTM D 1004	≥ 42 lb (min. avg.)
Puncture Resistance	45,000 lbs	ASTM D 4833	≥ 90 lb (min. avg.)
Stress Crack Resistance	per GRI GM-10	ASTM D 5397 (App.)	300 hr
Carbon Black Content	20,000 lbs.	ASTM D 4218	2.0 % - 3.0 %
Carbon Black Dispersion[3] 1. Categories 1 or 2 2. Category 3	45,000 lbs.	ASTM D 5596	9 1
Oxidative Induction Time (OIT) Standard OIT or High Pressure OIT	200,000 lbs	ASTM D 3895 ASTM D 5885	100 min. (min. avg.) 400 min. (min. avg.)
Seam Properties 1. Shear Strength 2. Peel Strength a) Hot Wedge		ASTM D 6392	120 lb/in 91 lb/in

b) Extrusion Fillet			78 lb/in
Oven Aging @ 85ºC [7][8] 1. Standard OIT (min. avg.) - % retained after 90 days 2. High Pressure OIT (min. avg.) - % retained after 90 days	Per Each Formulation	ASTM D5721 ASTM D3895 ASTMD5885	55% 80%
UV Resistance [9] 1. Standard OIT (min. avg.) 2. High Pressure OIT (min. avg.) - % retained after 1600 hours [11]	Per Each Formulation	GM11 ASTM D3895 ASTMD5885	N. R. 50%

Notes:

1 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥5 mils.

2 The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. therefore, these tensile properties are minimum average values.

3 Dispersion only apples to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than one (1) view from Category 3.

5.6 GEOMEMBRANE INSTALLATION

5.6.1 The geomembrane shall be packaged and shipped by appropriate means to ensure that no damage is incurred. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. The rolls shall be stored on a prepared smooth surface (not wooden pallets) and shall not be stacked.

5.6.2 The manufacturer assumes responsibility for initial loading the geomembrane. Off-loading and storage of the materials shall be the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Purchaser. No off-loading shall be done unless monitored by the Purchaser’s Representative. Damage occurring during off-loading shall be documented by the Purchaser and the Contractor. The Purchaser shall be the final authority on determination of damage.

5.6.3 The installation of the geomembrane shall be in accordance with the manufacturer’s recommendations and these Specifications. The Contractor shall submit a panel layout drawing and a detailed, written procedure for the Purchaser’s review fourteen days prior to installation.

5.6.4 All seams and non-seam areas of the geomembrane shall be inspected by the inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

5.6.5 The anchor trench shall be excavated to the lines, grades, and widths shown on the project construction drawings, prior to liner system placement. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the geomembrane.

5.6.6 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.

5.6.7 The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the Purchaser’s Representative. Placement of the geomembrane shall not damage the clay liner.

5.6.8 Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

5.6.9 Personnel working on the geomembrane shall not smoke or wear damaging shoes.

5.6.10 The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil.

5.6.11 Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

5.6.12 Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F. Placement can proceed below 32° F only after it has been verified by the inspector that the material can be seamed according to the specification. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the installation supervisor.

5.7 GEOMEMBRANE FIELD SEAMING

5.7.1 Field seams shall be made in accordance with the manufacturer’s recommendations. The Contractor shall submit a copy of the proposed seaming procedures for the Purchaser’s review.

5.7.2 Approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Cross seams will be allowed on slopes provided that cross seams are cut at 45º and adjacent cross seams are staggered. Cross seams will be kept to the lower half of the slope and only one cross seam will be allowed per panel slope length.

5.7.3 No base T-seam shall be closer than five (5) feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and “fishmouths”. If a fishmouth or wrinkle is found, it shall be relieved and cap-stripped.

5.7.4 Geomembrane panels must have a finished minimum overlap of four (4) inches for fusion welding and six (6) inches for extrusion welding.

5.7.5 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

5.8 GEOMEMBRANE FIELD TEST SEAMS

5.8.1 Field test seams shall be made in accordance with the manufacturer’s recommendations. The Contractor shall submit a copy of the proposed testing procedures for the Purchaser’s review.

5.8.2 Field test seams shall be conducted on the liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each seaming period and at least once every four (4) hours, for each seaming apparatus and personnel used that day.

5.8.3 All test seams shall be made in contact with the subgrade. Welding rod used for extrusion welding shall have the same properties as the resin used to manufacture the geomembrane.

5.8.4 The installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing or Air Pressure Testing (for double fusion seams only).

5.9 GEOMEMBRANE DESTRUCTIVE SEAM TESTING

5.9.1 Destructive seam testing should be minimized to preserve the integrity of the liner. The Contractor shall provide the Purchaser with one (1) destructive test sample once per 500 cumulative feet of seam length from a location specified by the inspector.

5.9.2 In order to obtain test results prior to completion of liner installation, samples shall be cut by the installer as the seaming progresses. The installer shall also record the date, location, and pass or fail description. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately patched and vacuum tested.

5.9.3 The samples shall be 12 inches wide by 36 inches long with the seam centered lengthwise. The sample shall be cut into three equal-length pieces, one to be given to the inspector, one to be given to the Purchaser, and one to the installer.

5.9.4 The inspector shall test ten one (1)-inch wide specimens from his sample; five (5) specimens for shear strength and five (5) for peel strength. Seam test results shall be evaluated using the current GRI Test Method GM19 which allows for 4 or 5 specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel excursion will not exceed 25%.

5.9.5 The Purchaser, at his discretion and expense, may send seam samples to a laboratory for testing. The test method and procedures to be used by the independent laboratory shall be the same as used in field testing.

5.9.6 The following procedures shall apply whenever a sample fails the field destructive test:

A. The installer shall cap strip the seam between the failed location and any passed test locations.

B. The installer can retrace the welding path to an intermediate location (usually 10 feet from the location of the failed test), and take a sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, then the process is repeated.

C. Over the length of seam failure, the installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.

5.9.7 Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non-destructive testing shall be marked by the inspector, and repaired accordingly.

5.9.8 Repair Procedures

- Defective seams shall be cap stripped or replaced.

- Small holes shall be repaired by extrusion welding a bead of extrudate over the hole. If the hole is larger than one-quarter inch, it shall be patched.

- Tears shall be repaired by patching. If the tear is on a slope or an area susceptible to stress and has a sharp end it must be rounded prior to patching.

- Blisters, large cuts and undispersed raw materials shall be repaired by patches.

- Patches shall be completed by extrusion welding. The weld area shall be ground no more than 10 minutes prior to welding. No more than 10% of the thickness shall be removed by grinding. Welding shall commence where the grinding started and must overlap the previous seam by at least two (2) inches. Reseaming over an existing seam without regrinding shall not be permitted. The welding shall restart by grinding the existing seam and rewelding a new seam.

- Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of six (6) inches beyond the edge of defects.

5.9.9 Verification of Repairs

- Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

- The inspector shall keep daily documentation of all non-destructive and destructive testing. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested.

5.10 BACKFILLING OF ANCHOR TRENCH

5.10.1 The anchor trench shall be backfilled by the earthwork contractor. Trench backfill material shall be placed and compacted in accordance with these specifications.

5.10.2 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. If damage occurs, it shall be repaired prior to backfilling.

5.11 GEOMEMBRANE ACCEPTANCE

5.11.1 The installer shall retain all ownership and responsibility for the geomembrane until accepted by the Purchaser. Final acceptance is when all of the following conditions are met:

- Installation is Finished
- Verification of the adequacy of all field seams and repairs, including associated testing, is complete.
- Sign-off of acceptance of the geomembrane has been made by the Purchaser.

6.0 GEOCOMPOSITE DRAINAGE MATERIAL

6.1 GENERAL

6.1.1 A geocomposite drainage material shall be placed on the bottom and inside slopes of Cells 1 and 2, overlying the HDPE liner as shown on the construction drawings.

6.1.2 The geocomposite on the bottom and inside side slopes of Cells 1 and 2 shall be covered with a one (1)-foot layer of soil having a minimum permeability of 1 x 10^{-3} cm/sec.

6.1.3 The drainage material shall be placed in accordance with these Specifications, the manufacturer’s recommendations, and the details indicated on drawings.

6.1.4 Heavy vehicles shall not be permitted to operate directly on the geocomposite drainage material. Rubber-tired ATV’s and trucks are acceptable if wheel contact is less than six (6) psi.

6.2 GEOCOMPOSITE CONTRACTOR QUALIFICATIONS

6.2.1 The drainage material manufacturer shall have successfully manufactured five (5) million square feet of polyethylene drainage material.

6.2.2 Installation of the drainage material shall be performed by the manufacturer or be a manufacturer-approved dealer/installer. The drainage material installer must either have installed at least one (1) million square feet of product, **or** must provide to the Purchaser satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner.

6.2.3 The installation supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the contract documents.

6.2.4 The Contractor shall provide, at its expense, a third-party inspector for CQC of the geocomposite installation. The inspector shall be an individual or company who is independent from the manufacturer and installer and shall be responsible for monitoring and documenting activities related to the CQC of the geocomposite throughout installation. The inspector shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The Contractor shall provide the Purchaser with a statement of the inspector's qualifications prior to starting installation of the geocomposite.

6.2.5 A Manufacturer’s Representative may be on site during the initial phase of the geocomposite installation to provide assistance to the Contractor.

6.3 GEOCOMPOSITE LABELING, DELIVERY, STORAGE, AND HANDLING REQUIRMENTS

6.3.1 Each roll of material delivered to the site shall be wrapped and labeled by the manufacturer. The label shall contain the following information:

- manufacturer’s name
- product identification
- length and width
- roll number

6.3.2 The drainage material will be stored as specified by the manufacturer in an area specified by the Purchaser. The storage will be free of materials capable of damaging the material.

6.3.3 Unloading of the drainage material from the delivery trucks will be performed by the Contractor. Unloading of the materials will be performed as directed by the manufacturer.

6.3.4 The rolls must be adequate for safe transportation to the point of delivery, offloading and storage. Storage measures will be taken as specifically stated by the manufacturer.

6.4 GEOCOMPOSITE PROPERTIES

6.4.1 The geocomposite shall consist of one (1) layer of HDPE drainage net (geonet) connected to two (2) layers of geotextile to create a double-sided geocomposite. The geocomposite drainage layer shall be TransNet TN 330, as manufactured by SKAPS, or approved equal.

6.4.2 The geocomposite shall be manufactured of new first quality polyethylene resin and shall be compounded and manufactured specifically for the intended application.

6.4.3 The properties of the drainage layer shall be as follows:

Tested Property	Test Method	Units	Value	Qualifier
Geonet Core (1)				
Thickness	ASTM D 5199	mil	330±30	range
Density	ASTM D 1505	g/cc	0.94	minimum
Carbon Black Content	ASTM D 4218	%	2.0 to 3.0	range
Tensile Strength	ASTM D 5035	lbs/inch	95	minimum
Transmissivity(2)	ASTM D 4716	m^2/sec	8 x 10^{-3}	MARV
Geotextile (prior to lamination) (1,3)				
Mass per Unit Area	ASTM D 5261	oz/yd^2	6	MARV
Grab Tensile	ASTM D 4632	lbs	160	MARV
Flow Rate	ASTM D 4491	gpm/ ft^2	125	MARV
Puncture Strength	ASTM D 4833	lbs	95	MARV
Permittivity	ASTM D 4491	Sec^{-1}	1.63	MARV
AOS	ASTM D 4751	US Sieve	70 sieve	MARV
Geocomposite				
Transmissivity(2)	ASTM D 4716	m^2/sec	9 x 10^{-4}	MARV
Ply Adhesion (min)	ASTM D 7005	lbs/in	0.5	MARV
Ply Adhesion (avg)	ASTM D 7005	lbs/in	1.0	MARV

Notes

1 Component properties prior to lamination.

2 Transmissivity measured using water at 70°±4º F, with a gradient of 0.1 and a confining pressure of 10,000psf between steel plates after 15 minutes.

3 **If a different weight geotextile is used, values are subject to change. Geotextile weight dependent upon D_{85} of cover material.**

6.5 GEOCOMPOSITE PLACEMENT

6.5.1 The geocomposite roll shall be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the Purchaser's Representative.

6.5.2 In the presence of wind, all geocomposites shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.

6.5.3 The geocomposite shall be properly anchored in the anchor trenches, common to the HDPE, to resist sliding as shown on the construction drawings. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.

6.5.4 In applying fill material, no equipment shall drive directly across the geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.

6.5.5 The cover soil shall be placed in the geocomposite in a manner that prevents damage to the geocomposite.

6.5.6 Each component of the geocomposite will be secured or seamed to the like component at overlaps. Adjacent edges of the geonet along the length of the roll shall be placed with the edges of each geonet butted against each other. The overlaps shall be joined by tying the geonet structure with plastic cable ties spaced every five (5) feet along the roll length.

6.5.7 Adjoining geocomposite/geonet rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite/geonet a minimum of 12 inches across the roll width.

6.5.8 The geonet portion shall be tied every six (6) inches in the anchor trench.

6.5.9 Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.

6.5.10 Any rips, tears or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geonet by tying every six (6) inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be cut out and the two portions of the geonet shall be joined in accordance with Sections 6.5.6 and 6.5.7 above.

6.5.11 After installation, the Contractor shall submit certificates, signed by the Contractor and the CQA Inspector, that the geocomposite was placed in accordance with these Specifications.

6.6 GEOCOMPOSITE COVER

6.6.1 In applying fill or cover material, no equipment shall drive directly across the geocomposite. The specified cover material shall be placed and spread utilizing vehicles with a low ground pressure.

6.6.2 A sandy soil cover shall be placed on the drainage material. The soil shall have a minimum D_{85} as follows.

Fabric Weight	**Minimum D_{85}**
10 oz Fabric	.195 mm
8 oz Fabric	.235 mm
6 oz. Fabric	.275 mm

6.6.3 Alternative cover material may be used so long as its gradation meets the requirements of Section 6.6.2.

6.6.4 A minimum of one foot of soil shall be placed as cover material at the time of construction.

7.0 DISCHARGE PIPES

7.1 GENERAL

7.1.1 Discharge pipes shall be of size and specifications as indicated in the Drawings.

7.1.2 All pipes penetrating the dike structure shall be encased in a minimum of 12 inches of flowable fill above and below and 18 inches of flowable fill on the sides. Flowable fill shall meet the specifications shown on the Drawings.

7.1.3 Hold down straps shall be used on the pipe while placing the flowable fill.

7.1.4 The compacted fill material shall meet the requirements of Section 2.5 of this Specification and shall be placed in accordance with the same. It shall be clean soil, free of roots, vegetation, rocks greater than 4-inches maximum dimension, or other objectionable material. If machine placement and compaction is not feasible, the fill material shall be placed in 4-inch lifts and hand compacted under and around the pipe to at least the same density as the adjacent fill material.

8.0 VEGETATION

8.1 GENERAL

8.1.1 A layer of topsoil 4-inches to 6-inches in final thickness shall be placed on all areas to be grassed. All disturbed areas not covered with liner material, as shown on the Drawings, shall be grassed. Topsoil shall be free of subsoil, clay, weeds, roots, and impurities. Hydroseeding methods may be used.

8.1.2 The Contractor shall produce a satisfactory stand of perennial grass in accordance with the vegetation schedule shown on the Drawings. If it is necessary to repeat any or all the work, including plowing, fertilizing, watering, mulching and seeding, the Contractor shall repeat these operations until a satisfactory stand is obtained at no additional cost to the Purchaser.

8.1.3 Final stabilization shall be defined as follows: all soil disturbing activities at the site have been completed, and that for unpaved areas and areas not covered by permanent structures, 100% of the soil surface is uniformly covered in permanent vegetation with a density of 70% or greater, or equivalent permanent stabilization measures (such as the use of rip rap, gabions, permanent mulches or geotextiles) have been employed.

8.1.4 Measures shall be taken to prevent erosion of the topsoil layer and vegetation until a full vegetative growth has been obtained. The Contractor shall make daily inspections of the seeded areas and repair all eroded areas to the satisfaction of the Purchaser.

8.1.5 After seeding, an erosion control biodegradable straw blanket shall be installed on the exterior slopes of the dikes and any areas that have slopes of 3:1 or steeper. This material shall be a BioNet S150BN Double Net Straw Blanket by North American Green, or approved equal. The blanket shall be installed per manufacturer’s installation instructions. However, the blanket shall be tacked as necessary to the ground to withstand the upward growth of grass and to permit the establishment of grass through the blanket. This shall be done in such a manner as to not damage the underlying HDPE, geocomposite, or GCL. Failure to accomplish this will require that the effected area be re-grassed and redone to the satisfaction of the Project Construction Manager.

8.1.6 Graded areas that are to be grassed, which have slopes less steep than 3:1, shall be mulched with straw or other suitable material.

8.1.7 Water required to promote a satisfactory growth shall be furnished by the Purchaser and applied by the Contractor.

9.0 SUBMITTALS

9.1 GEOMEMBRANE (HDPE) SUBMITTALS

9.1.1 The Contractor shall provide to the Purchaser a Quality Control (QC) Program and Manual, or descriptive documentation for manufacture of the geomembrane from the manufacturer.

9.1.2 The Contractor shall provide to the Purchaser qualification statements from the geomembrane (HDPE) manufacturer, certified installer and CQC inspector documenting the minimum requirements of Sections 5.2.1, 5.2.2, and 5.2.3 of these Specifications.

9.1.3 The Contractor shall provide to the Purchaser QC certificates for both the HDPE liner and the welding rods.

9.1.4 The Contractor shall submit a certification from the manufacturer of the geomembrane stating that the sheeting meets the physical property requirements noted in Sections 5.3, 5.4, and 5.5 of these Specifications.

9.1.5 The Contractor shall submit a panel layout drawing for the HDPE and a detailed, written installation procedure for the Purchaser’s review fourteen days prior to the start of installation.

9.1.6 After installation, the Contractor shall submit a certification, signed by the Contractor and signed and sealed by the CQC Inspector, that the HDPE was placed in accordance with these Specifications.

9.2 GEOCOMPOSITE DRAINAGE MATERIAL SUBMITTALS

9.2.1 The Contractor shall provide the Quality Control (QC) Program and Manual, or descriptive documentation from the manufacturer of the geocomposite materials prior to the delivery of the geocomposite.

9.2.2 The Contractor shall provide to the Purchaser qualification statements from the geocomposite manufacturer, certified installer and CQC inspector documenting the minimum requirements of Sections 6.2.1, 6.2.2, 6.2.3, and 6.2.4 of these Specifications.

9.2.3 The Contractor shall provide the manufacturer’s certification that the material was manufactured in accordance with this specification, together with a report of test results, prior to material shipment.

9.2.4 The Contractor shall submit a panel layout drawing of the drainage material and a detailed, written procedure for the Purchaser’s review fourteen days prior to the start of installation.

9.2.5 After installation, the Contractor shall submit certificates, signed by the Contractor and the CQA Inspector, that the geocomposite was placed in accordance with these Specifications.

9.3 GEOSYNTHETIC CLAY LINER (GCL) SUBMITTALS

9.3.1 The Contractor shall provide to the Purchaser a Construction Quality Control (CQC) Program and Manual, or descriptive documentation for manufacture of the GCL from the manufacturer.

9.3.2 The Contractor shall provide to the Purchaser qualification statements from the GCL manufacturer, certified installer, and CQC inspector documenting the minimum requirements of Sections 4.2.1, 4.2.2, and 4.2.3 of these Specifications.

9.3.3 The Contractor shall provide to Purchaser placement procedures and a panel layout for placement of the GCL panels over the area of installation fourteen days prior to the start of liner installation.

9.3.4 Upon each shipment, the Contractor shall furnish the GCL manufacturer's Quality Assurance/Quality Control (QA/QC) roll certifications, signed by a responsible party employed by the GCL manufacturer, to verify that the materials supplied for the project are in accordance with the requirements of Section 4.3 this Specification. The certifications shall reference the lot and roll number as well as the manufacturer’s name and address.

9.3.5 The certifications shall include: 1) the Certificates of Analysis for the bentonite clay used in GCL production demonstrating compliance with the parameters swell index and fluid loss; and 2) manufacturer’s test data for finished GCL product(s) of bentonite mass/area, GCL tensile strength, and GCL peel strength (reinforced GCL only) demonstrating compliance with the index. Manufacturer’s test data for finished GCL product(s) including GCL index flux, permeability, and hydrated internal shear strength data demonstrating compliance with the performance parameters shall be made available upon request by the Purchaser.

9.3.6 As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor, his CQC Inspector, and the Purchaser’s Representative for each area that is covered by the GCL.

9.3.7 After installation, the Contractor shall submit a certification, signed by the Contractor and signed and sealed by the CQC Inspector, that the GCL was placed in accordance with these Specifications.

9.4 SOILS TESTING LABORATORY

9.3.1 The Contractor shall provide to the Purchaser the qualifications of third party contracted to perform the QC testing for the structural earth fill and the clay liner.

9.5 THIRD PARTY QUALITY CONTROL

9.4.1 The Contractor shall provide to the Purchaser the qualifications of a third-party inspector for construction quality control (CQC) of the clay liner installation documenting the minimum requirements of Section 2.6 of these Specifications.

9.4.2 The Contractor shall provide to the Purchaser the qualifications of a third-party inspector for construction quality control (CQC) of the HDPE installation documenting the minimum requirements of Section 5.6 of these Specifications.

9.4.3 The Contractor shall provide the Purchaser the qualifications of a third-party inspector for CQC of the geocomposite installation documenting the minimum requirements of Section 6.5 of these Specifications.

10.0 RECORDS

10.1 QUALTIY CONTROL RECORDS

10.1.1 The quality control records of inspection and testing shall be compiled by the Contractor’s Quality Control Inspector and provided to the Purchaser upon completion of the Project. Copies of the daily inspection reports and field quality control records shall be provided to the Purchaser on a weekly basis or as required. All records shall be forwarded to the Plant’s permanent file to be retained as a permanent record of the project.

10.2 RECORD TOPOGRAPHIC SURVEY

10.2.1 A record topographic survey will be performed by the Purchaser to fully document the lateral and vertical extent of the developed area. This survey will be maintained as part of the permanent record.

GYPSUM DISPOSAL CELL TECHNICAL SPECIFICATIONS

INQUIRY NUMBER 11-3415-C-APC

SOUTHERN COMPANY GENERATION ENGINEERING AND CONSTRUCTION SERVICES

TECHNICAL SPECIFICATIONS

FOR THE

CONSTRUCTION OF CELL 1 AND SEDIMENTATION POND OF THE DRY GYPSUM STORAGE FACILITY

AT

PLANT GORGAS

ALABAMA POWER COMPANY

Prepared By: Rachel A. Garrett Date: 6/6/11

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REVISIONS

NO.	DESCRIPTION	BY	REVIEWED	APPROVED	DATE
0	Issued for Construction	RAG	JCP/AOG/THH	JBS	6/10/11
1	Re-issued for Construction	RAG	JCP/THH/NGM/AOG	JBS	11/16/11
2	Re-issued with changes in particle size acceptability (Sec. 2.5)	RAG	JCP/THH/AOG	JBS	1/9/12

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TECHNICAL SPECIFICATION
FOR THE CONSTRUCTION OF CELL 1 AND SEDIMENTATION POND
OF THE DRY GYPSUM STORAGE FACILITY
AT
PLANT GORGAS
ALABAMA POWER COMPANY

1.0 GENERAL

Plant Gorgas is a fossil fueled electric generating plant located in Walker County, Alabama, along the Black Warrior River near of the city of Parrish. The purpose of this work is to develop the first of several planned cells as a disposal area for dry gypsum generated from flue gas desulphurization equipment.

1.1 GENERAL INFORMATION

1.1.1 These Specifications, all related attachments and associated documents cover the furnishing of all materials (unless otherwise noted), labor, supervision, equipment, and tools required for the construction of the Dry Gypsum Storage Facility at Plant Gaston. The technical and construction requirements, including notes, Specifications, and design data continue on the Drawings. The Drawings and Notes are an integral part of these Specifications.

1.1.2 The provisions of these Specifications shall govern unless otherwise specified in the contract documents. In case of conflicting requirements, the contract documents shall govern. Discrepancies between the Drawings and the Specifications shall be brought to the attention of the Purchaser for resolution before the performance of the work. In the case of discrepancies between the scale dimensions on the Drawings and the dimensions the written dimensions shall govern.

1.1.3 The following terms shall apply to these Technical Specifications ("Specifications"):

a) The terms "Purchaser" means Alabama Power Company (APC).

b) The term “Contractor” means the entity awarded the contract to furnish the materials and perform the work as described herein, to construct the Gypsum Disposal Facility as specified in the contract documents.

c) The term “Project Construction Manager”, (PCM), means the on-site manager of the project or his designated representative. He is the authorized representative at the site for the Purchaser.

d) The term "Purchaser's Representative" means the representative designated by the PCM to perform certain activities under these Specifications.

e) The terms “Accepted, Acceptable, or Approved” denotes that of which must be acceptable, accepted or approved by the Project Construction Manager or his authorized representative.

1.1.4 The Contractor shall ensure that all work is performed in accordance with the Occupational Safety and Health Act of 1970 and other Standards and Codes listed herein (latest revision).

1.1.5 The Contractor shall receive, unload, haul to site, handle, store, place, and secure all materials and equipment. Any security measures taken for the protection of the Contractor’s equipment shall be at his expense.

1.1.6 The Contractor shall furnish and keep in good working condition at all times sufficient equipment of the proper design and capacity to do all work described under these Specifications and in accordance with the established schedule.

1.1.7 The Contractor shall furnish appropriate equipment for minimizing fugitive dust.

1.1.8 The Contractor shall comply with all applicable state and county regulations concerning hazardous material disposal and burning operations, if allowed by the Purchaser. The Contractor shall have the responsibility for obtaining any necessary permits for these activities.

1.1.9 All earthwork, including ramps and access roads, done for the convenience of the Contractor shall be done at his expense. Such work will be restored to its original elevation at the Contractor’s expense if the Purchaser so desires.

1.1.10 The Contractor shall install, at his expense, any drainage piping required because of the Contractor’s mode of operation including his ramps and roads.

1.1.11 The Contractor shall provide traffic control during roadway related construction activities and material deliveries. This shall be coordinated with other activities ongoing at the plant. If within active and congested areas around the plant, traffic control shall include flag persons, barriers, and other control aids to provide for the safe routing of traffic in the affected area.

1.1.12 The Contractor shall be responsible for hiring a qualified third party quality assurance firm or firms to handle all quality assurance testing. This shall be at the Contractor's expense.

1.1.13 The Contractor shall inform the Purchaser of any existing wells encountered within the footprint of the construction or the proposed borrow area that have not been previously abandoned. If present and abandonment is necessary, these wells shall be abandoned by the Purchaser. Monitoring wells shall not be damaged or destroyed by construction activities. Any monitoring well damaged or destroyed by the Contractor and his activities shall be replaced at no cost to the Purchaser.

1.2 APPLICABLE DOCUMENTS

1.2.1 Drawings – Reference Inquiry Package for Drawing List.

1.2.2 The following Codes, Standards, Specifications, Publications, and/or Regulations shall be made part of these Specifications and will become part of the contract entered into for performance of the work covered herein. The latest edition in effect at the time of the contract shall apply. Other codes and standards shall be incorporated as referenced in this document. The omission of any Codes and/or Standards from this list does not relieve the Contractor of his responsibility to follow the latest revision of all applicable codes and standards for conducting the work.

Occupational Safety and Health Administration

- Occupational Safety and Health Act of 1970

American Society for Testing and Materials (ASTM)

- ASTM D 422 – Standard Test Method for Particle-Size Analysis of Soils
- ASTM D 698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
- ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil In - Place by the Sand Cone Method
- ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D 2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)

- ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System)

- ASTM D 2488 - Description and Identification of Soils (Visual-Manual Procedure)

- ASTM D 6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil – Aggregate In Place by Nuclear Methods

- ASTM D 2937 - Standard Test Method for Density of Soil In Place by the Drive Cylinder Method

- ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method

- ASTM D 4959 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method

- ASTM D 1587 - Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes

- ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

- ASTM D 792 – Standard Test Methods for Density and Specific Gravity (relative density) and Density of Plastics by Displacement

- ASTM D 1004 - Standard Test Method for Tear Resistance of Plastic Film and Sheeting

- ASTM D 1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

- ASTM D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique

- ASTM D 1603 - Standard Test Method for Carbon Black in Olefin Plastics

- ASTM D 3895 - Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry

- ASTM D 4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique

- ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

- ASTM D 5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics

- ASTM D 5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

- ASTM D 5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

- ASTM D 5721 - Standard Practice for Air-Oven Aging of Polyolefin Geomembranes

- ASTM D 5885 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry

- ASTM D 5994 - Standard Test Method for Measuring Core Thickness of Textured Geomembranes

- ASTM D 6392 – Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

- ASTM D 6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

Geosynthetic Research Institute GRI Standards

- GM 10 - The Stress Crack Resistance of HDPE Geomembrane Sheet

- GM 11 - Accelerated Weathering of Geomembranes using a Fluorescent UVA Device

- GM 12 - Asperity Measurement of Textured Geomembranes Using a Depth Gage

- GM 13 - Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Geomembranes

Corps of Engineers EM-LST, Appendix VII, Falling-Head Permeability Test

Codes specific to the local county

Alabama Department of Environmental Management regulations

Environmental Protection Agency (EPA) regulations

2.0 EARTHWORK

2.1 SITE CONDITIONS

2.1.1 The Contractor shall visit the site and acquaint himself with site conditions, utility locations, and the proposed scope of work.

2.2 LINES AND GRADES

2.2.1 The project shall be constructed to the elevations, lines, grades and cross sections shown on applicable Drawings. The Purchaser reserves the right to increase the foundation widths, change the embankment slopes, and to make other changes in the embankment sections as conditions indicate are necessary for the construction of a safe and permanent structure. The Contractor shall be compensated for changes in plan and/or sections resulting in changes of quantities of materials.

2.2.2 The above grade soil within the proposed footprint shall be removed down to base grade. The soil may be used for fill construction material if it meets the specifications of Section 2.5 and may be used for compacted clay liner if it meets the specifications of Section 2.6.

2.3 CLEARING, GRUBBING, AND STRIPPING

2.3.1 Clearing, grubbing and stripping will be required to prepare the work area for construction.

2.3.2 Prior to any clearing or grubbing operations, adequate erosion control measures should be in place. At a minimum, all federal, state and local guidelines should be followed.

2.3.3 Vegetated areas within the construction footprint shall be cleared, grubbed, and stripped of any vegetation, organic matter and/or any other debris. Stripped topsoil shall be stockpiled at a location on the site to be designated by the Project Construction Manager.

2.3.4 The grubbed area shall be harrowed and raked with a tractor-mounted root rake to collect all small material previously overlooked. The tractor shall be of adequate size to achieve a minimum of 4 inches penetration of the root rake teeth. The root rake teeth shall not be more than 12 inches apart.

2.3.5 Trees, stumps, and brush cleared from the above areas shall be disposed of by burning, if allowed by the Purchaser, by mulching, or by removal from the site. All burning shall be performed in accordance with state and local regulations. Burn pits shall be located outside of the construction area, borrow area, outside of future cell construction, and off right-of-ways.

2.3.6 Burning operations, if permitted by the Purchaser, shall be conducted only in previously cleared areas and away from standing timber, structures, or other flammable materials. Materials to be burned shall be properly stacked, by dozers, in piles sufficiently large enough to facilitate the complete burning of all the materials in the pile. The Contractor shall be subject to all public laws governing such burning operations and shall be responsible for any damage to life or property as a result of burning either on the Purchaser's property or the property of others. Fires shall not be started unless tractors are available in the immediate vicinity to check the spread of fire outside the cleared area. Fires shall be guarded at all times and shall be under constant attendance until they have burned out or have been extinguished.

2.3.7 Spoil material shall be disposed of only in areas to be designated by the Purchaser. The Contractor shall slope the spoil area for drainage, implement necessary erosion control measures, and provide a perennial stand of vegetation.

2.4 SUBGRADE PREPARATION

2.4.1 Erosion and sediment control measures shall be prepared and placed first, where necessary.

2.4.2 Existing overburden soils shall be excavated to the excavation limits indicated on the drawings. Material suitable for topsoil, material to be used as fill material and material suitable for use as clay liner material shall all be stockpiled separately.

2.4.3 The entire cell subgrade shall be proof-rolled utilizing loaded, off-road trucks with a gross machine weight, including payload of 40 tons of soil, that will impart approximately 7600 psf subgrade loading over a minimum tire width of 2 feet. Prior to receiving earth fill, the foundation area shall be scarified by harrowing or other suitable means.

2.4.4 Any areas failing proof roll shall be undercut and replaced with compacted structural soil fill and re-rolled.

2.4.5 No fill shall be placed on any part of the subgrade until such areas have been proof rolled and approved by the Purchaser.

2.4.6 Work flow shall be planned such that the first fill lift is placed soon after subgrade compaction to minimize subgrade exposure to inclement weather.

2.4.7 The Contractor shall be required to prepare the base and interior dike slopes, including the sedimentation pond, for installation of the HDPE liner surface as shown on the Drawings. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than ½-inch in diameter, or debris of any kind. These surfaces shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade.

2.5 FILL MATERIAL

2.5.1 On site soils consist of clay with various fractions of weathered rock. Coal mine spoils, consisting of predominantly gravel size particles, are also present. Non-organic, non-plastic soils and coal mine spoils excavated from the site are generally suitable for fill materials if they meet the specifications in sections 2.5.2 and 2.5.3.

2.5.2 ROCK

2.5.2.1 Rock at the site consists of Shale and Sandstone.

2.5.2.2 Rock materials excavated from the site may be used for fill materials under the following conditions:

- Rock fragments larger than **4 inches** may not be used as **structural fill** (as defined in Section 2.5.3).
- Rock fill may not be placed **within the upper 5 feet** of any fill area.
- Rock shall at no time be placed directly beneath a liner.
- Particle sizes larger than **24 inches** may not be used for fill material in any circumstances.

2.5.3 STRUCTURAL FILL

2.5.3.1 Structural fill will be required for the construction of the berms for the sedimentation pond, the gypsum storage cell and other uses, if any, requiring compacted fill.

2.5.3.2 Structural fill shall consist of the soil, rock or mine spoils materials meeting the requirements stated herein and shall be placed and compacted in accordance with these Specifications.

2.5.3.3 Structural fill will contain no particle sizes greater than **4 inches** in diameter.

2.5.3.4 Preparation for structural fill shall consist of the removal of any organic or deleterious materials present within the extent of the fill operation.

2.5.3.5 No structural fill shall be placed on any part of the foundation until such areas have been inspected and approved by the Owner.

2.5.3.6 Structural fill shall be placed in uniform layers of eight inches, nominal thickness, loose measurement, for one foot beyond the full width of the fill on each side. Each layer shall be kept level with the necessary grading equipment. Upon completion of compaction, the slopes shall be cut back to the final slope. Particular care must be used to obtain the required compaction along the edges of the fill slopes. Slopes will require compaction after they have been cut back to minimize water infiltration and erosion.

2.5.3.7 During the dumping and spreading processes, the Contractor shall maintain at all times a force of men adequate for removal of roots and debris from all structural fill materials and all stones greater than four inch maximum dimension. Stones, roots, and debris shall be removed from the structural fill and disposed of in an approved manner.

2.5.3.8 When moisture content is too low, the moisture content shall be adjusted to within the specification. Moisture adjustment shall be done by wetting and disking sufficiently to bring the moisture content within the specified range.

2.5.3.9 If the moisture content is too high, the Contractor will be permitted to stockpile and disk the fill material to promote drying to bring it back within the allowable moisture range. Scarifying of the lift and recompaction after drying shall also be permitted.

2.5.3.10 The Contractor will be required to remove any compacted material that does not comply with the compaction requirements (density or moisture) and replace the fill at his own expense.

2.5.3.11 Structural fill which cannot be compacted with roller equipment because of inadequate clearances shall be spread in 4-inch layers and compacted with power tampers to the extent required by the specifications for structural fill material.

2.5.4 Pipe penetrations shall be encapsulated in flowable fill as shown on the Drawings.

2.5.5 No earth fill shall be placed on any part of the foundation until such areas have been inspected and approved by the Project Construction Manager.

2.5.6 Quality control testing shall be performed on all earth fill in accordance with Section 2.8 of this Specification. No earth fill layer may be placed until the Project Construction Manager has verified that the underlying layer has met the compaction and/or moisture requirements.

2.5.7 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Project Construction Manger, before the succeeding layer is placed.

2.5.8 Earth fill material that is not clay liner shall be compacted to a minimum 95% maximum dry density, as determined by the Standard Proctor compaction test (ASTM D698). The moisture content of the earth fill at the time of placement shall be between -3% and +3% of the optimum moisture obtained by Standard Proctor compaction test. The Contractor shall strive to place the earth fill material on the wet side of optimum.

2.5.9 When moisture content is too low, the moisture content shall be adjusted to within the above specification prior to compaction. Moisture adjustment shall be by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and disking of the layer shall be done after deposition, but before compaction.

2.5.10 If the moisture content is too high, the Contractor will be permitted to stockpile and disk the earth fill material to promote drying to bring it back within the allowable moisture range. This drying must be done prior to placement.

2.5.11 The Contractor will be required to remove any compacted material that does not comply with the compaction and/or moisture requirements and replace the compacted earth fill to comply with these Specifications at his own expense.

2.5.12 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified in this Section.

2.5.13 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to insure that the correct reference Proctor curves are being used for compaction check

2.5.14 Fill materials may be used if the total organic carbon (TOC) content is less than 5% and if approved by the Project Construction Manager. Material with greater than 5% TOC may not be used under the footprint of the dike or as structural dike fill. The contractor must provide laboratory analysis for approval by the Project Construction Manager.

2.5.15 Material with greater than 5% TOC may be used as structural dike fill if it is blended with other soil to fulfill the TOC requirement.

2.5.16 If the construction of the facility is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of earth fill material before placing additional layers.

2.5.17 Exterior dike slopes shall be grassed upon reaching final grade in accordance with the Vegetation Schedule from Section 7.

2.6 COMPACTED CLAY LINER

2.6.1 A compacted clay liner shall be installed as the upper two feet of earth fill underlying the HDPE liner. The clay liner shall be placed and compacted in accordance with these Specifications and Drawings.

2.6.2 Compacted clay liner material shall have a in-place permeability equal to or less than 1 x 10^{-7} cm/sec, shall meet USCS Classification of CL, CH or SC, shall contain a minimum of 30% material passing the #200 sieve, shall have a liquid limit (LL) of greater than or equal to 30, shall have a plasticity index (PI) greater than or equal to 15, shall have a maximum clod size of 2 inches, and shall be free of organics or other debris.

2.6.3 Prior to placement of the clay liner, the borrow material shall be sampled to test its feasibility for use as a clay liner. A minimum of three soil samples of clay shall be obtained for laboratory testing from the clay portion of the borrow area. Laboratory testing on the clay samples shall include the Standard Proctor density (ASTM D 698), permeability by constant head (ASTM D 2434) or falling head test, grain size distribution and hydrometer analysis (ASTM D 422), Atterberg Limits (ASTM D 4318) and in-place moisture (ASTM D 2216).

2.6.4 Clay liner material shall be placed in uniform layers of 8 inches, nominal thickness, loose measurement. Each layer shall be kept level with the necessary grading equipment. Upon completion of compaction, fill slopes shall be cut back to the final slope.

2.6.5 Quality control testing shall be performed on the liner in accordance with Section 2.8 of this Specification. No clay liner layer may be placed until the Project Construction Manager has verified that the underlying layer has met the compaction, permeability, and/or moisture requirements.

2.6.6 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Project Construction Manger, before the succeeding layer is placed.

2.6.7 Clay liner material shall be compacted to a minimum 95% maximum dry density, as determined by the Standard Proctor compaction test (ASTM D 698), or to the percent compaction required to achieve the specified permeability, whichever is greater. The moisture content of the clay liner at the time of placement shall be +1% to +3% wet of optimum as determined by the Standard Proctor compaction test.

2.6.8 When moisture content is too low, the moisture content shall be adjusted to within the above specification prior to compaction. Moisture adjustment shall be by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and disking of the layer shall be done after deposition, but before compaction.

2.6.9 If the moisture content is too high, the Contractor will be permitted to stockpile and disk the liner material to promote drying to bring it back within the allowable moisture range. This drying must be done prior to placement.

2.6.10 Liner material which cannot be compacted with roller equipment because of inadequate clearances shall be spread in 4-inch layers and compacted with power tampers to the extent required by the specifications in this Section.

2.6.11 The Contractor will be required to remove any compacted material that does not comply with the compaction, moisture, and/or permeability requirements and replace the compacted earth fill to comply with these Specifications at his own expense.

2.6.12 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified in this Section.

2.6.13 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to insure that the correct reference Proctor curves are being used for compaction check.

2.6.14 If the construction of the clay liner is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of liner material before placing additional layers.

2.6.15 The Contractor shall be required to repair erosion features, desiccation cracks, and other defects in the clay liner. All soils and sediments that have been transported onto the active clay liner placement areas from storm runoff shall be removed or graded away from the clay liner. All repairs to the liner shall be completed prior to the subsequent lift of clay material placed.

2.7 EARTHWORK EQUIPMENT

2.7.1 The Earthwork Contractor shall be responsible for providing all earthwork equipment necessary to perform the work set forth in these Specifications. The Contractor shall be responsible for maintaining the equipment during the contract period. Any delays in work activities due to equipment maintenance must be reported to the Project Construction Manager for determination of impacts on the schedule.

2.7.2 The Contractor shall be responsible for the cleaning of haul vehicles. The Contractor shall wash down the wheels, outside body, cab, undercarriage, etc. of all haul vehicles to prevent spreading material during transit of the equipment out of the boundary of the working area.

2.7.3 All of the Contractor’s equipment shall be operated in a safe, careful manner in accordance with these Specifications.

2.8 QUALITY CONTROL TESTING

2.8.1 Field density and moisture content testing shall be performed by a third party quality assurance firm at the Contractor’s expense to verify that compaction requirements have been achieved. In-place field density testing of the compacted soil shall be performed in accordance with the procedure ASTM D 1556-00, the sand cone method. Test results reports should include both the moisture content and dry density, along with other data such as location, elevation, Proctor curve used for comparison, etc.

2.8.2 Testing procedures of in-place density and moisture content by nuclear methods is described in ASTM D 6938. This procedure may be used provided: 1) acceptable correlation with sand cone density test results can be obtained according to the guidelines of Section 7, “Calibration”, of ASTM D 6938, and 2) the initial correlation results are reviewed and use of the nuclear device is approved by the Project Construction Manager. In addition, it shall be required that the testing agency or representative have the necessary licenses to operate a nuclear energy source, and to take all safety precautions per Section 6 of ASTM D 6938.

2.8.3 In the event of repeated failures, or water content and density test values plotting far from the Proctor curves used for comparison in computing percent compaction, it shall be the option of the Project Construction Manager to require one or two point Proctor checks (on the dry side of optimum) to verify that the proper Proctor curve is being referenced. If not, a new Proctor curve determined by a five-point test shall be required. The Contractor shall sample and perform the five-point testing, all at the Contractor's expense.

2.8.4 If the compaction requirements for a lift have not been achieved, the Purchaser shall direct the Contractor to either rework the lift to obtain the compaction requirements or remove and replace with a new lift for compaction, all at the Contractor's expense.

2.8.5 The in-place water content and density testing frequency for all compacted soil, including the clay liner, shall be one test for each 20,000 square feet of lift area or portion thereof for each lift, with a minimum of one test performed for each 200 lineal feet of dike per lift as measured parallel to the dike axis.

2.8.6 Laboratory confirmation testing for the compacted clay liner material placed in the upper two (2) feet below the final grade shall be performed to verify that the permeability of the compacted liner is equal to or less than 1 x 10^{-7} cm/sec using either the falling head or back pressure permeability test. The confirmation testing shall consist of obtaining undisturbed samples of the clay liner for laboratory confirmation of field density, moisture content, and hydraulic conductivity of field compacted material. The undisturbed samples shall be obtained by pushing a thin walled drive cylinder into the compacted liner at a frequency of one (1) tube per one (1) acre of liner material per lift.

2.8.7 The drive tubes used to collect the undisturbed samples shall be cleaned and paraffin sealed to preserve the moisture content and delivered to the independent soil testing laboratory. The location, lift, and depth below the surface should be recorded with each sample. The undisturbed samples shall be stored and handled in such a manner as to prevent damage to the sample from freezing, transporting or other means. After the undisturbed samples are taken, the holes shall be filled with bentonite (powder, chips, or pellets) to maintain the integrity of the fill.

2.8.8 The results of all permeability tests by the testing laboratory shall be reported to the Owner's Engineer. If any permeability test result is higher than the minimum required value of 1 x 10^{-7} cm/sec, the Contractor shall rework or replace a section or entire lift of the clay layer being constructed, at the Contractor's expense. All reworked or replaced sections of clay liner shall be retested and meet the minimum permeability requirements.

3.0 DRAINAGE DITCHES, CHANNELS AND SLOPES

3.1 GENERAL

3.1.1 All drainage channels and perimeter drainage ditches shall be excavated to the lines, grades, cross-sections, and elevations indicated on the Drawings. The waterways shall be free of bank projections or other irregularities which will impede normal flow.

3.1.2 All earth removed and not used in construction shall be disposed of so that it will not interfere with the functioning of the waterway.

4.0 GEOMEMBRANE (HDPE) LINER

4.1 GENERAL

4.1.1 A textured, high density polyethylene (HDPE) liner shall be placed on the bottom and inside slopes of Cell 1 and along the bottom and inside slopes of the sedimentation pond, as shown on the Drawings.

4.1.2 The HDPE liner material shall meet the requirements of this Sections and shall be installed with perimeter anchor trenches as shown on the Drawings.

4.1.3 Heavy vehicles shall not be permitted to operate directly on the liner material. Rubber-tired ATV’s and trucks are acceptable if wheel contact is less than six (6) psi.

4.1.4 In areas of heavy traffic, the geomembrane shall be protected by placing protective cover over the geomembrane.

4.1.5 If the geomembrane is damaged by vehicular traffic, it shall be replaced at the Contractor's expense.

4.1.6 In the bottom of the cell (not including the sides of the dike), the HDPE liner shall be overlain by single-sided geocomposite drainage material.

4.1.7 A Manufacturer's Representative may be on site during the initial phase of the HDPE installation to provide assistance to the Contractor.

4.2 GEOMEMBRANE CONTRACTOR QUALIFICATIONS

4.2.1 The manufacturer of the HDPE material shall have at least five (5) years continuous experience in manufacturing polyethylene geomembrane and/or experience totaling 10,000,000 square feet of manufactured polyethylene geomembrane.

4.2.2 The installation contractor shall be qualified and trained to install the manufacturer's geomembrane. Installation shall be performed under the constant direction of a field installation supervisor who shall remain on site and be responsible, throughout the liner installation, for liner layout, seaming, testing, repairs, and all other activities by the Installer. The field installation supervisor shall have installed or supervised the installation of a minimum of 2,000,000 square feet of polyethylene geomembrane. Seaming shall be performed under the direction of a master seamer (who may also be the field installation supervisor) who has seamed a minimum of 1,000,000 square feet of polyethylene geomembrane, using the same type of seaming apparatus specified for this project. The field installation supervisor and/or master seamer shall be present whenever seaming is performed.

4.2.3 The Contractor shall provide a third-party inspector for construction quality control (CQC) of the HDPE installation. The HDPE inspector shall be an individual or company who is independent from the manufacturer and installer, who shall be responsible for monitoring and documenting activities related to the CQC of the HDPE throughout installation. The inspector shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The Contractor shall provide the Purchaser with a statement of qualifications (SOQ) for the HDPE inspector prior to starting work.

4.3 GEOMEMBRANE MATERIAL

4.3.1 The geomembrane shall be 60 mil thick, textured on both sides, high density polyethylene (HDPE), a minimum 22.5 feet seamless width, as manufactured by Gundle/SLT Environmental Incorporated (GSE), or an approved equal. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.

4.3.2 The Contractor shall provide QC certificates for both the liner and the welding rods.

4.3.3 The surface of the geomembrane shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter except that, if in the opinion of the Purchaser's Representative the blemish will not adversely affect properties and use of the liner, the Purchaser's Representative may accept the liner after sufficient laboratory test data are provided to support such acceptance, and further provided all such testing is done at the sole expense of the Contractor.

4.3.4 The geomembrane shall be supplied in rolls. Labels on each roll shall identify the thickness of the material, the length and width of the roll, batch and roll numbers, and the name of the manufacturer.

4.4 GEOMEMBRANE RAW MATERIALS

The geomembrane shall be manufactured of polyethylene resins and shall be compounded and manufactured specifically for the intended purpose. The Contractor shall submit a certification from the manufacturer of the geomembrane that the sheeting meets the following physical property requirements.

Property	Test Method	HDPE Requirements
Density, g/cc	ASTM D 1505	0.932
Melt Index,g/10 min.	ASTM D 1238	≤1.0
OIT, min	ASTM D 3895 ASTM D 5885	100

4.5 GEOMEMBRANE ROLLS

The geomembrane rolls shall meet or exceed the following specifications. Certification shall be provided for each roll stating that these items have been met or exceeded. The certification shall reference the manufacturer's batch and roll number and shall indicate the name of the manufacturer.

TEXTURED HDPE GEOMEMBRANE - 60 MIL (Per GRI GM-13 and GRI GM-19)

Property	**Frequency**	**Test Method**	**Minimum Average Value**
Thickness 1. Minimum Average 2. Lowest individual of 8 of 10 readings 3. Lowest individual of 10 readings	per roll	ASTM D 5994	57 mil nom 54 mil 51 mil
Asperity Height[1]	Every 2nd Roll	GRI GM12	10 mil
Density	Once per 200,000 lbs of resin	ASTM D 1505 ASTM D 792	≥ 0.940 g/cc
Tensile Properties[2] 1. Yield Strength 2. Break Strength 3. Yield Elongation 4. Break Elongation	20,000 lbs.	ASTM D 6693, Type IV Dumbell, 2 ipm G.L.=1.3 in G.L.=2.0 in	≥ 126 lb/in ≥ 90 lb/in 12 % 100 %
Tear Resistance	45,000 lbs	ASTM D 1004	≥ 42 lb (min. avg.)
Puncture Resistance	45,000 lbs	ASTM D 4833	≥ 90 lb (min. avg.)
Stress Crack Resistance	per GRI GM-10	ASTM D 5397 (App.)	300 hr
Carbon Black Content	20,000 lbs.	ASTM D 1603	2.0 % - 3.0 %
Carbon Black Dispersion[3] 1. Categories 1 or 2 2. Category 3	45,000 lbs.	ASTM D 5596	9 1
Oxidative Induction Time (OIT) Standard OIT or High Pressure OIT	200,000 lbs	ASTM D 3895 ASTM D 5885	100 min. (min. avg.) 400 min. (min. avg.)
Seam Properties 1. Shear Strength 2. Peel Strength a) Hot Wedge b) Extrusion Fillet		ASTM D 6392	120 lb/in 91 lb/in 78 lb/in
Oven Aging @ 85ºC [7,8] 1. Standard OIT (min. avg.) - % retained after 90 days 2. High Pressure OIT (min. avg.) - %	Per Each Formulation	ASTM D5721 ASTM D3895 ASTMD5885	55% 80%

retained after 90 days			
UV Resistance [9] 1. Standard OIT (min. avg.) 2. High Pressure OIT (min. avg.) - % retained after 1600 hours [11]	Per Each Formulation	GM11 ASTM D3895 ASTMD5885	N. R. 50%

Notes:

1 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥5 mils.

2 The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. therefore, these tensile properties are minimum average values.

3 Dispersion only apples to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than one (1) view from Category 3.

4.6 GEOMEMBRANE INSTALLATION

4.6.1 The geomembrane shall be packaged and shipped by appropriate means to ensure that no damage is incurred. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. The rolls shall be stored on a prepared smooth surface (not wooden pallets) and shall not be stacked.

4.6.2 The manufacturer assumes responsibility for initial loading the geomembrane. Off-loading and storage of the materials shall be the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Purchaser. No off-loading shall be done unless monitored by the Purchaser’s Representative. Damage occurring during off-loading shall be documented by the Purchaser and the Contractor. The Purchaser shall be the final authority on determination of damage.

4.6.3 The installation of the geomembrane shall be in accordance with the manufacturer’s recommendations and these Specifications. The Contractor shall submit a panel layout drawing and a detailed, written procedure for the Purchaser’s review fourteen days prior to installation.

4.6.4 All seams and non-seam areas of the geomembrane shall be inspected by the inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

4.6.5 The anchor trench shall be excavated to the lines, grades, and widths shown on the project construction drawings, prior to liner system placement. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the geomembrane.

4.6.6 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.

4.6.7 The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the Purchaser’s Representative. Placement of the geomembrane shall not damage the clay liner.

4.6.8 Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

4.6.9 Heavy vehicles shall not be permitted to operate directly on the geomembrane material. Rubber-tired ATV’s and trucks are acceptable if wheel contact is less than six (6) psi.

4.6.10 Personnel working on the geomembrane shall not smoke or wear damaging shoes.

4.6.11 The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil.

4.6.12 Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

4.6.13 Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F. Placement can proceed below 32° F only after it has been verified by the inspector that the material can be seamed according to the specification. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the installation supervisor.

4.7 GEOMEMBRANE FIELD SEAMING

4.7.1 Field seams shall be made in accordance with the manufacturer’s recommendations. The Contractor shall submit a copy of the proposed seaming procedures for the Purchaser’s review.

4.7.2 Approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Cross seams will be allowed on slopes provided that cross seams are cut at 45º and adjacent cross seams are staggered. Cross seams will be kept to the lower half of the slope and only one cross seam will be allowed per panel slope length.

4.7.3 No base T-seam shall be closer than five (5) feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and cap-stripped.

4.7.4 Geomembrane panels must have a finished minimum overlap of four (4) inches for fusion welding and six (6) inches for extrusion welding.

4.7.5 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

4.8 GEOMEMBRANE FIELD TEST SEAMS

4.8.1 Field test seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit a copy of the proposed testing procedures for the Purchaser's review.

4.8.2 Field test seams shall be conducted on the liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each seaming period and at least once every four (4) hours, for each seaming apparatus and personnel used that day.

4.8.3 All test seams shall be made in contact with the subgrade. Welding rod used for extrusion welding shall have the same properties as the resin used to manufacture the geomembrane.

4.8.4 The installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing or Air Pressure Testing (for double fusion seams only).

4.9 GEOMEMBRANE DESTRUCTIVE SEAM TESTING

4.9.1 Destructive seam testing should be minimized to preserve the integrity of the liner. The Contractor shall provide the Purchaser with one (1) destructive test sample once per 500 cumulative feet of seam length from a location specified by the inspector.

4.9.2 In order to obtain test results prior to completion of liner installation, samples shall be cut by the installer as the seaming progresses. The installer shall also record the date, location, and pass or fail description. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately patched and vacuum tested.

4.9.3 The samples shall be 12 inches wide by 36 inches long with the seam centered lengthwise. The sample shall be cut into three equal-length pieces, one to be given to the inspector, one to be given to the Purchaser, and one to the installer.

4.9.4 The inspector shall test ten one (1)-inch wide specimens from his sample; five (5) specimens for shear strength and five (5) for peel strength. Seam test results shall be evaluated using the current GRI Test Method GM19 which allows for 4 or 5 specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel excursion will not exceed 25%.

4.9.5 The Purchaser, at his discretion and expense, may send seam samples to a laboratory for testing. The test method and procedures to be used by the independent laboratory shall be the same as used in field testing.

4.9.6 The following procedures shall apply whenever a sample fails the field destructive test:

A. The installer shall cap strip the seam between the failed location and any passed test locations.

B. The installer can retrace the welding path to an intermediate location (usually 10 feet from the location of the failed test), and take a sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, then the process is repeated.

C. Over the length of seam failure, the installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.

4.9.7 Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non-destructive testing shall be marked by the inspector, and repaired accordingly.

4.9.8 Repair Procedures

- Defective seams shall be cap stripped or replaced.

- Small holes shall be repaired by extrusion welding a bead of extrudate over the hole. If the hole is larger than one-quarter inch, it shall be patched.

- Tears shall be repaired by patching. If the tear is on a slope or an area susceptible to stress and has a sharp end it must be rounded prior to patching.
- Blisters, large cuts and undispersed raw materials shall be repaired by patches.
- Patches shall be completed by extrusion welding. The weld area shall be ground no more than 10 minutes prior to welding. No more than 10% of the thickness shall be removed by grinding. Welding shall commence where the grinding started and must overlap the previous seam by at least two (2) inches. Reseaming over an existing seam without regrinding shall not be permitted. The welding shall restart by grinding the existing seam and rewelding a new seam.
- Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of six (6) inches beyond the edge of defects.

4.9.9 Verification of Repairs

- Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.
- The inspector shall keep daily documentation of all non-destructive and destructive testing. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested.

4.10 BACKFILLING OF ANCHOR TRENCH

4.10.1 The anchor trench shall be backfilled by the earthwork contractor. Trench backfill material shall be placed and compacted in accordance with these specifications.

4.10.2 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. If damage occurs, it shall be repaired prior to backfilling.

4.11 GEOMEMBRANE ACCEPTANCE

4.11.1 The installer shall retain all ownership and responsibility for the geomembrane until accepted by the Purchaser. Final acceptance is when all of the following conditions are met:

- Installation is Finished
- Verification of the adequacy of all field seams and repairs, including associated testing, is complete.
- Sign-off of acceptance of the geomembrane has been made by the Purchaser.

5.0 GEOCOMPOSITE DRAINAGE MATERIAL

5.1 GENERAL

5.1.1 A geocomposite drainage material shall be placed on the bottom and inside slopes of Cell 1, overlying the HDPE liner as shown on the construction drawings.

5.1.2 The geocomposite on the bottom and inside side slopes of Cell 1 shall be covered with a two (2)-foot layer of soil having a minimum permeability of 1 x 10^{-3} cm/sec.

5.1.3 The drainage material shall be placed in accordance with these Specifications, the manufacturer's recommendations, and the details indicated on drawings.

5.1.4 Heavy vehicles shall not be permitted to operate directly on the geocomposite drainage material. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than six (6) psi.

5.2 GEOCOMPOSITE CONTRACTOR QUALIFICATIONS

5.2.1 The drainage material manufacturer shall have successfully manufactured five (5) million square feet of polyethylene drainage material.

5.2.2 Installation of the drainage material shall be performed by the manufacturer or be a manufacturer-approved dealer/installer. The drainage material installer must either have installed at least one (1) million square feet of product, **or** must provide to the Purchaser satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner.

5.2.3 The installation supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the contract documents.

5.2.4 The Contractor shall provide, at its expense, a third-party inspector for CQC of the geocomposite installation. The inspector shall be an individual or company who is independent from the manufacturer and installer and shall be responsible for monitoring and documenting activities related to the CQC of the geocomposite throughout installation. The inspector shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The Contractor shall provide the Purchaser with a statement of the inspector's qualifications prior to starting installation of the geocomposite.

5.2.5 A Manufacturer’s Representative may be on site during the initial phase of the geocomposite installation to provide assistance to the Contractor.

5.3 DRAINAGE MATERIAL LABELING, DELIVERY, STORAGE, AND HANDLING REQUIREMENTS

5.3.1 Each roll of material delivered to the site shall be wrapped and labeled by the manufacturer. The label shall contain the following information:

- manufacturer’s name
- product identification
- length and width
- roll number

5.3.2 The drainage material will be stored as specified by the manufacturer in an area specified by the Purchaser. The storage will be free of materials capable of damaging the material.

5.3.3 Unloading of the drainage material from the delivery trucks will be performed by the Contractor. Unloading of the materials will be performed as directed by the manufacturer.

5.3.4 The rolls must be adequate for safe transportation to the point of delivery, offloading and storage. Storage measures will be taken as specifically stated by the manufacturer.

5.4 DRAINAGE MATERIAL PROPERTIES

5.4.1 The geocomposite shall consist of one (1) layer of HDPE drainage net (geonet) connected to one (1) layer of geotextile to create a single sided geocomposite. The geocomposite drainage layer shall be FabriNet UF, as manufactured by GSE, or approved equal.

5.4.2 The geocomposite shall be manufactured of new first quality polyethylene resin and shall be compounded and manufactured specifically for the intended application.

5.4.3 The minimum average properties of the drainage layer shall be as follows:

Tested Property	Test Method	Frequency	Units	Value[(1)]
Geonet Core (HyperNet-UF) [(4)]				
Thickness	ASTM D 5199	1/50,000 ft^2	mil	300
Density	ASTM D 1505	1/50,000 ft^2	g/cc	0.94
Carbon Black Content	ASTM D 1603*/4218	1/50,000 ft^2	%	2.0
Tensile Strength	ASTM D 5035		lbs/inch	75
Transmissivity[(2)]	ASTM D 4716		gal/min/ft	38.64
Transmissivity[(2)]	ASTM D 4716		m^2/sec	8 x 10^{-3}
Geotextile (prior to lamination) [(4, 5, 6)]				
Mass per Unit Area	ASTM D 5261	1/90,000 ft^2	oz/yd^2	10
Grab Tensile	ASTM D 4632	1/90,000 ft^2	lbs	260
Flow Rate	ASTM D 4491	1/540,000 ft^2	gpm/ ft^2	75
Puncture Strength	ASTM D 4833	1/90,000 ft^2	lbs	165
Permittivity	ASTM D 4491	1/540,000 ft^2	Sec^{-1}	1.0
AOS	ASTM D 4751	1/540,000 ft^2	US Sieve	100 sieve
UV Resistance	ASTM D 4355	once per formulation	% retained (500 hr)	70
Geocomposite				
Transmissivity[(2)]	ASTM D 4716	1/540,000 ft^2	gal/min ft	14.5
Transmissivity[(2)]	ASTM D 4716	1/540,000 ft^2	m^2/sec	3 x 10^{-3}
Ply Adhesion	ASTM D 7005	1/50,000 ft^2	lbs/in	1.0
Roll Width[(3)]			ft	15
Roll Length[(3)]			ft	180
Roll Area			ft^2	2,700

Notes

1 These are minimum average roll values (MARV values) and are based on the cumulative results of specimens tested by GSE. AOS in mm units is a maximum average roll value.
2 Gradient of 0.1, normal load of 10,000 psf, water at 70° F, between stainless steel plates for 15 minutes.
3 Roll widths and lengths have a tolerance of ±1%.
4 Component properties prior to lamination.
5 Refer to geotextile product data sheet for additional specifications.

6 **If a different weight geotextile is used, values are subject to change. Geotextile weight dependent upon D_{85} of cover material, see section 5.6.2**
* Modified.

5.5 DRAINAGE MATERIAL PLACEMENT

5.5.1 The geocomposite roll shall be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the Purchaser's Representative.

5.5.2 The geocomposite shall be installed with the geotextile up, ie. above the Geonet Core.

5.5.3 In the presence of wind, all geocomposites shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.

5.5.4 The geocomposite shall be properly anchored in the anchor trenches, common to the HDPE, to resist sliding as shown on the construction drawings. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.

5.5.5 In applying fill material, no equipment shall drive directly across the geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.

5.5.6 The cover soil shall be placed in the geocomposite in a manner that prevents damage to the geocomposite.

5.5.7 Each component of the geocomposite will be secured or seamed to the like component at overlaps. Adjacent edges of the geonet along the length of the roll shall be placed with the edges of each geonet butted against each other. The overlaps shall be joined by tying the geonet structure with plastic cable ties spaced every five (5) feet along the roll length.

5.5.8 Adjoining geocomposite/geonet rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite/geonet a minimum of 12 inches across the roll width.

5.5.9 The geonet portion shall be tied every six (6) inches in the anchor trench.

5.5.10 Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.

5.5.11 Any rips, tears or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geonet by tying every six (6) inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be cut out and the two portions of the geonet shall be joined in accordance with Sections 5.5.7 and 5.5.8 above.

5.5.12 After installation, the Contractor shall submit certificates, signed by the Contractor and the CQA Inspector, that the geocomposite was placed in accordance with these Specifications.

5.6 DRAINAGE MATERIAL COVER

5.6.1 In applying fill or cover material, no equipment shall drive directly across the geocomposite. The specified cover material shall be placed and spread utilizing vehicles with a low ground pressure.

5.6.2 A sandy soil cover shall be placed on the drainage material. The soil shall have a minimum D_{85} as follows.

Fabric Weight	**Minimum D_{85}**
10 oz Fabric	.195 mm
8 oz Fabric	.235 mm
6 oz. Fabric	.275 mm

5.6.3 Alternative cover material may be used (ie., bottom ash) so long as its gradation meets the requirements of Section 5.6.2.

5.6.4 A minimum of two feet of soil or one foot of soil and one foot of gypsum shall be placed as cover material at the time of construction.

6.0 DISCHARGE PIPES

6.1 GENERAL

6.1.1 Discharge pipes shall be of size and specifications as indicated in the Drawings.

6.1.2 All pipes penetrating the dike structure shall be encased in a minimum of 12 inches of flowable fill above and below and 18 inches of flowable fill on the sides. Flowable fill shall meet the specifications shown on the Drawings.

6.1.3 Hold down straps shall be used on the pipe while placing the flowable fill.

6.1.4 The compacted fill material shall meet the requirements of Section 2.5 of this Specification and shall be placed in accordance with the same. It shall be clean soil, free of roots, vegetation, rocks greater than 3 inches maximum dimension, or other objectionable material. If machine placement and compaction is not feasible, the fill material shall be placed in 4-inch lifts and hand compacted under and around the pipe to at least the same density as the adjacent fill material.

7.0 VEGETATION

7.1 GENERAL

7.1.1 A layer of topsoil 4-inches to 6-inches in final thickness shall be placed on all areas to be grassed. All disturbed areas not covered with liner material, as shown on the Drawings, shall be grassed. Topsoil shall be free of subsoil, clay, weeds, roots, and impurities. Hydroseeding methods may be used.

7.1.2 The Contractor shall produce a satisfactory stand of perennial grass in accordance with the vegetation schedule shown on the drawings (D-587887). If it is necessary to repeat any or all the work, including plowing, fertilizing, watering, mulching and seeding, the Contractor shall repeat these operations until a satisfactory stand is obtained at no additional cost to the Purchaser.

7.1.3 Final stabilization shall be defined as follows: all soil disturbing activities at the site have been completed, and that for unpaved areas and areas not covered by permanent structures, 100% of the soil surface is uniformly covered in permanent vegetation with a density of 70% or greater, or equivalent permanent stabilization measures (such as the use of rip rap, gabions, permanent mulches or geotextiles) have been employed.

7.1.4 Measures shall be taken to prevent erosion of the topsoil layer and vegetation until a full vegetative growth has been obtained. The Contractor shall make daily inspections of the seeded areas and repair all eroded areas to the satisfaction of the Purchaser.

7.1.5 After seeding, an erosion control biodegradable straw blanket shall be installed on the exterior slopes of the dikes and any areas that have slopes of 3:1 or steeper. This material shall be a BioNet S150BN Double Net Straw Blanket by North American Green, or approved equal. The blanket shall be installed per manufacturer’s installation instructions. However, the blanket shall be tacked as necessary to the ground to withstand the upward growth of grass and to permit the establishment of grass through the blanket. Failure to accomplish this will require that the effected area be re-grassed and redone to the satisfaction of the Project Construction Manager.

7.1.6 Graded areas that are to be grassed, which have slopes less steep than 3:1, shall be mulched with straw or other suitable material.

7.1.7 Water required to promote a satisfactory growth shall be furnished by the Purchaser and applied by the Contractor.

8.0 SUBMITTALS

8.1 GEOMEMBRANE (HDPE) SUBMITTALS

8.1.1 The Contractor shall provide to the Purchaser a Quality Control (QC) Program and Manual, or descriptive documentation for manufacture of the geomembrane from the manufacturer.

8.1.2 The Contractor shall provide to the Purchaser qualification statements from the geomembrane (HDPE) manufacturer, certified installer and CQC inspector documenting the minimum requirements of Sections 4.2.1, 4.2.2, and 4.2.3 of these Specifications.

8.1.3 The Contractor shall provide to the Purchaser QC certificates for both the HDPE liner and the welding rods.

8.1.4 The Contractor shall submit a certification from the manufacturer of the geomembrane stating that the sheeting meets the physical property requirements noted in Sections 4.4 and 4.5 of these Specifications.

8.1.5 The Contractor shall submit a panel layout drawing for the HDPE and a detailed, written installation procedure for the Purchaser’s review fourteen days prior to the start of installation.

8.2 GEOCOMPOSITE DRAINAGE MATERIAL SUBMITTALS

8.2.1 The Contractor shall provide the Quality Control (QC) Program and Manual, or descriptive documentation from the manufacturer of the geocomposite materials prior to the delivery of the geocomposite.

8.2.2 The Contractor shall provide to the Purchaser qualification statements from the geocomposite manufacturer, certified installer and CQC inspector documenting the minimum requirements of Sections 5.2.1, 5.2.2, 5.2.3, and 5.2.4 of these Specifications.

8.2.3 The Contractor shall provide the manufacturer's certification that the material was manufactured in accordance with this specification, together with a report of test results, prior to material shipment.

8.2.4 The Contractor shall submit a panel layout drawing of the drainage material and a detailed, written procedure for the Purchaser's review fourteen days prior to the start of installation.

8.2.5 After installation, the Contractor shall submit certificates, signed by the Contractor and the CQA Inspector, that the geocomposite was placed in accordance with these Specifications.

8.3 SOILS TESTING LABORATORY

8.3.1 The Contractor shall provide to the Purchaser the qualifications of third party contracted to perform the QC testing for the structural earth fill and the clay liner.

8.4 THIRD PARTY QUALITY CONTROL

8.4.1 The Contractor shall provide to the Purchaser the qualifications of a third-party inspector for construction quality control (CQC) of the clay liner installation documenting the minimum requirements of Section 2.6 of these Specifications.

8.4.2 The Contractor shall provide to the Purchaser the qualifications of a third-party inspector for construction quality control (CQC) of the HDPE installation documenting the minimum requirements of Section 4.2.3 of these Specifications.

8.4.3 The Contractor shall provide the Purchaser the qualifications of a third-party inspector for CQC of the geocomposite installation documenting the minimum requirements of Section 5.2.4 of these Specifications.

9.0 RECORDS

9.1 QUALITY CONTROL RECORDS

The quality control records of inspection and testing shall be compiled by the Contractor's Quality Control Inspector and provided to the Purchaser upon completion of the Project. Copies of the daily inspection reports and field quality control records shall be provided to the Purchaser on a weekly basis or as required. All records shall be forwarded to the Plant's permanent file to be retained as a permanent record of the project.

9.2 RECORD TOPOGRAPHIC SURVEY

A record topographic survey will be performed by the Purchaser to fully document the lateral and vertical extent of the developed area. This survey will be maintained as part of the permanent record.

APPENDIX 8
CLOSURE AND POST-CLOSURE CARE PLANS

CLOSURE PLAN FOR EXISTING CCR LANDFILL
PLANT GORGAS CCR LANDFILL – LINED DISPOSAL CELLS
ADEM Admin. Code r. 335-13-4-.20(2)

SITE INFORMATION

Site Name / Address
Plant Gorgas
460 Gorgas Road
Parrish, Alabama 35580

Owner Name / Address
Alabama Power Company
600 North 18th Street
Birmingham, AL 35203

CCR Unit

Plant Gorgas CCR Landfill

Closure Method

Close In-Place

CLOSURE PLAN DESCRIPTION

The Plant Gorgas lined CCR Landfill disposal cells will be closed by leaving CCR in place. The ash subgrade for the final cover of the Landfill will be graded to create a stable subgrade for construction of the final cover system. In accordance with r. 335-13-4-.20(2)(b)1., the final cover will be constructed to control, minimize or eliminate, to the maximum extent feasible, post closure infiltration of liquids into the waste and potential releases of CCR from the unit. This will be prevented by providing sufficient grades and slopes; ensuring slope and cover system stability; minimizing the need for further maintenance; and completing closure in the shortest amount of time consistent with recognized and generally accepted good engineering practices.

The final cover system will be graded so that surface water does not pond over the landfill units.

Final slopes will be 33 percent (3H:1V). The Department has previously provided a variance on slope angle from the requirement for slopes to be no steeper than 25 percent (Permit 64-10 dated June 24, 2016.)

Closure activities will begin no later than 30 days after the date of known final receipt of wastes. If the disposal units have remaining capacity and there is a reasonable likelihood that the units will receive additional waste, closure activities will begin no later than 1 year after the date of known final receipt of waste, or an extension will be requested from the Department and steps necessary to prevent threats to human health and the environment will continue to be taken.

CLOSURE PLAN FOR EXISTING CCR LANDFILL
PLANT GORGAS CCR LANDFILL – LINED DISPOSAL CELLS
ADEM Admin. Code r. 335-13-4-.20(2)

Within 90 days after permit expiration or when final closure requirements are achieved, Alabama Power will record a notation onto the land deed containing the property utilized for disposal and obtain environmental covenant in accordance with applicable Department regulations. A copy will be placed in the Operating Record within 120 days after closure and Alabama Power will provide a copy to the Department.

335-13-4-.20(2)(a)1. - Description of Final Cover System

The final cover for the lined disposal cells will be designed to minimize infiltration and erosion and is currently designed to consist of a GCL overlain by a 60-mil HDPE liner and a double-sided geocomposite drainage layer covered with 12 inches of protective soil and 6 inches of topsoil. The cover system to be used meets or exceeds the requirements of r. 335-13-4-.20(b)1 in that the permeability of the final cover system will be less than or equal to the permeability of the composite bottom liner system. Final design will ensure the disruption of the integrity of the final cover system is minimized through a design that accommodates settlement and subsidence, in addition to providing an erosion layer for protection from wind or water erosion.

335-13-4-.20(2)(a)2. – Estimate of the largest area of the CCR unit ever requiring a final cover

The Gorgas CCR Landfill includes 3 disposal cells having a total design disposal footprint of approximately 33 acres. The final cover will be applied to the individual footprints of the CCR unit disposal cells.

335-13-4-.20(2)(a)3.– Estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit

The Gorgas CCR Landfill lined disposal cells have been designed with a combined capacity of about 2,500,000 cubic yards.

335-13-4-.20(2)(a)4.– Closure Schedule

The milestones and the associated timeframes presented below are initial estimates. Some of the activities associated with the milestones will overlap. Milestones reflect approximate time to implement closure. The facility is still operational so the date to initiate closure has not yet been established; therefore, a reasonable estimate of the year of completing closure is not yet available. However, once closure is initiated it will take an estimated 18 months to complete all closure activities.

Milestones

Regulatory Interface – 6 months
Grading and Stabilization – 3 months
Installation of final cover – 9 months
Estimate of Year in which all closure activities will be completed – Approximately 12 months after initiation of closure. As this estimated time required for closure exceeds the 180-day closure completion requirement outlined in r. 335-13-4-.20(2)(g), it is anticipated that an extension of the closure period will be requested.

CLOSURE PLAN FOR EXISTING CCR LANDFILL
PLANT GORGAS CCR LANDFILL – LINED DISPOSAL CELLS
ADEM Admin. Code r. 335-13-4-.20(2)

Certification Statement

Written Closure Plan for a CCR Landfill

Site Name / Address

Plant Gorgas
460 Gorgas Road
Parrish, AL 35580

Owner Name / Address

Alabama Power Company
600 North 18th Street
Birmingham, AL 35203

CCR Unit

Plant Gorgas CCR Landfill

I hereby certify that the written closure plan was prepared in accordance with the requirements of ADEM Admin. Code 335-13-4-.20(2)(a), and that the final cover system will meet the requirements of r. 335-13-4-.20(2)(b).

12/4/18

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

16516
JAMES C. PEGUES, JR.

POST-CLOSURE CARE PLAN FOR EXISTING CCR LANDFILL
PLANT GORGAS CCR LANDFILL – LINED DISPOSAL CELLS
ADEM Admin. Code r. 335-13-4-.20(3)

The Alabama Department of Environmental Management Solid Waste Program Division 13 regulations (ADEM Admin. Code r. 335-13-4-.20(1)) requires the owner or operator of an existing CCR landfill that is closed in place to provide for post-closure care of the unit for a period of at least 30 years. Post-closure care includes maintenance of the facility, as well as groundwater monitoring in accordance Department regulations.

The CCR landfill located at Alabama Power Company's Plant Gorgas is currently expected to be closed in place under the provisions of r. 335-13-4-.20 when the facility is full and no longer needed. Following closure, maintenance will be provided on the final cover system for the required post-closure care period so that the integrity and effectiveness of the final cover system will be maintained. The leachate collection and removal systems in the lined disposal cells will also be maintained. Maintenance activities will include, as needed, repairs to the final cover to correct any effects related to settlement, subsidence, erosion or other events, and will be performed to prevent run-on or run-off from eroding or otherwise damaging the final cover. Maintenance tasks could include, but not be limited to, repair of erosion features, replacement of eroded cover soils and re-establishment of vegetation, where applicable.

Post-closure maintenance will include quarterly inspections and any problems identified will be corrected in a timely manner. All eroded areas or areas having extensive surface cracks will be filled with suitable soil cover and appropriate cover established. Areas where ponding of water occurs will be maintained and regraded to reduce the potential for future ponding. Signs will be posted stating the facility is closed. Any required monitoring devices and pollution control equipment will be maintained.

The groundwater monitoring system will be maintained throughout the required post-closure care period. Groundwater monitoring will be performed on a semiannual basis during the required post-closure care period as well.

During the post closure care period, the following office (s) can be contacted about the facility during the post-closure care period.

Gorgas Steam Plant
Compliance and Support Manager
460 Gorgas Road, Parrish, AL 35580-5715
1-205-686-2103
G2CCRPostGOR@southernco.com

At the present time, there is no planned use of the facility after closure. If current plans change, they will be noted in an amendment to this post-closure care plan. Any future use of the property after closure will not disturb the integrity of the final cover, liner or any other component of the containment system. Furthermore, the functionality of the groundwater monitoring system will be maintained.

No later than 60 days following completion of the post-closure care period of 30 years, Alabama Power Company will prepare a notification verifying completion of the post-closure care.

I hereby certify that this post-closure care plan has been prepared in accordance with the requirements of r. 335-13-4-.20(3).

12/3/18

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

16516
JAMES C. PEGUES, JR.

APPENDIX 9
OPERATIONS PLAN

OPERATION PLAN
PLANT GORGAS CCR LANDFILL

William Crawford Gorgas Electric Generating Plant (Plant Gorgas) is located in southeastern Walker County, Alabama, approximately fifteen miles south of Jasper, at 460 Gorgas Road Parrish, AL 35580. Plant Gorgas, the oldest operating fossil plant in Alabama, came on-line in 1917 when the first of ten generating units had been completed; three of these generating units are still active.

The landfill facility is located on Plant Gorgas property (owned by Alabama Power Company) and will receive waste only from Alabama Power operations.

Cover

Daily and intermediate cover is not expected to be a requirement for the CCR disposal areas, particularly for the working face of the cell. As backslopes of the cells achieve planned finished grade, temporary soil cover will be placed, as needed, and vegetation will be established. Intermediate cover will not be routinely utilized on the active face of the CCR disposal areas. Any exposed area of the CCR disposal area materials that will not receive ash or gypsum for three months will be covered with temporary soil cover.

Stacking plan drawings for the CCR cells show a 6 inch intermediate cover to be placed on all exterior slopes of stacked waste during filling operations which will be vegetated and maintained until final stabilization and closure.

Leachate Ponds Operational Information

The CCB-Baghouse disposal area utilizes two lined composite lined disposal cells and two composite lined leachate and storm water ponds. Until Cell 2 receives waste, the two ponds will be isolated; Pond 2 will receive non-contact storm water from Cell 2. While Cell 2 is not in use, Pond 2 provides enough storage for a 24-hour 10 year storm event for the drainage area of Cell 2. Pond 1 provides storage for a 24-hour 100 year storm event, plus an additional amount of storage for a 24-hour 10 year storm event for the Cell 1 drainage area.

Once Cell 2 is operational, Ponds 1 and 2 will be connected and work together to provide enough storage for a 24-hour 100 year flood for Cells 1 and 2, plus an additional volume for a 24-hour 10 year storm event for the Cell 2 drainage area.

The water levels will actively be monitored and the ponds will be managed with pumps and discharge lines to ensure the water levels remain at a level to prevent water from backing up into the disposal cells onto the liner.

The leachate and storm water collected in the ponds will be beneficially used to condition the waste to improve the workability and compactability of the material in the landfill cell.

Discharges from these ponds are interconnected to the Plant Gorgas wastewater treatment system and covered under the facility's National Pollutant Discharge Elimination System (NPDES) Permit No AL0002909.

Access

Plant Gorgas and Alabama Power will control access to the facility and prevent unauthorized vehicular traffic and illegal dumping of wastes through the use of artificial barriers, natural barriers, or both, as appropriate.

Operational Standards

Waste accepted at the facility will originate only from Alabama Power Company. The waste disposed of in the facility will include CCR-related materials, to include flyash, FGD gypsum and baghouse byproducts consisting of a mixture of any or all of the following: flyash, powdered activated carbon, lime or other comparable dry sorbent material.

No prohibited wastes will be disposed of in the facility, including Hazardous or PCB waste, regulated medical wastes or liquid waste streams.

Random inspections of incoming loads to the disposal facility will be conducted to insure no prohibited wastes are disposed of in the facility. Plant personnel assigned to operations within the landfill are routinely trained to identify such waste streams.

Open burning of wastes within the permitted limits of the landfill will not be conducted. If burning of trees and stumps associated with landfill construction activities is needed within the permitted boundary, such activities will be properly permitted through the Department and the Alabama Forestry Commission.

All waste will be confined to as small a space as possible. Alabama Power has previously been granted a variance (under prior permitting activities for the facility) to allow final graded slopes in the CCR cells to be no steeper than 3H:1V (33%). CCR has different material properties than MSW, which generally requires flatter slopes (no steeper than 4H:1V).

Each of the various CCR wastes will have their own unique characteristics and will be disposed of in individual cells containing comparable wastes. In general, disposal operations for these wastes will follow the same guidelines. The CCR materials will be conditioned with moisture prior to transport and disposal at the landfill, and/or as a part of placement and compaction activities. In order to minimize the potential for fugitive dust, the area of exposed CCR in the working area of the stacks shall be limited and slopes will not exceed 3: 1 (33%). Conditioned CCR waste shall be spread in continuous uniformly thick and relative horizontal layers. The maximum loose thickness of each lift shall not exceed 12 inches (nominal loose thickness).

Gypsum will be placed in the bottom of the CCR cells in order to provide a working surface that is protective of the liner system. The gypsum will be placed in front of the working equipment at all times to eliminate contact between the equipment and liner material. Then as required during filling operations, waste will be worked up the sides of the cell from the bottom.

The CCR materials will be compacted with suitable earthmoving equipment to achieve a minimum 90% of its maximum dry density determined in accordance with ASTM D 698. Density tests shall be performed on a compacted CCR lift during initial filling operations to determine the required number of equipment passes to achieve compaction. Moisture contents shall be adjusted appropriately by wetting or drying methods to maintain suitable compaction moisture.

If the surface of a CCR lift is expected to be exposed for longer than 24 hours, the surface shall be rolled with a smooth drum roller to seal the surface to reduce infiltration and to prevent ponding of precipitation. Any exposed area of the CCR materials that will not receive ash or gypsum for three months shall be covered with temporary soil cover.

As some CCR materials are suitable for beneficial reuse and the market for reuse of these materials fluctuates, it may be desirable to salvage CCR wastes from the landfill after disposal. All such salvaging will be closely controlled and performed in such a manner so as to not damage the disposal cell leachate collection and liner systems.

The volume of available airspace associated with the CCR disposal cells:

Disposal Cell	**Approximate Airspace Volume (cubic yards)**
Baghouse Byproduct Cell 1	339,500
Baghouse Byproduct Cell 1	703,000
Gypsum Cell	1,800,000

Recordkeeping [r. 335-13-15-.08]

Alabama Power will maintain an operating record at Plant Gorgas that contains the following information:

- A copy of the Solid Waste Disposal Permit as issued by the Department
- The permit application, operational narrative and engineering drawings
- Reports or documentation generated during the normal operation of the facility

Each report or other documentation generated during the normal operation of the facility will be retained for at least a period of five years follow the date of each occurrence, measurement, maintenance, corrective action, report, record or study.

All information in the operating record will be furnished upon request to ADEM and will be made available at reasonable times for inspection by ADEM.

In accordance with the requirements of 335-13-15 [per 335-13-5-.02(1)(h)5.], all required plans and assessments periodically required for CCR landfills will be updated when conditions change that modify such updates. Amended plans and assessments will be placed in the Plant Gorgas Operating Record, posted to the public internet website and notifications will be made to the Director of the Department.

APPENDIX 10
ADJACENT PROPERTY OWNERS

No other landowners adjoin the surveyed facility boundary for this CCR Unit.

APPENDIX 11
UNSTABLE AREA DEMONSTRATION

LOCATION RESTRICTION DEMONSTRATION
UNSTABLE AREAS (40 C.F.R. 257.64 and ADEM Admin. Code r. 335-13-15-.03(5))
PLANT GORGAS CCR LANDFILL
ALABAMA POWER COMPANY

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257, Subpart D) and the State of Alabama's ADEM Admin. Code Chapter 335-13-15 require the owner or operator of an existing CCR surface impoundment to make a demonstration that the facility meets certain location restrictions. Per § 257.64 and ADEM Admin. Code r. 335-13-15-.03(5), the owner or operator must demonstrate that the facility is not located within an unstable area; otherwise, a demonstration must be made that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. An unstable area is defined in the regulations as a location that is susceptible to natural or human induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movements and karst terrains.

The CCR landfill located at Alabama Power Company's Plant Gorgas referred to as the Plant Gorgas CCR Landfill is located on Plant Gorgas property, near Parrish, Walker County, Alabama. The lined CCR landfill is formed by excavations in previously placed mine spoil material as well as the construction of earthen embankments. The embankments have been properly constructed using mechanical stabilization, compacted to a density sufficient to withstand the range of loading conditions. Factor of safety assessments have indicated that the embankments meet the generally accepted minimum factors of safety. The foundations beneath the embankments and the CCR unit generally consist of previously placed mine spoils. Calculations at the time of original design and permitting documented that strains in the liner due to consolidation of the underlying mine spoil would be on the order of 1.7 percent, well within the manufacturer's tolerable strain limit of 4 percent. Furthermore, the CCR unit is not located within karst terrain, and the site and its surrounding areas are not subject to mass movements (e.g. landslides).

I hereby certify that the unstable area location restriction demonstration was conducted in accordance with 40 C.F.R. Part 257.64 and ADEM Admin. Code r. 335-13-15-.03(5).

12/17/18

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

16516
JAMES C. PEGUES, JR.

LOCATION RESTRICTION DEMONSTRATION
UNSTABLE AREAS (40 C.F.R. 257.64 and ADEM Admin. Code r. 335-13-15-.03(5))
PLANT GORGAS GYPSUM LANDFILL
ALABAMA POWER COMPANY

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257, Subpart D) and the State of Alabama's ADEM Admin. Code Chapter 335-13-15 require the owner or operator of an existing CCR surface impoundment to make a demonstration that the facility meets certain location restrictions. Per § 257.64 and ADEM Admin. Code r. 335-13-15-.03(5), the owner or operator must demonstrate that the facility is not located within an unstable area; otherwise, a demonstration must be made that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. An unstable area is defined in the regulations as a location that is susceptible to natural or human induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movements and karst terrains.

The CCR landfill located at Alabama Power Company's Plant Gorgas, referred to as the Plant Gorgas Gypsum Landfill, is located on Plant Gorgas property, near Parrish, Walker County, Alabama. The lined CCR landfill is formed by excavations in previously placed mine spoil material as well as the construction of earthen embankments. The embankments have been properly constructed using mechanical stabilization, compacted to a density sufficient to withstand the range of loading conditions. Factor of safety assessments have indicated that the embankments meet the generally accepted minimum factors of safety. The foundations beneath the embankments and the CCR unit generally consist of previously placed mine spoils. Calculations at the time of original design and permitting for the adjoining CCR Landfill documented that strains in the liner due to consolidation of the underlying mine spoil would be on the order of 1.7 percent, well within the manufacturer's tolerable strain limit of 4 percent. The CCR Landfill calculation assumed mine spoil depths of up to 125 feet. The mine spoil depths beneath the Gypsum Landfill were determined to be less than 100 feet. Therefore, the calculation for the CCR Landfill is applicable for the Gypsum Landfill, as less thickness of mine spoil would result in less settlement, and therefore less strain. Furthermore, the CCR unit is not located within karst terrain, and the site and its surrounding areas are not subject to mass movements (e.g. landslides).

I hereby certify that the unstable area location restriction demonstration was conducted in accordance with 40 C.F.R. Part 257.64 and ADEM Admin. Code r. 335-13-15-.03(5).

10/17/18

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