# *COAL COMBUSTION RESIDUAL FACILITY PERMIT*

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| **PERMITTEE:** | **Alabama Power Company** |
| **FACILITY NAME:** | **Gadsden Steam Plant** |
| **FACILITY ADDRESS:** | **1000 Goodyear Avenue<br>Gadsden, Alabama 35903** |
| **PERMIT NUMBER:** | **28-09** |
| **UNITS PERMITTED:** | **Plant Gadsden Ash Pond** |

**In accordance with and subject to the provisions of the Solid Wastes & Recyclable Materials Management Act, as amended, Code of Alabama 1975, SS 22-27-1 to 22-27-27 ("SWRMMA"), the Alabama Environmental Management Act, as amended, Code of Alabama 1975, SS 22-22A-1 to 22-22A-15, and rules and regulations adopted thereunder, and subject further to the conditions set forth in this permit, the Permittee is hereby authorized to manage coal combustion residuals at the above-described facility location.**

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| **ISSUANCE DATE:** | **????????????** |
| **EFFECTIVE DATE:** | **????????????** |
| **EXPIRATION DATE:** | **????????????** |

**Alabama Department of Environmental Management**

**ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT**
**COAL COMBUSTION RESIDUAL PERMIT**

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| Permittee: | Alabama Power Company<br>P.O. Box 2641<br>Birmingham, Alabama 35291 |
| Facility Name: | Gadsden Steam Plant |
| Facility Address: | 1000 Goodyear Avenue<br>Gadsden, Alabama 35903 |
| Permit Number: | 28-09 |
| Units Permitted: | Plant Gadsden Ash Pond |

Pursuant to the Solid Wastes & Recyclable Materials Management Act, Code of Alabama 1975, §§22-27-1, et seq., as amended, and attendant regulations promulgated thereunder by the Alabama Department of Environmental Management (ADEM), this permit is issued to Alabama Power Company (hereinafter called the Permittee) for the coal combustion residual units located at the Gadsden Steam Plant.

The Permittee must comply with all terms and conditions of this permit. This permit consists of the conditions set forth herein (including those in all attachments), and the applicable regulations contained in Chapters 335-13-1 through 335-13-16 of the ADEM Administrative Code (referred to as the "ADEM Admin. Code" or “335-13”). Rules cited are set forth in this document for the purpose of Permittee reference. A Rule that is cited incorrectly in this document does not constitute grounds for noncompliance on the part of the Permittee. Applicable ADEM Administrative Codes are those that are in effect on the date of issuance of this permit or the revisions approved after permit issuance.

This permit is based on the information submitted to ADEM on December 5, 2018, and as amended, and known as the Permit Application (hereby incorporated by reference and hereinafter referred to as the Application). Inaccuracies found in this information could lead to the termination or modification of this permit and potential enforcement action. The Permittee must inform ADEM of deviations from or changes in the information in the Application that would affect the Permittee's ability to comply with the applicable ADEM Admin. Code or permit conditions.

This permit is effective as of **?????????????**, and shall remain in effect until **??????????????**, unless suspended or revoked.

_____ _____
Alabama Department of Environmental Management Date Signed

## SECTION I. SUMMARY OF UNITS.

A. Plant Gadsden Ash Pond.

1. Unit Type. Surface Impoundment.

2. Status. Permit to Close.

3. Location. Section 2, Township 12 South, Range 6 East in Etowah County, Alabama.

4. Size. The facility boundary consists of approximately 130.22 acres with a disposal area that consists of approximately 58.73 acres.

## SECTION II. STANDARD CONDITIONS.

A. Effect of Permit. The Permittee is required to manage coal combustion residuals (CCR) in accordance with the conditions of this permit and 335-13. Issuance of this permit does not convey property rights of any sort or an exclusive privilege, nor does it authorize the injury to persons or property, the invasion of other private rights, or the infringement of state or local laws or regulations. Except for actions brought under Code of Alabama 1975, §§22-27-1, *et seq*., as amended, compliance with the conditions of this permit shall be deemed to be compliance with applicable requirements in effect as of the date of issuance of this permit and future revisions.

B. Permit Actions. This permit may be suspended, revoked or modified for cause. The filing of a request for a permit modification or the notification of planned changes or anticipated noncompliance on the part of the Permittee, and the suspension or revocation does not stay the applicability or enforceability of any permit condition.

C. Severability. The provisions of this permit are severable, and if a provision of this permit, or the application of a provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

D. Definitions. For the purpose of this permit, terms used herein shall have the same meaning as those in 335-13, unless this permit specifically provides otherwise; where terms are not otherwise defined, the meaning associated with such terms shall be as defined by a standard dictionary reference or the generally accepted scientific or industrial meaning of the term.

1. "EPA" means the United States Environmental Protection Agency.

2. "Permit Application" means all permit application forms, design plans, operational plans, closure plans, technical data, reports, specifications, plats, geological and hydrological reports, and other materials which are submitted to ADEM in pursuit of a CCR permit.

3. "Permit to Close" means written authorization granted to a person by the Department to close a CCR unit consistent with the Application, this permit, and 335-13.

E. Duties and Requirements.

1. Duty to Comply. The Permittee must comply with all conditions of this permit except to the extent and for the duration such noncompliance is authorized by a variance granted by ADEM. A permit noncompliance, other than noncompliance authorized by a variance, constitutes a violation of Code of Alabama 1975, §§22-27-1 et seq., as amended, and is grounds for enforcement action, permit suspension, revocation, modification, and/or denial of a permit renewal application.

2. Duty to Reapply. If the Permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the Permittee must apply for and obtain a new permit. The renewal application must be submitted to ADEM at least 270 days before this permit expires.

3. Permit Expiration. This permit and all conditions therein will remain in effect beyond the permit's expiration date if the Permittee has submitted a timely, complete application as required by Section II.E.2., and, through no fault of the Permittee, ADEM has not made a final decision regarding the renewal application.

4. Need to Halt or Reduce Activity Not A Defense. It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of this permit.

5. Duty to Mitigate. In the event of noncompliance with this permit, the Permittee shall take all reasonable steps to minimize releases to the environment and shall carry out such measures as are reasonable to prevent significant adverse impacts on human health or the environment.

6. Proper Operation and Maintenance. The Permittee shall at all times properly operate and maintain all facilities and systems of control (and related appurtenances) that are installed or used by the Permittee to achieve compliance with the conditions of this permit.

7. Duty to Provide Information. If requested, the Permittee shall furnish to ADEM, within a reasonable time, the information that ADEM may reasonably need to determine whether cause exists for denying, suspending, revoking, or modifying this permit, or to determine compliance with this permit. If requested, the Permittee shall also furnish ADEM with copies of records kept as a requirement of this permit.

8. Inspection and Entry. Upon presentation of credentials and other documents as may be required by law, the Permittee shall allow the employees of ADEM or their authorized representative to:

   a. Enter at reasonable times the Permittee's premises where the regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit.

   b. Have access to and copy, at reasonable times, the records that must be kept under the conditions of this permit.

   c. Inspect, at reasonable times, the facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit.

   d. Sample or monitor, at reasonable times, the substances or parameters at a location for the purposes of assuring permit compliance or as otherwise authorized by Code of Alabama 1975, §§22-27-1 *et seq*.

9. Reporting Planned Changes. The Permittee shall notify ADEM, in the form of a request for permit modification, at least 90 days prior to any change described in 335-13-15-.13(1) and (2), or change in the design or operating procedure as described in this permit, including planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

10. Transfer of Permit. This permit may be transferred to a new owner or operator. All requests for transfer of permits shall be in writing and shall be submitted on forms provided by ADEM. Before transferring ownership or operation of the facility during its operating life, the Permittee shall notify the new owner or operator in writing of the requirements of this permit.

11. Noncompliance. The Permittee shall report all instances of noncompliance to the Department within 30 days of its finding, unless otherwise required by 335-13-15.

12. Other Information. If the Permittee becomes aware that information required by the Application was not submitted or was incorrect in the Application or in a report to ADEM, the Permittee shall promptly submit such facts or information. In addition, upon request, the Permittee shall furnish to ADEM, within a reasonable time, information related to compliance with the permit.

F. Signatory Requirement. All applications, reports or information required by this permit, or otherwise submitted to ADEM, shall be signed and certified by the owner as follows:

1. If a city, county, or other municipality or governmental entity, by the ranking elected official, or by a duly authorized representative of that person.

2. If a corporation, organization, or other legal entity, by a principal executive officer, of at least the level of Vice President, or by a duly authorized representative of that person.

G. Confidential Information. The Permittee may claim information submitted as confidential if the information is protected under Code of Alabama 1975 §22-39-18, as amended.

H. State Laws and Regulations. Nothing in this permit shall be construed to preclude the initiation of a legal action or to relieve the Permittee from the responsibilities, liabilities, or penalties established pursuant to an applicable state law or regulation.

## SECTION III. GENERAL OPERATING CONDITIONS.

A. Operation of Facility. The Permittee shall operate and maintain the facility:

1. Consistent with the Application, this permit, and 335-13-15.

2. To minimize the possibility of an unplanned sudden or nonsudden release of contaminants (including leachate) to air, soil, groundwater, or surface water, which could threaten human health or the environment.

B. Boundary Markers. The Permittee shall ensure that the disposal boundaries of operational units and units in post-closure are identified with a sufficient number of permanent boundary markers that are at least visible from one marker to the next.

C. Open Burning. The Permittee shall not allow open burning without prior written approval from ADEM and other appropriate agencies. A burn request should be submitted in writing to ADEM outlining why that burn request should be granted. This request should include, but not be limited to, specifically what areas will be utilized, types of waste to be burned, the projected starting and completion dates for the project, and the projected days and hours of operation. The approval, if granted, shall be included in the operating record.

D. Equipment. Adequate equipment shall be provided to insure continued operation in accordance with the permit and regulations.

E. Security. The Permittee shall provide artificial and/or natural barriers, which prevent entry of unauthorized vehicular traffic to the facility.

F. Personnel. The Permittee shall maintain adequate personnel to ensure continued and smooth operation of the facility.

G. Adverse Weather Disposal. [RESERVED].

H. Environmental Monitoring and Treatment Structures. The Permittee shall provide protection and proper maintenance of environmental monitoring and treatment structures.

I. Identification Marker. The Permittee shall provide a permanent identification marker for each CCR unit, at least six feet high showing the permit number, name and owner of the unit.

## SECTION IV. SPECIFIC REQUIREMENTS FOR OPERATIONAL CCR UNITS. [RESERVED]

## SECTION V. GROUNDWATER MONITORING AND CORRECTIVE ACTION REQUIREMENTS.

A. Groundwater Monitoring System. The Permittee shall install and/or maintain a groundwater monitoring system, identified in Table 1, as specified in 335-13-15-.06(2) and the approved groundwater monitoring plan.

B. Groundwater Sampling and Analysis Requirements.

1. The Permittee shall use the techniques and procedures as specified in 335-13-15-.06(4) thru (9) and the approved groundwater monitoring plan to provide an accurate representation of groundwater quality when sampling and analyzing the monitoring wells identified in Table 1. (See Section IX.A. and B.)

2. In addition, the Permittee shall record water levels, mean sea level elevation measuring point, depth to water, and the results of field tests for pH and specific conductance at the time of sampling for each well.

3. Samples shall be collected, preserved, and shipped (when shipped off-site for analysis) in accordance with the procedures specified in the approved groundwater monitoring plan.

4. Samples shall be analyzed according to the procedures specified of the approved groundwater monitoring plan, Standard Methods for the Examination of Water and Wastewater (American Public Health Association, latest edition), Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020), Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA Publication SW-846, latest edition), or other appropriate methods approved by this Department. All field tests must be conducted using approved EPA test kits and procedures.

5. Samples shall be tracked and controlled using the chain-of-custody and QA/QC procedures specified of the approved groundwater monitoring plan.

6. Samples shall be conducted within a period of four weeks for each semi-annual sampling event, beginning with the effective date of this permit.

7. The Permittee shall install and maintain additional groundwater monitoring wells as necessary to assess changes in the rate and extent of any plume of contamination or as otherwise deemed necessary to maintain compliance with 335-13-15-.06. A plan in the form of a permit modification request should be submitted to the Department as required by Section V.D.

C. Corrective Action.

1. Assessment of Corrective Measures. The Permittee must initiate an assessment of corrective measures as specified in 335-13-15-.06(7) if any constituent listed in Appendix IV of 335-13-15 has been detected at a statistically significant level exceeding the groundwater protection standard, or immediately upon detection of a release from the CCR unit.

   a. The permittee must continue to monitor groundwater in accordance with the assessment monitoring program while assessing corrective measures.

2. Selection of Remedy. Based on the results of the corrective measures assessment, the Permittee must select a remedy as specified in 335-13-15-.06(8).

3. Implementation of the Corrective Action Program. Within 90 days of selecting a remedy, the Permittee must initiate remedial activities as specified in 335-13-15-.06(9), and shall be required to modify the permit in accordance with Section II.E.9.

D. Permit Modification. The Permittee shall submit a report to ADEM with a permit modification request specifying the design, location and installation of additional monitoring wells. This report shall be submitted within ninety (90) days prior to the installation which, at a minimum, shall include.

1. Well construction techniques including proposed casing depths, proposed total depth, and proposed screened interval of well(s);

2. Well development method(s);

3. A complete analysis of well construction materials;

4. A schedule of implementation for construction; and

5. Provisions for determining the lithologic characteristics, hydraulic conductivity and grain-size distribution for the applicable aquifer unit(s) at the location of the new well(s).

E. Recordkeeping and Reporting.

1. Recordkeeping. Records of monitoring and corrective action information shall include:

a. The exact place, date, and time of sampling or measurement.

b. The individual(s) and company who performed the sampling or measurements.

c. The date(s) analyses were performed.

d. The individual(s) and company who performed the analyses.

e. The analytical techniques or methods used.

f. The results of such analyses.

2. Reporting. The Permittee shall submit reports on all monitoring and corrective activities conducted pursuant to the requirements of this permit and 335-13-15. The reports should contain all monitoring results and conclusions from samples and measurements conducted during the sampling period.

TABLE 1
GROUNDWATER MONITORING WELLS

| Monitoring Well Number | Top of Casing (feet msl) | Unit Monitoring |
|---|---|---|
| | Background Wells | |
| GSD-AP-MW-14 | 548.34 | Ash |
| GSD-AP-MW-16 | To Be Installed | Ash |
| GSD-AP-MW-17 | To Be Installed | Ash |
| | Compliance Wells | |
| GSD-AP-MW-1 | 526.37 | Ash |
| GSD-AP-MW-2 | 526.16 | Ash |
| GSD-AP-MW-3 | 526.80 | Ash |
| GSD-AP-MW-4 | 520.60 | Ash |
| GSD-AP-MW-5 | 516.27 | Ash |
| GSD-AP-MW-6 | 515.23 | Ash |
| GSD-AP-MW-7 | 519.86 | Ash |
| GSD-AP-MW-8 | 519.22 | Ash |
| GSD-AP-MW-9 | 520.36 | Ash |
| GSD-AP-MW-10 | 530.93 | Ash |
| GSD-AP-MW-11 | 517.01 | Ash |
| GSD-AP-MW-12 | 521.82 | Ash |
| GSD-AP-PZ-1 | 521.71 | Ash |
| GSD-AP-PZ-5 | 524.26 | Ash |
| GSD-AP-PZ-6 | 519.60 | Ash |
| | Delineation Wells | |
| GSD-AP-MW-2V | 525.31 | Ash |
| GSD-AP-MW-4V | 520.33 | Ash |
| GSD-AP-MW-18H | 524.45 | Ash |
| GSD-AP-MW-19H | 517.32 | Ash |
| GSD-AP-MW-20H | 516.68 | Ash |
| | Piezometers (Water Level Reading) | |
| GSD-AP-PZ-2 | 516.49 | Ash |

## SECTION VI. SURFACE WATER MANAGEMENT REQUIREMENTS.

A. Discharges.

1. The Permittee shall not cause a discharge of pollutants into waters of the State, including wetlands, that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES), Alabama Water Pollution Control Act, Code of Alabama 1975, §§ 22-22-1 to 22-22-14 and/or section 404 of the Clean Water Act, or cause non-point source pollution.

2. The Permittee shall not cause non-point source pollution of waters of the State, including wetlands, that violates any requirements of an area wide and statewide water quality management plan that has been approved under the Alabama Water Pollution Control Act.

B. Stormwater Permit. Surface water discharges from drainage control structures shall be permitted through the ADEM Water Division's NPDES Program.

## SECTION VII. CLOSURE AND POST- CLOSURE REQUIREMENTS.

A. Closure Timeframe and Notifications. The Permittee shall close their CCR units as specified in 335-13-15-.07(2), this permit and the Application.

B. Criteria for Closure.

1. Cover. Closure of a CCR landfill, surface impoundment, or any lateral expansion of a CCR unit must be completed by either leaving the CCR in place and installing a final cover system or through removal of the CCR and decontamination of the CCR unit, as described in 335-13-15-.07(3)(b) through (j). The minimum and maximum final grade of the final cover system may be less than 5 percent and greater than 25 percent, as specified in the Permit Application. (See Section IX.C.)

2. Written Closure Plan. The written closure plan, as part of the Application, must include, at a minimum, the information specified in 335-13-15-.07(3)(b)1.(i) through (vi).

3. Initiation of Closure Activities. Except as provided for in 335-13-15-.07(3)(e)4 and 335-13-15-.07(4), the owner or operator of a CCR unit must commence closure of the CCR unit no later than the applicable timeframes specified in either 335-13-15-.07(3)(e)1 or 2.

4. Completion of closure activities. Except as provided for in 335-13-15-.07(3)(f)2, the owner or operator must complete closure of the CCR unit subject to the requirements in 335-13-15-.07(3)(f)1.(i) through (ii).

5. Notifications. No later than the date the owner or operator initiates closure of a CCR unit, the owner or operator must prepare a notification of intent to close a CCR unit. The notification must include the certification by a qualified professional engineer for the design of the final cover system as required by 335-13-15-.07(3)(d)3.(iii), if applicable. The owner or operator has completed the notification when it has been submitted to the Department and placed in the facility's operating record as required by 335-13-15-.08(1)(i)7.

   a. Within 30 days of completion of closure of the CCR unit, the owner or operator must prepare a notification of closure of a CCR unit. The notification must include the certification by a qualified professional engineer as required by 335-13-15-.07(3)(f)3. The owner or operator has completed the notification when it has been submitted to the Department and placed in the facility's operating record as required by 335-13-15.08(1)(i)8.

6. Deed Notations. The Permittee must submit deed notations as specified in 335-13-15-.07(3)(i)1 through 4.

7. Post Closure. Following closure, the owner or operator of a CCR unit must comply with the Uniform Environmental Covenants Program as specified in 335-5 and provide an environmental covenant to the Department. The owner or operator must place the executed environmental covenant in the facility's operating record as required by 335-13-15-08(1)(i)10.

C. Post Closure Requirements.

1. Applicability. Except as provided by either 335-13-15-.07(5)(a)2., this section applies to owners or operators of CCR landfills, CCR surface impoundments, and all lateral expansions of CCR units that are subject to the closure criteria under 335-13-15-.07(3).

   a. An owner or operator of a CCR unit that elects to close a CCR unit by removing CCR as provided by 335-13-15-.07(3)(c) is not subject to the post closure care criteria under this section.

2. Post-Closure Care Period. Post-closure care activities shall be conducted after closure of each unit throughout the life of this permit and continuing for a period of thirty (30) years following closure of the facility. ADEM may shorten or extend the post-closure care period applicable to the solid waste disposal facility. The Permittee shall reapply in order to fulfill the post-closure care requirements of this permit.

   a. If at the end of the post-closure care period the owner or operator of the CCR unit is operating under assessment monitoring in accordance with 335-13-15-.06(6), the owner or operator must continue to conduct post-closure care until the owner or operator returns to detection monitoring in accordance with 335-13-15-.06(6)(e)

3. Post-Closure Maintenance. The Permittee shall provide post closure maintenance of the facility to include regularly scheduled inspections. This shall include maintenance of the cover, vegetation, monitoring devices and pollution control equipment and correction of other deficiencies that may be observed by ADEM. Monitoring requirements shall continue throughout the post closure period as determined by ADEM unless all waste is removed and no unpermitted discharge to waters of the State have occurred.

4. Post-Closure Use of Property. The Permittee shall ensure that post closure use of the property never be allowed to disturb the integrity of the final cover, liner, or other components of the containment system. This shall preclude the growing of deep-rooted vegetation on the closed area.

5. Written Post Closure Plan.

   a. Content of the plan. The owner or operator of a CCR unit must prepare and submit to the Department as part of the permit application a written post closure plan that includes, at a minimum, the information specified in 335-13-15-.07(5)(d)1.(i) through (iii).

   b. Amendment. Amendments to the post closure written plan must be made in accordance with 335-13-15-.07(5)(d)3. (i) through (iii). The Permittee shall be required to modify the permit in accordance with Section II.E.9.

6. Notification. Notification of completion of post-closure care period. No later than 60 days following the completion of the post-closure care period, the owner or operator of the CCR unit must prepare a notification verifying that post closure care has been completed. The notification must include the certification by a qualified professional engineer verifying that post-closure care has been completed in accordance with the closure plan specified in 335-13-15-.07(5)(d) and the requirements of this section. The owner or operator has completed the notification when it has been submitted to the Department and placed in the facility's operating record as required by 335-13-15-.08(1)(i)14.

D. Removal of Waste. If the Permittee, or any other person(s), wishes to remove waste, waste residues, or any liner or contaminated soils, the owner must request and receive prior approval from the Department.

## SECTION VIII. REPORTING, RECORDKEEPING, NOTIFICATION, AND POSTING REQUIREMENTS.

A. Reporting. All applications, certifications, demonstrations, designs, documentation, plans, reports and/or requests which are required by this permit or 335-13-15 should be sent via signed mail (i.e. certified mail, express mail delivery service, etc.) or hand delivered to:

1. Mailing Address.
   Chief, Solid Waste Branch, Land Division
   Alabama Department of Environmental Management
   P.O. Box 301463
   Montgomery, AL 36130-1463

2. Physical Address.
   Chief, Solid Waste Branch, Land Division
   Alabama Department of Environmental Management
   1400 Coliseum Blvd.
   Montgomery, Alabama 36110-2400

B. Recordkeeping. The Permittee must maintain a written operating record at the facility that includes:

1. All information required by this permit or 335-13-15-.08(1).

2. Copies of this Permit and the Application.

3. Copies of all variances granted by ADEM, including copies of all approvals of special operating conditions.

C. Retention. The Permittee must retain each file for at least ten years following the documentation date. This period may be extended by the request of ADEM at any time and are automatically extended during the course of an unresolved enforcement action regarding this facility.

D. Availability. All records, including plans, required under this permit or 335-13 must be furnished upon request, and made available at reasonable times for inspection by an officer, employee, or representative of ADEM.

E. Notification. The Permittee must submit the notifications required under 335-13-15-.08(2) to the Director before the close of business on the day the notification is required to be completed and, unless otherwise required, within 30 days of placing the notice in the operating record.

F. Posting of Information to the Internet. The Permittee must maintain a publicly accessible internet site, titled, "CCR Rule Compliance Data and Information," containing the information specified in 335-13-15-.08(3). Unless otherwise required, postings must be made within 30 days of placing the information in the operating record.

## SECTION IX. VARIANCES AND SPECIAL CONDITIONS.

A. The Permittee may exclude boron as an Appendix IV assessment monitoring constituent. (See Section V.B.1.)

B. The Permittee is granted a variance from ADEM Admin. Code r. 335-13-15-.06(6)(h)2. in regards to cobalt, lead, lithium and molybdenum allowing standards of 6 micrograms per liter (µg/L) for cobalt; 15 µg/L for lead; 40 µg/L for lithium; and 100 µg/L for molybdenum. Should the background concentration be higher than the Maximum Contaminant Level or rule specified Groundwater Protection Standard (GWPS), including these

GWPS values for cobalt, lead, lithium and molybdenum, the provisions of 335-13-15-.06(6)(h)3. will continue to allow the use of the background concentration to establish the GWPS. (See Section V.B.1.)

C. The Permittee is granted a variance from ADEM Admin. Code r. 335-13-15-.07(3)(d)3.(i)(III) & (IV), requiring that the final grade of the cover system be a minimum of 5 percent and maximum of 25 percent. (See Section VII.B.1.)

D. The Permittee is granted a variance from ADEM Admin. Code r. 335-13-15-.03(6) requiring a 100 foot buffer from the perimeter of the facility boundary.

Any variance granted by ADEM may be terminated by ADEM whenever ADEM finds, after notice and opportunity for hearing, that the petitioner is in violation of any requirement, condition, schedule, limitation or any other provision of the variance, or that operation under the variance does not meet the minimum requirements established by state and federal laws and regulations or is unreasonably threatening the public health.

Alabama Power

**Dustin G. Brooks**
Environmental Affairs Supervisor
Environmental Compliance

600 North 18th Street
Post Office Box 2641
12N-0830
Birmingham, Alabama 35291

Tel 205.257.4194
Fax 205.257.4349
dgbrooks@southernco.com

April 30, 2020

Received: 4/30/20

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

Re: Revised Closure Permit Application for the Plant Gadsden Ash Pond

Dear Mr. Story:

Alabama Power Company is the owner and operator of the Plant Gadsden Ash Pond, located at Gadsden, Alabama. Pursuant to rule 335-13-15-.09(1)(c) of the regulations of the Alabama Department of Environmental Management (ADEM), and in response to your letter dated April 10, 2020, please find enclosed a revised closure permit application for the Plant Gadsden Ash Pond. This revised closure permit application has been prepared to update the permit application package previously submitted to ADEM in December 2018. Specifically, a revised groundwater monitoring plan submitted on April 15, 2020 has been incorporated into the Plant Gadsden Pond closure permit application package.

The Plant Gadsden Ash Pond is an "inactive CCR surface impoundment" as defined by rule 335-13-15-.02(29). Pursuant to rules 335-13-15-.07(1)(e)2.(i) and 335-13-15-.08(1)(e), Alabama Power completed the applicable location restriction demonstrations and placed them in the facility's operating record on April 16, 2020. Permit application materials have been prepared and submitted in accordance with rule 335-13-15-.09(1)(c).

Thank you for your consideration. Please feel free to contact me if Alabama Power can provide additional information or answer any questions.

Sincerely,

Dustin Brooks

Enclosures

# PERMIT APPLICATION FOR CCR SURFACE IMPOUNDMENT

## PLANT GADSDEN ASH POND

## GADSDEN, ALABAMA

## ALABAMA POWER COMPANY

**PERMIT APPLICATION FOR CCR SURFACE IMPOUNDMENT**

**PLANT GADSDEN ASH POND**

**335-13-15-.09(1)(c)**

## 1. ADEM Application form

The completed application form can be found in Appendix 1.

## 2. Boundary plat and legal property description

A boundary plat and legal description can be found in Appendix 2. This drawing includes a 100-ft offset line from the property boundary to reflect a buffer zone. *See* ADEM Admin. Code r. 335-13-15-.03(6). As can be seen, a variance is being requested for areas near the southeast corner of the property due to the closure footprint being within the 100-ft offset. *See* ADEM Admin. Code r. 335-13-15-.15.

## 3. Hazard Potential Classification [335-13-15-.04(4)(a)2.] and Emergency Action Plan (EAP) [335-13-15-.04(4)(a)3.].

The Plant Gadsden Ash Pond has undergone physical closure activities and is in the process of completing the regulatory requirements of 40 CFR 257.102(d) and 335-13-15-.07(3)(d). It no longer impounds free water nor receives CCR. Prior to closure, however, the Plant Gadsden Ash Pond was deemed to have a Significant Hazard Potential Classification in that failure or mis-operation of the CCR unit would result in no probable loss of human life but could potentially result in economic loss and/or environmental damage.

As stated above, the Plant Gadsden Ash Pond has undergone physical closure activities and no longer impounds water. Therefore, an Emergency Action Plan is not necessary, and is not included in this permit application.

Should ADEM deem the Hazard Potential Classification and Emergency Action Plan as requirements of its regulations, Alabama Power requests a variance. A variance may be granted because federal standards do not require these documents for closed facilities, *see* 40 C.F.R. §§ 257.101, 257.102, 257.104, and there is no purpose, whether for public health, the environment, or otherwise, for a dry facility to develop and maintain documents intended for surface impoundments.

## 4. History of Construction and Structural Stability Assessments:

### i. History of Construction [335-13-15-.04(4)(c)1.(i) through (xii)].

The History of Construction document, including applicable drawings and figures, can be found in Appendix 3.

ii. **Structural Stability Assessment [335-13-15-.04(4)(d)].**

The Plant Gadsden Ash Pond was formed by an engineered perimeter embankment. The embankment foundation soils generally consist of stable clays and silty clays.

Slope protection against surface erosion consists of grassy vegetation on the exterior dikes. Interior slopes have generally been incorporated into the closure system. Since the ash pond has undergone closure activities and no longer impounds water, wave action and rapid drawdown is not a concern.

The perimeter embankments have been properly constructed using mechanical stabilization and compacted to a density sufficient to withstand the range of loading conditions. Embankment soils generally consist of compacted clays and silts.

Vegetated slopes of the dike are properly maintained to a manageable height to allow for periodic inspection.

As the ash pond no longer impounds water, there are no spillways or discharge pipes in operation that are associated with the ash storage areas.

None of the downstream slopes of the embankment are subject to significant inundation from adjacent water bodies. The established vegetation serves well in protecting all downstream slopes.

iii. **Safety Factor Assessment [335-13-15-.04(4)(e)].**

Stability analyses on the dewatered and closed facility indicates the minimum factor of safety for under long-term, normal conditions is 2.1. The minimum factor of safety for seismic loading is 1.6. Calculations for factor of safety can be found in Appendix 4.

## 5. On-site Control Points

Control Points are shown on Drawing No. E523658 and E523659 found in Appendix 5.

## 6. Topographical maps, Grading Plans and Stacking Plans

Drawings showing existing topographic maps, grading plans for the initial disposal cell and stacking plans showing planned final grades are shown in Appendix 5.

## 7. Quality Assurance/Quality Control (QA/QC) Plan

The Technical Specifications for Closure of the Gadsden Ash Pond, which served as the QA/QC manual for the closure project, is included in Appendix 6.

## 8. Operation Plan

An Operation Plan for the facility can be found in Appendix 7. Attachments to this Operation Plan includes the following, unless as noted otherwise:

i. Groundwater monitoring and analysis program [335-13-15-.06.]
ii. Recordkeeping and Notification Compliance Procedures [335-13-15-.08.]

A CCR dust control plan was prepared for use prior to the completion of the construction of the cover system. As all ash has now been capped with a synthetic cover system, this CCR dust control plan is no longer valid and is not included in the Operation Plan. Should ADEM deem a dust control plan to be a requirement of its regulations, Alabama Power requests a variance. A variance may be granted because federal standards do not require this document for a closed facility, see 40 C.F.R. §§ 257.101, 257.102, 257.104, and there is no purpose, whether for public health, the environment, or otherwise, for a closed facility to develop and maintain documents intended for a facility with exposed CCR.

The Gadsden Ash Pond has undergone physical closure activities and no longer impounds water. Therefore, an inflow design flood control system plan is not included in the Operation Plan. Should ADEM deem an inflow design flood control system plan to be a requirement of its regulations, Alabama Power requests a variance. A variance may be granted because federal standards do not require this document for a closed facility, see 40 C.F.R. §§ 257.101, 257.102, 257.104, and there is no purpose, whether for public health, the environment, or otherwise, for a dry, closed facility to develop and maintain documents intended for surface impoundments.

The procedure for updating all plans and assessments has been included in the Operation Plan.

## 9. Written Closure and Post-closure Plan [335-13-15-.07.]

Written closure and post-closure care plans can be found in Appendix 8.

## 10. Supplemental Information

Reserved

## 11. Adjacent Property Owners

A list of adjoining property owners can be found in Appendix 10.

By signature below, I hereby certify that the information contained within this permit application is accurate and correct based on the available information.

12/4/18

James C. Pegues, P.E., D.GE
Alabama Licensed Professional Engineer No. 16516

Mike Godfrey

Mike Godfrey
Alabama Power Company

# APPENDIX 1

# APPLICATION FORM

# SOLID WASTE APPLICATION

**PERMIT APPLICATION**
**SOLID WASTE DISPOSAL FACILITY**
**ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT**
**(Submit in Triplicate)**

1. **Facility type:**
   - _____ **Municipal Solid Waste Landfill (MSWLF)**
   - _____ **Industrial Landfill (ILF)**
   - _____ **CCR Landfill (CCRLF)**
   - _X_ **CCR Surface Impoundment (CCRSI)**
   - _____ **Other (explain)**_____

2. **Facility Name** Plant Gadsden CCR Surface Impoundment (CCRSI)

3. **Applicant:**

   **Name:** Mr. Mike Godfrey (Physical Address)

   **Address:** Alabama Power Company
   Post Office Box 2641
   Birmingham, Alabama 35291

   Plant Gadsden
   1000 Goodyear Avenue
   Gadsden, AL 35903

   **Telephone:** (205) 257-6131 (256) 543-5194

4. **Location: (include county highway map or USGS map)**

   **Township** 12S **Range** 6E
   **Section** 02 **County** Etowah

5. **Land Owner:**

   **Name:** Alabama Power Company

   **Address:** Post Office Box 2641
   Birmingham, Alabama 35291

   **Telephone:** (205) 257-4194

   **(Attach copy of agreement from landowner if applicable.)**

6. **Contact Person:**

**Name** James Douglas | Tambria Ware

**Position or Affiliation** Environmental Affairs Specialist | Compliance Specialist

**Address:** Post Office Box 2641, Birmingham, AL 35291 | 1000 Goodyear Avenue, Gadsden, AL 35903

**Telephone:** (205) 257-6782 | (256) 549-6136

7. **Size of Facility:** 130.22 **Acres**

**Size of Disposal Area(s):** 58.73 **Acres**

8. **Identify proposed service area or specific industry that waste will be received from:**

The Plant Gadsden CCRSI has undergone closure and no longer receives waste.

9. **Proposed maximum average daily volume to be received at landfill (choose one):**

N/A **Tons/Day** N/A **Cubic Yards/Day**

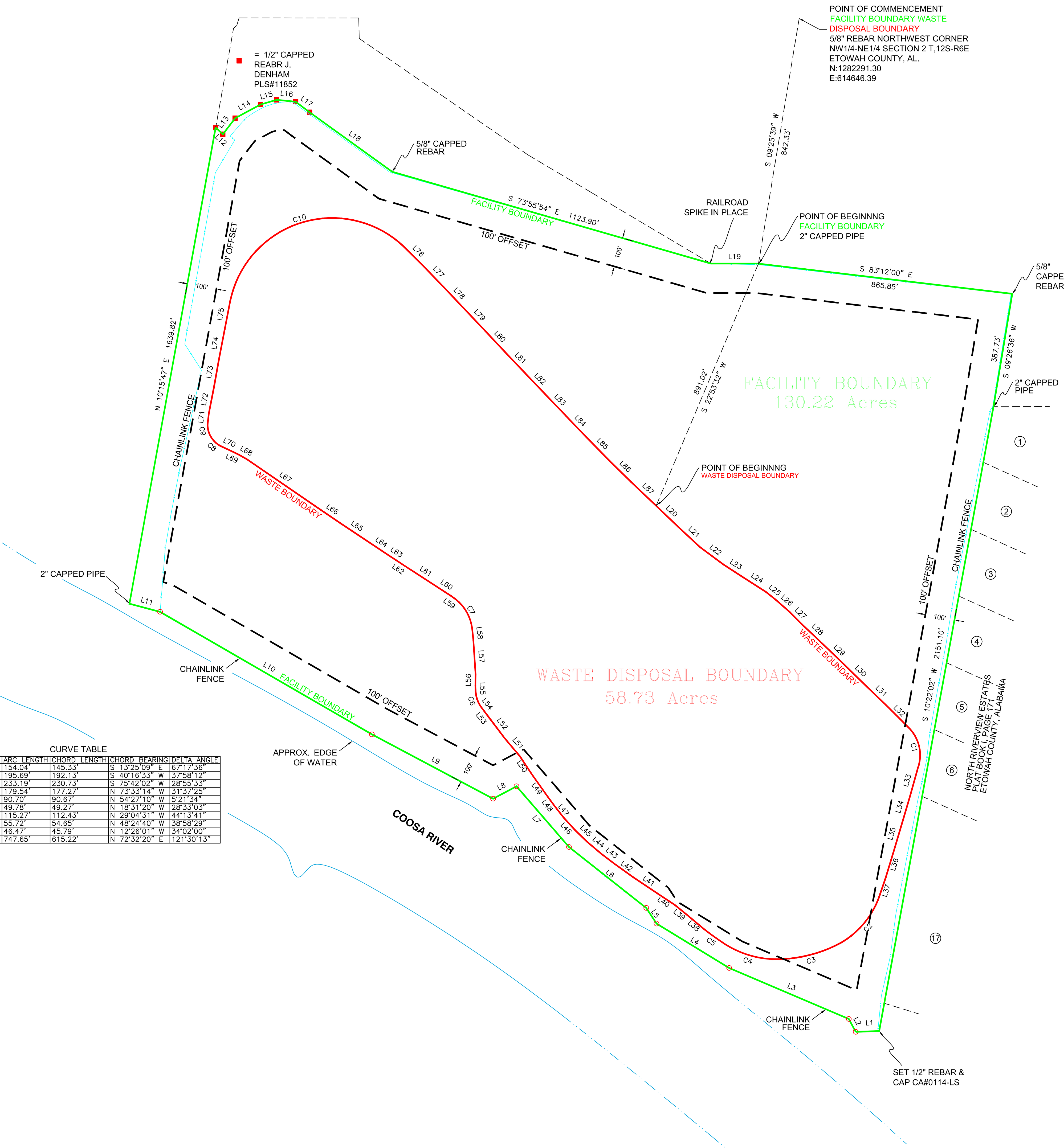
10. **List all waste streams to be accepted at the facility (i.e., household solid waste, wood boiler ash, tires, trees, limbs, stumps, etc.):**

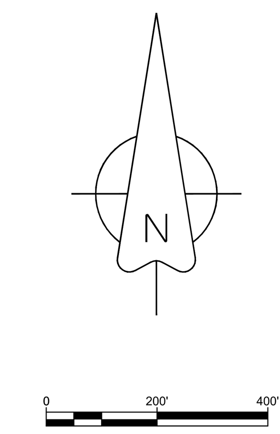
The Plant Gadsden CCRSI contains CCR related materials.

**SIGNATURE** 10/1/18 **DATE**

# APPENDIX 2

## BOUNDARY SURVEY AND LEGAL DESCRIPTION




GRID COORDINATES
ALABAMA STATE PLANE
NAD 83 EAST ZONE

LINE TABLE

| LINE | BEARING | DISTANCE |
|---|---|---|
| L1 | S 88°00'10" W | 79.50' |
| L2 | N 28°13'26" W | 49.62' |
| L3 | N 66°54'41" W | 440.66' |
| L4 | N 58°33'45" W | 288.34' |
| L5 | N 33°23'06" W | 63.34' |
| L6 | N 51°42'07" W | 333.49' |
| L7 | N 40°50'05" W | 271.86' |
| L8 | S 62°02'17" W | 89.93' |
| L9 | N 61°59'57" W | 464.74' |
| L10 | N 59°57'02" W | 829.14' |
| L11 | N 75°05'54" W | 107.69' |
| L12 | S 47°12'47" E | 33.13' |
| L13 | N 37°29'01" E | 68.61' |
| L14 | N 61°39'58" E | 97.42' |
| L15 | N 73°50'52" E | 56.88' |
| L16 | S 84°25'57" E | 64.80' |
| L17 | S 52°58'40" E | 59.27' |
| L18 | S 54°11'17" E | 344.79' |
| L19 | S 89°57'26" E | 161.11' |
| L20 | S 46°17'19" E | 102.43' |
| L21 | S 47°07'25" E | 101.57' |
| L22 | S 53°20'12" E | 98.41' |
| L23 | S 56°52'23" E | 73.11' |
| L24 | S 57°17'47" E | 98.70' |
| L25 | S 51°38'18" E | 40.64' |
| L26 | S 48°45'46" E | 64.81' |
| L27 | S 44°44'47" E | 59.73' |
| L28 | S 46°40'47" E | 100.85' |
| L29 | S 46°07'45" E | 101.54' |
| L30 | S 45°37'40" E | 100.60' |
| L31 | S 46°14'12" E | 90.27' |
| L32 | S 45°03'24" E | 105.09' |
| L33 | S 15°35'23" W | 96.37' |
| L34 | S 16°16'55" W | 89.17' |
| L35 | S 16°36'06" W | 102.50' |
| L36 | S 16°46'22" W | 100.31' |
| L37 | S 19°10'31" W | 74.39' |
| L38 | N 50°00'58" W | 68.39' |
| L39 | N 50°44'38" W | 58.87' |
| L40 | N 56°30'51" W | 71.40' |
| L41 | N 56°10'11" W | 98.73' |
| L42 | N 54°20'15" W | 79.53' |
| L43 | N 52°46'23" W | 53.49' |
| L44 | N 49°42'13" W | 63.80' |
| L45 | N 45°55'08" W | 55.29' |
| L46 | N 42°14'11" W | 58.50' |
| L47 | N 38°04'52" W | 47.92' |
| L48 | N 36°37'14" W | 37.47' |
| L49 | N 35°20'40" W | 97.82' |
| L50 | N 33°24'39" W | 71.29' |
| L51 | N 40°08'05" W | 80.02' |
| L52 | N 37°03'25" W | 87.86' |
| L53 | N 37°08'03" W | 29.80' |
| L54 | N 36°29'37" W | 20.35' |
| L55 | N 02°21'18" W | 21.93' |
| L56 | N 00°56'55" E | 37.33' |
| L57 | N 03°40'02" W | 119.67' |
| L58 | N 06°14'21" W | 37.00' |
| L59 | N 53°55'09" W | 18.38' |
| L60 | N 57°00'13" W | 69.88' |
| L61 | N 57°03'10" W | 102.27' |
| L62 | N 56°46'13" W | 53.80' |
| L63 | N 56°29'36" W | 23.22' |
| L64 | N 56°20'14" W | 98.59' |
| L65 | N 56°25'56" W | 100.88' |
| L66 | N 55°41'53" W | 101.44' |
| L67 | N 55°32'04" W | 284.20' |
| L68 | N 60°30'07" W | 31.11' |
| L69 | N 64°21'32" W | 31.84' |
| L70 | N 64°58'53" W | 29.56' |
| L71 | N 06°45'39" E | 33.59' |
| L72 | N 11°05'08" E | 88.37' |
| L73 | N 10°07'49" E | 100.12' |
| L74 | N 10°59'14" E | 99.06' |
| L75 | N 10°55'14" E | 100.62' |
| L76 | S 45°09'28" E | 95.48' |
| L77 | S 43°58'38" E | 99.92' |
| L78 | S 43°22'34" E | 101.21' |
| L79 | S 43°27'17" E | 100.75' |
| L80 | S 43°13'54" E | 99.28' |
| L81 | S 43°29'53" E | 99.85' |
| L82 | S 43°40'25" E | 96.52' |
| L83 | S 43°44'51" E | 100.42' |
| L84 | S 43°44'13" E | 97.96' |
| L85 | S 44°25'43" E | 118.34' |
| L86 | S 45°31'03" E | 100.51' |
| L87 | S 46°27'28" E | 117.18' |

CURVE TABLE

| CURVE | RADIUS | ARC LENGTH | CHORD LENGTH | CHORD BEARING | DELTA ANGLE |
|---|---|---|---|---|---|
| C1 | 131.15' | 154.04' | 145.33' | S 13°25'09" E | 67°17'36" |
| C2 | 295.29' | 195.69' | 192.13' | S 40°16'33" W | 37°58'12" |
| C3 | 461.91' | 233.19' | 230.73' | S 75°42'02" W | 28°55'33" |
| C4 | 325.29' | 179.54' | 177.27' | N 73°33'14" W | 31°37'25" |
| C5 | 969.67' | 90.70' | 90.67' | N 54°27'10" W | 5°21'34" |
| C6 | 99.90' | 49.78' | 49.27' | N 18°31'20" W | 28°33'03" |
| C7 | 149.32' | 115.27' | 112.43' | N 29°04'31" W | 44°13'41" |
| C8 | 81.92' | 55.72' | 54.65' | N 48°24'40" W | 38°58'29" |
| C9 | 78.23' | 46.47' | 45.79' | N 12°26'01" W | 34°02'00" |
| C10 | 352.56' | 747.65' | 615.22' | N 72°32'20" E | 121°30'13" |

## LEGEND:

(M) = MEASURED
(R) = RECORDED (MAP,DEED,PLAT,ETC.)
(M & R) = MEASURED & RECORDED
(PS) = PREVIOUS SURVEY
P.L.S. = PROFESSIONAL LAND SURVEYOR
CA = CERTIFICATE OF AUTHORIZATION
(0114 - LAND SURVEYING)
G.P.S. = GLOBAL POSITIONING SYSTEM
POB = POINT OF BEGINNING
POC = POINT OF COMMENCEMENT
= FACILITY BOUNDARY
= WASTE DISPOSAL BOUNDARY
= 100' OFFSET LINE
= CHAINLINK FENCE

Copyright Ray & Gilliland P.C. 2018

STATE OF ALABAMA
ETOWAH COUNTY

I, Christopher M. Ray, a Registered Land Surveyor in the State of Alabama, hereby certify that all parts of this survey and plat (or drawing) have been completed in accordance with the requirements of the Standards for the Practice of Surveying in the State of Alabama, being more particularly described as follows, to-wit:

PLANT GADSDEN ASH POND
FACILITY BOUNDARY:
Commence at a 5/8" rebar in place being the Northwest corner of the Northwest one-fourth of the Northeast one-fourth of Section 2, Township 12 South, Range 6 East, Etowah County, Alabama having coordinates of N:1282291.30 and E:614646.39; thence proceed South 09° 25' 39" West for a distance of 842.33 feet to a 2" capped pipe in place, said point being the point of beginning. From this beginning point proceed South 83° 12' 00" East along a chain link fence for a distance of 865.85 feet to a 5/8" capped rebar in place; thence proceed South 09° 26' 36" West along a chain link fence for a distance of 387.73 feet to a 2" capped pipe in place; thence proceed South 10° 22' 02" West for a distance of 2151.10 feet (set ½" rebar CA-0114-LS); thence proceed South 88° 00' 10" West along a chain link fence for a distance of 79.50 feet; thence proceed North 28° 13' 26" West along a chain link fence for a distance of 49.62 feet; thence proceed North 66° 54' 41" West along a chain link fence for a distance of 440.66 feet; thence proceed North 58° 33' 45" West along a chain link fence for a distance of 288.34 feet; thence proceed North 33° 23' 06" West along a chain link fence for a distance of 63.34 feet; thence proceed North 51° 42' 07" West along a chain link fence for a distance of 333.49 feet; thence proceed North 40° 50' 05" West along a chain link fence for a distance of 271.86 feet; thence proceed South 62° 02' 17" West along a chain link fence for a distance of 89.93 feet; thence proceed North 61° 59' 57" West along a chain link fence for a distance of 464.74 feet; thence proceed North 59° 57' 02" West along a chain link fence for a distance of 829.14 feet; thence proceed North 75° 05' 54" West for a distance of 107.69 feet to a 2" capped pipe in place; thence proceed North 10° 15' 47" East for a distance of 1639.82 feet; thence proceed South 47° 12' 47" East for a distance of 33.13 feet; thence proceed North 37° 29' 01" East for a distance of 68.61 feet; thence proceed North 61° 39' 58" East for a distance of 97.42 feet; thence proceed North 73° 50' 52" East for a distance of 56.88 feet; thence proceed South 84° 25' 57" East for f a distance of 64.80 feet; thence proceed South 52° 58' 40" East for a distance of 59.27 feet; thence proceed South 54° 11' 17" East along a chain link fence for a distance of 344.79 feet to a 5/8" capped rebar; thence proceed South 73° 55' 54" East along a chain link fence for a distance of 1123.90 feet to a railroad spike in place; thence proceed South 89° 57' 26" East along a chain link fence for a distance of 161.11 feet to the point of beginning.

The above described land is located in Section 2, Township 12 South, Range 6 East, Etowah County, Alabama and contains 130.22 acres.

PLANT GADSDEN ASH POND
WASTE DISPOSAL BOUNDARY:
Commence at a 5/8" rebar in place being the Northwest corner of the Northwest one-fourth of the Northeast one-fourth of Section 2, Township 12 South, Range 6 East, Etowah County, Alabama; thence proceed South 09° 25' 39" West for a distance of 842.33 feet to a 2" capped pipe in place; thence proceed South 11° 53' 32" West for a distance of 891.02 feet to the point of beginning. From this beginning point proceed South 46° 17' 19" East for a distance of 102.43 feet; thence proceed South 47° 07' 25" East for a distance of 101.57 feet; thence proceed South 53° 20' 12" East for a distance of 98.41 feet; thence proceed South 56° 52' 23" East for a distance of 73.11 feet; thence proceed South 57° 17' 47" East for a distance of 98.70 feet; thence proceed South 51° 38' 18" East for a distance of 40.64 feet; thence proceed South 48° 45' 46" East for a distance of 64.81 feet; thence proceed South 44° 44' 47" East for a distance of 59.73 feet;
thence proceed South 46° 40' 47" East for a distance of 100.85 feet; thence proceed South 46° 07' 45" East for a distance of 101.54 feet; thence proceed South 45° 37' 40" East for a distance of 100.60 feet; thence proceed South 46° 14' 12" East for a distance of 90.27 feet; thence proceed South 45° 03' 24" East for a distance of 105.09 feet to the P. C. of a concave curve right having a radius of 131.15 feet and an arc length of 154.04 feet; thence proceed Southeasterly along the curvature of said curve for a chord bearing and distance of South 13° 25' 09" East, 145.33 feet to the P. T. of said curve; thence proceed South 15° 35' 23" West for a distance of 96.37 feet; thence proceed South 16° 16' 55" West for a distance of 89.17 feet; thence proceed South 16° 36' 06" West for a distance of 102.50 feet; thence proceed South 16° 46' 22" West for a distance of 100.31 feet; thence proceed South 19° 10' 31" West for a distance of 74.39 feet to a compound curve right having a radius of 295.29 feet and an arc length of 195.69 feet; thence proceed Southwesterly along the curvature of said compound curve for a chord bearing and distance of South 40° 16' 33" West, 192.13 feet; thence proceed Southwesterly along said compound curve right having a radius of 461.91 feet and an arc length 233.19 feet for a chord bearing and distance of South 75° 42' 02" West, 230.73 feet; thence proceed Northwesterly along said a compound curve right having a radius of 325.29 feet and an arc length of 179.54 feet for a chord bearing and distance of North 73° 33' 14" West , 177.27 feet; thence proceed Northwesterly along said compound curve right having a radius of 969.67 feet and an arc length of 90.70 feet for a chord bearing and distance of North 54° 27' 10" West , 90.67 feet; thence proceed North 50° 00' 58" West for a distance of 68.39 feet; thence proceed North 50° 44' 38" West for a distance of 58.87 feet; thence proceed North 56° 30' 51" West for a distance of 71.40 feet; thence proceed North 56° 10' 11" West for a distance of 98.73 feet; thence proceed North 54° 20' 15" West for a distance of 79.53 feet; thence proceed North 52° 46' 23" West for a distance of 53.49 feet; thence proceed North 49° 42' 13" West for a distance of 63.80 feet; thence proceed North 45° 55' 08" West for a distance of 55.29 feet; thence proceed North 42° 14' 11" West for a distance of 58.50 feet; thence proceed North 38° 04' 52" West for a distance of 47.92 feet; thence proceed North 36° 37' 14" West for a distance of 37.47 feet; thence proceed North 35° 20' 40" West for a distance of 97.82 feet; thence proceed North 33° 24' 39" West for a distance of 71.29 feet; thence proceed North 40° 08' 05" West for a distance of 80.02 feet; thence proceed North 37° 03' 25" West for a distance of 87.86 feet; thence proceed North 37° 08' 03" West for a distance of 29.80 feet; thence proceed North 36° 29' 37" West for a distance of 20.35 feet to the P. C. of a compound curve right having a radius of 99.90 feet and an arc length of 49.78 feet; thence proceed Northwesterly along the curvature of said curve for a chord bearing and distance of North 18° 31' 20" West, 49.27 feet to the P. T. of said curve; thence proceed North 02° 21' 18" West for a distance of 21.93 feet; thence proceed North 00° 56' 55" East for a distance of 37.33 feet; thence proceed North 03° 40' 02" West for a distance of 119.67 feet; thence proceed North 06° 14' 21" West for a distance of 37.00 feet to a concave curve left having a radius of 149. 32 feet and an arc length of 115.27 feet;
thence proceed Northwesterly along the curvature of said curve for a chord bearing and distance North 29° 04' 31" West 112.43 feet to the P. T. of said curve; thence proceed North 53° 55' 09" West for a distance of 18.38 feet; thence proceed North 57° 00' 13" West for a distance of 69.88 feet; thence proceed North 57° 03' 10" West for a distance of 102.27 feet; thence proceed North 56° 46' 13" West for a distance of 53.80 feet; thence proceed North 56° 29' 36" West for a distance of 23.22 feet; thence proceed North 56° 20' 14" West for a distance of 98.59 feet; thence proceed North 56° 25' 56" West for a distance of 100.88 feet; thence proceed North 55° 41' 53" West for a distance of 101.44 feet; thence proceed North 55° 32' 04" West for a distance of 284.20 feet; thence proceed North 60° 30' 07" West for a distance of 31.11 feet; thence proceed North 64° 21' 32" West for a distance of 31.84 feet; thence proceed North 64° 58' 53" West for a distance of 29.56 feet to the P. C. of a concave curve right having a radius of 81.92 feet and an arc length of 55.72 feet; thence proceed Northwesterly along the curvature of said curve for a chord bearing and distance of North 48° 24' 40" West, 54.65 feet; thence proceed Northwesterly along a compound curve right having a radius of 78.23 and an arc length of 46.47 feet for a chord bearing and distance of North 12° 26' 01" West 45.79 feet; thence proceed North 06° 45' 39" East for a distance of 33.59 feet; thence proceed North 11° 05' 08" East for a distance of 88.37 feet; thence proceed North 10° 07' 49" East for a distance of 100.12 feet; thence proceed North 10° 59' 14" East for a distance of 99.06 feet; thence proceed North 10° 55' 14" East for a distance of 100.62 feet to the P. C. of a concave curve right having a radius of 352.56 feet and an arc length of 747.65 feet; thence proceed Northeasterly along the curvature of said curve for a chord bearing and distance of North 72 32' 20" East, 615.22 feet to the P. T. of said curve; thence proceed South 45° 09' 28" East for a distance of 95.48 feet; thence proceed South 43° 58' 38" East for a distance of 99.92 feet; thence proceed South 43° 22' 34" East for a distance of 101.21 feet; thence proceed South 43° 27' 17" East for a distance of 100.75 feet; thence proceed South 43° 13' 54" East for a distance of 99.28 feet; thence proceed South 43° 29' 53" East for a distance of 99.85 feet; thence proceed South 43° 40' 25" East for a distance of 96.52 feet; thence proceed South 43° 44' 51" East for a distance of 100.42 feet; thence proceed South 43° 44' 13" East for a distance of 97.96 feet; thence proceed South 44° 25' 43" East for a distance of 118.34 feet; thence proceed South 45° 31' 03" East for a distance of 100.51 feet; thence proceed South 46° 27' 28" East for a distance of 117.18 feet to the point of beginning.

The above described land is located in Section 2, Township 12 South, Range 6 East, Etowah County, Alabama and contains 58.73 acres.

According to my survey this the 19th day of September, 2018.

ALABAMA LICENSED No. 26017 PROFESSIONAL LAND SURVEYOR CHRISTOPHER M. RAY

[signature]

Christopher M. Ray, Ala. Reg. No. 26017
Ray and Gilliland, P. C., Ala. Board Cert. No. CA-0114-LS

RAY & GILLILAND, P.C.
122 NORTH CALHOUN AVENUE
P.O. BOX 1183
SYLACAUGA, ALABAMA 35150
TEL NO. (256) 245-3243
FAX NO. (256) 245-3202

FILE: GADSDEN
DRAWN BY: CMR
SCALE: 1" = 200'
BOUNDARY SURVEY
DATE: SEPTEMBER 18, 2018

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| REVISION | DATE |
|---|---|
| | 09/25/2018 |

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| ENP | | | XXX | XXX | XXX | |

**Alabama Power Company**

Plant Gadsden
FACILITY & WASTE BOUNDARY
PERMIT DRAWING

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| As Noted | 4341GAD | 1 | FINAL | 0 |

ANSI E: 44x34

# APPENDIX 3

## HISTORY OF CONSTRUCTION DOCUMENTS

**HISTORY OF CONSTRUCTION FOR EXISTING CCR SURFACE IMPOUNDMENT**
**PLANT GADSDEN ASH POND**
**335-13-15-.04(4)(c)(1)(i)-(xii)**

***(i) Site Name and Ownership Information:***

| | |
|---|---|
| Site Name: | Gadsden Steam Plant |
| Site Location: | Gadsden, AL |
| Owner: | Alabama Power Company |
| Address: | 1313 6th Ave N, Birmingham, AL 35203<br>Birmingham, AL 35203 |
| CCR Impoundment Name: | Plant Gadsden Ash Pond |
| NID ID: | No. 1428 |

ADEM Regulations 335-13-15-.04(4)(c) requires the owner or operator of an existing CCR surface impoundment to compile a history of construction. To the extent feasible, the following information is provided:

***(ii) Location of CCR Unit:***

N 34.0189°, W 85.9731°
See Location Map in Appendix A of this document.

***(iii) Purpose of CCR Impoundment:***

The Gadsden Steam Plant (Plant Gadsden) is a two-unit, natural gas-fired, power generation facility. Plant Gadsden was originally coal fired but was converted to natural gas in 2015. The Plant Gadsden Ash Pond was constructed to receive, and store, coal combustion residuals and process water produced by Plant Gadsden. The Ash Pond has not received ash since 2015.

***(iv) Watershed Description:***

Plant Gadsden and the Ash Pond are located within the Turkey Town Creek HUC 12 watershed which has an area of 57,412 acres. The Turkey Town Creek watershed is part of the larger Middle Coosa HUC 8 watershed which has an area of 1,653,549 acres. The inflow into the Ash Pond consists of the rainfall that falls within the limits of the surface impoundment and its perimeter access road only.

***(v) Description of physical and engineering properties of CCR impoundment foundation/abutments:***

Plant Gadsden's Ash Pond is located within the Appalachian thrust belt of the Cumberland Plateau physiographic province. The Appalachian thrust belt is a series of northeast trending thrust sheets and folds of Cambrian and Pennsylvanian age. The thrust sheets represent décollment detached at the base of the Paleozoic sedimentary strata which overlie Precambrian crystalline basement rock. Alluvial and high terrace deposits are exposed at Plant Gadsden and are underlain by Conasauga and Knox formations. These consist of varying amounts of sand, silt, clay, and gravel associated with river deposition.

***(vi) Summary of Site Preparation and Construction Activities:***

The Plant Gadsden Ash Pond was constructed in 1949 by creating an earthen dike around an existing bottom area upslope from the Coosa River. The Ash Pond's original discharge structure was constructed on the Coosa River side of the impoundment and discharged into a channel feeding the river. This is shown on D-77547 attached in the Appendix A.

The first expansion of the Ash Pond occurred in 1976 and included the construction of a new western impoundment and emergency discharge structure. The new dike was constructed against the western dike face of the original (1949) impoundment while the pond's discharge structure was relocated so that it discharged into a nearby lake that feeds the Coosa River. This is shown on E-312011 attached in Appendix A.

The final expansion came in 1978 when the western pond dike (constructed in 1976) was expanded to the northwest toward the Twin Bridges golf course. The final expansion led to the discharge structure being located once again on the Coosa River. This new discharge structure served to not only manage emergency storm water flows but to serve as a treated water draw source for the plant's processes. This is shown on E-318035 attached in Appendix A.

The Ash Pond stopped receiving coal ash in 2015 when Units 1 and 2 were converted to natural gas; however, it continued to receive process water from the plant. The discharge structure continued to function as designed until 2016 when closure activities began. The discharge structure was then used during closure for discharge of water from the temporary water treatment system.

Closure activities began in 2016. The CCR was initially graded to its final configuration and covered. Remaining activities necessary to achieve compliance with regulatory closure requirements were completed in 2018.

Drawings showing the topography and location of the Ash Pond are included in the appendix as engineering diagrams.

***(vii) Engineering Diagram:***

The following drawings relevant to the location and topography of the Plant Gadsden Ash Pond can be found in Appendix A:

(i) 1967 USGS Topographic Map
(ii) Gadsden Steam Plant Ash Disposal Area – drawing D-77547 dated December 1949
(iii) Gadsden Ash Pond Extension Stage II – drawing E-312011 dated April 1976 (2 sheets)
(iv) Gadsden Ash Pond Extension Stage III – drawing E-318035 dated July 1978 (2 sheets)
(v) Gadsden Ash Pond Closure Project – drawing E523667 dated May 2016
(vi) Gadsden Ash Pond Closure Project – drawing E523668 dated May 2016
(vii) Gadsden Ash Pond Closure Project – drawing E523666 Sections and Details – Sheet 6 dated May 2016

***(viii) Description of Instrumentation:***

There is no instrumentation at the Plant Gadsden Ash Pond.

***(ix) Storm water management and area-capacity curves:***

There is no stage-storage curve data available as the ash pond has been dewatered and the ash has been covered by an engineered, relatively impermeable cover system. Storm water runoff from the cover system is

managed in the southwest detention pond; however, there is no permanent storage of water within the closed impoundment.

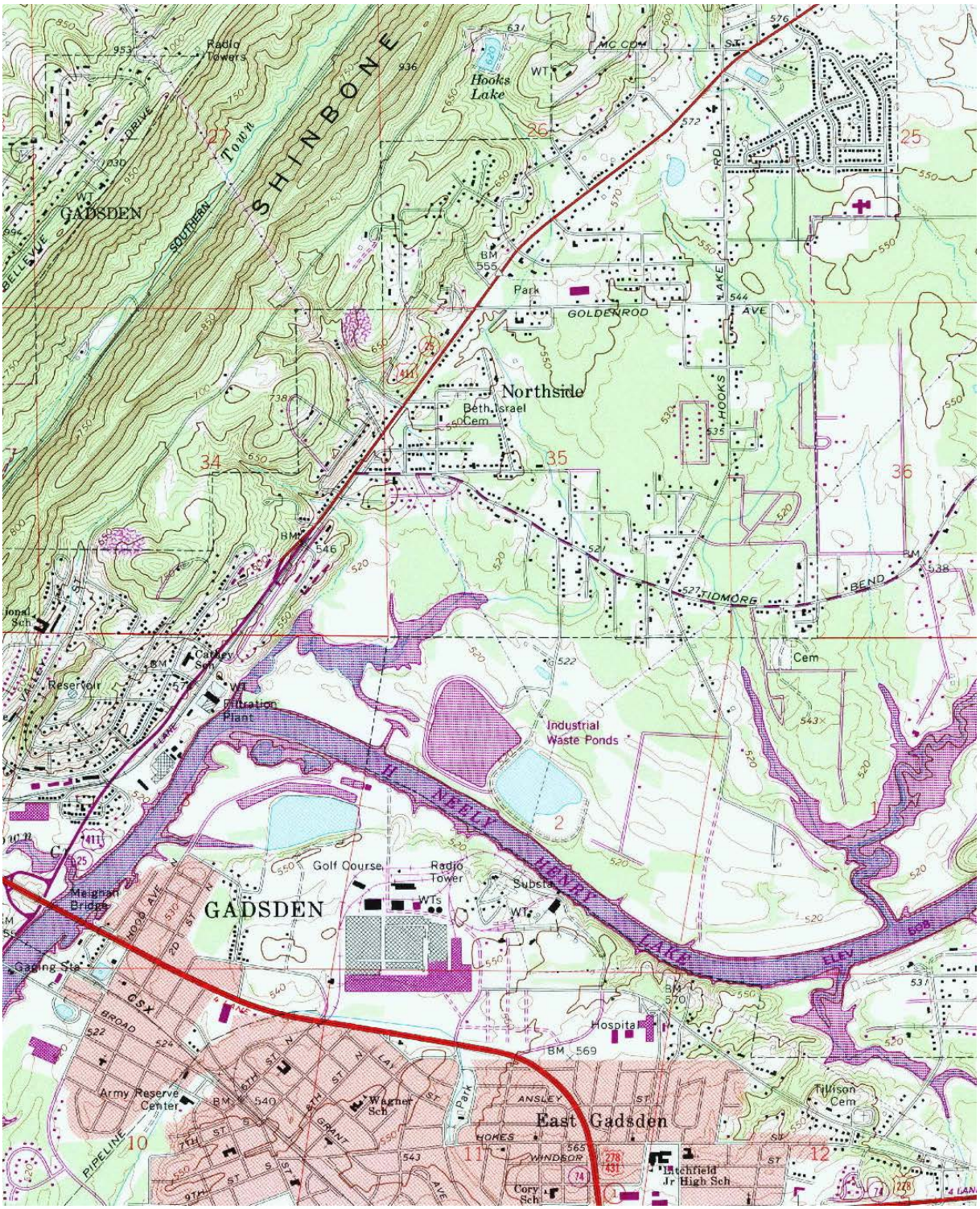
***(x) Provisions for surveillance, maintenance and repair:***

Inspections of dikes are critical components and were conducted on a regular basis prior to and during closure construction—at least annually by professional dam safety engineers and at least weekly by trained plant personnel. In addition, inspections were performed after significant events such as storms. The inspections provided assurance that the structures were sound and that action was taken, as needed, based on the findings. Safety inspections included numerous checklist items. Specific items vary from site to site but may include observations of such things as pond levels, weather conditions, rainfall since the prior inspection, instrument readings, conditions of slopes and drains, erosion, animal damage, ant hills, alignment of retaining structures and more. Dam safety engineers assess instrument readings, inspect any maintenance or remediation performed since the previous inspection, check the status of work recommended at prior inspections, ensure that emergency notification information is current and evaluate any items noted during plant personnel inspections.

***(xii) Known record of structural instability:***

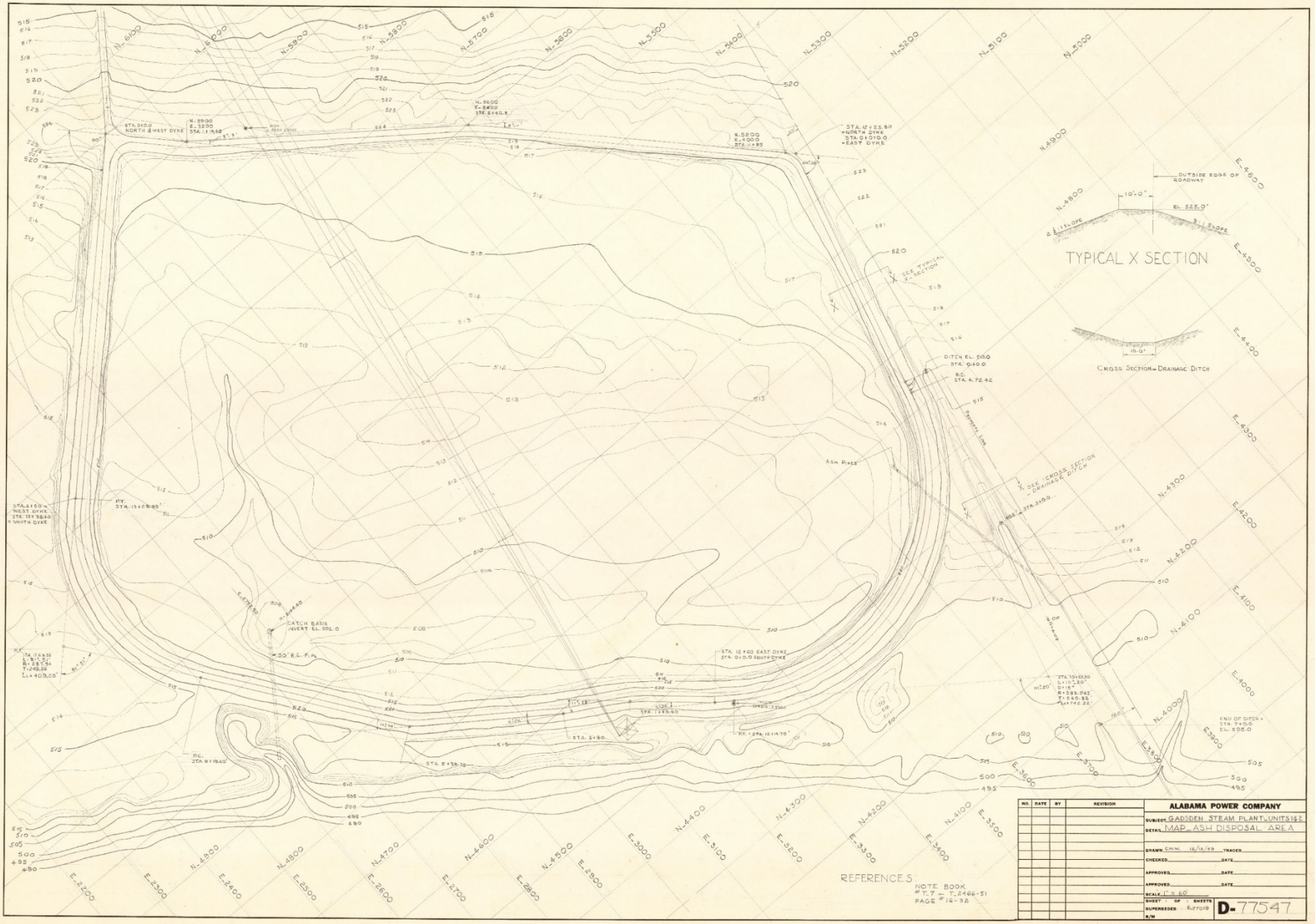
There are no known instances of structural instability at the CCR unit.

# Appendix A




**Plant Gadsden USGS Topo**

**USGS -1967 – Scale: 1 = 24,000**


TYPICAL X SECTION
OUTSIDE EDGE OF ROADWAY
10'-0"
EL. 525.0'
2:1 SLOPE
3:1 SLOPE
CROSS SECTION - DRAINAGE DITCH
STA. 0+10.0 NORTH & WEST DYKE
N. 5900 E. 3200 STA. 1+14.40
N. 5600 E. 2400 STA. 8+40.8
N. 5200 E. 4000 STA. 11+95
STA. 12+25.80 = NORTH DYKE STA. 0+10.0 = EAST DYKE
SEE TYPICAL X-SECTION
DITCH EL. 510.0 STA. 0+10.0
P.C. STA. 4.72+42
PROPERTY LINE
ASH PIPES
SEE CROSS SECTION DRAINAGE DITCH
STA. 2+50.0 = "WEST DYKE" STA. 12+38.60 = SOUTH DYKE
P.T. STA. 13+28.85'
CATCH BASIN INVERT EL. 501.0
30" R.C. PIPE
STA. 12+60 EAST DYKE STA. 0+10.0 South Dyke
STA. 1+43.60
P.T. = STA. 12+19.70'
STA. 2+80
STA. 5+38.30
P.C. STA. 8+18.40'
STA. 10+33.30 Δ=111°20' D=18° R=383.065 T=540.85 L=742.22
END OF DITCH = STA. 7+10.0 EL. 505.0
REFERENCES
NOTE BOOK # T.7 - T.2466-51 PAGE # 16-32
ALABAMA POWER COMPANY
SUBJECT GADSDEN STEAM PLANT-UNITS 1 & 2
DETAIL MAP - ASH DISPOSAL AREA
DRAWN C.W.W. 12/2/49 TRACED
CHECKED DATE
APPROVED DATE
APPROVED DATE
SCALE 1" = 60'
SHEET OF SHEETS
SUPERSEDES E-77018
B/M
D-77547
NO. DATE BY REVISION

NOTE: REROUTE EXISTING ROAD SO AS TO STAY ON APCO PROPERTY (APPROX. AS SHOWN).
ITEM 1-A-2
W. G. JOHNSON
164
THIS ROAD TO BE CLOSED TO TRAFFIC
EXISTING ROAD
Old Field
515
510
520
525
530
535
Rural Line
Cultivated Field
Wooded
Yard
House
Chicken House
Barn
Pasture
Wooded Area
NOTE: FIELD ROUTE ACCESSWAY INTO EXISTING ROAD AS SHOWN.
N 1,280,956.96
E 457,312.74
APCO PROPERTY LINE
BORROW PIT A
AVERAGE DEPTH OF OVERBURDEN = 4.4'
ITEM 1-D
PT@N 1,280,987.05
E 456,613.08
PLACE MUCKED OUT MATERIAL IN THESE AREAS
DISCH. STR. @
N 1,280,918.63
E 456,562.96
ITEM 1-F
Δ = 65° 31'
R = 172.5'
T = 100'
L = 197.25'
NOTE: SEE D-312405 - D-312406 FOR DETAILS ON DISCHARGE STRUCTURE
SLOUGH "A"
PC@N
E
℄ DISCH. STR.
NOTE: FIELD ROUTE DITCH TO DIVERT DISCHARGE INTO SLOUGH SEE D-312405 FOR LOCATION
ITEM 1-F
72B1120
N 1,281,020.35
E 456,349.41
PI@N 1,280,983.45
E 456,515.90

| REV #3 | R J COX | 6-16-78 | REV #2 | R J COX | 7-8-77 | REV. #1 | D. CREEL | 5-12-76 | REV. #1 | D. CREEL | 4-28-76 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ADD TO TITLE-STAGE II - | | | RAISED EL. 520' TO EL. 522' | | | GENERAL REVISION | | | ALTERED DIKE LOCATION & GEN. REVISION | | |

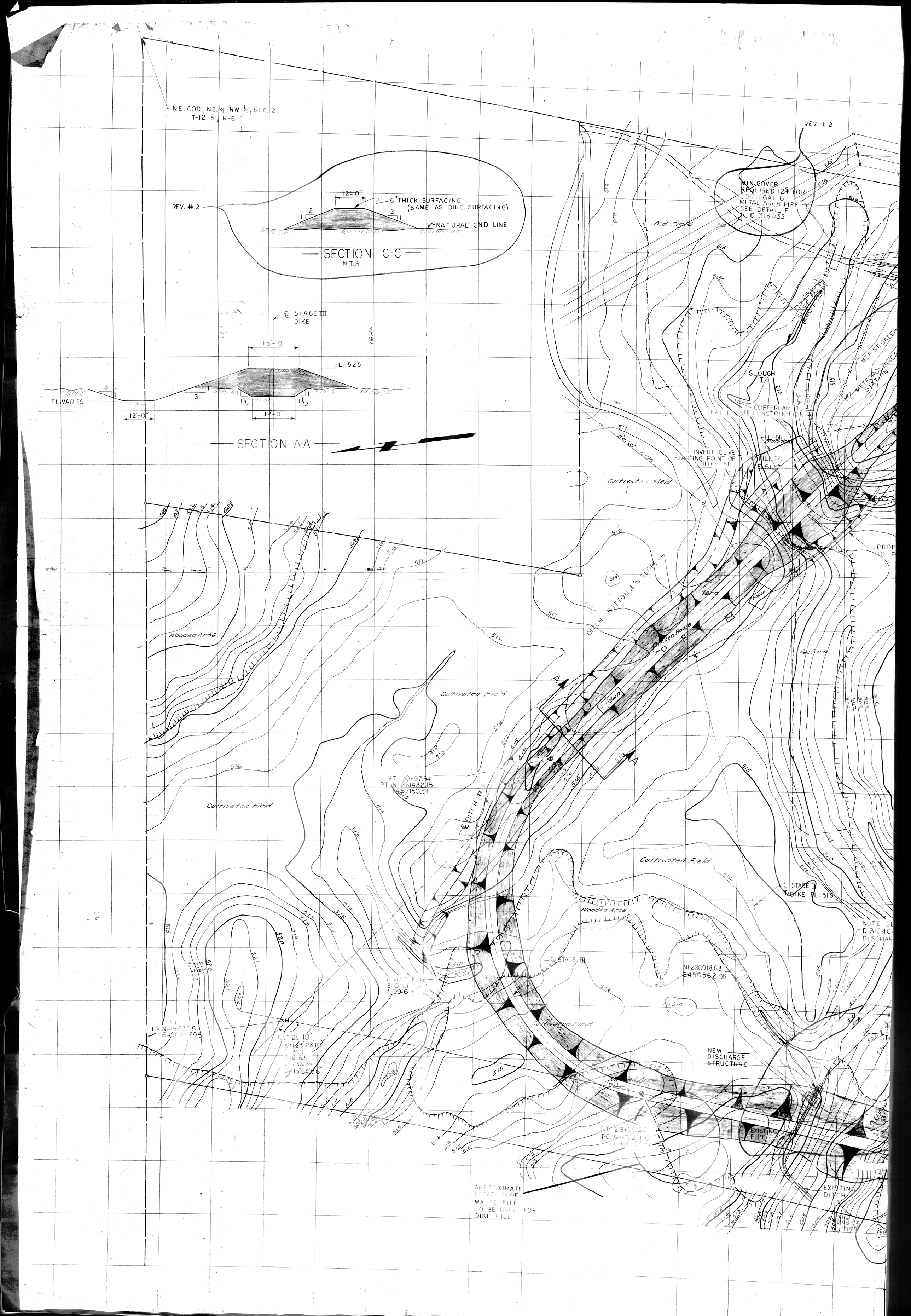
DRAWN RDD CHECKED Nice Sami TRACED
APPROVED DATE
APPROVED DATE

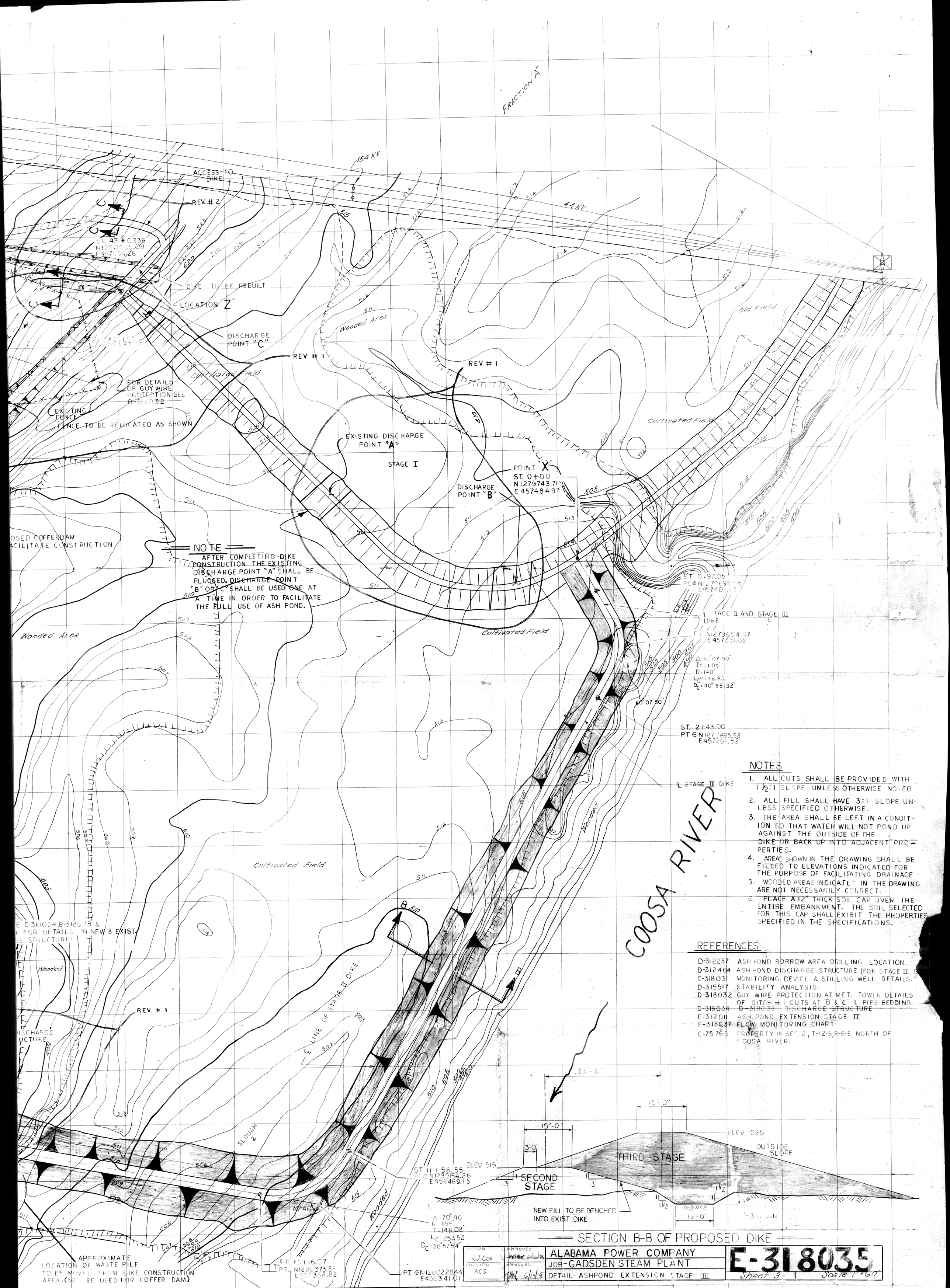
**ALABAMA POWER COMPANY**

JOB GADSDEN STEAM PLANT
DETAIL ASHPOND EXTENTION-STAGE II

SCALE 1" = 60' B/M
SHEET 1 OF 1 SHEETS
SUPERSEDES

E-312011


N.E. COR, N.E. 1/4, NW 1/4, SEC. 2.
T-12-S, R-6-E
REV. # 2
12'-0"
6" THICK SURFACING
(SAME AS DIKE SURFACING)
NATURAL GND LINE
SECTION C-C
N.T.S.
℄ STAGE III
DIKE
15'-0"
EL 525
EL VARIES
12'-0"
SECTION A-A
MIN. COVER
REQUIRED 12" FOR
CORREGATED
METAL ARCH PIPE
SEE DETAIL 'F'
D-318032
Old Field
SLOUGH
I
COFFERDAM TO
FACILITATE CONSTRUCTION
EL 511
INVERT EL @
STARTING POINT OF
DITCH 511
FILL TO
EL 511
Cultivated Field
Wooded Area
DITCH BOTTOM .1% SLOPE
House
Yard
Chicken House
Barn
Pasture
ST 30+97.54
PT N1281432.15
E457150.51
℄ DITCH #1
Wooded Area
℄ STAGE III
DIKE EL. 515
NOTE SE
D 312405
DISCHARG
N1280918.63
E456562.98
NEW
DISCHARGE
STRUCTURE
EXISTING
PIPE
EXISTING
DITCH
APPROXIMATE
LOCATION OF
WASTE FILE
TO BE USED FOR
DIKE FILL




## NOTES

1. ALL CUTS SHALL BE PROVIDED WITH 1½:1 SLOPE UNLESS OTHERWISE NOTED
2. ALL FILL SHALL HAVE 3:1 SLOPE UNLESS SPECIFIED OTHERWISE.
3. THE AREA SHALL BE LEFT IN A CONDITION SO THAT WATER WILL NOT POND UP AGAINST THE OUTSIDE OF THE DIKE OR BACK UP INTO ADJACENT PROPERTIES.
4. AREAS SHOWN IN THE DRAWING SHALL BE FILLED TO ELEVATIONS INDICATED FOR THE PURPOSE OF FACILITATING DRAINAGE
5. WOODED AREAS INDICATED IN THE DRAWING ARE NOT NECESSARILY CORRECT.
6. PLACE A 12" THICK SOIL CAP OVER THE ENTIRE EMBANKMENT. THE SOIL SELECTED FOR THIS CAP SHALL EXIBIT THE PROPERTIES SPECIFIED IN THE SPECIFICATIONS.

## REFERENCES

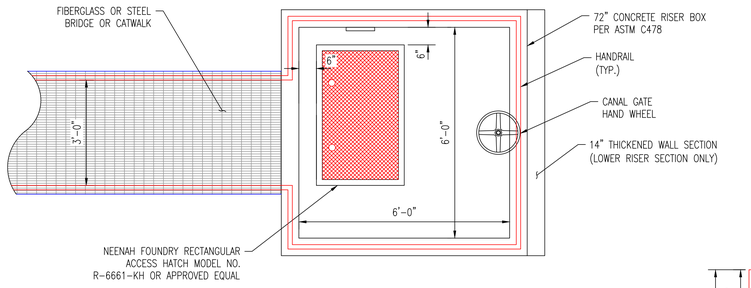
| | |
|---|---|
| D-312287 | ASH POND BORROW AREA DRILLING LOCATION. |
| D-312404 | ASH POND DISCHARGE STRUCTURE. (FOR STAGE II D |
| C-318031 | MONITORING DEVICE & STILLING WELL DETAILS. |
| D-315517 | STABILITY ANALYSIS. |
| D-318032 | GUY WIRE PROTECTION AT MET. TOWER DETAILS OF DITCH #1 CUTS AT "B" & "C" & PIPE BEDDING. |
| D-318034 | D-318038 DISCHARGE STRUCTURE |
| E-312011 | ASH POND EXTENSION STAGE II |
| F-318037 | FLOW MONITORING CHART |
| C-75765 | PROPERTY IN SEC. 2, T-12-S, R-6-E NORTH OF COOSA RIVER. |

SECTION B-B OF PROPOSED DIKE

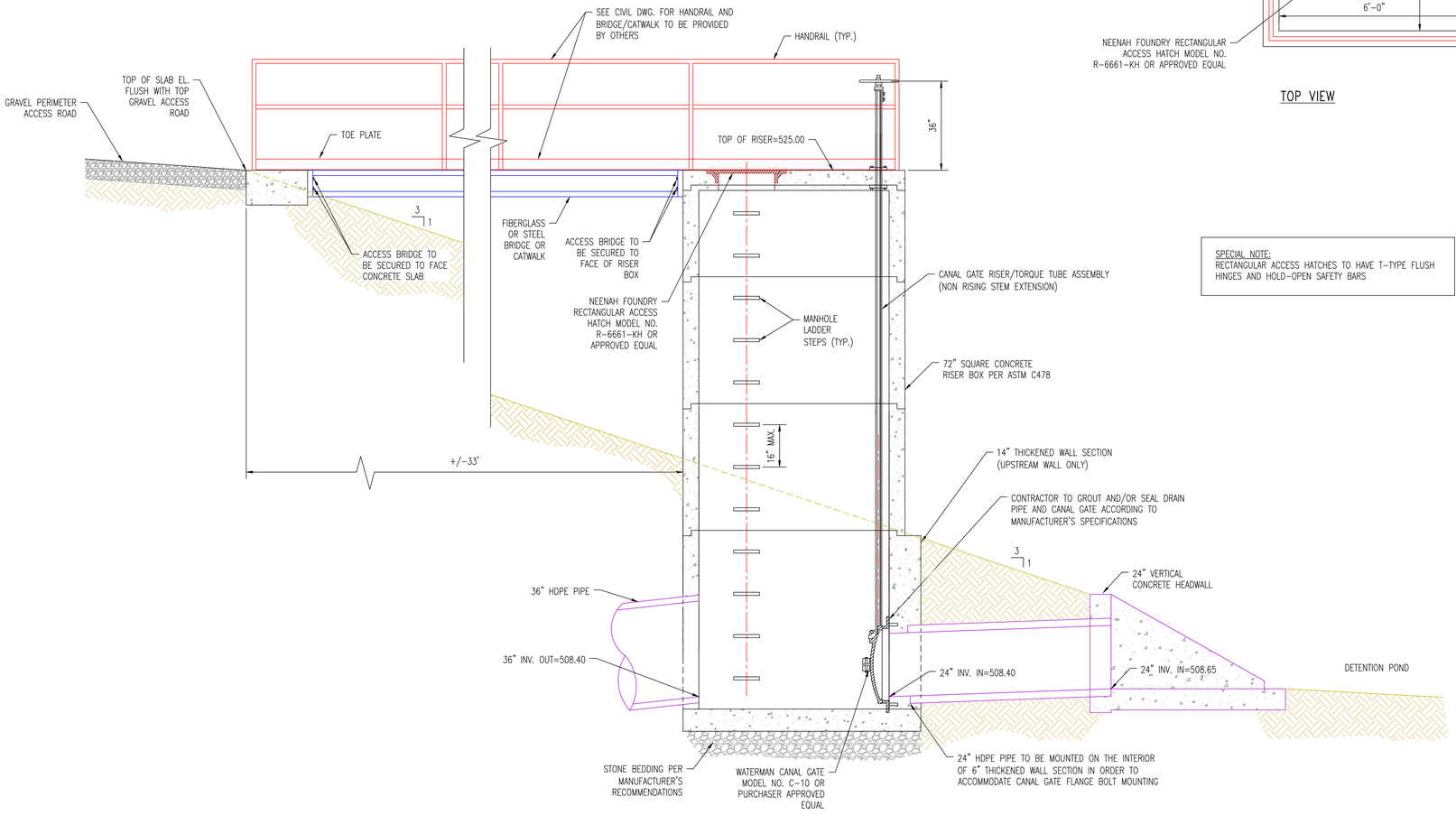
| | | | |
|---|---|---|---|
| DRAWN R.J. COX | APPROVED | ALABAMA POWER COMPANY | E-318035 |
| CHECKED ACS | APPROVED 6/19/78 | JOB-GADSDEN STEAM PLANT | |
| | | DETAIL-ASHPOND EXTENSION STAGE III | Sheet 3 — Scale 1"=60' |

| REV. | | | REV. | | | REV. | | |
|---|---|---|---|---|---|---|---|---|
| 3 | S.M.SELF | 10-5-78 | 2 | R.J. COX | 8-3-78 | 1 | R.J. COX | 7-25-78 |
| REVISED THE CO-ORDINATES AND CURVE DATA. | | | SHOWED ACCESS TO DIKE AND SPECIFIED MIN. 12" COVER REQUIRED FOR ARCH PIPE | | | GENERAL REVISION. | | |

NOTES:
1. CONTRACTOR TO PROVIDE ENGINEERED DRAWINGS FOR CANAL GATE, NON-RISING STEM EXTENSION AND THE ASSOCIATED CONCRETE RISER STRUCTURE.

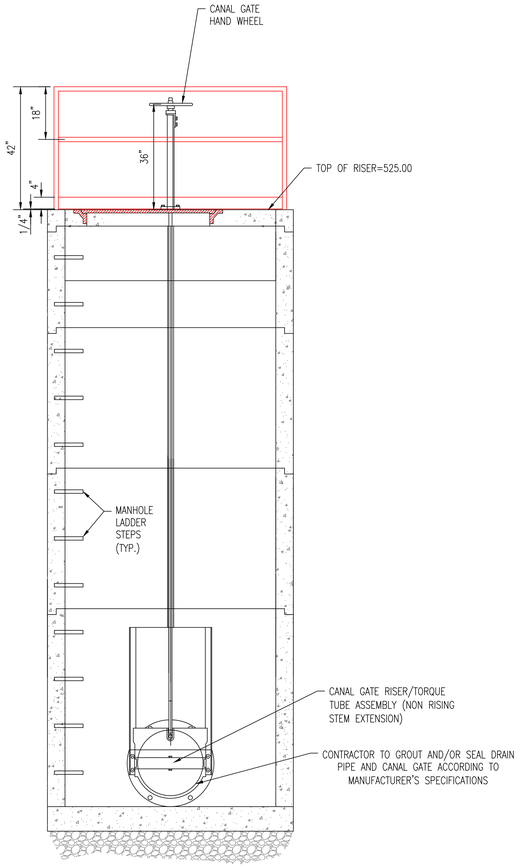



TOP VIEW




ELEVATION VIEW NO. 1

SPECIAL NOTE:
RECTANGULAR ACCESS HATCHES TO HAVE T-TYPE FLUSH HINGES AND HOLD-OPEN SAFETY BARS




ELEVATION VIEW NO. 2

OUTLET RISER STRUCTURE
(WITH CANAL C-10 OUTLET CONTROL GATE)
N.T.S.
(E523659)

NOTES:
1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

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| REVISION | DATE |
|---|---|
| 0 | 5-19-16 |

ISSUED FOR CONSTRUCTION

PROJ ID: GAD15003
MWO: APC368037
APC368039
APC368040

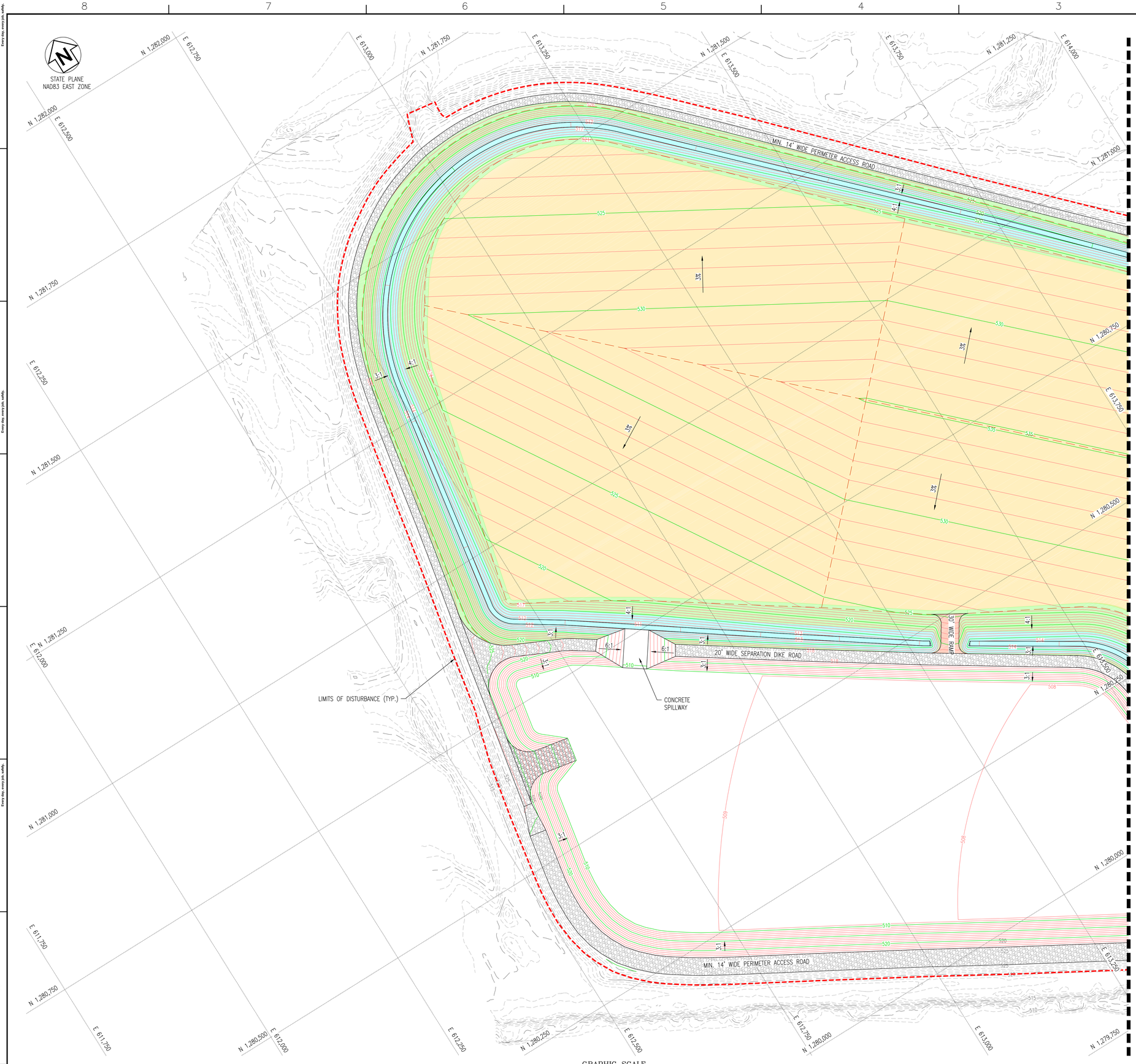
ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR | SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DSM | RCB | THB | | | | JMG | AS SHOWN | E523666 | 1 | FINAL | 0 |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
SECTIONS AND DETAILS
SHEET 6

ANSI E: 44x34




## LEGEND

- EXISTING CONTOURS (MAJOR)
- EXISTING CONTOURS (MINOR)
- EXISTING SPOT ELEV.
- EXISTING WATER LEVEL
- EXISTING ROADS
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING STORM PIPE
- EXISTING STORM PIPE AND WINGWALL
- EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES
- EXISTING ELECTRICAL CONDUIT
- LIMITS OF DISTURBANCE
- CONTOURS (MAJOR)
- CONTOURS (MINOR)
- RIDGELINE OR GRADE BREAK
- STORM PIPE
- STORM PIPE & HEADWALL
- RIPRAP
- G.A.B. ROADS

## ENGINEERED TURF LEGEND

- ENGINEERED TURF WITH 16 OZ. GEOTEXTILE AND TRACKING SURFACE
- ENGINEERED TURF WITH SAND INFILL
- ENGINEERED TURF WITH HYDROBINDER INFILL
- ENGINEERED TURF WITH ARMORFILL INFILL

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

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**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

REVISION 0 DATE 5-19-16

ISSUED FOR CONSTRUCTION

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC368040

ASH POND CLOSURE PROJECT

PLANT GADSDEN
ENGINEERED TURF INFILL DELINEATION PLAN
SHEET 1

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR | SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | | | | JMG | 1"=60' | E523667 | 1 | FINAL | 0 |

ANSI E: 44x34

STATE PLANE
NAD83 EAST ZONE

MATCH LINE (SEE DRAWING E523667)

MIN. 14' WIDE PERIMETER ACCESS ROAD

30' WIDE RAMP

LIMITS OF DISTURBANCE (TYP.)

CONCRETE SPILLWAY

20' WIDE SEPARATION DIKE ROAD

CO2 STORAGE BUILDING

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 520 | EXISTING CONTOURS (MINOR) |
| x530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| x | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| SI | EXISTING STORM PIPE |
| SI | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| OHE | EXISTING ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 730 | CONTOURS (MAJOR) |
| 729 | CONTOURS (MINOR) |
| | RIDGELINE OR GRADE BREAK |
| | STORM PIPE |
| | STORM PIPE & HEADWALL |
| | RIPRAP |
| | G.A.B. ROADS |

x 731.10

## ENGINEERED TURF LEGEND

- ENGINEERED TURF WITH 16 OZ. GEOTEXTILE AND TRACKING SURFACE
- ENGINEERED TURF WITH SAND INFILL
- ENGINEERED TURF WITH HYDROBINDER INFILL
- ENGINEERED TURF WITH ARMORFILL INFILL

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE

60 0 30 60 120 240

( IN FEET )
1 inch = 60 ft.

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| REVISION | DATE |
|---|---|
| 0 | 5-19-16 |

ISSUED FOR CONSTRUCTION

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC368040

ASH POND CLOSURE PROJECT

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
ENGINEERED TURF INFILL DELINEATION PLAN
SHEET 2

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | | | | JMG |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=60' | E523668 | 1 | FINAL | 0 |

ANSI E: 44x34

# APPENDIX 4

# FACTOR OF SAFETY CALCULATIONS

**INITIAL SAFETY FACTOR ASSESSMENT**
**40 C.F.R. PART 257.73**
**PLANT GADSDEN ASH POND**
**ALABAMA POWER COMPANY**

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257 and Part 261), §257.73(e), requires the owner or operator of an existing CCR surface impoundment to conduct periodic safety factor assessments. The owner or operator must document that the minimum safety factors outlined in §257.73(e)(1)(i) through (iv) for the critical embankment section are achieved.

The Plant Gadsden Ash Pond has undergone physical closure activities and is in the process of completing the regulatory requirements of §257.102(d). It no longer impounds free water nor receives CCR. As such, the Gadsden Ash Pond no longer meets the definition of a CCR Surface Impoundment.

I hereby certify that the documentation above is accurate based on current available information.

11/7/18

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

ALABAMA LICENSED 16516 PROFESSIONAL ENGINEER JAMES C. PEGUES, JR.

SOUTHERN COMPANY

**Engineering and Construction Services Calculation**

| **Calculation Number:** |
|---|
| **TV-GC-APC368039-001** |

| **Project/Plant:** Plant Gadsden Ash Pond | **Unit(s):** - | **Discipline/Area:** E&FS |
|---|---|---|
| **Title/Subject:** Post-Closure Factor of Safety Assessment | | |
| **Purpose/Objective:** Analyze Post-Closure Stability of the Ash Pond Dike | | |
| **System or Equipment Tag Numbers:** NA | **Originator:** Stacey H. Simpson, P.E. | |

**Contents**


| Topic | Page | Attachments (Computer Printouts, Tech. Papers, Sketches, Correspondence) | # of Pages |
|---|---|---|---|
| Purpose of Calculation | 2 | Attachment A: Results of Slope/W Analyses | 2 |
| Methodology | 2 | Attachment B: 1949 Typical Section and Critical Section Profile | 2 |
| Criteria and Assumptions | 2 | Attachment C: Summary of Berm Strength Parameters Used in Analyses | 1 |
| Input Data | 3 | | |
| Summary of Conclusions | 4 | | |
| Body of Calculation | 4 | | |
| Design Inputs/References | 4 | | |
| | | | |
| Total # of pages including cover sheet & attachments: | 12 | | |


**Revision Record**

| Rev. No. | Description | Originator Initial / Date | Reviewer Initial / Date | Approver Initial / Date |
|---|---|---|---|---|
| 0 | Issued for Information | SHS/09/24/18 | JAL/09/28/18 | JCP/09/28/18 |
| | | | | |
| | | | | |
| | | | | |

**Notes:**

## Purpose of Calculation

The Alabama Department of Environmental Management (ADEM) "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" [ADEM Admin. Code r. 335-13-15-.04(04)(e)] requires the owner or operator of an existing CCR surface impoundment to document that minimum safety factors for the critical embankment section are achieved.

The Plant Gadsden Ash Pond has undergone physical closure activities and is in the process of completing the regulatory requirements of 40 CFR 257.102(d) and 335-13-15-.07(3). It no longer impounds free water nor receives CCR. The purpose of this calculation is to provide documentation that minimum safety factors of the dewatered and closed impoundment have been achieved as prescribed by the ADEM CCR Rule.

## Methodology

The calculation was performed using the following methods and software:

GeoStudio 2018 (Version 9.0.5.16316), June 2018 Release, Copyright 1991-2018, GEO-SLOPE International, Ltd. The Morgenstern-Price analytical method with an entry-exit slip surface was used for slope stability calculation.

The seismic site coefficient was calculated using the method outlined in *Pseudostatic Coefficient for Use in Simplified Seismic Slope Stability Evaluation*, J.D. Bray and T. Travasarou (2009).

U.S. Geological Survey (USGS) Earthquake Hazards Program – Unified Hazard Tool [Online application].

USGS Earthquake Hazards Program - U.S. Seismic Design Maps (Beta version) [Online application].

## Criteria and Assumptions

Slope stability models were run using the following assumptions and design criteria:

- Long term, dewatered and closed footprint. Dewatered, stacked ash constructed to closure design grades. Water table elevation used for the analysis is representative of the highest water condition observed from post-closure potentiometric surface maps.

- The input ground motions were selected based on sources identified using the interactive de-aggregation of the USGS-published 2014 Uniform Hazard Response Spectrum (UHRS) at a 2% Probability of Exceedance in 50 years. Site-specific design spectral accelerations, based on the risk-targeted maximum considered earthquake ($MCE_R$), were determined using the USGS US Seismic Design Maps and 2015 NEHRP Provisions for Site Class D.

The median ground motions were then used to calculate a pseudostatic seismic coefficient using the approach suggested by Bray and Tavasarou (2009). The procedure calculates the seismic coefficient for an allowable seismic displacement and a probability of exceedance of the displacement. For this analysis, an allowable displacement of 0.5 feet and a probability of exceedance of 16% were conservatively selected, providing a seismic coefficient of $k_h$ = 0.078g for horizontal acceleration in the stability analysis.

## Input Data

| Material Description | Unit Weight, pcf | Effective Stress Parameters | |
|---|---|---|---|
| | | Cohesion, psf | Phi Angle, degrees |
| Berm (clayey silt) | 128 | 30 | 29 |
| Silty Clay | 120 | 125 | 28 |
| Clayey Silty Sand | 110 | 0 | 30 |
| Rock | Modeled as impenetrable geomaterial | | |
| Ash | 98 | 15 | 25 |

- Material Properties: Two consolidated, undrained triaxial tests were performed on Shelby tube samples recovered from the perimeter dike during a geotechnical evaluation performed in preparation for the 2010 dike remediation project. These tests provided total and effective shear strength values of constructed embankment soils. Soil classification testing, unit weight and moisture content determination were also determined for these samples.

  Stacked ash properties were determined by correlating moisture density tests taken during ash placement operations at the Gadsden impoundment with data obtained from similar ash deposits at other operating facilities.

  Foundation zone soil properties were estimated using published correlations with data obtained from geotechnical borings and well installations performed within the former ash pond and along the outer berm perimeter.

- Phreatic Surface: Monitoring well and piezometer readings were used as a basis for the phreatic surface modeled within the berm and the foundation soils.

- The critical section was selected as the location having the apparent maximum exterior berm height influenced by the greatest ash stack load. The cross-section used in the analysis was modeled using a section developed from Drawing E523657. This section is located in the southeastern corner of the closed impoundment.

- Ash stack and berm lithology was developed for the stability analysis by reviewing historical design/construction drawings and data from geotechnical borings and well installations performed within the former ash pond and along the perimeter dike.

## Summary of Conclusions

The following table summarizes the factors of safety resulting from the slope stability analyses. The analyses determined that the factors of safety of the closed surface impoundment meet or exceed the minimum criteria set forth in the ADEM's CCR standards. The results are summarized in the following table.

**Factor of Safety Summary Table**

| Loading Condition | Minimum Calculated Factor of Safety (FOS) | Minimum Required FOS |
|---|---|---|
| Long-term, dewatered and closed footprint (Static) | 2.1 | 1.50 |
| Long-term, dewatered and closed footprint (Seismic) | 1.6 | 1.00 |

## Body of Calculation

Slope/W modeling is attached.

## Design Inputs/References

- Bray, J. D. and Travasarou, T., *Pseudostatic Coefficient for Use in Simplified Seismic Slope Stability Evaluation*, Journal of Geotechnical and Environmental Engineering, American Society of Civil Engineers, September 2009

- U.S. Geological Survey (USGS) Earthquake Hazards Program – Unified Hazard Tool [Online application]. Available on the internet: https://earthquake.usgs.gov/hazards/interactive/

- USGS Earthquake Hazards Program - U.S. Seismic Design Maps (Beta version) [Online application]. Available on the internet: https://earthquake.usgs.gov/designmaps/beta/us/

- APC Drawing D77547, 1949 Upper Pond Dike Construction, Typical Section

- SCS Drawing ES523657 - Design Closure Grading Plan

# ATTACHMENT A

## RESULTS OF SLOPE/W ANALYSES

Name: Ash
Unit Weight: 98 pcf
Cohesion': 15 psf
Phi': 25 °

Name: Berm (clayey silt)
Unit Weight: 128 pcf
Cohesion': 30 psf
Phi': 29 °

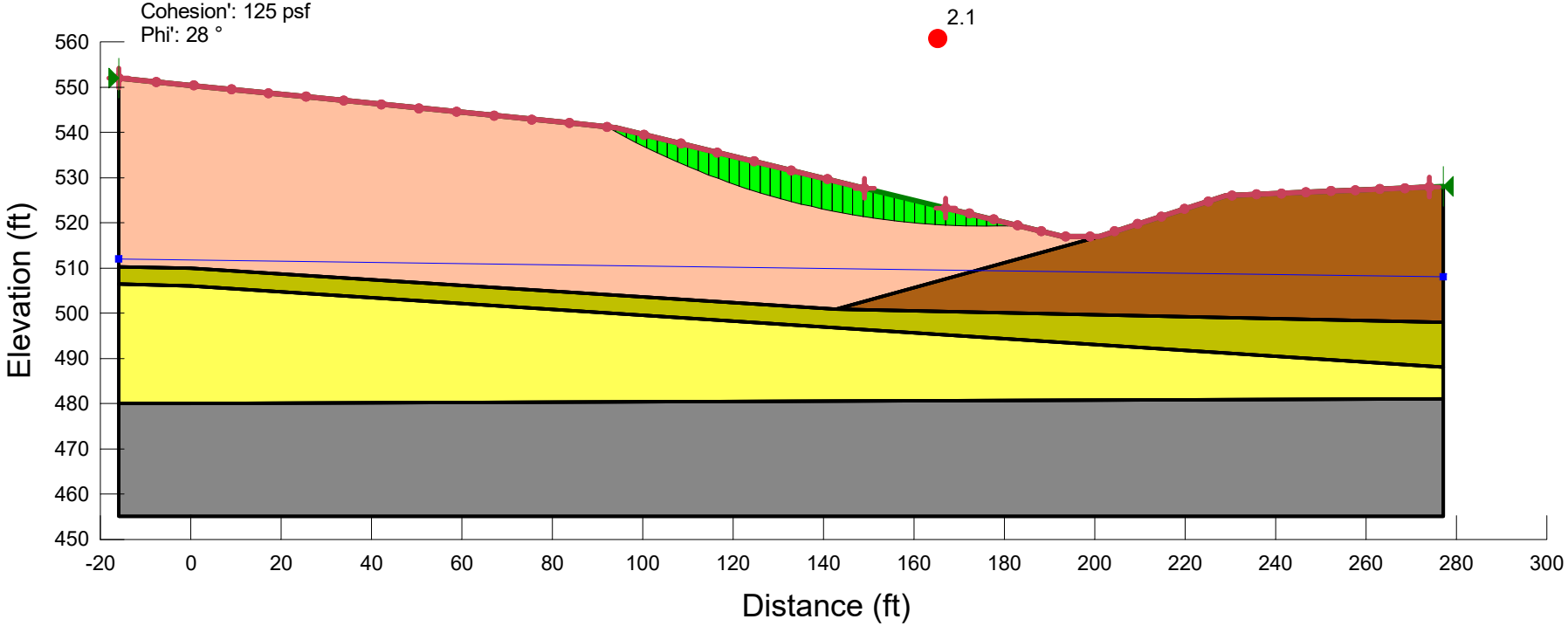
Name: Clayey/Silty Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Rock

Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 125 psf
Phi': 28 °

**PLANT GADSDEN ASH POND CLOSURE**
**SLOPE STABILITY**

**STATIC ANALYSIS**



Name: Ash
Unit Weight: 98 pcf
Cohesion': 15 psf
Phi': 25 °

Name: Berm (clayey silt)
Unit Weight: 128 pcf
Cohesion': 30 psf
Phi': 29 °

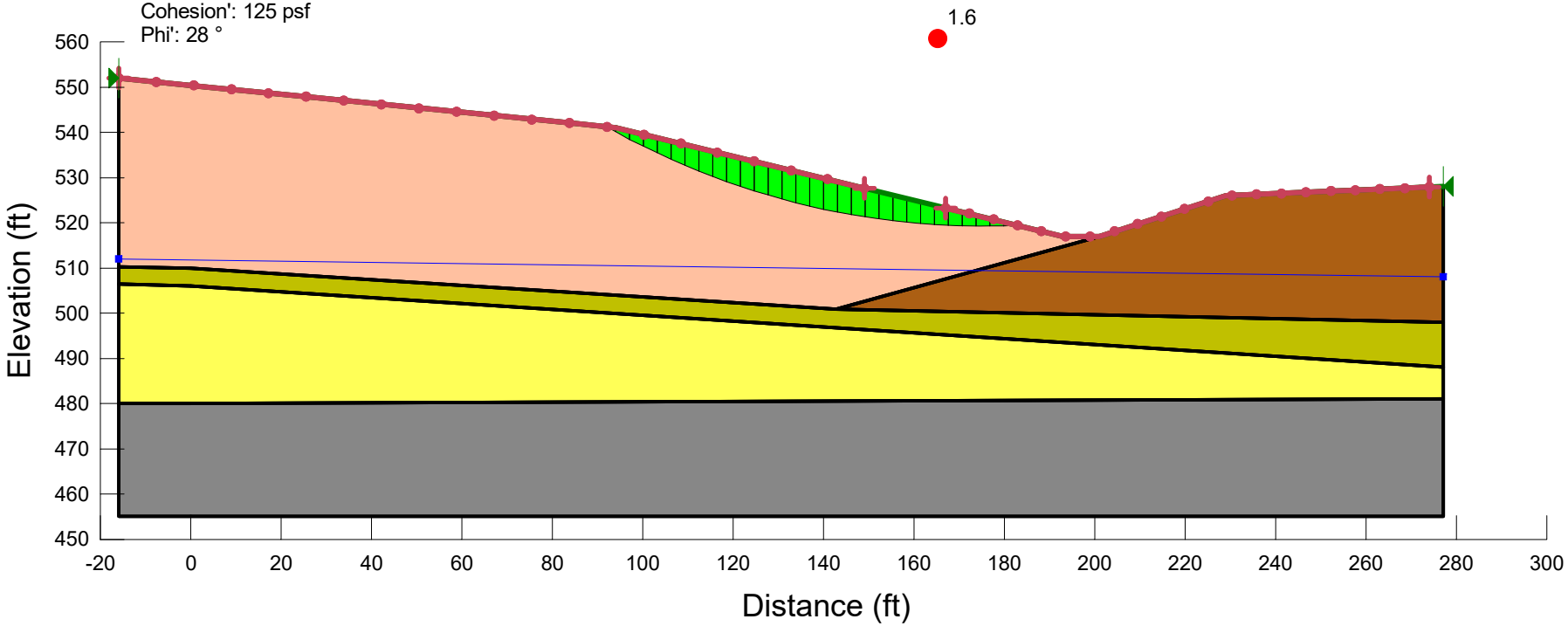
Name: Clayey/Silty Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Rock

Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 125 psf
Phi': 28 °

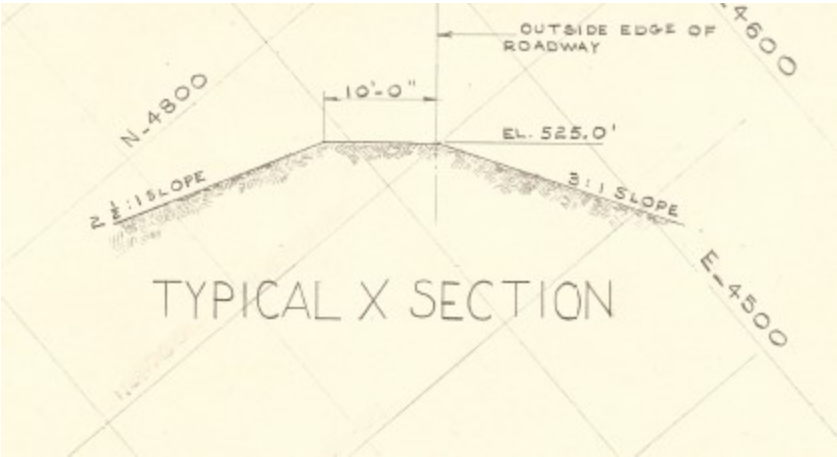
**PLANT GADSDEN ASH POND CLOSURE**
**SLOPE STABILITY**

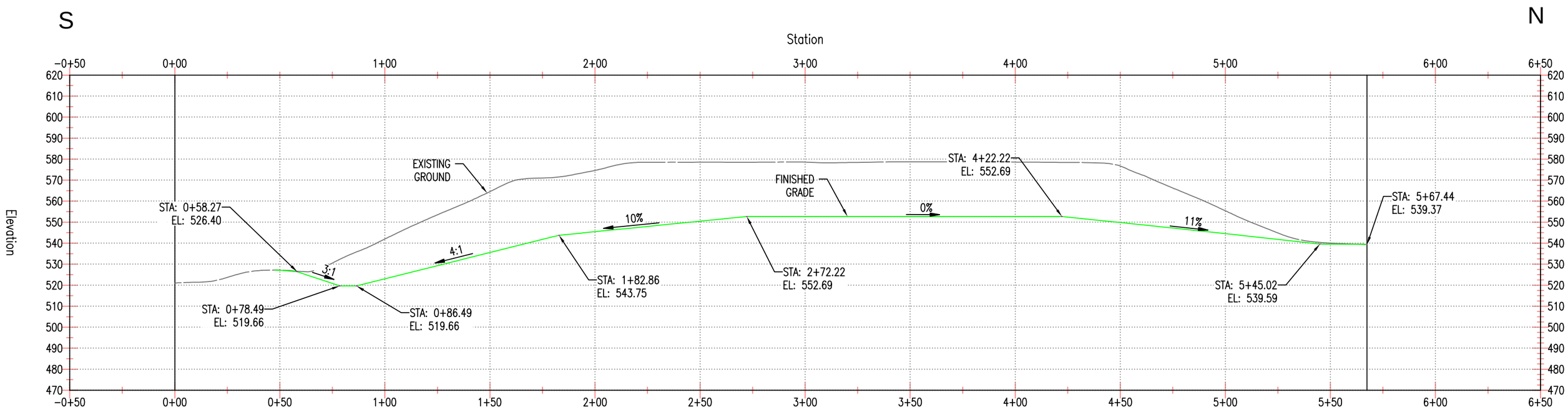
**SEISMIC ANALYSIS**
**Horz Seismic Coef.: 0.078**



# ATTACHMENT B

## 1949 TYPICAL SECTION AND CRITICAL SECTION PROFILE


OUTSIDE EDGE OF ROADWAY
10'-0"
EL. 525.0'
N-4800
E-4600
2 1/2:1 SLOPE
3:1 SLOPE
E-4500
TYPICAL X SECTION


S
N
Station
Elevation
EXISTING GROUND
FINISHED GRADE
STA: 0+58.27
EL: 526.40
STA: 0+78.49
EL: 519.66
STA: 0+86.49
EL: 519.66
STA: 1+82.86
EL: 543.75
STA: 2+72.22
EL: 552.69
STA: 4+22.22
EL: 552.69
STA: 5+45.02
EL: 539.59
STA: 5+67.44
EL: 539.37
10%
0%
11%
4:1
3:1

SCALE: 1"=30'

# ATTACHMENT C

## SUMMARY OF BERM STRENGTH PARAMETERS USED IN ANALYSES

**Table 2**
**Shelby Tube Sample Descriptions**

| Boring | Depth (ft) | Comments |
|---|---|---|
| B1 | 12-14 | Classified as an ML. CU testing was preformed on this sample. Parameters used in SSA: C = 576 psf, Φ = 29°, C' = 0, Φ' = 36° |
| B2 | 5-7 | Classified as an MH. CU testing was preformed on this sample. Parameters used in SSA: C = 562 psf, Φ = 19°, C' = 28.8 psf, Φ' = 29 |

# APPENDIX 5

## TOPOGRAPHIC MAPS, GRADING PLANS AND FINAL STACKING PLANS

STATE PLANE
NAD83 EAST ZONE

24" CMP IN DISREPAIR, COLLAPSED & SILTED IN. INV. ELEV. 519.20

WETLANDS

36" CORR. HDPE W/COLLAPSED TOP & SILTED IN. INV. ELEV. 512.73

36" CORR. HDPE IN GOOD REPAIR. INV. ELEV. 513.01 WATERLINE ELEV. 513.84

SUBMERGED PIPE, NO OUTLET FOUND

OLD 12" METAL PIPE FOUND IN BAD REPAIR, CORRODED AND SILTED IN. INV. ELEV. 513.47

18" PLASTIC PIPE INV=525.20

18" PLASTIC PIPE INV=525.37

CO2 STORAGE BUILDING

W-BLOCK WALL

48" PLASTIC PIPE INV=509.84

48" PLASTIC PIPE INV=509.85

EXISTING LIMITS OF ASH

6" ELECT. CONDUIT

GRAVEL PERIMETER ROAD

FENCE

48" VERT. PIPE TOP=524.94

LIDAR W.S.E. 523.1

TOP 36" CMP =527.03

36" CMP

TOP 36" CMP =528.83

FLOATING SILT CURTAIN

24" CONC. PIPE TOP=508.96

TOP 1" PIPE

TOP 3" PIPES (3)

NO SOUNDING THIS SIDE OF BAFFLE

48" VERT. PIPE

WING WALL TOP=515.24

36" CONC. PIPE INV=510.87

EDGE OF WATER

COOSA RIVER

8" PIPE FROM PLANT

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| ×WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING FENCE |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E | EXISTING ELECTRICAL CONDUIT |
| | EXISTING FLOATING SILT CURTAIN |
| | EXISTING LIMITS OF ASH |

## GENERAL NOTES:

1. FOR DRAWING INDEX, SEE DRAWING E523619.
2. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS, SEE DRAWING E523620.

GRAPHIC SCALE

100 0 50 100 200 400

( IN FEET )
1 inch = 100 ft.

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| REVISION | DATE |
|---|---|
| 0 | 5-19-16 |

ISSUED FOR CONSTRUCTION

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC368040

ASH POND CLOSURE PROJECT

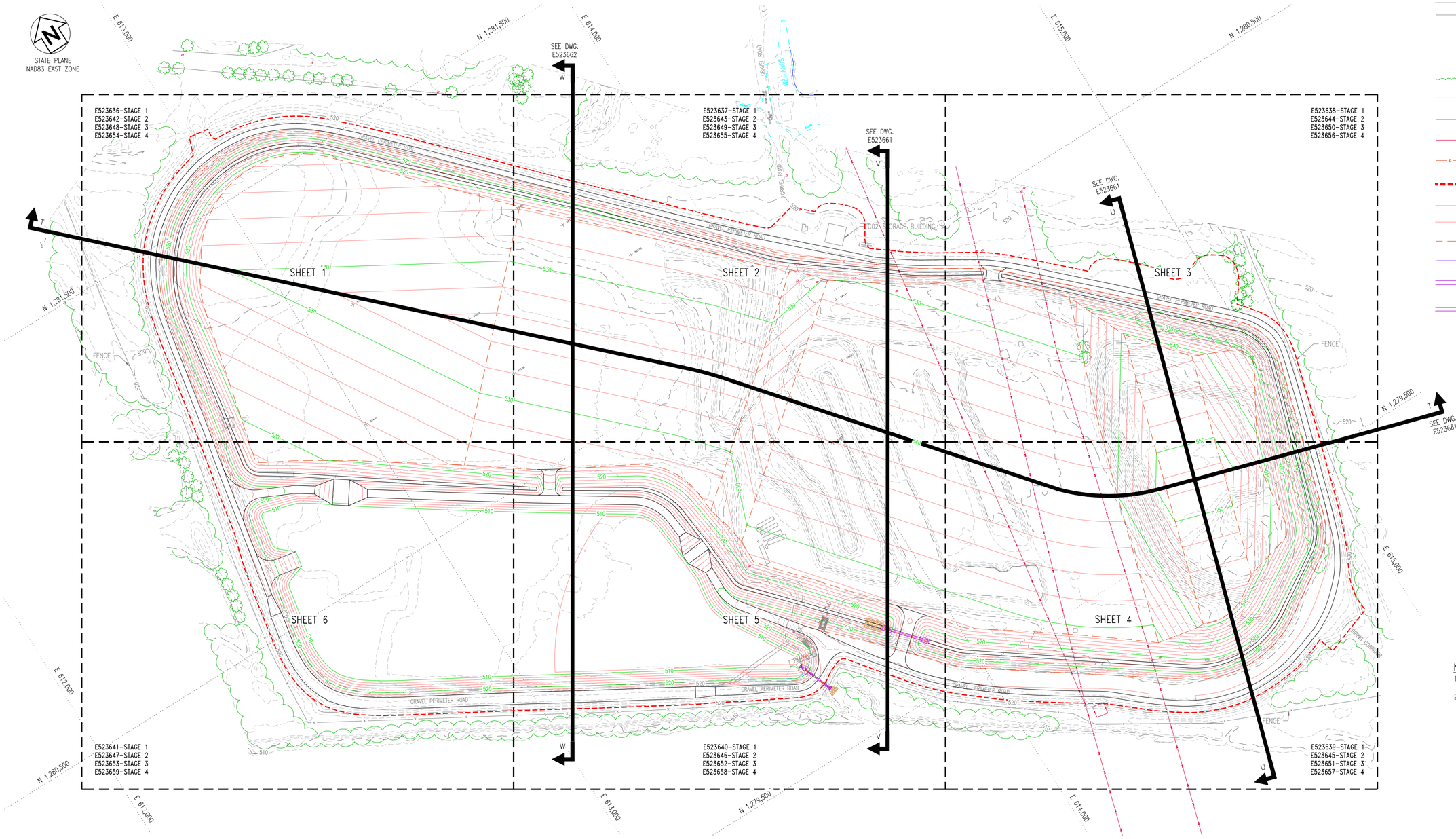
| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| JAA | RCB | THB | | | | JMG |

**Southern Company Generation Engineering and Construction Services**
FOR
**Alabama Power Company**

PLANT GADSDEN
EXISTING TOPOGRAPHIC MAP

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=100' | E523621 | 1 | FINAL | 0 |

ANSI E: 44x34




## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| x530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |
| | STORM PIPE |
| | STORM PIPE AND SLOPED CONC. HEADWALL |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE

100 0 50 100 200 400

( IN FEET )
1 inch = 100 ft.

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| REVISION | DATE |
|---|---|
| 0 | 5-19-16 |

ISSUED FOR CONSTRUCTION

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC368040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| JAA | RCB | THB | | | | JMG |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
GENERAL ARRANGEMENT PLAN
FOR GRADING AND DRAINAGE PLANS

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=100' | **E523635** | 1 | FINAL | 0 |

ANSI E: 44x34

STATE PLANE
NAD83 EAST ZONE

48" PLASTIC PIPE
INV=509.84

48" PLASTIC PIPE
INV=509.85

HOLD OUTSIDE EDGE
OF EXISTING G.A.B.
PERIMETER ROAD

GRAVEL PERIMETER ROAD

MIN. 14' G.A.B. PERIMETER ROAD

14' MIN.

LIMITS OF DISTURBANCE
(SEE DWGS. E523625 & E523626)

FINAL ASH LIMITS

N 1281541.43
E 613215.42

N 1281537.75
E 613222.52

N 1281534.32
E 613211.74

N 1281530.64
E 613218.85

N 1281411.27
E 613367.44

N 1281405.57
E 613373.04

N 1281405.67
E 613361.73

N 1281399.96
E 613367.33

N 1281572.55
E 613026.38

N 1281571.34
E 613018.47

N 1281564.57
E 613027.64

N 1281563.43
E 613019.67

N 1281268.57
E 613507.56

N 1281262.86
E 613513.17

N 1281262.96
E 613501.85

N 1281257.26
E 613507.46

DRAINAGE WINDOW – TYP.
(SEE DETAIL, DWG. E523689)

N 1281485.27
E 612847.26

N 1281479.59
E 612852.89

N 1281479.64
E 612841.58

N 1281473.96
E 612847.21

N 1281309.38
E 612753.81

N 1281308.06
E 612761.70

N 1281301.49
E 612752.49

N 1281300.17
E 612760.38

MIN. 14' G.A.B. PERIMETER ROAD

DRAINAGE WINDOW – TYP.
(SEE DETAIL, DWG. E523689)

N 1281112.10
E 612720.90

N 1281110.78
E 612728.79

N 1281102.89
E 612727.47

N 1281104.21
E 612719.58

14' MIN.

HOLD OUTSIDE EDGE
OF EXISTING G.A.B.
PERIMETER ROAD

48" VERT. PIPE
TOP=524.94

24" CONC. PIPE
TOP=508.96

FENCE

MATCH LINE – SEE DRAWING E523659

MATCH LINE – SEE DRAWING E523655

KEY MAP
NOT TO SCALE

E523654 E523655 E523656
E523659 E523658 E523657

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 × | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| × | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| SS | EXISTING STORM PIPE |
| SS | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | LIMITS OF DISTURBANCE |
| | DRAINAGE WINDOW 1 |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

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**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 4
SHEET 1

| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|
| 1 | 6-30-17 | DSM | THB | RCB | | | | SSS |
| ADDED DRAINAGE WINDOWS IN PERIMETER DITCH AND LEGEND<br>PROJ. I.D.: GAD15003<br>MWO: APC368037<br>APC368039<br>APC368040<br>DCN NO. ?????<br>ASH POND CLOSURE PROJECT | | | | | | | | |
| 0 | 5-19-16 | EEJ / DSM | RCB | THB | | | | JMG |
| ISSUED FOR CONSTRUCTION<br>PROJ. I.D.: GAD15003<br>MWO: APC368037<br>APC368039<br>APC368040<br>ASH POND CLOSURE PROJECT | | | | | | | | |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523654 | 1 | FINAL | 1 |

ANSI E: 44x34

STATE PLANE
NAD83 EAST ZONE

36" CORR. HDPE IN GOOD REPAIR.
INV. ELEV. 513.01
WATERLINE ELEV. 513.84

36" CORR. HDPE W/COLLAPSED TOP
& SILTED IN.
INV. ELEV. 512.73

SUBMERGED PIPE.
NO OUTLET FOUND

WETLANDS

POSSIBLE FLOW DIRECTION

OLD 12" METAL PIPE FOUND
IN BAD REPAIR, CORRODED
AND SILTED IN.
INV. ELEV. 513.47

FINAL ASH LIMITS

HOLD OUTSIDE EDGE
OF EXISTING G.A.B.
PERIMETER ROAD

14'
MIN.

MIN. 14' G.A.B. PERIMETER ROAD

LIMITS OF DISTURBANCE
(SEE DWGS. E523625 & E523626)

GRAVEL PERIMETER ROAD

DRAINAGE WINDOW – TYP.
(SEE DETAIL, DWG. E523689)

N 1281125.87
E 613647.69

N 1281120.16
E 613653.29

N 1281114.55
E 613647.59

N 1281120.26
E 613641.98

N 1280981.20
E 613788.50

N 1280975.37
E 613793.98

N 1280975.73
E 613782.67

N 1280969.89
E 613788.15

N 1280836.70
E 613924.21

N 1280830.87
E 613929.69

N 1280831.22
E 613918.38

N 1280825.39
E 613923.85

CONTRACTOR TO CONSULT
PURCHASER PRIOR TO
REMOVING EXISTING PIPE.

18" PLASTIC PIPE
INV=525.20

P.I. 396.52'R
L=60.31', T=30.21'
Δ=8°42'54"
N 1280636.32
E 614107.14

P.T. ℄ DITCH
N 1280617.82
E 614131.03
EL. 521.68

CO2 STORAGE BUILDING

E523662

18" PLASTIC PIPE
INV=525.37

℄ 8' WIDE PERIMETER DITCH
@ 0.43% GRADE
SEE PERIMETER DITCH TYPICAL
SECTION DWG E523663

HOLD OUTSIDE EDGE
OF EXISTING G.A.B.
PERIMETER ROAD

N 1280683.42
E 614068.18

N 1280689.24
E 614062.69

N 1280683.74
E 614056.88

N 1280677.92
E 614062.37

P.I. ℄ 8' WIDE DITCH
(STAGE 3)
N 1280660.15
E 614084.52
EL. 521.41

P.I. GRADE BREAK
N 1280630.35
E 614082.97
EL. 526.00

P.I. GRADE BREAKS
N 1280608.22
E 614109.75
EL. 525.81

N 1280559.02
E 614213.51

N 1280554.13
E 614219.83

N 1280547.80
E 614214.94

N 1280552.70
E 614208.61

P.I. ℄ 8' WIDE DITCH
(STAGE 1)
N 1280574.61
E 614186.85
EL. 521.99

P.I. GRADE BREAKS
N 1280529.68
E 614180.37
EL. 530.96

N 1280435.69
E 614373.89

N 1280431.15
E 614380.48

N 1280429.10
E 614369.35

N 1280424.56
E 614375.94

DRAINAGE WINDOW – TYP.
(SEE DETAIL, DWG. E523689)

E523663

P.C. RIDGELINE
(STAGE 3)
N 1280529.98
E 613764.47
EL. 535.10

P.I. 1000'R
L=109.97', T=54.91'
Δ=6°17'09"
N 1280491.78
E 613803.91

P.T. RIDGELINE
N 1280449.48
E 613838.92
EL. 535.10

RIDGELINE GRADE BREAK
N 1280404.28
E 613876.57
EL. 535.10

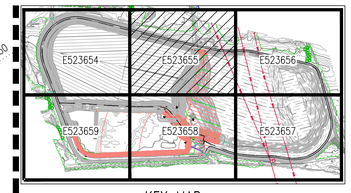
RIDGELINE GRADE BREAK
N 1280328.94
E 613939.30
EL. 540.00

RIDGELINE (PHASE 1)
N 1280231.66
E 614020.31
EL. 540.00

MATCH LINE – SEE DRAWING E523654

MATCH LINE – SEE DRAWING E523656

MATCH LINE – SEE DRAWING E523658




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 × | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| × | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| SS | EXISTING STORM PIPE |
| SS | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| ×531.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| × | FENCE |
| | STORM PIPE |
| | STORM PIPE & HEADWALL |
| | NEW RIPRAP |
| | DRAINAGE WINDOW 1 |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

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| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|
| 1 | 6-30-17 | DSM | THB | RCB | | | | SSS |
| ADDED DRAINAGE WINDOWS IN PERIMETER DITCH AND LEGEND<br>PROJ. I.D.: GAD15003<br>MWO: APC368037<br>APC368039<br>APC368040<br>DCN NO. ?????<br>ASH POND CLOSURE PROJECT | | | | | | | | |
| 0 | 5-19-16 | EEJ DSM | RCB | THB | | | | JMC |
| ISSUED FOR CONSTRUCTION<br>PROJ. I.D.: GAD15003<br>MWO: APC368037<br>APC368039<br>APC368040<br>ASH POND CLOSURE PROJECT | | | | | | | | |

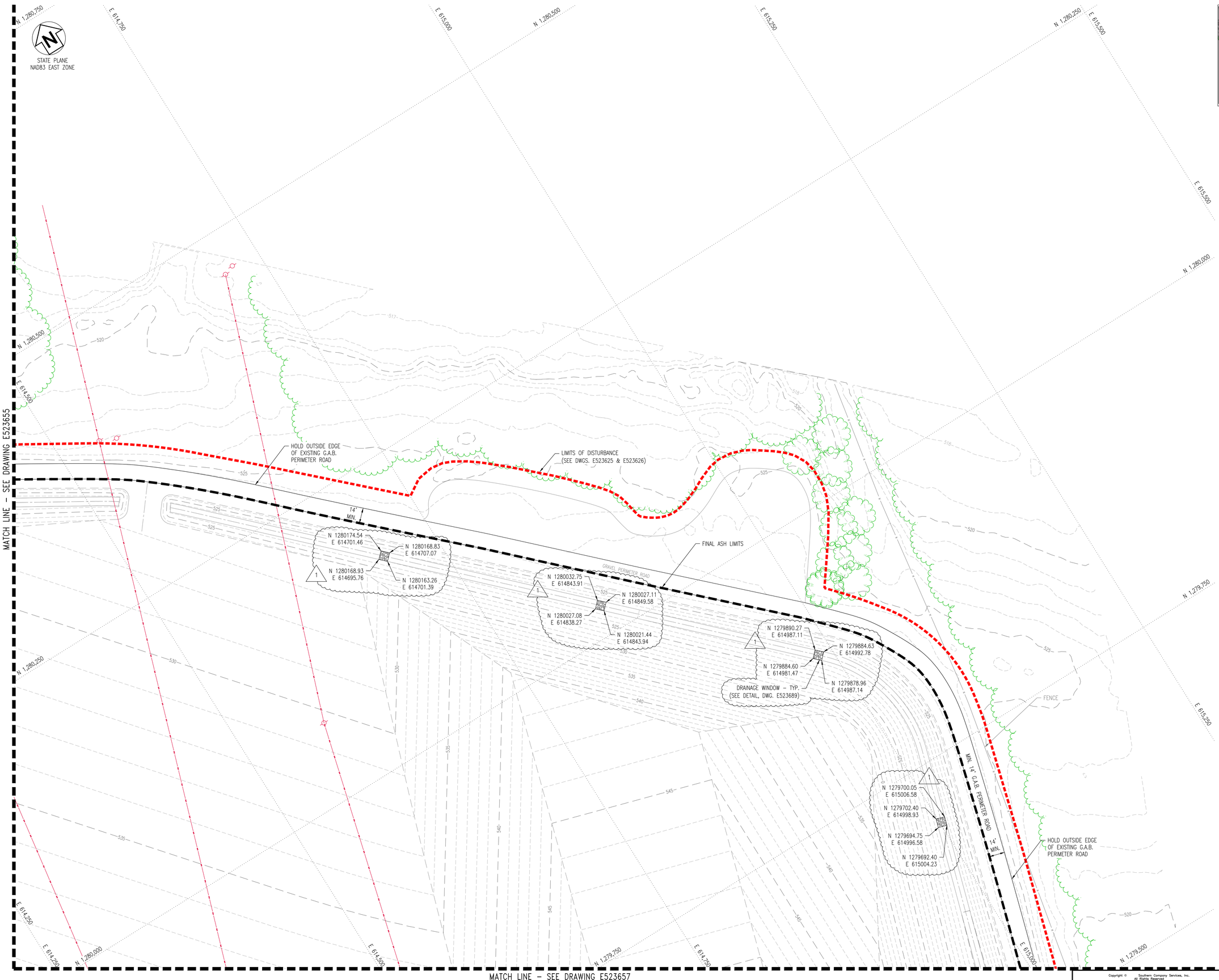
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

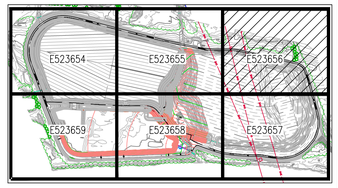
**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 4
SHEET 2

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523655 | 1 | FINAL | 1 |

ANSI E: 44x34




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| | EXISTING TREELINE |
| SS | EXISTING STORM PIPE |
| SS | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | LIMITS OF DISTURBANCE |
| 1 | DRAINAGE WINDOW |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE

30 0 15 30 60 120

( IN FEET )
1 inch = 30 ft.

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**Southern Company Generation Engineering and Construction Services**
FOR
**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 4
SHEET 3

| REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

| REVISION | DATE | REVISION | DATE |
|---|---|---|---|
| 1 | 6-30-17 | 0 | 5-19-16 |
| ADDED DRAINAGE WINDOWS IN PERIMETER DITCH AND LEGEND<br>PROJ. I.D.: GAD15003<br>MWO: APC368037<br>APC368039<br>APC368040<br>DCN NO. ?????<br>ASH POND CLOSURE PROJECT | | ISSUED FOR CONSTRUCTION<br>PROJ. I.D.: GAD15003<br>MWO: APC368037<br>APC368039<br>APC368040<br>ASH POND CLOSURE PROJECT | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DSM | THB | RCB | | | | SSS | EEJ DSM | RCB | THB | | | | JMG |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523656 | 1 | FINAL | 1 |

ANSI E: 44x34

MATCH LINE – SEE DRAWING E523656

MATCH LINE – SEE DRAWING E523658

STATE PLANE
NAD83 EAST ZONE

N 1,280,000
N 1,279,750
N 1,279,500
N 1,279,250
N 1,279,000
N 1,278,750
E 614,250
E 614,500
E 614,750
E 615,000
E 614,000

N 1279508.74
E 614948.24
N 1279511.10
E 614940.59
N 1279503.45
E 614938.25
N 1279501.09
E 614945.90

14' MIN.

HOLD OUTSIDE EDGE OF EXISTING G.A.B. PERIMETER ROAD

MIN. 14' G.A.B. PERIMETER ROAD

N 1279327.50
E 614870.63
N 1279321.88
E 614876.24
N 1279321.85
E 614864.97
N 1279316.19
E 614870.62

N 1279218.35
E 614704.61
N 1279211.44
E 614708.63
N 1279214.33
E 614697.70
N 1279207.42
E 614701.72

N 1279534.87
E 614015.65
N 1279530.20
E 614022.15
N 1279528.38
E 614010.98
N 1279523.70
E 614017.47

N 1279417.99
E 614177.95
N 1279413.32
E 614184.44
N 1279411.50
E 614173.27
N 1279406.83
E 614179.77

DRAINAGE WINDOW – TYP.
(SEE DETAIL, DWG. E523689)

N 1279301.11
E 614340.24
N 1279296.44
E 614346.74
N 1279294.62
E 614335.57
N 1279289.95
E 614342.06

N 1279195.22
E 614507.34
N 1279192.91
E 614515.00
N 1279187.56
E 614505.03
N 1279185.28
E 614512.70

FINAL ASH LIMITS

GRAVEL PERIMETER ROAD

14' MIN.

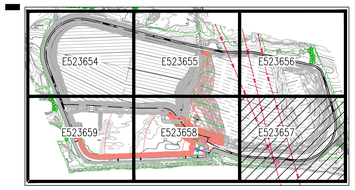
MIN. 14' G.A.B. PERIMETER ROAD

LIMITS OF DISTURBANCE
(SEE DWGS. E523625 & E523626)

HOLD OUTSIDE EDGE OF EXISTING G.A.B. PERIMETER ROAD

FENCE

POND CORRIDOR




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 × | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| × | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| SS | EXISTING STORM PIPE |
| SS | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | LIMITS OF DISTURBANCE |
| 1 | DRAINAGE WINDOW |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

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**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

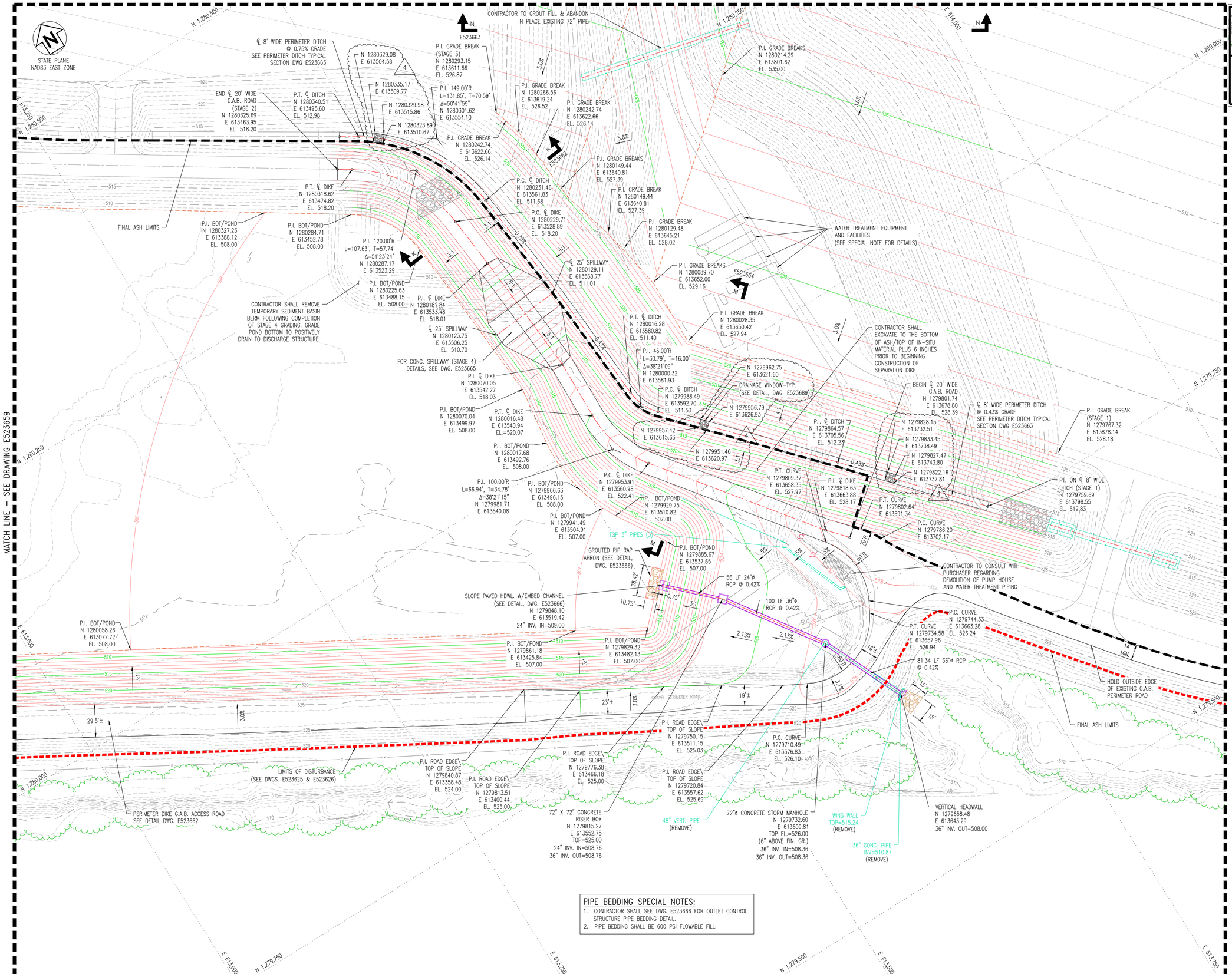
PLANT GADSDEN
GRADING AND DRANAGE PLAN
STAGE 4
SHEET 4

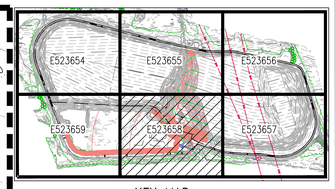
| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|
| 1 | 6-30-17 | DSM | THB | RCB | | | | SSS |
| ADDED DRAINAGE WINDOWS IN PERIMETER DITCH AND LEGEND<br>PROJ. I.D.: GAD15003<br>MWO: APC368037<br>APC368039<br>APC368040<br>DCN NO. ?????<br>ASH POND CLOSURE PROJECT | | | | | | | | |
| 0 | 5-19-16 | EEJ / DSM | RCB | THB | | | | JMG |
| ISSUED FOR CONSTRUCTION<br>PROJ. I.D.: GAD15003<br>MWO: APC368037<br>APC368039<br>APC368040<br>ASH POND CLOSURE PROJECT | | | | | | | | |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523657 | 1 | FINAL | 1 |

ANSI E: 44x34

MATCH LINE – SEE DRAWING E523655




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| x530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | LIMITS OF DISTURBANCE |
| | FLOATING SILT CURTAIN |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| x 531.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |
| | STORM PIPE |
| | STORM PIPE AND CONC. VERTICAL HEADWALL |
| | RIPRAP |
| | DRAINAGE WINDOW 4 |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.
3. SPECIAL NOTE: CONTRACTOR SHALL COORDINATE WITH PURCHASER REGARDING PORTABLE WATER TREATMENT SYSTEM RELOCATION PRIOR TO COMPLETION OF STAGE 4 GRADING AND CONSTRUCTION ACTIVITIES.

GRAPHIC SCALE

30 0 15 30 60 120

( IN FEET )
1 inch = 30 ft.

## PIPE BEDDING SPECIAL NOTES:

1. CONTRACTOR SHALL SEE DWG. E523666 FOR OUTLET CONTROL STRUCTURE PIPE BEDDING DETAIL.
2. PIPE BEDDING SHALL BE 600 PSI FLOWABLE FILL.

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| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| REVISION 4 | DATE 6-30-17 | DSM | THB | RCB | | | | SSS |
| ADDED DRAINAGE WINDOWS IN PERIMETER DITCH AND LEGEND<br>PROJ. I.D.: GAD15003<br>MWO: APC368037 APC368039 APC368040 DCN NO. ????? ASH POND CLOSURE PROJECT | | | | | | | | |
| REVISION 3 | DATE 01-19-17 | DSM | RCB | THB | | | | JCP |
| 3A–ADD EMBED CHANNEL TO SLOPE PAVED HDWL. IN POND<br>3B–REMOVED FLOATING SILT CURTAIN<br>PROJ. I.D.: GAD15003<br>MWO: APC368037 APC368039 APC368040 DCN #9 ASH POND CLOSURE PROJECT | | | | | | | | |
| REVISION 2 | DATE 12-12-16 | DSM | RCB | THB | | | | JCP |
| 2–GRADNG REVISIONS IN DETENTION POND AND RIPRAP APRON REVISIONS<br>PROJ. I.D.: GAD15003<br>MWO: APC368037 APC368039 APC368040 DCN #8 ASH POND CLOSURE PROJECT | | | | | | | | |
| REVISION 1–CONT'D | DATE 11-17-16 | EEJ DSM | RCB | THB | | | | JCP |
| 1B–ADDITION OF PIPE BEDDING SPECIAL NOTES.<br>PROJ. I.D.: GAD15003<br>MWO: APC368037 APC368039 APC368040 DCN #7 ASH POND CLOSURE PROJECT | | | | | | | | |
| REVISION 1 | DATE 11-17-16 | EEJ DSM | RCB | THB | | | | JCP |
| 1A–REVISED GRADING AND STORM WATER OUTLET STRUCTURE AND DISCHARGE PIPING.<br>PROJ. I.D.: GAD15003<br>MWO: APC368037 APC368039 APC368040 DCN #7 ASH POND CLOSURE PROJECT | | | | | | | | |
| REVISION 0 | DATE 5-19-16 | EEJ DSM | RCB | THB | | | | JMG |
| ISSUED FOR CONSTRUCTION<br>PROJ. I.D.: GAD15003<br>MWO: APC368037 APC368039 APC368040 ASH POND CLOSURE PROJECT | | | | | | | | |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 4
SHEET 5

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523658 | 1 | FINAL | 4 |

ANSI E: 44x34

MATCH LINE – SEE DRAWING E523654

STATE PLANE
NAD83 EAST ZONE

FINAL ASH LIMITS

MIN. 14' G.A.B. PERIMETER ROAD

HOLD OUTSIDE EDGE OF EXISTING G.A.B. PERIMETER ROAD

LIMITS OF DISTURBANCE (SEE DWGS. E523625 & E523626)

N 1280914.07
E 612687.94

N 1280906.07
E 612688.09

N 1280914.22
E 612695.94

N 1280906.23
E 612696.09

N 1280817.47
E 612804.17

N 1280810.94
E 612799.53

N 1280812.84
E 612810.69

N 1280806.31
E 612806.06

N 1280614.80
E 613088.55

N 1280608.24
E 613083.95

DRAINAGE WINDOW–TYP.
(SEE DETAIL, DWG. E523689)

N 1280610.20
E 613095.09

N 1280603.65
E 613090.50

P.C. BOT/POND
N 1280786.71
E 612670.97
EL. 509.95

P.I. 10'R
L=16.88', T=11.25'
Δ=96°44'26"
N 1280790.01
E 612660.21

P.T. BOT/POND
N 1280778.94
E 612658.20
EL. 509.96

P.I. BOT/POND
N 1280759.73
E 612756.19
EL. 509.76

P.I. BOT/POND
N 1280763.44
E 612746.93
EL. 509.79

P.I. BOT/POND
N 1280707.54
E 612645.24
EL. 509.86

P.I. BOT/POND
N 1280691.07
E 612651.17
EL. 509.82

P.I. BOT/POND
N 1280661.02
E 612686.80
EL. 509.70

P.I. BOT/POND
N 1280621.63
E 612679.81
EL. 509.64

P.I. BOT/POND
N 1280606.41
E 612636.15
EL. 509.70

P.I. BOT/POND
N 1280592.58
E 612624.31
EL. 509.70

P.I. BOT/POND
N 1280577.09
E 613016.23
EL. 509.00

P.I. ROAD EDGE\TOP OF SLOPE
N 1280600.50
E 612576.32
EL. ???

P.I. ROAD EDGE\TOP OF SLOPE
N 1280550.35
E 612572.81
EL. 524.00

P.C. CURVE
N 1280461.39
E 612556.62
EL. 524.00

P.I. 235.76'R
L=105.82', T=53.82'
Δ=25°43'1"
N 1280408.39
E 612547.28

P.C.C. CURVE
N 1280356.59
E 612561.86
EL. 524.00

P.I. 160.12'R
L=99.63', T=51.56'
Δ=35°38'35"
N 1280307.27
E 612576.62

P.C.C. CURVE
N 1280275.79
E 612617.37
EL. 524.00

P.I. 802.24'R
L=120.87', T=60.55'
Δ=8°37'58"
N 1280238.61
E 612665.16

P.C. CURVE
N 1280209.02
E 612717.99
EL. 524.00

P.I. ROAD EDGE\TOP OF SLOPE
N 1280130.62
E 612856.12
EL. 524.00

P.I. BOT/POND
N 1280456.23
E 612599.63
EL. 509.99

P.I. BOT/POND
N 1280405.38
E 612597.59
EL. 509.99

P.I. BOT/POND
N 1280356.44
E 612608.85
EL. 509.99

P.I. BOT/POND
N 1280298.83
E 612659.84
EL. 509.97

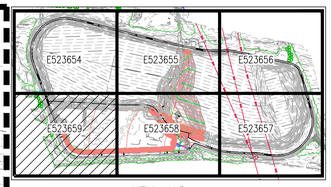
P.I. BOT/POND
N 1280254.72
E 612729.29
EL. 509.00

CONTRACTOR SHALL REMOVE TEMPORARY SEDIMENT BASIN BERM FOLLOWING COMPLETION OF STAGE 4 GRADING. GRADE POND BOTTOM TO POSITIVELY DRAIN TO DISCHARGE STRUCTURE.

GRAVEL PERIMETER ROAD

PERIMETER DIKE G.A.B. ACCESS ROAD
SEE DETAIL DWG. E523664

0.25%
3:1
3.0%
28'±
29.5'±




KEY MAP
NOT TO SCALE

MATCH LINE – SEE DRAWING E523658

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| | DRAINAGE WINDOW |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

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| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|
| 2 | 6-30-17 | DSM | THB | RCB | | | | SSS |
| 1 | 01-19-17 | DSM | RCB | THB | | | | JCP |
| 0 | 5-19-16 | EEJ DSM | RCB | THB | | | | JMG |

REVISION 2: ADDED DRAINAGE WINDOWS IN PERIMETER DITCH AND LEGEND
PROJ. I.D.: GAD15003
MWO: APC368037, APC368039, APC368040 — DCN NO. ????? — ASH POND CLOSURE PROJECT

REVISION 1: 1–DETENTION POND ACCESS RAMP REVISIONS AND SECTIONS
PROJ. I.D.: GAD15003
MWO: APC368037, APC368039, APC368040 — DCN #9 — ASH POND CLOSURE PROJECT

REVISION 0: ISSUED FOR CONSTRUCTION
PROJ. I.D.: GAD15003
MWO: APC368037, APC368039, APC368040 — ASH POND CLOSURE PROJECT

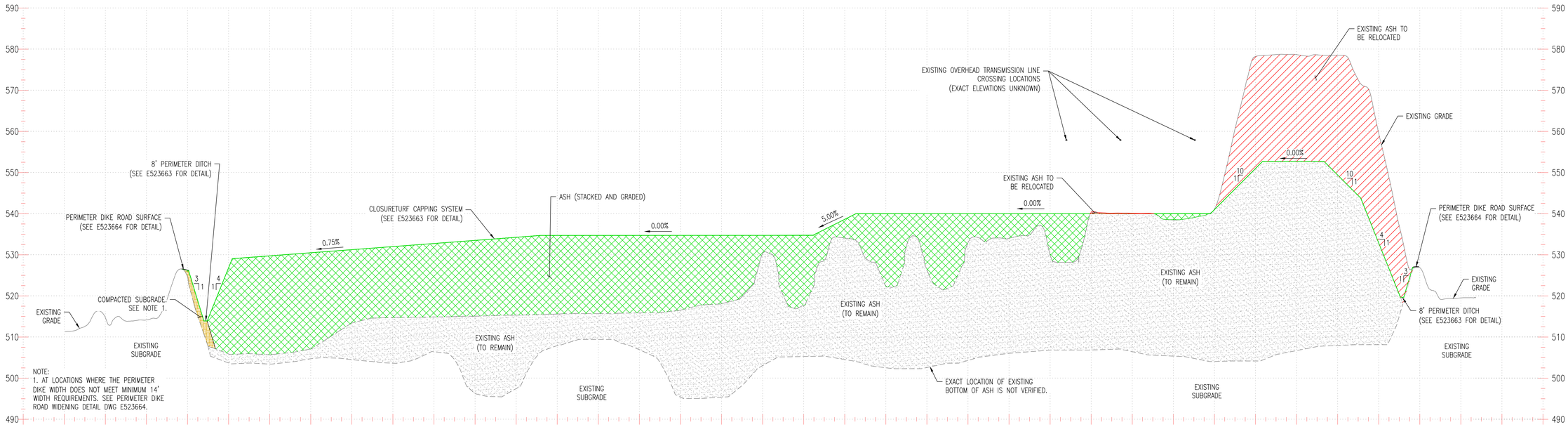
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 4
SHEET 6

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523659 | 1 | FINAL | 2 |

ANSI E: 44x34

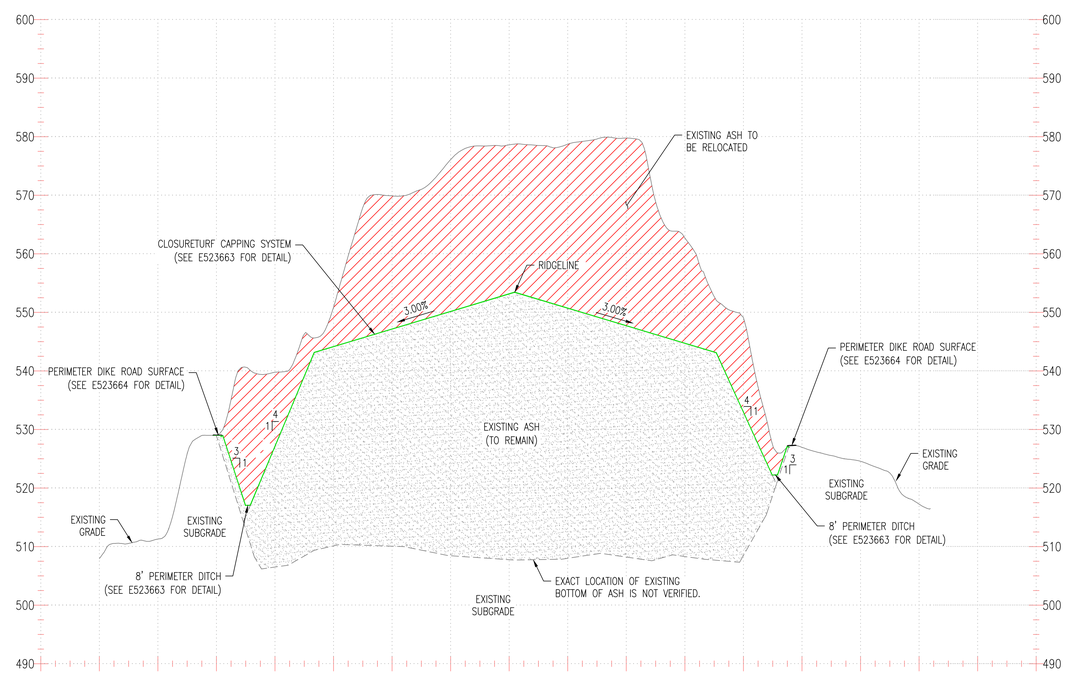



NOTE:
1. AT LOCATIONS WHERE THE PERIMETER DIKE WIDTH DOES NOT MEET MINIMUM 14' WIDTH REQUIREMENTS. SEE PERIMETER DIKE ROAD WIDENING DETAIL DWG E523664.

EXISTING ASH (TO REMAIN)
ASH (STACKED AND GRADED)
EXISTING ASH (TO BE RELOCATED)
COMPACTED SUBGRADE

## SECTION T–T

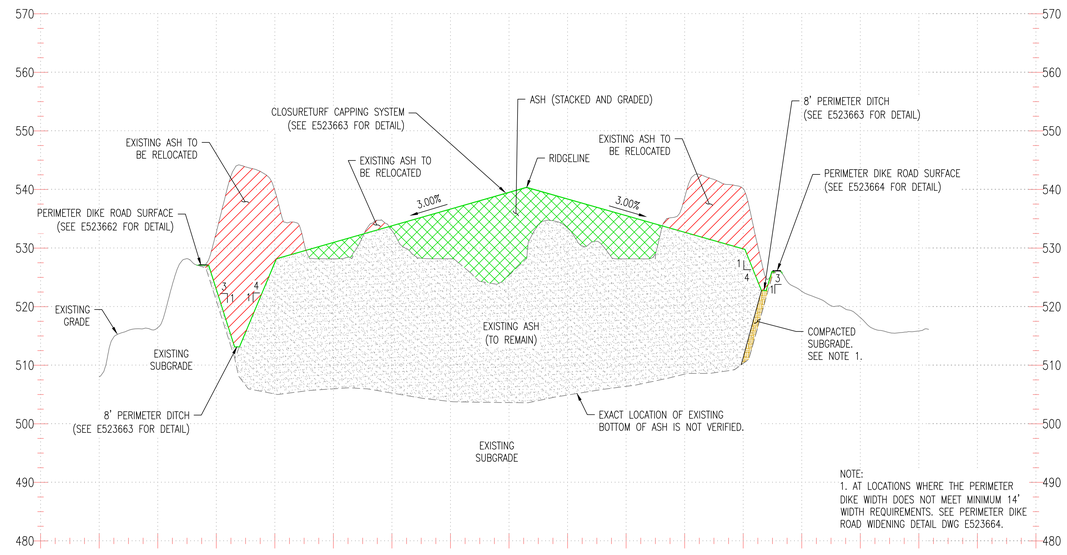
SCALE: 1"=100' HORIZ.
1"=10' VERT.
(E523635)




EXISTING ASH (TO REMAIN)
EXISTING ASH (TO BE RELOCATED)

## SECTION U–U

SCALE: 1"=100' HORIZ.
1"=10' VERT.
(E523635)




NOTE:
1. AT LOCATIONS WHERE THE PERIMETER DIKE WIDTH DOES NOT MEET MINIMUM 14' WIDTH REQUIREMENTS. SEE PERIMETER DIKE ROAD WIDENING DETAIL DWG E523664.

EXISTING ASH (TO REMAIN)
ASH (STACKED AND GRADED)
EXISTING ASH (TO BE RELOCATED)
COMPACTED SUBGRADE

## SECTION V–V

SCALE: 1"=100' HORIZ.
1"=10' VERT.
(E523635)

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

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**Southern Company Generation Engineering and Construction Services**
FOR
**Alabama Power Company**

| REVISION | DATE |
|---|---|
| 0 | 5–19–16 |

ISSUED FOR CONSTRUCTION

PROJ ID: GAD15003
MWO: APC368037
APC368039
APC368040

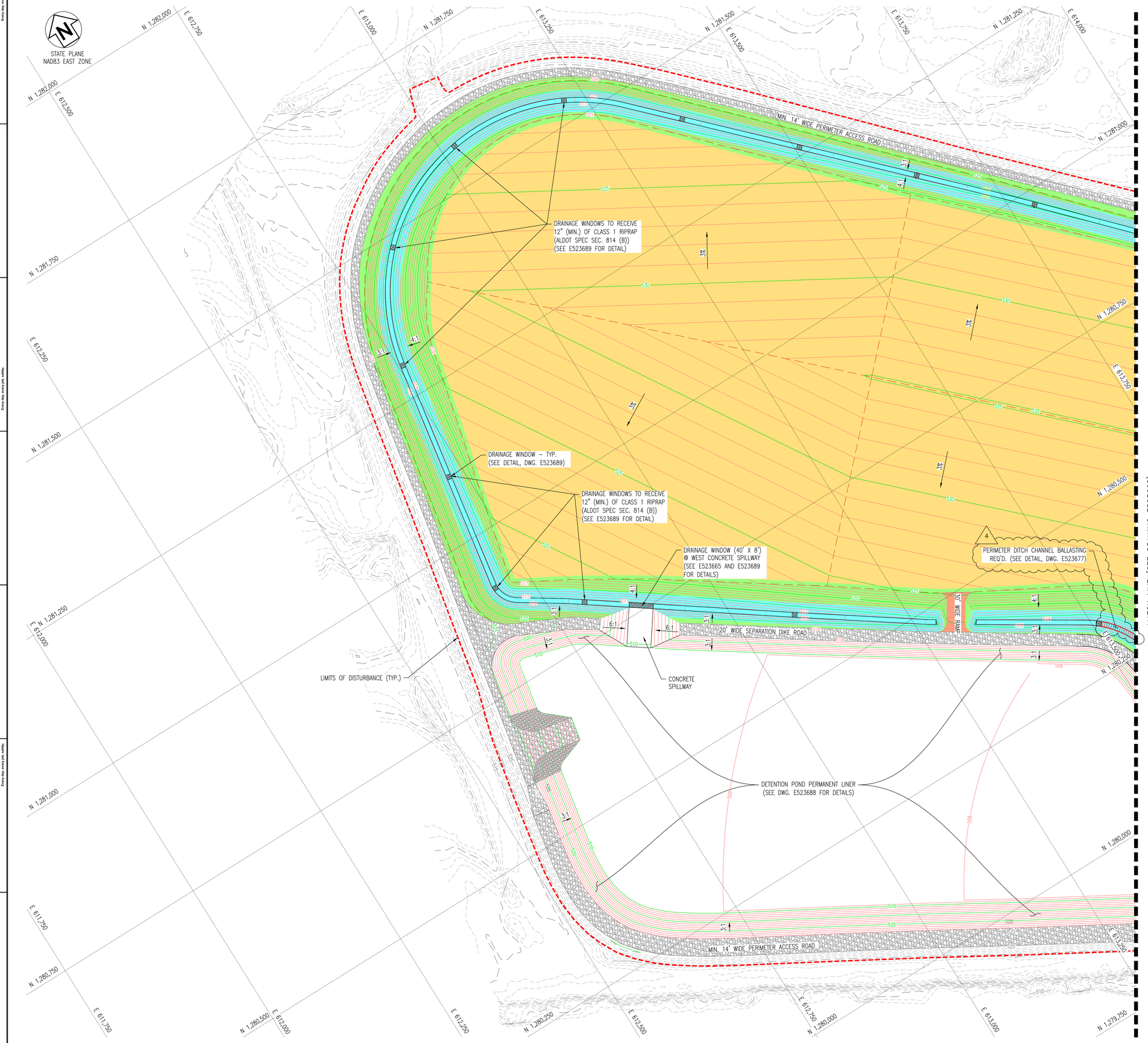
ASH POND CLOSURE PROJECT

PLANT GADSDEN
SECTIONS AND DETAILS
SHEET 1

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| DSM | RCB | THB | | | | JMG |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| AS SHOWN | E523661 | 1 | FINAL | 0 |

ANSI E: 44x34




## LEGEND

- EXISTING CONTOURS (MAJOR)
- EXISTING CONTOURS (MINOR)
- EXISTING SPOT ELEV.
- EXISTING WATER LEVEL
- EXISTING ROADS
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING STORM PIPE
- EXISTING STORM PIPE AND WINGWALL
- EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES
- EXISTING ELECTRICAL CONDUIT
- LIMITS OF DISTURBANCE
- CONTOURS (MAJOR)
- CONTOURS (MINOR)
- RIDGELINE OR GRADE BREAK
- STORM PIPE
- STORM PIPE & HEADWALL
- RIPRAP
- G.A.B. ROADS
- DRAINAGE WINDOW

## ENGINEERED TURF LEGEND

- ENGINEERED TURF WITH 16 OZ. GEOTEXTILE AND TRACKING SURFACE
- ENGINEERED TURF WITH SAND INFILL
- ENGINEERED TURF WITH HYDROBINDER INFILL
- ENGINEERED TURF WITH ARMORFILL INFILL

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|
| 4 – ADDED PERIMETER DITCH CHANNEL BALLASTING<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>DCN #74 ASH POND CLOSURE PROJECT | 4-24-18 | DSM | THB | RCB | | | | SSS |
| 3A – ADDED DRAINAGE WINDOW AT WEST SPILLWAY<br>3B – REVISED DRAINAGE WINDOWS TO RECEIVE CL. 1 RIPRAP<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>DCN #65 ASH POND CLOSURE PROJECT | 11-15-17 | THB | JKB | THB | | | | SSS |
| 2 – ADDED DRAINAGE WINDOWS IN PERIMETER DITCHES AND UPDATED LEGEND<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>DCN #32 ASH POND CLOSURE PROJECT | 6-30-17 | DSM | THB | RCB | | | | SSS |
| 1 – ADDED STONE BESIDE DETENTION POND RAMP AND DETENTION POND PERMANENT LINER NOTE<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>DCN #9 ASH POND CLOSURE PROJECT | 1-19-17 | DSM | RCB | THB | | | | JCP |
| 0 – ISSUED FOR CONSTRUCTION<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>ASH POND CLOSURE PROJECT | 5-19-16 | EEJ / DSM | RCB | THB | | | | JMG |

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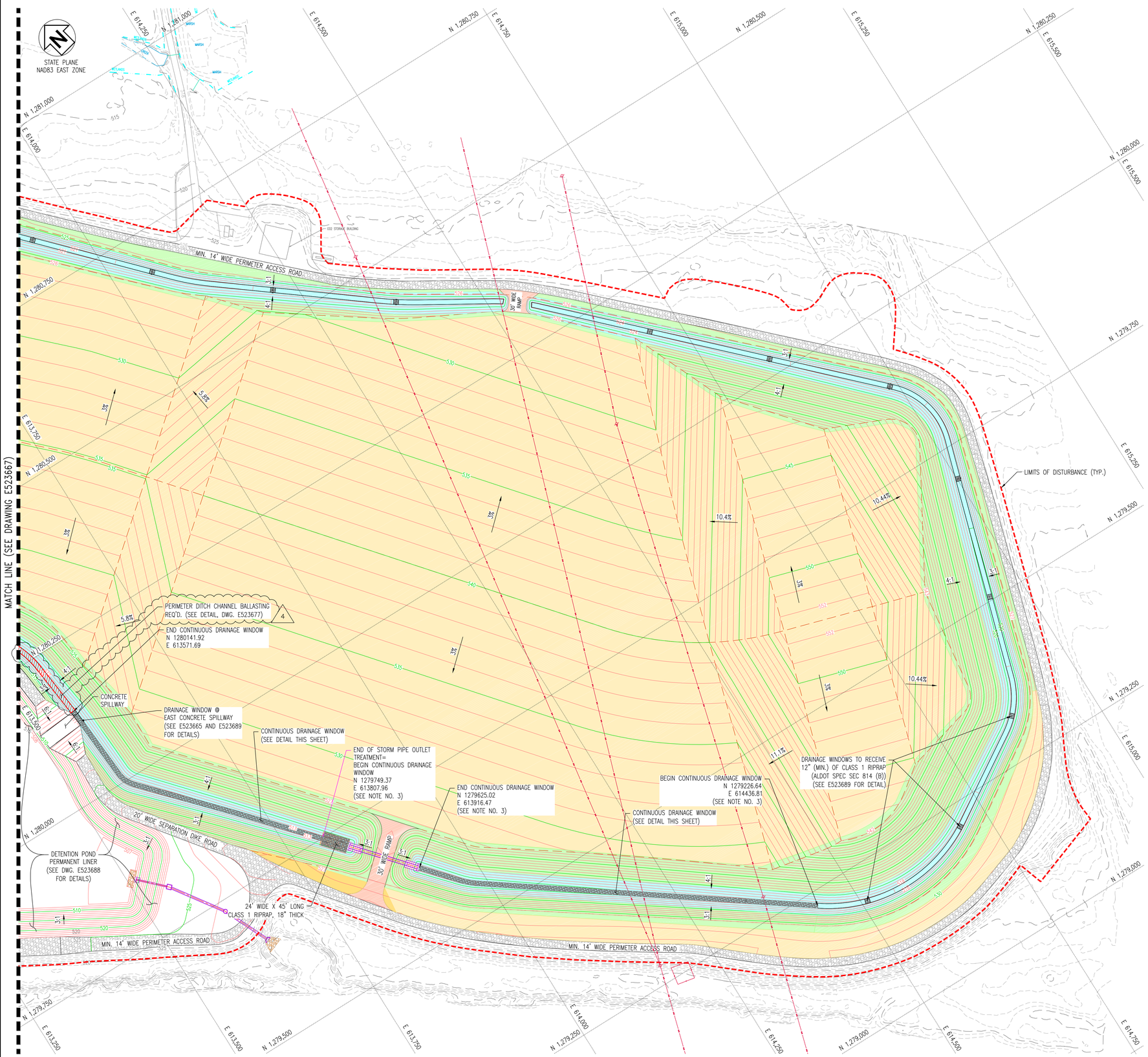
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
ENGINEERED TURF INFILL DELINEATION PLAN
SHEET 1

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=60' | E523667 | 1 | FINAL | 4 |

ANSI E: 44x34

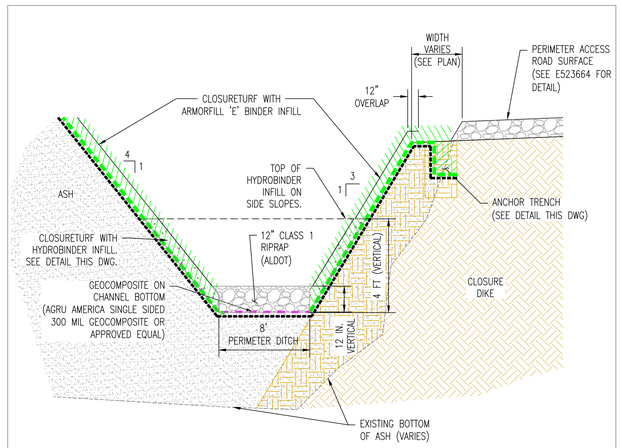



## LEGEND

- EXISTING CONTOURS (MAJOR)
- EXISTING CONTOURS (MINOR)
- EXISTING SPOT ELEV.
- EXISTING WATER LEVEL
- EXISTING ROADS
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING STORM PIPE
- EXISTING STORM PIPE AND WINGWALL
- EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES
- EXISTING ELECTRICAL CONDUIT
- LIMITS OF DISTURBANCE
- CONTOURS (MAJOR)
- CONTOURS (MINOR)
- RIDGELINE OR GRADE BREAK
- STORM PIPE
- STORM PIPE & HEADWALL
- RIPRAP
- G.A.B. ROADS
- DRAINAGE WINDOW

## ENGINEERED TURF LEGEND

- ENGINEERED TURF WITH 16 OZ. GEOTEXTILE AND TRACKING SURFACE
- ENGINEERED TURF WITH SAND INFILL
- ENGINEERED TURF WITH HYDROBINDER INFILL
- ENGINEERED TURF WITH ARMORFILL INFILL




## PERIMETER DITCH CONTINUOUS DRAINAGE WINDOW DETAIL

N.T.S.

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.
3. CONTRACTOR SHALL HAVE PURCHASER APPROVAL PRIOR TO FIELD MODIFYING THE EXACT EXTENTS OF THE CONTINUOUS DRAINAGE WINDOW. FIELD MODIFICATIONS MAY BE NECESSARY TO BEST FIT WINDOW WITH FINAL CHANNEL CONDITIONS.

GRAPHIC SCALE

60 0 30 60 120 240

( IN FEET )
1 inch = 60 ft.

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**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
ENGINEERED TURF INFILL DELINEATION PLAN
SHEET 2

| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|
| 0 | 5-19-16 | ISSUED FOR CONSTRUCTION | | | | | | |
| 1 | 1-19-17 | 1-ADDED DETENTION POND PERMANENT LINER NOTE<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>DCN #9<br>ASH POND CLOSURE PROJECT | DSM | RCB | THB | | | JCP |
| 2 | 6-30-17 | 2-ADDED DRAINAGE WINDOWS IN PERIMETER DITCHES AND UPDATED LEGEND<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>DCN #32<br>ASH POND CLOSURE PROJECT | DSM | THB | RCB | | | SSS |
| 3 | 11-15-17 | 3A-ADDED CONTINUOUS DRAINAGE WINDOW TO THE EAST SPILLWAY, ADDED PIPE OUTLET TREATMENT<br>3B-ADDED NOTE NO. 3<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>DCN #65<br>ASH POND CLOSURE PROJECT | THB | JKB | THB | | | SSS |
| 3-CONT'D | 11-15-17 | 3C-REVISED DRAINAGE WINDOWS TO RECEIVED CLASS 1 RIPRAP (ALDOT)<br>3D-ADDED CONTINUOS DRAINAGE WINDOW DETAIL<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>DCN #65<br>ASH POND CLOSURE PROJECT | THB | JKB | THB | | | SSS |
| 4 | 4-24-18 | 4-ADDED PERIMETER DITCH CHANNEL BALLASTING<br>PROJ. I.D.: GAD15003<br>MWO: APC368037, APC368039, APC368040<br>DCN #74<br>ASH POND CLOSURE PROJECT | DSM | THB | RCB | | | SSS |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=60' | E523668 | 1 | FINAL | 4 |

ANSI E: 44x34

# APPENDIX 6

# POND CLOSURE TECHNICAL SPECIFICATIONS

**INQUIRY NUMBER A57207**

**SOUTHERN COMPANY GENERATION**
**ENGINEERING AND CONSTRUCTION SERVICES**

**TECHNICAL SPECIFICATIONS**
**SECTION 312300**

**FOR**

# EARTHWORK AND FINAL COVER INSTALLATION FOR ASH POND CLOSURE

**FOR**

**PLANT GADSDEN**

**ALABAMA POWER COMPANY**

Prepared By: Stacey H. Simpson Date: 2/22/2017

Reviewed By:

| Name - Discipline | Initials | Date |
|---|---|---|
| A. Thomas H. Bordelon – Site Civil Design | THB | 2/22/2017 |

Approved By: Joshua A. Lippert, Principal Engineer Date: 2/22/2017

REVISIONS

| NO. | DESCRIPTION | BY | REVIEWED | APPROVED | DATE |
|---|---|---|---|---|---|
| 0 | Revised for Construction | SHS | THB | JAL | 2/22/2017 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

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TABLE OF CONTENTS

**1.0 GENERAL ... 3**
**2.0 COVER SYSTEM AND CERTIFICATION ... 5**
2.1 Cover System ... 5
2.2 Certification ... 6
**3.0 APPLICABLE DOCUMENTS ... 6**
3.1 Drawings ... 6
3.2 Codes and Standards ... 6
**4.0 SITE CONDITIONS ... 10**
**5.0 THIRD PARTY QUALITY CONTROL ... 10**
**6.0 LINES AND GRADES ... 10**
**7.0 CLEAR, GRUBBING, AND STRIPPING ... 10**
**8.0 FOUNDATION AND SUBGRADE PREPARATION ... 11**
8.1 Areas to Receive Fill ... 11
8.2 Geomembrane Subgrade ... 11
**9.0 BRIDGING LAYER ... 11**
**10.0 STRUCTURAL EARTH FILL AND ASH FILL ... 12**
**11.0 ASH EXCAVATION ... 14**
**12.0 GEOMEMBRANE LINER, ENGINEERED TURF & SAND BALLAST (CLOSURETURF® COVER SYSTEM) ... 14**
12.1 General ... 14
12.2 Submittals ... 15
12.3 Installation Contractor Qualifications ... 17
12.4 Materials, Delivery and Storage ... 17
12.5 Equipment ... 21
12.6 Geomembrane Installation ... 21
12.7 Geomembrane Field Seaming ... 23
12.8 Geomembrane Field Trial Seams ... 24
12.9 Geomembrane Destructive Seam Testing for Fusion and Extrusion Seaming ... 24
12.10 Geomembrane Repair Procedures ... 25
12.11 Verification of Repairs ... 26
12.12 Engineered Turf Deployment ... 27
12.13 Equipment on Engineered Turf ... 27
12.14 Engineered Turf Repair Procedure ... 30
12.15 Sand Ballast Infill ... 30
12.16 ArmorFill™ Application ... 31
12.17 HydroBinder™ Infill Installation ... 31
12.18 HydroBinder™ Repair Procedures ... 33
12.19 Anchor Trench ... 34
12.20 Acceptance of ClosureTurf® Cover System ... 35
**13.0 SEDIMENT AND EROSION CONTROL ... 35**
**14.0 VEGETATION ... 35**
**15.0 RECORDS ... 36**
15.1 Quality Control Records ... 36
15.2 Record Topographic Survey ... 37

# INQUIRY NUMBER A57207

# TECHNICAL SPECIFICATIONS

# EARTHWORK AND FINAL COVER INSTALLATION FOR ASH POND CLOSURE

## 1.0 GENERAL

1.1 Plant Gadsden located in Gadsden, Etowah County, Alabama has decommissioned its coal fuel infrastructure. As a result, the ash pond will be closed under the requirements of Section 257.100 of 40 CFR Part 257 Subpart D, known hereafter as the "CCR Rule." The ash pond closure strategy at Plant Gadsden comprises re-grading the dry ash stack in the Upper Pond as needed to achieve a minimum 3% slope, consolidating the ash in the Lower Pond to about 30 acres in the northern portion of the Lower Pond, and closing the southern portion of Lower Pond by removal of ash. A continuous cover will be constructed over the re-graded Upper Pond and consolidated ash in the Lower Pond.

1.2 These Specifications, and all related attachments and associated documents, cover the furnishing of all materials (unless otherwise noted), labor, and supervision required for the in-place closure of the ash pond, including installation of a final cover system for the ash pond as described herein and presented on the Closure Drawings, and the technical and construction requirements, including notes, specifications, and design data contained in the Drawings. The Drawings and Notes are an integral part of these Specifications.

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, and to construct the final cover system as specified in the contract documents.

c) The term "Construction Site Manager" (CSM) 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 CSM 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 CSM or his authorized representative.

f) The terms "CQC Firm", "CQC Inspector", and "CQC Professional Engineer" refer to the Contractor's third party firm responsible for construction quality control monitoring, testing and documentation for all work performed during the construction of the facility.

1.4 Any discrepancies between the Drawings noted in Section 3.1 and the provisions of 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 written dimensions, the written dimensions shall govern.

1.5 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).

1.6 As necessary, the Purchaser will file for a National Pollutant Discharge Elimination System (NPDES) Construction General Permit for storm water discharge under ALR100000 (discharges from construction activities that result in a total land disturbance of one acre or greater and sites less than one acre but are part of a common plan of development or sale) from the Alabama Department of Environmental Management (ADEM). The Contractor shall be responsible for obtaining any other necessary permits for conducting the work covered by these Specifications.

1.7 All land disturbing activities shall be consistent with the minimum standards in the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas*, latest revision.

1.8 Installation and maintenance of erosion and sediment control measures (e.g. “BMPs”) and monitoring of surface waters during construction, if required, shall be performed by the Contractor in accordance with the NPDES Construction General Permit (Permit Number ALR100000) and the Construction Best Management Practices Plan (CBMPP), respectively.

1.9 The Contractor shall provide methods, means, and facilities to prevent contamination of the soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by the construction activities. Toxic liquids, chemicals, fuels, and lubricants shall be deposited into containers for subsequent removal offsite in accordance with all applicable federal, state, and local codes and standards.

1.10 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. The Purchaser’s acceptance of the Contractor’s list of equipment shall not be construed to mean that the listed equipment is adequate or sufficient to perform the work or that additional equipment shall not be required to maintain the schedule or perform the work specified herein.

1.11 The Contractor shall furnish appropriate equipment for minimizing fugitive dust. The Contractor shall continually take steps necessary to minimize dust created by all equipment, vehicles, work activities, or storage areas. These steps shall include, but not be limited to, watering roads and work areas. Open-bodied trucks handling sand, stone, gravel, or earth shall be covered if the truck is traveling off site. The Contractor shall not deposit dirt, mud, or debris on public roads, plant roads, or adjacent properties.

1.12 The Contractor is responsible for the unloading, handling, and storage of all materials supplied by him and shall ensure that all materials are handled and stored so as to prevent any damage. Materials damaged during handling, shipping, or storage shall be replaced at no cost to the Purchaser. The Contractor shall store materials only in areas as directed by the Purchaser. Any security measures taken for the protection of the Contractor's equipment shall be at the Contractor's expense.

1.13 The Contractor shall have the responsibility for obtaining a third party CQC Firm for testing for all work performed during the construction of the facility. The Contractor should submit all certifications and inspector qualifications required by this Specification to the Purchaser to be reviewed and approved prior to the start of work.

1.14 All measuring and testing equipment (M&TE) calibration documentation, for both contractor equipment and third-party CQC equipment, should be submitted to the Purchaser for review and approval prior to the start of work.

1.15 All earthwork, including ramps and access roads, done for the convenience of the Contractor, shall be done at his expense unless instructed to be completed by the purchaser. Such work will be restored to its original elevation, or the elevation indicated on the drawings, at the Contractor's expense if the Purchaser so desires.

1.16 The Contractor shall install, at his expense unless expected to be completed by the Purchaser, any drainage piping required because of the Contractor's mode of operation including ramps and roads.

1.17 The Contractor and the CSM, or his representative, shall mutually determine a designated path for vehicles that are used by the Contractor or that haul material to and within the site for the Contractor. The Contractor's vehicles outside the designated traffic path must not obstruct or hinder traffic flow on the site. The Contractor shall provide traffic control during roadway related construction activities and material deliveries. This shall be coordinated with other activities at the site. If within active and congested areas, traffic control shall include flag persons, barriers, and other control aids to provide for the safe routing of traffic in the affected area.

1.18 At all times, the Contractor shall provide protection to prevent damage to existing facilities, roads, underground pipes, and other Purchaser's equipment and property that may be on site. The Contractor will be liable for any damages to APC property caused by the Contractor.

1.19 The Purchaser shall have the right to inspect the Contractor's work as deemed necessary. The Purchaser shall have the right to inspect the Contractor's work locations, to inspect the materials in use, to meet and discuss with the Contractor the progress of the work and the manner in which it is being done. The Purchaser shall have the authority to reject materials or suspend any work not performed in accordance with these Specifications. The Contractor shall be responsible for performing the work in strict accordance with these Specifications, and the presence of the Purchaser's Representative shall not relieve the Contractor and his subcontractors of that responsibility.

1.20 Piezometers and groundwater monitoring wells located in the site area shall not be damaged or destroyed by construction activities. The Contractor shall provide Purchaser-approved measures to protect the piezometers and wells in the site area. Any monitoring well(s) damaged or destroyed by the Contractor and/or his activities will be immediately reported to the Purchaser and shall be replaced at no cost to the Purchaser, within a timeframe and using methods acceptable to the Purchaser.

## 2.0 COVER SYSTEM AND CERTIFICATION

### 2.1 Cover System

Closure of the Ash Pond shall be accomplished by the installation of a final cover system designed to minimize infiltration and erosion. The final cover system will consist of the ClosureTurf® system as manufactured by Watershed Geosynthetics and Agru America. This system consists of an Agru 50 mil linear low density polyethylene (LLDPE) SuperGripnet® geomembrane, engineered turf, and sand ballast.

## 2.2 Certification

The installation of the final cover system for the ash pond shall be certified as being constructed in accordance with the EPA's final CCR Rule promulgated in 40 CFR 257. This certification shall be performed by a professional engineer registered to practice in the State of Alabama and placed in the ash pond operating record within 60 days of the completion of all construction activities. This Certification will be provided by the Purchaser or the Purchaser's Representative.

# 3.0 APPLICABLE DOCUMENTS

## 3.1 Drawings

The Drawing List is contained on the Drawings.

## 3.2 Codes and Standards

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.

If codes or standards are found to conflict with each other, it should be brought to the attention of the Purchaser to determine which is most applicable.

Occupational Safety and Health Administration

- Occupational Safety and Health Act of 1970

ASTM International (ASTM)

- ASTM C 33 – Standard Specification for Concrete Aggregates
- ASTM C 117 – Standard Test Method for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 136 – Standard Test Method for Sieve Analysis of fine and Coarse Aggregates
- 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 (12 400 ft-lbf/ft$^3$ (600 kN-m/m$^3$))
- 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 (Graves Tear) 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 1556 – Standard Test Method for Density and Unit Weight of Soil In - Place by the Sand Cone Method
- ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/$m^3$))
- ASTM D 1587 - Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
- 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 2937 - Standard Test Method for Density of Soil In Place by the Drive Cylinder Method
- ASTM D 3017 – Standard Test Method for Water Content of Soil and Rock In Place Nuclear Methods (Shallow Depth)
- 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 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- 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 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method

- 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 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- ASTM D 4959 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method
- 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 5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- 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 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 6938 Rev B - Standard Test Method for In-Place Density and Water

Content of Soil and Soil – Aggregate In Place by Nuclear Methods (Shallow Depth)

- ASTM D 7005 - Determining the Bond Strength (Ply Adhesion) of Geocomposites
- ASTM D1204 -Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
- ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- ASTM D1907 - Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method
- ASTM D2256 -Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method
- ASTM D3218 -Standard Specification for Polyolefin Monofilaments
- ASTM D5323 – Standard Test Method for Determination of 2% Secant Modulus for Polyethylene Geomembranes
- ASTM D5617 – Standard Test Method for Multi-Axial Tension Test for Geosynthetics
- ASTM D6913 -Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D7007 – Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials

Geosynthetic Research Institute (GRI) Standards

- GM 11 - Accelerated Weathering of Geomembranes using a Fluorescent UVA Device
- GM 12 - Asperity Measurement of Textured Geomembranes Using a Depth Gage
- GM 17 – Test Methods, Test Properties, and Testing Frequency and for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes
- GM 19 – Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

United States Environmental Protection Guidance

- Environmental Protection Agency (EPA) Final Rule for Disposal of Coal Combustion Residuals (CCR) from Electric Utilities, 40CFR257.
- EPA/600/R-93/182, September 1993, 305 pgs.
- U. S. EPA Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities"

Alabama Department of Environmental Management (ADEM) regulations

Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas

## 4.0 SITE CONDITIONS

4.1 The Contractor shall visit the site and acquaint himself with site conditions, utility locations, and the proposed scope of work.

4.2 The Contractor is responsible for acquiring and maintaining an excavation permit per Alabama state law.

4.3 Vibratory equipment shall have vibratory devices mechanically disengaged and rendered inoperable while operating on dikes or the ash pond.

## 5.0 THIRD PARTY QUALITY CONTROL

5.1 The Contractor shall provide to the Purchaser, for the Purchaser's acceptance and approval, the following documentation indicating that the Contractor's Third Party Quality Control firm and personnel that will participate in this Project meet the minimum experience and qualifications indicated herein:

a) Qualifications of a third-party construction quality control (CQC) Inspector for the placement and compaction of the compacted structural fill.

b) Qualifications of a third-party CQC Inspector for installation of the ClosureTurf® Final Cover System documenting the minimum requirements of Section 12.3.5 of these Specifications.

c) Qualifications of the third party's soil testing laboratory contracted to perform the CQC testing for the structural earth fill.

## 6.0 LINES AND GRADES

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 such 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 the changes in plan and/or sections resulting in changes in quantities of materials.

## 7.0 CLEAR, GRUBBING, AND STRIPPING

7.1 Prior to any clearing or grubbing operations, initial BMPs shall be installed. Erosion control measures and best management practices shown in the CBMPP shall be followed.

7.2 The footprint of the ash pond shall be cleared of any woody vegetation prior to excavation and/or fill operations.

7.3 Ash-laden roots on grubbed and stripped material shall be disposed of in an off-site landfill approved by the Purchaser.

7.4 Spoil material shall be disposed of in an off-site landfill approved by the Purchaser.

## 8.0 FOUNDATION AND SUBGRADE PREPARATION

### 8.1 Areas to Receive Fill

8.1.1 The Contractor shall prepare, install and maintain erosion and sediment control measures, as required by the CBMPP. If measures beyond those in the CBMPP are deemed necessary, contact the CSM to have those reviewed and approved by the CBMPP engineer and the CBMPP updated PRIOR to the measures being installed.

8.1.2 Topsoil material and the material to be used as structural earth fill shall be stockpiled separately in a location specified by the Purchaser's Representative.

8.1.3 Proof-roll the entire subgrade utilizing loaded, off-road trucks with a gross machine weight, including payload, of 40 tons. The subgrade is considered to have passed the proof-roll if minimal heaving is observed and the subsequent lift of fill is able to achieve the applicable compaction standard. Any areas failing proof-roll shall be undercut and replaced with structural soil fill and re-rolled, or modified through the use of bridging layer as described in Section 9.0.

8.1.4 Prior to receiving structural earth fill, the foundation areas shall be scarified by harrowing or other suitable means. The moisture content of the roughened surface shall be adjusted to within the limits provided in Section 10.11. No fill shall be placed on any part of the subgrade until such areas have been conditioned, proof-rolled, inspected, and approved in writing by the Contractor's CQC Inspector and the Purchaser.

8.1.5 Work flow shall be planned such that the first embankment fill lift is placed soon after subgrade compaction to minimize subgrade exposure to inclement weather.

### 8.2 Geomembrane Subgrade

8.2.1 The Contractor shall maintain the subgrade suitability and integrity until the geomembrane installation is completed and accepted.

8.2.2 The Contractor shall repair rough areas and any damage to the subgrade caused by installation of the geomembrane.

8.2.3 Subgrade shall be smooth, uniform, firm and free from rocks or other debris. For deployment over soil subgrade, no rocks or protrusions greater than 1/2-inch in diameter shall be exposed at the subgrade surface.

8.2.4 The Contractor shall verify that the surface on which the geomembrane will be installed is acceptable. In so doing the Contractor shall assume full liability for the accepted surface.

8.2.5 The Contractor shall submit written certificates of subgrade acceptance, signed by the Contractor, CQC Inspector, and the Purchaser's Representative, for each area prepared for geomembrane placement.

8.2.6 The beginning of installation means acceptance of existing conditions. The Contractor shall be responsible for maintenance of the geomembrane covered subgrade once installation of geomembrane begins.

## 9.0 BRIDGING LAYER

9.1 Where it can be demonstrated that it is impracticable to proof-roll the subgrade as specified in Section 8.1 or achieve the degree of compaction specified in Section 10.11, a bridging layer may be placed.

9.2 The bridging layer shall be of sufficient thickness to allow the passage of earthmoving equipment with minimal surface heaving, but no more than 4 feet in thickness.

9.3 The bridging layer shall be end-dumped and spread in a single layer. The compaction requirements of Section 10.11 will not apply to the bridging layer.

9.4 Acceptable materials for the construction of the bridging layer include structural earth fill as defined in Section 10.2, ash fill, sand, and rock fill materials.

9.5 Any ash fill used in the bridging lift must have been excavated from the ash pond and not at any point been transported out of the pond.

9.6 Geogrid reinforcement may be used as part of the bridging layer. All geogrid should be placed in accordance with the manufacturer's recommendations.

## 10.0 STRUCTURAL EARTH FILL AND ASH FILL

10.1 The Contractor shall provide third party CQC testing for all earth work performed for the closure of the Ash Pond.

10.2 Compacted earth fill should generally consist of sandy clays (CL), clayey silts (ML), clayey sands (SC), and clayey to silty sands (SC/SM) from an off-site borrow area that is permitted by the Alabama Department of Environmental Management (ADEM).

10.3 No earth fill or ash shall be placed on any part of the subgrade until such areas have proof-rolled, inspected, and approved in writing by the soils CQC Inspector and the Purchaser's Representative.

10.4 Ash shall be placed in uniform layers of 8 inches, nominal thickness, loose measurement. The thickness of each layer shall be kept uniform with the necessary grading equipment. Particular care must be used to obtain the required compaction along the edges of fill slopes.

10.5 Structural fill should be placed in uniform layers of 8 inches, nominal thickness, loose measurement. The thickness of each layer shall be kept uniform 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 fill slopes.

10.6 Vibratory compaction equipment is not permitted to operate on the dike or ash pond. Equipment that has vibratory capability must have the vibratory component mechanically disengaged and rendered inoperable while operating on the dike or ash pond.

10.7 Contractor shall not use construction equipment that results in contact pressures exceeding 3,000 psf on top of the dike. Exceptions may be allowed with the approval of the Purchaser.

10.8 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 Purchaser's Representative, before the succeeding layer is placed.

10.9 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 earth fill materials and all stones and clay clods greater than 3-inch maximum. Clay clod size may be reduced in size to meet this Specification by disking, tilling or other means. The distribution of materials throughout the structural fill shall be essentially uniform and free of any lenses, pockets, streaks, or layers of materials differing substantially in texture, moisture content, or gradation from the surrounding material.

10.10 The compacted structural fill and ash subgrade beneath the LLDPE component of the final cover shall be free of roots, debris, and all stones and clay clods greater than ½-inch maximum dimension. Clay clod size may be reduced in size to meet this

Specification by disking, tilling or other means.

10.11 Structural earth fill and ash material shall be compacted to a minimum of 95% of the relative maximum dry density as determined by the standard Proctor compaction test (ASTM D 698). The moisture content of the earth fill at the time of placement shall be within -3% and +3% of the optimum moisture obtained by standard Proctor compaction test.

10.12 When moisture content is too low, the moisture content shall be adjusted to within the above limits prior to compaction. Moisture adjustment shall be achieved by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and harrowing of the layer shall be done after deposition, but before compaction.

10.13 If the moisture content is too high, the Contractor will be permitted to disk in place or stockpile and disk the earth fill material to promote drying to bring it back within the allowable moisture range.

10.14 The Contractor will be required to remove any compacted material that does not comply with the compaction requirements and replace the compacted earth fill to comply with this Specification at his own expense.

10.15 Structural earth fill or ash which cannot be compacted with roller equipment because of inadequate clearances shall be spread in 4-inch layers and compacted with hand-guided power tampers to the extent required by these Specifications. Rocks two inches and greater, in any dimension, roots, and debris shall be removed from the fill and disposed of in an approved manner.

10.16 Field density and moisture content tests shall be performed daily in all types of material being placed. At a minimum, one in place density test shall be performed for each lift for each day fill material is placed.

10.17 For earth fill and ash material, at least one field moisture content and density test shall be performed for every 1,000 cy of fill (1 test per acre of lift area) or more often if deemed necessary in the opinion of the Purchaser's Representative.

10.18 If an in-place density or moisture test fails to meet the requirements for compaction and/or moisture, the area shall be reworked and then retested. If, however, the second test fails to meet the criteria, the area failing the criteria shall be delineated, and reworked or removed, and then retested. The areas requiring reworking/recompacting shall be noted on record drawings and reported.

10.19 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 Purchaser's Representative, to require one or two-point Proctor checks 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.

10.20 The surveyed location, lift designation, and elevation or depth of the field density and moisture tests (passing, failing, and retests) shall be recorded and noted on the respective test records. The locations of these tests shall be shown on a figure or drawing.

10.21 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 above.

10.22 If the construction of the embankment 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.

10.23 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to ensure that the correct reference Proctor curves are being used for compaction check.

10.24 Earth fill areas, ditches, and other disturbed areas outside the cover area shall be grassed upon reaching final grade in accordance with these Specifications, the CBMPP and the Vegetation Schedule shown on the Drawings.

## 11.0 ASH EXCAVATION

11.1 The ash from the southern portion of the Lower Pond shall be excavated to the lines and grades as shown on the drawings.

11.2 All ash and visibly ash-impacted material should be removed from areas subject to closure by ash removal. The excavated subgrade surface shall be inspected and approved by the Certifying Engineer or his designated representative, with joint approval of APC Environmental Affairs.

11.3 Following the Certifying Engineer's approval, and with joint approval of APC Environmental Affairs, the Contractor's Representative shall provide documentation of excavated subgrade surfaces certified in Section 11.2 which shall include spot elevations taken in enough locations to provide reasonable representation of the area being approved; maximum 100ft. by 100ft. grid. Survey drawings shall be signed and sealed by a professional land surveyor registered to practice in the state of Alabama. Photographic documentation of approved surfaces shall also be provided.

11.4 Following documentation, excavation shall continue to a depth of a minimum 6 inches below visibly ash-impacted materials. Upon completion of the 6-inch over-excavation, final excavated grades shall be inspected and approved by the Certifying Engineer or his designated representative, with joint approval of APC Environmental Affairs.

11.5 Following the Certifying Engineer's approval, and with joint approval of APC Environmental Affairs, the Contractor's Representative shall provide documentation of the over-excavated subgrade certified in Section 11.4 which shall include spot elevations taken in enough locations to provide reasonable representation of the area being approved; maximum 100ft. by 100ft. grid. Survey drawings shall be signed and sealed by a professional land surveyor registered to practice in the state of Alabama. Photographic documentation of approved surfaces shall also be provided.

11.6 All survey shots shall be "stacked" in order to properly verify the given layer's thickness.

11.7 Thickness determinations obtained at grid points on slopes shall be made normal to the slopes.

11.8 Ash shall not be allowed to discharge to State waters or the environment during ash pond closure activities.

## 12.0 GEOMEMBRANE LINER, ENGINEERED TURF & SAND BALLAST (CLOSURETURF® COVER SYSTEM)

### 12.1 General

12.1.1 ArmorFill™ E, a specialty component of the ClosureTurf® system, is a proprietary

polymer-based product developed by Watershed Geosynthetics specifically to bind the ASTM-C33 sand infill component of the ClosureTurf® system for long-term performance applications.

12.1.2 HydroBinder™, a specialized component of the ClosureTurf® system, is a proprietary cementitious product used as an infill component of the ClosureTurf® system for high-velocity applications in swales and drainage channels.

12.1.3 HydroBinder™ shall be used for the slope drainage system at locations shown on the drawings.

12.1.4 ArmorFill™ E shall be used at transitions between Closure Turf® and HydroBinder™ as specified on the drawings.

12.1.5 The structured geomembrane shall be comprised of 50 mil linear low density polyethylene (LLDPE) Super Gripnet® structured geomembrane material as manufactured by Agru America. Product properties are listed in Section 12.4, Table 1.

12.1.6 The Engineered Turf layer consists of two polypropylene woven geotextiles tufted with polyethylene yarns overlying the 50 mil LLDPE structured geomembrane. Product properties are listed in Section 12.4, Table 2.

12.1.7 Color of the Engineered Turf layer shall be of standard color (100% green), or enhanced color (75% green + 25% tan).

12.1.8 The structured geomembrane and the engineered turf must be purchased as a system from the same supplier to ensure desired performance.

12.1.9 The sand infill for the Engineered Turf ballast shall consist of grain size distributions meeting ASTM C-33 specifications shown in Section 12.4, Table 3. All infill material shall meet ASTM C33 specifications unless otherwise approved by the Purchaser.

12.1.10 ArmorFill™ E shall consist of the proprietary polymer emulsion component and be mixed according to the requirements shown in Section 12.4, Table 4.

12.1.11 The HydroBinder™ infill for the Engineered Turf ballast shall consist of the proprietary cementitious product and meet the requirements as shown in Section 12.4, Table 5. All cementitious infill mix design shall meet ASTM C387 specifications for high strength mortars as described in Table 5 unless otherwise approved by the Purchaser.

12.1.12 A Manufacturer's Representative shall be on site during the initial phase of the ClosureTurf® installation and ArmorFill™ E/HydroBinder™ application to provide assistance to the Contractor.

12.1.13 At the request of the Purchaser or the Purchaser's Representative, representative product samples of the materials used on this project shall be provided for the Purchaser's use in confirmation testing for material properties.

## 12.2 Submittals

12.2.1 The ClosureTurf® installation contractor shall be an experienced and trained ClosureTurf® installer and be able to provide documentation that they have manufacturer's approval status. The ClosureTurf® installation contractor shall also utilize a licensed installer for the sand infill installation and ArmorFill™E/HydroBinder™ application of ClosureTurf® if not licensed to install the infill themselves. A Copy of Installer's Letter of Approval or License issued by the Manufacturer shall be provided to the Purchaser.

12.2.2 The Contractor shall provide to the Purchaser qualification statements from the geomembrane Installation Contractor, and a Statement of Qualifications for the CQC

Inspector and laboratory documenting the minimum requirements of Section 12.3 of these Specifications.

12.2.3 The Contractor shall provide the manufacturer product data sheets for all material to be provided for the project.

12.2.4 The Contractor shall provide to the Purchaser the Manufacturer's Quality Control (CQC) Program, including tests, test procedures, and frequencies, for manufacture of all materials for this project.

12.2.5 A copy of the manufacturer's quality control results shall be submitted to the Purchaser's Representative a minimum of seven calendar days prior to geomembrane shipment to the site. Quality control testing shall be performed by the manufacturer in accordance with the test procedures, and frequency listed in the Quality Control Program and as approved by the Purchaser's Representative. Prior to delivery, the following shall be submitted to the Owner's Representative for Review:

a) Certification stating all geomembrane rolls are furnished by one manufacturer, and all rolls are manufactured from one resin type.

b) Copies of quality control certificates issued by the Manufacturer. The quality control certificates shall include:

1. Roll numbers and identification;
2. Sampling procedures; and
3. Results of quality control tests, including descriptions of the test methods used.
4. The results of the manufacturing quality control tests shall meet or exceed the property values listed in Section 12.4.
5. Geomembrane delivery, storage, handling and installation instructions.

12.2.6 Extrudate Beads and/or Welding Rods:

a) Statement of production dates.

b) Certification stating all extrudate is from one manufacturer and is the same resin type as the resin used to manufacture the geomembrane rolls.

c) Copies of quality control certificates issued by the Manufacturer.

12.2.7 The Engineered Turf manufacturer shall provide inspection records of the tufting procedures for the Turf material. These will include visual inspection records of the following properties every 150,000 sq. ft:

a) Tufting Gauge

b) Pile height

c) Roll Length and roll numbers.

12.2.8 The Manufacturer shall also provide documentation on the geotextile product and yarn manufacturer minimum properties for the Engineered Turf.

12.2.9 The Engineered Turf manufacturer shall provide pantone color codes available for Engineered Turf component.

12.2.10 Prior to mobilization of the Installer to the site, Contractor shall submit shop drawings indicating panel layout and field seams 14 calendar days prior to installation of geomembrane.

12.2.11 The Contractor shall furnish the Purchaser upon completion of the project:

a) A 1-year warranty provided by the Geosynthetics Installer against defects in workmanship. Warranty conditions concerning limits of liability will be evaluated and must be acceptable to the Owner.

b) As-built Geomembrane Panel Drawings. As-built Drawings shall include panel locations, panel identification numbers, geomembrane roll numbers for each

panel, seam caps, destructive sample locations, and repairs.

12.2.12 The Contractor shall submit a certification from the manufacturer of the geomembrane that the raw materials, and finished geomembrane rolls, meet the physical property requirements indicated in these Specifications.

12.2.13 After installation, the Contractor shall submit a certification, signed by the Contractor and signed and sealed by the CQC Firm's Professional Engineer, that the geomembrane and ClosureTurf® cover system was placed in accordance with these Specifications.

## 12.3 Installation Contractor Qualifications

12.3.1 The Superintendent shall have supervised the installation of a minimum of 2,000,000 square feet of polyethylene geomembrane and 500,000 square feet of geotextile.

12.3.2 The master seamer shall have experience seaming a minimum of 1,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site.

12.3.3 All other seaming personnel shall have seamed at least 100,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Personnel who have seamed less than 100,000 square feet of polyethylene geomembrane shall be allowed to seam only under the direct supervision of the master seamer or Superintendent.

12.3.4 The installation Contractor shall attend the manufacturer's course on installation procedures for the ClosureTurf® system. Certificates of course completion shall be submitted by the Contractor.

12.3.5 The Contractor shall provide a third-party inspector for construction quality control (CQC) of the LLDPE installation. The LLDPE inspector shall be an individual or company who is independent from the geomembrane manufacturer and installer, who shall be responsible for monitoring and documenting activities related to the CQC of the LLDPE throughout installation. The inspector who is on site monitoring the installation activities every day that they are taking place, shall have provided CQC services for the installation of the proposed or similar products for at least five completed projects totaling not less than 1,000,000 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 LLDPE inspector prior to starting work.

## 12.4 Materials, Delivery and Storage

12.4.1 The structured geomembrane shall be comprised of 50 mil linear low density polyethylene (LLDPE) Super Gripnet® structured geomembrane material as manufactured by Agru America, with a minimum 23-foot seamless width. There shall be no factory seams. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.

12.4.2 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 raw materials meet the physical property requirements indicated in the following table.

12.4.3 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.

12.4.4 The geomembrane shall be supplied in rolls; folds will not be permitted. Identify each roll with labels indicating lot number, roll number, thickness, length, width, manufacturer, and plant location.

12.4.5 Resin shall be LLDPE, new, first quality, compounded and manufactured specifically for producing LLDPE geomembrane.

12.4.6 Extrudate Rod or Bead shall be made from same resin as the geomembrane. Additives shall be thoroughly dispersed. The rods or beads shall be free of contamination by moisture or foreign matter.

12.4.7 All rolls of Engineered Turf delivered to the site shall be inspected for the following:

a) The Engineered Turf is wrapped in rolls with protective covering.
b) The rolls are not damaged during unloading.
c) Protect the Engineered Turf from mud, soil, dirt, dust, debris, cutting, or impact forces.
d) Each roll must be marked or tagged with proper, original, manufacturer - applied identification.
e) Separate damaged rolls from undamaged rolls and store at locations designated by the Purchaser until proper disposition of material is determined by the Purchaser.
f) The Purchaser will be the final authority regarding damage.
g) Separate rolls without proper documentation and store until the Purchaser's Representative approval is received.

12.4.8 The materials shall be stored in space allocated by the Purchaser.

12.4.9 The materials shall be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

12.4.10 The materials shall be stored on level prepared surface (not on wooden pallets).

12.4.11 The materials shall be stacked per Manufacturer's recommendation but no more than three rolls high for geomembrane and geocomposite, and no more than five rolls for ClosureTurf®. Other height restrictions may apply based on site specific safety requirements.

12.4.12 Appropriate handling equipment shall be used to load, move or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader and roll bars for deployment. Dragging panels on ground surface will not be permitted.

12.4.13 The Installer is responsible for storage, and transporting material from storage area to installation area.

12.4.14 Damaged geomembrane will be documented by the Purchaser's Representative.

12.4.15 Damaged geomembrane may be repaired, if approved by the Purchaser's Representative, in accordance with these Specifications or shall be replaced at no additional cost to the Owner.

| TABLE 1 - STRUCTURED LLDPE GEOMEMBRANE - 50 MIL Super GripNet by Agru America | | | |
|---|---|---|---|
| Property | Frequency | Test Method | Minimum Average Value |
| Raw Materials:<br>Density<br><br>Melt Index<br><br>Oxidative Induction Time (OIT)<br>Standard OIT<br>Or<br>High Pressure OIT | <br>Once per 200,000 lbs of resin<br>Once per 200,000 lbs resin<br>Once per 200,000 lbs resin | <br>ASTM D 1505<br>ASTM D 792<br>ASTM D 1238,190˚C, 2.16kg<br><br><br>ASTM D 3895<br><br>ASTM D 5885 | <br>Max. 0.939 g/cc<br><br>≤ 1.0 g/10 min.<br><br><br>100 min. (min. avg.)<br><br>400 min. (min. avg.) |
| Thickness<br>Minimum Average<br>Lowest individual of 8 of 10 readings | per roll | ASTM D 5994 | <br>50 mils<br>45 mils |
| Drainage Stud Height (min. avg) | Every Second Roll | ASTM D7466[2] | 130 mil |
| Friction Spike Height (min. avg) | Every Second Roll | ASTM D7466[2] | 175 mil |
| Density | Once per 200,000 lbs of resin | ASTM D 792B | Max. 0.939 g/cc |
| Tensile Properties (avg. both directions) (min. avg)<br>Yield Strength<br>Break Strength<br>Yield Elongation<br>Break Elongation | 20,000 lbs. | ASTM D 6693, Type IV<br><br>2 in/min | <br><br>N/A<br>105 lb/in<br>N/A<br>300 % |
| Tear Resistance | 45,000 lbs | ASTM D 1004 | 30 lb (min. avg.) |
| Puncture Resistance | 45,000 lbs | ASTM D 4833 | 55 lb (min. avg.) |
| 2% Modulus lb/in (max) | Per formulation | D5323 | 3000 (max) |
| Axi-Symmetric Break Resistance Strain - % (min.) | Per formulation | D5617 | 30 |
| Carbon Black Content | 20,000 lbs. | ASTM D 4218 | 2.0 % - 3.0 % |
| Carbon Black Dispersion | 45,000 lbs. | ASTM D 5596 | Only near spherical agglomerates:<br>10 views Cat. 1 or 2 No more than one (1) view from Category 3. |
| Oxidative Induction Time (OIT)<br>Standard OIT, minutes | 200,000 lbs | ASTM D 3895, 200˚C, 1 atm $0_2$ | ≥140 min. |
| Oven Aging @ 85ºC<br>High Pressure OIT (min. avg.) - % retained after 90 days | Per Each Formulation | ASTM D5721<br>ASTM D5885, 150˚C, 500psi $0_2$ | 60% |
| UV Resistance<br>High Pressure OIT - % retained after 1600 hours | Per Each Formulation | ASTM D7238<br><br>ASTM D5885, 150˚C, 500psi $0_2$ | (20hr. cycle @ 75˚C/4hr. condensation @60˚)<br>35% |

1. Reference GRI GM17 & LLDPE Super Gripnet Liner Product Data Sheet, Agru America.
2. Even though ASTM D7466 is specific to textured geomembrane, this method is still applicable for SuperGrip materials.

| TABLE 2 - ENGINEERED TURF COMPONENT | | | |
|---|---|---|---|
| Property | Frequency | Test Method | Minimum Average Value |
| CBR Puncture | Once per 150,000 sf | ASTM D 6241 | 800 lbs (MARV) |
| Tensile Product (MD/XD) | Once per 150,000 sf | ASTM D 4595 | 1000 lb/ft min. (MARV) |
| Rainfall Induced Erosion | N/A | ASTM D 6459 | <0.45% Infill Loss 6 in/hr |
| Aerodynamic Evaluation | N/A | GTRI Wind Tunnel | 120 mph with max. uplift of 0.12 psf |
| Turf Fiber UV Stability | N/A | ASTM G147 | >60% retained tensile strength @ 100 yrs (projected) |
| Backing system UV Stability (Exposed) | N/A | ASTM G154 Modified Cycle 1, UVA340 | 110 lb/ft retained tensile strength @ 6500 hrs (projected) |
| Steady State Hydraulic Overtopping (ClosureTurf® with HydroBinder™) | N/A | ASTM D7277<br>ASTM D7276 | 5 ft overtopping resulting in 29 fps velocity & 8.8 psf shear stress for Manning N Value of 0.02 |
| Full Scale Wave Overtopping Test – Cumulative Volume (ClosureTurf® with HydroBinder™) | N/A | CSU Wave Simulator | 165,000 $ft^3$/ft |
| Full Scale Wave Overtopping Test – Max. Avg. Wave Overtopping Discharge (ClosureTurf® w/ HydroBinderTM) | | CSU Wave Simulator | 4.0 $ft^3$/s/ft |
| Transmissivity w/ underlying structured geomembrane, Normal Stress @ 50 psf & 0.33$m^2$/sec | NA | ASTM D4716 | 2.5 x $10^{-3}$ $m^2$/sec, min. |
| Internal Friction of combined components | N/A | ASTM D5321 | 35˚, min. |
| | | | |

| TABLE 3 - ENGINEERED TURF INFILL & BALLAST SAND | |
|---|---|
| ASTM C33 | |
| Sieve | Percent Passing |
| 3/8 in. (9.5mm) | 100 |
| No. 4 (4.75 mm) | 95 – 100 |
| No. 8 (2.36 mm) | 80 – 100 |
| No. 16 (1.18 mm) | 50 – 85 |
| No. 30 (600 µm) | 25 – 60 |
| No. 50 (300 µm) | 5 – 30 |
| No. 100 (150 µm) | 0 - 10 |
| | |

| TABLE 4 – ArmorFill™ POLYMER EMULSION | |
|---|---|
| Product | Full Strength Emulsion (260-gallon tote typical) |
| Mix | 6 parts water to 1 part ArmorFill Polymer Emulsion |

| TABLE 5 – ENGINEERED TURF HydroBinder™ INFILL & BALLAST | |
|---|---|
| Product | 80 lb. bags or 3000 lb. bulk super sacks |
| Cement | Portland Cement Brand meeting ASTM C150, Type I or II. Only one brand used throughout project. |
| Cementitious Infill Mix | ASTM C387 for high strength mortars. Min. 28 day compressive strength of 5000 psi for the batched material as supplied (see Spec Section 12.17.16 for testing requirements) |

## 12.5 Equipment

12.5.1 Heavy vehicles shall not be permitted to operate directly on the liner material. Rubber-tired ATV's and flat-track skid steers are acceptable if wheel contact (ground pressure) is less than 6 psi.

12.5.2 In areas of heavy traffic, the geomembrane shall be protected by placing protective cover, with a minimum thickness of 3 feet, over the geomembrane.

12.5.3 If the geomembrane is damaged by vehicular traffic, it shall be replaced at the Contractor's expense.

12.5.4 Equipment on the geomembrane shall meet the specifications of Table 6 contained in Section 12.13.

## 12.6 Geomembrane Installation

12.6.1 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, solvents, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. Stacking of the rolls is allowed following manufacturer's recommendations.

12.6.2 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.

12.6.3 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 installation procedure for the Purchaser's review fourteen days prior to installation.

12.6.4 All seam and non-seam areas of the geomembrane shall be inspected by the CQC 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.

12.6.5 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.

12.6.6 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.

12.6.7 The geomembrane shall not be deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, in the presence of excessive winds, or in excessive heat or cold.

12.6.8 Each panel shall be marked with an "identification code" (number or letter) consistent with the layout plan. The identification code shall be simple and logical. Markings shall not be used that permanently alter the line, such as stampings, weld marks, hydrocarbon marks, etc. The number of panels deployed in one day shall be limited by the number of panels which can be seamed on the same day. All deployed panels shall be seamed to adjacent panels by the end of each day.

12.6.9 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. The equipment shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons, deployment or other means. The placement shall be observed by the CQC Inspector and the Purchaser's Representative.

12.6.10 The Contractor shall inspect the subgrade preparation prior to liner installation. The subgrade shall be compacted in accordance with the Specifications. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with appropriate and properly compacted material. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than one-half inch in diameter, or debris of any kind. The subgrade shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. The surface shall contain no rutting, cracks or tire tracks exceeding ¼ inch in depth. Standing water or excessive moisture shall not be allowed.

12.6.11 The Contractor, on a daily basis, shall approve the surface on which the geomembrane 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.

12.6.12 The Contractor shall submit written Certificates of Subgrade Acceptance, signed by the Contractor, CQC Inspector, and Purchaser's Representative, for each area prepared for geomembrane installation. This shall be done prior to commencing work.

12.6.13 Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

12.6.14 Personnel working on the geomembrane shall not smoke or wear damaging shoes.

12.6.15 The method used to unroll the panels shall not cause scratches, crimps, or creases in the geomembrane.

12.6.16 Unroll panels with the spike down and the stud side up for the structured geomembrane to assure that the deployment method protects the geomembrane from scratches and crimps and protects soil surface.

12.6.17 Unroll panels with adequate tension to prevent undulations or wrinkles when placed on the ground. The spike side down prevents easy movement of the panel. Individual panels placed with more than 5 undulations greater than 2 inches in height shall be deployed again.

12.6.18 Use a method to minimize wrinkles, especially differential wrinkles between adjacent

panels.

12.6.19 Place adequate hold-downs to prevent uplift by wind. 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).

12.6.20 Protect geomembrane in heavy traffic areas by geotextile, extra geomembrane or other suitable materials.

12.6.21 Do not allow vehicular traffic on unprotected geomembrane surface.

12.6.22 Panels deployed on grades steeper than 12% shall extend a minimum of 5 feet beyond the crest or toe of that grade with no cross seams. Cross seams may be allowed by following the guidelines in Section 12.7.3.

12.6.23 Visually inspect sheet surface during unrolling of geomembrane and mark faulty or suspect areas for repair or test. Replace faulty (requires more than one patch per 200 square feet) geomembrane stock at no additional cost to the Owner.

12.6.24 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 CQC 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.

12.6.25 After panel deployment and before welding, any horizontal wrinkles must be walked down or wiggled down the slope to minimize wrinkles after welding.

12.6.26 Limit maximum wrinkle height to 4 inches during warmer ambient temperatures and 2 to 3 inches in cooler temperatures.

12.6.27 Geomembrane wrinkles shall not be folded over.

12.6.28 After each panel welding, the sheet should be hand pulled in order to avoid the formation of ridging along the seams (snapping).

12.6.29 Physically remove wrinkles by walking them or by pretension pulling on the sheet after welding each panel.

## 12.7 Geomembrane Field Seaming

12.7.1 Field seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit a copy of the proposed seaming procedures (both fusion and extrusion welding, including preparation procedures), prior to commencement of seaming, for the Purchaser's review and approval.

12.7.2 Remove studs and spikes from the structured geomembrane at butt weld locations. During the stud/spike removal operation, do not reduce the thickness of the barrier section of the geomembrane to less than the minimum thickness listed in Section 12.4.

12.7.3 The only 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 shall be kept to the lower half of the slope. No more than one cross seam will be allowed per panel slope length.

12.7.4 No seam of any kind shall be closer than 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.

12.7.5 Geomembrane panels must have a finished minimum overlap of 4 inches for fusion welding and 6 inches for extrusion welding.

12.7.6 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

12.7.7 Generators used to power welding/grinding apparatus shall be placed on a rub sheet and/or in a HDPE tub to prevent damages caused by vibrations/equipment leaks and to protect the liner during refueling of these generators.

12.7.8 The Installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing for extrusion welds or Air Pressure Testing for double fusion seams. In areas where vacuum box testing is not applicable, spark testing shall be used (i.e. around pipes).

12.7.9 Where flumes exit down the slope, provide a full panel width parallel to the flow line, avoiding seams along the bottom of the flume. If flume width is too wide for a full panel, seams shall be placed on the interior flume slope, above the flow line.

## 12.8 Geomembrane Field Trial Seams

12.8.1 Field trial seams shall be made in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall submit a copy of the proposed testing procedures for the Purchaser's review and approval.

12.8.2 Field trial seams shall be conducted, per seaming apparatus and per seamer, on the liner to verify that seaming conditions are satisfactory. Trial seams shall be conducted at the beginning of each seaming period, at least once every four hours for each seaming apparatus and personnel used that day. Additional field trial seams may be requested by and at the discretion of the Purchaser's Representative.

12.8.3 All trial 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.

12.8.4 Field trial seaming shall be conducted under the same ambient temperature and preheating conditions as the production seams.

12.8.5 Field trial seams shall be destructively tested in accordance with Section 12.9.

## 12.9 Geomembrane Destructive Seam Testing for Fusion and Extrusion Seaming

12.9.1 Destructive seam testing should be minimized to preserve the integrity of the liner. The Contractor shall take 1 destructive test sample once per 500 cumulative feet of fusion seam length, per fusion welding device, from a location specified by the CQC Inspector. This frequency applies to extrusion seams as well. If the amount of extrusion seaming is < 500 feet then a minimum of 1 extrusion destructive test shall be performed.

12.9.2 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.

12.9.3 The samples shall be a minimum of 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 Installer, one to be given to the Contractor's CQC Inspector, and one to the Purchaser.

12.9.4 The Installer shall test 10 1-inch wide specimens from his sample; 5 specimens for shear strength and 5 for peel strength. The CQC Inspector shall submit samples to an independent laboratory for confirmation testing. Seam test results shall be evaluated using the current GRI Test Method GM19 which allows for 4 of 5 specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel separation shall not exceed 25%.

12.9.5 Seams shall be tested according to the following methodology:

| **Property** | **Test Method** | **Minimum Average Value** |
|---|---|---|
| Seam Properties | ASTM D 6392 | |
| 1. Shear Strength | GM19 | 75 lb/in |
| 2. Peel Strength | | |
| • Hot Wedge | | 63 lb/in |
| • Extrusion Fillet | | 57 lb/in |

*Note: When destructive seam testing is performed on a 40 mil to 50 mil seam, the 40 mil seam properties above shall dictate.*

12.9.6 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.

12.9.7 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 shall retrace the welding path to a location (initially a minimum of 10 feet on each side of the failed seam location) to identify and isolate the failed seam in both previous and next direction of failed destructive, by taking two new samples, one from each direction. If these tests pass, then the seam shall be cap stripped between the passing tests. 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.

d) 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.

e) 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.

## 12.10 Geomembrane Repair Procedures

12.10.1 The geomembrane will be inspected before and after seaming for evidence of 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. The geomembrane surface shall be swept or washed by the Installer if surface

contamination inhibits inspection. The Installer shall ensure that an inspection of the geomembrane precedes any seaming of that section.

12.10.2 Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

12.10.3 Repair, removal and replacement shall be at the Installers expense if the damage results from the Installer's activities.

12.10.4 Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. The Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the Purchaser's Representative and the Installer.

12.10.5 The following repair procedures shall apply:

a) Defective seams shall be cap stripped or replaced.
b) All holes of any size shall be patched.
c) 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.
d) Blisters, large cuts and undispersed raw materials shall be repaired by patches.
e) 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 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.
f) Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum 6 inches beyond the edge of defects.
g) All T's and intersections shall be patched. Welding the excess overlap is not permitted.
h) Geomembrane surfaces to be repaired shall be abraded (extrusion welds only) no more than ½ hour prior to the repair.
i) All geomembrane surfaces shall be clean and dry at the time of repair.
j) The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the Owner's Representative.
k) Extend patches or caps at least 6 inches beyond the edge of the defect, i.e., be a minimum of 12 inches in diameter, and round all corners of material to be patched.
l) Bevel the edge of the patch and do not cut patch with repair sheet in contact with geomembrane. Temporarily bond the patch to the geomembrane with an approved method, extrusion weld the patch and then vacuum test the repair.

## 12.11 Verification of Repairs

12.11.1 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.

12.11.2 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. (i.e., Test 1 followed by Test 1R1).

## 12.12 Engineered Turf Deployment

12.12.1 After geomembrane installation, including required documentation, has been completed, the geomembrane surface shall be cleared of all significant deposits of stones, soil and debris that could damage the geomembrane or impede the hydraulic function between the stud side of the structured geomembrane and the Engineered Turf component. Any soil or debris washed down to the toe of slope during cleaning procedures shall be physically removed from the geomembrane surface without damage to the geomembrane. No turf shall be deployed until the geomembrane has been inspected and approved in writing by the Contractor's QC Inspector and the Purchaser.

12.12.2 The Engineered Turf shall be deployed without damage to the geotextile component and minimal loss of the synthetic grass component. Deployment equipment shall not damage the Engineered Turf geotextile, cause synthetic grass loss, or damage underlying geomembrane by handling, trafficking, leakage of hydrocarbons, or by other means.

12.12.3 The Engineered Turf shall be deployed smooth and free of tension, stress, folds, wrinkles, creases, and free of contaminants such as soil, grease, fuel, etc.

12.12.4 The Engineered Turf shall be deployed with the synthetic grass blades pointing towards the top of the slope on sideslopes greater than 12%. In ditches, the orientation requirement of the grass blades shall not apply.

12.12.5 Engineered Turf shall be secured with sand bag anchoring at the top of the slope and then rolled down the slope.

12.12.6 Seaming operations shall be performed using a 4-inch overlap and fastened with heavy-duty textile stitching machine. A prayer type seam is to be constructed using a Nulong sewing machine or equivalent. Stitching operations shall be performed such that the woven geotextiles are not exposed. Sewing shall occur between the 1st and 2nd row of stiches to avoid exposure of the black geotextile after flipping the panel.

12.12.7 After seaming operations, the ends of the Engineered Turf panels shall be permanently anchored in the perimeter and bench roadways.

12.12.8 Construction equipment on the deployed Engineered Turf shall be minimized to reduce the potential for geosynthetic material puncture. Equipment travel on exposed structured geomembrane is prohibited. Small equipment such as generators shall be placed on scrap geomembrane material (rub sheets) above geosynthetic materials in the ClosureTurf® Final Cover System.

12.12.9 Seams shall be at least 5 feet away from stress points such as the crest of slopes greater than 12%. Where possible, seams shall be made only across ditch and swale cross-sections with minimal seam intersections. When seams are necessary along flow lines, a full panel width shall be placed along the bottom of the ditch with seams above the flow line., avoiding seams along the bottom of the ditch. If ditch width is too wide for a full panel, seams shall be placed in the interior ditch slope above the flow line.

12.12.10 Engineering turf shall be protected against dust and dirt accumulation prior to infill placement. Contractor shall ensure clean engineering turf prior to installation of infill. No infill materials shall be deployed until the engineered turf has been inspected and approved in writing by the Contractor's QC Inspector and the Purchaser.

## 12.13 Equipment on Engineered Turf

12.13.1 Equipment utilized for ballast sand and ArmorFill™/HydroBinder™ applications on top of the engineered turf alone and slopes flatter than 15% shall be limited to light

rubber-tired, flat-track skid steer or padded track equipment with a maximum ground pressure less than 6 psi. No equipment at all is allowed on top of the engineered turf alone with slopes exceeding 15%.

12.13.2 Post sand ballast and ArmorFill™/HydroBinder™ deployment, drivability ground pressures for the top deck and/or slopes less than 15% shall be limited to 15 psi. Post sand ballast and ArmorFill™/HydroBinder™ deployment drivability ground pressures for slopes greater than 15% shall be limited to 6 psi. Post sand ballast is defined as a sand infill of a minimum of ½ inches in thickness. A ground pressure of 35 psi is acceptable only for stationary type equipment such as the CAS AT7 sand/rock slinger to be used for deployment of sand ballast/ArmorFill™/HydroBinder™ on the top deck as well as on slopes. If this or similar equipment is used, it shall be moved unloaded. A minimum of 2 inches of additional ballast sand is required under the stationary equipment to protect the underlying engineered turf. The table below includes all acceptable equipment, ground pressures, and tire pressures.

12.13.3 It is preferable to deploy the sand and/or ArmorFill™/HydroBinder™ horizontal to the slope and not straight up and down. In cases where the equipment is required to go up and down the slope, it shall traverse the slope at a 45 degree angle.

12.13.4 No equipment will be left running and unattended over the constructed geosynthetics. For areas of frequent or heavy traffic, thicker infill may be required as specified on the drawings or as directed by Purchaser's Representative.

12.13.5 Equipment operators shall inspect equipment rubber tires or tracks for sharp protrusions from foreign matter or tire/track damage, embedded rocks, or other foreign materials protruding from tires/track and remove such protrusions and foreign matter prior to driving on the geomembrane or Engineered Turf. Equipment travel paths driven on geomembrane and Engineered Turf shall be as straight as possible with no sharp turns, sudden stops or quick starts.

12.13.6 Table 6 below includes all acceptable equipment, tire pressures, and ground pressures. The Contractor shall provide to Purchaser a list of all proposed equipment with determined ground pressures and tire pressures 14 days prior to the start of engineered turf installation.

| TABLE 6 – ALLOWABLE EQUIPMENT, GROUND PRESSURES AND TIRE PRESSURES FOR OPERATION ON INSTALLED ClosureTurf® COMPONENTS | | | | |
|---|---|---|---|---|
| **Component** | **Allowable Equipment** | **Allowable Ground Pressure (PSI)** | **Allowable Tire Pressure (PSI)** | **Remarks** |
| LLDPE (All Locations) | Light Rubber tired ATV's, flat-track skid steer | < 6 psi | NA | No sharp turns or sudden stops. Maintain slower speeds. |
| Turf only (slopes exceeding 15%) | No equipment | - | - | - |
| Turf only (slopes flatter than 15%) | Light Rubber tired ATV's, flat-track skid steer or padded tracked equipment (continuous flat surface) | < 6 psi | < 30 psi | No sharp turns or sudden stops. Maintain slower speeds. |
| Turf with min. sand infill requirement (1/2") (post construction) (slopes flatter than 15%) | Light Rubber tired ATV's, rubber tired tractors, skid steer | <15 psi | 30 to 60 psi based on slope angle, up to 80 psi based on subgrade and Eng. of Record approval | No sharp turns or sudden stops. Maintain slower speeds. |
| Turf with min. sand infill requirement (1/2") (post construction) (slopes exceeding 15%) | Light Rubber tired ATV's or skid steer | < 6 psi | 30 to 60 psi based on slope angle, up to 80 psi based on subgrade and Eng. of Record approval | Deployment shall be horizontal to the slope and not straight up and down. In cases where equipment shall traverse the slope, they shall travel at a 45 degree angle. No sharp turns or sudden stops. Maintain slower speeds. |
| Turf with min. sand infill requirement (1/2") (post construction) (slopes flatter than 15%) | CAS AT7 sand/rock slinger (or equivalent type) | <35 psi | 30 to 60 psi, preferably on the lower side while stationary | Equipment shall be stationary and additional sand ballast (2-inch min.) shall be built up under the equipment to provide additional protection to the underlying liner. Equipment is intended to be stationary. Upon relocating equipment, it shall be moved unloaded. |

## 12.14 Engineered Turf Repair Procedure

12.14.1 All Turf repairs will be completed by using a heat bonded seam. This can be accomplished by using a hand held leister or a Varimat V2 leistering machine.

12.14.2 All seams with considerable length should use the Varimat V2 leistering machine. This gives consistent pressure (77 lbs) throughout the seam. Seam strength is a combination between weight and temperature. The temperature of the Varimat V2 leistering machine should be discussed prior to use because temperature control is a variable that can be increased/decreased depending on weather conditions.

12.14.3 A hand held leister should be used in smaller/concentrated areas. This may include areas around well heads or patches where Turf was cut.

## 12.15 Sand Ballast Infill

12.15.1 The sand layer will be a minimum ½-inch thick, but not greater than ¾-inches thick, and shall be worked into the Engineered Turf layer as in-fill between the synthetic yarn blades. The physical characteristics of the sand layer will be evaluated through visual observation (and laboratory testing if deemed necessary by the CQC Inspector) before construction and visual observation during construction. Additional testing during construction will be at the discretion of the CQC Inspector.

12.15.2 The sand may be spread using low ground pressure equipment and a pull-behind spreader bar following guidelines provided in Section 12.13. Rotary brush equipment may be used to evenly distribute the sand infill into the synthetic grass matrix. The sand spreading operation shall be done in front of deployment equipment travel to improve the bearing capacity of the cover system below. Use of rotary brush equipment shall be performed in a manner that does not result in removal of the synthetic grass blades from the underlying woven geotextile.

12.15.3 Conveyor systems and or blower equipment may be used to spread and place the sand in-fill on slopes too steep for equipment contact. These deployment systems shall not be used during wind speed conditions higher than 15 miles per hour. Dust generation may be mitigated by maintaining the sand infill at a moisture content sufficient to control dust but not impede the placement operation.

12.15.4 Contractor shall explain in detail in the pre-construction meeting the method of sand deployment to be used. The method shall be approved by the Purchaser. For slopes steeper than 3H:1V the sand infill shall be placed using long reach conveyors belts or using water or air express blower methods. The sand layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability.

12.15.5 Sand ballast infill shall completely cover the double-layer woven geotextile of the Engineered Turf component. Areas of exposed geotextile or thin layering of sand ballast unsatisfactory to the requirements of Section 12.4, Table 3, shall receive additional sand ballast. If the cause of poor sand ballast placement and resulting geotextile exposure is wrinkles in the underlying structure geomembrane, the Engineered Turf component shall be pulled back from the geomembrane component, the geomembrane wrinkle removed and the geomembrane shall repaired per the requirements in these specifications. The Engineered Turf shall be re-deployed and ballasted with sand infill satisfactory to the requirements of this section and Section

12.4, Table 3.

12.15.6 The CQC Inspector shall verify that a minimum thickness of ½ inch of sand is placed on the Turf. Frequency will be 20 measurements per acre of final cover installed.

12.15.7 The Contractor shall provide to the Purchaser the grain size distribution, from the source of the sand infill/ballast, for every 250 cy of material or more frequent if requested by the purchaser.

## 12.16 ArmorFill™ Application

12.16.1 ArmorFill™ is a proprietary polymer-based product developed by Watershed Geosynthetics specifically to bind the ASTM-C33 sand infill component of the ClosureTurf® system for long-term performance applications.

12.16.2 Application of ArmorFill™ will be performed by an installer certified by Watershed Geosynthetics.

12.16.3 To obtain the proper ratio, mix ArmorFill™ at a rate of 6 parts water to 1 part ArmorFill™ by volume (Section 12.4, Table 4).

12.16.4 Apply ArmorFill™ under dry weather conditions and when precipitation is not expected for at least 24 hours after installation.

12.16.5 Apply ArmorFill™ on a previously installed ClosureTurf® system that is free of leaves and other material that may inhibit the penetration of the ArmorFill™ into the sand component.

12.16.6 Apply ArmorFill™ only after approval of the finished ClosureTurf® product installation.

12.16.7 Mix in a hydraulic conveyance system such as a hydro seeding device that contains a mechanical agitator/auger type mixer that is sized appropriately for the project. (Example: Finn T-Series Hydro Seeder or equivalent).

12.16.8 Place water into tank before mixing ArmorFill™ .

12.16.9 Fully agitate the ArmorFill™ throughout the application process.

12.16.10 ArmorFill™ application equipment will have a 2-inch diameter hose with a spray adjustment nozzle and cut off function in the nozzle head.

12.16.11 Reduce the number of equipment set-ups required and take care with the application hose so as previously applied ArmorFill™ is not displaced by dragging.

12.16.12 Spray product evenly.

12.16.13 Apply ArmorFill™ at a rate of approximately 2,600 gallons of the mix per acre.

12.16.14 All waste products will be disposed of in accordance with site regulations and as approved by Purchaser.

12.16.15 Do not apply ArmorFill™ in inclement weather or in freezing temperatures. Inclement weather shall mean the existence of rain or lightening, or abnormal climatic conditions (whether they be those of hail, snow, cold, high wind, extreme high temperature or the like or any combination thereof) by virtue of which it is either not reasonable or not safe for employees exposed to continue working.

12.16.16 Avoid unnecessary foot traffic on the applied product for 24 hours.

12.16.17 No vehicle traffic is allowed on the applied product for 7 calendar days.

## 12.17 HydroBinder™ Infill Installation

12.17.1 Installation of the HydroBinder™ infill for the engineered turf shall be performed by a licensed installer.

12.17.2 The HydroBinder™ infill layer shall be have a minimum thickness of ¾ inch, but not greater than 1 inch, in dry thickness. The desired thickness will be achieved prior to the hydration process. At grade breaks and drainage benches, the thickness of the HydroBinder™ shall be increased as specified on the drawings or as directed by Purchaser's Representative.

12.17.3 Weep holes may be required at downchutes and other locations for draining the internal drainage layer through the engineered turf. Remove the HydroBinder™ in the areas of the weep holes prior to hydration or block the weep hole locations prior to infilling. Blocks may consist of pipe, dowels, etc. If weep holes are required, weep hole diameters shall be 1 inch and be installed along the toe of the slope at intervals designated by the Purchaser. In addition, drainage relief may be required in perimeter ditch locations utilizing drainage windows. At specified intervals and locations, the engineered turf will be shingled in the direction of flow with a small section of the HydroBinder™ removed therefore draining the internal drainage layer through the engineered turf. The Purchaser and/or Purchaser's Representative will provide weep hole and drainage window locations and details based on the manufacturer's recommendations.

12.17.4 The HydroBinder™ infill shall be installed into the engineered turf while it is in a dry state. The engineered turf shall be dry. If the engineered turf is wet from rain or dew, the installer shall wait until it is dry. The installer may attempt to speed up the drying process by using a blower. In addition, the infill shall not be installed in inclement, wet or rainy weather, or the threat of inclement weather. Also, the infill shall not be installed in freezing temperatures. If HydroBinder™ is exposed to construction traffic or inclement weather within 48 hours, those areas shall be inspected by Contractor's QC and Purchaser, and if evaluated to be damaged shall be replaced.

12.17.5 The infill shall be worked into the engineered turf layer between the synthetic yarn blades so that the tuffs are in an upright position. The physical characteristics of the infill layer will be evaluated through visual observation before construction and visual observation during construction. Additional testing during construction will be at the discretion of the CQC Inspector.

12.17.6 The hydration process must occur the day of the infill placement.

12.17.7 Personnel access on the engineered turf shall be prohibited for 48 hours following the hydration of the HydroBinder™.

12.17.8 The infill shall be thoroughly hydrated; however, care must be taken to avoid displacement of the non-hydrated infill. The Installer shall not overhydrate the infill so that water begins to run-off and cause erosion of the cement infill. The objective is to soak the area to start the hydration process but not to inundate with water beyond saturation.

12.17.9 Once hydration is completed as described, backfill and compaction of the anchor trenches should take place.

12.17.10 The HydroBinder™ infill may be spread using low ground pressure equipment and a pull-behind spreader bar. Rotary brush equipment may be used to evenly distribute the infill into the synthetic grass matrix. The infill spreading operation shall be done in front of deployment equipment travel to improve the bearing capacity of the cover system below. Use of rotary brush equipment shall be performed in a manner that does not result in removal of the synthetic grass blades from the underlying woven

geotextile. In addition, hand spreading and rakes maybe be used to spread the infill material. If rakes are used, only plastic rakes or flexible, pronged metal rakes shall be allowed.

12.17.11 Conveyor systems and or blower equipment may be used to spread and place the infill on slopes too steep for equipment contact. These deployment systems shall not be used during wind speed conditions higher than 15 miles per hour. Dust generation may be mitigated by maintaining the infill at a moisture content sufficient to control dust but not impede the placement operation.

12.17.12 Contractor shall explain in detail in the pre-construction meeting the method of infill deployment to be used. The method shall be approved by the Purchaser. For slopes steeper than 3H:1V the infill shall be placed using long reach conveyors belts or using water or air express blower methods. The infill layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability.

12.17.13 HydroBinder™ infill shall completely cover the double-layer woven geotextile of the engineered turf component. Areas of exposed geotextile or thin layering of infill unsatisfactory to the requirements of this Section shall receive additional infill. If the cause of poor infill placement and resulting geotextile exposure is wrinkles in the underlying structure geomembrane, the engineered turf component shall be pulled back from the geomembrane component, the geomembrane wrinkle removed and the geomembrane repaired per the requirements of Section 12.10. The Engineered Turf shall be re-deployed and ballasted with infill satisfactory to the requirements of this Section and Section 12.4, Table 5.

12.17.14 For areas with exposed geotextile due to wrinkles and isolated small voids, a UV resistant coating shall be applied to the exposed area and additional infill material shall be applied immediately to the coating and hydrated. The UV coating product shall be manufactured by Quikrete (product #8640), Sakrete product (#60205006), or approved equivalent.

12.17.15 The QC Inspector shall verify that a minimum thickness of ¾ inch of infill (dry) is placed on the synthetic turf. Frequency shall be 1 test per 100 linear feet of ditch and 20 measurements per acre of final cover installed. Thickness measurements shall be taken using a caliper or equivalent device. CQC shall also inspect to confirm full hydration by excavating with a small tool into the infill.

12.17.16 The Contractor shall provide to the Purchaser the manufacturers certifications for the HydroBinder™ infill properties listed in Section 12.4, Table 5. One certification of compressive strength is required per batch of material.

## 12.18 HydroBinder™ Repair Procedures

12.18.1 Areas where the HydroBinder™ has cracked, crushed, or has voids shall be repaired according to the manufacturers specifications.

12.18.2 Affected areas shall be cleaned by removing the loose infill. Confirm that the Engineering Turf and underlying components are not damaged. If damage is observed, repair procedures for the specific component shall be followed as per Sections 12.10 and/or 12.17. The owner shall be notified of any damage prior to repair.

12.18.3 Cracks in the HydroBinder™ shall be sealed by applying concrete crack sealants such as Quikrete product #8640, Sakrete Product #60205006, or an approved equivalent.

12.18.4 For areas of concern that are larger than cracks, new HydroBinder™ infill shall be applied to the affected area. The infill material shall be applied dry to a minimum thickness of ¾ inch, or thicker for grade breaks, drainage benches, and traffic ways, and shall match the thickness of the intact HydroBinder™. Installation of the infill shall follow guidelines set forth in Section 12.17.

12.18.5 The area shall be raked or broomed to pull the engineered turf fibers up through the dry infill mix without causing damage to the existing geomembrane and Turf components, following guidelines in Section 12.17.10.

12.18.6 The CQC inspector shall keep daily documentation of all repairs. This documentation shall identify all repairs, areas, size, location, and procedures and include before and after photographs.

## 12.19 Anchor Trench

12.19.1 Avoid backfilling the anchor trenches until the synthetic grass and sand infill placement of the ClosureTurf® component has been completed. This will allow corrections in the field during the deployment of both the geomembrane and the synthetic grass component. Note that wrinkles will travel down the slopes and cannot be redistributed up slopes, so is important that both top and bottom anchor trenches remain open so that pulling adjustments can be made.

12.19.2 The geomembrane anchor trench shall be left open until seaming is completed.

12.19.3 Expansion and contraction of the geomembrane should be accounted for in the geomembrane placement. Prior to backfilling, the depth of penetration of the geomembrane into the anchor trench will be verified by the CQC Inspector at a minimum of 100 foot spacing along the anchor trench. The anchor trench should be filled in the morning when temperatures are coolest to reduce bridging of the geomembrane.

12.19.4 General fill material placed in anchor trenches will be placed in uniform lifts, which do not exceed 12 inches in loose thickness and are compacted. In-place moisture/density tests may be taken at the discretion of the CQC Inspector to evaluate the quality of the backfill. The test results will not be required as part of the final documentation. Slightly rounded corners will be provided in anchor trenches where the geomembrane enters the trench so as to avoid sharp bends in the geomembrane. No loose soil (e.g., excessive water content) will be allowed to underlie the anchored components of ClosureTurf® Final Cover System.

12.19.5 The geomembrane and the Engineered Turf should cover the entire trench floor.

12.19.6 The anchor trench shall be backfilled with soil meeting the requirements of Structural fill as described in Section 10.0 with the exception that the maximum particle size shall be limited to ½-inch in the largest dimension.

12.19.7 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane or Engineered Turf. If damage occurs, it shall be repaired prior to backfilling and at the Contractor's expense.

12.19.8 The geomembrane shall be in intimate contact with the anchor trench inside wall and bottom as per the details. Intimate contact shall be maintained during backfilling operations. Unacceptable wrinkles, ripples, fish mouths, and/or bunching shall be removed and patched.

12.19.9 The Engineered Turf component shall be in intimate contact with the structured

geomembrane. Intimate contact shall be maintained during backfilling operations. Unacceptable wrinkles, ripples, and/or bunching shall be removed and patched.

12.20 **Acceptance of ClosureTurf® Cover System**

The Installer shall retain all ownership and responsibility for the Closure Turf® cover system until accepted by the Purchaser. Final acceptance is when all of the following conditions are met:

a) Installation is finished;
b) All submittals completed;
c) Verification of the adequacy of all field seams and repairs, including associated testing, is complete;
d) Receipt of approved, final panel layout drawing (as-builts);
e) Construction area cleaned;
f) Final field inspection completed (all punch list items from previous inspections shall be complete);
g) Sign-off of acceptance of the Closure Turf® system has been made by the Purchaser;
h) Warranty signed over to Purchaser.

## 13.0 SEDIMENT AND EROSION CONTROL

13.1 Minimum sediment and erosion control measures are shown on the Drawings and in the CBMPP for the Plant Gadsden Ash Pond Closure. Additional measures shall be taken as required or as directed by the Purchaser to minimize erosion of soil.

13.2 During the course of this project, the Contractor shall plan and coordinate his work to minimize the amount of suspended soil particles entering rivers and streams or leaving the general work area and being deposited in undesirable places. Any property damage or fines resulting from the Contractor's negligence shall be borne by the Contractor.

13.3 The Contractor shall not excavate, uncover or denude areas of work until adequate erosion and sediment control measures are installed. The Contractor's earthmoving operations shall at all times be in full compliance with the requirements of the Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas.

13.4 The Purchaser will inspect the sediment and erosion control practices (e.g. "BMPs") employed to evaluate their effectiveness. Any deficiencies shall be immediately corrected by the Contractor at no cost to the Purchaser.

13.5 Erosion and sediment control measures shall be utilized and maintained as indicated in the Plans.

## 14.0 VEGETATION

14.1 A minimum 6-inch layer of topsoil shall be placed on all areas to be grassed.

14.2 Earth fill areas and other disturbed areas shall be grassed. Hydroseeding methods may be used.

14.3 The Contractor shall produce a satisfactory stand of perennial grass in accordance with the Vegetation Schedule as 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.

14.4 A satisfactory stand of grass is defined as 100% of soil surface being uniformly covered in permanent vegetation with a density of 70% or greater, or landscaped according to the Plan (uniformly covered with landscaping materials in planned landscaped areas), or equivalent permanent stabilization measures as defined in the Handbook (excluding a crop of annual vegetation and a seeding of target crop perennials appropriate for the region).

14.5 Measures shall be taken to prevent erosion of the topsoil layer and vegetation until a full vegetative growth has been obtained. After seeding, an erosion control biodegradable straw blanket shall be installed on any slopes equal to or steeper than 3H:1V. This material shall be as indicated on the Drawings. 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 affected area be re-grassed.

14.6 Water required to promote a satisfactory growth shall be furnished and applied by the Contractor as often as necessary to achieve the results outlined above.

14.7 The Contractor shall make daily inspections of the seeded areas and repair all eroded areas to the satisfaction of the Purchaser.

## 15.0 RECORDS

### 15.1 Quality Control Records

15.1.1 The quality control records of inspection and field quality control records shall be compiled by the Contractor's CQC Inspector and provided to the Purchaser on an on-going basis or as directed. The final records will provide the background data necessary for the certification of the final cover construction. All records shall be forwarded to the Plant's permanent file to be retained as a permanent record of the project.

15.1.2 At the completion of the construction of the final cover for the ash pond, a Construction Quality Assurance Report (Construction Certification), prepared by the Purchaser, will be submitted along with a registered engineer's certification that the final cover was constructed in accordance with the approved Closure/Post Closure drawings and the Alabama Rules for Solid Waste Management. The Contractor shall provide, at a minimum, the following information for preparation of the Certification Report:

a) Elevation Contour Drawings of the subgrade on a maximum 100ft. by 100ft. grid. Drawings to be signed and sealed by a land surveyor registered to practice in the state of Alabama.

b) For the ClosureTurf® cover system:

1. As-built drawings indicating panel locations, panel identification numbers, geomembrane roll numbers for each panel, seam caps, destructive sample locations, and repair locations.
2. Finished Grade - elevation contour drawings on the same maximum 100 ft. x 100 ft. grid as the Subgrade Elevation Contour Drawing. Drawings to be signed and sealed by a land surveyor registered to practice in the state of Alabama.

c) All survey shots shall be "stacked" in order to properly verify the given layer's thickness. The use of interpolation or other computer generated methods to achieve point stacking are not acceptable.

d) Thickness determinations obtained at grid points on slopes shall be made normal to the slopes.

e) All survey and topographic information shall be submitted in both "pdf" and "dwg" file formats which are compatible with AutoCAD 2010.

f) A summary of major construction activities which shall include a description of the activity and schedule dates. This summary shall be based on daily logs provided by the on-site inspector. This shall also serve to document the presence of a qualified member of the inspection team during any construction activity involving structural fill or any component of the liner.

g) Project CQC summary reports including all field testing and inspection results. This summary shall be inclusive of all passing tests as well as failing tests and retests. This shall include at a minimum, all field moisture content and density tests, Proctor curves, Atterberg limits, particle size distribution, CQC resumes, CQC welding rod certificates, subgrade acceptance forms, LLDPE panel deployment logs, fusion and extrusion trial seam logs, fusion and extrusion seam logs, LLDPE repair logs, pressure, vacuum and spark test logs, fusion and extrusion destructive test logs, concrete cylinder break reports, concrete pour cards, concrete tickets, rebar mill certification reports, and all daily field reports.

h) Copies of all field CQC reports for structural fill, ash fill, and geosynthetic installation.

## 15.2 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. Drawings to be signed and sealed by a land surveyor registered to practice in the state of Alabama.

# APPENDIX 7

# OPERATION PLAN

**OPERATION PLAN**
**PLANT GADSDEN ASH POND**
**ALABAMA POWER COMPANY**
**GADSDEN, ALABAMA**

This document serves as an operation plan for the closed Plant Gadsden Ash Pond. The Ash Pond, located in Gadsden, Alabama, is owned and operated by Alabama Power Company. This Operation Plan includes a discussion of Recordkeeping and Notification Compliance Procedures, a discussion of the procedures for updating the plans and assessments required by the Alabama Department of Environmental Management (Department) regulations and a description of the Groundwater Monitoring and Analysis program. As stated in the application narrative, the Gadsden Ash Pond has now been closed, and the requirements for a fugitive dust control plan and an inflow design flood control system are no longer applicable.

## Recordkeeping and Notification Compliance Procedures

As outlined in 335-13-15.08, each Owner or Operator of a CCR unit subject to the Department regulations must maintain files of certain information in an operating record at the facility. Each file is to be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record or study. Electronic storage of the records is acceptable. These records are to be made available to the Department upon request.

Certain notifications are to be made in accordance with the requirements of 335-13-15.08. In many instances, such notifications are to be placed in the facility's Operating Record. In certain instances, further notifications are to be made to the Department Directory within 30 days of placement of a notification into the Operating Records. Furthermore, a publicly accessible internet site must be established for posting of certain notifications and compliance information within 30 days of it being placed in the Operating Record.

Alabama Power and Plant Gadsden maintain an electronic Operating Record for the facility. In addition, a publicly accessible internet site has already been established for compliance with EPA's CCR Rule. Required notifications and compliance data, as outlined in 335-13-15-.08 and as applicable to the Plant Gadsden Ash Pond, will be maintained in the electronic Operating Record, and as required, made available on the publicly accessible internet site within 30 days of placement in the Operating Record. Furthermore, required notifications will be made to the Department Director within 30 days of placement in the Operating Record.

## Procedures for Updating Plans and Assessments

Certain plans and assessments are required to be updated at specified intervals and/or upon modification of certain components of the facility. If and when applicable, updates will be made to the

respective plans and assessments, and notifications placed in the Operating Record, posted to the publicly accessible internet site, and communicated in writing to the Department Director in accordance with the Department rules.

**Groundwater Monitoring Plan**

The groundwater monitoring plan can be found in the following pages.

Alabama Power

**Dustin G. Brooks**
**Environmental Affairs Supervisor**
**Environmental Compliance**

600 North 18th Street
Post Office Box 2641
12N-0830
Birmingham, Alabama 35291

Tel 205.257.4194
Fax 205.257.4349
dgbrooks@southernco.com

August 24, 2020

Via email to sss@adem.alabama.gov

Received: 8/24/20

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

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. It 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.*

**<u>Individual CCR Unit Comments</u>**

**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 30$^{th}$, 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 G. Brooks
Environmental Affairs Supervisor

cc: Eric Wallis – Southern Company Services

# PLANT GADSDEN ASH POND GROUNDWATER MONITORING PLAN

**Revised August 21, 2020**

**PREPARED FOR:**

Alabama Power

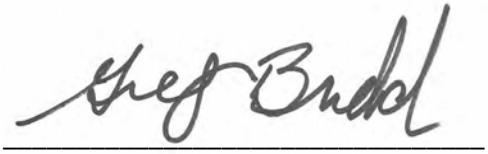
Southern Company Services
Earth Sciences and Environmental Engineering

# REVISED GROUNDWATER MONITORING PLAN

## ALABAMA POWER COMPANY - PLANT GADSDEN

This *Revised Groundwater Monitoring Plan, Alabama Power Company - Plant Gadsden Ash Pond*, 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:**



_____ _____8/21/2020_____

Gregory F. Budd, P.G. Date

Alabama Professional Geologist No. 1455

# TABLE OF CONTENTS

1. INTRODUCTION ..... 1
2. SITE LOCATION AND DESCRIPTION ..... 2
3. GEOLOGIC AND HYDROGEOLOGIC CONDITIONS ..... 3
4. SELECTION OF WELL LOCATIONS ..... 5
4.1 COMPLIANCE MONITORING NETWORK ..... 5
4.2 BACKGROUND MONITORING WELLS ..... 6
4.2.1 Groundwater Elevations and Flow ..... 6
4.2.2 Groundwater Geochemistry ..... 7
4.2.3 Statistical Screening ..... 8
4.3 DOWNGRADIENT COMPLIANCE WELLS ..... 8
4.4 DELINEATION WELL NETWORK ..... 10
4.5 UPDATING THE BACKGROUND WELL NETWORK ..... 10
5. MONITORING WELL DRILLING, CONSTRUCTION, ABANDONMENT & REPORTING ..... 12
5.1 DRILLING ..... 12
5.2 DESIGN AND CONSTRUCTION ..... 12
5.3 WELLS WITH INCONSISTENT WATER LEVELS ..... 14
5.4 WELL DEVELOPMENT ..... 14
5.5 ABANDONMENT ..... 15
5.6 DOCUMENTATION ..... 15
6. GROUNDWATER SAMPLING AND ANALYSIS PLAN ..... 16
6.1 SAMPLE COLLECTION ..... 16
6.2 SAMPLE PRESERVATION AND SHIPMENT ..... 17
6.3 ANALYTICAL METHODS ..... 18
6.4 CHAIN OF CUSTODY CONTROL ..... 18
6.5 SAMPLING PARAMETERS AND FREQUENCY ..... 19
6.6 QUALITY ASSURANCE AND QUALITY CONTROL ..... 19
7. REPORTING RESULTS ..... 21
7.1 14-DAY NOTIFICATION ..... 21
7.2 SEMI-ANNUAL GROUNDWATER MONITORING REPORTS ..... 21
8. STATISTICAL ANALYSIS ..... 23
8.1 DETECTION MONITORING ..... 23
8.2 ASSESSMENT MONITORING ..... 24
8.2.1 Delineation Wells ..... 24
9. REFERENCES ..... 26

## List of Tables

Table 1 Groundwater Monitoring Well Network Details
Table 2 Upgradient Comparisons – Key Indicator Parameters
Table 3 Monitoring Parameters and Project Reporting Limits
Table 4 Groundwater Monitoring Parameters and Frequency

## List of Figures

Figure 1 Site Location Map
Figure 2 Site Plan Map
Figure 3 Site Topographic Map
Figure 4 Site Geologic Map
Figure 5A Geologic Cross-Section A-A'
Figure 5B Geologic Cross-Section B-B'
Figure 6 Potentiometric Surface Map (August 19, 2019)
Figure 7 Monitoring Well Location Map

## List of Appendices

Appendix A Well Installation and Field Logs
Appendix B Statistical Analysis Plan
Appendix C APC Low Flow Groundwater Sampling Technical Standard Operating Procedures

# 1. INTRODUCTION

The Plant Gadsden Ash Pond 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 Gadsden Ash Pond 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). This Groundwater Monitoring Plan (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.

The Ash Pond is currently performing assessment monitoring. Groundwater monitoring has occurred since 2017 and results reported to ADEM. Background sampling was performed over the period of December 2017 to February 2019. Groundwater sampling for the first detection monitoring event after the background period was performed in February 2019. In July 2019 statistically significant increases (SSIs) of monitored constituents were detected above background levels. Pursuant to State and Federal regulations assessment monitoring was implemented. Assessment monitoring activities were conducted within 90 days of initiating and took place between August 19$^{th}$ and August 22$^{nd}$. During assessment monitoring, Appendix IV constituents were detected at statistically significant levels (SSLs) above groundwater protection standards (GWPS) and documented on January 12, 2020 and included in the second semi-annual groundwater monitoring and corrective report of 2019 submitted to the Department on January 31, 2020. Consequently, an Assessment of Corrective Measures was initiated on April 11, 2020. The Site performs semi-annual assessment monitoring as additional site investigation work continues and a final remedy is developed.

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 Gadsden is located in the northeastern area of the city of Gadsden, in central Etowah County, Alabama. The physical address of the plant is 1000 Goodyear Avenue, Gadsden, AL 35903. Based on a visual inspection of U.S. Geological Survey (USGS) topographic maps and plant boundary files, the plant occupies Sections 2, 3, and 11, Township 12 South, Range 6 East (USGS, 1986). The Ash Pond is located northeast of the plant and separated from the main plant by the Coosa River. **Figure 1**, **Site Location Map**, depicts the location of the Plant and Ash Pond with respect to the surrounding area.

Plant Gadsden's Ash Pond went into service in 1948 and was expanded in 1976, 1979, and 1983. The Ash Pond covers an area of approximately 68 acres. Physical closure of the Ash Pond was initiated in 2016 and completed in 2018. **Figure 2, Site Plan Map**, depicts the general configuration of the coal combustion residual (CCR) unit and the Site monitoring well network. **Figure 3, Site Topographic Map**, provides the topography of the Site.

# 3. GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Plant Gadsden is located in the Appalachian thrust belt. The Appalachian thrust belt consists of a series of northeast trending thrust sheets and folds of Cambrian to Pennsylvanian age strata. In general, the valleys represent eroded or breached anticlines underlain by Cambrian and Ordovician age carbonates. The ridge crests are typically composed of relatively resistant sandstone and chert units and represent erosional remnants (Mann and Baker, 1995).

The Appalachian thrust belt is bordered to the west by the Black Warrior basin, to the northwest by the East Warrior Platform, and to the north-northwest by the Nashville dome. It is bordered to the southeast by the Appalachian Piedmont (Osborne and Raymond, 1992).

A thrust fault lies in the vicinity of Plant Gadsden. The exact geometry and configuration of the fault is unknown as the fault is concealed under alluvium. Various authors describe it as one continuous thrust fault; the Gadsden Fault (Bossong, 1989), or as two separate faults; the Gadsden Fault to the northwest of the plant, and the Rome Fault to the northeast of the plant (Mann and Baker, 1995).

In either case, this thrust fault forms a boundary between two sub-areas. To the north of the fault, folds and faults have a more moderate expression and generally trend to the northeast. To the south of the thrust fault, geologic structures become more complex, folding is more intense, and the structures trend in a more easterly orientation (Bossong, 1989). In general, faults in this region (including the Gadsden Fault) were active during the late Paleozoic Alleghanian orogeny but are not considered to be presently active. **Figure 4**, **Site Geologic Map**, illustrates the surface geology at the site and neighboring areas.

Near the site, the geology consists of Quaternary-age alluvial low terrace deposits and high terrace deposits consisting of varying amounts of sand, silt, clay, and gravel associated with river deposition (Raymond et al., 1988). The alluvial deposits overlay the Conasauga Formation (Middle and Upper Cambrian) which consists of varying amounts of limestone, dolomite, and shale. Chert and siltstone horizons are present locally. The Conasauga Formation can be characterized as a shoaling-upward succession in which deep water shale grades vertically into a diverse assemblage of carbonate ramp facies. In Etowah County, the Conasauga Formation has been targeted as a potential source for shale gas and is preserved within the Gadsden antiform (Pashin, 2008). **Figure 5A, Geologic Cross-Section A-A' and Figure 5B, Geologic Cross-Section B-B',** illustrates the geologic layering beneath the site.

There are three primary aquifer systems in the plant vicinity: the Pottsville aquifer system, the Tuscumbia-Fort Payne aquifer system, and the Knox-Shady aquifer system (Bossong, 1989). Groundwater also occurs in the Quaternary alluvial deposits in usable quantities. The uppermost aquifer beneath the site corresponds to coarse and more permeable fraction of alluvial overburden soils and weathered/fractured rock near the soil-rock interface. The uppermost aquifer is typically located at depths between 15 and 50 feet below ground surface (BGS). Soils are generally poorly graded sands with layers of clay and well-

graded gravels that overlay a mudstone or shale bedrock. The potentiometric surface presented in **Figure 6, Potentiometric Surface Map (August 19, 2019)**, represents groundwater flow at the site.

Groundwater flow is accomplished via porous (Darcy) flow mechanics with potential for preferential movement along more conductive sand and gravel lenses. Groundwater flow at the site is a subdued replica of the natural topography where gravity is the dominant force driving flow. Groundwater flows from higher topographic elevations near the northernmost edge of the Ash Pond to the north, south, east, and west.

# 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. Boring logs and well construction data for each compliance and delineation well are presented in **Appendix A, Well Installation and Field Logs.**

## 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 groundwater monitoring network at Plant Gadsden Ash Pond is subdivided into background and compliance locations as based upon potentiometric contours and interpretations by a qualified groundwater scientist. Delineation wells are augmented to the Site groundwater monitoring network if assessment monitoring results indicate further investigation is necessary to assess the impact to groundwater near the downgradient compliance wells.

Background wells represent the quality of background water that has not been or would not be affected by leakage from a unit. Compliance wells are screened within the uppermost aquifer (installed within higher-permeability zones near the base of the alluvial deposits and near the interface with underlying rock ) 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.

Monitoring wells target the uppermost aquifer with wells screened in coarse fractions of the alluvial materials or more weathered, fractured upper bedrock beneath the Site. Due to historic radial components of groundwater flow near the Ash Pond, upgradient wells were located on the opposite side of the Coosa River (south or Plant Proper side). The geologic layering on both sides of the river is similar as shown on **Figure 4** and therefore, should provide representative water quality. The Coosa River provides a groundwater divide for the uppermost aquifer system preserving plant side locations as upgradient or unimpacted from flow from the pond side.

Four piezometers have been utilized historically for purposes of better defining groundwater flow direction at the Site (GSD-AP-PZ-1, GSD-AP-PZ-2, GSD-AP-PZ-5, and GSD-AP-PZ-6). Piezometers GSD-AP-PZ-1, GSD-AP-PZ-5, and GSD-AP-PZ-6 were converted to downgradient monitoring wells during the background monitoring period and will remain downgradient compliance wells.

## 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**, 3 monitoring wells (GSD-AP-MW-14, GSD-AP-MW-16 and GSD-AP-MW-17) located upgradient of the Ash Pond serve as background monitoring wells.

### 4.2.1 Groundwater Elevations and Flow

Historically, radial flow has been observed at the Ash Pond and identifying a truly upgradient location in the vicinity was infeasible. To meet the requirements of the rules for siting background wells and establish background groundwater quality not affected by a release from the unit, on-site groundwater monitoring wells were installed within the same geologic formation as site monitoring wells and across the river from

the Ash Pond. Monitoring well locations GSD-AP-MW-14, GSD-AP-MW-16, and GSD-AP-MW-17 serve as upgradient locations for the Ash Pond. These well locations are located on the opposite side of the Coosa river and are hydraulically disconnected from downgradient flow away from the Gadsden Ash Pond.

Groundwater flow direction as determined from Site potentiometric surface contour maps demonstrate that groundwater flow on both sides of the river (Plant and Ash Pond) are generally towards the Coosa River. The Coosa River separates the groundwater flow systems on either side and forms a known head boundary between the Ash Pond and the Plant Proper. This groundwater divide or boundary preserves the plant side locations as upgradient or unimpacted from the ash pond side groundwater flow system.

**Figure 6, Potentiometric Surface Contour Map (August 19, 2019)** depicts groundwater elevations and inferred groundwater flow direction. On the Ash Pond side (north), groundwater flow direction in the immediate vicinity of the Ash Pond is to the south and towards the Coosa River. To the north of the Ash Pond, potentiometric surface contours appear to form a localized groundwater divide where groundwater flows to the north (north of the divide) or to the south (south of the divide). The groundwater divide appears to be centered approximately 120 feet north of the Ash Pond and therefore, indicates north to south flow across the Ash Pond. Groundwater flow in the area of upgradient locations is from south to north. The recent potentiometric surface contour map conveying these groundwater flow elements provide sufficient information to justify wells GSD-AP-MW-14, GSD-AP-MW-16 and GSD-AP-MW-17 as upgradient of the Ash Pond.

### 4.2.2 Groundwater Geochemistry

A comparison of the concentrations of key EPA Appendix III and Appendix IV indicator parameters can be particularly useful in determining if a well is impacted by the CCR unit. For this discussion, average concentrations of key indicator parameters from upgradient well locations were compared to downgradient wells suspected of being impacted by the CCR Unit, and groundwater protection standards (GWPS). Concentrations of key CCR indicator parameters such as boron, arsenic, and lithium are below laboratory detection in upgradient wells. The results from these comparisons demonstrate that locations GSD-AP-MW-14, GSD-AP-MW-16 and GSD-AP-MW-17 are not impacted by the CCR unit.

Concentrations of key CCR indicator parameters such as boron, arsenic, and lithium are below laboratory detection in these locations. Other potential indicator parameters such as chloride and sulfate are significantly lower in these well locations than observed in downgradient wells suspected of being impacted by the CCR Unit. The results from these comparisons demonstrate that locations GSD-AP-MW-14, GSD-AP-MW-16 and GSD-AP-MW-17 are not impacted by the CCR unit. Additionally, except for cobalt, concentrations of key indicator parameters are lower than federally derived GWPS. Cobalt concentrations in upgradient wells GSD-AP-MW-14 and GSD-AP-MW-16 display natural variability and range from 0.0114 to 0.0538 mg/L with average concentration of 0.03 and 0.025 mg/L, respectively. 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 is 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-soil/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), pH values closer to those of the Ash Pond, and higher conductivity (indicates higher total dissolved solids).

As presented in **Table 2,** well locations GSD-AP-MW-14 and GSD-AP-MW-16 generally do show lower pH, significantly higher DO, much more positive ORP, and lower conductivity when compared to downgradient wells suspected of being impacted by the CCR Unit. Upgradient well GSD-AP-MW-17 is installed slightly deeper in rock and therefore, reflects slightly different geochemical conditions associated with the deeper subsurface beneath the Site. This location and screened interval of this well is useful for comparing against vertical delineation wells in rock as well as provides upgradient water quality in the Conasauga Formation as several downgradient wells are screened near and across the soil – Conasauga Formation interface.

This comparison of field data supports an upgradient/background designation as field parameters are consistent with recharging meteoric water rather than reducing and high-conductivity waters associated with pond water and impacted downgradient wells.

#### 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 Unit. A thorough review of previously conducted field investigations was conducted to ensure that wells were located properly and screened across the appropriate intervals to identify impacts to groundwater. In 2013, Southern Company Services' Earth Science and Environmental Engineering conducted preliminary geologic and hydrogeologic investigations at the facility to establish a baseline knowledge of the Site. The purpose of the report was to summarize

results of investigations performed in preparation of potential future requirements for groundwater monitoring activities at Plant Gadsden.

The primary objectives of the investigation were to (1) define site geology and (2) characterize site specific hydrogeology. Six borings were drilled near the Ash Pond at Plant Gadsden for this investigation. The unconsolidated shallow, subsurface strata in the borings were logged and rock coring was conducted as needed. Piezometers were installed in each boring for the purpose of water level monitoring. Water level readings measured at the time of piezometer installation (August 2013) and from the months of January and February 2014 were gathered to explore temporal trends in groundwater elevation at the site. Based on literature reviews, borehole logging, and water level measurements, a preliminary characterization of site geology and hydrogeology was performed.

Monitoring well locations GSD-AP-MW-1 through GSD-AP-MW-17, and piezometer locations GSA-AP-PZ-1, GSD-AP-PZ-5, and GSD-AP-PS-6 were designated as downgradient locations for the Ash Pond. Downgradient locations are located north, south, east, and west of the Ash Pond as determined by water level monitoring and potentiometric surface maps constructed for the Site.

Downgradient wells to the north of the Ash Pond were generally installed at the base of coarse fluvial gravels or in sediments just above the top of rock interface and lateral to or just below the base of the Ash Pond to intercept preferential flow. Downgradient wells to the south of the Ash Pond were generally installed across the soil – Conasauga (rock) interface as coarse fluvial sediments are absent to the south of the Ash Pond and instead lower permeability clays are encountered. These wells are screened to intercept preferential flow/seepage along the top of rock interface and beneath or lateral to the base of the Ash Pond. Cross-sections presented in Figure 5A and 5B illustrate these changes in lithologic layering beneath the Site.

Groundwater level monitoring was initiated with background sampling in December of 2017 before Ash Pond closure and dewatering was complete. Groundwater elevation contours between December 2017 and December 2018 displayed a radial pattern of groundwater flow away from the Site. Groundwater flow was interpreted to flow to the north, south, east, and west from this mound. Therefore, wells and piezometers around the periphery of the pond are all classified as downgradient. Between December 2018 and February 2019 (5-7 months after physical closure) the radial groundwater flow pattern appeared to diminish and became a north to south groundwater flow pattern. We believe this is likely the result of groundwater flow restoring to pre-pond conditions as the hydraulic influence of the pond was eliminated by closure and dewatering activities. Data from subsequent monitoring events will be used to further evaluate potential restoration of groundwater flow pattern related to pond closure activities.

The groundwater monitoring network at the Ash Pond has identified statistical exceedances of monitored parameters above background levels and GWPS. This is compelling evidence that the network is effective and functioning as intended.

## 4.4 DELINEATION WELL NETWORK

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 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.

Delineation wells, when installed, will be sampled along with the compliance groundwater monitoring events during semi-annual compliance sampling events. Occasionally, due to the remote nature or location along surface water bodies, delineation wells may not be accessible due to unavoidable circumstances (flooding, impassable access, etc). In this event, delineation wells will be sampled at a later date or during the next scheduled semi-annual sampling event. Existing delineation well locations and details are presented on **Table 1** and **Figure 7**. **Table 1** will be updated if additional delineation wells are required.

## 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 only 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 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 may 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.

Soil borings will be advanced from the land surface to the desired depth by utilizing conventional drilling methods, such as hollow-stem augers, rotary wash, rotasonic, or direct push technology (DPT). Only potable water will be used; drilling muds and air systems will be avoided to the extent possible.

The minimum soil 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 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 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 length will not exceed 10 feet without justification as to why a longer screen is necessary (e.g. significant variation in groundwater level). 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.

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 (i.e. 3 ft x 3 ft x 0.5 ft) 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.

# 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 Project 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 statistically significant increase (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 will be sampled for Appendix III and IV constituents during assessment monitoring.

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 August 1st 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 January 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**, interwell prediction limits, combined with a 1-of-2 verification strategy, are used to evaluate boron, calcium, chloride, fluoride, pH, sulfate, and TDS. 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 attached Statistical Analysis Plan, which was updated in April 2020 with additional data screening and 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.

Inter-well 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, and if delineation wells are required, any newly-installed delineation well 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 | Installation Date | Northing [1] | Easting [1] | Ground Elevation [2] | Top of Casing Elevation [2] | Well Depth (ft.) Below Top of Casing | Top of Screen Elevation [2,4] | Bottom of Screen Elevation [2,4] | Screen Length (ft) |
|---|---|---|---|---|---|---|---|---|---|---|
| GSD-AP-MW-1 | Downgradient | 8/8/2017 | 1279914.40 | 615079.93 | 523.48 | 526.37 | 27.79 | 509.08 | 499.08 | 10 |
| GSD-AP-MW-2 | Downgradient | 8/10/2017 | 1280352.80 | 614599.21 | 523.04 | 526.16 | 28.17 | 508.49 | 498.49 | 10 |
| GSD-AP-MW-3 | Downgradient | 8/11/2017 | 1280742.72 | 614102.00 | 523.68 | 526.80 | 27.45 | 509.85 | 499.85 | 10 |
| GSD-AP-MW-4 | Downgradient | 7/15/2013 | 1281001.39 | 613884.36 | 517.27 | 520.60 | 26.27 | 504.83 | 494.83 | 10 |
| GSD-AP-MW-5 | Downgradient | 8/15/2017 | 1281367.84 | 613584.86 | 513.26 | 516.27 | 26.88 | 499.89 | 489.89 | 10 |
| GSD-AP-MW-6 | Downgradient | 8/3/2017 | 1281745.78 | 612969.64 | 512.09 | 515.23 | 26.25 | 499.48 | 489.48 | 10 |
| GSD-AP-MW-7 | Downgradient | 7/16/2013 | 1281131.20 | 612627.76 | 517.05 | 519.86 | 30.30 | 500.06 | 490.06 | 10 |
| GSD-AP-MW-8 | Downgradient | 8/2/2017 | 1280261.79 | 612527.24 | 516.02 | 519.22 | 32.68 | 497.04 | 487.04 | 10 |
| GSD-AP-MW-9 | Downgradient | 7/16/2013 | 1279916.88 | 613123.38 | 517.41 | 520.36 | 35.19 | 495.67 | 485.67 | 10 |
| GSD-AP-MW-10 | Downgradient | 8/3/2017 | 1279709.35 | 613729.63 | 527.70 | 530.91 | 48.42 | 492.99 | 482.99 | 10 |
| GSD-AP-MW-11 | Downgradient | 7/17/2013 | 1279209.03 | 614235.25 | 514.18 | 517.01 | 34.00 | 492.51 | 482.51 | 10 |
| GSD-AP-MW-12 | Downgradient | 7/17/2013 | 1279381.38 | 614989.08 | 518.73 | 521.82 | 31.75 | 500.57 | 490.57 | 10 |
| GSD-AP-MW-14 | Upgradient | 3/27/2018 | 1277336.39 | 615233.22 | 545.49 | 548.34 | 32.84 | 525.50 | 516.00 | 10 |
| GSD-AP-MW-16 | Upgradient | 9/20/2018 | 1277286.36 | 615079.67 | 553.08 | 555.83 | 36.23 | 530.10 | 520.10 | 10 |
| GSD-AP-MW-17 | Upgradient | 9/24/2018 | 1277101.94 | 615157.25 | 546.88 | 550.11 | 62.78 | 497.83 | 487.83 | 10 |
| GSD-AP-PZ-1 [3] | Downgradient | 8/14/2017 | 1281425.06 | 614048.07 | 518.80 | 521.64 | 27.47 | 504.67 | 494.67 | 10 |
| GSD-AP-PZ-2 [3] | Piezometer | 8/16/2017 | 1281957.82 | 612944.02 | 513.46 | 516.49 | 23.94 | 503.05 | 493.05 | 10 |
| GSD-AP-PZ-5 [3] | Downgradient | 3/28/2018 | 1280939.08 | 614998.03 | 521.36 | 524.26 | 30.77 | 503.99 | 493.99 | 10 |
| GSD-AP-PZ-6 [3] | Downgradient | 3/28/2018 | 1280911.35 | 614555.89 | 516.69 | 519.60 | 22.35 | 507.75 | 497.75 | 10 |
| GSD-AP-MW-2V | Vertical Delineation | 10/24/2019 | 1280364.25 | 614608.05 | 522.90 | 525.31 | 62.41 | 472.90 | 462.90 | 10 |
| GSD-AP-MW-4V | Vertical Delineation | 10/22/2019 | 1280986.06 | 613900.64 | 517.56 | 520.33 | 44.75 | 485.58 | 475.58 | 10 |
| GSD-AP-MW-18H | Horizontal Delineation | 10/24/2019 | 1280350.60 | 615161.03 | 522.28 | 524.45 | 27.60 | 506.85 | 496.85 | 10 |
| GSD-AP-MW-19H | Horizontal Delineation | 10/24/2019 | 1280656.67 | 614589.91 | 513.95 | 517.32 | 22.08 | 505.24 | 495.24 | 10 |
| GSD-AP-MW-20H | Horizontal Delineation | 10/24/2019 | 1281024.09 | 613927.12 | 514.28 | 516.68 | 20.29 | 506.39 | 496.39 | 10 |

Notes:
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. With the exception of GSD-AP-PZ-2, piezometers have been converted to downgradient compliance wells.
4. Top of screen and bottom of screen elevations are calculated relative to Top of Casing elevation and less the well sump length of 0.4'.

## Table 2. Plant Gadsden 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) | **Arsenic** (mg/L) | **Cobalt** (mg/L) | **Lithium** (mg/L) | **Molybdenum** (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upgradient | GSD-AP-MW-14 | 4.06 | 4.04 | 280.92 | 263.61 | Non-Detect [1] | 13.61 | 107.89 | 2.97 | Non-Detect [1] | 0.030 | Non-Detect [1] | Non-Detect [1] |
| | GSD-AP-MW-16 | 4.07 | 4.68 | 174.1 | 242.48 | Non-Detect | 17.60 | 96.11 | 3.63 | Non-Detect | 0.025 | Non-Detect | Non-Detect |
| | GSD-AP-MW-17 | 0.43 | 8.87 | 8.19 | 274.75 | Non-Detect | 21.93 | 11.50 | 3.34 | Non-Detect | Non-Detect | Non-Detect | Non-Detect |
| | | | | | | | | | | | | | |
| Downgradient Compliance [2] | GSD-AP-MW-2 | 0.15 | 6.57 | -65.57 | 720.88 | 0.672 | 105.28 | 162.88 | 3.06 | 0.816 | 0.0312 | 0.0696 | 0.0210 |
| | GSD-AP-MW-4 | 0.08 | 6.67 | -113.10 | 421.67 | 0.477 | 28.23 | 2.63 | 9.69 | 0.012 | 0.0280 | Non-Detect | Non-Detect |

Notes:

1. Non-Detect indicates the result was not detected above the MDL and is considered a non-detect.
2. Only downgradient wells with SSLs selected for comparison

# 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**

- Ash Pond Boundary
- Property Boundary (Approximate)

N

0 500 1,000 2,000 Feet

| | |
|---|---|
| SCALE | 1:8000 |
| DATE | 2/25/2020 |
| DRAWN BY | KWR |
| CHECKED BY | GBD |

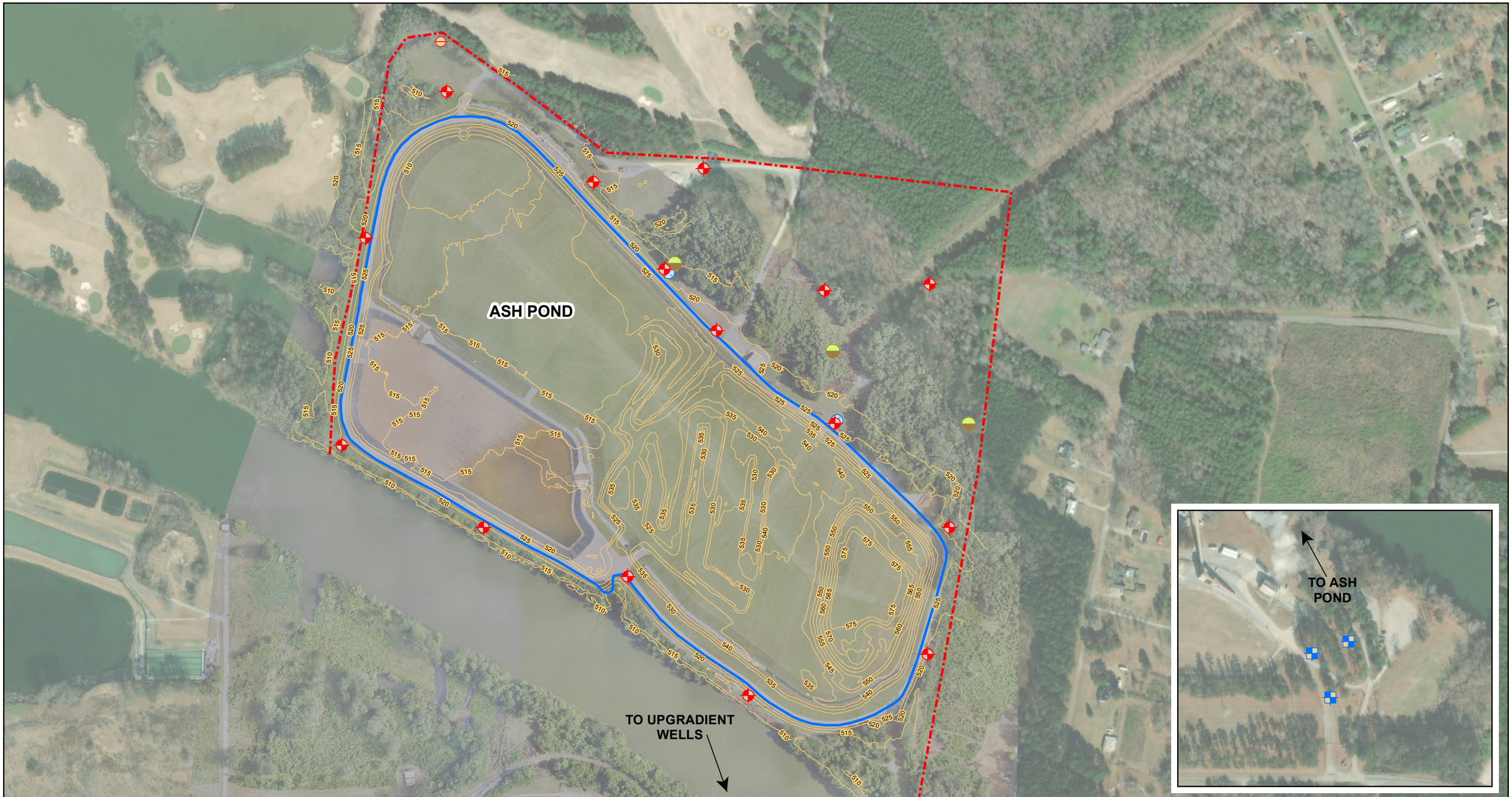
DRAWING TITLE

SITE LOCATION MAP
PLANT GADSDEN ASH POND

FIGURE NO

**FIGURE 1**

Southern Company




**Legend**

- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Piezometer
- Horizontal Delineation Well
- Vertical Delineation Well
- Ash Pond Boundary
- 5-foot Topographic Contour

N

0 250 500 1,000 1,500 Feet

| | |
|---|---|
| SCALE | 1:4800 |
| DATE | 4/6/2020 |
| DRAWN BY | KWR |
| CHECKED BY | GBD |

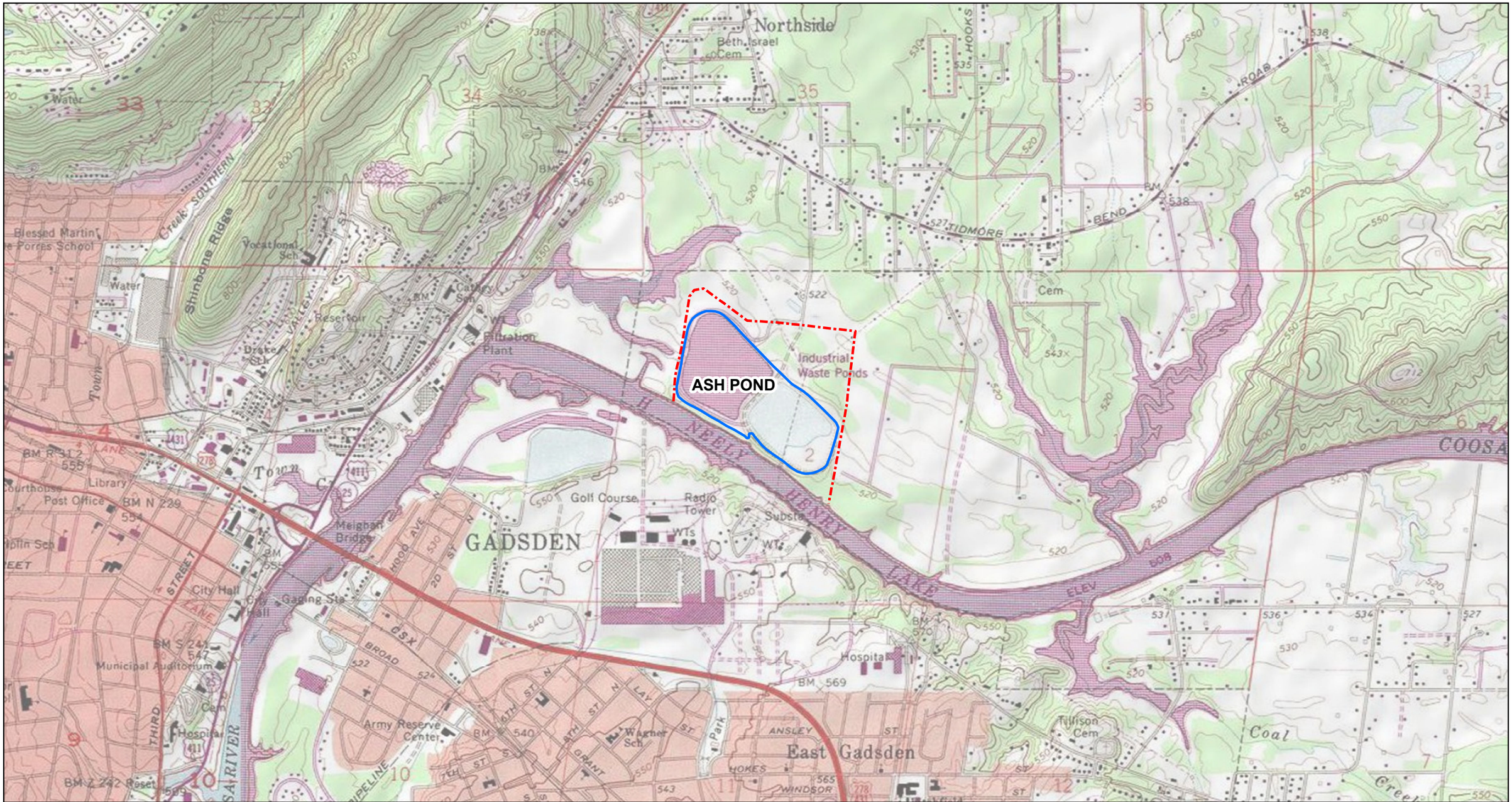
DRAWING TITLE

SITE PLAN MAP
PLANT GADSDEN ASH POND

FIGURE NO

**FIGURE 2**

Southern Company




**Legend**

- Ash Pond Boundary
- Property Boundary (Approximate)

N

0 500 1,000 2,000 3,000 4,000 5,000 6,000 Feet

| | |
|---|---|
| SCALE | 1:18000 |
| DATE | 2/25/2020 |
| DRAWN BY | KWR |
| CHECKED BY | CTL |

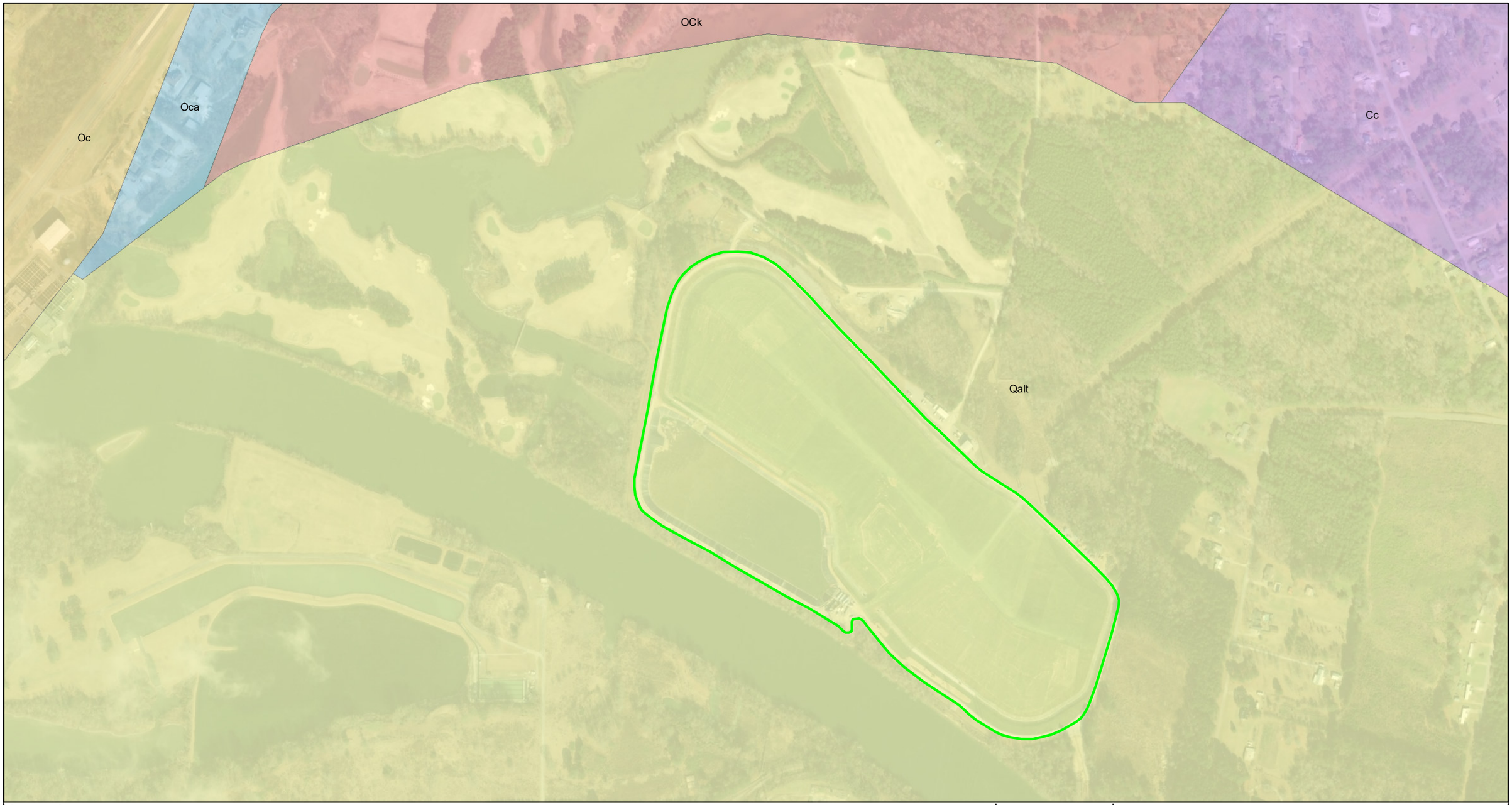
DRAWING TITLE

SITE TOPOGRAPHIC MAP
PLANT GADSDEN ASH POND

FIGURE NO

**FIGURE 3**

Southern Company




**Legend**

- Ash Pond Boundary

**Geologic Units**

- Alluvial, coastal, and low terrace deposits (Qalt)
- Attalla Chert Conglomerate Member of the Chickamauga Limestone (Oca)
- Chickamauga Limestone (Oc)
- Conasauga Formation (Cc)
- Knox Group undifferentiated (OCk)

N

0 250 500 1,000 1,500 2,000 Feet

| | |
|---|---|
| SCALE | 1:6000 |
| DATE | 4/14/2020 |
| DRAWN BY | KWR |
| CHECKED BY | GBD |

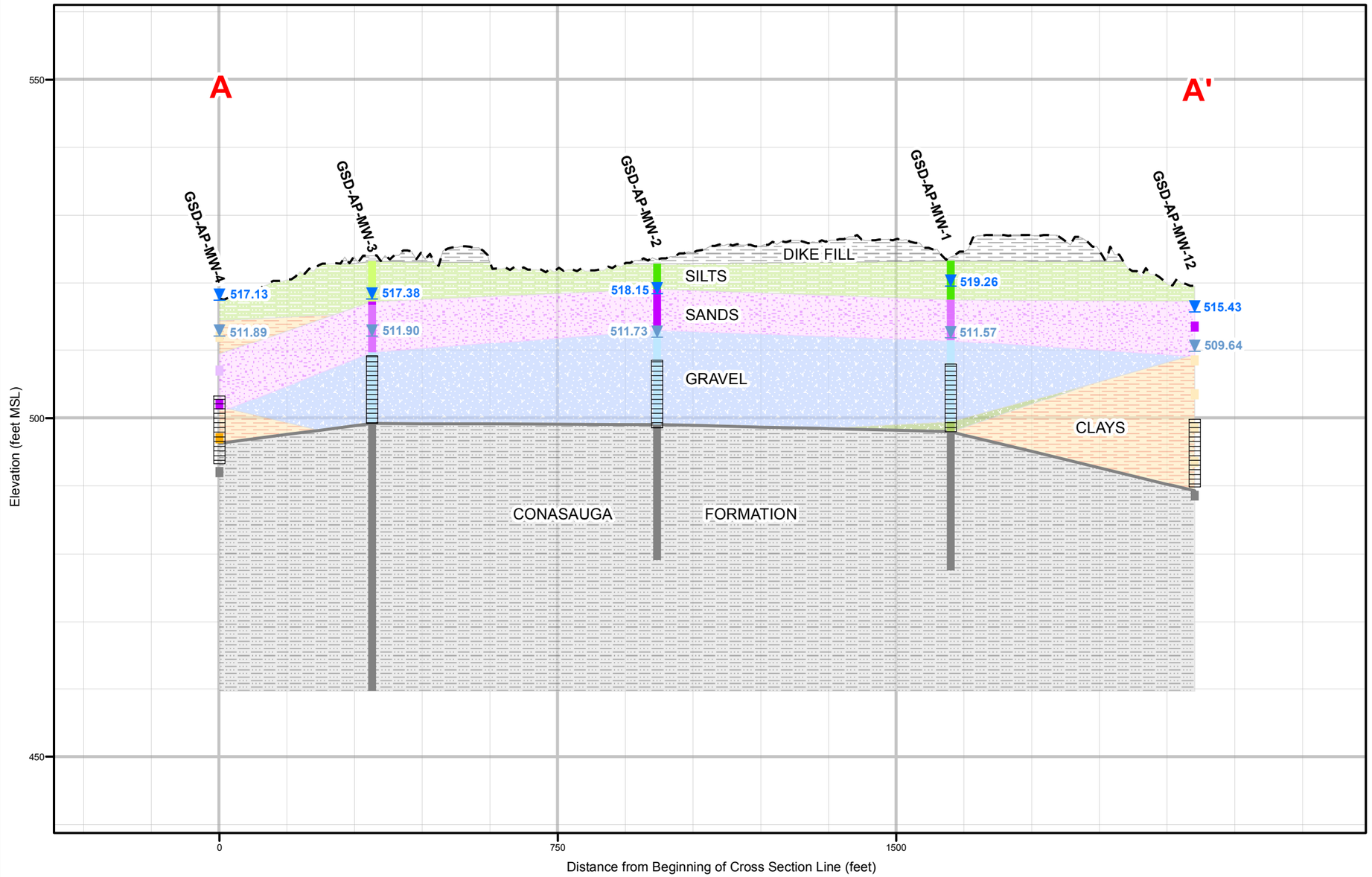
DRAWING TITLE

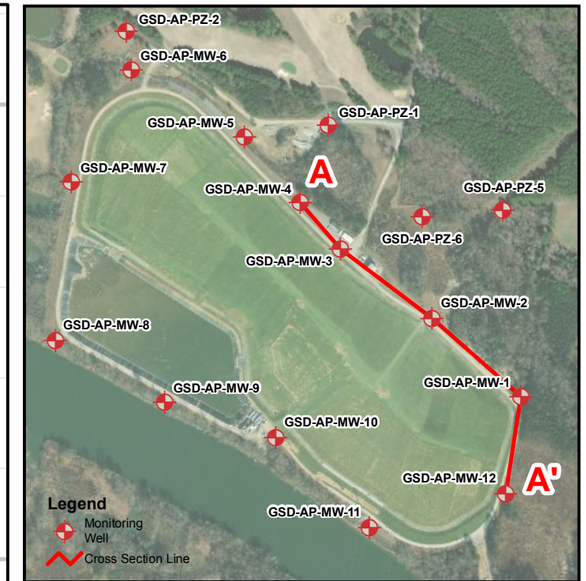
SITE GEOLOGIC MAP
PLANT GADSDEN ASH POND

FIGURE NO

**FIGURE 4**

Southern Company



Notes: 1. Stratagraphic layers were correlated using boring data.
2. Elevation data are reported using feet above Mean Sea Level (MSL).
3. Maximum and minimum groundwater elevation data were derived from the highest and lowest groundwater elevation values measured during events spanning February 6, 2018 to August 19, 2019.
4. Vertical exaggeration is 15x.

**Legend**

- Maximum Groundwater Elevation
- Minimum Groundwater Elevation
- Unit Boundary
- Screen Interval
- Ground Surface Elevation

Borehole Descriptions

- Topsoil/Fill
- Lean and Sandy Lean Clay
- Silty Clay
- Silt
- Sandy Silt
- Silty Sand
- Well-graded Sand
- Poorly-graded Sands
- Clay, Sand, and Gravel Mix
- Well-graded Gravel
- Mudstone/Shale

Geologic Units

- Dike Fill
- Clays
- Silts
- Sands
- Gravel
- Undifferentiated Clay, Sand, and Gravel
- Mudstone/Shale

| | |
|---|---|
| HORIZONTAL SCALE | 1:3000 |
| DATE | 4/14/2020 |
| DRAWN BY | KAR |
| CHECKED BY | GDB |

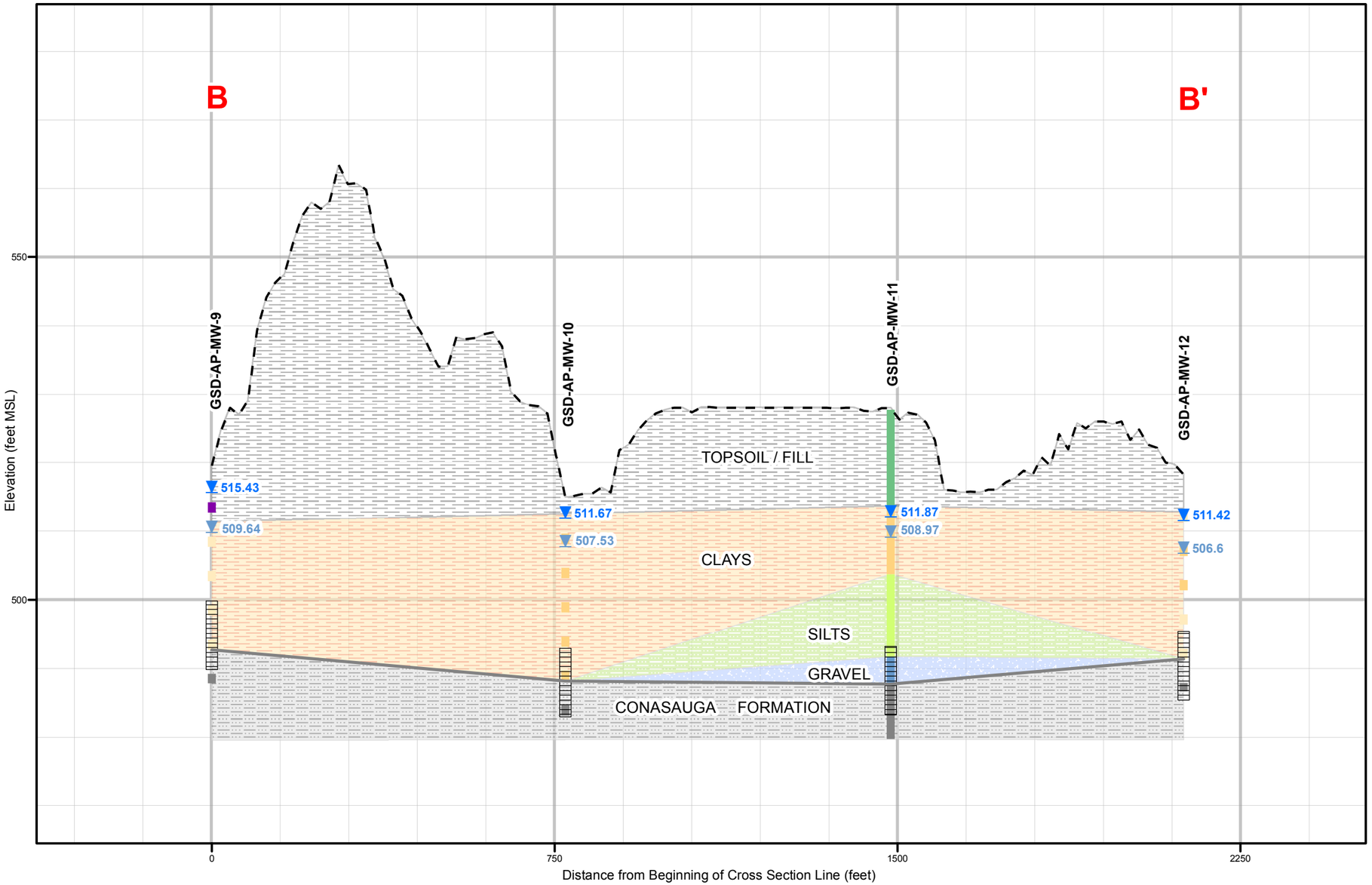
DRAWING TITLE

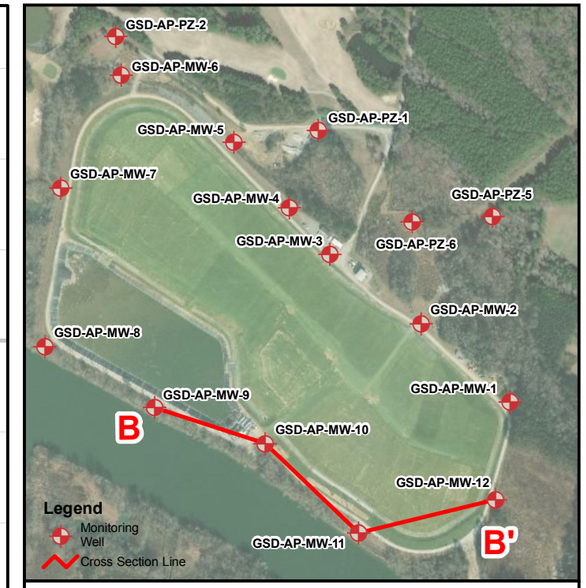
GEOLOGIC CROSS-SECTION A - A'
PLANT GADSDEN ASH POND

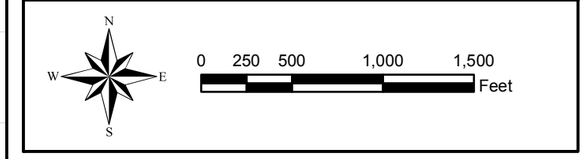
FIGURE NO

**FIGURE 5A**

Southern Company




Notes: 1. Stratagraphic layers were correlated using boring data.
2. Elevation data are reported using feet above Mean Sea Level (MSL).
3. Maximum and minimum groundwater elevation data were derived from the highest and lowest groundwater elevation values measured during events spanning February 6, 2018 to August 19, 2019.
4. Vertical exaggeration is 15x.

**Legend**

- Maximum Groundwater Elevation
- Minimum Groundwater Elevation
- Unit Boundary
- Screen Interval
- Ground Surface Elevation

Borehole Descriptions

- Clay, Silt, and Gravel Fill
- Lean Clays
- Fat and Silty Clays
- Silt
- Poorly-graded Gravelly Sand
- Well-graded Gravel
- Shale/Siltstone

Geologic Units

- Topsoil/Fill
- Clays
- Silts
- Gravel
- Siltstone/Shale

| | |
|---|---|
| HORIZONTAL SCALE | 1:3000 |
| DATE | 4/14/2020 |
| DRAWN BY | KAR |
| CHECKED BY | CTL |

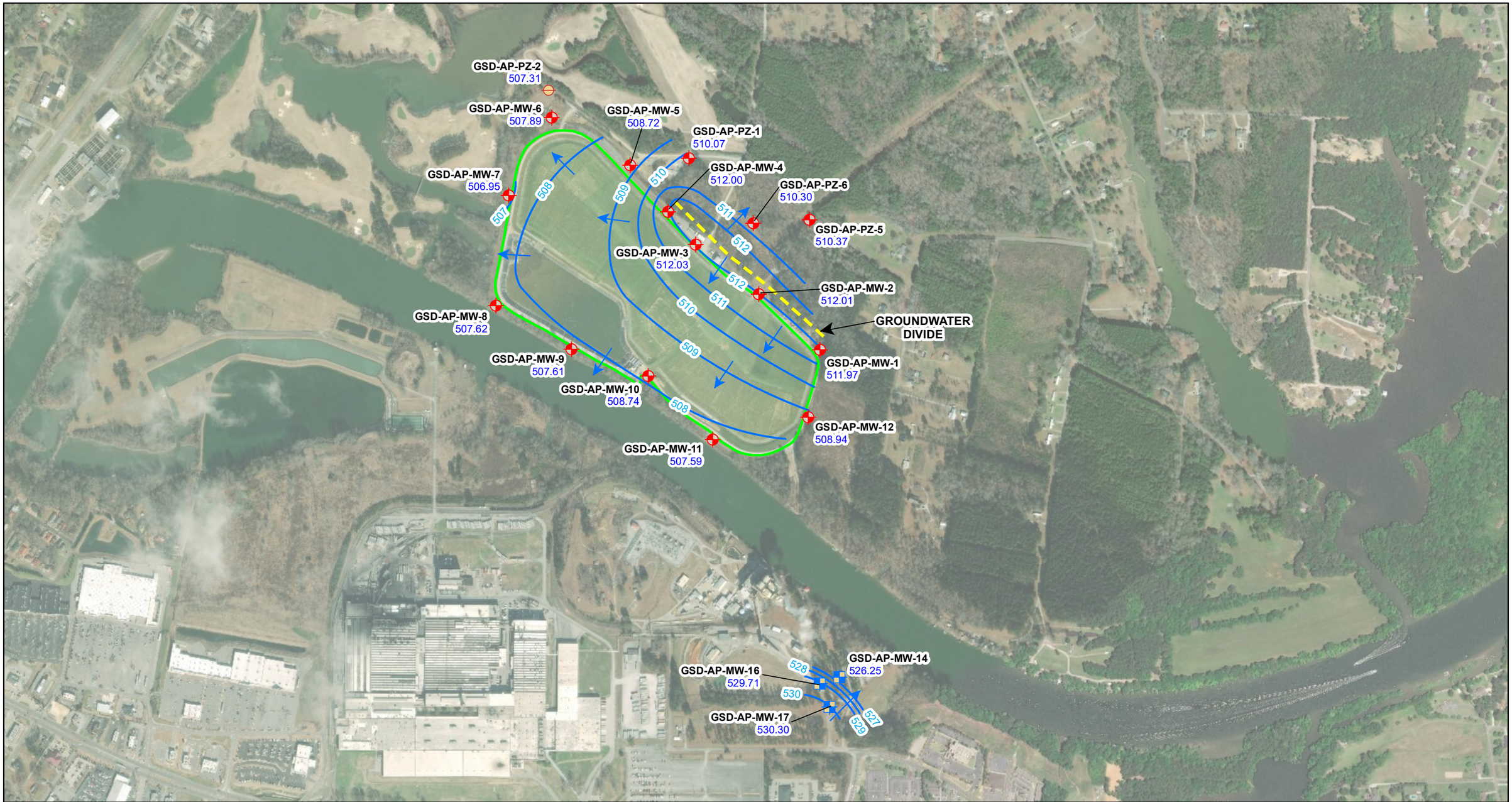
DRAWING TITLE

GEOLOGIC CROSS-SECTION B - B'
PLANT GADSDEN ASH POND

FIGURE NO

**FIGURE 5B**

Southern Company




**Legend**

- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Piezometer
- **GN-AP-MW-1** Well ID
- 511.97 Groundwater Elevation
- Potentiometric Surface Contour (ft NAVD88)
- Approximate Groundwater Flow Direction
- Ash Pond Boundary

N

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

NOTE: NAVD88 indicates North American Vertical Datum of 1988.

| | |
|---|---|
| SCALE | 1:9000 |
| DATE | 4/13/2020 |
| DRAWN BY | KWR |
| CHECKED BY | GBD |

DRAWING TITLE

POTENTIOMETRIC SURFACE CONTOUR MAP
AUGUST 19, 2019
PLANT GADSDEN ASH POND

FIGURE NO

**FIGURE 6**

Southern Company

**Legend**

- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Piezometer
- Horizontal Delineation Well
- Vertical Delineation Well
- Ash Pond Boundary

N

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

| | |
|---|---|
| SCALE | 1:9000 |
| DATE | 4/2/2020 |
| DRAWN BY | KAR |
| CHECKED BY | GBD |

DRAWING TITLE

MONITORING WELL LOCATION MAP
PLANT GADSDEN ASH POND

FIGURE NO

**FIGURE 7**

Southern Company

# Appendix A

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20



SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

**DATE STARTED** 8/7/2017 **COMPLETED** 8/8/2017 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** Supersonic **METHOD** Sonic
**DRILLED BY** T. Taylor **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 46 ft. **GROUND WATER DEPTH: DURING** 12 ft. **COMP.** 11.49 ft. **DELAYED**
**NOTES** ~20.5' into bedrock Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | - mottled gray (10YR 5/1) and dark gray (10YR 4/1) topsoil dry, loose | | | Completion: protective steel cover; 3-foot square concrete pad |
| | | **Silt (ML)**<br>- yellowish red (5YR 4/6) alluvium dry, stiff, sandy silt, micaceous, with organics | | | Surface Seal: concrete |
| 5 | | | | | Annular Fill: cement-bentonite grout |
| | | **Well-graded Sand (SW)**<br>- strong brown (7.5YR 5/6) alluvium moist, loose, fine- to coarse-grained<br>- SW: yellowish red (5YR 4/6) alluvium very moist, loose, gravelly sand, about 10% gravel | | | |
| 10 | | - SW: yellowish red (5YR 4/6) alluvium WET, loose | | | Annular Seal: bentonite pellets |
| | | **Well-graded Gravel (GW)**<br>- brown (7.5YR 5/4) alluvium WET, loose, gravelly sand, medium- to coarse-grained, with about 30% gravel, pea-sized to 1" | | | Filter: silica filter sand |
| 15 | | - GW: brown (7.5YR 5/4) alluvium WET, loose, medium- to coarse-grained, with gravel content increasing to about 50%, subangular to subrounded gravel to 1.5"<br>with gravel content increasing to about 50%, subangular to subrounded gravel to 1.5" | | | |
| 20 | | - GW: black (5YR 2.5/1) alluvium WET, loose | | | **Standpipe: 2" OD PVC (SCH 40)**<br>Screen: 10 ft; slotted |
| 25 | | **Clayey Sand (SW)**<br>- strong brown (7.5YR 5/6) alluvium WET, loose, clay/sand and gravel, fine- to medium-grained | | | Sump:0.5 ft. |
| | | **Mudstone**<br>- light gray (N7) and medium light gray (N6) very fine grain, medium hard to hard, mudstone, reacts to HCl in powdered form | | | |
| 30 | | | | | |
| 35 | | - Mudstone: light gray (N7) and medium light gray (N6) very fine grain, medium hard to hard, mudstone, with sparse thin calcite layers | | | Backfill:Silica Sand over bentonite pellets |
| 40 | | | | | |

*(Continued Next Page)*

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20

SOUTHERN COMPANY

# LOG OF TEST BORING



**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | | | | Completion: protective steel cover; 3-foot square concrete pad (CONTINUED) |
| 45 | | **Mudstone** *(Con't)* | | | Backfill:Silica Sand over bentonite pellets |
| 50 | | Bottom of borehole at 46.0 feet. | | | |
| 55 | | | | | |
| 60 | | | | | |
| 65 | | | | | |
| 70 | | | | | |
| 75 | | | | | |
| 80 | | | | | |
| 85 | | | | | |

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20



SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

**DATE STARTED** 8/8/2017 **COMPLETED** 8/10/2017 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** Supersonic **METHOD** Sonic
**DRILLED BY** T. Taylor **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 44 ft. **GROUND WATER DEPTH: DURING** 10 ft. **COMP.** 11.37 ft. **DELAYED**
**NOTES** ~20' into bedrock Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | **(FILL)**<br>- dark yellowish brown (10YR 4/4) and dark yellowish brown (10YR 4/6) topsoil dry, loose, sandy silt<br>**Silt (ML)**<br>- alluvium dry, slightly cohesive, sandy silt, with organics and sparse black mottles | | | Completion:<br>protective steel cover; 3-foot square concrete pad<br>Surface Seal:<br>concrete |
| 5 | | **Poorly-graded Sand (SP)**<br>- alluvium moist, loose, sand, becoming gravelly, fine- to medium-grained | | | Annular Fill:<br>cement-bentonite grout |
| 10 | | **Well-graded Gravel (GW)**<br>- alluvium WET, loose, gravelly sand, medium- to coarse-grained, with about 25% subrounded gravel to 1" | | | Annular Seal:<br>bentonite pellets |
| 15 | | - GW: alluvium WET, loose, gravelly sand, medium- to coarse-grained | | | Filter:<br>silica filter sand |
| 20 | | - GW: alluvium WET, loose, gravelly sand, with about 30% gravel to 1.5", primarily quartz, subrounded | | | **Standpipe:**<br>**2" OD PVC (SCH 40)**<br>Screen:<br>10 ft; slotted |
| 25 | | **mudstone**<br>- medium dark gray (N4) very fine grain, soft, highly weathered, weathered shale and mudstone, low HCl reaction, somewhat friable | | | Sump:0.5 ft. |
| 30 | | | | | |
| 35 | | - mudstone: banded with medium gray (N5) and medium dark gray (N4) very fine grain, medium, lower weathered, flow banded, mudstone, with dark gray and gray bands, low HCl reaction, less weathered, with abundant calcite, white (N9.5) | | | Backfill:Silica Sand over bentonite pellets |
| 40 | | | | | |

*(Continued Next Page)*

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20

SOUTHERN COMPANY

# LOG OF TEST BORING



**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | | | | Completion: protective steel cover; 3-foot square concrete pad (CONTINUED) |
| | | **mudstone** *(Con't)* | | | Backfill:Silica Sand over bentonite pellets |
| 45 | | Bottom of borehole at 44.0 feet. | | | |
| 50 | | | | | |
| 55 | | | | | |
| 60 | | | | | |
| 65 | | | | | |
| 70 | | | | | |
| 75 | | | | | |
| 80 | | | | | |
| 85 | | | | | |

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20



SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

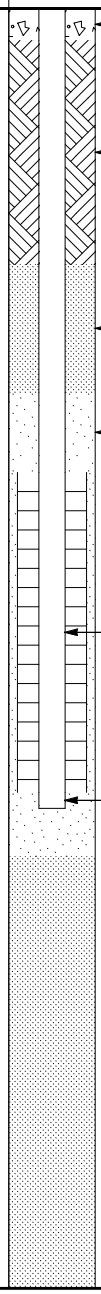
**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

**DATE STARTED** 8/10/2017 **COMPLETED** 8/11/2017 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** Supersonic **METHOD** Sonic
**DRILLED BY** T. Taylor **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 64 ft. **GROUND WATER DEPTH: DURING** 9 ft. **COMP.** 12.25 ft. **DELAYED**
**NOTES** ~39.5' into bedrock Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|
| | | **(topsoil)**<br>- dark gray (7.5YR 4/1) topsoil dry, loose, topsoil, sandy silt, with organics<br>**Silt (ML)**<br>- yellowish red (5YR 4/6) alluvium dry, cohesive, low plasticity<br>- ML: yellowish red (5YR 4/6) alluvium dry, cohesive, becoming sandier | | |
| 5 | | | | |
| | | **Poorly-graded Sand (SP)**<br>- yellowish red (5YR 4/6) alluvium dry, loose<br>**Well-graded Sand (SW)**<br>- strong brown (7.5YR 5/8) and reddish yellow (7.5YR 6/8) alluvium moist, loose, sand, fine- to coarse-grained, with subrounded gravel increasing in density with depth<br>- SW: strong brown (7.5YR 5/8) and reddish yellow (7.5YR 6/8) alluvium wet, loose<br>- SW: brownish yellow (10YR 6/8) alluvium wet, loose, sand, fine-grained, with very sparse, small gravel | | |
| 10 | | | | |
| 15 | | **Well-graded Gravel (GW)**<br>- strong brown (7.5YR 5/6) and strong brown (7.5YR 4/6) alluvium wet, loose, gravelly sand, medium- to coarse-grained, with about 30% subangular to subrounded gravel<br>- GW: Banded reddish yellow (7.5YR 6/8) and black (7.5YR 2.5/1) | | |
| 20 | | - GW: pale yellow (2.5Y 7/4) alluvium wet, loose, near 50/50 mixture of coarse sand and gravel, subrounded to rounded, up to 2" | | |
| 25 | | **mudstone**<br>- medium light gray (N6), medium gray (N5) and light gray (N7) very fine grain, fissile, weathered mudstone (N6 to N5) in light gray (N7) pulverized rock flour, with low HCL reaction in rock and strong reaction in flour | | |
| 30 | | | | |
| 35 | | - mudstone: medium dark gray (N4) fine to very fine grain, medium soft to medium hard, mudstone, reacts to HCL especially in powdered form | | |
| 40 | | | | |

WELL DATA

Completion:
protective steel cover; 3-foot square concrete pad



- Surface Seal: concrete
- Annular Fill: cement-bentonite grout
- Annular Seal: bentonite pellets
- Filter: silica filter sand
- **Standpipe: 2" OD PVC (SCH 40)**
- Screen: 10 ft; slotted
- Sump:0.5 ft.
- Backfill:Silica Sand over bentonite pellets

*(Continued Next Page)*

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20

SOUTHERN COMPANY

# LOG OF TEST BORING



**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | **mudstone** *(Con't)* | | | Completion: protective steel cover; 3-foot square concrete pad (CONTINUED) |
| 45 | | - mudstone: medium dark gray (N4) fine to very fine grain, medium, mudstone, with thin (2-3 mm) calcite veins, with low HCL reaction, slaty, slightly decomposed | | | |
| 50 | | | | | Backfill:Silica Sand over bentonite pellets |
| 55 | | - mudstone: medium dark gray (N4) fine to very fine grain, soft to medium hard, slightly to moderately weathered, mudstone, slaty, with low HCL reaction | | | |
| 60 | | | | | |
| 65 | | Bottom of borehole at 64.0 feet. | | | |
| 70 | | | | | |
| 75 | | | | | |
| 80 | | | | | |
| 85 | | | | | |

# BORING GSD-AP-MW-4

(previously PZ-1)



ES2283

SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/15/2013 **COMPLETED** 7/15/2013 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 24.8 ft. **GROUND WATER DEPTH: DURING** 1.6 ft. **COMP.** **DELAYED** 0.8 ft. after 72 hrs.
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | STRATA DESCRIPTION | SAMPLE TYPE NUMBER | SAMPLE DEPTH (ft.) | BLOW COUNTS (N-VALUE) / PERCENT RECOVERY (RQD) | COMMENTS |
|---|---|---|---|---|---|---|
| 5 | | **Sandy Lean Clay (CL)** - damp, soft, no plasticity, fine grain, Olive gray to orange-brown; micaceous | SS -1 | 4.5-6.0 | 2-2-2 ( **4**) | |
| 10 | | **Silty Sand (SM)** - wet, very loose, no plasticity, medium grain, Orange-brown | SS -2 | 9.5-11.0 | 1-2-1 ( **3**) | |
| 15 | | **Poorly-graded Gravelly Sand (SP)** - wet, loose, no plasticity, medium grain, Some cobbles present; subrounded to angular | SS -3 | 14.5-16.0 | 1-3-7 ( **10**) | |
| 20 | | **Silty Clay (CL-ML)** - damp, very stiff, no plasticity, Orange-brown w/ black SHALE foliated lenses showing red staining | SS -4 | 19.5-21.0 | 5-7-13 ( **20**) | |
| | | - hard, no plasticity | SS -5 | 24.5-25.8 | 50-0-0/3" (**100+**) | Auger refusal at 26 ft. |

Bottom of borehole at 24.8 feet.

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# BORING GSD-AP-MW-4

(previously PZ-1)



ES2283

SOUTHERN COMPANY

# RECORD OF WELL CONSTRUCTION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/15/2013 **COMPLETED** 7/15/2013 **SURF. ELEV.** 517.3 **COORDINATES:** N:1,280,918.44 E:457,711.98
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 24.8 ft. **GROUND WATER DEPTH: DURING** 1.6 ft. **COMP.** **DELAYED** 0.8 ft. after 72 hrs.
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA ELEV. | Strata | DEPTH (ft) | WELL DATA | ELEV. (DEPTH) | COMMENTS |
|---|---|---|---|---|---|
| | | | Surface: protective steel cover; 2-foot square concrete pad | | |
| | | | **Well: 2" OD PVC (SCH 40)** | | |
| | | | Annular Fill: cement-bentonite grout | | |
| 511.3 | | 5 | | | |
| | | | | 509.4 (7.9) | |
| | | 10 | Annular Seal: bentonite pellets | | |
| 506.3 | | | | 506.2 (11.1) | |
| | | | Filter: silica filter sand | | |
| | | | | 503.3 (14.0) | |
| 501.3 | | 15 | | | |
| | | | Screen: 10 ft. slotted | | |
| 496.3 | | 20 | | | |
| | | | | 493.3 (24.0) | |
| | | | Sump:0.80 ft. | | |
| 491.3 | | | | | |

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

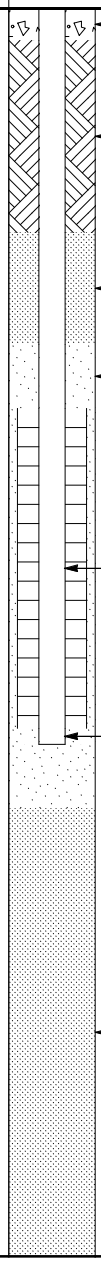
**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

**DATE STARTED** 8/14/2017 **COMPLETED** 8/15/2017 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** Supersonic **METHOD** Sonic
**DRILLED BY** T. Taylor **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 39 ft. **GROUND WATER DEPTH: DURING** 9 ft. **COMP.** 5.23 ft. **DELAYED**
**NOTES** ~21' into bedrock Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|
| | | - topsoil dry, loose, topsoil with organics | | |
| | | **Elastic Silt (MH)**<br>- mottled brownish yellow (10YR 6/8) and light gray (5Y 7/1) alluvium moist, cohesive, moderately, clayey silt, moderately plastic | | |
| 5 | | - MH: mottled strong brown (7.5YR 4/6) and light gray (5Y 7/1) saprolite dry, cohesive, low, clayey, sandy silt, with relic bedding, low plasticity | | |
| 10 | | **Poorly-graded Sand (SP)**<br>- mottled brown (7.5YR 4/2) and very pale brown / grayish orange (10YR 7/4) saprolite wet, loose, low, sand, fine- to medium-grained | | |
| 15 | | **Well-graded Gravel (GW)**<br>- mottled brown (7.5YR 4/2) and very pale brown / grayish orange (10YR 7/4) saprolite wet, loose, low, sand, fine- to very coarse-grained, wih small (to 1") subangular to subrounded gravel | | |
| | | **Silty Clay (CL-ML)**<br>- medium gray (N5) saprolite dry, stiff, low, silt/clay matrix with weathered mudstone pieces | | |
| 20 | | **mudstone**<br>- medium gray (N5), medium dark gray (N4) and dark gray (N3) fine grain, medium soft to medium hard, moderately to highly weathered, gray (N5 to N4) mudstone in N3 pulverized rock matrix, with moderate reaction to HCL | | |
| 25 | | - mudstone: medium gray (N5) and medium dark gray (N4) fine grain, medium soft to medium hard, mudstone, with thin calcite veins, mild to moderate reaction to HCL | | |
| 30 | | | | |
| 35 | | | | |
| 40 | | Bottom of borehole at 39.0 feet. | | |

WELL DATA

Completion:
protective steel cover; 3-foot square concrete pad



- Surface Seal: concrete
- Annular Fill: cement-bentonite grout
- Annular Seal: bentonite pellets
- Filter: silica filter sand
- **Standpipe: 2" OD PVC (SCH 40)**
  Screen: 10 ft; slotted
- Sump:0.5 ft.
- Backfill:Silica Sand over bentonite pellets

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

**DATE STARTED** 8/3/2017 **COMPLETED** 8/3/2017 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** Supersonic **METHOD** Sonic
**DRILLED BY** T. Taylor **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 25 ft. **GROUND WATER DEPTH: DURING** 12 ft. **COMP.** 5.25 ft. **DELAYED**
**NOTES** ~10' into bedrock Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | **(TOPSOIL)**<br>- topsoil dry, loose, topsoil | | | Completion:<br>protective steel cover; 3-foot square concrete pad |
| | | **Silt (ML)**<br>- mottled yellow (10YR 7/6) and reddish yellow (7.5YR 6/6) alluvium dry, loose, clayey silt, with organics, with very pale brown mottles at 3' BLS | | | Surface Seal:<br>concrete |
| 5 | | - ML: mottled yellow (10YR 7/6), reddish yellow (7.5YR 6/6) and very pale brown (10YR 8/3) alluvium dry, loose, becoming sandy, clayey silt | | | Annular Fill:<br>cement-bentonite grout |
| | | | | | Annular Seal:<br>bentonite pellets |
| 10 | | **Poorly-graded Sand (SP)**<br>- brown (7.5YR 4/2) alluvium moist, loose, sand, with layers of clay | | | Filter:<br>silica filter sand |
| | | **Well-graded Gravel (GW)**<br>- yellow (10YR 7/6) alluvium wet, loose, gravelly sand, medium- to coarse-grained, with about 25% gravel to 1", subrounded, quartz | | | |
| 15 | | **Silty Sand (SM)**<br>- alluvium wet, loose, 6" silty zone | | | |
| | | **Well-graded Gravel (SM)**<br>- gray (10YR 5/1) alluvium wet, loose, mixed clay/sand/gravel | | | **Standpipe:**<br>**2" OD PVC (SCH 40)**<br>Screen:<br>10 ft; slotted |
| 20 | | - light gray (N7) and greenish gray (5BG 5/1)<br>- medium gray (N5)<br>- light gray (N7) and medium gray (N5) | | | |
| 25 | | | | | Sump:0.5 ft. |
| | | Bottom of borehole at 25.0 feet. | | | |
| 30 | | | | | |
| 35 | | | | | |
| 40 | | | | | |

# BORING GSD-AP-MW-7
(previously PZ-2)


ES2283

SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/15/2013 **COMPLETED** 7/16/2013 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger; Rotosonic
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 29.7 ft. **GROUND WATER DEPTH: DURING** 10.6 ft. **COMP.** **DELAYED** 7.1 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | STRATA DESCRIPTION | SAMPLE TYPE NUMBER | SAMPLE DEPTH (ft.) | BLOW COUNTS (N-VALUE) / PERCENT RECOVERY (RQD) | COMMENTS |
|---|---|---|---|---|---|---|
| 5 | | **Silty Clay (CL-ML)** - damp, stiff, no plasticity, Orange-brown; micaceous | SS -1 | 4.5-6.0 | 3-4-6 ( **10**) | |
| 10 | | **Silty Clay (CL-ML)** - moist, medium stiff, no plasticity, SAA | SS -2 | 9.5-11.0 | 3-2-4 ( **6**) | |
| 15 | | **Silty Clay (CL-ML)** - wet, soft, no plasticity, SAA | SS -3 | 14.5-16.0 | 2-2-2 ( **4**) | |
| 20 | | **Silty Clay (CL-ML)** - wet, medium stiff, no plasticity, SAA; fine sands dominate | SS -4 | 19.5-21.0 | 2-2-3 ( **5**) | |
| 25 | | **Poorly-graded Gravelly Sand (SP)** - wet, medium dense, no plasticity, fine to coarse grain, Orange-brown | SS -5 | 24.5-26.0 | 13-10-8 ( **18**) | |

Bottom of borehole at 29.7 feet.

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# RECORD OF WELL CONSTRUCTION

**BORING GSD-AP-MW-7**
**(previously PZ-2)**


**ES2283**

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/15/2013 **COMPLETED** 7/16/2013 **SURF. ELEV.** 516.9 **COORDINATES:** N:1,281,048.22 E:456,455.35
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger; Rotosonic
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 29.7 ft. **GROUND WATER DEPTH: DURING** 10.6 ft. **COMP.** **DELAYED** 7.1 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA ELEV. | Strata | DEPTH (ft) | WELL DATA | ELEV. (DEPTH) | COMMENTS |
|---|---|---|---|---|---|
| | | | Surface: protective steel cover; 2-foot square concrete pad | | |
| | | | **Well: 2" OD PVC (SCH 40)** | | |
| 510.9 | | 5 | Annular Fill: cement-bentonite grout | | |
| 505.9 | | 10 | | | |
| | | | | 504.3 (12.6) | |
| | | | Annular Seal: bentonite pellets | | |
| | | 15 | | 502.0 (14.9) | |
| 500.9 | | | Filter: silica filter sand | | |
| | | | | 499.6 (17.3) | |
| 495.9 | | 20 | | | |
| | | | Screen: 10 ft. slotted | | |
| 490.9 | | 25 | | | |

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

**DATE STARTED** 8/2/2017 **COMPLETED** 8/2/2017 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** Supersonic **METHOD** Sonic
**DRILLED BY** T. Taylor **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 35 ft. **GROUND WATER DEPTH: DURING** 18 ft. **COMP.** 11.41 ft. **DELAYED**
**NOTES** ~8' into bedrock Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | **(TOPSOIL)**<br>- reddish yellow (7.5YR 7/6) topsoil dry, loose, topsoil, with organics<br>**Low Plastic Organic Silt or Clay (OL)**<br>- pale brown (10YR 6/3) alluvium dry, loose, silt, with organics<br>- OL: reddish yellow (7.5YR 6/6) alluvium dry, cohesive, sandy silt, with organics, no plasticity | | | Completion:<br>protective steel cover; 3-foot square concrete pad<br>Surface Seal: concrete |
| 5 | | **Elastic Silt (MH)**<br>- mottled reddish yellow (7.5YR 6/6), light yellowish brown (10YR 6/4) and white / yellowish gray (5Y 8/1) alluvium dry, cohesive, silt, moderately plastic, with white mottles | | | Annular Fill: cement-bentonite grout |
| 10 | | - MH: moist | | | |
| 15 | | **Well-graded Sand (SW)**<br>- mottled very pale brown / grayish orange (10YR 7/4) and light yellowish brown (10YR 6/4) alluvium moist, loose, sand, medium- to coarse-grained, micaceous<br>- SW: dark yellowish brown (10YR 4/4) alluvium moist, loose, sand, medium- to coarse-grained<br>- SW: reddish yellow (7.5YR 6/8) alluvium wet, loose | | | Annular Seal: bentonite pellets<br>Filter: silica filter sand |
| 20 | | | | | |
| 25 | | **Well-graded Gravel (GW)**<br>- mottled very pale brown (10YR 7/3) and pale brown (10YR 6/3) alluvium wet, loose, gravelly sand, medium- to coarse-grained, with about 10% small gravel<br>- GW: yellowish brown / moderate yellowish brown (10YR 5/4) alluvium saturated, loose, near 50/50 mix of sand and gravel, with subangular to subrounded gravel to 2"<br>- gray / light olive gray (5Y 6/1) and gray (5Y 5/1) | | | **Standpipe: 2" OD PVC (SCH 40)**<br>Screen: 10 ft; slotted |
| 30 | | - light gray (N7) and medium dark gray (N4) | | | Sump:0.5 ft.<br>Backfill:Silica Sand over bentonite pellets |
| 35 | | | | | |
| 40 | | Bottom of borehole at 35.0 feet. | | | |

# BORING GSD-AP-MW-9
(previously PZ-3)


ES2283

SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/16/2013 **COMPLETED** 7/16/2013 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 33 ft. **GROUND WATER DEPTH: DURING** 8.2 ft. **COMP.** **DELAYED** 9.1 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | STRATA DESCRIPTION | SAMPLE TYPE NUMBER | SAMPLE DEPTH (ft.) | BLOW COUNTS (N-VALUE) / PERCENT RECOVERY (RQD) | COMMENTS |
|---|---|---|---|---|---|---|
| 5 | | **Sandy Lean Clay (CL)** - dry, stiff, Orange-brown; fine-grained sands; micaceous | SS -1 | 4.5-6.0 | 4-5-6 ( **11**) | |
| 10 | | **Silty Clay (CL-ML)** - wet, soft, Orange-brown; micaceous | SS -2 | 9.5-11.0 | 2-1-2 ( **3**) | |
| 15 | | **Silty Clay (CL-ML)** - wet, very soft, SAA | SS -3 | 14.5-16.0 | 1-1-1 ( **2**) | |
| 20 | | **Sandy Lean Clay (CL)** - damp, stiff, Orange-red/black/olive mottled; fine-grained sands; micaceous | SS -4 | 19.5-21.0 | 3-5-5 ( **10**) | |
| 25 | | **Sandy Lean Clay (CL)** - damp, medium stiff, Orange/ light gray mottled; fine-grained sands; micaceous | SS -5 | 24.5-26.0 | 2-3-2 ( **5**) | |
| 30 | | - damp, hard, Blue gray SHALE w/ sandy gravel; foliation present | SS -6 | 29.5-30.7 | 36-40-50/2" (**100+**) | |

Bottom of borehole at 33.0 feet.

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# RECORD OF WELL CONSTRUCTION

**BORING GSD-AP-MW-9**
**(previously PZ-3)**


**ES2283**

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/16/2013 **COMPLETED** 7/16/2013 **SURF. ELEV.** 517.3 **COORDINATES:** N:1,279,833.84 E:456,950.99
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 33 ft. **GROUND WATER DEPTH: DURING** 8.2 ft. **COMP.** **DELAYED** 9.1 ft. after 48 hrs.
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA ELEV. | Strata | DEPTH (ft) | WELL DATA | ELEV. (DEPTH) | COMMENTS |
|---|---|---|---|---|---|
| | | | Surface: protective steel cover; 2-foot square concrete pad | | |
| | | | **Well: 2" OD PVC (SCH 40)** | | |
| 511.3 | | 5 | | | |
| | | | Annular Fill: cement-bentonite grout | | |
| 506.3 | | 10 | | | |
| 501.3 | | 15 | | | |
| | | | | 501.4 (15.9) | |
| | | | Annular Seal: bentonite pellets | | |
| | | | | 499.3 (18.0) | |
| 496.3 | | 20 | Filter: silica filter sand | | |
| | | | | 495.3 (22.0) | |
| 491.3 | | 25 | | | |
| | | | Screen: 10 ft. slotted | | |
| 486.3 | | 30 | | | |

2012 WELL CONSTRUCTION RECORD - ESEE DATABASE.GDT - 3/4/14 15:45 - T:\ESEE MAJOR PROJECTS\PROJECTS\GADSDEN\ES2283_ASH POND PIEZ INSTALLATION\DATA\PIEZ_LOGS & WELL CONSTRUCTION.GPJ

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20



SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

**DATE STARTED** 8/3/2017 **COMPLETED** 8/3/2017 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** Supersonic **METHOD** Sonic
**DRILLED BY** T. Taylor **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 48 ft. **GROUND WATER DEPTH: DURING** 24 ft. **COMP.** 19.25 ft. **DELAYED**
**NOTES** ~3' into bedrock Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | **Poorly-graded Sandy Gravel (GPS)**<br>- mottled pink (7.5YR 7/4) and reddish yellow (7.5YR 7/6) fill dry, loose, slag and road base (compacted sand/gravel), with gravel pea-sized to 4" | | | Completion:<br>protective steel cover; 3-foot square concrete pad<br>Surface Seal:<br>concrete |
| 5 | | **Medium to High Plastic Organic Clay or Silt (OH)**<br>- mottled brownish yellow / dark yellowish orange (10YR 6/6) and black (10YR 2/1) topsoil dry, cohesive, silt, high plasticity, organic-rich, with black mottles | | | |
| 10 | | - OH: mottled yellow (2.5Y 7/6) and strong brown (7.5YR 5/8) topsoil dry, cohesive, clayey silt, with abundant tree roots/organics | | | |
| 15 | | **Fat Clay (CH)**<br>- mottled gray (2.5Y 5/1), grayish brown (2.5Y 5/2) and reddish yellow (7.5YR 6/6) alluvium dry, cohesive, silty clay, high plasticity, micaceous | | | Annular Fill:<br>cement-bentonite grout |
| 20 | | - moist, with very dark gray mottles | | | |
| 25 | | **Silt (ML)**<br>- mottled gray (2.5Y 5/1), grayish brown (2.5Y 5/2) and greenish gray (5BG 6/1) alluvium moist, cohesive, sandy, clayey silt, becoming more stiff and less plastic | | | |
| 30 | | | | | Annular Seal:<br>bentonite pellets |
| | | - ML: mottled strong brown (7.5YR 5/6) and medium light gray (N6) alluvium wet, cohesive, sandy silt, low plasticity | | | Filter:<br>silica filter sand |
| 35 | | | | | |
| | | **Well-graded Gravel (GW)**<br>- yellowish brown / moderate yellowish brown (10YR 5/4) alluvium saturated, loose, gravelly sand, medium-grained, with subrounded to subangular gravel to 2"<br>- GW: medium gray (N5) alluvium saturated, loose | | | **Standpipe:**<br>**2" OD PVC (SCH 40)**<br>Screen:<br>10 ft; slotted |
| 40 | | | | | |

*(Continued Next Page)*

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20

SOUTHERN COMPANY

# LOG OF TEST BORING



**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | - GW: alluvium saturated, loose, sand/gravel, with about 40% subangular to subrounded gravel to 1" | | | Completion: protective steel cover; 3-foot square concrete pad (CONTINUED) |
| | | - light gray (N7) | | | **Standpipe: 2" OD PVC (SCH 40)** Screen: 10 ft; slotted Sump:0.5 ft. |
| 45 | | - light gray (N7) and medium gray (N5) | | | |
| | | Bottom of borehole at 48.0 feet. | | | |
| 50 | | | | | |
| 55 | | | | | |
| 60 | | | | | |
| 65 | | | | | |
| 70 | | | | | |
| 75 | | | | | |
| 80 | | | | | |
| 85 | | | | | |

# BORING GSD-AP-MW-11
(previously PZ-4)

# LOG OF TEST BORING


ES2283

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/16/2013 **COMPLETED** 7/17/2013 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 32.3 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 3 ft. after 24 hrs.
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | STRATA DESCRIPTION | SAMPLE TYPE NUMBER | SAMPLE DEPTH (ft.) | BLOW COUNTS (N-VALUE) / PERCENT RECOVERY (RQD) | COMMENTS |
|---|---|---|---|---|---|---|
| 5 | | **Silty Clay (CL-ML)**<br>- damp, medium stiff, Orange-brown; micaceous | SS -1 | 4.5-6.0 | 2-2-3 ( **5**) | |
| 10 | | **Silty Clay (CL-ML)**<br>- damp, medium stiff, low plasticity, SAA | SS -2 | 9.5-11.0 | 2-2-3 ( **5**) | |
| 15 | | **Fat Clay (CH)**<br>- moist, soft, medium to high plasticity, Orange-brown; micaceous | SS -3 | 14.5-16.0 | 1-2-1 ( **3**) | |
| 20 | | **Fat Clay (CH)**<br>- wet, soft, medium to high plasticity, SAA; except Tan mottled | SS -4 | 19.5-21.0 | 1-2-2 ( **4**) | |
| 25 | | **Fat Clay (CH)**<br>- wet, soft, high plasticity, Blue-gray; micaceous | SS -5 | 24.5-26.0 | 1-1-2 ( **3**) | |
| 30 | | - dry, very stiff, no plasticity, Blue-gray | SS -6 | 29.5-31.0 | 6-9-9 ( **18**) | |

Bottom of borehole at 32.3 feet.

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# RECORD OF WELL CONSTRUCTION

**BORING GSD-AP-MW-11**
**(previously PZ-4)**


**ES2283**

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/16/2013 **COMPLETED** 7/17/2013 **SURF. ELEV.** 514.0 **COORDINATES:** N:1,279,126.09 E:458,062.81
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 32.3 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 3 ft. after 24 hrs.
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA ELEV. | Strata | DEPTH (ft) | WELL DATA | ELEV. (DEPTH) | COMMENTS |
|---|---|---|---|---|---|
| | | | Surface: protective steel cover; 2-foot square concrete pad | | |
| | | | **Well: 2" OD PVC (SCH 40)** | | |
| 508.0 | | 5 | | | |
| | | | Annular Fill: cement-bentonite grout | | |
| 503.0 | | 10 | | | |
| | | | | 500.9 (13.1) | |
| | | 15 | Annular Seal: bentonite pellets | | |
| 498.0 | | | | 498.3 (15.7) | |
| | | | Filter: silica filter sand | | |
| 493.0 | | 20 | | | |
| | | | | 492.8 (21.2) | |
| 488.0 | | 25 | Screen: 10 ft. slotted | | |
| 483.0 | | 30 | | | |

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# BORING GSD-AP-MW-12
(previously PZ-5)


ES2283

SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/17/2013 **COMPLETED** 7/17/2013 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 30 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 4.4 ft. after 24 hrs.
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | STRATA DESCRIPTION | SAMPLE TYPE NUMBER | SAMPLE DEPTH (ft.) | BLOW COUNTS (N-VALUE) / PERCENT RECOVERY (RQD) | COMMENTS |
|---|---|---|---|---|---|---|
| 5 | | **Poorly-graded Gravelly Sand (SP)** - wet, very loose, Gray-brown; fine to coarse-grained sands with fine gravels | SS -1 | 4.5-6.0 | 2-1-1 ( **2**) | |
| 10 | | **Lean Clay (CL)** - damp, hard, Light gray/ orange mottled; micaceous | SS -2 | 9.5-11.0 | 4-6-8 ( **14**) | |
| 15 | | **Lean Clay (CL)** - moist, medium stiff, low plasticity, SAA | SS -3 | 14.5-16.0 | 4-3-4 ( **7**) | |
| 20 | | **Lean Clay (CL)** - moist, medium stiff, low plasticity, SAA | SS -4 | 19.5-21.0 | 4-3-3 ( **6**) | |
| 25 | | **Sandy Lean Clay (CL)** - damp, hard, Orange-brown; fine to medium-coarse sands with coarse gravels. | SS -5 | 24.5-26.0 | 8-15-37 ( **52**) | |
| 30 | | - hard, Gray; foliated; red staining present along foliations | SS -6 | 29.5-30.9 | 50 (**100+**) | Auger refusal at 31 ft. |

Bottom of borehole at 30.0 feet.

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# RECORD OF WELL CONSTRUCTION

**BORING GSD-AP-MW-12**
**(previously PZ-5)**


**ES2283**

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Piezometers
**LOCATION** Plant Gadsden Ash Pond

**DATE STARTED** 7/17/2013 **COMPLETED** 7/17/2013 **SURF. ELEV.** 518.9 **COORDINATES:** N:1,279,298.40 E:458,816.65
**CONTRACTOR** SCS Field Services **EQUIPMENT** **METHOD** Hollow Stem Auger
**DRILLED BY** T. Milam **LOGGED BY** K. Byrd **CHECKED BY** **ANGLE** **BEARING**
**BORING DEPTH** 30 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 4.4 ft. after 24 hrs.
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA ELEV. | Strata | DEPTH (ft) | WELL DATA | ELEV. (DEPTH) | COMMENTS |
|---|---|---|---|---|---|
| | | | Surface: protective steel cover; 2-foot square concrete pad | | |
| 512.9 | | 5 | **Well: 2" OD PVC (SCH 40)** | | |
| | | | Annular Fill: cement-bentonite grout | | |
| 507.9 | | 10 | | | |
| | | | | 505.0 (13.9) | |
| 502.9 | | 15 | Annular Seal: bentonite pellets | | |
| | | | | 502.5 (16.4) | |
| | | | Filter: silica filter sand | | |
| | | | | 500.0 (18.9) | |
| 497.9 | | 20 | | | |
| | | | Screen: 10 ft. slotted | | |
| 492.9 | | 25 | | | |
| | | 30 | | | |
| 487.9 | | | | | |

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gadsden Ash Pond
LOCATION Plant Gadsden

DATE STARTED 3/27/2018 COMPLETED 3/27/2018 SURF. ELEV. Not Surveyed COORDINATES:
CONTRACTOR Cascade Drilling EQUIPMENT Track Sonic METHOD Sonic
DRILLED BY M. Hansen LOGGED BY S. McDonald CHECKED BY B. Coates ANGLE BEARING
BORING DEPTH 33 ft. GROUND WATER DEPTH: DURING 18 ft. COMP. 21.16 ft. DELAYED
NOTES Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **Utility Clearance (HYDROEXCAVATION)** | | |
| 5 | | | | |
| 10 | | | | |
| | | **Silty Sand (SM)**<br>- pale yellow (2.5Y 8/2) residuum moist, loose, non-plastic, fine- to medium-grained<br>**Poorly-graded Gravel (GP)**<br>- banded white (2.5Y 8/1) and reddish yellow (7.5YR 6/8) saprolite moist, loose, non-plastic, minor clay content, about 30% to 40% gravel to 3" diameter, angular to subrounded | | |
| 15 | | | | |
| | | - white (2.5Y 8/1) saprolite wet, loose, non-plastic, about 50% gravel, coarse- to very coarse-grained, subrounded to subangular | | |
| 20 | | - variegated white (2.5Y 8/1) and pale yellow (2.5Y 8/4) saprolite wet, loose, non-plastic, rounded to subangular gravel up to 3" diameter | | |
| 25 | | | | |
| | | **Clayey Gravel (GC)**<br>- pale yellow (2.5Y 7/4) saprolite wet, medium dense, moderately plastic, mixed sand/clay/gravel, with gravel to 5" diameter, subrounded to subangular<br>- brown (7.5YR 5/3) saprolite damp, medium stiff, moderately plastic | | |
| 30 | | - medium gray (N5) saprolite mixed clay/mudstone | | |
| | | **mudstone**<br>- light gray (N7) and medium light gray (N6) very fine grain, hard to very hard, strong HCL reaction | | |
| | | Bottom of borehole at 33.0 feet. | | |
| 35 | | | | |
| 40 | | | | |

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SOUTHERN COMPANY

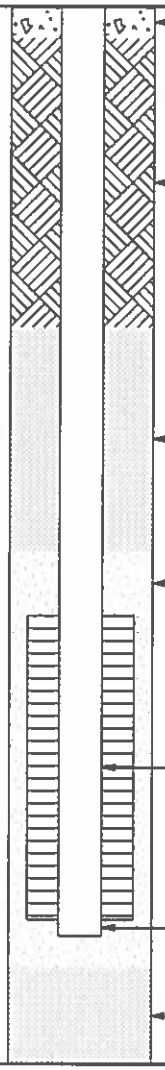
# LOG OF WELL CONSTRUCTION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gadsden Ash Pond
LOCATION Plant Gadsden

DATE STARTED 3/27/2018 COMPLETED 3/27/2018 SURF. ELEV. Not Surveyed COORDINATES:
CONTRACTOR Cascade Drilling EQUIPMENT Track Sonic METHOD Sonic
DRILLED BY M. Hansen LOGGED BY S. McDonald CHECKED BY B. Coates ANGLE BEARING
BORING DEPTH 33 ft. GROUND WATER DEPTH: DURING 18 ft. COMP. 21.16 ft. DELAYED
NOTES Well installed. Refer to well data sheet.

| DEPTH (ft) | GROUNDWATER OBSERVATIONS | WELL DATA<br>Completion:<br>Protective steel cover; 2-foot square concrete pad | NOTES |
|---|---|---|---|

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SOUTHERN COMPANY

# BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 9/20/2018 **COMPLETED** 9/20/2018 **GROUND ELEVATION** ft **COORDINATES** N E

**CONTRACTOR** Cascade Drilling **METHOD** Sonic **EQUIPMENT** Track Sonic

**DRILLED BY** R. Whitt **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **BORING DEPTH** 40 ft.

**GROUND WATER DEPTH: DURING** 25 ft. **COMP.** 21.16 ft. **DELAYED**

**NOTES** ~4.0' into bedrock Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| 5, 10 | | **Utility Clearance (HYDROEXCAVATION)** | | (Recovery=0% between 0 and 10ft.) |
| 15 | | **Silty Clay (CL-ML)**<br>- mottled red / moderate reddish brown (10R 4/6) and reddish gray (10R 6/1) alluvium moist | | (Recovery=100% between 10 and 20ft.) |
| 20 | | **Poorly-graded Sandy Gravel (GP-GC)**<br>- variegated light red / moderate reddish orange (10R 6/6) alluvium moist, rounded to subrounded, range in size from <0.5" - 3.0", trace coarse sand | | |
| 25 | | **Poorly-graded Sandy Gravel (GP-GM)**<br>- variegated pale yellow (2.5Y 8/2) and gray (2.5Y 6/1) alluvium wet, with coarse poorly graded angular sand | | (Recovery=100% between 20 and 30ft.) |
| 30 | | **Poorly-graded Gravelly Sand (SP-SM)**<br>- variegated yellow / pale yellowish orange (10YR 8/6) alluvium wet, moderately poorly graded angular to subangular, coarse grained | | |
| 35 | | **Lean Clay (CL)**<br>- variegated dark reddish brown (2.5YR 2.5/3) alluvium moist, trace coarse sands | | (Recovery=80% between 30 and 40ft.) |
| 40 | | - medium dark gray (N4) LIMESTONE | | |

Bottom of borehole at 40.0 feet.

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SOUTHERN COMPANY

# RECORD OF WELL CONSTRUCTION

**WELL: GSD-AP-MW-16**

APC439007

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 9/20/2018 **COMPLETED** 9/20/2018 **GROUND ELEVATION** ft **COORDINATES** N E

**CONTRACTOR** Cascade Drilling **METHOD** Sonic **EQUIPMENT** Track Sonic

**DRILLED BY** R. Whitt **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **BORING DEPTH** 40 ft.

**GROUND WATER DEPTH: DURING** 25 ft. **COMP.** 21.16 ft. **DELAYED**

**NOTES** ~4.0' into bedrock Well installed. Refer to well data sheet.

| BOREHOLE DATA (Strata) | DEPTH (ft) | WELL DATA | (DEPTH) | COMMENTS |
|---|---|---|---|---|
| | | Protective steel cover<br>3-foot square concrete pad<br>Top of casing Elev. = | | |
| | | Surface Seal: concrete | (1.0) | |
| | 5 | | | |
| | 10 | Annular Fill: cement-bentonite grout | | |
| | 15 | | | |
| | 20 | Annular Seal: bentonite pellets | (18.9) | |
| | | Filter: silica filter sand | (21.0) | |
| | 25 | | (23.0) | |
| | | **Well: 2" OD PVC (SCH 40)**<br>**Screen: 10 ft. slotted** | | |
| | 30 | | | |
| | | Sump:0.50 ft. | (33.0)<br>(33.5) | |
| | 35 | | | |
| | 40 | | | |

SOUTHERN COMPANY

# BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 9/21/2018 **COMPLETED** 9/24/2018 **GROUND ELEVATION** ft **COORDINATES** N E

**CONTRACTOR** Cascade Drilling **METHOD** Sonic **EQUIPMENT** Track Sonic

**DRILLED BY** R. Whitt **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **BORING DEPTH** 60 ft.

**GROUND WATER DEPTH: DURING** 19 ft. **COMP.** 20.66 ft. **DELAYED**

**NOTES** ~40' into bedrock Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **Utility Clearance (HYDROEXCAVATION)** | | (Recovery=0% between 0 and 10ft.) |
| 10 | | **Lean Clay (CL)**<br>- mottled white (2.5Y 8/1) and gray (2.5Y 5/1) alluvium moist, trace coarse sand | | (Recovery=100% between 10 and 20ft.) |
| 20 | | **Poorly-graded Sandy Gravel (GP-GM)**<br>- variegated yellow / pale yellowish orange (10YR 8/6) alluvium wet, gravel size <0.5 - 3.0", rounded to subrounded, coarsening downward, trace clay<br>- variegated with medium dark gray (N4) and dark gray (N3) LIMESTONE | | (Recovery=50% between 20 and 30ft.) |
| 30 | | | | (Recovery=50% between 30 and 40ft.) |
| 40 | | | | (Recovery=30% between 40 and 50ft.) |
| 50 | | - NO RECOVERY | | (Recovery=0% between 50 and 60ft.) |
| 60 | | Bottom of borehole at 60.0 feet. | | |

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SOUTHERN COMPANY

# RECORD OF WELL CONSTRUCTION

**WELL: GSD-AP-MW-17**

APC439007

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 9/21/2018 **COMPLETED** 9/24/2018 **GROUND ELEVATION** ft **COORDINATES** N E

**CONTRACTOR** Cascade Drilling **METHOD** Sonic **EQUIPMENT** Track Sonic

**DRILLED BY** R. Whitt **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **BORING DEPTH** 60 ft.

**GROUND WATER DEPTH: DURING** 19 ft. **COMP.** 20.66 ft. **DELAYED**

**NOTES** ~40' into bedrock Well installed. Refer to well data sheet.

| BOREHOLE DATA | DEPTH (ft) | WELL DATA | COMMENTS |
|---|---|---|---|
| Strata | | Protective steel cover<br>3-foot square concrete pad<br>Top of casing Elev. = (DEPTH) | |
| | | Surface Seal: concrete (1.0) | |
| | 10 | | |
| | 20 | Annular Fill: cement-bentonite grout | |
| | 30 | (33.5) | |
| | | Annular Seal: bentonite pellets | |
| | | Filter: silica filter sand (37.5) | |
| | 40 | (39.5) | |
| | 50 | **Well: 2" OD PVC (SCH 40)**<br>**Screen: 20 ft. slotted** | |
| | 60 | Sump:0.50 ft. | |

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20



SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

**DATE STARTED** 8/11/2017 **COMPLETED** 8/14/2017 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** Supersonic **METHOD** Sonic
**DRILLED BY** T. Taylor **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 24 ft. **GROUND WATER DEPTH: DURING** 14 ft. **COMP.** 8.17 ft. **DELAYED**
**NOTES** ~3' into bedrock

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS | WELL DATA |
|---|---|---|---|---|---|
| | | **Poorly-graded Gravel (GP)**<br>- slag Gravel and road base<br>**Silt (ML)**<br>- light yellowish brown (10YR 6/4) and brownish yellow / dark yellowish orange (10YR 6/6) subsoil dry, clayey silt, low to moderate plasticity<br>- mottled pale yellow (2.5Y 7/4), yellow (10YR 7/8) and white / yellowish gray (5Y 8/1) alluvium dry, sandy silt, low plasticity<br>- mottled white / yellowish gray (5Y 8/1), yellow (10YR 7/8) and red (2.5YR 5/8) alluvium dry, sandy silt, with some low clay content, moderate plasticity | | | Completion:<br>protective steel cover; 3-foot square concrete pad<br>Surface Seal: concrete<br>Annular Fill: cement-bentonite grout<br>Annular Seal: bentonite pellets |
| 5 | | | | | |
| 10 | | | | | |
| | | **Poorly-graded Sand (SP)**<br>- mottled brownish yellow / dark yellowish orange (10YR 6/6) and strong brown (7.5YR 5/8) alluvium moist, sand, fine- to medium-grained<br>- strong brown (7.5YR 5/8) alluvium wet, sand, fine- to medium-grained | | | Filter: silica filter sand |
| 15 | | | | | |
| | | **Poorly-graded Gravel (GP)**<br>- reddish yellow (7.5YR 6/8) alluvium wet, gravelly sand, coarse- to very coarse-grained, with subrounded gravel to 2" diameter | | | **Standpipe: 2" OD PVC (SCH 40)**<br>Screen: 10 ft; slotted |
| 20 | | **mudstone**<br>- fine grain, highly weathered, weathered mudstone in clay matrix<br>- mudstone: medium gray (N5) and medium dark gray (N4) very fine grain, medium, fissile | | | Sump:0.5 ft. |
| 25 | | Bottom of borehole at 24.0 feet. | | | |
| 30 | | | | | |
| 35 | | | | | |
| 40 | | | | | |

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 2/6/18 08:33 - T:\ESEE MAJOR PROJECTS\PROJECTS_ATTORNEY CLIENT PRIVILEGE_DRAFT\APC\PLANT GADSDEN\SITE CHARACTERIZATION\FIELD DATA\BORING AND PIEZOMETER DATA\GADSDEN 20



SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

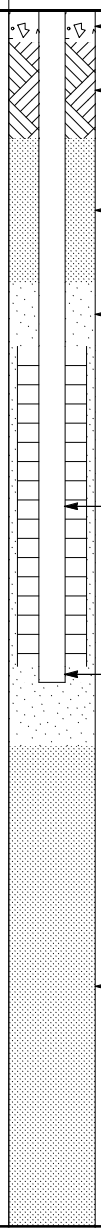
**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden

**DATE STARTED** 8/15/2017 **COMPLETED** 8/16/2017 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** Supersonic **METHOD** Sonic
**DRILLED BY** T. Taylor **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 38 ft. **GROUND WATER DEPTH: DURING** 12.5 ft. **COMP.** 8.37 ft. **DELAYED**
**NOTES** ~21' into bedrock

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | GROUNDWATER OBSERVATIONS |
|---|---|---|---|---|
| | | - dark gray / brownish gray (5YR 4/1) topsoil dry, topsoil with organics | | |
| | | - reddish yellow (7.5YR 6/6) fill dry, road base - gravel/sand mixture, with gravel to 3" | | |
| | | **Silt (ML)** | | |
| 5 | | - grayish brown (10YR 5/2) residuum dry, cohesive, clayey silt, low plasticity, with organics<br>- mottled reddish yellow (7.5YR 6/8), light gray (7.5YR 7/1) and very dark gray (7.5YR 3/1) residuum dry, sandy, clayey silt, becoming sandy at 7' BLS | | |
| | | **Poorly-graded Gravel (GP)** | | |
| 10 | | - reddish yellow (7.5YR 6/8), light gray (7.5YR 7/1) and very dark gray (7.5YR 3/1) residuum silt/gravel, near 50% gravel, subrounded, up to 1" | | |
| | | **Poorly-graded Sand (SP)** | | |
| | | - pale brown (10YR 6/3), brownish yellow (10YR 6/8) and gray (10YR 6/1) alluvium moist, sand, fine- to medium-grained | | |
| | | **Well-graded Gravel (GW)** | | |
| 15 | | - pale brown (10YR 6/3) and brownish yellow (10YR 6/8) alluvium moist, gravelly sand, medium- to very coarse-grained, with subrounded gravel, very moist | | |
| | | **Lean Clay (CL)** | | |
| | | - medium dark gray (N4) saprolite mudstone in clay matrix | | |
| | | **mudstone** | | |
| 20 | | - medium light gray (N6) and light gray (N7) mudstone in matrix of pulverized rock flour, with low HCL reaction in rock to moderate reaction in flour, with sparse calcite | | |
| 25 | | - mudstone: medium gray (N5) and medium dark gray (N4) medium, mudstone, in light gray (N7) pulverized rock flour, with evidence of sparse calcite, with HCL reaction | | |
| 30 | | | | |
| 35 | | | | |
| 40 | | Bottom of borehole at 38.0 feet. | | |

WELL DATA

Completion:
protective steel cover; 3-foot square concrete pad



- Surface Seal: concrete
- Annular Fill: cement-bentonite grout
- Annular Seal: bentonite pellets
- Filter: silica filter sand
- **Standpipe: 2" OD PVC (SCH 40)**
- Screen: 10 ft; slotted
- Sump:0.5 ft.
- Backfill:Silica Sand over bentonite pellets

SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gadsden Ash Pond
LOCATION Plant Gadsden

DATE STARTED 3/28/2018 COMPLETED 3/28/2018 SURF. ELEV. Not Surveyed COORDINATES:
CONTRACTOR Cascade Drilling EQUIPMENT Track Sonic METHOD Sonic
DRILLED BY M. Hansen LOGGED BY S. McDonald CHECKED BY B. Coates ANGLE BEARING
BORING DEPTH 30 ft. GROUND WATER DEPTH: DURING 13 ft. COMP. 7.01 ft. DELAYED
NOTES

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **Silt (ML)**<br>- mottled very light gray (N8) and strong brown (7.5YR 5/8) residuum dry, medium stiff, non-plastic, clayey | | |
| 5 | | - ML: mottled very light gray (N8) and strong brown (7.5YR 5/8) saprolite dry, soft, moderately plastic | | |
| 10 | | **Silty Sand (SM)**<br>- mottled reddish yellow (7.5YR 6/6) and pale yellow (2.5Y 8/2) saprolite dry, soft, non-plastic, fine- to very fine-grained, with sparse pebbles | | |
| 15 | | **Poorly-graded Gravel (GP)**<br>- dark yellowish brown (10YR 4/6) saprolite wet, loose, non-plastic, fine- to medium-grained, with subrounded to subangular gravel<br>**Poorly-graded Sand (SP)**<br>- strong brown (7.5YR 5/8) saprolite wet, loose, non-plastic, micaceous, fine- to medium-grained<br>- SP: banded strong brown (7.5YR 5/8) and pale yellow (2.5Y 8/3) saprolite wet, loose, non-plastic, with about 10% gravel | | |
| 20 | | - brown (7.5YR 4/4) saprolite wet, very loose, non-plastic, gravelly, with about 50% gravel and 50% sand, medium- to coarse-grained, subrounded to angular gravel<br>- brown (7.5YR 4/4) saprolite wet, loose, non-plastic, with about 25% gravel, subrounded to angular, fine- to coarse-grained, coarsening downward | | |
| 25 | | **Poorly-graded Gravel (GP)**<br>- banded strong brown (7.5YR 5/8) and very dark gray (7.5YR 3/1) saprolite wet, very loose, non-plastic, with about 20% sand, angular to rounded gravel pea-sized to 4" diameter | | |
| 30 | | **Lean Clay (CL)**<br>- light yellowish brown (10YR 6/4) saprolite damp, medium stiff, moderately plastic, gravelly<br>**mudstone**<br>- medium gray (N5) very fine grain, highly weathered, in clayey matrix, strong HCL reaction | | |
| 35 | | Bottom of borehole at 30.0 feet. | | |
| 40 | | | | |

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SOUTHERN COMPANY

# LOG OF WELL CONSTRUCTION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gadsden Ash Pond
LOCATION Plant Gadsden

DATE STARTED 3/28/2018 COMPLETED 3/28/2018 SURF. ELEV. Not Surveyed COORDINATES:
CONTRACTOR Cascade Drilling EQUIPMENT Track Sonic METHOD Sonic
DRILLED BY M. Hansen LOGGED BY S. McDonald CHECKED BY B. Coates ANGLE BEARING
BORING DEPTH 30 ft. GROUND WATER DEPTH: DURING 13 ft. COMP. 7.01 ft. DELAYED
NOTES

| DEPTH (ft) | GROUNDWATER OBSERVATIONS | WELL DATA<br>Completion:<br>Protective steel cover; 2-foot square concrete pad | NOTES |
|---|---|---|---|
| 5 | | Surface Seal: concrete<br>Annular Fill: cement-bentonite grout | |
| 10 | | Annular Seal: bentonite pellets | |
| 15 | | Filter: silica filter sand | |
| 20 | | | |
| 25 | | Standpipe: 2" OD PVC (SCH 40)<br>Screen: 9.5 ft; slotted | |
| 30 | | Sump: 0.50 ft. | |
| 35 | | | |
| 40 | | | |

WELL CONSTRUCTION LOG - ESEE DATABASE.GDT - 4/10/18 14:24 - S:\WORKGROUPS\APC GENERAL SERVICE COMPLEX\CIVIL TECH SUPPORT\DRILLING\PROJECTS\AL-GADSDEN\GADSDEN WELLS 2018\GADSDEN 2018.GPJ

SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gadsden Ash Pond
LOCATION Plant Gadsden

DATE STARTED 3/28/2018 COMPLETED 3/28/2018 SURF. ELEV. Not Surveyed COORDINATES:
CONTRACTOR Cascade Drilling EQUIPMENT Track Sonic METHOD Sonic
DRILLED BY M. Hansen LOGGED BY S. McDonald CHECKED BY B. Coates ANGLE BEARING
BORING DEPTH 20 ft. GROUND WATER DEPTH: DURING 11 ft. COMP. 2.52 ft. DELAYED
NOTES

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **Silty Clay (CL-ML)**<br>- mottled reddish yellow (5YR 6/8) and white / pinkish gray (5YR 8/1) residuum dry, soft, highly plastic, with organics, micaceous | | |
| 5 | | **Clayey Sand (SC)**<br>- mottled reddish yellow (5YR 6/8) and white / pinkish gray (5YR 8/1) residuum dry, soft, highly plastic<br>**Poorly-graded Sand (SP)**<br>- brownish yellow (10YR 6/8) residuum very moist, loose, non-plastic, fine- to coarse-grained, subrounded to angular gravel to 1" diameter, micaceous | | |
| 10 | | **Lean Clay (CL)**<br>- mottled red (10R 5/8) and yellow (2.5Y 7/6) residuum moist, moderately plastic, sandy<br>**Poorly-graded Sand (SP)**<br>- mottled red (10R 5/8) and yellow (2.5Y 7/6) residuum wet, loose, non-plastic, gravelly, with pea-sized to 1" gravel, subrounded to subangular, about 30% gravel<br>- very pale brown / grayish orange (10YR 7/4) residuum wet, loose, non-plastic, with subrounded gravel to 3" diameter | | |
| 15 | | **Silt (ML)**<br>- reddish yellow (5YR 6/8) saprolite moist, medium stiff, moderately plastic, clayey, with relic bedding<br>**mudstone**<br>- medium gray (N5) hard, highly weathered, mixed with clay | | |
| 20 | | Bottom of borehole at 20.0 feet. | | |
| 25 | | | | |
| 30 | | | | |
| 35 | | | | |
| 40 | | | | |

SIMPLE GEOLOGY LOG - ESEE DATABASE.GDT - 4/10/18 14:24 - S:\WORKGROUPS\APC GENERAL SERVICE COMPLEX\CIVIL TECH SUPPORT\DRILLING\PROJECTS\AL-GADSDEN\GADSDEN WELLS 2018\GADSDEN 2018.GPJ

SOUTHERN COMPANY

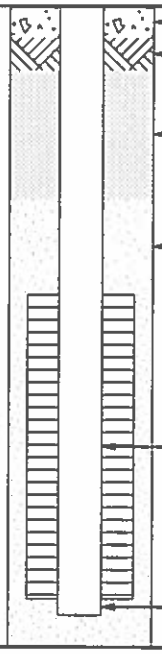
# LOG OF WELL CONSTRUCTION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gadsden Ash Pond
LOCATION Plant Gadsden

DATE STARTED 3/28/2018 COMPLETED 3/28/2018 SURF. ELEV. Not Surveyed COORDINATES:
CONTRACTOR Cascade Drilling EQUIPMENT Track Sonic METHOD Sonic
DRILLED BY M. Hansen LOGGED BY S. McDonald CHECKED BY B. Coates ANGLE BEARING
BORING DEPTH 20 ft. GROUND WATER DEPTH: DURING 11 ft. COMP. 2.52 ft. DELAYED
NOTES

| DEPTH (ft) | GROUNDWATER OBSERVATIONS | WELL DATA<br>Completion:<br>Protective steel cover; 2-foot square concrete pad | NOTES |
|---|---|---|---|
| 5 | | Surface Seal: concrete<br>Annular Fill: cement-bentonite grout<br>Annular Seal: bentonite pellets<br>Filter: silica filter sand | |
| 10 | | | |
| 15 | | **Standpipe: 2" OD PVC (SCH 40)**<br>Screen: 9.5 ft; slotted | |
| 20 | | Sump: 0.50 ft. | |
| 25 | | | |
| 30 | | | |
| 35 | | | |
| 40 | | | |



SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 6/5/2019 **COMPLETED** 6/5/2019 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade Drilling **EQUIPMENT** miniSonic **METHOD** Hand auger; Sonic
**DRILLED BY** M. Rodrigues **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 30 ft. **GROUND WATER DEPTH: DURING** 13 ft. **COMP.** 10.7 ft. **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **Topsoil (TOPSOIL)**<br>- light yellowish brown (10YR 6/4) topsoil dry, loose, clayey silt, with organics | | |
| 5 | | **Silt (ML)**<br>- yellowish red (5YR 5/8) dry, medium stiff, nonplastic, clayey, cohesive, with sparse micas<br>- mottled yellowish red (5YR 5/8) and yellow (2.5Y 7/6) dry, medium stiff, nonplastic, cohesion increasing with depth<br>- becoming sandy | | |
| 10 | | **Silty Sand (SM)**<br>- reddish yellow (7.5YR 6/6) alluvium dry, medium dense, fine-grained, micaceous, with sparse gravel to 1" diameter, rounded to subrounded<br>- moist | | |
| 15 | | **Poorly-graded Sand (SP)**<br>- strong brown (7.5YR 5/6) and white (2.5Y 8/1) alluvium moist, loose to medium dense, fine-grained, micaceous, with sparse subrounded gravel<br>- strong brown (7.5YR 5/6) and white (2.5Y 8/1) alluvium wet, loose, fine-grained, gravelly, with ~15%-20% gravel to 1", subangular to subrounded | | |
| 20 | | **Poorly-graded Gravel (GP)**<br>- brown (10YR 4/3) wet, loose, ~50% gravel and 50% sand, fine- to coarse-grained, subangular to subrounded, with gravel to 1.5" diameter<br>- yellowish brown (10YR 5/8) alluvium wet, very loose, as described above<br>- yellowish brown (10YR 5/8) alluvium wet, very loose, estimated ~70% gravel and ~30% sand | | |
| 25 | | **Well-graded Gravel (GW)**<br>- dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/8) alluvium wet, loose, sandy gravel, with pea-sized to 3" gravel, subangular to subrounded, est. ~70%-80% gravel, trace fines (<5%)<br>- gravel content decreasing | | |
| 30 | | **Poorly-graded Sand with Clay (SP-SC)**<br>- dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/8) alluvium wet, plastic, clayey, gravelly sand, fine-grained, with ~10% small, subrounded gravel | | |
| 35 | | **Lean Clay (CL)**<br>- dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/8) alluvium wet, medium plasticity, sandy, gravelly clay, with ~25%-30% gravel to 2.5", subangular to subrounded<br>- light gray (N7) and medium gray (N5) saprolite dry, weathered mudstone, fine-grained, interlayered wih clayey, sandy gravel, with subrounded gravel to 1" | | |
| 40 | | **mudstone**<br>- medium gray (N5) and light gray (N7) fine to very fine grain, medium hard | | |

Bottom of borehole at 30.0 feet.

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 10/24/2019 **COMPLETED** 10/24/2019 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade **EQUIPMENT** Sonic 8140LC **METHOD** Rotosonic
**DRILLED BY** M. Rodrigues **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 20 ft. **GROUND WATER DEPTH: DURING** 10 ft. **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **Topsoil (TOPSOIL)**<br>- topsoil dry, soft, nonplastic, silty, with heavy organics | | |
| | | **Fat Clay (CH)**<br>- mottled light gray (N7) and reddish yellow (7.5YR 6/8) alluvium moist, stiff, high plasticity, silty, cohesive, with organics | | |
| 5 | | - mottled light gray (N7) and reddish yellow (7.5YR 6/8) alluvium dry, stiff to very stiff, medium to high plasticity, cohesive, becoming silty again by 9' | | |
| 10 | | **Clayey Sand (SC)**<br>- mottled light gray (N7) and yellow (10YR 7/8) alluvium wet, medium dense to dense, fine-grained, coarsening downward | | |
| 15 | | **Well-graded Sand (SW)**<br>- yellow (10YR 7/8) and brownish yellow (10YR 6/8) alluvium wet, loose, gravelly, with ~30% gravel to 1" diameter | | |
| | | **Well-graded Gravel (GW)**<br>- alluvium wet, loose, ~50% gravel and 50% sand, fine- to coarse-grained, subangular to rounded, with gravel to 1" diameter, subangular to subrounded | | |
| 20 | | **Silt (ML)**<br>- yellowish red (5YR 5/8) alluvium dry, stiff to very stiff, low plasticity, clayey, noncohesive, with sparse gravel to 1", subangular to subrounded<br>- medium dark gray (N4) saprolite dry, very stiff to hard, nonplastic, clayey, noncohesive, with weathered rock | | |
| | | **Mudstone**<br>- very fine grain, soft to medium hard, highly weathered, strong HCL reaction in powdered rock | | |
| 25 | | Bottom of borehole at 20.0 feet. | | |
| 30 | | | | |

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 10/24/2019 **COMPLETED** 10/24/2019 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade **EQUIPMENT** Sonic 8140LC **METHOD** Rotosonic
**DRILLED BY** M. Rodrigues **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 19 ft. **GROUND WATER DEPTH: DURING** **COMP.** 5.95 ft. **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **Topsoil (TOPSOIL)**<br>- brown (10YR 4/3) topsoil dry, soft to medium, nonplastic, clayey, with organics | | |
| | | **Silt (ML)**<br>- yellowish brown / moderate yellowish brown (10YR 5/4) subsoil dry, soft, nonplastic, with organics, noncohesive | | |
| | | **Coal Combustion Byproduct (ASH)**<br>- medium dark gray (N4) fill dry, soft, nonplastic, fly, with organics, noncohesive | | |
| 5 | | **Fat Clay (CH)**<br>- mottled brownish yellow (10YR 6/8) and pale olive / dusky yellow (5Y 6/4) alluvium moist, stiff, high plasticity, silty, cohesive | | |
| | | **Poorly-graded Sand with Clay (SP-SC)**<br>- brownish yellow / dark yellowish orange (10YR 6/6) alluvium wet, medium dense, with ~10%-15% gravel, sand fine-grained and subangular, gravel subrounded to 1/2 cm | | |
| 10 | | **Well-graded Sand (SW)**<br>- grading brownish yellow / dark yellowish orange (10YR 6/6) and brownish yellow (10YR 6/8) alluvium wet, loose to medium dense, gravelly, fine- to coarse-grained, angular to subrounded, with minor clay, ~20% gravel to 1.5", rounded to subangular<br>- gravelly, fine- to coarse-grained, angular to subrounded, ~35-40% gravel to 1.5", rounded to subangular | | |
| 15 | | **Lean Clay (CL)**<br>- yellowish brown (10YR 5/6) alluvium dry, very stiff, low to medium plasticity, silty, noncohesive<br>- medium gray (N5) and medium dark gray (N4) alluvium dry, very stiff to hard, low plasticity, silty, noncohesive | | |
| | | **mudstone and shale**<br>- very fine grain, medium hard, highly to moderately weathered, interbedded shale and mudstone, strong HCL reaction in rock flour to medium in rock | | |
| 20 | | | | |
| 25 | | | | |
| 30 | | | | |

Bottom of borehole at 19.0 feet.

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 10/23/2019 **COMPLETED** 10/23/2019 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade **EQUIPMENT** Sonic 8140LR **METHOD** Rotosonic
**DRILLED BY** M. Rodrigues **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 60 ft. **GROUND WATER DEPTH: DURING** **COMP.** 5.42 ft. **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **Topsoil (TOPSOIL)**<br>- yellowish brown / moderate yellowish brown (10YR 5/4) topsoil dry, nonplastic, silty, noncohesive, with organics<br>**Silt (ML)**<br>- grading reddish yellow (5YR 6/8) and red (2.5YR 5/8) alluvium dry, medium stiff to stiff, nonplastic, noncohesive, with sparse black mottles | | |
| 5 | | **Silty Sand (SM)**<br>- mottled yellowish red (5YR 5/8) and reddish yellow (7.5YR 6/8) alluvium dry, loose to medium dense, fine-grained, with sparse (<10%) subangular to subrounded gravel to 1/2", gravel increasing to ~20% by 10' | | |
| 10 | | **Well-graded Sand (SW)**<br>- mottled light yellowish brown (10YR 6/4) and brownish yellow / dark yellowish orange (10YR 6/6) alluvium wet, fine- to coarse-grained, angular to subrounded grains, with ~25-30% angular to subrounded gravel to 1" | | |
| 15 | | - very dark brown / dusky yellowish brown (10YR 2/2) alluvium wet, fine- to coarse-grained, with ~25-30% gravel to 1"<br>- mottled brownish yellow (10YR 6/8) and yellow (10YR 7/8) alluvium wet, loose, fine- to coarse-grained, angular to subrounded grains, with ~30% gravel to 1.5", subrounded to subangular | | |
| 20 | | - mottled brownish yellow (10YR 6/8) and yellow (10YR 7/8) alluvium wet, loose, fine- to coarse-grained, with ~40-50% gravel to 2", subangular to subrounded, abundant quartz | | |
| 25 | | **Well-graded Gravel (GW)**<br>- mottled brownish yellow (10YR 6/8) and yellow (10YR 7/8) alluvium wet, loose, ~50-60% gravel, small to 1.5", subangular to subrounded, abundant quartz | | |
| 30 | | **Silt (ML)**<br>- brownish yellow (10YR 6/8) saprolite dry, stiff, low plasticity, clayey, cohesive<br>**mudstone**<br>- medium light gray (N6) and medium gray (N5) very fine grain, medium hard to hard, moderately weathered, shaly, low to medium HCL reaction in rock to strong reaction in crushed rock | | |
| 35 | | - mudstone: medium dark gray (N4) and medium light gray (N6) very fine grain, medium hard, slightly weathered, flow banded, with 1' alluvial gravel at top, angular to subrounded, low HCl reaction in rock to medium reaction in crushed rock | | |
| 40 | | | | |

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **mudstone** *(Con't)*<br>- no recovery | | |
| 45 | | - mudstone: medium dark gray (N4) and medium gray (N5) very fine grain, medium hard, slightly weathered, flow banded, with thin calcite infilling, low HCL reaction in rock to medium reaction in crushed rock | | |
| 50 | | - no recovery | | |
| 55 | | - mudstone: medium dark gray (N4) and medium gray (N5) very fine grain, medium hard to hard, slightly weathered, flow banded, bands 2 mm to 1" thick, low HCL reaction in rock to medium reaction in crushed rock, with calcite, shaly/fissile in spots | | |
| 60 | | Bottom of borehole at 60.0 feet. | | |
| 65 | | | | |
| 70 | | | | |
| 75 | | | | |
| 80 | | | | |
| 85 | | | | |

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 10/22/2019 **COMPLETED** 10/22/2019 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade **EQUIPMENT** Sonic 8140LR **METHOD** Rotosonic
**DRILLED BY** M. Rodrigues **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 45 ft. **GROUND WATER DEPTH: DURING** **COMP.** 16.18 ft. **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **Topsoil (TOPSOIL)**<br>- brownish yellow (10YR 6/8) topsoil dry, medium stiff, nonplastic, clayey silt, with organics<br>**Silt (ML)**<br>- pale brown (10YR 6/3) alluvium damp, nonplastic, clayey, with roots/organics, noncohesive<br>- brownish yellow (10YR 6/8) and very pale brown / very pale orange (10YR 8/2) alluvium dry, low plasticity, clayey, cohesive | | |
| 5 | | **Clayey Sand (SC)**<br>- yellow / pale yellowish orange (10YR 8/6) and brownish yellow (10YR 6/8) alluvium wet, medium dense to dense, clayey, gravelly, subangular to subrounded sand, with ~15-20% angular to subangular gravel, with clay content decreasing and gravel size increasing to 1" with depth | | |
| 10 | | **Well-graded Sand (SW)**<br>- yellowish brown (10YR 5/6) and brownish yellow / dark yellowish orange (10YR 6/6) alluvium wet, loose, no clay content below 11.5', with ~35-40% gravel to 1", angular to subrounded | | |
| 15 | | - same as above, with ~50% gravel | | |
| | | **Lean Clay (CL)**<br>- yellowish red (5YR 5/8) alluvium dry, very stiff to hard, nonplastic, silty, noncohesive<br>- reddish yellow (5YR 6/8) alluvium dry, stiff, low to medium plasticity, gravelly, with ~40-50% gravel to 1", subangular to subrounded | | |
| 20 | | - gray (5Y 5/1) and dark gray / olive gray (5Y 4/1) saprolite dry, very stiff to hard, nonplastic, cohesive<br>**mudstone**<br>- medium light gray (N6) and medium dark gray (N4) fine to very fine grain, medium hard to hard, slightly weathered, with alluvial gravel to 1.5", subangular to subrounded, possibly carried down, with low HCL reaction in rock to medium reaction in crushed rock | | |
| 25 | | | | |
| 30 | | | | |

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SOUTHERN COMPANY

# LOG OF TEST BORING

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | HCL REACTION (Weak / Moderate / Strong) | COMMENTS |
|---|---|---|---|---|
| | | **mudstone** *(Con't)* | | |
| 35 | | - no recovery | | |
| 40 | | - mudstone: medium gray (N5) and medium dark gray (N4) fine to very fine grain, hard to very hard, slightly weathered, traces of calcite, low HCL reaction in rock to medium reaction in crushed rock, with sparse alluvial gravel (chert, sandstone, quartz) to 1.5" in top 2', angular to subrounded, possibly not native | | |
| 45 | | | | |
| | | Bottom of borehole at 45.0 feet. | | |
| 50 | | | | |
| 55 | | | | |
| 60 | | | | |
| 65 | | | | |

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SOUTHERN COMPANY

# RECORD OF WELL CONSTRUCTION

**WELL: GSD-AP-MW-19H**

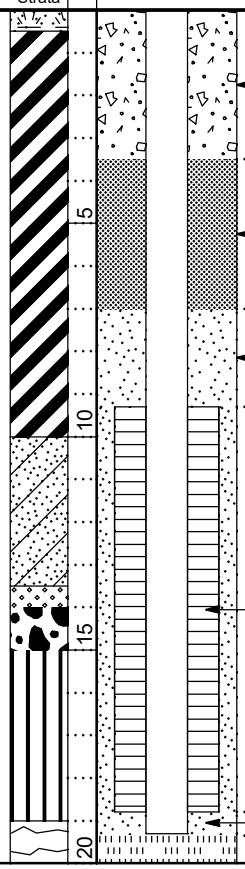
APC439007

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 10/24/2019 **COMPLETED** 10/24/2019 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade **EQUIPMENT** Sonic 8140LC **METHOD** Rotosonic
**DRILLED BY** M. Rodrigues **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 20 ft. **GROUND WATER DEPTH: DURING** 10 ft. **COMP.** **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA | DEPTH (ft) | WELL DATA | COMMENTS |
|---|---|---|---|
| Strata | | Protective steel cover<br>3-foot square concrete pad | |




(DEPTH)

Surface Seal: concrete

(3.5)

Annular Seal: 3/8 Bentonite Non-Coated Pellets

(7.0)

Filter: 20-40 graded silica filter sand

(9.3)

**Well: 2" OD PVC (SCH 40)**
**Screen: 9.5 ft. 0.010" slot prepack**

Sump:0.50 ft.

(18.8)
(19.3)

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SOUTHERN COMPANY

# RECORD OF WELL CONSTRUCTION

**WELL: GSD-AP-MW-20H**

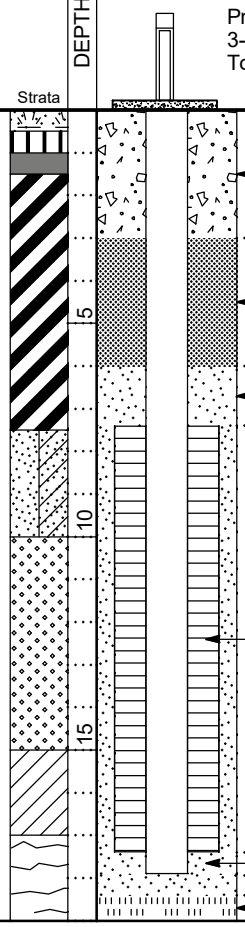
APC439007

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 10/24/2019 **COMPLETED** 10/24/2019 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade **EQUIPMENT** Sonic 8140LC **METHOD** Rotosonic
**DRILLED BY** M. Rodrigues **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 19 ft. **GROUND WATER DEPTH: DURING** **COMP.** 5.95 ft. **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA | DEPTH (ft) | WELL DATA | COMMENTS |
|---|---|---|---|
| Strata | | Protective steel cover<br>3-foot square concrete pad<br>Top of casing Elev. = (DEPTH) | |




Surface Seal: concrete (3.0)
Annular Seal: 3/8 Bentonite Non-Coated Pellets (6.0)
Filter: 20-40 graded silica filter sand (7.4)
**Well: 2" OD PVC (SCH 40)**
**Screen: 10 ft. 0.010" slot prepack**
Sump:0.50 ft. (17.4)
(17.9)
Backfill:Silica Sand (18.4)

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SOUTHERN COMPANY

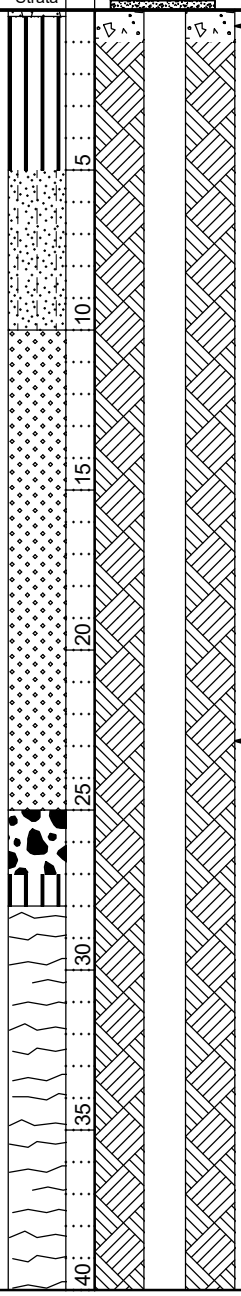
# RECORD OF WELL CONSTRUCTION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 10/23/2019 **COMPLETED** 10/23/2019 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade **EQUIPMENT** Sonic 8140LC **METHOD** Rotosonic
**DRILLED BY** M. Rodrigues **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 60 ft. **GROUND WATER DEPTH: DURING** **COMP.** 5.42 ft. **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA | DEPTH (ft) | WELL DATA | COMMENTS |
|---|---|---|---|
| Strata | | Protective steel cover<br>3-foot square concrete pad<br>Top of casing Elev. = (DEPTH) | |




Surface Seal: concrete (1.0)

Annular Fill: cement-bentonite grout

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SOUTHERN COMPANY

# RECORD OF WELL CONSTRUCTION

**WELL: GSD-AP-MW-2V**

**APC439007**

**SOUTHERN COMPANY SERVICES, INC.**
**EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING**

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

| BOREHOLE DATA | DEPTH (ft) | WELL DATA | COMMENTS |
|---|---|---|---|
| Strata | | Protective steel cover<br>3-foot square concrete pad<br>Top of casing Elev. = | |
| | | (CONTINUED) | (DEPTH) |
| | 45 | | (44.7) |
| | | Annular Seal: 3/8 Bentonite Non-Coated Pellets | |
| | | | (47.7) |
| | 50 | Filter: 20-40 graded silica filter sand | |
| | | | (50.0) |
| | 55 | **Well: 2" OD PVC (SCH 40)**<br>**Screen: 9.5 ft. 0.010" slot prepack** | |
| | 60 | Sump:0.50 ft. | |

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SOUTHERN COMPANY

# RECORD OF WELL CONSTRUCTION

**WELL: GSD-AP-MW-2VA**

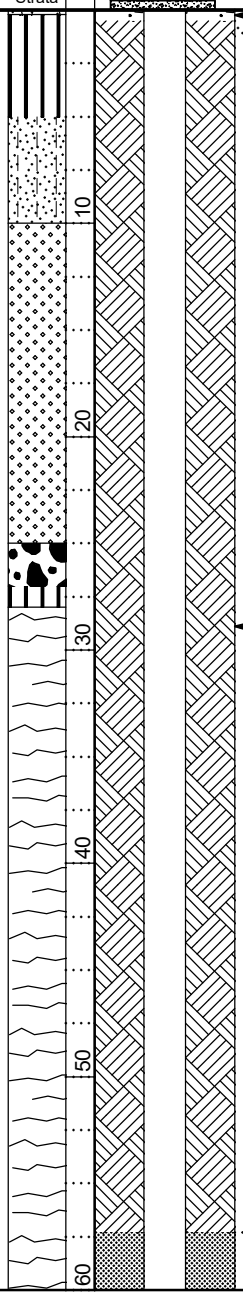
APC439007

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 1/28/2020 **COMPLETED** 1/30/2020 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade **EQUIPMENT** Sonic Truck **METHOD** Rotosonic
**DRILLED BY** J. Smith **LOGGED BY** S. Baxter **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 117 ft. **GROUND WATER DEPTH: DURING** 8.5 ft. **COMP.** 40.15 ft. **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA | DEPTH (ft) | WELL DATA | COMMENTS |
|---|---|---|---|
| Strata | | Protective steel cover<br>3-foot square concrete pad<br>Top of casing Elev. = | |
| | | (DEPTH) | |
| | | Surface Seal: concrete (0.5) | |
| | 10 | | |
| | 20 | | |
| | 30 | Annular Fill: cement-bentonite grout | |
| | 40 | | |
| | 50 | | |
| | 60 | (57.3) | |



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SOUTHERN COMPANY

# RECORD OF WELL CONSTRUCTION

**WELL: GSD-AP-MW-2VA**

APC439007

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

| BOREHOLE DATA | DEPTH (ft) | WELL DATA | | COMMENTS |
|---|---|---|---|---|
| Strata | | Protective steel cover<br>3-foot square concrete pad<br>Top of casing Elev. = | | |
| | | (CONTINUED) | (DEPTH) | |
| | | Annular Seal: 3/8 Bentonite Non-Coated Pellets | | |
| | | Filter: 20-40 graded silica filter sand | (62.9) | |
| | | | (65.0) | |
| | 70 | **Well: 2" OD PVC (SCH 40)**<br>**Screen: 10 ft. 0.010" slot prepack** | | |
| | | Sump:0.90 ft. | (75.0)<br>(75.9) | |
| | 80 | | (80.0) | |
| | 90 | | | |
| | 100 | Backfill:Silica Sand | | |
| | 110 | | | |

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SOUTHERN COMPANY

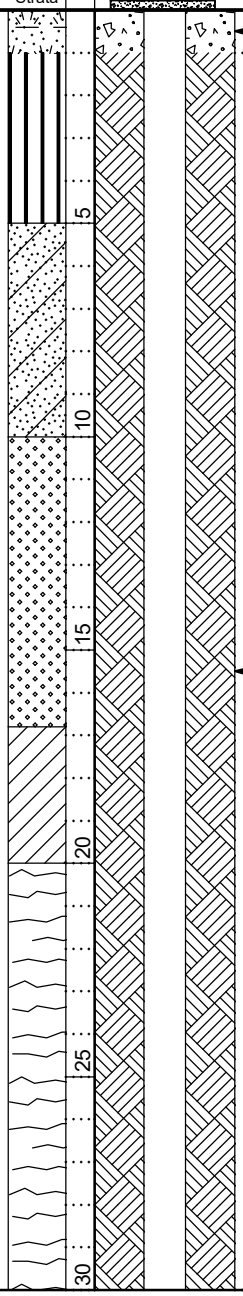
# RECORD OF WELL CONSTRUCTION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

**DATE STARTED** 10/22/2019 **COMPLETED** 10/22/2019 **SURF. ELEV.** Not Surveyed **COORDINATES:**
**CONTRACTOR** Cascade **EQUIPMENT** Sonic 8140LC **METHOD** Rotosonic
**DRILLED BY** M. Rodrigues **LOGGED BY** S. McDonald **CHECKED BY** B. Coates **ANGLE** **BEARING**
**BORING DEPTH** 45 ft. **GROUND WATER DEPTH: DURING** **COMP.** 16.18 ft. **DELAYED**
**NOTES** Well installed. Refer to well data sheet.

| BOREHOLE DATA | DEPTH (ft) | WELL DATA | COMMENTS |
|---|---|---|---|
| Strata | | Protective steel cover<br>3-foot square concrete pad<br>Top of casing Elev. = (DEPTH) | |
| | | Surface Seal: concrete (1.0) | |
| | 5 | | |
| | 10 | | |
| | 15 | Annular Fill: cement-bentonite grout | |
| | 20 | | |
| | 25 | | |
| | 30 | | |



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SOUTHERN COMPANY

# RECORD OF WELL CONSTRUCTION

**WELL: GSD-AP-MW-4V**

APC439007

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

**PROJECT** Plant Gadsden Ash Pond
**LOCATION** Plant Gadsden, Gadsden, Alabama

| BOREHOLE DATA | DEPTH (ft) | WELL DATA | COMMENTS |
|---|---|---|---|
| Strata | | Protective steel cover<br>3-foot square concrete pad<br>Top of casing Elev. = | |
| | | (CONTINUED) (DEPTH) | |
| | | (30.0) Annular Seal: 3/8 Bentonite Non-Coated Pellets | |
| | | (33.0) Filter: 20-40 graded silica filter sand | |
| | 35 | (35.0) | |
| | 40 | **Well: 2" OD PVC (SCH 40)**<br>**Screen: 9.5 ft. 0.010" slot prepack** | |
| | 45 | Sump:0.50 ft. (44.5) | |

# Appendix B

# ALABAMA POWER COMPANY
# PLANT GADSDEN
# ASH POND
# STATISTICAL ANALYSIS PLAN

Prepared for

Alabama Power Company
Birmingham, Alabama

Prepared by

Groundwater Stats Consulting
Mobile, Alabama

Revised August 2020

Alabama Power

# ALABAMA POWER COMPANY
# PLANT GADSDEN
# ASH POND
# 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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**TABLE OF CONTENTS**


1.0 Introduction ..... 3
2.0 Background ..... 4
2.1 Background Screening ..... 4
2.1.1 Outlier Testing ..... 5
2.1.2 Testing and Adjusting for Seasonal Effects ..... 5
2.1.3 Temporal Trend Testing ..... 5
2.1.4 Sample Size ..... 7
2.1.5 Non-Detect Data ..... 7
2.2 Updating Interwell Background ..... 7
2.2.1 Adding to the Background Well Network ..... 8
2.2.2 Removing Wells and Data from Background ..... 9
2.3 Updating Intrawell Background ..... 10
3.0 Statistical Approach for Detection Monitoring ..... 11
3.1 Statistical Method ..... 11
3.2 Prediction Limits ..... 12
3.3 Criteria for Using the Interwell Statistical Methodology ..... 12
3.3.1 Aquifer Designation and Monitoring Wells ..... 12
3.4 Criteria for Using an Intrawell Statistical Methodology ..... 13
3.4.1 Screening of Prospective Historical Background Data ..... 13
3.4.2 Stable Naturally Occurring Concentrations ..... 13
3.5 Site-Wide False Positive Rates (SWFPR) and Statistical Power ..... 14
3.6 Determination of Future Compliance Observations Falling Within Background Limits ..... 14
3.7 Statistical Power ..... 15
4.0 Statistical Approach for Assessment Monitoring & Corrective Action ..... 15
4.1 Assessment Monitoring ..... 16
4.2 Corrective Action ..... 17
5.0 Site-Specific Statistical Analysis Methods ..... 17
5.1 Detection Monitoring Program ..... 17
5.1.1 Parametric Prediction Limits ..... 18
5.1.2 Nonparametric Prediction Limits ..... 18
5.1.3 Retesting Strategy ..... 19
5.1.4 Background Data Set ..... 19
5.2 Assessment Monitoring Program ..... 20

5.3 Corrective Action Monitoring Program ..... 21
6.0 Bibliography ..... 22

**APPENDICES**

Appendix A Background Screening and Compliance Evaluation

## 1.0 INTRODUCTION

This updated Statistical Analysis Plan (SAP) describes the site-specific statistical analysis approach that is typically used to evaluate groundwater pursuant to ADEM Admin. Code r. 335-13-15-.06 and 40 CFR Part 257. 90 through 95 under detection and assessment monitoring programs. Note, however, that interwell prediction limits will be used at Alabama Power Company's Plant Gadsden Ash Pond for Appendix III Detection Monitoring parameters in accordance with Alabama Department of Environmental Management (ADEM) guidelines. Future changes in the statistical analysis approach require approval from ADEM.

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:

[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

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

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.

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

[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.

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.

## 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 is typically 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.

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

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 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

[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.

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 95% 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

Groundwater quality data will be evaluated through use of interwell prediction limits for all Appendix III constituents combined with a 1-of-2 resampling strategy. If a statistical exceedance is found, an 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 Gadsden Ash Pond 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
w= 15 (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 resample(s) 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. When 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.

[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.

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# Figures

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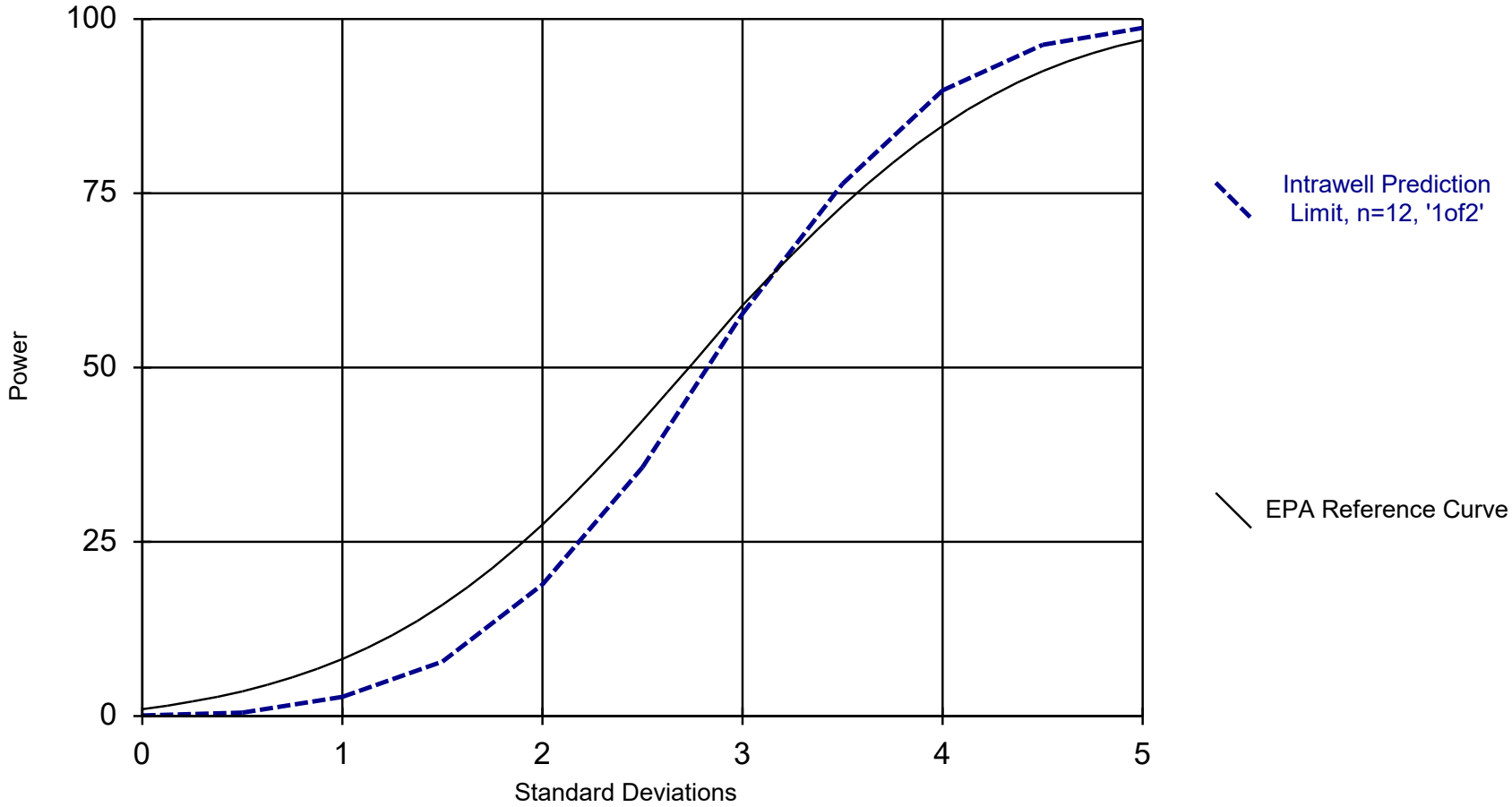
# Table 1.
# Groundwater Monitoring Well Network Details

| Well Name | Purpose | Installation Date | Northing [1] | Easting [1] | Ground Elevation [2] | Top of Casing Elevation [2] | Well Depth (ft.) Below Top of Casing | Top of Screen Elevation [2,4] | Bottom of Screen Elevation [2,4] | Screen Length (ft) |
|---|---|---|---|---|---|---|---|---|---|---|
| GSD-AP-MW-1 | Downgradient | 8/8/2017 | 1279914.40 | 615079.93 | 523.48 | 526.37 | 27.79 | 509.08 | 499.08 | 10 |
| GSD-AP-MW-2 | Downgradient | 8/10/2017 | 1280352.80 | 614599.21 | 523.04 | 526.16 | 28.17 | 508.49 | 498.49 | 10 |
| GSD-AP-MW-3 | Downgradient | 8/11/2017 | 1280742.72 | 614102.00 | 523.68 | 526.80 | 27.45 | 509.85 | 499.85 | 10 |
| GSD-AP-MW-4 | Downgradient | 7/15/2013 | 1281001.39 | 613884.36 | 517.27 | 520.60 | 26.27 | 504.83 | 494.83 | 10 |
| GSD-AP-MW-5 | Downgradient | 8/15/2017 | 1281367.84 | 613584.86 | 513.26 | 516.27 | 26.88 | 499.89 | 489.89 | 10 |
| GSD-AP-MW-6 | Downgradient | 8/3/2017 | 1281745.78 | 612969.64 | 512.09 | 515.23 | 26.25 | 499.48 | 489.48 | 10 |
| GSD-AP-MW-7 | Downgradient | 7/16/2013 | 1281131.20 | 612627.76 | 517.05 | 519.86 | 30.30 | 500.06 | 490.06 | 10 |
| GSD-AP-MW-8 | Downgradient | 8/2/2017 | 1280261.79 | 612527.24 | 516.02 | 519.22 | 32.68 | 497.04 | 487.04 | 10 |
| GSD-AP-MW-9 | Downgradient | 7/16/2013 | 1279916.88 | 613123.38 | 517.41 | 520.36 | 35.19 | 495.67 | 485.67 | 10 |
| GSD-AP-MW-10 | Downgradient | 8/3/2017 | 1279709.35 | 613729.63 | 527.70 | 530.91 | 48.42 | 492.99 | 482.99 | 10 |
| GSD-AP-MW-11 | Downgradient | 7/17/2013 | 1279209.03 | 614235.25 | 514.18 | 517.01 | 34.00 | 492.51 | 482.51 | 10 |
| GSD-AP-MW-12 | Downgradient | 7/17/2013 | 1279381.38 | 614989.08 | 518.73 | 521.82 | 31.75 | 500.57 | 490.57 | 10 |
| GSD-AP-MW-14 | Upgradient | 3/27/2018 | 1277336.39 | 615233.22 | 545.49 | 548.34 | 32.84 | 525.50 | 516.00 | 10 |
| GSD-AP-MW-16 | Upgradient | 9/20/2018 | 1277286.36 | 615079.67 | 553.08 | 555.83 | 36.23 | 530.10 | 520.10 | 10 |
| GSD-AP-MW-17 | Upgradient | 9/24/2018 | 1277101.94 | 615157.25 | 546.88 | 550.11 | 62.78 | 497.83 | 487.83 | 10 |
| GSD-AP-PZ-1 [3] | Downgradient | 8/14/2017 | 1281425.06 | 614048.07 | 518.80 | 521.64 | 27.47 | 504.67 | 494.67 | 10 |
| GSD-AP-PZ-2 [3] | Piezometer | 8/16/2017 | 1281957.82 | 612944.02 | 513.46 | 516.49 | 23.94 | 503.05 | 493.05 | 10 |
| GSD-AP-PZ-5 [3] | Downgradient | 3/28/2018 | 1280939.08 | 614998.03 | 521.36 | 524.26 | 30.77 | 503.99 | 493.99 | 10 |
| GSD-AP-PZ-6 [3] | Downgradient | 3/28/2018 | 1280911.35 | 614555.89 | 516.69 | 519.60 | 22.35 | 507.75 | 497.75 | 10 |
| GSD-AP-MW-2V | Vertical Delineation | 10/24/2019 | 1280364.25 | 614608.05 | 522.90 | 525.31 | 62.41 | 472.90 | 462.90 | 10 |
| GSD-AP-MW-4V | Vertical Delineation | 10/22/2019 | 1280986.06 | 613900.64 | 517.56 | 520.33 | 44.75 | 485.58 | 475.58 | 10 |
| GSD-AP-MW-18H | Horizontal Delineation | 10/24/2019 | 1280350.60 | 615161.03 | 522.28 | 524.45 | 27.60 | 506.85 | 496.85 | 10 |
| GSD-AP-MW-19H | Horizontal Delineation | 10/24/2019 | 1280656.67 | 614589.91 | 513.95 | 517.32 | 22.08 | 505.24 | 495.24 | 10 |
| GSD-AP-MW-20H | Horizontal Delineation | 10/24/2019 | 1281024.09 | 613927.12 | 514.28 | 516.68 | 20.29 | 506.39 | 496.39 | 10 |

Notes:
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. With the exception of GSD-AP-PZ-2, piezometers have been converted to downgradient compliance wells.
4. Top of screen and bottom of screen elevations are calculated relative to Top of Casing elevation and less the well sump length of 0.4’.

# Power Curve

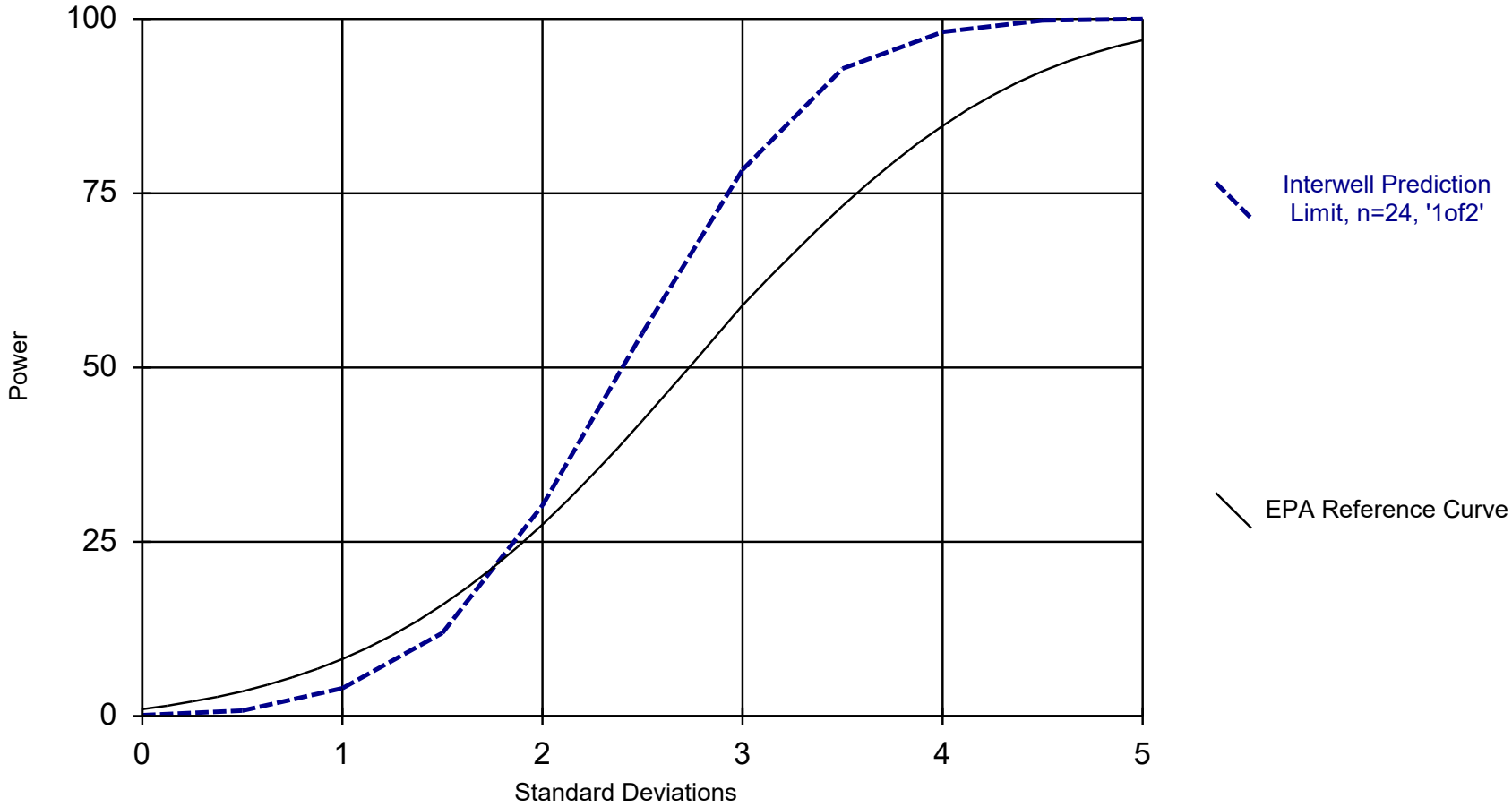



Kappa = 2.772, based on 15 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/10/2020 8:07 AM

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Power Curve




Kappa = 2.316, based on 15 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/10/2020 8:41 AM

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Appendix A
# Background Screening and Compliance Evaluation

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GROUNDWATER STATS
CONSULTING

April 17, 2019

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

Re: Plant Gadsden Landfill
Background Data Screening & Recommended Statistical Methods

Dear Mr. Dyer,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the background screening and recommended statistical analysis method setup for groundwater quality for Alabama Power Company's Plant Gadsden Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) and follows the USEPA Unified Guidance (2009).

Sampling began for the CCR program in December 2017, and at least 8 background samples have been collected at each of the groundwater monitoring wells.

The monitoring well network, as provided by Southern Company Services, consists of the following:

- **Upgradient wells:** GSD-AP-MW-14, GSD-AP-MW-16, GSD-AP-MW-17
- **Downgradient wells:** GSD-AP-MW-1, GSD-AP-MW-2, GSD-AP-MW-3, GSD-AP-MW-4, GSD-AP-MW-5, GSD-AP-MW-6, GSD-AP-MW-7, GSD-AP-MW-8, GSD-AP-MW-9, GSD-AP-MW-10, GSD-AP-MW-11, GSD-AP-MW-12, GSD-AP-PZ-1, GSD-AP-PZ-5, GSD-AP-PZ-6

Data were sent electronically to Groundwater Stats Consulting, and the statistical 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;
- **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters at all wells are provided for the purpose of screening data at these wells (Figure A). Additionally, a separate section of box plots is included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

Data at all wells were evaluated for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves are provided to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance. The EPA suggests the selected statistical method should provide at least 55% power at 3 standard deviations or at least 80% power at 4 standard deviations.

## Background Screening

### Outlier and Trend Testing

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not representative of the current background data population. Suspected outliers at all wells for Appendix III and Appendix IV parameters are formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits.

Using the Tukey box plot method, two outliers were identified. A summary of those findings is included with the tests (Figure C). While this is not the case in the present data

set, when the most recent value is identified as an outlier, values are not flagged in the database at this time as they may represent a possible trend. If future values do not remain at similar concentrations, these values will be flagged as outliers and deselected. Several low values exist in the data sets and appear on the graphs as possible low outliers relative to the laboratory's Practical Quantitation Limit. However, these values are observed trace values (i.e. measurements reported by the laboratory between the Method Detection Limit and the Practical Quantitation Limit) and, therefore, were not flagged as outliers.

Of the outliers identified by Tukey's method, only one value was flagged as such in the database as the other value was similar to remaining measurements within the same well and neighboring wells. When any values are flagged in the database as outliers, they are plotted in a disconnected and lighter symbol on the time series graph. The accompanying data pages will display the flagged value in a lighter font as well. A substitution of the most recent reporting limit was applied when varying detection limits existed in data. When the reporting limit was higher than the Regional Screening Levels discussed below, nondetects were substituted with one half the reporting limit.

No obvious seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release.

While trends may be identified by visual inspection, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends (Figure D). In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, all available data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When any records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed several statistically significant decreasing and increasing trends for the Appendix III parameters as may be seen on the Trend Test Summary Table (Figure D). Most of the trends noted were relatively low in magnitude when compared to average concentrations, and the background time period is short with

less than two years of record, making it difficult to separate trends from normal year-to-year variation; therefore, no adjustments were made to the data sets. If the observed decreasing or increasing trends persist over a longer time frame, some records may need to be truncated.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach (Figure E). Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, 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 are not representative of the current background data population; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

The ANOVA identified variation among upgradient well data for all Appendix III parameters except TDS. Therefore, interwell method are recommended initially for TDS, and all other constituents were further evaluated as described below for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results is included with the reports in Figure E.

Appendix III – Intrawell Method Eligibility Screening

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are representative of the background data population, and that will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps are required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells to concentrations reported in upgradient wells for Appendix III parameters.

Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site. Two-sided tolerance limits are included for pH and represent both the upper and lower ranges of possible measurements in background wells.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent where intrawell analyses are recommended, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using pooled upgradient well data for each of the Appendix III parameters (Figure F). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above, to determine intrawell eligibility where applicable (Figure G). Parametric confidence intervals around the population mean are 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 are 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, eight samples are recommended. 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.

When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Note that this screening identifies whether confidence intervals are above a background standard, but does not identify the reason for this occurrence. Therefore, only the wells/parameters with confidence intervals which did not exceed background standards are eligible for intrawell prediction limits.

At least one confidence interval exceedance was noted for boron, calcium, chloride and sulfate; therefore, interwell methods are initially recommended for these parameters along with TDS based on the results of the ANOVA. Intrawell methods, therefore, are recommended for fluoride and pH. If further evaluation confirms natural variation in groundwater, intrawell methods will be considered for parameters currently recommended for interwell methods.

Appendix III Parameters – Establishing Statistical Limits

Intrawell prediction limits, combined with a 1-of-3 resample plan, were constructed for fluoride and pH; and interwell prediction limits, combined with a 1-of-2 resample plan, were constructed for boron, calcium, chloride, sulfate and TDS using all available data through February 2019 to develop background limits (Figures H and I, respectively). The most recent observation at each well will be compared to its respective background limit (i.e. intrawell or interwell) during each subsequent semi-annual sampling event.

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 determine whether there are statistically significant increases (SSIs). 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.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes. In the interwell case, newer data will be included in background following each event, provided that upgradient well data are reviewed for outliers and trending data. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even

though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample, and the 1-of-3 resample plan allows for collection of up to two additional samples, to determine whether the initial exceedance is confirmed. When the resamples confirm 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 and, therefore, no further action is necessary. Summary tables of the background prediction limits follow this letter in Figures H and I.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. The confidence levels associated with parametric prediction limits are based on an overall false positive rate of 5%. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized where the highest background value is used to establish the upper prediction limit (and lowest value in the case of pH). The associated confidence level is dependent on the number of available background, future comparisons and 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 (USEPA Unified Guidance, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects.
- 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.

Appendix IV Parameters – Assessment Monitoring Program

During an Assessment Monitoring program, confidence intervals are constructed at all wells for detected Appendix IV parameters and compared to a Groundwater Protection Standard (GWPS). A minimum of 4 samples is required to construct confidence intervals; however, 8 samples are recommended for better representation of the true average population. The GWPS includes the established Maximum Contaminant Levels (MCLs), the Regional Screening Levels (RSLs) for parameters without MCLs (cobalt, lead, lithium and molybdenum), or background as discussed below. Parametric confidence intervals are constructed with 99% confidence when data follow a normal or transformed-normal distribution. For all other cases, nonparametric confidence intervals are constructed, with the confidence level based on the number of samples available. The GWPS is exceeded only when the entire confidence interval exceeds its respective GWPS.

Background limits are established for the Appendix IV parameters using upper tolerance limits constructed with 95% confidence/95% coverage using pooled upgradient well data, for comparison against established MCLs (Figure J). When background limits, or Alternate Contaminant Levels (ACLs), are higher than established MCLs or RSLs, the CCR Rule recommends using these ACLs as the GWPS for the confidence interval comparisons. Since the scope of this project included screening and development of background limits for Appendix III Detection Monitoring statistics, a table of the Appendix IV GWPS derived from MCLs, RSLs and background comparisons is provided in Figure K, but no confidence intervals were constructed in this report.

**Recommendations**

Based on the background screening described in this letter, the following statistical methods are recommended at this site in accordance with the USEPA Unified Guidance for the Appendix III parameters:

1) Intrawell prediction limits, combined with a 1-of-3 resample plan for fluoride and pH;
2) Interwell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, chloride, sulfate and TDS.

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

For Groundwater Stats Consulting,

Kristina L. Rayner
Groundwater Statistician

# Figures

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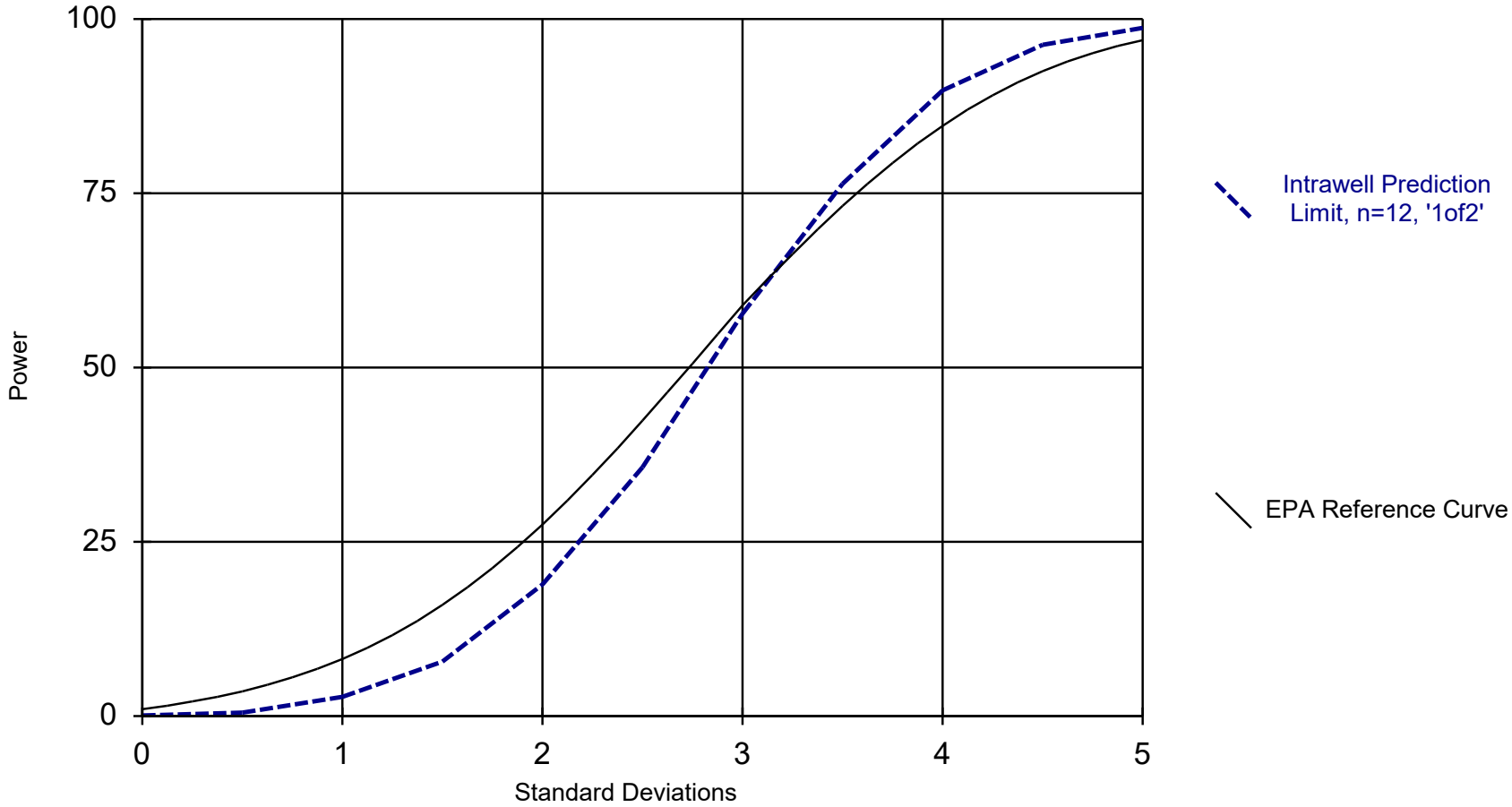
# Power Curve

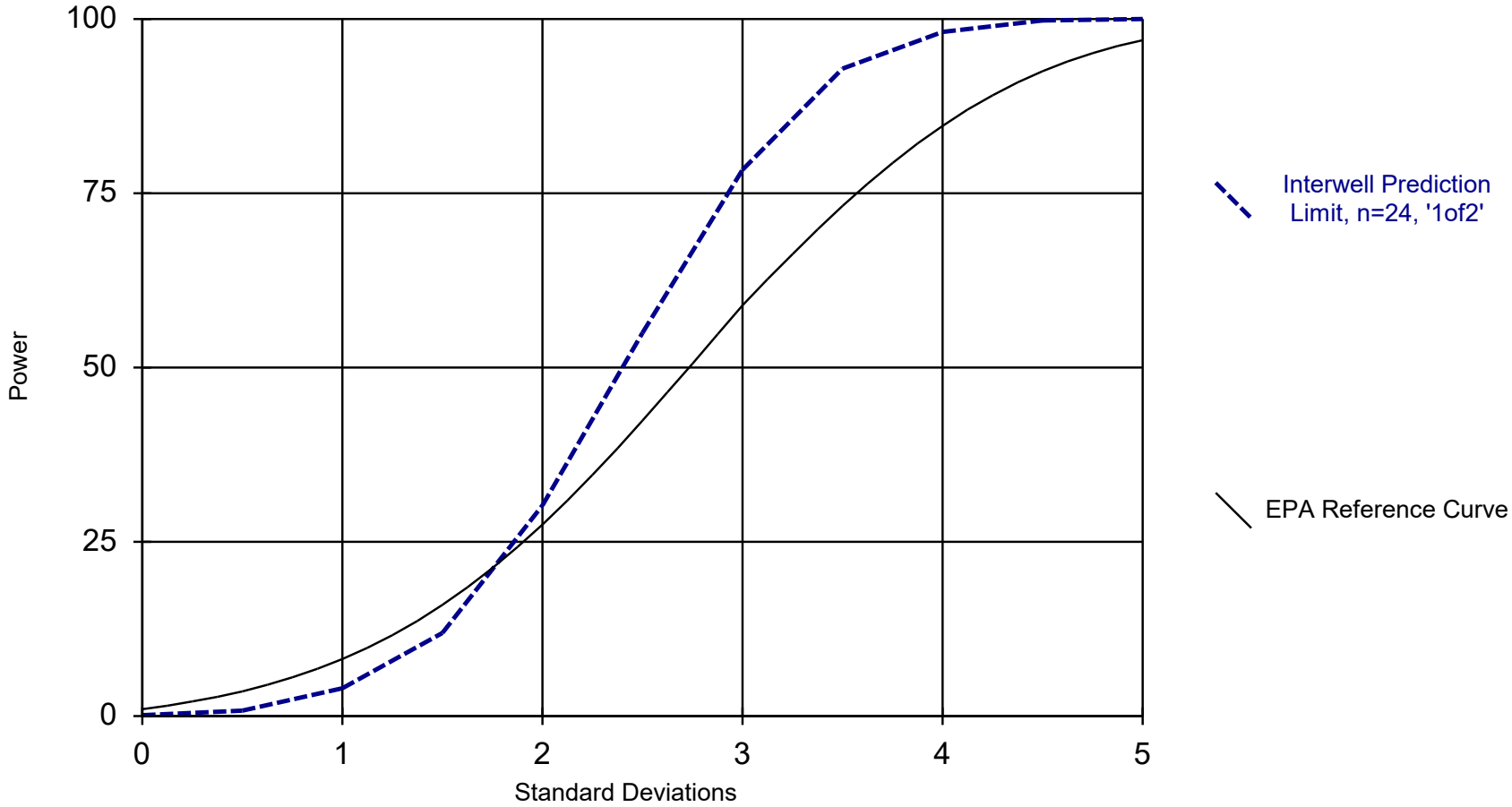



Kappa = 2.772, based on 15 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/10/2020 8:07 AM

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Power Curve



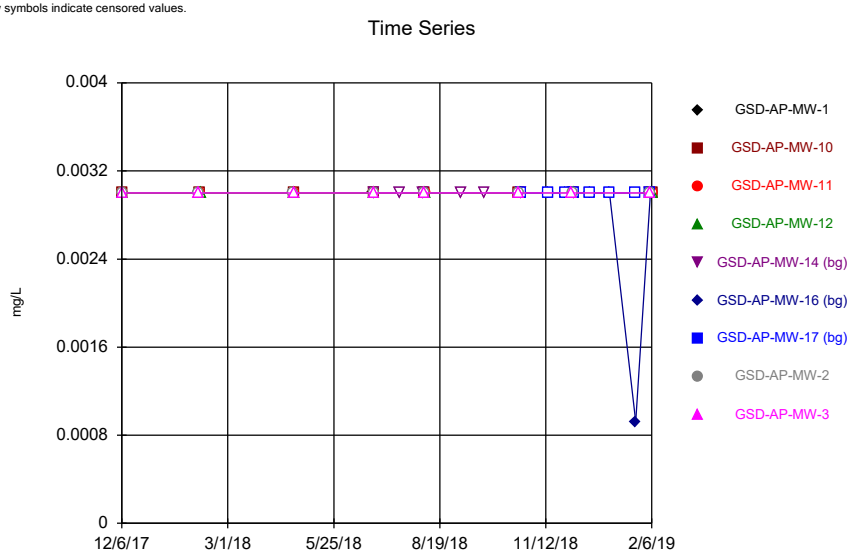

Kappa = 2.316, based on 15 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/10/2020 8:41 AM

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

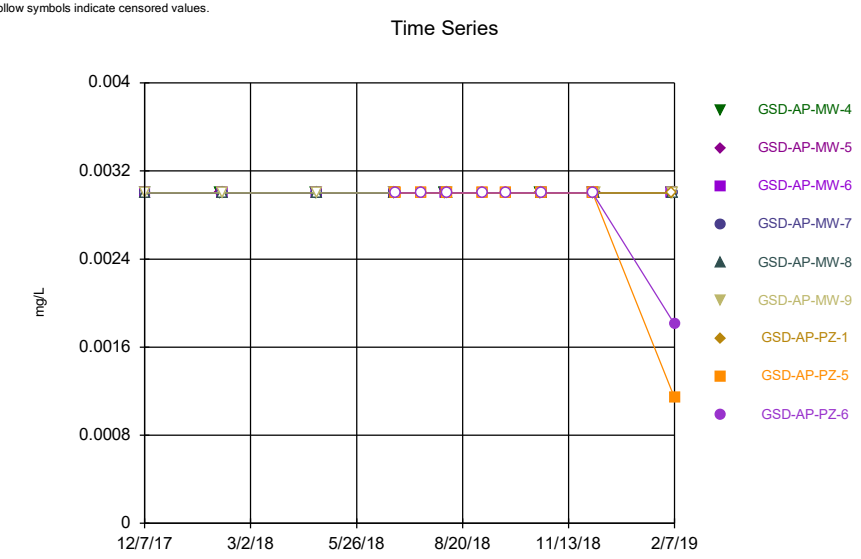
# FIGURE A.

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



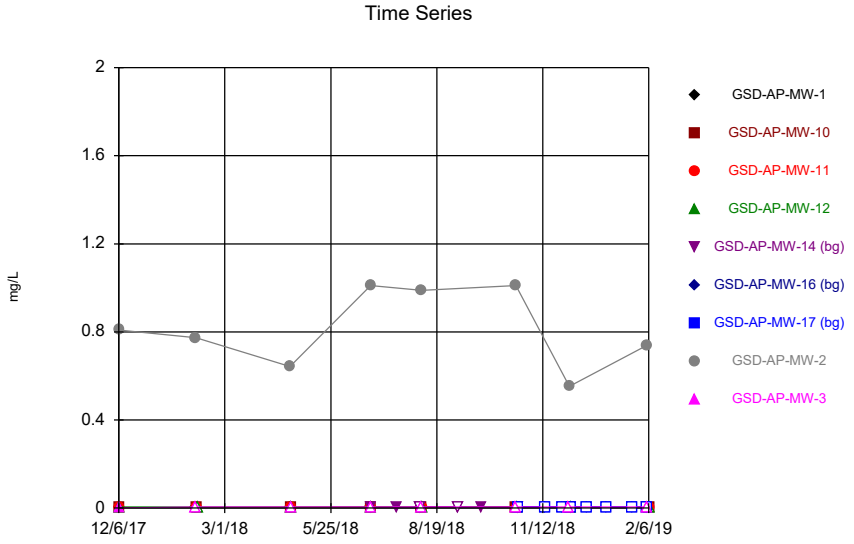

Constituent: Antimony Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



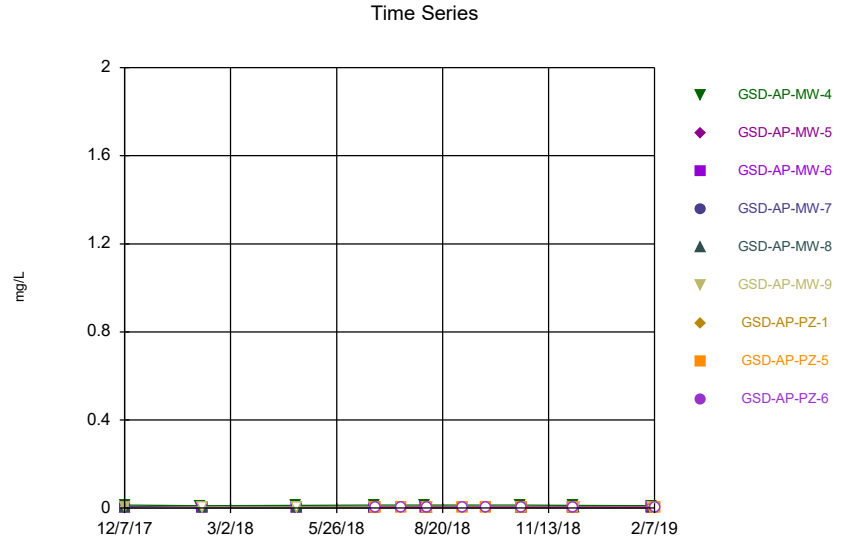

Constituent: Antimony Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Arsenic Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Arsenic Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Antimony (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.003 | <0.003 | <0.003 | <0.003 | | | | <0.003 | <0.003 |
| 2/6/2018 | <0.003 | | | | | | | <0.003 | <0.003 |
| 2/7/2018 | | <0.003 | <0.003 | | | | | | |
| 2/8/2018 | | | | <0.003 | | | | | |
| 4/23/2018 | <0.003 | | | | | | | <0.003 | |
| 4/24/2018 | | <0.003 | <0.003 | <0.003 | | | | | <0.003 |
| 6/26/2018 | <0.003 | | | | | | | | |
| 6/27/2018 | | <0.003 | <0.003 | <0.003 | <0.003 | | | <0.003 | <0.003 |
| 7/18/2018 | | | | | <0.003 | | | | |
| 8/6/2018 | | | | | <0.003 | | | | |
| 8/7/2018 | <0.003 | <0.003 | | | | | | <0.003 | <0.003 |
| 8/8/2018 | | | <0.003 | <0.003 | | | | | |
| 9/5/2018 | | | | | <0.003 | | | | |
| 9/24/2018 | | | | | <0.003 | | | | |
| 10/22/2018 | <0.003 | <0.003 | | | | | | <0.003 | <0.003 |
| 10/23/2018 | | | <0.003 | <0.003 | | | | | |
| 10/24/2018 | | | | | <0.003 | <0.003 | <0.003 | | |
| 11/14/2018 | | | | | | <0.003 | <0.003 | | |
| 11/28/2018 | | | | | | <0.003 | <0.003 | | |
| 12/3/2018 | | | | | | | | | <0.003 |
| 12/4/2018 | <0.003 | <0.003 | <0.003 | | | | | <0.003 | |
| 12/5/2018 | | | | <0.003 | <0.003 | <0.003 | <0.003 | | |
| 12/18/2018 | | | | | | <0.003 | <0.003 | | |
| 1/3/2019 | | | | | | <0.003 | <0.003 | | |
| 1/24/2019 | | | | | | 0.000922 (J) | <0.003 | | |
| 2/5/2019 | <0.003 | | | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| 2/6/2019 | | <0.003 | <0.003 | <0.003 | | | | | |

# Time Series

Constituent: Antimony (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | | | |
| 2/6/2018 | <0.003 | <0.003 | | | | | | | |
| 2/8/2018 | | | <0.003 | <0.003 | <0.003 | <0.003 | | | |
| 4/24/2018 | <0.003 | | | | | | | | |
| 4/25/2018 | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | | | |
| 6/26/2018 | <0.003 | | <0.003 | <0.003 | <0.003 | <0.003 | | | |
| 6/27/2018 | | <0.003 | | | | | <0.003 | <0.003 | <0.003 |
| 7/18/2018 | | | | | | | <0.003 | <0.003 | <0.003 |
| 8/6/2018 | <0.003 | | | | | | | | |
| 8/7/2018 | | <0.003 | <0.003 | | | | <0.003 | | |
| 8/8/2018 | | | | <0.003 | <0.003 | <0.003 | | <0.003 | <0.003 |
| 9/5/2018 | | | | | | | <0.003 | <0.003 | <0.003 |
| 9/24/2018 | | | | | | | <0.003 | <0.003 | <0.003 |
| 10/22/2018 | <0.003 | | | | | | <0.003 | | |
| 10/23/2018 | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | | <0.003 | <0.003 |
| 12/3/2018 | <0.003 | | <0.003 | | | | <0.003 | <0.003 | <0.003 |
| 12/4/2018 | | | | <0.003 | <0.003 | | | | |
| 12/5/2018 | | <0.003 | | | | <0.003 | | | |
| 2/5/2019 | <0.003 | <0.003 | <0.003 | | | | <0.003 | | |
| 2/6/2019 | | | | <0.003 | <0.003 | <0.003 | | | |
| 2/7/2019 | | | | | | | | 0.00114 (J) | 0.00181 (J) |

# Time Series

Constituent: Arsenic (mg/L)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 0.00179 (J) | 0.00247 (J) | 0.00279 (J) | <0.005 | | | | 0.809 | 0.00101 (J) |
| 2/6/2018 | 0.00191 (J) | | | | | | | 0.774 | <0.005 |
| 2/7/2018 | | 0.00192 (J) | 0.00252 (J) | | | | | | |
| 2/8/2018 | | | | <0.005 | | | | | |
| 4/23/2018 | 0.0023 (J) | | | | | | | 0.643 | |
| 4/24/2018 | | 0.00218 (J) | 0.00283 (J) | <0.005 | | | | | <0.005 |
| 6/26/2018 | 0.00306 (J) | | | | | | | | |
| 6/27/2018 | | 0.00419 (J) | 0.00289 (J) | <0.005 | 0.00165 (J) | | | 1.01 | <0.005 |
| 7/18/2018 | | | | | 0.00117 (J) | | | | |
| 8/6/2018 | | | | | <0.005 | | | | |
| 8/7/2018 | 0.00336 (J) | 0.00365 (J) | | | | | | 0.988 | <0.005 |
| 8/8/2018 | | | 0.00265 (J) | <0.005 | | | | | |
| 9/5/2018 | | | | | <0.005 | | | | |
| 9/24/2018 | | | | | 0.00148 (J) | | | | |
| 10/22/2018 | 0.00451 (J) | 0.00404 (J) | | | | | | 1.01 | <0.005 |
| 10/23/2018 | | | 0.00287 (J) | <0.005 | | | | | |
| 10/24/2018 | | | | | <0.005 | <0.005 | <0.005 | | |
| 11/14/2018 | | | | | | <0.005 | <0.005 | | |
| 11/28/2018 | | | | | | 0.00124 (J) | <0.005 | | |
| 12/3/2018 | | | | | | | | | <0.005 |
| 12/4/2018 | 0.00471 (J) | 0.00332 (J) | 0.00271 (J) | | | | | 0.553 | |
| 12/5/2018 | | | | <0.005 | <0.005 | 0.00113 (J) | <0.005 | | |
| 12/18/2018 | | | | | | 0.00113 (J) | <0.005 | | |
| 1/3/2019 | | | | | | 0.00175 (J) | <0.005 | | |
| 1/24/2019 | | | | | | 0.00257 (J) | <0.005 | | |
| 2/5/2019 | 0.00365 (J) | | | | 0.00119 (J) | 0.00355 (J) | <0.005 | 0.74 | <0.005 |
| 2/6/2019 | | 0.00333 (J) | 0.00272 (J) | <0.005 | | | | | |

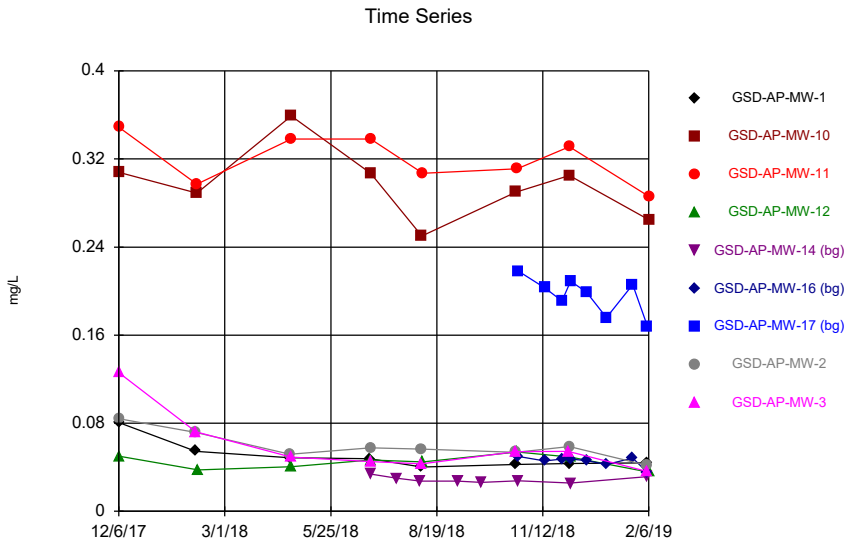
# Time Series

Constituent: Arsenic (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

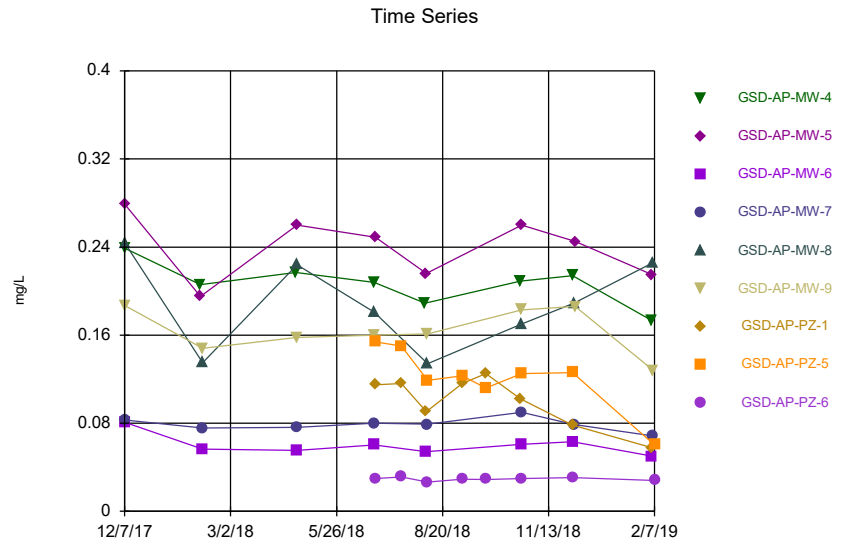
| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 0.0132 | <0.005 | <0.005 | <0.005 | 0.00313 (J) | 0.00112 (J) | | | |
| 2/6/2018 | 0.0105 | <0.005 | | | | | | | |
| 2/8/2018 | | | <0.005 | <0.005 | 0.00247 (J) | <0.005 | | | |
| 4/24/2018 | 0.0124 | | | | | | | | |
| 4/25/2018 | | <0.005 | <0.005 | <0.005 | 0.00291 (J) | <0.005 | | | |
| 6/26/2018 | 0.0132 | | <0.005 | <0.005 | 0.00265 (J) | <0.005 | | | |
| 6/27/2018 | | <0.005 | | | | | <0.005 | <0.005 | <0.005 |
| 7/18/2018 | | | | | | | <0.005 | <0.005 | <0.005 |
| 8/6/2018 | 0.013 | | | | | | | | |
| 8/7/2018 | | <0.005 | <0.005 | | | | <0.005 | | |
| 8/8/2018 | | | | <0.005 | 0.00203 (J) | <0.005 | | <0.005 | <0.005 |
| 9/5/2018 | | | | | | | <0.005 | <0.005 | <0.005 |
| 9/24/2018 | | | | | | | <0.005 | <0.005 | <0.005 |
| 10/22/2018 | 0.0144 | | | | | | <0.005 | | |
| 10/23/2018 | | <0.005 | <0.005 | <0.005 | 0.00246 (J) | <0.005 | | <0.005 | <0.005 |
| 12/3/2018 | 0.0119 | | <0.005 | | | | <0.005 | <0.005 | <0.005 |
| 12/4/2018 | | | | <0.005 | 0.00328 (J) | | | | |
| 12/5/2018 | | <0.005 | | | | 0.00111 (J) | | | |
| 2/5/2019 | 0.0107 | <0.005 | <0.005 | | | | <0.005 | | |
| 2/6/2019 | | | | <0.005 | 0.00325 (J) | <0.005 | | | |
| 2/7/2019 | | | | | | | | <0.005 | <0.005 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



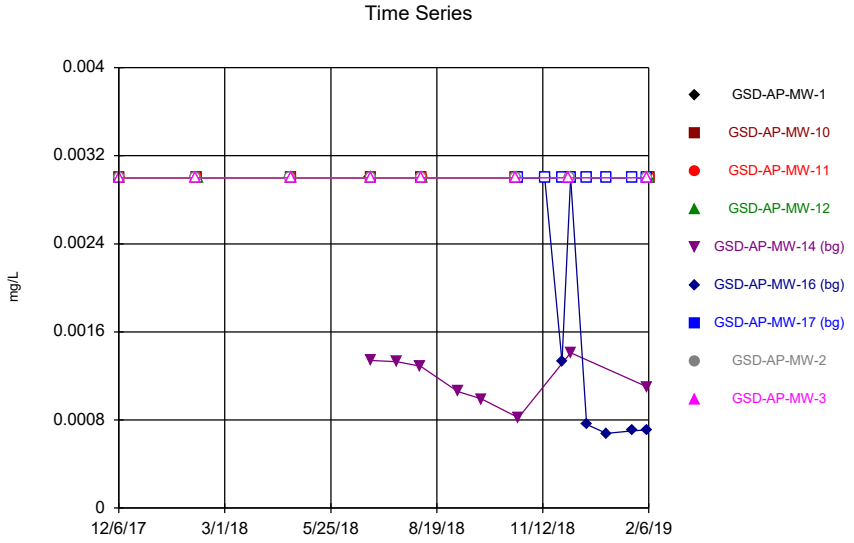

Constituent: Barium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



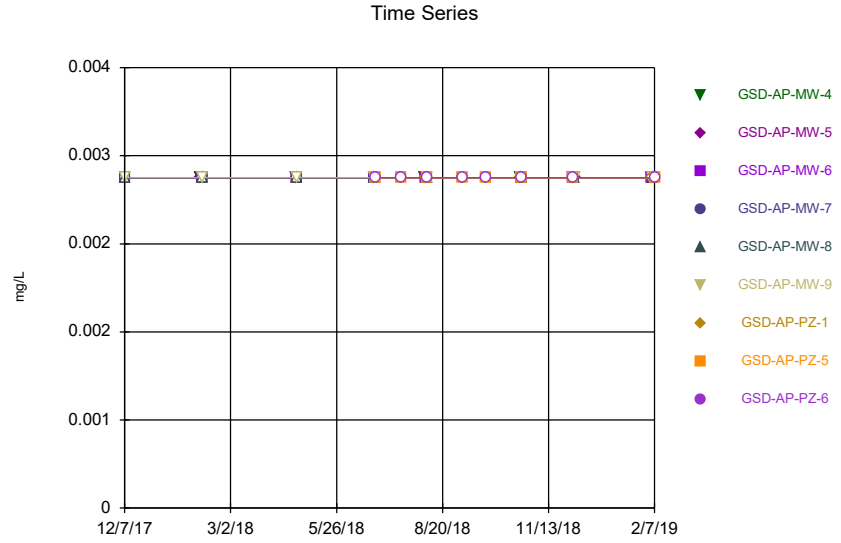

Constituent: Barium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Beryllium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Beryllium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Barium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 0.0807 | 0.308 | 0.349 | 0.0501 | | | | 0.0842 | 0.126 |
| 2/6/2018 | 0.0546 | | | | | | | 0.0716 | 0.0721 |
| 2/7/2018 | | 0.289 | 0.297 | | | | | | |
| 2/8/2018 | | | | 0.0375 | | | | | |
| 4/23/2018 | 0.0488 | | | | | | | 0.0518 | |
| 4/24/2018 | | 0.359 | 0.338 | 0.0405 | | | | | 0.0492 |
| 6/26/2018 | 0.0479 | | | | | | | | |
| 6/27/2018 | | 0.307 | 0.338 | 0.0466 | 0.0338 | | | 0.0578 | 0.0453 |
| 7/18/2018 | | | | | 0.03 | | | | |
| 8/6/2018 | | | | | 0.0274 | | | | |
| 8/7/2018 | 0.0402 | 0.25 | | | | | | 0.0566 | 0.0431 |
| 8/8/2018 | | | 0.307 | 0.0448 | | | | | |
| 9/5/2018 | | | | | 0.0275 | | | | |
| 9/24/2018 | | | | | 0.0264 | | | | |
| 10/22/2018 | 0.0427 | 0.29 | | | | | | 0.0536 | 0.0541 |
| 10/23/2018 | | | 0.311 | 0.054 | | | | | |
| 10/24/2018 | | | | | 0.0276 | 0.0499 | 0.218 | | |
| 11/14/2018 | | | | | | 0.0458 | 0.203 | | |
| 11/28/2018 | | | | | | 0.0476 | 0.191 | | |
| 12/3/2018 | | | | | | | | | 0.0545 |
| 12/4/2018 | 0.0434 | 0.305 | 0.331 | | | | | 0.0589 | |
| 12/5/2018 | | | | 0.0493 | 0.0256 | 0.0475 | 0.209 | | |
| 12/18/2018 | | | | | | 0.0461 | 0.199 | | |
| 1/3/2019 | | | | | | 0.0426 | 0.176 | | |
| 1/24/2019 | | | | | | 0.0485 | 0.206 | | |
| 2/5/2019 | 0.0439 | | | | 0.0314 | 0.0354 | 0.168 | 0.0418 | 0.0363 |
| 2/6/2019 | | 0.265 | 0.286 | 0.0357 | | | | | |

# Time Series

Constituent: Barium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 0.239 | 0.279 | 0.0809 | 0.083 | 0.244 | 0.187 | | | |
| 2/6/2018 | 0.206 | 0.195 | | | | | | | |
| 2/8/2018 | | | 0.0566 | 0.0756 | 0.135 | 0.148 | | | |
| 4/24/2018 | 0.217 | | | | | | | | |
| 4/25/2018 | | 0.26 | 0.0553 | 0.0764 | 0.224 | 0.158 | | | |
| 6/26/2018 | 0.208 | | 0.0604 | 0.0799 | 0.181 | 0.16 | | | |
| 6/27/2018 | | 0.249 | | | | | 0.115 | 0.154 | 0.0298 |
| 7/18/2018 | | | | | | | 0.116 | 0.15 | 0.0312 |
| 8/6/2018 | 0.189 | | | | | | | | |
| 8/7/2018 | | 0.216 | 0.0542 | | | | 0.0906 | | |
| 8/8/2018 | | | | 0.0791 | 0.134 | 0.161 | | 0.119 | 0.0265 |
| 9/5/2018 | | | | | | | 0.116 | 0.123 | 0.0291 |
| 9/24/2018 | | | | | | | 0.125 | 0.112 | 0.029 |
| 10/22/2018 | 0.209 | | | | | | 0.102 | | |
| 10/23/2018 | | 0.26 | 0.0608 | 0.0898 | 0.17 | 0.183 | | 0.125 | 0.0298 |
| 12/3/2018 | 0.214 | | 0.0633 | | | | 0.0784 | 0.126 | 0.0307 |
| 12/4/2018 | | | | 0.0789 | 0.189 | | | | |
| 12/5/2018 | | 0.245 | | | | 0.186 | | | |
| 2/5/2019 | 0.173 | 0.215 | 0.05 | | | | 0.0578 | | |
| 2/6/2019 | | | | 0.0685 | 0.226 | 0.128 | | | |
| 2/7/2019 | | | | | | | | 0.0602 | 0.028 |

# Time Series

Constituent: Beryllium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.003 | <0.003 | <0.003 | <0.003 | | | | <0.003 | <0.003 |
| 2/6/2018 | <0.003 | | | | | | | <0.003 | <0.003 |
| 2/7/2018 | | <0.003 | <0.003 | | | | | | |
| 2/8/2018 | | | | <0.003 | | | | | |
| 4/23/2018 | <0.003 | | | | | | | <0.003 | |
| 4/24/2018 | | <0.003 | <0.003 | <0.003 | | | | | <0.003 |
| 6/26/2018 | <0.003 | | | | | | | | |
| 6/27/2018 | | <0.003 | <0.003 | <0.003 | 0.00134 (J) | | | <0.003 | <0.003 |
| 7/18/2018 | | | | | 0.00133 (J) | | | | |
| 8/6/2018 | | | | | 0.00129 (J) | | | | |
| 8/7/2018 | <0.003 | <0.003 | | | | | | <0.003 | <0.003 |
| 8/8/2018 | | | <0.003 | <0.003 | | | | | |
| 9/5/2018 | | | | | 0.00106 (J) | | | | |
| 9/24/2018 | | | | | 0.000991 (J) | | | | |
| 10/22/2018 | <0.003 | <0.003 | | | | | | <0.003 | <0.003 |
| 10/23/2018 | | | <0.003 | <0.003 | | | | | |
| 10/24/2018 | | | | | 0.00082 (J) | <0.003 | <0.003 | | |
| 11/14/2018 | | | | | | <0.003 | <0.003 | | |
| 11/28/2018 | | | | | | 0.00133 (J) | <0.003 | | |
| 12/3/2018 | | | | | | | | | <0.003 |
| 12/4/2018 | <0.003 | <0.003 | <0.003 | | | | | <0.003 | |
| 12/5/2018 | | | | <0.003 | 0.00141 (J) | <0.003 | <0.003 | | |
| 12/18/2018 | | | | | | 0.000761 (J) | <0.003 | | |
| 1/3/2019 | | | | | | 0.000677 (J) | <0.003 | | |
| 1/24/2019 | | | | | | 0.000703 (J) | <0.003 | | |
| 2/5/2019 | <0.003 | | | | 0.0011 (J) | 0.000711 (J) | <0.003 | <0.003 | <0.003 |
| 2/6/2019 | | <0.003 | <0.003 | <0.003 | | | | | |

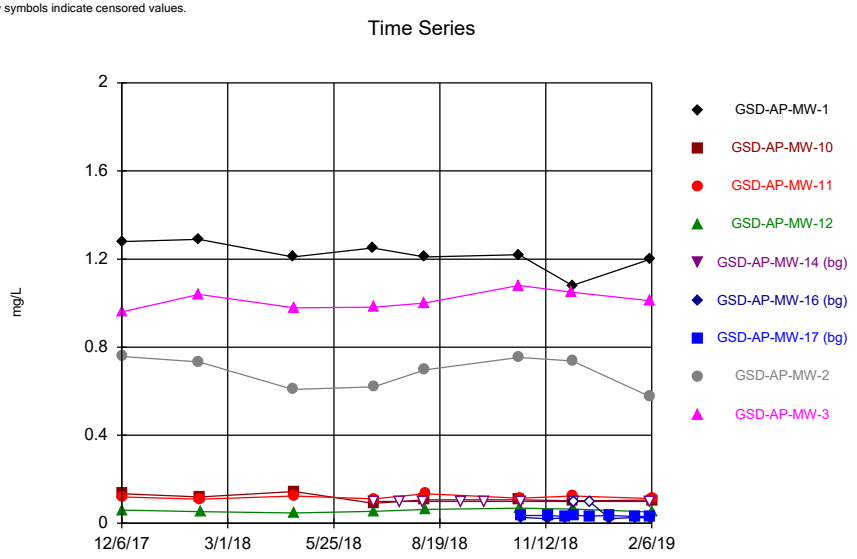
# Time Series

Constituent: Beryllium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

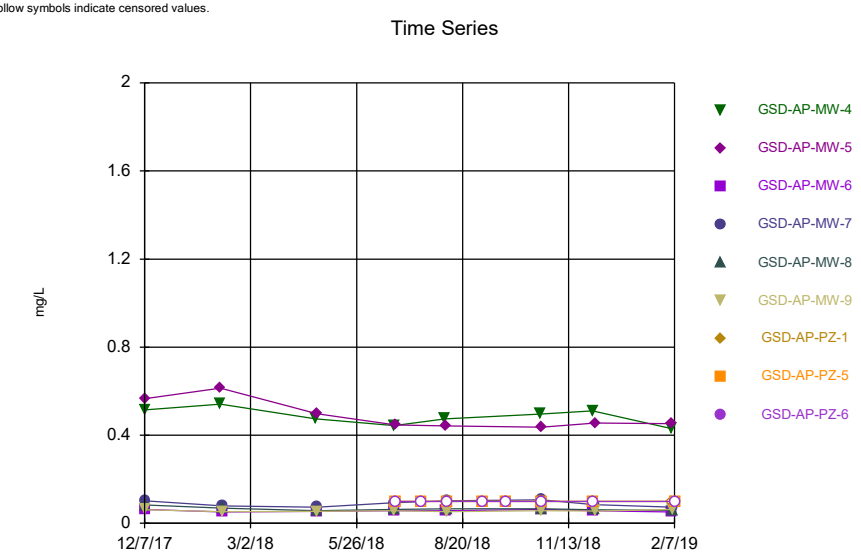
| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | | | |
| 2/6/2018 | <0.003 | <0.003 | | | | | | | |
| 2/8/2018 | | | <0.003 | <0.003 | <0.003 | <0.003 | | | |
| 4/24/2018 | <0.003 | | | | | | | | |
| 4/25/2018 | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | | | |
| 6/26/2018 | <0.003 | | <0.003 | <0.003 | <0.003 | <0.003 | | | |
| 6/27/2018 | | <0.003 | | | | | <0.003 | <0.003 | <0.003 |
| 7/18/2018 | | | | | | | <0.003 | <0.003 | <0.003 |
| 8/6/2018 | <0.003 | | | | | | | | |
| 8/7/2018 | | <0.003 | <0.003 | | | | <0.003 | | |
| 8/8/2018 | | | | <0.003 | <0.003 | <0.003 | | <0.003 | <0.003 |
| 9/5/2018 | | | | | | | <0.003 | <0.003 | <0.003 |
| 9/24/2018 | | | | | | | <0.003 | <0.003 | <0.003 |
| 10/22/2018 | <0.003 | | | | | | <0.003 | | |
| 10/23/2018 | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | | <0.003 | <0.003 |
| 12/3/2018 | <0.003 | | <0.003 | | | | <0.003 | <0.003 | <0.003 |
| 12/4/2018 | | | | <0.003 | <0.003 | | | | |
| 12/5/2018 | | <0.003 | | | | <0.003 | | | |
| 2/5/2019 | <0.003 | <0.003 | <0.003 | | | | <0.003 | | |
| 2/6/2019 | | | | <0.003 | <0.003 | <0.003 | | | |
| 2/7/2019 | | | | | | | | <0.003 | <0.003 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



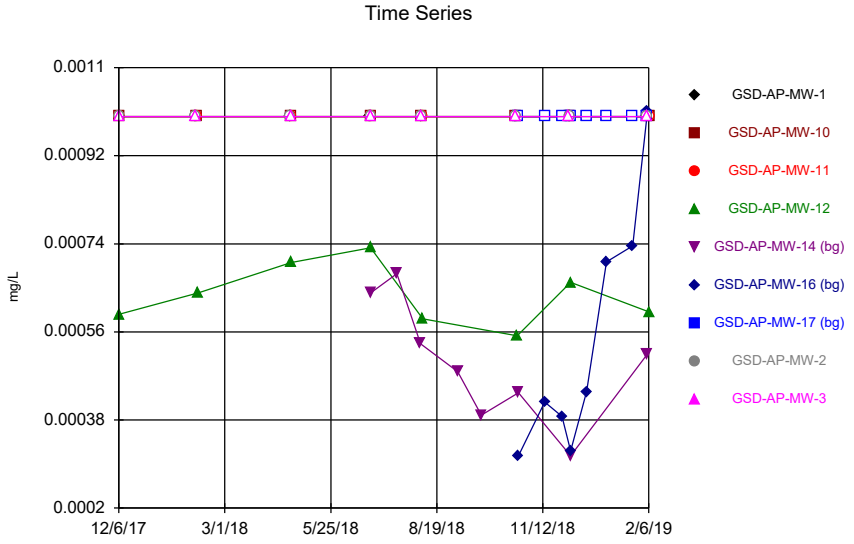

Constituent: Boron Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



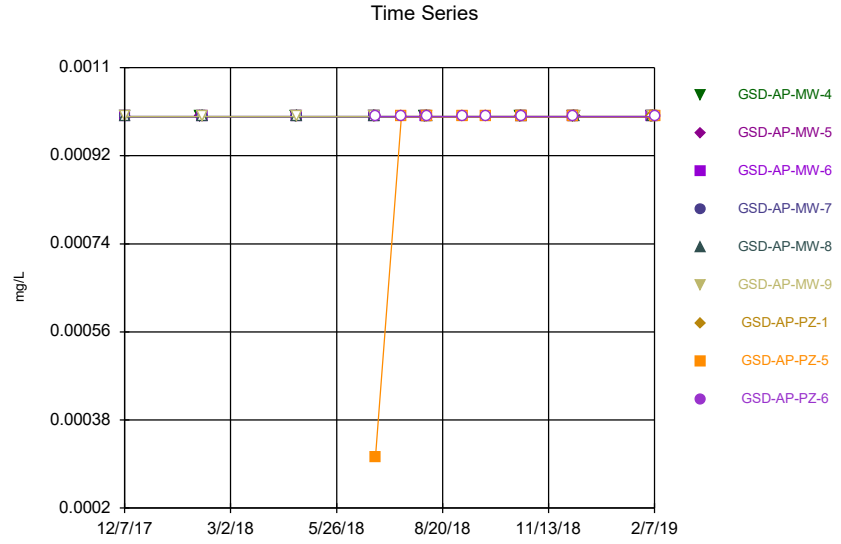

Constituent: Boron Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Cadmium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Cadmium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Boron (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 1.28 | 0.135 | 0.12 | 0.0605 (J) | | | | 0.758 | 0.959 |
| 2/6/2018 | 1.29 | | | | | | | 0.733 | 1.04 |
| 2/7/2018 | | 0.12 | 0.109 | | | | | | |
| 2/8/2018 | | | | 0.0527 (J) | | | | | |
| 4/23/2018 | 1.21 | | | | | | | 0.608 | |
| 4/24/2018 | | 0.144 | 0.124 | 0.0476 (J) | | | | | 0.979 |
| 6/26/2018 | 1.25 | | | | | | | | |
| 6/27/2018 | | 0.0903 (J) | 0.111 | 0.0539 (J) | <0.1 | | | 0.619 | 0.982 |
| 7/18/2018 | | | | | <0.1 | | | | |
| 8/6/2018 | | | | | <0.1 | | | | |
| 8/7/2018 | 1.21 | 0.106 | | | | | | 0.697 | 1 |
| 8/8/2018 | | | 0.135 | 0.0637 (J) | | | | | |
| 9/5/2018 | | | | | <0.1 | | | | |
| 9/24/2018 | | | | | <0.1 | | | | |
| 10/22/2018 | 1.22 | 0.107 | | | | | | 0.754 | 1.08 |
| 10/23/2018 | | | 0.114 | 0.0696 (J) | | | | | |
| 10/24/2018 | | | | | <0.1 | 0.0261 (J) | 0.0357 (J) | | |
| 11/14/2018 | | | | | | 0.0209 (J) | 0.0348 (J) | | |
| 11/28/2018 | | | | | | 0.0239 (J) | 0.0313 (J) | | |
| 12/3/2018 | | | | | | | | | 1.05 |
| 12/4/2018 | 1.08 | 0.103 | 0.124 | | | | | 0.737 | |
| 12/5/2018 | | | | 0.0652 (J) | <0.1 | <0.1 | 0.0363 (J) | | |
| 12/18/2018 | | | | | | <0.1 | 0.033 (J) | | |
| 1/3/2019 | | | | | | 0.0209 (J) | 0.036 (J) | | |
| 1/24/2019 | | | | | | 0.0271 (J) | 0.0307 (J) | | |
| 2/5/2019 | 1.2 | | | | <0.1 | 0.0245 (J) | 0.0306 (J) | 0.575 | 1.01 |
| 2/6/2019 | | 0.105 | 0.112 | 0.051 (J) | | | | | |

# Time Series

Constituent: Boron (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 0.515 | 0.566 | 0.063 (J) | 0.102 | 0.0828 (J) | 0.0614 (J) | | | |
| 2/6/2018 | 0.541 | 0.614 | | | | | | | |
| 2/8/2018 | | | 0.0508 (J) | 0.0787 (J) | 0.0691 (J) | 0.0531 (J) | | | |
| 4/24/2018 | 0.475 | | | | | | | | |
| 4/25/2018 | | 0.498 | 0.0548 (J) | 0.0734 (J) | 0.0571 (J) | 0.0551 (J) | | | |
| 6/26/2018 | 0.444 | | 0.0571 (J) | 0.094 (J) | 0.0634 (J) | 0.0568 (J) | | | |
| 6/27/2018 | | 0.446 | | | | | <0.1 | <0.1 | <0.1 |
| 7/18/2018 | | | | | | | <0.1 | <0.1 | <0.1 |
| 8/6/2018 | 0.474 | | | | | | | | |
| 8/7/2018 | | 0.442 | 0.0571 (J) | | | | <0.1 | | |
| 8/8/2018 | | | | 0.103 | 0.0659 (J) | 0.0524 (J) | | <0.1 | <0.1 |
| 9/5/2018 | | | | | | | <0.1 | <0.1 | <0.1 |
| 9/24/2018 | | | | | | | <0.1 | <0.1 | <0.1 |
| 10/22/2018 | 0.496 | | | | | | <0.1 | | |
| 10/23/2018 | | 0.436 | 0.0636 (J) | 0.106 | 0.0666 (J) | 0.0576 (J) | | <0.1 | <0.1 |
| 12/3/2018 | 0.51 | | 0.0568 (J) | | | | <0.1 | <0.1 | <0.1 |
| 12/4/2018 | | | | 0.085 (J) | 0.0617 (J) | | | | |
| 12/5/2018 | | 0.456 | | | | 0.0561 (J) | | | |
| 2/5/2019 | 0.43 | 0.453 | 0.0517 (J) | | | | <0.1 | | |
| 2/6/2019 | | | | 0.0733 (J) | 0.0586 (J) | 0.0627 (J) | | | |
| 2/7/2019 | | | | | | | | <0.1 | <0.1 |

# Time Series

Constituent: Cadmium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.001 | <0.001 | <0.001 | 0.000596 (J) | | | | <0.001 | <0.001 |
| 2/6/2018 | <0.001 | | | | | | | <0.001 | <0.001 |
| 2/7/2018 | | <0.001 | <0.001 | | | | | | |
| 2/8/2018 | | | | 0.00064 (J) | | | | | |
| 4/23/2018 | <0.001 | | | | | | | <0.001 | |
| 4/24/2018 | | <0.001 | <0.001 | 0.000702 (J) | | | | | <0.001 |
| 6/26/2018 | <0.001 | | | | | | | | |
| 6/27/2018 | | <0.001 | <0.001 | 0.000732 (J) | 0.00064 (J) | | | <0.001 | <0.001 |
| 7/18/2018 | | | | | 0.000679 (J) | | | | |
| 8/6/2018 | | | | | 0.000536 (J) | | | | |
| 8/7/2018 | <0.001 | <0.001 | | | | | | <0.001 | <0.001 |
| 8/8/2018 | | | <0.001 | 0.000587 (J) | | | | | |
| 9/5/2018 | | | | | 0.000479 (J) | | | | |
| 9/24/2018 | | | | | 0.00039 (J) | | | | |
| 10/22/2018 | <0.001 | <0.001 | | | | | | <0.001 | <0.001 |
| 10/23/2018 | | | <0.001 | 0.000552 (J) | | | | | |
| 10/24/2018 | | | | | 0.000436 (J) | 0.000307 (J) | <0.001 | | |
| 11/14/2018 | | | | | | 0.000417 (J) | <0.001 | | |
| 11/28/2018 | | | | | | 0.000387 (J) | <0.001 | | |
| 12/3/2018 | | | | | | | | | <0.001 |
| 12/4/2018 | <0.001 | <0.001 | <0.001 | | | | | <0.001 | |
| 12/5/2018 | | | | 0.000661 (J) | 0.000307 (J) | 0.000317 (J) | <0.001 | | |
| 12/18/2018 | | | | | | 0.000438 (J) | <0.001 | | |
| 1/3/2019 | | | | | | 0.000703 (J) | <0.001 | | |
| 1/24/2019 | | | | | | 0.000736 (J) | <0.001 | | |
| 2/5/2019 | <0.001 | | | | 0.000515 (J) | 0.00101 | <0.001 | <0.001 | <0.001 |
| 2/6/2019 | | <0.001 | <0.001 | 0.000601 (J) | | | | | |

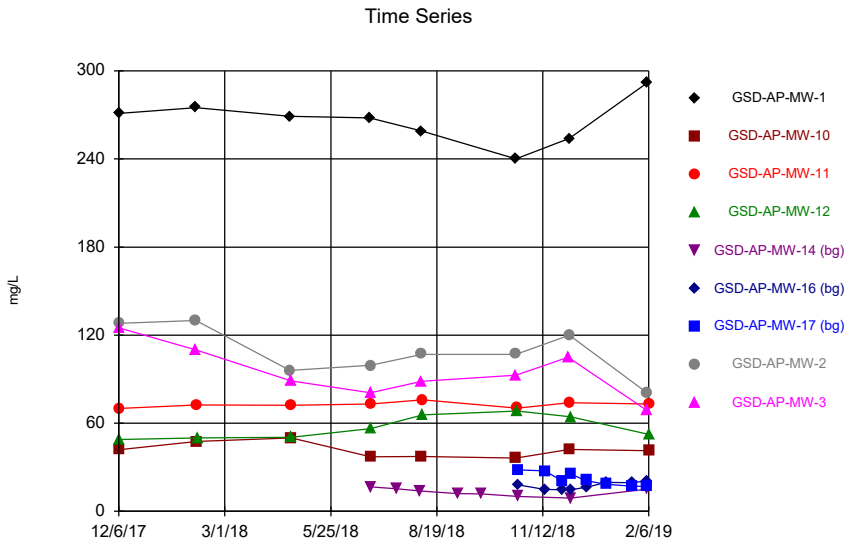
# Time Series

Constituent: Cadmium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

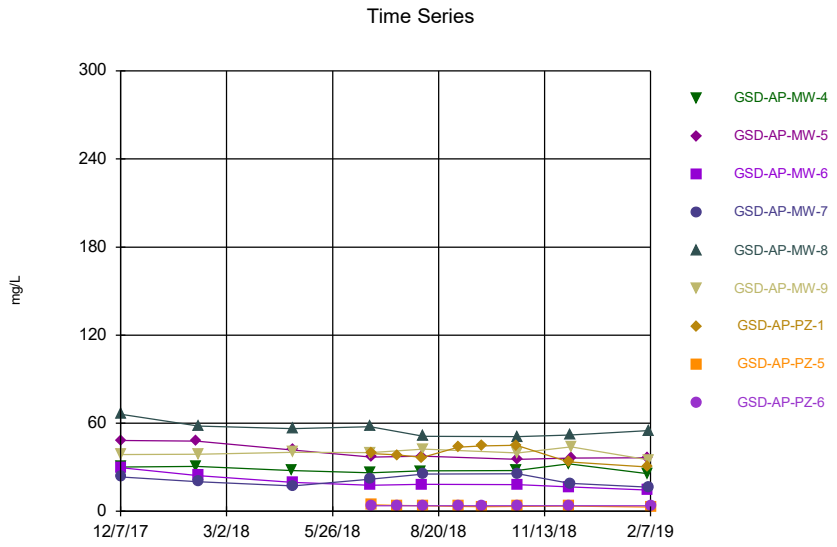
| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | | | |
| 2/6/2018 | <0.001 | <0.001 | | | | | | | |
| 2/8/2018 | | | <0.001 | <0.001 | <0.001 | <0.001 | | | |
| 4/24/2018 | <0.001 | | | | | | | | |
| 4/25/2018 | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | | | |
| 6/26/2018 | <0.001 | | <0.001 | <0.001 | <0.001 | <0.001 | | | |
| 6/27/2018 | | <0.001 | | | | | <0.001 | 0.000304 (J) | <0.001 |
| 7/18/2018 | | | | | | | <0.001 | <0.001 | <0.001 |
| 8/6/2018 | <0.001 | | | | | | | | |
| 8/7/2018 | | <0.001 | <0.001 | | | | <0.001 | | |
| 8/8/2018 | | | | <0.001 | <0.001 | <0.001 | | <0.001 | <0.001 |
| 9/5/2018 | | | | | | | <0.001 | <0.001 | <0.001 |
| 9/24/2018 | | | | | | | <0.001 | <0.001 | <0.001 |
| 10/22/2018 | <0.001 | | | | | | <0.001 | | |
| 10/23/2018 | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | | <0.001 | <0.001 |
| 12/3/2018 | <0.001 | | <0.001 | | | | <0.001 | <0.001 | <0.001 |
| 12/4/2018 | | | | <0.001 | <0.001 | | | | |
| 12/5/2018 | | <0.001 | | | | <0.001 | | | |
| 2/5/2019 | <0.001 | <0.001 | <0.001 | | | | <0.001 | | |
| 2/6/2019 | | | | <0.001 | <0.001 | <0.001 | | | |
| 2/7/2019 | | | | | | | | <0.001 | <0.001 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



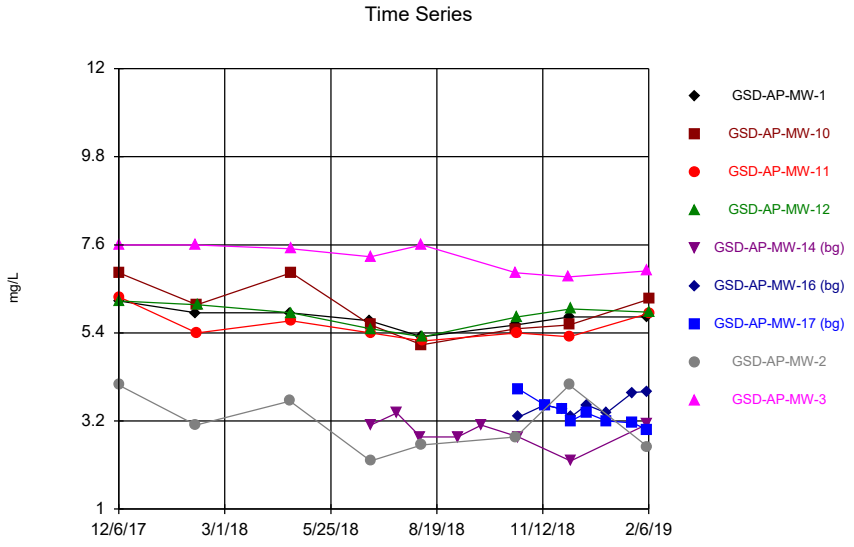

Constituent: Calcium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



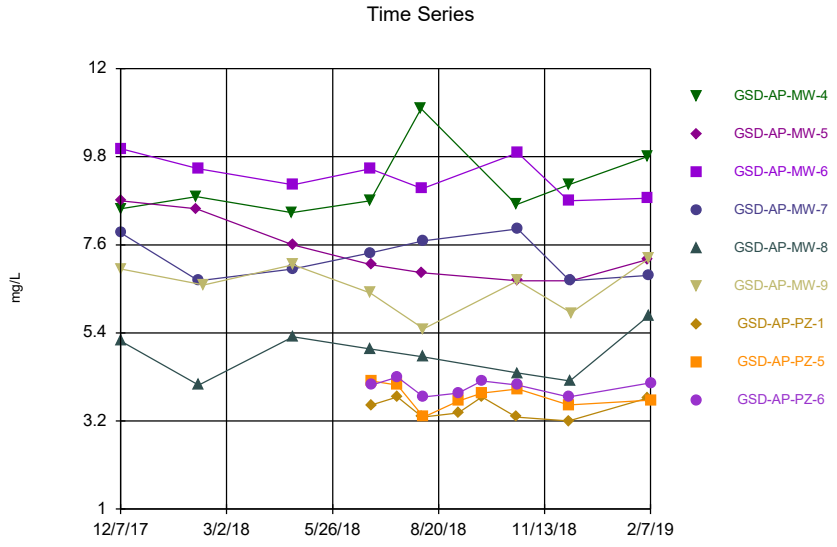

Constituent: Calcium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG




Constituent: Chloride Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG




Constituent: Chloride Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Calcium (mg/L)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 271 | 42 | 70 | 49 | | | | 128 | 125 |
| 2/6/2018 | 275 | | | | | | | 130 | 110 |
| 2/7/2018 | | 47.6 | 72.4 | | | | | | |
| 2/8/2018 | | | | 50 | | | | | |
| 4/23/2018 | 269 | | | | | | | 95.9 | |
| 4/24/2018 | | 50.1 | 72.3 | 50.5 | | | | | 88.8 |
| 6/26/2018 | 268 | | | | | | | | |
| 6/27/2018 | | 37.1 | 73.1 | 56.3 | 16.6 | | | 99.4 | 80.8 |
| 7/18/2018 | | | | | 15.3 | | | | |
| 8/6/2018 | | | | | 13.8 | | | | |
| 8/7/2018 | 259 | 37.4 | | | | | | 107 | 88.5 |
| 8/8/2018 | | | 76 | 65.7 | | | | | |
| 9/5/2018 | | | | | 12.1 | | | | |
| 9/24/2018 | | | | | 11.8 | | | | |
| 10/22/2018 | 240 | 36.3 | | | | | | 107 | 92.7 |
| 10/23/2018 | | | 70.2 | 68.3 | | | | | |
| 10/24/2018 | | | | | 10.2 | 18 | 28.3 | | |
| 11/14/2018 | | | | | | 14.9 | 27.5 | | |
| 11/28/2018 | | | | | | 14.8 | 20.7 | | |
| 12/3/2018 | | | | | | | | | 105 |
| 12/4/2018 | 254 | 42.1 | 74 | | | | | 120 | |
| 12/5/2018 | | | | 64.3 | 9.14 | 14.8 | 25.3 | | |
| 12/18/2018 | | | | | | 16.4 | 20.9 | | |
| 1/3/2019 | | | | | | 19.7 | 18.5 | | |
| 1/24/2019 | | | | | | 19.6 | 17 | | |
| 2/5/2019 | 292 | | | | 15.1 | 20.8 | 17.1 | 80.6 | 68.6 |
| 2/6/2019 | | 41.3 | 73.1 | 52.3 | | | | | |

# Time Series

Constituent: Calcium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 30.1 | 48.2 | 29.8 | 23.4 | 66.1 | 38.7 | | | |
| 2/6/2018 | 30.6 | 47.8 | | | | | | | |
| 2/8/2018 | | | 24.3 | 20.1 | 58 | 38.8 | | | |
| 4/24/2018 | 27.8 | | | | | | | | |
| 4/25/2018 | | 41.8 | 19.8 | 17.4 | 56.3 | 40.3 | | | |
| 6/26/2018 | 26.2 | | 17.8 | 21.8 | 57.7 | 39.9 | | | |
| 6/27/2018 | | 36.9 | | | | | 39.4 | 4.56 | 3.89 |
| 7/18/2018 | | | | | | | 38.4 | 3.92 | 3.8 |
| 8/6/2018 | 27.5 | | | | | | | | |
| 8/7/2018 | | 37.6 | 18.3 | | | | 36.7 | | |
| 8/8/2018 | | | | 25.4 | 51.2 | 42.3 | | 3.74 | 3.89 |
| 9/5/2018 | | | | | | | 43.6 | 3.38 | 3.78 |
| 9/24/2018 | | | | | | | 44.5 | 3.25 | 3.73 |
| 10/22/2018 | 27.7 | | | | | | 45 | | |
| 10/23/2018 | | 35.3 | 18.1 | 25.6 | 50.9 | 39.8 | | 3.37 | 3.79 |
| 12/3/2018 | 32.3 | | 16.6 | | | | 33.7 | 3.67 | 3.79 |
| 12/4/2018 | | | | 19 | 51.9 | | | | |
| 12/5/2018 | | 36.3 | | | | 43.8 | | | |
| 2/5/2019 | 25.5 | 36.6 | 14.4 | | | | 30.1 | | |
| 2/6/2019 | | | | 16.4 | 55 | 34.9 | | | |
| 2/7/2019 | | | | | | | | 2.89 | 3.75 |

# Time Series

Constituent: Chloride (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 6.2 | 6.9 | 6.3 | 6.2 | | | | 4.1 | 7.6 |
| 2/6/2018 | 5.9 | | | | | | | 3.1 | 7.6 |
| 2/7/2018 | | 6.1 | 5.4 | | | | | | |
| 2/8/2018 | | | | 6.1 | | | | | |
| 4/23/2018 | 5.9 | | | | | | | 3.7 | |
| 4/24/2018 | | 6.9 | 5.7 | 5.9 | | | | | 7.5 |
| 6/26/2018 | 5.7 | | | | | | | | |
| 6/27/2018 | | 5.6 | 5.4 | 5.5 | 3.1 | | | 2.2 | 7.3 |
| 7/18/2018 | | | | | 3.4 | | | | |
| 8/6/2018 | | | | | 2.8 | | | | |
| 8/7/2018 | 5.3 | 5.1 | | | | | | 2.6 | 7.6 |
| 8/8/2018 | | | 5.2 | 5.3 | | | | | |
| 9/5/2018 | | | | | 2.8 | | | | |
| 9/24/2018 | | | | | 3.1 | | | | |
| 10/22/2018 | 5.6 | 5.5 | | | | | | 2.8 | 6.9 |
| 10/23/2018 | | | 5.4 | 5.8 | | | | | |
| 10/24/2018 | | | | | 2.8 | 3.3 | 4 | | |
| 11/14/2018 | | | | | | 3.6 | 3.6 | | |
| 11/28/2018 | | | | | | 3.5 | 3.5 | | |
| 12/3/2018 | | | | | | | | | 6.8 |
| 12/4/2018 | 5.8 | 5.6 | 5.3 | | | | | 4.1 | |
| 12/5/2018 | | | | 6 | 2.2 | 3.3 | 3.2 | | |
| 12/18/2018 | | | | | | 3.6 | 3.4 | | |
| 1/3/2019 | | | | | | 3.4 | 3.2 | | |
| 1/24/2019 | | | | | | 3.91 | 3.15 | | |
| 2/5/2019 | 5.8 | | | | 3.12 | 3.94 | 2.98 | 2.56 | 6.95 |
| 2/6/2019 | | 6.24 | 5.89 | 5.92 | | | | | |

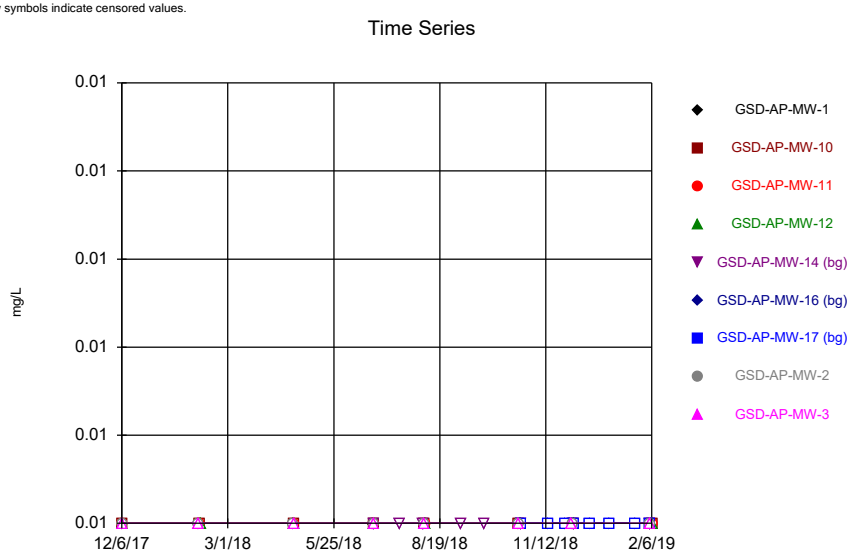
# Time Series

Constituent: Chloride (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

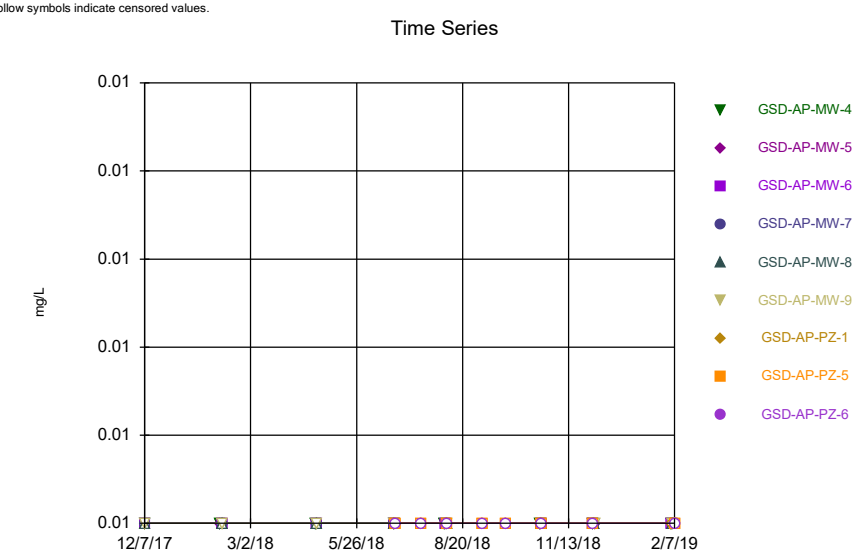
| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 8.5 | 8.7 | 10 | 7.9 | 5.2 | 7 | | | |
| 2/6/2018 | 8.8 | 8.5 | | | | | | | |
| 2/8/2018 | | | 9.5 | 6.7 | 4.1 | | | | |
| 2/12/2018 | | | | | | 6.6 | | | |
| 4/24/2018 | 8.4 | | | | | | | | |
| 4/25/2018 | | 7.6 | 9.1 | 7 | 5.3 | 7.1 | | | |
| 6/26/2018 | 8.7 | | 9.5 | 7.4 | 5 | 6.4 | | | |
| 6/27/2018 | | 7.1 | | | | | 3.6 | 4.2 | 4.1 |
| 7/18/2018 | | | | | | | 3.8 | 4.1 | 4.3 |
| 8/6/2018 | 11 | | | | | | | | |
| 8/7/2018 | | 6.9 | 9 | | | | 3.3 | | |
| 8/8/2018 | | | | 7.7 | 4.8 | 5.5 | | 3.3 | 3.8 |
| 9/5/2018 | | | | | | | 3.4 | 3.7 | 3.9 |
| 9/24/2018 | | | | | | | 3.8 | 3.9 | 4.2 |
| 10/22/2018 | 8.6 | | | | | | 3.3 | | |
| 10/23/2018 | | 6.7 | 9.9 | 8 | 4.4 | 6.7 | | 4 | 4.1 |
| 12/3/2018 | 9.1 | | 8.7 | | | | 3.2 | 3.6 | 3.8 |
| 12/4/2018 | | | | 6.7 | 4.2 | | | | |
| 12/5/2018 | | 6.7 | | | | 5.9 | | | |
| 2/5/2019 | 9.81 | 7.24 | 8.76 | | | | 3.78 | | |
| 2/6/2019 | | | | 6.84 | 5.84 | 7.26 | | | |
| 2/7/2019 | | | | | | | | 3.72 | 4.15 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



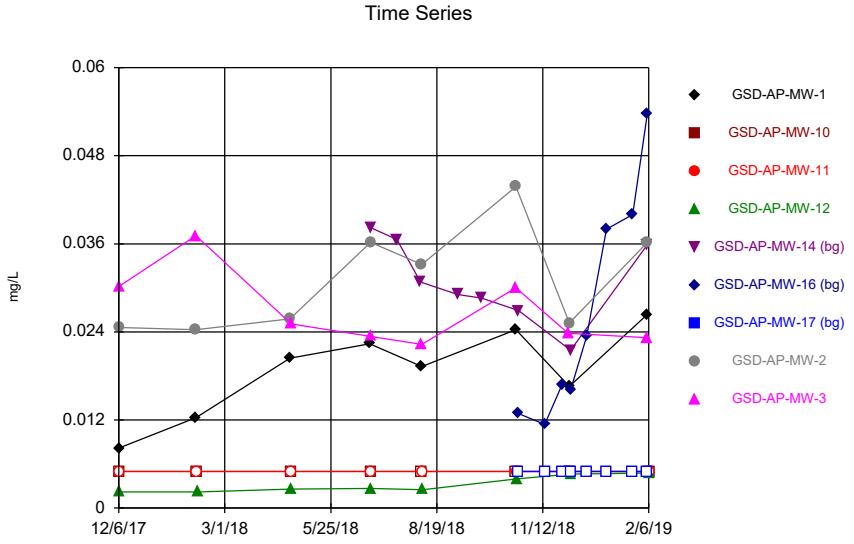

Constituent: Chromium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



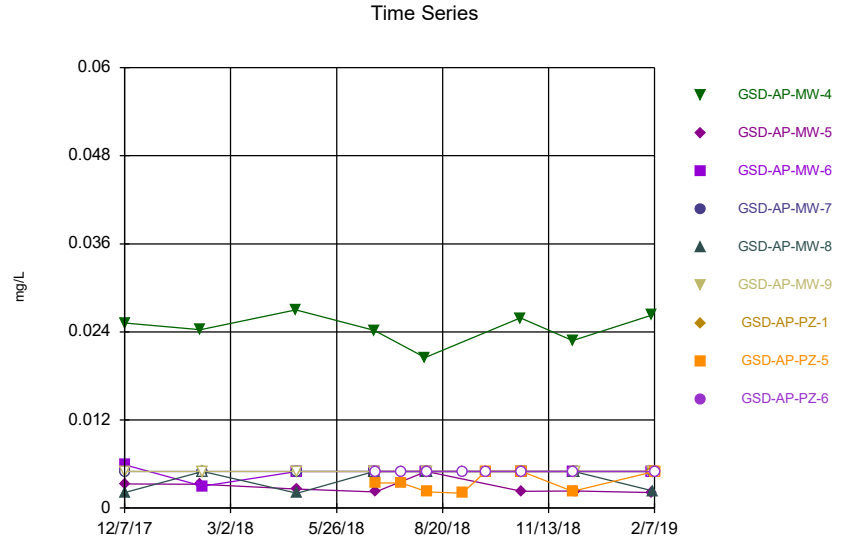

Constituent: Chromium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Cobalt Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Cobalt Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Chromium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.01 | <0.01 | <0.01 | <0.01 | | | | <0.01 | <0.01 |
| 2/6/2018 | <0.01 | | | | | | | <0.01 | <0.01 |
| 2/7/2018 | | <0.01 | <0.01 | | | | | | |
| 2/8/2018 | | | | <0.01 | | | | | |
| 4/23/2018 | <0.01 | | | | | | | <0.01 | |
| 4/24/2018 | | <0.01 | <0.01 | <0.01 | | | | | <0.01 |
| 6/26/2018 | <0.01 | | | | | | | | |
| 6/27/2018 | | <0.01 | <0.01 | <0.01 | <0.01 | | | <0.01 | <0.01 |
| 7/18/2018 | | | | | <0.01 | | | | |
| 8/6/2018 | | | | | <0.01 | | | | |
| 8/7/2018 | <0.01 | <0.01 | | | | | | <0.01 | <0.01 |
| 8/8/2018 | | | <0.01 | <0.01 | | | | | |
| 9/5/2018 | | | | | <0.01 | | | | |
| 9/24/2018 | | | | | <0.01 | | | | |
| 10/22/2018 | <0.01 | <0.01 | | | | | | <0.01 | <0.01 |
| 10/23/2018 | | | <0.01 | <0.01 | | | | | |
| 10/24/2018 | | | | | <0.01 | <0.01 | <0.01 | | |
| 11/14/2018 | | | | | | <0.01 | <0.01 | | |
| 11/28/2018 | | | | | | <0.01 | <0.01 | | |
| 12/3/2018 | | | | | | | | | <0.01 |
| 12/4/2018 | <0.01 | <0.01 | <0.01 | | | | | <0.01 | |
| 12/5/2018 | | | | <0.01 | <0.01 | <0.01 | <0.01 | | |
| 12/18/2018 | | | | | | <0.01 | <0.01 | | |
| 1/3/2019 | | | | | | <0.01 | <0.01 | | |
| 1/24/2019 | | | | | | <0.01 | <0.01 | | |
| 2/5/2019 | <0.01 | | | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| 2/6/2019 | | <0.01 | <0.01 | <0.01 | | | | | |

# Time Series

Constituent: Chromium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 2/6/2018 | <0.01 | <0.01 | | | | | | | |
| 2/8/2018 | | | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 4/24/2018 | <0.01 | | | | | | | | |
| 4/25/2018 | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 6/26/2018 | <0.01 | | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 6/27/2018 | | <0.01 | | | | | <0.01 | <0.01 | <0.01 |
| 7/18/2018 | | | | | | | <0.01 | <0.01 | <0.01 |
| 8/6/2018 | <0.01 | | | | | | | | |
| 8/7/2018 | | <0.01 | <0.01 | | | | <0.01 | | |
| 8/8/2018 | | | | <0.01 | <0.01 | <0.01 | | <0.01 | <0.01 |
| 9/5/2018 | | | | | | | <0.01 | <0.01 | <0.01 |
| 9/24/2018 | | | | | | | <0.01 | <0.01 | <0.01 |
| 10/22/2018 | <0.01 | | | | | | <0.01 | | |
| 10/23/2018 | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | <0.01 | <0.01 |
| 12/3/2018 | <0.01 | | <0.01 | | | | <0.01 | <0.01 | <0.01 |
| 12/4/2018 | | | | <0.01 | <0.01 | | | | |
| 12/5/2018 | | <0.01 | | | | <0.01 | | | |
| 2/5/2019 | <0.01 | <0.01 | <0.01 | | | | <0.01 | | |
| 2/6/2019 | | | | <0.01 | <0.01 | <0.01 | | | |
| 2/7/2019 | | | | | | | | <0.01 | <0.01 |

# Time Series

Constituent: Cobalt (mg/L)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 0.00818 (J) | <0.005 | <0.005 | 0.00221 (J) | | | | 0.0246 | 0.0302 |
| 2/6/2018 | 0.0123 | | | | | | | 0.0243 | 0.0371 |
| 2/7/2018 | | <0.005 | <0.005 | | | | | | |
| 2/8/2018 | | | | 0.00221 (J) | | | | | |
| 4/23/2018 | 0.0204 | | | | | | | 0.0258 | |
| 4/24/2018 | | <0.005 | <0.005 | 0.00257 (J) | | | | | 0.0251 |
| 6/26/2018 | 0.0224 | | | | | | | | |
| 6/27/2018 | | <0.005 | <0.005 | 0.00266 (J) | 0.0382 | | | 0.0362 | 0.0234 |
| 7/18/2018 | | | | | 0.0366 | | | | |
| 8/6/2018 | | | | | 0.0308 | | | | |
| 8/7/2018 | 0.0193 | <0.005 | | | | | | 0.0332 | 0.0223 |
| 8/8/2018 | | | <0.005 | 0.00251 (J) | | | | | |
| 9/5/2018 | | | | | 0.0291 | | | | |
| 9/24/2018 | | | | | 0.0286 | | | | |
| 10/22/2018 | 0.0243 | <0.005 | | | | | | 0.0438 | 0.03 |
| 10/23/2018 | | | <0.005 | 0.00399 (J) | | | | | |
| 10/24/2018 | | | | | 0.0269 | 0.0129 | <0.005 | | |
| 11/14/2018 | | | | | | 0.0114 | <0.005 | | |
| 11/28/2018 | | | | | | 0.0168 | <0.005 | | |
| 12/3/2018 | | | | | | | | | 0.0238 |
| 12/4/2018 | 0.0166 | <0.005 | <0.005 | | | | | 0.0252 | |
| 12/5/2018 | | | | 0.00466 (J) | 0.0215 | 0.0161 | <0.005 | | |
| 12/18/2018 | | | | | | 0.0234 | <0.005 | | |
| 1/3/2019 | | | | | | 0.038 | <0.005 | | |
| 1/24/2019 | | | | | | 0.04 | <0.005 | | |
| 2/5/2019 | 0.0264 | | | | 0.0359 | 0.0538 | <0.005 | 0.0362 | 0.0232 |
| 2/6/2019 | | <0.005 | <0.005 | 0.00475 (J) | | | | | |

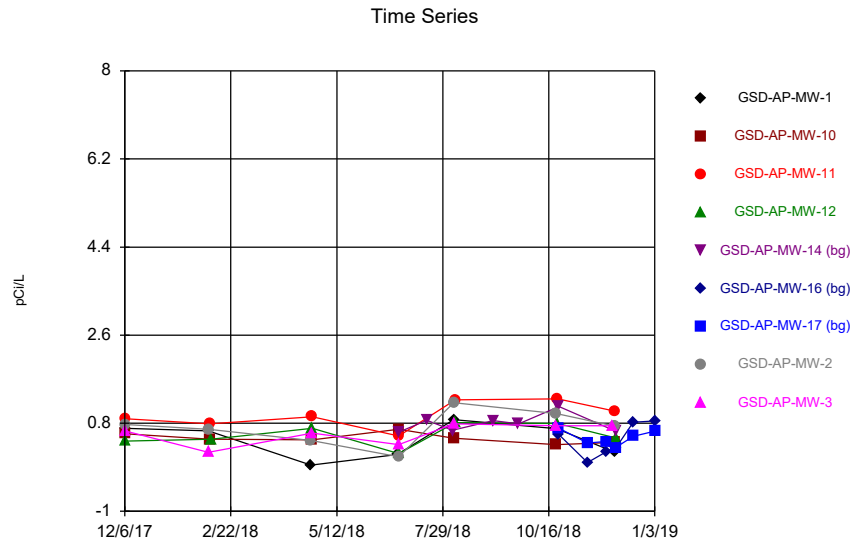
# Time Series

Constituent: Cobalt (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

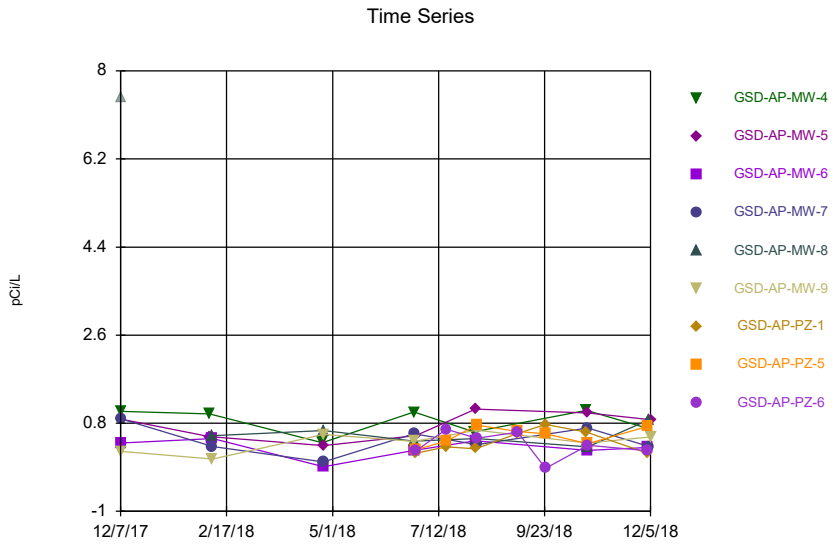
| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 0.0252 | 0.00331 (J) | 0.00592 (J) | <0.005 | 0.00212 (J) | <0.005 | | | |
| 2/6/2018 | 0.0243 | 0.00323 (J) | | | | | | | |
| 2/8/2018 | | | 0.00297 (J) | <0.005 | <0.005 | <0.005 | | | |
| 4/24/2018 | 0.027 | | | | | | | | |
| 4/25/2018 | | 0.00258 (J) | <0.005 | <0.005 | 0.00204 (J) | <0.005 | | | |
| 6/26/2018 | 0.0242 | | <0.005 | <0.005 | <0.005 | <0.005 | | | |
| 6/27/2018 | | 0.00218 (J) | | | | | <0.005 | 0.00341 (J) | <0.005 |
| 7/18/2018 | | | | | | | <0.005 | 0.00341 (J) | <0.005 |
| 8/6/2018 | 0.0205 | | | | | | | | |
| 8/7/2018 | | <0.005 | <0.005 | | | | <0.005 | | |
| 8/8/2018 | | | | <0.005 | <0.005 | <0.005 | | 0.00221 (J) | <0.005 |
| 9/5/2018 | | | | | | | <0.005 | 0.00202 (J) | <0.005 |
| 9/24/2018 | | | | | | | <0.005 | <0.005 | <0.005 |
| 10/22/2018 | 0.0259 | | | | | | <0.005 | | |
| 10/23/2018 | | 0.0023 (J) | <0.005 | <0.005 | <0.005 | <0.005 | | <0.005 | <0.005 |
| 12/3/2018 | 0.0228 | | <0.005 | | | | <0.005 | 0.00227 (J) | <0.005 |
| 12/4/2018 | | | | <0.005 | <0.005 | | | | |
| 12/5/2018 | | 0.00233 (J) | | | | <0.005 | | | |
| 2/5/2019 | 0.0263 | 0.0021 (J) | <0.005 | | | | <0.005 | | |
| 2/6/2019 | | | | <0.005 | 0.00232 (J) | <0.005 | | | |
| 2/7/2019 | | | | | | | | <0.005 | <0.005 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



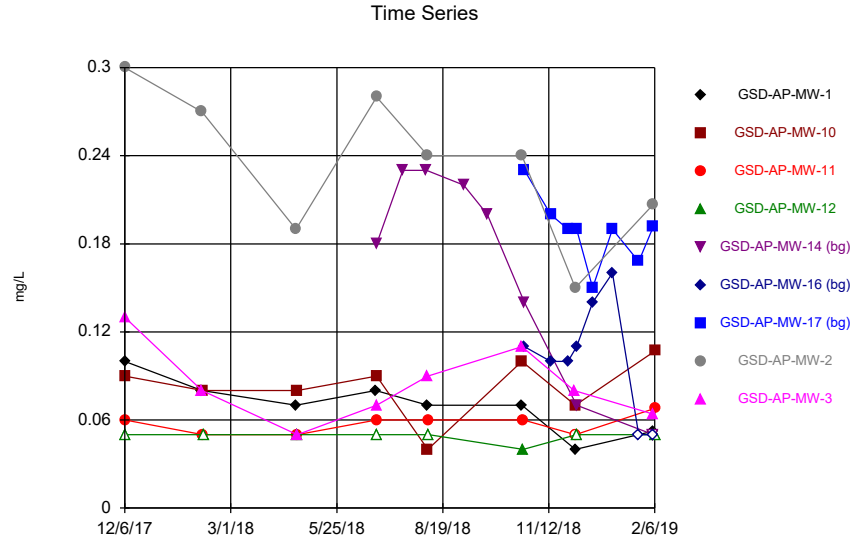

Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



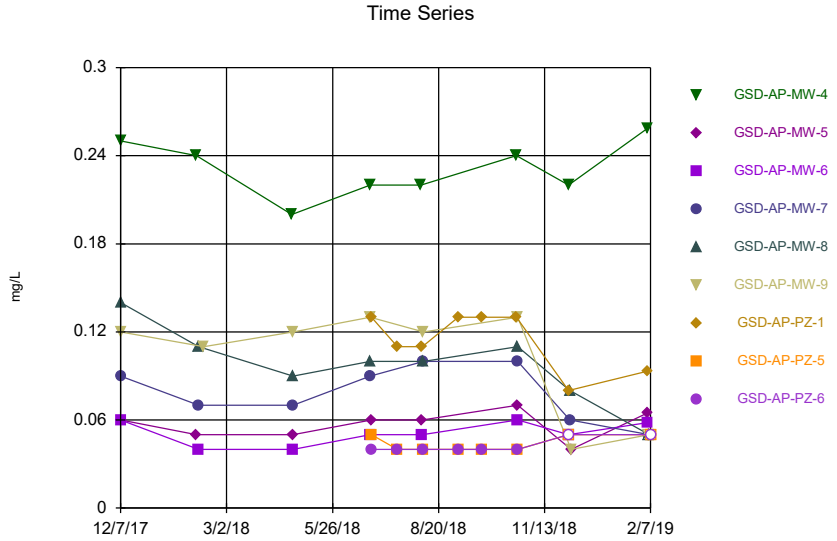

Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Fluoride Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Fluoride Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Combined Radium 226 + 228 (pCi/L)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 0.694 | 0.585 | 0.891 | 0.435 (U) | | | | 0.772 | 0.643 |
| 2/6/2018 | 0.641 | | | | | | | 0.679 | 0.209 (U) |
| 2/7/2018 | | 0.474 | 0.786 | | | | | | |
| 2/8/2018 | | | | 0.477 | | | | | |
| 4/23/2018 | -0.0527 (U) | | | | | | | 0.447 (U) | |
| 4/24/2018 | | 0.463 (U) | 0.935 | 0.695 | | | | | 0.596 |
| 6/26/2018 | 0.162 (U) | | | | | | | | |
| 6/27/2018 | | 0.678 | 0.537 | 0.183 (U) | 0.616 | | | 0.117 (U) | 0.363 (U) |
| 7/18/2018 | | | | | 0.859 | | | | |
| 8/6/2018 | | | | | 0.654 | | | | |
| 8/7/2018 | 0.87 | 0.495 (U) | | | | | | 1.22 | 0.788 |
| 8/8/2018 | | | 1.28 | 0.817 | | | | | |
| 9/5/2018 | | | | | 0.855 | | | | |
| 9/24/2018 | | | | | 0.787 | | | | |
| 10/22/2018 | 0.691 | 0.36 (U) | | | | | | 0.996 | 0.749 |
| 10/23/2018 | | | 1.3 | 0.796 | | | | | |
| 10/24/2018 | | | | | 1.14 | 0.564 | 0.694 | | |
| 11/14/2018 | | | | | | -0.0027 (U) | 0.398 (U) | | |
| 11/28/2018 | | | | | | 0.222 (U) | 0.428 (U) | | |
| 12/3/2018 | | | | | | | | | 0.749 |
| 12/4/2018 | 0.213 (U) | 0.407 (U) | 1.05 | | | | | 0.739 | |
| 12/5/2018 | | | | 0.498 (U) | 0.64 | 0.288 (U) | 0.302 (U) | | |
| 12/18/2018 | | | | | | 0.822 | 0.535 (U) | | |
| 1/3/2019 | | | | | | 0.844 | 0.64 | | |

# Time Series

Constituent: Combined Radium 226 + 228 (pCi/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 1.04 | 0.885 | 0.394 (U) | 0.895 | 7.45 (o) | 0.226 (U) | | | |
| 2/6/2018 | 0.989 | 0.524 | | | | | | | |
| 2/8/2018 | | | 0.489 | 0.322 (U) | 0.549 | 0.071 (U) | | | |
| 4/24/2018 | 0.405 (U) | | | | | | | | |
| 4/25/2018 | | 0.341 (U) | -0.0902 (U) | 0.0097 (U) | 0.65 | 0.569 | | | |
| 6/26/2018 | 1.03 | | 0.245 (U) | 0.587 | 0.436 (U) | 0.43 (U) | | | |
| 6/27/2018 | | 0.546 | | | | | 0.188 (U) | 0.259 (U) | 0.231 (U) |
| 7/18/2018 | | | | | | | 0.314 (U) | 0.434 | 0.676 |
| 8/6/2018 | 0.622 | | | | | | | | |
| 8/7/2018 | | 1.09 | 0.439 (U) | | | | 0.279 (U) | | |
| 8/8/2018 | | | | 0.364 (U) | 0.486 (U) | 0.656 | | 0.763 | 0.496 |
| 9/5/2018 | | | | | | | 0.589 | 0.631 | 0.62 |
| 9/24/2018 | | | | | | | 0.772 | 0.588 | -0.12 (U) |
| 10/22/2018 | 1.06 | | | | | | 0.621 | | |
| 10/23/2018 | | 1.01 | 0.243 (U) | 0.703 | 0.319 (U) | 0.395 (U) | | 0.383 (U) | 0.352 (U) |
| 12/3/2018 | 0.697 | | 0.304 (U) | | | | 0.188 (U) | 0.736 | 0.238 (U) |
| 12/4/2018 | | | | 0.325 (U) | 0.875 | | | | |
| 12/5/2018 | | 0.876 | | | | 0.52 (U) | | | |

# Time Series

Constituent: Fluoride (mg/L)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 0.1 | 0.09 (J) | 0.06 (J) | <0.1 | | | | 0.3 | 0.13 |
| 2/6/2018 | 0.08 (J) | | | | | | | 0.27 | 0.08 (J) |
| 2/7/2018 | | 0.08 (J) | 0.05 (J) | | | | | | |
| 2/8/2018 | | | | <0.1 | | | | | |
| 4/23/2018 | 0.07 (J) | | | | | | | 0.19 | |
| 4/24/2018 | | 0.08 (J) | 0.05 (J) | <0.1 | | | | | 0.05 (J) |
| 6/26/2018 | 0.08 (J) | | | | | | | | |
| 6/27/2018 | | 0.09 (J) | 0.06 (J) | <0.1 | 0.18 | | | 0.28 | 0.07 (J) |
| 7/18/2018 | | | | | 0.23 | | | | |
| 8/6/2018 | | | | | 0.23 | | | | |
| 8/7/2018 | 0.07 (J) | 0.04 (J) | | | | | | 0.24 | 0.09 (J) |
| 8/8/2018 | | | 0.06 (J) | <0.1 | | | | | |
| 9/5/2018 | | | | | 0.22 | | | | |
| 9/24/2018 | | | | | 0.2 | | | | |
| 10/22/2018 | 0.07 (J) | 0.1 | | | | | | 0.24 | 0.11 |
| 10/23/2018 | | | 0.06 (J) | 0.04 (J) | | | | | |
| 10/24/2018 | | | | | 0.14 | 0.11 | 0.23 | | |
| 11/14/2018 | | | | | | 0.1 | 0.2 | | |
| 11/28/2018 | | | | | | 0.1 | 0.19 | | |
| 12/3/2018 | | | | | | | | | 0.08 (J) |
| 12/4/2018 | 0.04 (J) | 0.07 (J) | <0.1 | | | | | 0.15 | |
| 12/5/2018 | | | | <0.1 | 0.07 (J) | 0.11 | 0.19 | | |
| 12/18/2018 | | | | | | 0.14 | 0.15 | | |
| 1/3/2019 | | | | | | 0.16 | 0.19 | | |
| 1/24/2019 | | | | | | <0.1 | 0.168 | | |
| 2/5/2019 | 0.0525 (J) | | | | <0.1 | <0.1 | 0.192 | 0.207 | 0.064 (J) |
| 2/6/2019 | | 0.107 | 0.0678 (J) | <0.1 | | | | | |

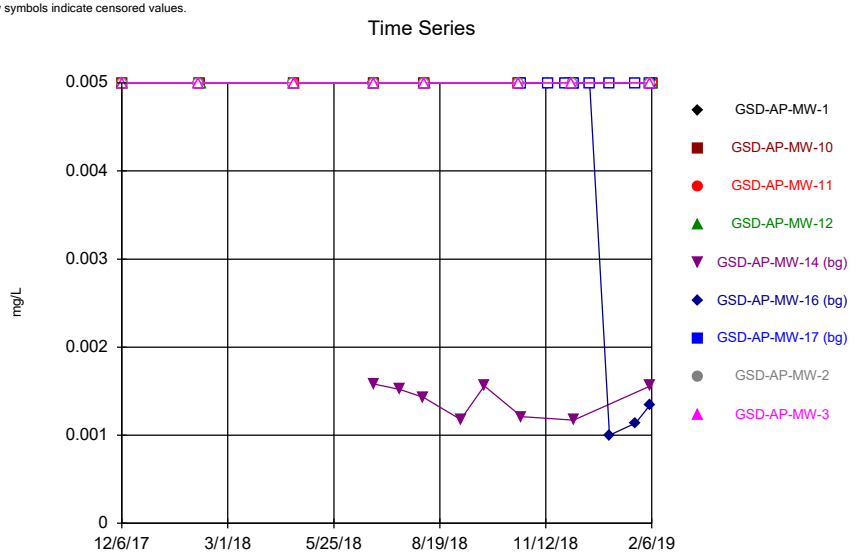
# Time Series

Constituent: Fluoride (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

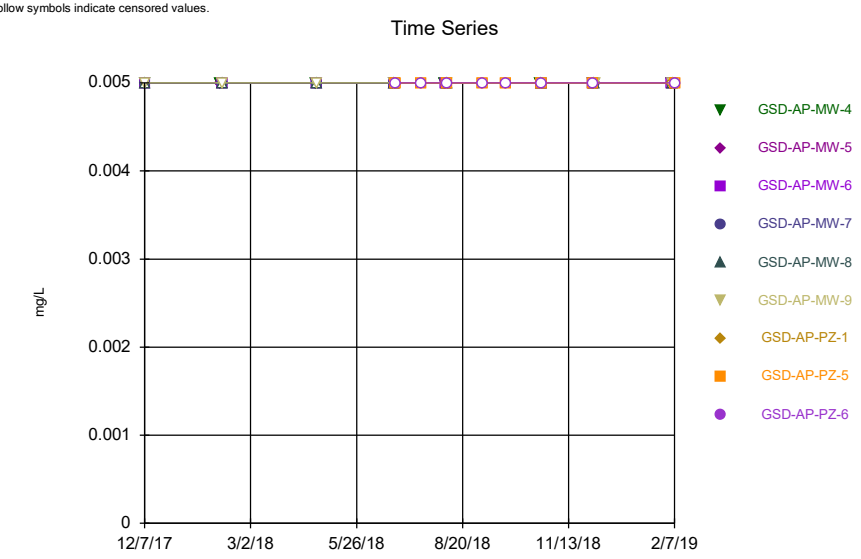
| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 0.25 | 0.06 (J) | 0.06 (J) | 0.09 (J) | 0.14 | 0.12 | | | |
| 2/6/2018 | 0.24 | 0.05 (J) | | | | | | | |
| 2/8/2018 | | | 0.04 (J) | 0.07 (J) | 0.11 | | | | |
| 2/12/2018 | | | | | | 0.11 | | | |
| 4/24/2018 | 0.2 | | | | | | | | |
| 4/25/2018 | | 0.05 (J) | 0.04 (J) | 0.07 (J) | 0.09 (J) | 0.12 | | | |
| 6/26/2018 | 0.22 | | 0.05 (J) | 0.09 (J) | 0.1 | 0.13 | | | |
| 6/27/2018 | | 0.06 (J) | | | | | 0.13 | 0.05 (J) | 0.04 (J) |
| 7/18/2018 | | | | | | | 0.11 | 0.04 (J) | 0.04 (J) |
| 8/6/2018 | 0.22 | | | | | | | | |
| 8/7/2018 | | 0.06 (J) | 0.05 (J) | | | | 0.11 | | |
| 8/8/2018 | | | | 0.1 | 0.1 | 0.12 | | 0.04 (J) | 0.04 (J) |
| 9/5/2018 | | | | | | | 0.13 | 0.04 (J) | 0.04 (J) |
| 9/24/2018 | | | | | | | 0.13 | 0.04 (J) | 0.04 (J) |
| 10/22/2018 | 0.24 | | | | | | 0.13 | | |
| 10/23/2018 | | 0.07 (J) | 0.06 (J) | 0.1 | 0.11 | 0.13 | | 0.04 (J) | 0.04 (J) |
| 12/3/2018 | 0.22 | | <0.1 | | | | 0.08 (J) | <0.1 | <0.1 |
| 12/4/2018 | | | | 0.06 (J) | 0.08 (J) | | | | |
| 12/5/2018 | | 0.04 (J) | | | | 0.04 (J) | | | |
| 2/5/2019 | 0.259 | 0.0651 (J) | 0.0583 (J) | | | | 0.0934 (J) | | |
| 2/6/2019 | | | | <0.1 | <0.1 | <0.1 | | | |
| 2/7/2019 | | | | | | | | <0.1 | <0.1 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



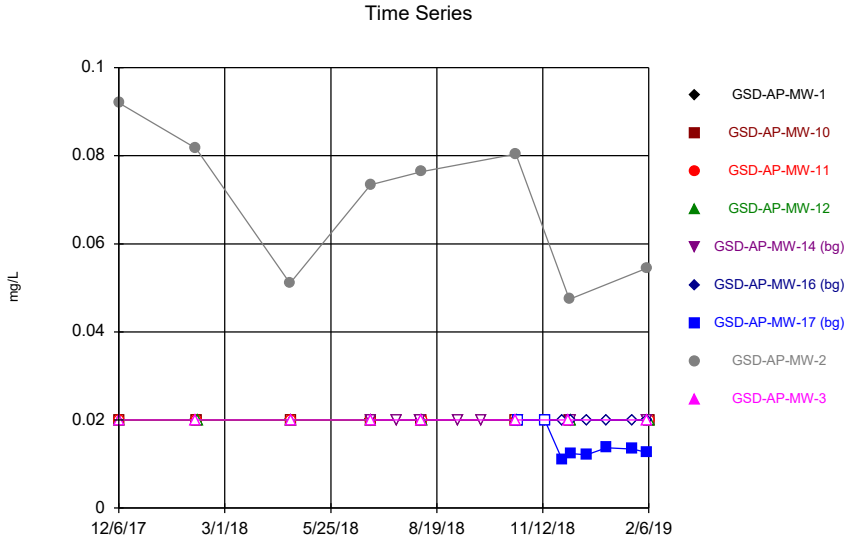

Constituent: Lead Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



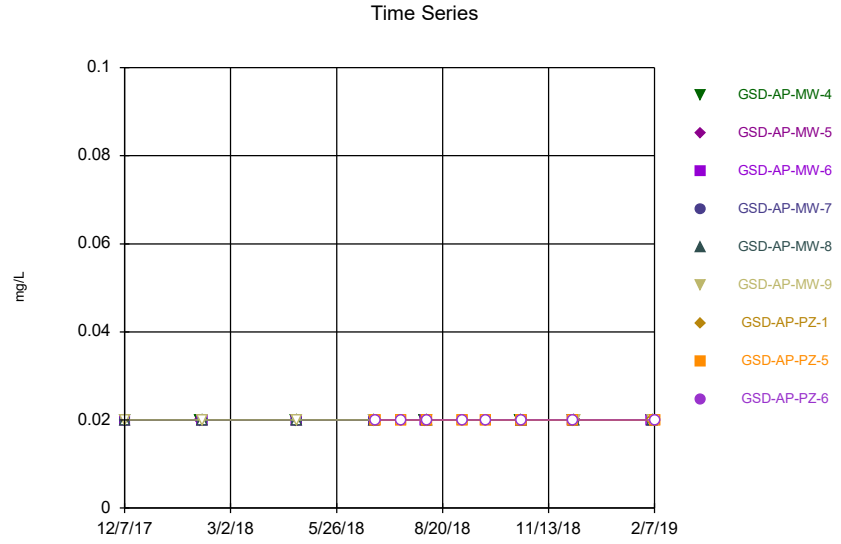

Constituent: Lead Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Lithium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Lithium Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Lead (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.005 | <0.005 | <0.005 | <0.005 | | | | <0.005 | <0.005 |
| 2/6/2018 | <0.005 | | | | | | | <0.005 | <0.005 |
| 2/7/2018 | | <0.005 | <0.005 | | | | | | |
| 2/8/2018 | | | | <0.005 | | | | | |
| 4/23/2018 | <0.005 | | | | | | | <0.005 | |
| 4/24/2018 | | <0.005 | <0.005 | <0.005 | | | | | <0.005 |
| 6/26/2018 | <0.005 | | | | | | | | |
| 6/27/2018 | | <0.005 | <0.005 | <0.005 | 0.00158 (J) | | | <0.005 | <0.005 |
| 7/18/2018 | | | | | 0.00152 (J) | | | | |
| 8/6/2018 | | | | | 0.00143 (J) | | | | |
| 8/7/2018 | <0.005 | <0.005 | | | | | | <0.005 | <0.005 |
| 8/8/2018 | | | <0.005 | <0.005 | | | | | |
| 9/5/2018 | | | | | 0.00118 (J) | | | | |
| 9/24/2018 | | | | | 0.00156 (J) | | | | |
| 10/22/2018 | <0.005 | <0.005 | | | | | | <0.005 | <0.005 |
| 10/23/2018 | | | <0.005 | <0.005 | | | | | |
| 10/24/2018 | | | | | 0.00121 (J) | <0.005 | <0.005 | | |
| 11/14/2018 | | | | | | <0.005 | <0.005 | | |
| 11/28/2018 | | | | | | <0.005 | <0.005 | | |
| 12/3/2018 | | | | | | | | | <0.005 |
| 12/4/2018 | <0.005 | <0.005 | <0.005 | | | | | <0.005 | |
| 12/5/2018 | | | | <0.005 | 0.00117 (J) | <0.005 | <0.005 | | |
| 12/18/2018 | | | | | | <0.005 | <0.005 | | |
| 1/3/2019 | | | | | | 0.001 (J) | <0.005 | | |
| 1/24/2019 | | | | | | 0.00114 (J) | <0.005 | | |
| 2/5/2019 | <0.005 | | | | 0.00156 (J) | 0.00135 (J) | <0.005 | <0.005 | <0.005 |
| 2/6/2019 | | <0.005 | <0.005 | <0.005 | | | | | |

# Time Series

Constituent: Lead (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | | | |
| 2/6/2018 | <0.005 | <0.005 | | | | | | | |
| 2/8/2018 | | | <0.005 | <0.005 | <0.005 | <0.005 | | | |
| 4/24/2018 | <0.005 | | | | | | | | |
| 4/25/2018 | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | | | |
| 6/26/2018 | <0.005 | | <0.005 | <0.005 | <0.005 | <0.005 | | | |
| 6/27/2018 | | <0.005 | | | | | <0.005 | <0.005 | <0.005 |
| 7/18/2018 | | | | | | | <0.005 | <0.005 | <0.005 |
| 8/6/2018 | <0.005 | | | | | | | | |
| 8/7/2018 | | <0.005 | <0.005 | | | | <0.005 | | |
| 8/8/2018 | | | | <0.005 | <0.005 | <0.005 | | <0.005 | <0.005 |
| 9/5/2018 | | | | | | | <0.005 | <0.005 | <0.005 |
| 9/24/2018 | | | | | | | <0.005 | <0.005 | <0.005 |
| 10/22/2018 | <0.005 | | | | | | <0.005 | | |
| 10/23/2018 | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | | <0.005 | <0.005 |
| 12/3/2018 | <0.005 | | <0.005 | | | | <0.005 | <0.005 | <0.005 |
| 12/4/2018 | | | | <0.005 | <0.005 | | | | |
| 12/5/2018 | | <0.005 | | | | <0.005 | | | |
| 2/5/2019 | <0.005 | <0.005 | <0.005 | | | | <0.005 | | |
| 2/6/2019 | | | | <0.005 | <0.005 | <0.005 | | | |
| 2/7/2019 | | | | | | | | <0.005 | <0.005 |

# Time Series

Constituent: Lithium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.02 | <0.02 | <0.02 | <0.02 | | | | 0.092 | <0.02 |
| 2/6/2018 | <0.02 | | | | | | | 0.0817 | <0.02 |
| 2/7/2018 | | <0.02 | <0.02 | | | | | | |
| 2/8/2018 | | | | <0.02 | | | | | |
| 4/23/2018 | <0.02 | | | | | | | 0.051 | |
| 4/24/2018 | | <0.02 | <0.02 | <0.02 | | | | | <0.02 |
| 6/26/2018 | <0.02 | | | | | | | | |
| 6/27/2018 | | <0.02 | <0.02 | <0.02 | <0.02 | | | 0.0734 | <0.02 |
| 7/18/2018 | | | | | <0.02 | | | | |
| 8/6/2018 | | | | | <0.02 | | | | |
| 8/7/2018 | <0.02 | <0.02 | | | | | | 0.0764 | <0.02 |
| 8/8/2018 | | | <0.02 | <0.02 | | | | | |
| 9/5/2018 | | | | | <0.02 | | | | |
| 9/24/2018 | | | | | <0.02 | | | | |
| 10/22/2018 | <0.02 | <0.02 | | | | | | 0.0804 | <0.02 |
| 10/23/2018 | | | <0.02 | <0.02 | | | | | |
| 10/24/2018 | | | | | <0.02 | <0.02 | <0.02 | | |
| 11/14/2018 | | | | | | <0.02 | <0.02 | | |
| 11/28/2018 | | | | | | <0.02 | 0.0111 (J) | | |
| 12/3/2018 | | | | | | | | | <0.02 |
| 12/4/2018 | <0.02 | <0.02 | <0.02 | | | | | 0.0474 | |
| 12/5/2018 | | | | <0.02 | <0.02 | <0.02 | 0.0124 (J) | | |
| 12/18/2018 | | | | | | <0.02 | 0.0121 (J) | | |
| 1/3/2019 | | | | | | <0.02 | 0.0137 (J) | | |
| 1/24/2019 | | | | | | <0.02 | 0.0134 (J) | | |
| 2/5/2019 | <0.02 | | | | <0.02 | <0.02 | 0.0126 (J) | 0.0545 | <0.02 |
| 2/6/2019 | | <0.02 | <0.02 | <0.02 | | | | | |

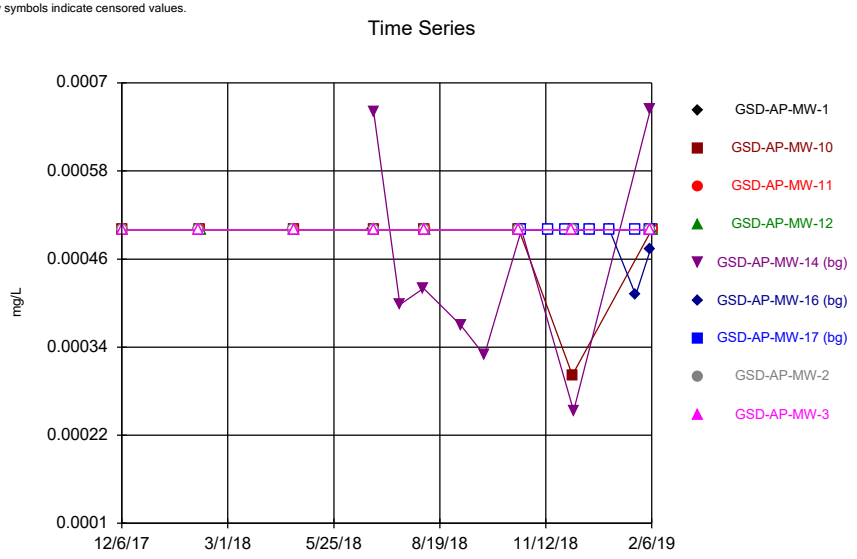
# Time Series

Constituent: Lithium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

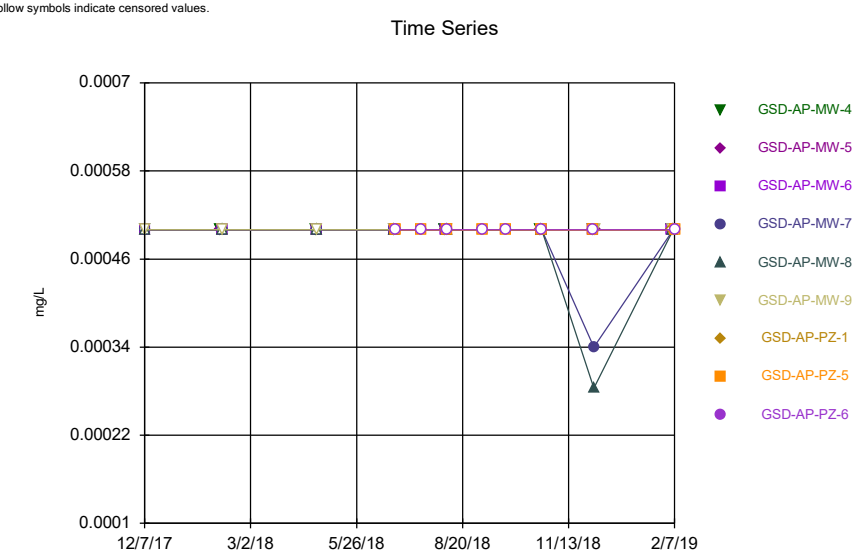
| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | | | |
| 2/6/2018 | <0.02 | <0.02 | | | | | | | |
| 2/8/2018 | | | <0.02 | <0.02 | <0.02 | <0.02 | | | |
| 4/24/2018 | <0.02 | | | | | | | | |
| 4/25/2018 | | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | | | |
| 6/26/2018 | <0.02 | | <0.02 | <0.02 | <0.02 | <0.02 | | | |
| 6/27/2018 | | <0.02 | | | | | <0.02 | <0.02 | <0.02 |
| 7/18/2018 | | | | | | | <0.02 | <0.02 | <0.02 |
| 8/6/2018 | <0.02 | | | | | | | | |
| 8/7/2018 | | <0.02 | <0.02 | | | | <0.02 | | |
| 8/8/2018 | | | | <0.02 | <0.02 | <0.02 | | <0.02 | <0.02 |
| 9/5/2018 | | | | | | | <0.02 | <0.02 | <0.02 |
| 9/24/2018 | | | | | | | <0.02 | <0.02 | <0.02 |
| 10/22/2018 | <0.02 | | | | | | <0.02 | | |
| 10/23/2018 | | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | | <0.02 | <0.02 |
| 12/3/2018 | <0.02 | | <0.02 | | | | <0.02 | <0.02 | <0.02 |
| 12/4/2018 | | | | <0.02 | <0.02 | | | | |
| 12/5/2018 | | <0.02 | | | | <0.02 | | | |
| 2/5/2019 | <0.02 | <0.02 | <0.02 | | | | <0.02 | | |
| 2/6/2019 | | | | <0.02 | <0.02 | <0.02 | | | |
| 2/7/2019 | | | | | | | | <0.02 | <0.02 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



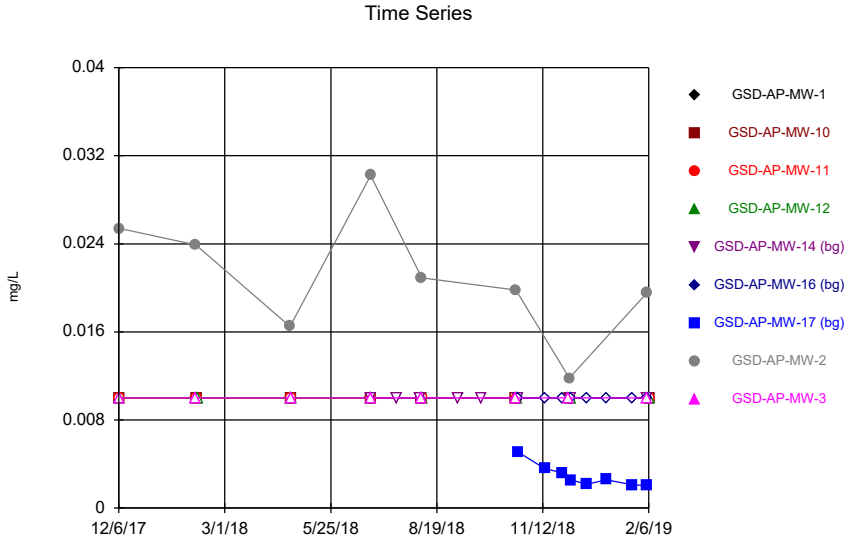

Constituent: Mercury Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



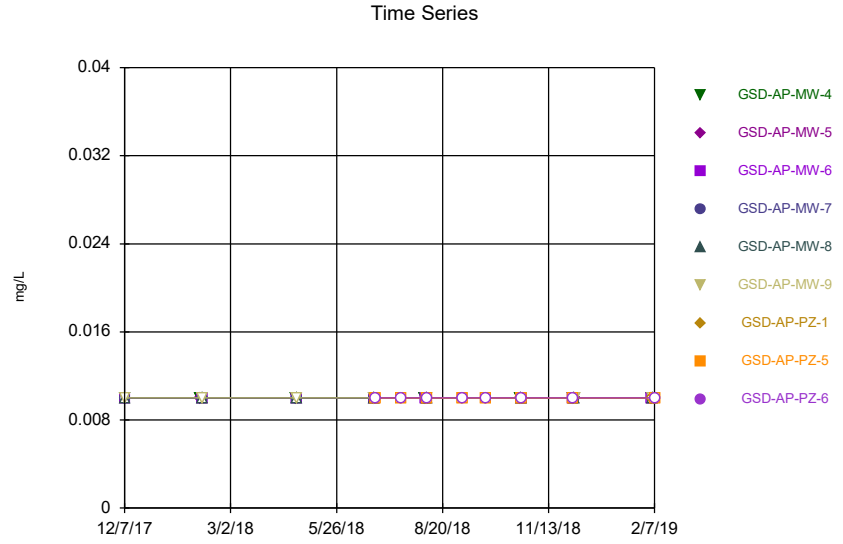

Constituent: Mercury Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Molybdenum Analysis Run 4/2/2019 3:36 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Molybdenum Analysis Run 4/2/2019 3:37 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Mercury (mg/L)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | | | | <0.0005 | <0.0005 |
| 2/6/2018 | <0.0005 | | | | | | | <0.0005 | <0.0005 |
| 2/7/2018 | | <0.0005 | <0.0005 | | | | | | |
| 2/8/2018 | | | | <0.0005 | | | | | |
| 4/23/2018 | <0.0005 | | | | | | | <0.0005 | |
| 4/24/2018 | | <0.0005 | <0.0005 | <0.0005 | | | | | <0.0005 |
| 6/26/2018 | <0.0005 | | | | | | | | |
| 6/27/2018 | | <0.0005 | <0.0005 | <0.0005 | 0.000661 | | | <0.0005 | <0.0005 |
| 7/18/2018 | | | | | 0.000398 (J) | | | | |
| 8/6/2018 | | | | | 0.00042 (J) | | | | |
| 8/7/2018 | <0.0005 | <0.0005 | | | | | | <0.0005 | <0.0005 |
| 8/8/2018 | | | <0.0005 | <0.0005 | | | | | |
| 9/5/2018 | | | | | 0.00037 (J) | | | | |
| 9/24/2018 | | | | | 0.000329 (J) | | | | |
| 10/22/2018 | <0.0005 | <0.0005 | | | | | | <0.0005 | <0.0005 |
| 10/23/2018 | | | <0.0005 | <0.0005 | | | | | |
| 10/24/2018 | | | | | <0.0005 | <0.0005 | <0.0005 | | |
| 11/14/2018 | | | | | | <0.0005 | <0.0005 | | |
| 11/28/2018 | | | | | | <0.0005 | <0.0005 | | |
| 12/3/2018 | | | | | | | | | <0.0005 |
| 12/4/2018 | <0.0005 | 0.000302 (J) | <0.0005 | | | | | <0.0005 | |
| 12/5/2018 | | | | <0.0005 | 0.000253 (J) | <0.0005 | <0.0005 | | |
| 12/18/2018 | | | | | | <0.0005 | <0.0005 | | |
| 1/3/2019 | | | | | | <0.0005 | <0.0005 | | |
| 1/24/2019 | | | | | | 0.000411 (J) | <0.0005 | | |
| 2/5/2019 | <0.0005 | | | | 0.000664 | 0.000473 (J) | <0.0005 | <0.0005 | <0.0005 |
| 2/6/2019 | | <0.0005 | <0.0005 | <0.0005 | | | | | |

# Time Series

Constituent: Mercury (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | | | |
| 2/6/2018 | <0.0005 | <0.0005 | | | | | | | |
| 2/8/2018 | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | | | |
| 4/24/2018 | <0.0005 | | | | | | | | |
| 4/25/2018 | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | | | |
| 6/26/2018 | <0.0005 | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | | | |
| 6/27/2018 | | <0.0005 | | | | | <0.0005 | <0.0005 | <0.0005 |
| 7/18/2018 | | | | | | | <0.0005 | <0.0005 | <0.0005 |
| 8/6/2018 | <0.0005 | | | | | | | | |
| 8/7/2018 | | <0.0005 | <0.0005 | | | | <0.0005 | | |
| 8/8/2018 | | | | <0.0005 | <0.0005 | <0.0005 | | <0.0005 | <0.0005 |
| 9/5/2018 | | | | | | | <0.0005 | <0.0005 | <0.0005 |
| 9/24/2018 | | | | | | | <0.0005 | <0.0005 | <0.0005 |
| 10/22/2018 | <0.0005 | | | | | | <0.0005 | | |
| 10/23/2018 | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | | <0.0005 | <0.0005 |
| 12/3/2018 | <0.0005 | | <0.0005 | | | | <0.0005 | <0.0005 | <0.0005 |
| 12/4/2018 | | | | 0.00034 (J) | 0.000284 (J) | | | | |
| 12/5/2018 | | <0.0005 | | | | <0.0005 | | | |
| 2/5/2019 | <0.0005 | <0.0005 | <0.0005 | | | | <0.0005 | | |
| 2/6/2019 | | | | <0.0005 | <0.0005 | <0.0005 | | | |
| 2/7/2019 | | | | | | | | <0.0005 | <0.0005 |

# Time Series

Constituent: Molybdenum (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.01 | <0.01 | <0.01 | <0.01 | | | | 0.0254 | <0.01 |
| 2/6/2018 | <0.01 | | | | | | | 0.0239 | <0.01 |
| 2/7/2018 | | <0.01 | <0.01 | | | | | | |
| 2/8/2018 | | | | <0.01 | | | | | |
| 4/23/2018 | <0.01 | | | | | | | 0.0165 | |
| 4/24/2018 | | <0.01 | <0.01 | <0.01 | | | | | <0.01 |
| 6/26/2018 | <0.01 | | | | | | | | |
| 6/27/2018 | | <0.01 | <0.01 | <0.01 | <0.01 | | | 0.0302 | <0.01 |
| 7/18/2018 | | | | | <0.01 | | | | |
| 8/6/2018 | | | | | <0.01 | | | | |
| 8/7/2018 | <0.01 | <0.01 | | | | | | 0.0209 | <0.01 |
| 8/8/2018 | | | <0.01 | <0.01 | | | | | |
| 9/5/2018 | | | | | <0.01 | | | | |
| 9/24/2018 | | | | | <0.01 | | | | |
| 10/22/2018 | <0.01 | <0.01 | | | | | | 0.0198 | <0.01 |
| 10/23/2018 | | | <0.01 | <0.01 | | | | | |
| 10/24/2018 | | | | | <0.01 | <0.01 | 0.00507 (J) | | |
| 11/14/2018 | | | | | | <0.01 | 0.00358 (J) | | |
| 11/28/2018 | | | | | | <0.01 | 0.00322 (J) | | |
| 12/3/2018 | | | | | | | | | <0.01 |
| 12/4/2018 | <0.01 | <0.01 | <0.01 | | | | | 0.0118 | |
| 12/5/2018 | | | | <0.01 | <0.01 | <0.01 | 0.00256 (J) | | |
| 12/18/2018 | | | | | | <0.01 | 0.00215 (J) | | |
| 1/3/2019 | | | | | | <0.01 | 0.00257 (J) | | |
| 1/24/2019 | | | | | | <0.01 | 0.00211 (J) | | |
| 2/5/2019 | <0.01 | | | | <0.01 | <0.01 | 0.00205 (J) | 0.0196 | <0.01 |
| 2/6/2019 | | <0.01 | <0.01 | <0.01 | | | | | |

# Time Series

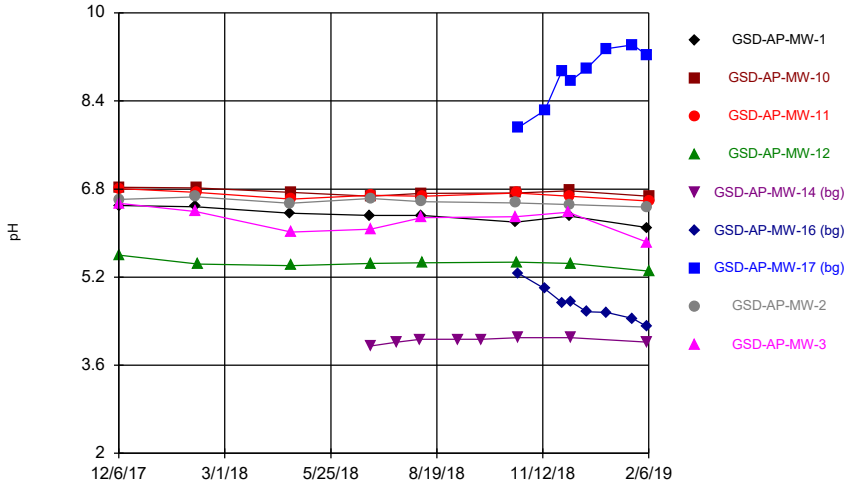
Constituent: Molybdenum (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 2/6/2018 | <0.01 | <0.01 | | | | | | | |
| 2/8/2018 | | | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 4/24/2018 | <0.01 | | | | | | | | |
| 4/25/2018 | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 6/26/2018 | <0.01 | | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 6/27/2018 | | <0.01 | | | | | <0.01 | <0.01 | <0.01 |
| 7/18/2018 | | | | | | | <0.01 | <0.01 | <0.01 |
| 8/6/2018 | <0.01 | | | | | | | | |
| 8/7/2018 | | <0.01 | <0.01 | | | | <0.01 | | |
| 8/8/2018 | | | | <0.01 | <0.01 | <0.01 | | <0.01 | <0.01 |
| 9/5/2018 | | | | | | | <0.01 | <0.01 | <0.01 |
| 9/24/2018 | | | | | | | <0.01 | <0.01 | <0.01 |
| 10/22/2018 | <0.01 | | | | | | <0.01 | | |
| 10/23/2018 | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | <0.01 | <0.01 |
| 12/3/2018 | <0.01 | | <0.01 | | | | <0.01 | <0.01 | <0.01 |
| 12/4/2018 | | | | <0.01 | <0.01 | | | | |
| 12/5/2018 | | <0.01 | | | | <0.01 | | | |
| 2/5/2019 | <0.01 | <0.01 | <0.01 | | | | <0.01 | | |
| 2/6/2019 | | | | <0.01 | <0.01 | <0.01 | | | |
| 2/7/2019 | | | | | | | | <0.01 | <0.01 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series

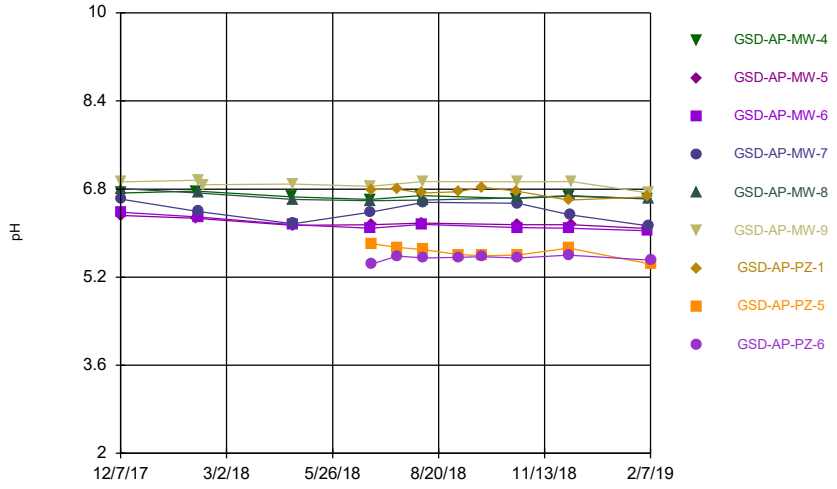



Constituent: pH Analysis Run 4/2/2019 3:37 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series

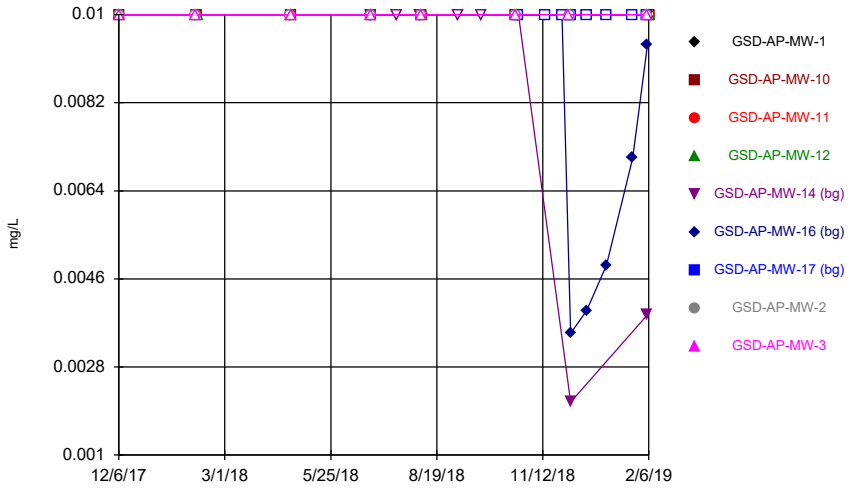



Constituent: pH Analysis Run 4/2/2019 3:37 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series

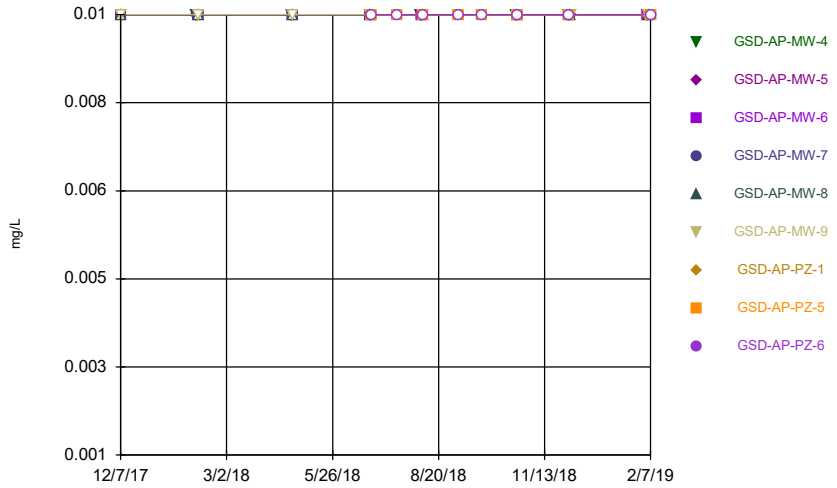



Constituent: Selenium Analysis Run 4/2/2019 3:37 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series




Constituent: Selenium Analysis Run 4/2/2019 3:37 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: pH (pH)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 6.5 | 6.83 | 6.81 | 5.6 | | | | 6.61 | 6.54 |
| 2/6/2018 | 6.48 | | | | | | | 6.66 | 6.39 |
| 2/7/2018 | | 6.82 | 6.74 | | | | | | |
| 2/8/2018 | | | | 5.44 | | | | | |
| 4/23/2018 | 6.36 | | | | | | | 6.54 | |
| 4/24/2018 | | 6.74 | 6.62 | 5.41 | | | | | 6.02 |
| 6/26/2018 | 6.32 | | | | | | | | |
| 6/27/2018 | | 6.67 | 6.69 | 5.45 | 3.95 | | | 6.63 | 6.07 |
| 7/18/2018 | | | | | 4.02 | | | | |
| 8/6/2018 | | | | | 4.07 | | | | |
| 8/7/2018 | 6.32 | 6.72 | | | | | | 6.57 | 6.28 |
| 8/8/2018 | | | 6.67 | 5.46 | | | | | |
| 9/5/2018 | | | | | 4.07 | | | | |
| 9/24/2018 | | | | | 4.07 | | | | |
| 10/22/2018 | 6.2 | 6.73 | | | | | | 6.55 | 6.3 |
| 10/23/2018 | | | 6.73 | 5.47 | | | | | |
| 10/24/2018 | | | | | 4.1 | 5.27 | 7.92 | | |
| 11/14/2018 | | | | | | 4.99 | 8.23 | | |
| 11/28/2018 | | | | | | 4.74 | 8.95 | | |
| 12/3/2018 | | | | | | | | | 6.38 |
| 12/4/2018 | 6.31 | 6.77 | 6.67 | | | | | 6.52 | |
| 12/5/2018 | | | | 5.45 | 4.1 | 4.76 | 8.77 | | |
| 12/18/2018 | | | | | | 4.57 | 8.99 | | |
| 1/3/2019 | | | | | | 4.56 | 9.35 | | |
| 1/24/2019 | | | | | | 4.45 | 9.42 | | |
| 2/5/2019 | 6.1 | | | | 4.02 | 4.3 | 9.23 | 6.47 | 5.83 |
| 2/6/2019 | | 6.67 | 6.58 | 5.31 | | | | | |

# Time Series

Constituent: pH (pH)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 6.73 | 6.32 | 6.38 | 6.62 | 6.81 | 6.93 | | | |
| 2/6/2018 | 6.76 | 6.27 | | | | | | | |
| 2/8/2018 | | | 6.29 | 6.39 | 6.73 | 6.96 | | | |
| 2/12/2018 | | | | | | 6.88 | | | |
| 4/24/2018 | 6.66 | | | | | | | | |
| 4/25/2018 | | 6.14 | 6.15 | 6.17 | 6.61 | 6.89 | | | |
| 6/26/2018 | 6.61 | | 6.09 | 6.38 | 6.59 | 6.85 | | | |
| 6/27/2018 | | 6.15 | | | | | 6.79 | 5.81 | 5.44 |
| 7/18/2018 | | | | | | | 6.8 | 5.74 | 5.58 |
| 8/6/2018 | 6.68 | | | | | | | | |
| 8/7/2018 | | 6.18 | 6.16 | | | | 6.73 | | |
| 8/8/2018 | | | | 6.56 | 6.6 | 6.94 | | 5.7 | 5.55 |
| 9/5/2018 | | | | | | | 6.75 | 5.61 | 5.56 |
| 9/24/2018 | | | | | | | 6.83 | 5.59 | 5.57 |
| 10/22/2018 | 6.63 | | | | | | 6.76 | | |
| 10/23/2018 | | 6.15 | 6.1 | 6.54 | 6.64 | 6.93 | | 5.6 | 5.55 |
| 12/3/2018 | 6.67 | | 6.09 | | | | 6.6 | 5.73 | 5.6 |
| 12/4/2018 | | | | 6.33 | 6.68 | | | | |
| 12/5/2018 | | 6.15 | | | | 6.94 | | | |
| 2/5/2019 | 6.63 | 6.08 | 6.04 | | | | 6.66 | | |
| 2/6/2019 | | | | 6.13 | 6.62 | 6.73 | | | |
| 2/7/2019 | | | | | | | | 5.44 | 5.51 |

# Time Series

Constituent: Selenium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.01 | <0.01 | <0.01 | <0.01 | | | | <0.01 | <0.01 |
| 2/6/2018 | <0.01 | | | | | | | <0.01 | <0.01 |
| 2/7/2018 | | <0.01 | <0.01 | | | | | | |
| 2/8/2018 | | | | <0.01 | | | | | |
| 4/23/2018 | <0.01 | | | | | | | <0.01 | |
| 4/24/2018 | | <0.01 | <0.01 | <0.01 | | | | | <0.01 |
| 6/26/2018 | <0.01 | | | | | | | | |
| 6/27/2018 | | <0.01 | <0.01 | <0.01 | <0.01 | | | <0.01 | <0.01 |
| 7/18/2018 | | | | | <0.01 | | | | |
| 8/6/2018 | | | | | <0.01 | | | | |
| 8/7/2018 | <0.01 | <0.01 | | | | | | <0.01 | <0.01 |
| 8/8/2018 | | | <0.01 | <0.01 | | | | | |
| 9/5/2018 | | | | | <0.01 | | | | |
| 9/24/2018 | | | | | <0.01 | | | | |
| 10/22/2018 | <0.01 | <0.01 | | | | | | <0.01 | <0.01 |
| 10/23/2018 | | | <0.01 | <0.01 | | | | | |
| 10/24/2018 | | | | | <0.01 | <0.01 | <0.01 | | |
| 11/14/2018 | | | | | | <0.01 | <0.01 | | |
| 11/28/2018 | | | | | | <0.01 | <0.01 | | |
| 12/3/2018 | | | | | | | | | <0.01 |
| 12/4/2018 | <0.01 | <0.01 | <0.01 | | | | | <0.01 | |
| 12/5/2018 | | | | <0.01 | 0.00208 (J) | 0.00349 (J) | <0.01 | | |
| 12/18/2018 | | | | | | 0.00395 (J) | <0.01 | | |
| 1/3/2019 | | | | | | 0.00488 (J) | <0.01 | | |
| 1/24/2019 | | | | | | 0.00707 (J) | <0.01 | | |
| 2/5/2019 | <0.01 | | | | 0.00387 (J) | 0.00938 (J) | <0.01 | <0.01 | <0.01 |
| 2/6/2019 | | <0.01 | <0.01 | <0.01 | | | | | |

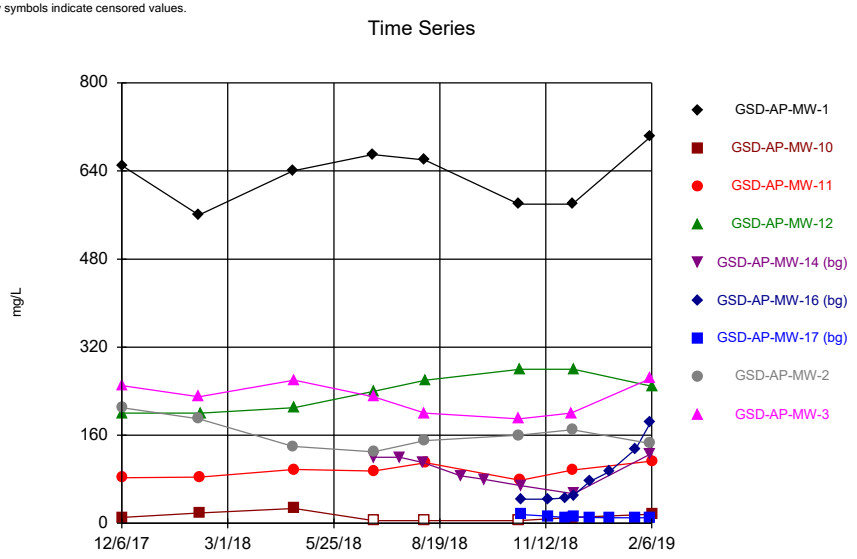
# Time Series

Constituent: Selenium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

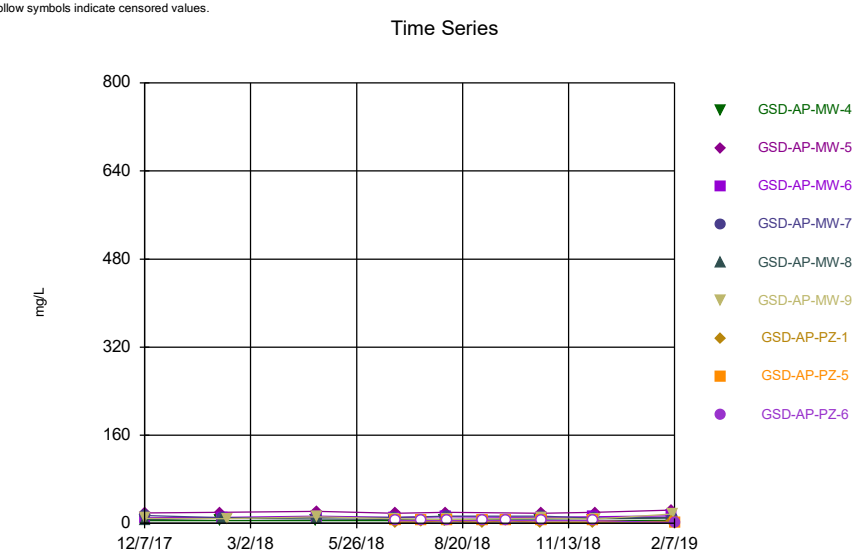
| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 2/6/2018 | <0.01 | <0.01 | | | | | | | |
| 2/8/2018 | | | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 4/24/2018 | <0.01 | | | | | | | | |
| 4/25/2018 | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 6/26/2018 | <0.01 | | <0.01 | <0.01 | <0.01 | <0.01 | | | |
| 6/27/2018 | | <0.01 | | | | | <0.01 | <0.01 | <0.01 |
| 7/18/2018 | | | | | | | <0.01 | <0.01 | <0.01 |
| 8/6/2018 | <0.01 | | | | | | | | |
| 8/7/2018 | | <0.01 | <0.01 | | | | <0.01 | | |
| 8/8/2018 | | | | <0.01 | <0.01 | <0.01 | | <0.01 | <0.01 |
| 9/5/2018 | | | | | | | <0.01 | <0.01 | <0.01 |
| 9/24/2018 | | | | | | | <0.01 | <0.01 | <0.01 |
| 10/22/2018 | <0.01 | | | | | | <0.01 | | |
| 10/23/2018 | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | <0.01 | <0.01 |
| 12/3/2018 | <0.01 | | <0.01 | | | | <0.01 | <0.01 | <0.01 |
| 12/4/2018 | | | | <0.01 | <0.01 | | | | |
| 12/5/2018 | | <0.01 | | | | <0.01 | | | |
| 2/5/2019 | <0.01 | <0.01 | <0.01 | | | | <0.01 | | |
| 2/6/2019 | | | | <0.01 | <0.01 | <0.01 | | | |
| 2/7/2019 | | | | | | | | <0.01 | <0.01 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



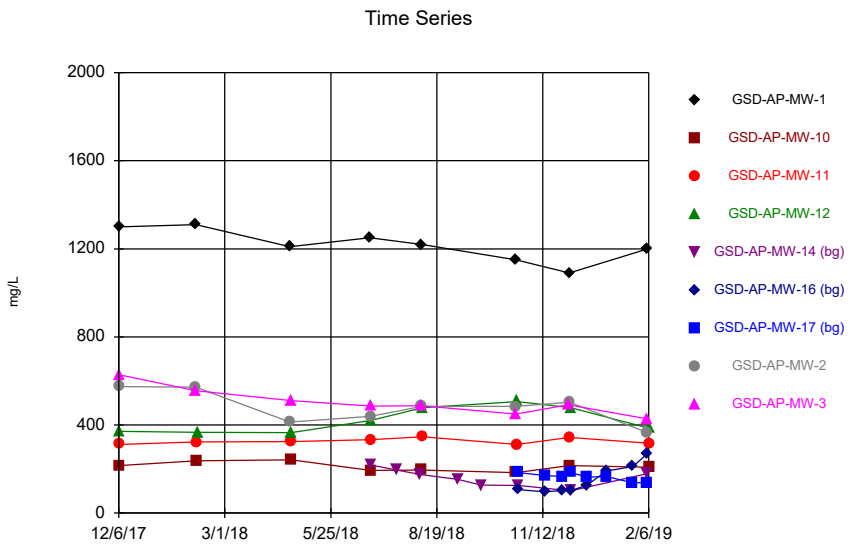

Constituent: Sulfate Analysis Run 4/2/2019 3:37 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



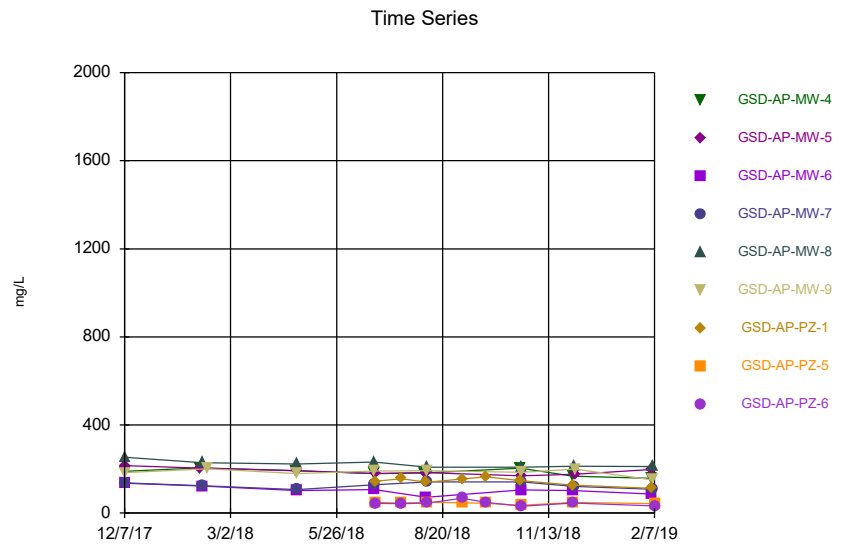

Constituent: Sulfate Analysis Run 4/2/2019 3:37 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG




Constituent: TDS Analysis Run 4/2/2019 3:37 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG




Constituent: TDS Analysis Run 4/2/2019 3:37 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Sulfate (mg/L)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 650 | 11 | 83 | 200 | | | | 210 | 250 |
| 2/6/2018 | 560 | | | | | | | 190 | 230 |
| 2/7/2018 | | 19 | 84 | | | | | | |
| 2/8/2018 | | | | 200 | | | | | |
| 4/23/2018 | 640 | | | | | | | 140 | |
| 4/24/2018 | | 27 | 98 | 210 | | | | | 260 |
| 6/26/2018 | 670 | | | | | | | | |
| 6/27/2018 | | <5 | 95 | 240 | 120 | | | 130 | 230 |
| 7/18/2018 | | | | | 120 | | | | |
| 8/6/2018 | | | | | 110 | | | | |
| 8/7/2018 | 660 | <5 | | | | | | 150 | 200 |
| 8/8/2018 | | | 110 | 260 | | | | | |
| 9/5/2018 | | | | | 86 | | | | |
| 9/24/2018 | | | | | 80 | | | | |
| 10/22/2018 | 580 | <5 | | | | | | 160 | 190 |
| 10/23/2018 | | | 78 | 280 | | | | | |
| 10/24/2018 | | | | | 68 | 44 | 16 | | |
| 11/14/2018 | | | | | | 44 | 13 | | |
| 11/28/2018 | | | | | | 46 | 11 | | |
| 12/3/2018 | | | | | | | | | 200 |
| 12/4/2018 | 580 | 11 | 97 | | | | | 170 | |
| 12/5/2018 | | | | 280 | 54 | 51 | 12 | | |
| 12/18/2018 | | | | | | 76 | 11 | | |
| 1/3/2019 | | | | | | 94 | 10 | | |
| 1/24/2019 | | | | | | 135 | 10.2 | | |
| 2/5/2019 | 702 | | | | 126 | 183 | 10.4 | 145 | 263 |
| 2/6/2019 | | 16.8 | 113 | 249 | | | | | |

# Time Series

Constituent: Sulfate (mg/L)  Analysis Run 4/2/2019 3:38 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <5 | 19 | 10 | 14 | 6.5 | 9 | | | |
| 2/6/2018 | <5 | 20 | | | | | | | |
| 2/8/2018 | | | 11 | 10 | 8.9 | | | | |
| 2/12/2018 | | | | | | 8.3 | | | |
| 4/24/2018 | <5 | | | | | | | | |
| 4/25/2018 | | 22 | 13 | 11 | 7.9 | 12 | | | |
| 6/26/2018 | <5 | | 11 | 11 | 7.5 | 8.5 | | | |
| 6/27/2018 | | 18 | | | | | 2.2 (J) | <5 | <5 |
| 7/18/2018 | | | | | | | 2.5 (J) | <5 | <5 |
| 8/6/2018 | <5 | | | | | | | | |
| 8/7/2018 | | 20 | 12 | | | | <5 | | |
| 8/8/2018 | | | | 13 | 7.3 | 6.7 | | <5 | <5 |
| 9/5/2018 | | | | | | | 1.4 (J) | <5 | <5 |
| 9/24/2018 | | | | | | | <5 | <5 | <5 |
| 10/22/2018 | <5 | | | | | | 1.7 (J) | | |
| 10/23/2018 | | 18 | 11 | 13 | 7.8 | 9.4 | | <5 | <5 |
| 12/3/2018 | <5 | | 12 | | | | 2.1 (J) | <5 | <5 |
| 12/4/2018 | | | | 9.8 | 8.2 | | | | |
| 12/5/2018 | | 20 | | | | 7.8 | | | |
| 2/5/2019 | 5.38 | 24.3 | 13.7 | | | | 3.99 | | |
| 2/6/2019 | | | | 10.8 | 9.53 | 17 | | | |
| 2/7/2019 | | | | | | | | 0.639 (J) | 1.69 |

# Time Series

Constituent: TDS (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | 1300 | 215 | 312 | 371 | | | | 574 | 628 |
| 2/6/2018 | 1310 | | | | | | | 572 | 556 |
| 2/7/2018 | | 237 | 323 | | | | | | |
| 2/8/2018 | | | | 367 | | | | | |
| 4/23/2018 | 1210 | | | | | | | 414 | |
| 4/24/2018 | | 242 | 324 | 365 | | | | | 510 |
| 6/26/2018 | 1250 | | | | | | | | |
| 6/27/2018 | | 194 | 333 | 421 | 219 | | | 440 | 486 |
| 7/18/2018 | | | | | 195 | | | | |
| 8/6/2018 | | | | | 175 | | | | |
| 8/7/2018 | 1220 | 195 | | | | | | 485 | 487 |
| 8/8/2018 | | | 346 | 479 | | | | | |
| 9/5/2018 | | | | | 153 | | | | |
| 9/24/2018 | | | | | 127 | | | | |
| 10/22/2018 | 1150 | 184 | | | | | | 484 | 450 |
| 10/23/2018 | | | 311 | 507 | | | | | |
| 10/24/2018 | | | | | 125 | 107 | 184 | | |
| 11/14/2018 | | | | | | 96.7 | 170 | | |
| 11/28/2018 | | | | | | 102 | 167 | | |
| 12/3/2018 | | | | | | | | | 492 |
| 12/4/2018 | 1090 | 215 | 343 | | | | | 504 | |
| 12/5/2018 | | | | 479 | 101 | 103 | 185 | | |
| 12/18/2018 | | | | | | 126 | 164 | | |
| 1/3/2019 | | | | | | 191 | 167 | | |
| 1/24/2019 | | | | | | 212 | 137 | | |
| 2/5/2019 | 1200 | | | | 180 | 269 | 138 | 366 | 428 |
| 2/6/2019 | | 208 | 317 | 385 | | | | | |

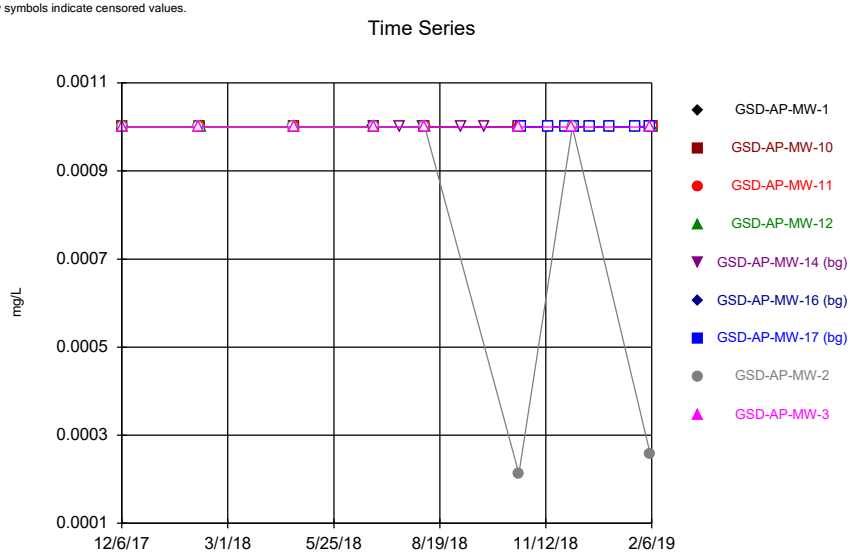
# Time Series

Constituent: TDS (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

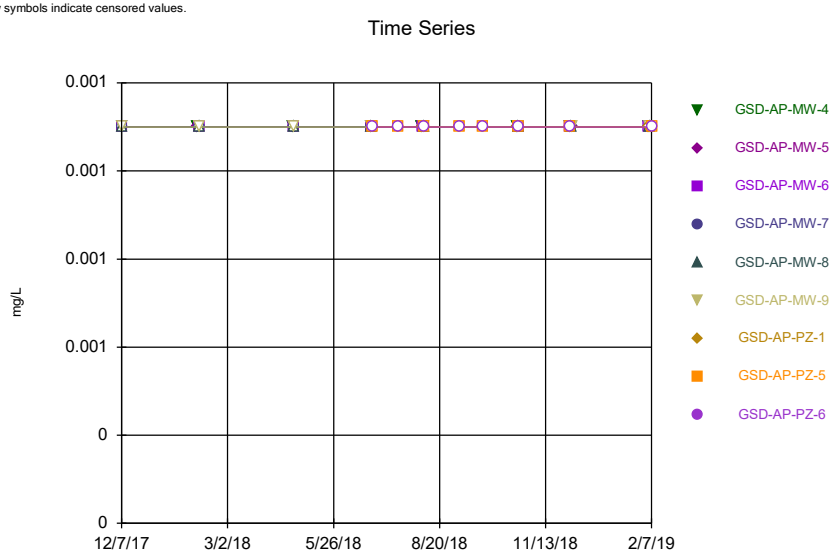
| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | 189 | 215 | 136 | 137 | 253 | 183 | | | |
| 2/6/2018 | 206 | 204 | | | | | | | |
| 2/8/2018 | | | 122 | 124 | 229 | | | | |
| 2/12/2018 | | | | | | 201 | | | |
| 4/24/2018 | 193 | | | | | | | | |
| 4/25/2018 | | 192 | 102 | 106 | 223 | 180 | | | |
| 6/26/2018 | 180 | | 106 | 129 | 232 | 191 | | | |
| 6/27/2018 | | 180 | | | | | 144 | 48.7 | 44 |
| 7/18/2018 | | | | | | | 156 | 46 | 42.7 |
| 8/6/2018 | 182 | | | | | | | | |
| 8/7/2018 | | 183 | 71.3 | | | | 140 | | |
| 8/8/2018 | | | | 142 | 208 | 192 | | 48 | 46 |
| 9/5/2018 | | | | | | | 154 | 47.3 | 67.3 |
| 9/24/2018 | | | | | | | 165 | 44.7 | 49.3 |
| 10/22/2018 | 204 | | | | | | 148 | | |
| 10/23/2018 | | 169 | 105 | 142 | 209 | 185 | | 35.3 | 31.3 |
| 12/3/2018 | 168 | | 102 | | | | 127 | 48.7 | 46 |
| 12/4/2018 | | | | 121 | 213 | | | | |
| 12/5/2018 | | 177 | | | | 200 | | | |
| 2/5/2019 | 158 | 198 | 86.7 | | | | 113 | | |
| 2/6/2019 | | | | 108 | 212 | 151 | | | |
| 2/7/2019 | | | | | | | | 42.7 | 32.7 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Thallium Analysis Run 4/2/2019 3:37 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.




Constituent: Thallium Analysis Run 4/2/2019 3:37 PM View: Descriptive
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# Time Series

Constituent: Thallium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-1 | GSD-AP-MW-10 | GSD-AP-MW-11 | GSD-AP-MW-12 | GSD-AP-MW-14 ... | GSD-AP-MW-16 ... | GSD-AP-MW-17 ... | GSD-AP-MW-2 | GSD-AP-MW-3 |
|---|---|---|---|---|---|---|---|---|---|
| 12/6/2017 | <0.001 | <0.001 | <0.001 | <0.001 | | | | <0.001 | <0.001 |
| 2/6/2018 | <0.001 | | | | | | | <0.001 | <0.001 |
| 2/7/2018 | | <0.001 | <0.001 | | | | | | |
| 2/8/2018 | | | | <0.001 | | | | | |
| 4/23/2018 | <0.001 | | | | | | | <0.001 | |
| 4/24/2018 | | <0.001 | <0.001 | <0.001 | | | | | <0.001 |
| 6/26/2018 | <0.001 | | | | | | | | |
| 6/27/2018 | | <0.001 | <0.001 | <0.001 | <0.001 | | | <0.001 | <0.001 |
| 7/18/2018 | | | | | <0.001 | | | | |
| 8/6/2018 | | | | | <0.001 | | | | |
| 8/7/2018 | <0.001 | <0.001 | | | | | | <0.001 | <0.001 |
| 8/8/2018 | | | <0.001 | <0.001 | | | | | |
| 9/5/2018 | | | | | <0.001 | | | | |
| 9/24/2018 | | | | | <0.001 | | | | |
| 10/22/2018 | <0.001 | <0.001 | | | | | | 0.000213 (J) | <0.001 |
| 10/23/2018 | | | <0.001 | <0.001 | | | | | |
| 10/24/2018 | | | | | <0.001 | <0.001 | <0.001 | | |
| 11/14/2018 | | | | | | <0.001 | <0.001 | | |
| 11/28/2018 | | | | | | <0.001 | <0.001 | | |
| 12/3/2018 | | | | | | | | | <0.001 |
| 12/4/2018 | <0.001 | <0.001 | <0.001 | | | | | <0.001 | |
| 12/5/2018 | | | | <0.001 | <0.001 | <0.001 | <0.001 | | |
| 12/18/2018 | | | | | | <0.001 | <0.001 | | |
| 1/3/2019 | | | | | | <0.001 | <0.001 | | |
| 1/24/2019 | | | | | | <0.001 | <0.001 | | |
| 2/5/2019 | <0.001 | | | | <0.001 | <0.001 | <0.001 | 0.000256 (J) | <0.001 |
| 2/6/2019 | | <0.001 | <0.001 | <0.001 | | | | | |

# Time Series

Constituent: Thallium (mg/L) Analysis Run 4/2/2019 3:38 PM View: Descriptive

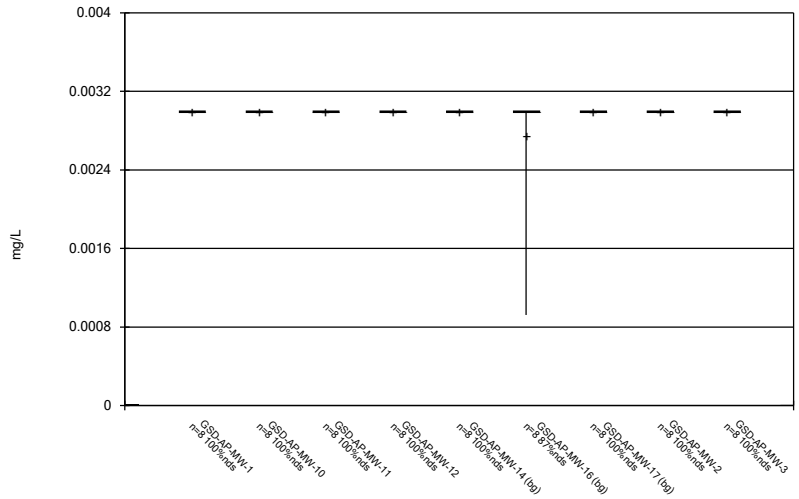
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

| | GSD-AP-MW-4 | GSD-AP-MW-5 | GSD-AP-MW-6 | GSD-AP-MW-7 | GSD-AP-MW-8 | GSD-AP-MW-9 | GSD-AP-PZ-1 | GSD-AP-PZ-5 | GSD-AP-PZ-6 |
|---|---|---|---|---|---|---|---|---|---|
| 12/7/2017 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | | | |
| 2/6/2018 | <0.001 | <0.001 | | | | | | | |
| 2/8/2018 | | | <0.001 | <0.001 | <0.001 | <0.001 | | | |
| 4/24/2018 | <0.001 | | | | | | | | |
| 4/25/2018 | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | | | |
| 6/26/2018 | <0.001 | | <0.001 | <0.001 | <0.001 | <0.001 | | | |
| 6/27/2018 | | <0.001 | | | | | <0.001 | <0.001 | <0.001 |
| 7/18/2018 | | | | | | | <0.001 | <0.001 | <0.001 |
| 8/6/2018 | <0.001 | | | | | | | | |
| 8/7/2018 | | <0.001 | <0.001 | | | | <0.001 | | |
| 8/8/2018 | | | | <0.001 | <0.001 | <0.001 | | <0.001 | <0.001 |
| 9/5/2018 | | | | | | | <0.001 | <0.001 | <0.001 |
| 9/24/2018 | | | | | | | <0.001 | <0.001 | <0.001 |
| 10/22/2018 | <0.001 | | | | | | <0.001 | | |
| 10/23/2018 | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | | <0.001 | <0.001 |
| 12/3/2018 | <0.001 | | <0.001 | | | | <0.001 | <0.001 | <0.001 |
| 12/4/2018 | | | | <0.001 | <0.001 | | | | |
| 12/5/2018 | | <0.001 | | | | <0.001 | | | |
| 2/5/2019 | <0.001 | <0.001 | <0.001 | | | | <0.001 | | |
| 2/6/2019 | | | | <0.001 | <0.001 | <0.001 | | | |
| 2/7/2019 | | | | | | | | <0.001 | <0.001 |

# FIGURE B.

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

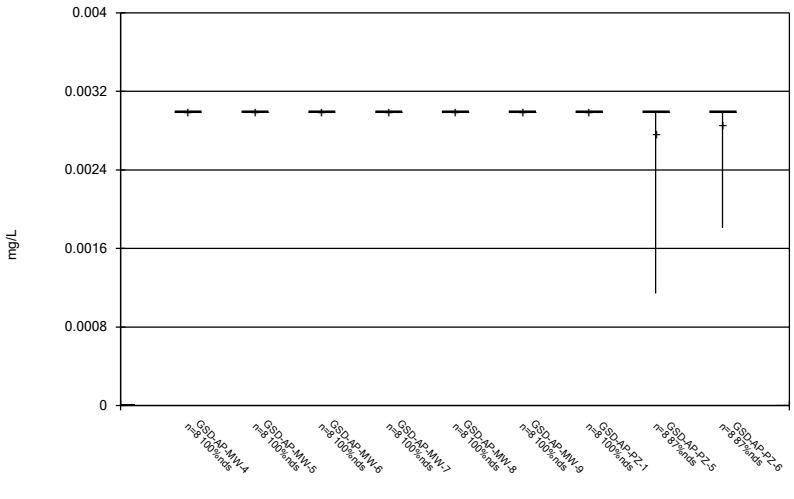



Constituent: Antimony Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

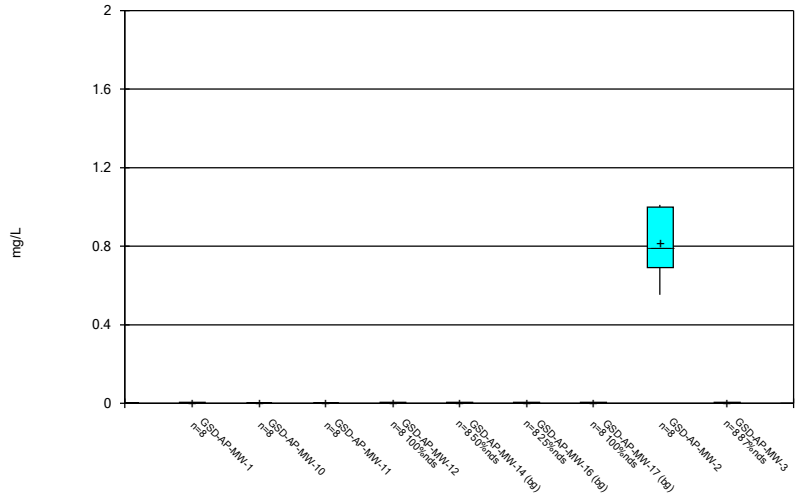



Constituent: Antimony Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

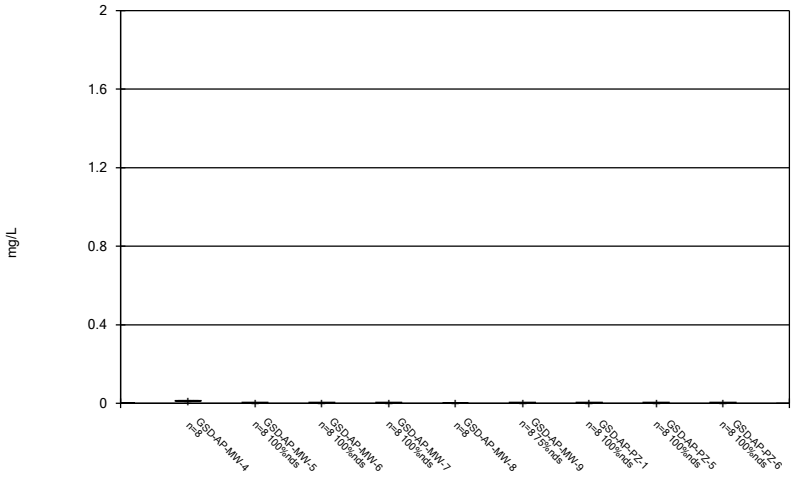



Constituent: Arsenic Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

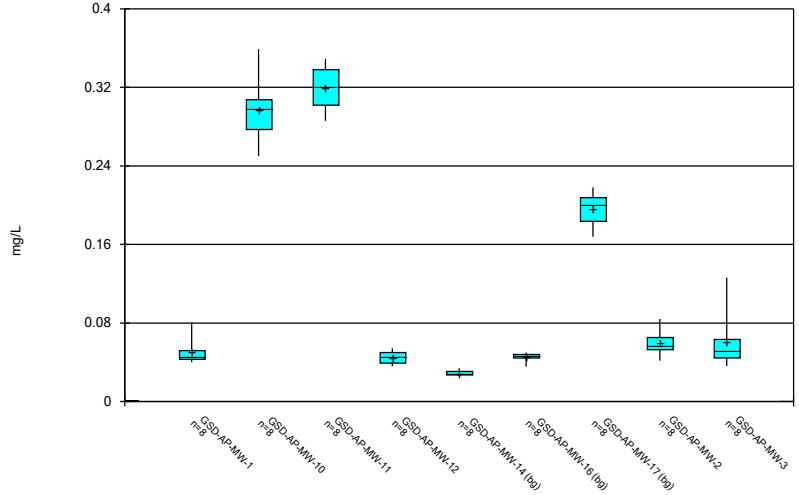



Constituent: Arsenic Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

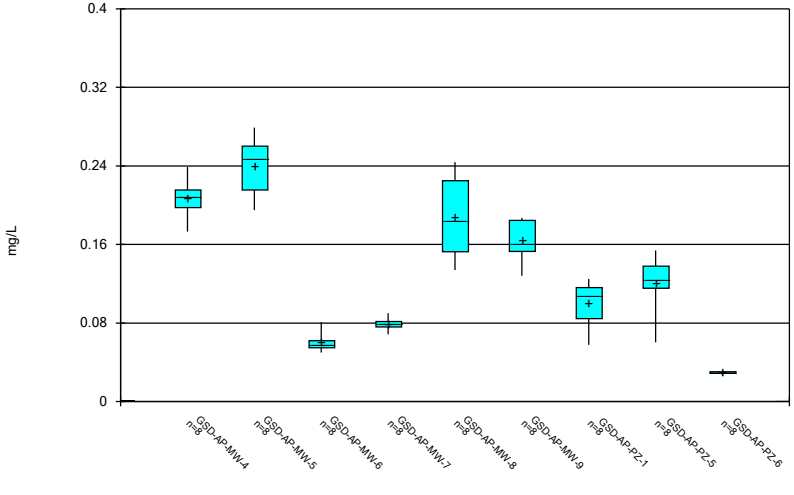



Constituent: Barium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

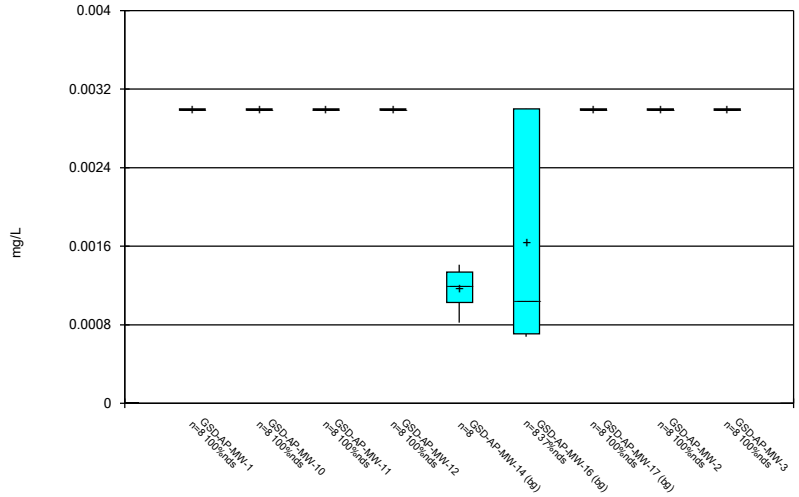



Constituent: Barium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

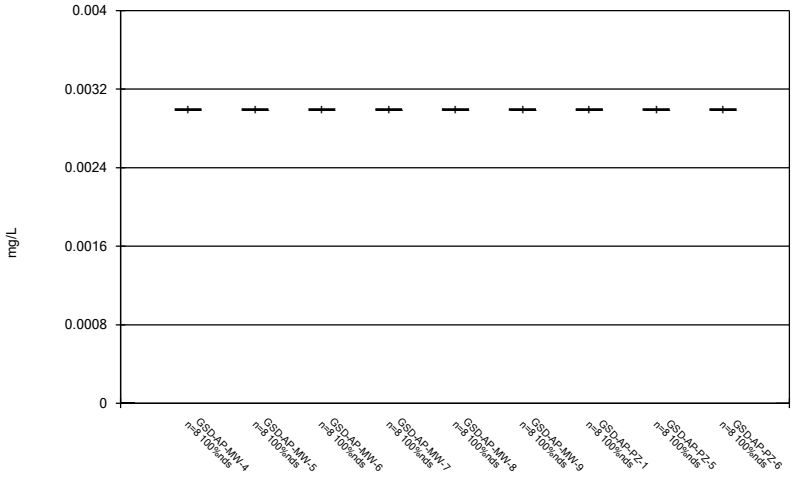



Constituent: Beryllium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

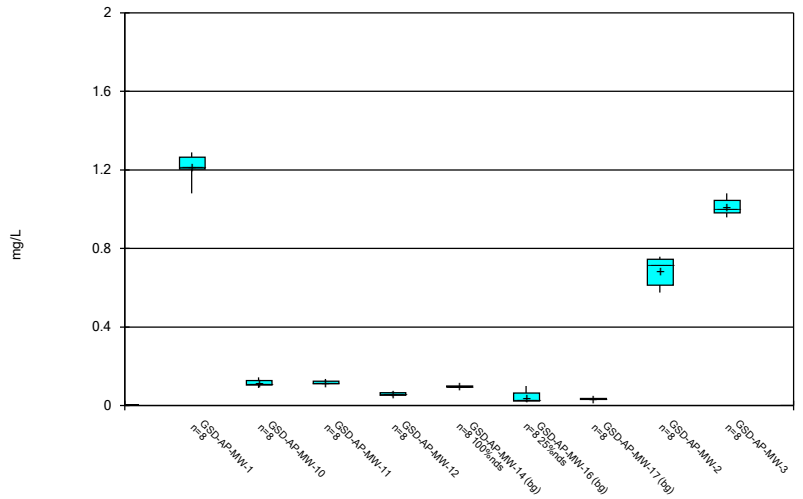



Constituent: Beryllium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

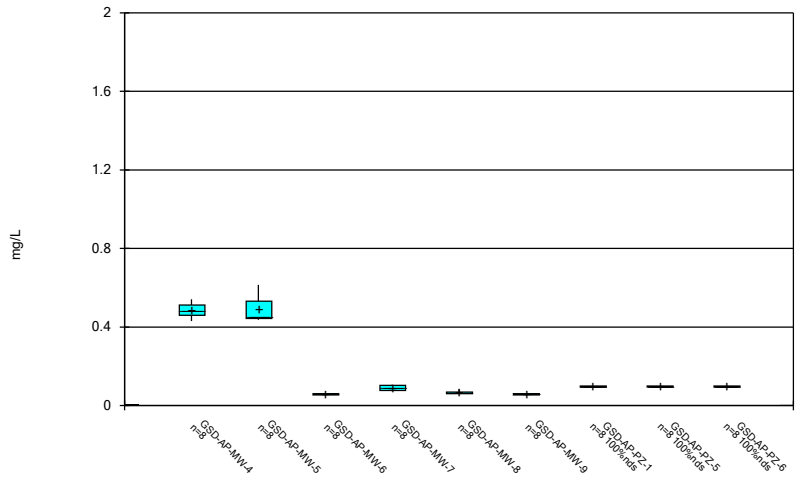



Constituent: Boron Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

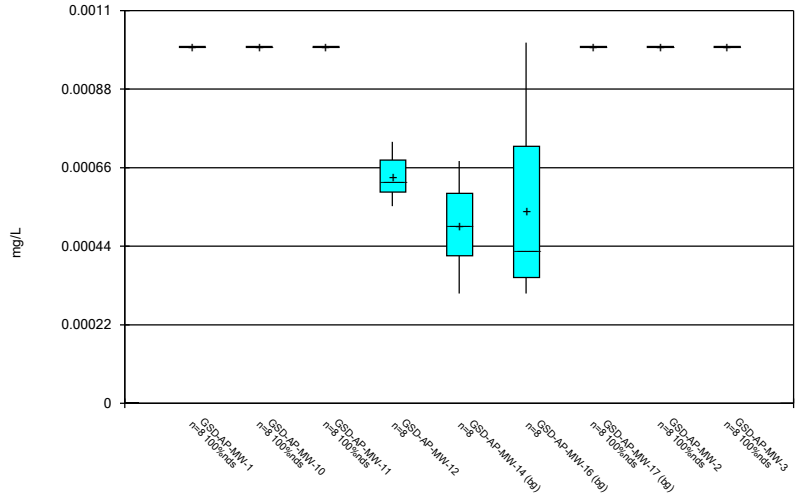



Constituent: Boron Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

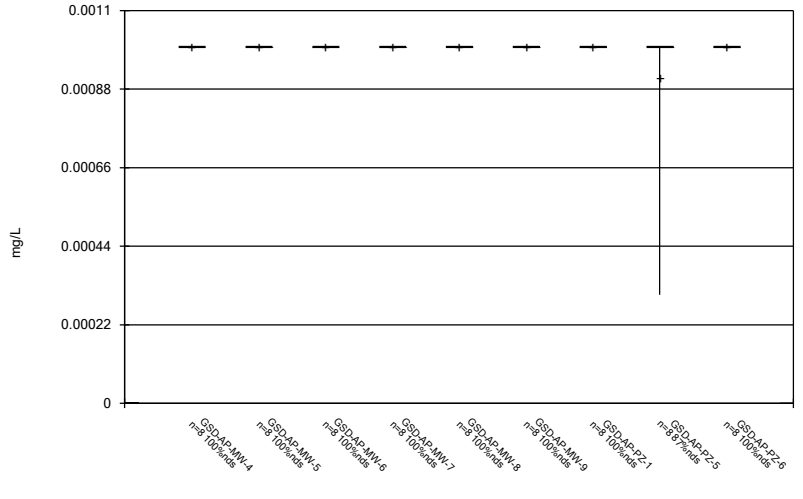



Constituent: Cadmium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

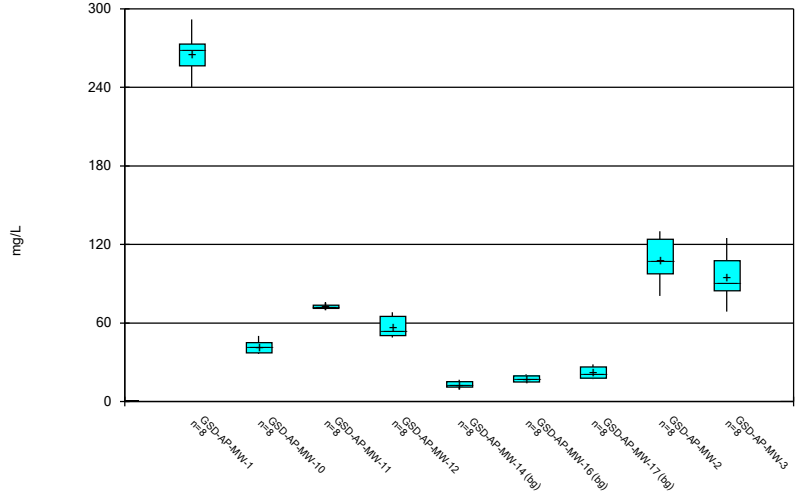



Constituent: Cadmium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

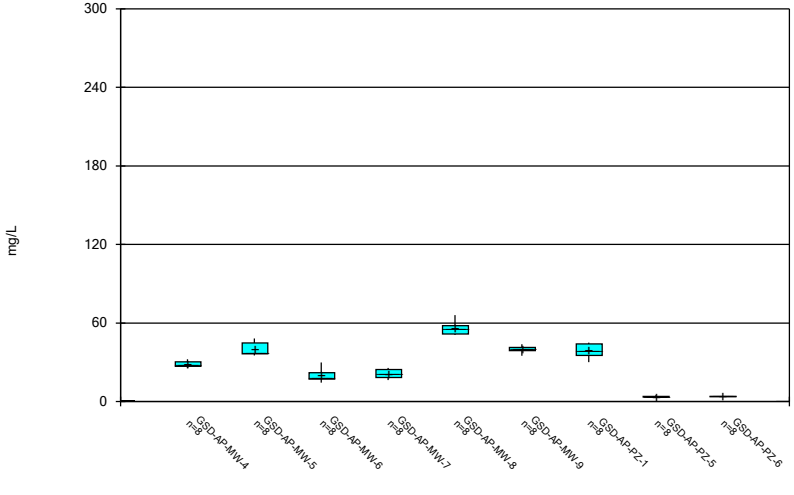



Constituent: Calcium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

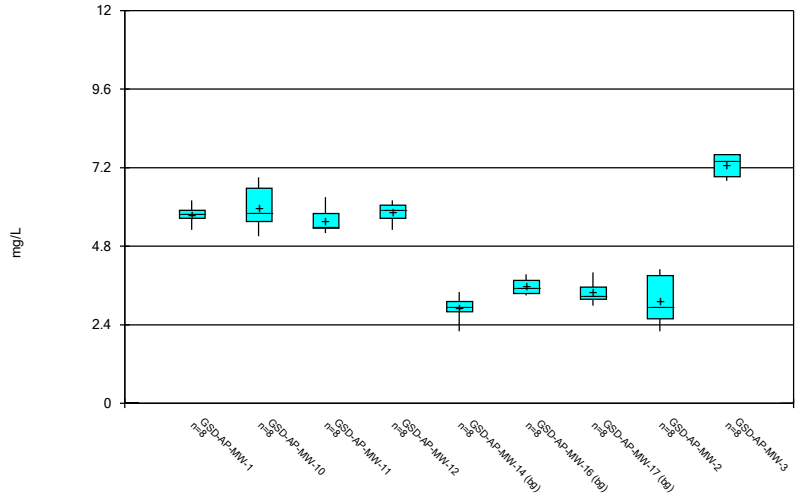



Constituent: Calcium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

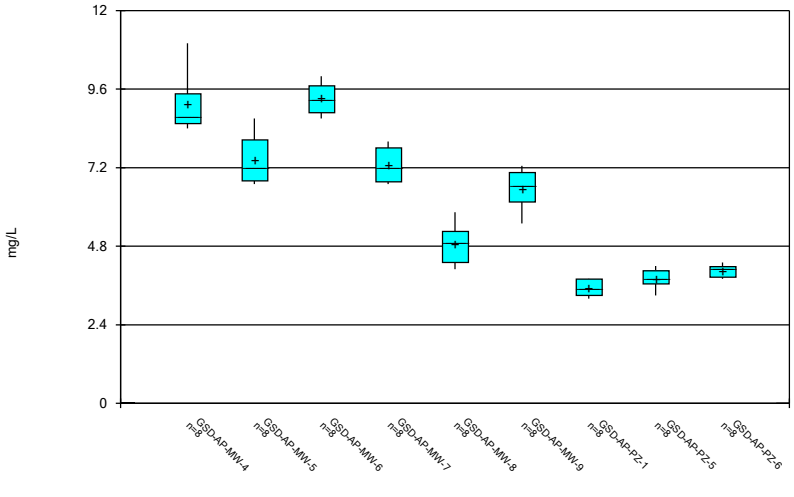



Constituent: Chloride Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

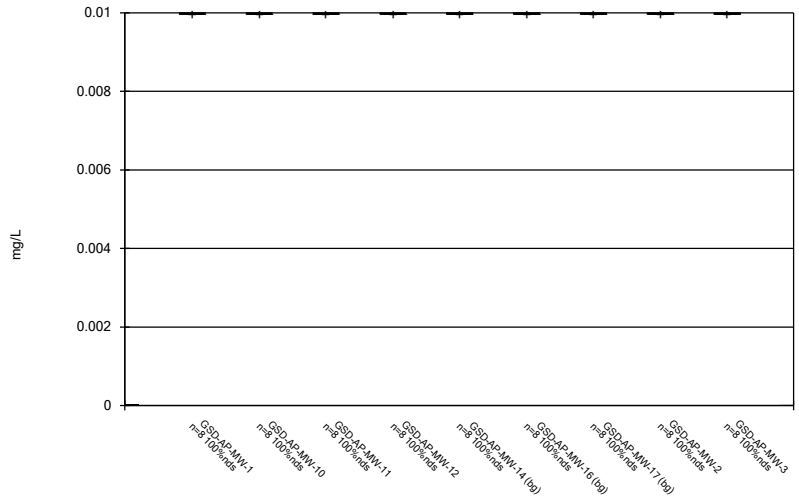



Constituent: Chloride Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

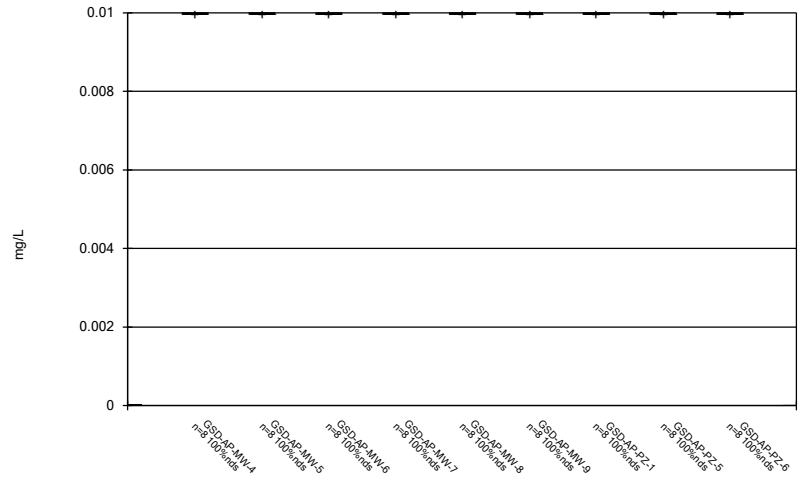



Constituent: Chromium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

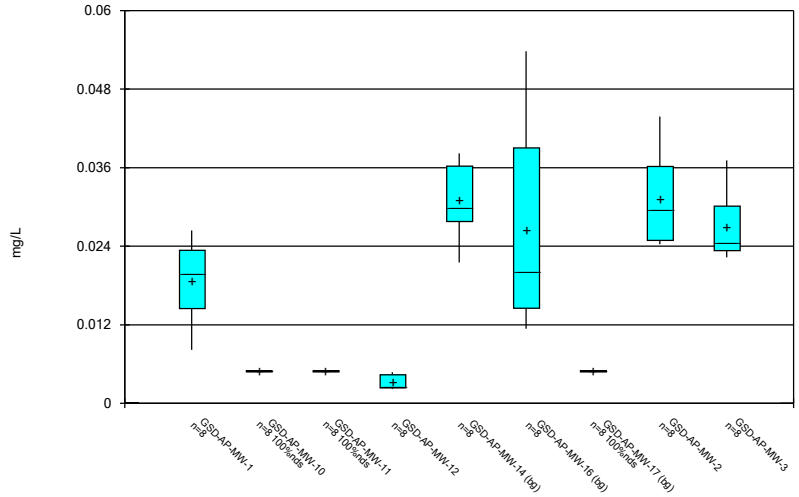



Constituent: Chromium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

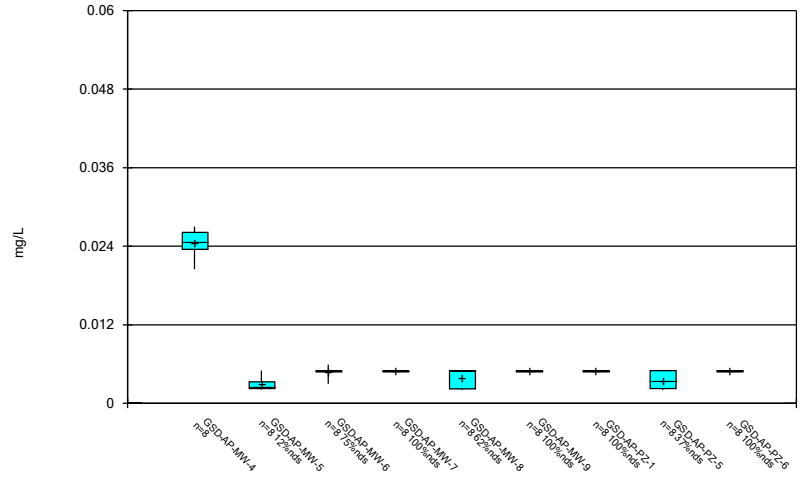



Constituent: Cobalt Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

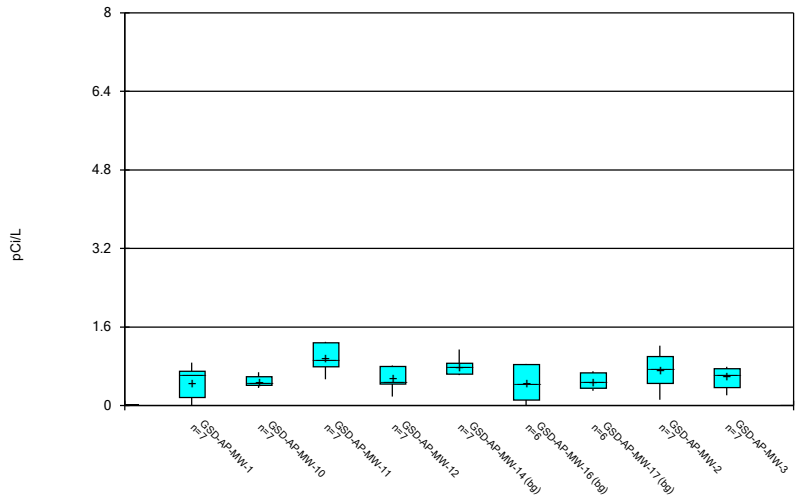



Constituent: Cobalt Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

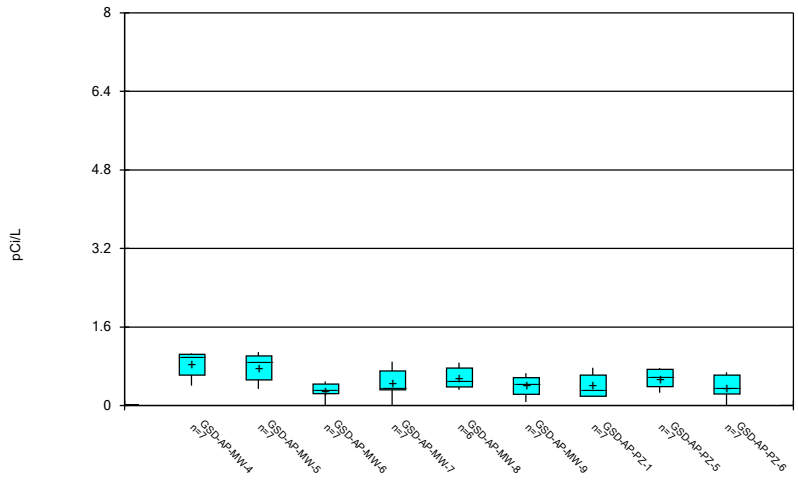



Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

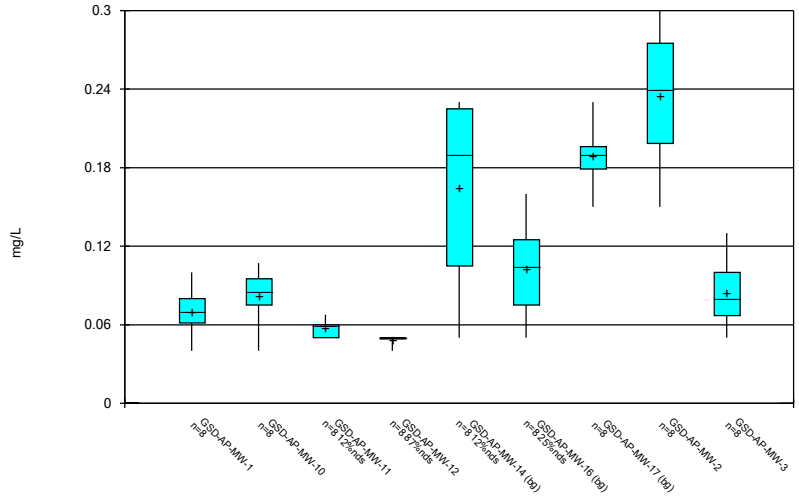



Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

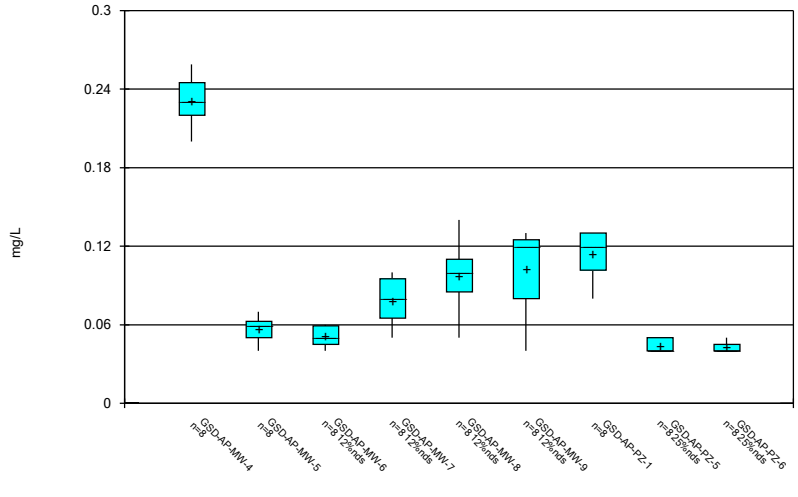



Constituent: Fluoride Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

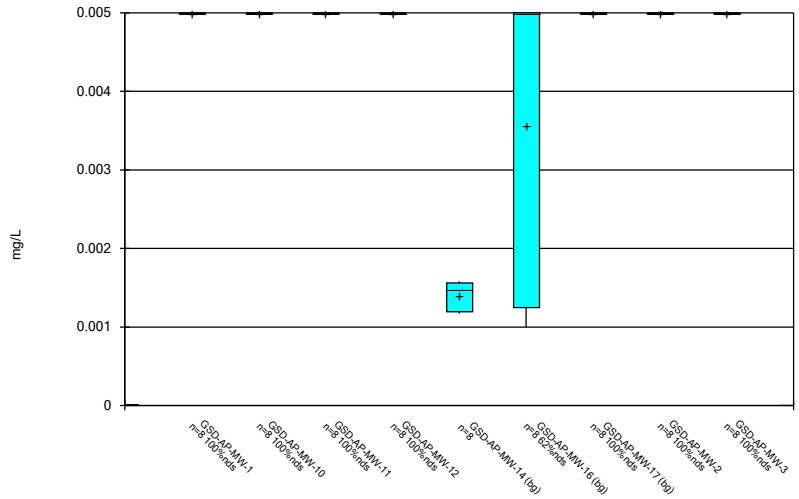



Constituent: Fluoride Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

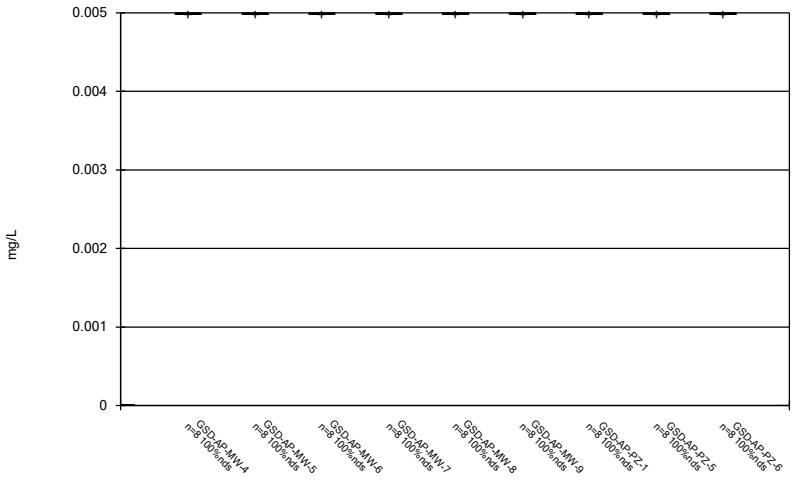



Constituent: Lead Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

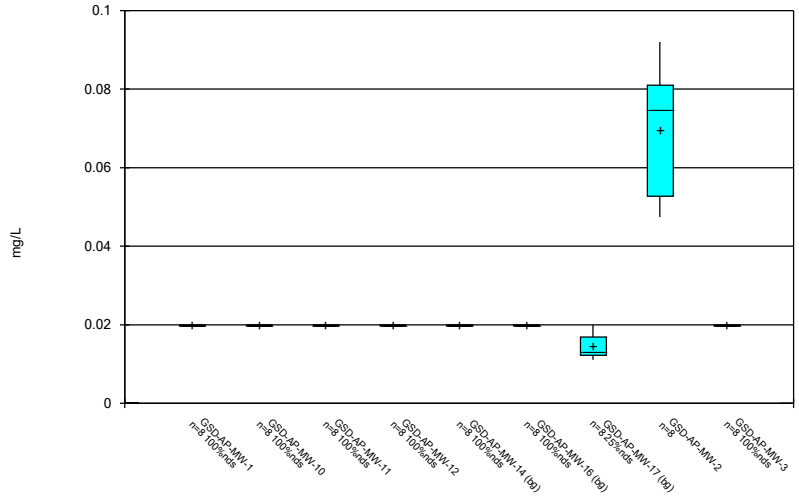



Constituent: Lead Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

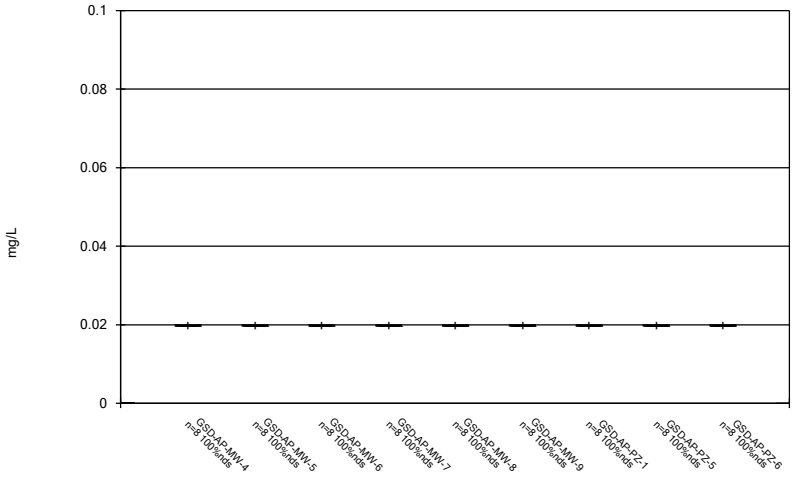



Constituent: Lithium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

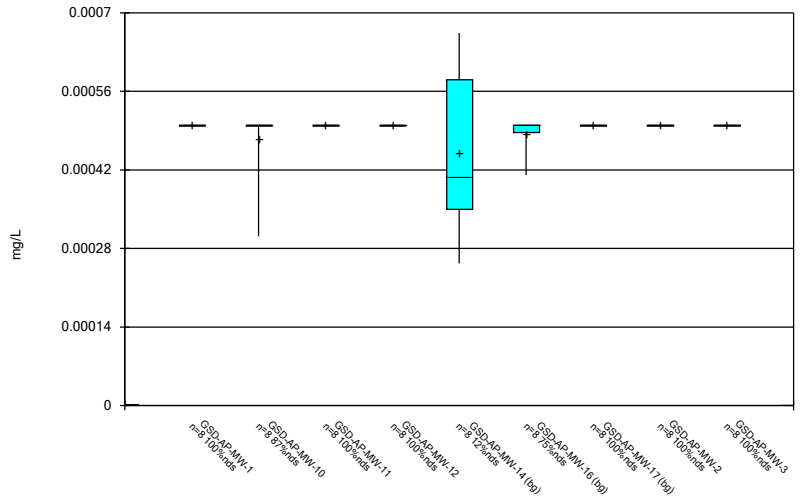



Constituent: Lithium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

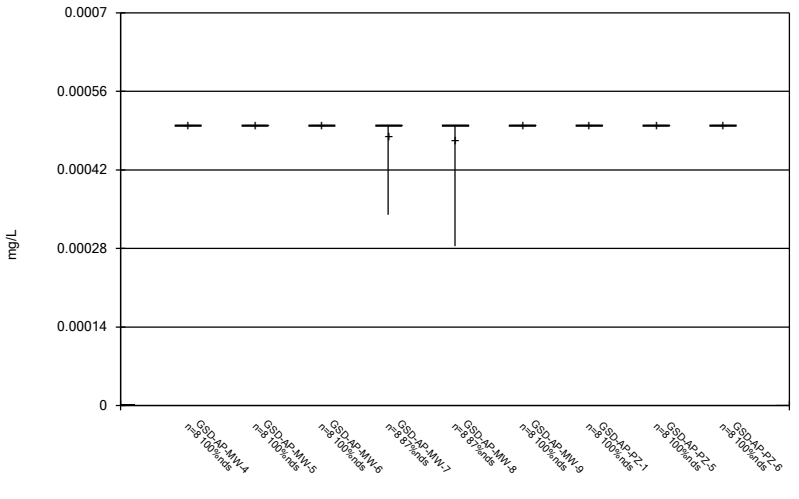



Constituent: Mercury Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

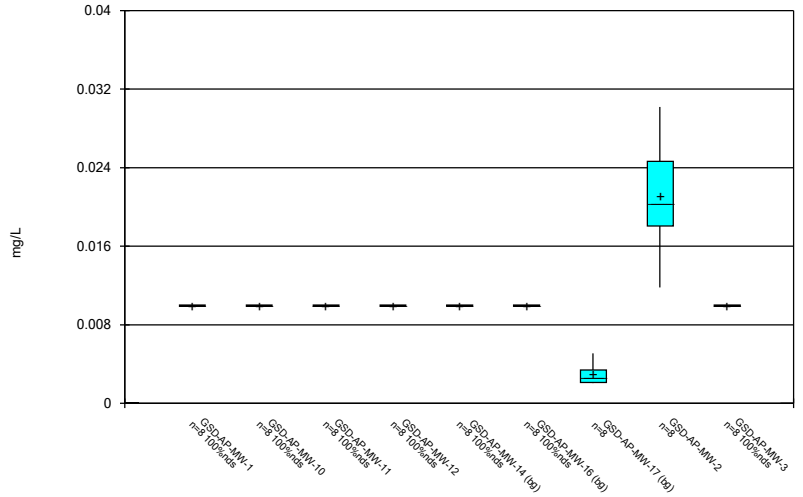



Constituent: Mercury Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

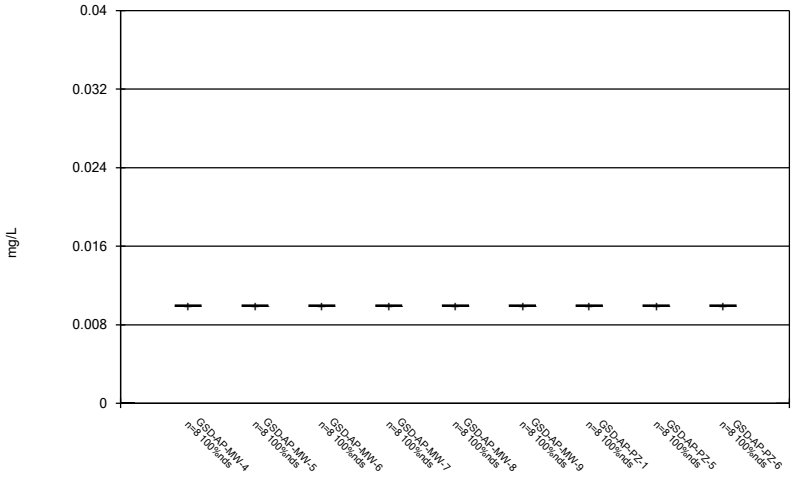



Constituent: Molybdenum Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

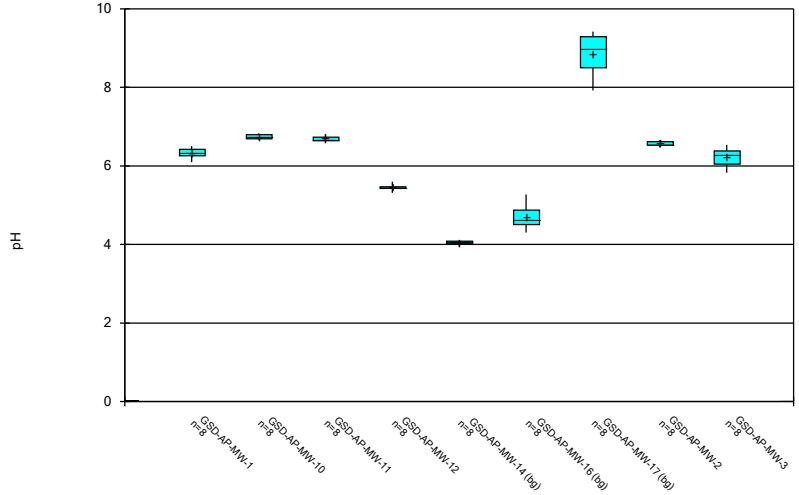



Constituent: Molybdenum Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

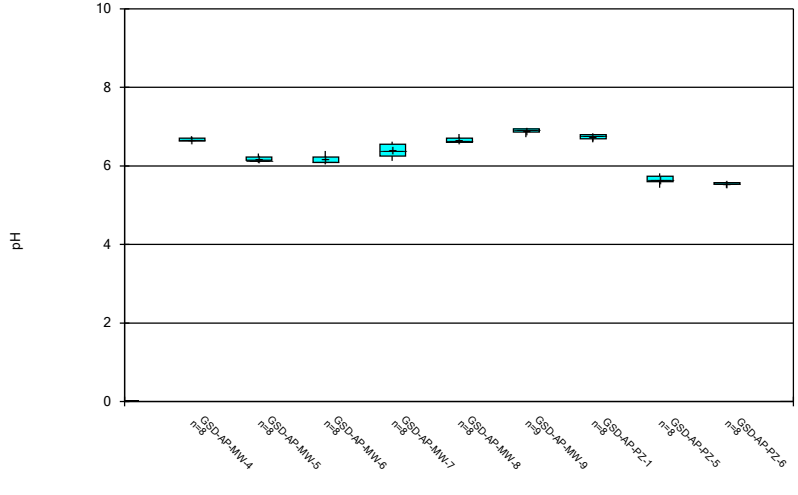



Constituent: pH Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

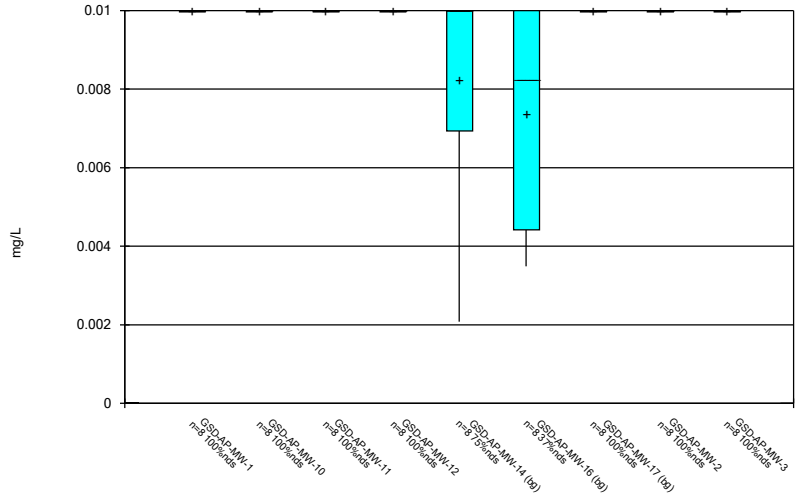



Constituent: pH Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

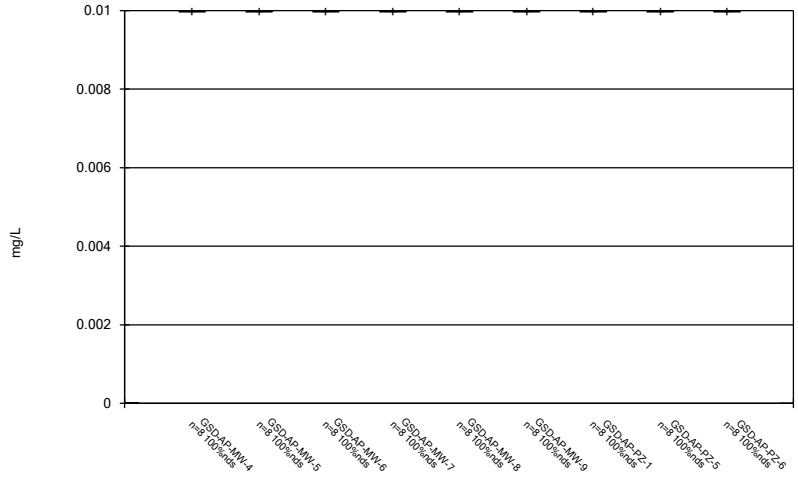



Constituent: Selenium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

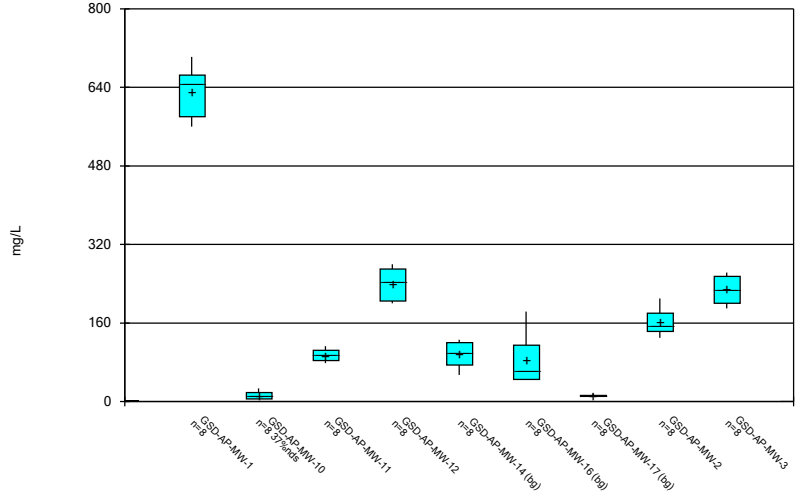



Constituent: Selenium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

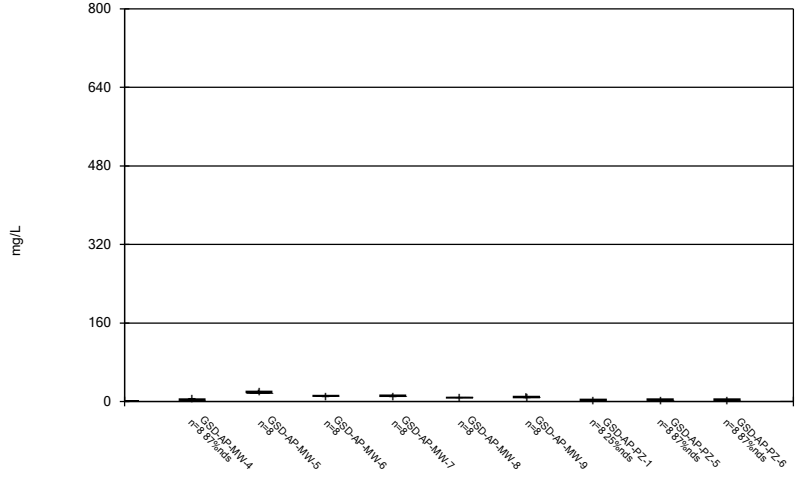



Constituent: Sulfate Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

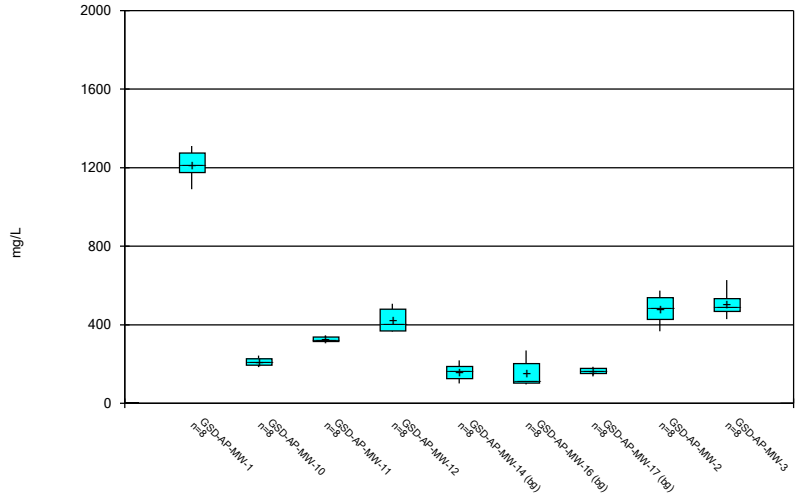



Constituent: Sulfate Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

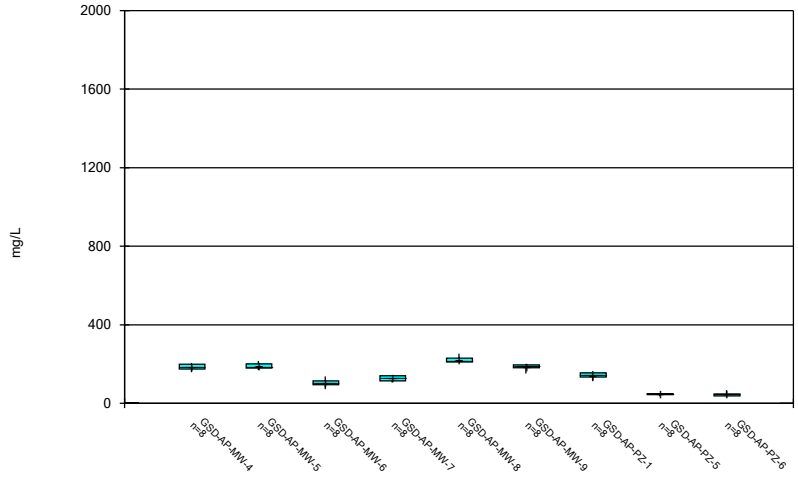



Constituent: TDS Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

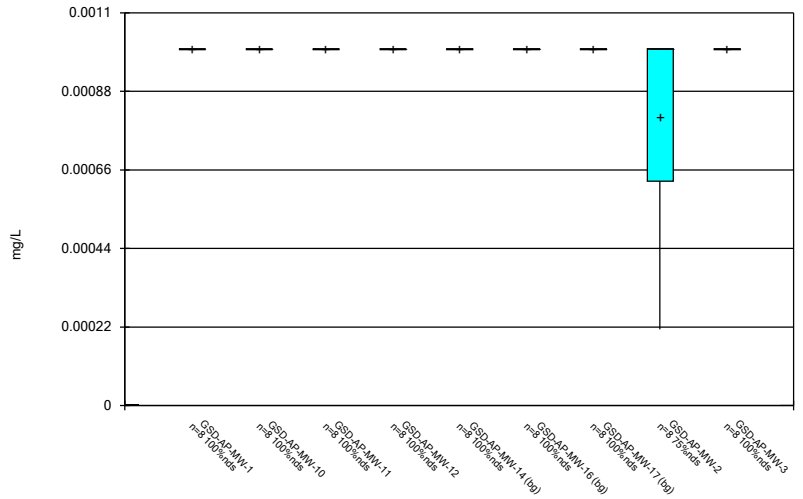



Constituent: TDS Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot

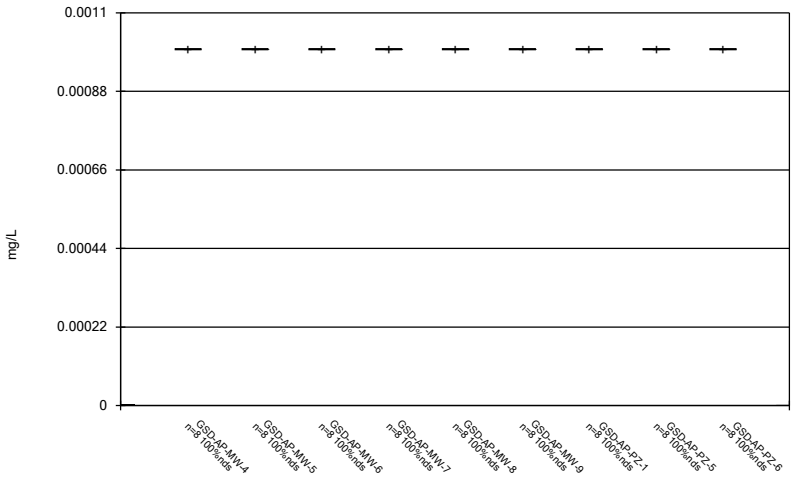



Constituent: Thallium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Box & Whiskers Plot




Constituent: Thallium Analysis Run 4/2/2019 3:39 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# FIGURE C.

# Outlier Summary

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/1/2019, 11:05 AM

| | GSD-AP-MW-8 Combined Radium 226 + 228 (pCi/L) |
|---|---|
| 12/7/2017 | 7.45 (o) |

# Outlier Analysis - Significant Results

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR  Printed 4/2/2019, 3:01 PM

| Constituent | Well | Outlier | Value(s) | Method | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|
| **Combined Radium 226 + 228 (pCi/L)** | **GSD-AP-MW-8** | **Yes** | **7.45** | **NP** | **7** | **1.538** | **2.613** | **ln(x)** | **ShapiroWilk** |
| **pH (pH)** | **GSD-AP-MW-12** | **Yes** | **5.6** | **NP** | **8** | **5.449** | **0.07954** | **ln(x)** | **ShapiroWilk** |

# Outlier Analysis - All Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:01 PM

| Constituent | Well | Outlier | Value(s) | Method | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|
| Antimony (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-14 (bg) | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-16 (bg) | n/a | n/a | NP | 8 | 0.00274 | 0.0007347 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-2 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.002768 | 0.0006576 | unknown | ShapiroWilk |
| Antimony (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.002851 | 0.0004207 | unknown | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-1 | No | n/a | NP | 8 | 0.003161 | 0.001114 | sqrt(x) | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-10 | No | n/a | NP | 8 | 0.003138 | 0.0008536 | x^2 | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-11 | No | n/a | NP | 8 | 0.002748 | 0.0001238 | x^6 | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 0.003186 | 0.001945 | ln(x) | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 0.002671 | 0.001659 | ln(x) | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 0.8159 | 0.1738 | x^(1/3) | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.004501 | 0.001411 | unknown | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-4 | No | n/a | NP | 8 | 0.01241 | 0.00133 | x^3 | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-8 | No | n/a | NP | 8 | 0.002773 | 0.0004453 | x^2 | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-MW-9 | No | n/a | NP | 8 | 0.004029 | 0.001798 | ln(x) | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Arsenic (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-1 | No | n/a | NP | 8 | 0.05028 | 0.01309 | ln(x) | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-10 | No | n/a | NP | 8 | 0.2966 | 0.03268 | ln(x) | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-11 | No | n/a | NP | 8 | 0.3196 | 0.0225 | x^3 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-12 | No | n/a | NP | 8 | 0.04481 | 0.006445 | x^2 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 0.02871 | 0.002783 | ln(x) | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 0.04543 | 0.004592 | x^6 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 0.1963 | 0.01699 | x^6 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 0.05954 | 0.01296 | ln(x) | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-3 | No | n/a | NP | 8 | 0.06008 | 0.02865 | ln(x) | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-4 | No | n/a | NP | 8 | 0.2069 | 0.01949 | x^2 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-5 | No | n/a | NP | 8 | 0.2399 | 0.02842 | x^3 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-6 | No | n/a | NP | 8 | 0.06019 | 0.009377 | ln(x) | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-7 | No | n/a | NP | 8 | 0.0789 | 0.006117 | sqrt(x) | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-8 | No | n/a | NP | 8 | 0.1879 | 0.04136 | x^2 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-MW-9 | No | n/a | NP | 8 | 0.1639 | 0.02066 | x^2 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-PZ-1 | No | n/a | NP | 8 | 0.1001 | 0.023 | x^3 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-PZ-5 | No | n/a | NP | 8 | 0.1212 | 0.02868 | x^3 | ShapiroWilk |
| Barium (mg/L) | GSD-AP-PZ-6 | No | n/a | NP | 8 | 0.02926 | 0.001499 | x^6 | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |

# Outlier Analysis - All Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:01 PM

| Constituent | Well | Outlier | Value(s) | Method | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|
| Beryllium (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 0.001168 | 0.0002063 | x^2 | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 0.001648 | 0.001139 | ln(x) | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-2 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Beryllium (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.003 | 0 | unknown | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-1 | No | n/a | NP | 8 | 1.218 | 0.06497 | x^6 | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-10 | No | n/a | NP | 8 | 0.1138 | 0.01794 | ln(x) | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-11 | No | n/a | NP | 8 | 0.1186 | 0.008815 | ln(x) | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-12 | No | n/a | NP | 8 | 0.05803 | 0.007812 | ln(x) | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-14 (bg) | n/a | n/a | NP | 8 | 0.1 | 0 | unknown | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 0.04293 | 0.0353 | ln(x) | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 0.03355 | 0.002448 | x^6 | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 0.6851 | 0.07332 | x^6 | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-3 | No | n/a | NP | 8 | 1.013 | 0.04105 | ln(x) | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-4 | No | n/a | NP | 8 | 0.4856 | 0.03724 | x^2 | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-5 | No | n/a | NP | 8 | 0.4889 | 0.06643 | ln(x) | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-6 | No | n/a | NP | 8 | 0.05686 | 0.004642 | ln(x) | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-7 | No | n/a | NP | 8 | 0.08943 | 0.01357 | x^2 | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-8 | No | n/a | NP | 8 | 0.06565 | 0.008022 | ln(x) | ShapiroWilk |
| Boron (mg/L) | GSD-AP-MW-9 | No | n/a | NP | 8 | 0.0569 | 0.003644 | ln(x) | ShapiroWilk |
| Boron (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.1 | 0 | unknown | ShapiroWilk |
| Boron (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.1 | 0 | unknown | ShapiroWilk |
| Boron (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.1 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-12 | No | n/a | NP | 8 | 0.0006339 | 0.00006148 | ln(x) | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 0.0004978 | 0.0001236 | sqrt(x) | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 0.0005394 | 0.0002504 | ln(x) | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-2 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.000913 | 0.0002461 | unknown | ShapiroWilk |
| Cadmium (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-1 | No | n/a | NP | 8 | 266 | 15.42 | normal | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-10 | No | n/a | NP | 8 | 41.74 | 4.994 | ln(x) | ShapiroWilk |

# Outlier Analysis - All Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:01 PM

| Constituent | Well | Outlier | Value(s) | Method | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|
| Calcium (mg/L) | GSD-AP-MW-11 | No | n/a | NP | 8 | 72.64 | 1.952 | x^(1/3) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-12 | No | n/a | NP | 8 | 57.05 | 7.878 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 13.01 | 2.626 | normal | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 17.38 | 2.473 | x^3 | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 21.91 | 4.55 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 108.5 | 16.9 | normal | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-3 | No | n/a | NP | 8 | 94.93 | 17.77 | x^(1/3) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-4 | No | n/a | NP | 8 | 28.46 | 2.324 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-5 | No | n/a | NP | 8 | 40.06 | 5.264 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-6 | No | n/a | NP | 8 | 19.89 | 4.91 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-7 | No | n/a | NP | 8 | 21.14 | 3.499 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-8 | No | n/a | NP | 8 | 55.89 | 5.011 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-MW-9 | No | n/a | NP | 8 | 39.81 | 2.638 | x^3 | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-PZ-1 | No | n/a | NP | 8 | 38.93 | 5.352 | x^2 | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-PZ-5 | No | n/a | NP | 8 | 3.598 | 0.5038 | ln(x) | ShapiroWilk |
| Calcium (mg/L) | GSD-AP-PZ-6 | No | n/a | NP | 8 | 3.803 | 0.05874 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-1 | No | n/a | NP | 8 | 5.775 | 0.2605 | x^3 | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-10 | No | n/a | NP | 8 | 5.993 | 0.6619 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-11 | No | n/a | NP | 8 | 5.574 | 0.3681 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-12 | No | n/a | NP | 8 | 5.84 | 0.3027 | x^6 | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 2.915 | 0.3579 | x^4 | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 3.569 | 0.249 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 3.379 | 0.3219 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 3.145 | 0.7354 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-3 | No | n/a | NP | 8 | 7.281 | 0.3463 | x^6 | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-4 | No | n/a | NP | 8 | 9.114 | 0.8834 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-5 | No | n/a | NP | 8 | 7.43 | 0.7818 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-6 | No | n/a | NP | 8 | 9.308 | 0.4944 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-7 | No | n/a | NP | 8 | 7.28 | 0.5396 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-8 | No | n/a | NP | 8 | 4.855 | 0.5997 | sqrt(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-MW-9 | No | n/a | NP | 8 | 6.558 | 0.6072 | x^6 | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-PZ-1 | No | n/a | NP | 8 | 3.523 | 0.2519 | ln(x) | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-PZ-5 | No | n/a | NP | 8 | 3.815 | 0.2939 | x^4 | ShapiroWilk |
| Chloride (mg/L) | GSD-AP-PZ-6 | No | n/a | NP | 8 | 4.044 | 0.1879 | x^6 | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-14 (bg) | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-16 (bg) | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-2 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Chromium (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-1 | No | n/a | NP | 8 | 0.01874 | 0.006137 | x^2 | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |

# Outlier Analysis - All Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:01 PM

| Constituent | Well | Outlier | Value(s) | Method | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|
| Cobalt (mg/L) | GSD-AP-MW-12 | No | n/a | NP | 8 | 0.003195 | 0.001088 | ln(x) | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 0.03095 | 0.005653 | normal | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 0.02655 | 0.01551 | ln(x) | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 0.03116 | 0.007261 | x^(1/3) | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-3 | No | n/a | NP | 8 | 0.02689 | 0.005134 | ln(x) | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-4 | No | n/a | NP | 8 | 0.02453 | 0.002103 | x^6 | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-5 | No | n/a | NP | 8 | 0.003504 | 0.002665 | ln(x) | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.004861 | 0.0008292 | unknown | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-8 | No | n/a | NP | 8 | 0.003935 | 0.001472 | ln(x) | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-PZ-5 | No | n/a | NP | 8 | 0.00354 | 0.001316 | ln(x) | ShapiroWilk |
| Cobalt (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-1 | No | n/a | NP | 7 | 0.4598 | 0.3468 | normal | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-10 | No | n/a | NP | 7 | 0.4946 | 0.1073 | ln(x) | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-11 | No | n/a | NP | 7 | 0.9684 | 0.2709 | normal | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-12 | No | n/a | NP | 7 | 0.5573 | 0.2267 | normal | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 7 | 0.793 | 0.1838 | ln(x) | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 6 | 0.4562 | 0.3434 | normal | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 6 | 0.4995 | 0.1505 | sqrt(x) | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-2 | No | n/a | NP | 7 | 0.71 | 0.3579 | normal | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-3 | No | n/a | NP | 7 | 0.5853 | 0.2195 | x^3 | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-4 | No | n/a | NP | 7 | 0.8347 | 0.2594 | x^2 | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-5 | No | n/a | NP | 7 | 0.7531 | 0.282 | x^2 | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-6 | No | n/a | NP | 7 | 0.2891 | 0.1922 | x^2 | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-7 | No | n/a | NP | 7 | 0.458 | 0.2926 | normal | ShapiroWilk |
| **Combined Radium 226 + 228 (pCi/L)** | **GSD-AP-MW-8** | **Yes** | **7.45** | **NP** | **7** | **1.538** | **2.613** | **ln(x)** | **ShapiroWilk** |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-MW-9 | No | n/a | NP | 7 | 0.4096 | 0.203 | x^2 | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-PZ-1 | No | n/a | NP | 7 | 0.4216 | 0.2351 | ln(x) | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-PZ-5 | No | n/a | NP | 7 | 0.542 | 0.1887 | normal | ShapiroWilk |
| Combined Radium 226 + 228 (pCi/L) | GSD-AP-PZ-6 | No | n/a | NP | 7 | 0.3561 | 0.2732 | normal | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-1 | No | n/a | NP | 8 | 0.07031 | 0.01815 | normal | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-10 | No | n/a | NP | 8 | 0.08213 | 0.02068 | x^3 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-11 | No | n/a | NP | 8 | 0.05723 | 0.006538 | x^3 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.04875 | 0.003536 | unknown | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 0.165 | 0.07151 | x^3 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 0.1025 | 0.03845 | x^2 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 0.1888 | 0.02322 | sqrt(x) | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 0.2346 | 0.05008 | x^2 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-3 | No | n/a | NP | 8 | 0.08425 | 0.02567 | ln(x) | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-4 | No | n/a | NP | 8 | 0.2311 | 0.01939 | x^2 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-5 | No | n/a | NP | 8 | 0.05689 | 0.009625 | x^3 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-6 | No | n/a | NP | 8 | 0.05104 | 0.008109 | x^2 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-7 | No | n/a | NP | 8 | 0.07875 | 0.01885 | normal | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-8 | No | n/a | NP | 8 | 0.0975 | 0.02605 | normal | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-MW-9 | No | n/a | NP | 8 | 0.1025 | 0.03615 | x^6 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-PZ-1 | No | n/a | NP | 8 | 0.1142 | 0.01941 | x^2 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-PZ-5 | No | n/a | NP | 8 | 0.04375 | 0.005175 | x^6 | ShapiroWilk |
| Fluoride (mg/L) | GSD-AP-PZ-6 | No | n/a | NP | 8 | 0.0425 | 0.004629 | sqrt(x) | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |

# Outlier Analysis - All Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:01 PM

| Constituent | Well | Outlier | Value(s) | Method | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|
| Lead (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 0.001401 | 0.0001837 | x^6 | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 0.003561 | 0.001988 | ln(x) | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-2 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lead (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.005 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-14 (bg) | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-16 (bg) | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 0.01441 | 0.003538 | ln(x) | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 0.0696 | 0.01644 | x^3 | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Lithium (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.02 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.0004753 | 0.00007 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 0.0004494 | 0.0001494 | ln(x) | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-16 (bg) | n/a | n/a | NP | 8 | 0.0004855 | 0.00003155 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-2 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.00048 | 0.00005657 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.000473 | 0.00007637 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Mercury (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.0005 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-14 (bg) | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |

# Outlier Analysis - All Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:01 PM

| Constituent | Well | Outlier | Value(s) | Method | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|
| Molybdenum (mg/L) | GSD-AP-MW-16 (bg) | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 0.002914 | 0.001029 | ln(x) | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 0.02101 | 0.005615 | normal | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Molybdenum (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| pH (pH) | GSD-AP-MW-1 | No | n/a | NP | 8 | 6.324 | 0.1322 | x^5 | ShapiroWilk |
| pH (pH) | GSD-AP-MW-10 | No | n/a | NP | 8 | 6.744 | 0.06046 | ln(x) | ShapiroWilk |
| pH (pH) | GSD-AP-MW-11 | No | n/a | NP | 8 | 6.689 | 0.072 | ln(x) | ShapiroWilk |
| **pH (pH)** | **GSD-AP-MW-12** | **Yes** | **5.6** | **NP** | **8** | **5.449** | **0.07954** | **ln(x)** | **ShapiroWilk** |
| pH (pH) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 4.05 | 0.05071 | x^6 | ShapiroWilk |
| pH (pH) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 4.705 | 0.3101 | ln(x) | ShapiroWilk |
| pH (pH) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 8.858 | 0.5351 | x^6 | ShapiroWilk |
| pH (pH) | GSD-AP-MW-2 | No | n/a | NP | 8 | 6.569 | 0.06221 | normal | ShapiroWilk |
| pH (pH) | GSD-AP-MW-3 | No | n/a | NP | 8 | 6.226 | 0.2334 | x^6 | ShapiroWilk |
| pH (pH) | GSD-AP-MW-4 | No | n/a | NP | 8 | 6.671 | 0.05167 | ln(x) | ShapiroWilk |
| pH (pH) | GSD-AP-MW-5 | No | n/a | NP | 8 | 6.18 | 0.07746 | ln(x) | ShapiroWilk |
| pH (pH) | GSD-AP-MW-6 | No | n/a | NP | 8 | 6.163 | 0.1154 | ln(x) | ShapiroWilk |
| pH (pH) | GSD-AP-MW-7 | No | n/a | NP | 8 | 6.39 | 0.1789 | x^6 | ShapiroWilk |
| pH (pH) | GSD-AP-MW-8 | No | n/a | NP | 8 | 6.66 | 0.07635 | ln(x) | ShapiroWilk |
| pH (pH) | GSD-AP-MW-9 | No | n/a | NP | 9 | 6.894 | 0.07091 | x^6 | ShapiroWilk |
| pH (pH) | GSD-AP-PZ-1 | No | n/a | NP | 8 | 6.74 | 0.07635 | x^6 | ShapiroWilk |
| pH (pH) | GSD-AP-PZ-5 | No | n/a | NP | 8 | 5.653 | 0.1161 | x^6 | ShapiroWilk |
| pH (pH) | GSD-AP-PZ-6 | No | n/a | NP | 8 | 5.545 | 0.04986 | x^6 | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 0.008244 | 0.003287 | ln(x) | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 0.007346 | 0.002874 | x^(1/3) | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-2 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Selenium (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.01 | 0 | unknown | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-1 | No | n/a | NP | 8 | 630.3 | 50.83 | x^5 | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-10 | No | n/a | NP | 8 | 12.48 | 7.966 | sqrt(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-11 | No | n/a | NP | 8 | 94.75 | 12.62 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-12 | No | n/a | NP | 8 | 239.9 | 33.34 | x^2 | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 95.5 | 27.12 | normal | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 84.13 | 51.13 | ln(x) | ShapiroWilk |

# Outlier Analysis - All Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:01 PM

| Constituent | Well | Outlier | Value(s) | Method | N | Mean | Std. Dev. | Distribution | Normality Test |
|---|---|---|---|---|---|---|---|---|---|
| Sulfate (mg/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 11.7 | 2.003 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 161.9 | 26.98 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-3 | No | n/a | NP | 8 | 227.9 | 28.67 | x^2 | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 5.048 | 0.1344 | unknown | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-5 | No | n/a | NP | 8 | 20.16 | 2.114 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-6 | No | n/a | NP | 8 | 11.71 | 1.209 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-7 | No | n/a | NP | 8 | 11.58 | 1.551 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-8 | No | n/a | NP | 8 | 7.954 | 0.9422 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-MW-9 | No | n/a | NP | 8 | 9.838 | 3.274 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-PZ-1 | No | n/a | NP | 8 | 2.986 | 1.46 | ln(x) | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 4.455 | 1.542 | unknown | ShapiroWilk |
| Sulfate (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 4.586 | 1.17 | unknown | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-1 | No | n/a | NP | 8 | 1216 | 73.28 | x^3 | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-10 | No | n/a | NP | 8 | 211.3 | 20.53 | ln(x) | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-11 | No | n/a | NP | 8 | 326.1 | 13.38 | ln(x) | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-12 | No | n/a | NP | 8 | 421.8 | 58.51 | ln(x) | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-14 (bg) | No | n/a | NP | 8 | 159.4 | 39.95 | normal | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-16 (bg) | No | n/a | NP | 8 | 150.8 | 64.87 | ln(x) | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-17 (bg) | No | n/a | NP | 8 | 164 | 18.13 | x^5 | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 479.9 | 72.57 | sqrt(x) | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-3 | No | n/a | NP | 8 | 504.6 | 62.75 | ln(x) | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-4 | No | n/a | NP | 8 | 185 | 16.62 | x^2 | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-5 | No | n/a | NP | 8 | 189.8 | 15.34 | ln(x) | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-6 | No | n/a | NP | 8 | 103.9 | 19.75 | normal | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-7 | No | n/a | NP | 8 | 126.1 | 14.12 | x^3 | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-8 | No | n/a | NP | 8 | 222.4 | 15.38 | ln(x) | ShapiroWilk |
| TDS (mg/L) | GSD-AP-MW-9 | No | n/a | NP | 8 | 185.4 | 15.81 | x^6 | ShapiroWilk |
| TDS (mg/L) | GSD-AP-PZ-1 | No | n/a | NP | 8 | 143.4 | 16.75 | x^4 | ShapiroWilk |
| TDS (mg/L) | GSD-AP-PZ-5 | No | n/a | NP | 8 | 45.18 | 4.502 | x^6 | ShapiroWilk |
| TDS (mg/L) | GSD-AP-PZ-6 | No | n/a | NP | 8 | 44.91 | 11.1 | ln(x) | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-1 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-10 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-11 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-12 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-14 (bg) | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-16 (bg) | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-17 (bg) | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-2 | No | n/a | NP | 8 | 0.0008086 | 0.0003545 | ln(x) | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-3 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-4 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-5 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-6 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-7 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-8 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-MW-9 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-PZ-1 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-PZ-5 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |
| Thallium (mg/L) | GSD-AP-PZ-6 | n/a | n/a | NP | 8 | 0.001 | 0 | unknown | ShapiroWilk |

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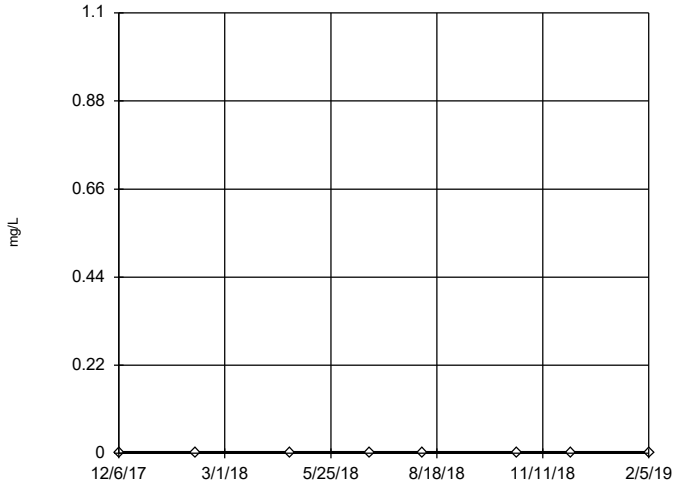
## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony Analysis Run 4/2/2019 2:53 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

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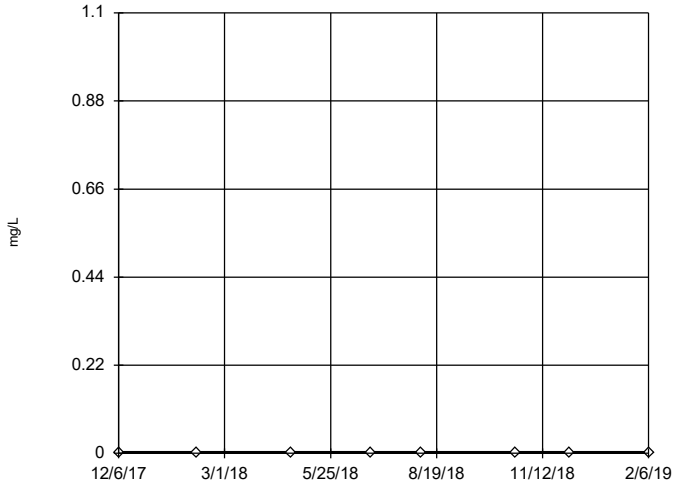
## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony Analysis Run 4/2/2019 2:53 PM View: Descriptive

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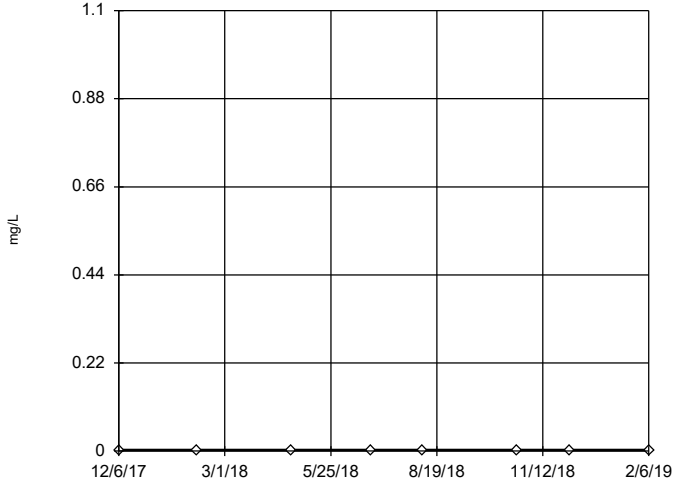
## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony Analysis Run 4/2/2019 2:53 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

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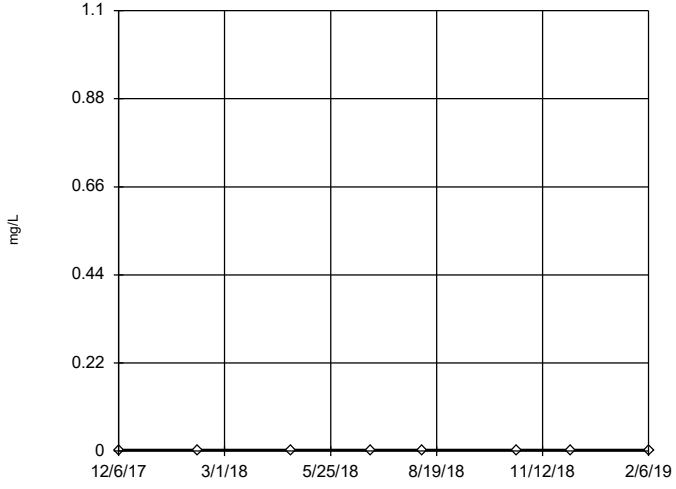
## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony Analysis Run 4/2/2019 2:53 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

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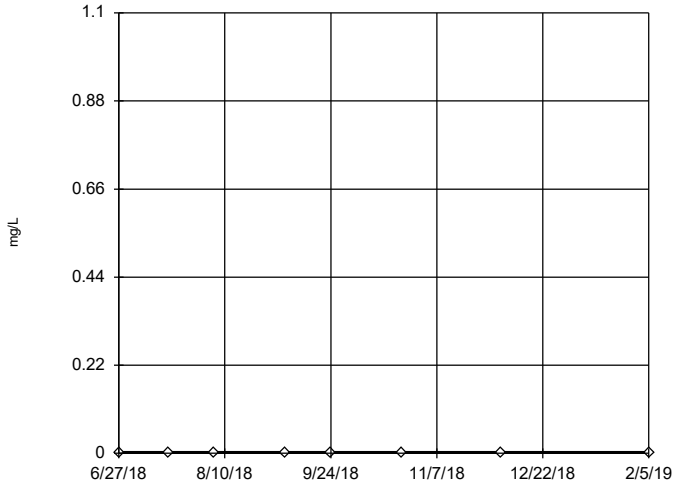
## Tukey's Outlier Screening

GSD-AP-MW-14 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony Analysis Run 4/2/2019 2:53 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

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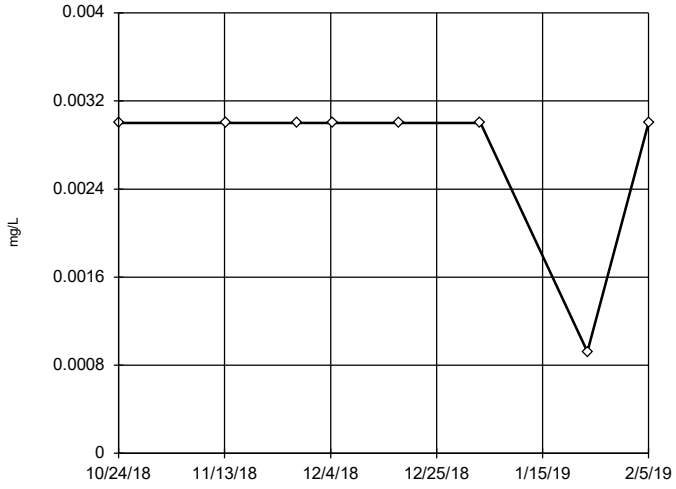
## Tukey's Outlier Screening

GSD-AP-MW-16 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony Analysis Run 4/2/2019 2:53 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

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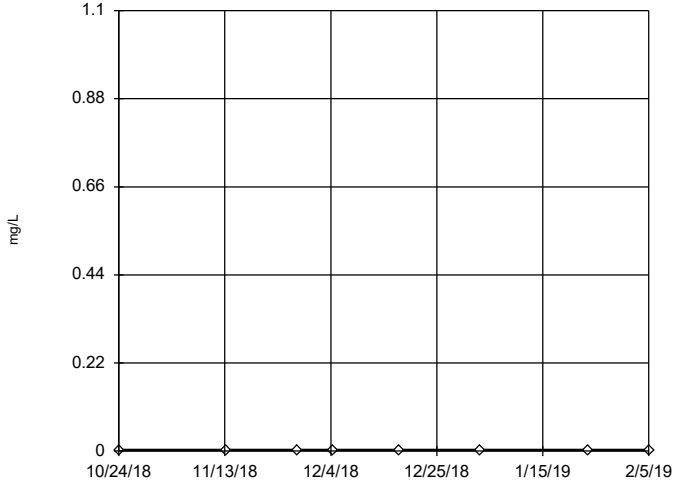
## Tukey's Outlier Screening

GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony Analysis Run 4/2/2019 2:53 PM View: Descriptive

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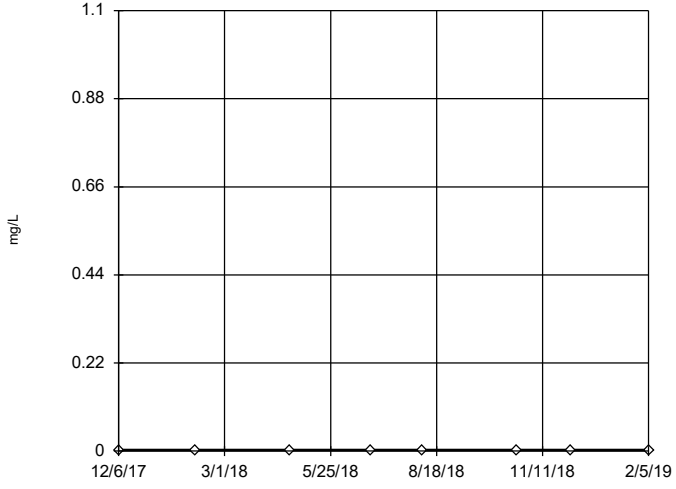
## Tukey's Outlier Screening

GSD-AP-MW-2




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

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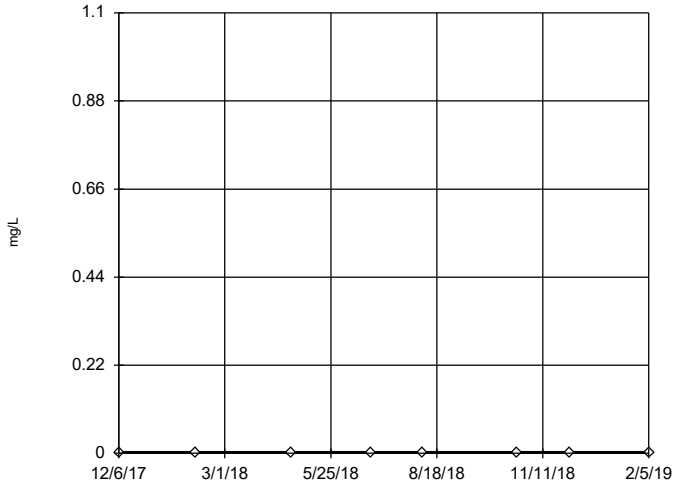
## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

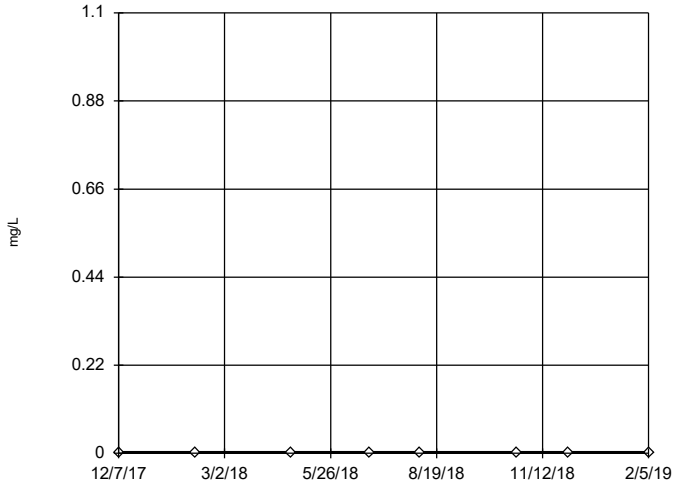
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

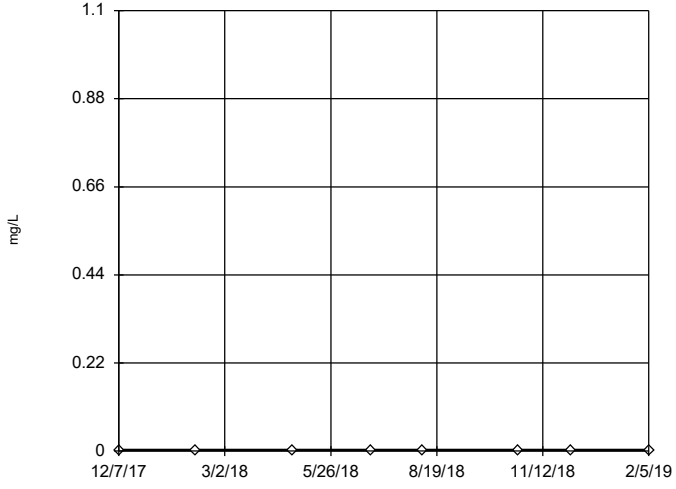
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

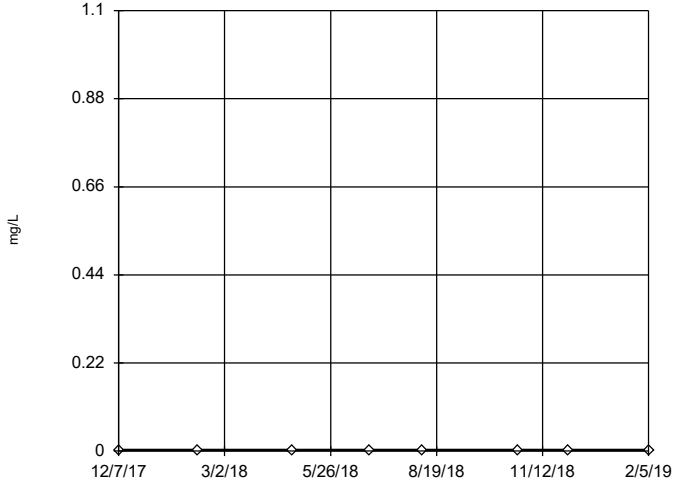
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

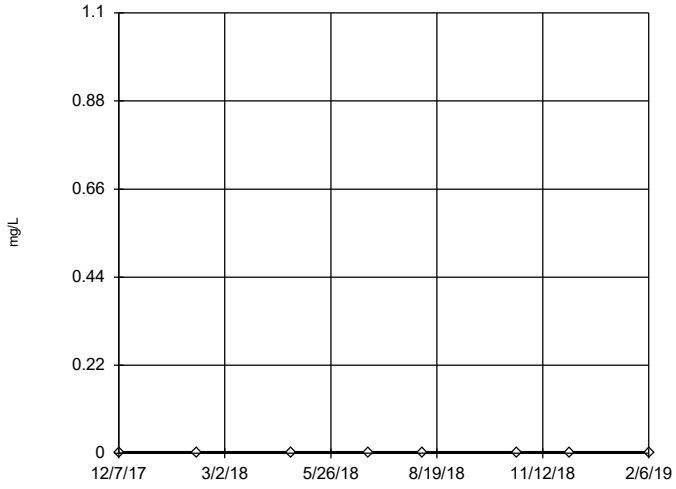
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

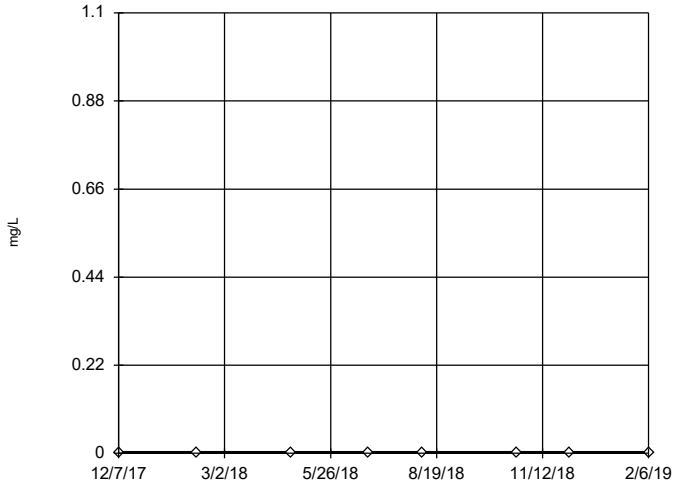
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

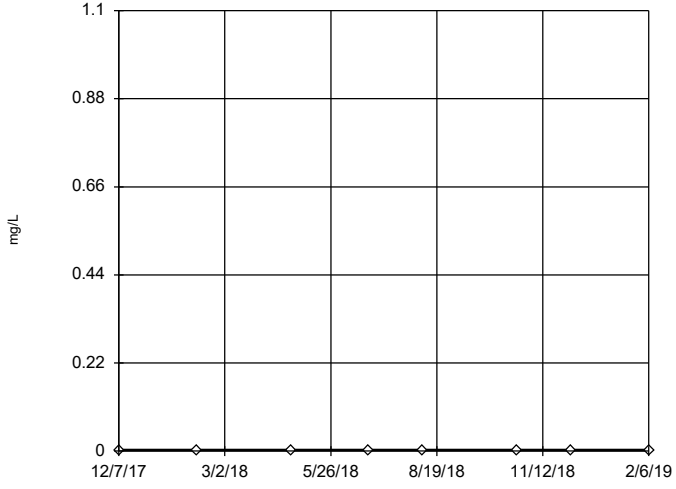
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

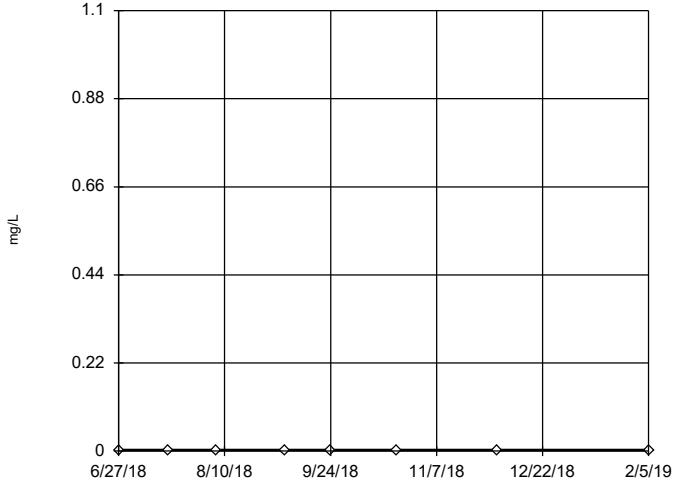
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

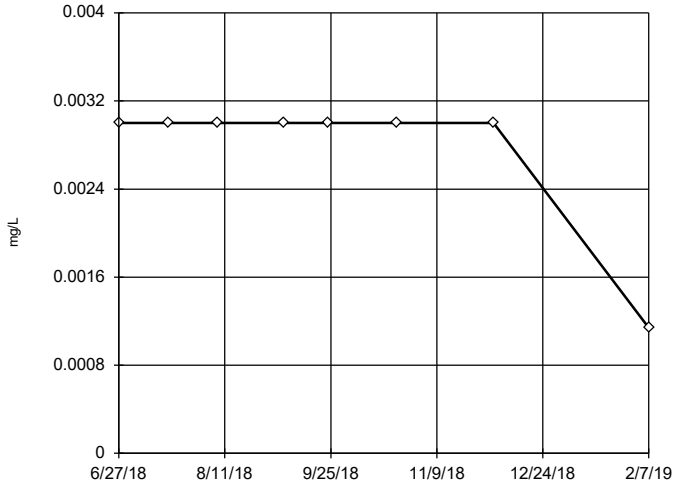
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

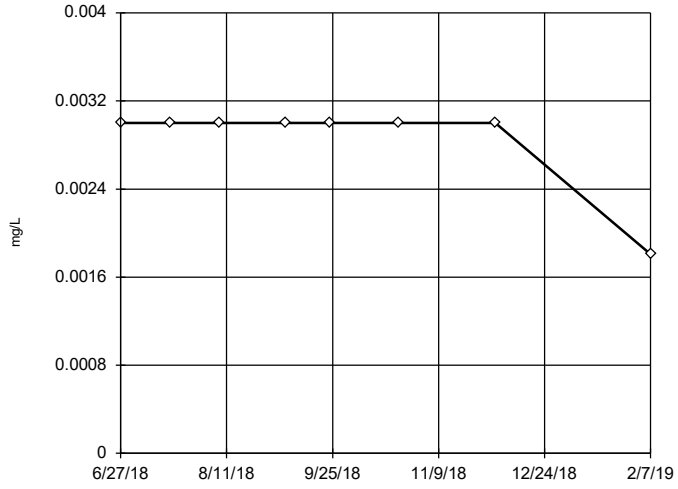
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

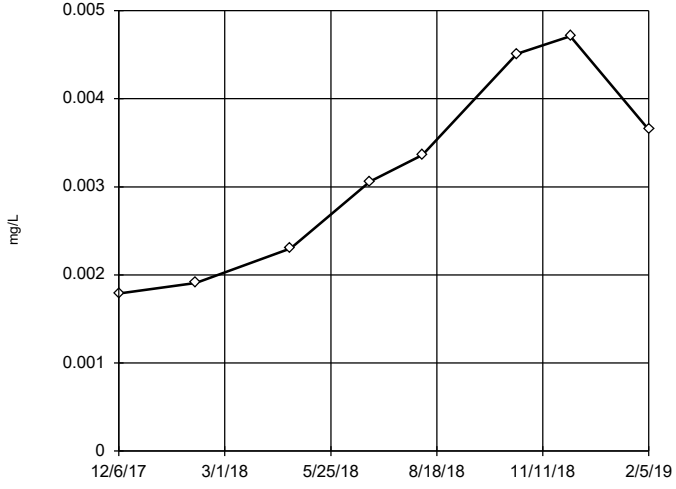
Constituent: Antimony Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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 = 0.01384, low cutoff = -0.00006454, based on IQR multiplier of 3.

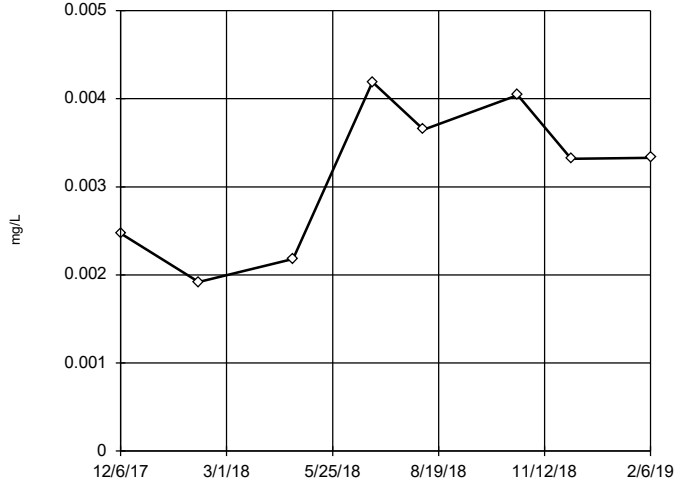
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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 = 0.006558, low cutoff = -0.004771, based on IQR multiplier of 3.

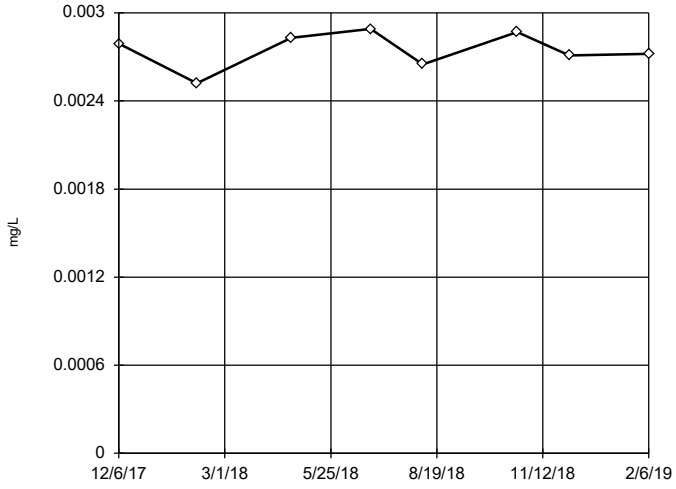
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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 = 0.003179, low cutoff = -0.002233, based on IQR multiplier of 3.

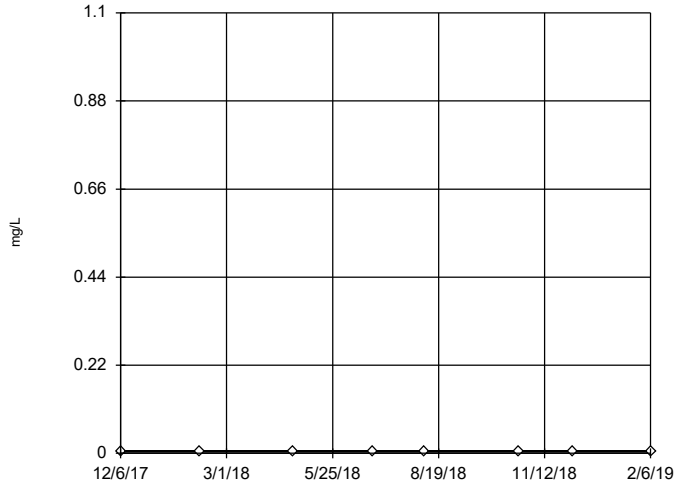
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

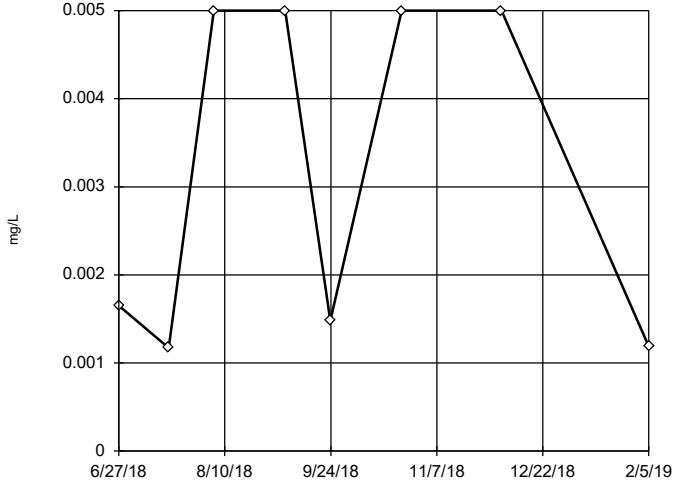
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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 = 0.2674, low cutoff = 0.00002481, based on IQR multiplier of 3.

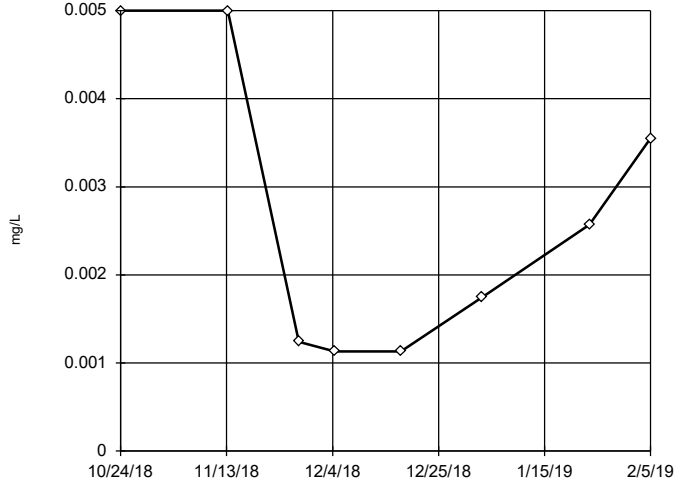
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 0.19, low cutoff = 0.00002625, based on IQR multiplier of 3.

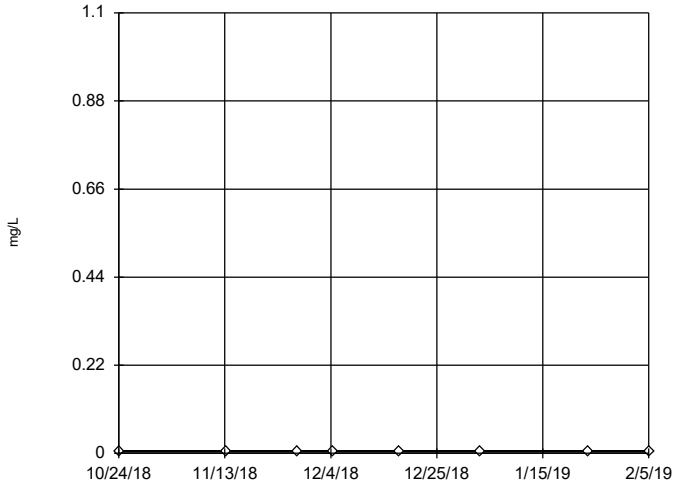
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

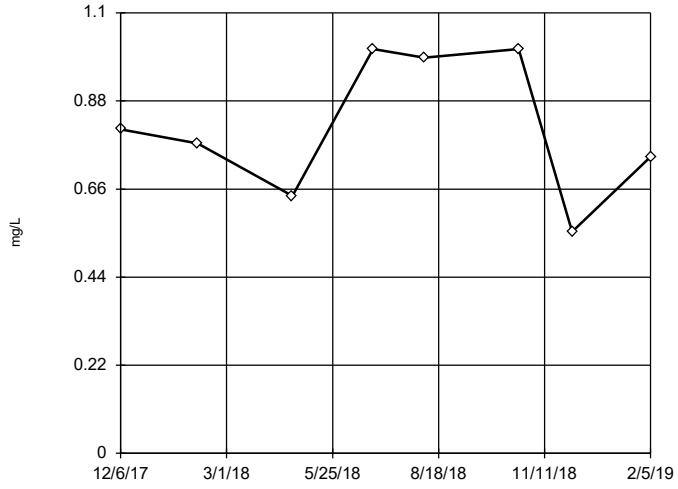
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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

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

High cutoff = 2.445, low cutoff = 0.1542, based on IQR multiplier of 3.

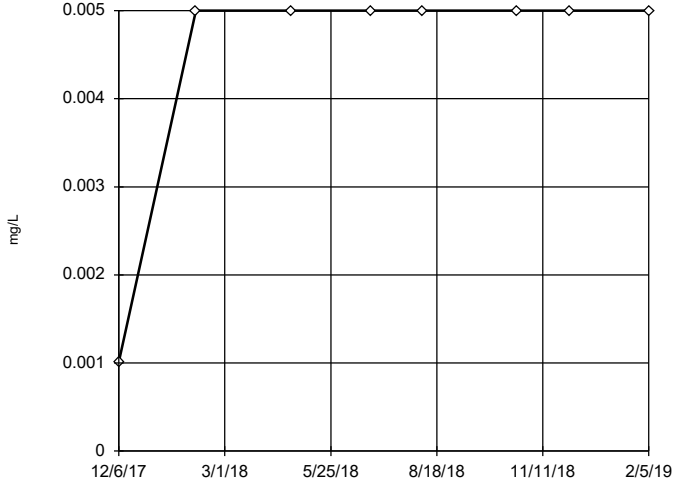
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

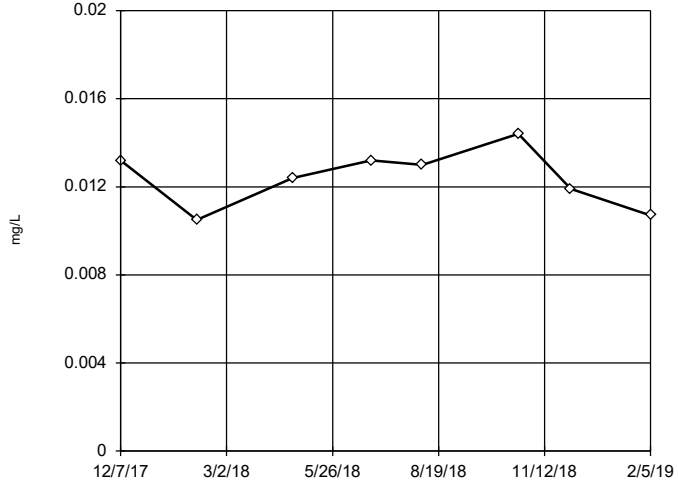
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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 = 0.01691, low cutoff = -0.01026, based on IQR multiplier of 3.

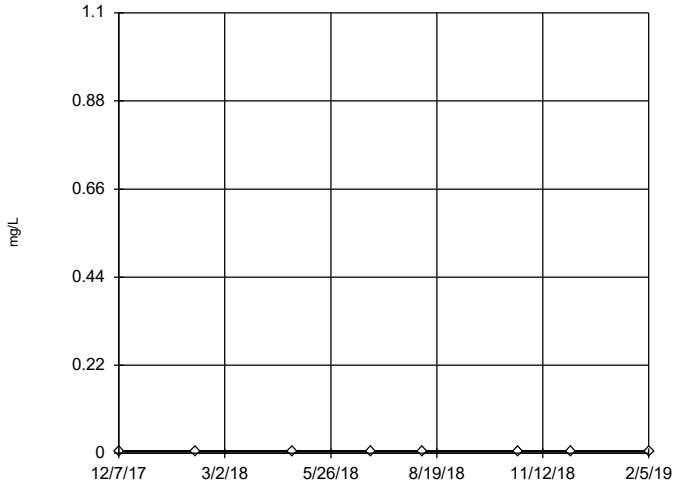
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

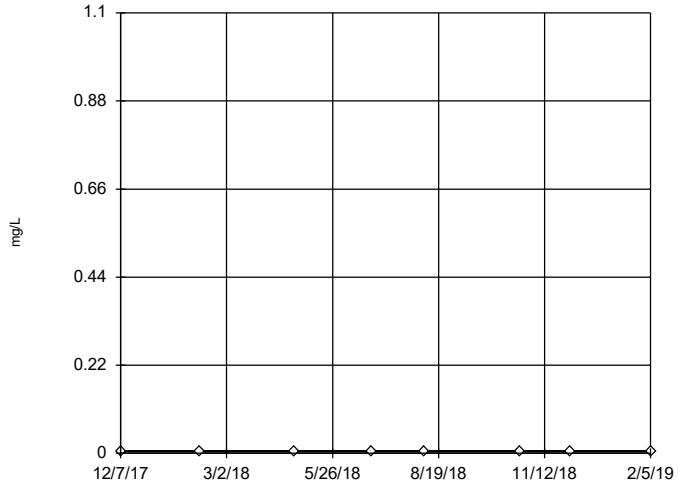
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

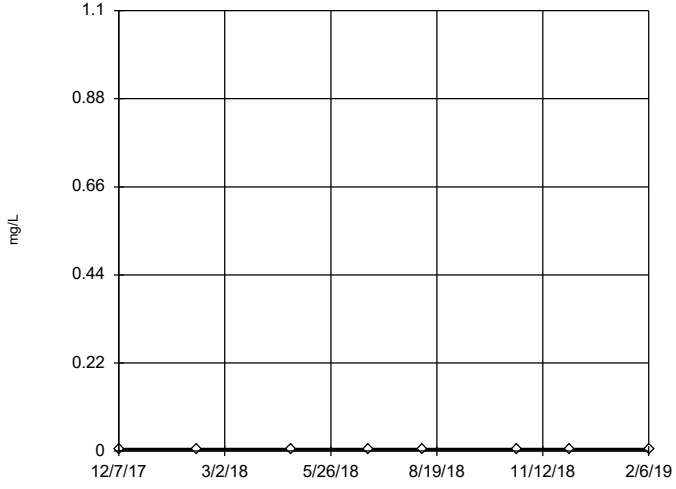
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

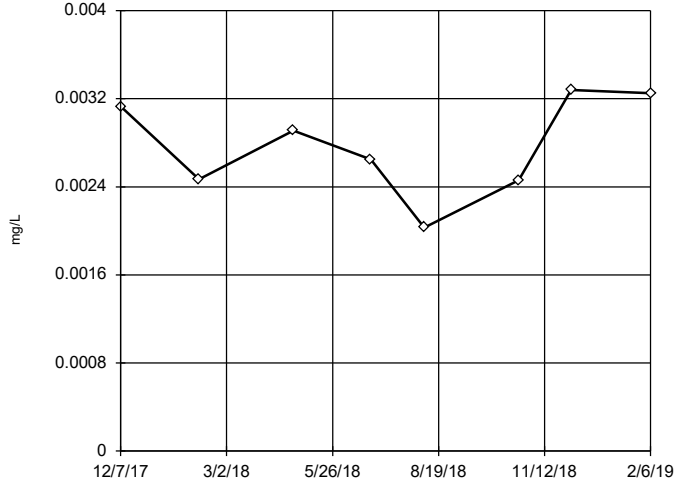
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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 = 0.004742, low cutoff = -0.002497, based on IQR multiplier of 3.

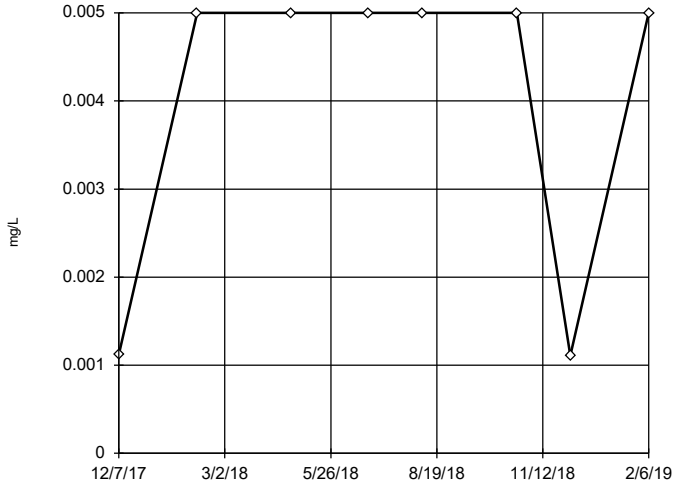
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-9




n = 8

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 = 0.04716, low cutoff = 0.0002509, based on IQR multiplier of 3.

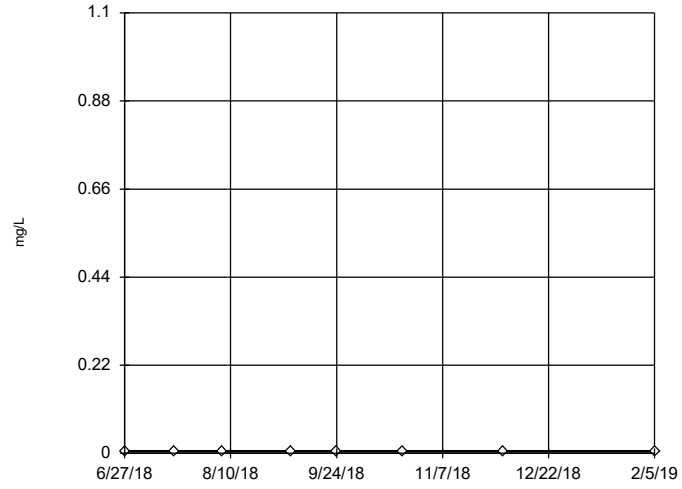
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

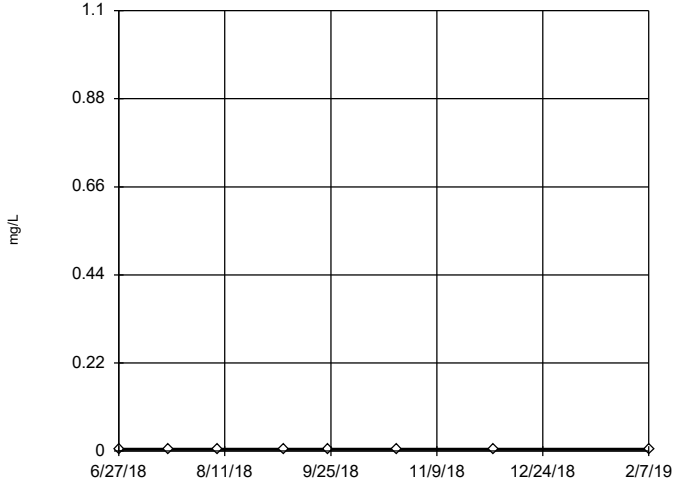
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

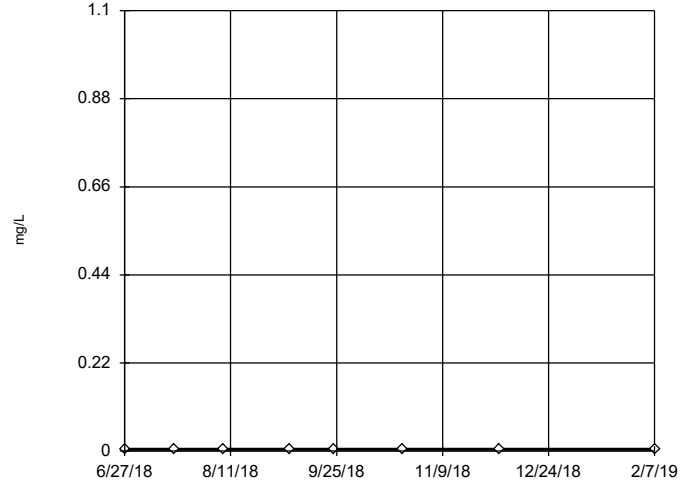
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

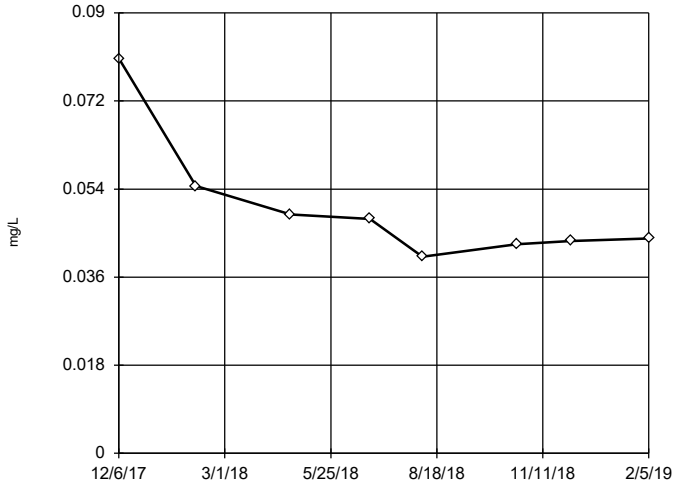
Constituent: Arsenic Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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 = 0.08899, low cutoff = 0.02497, based on IQR multiplier of 3.

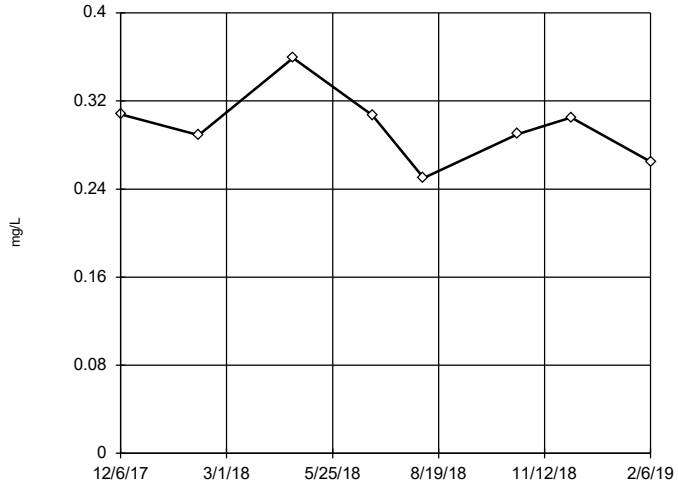
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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 = 0.4219, low cutoff = 0.2017, based on IQR multiplier of 3.

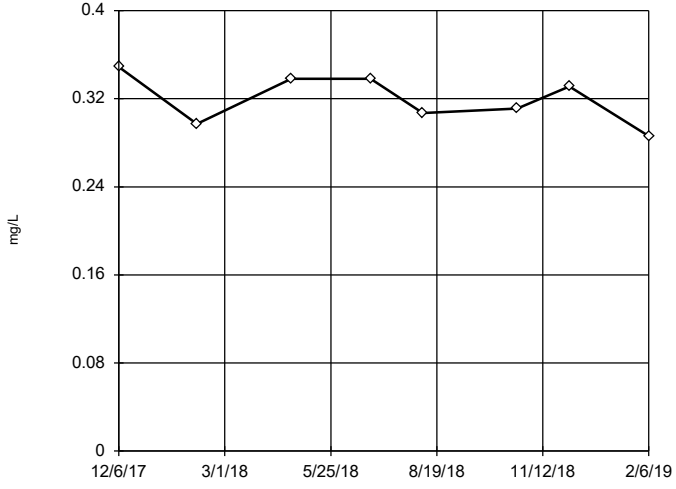
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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 = 0.4156, low cutoff = -0.1774, based on IQR multiplier of 3.

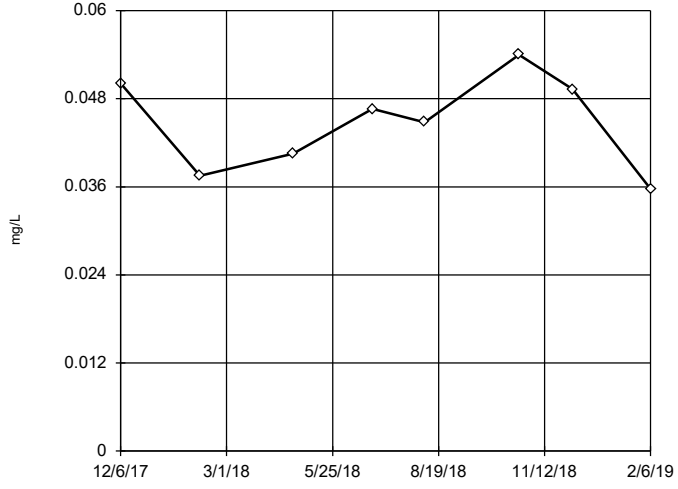
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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 = 0.07288, low cutoff = -0.0363, based on IQR multiplier of 3.

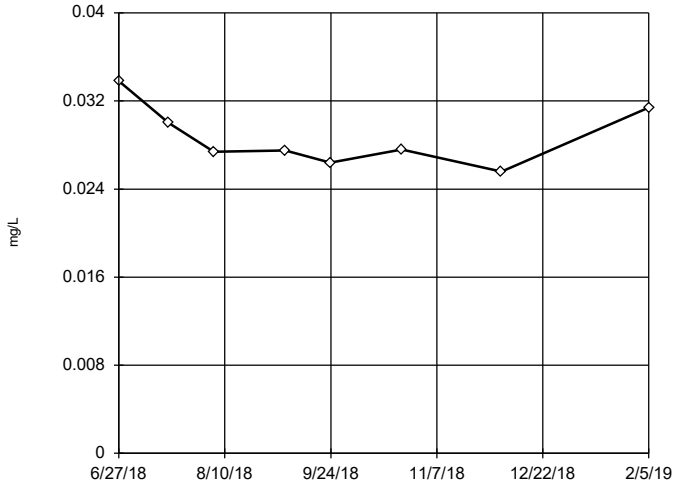
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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 = 0.04561, low cutoff = 0.0181, based on IQR multiplier of 3.

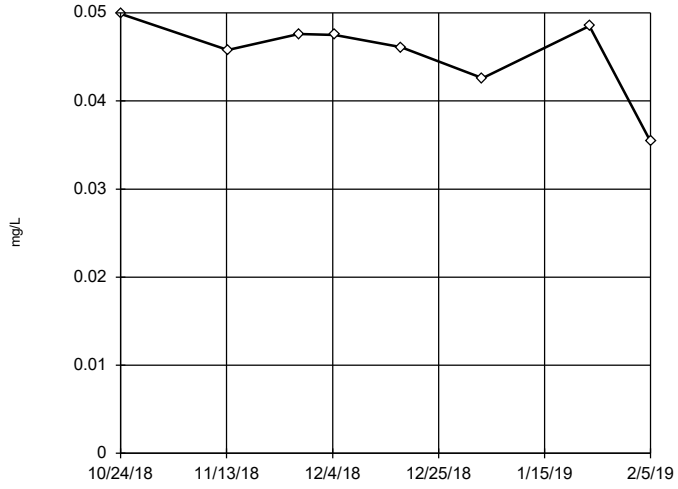
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 0.0546, low cutoff = -0.04326, based on IQR multiplier of 3.

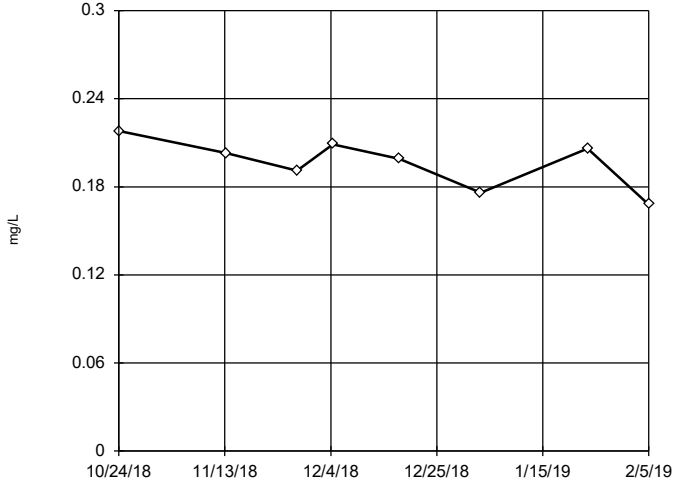
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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 = 0.2423, low cutoff = -0.2089, based on IQR multiplier of 3.

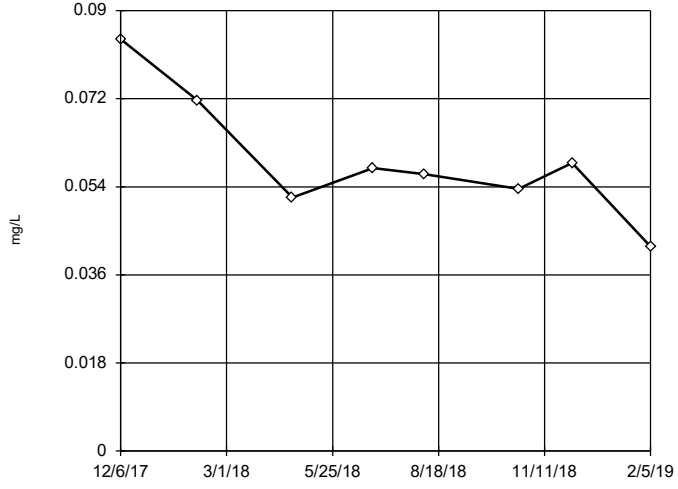
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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 = 0.1216, low cutoff = 0.02815, based on IQR multiplier of 3.

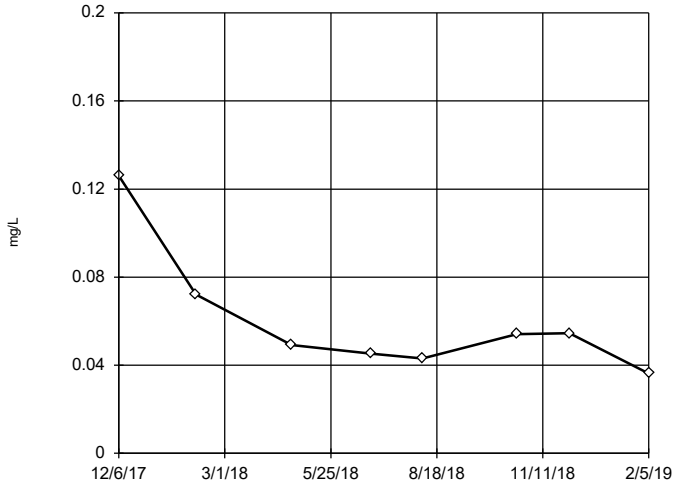
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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 = 0.179, low cutoff = 0.01548, based on IQR multiplier of 3.

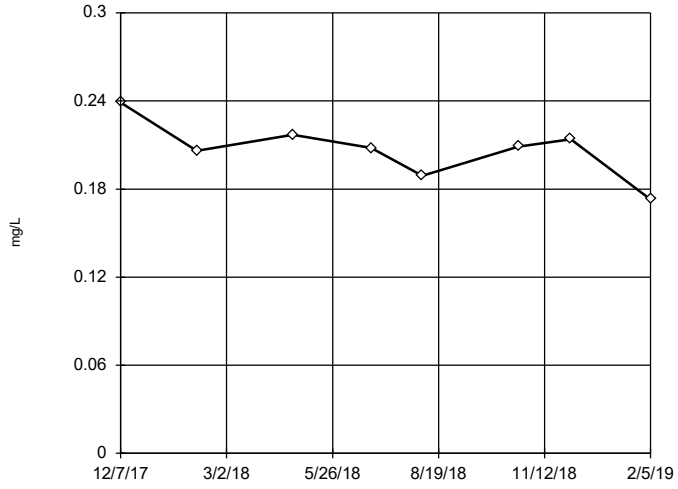
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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 = 0.2618, low cutoff = 0.1303, based on IQR multiplier of 3.

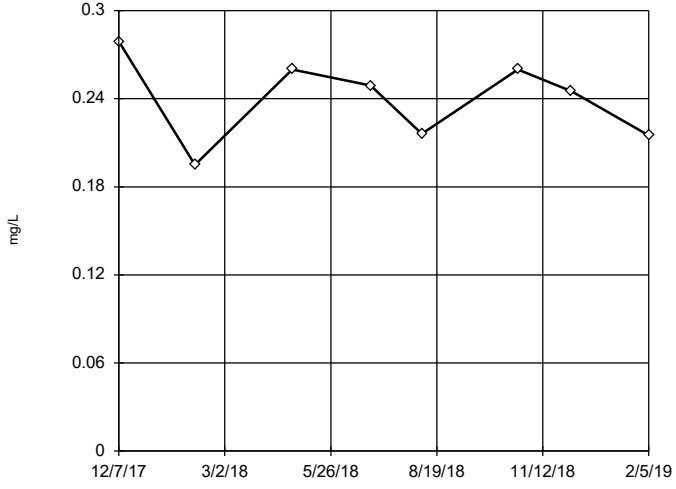
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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 = 0.3428, low cutoff = -0.2333, based on IQR multiplier of 3.

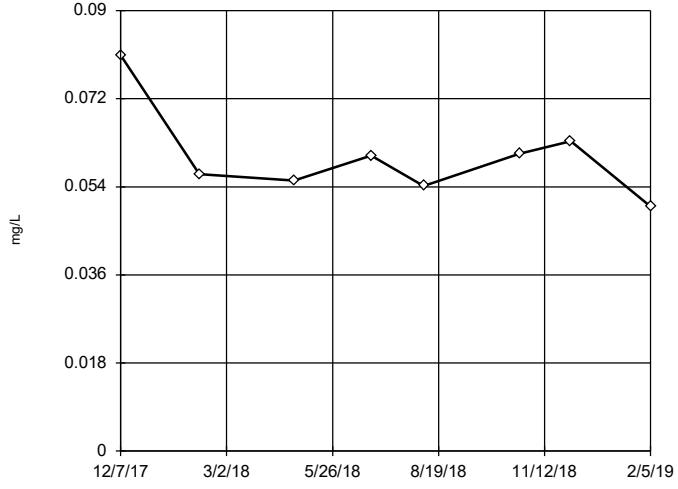
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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 = 0.09027, low cutoff = 0.03763, based on IQR multiplier of 3.

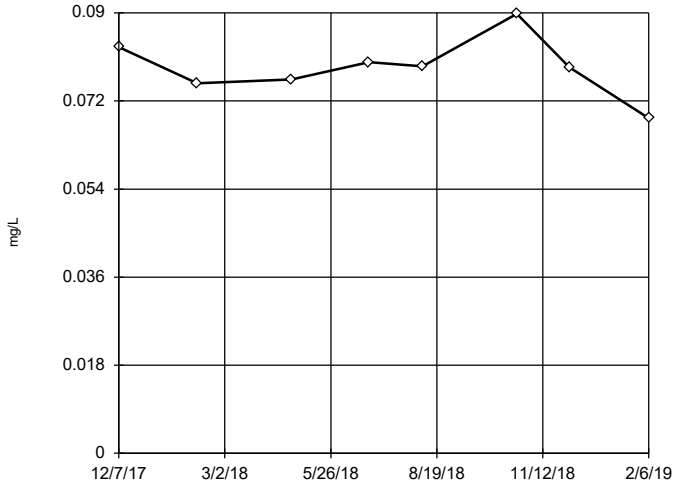
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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 = 0.0989, low cutoff = 0.0608, based on IQR multiplier of 3.

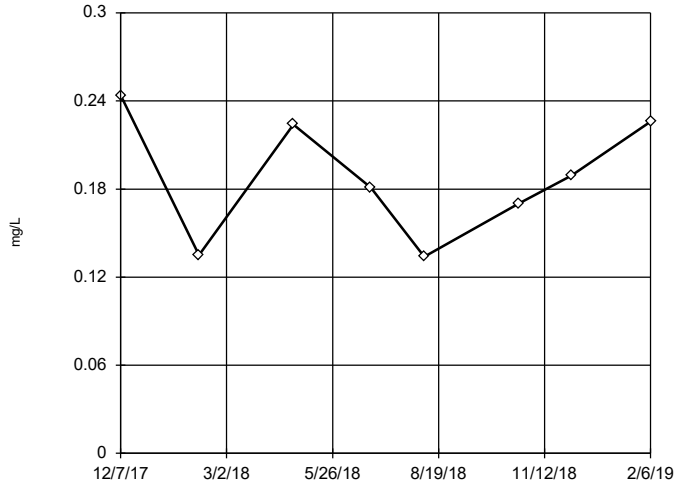
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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 = 0.3631, low cutoff = -0.2401, based on IQR multiplier of 3.

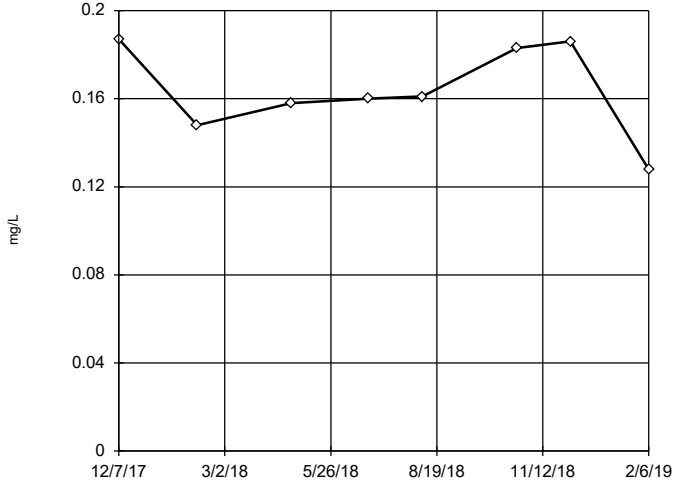
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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 = 0.2566, low cutoff = -0.09161, based on IQR multiplier of 3.

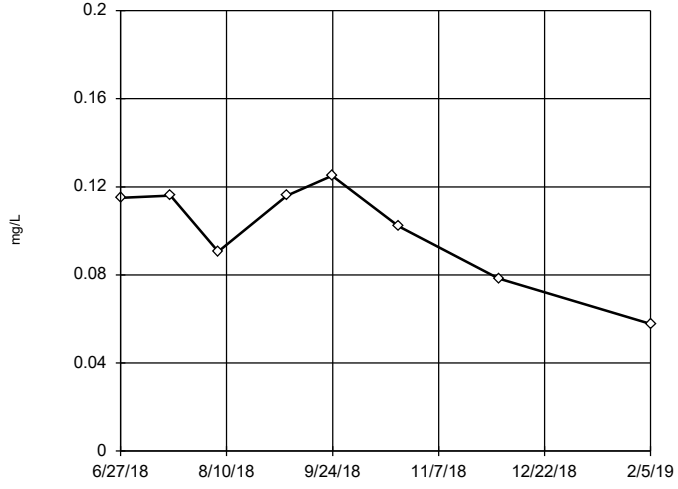
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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 = 0.1639, low cutoff = -0.1307, based on IQR multiplier of 3.

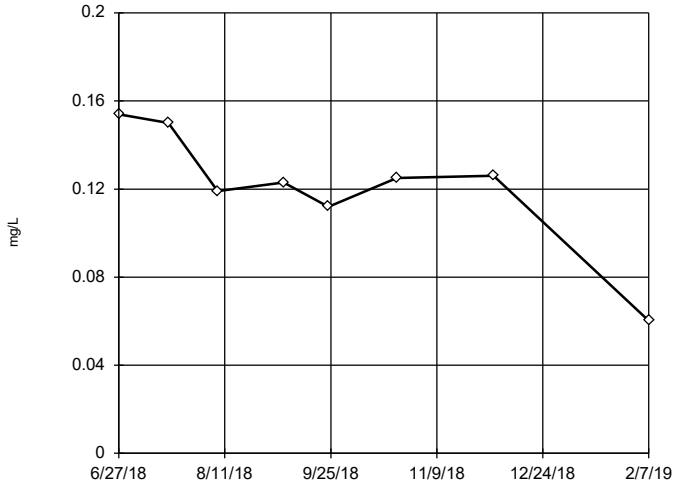
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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 = 0.1829, low cutoff = -0.1235, based on IQR multiplier of 3.

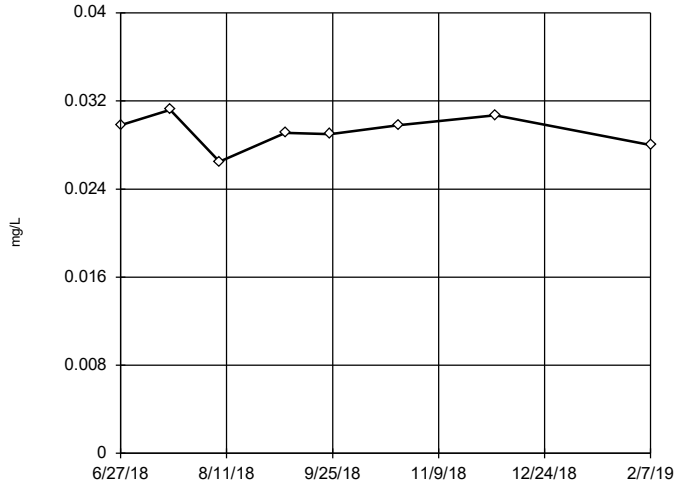
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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 = 0.03368, low cutoff = -0.02312, based on IQR multiplier of 3.

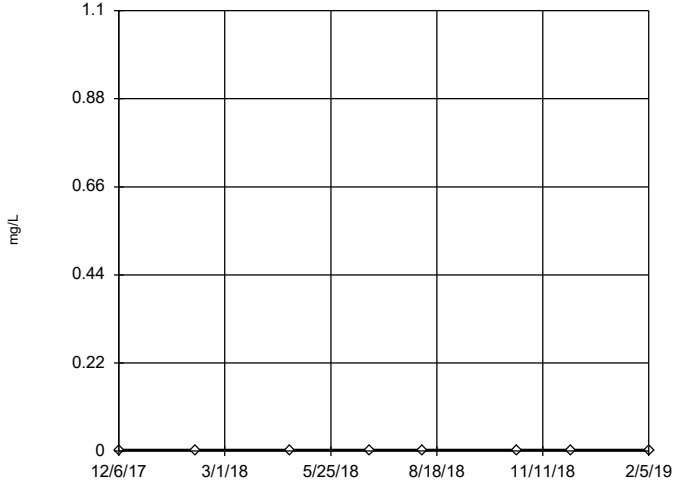
Constituent: Barium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

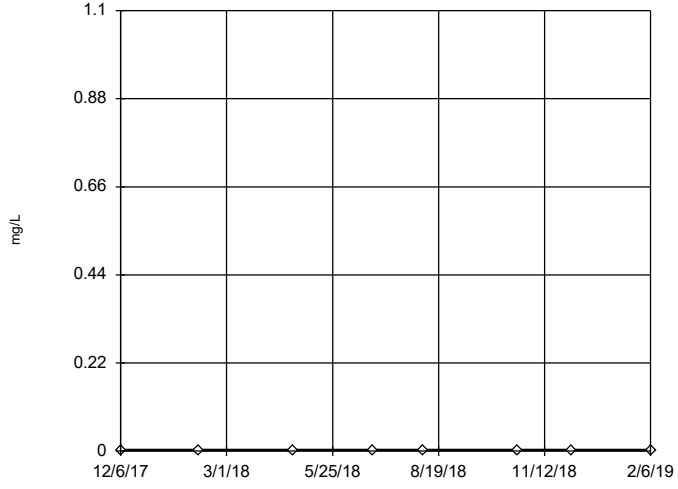
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

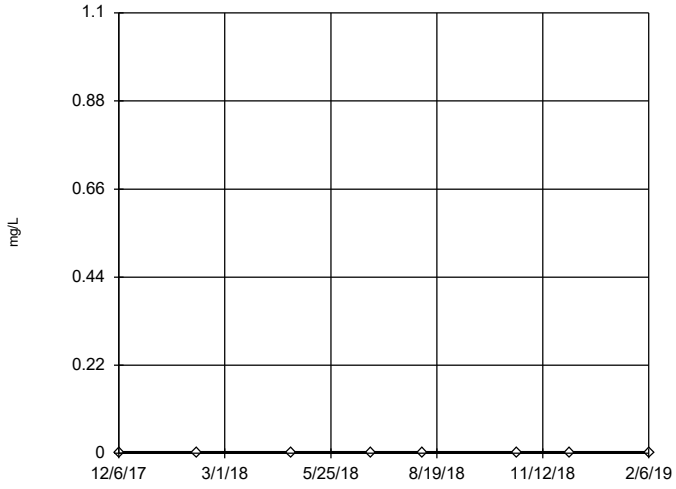
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

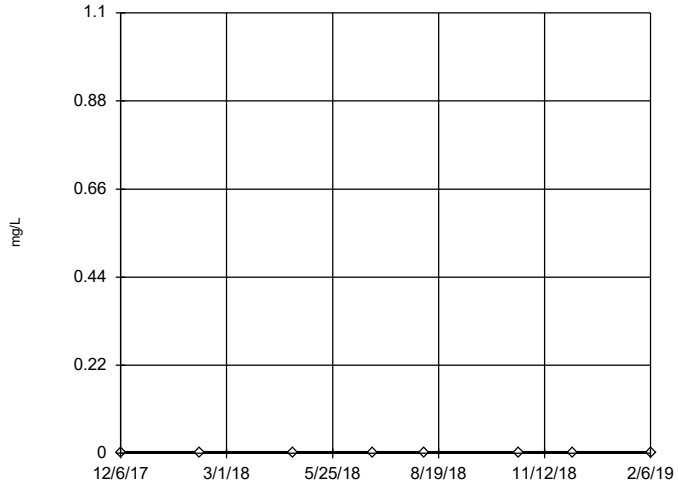
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

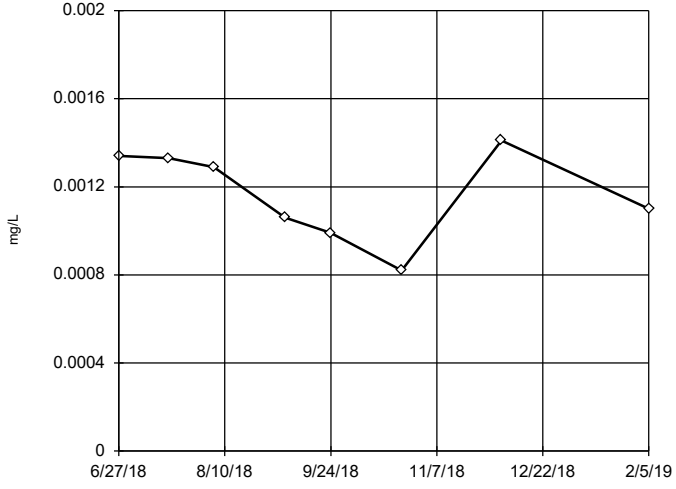
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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 = 0.001993, low cutoff = -0.001066, based on IQR multiplier of 3.

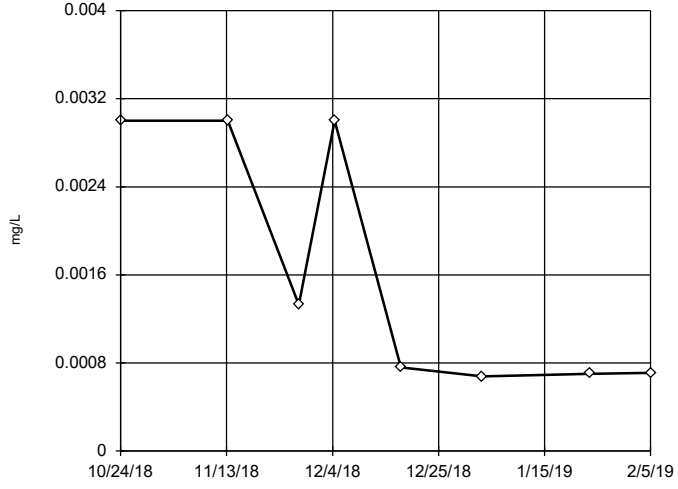
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 0.2292, low cutoff = 0.000009253, based on IQR multiplier of 3.

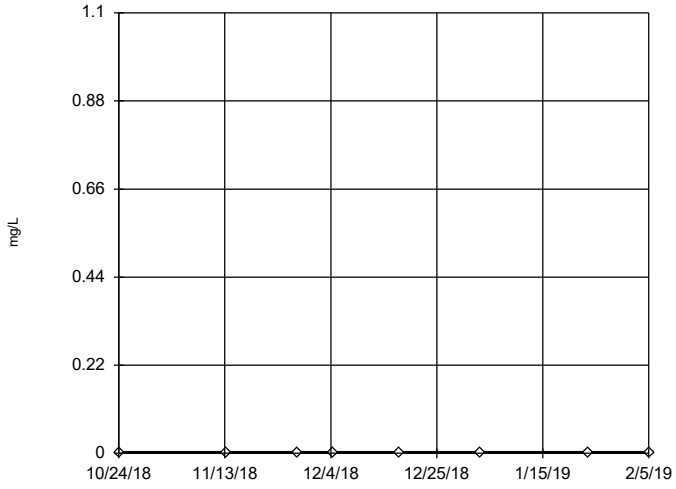
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

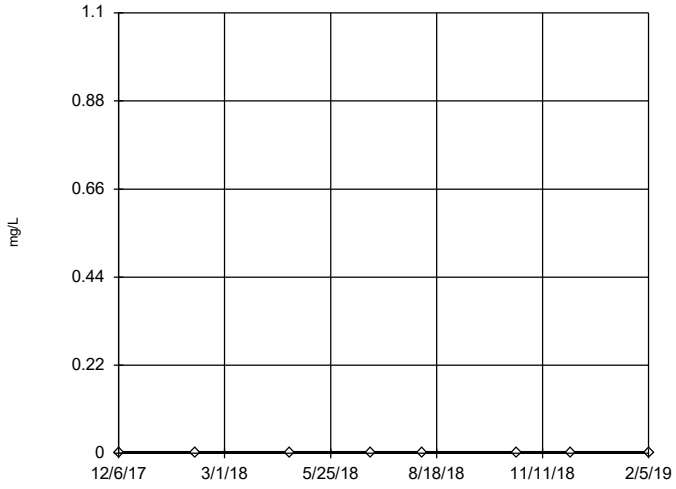
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-2




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

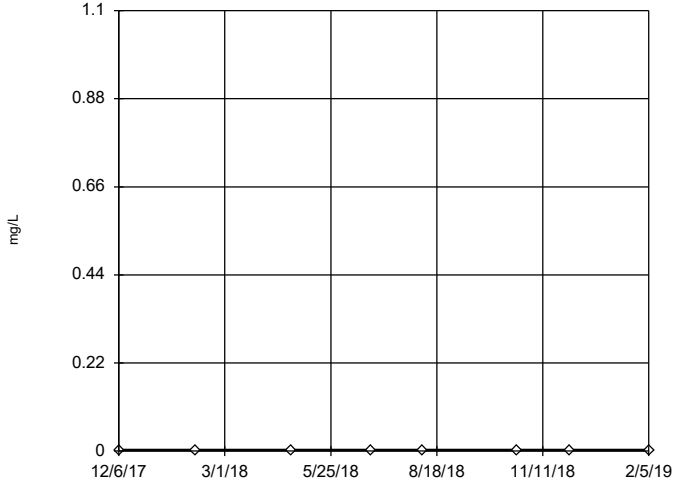
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

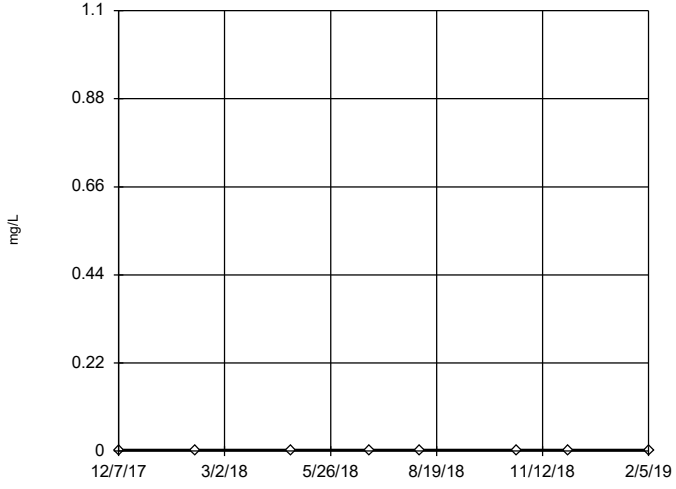
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

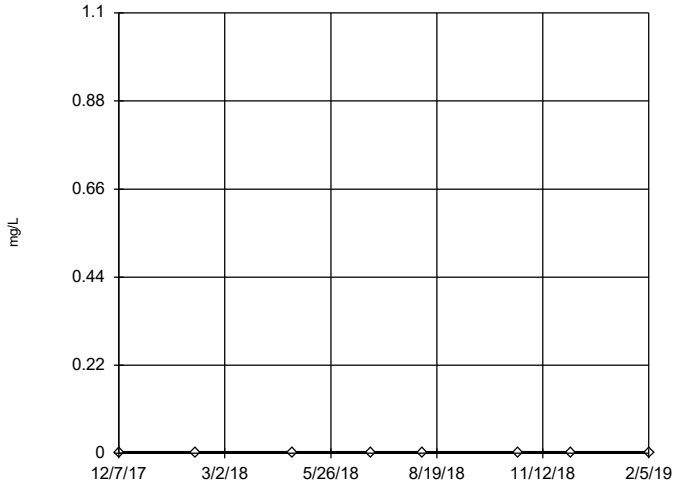
Constituent: Beryllium Analysis Run 4/2/2019 2:54 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

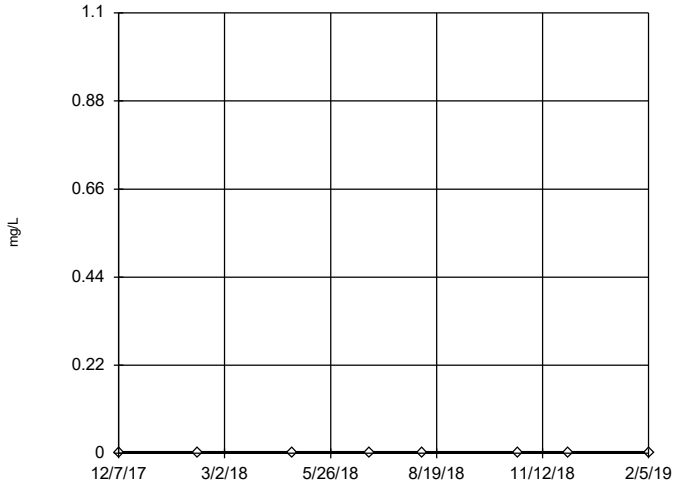
Constituent: Beryllium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

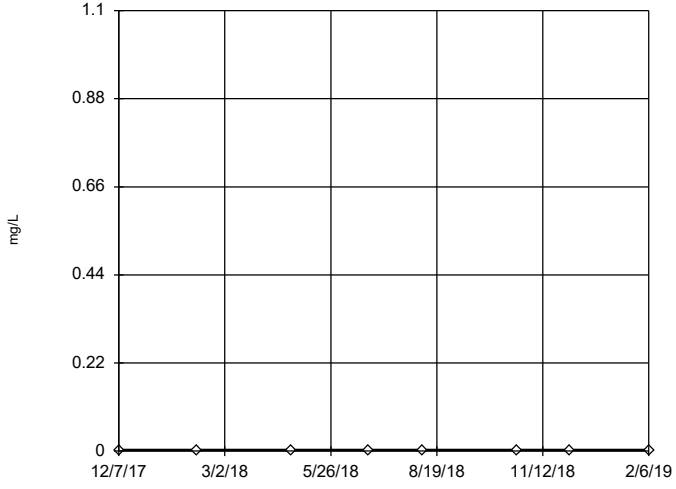
Constituent: Beryllium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

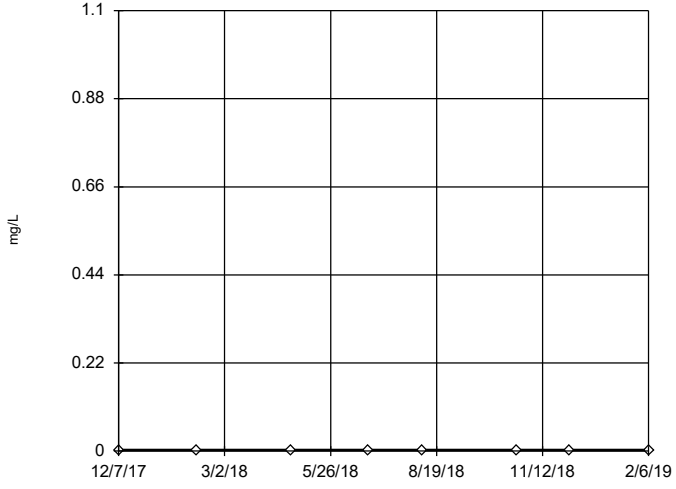
Constituent: Beryllium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

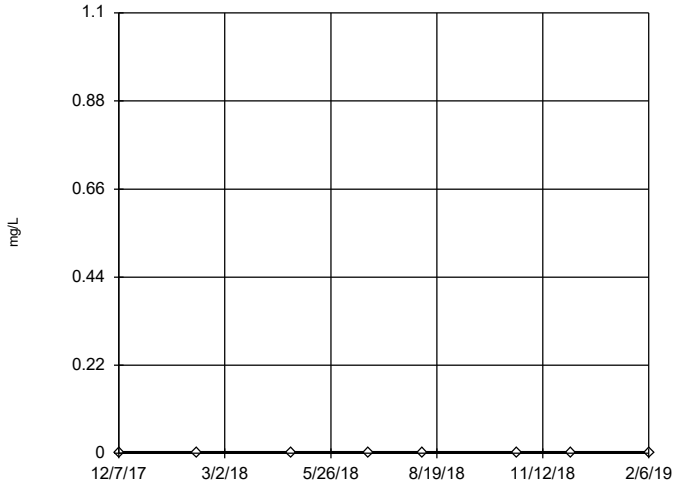
Constituent: Beryllium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

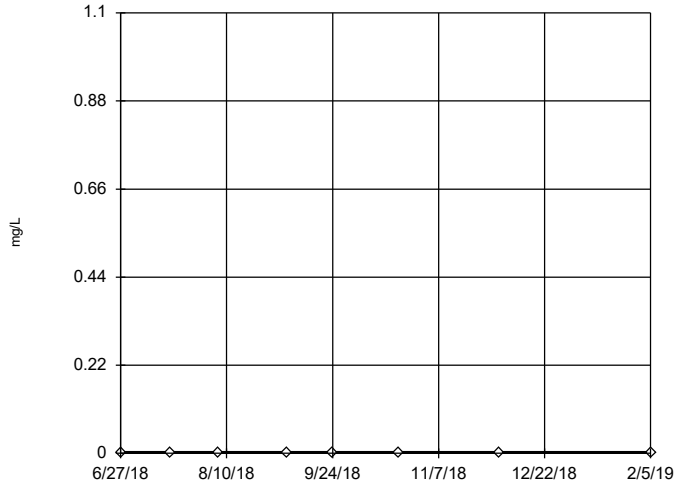
Constituent: Beryllium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

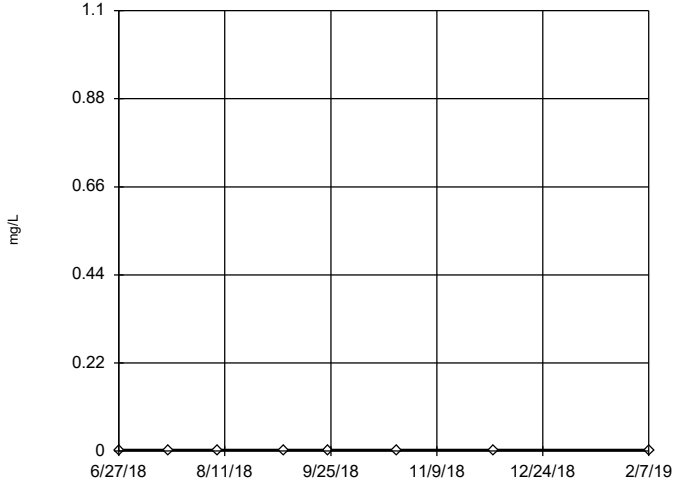
Constituent: Beryllium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

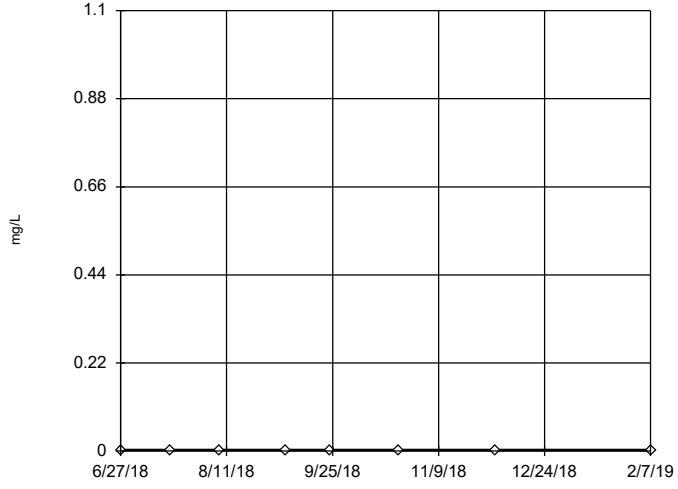
Constituent: Beryllium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

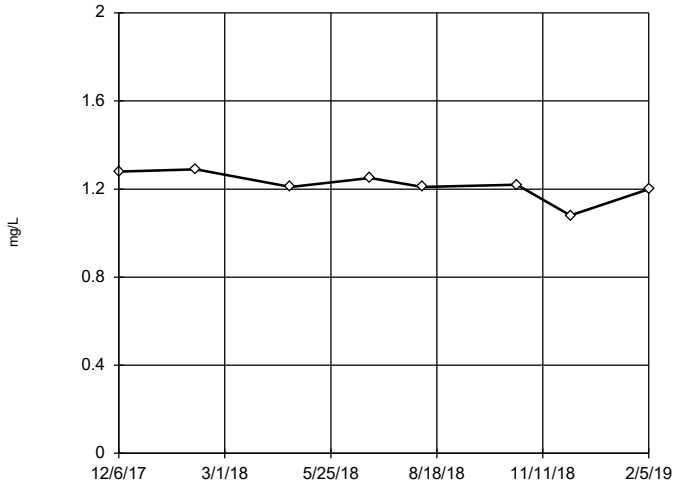
Constituent: Beryllium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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 = 1.391, low cutoff = -0.6424, based on IQR multiplier of 3.

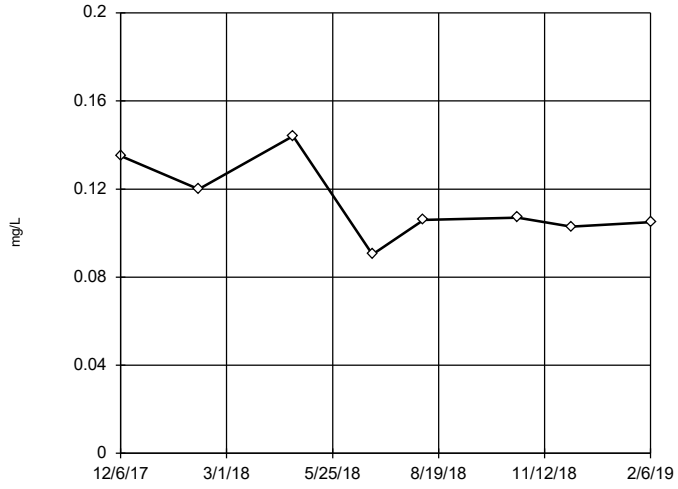
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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 = 0.2333, low cutoff = 0.05673, based on IQR multiplier of 3.

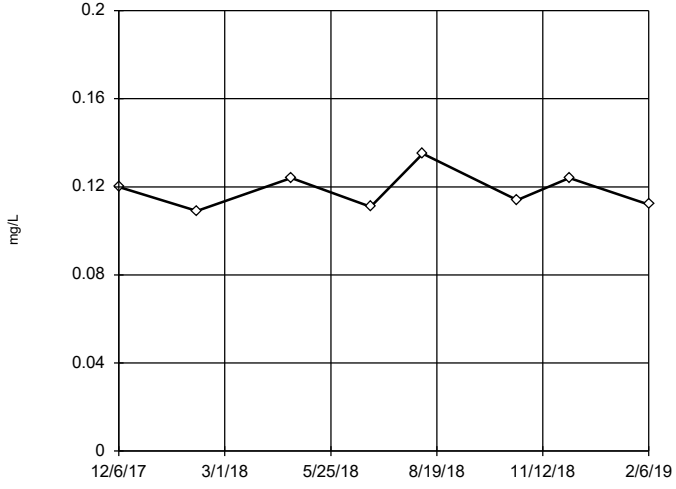
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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 = 0.1706, low cutoff = 0.08106, based on IQR multiplier of 3.

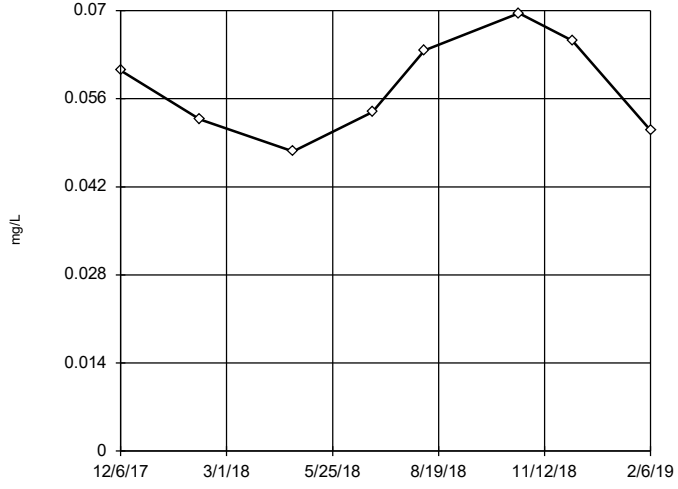
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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 = 0.1238, low cutoff = 0.02699, based on IQR multiplier of 3.

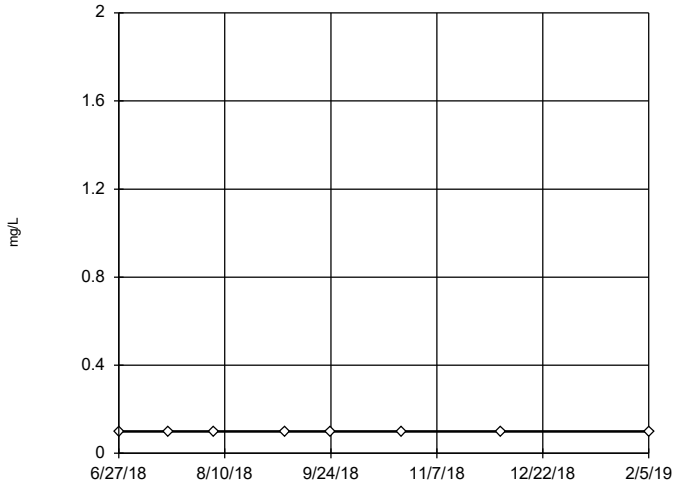
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-14 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

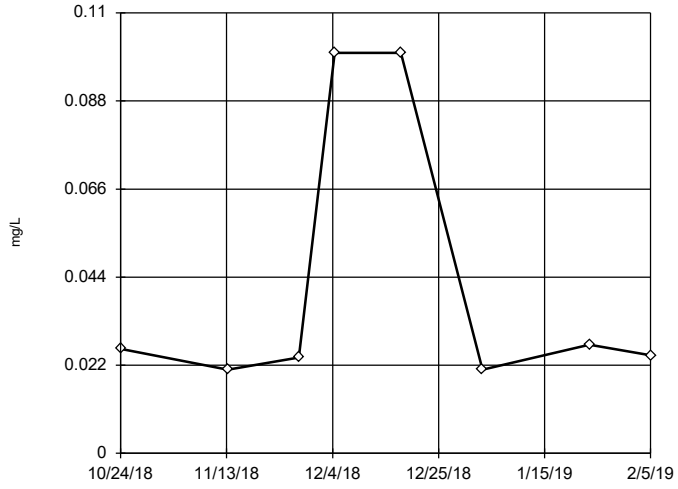
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-16 (bg)




n = 8

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 = 0.6578, low cutoff = 0.001769, based on IQR multiplier of 3.

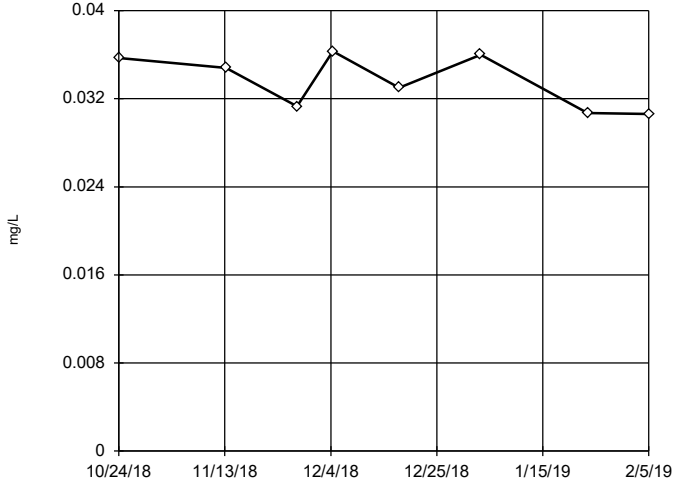
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-17 (bg)




n = 8

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 = 0.04242, low cutoff = -0.03758, based on IQR multiplier of 3.

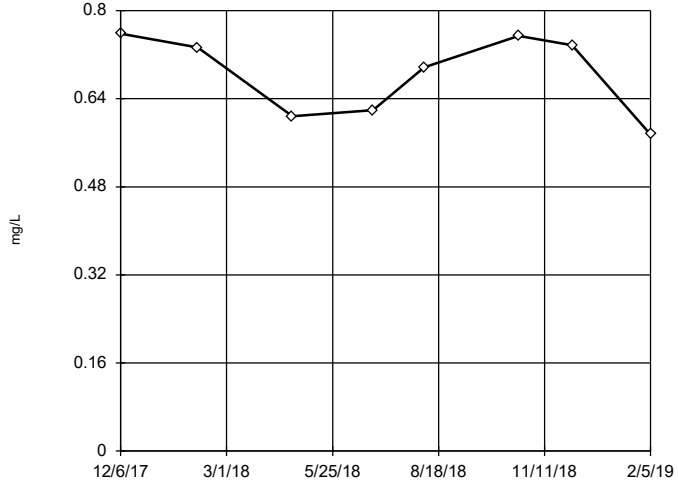
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-2




n = 8

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 = 0.899, low cutoff = -0.8193, based on IQR multiplier of 3.

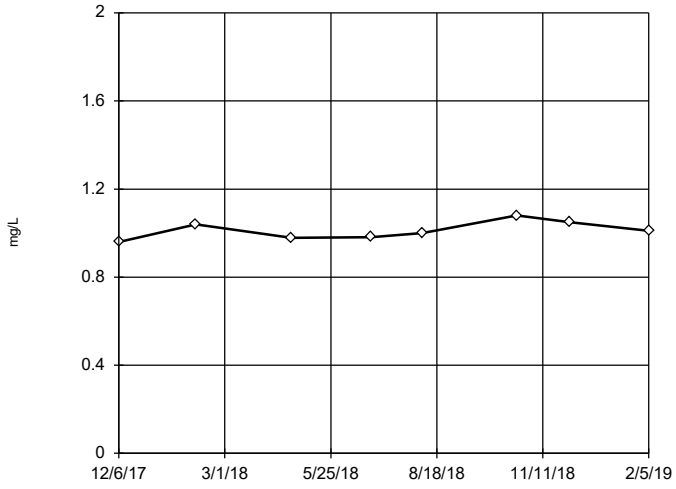
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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 = 1.265, low cutoff = 0.8099, based on IQR multiplier of 3.

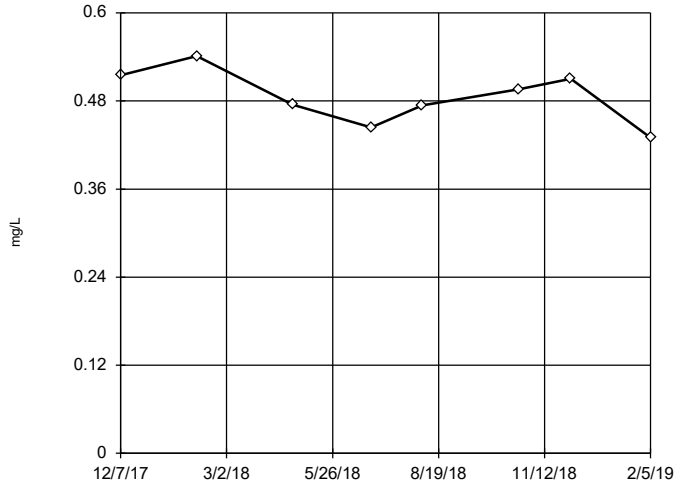
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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 = 0.6465, low cutoff = 0.2359, based on IQR multiplier of 3.

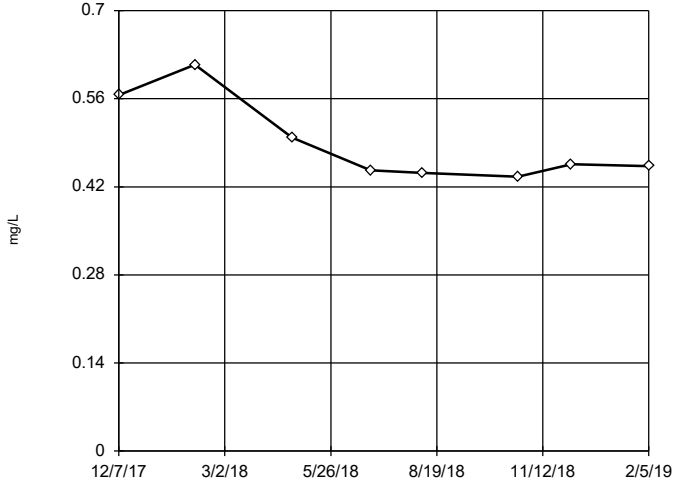
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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 = 0.9077, low cutoff = 0.2597, based on IQR multiplier of 3.

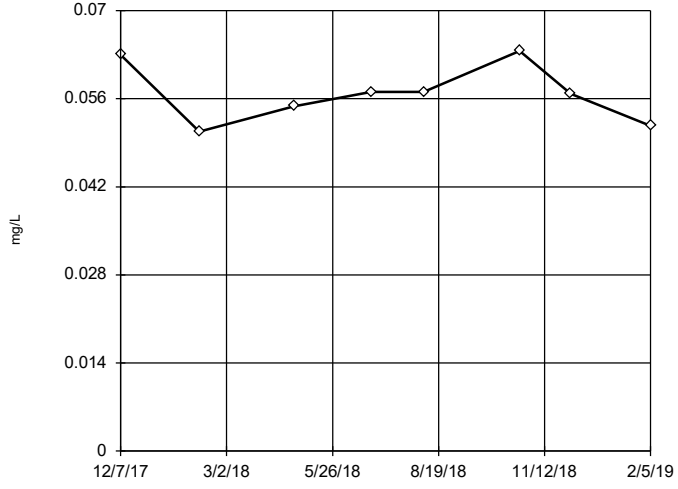
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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 = 0.08581, low cutoff = 0.0372, based on IQR multiplier of 3.

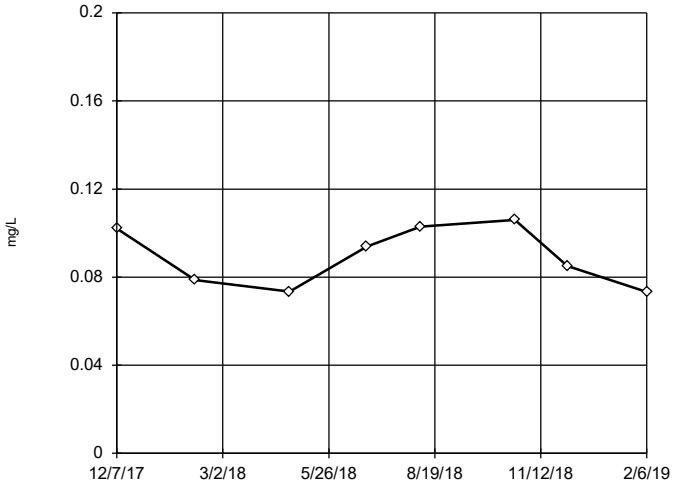
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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 = 0.157, low cutoff = -0.09142, based on IQR multiplier of 3.

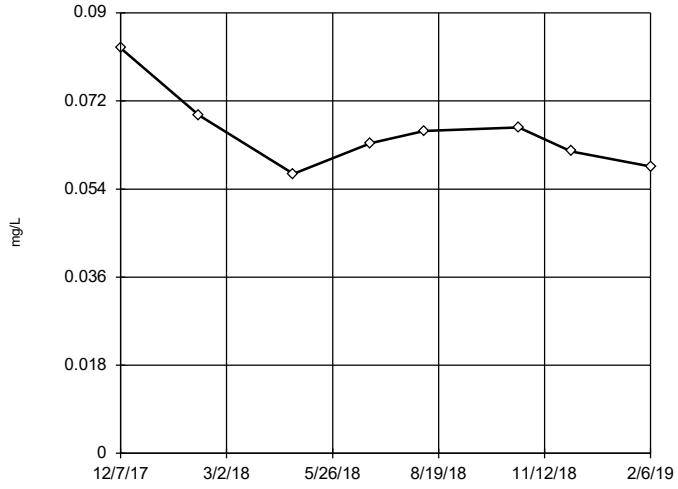
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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 = 0.09742, low cutoff = 0.04187, based on IQR multiplier of 3.

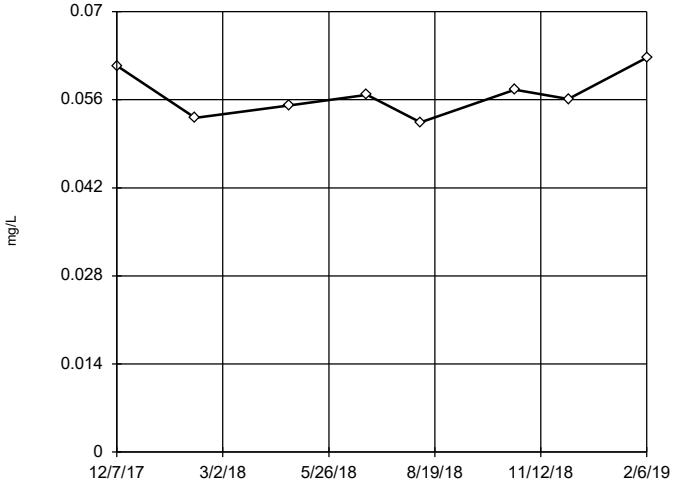
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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 = 0.07903, low cutoff = 0.0407, based on IQR multiplier of 3.

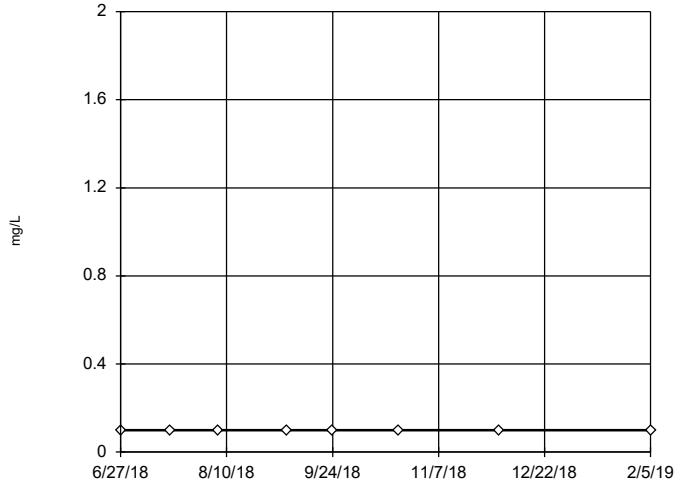
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

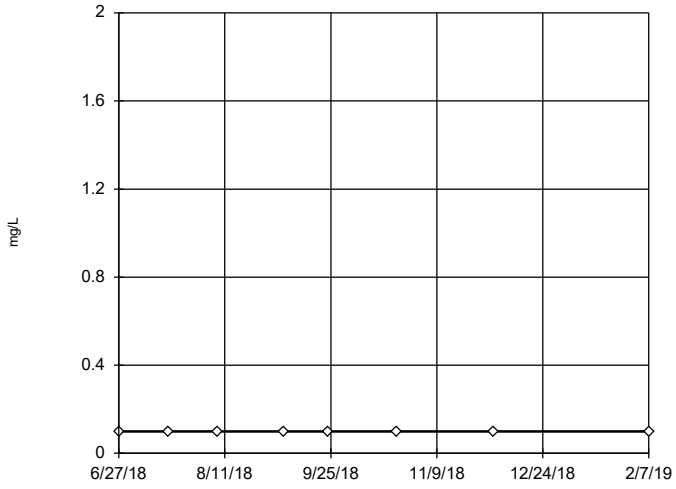
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

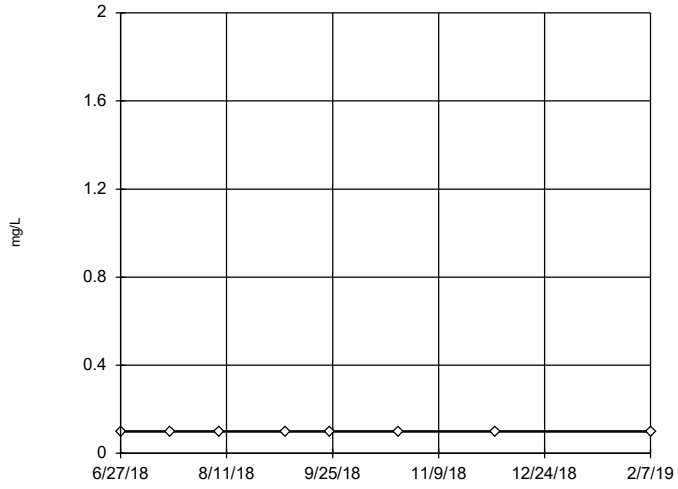
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

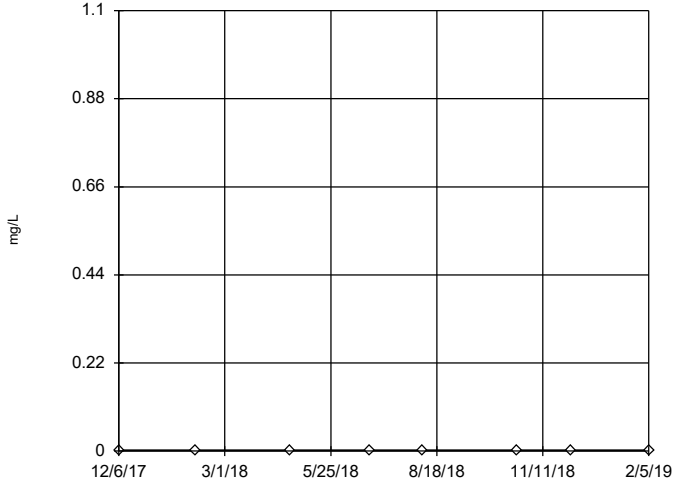
Constituent: Boron Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

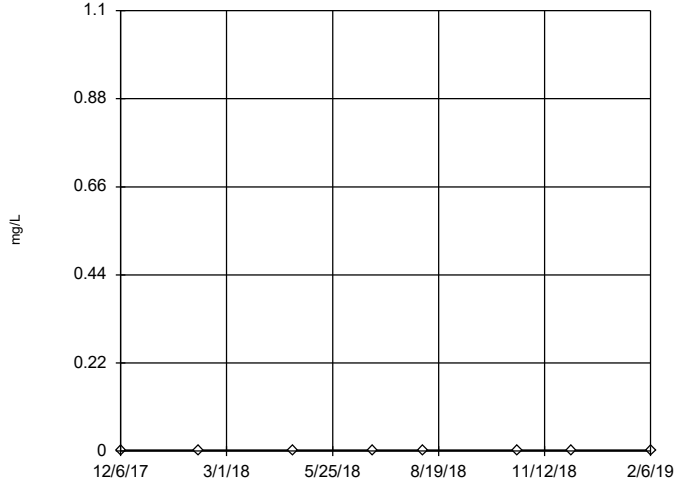
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

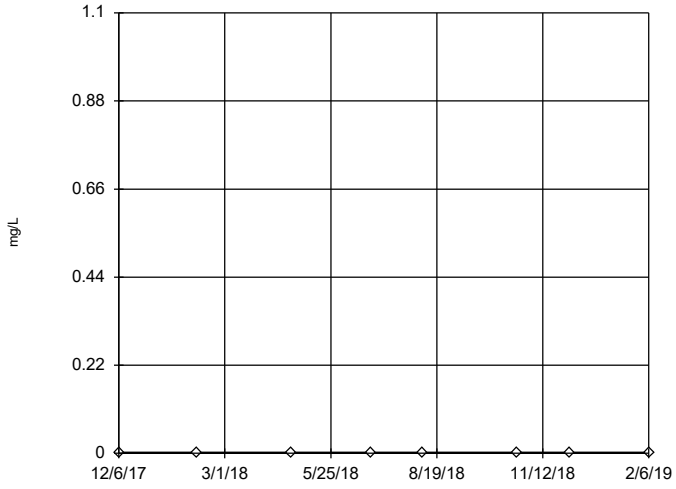
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

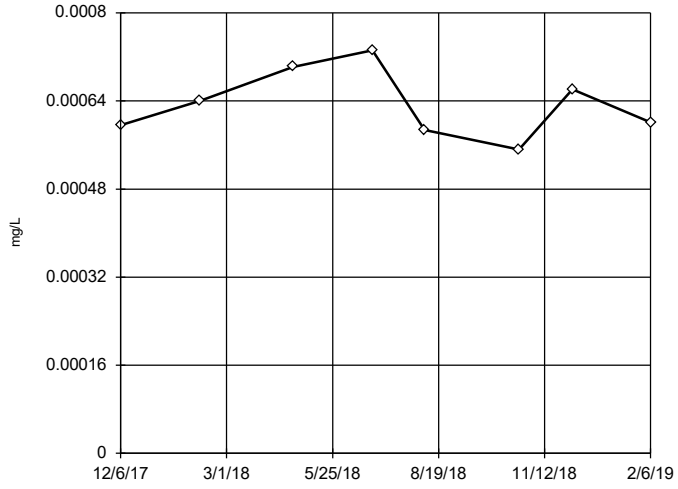
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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 = 0.001041, low cutoff = 0.0003872, based on IQR multiplier of 3.

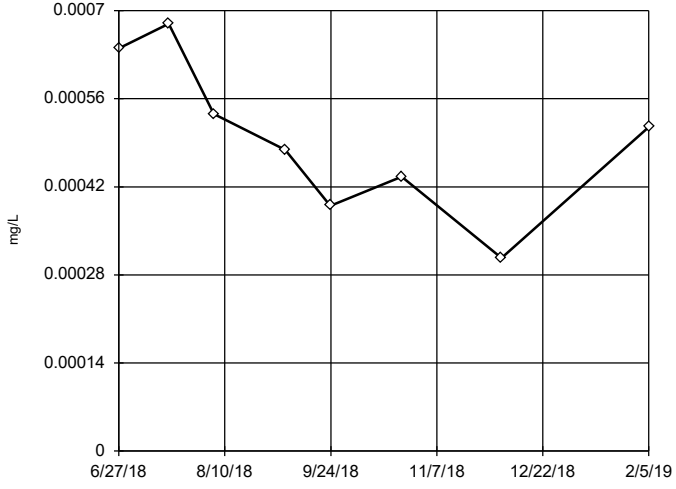
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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 = 0.001293, low cutoff = 0.00007367, based on IQR multiplier of 3.

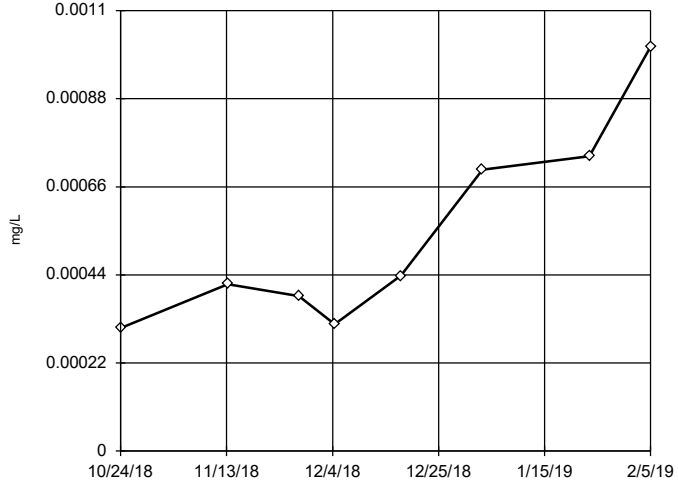
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 0.00623, low cutoff = 0.00004044, based on IQR multiplier of 3.

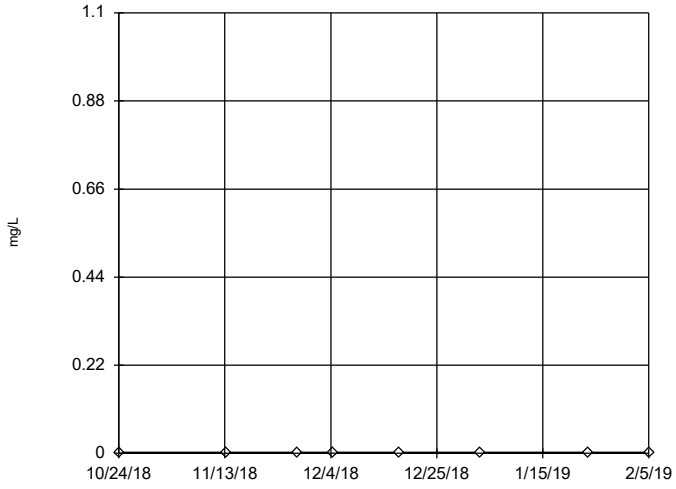
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

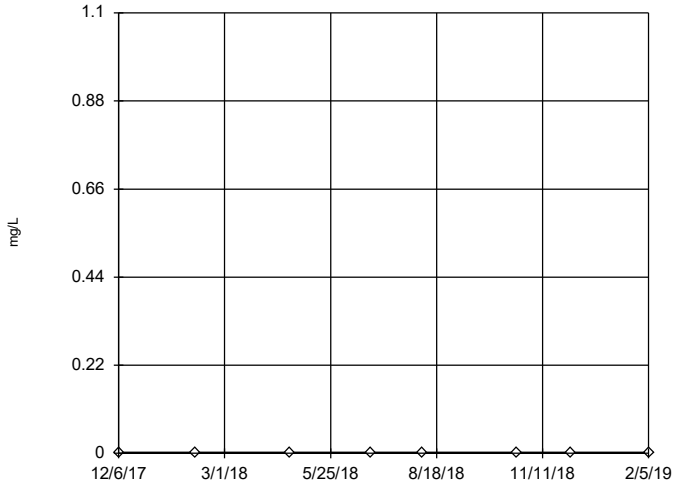
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

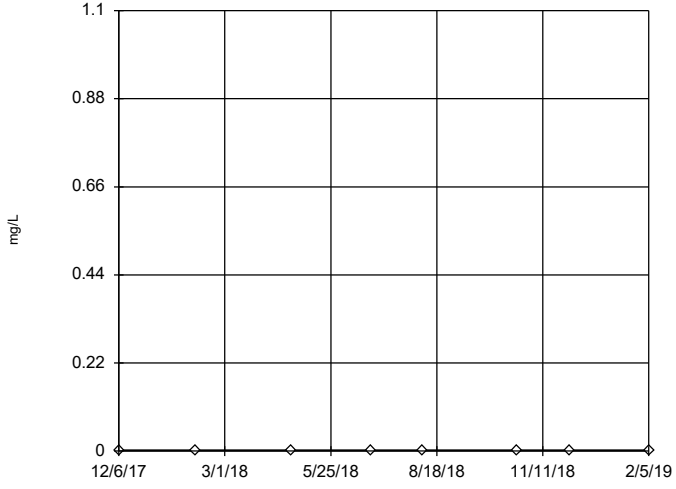
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

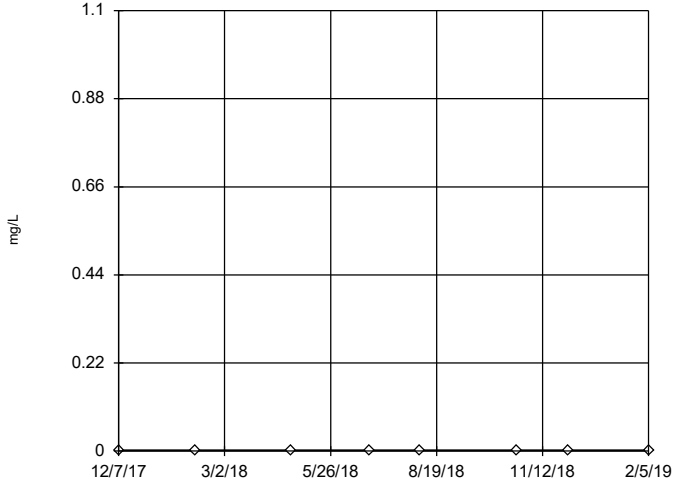
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

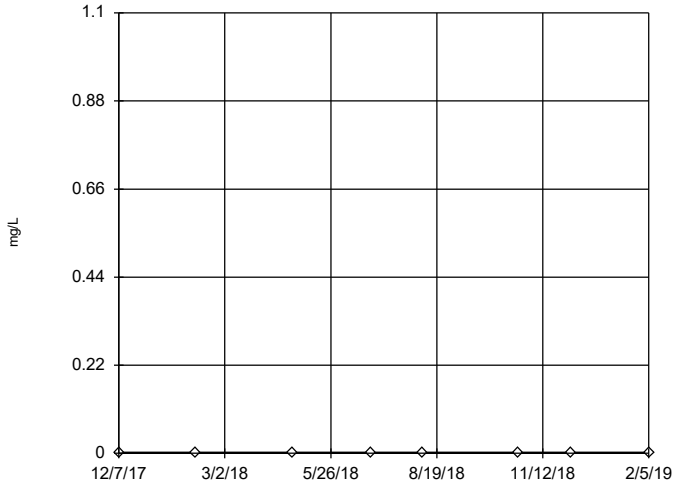
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

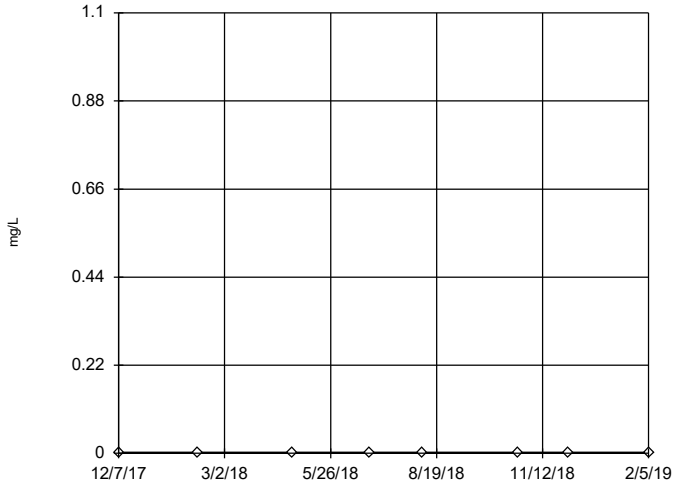
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

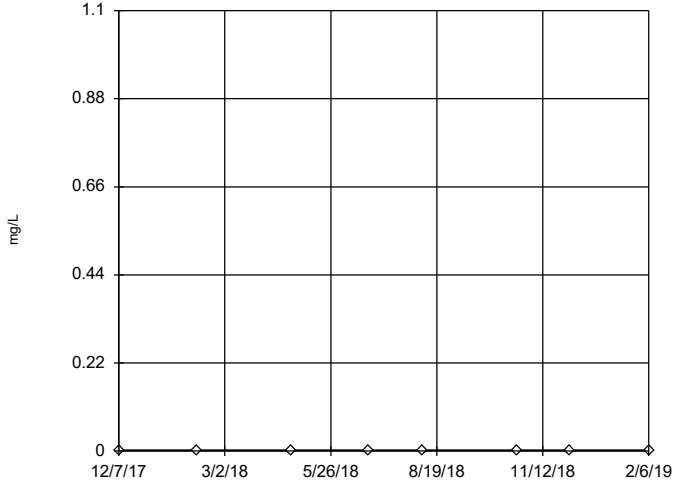
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

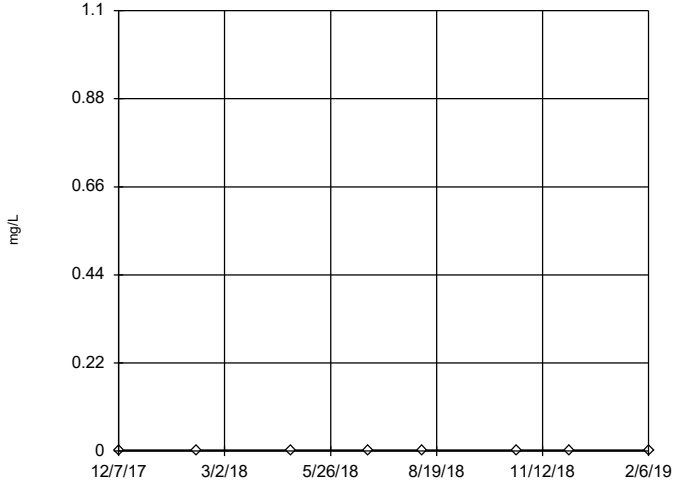
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

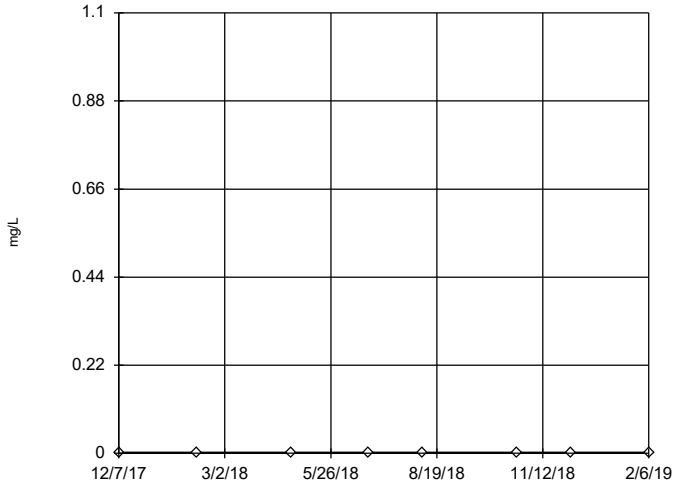
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

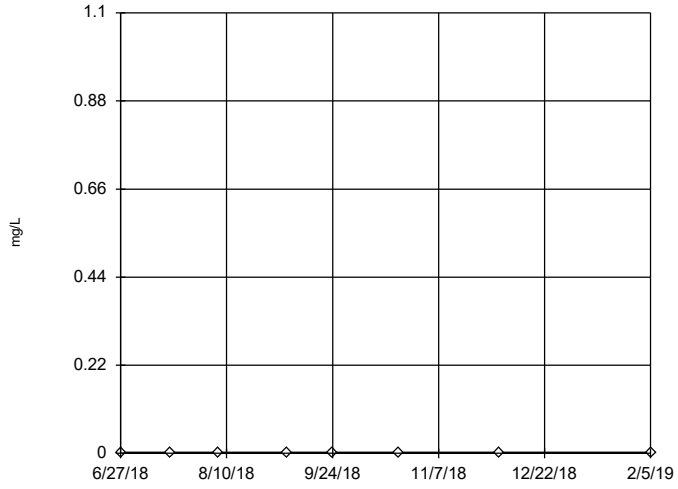
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

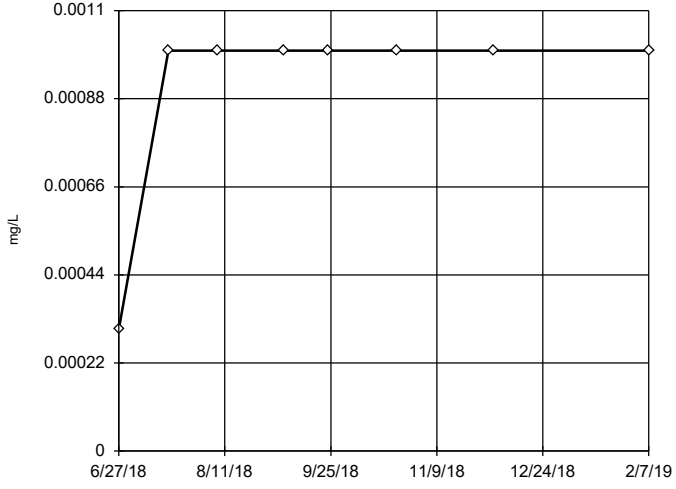
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

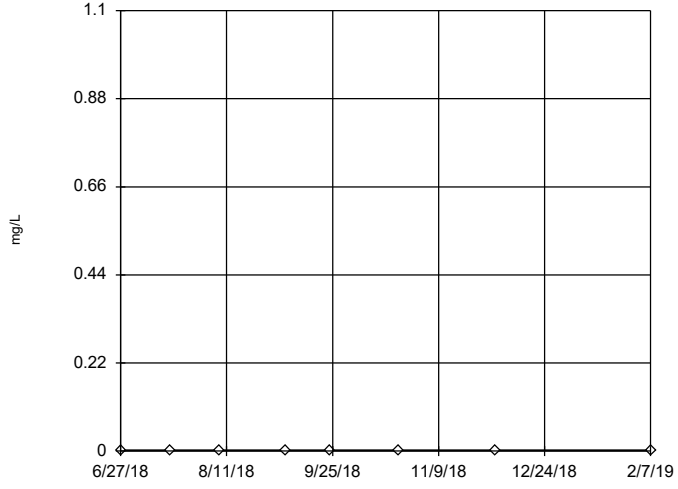
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

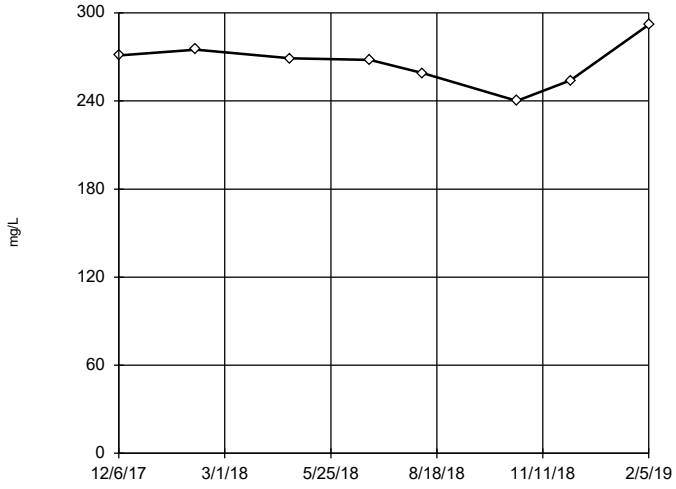
Constituent: Cadmium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

High cutoff = 322.5, low cutoff = 207, based on IQR multiplier of 3.

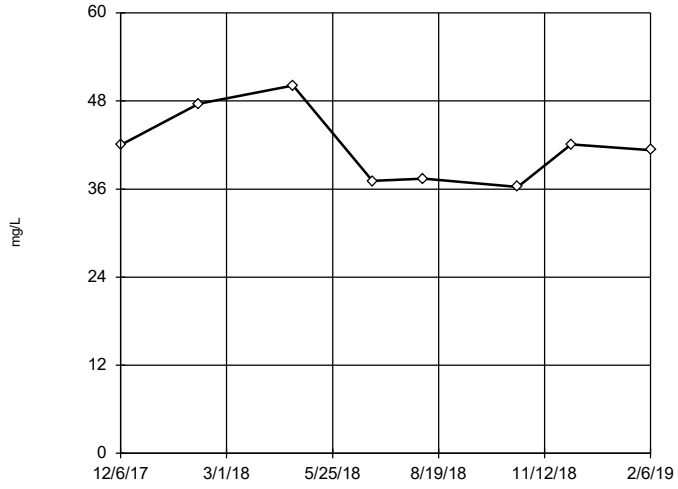
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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 = 77.7, low cutoff = 21.46, based on IQR multiplier of 3.

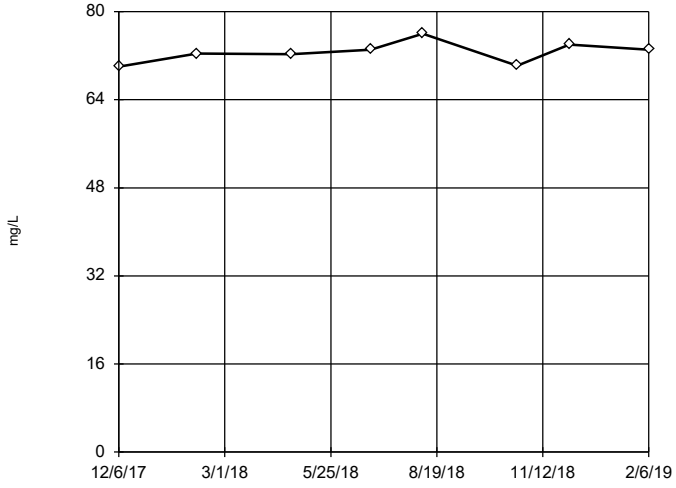
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

High cutoff = 80.76, low cutoff = 64.62, based on IQR multiplier of 3.

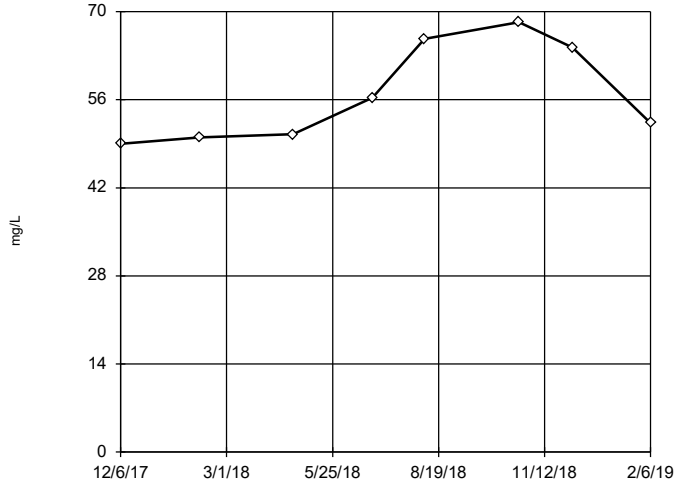
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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 = 140.7, low cutoff = 23.22, based on IQR multiplier of 3.

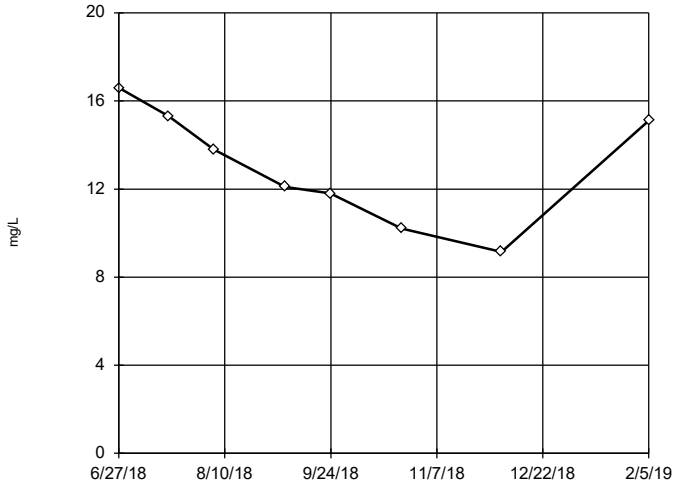
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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

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

High cutoff = 27.8, low cutoff = -1.6, based on IQR multiplier of 3.

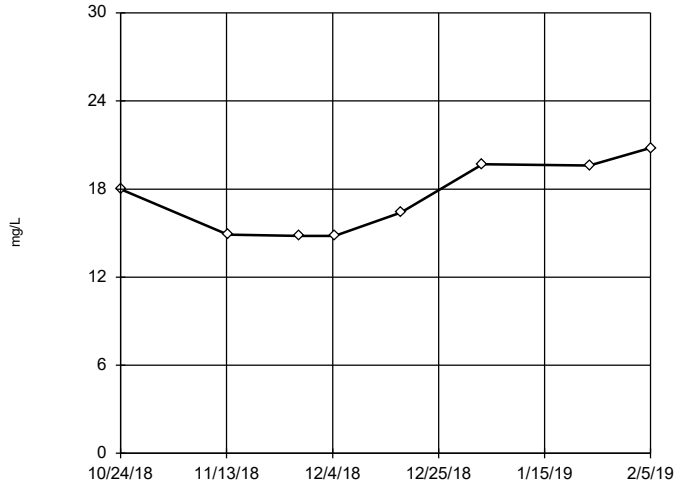
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 27.38, low cutoff = -21.3, based on IQR multiplier of 3.

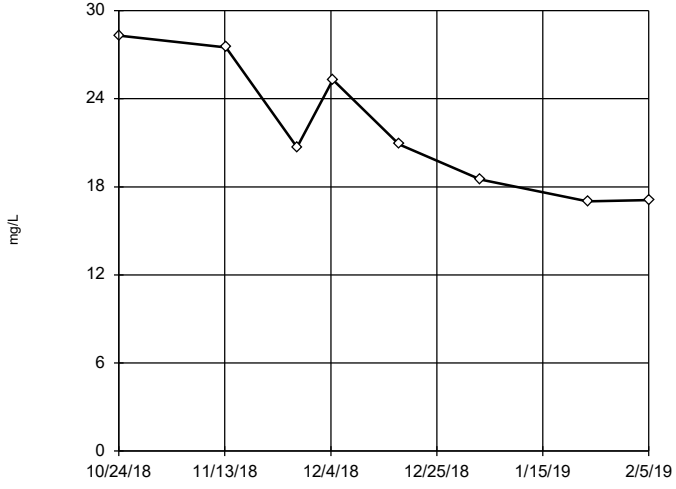
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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 = 86.03, low cutoff = 5.453, based on IQR multiplier of 3.

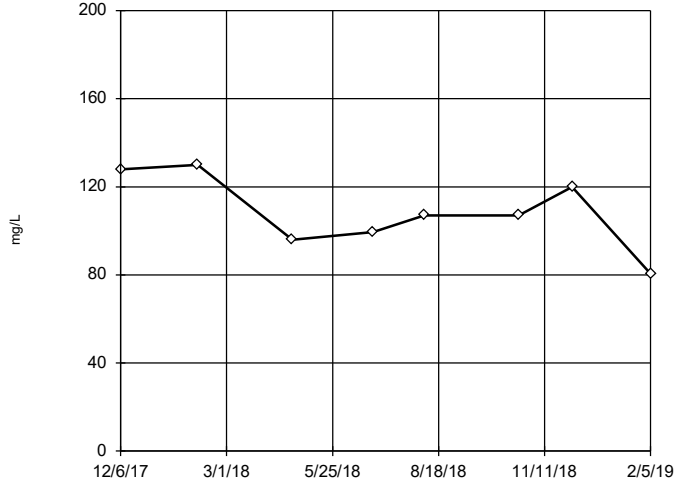
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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

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

High cutoff = 203.1, low cutoff = 18.6, based on IQR multiplier of 3.

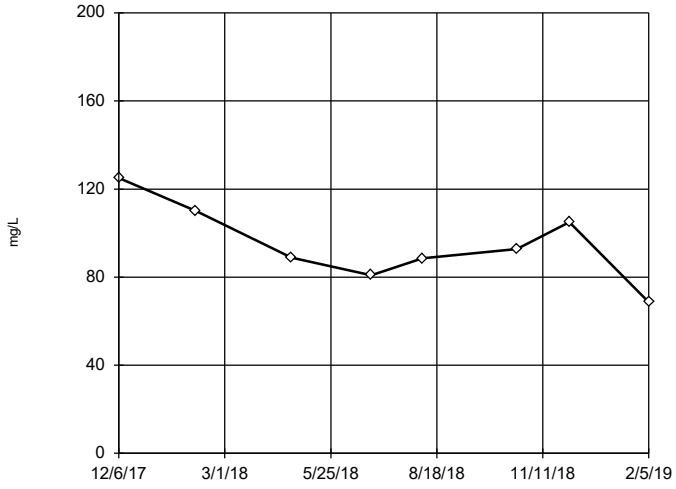
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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

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

High cutoff = 200.1, low cutoff = 35.79, based on IQR multiplier of 3.

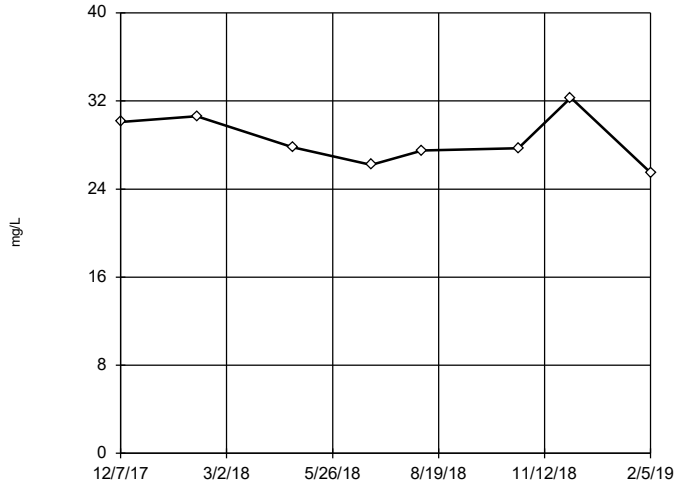
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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 = 43.87, low cutoff = 18.57, based on IQR multiplier of 3.

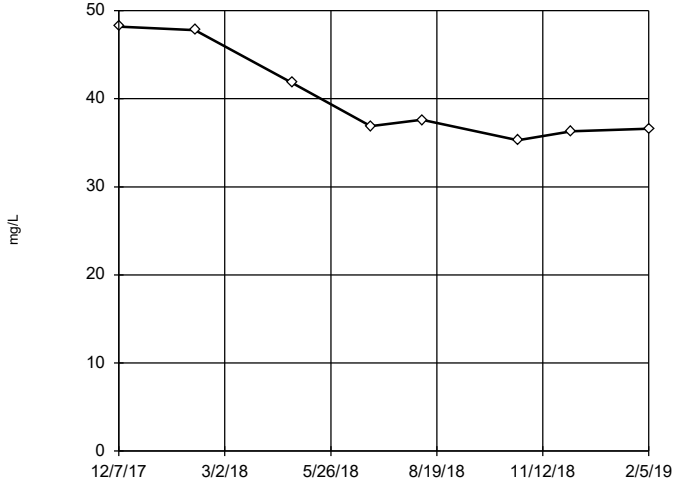
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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 = 82.44, low cutoff = 19.76, based on IQR multiplier of 3.

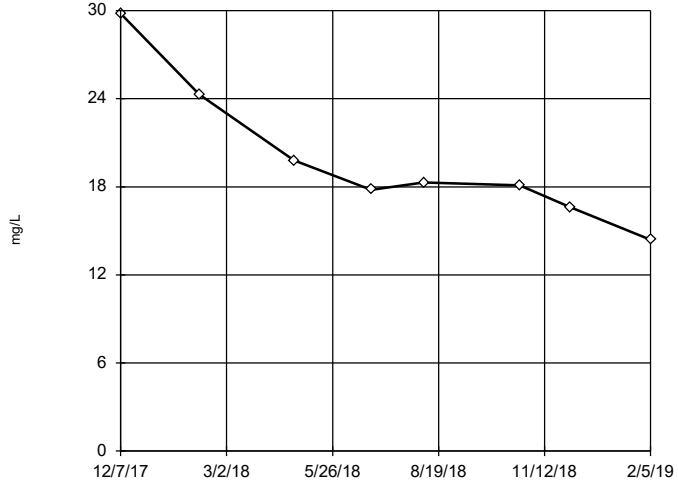
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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 = 45.58, low cutoff = 8.273, based on IQR multiplier of 3.

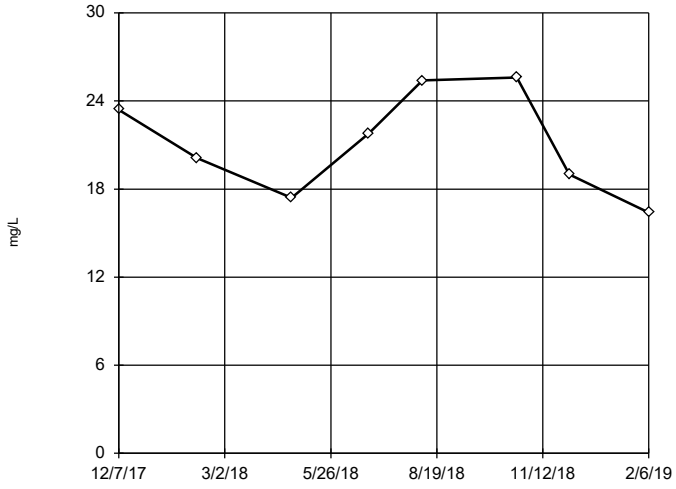
Constituent: Calcium Analysis Run 4/2/2019 2:55 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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 = 58.77, low cutoff = 7.543, based on IQR multiplier of 3.

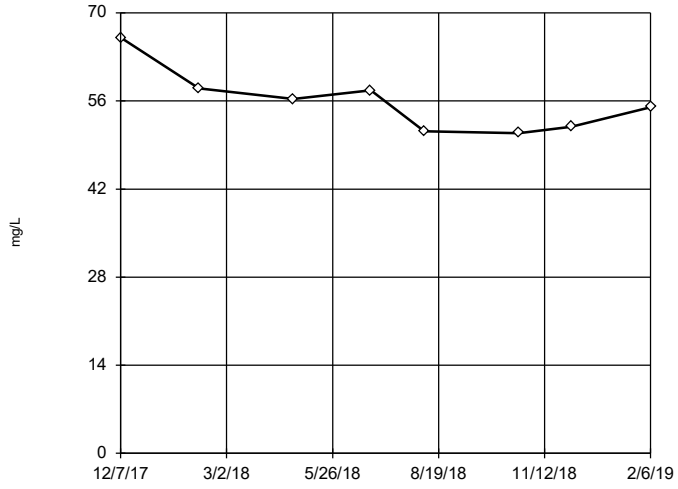
Constituent: Calcium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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 = 81.76, low cutoff = 36.47, based on IQR multiplier of 3.

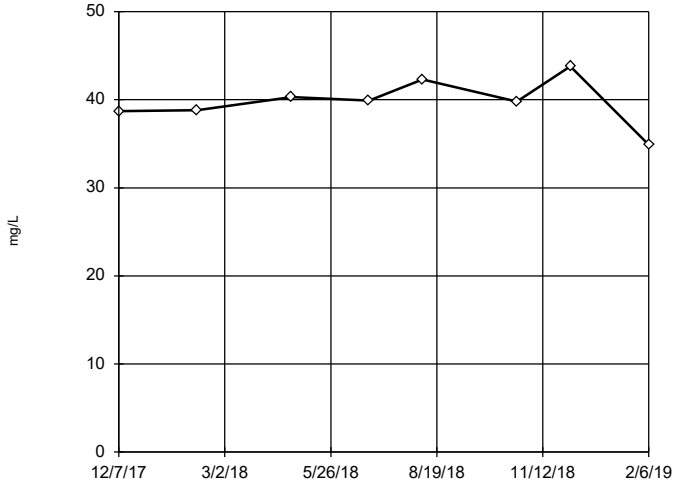
Constituent: Calcium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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 = 47.58, low cutoff = 27.61, based on IQR multiplier of 3.

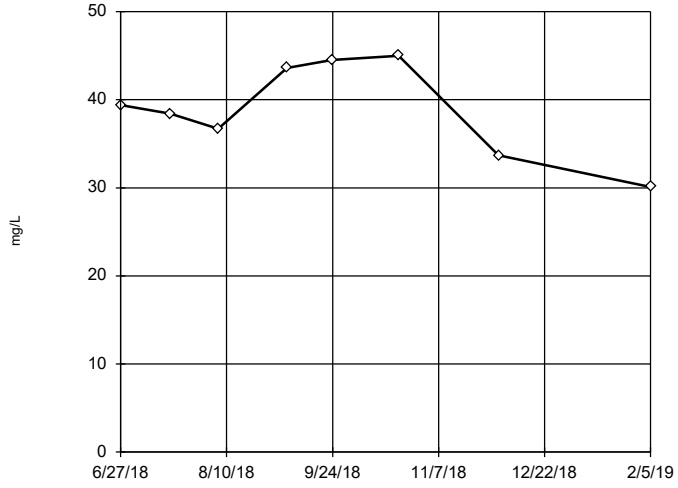
Constituent: Calcium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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 = 63.55, low cutoff = -29.27, based on IQR multiplier of 3.

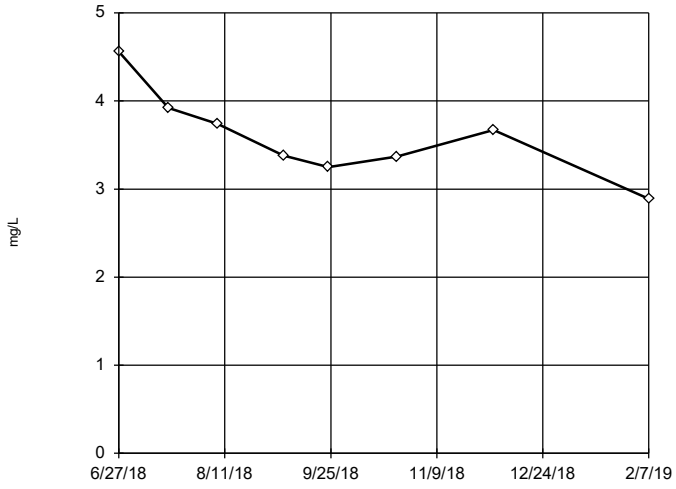
Constituent: Calcium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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 = 5.93, low cutoff = 2.137, based on IQR multiplier of 3.

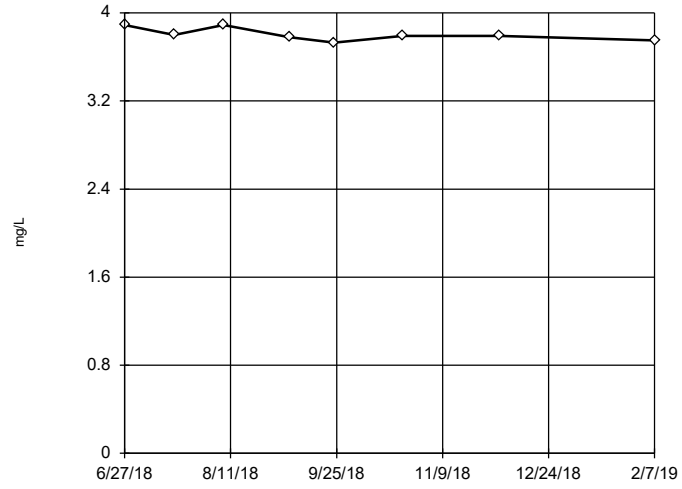
Constituent: Calcium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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 = 4.094, low cutoff = 3.535, based on IQR multiplier of 3.

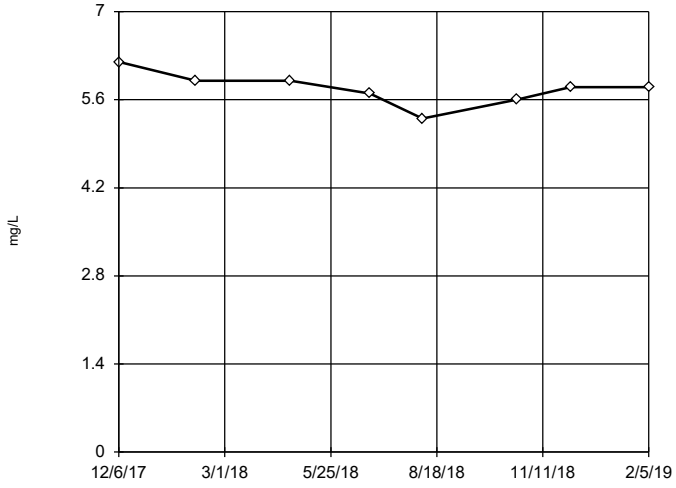
Constituent: Calcium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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 = 6.544, low cutoff = 4.725, based on IQR multiplier of 3.

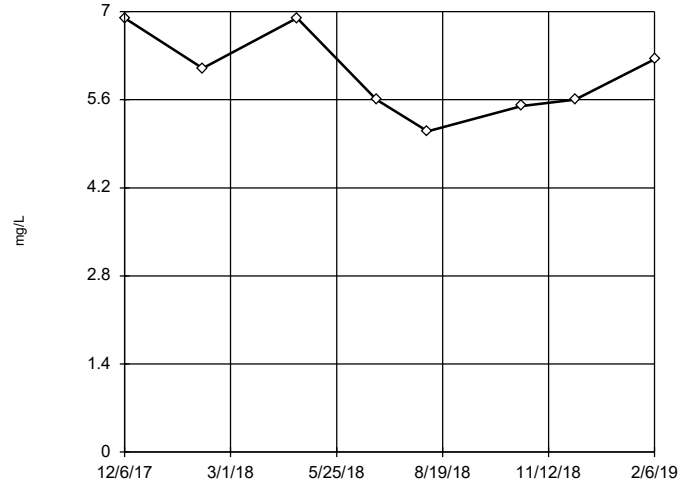
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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 = 10.85, low cutoff = 3.358, based on IQR multiplier of 3.

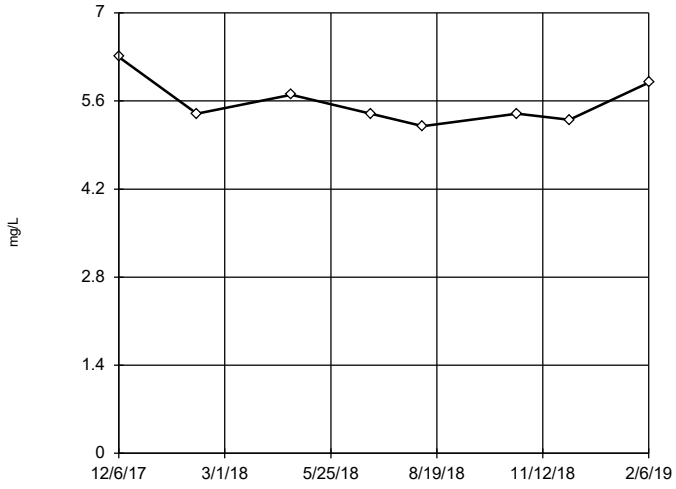
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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 = 7.362, low cutoff = 4.211, based on IQR multiplier of 3.

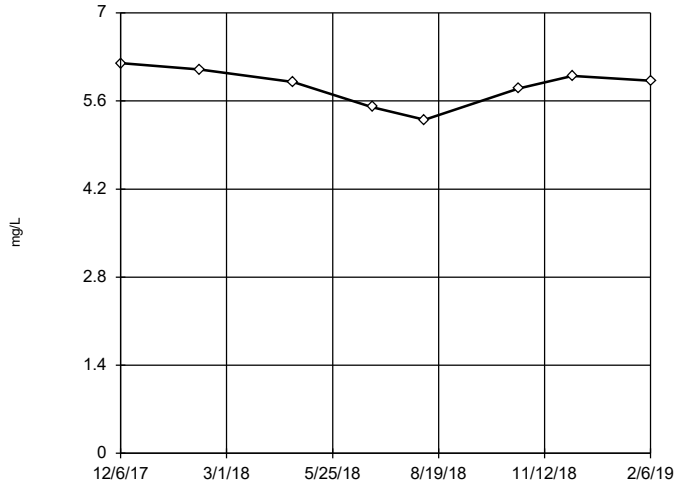
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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 = 6.787, low cutoff = -5.007, based on IQR multiplier of 3.

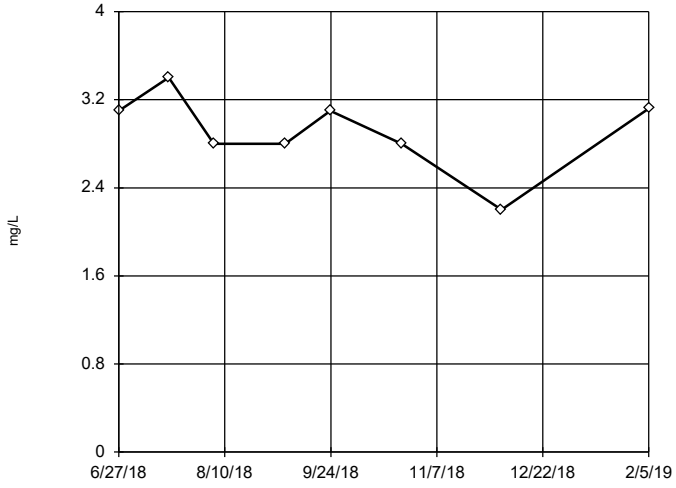
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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 = 3.712, low cutoff = -2.429, based on IQR multiplier of 3.

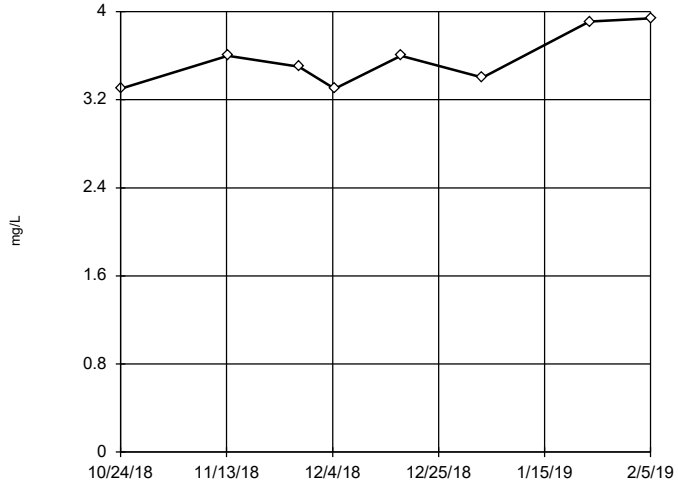
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 5.272, low cutoff = 2.384, based on IQR multiplier of 3.

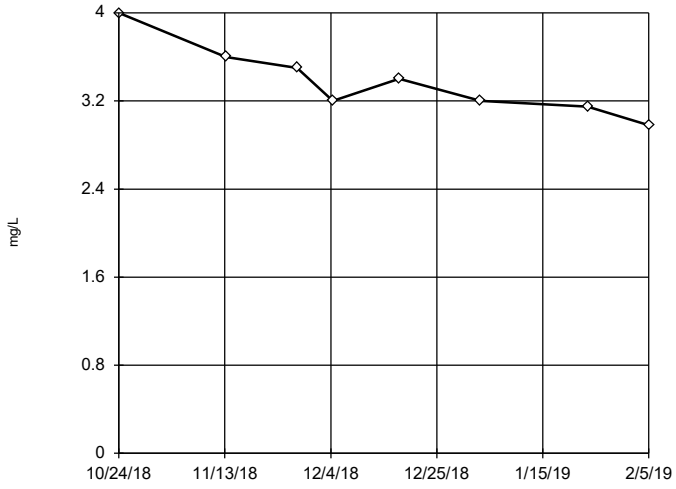
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-17 (bg)




n = 8

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 = 4.961, low cutoff = 2.272, based on IQR multiplier of 3.

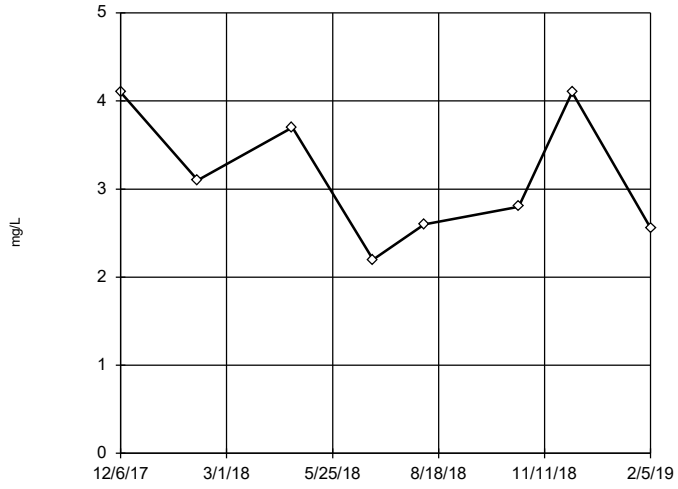
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-2




n = 8

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 = 13.4, low cutoff = 0.7498, based on IQR multiplier of 3.

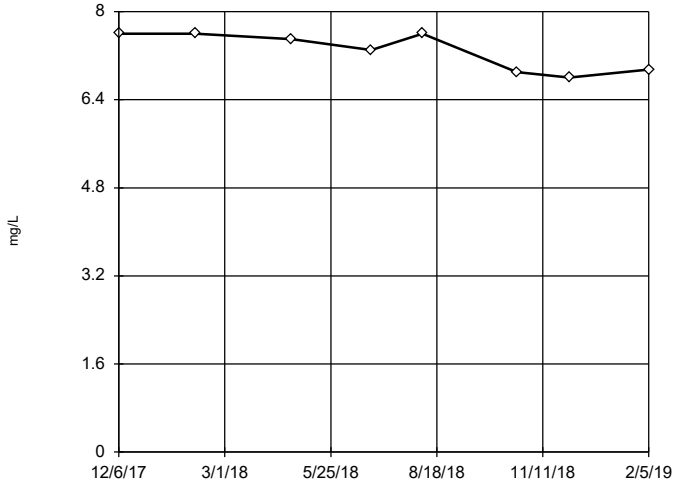
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-3




n = 8

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 = 8.721, low cutoff = -7.179, based on IQR multiplier of 3.

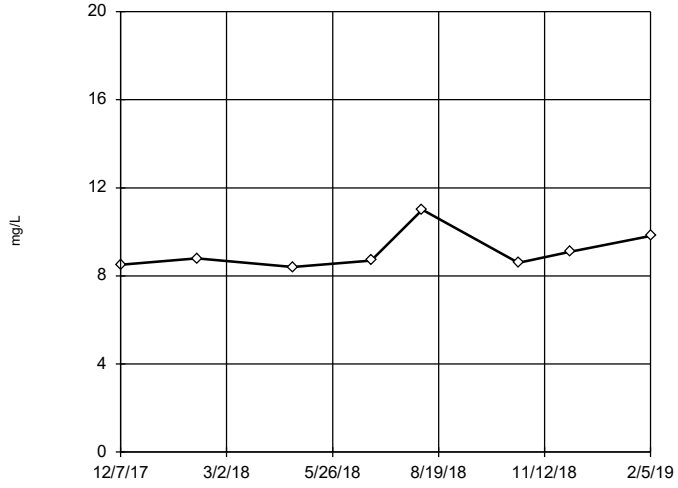
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-4




n = 8

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 = 12.75, low cutoff = 6.335, based on IQR multiplier of 3.

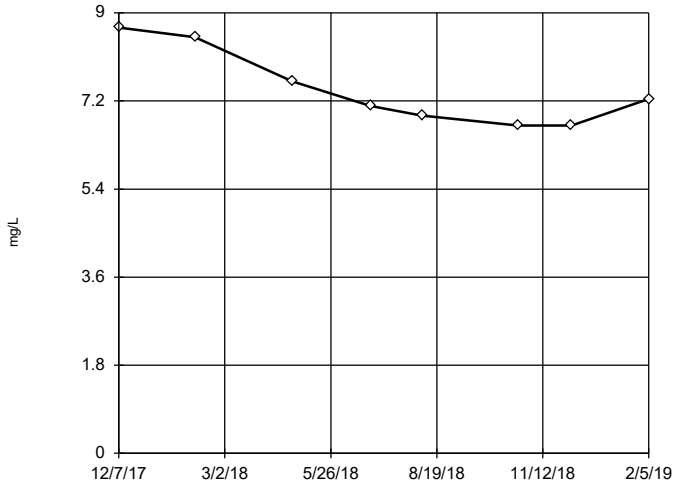
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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 = 13.28, low cutoff = 4.116, based on IQR multiplier of 3.

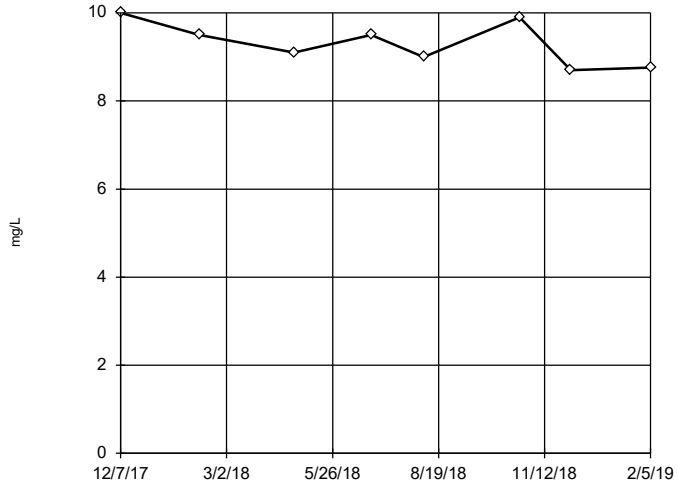
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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 = 12.64, low cutoff = 6.815, based on IQR multiplier of 3.

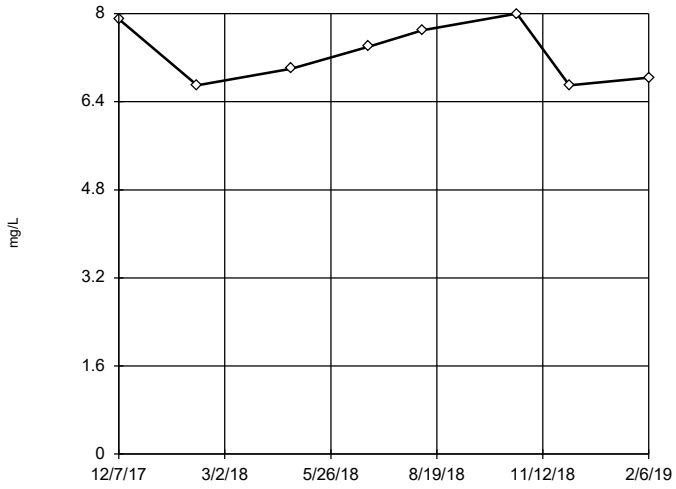
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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 = 11.93, low cutoff = 4.427, based on IQR multiplier of 3.

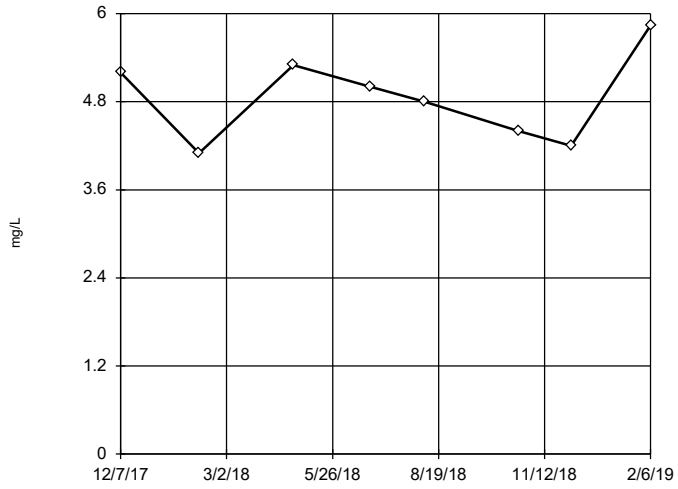
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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 = 8.67, low cutoff = 2.017, based on IQR multiplier of 3.

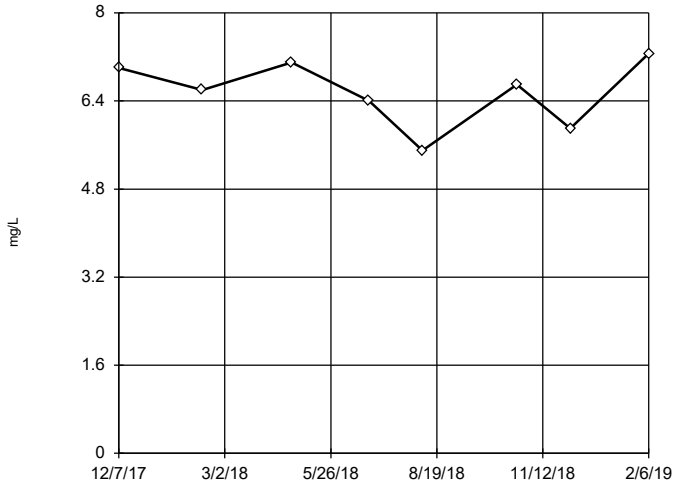
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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 = 8.292, low cutoff = -7.263, based on IQR multiplier of 3.

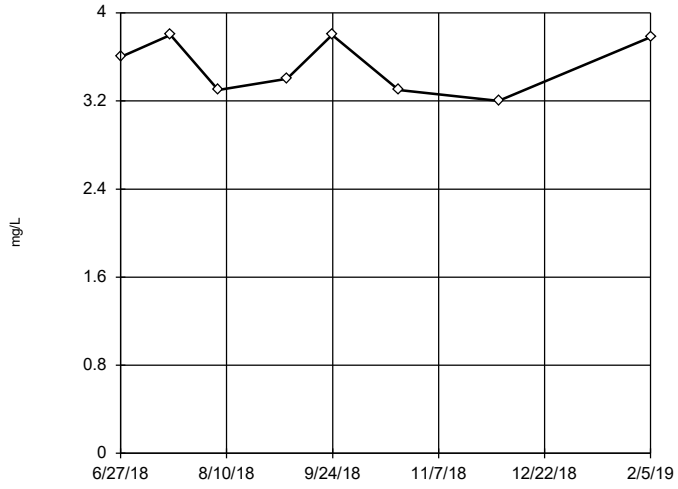
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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 = 5.741, low cutoff = 2.178, based on IQR multiplier of 3.

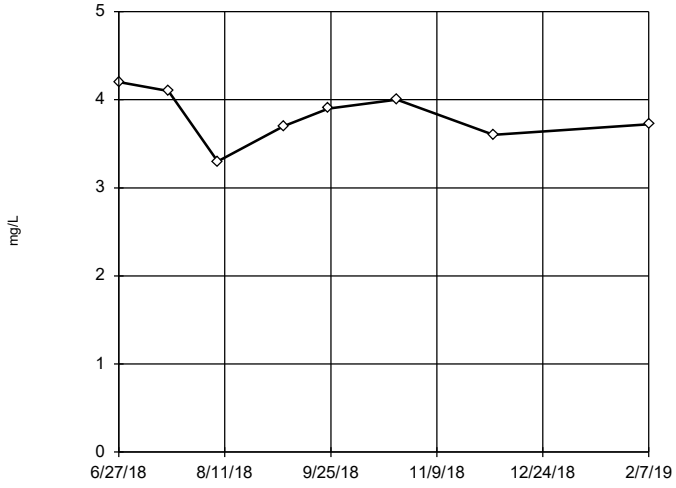
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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 = 4.83, low cutoff = -3.139, based on IQR multiplier of 3.

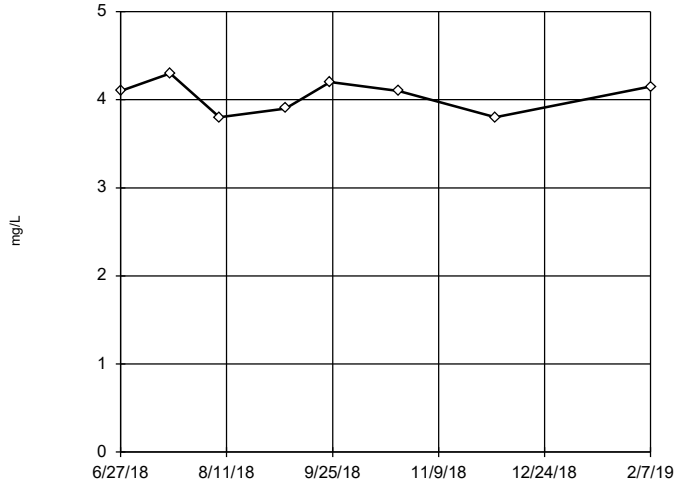
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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 = 4.744, low cutoff = -3.762, based on IQR multiplier of 3.

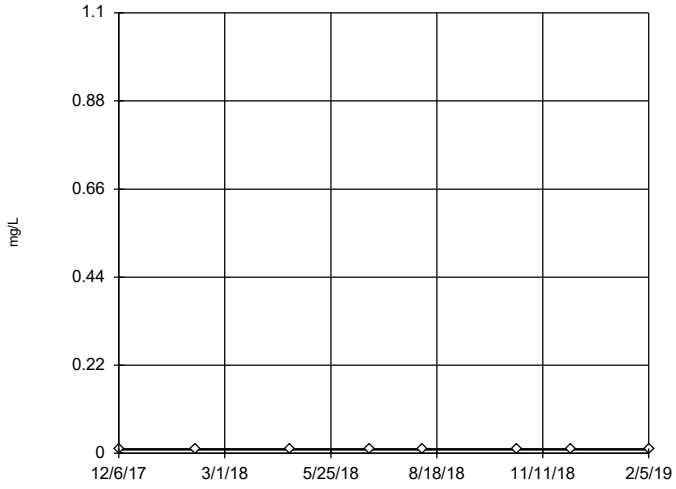
Constituent: Chloride Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

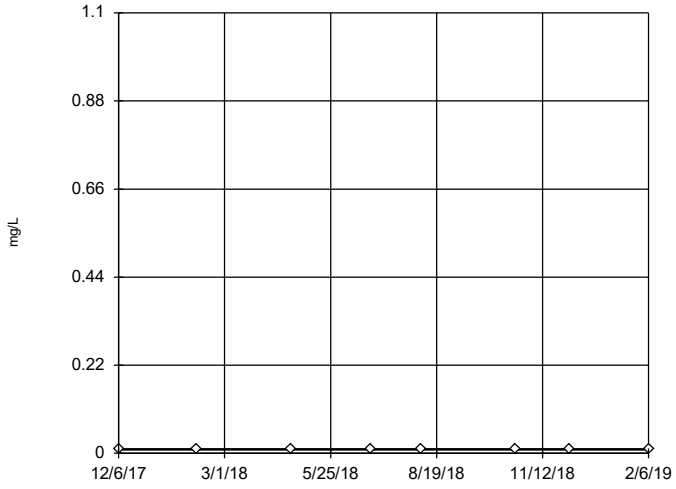
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

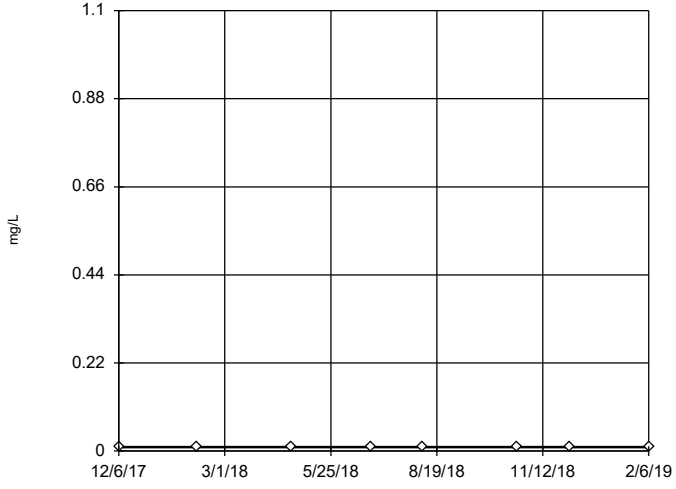
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

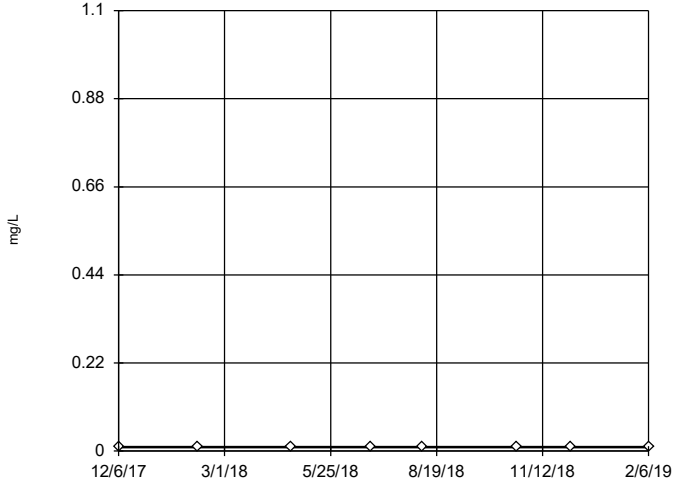
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

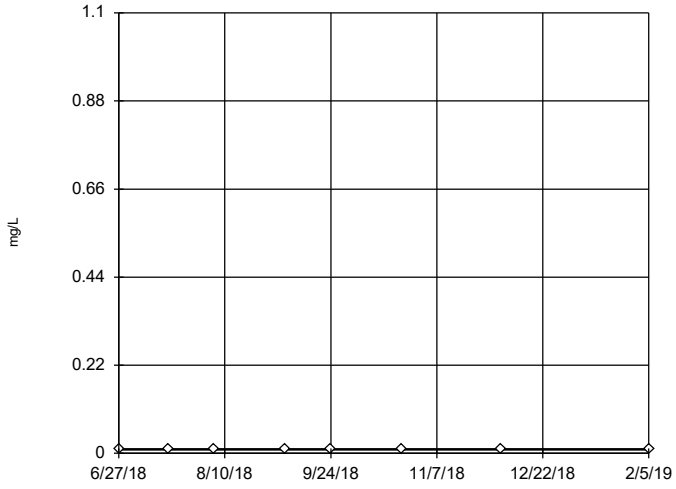
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-14 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

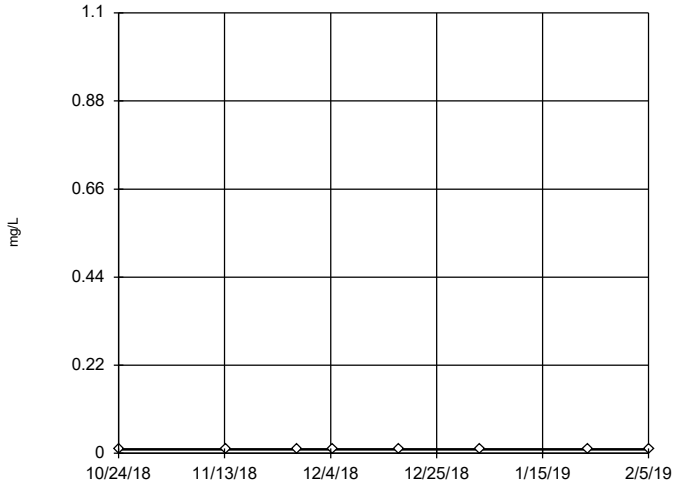
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-16 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

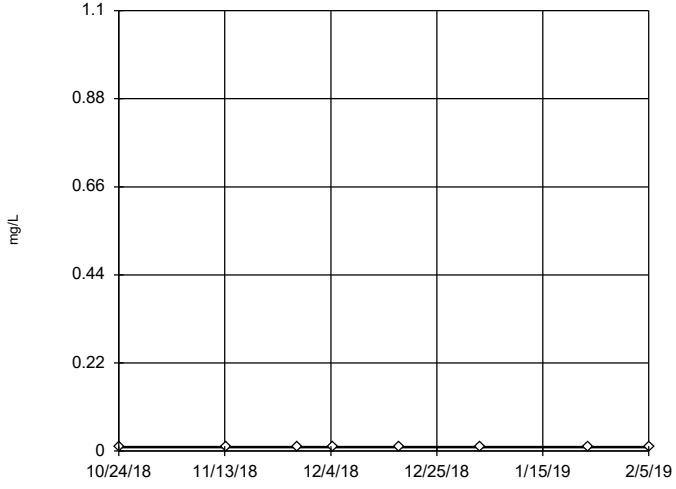
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

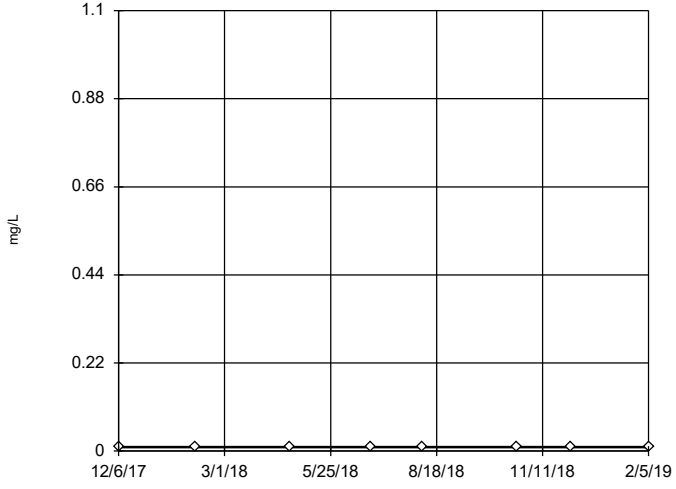
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-2




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

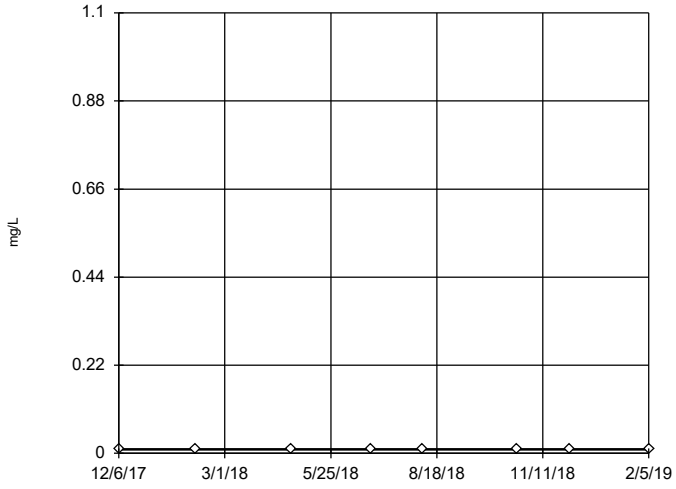
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

No outliers found.
Tukey's method select-
ed by user.

Data were cube root trans-
formed to achieve best
W statistic (graph shown
in original units).

The results were invalid-
ated, because the lower
and upper quartiles are
equal.

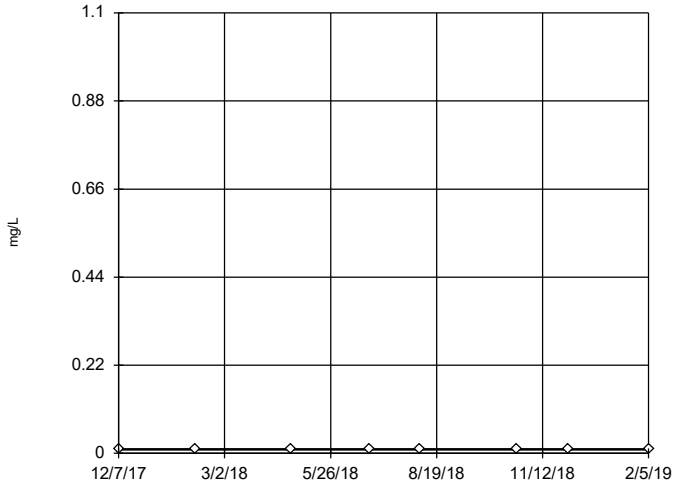
Constituent: Chromium  Analysis Run 4/2/2019 2:56 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

No outliers found.
Tukey's method select-
ed by user.

Data were cube root trans-
formed to achieve best
W statistic (graph shown
in original units).

The results were invalid-
ated, because the lower
and upper quartiles are
equal.

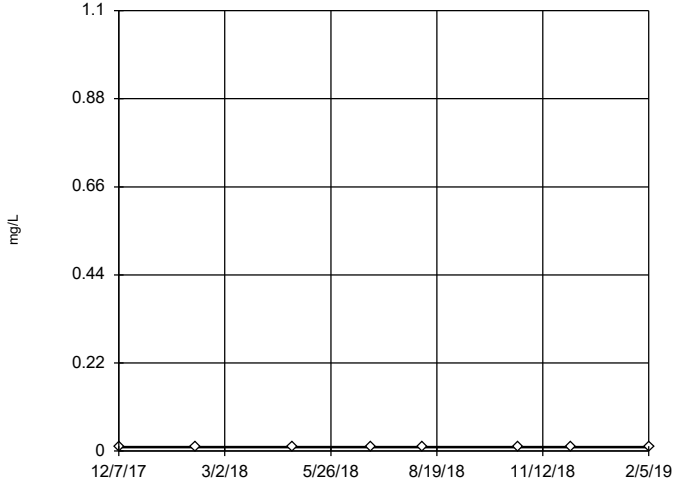
Constituent: Chromium  Analysis Run 4/2/2019 2:56 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

No outliers found.
Tukey's method select-
ed by user.

Data were cube root trans-
formed to achieve best
W statistic (graph shown
in original units).

The results were invalid-
ated, because the lower
and upper quartiles are
equal.

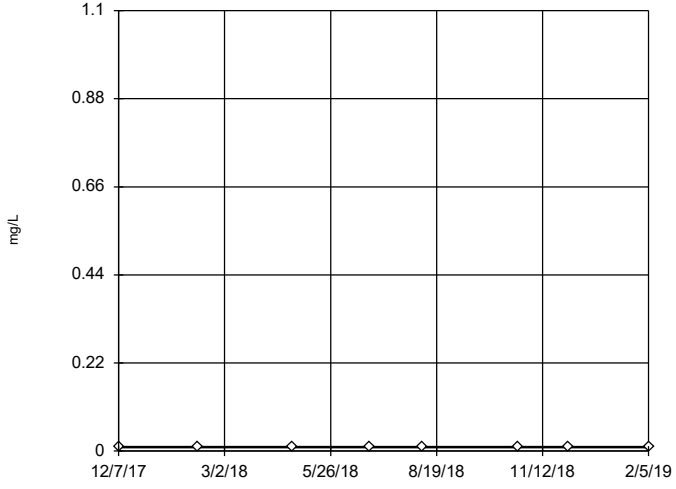
Constituent: Chromium  Analysis Run 4/2/2019 2:56 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

No outliers found.
Tukey's method select-
ed by user.

Data were cube root trans-
formed to achieve best
W statistic (graph shown
in original units).

The results were invalid-
ated, because the lower
and upper quartiles are
equal.

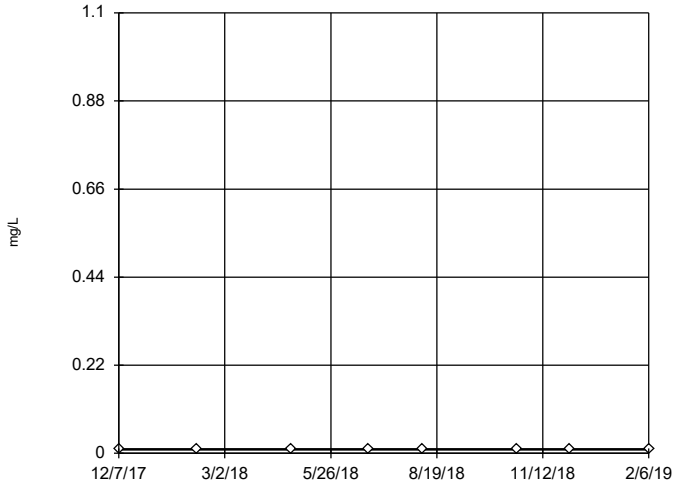
Constituent: Chromium  Analysis Run 4/2/2019 2:56 PM  View: Descriptive

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

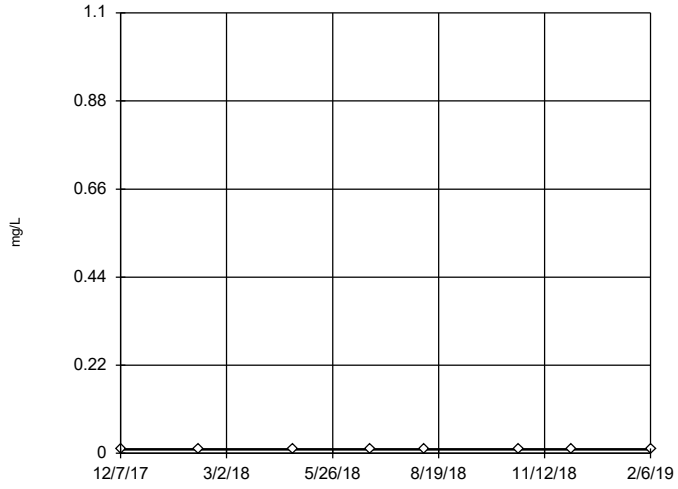
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

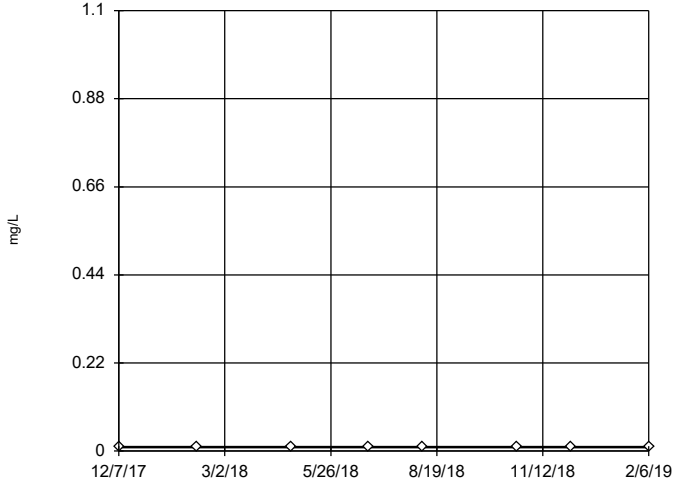
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

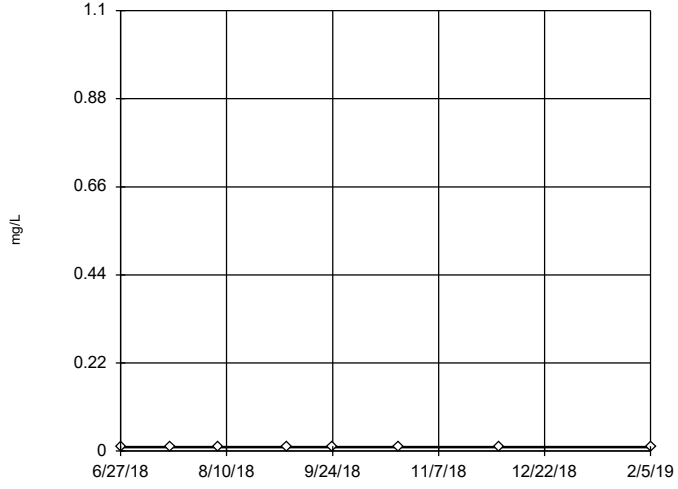
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

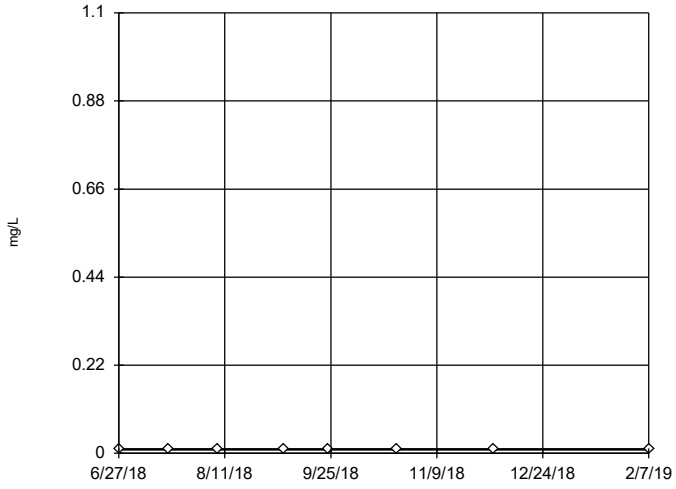
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

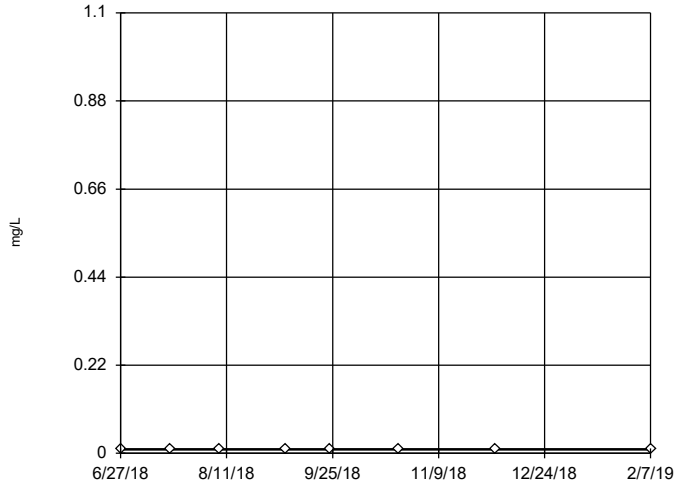
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

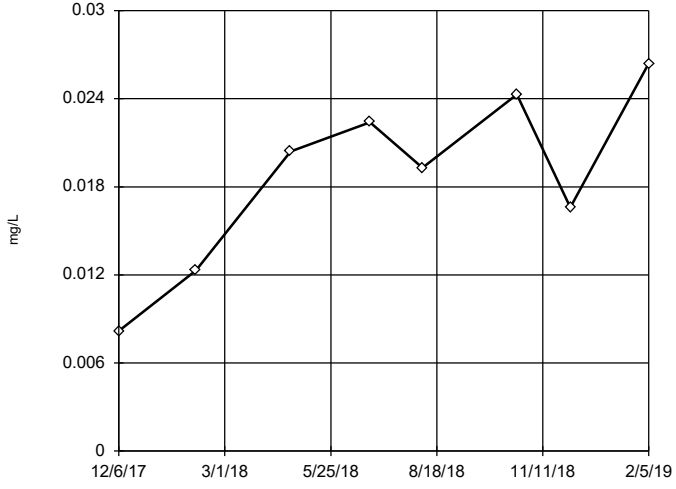
Constituent: Chromium Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-1




n = 8

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 = 0.0393, low cutoff = -0.02801, based on IQR multiplier of 3.

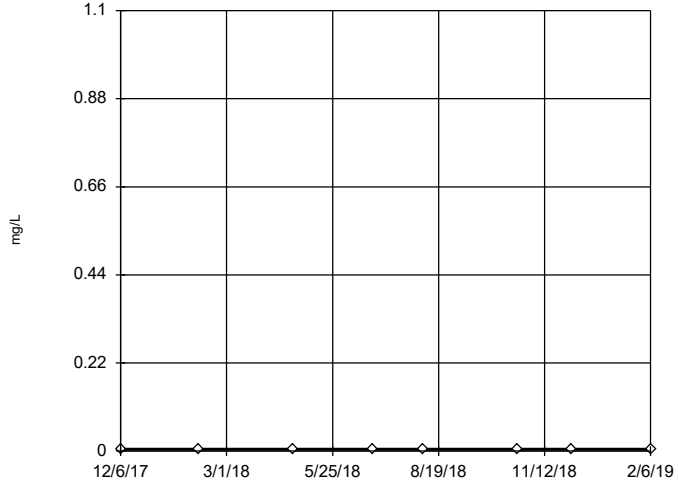
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

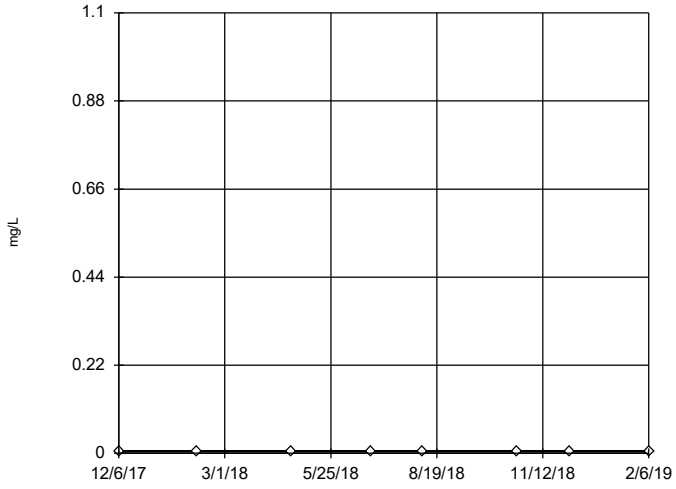
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

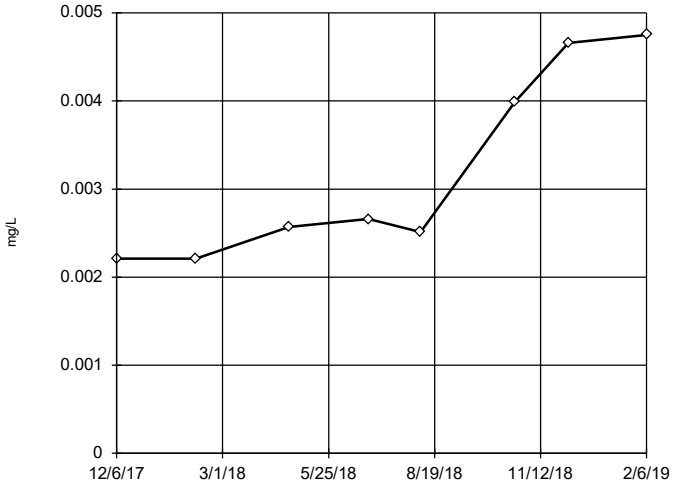
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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 = 0.02646, low cutoff = 0.0003838, based on IQR multiplier of 3.

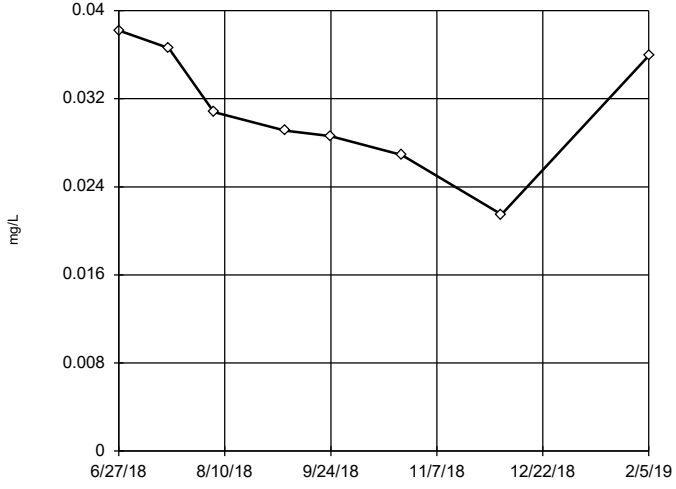
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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

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

High cutoff = 0.06175, low cutoff = 0.00225, based on IQR multiplier of 3.

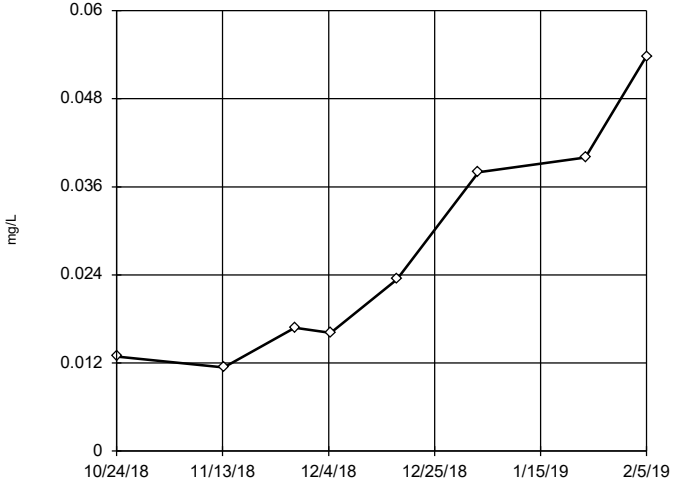
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 0.7719, low cutoff = 0.0007279, based on IQR multiplier of 3.

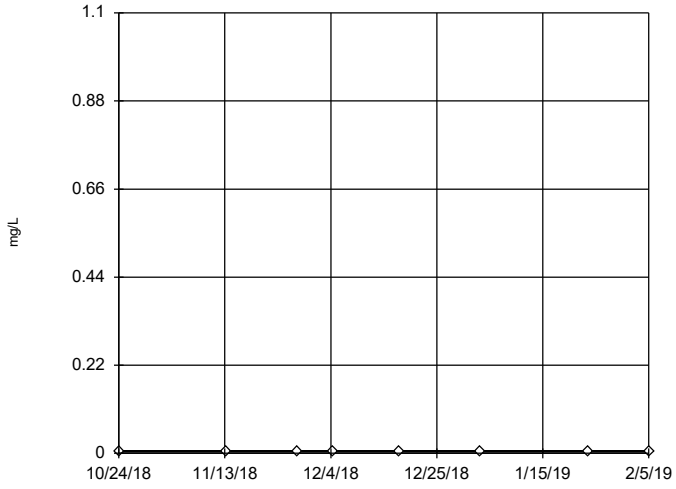
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

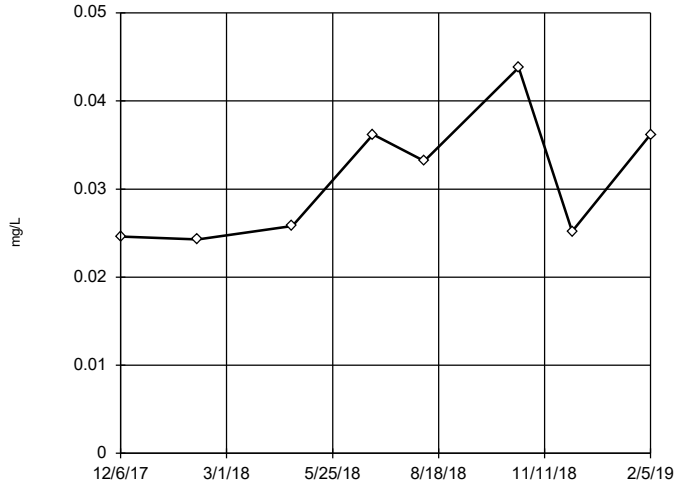
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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

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

High cutoff = 0.08943, low cutoff = 0.005416, based on IQR multiplier of 3.

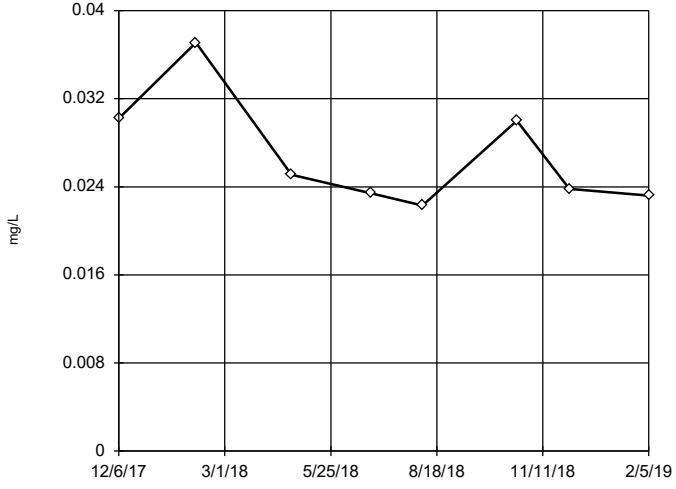
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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 = 0.06489, low cutoff = 0.01081, based on IQR multiplier of 3.

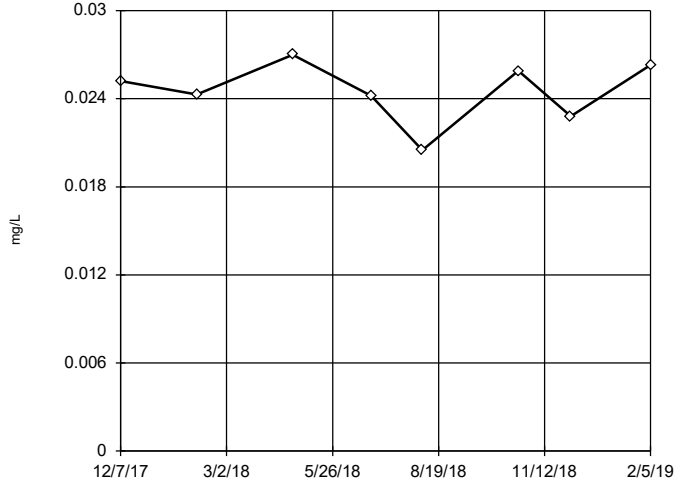
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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 = 0.03017, low cutoff = -0.02537, based on IQR multiplier of 3.

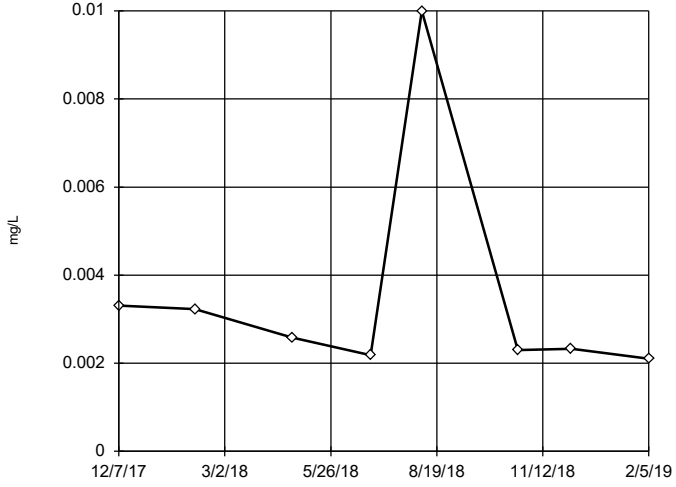
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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 = 0.01018, low cutoff = 0.0007192, based on IQR multiplier of 3.

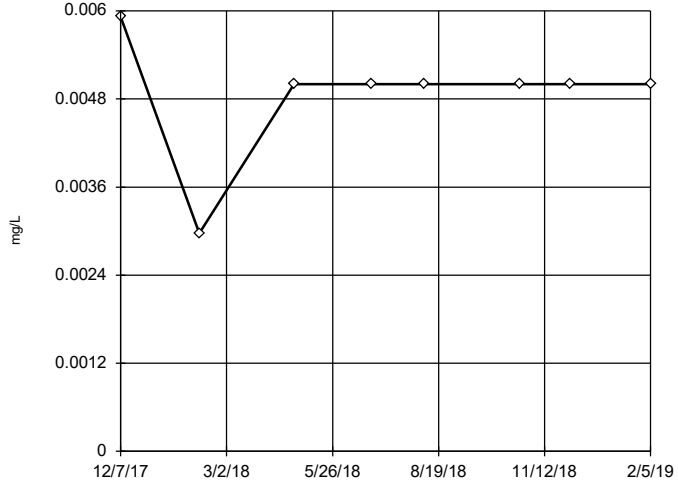
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

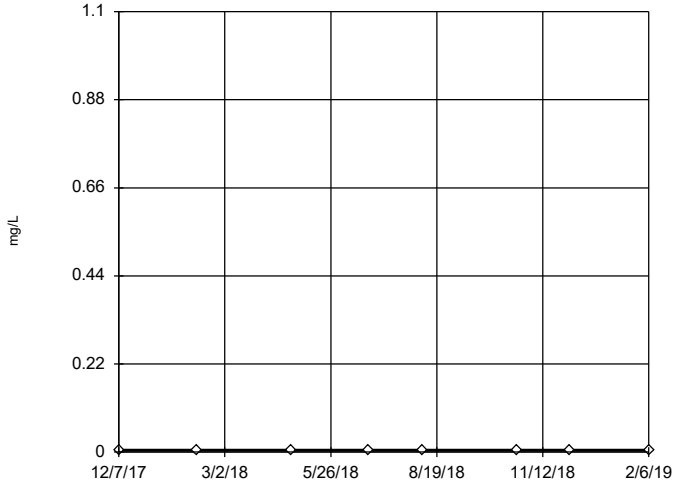
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

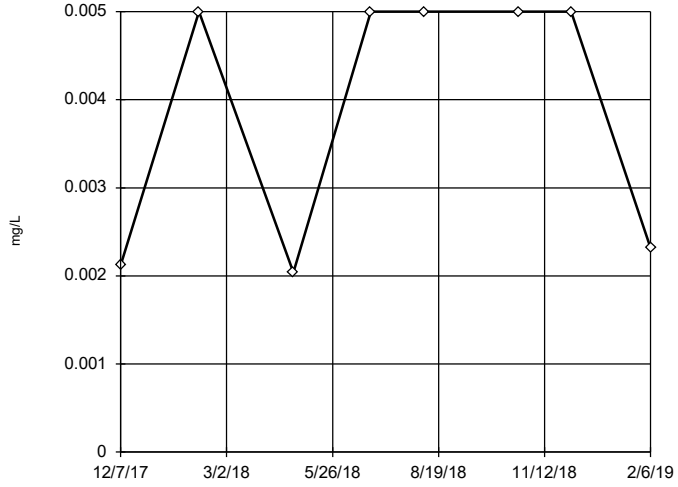
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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 = 0.0573, low cutoff = 0.0001935, based on IQR multiplier of 3.

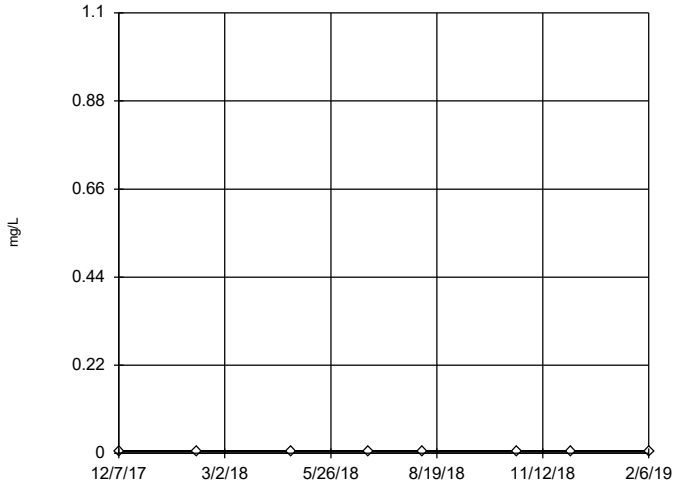
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

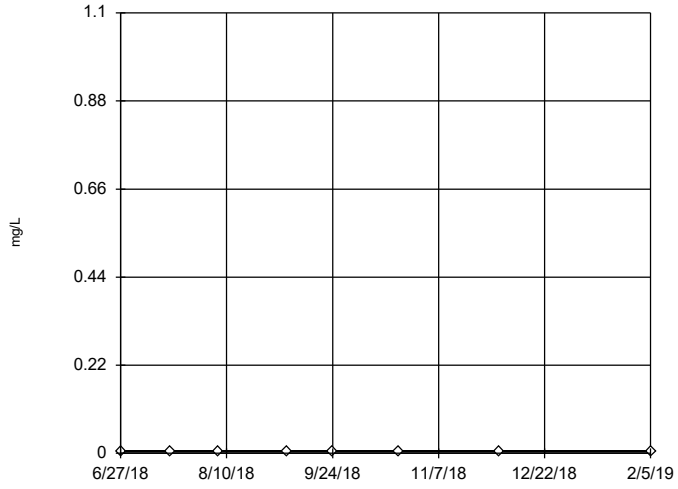
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

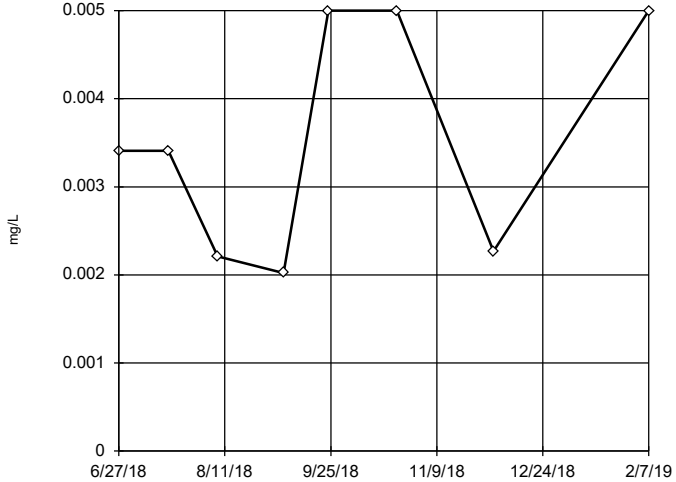
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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 = 0.05562, low cutoff = 0.0002013, based on IQR multiplier of 3.

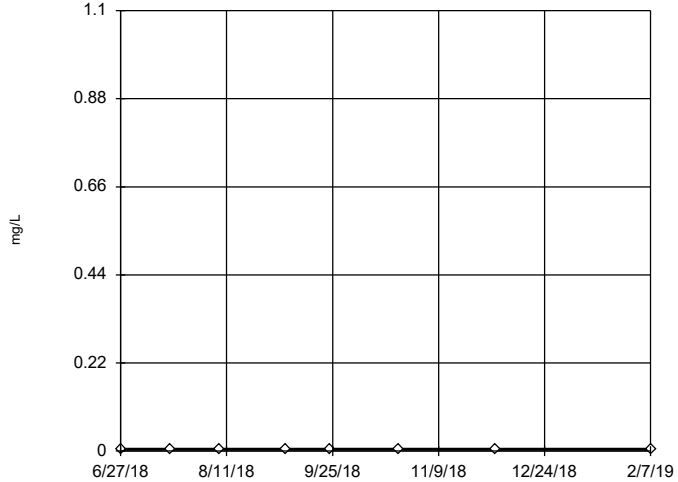
Constituent: Cobalt Analysis Run 4/2/2019 2:56 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

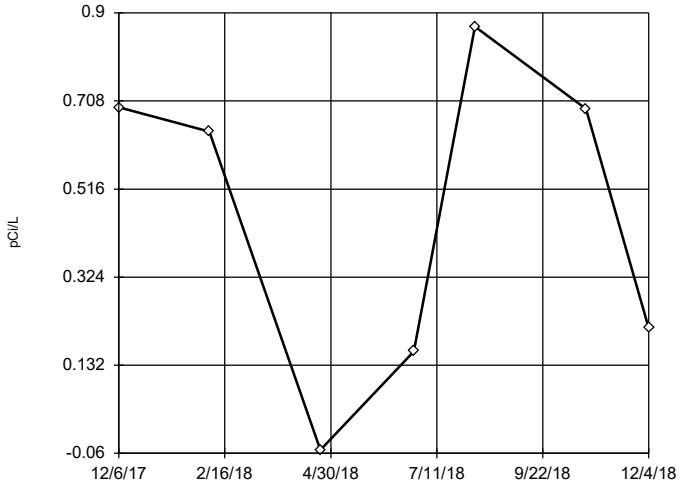
Constituent: Cobalt Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 7

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

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

High cutoff = 2.29, low cutoff = -1.434, based on IQR multiplier of 3.

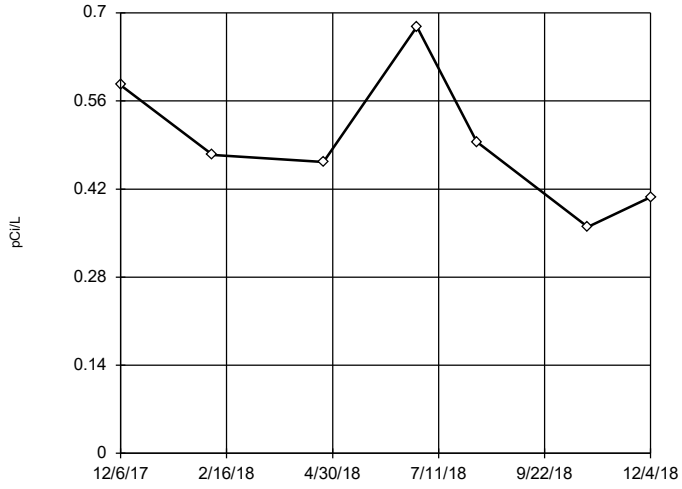
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 7

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 = 1.737, low cutoff = 0.1371, based on IQR multiplier of 3.

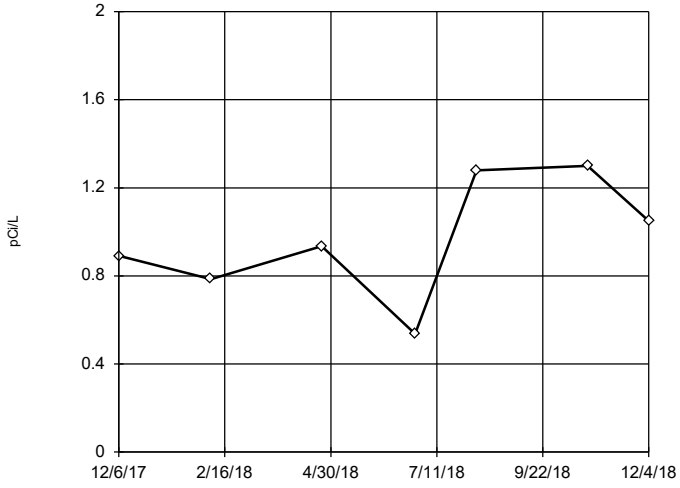
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 7

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

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

High cutoff = 2.762, low cutoff = -0.696, based on IQR multiplier of 3.

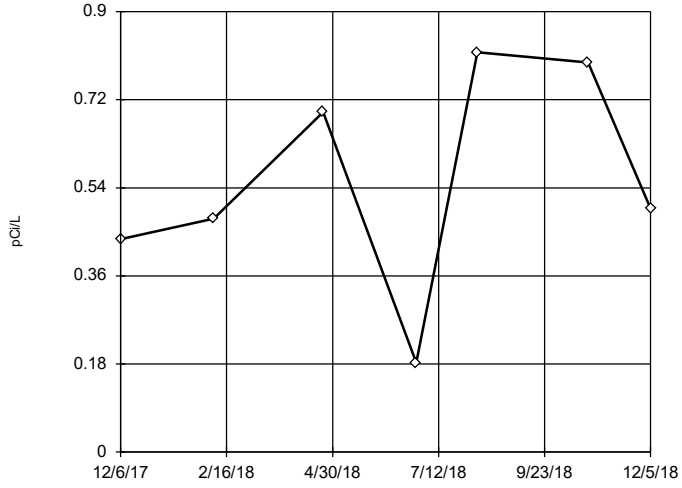
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 7

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

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

High cutoff = 1.879, low cutoff = -0.648, based on IQR multiplier of 3.

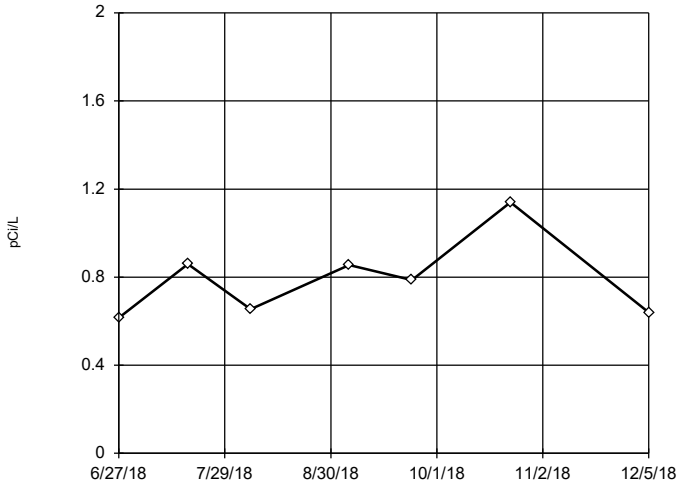
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 7

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 = 2.077, low cutoff = 0.2647, based on IQR multiplier of 3.

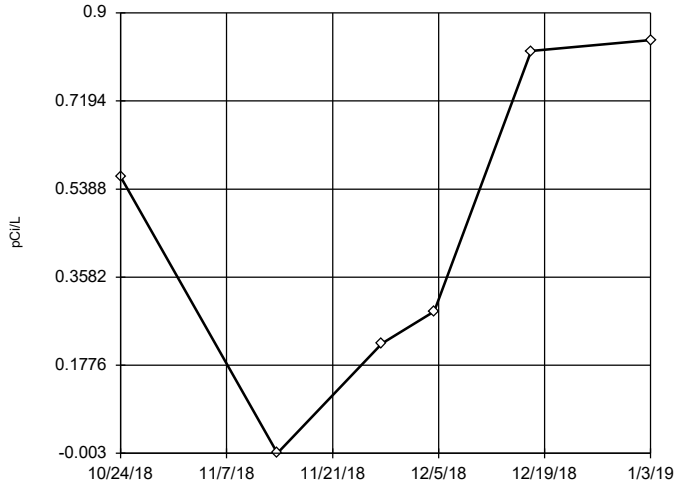
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 6

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

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

High cutoff = 3.003, low cutoff = -2.06, based on IQR multiplier of 3.

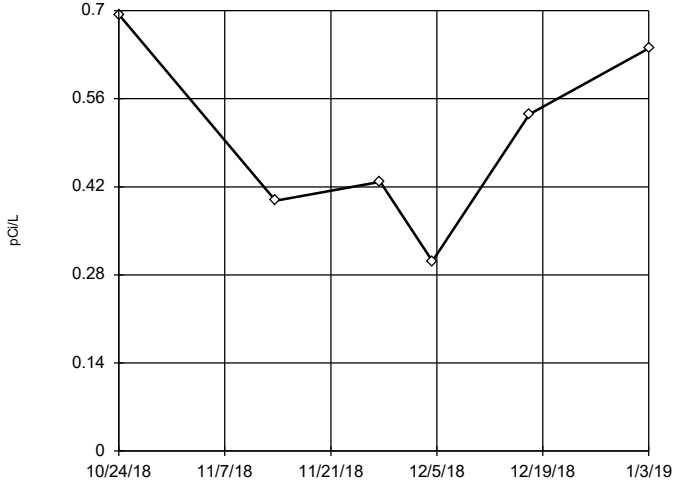
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 6

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 = 2.237, low cutoff = -0.007879, based on IQR multiplier of 3.

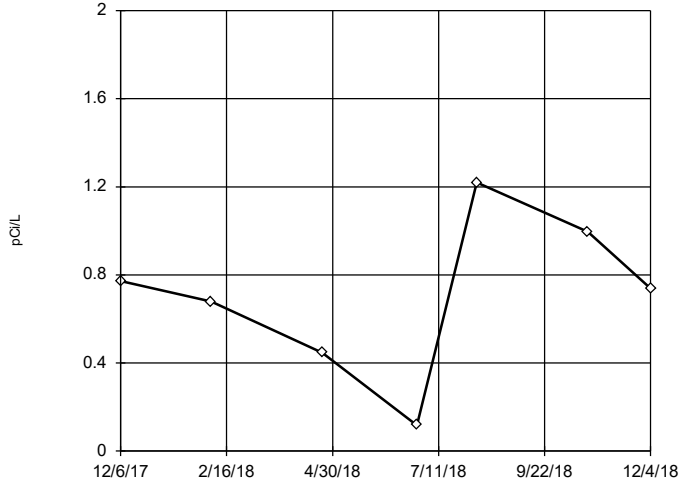
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 7

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

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

High cutoff = 2.643, low cutoff = -1.2, based on IQR multiplier of 3.

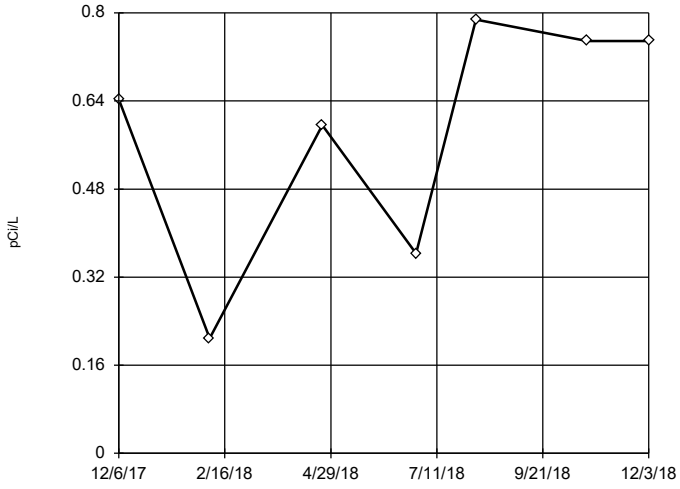
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 7

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 = 1.154, low cutoff = -1.023, based on IQR multiplier of 3.

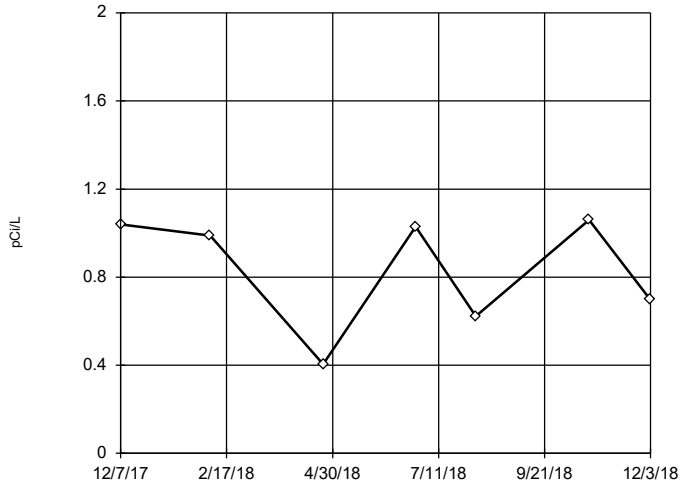
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 7

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 = 1.779, low cutoff = -1.303, based on IQR multiplier of 3.

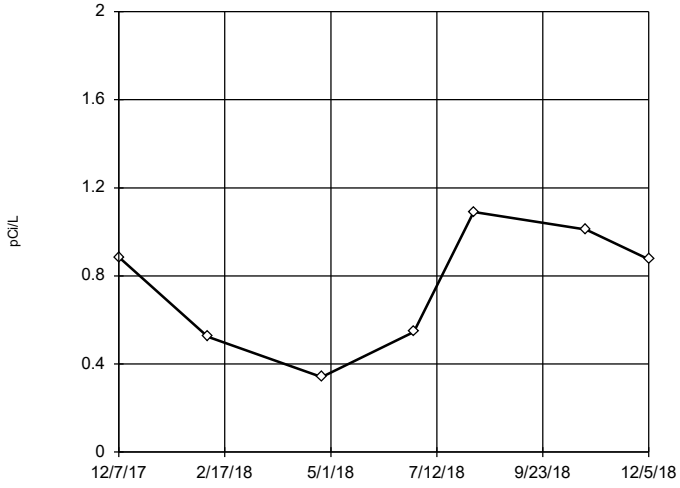
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 7

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 = 1.805, low cutoff = -1.401, based on IQR multiplier of 3.

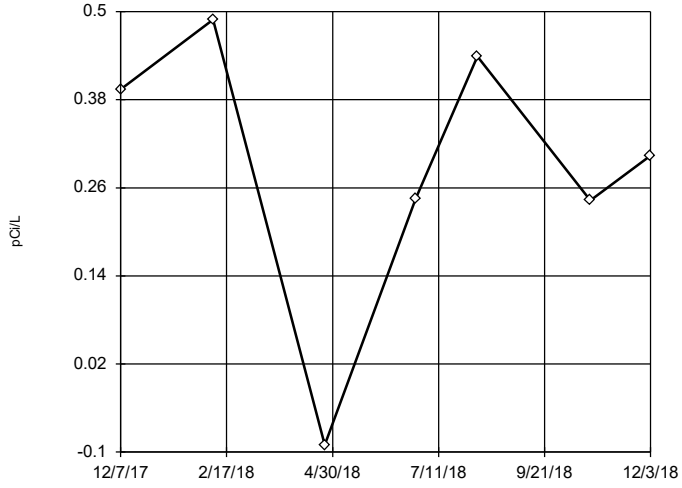
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 7

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 = 0.7705, low cutoff = -0.5848, based on IQR multiplier of 3.

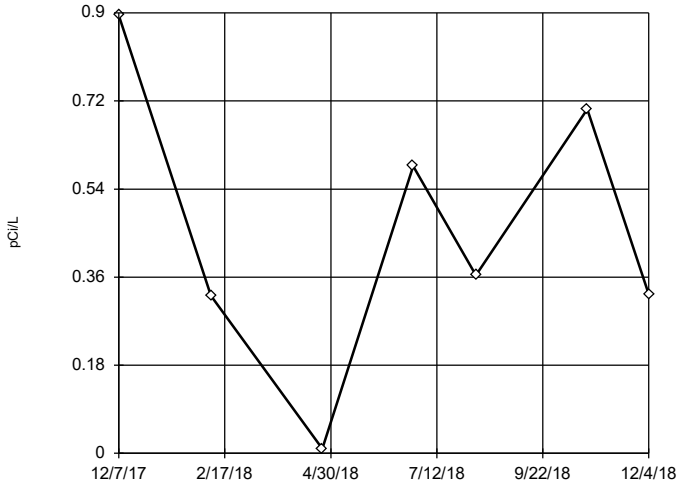
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 7

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

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

High cutoff = 1.846, low cutoff = -0.821, based on IQR multiplier of 3.

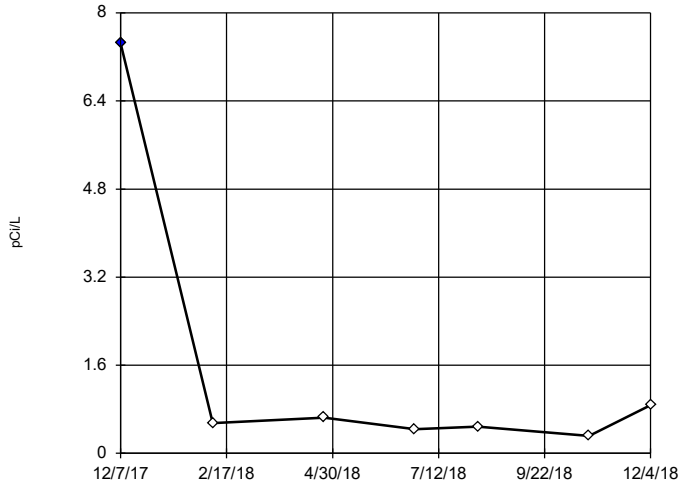
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 7

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 = 7.072, low cutoff = 0.05394, based on IQR multiplier of 3.

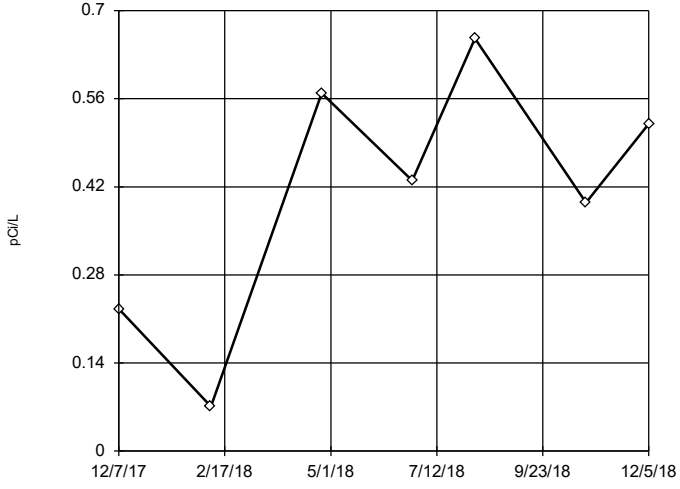
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 7

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 = 1.069, low cutoff = -0.8758, based on IQR multiplier of 3.

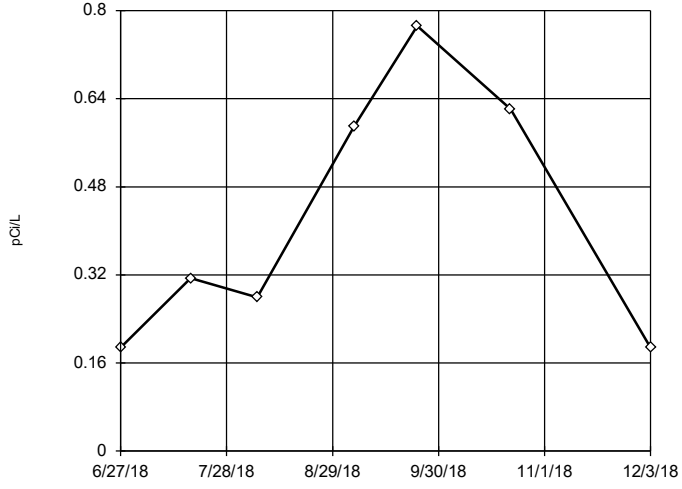
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 7

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 = 22.38, low cutoff = 0.005216, based on IQR multiplier of 3.

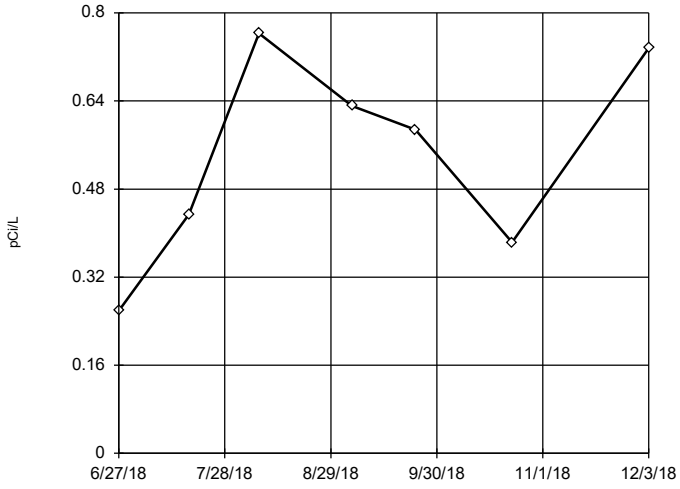
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 7

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

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

High cutoff = 1.795, low cutoff = -0.676, based on IQR multiplier of 3.

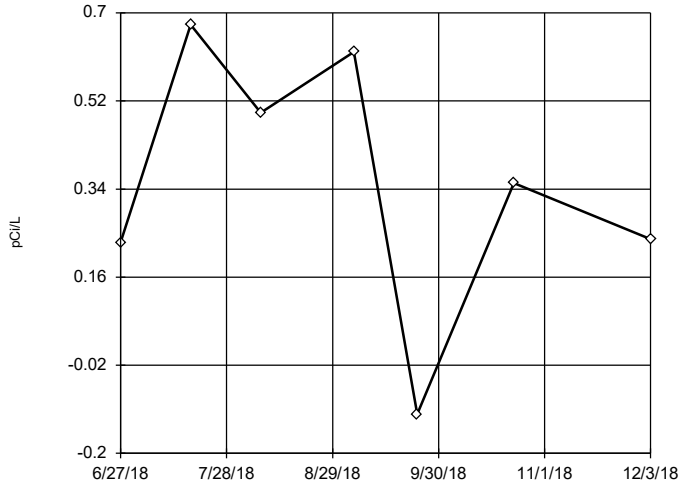
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 7

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

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

High cutoff = 1.787, low cutoff = -0.936, based on IQR multiplier of 3.

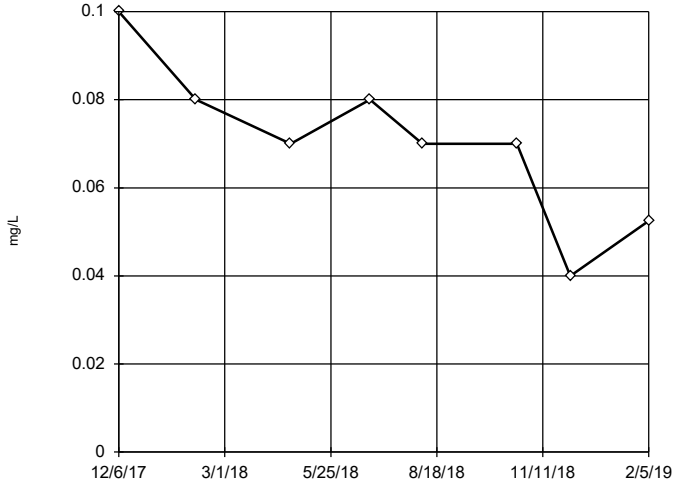
Constituent: Combined Radium 226 + 228 Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

High cutoff = 0.1363, low cutoff = 0.005, based on IQR multiplier of 3.

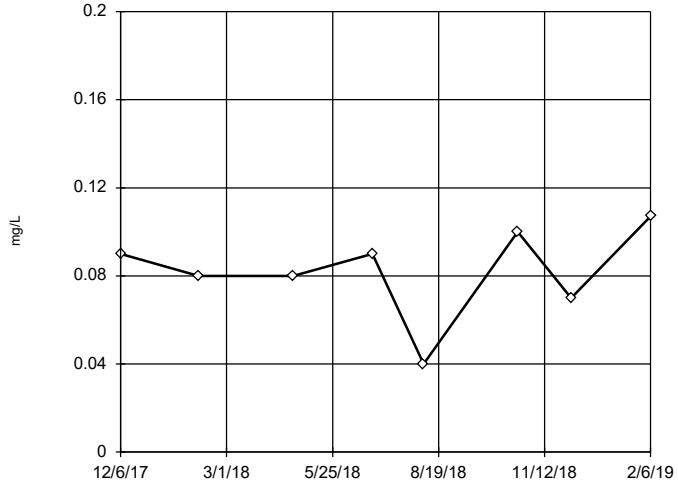
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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 = 0.1296, low cutoff = -0.09596, based on IQR multiplier of 3.

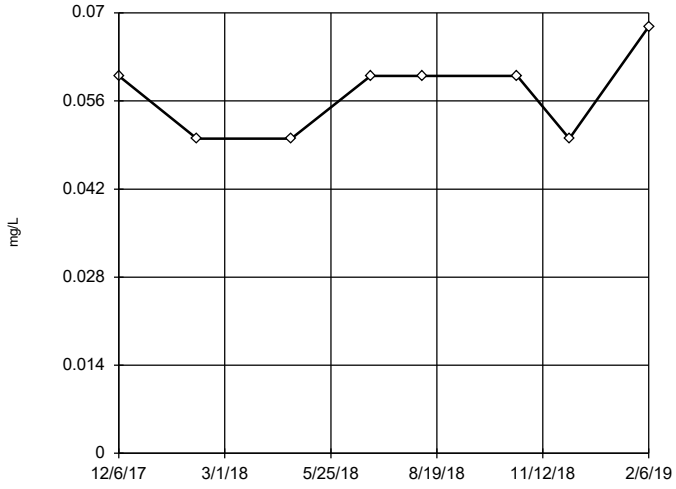
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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 = 0.07878, low cutoff = -0.0529, based on IQR multiplier of 3.

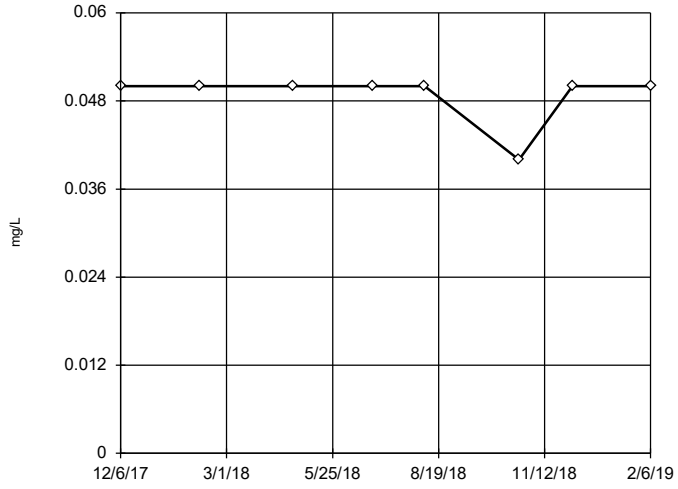
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

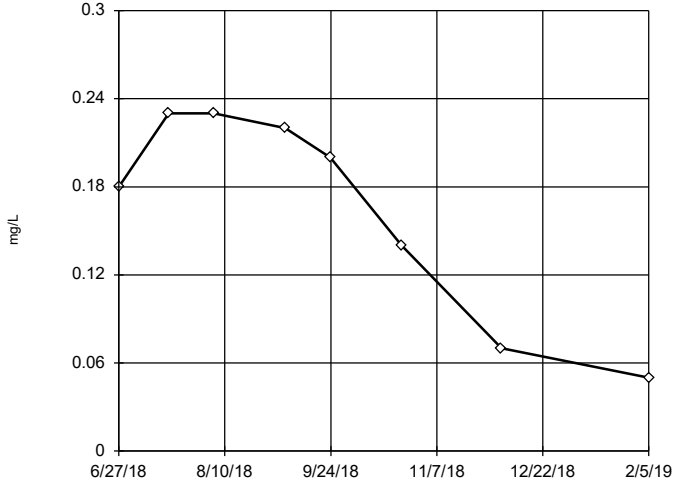
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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 = 0.3448, low cutoff = -0.3038, based on IQR multiplier of 3.

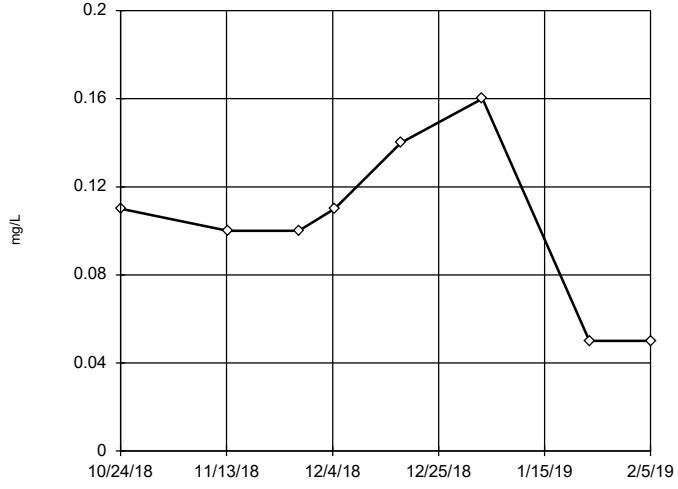
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 0.2113, low cutoff = -0.1502, based on IQR multiplier of 3.

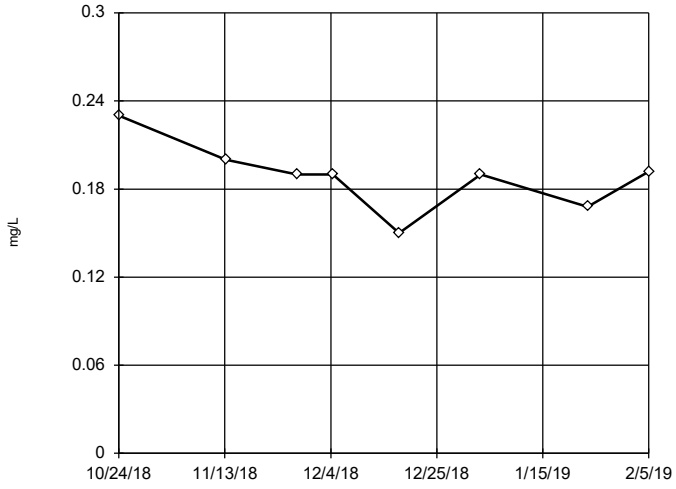
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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 = 0.2521, low cutoff = 0.1321, based on IQR multiplier of 3.

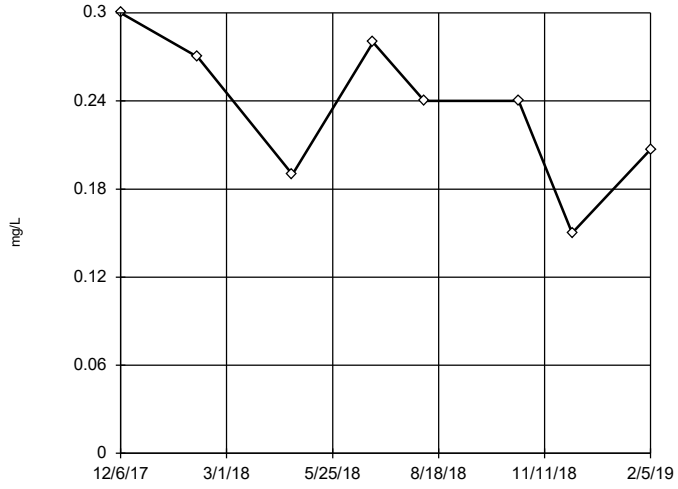
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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 = 0.4292, low cutoff = -0.2628, based on IQR multiplier of 3.

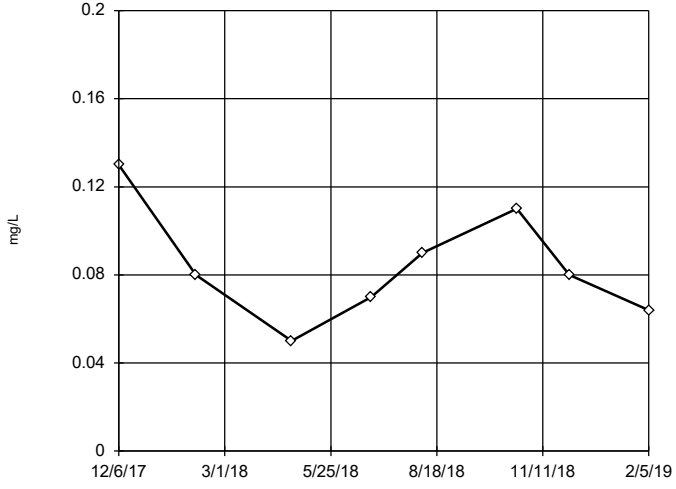
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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 = 0.3269, low cutoff = 0.02038, based on IQR multiplier of 3.

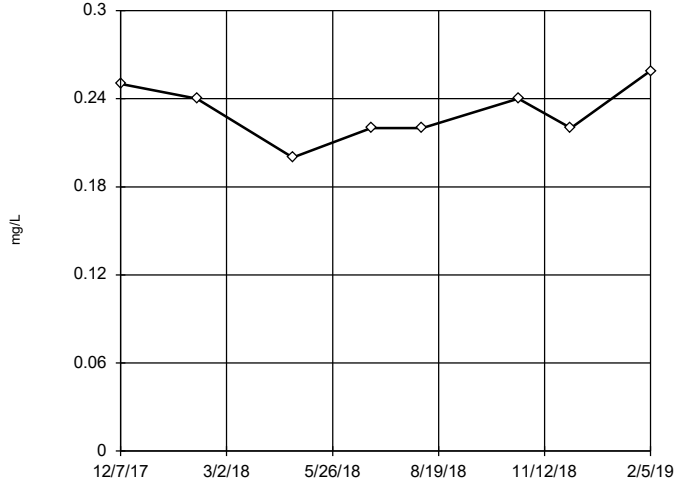
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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 = 0.3082, low cutoff = 0.116, based on IQR multiplier of 3.

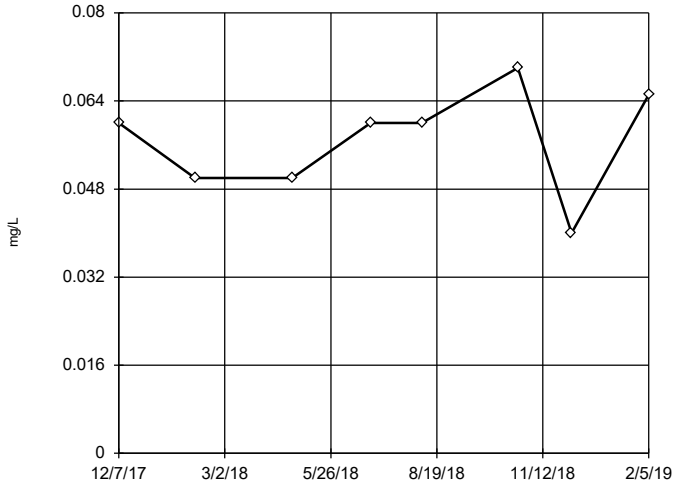
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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 = 0.08475, low cutoff = -0.06196, based on IQR multiplier of 3.

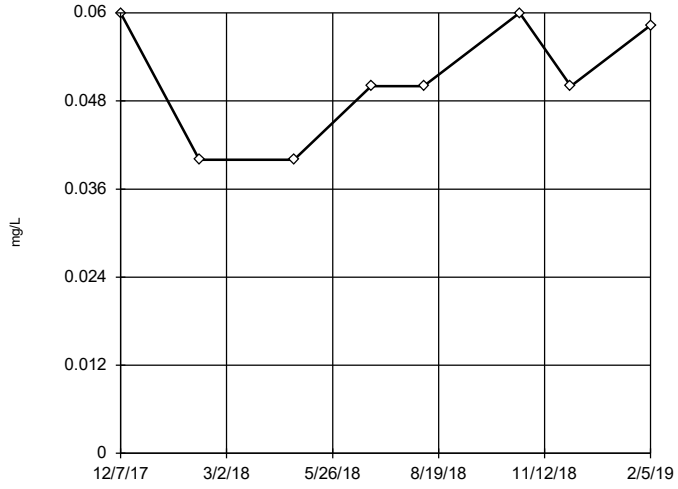
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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 = 0.08859, low cutoff = -0.04794, based on IQR multiplier of 3.

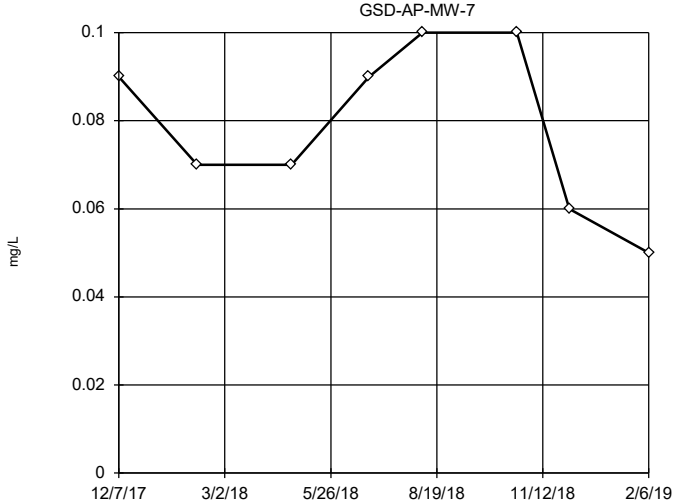
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

High cutoff = 0.185, low cutoff = -0.025, based on IQR multiplier of 3.

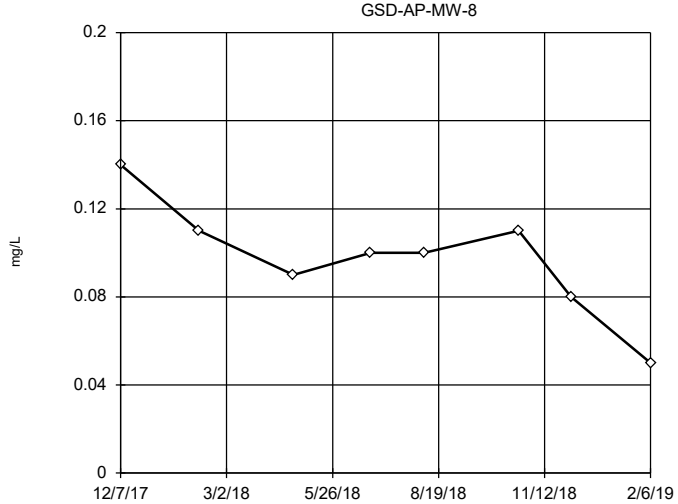
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

High cutoff = 0.185, low cutoff = 0.01, based on IQR multiplier of 3.

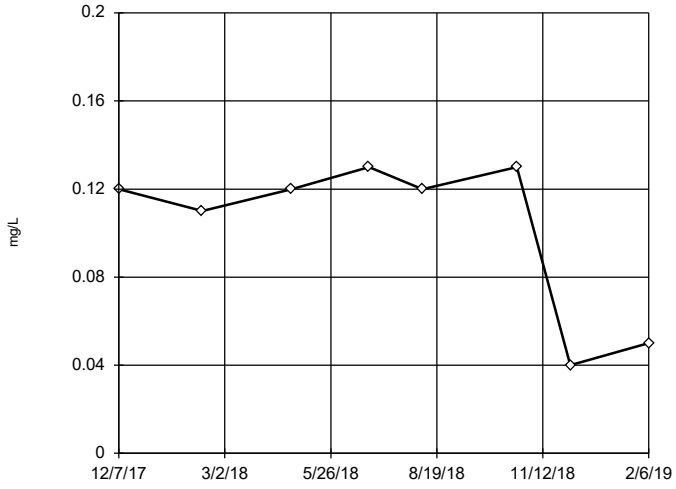
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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 = 0.1532, low cutoff = -0.1418, based on IQR multiplier of 3.

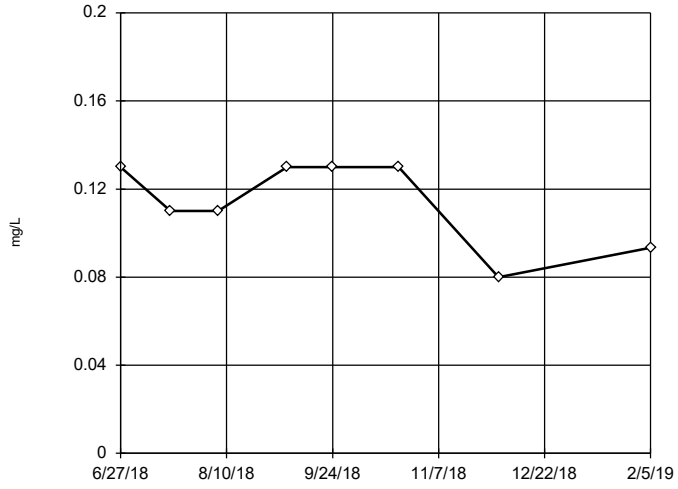
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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 = 0.1907, low cutoff = -0.09515, based on IQR multiplier of 3.

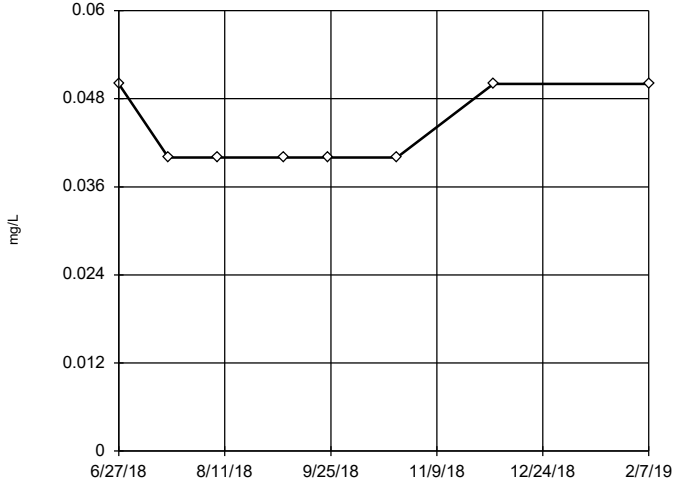
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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 = 0.06074, low cutoff = -0.05589, based on IQR multiplier of 3.

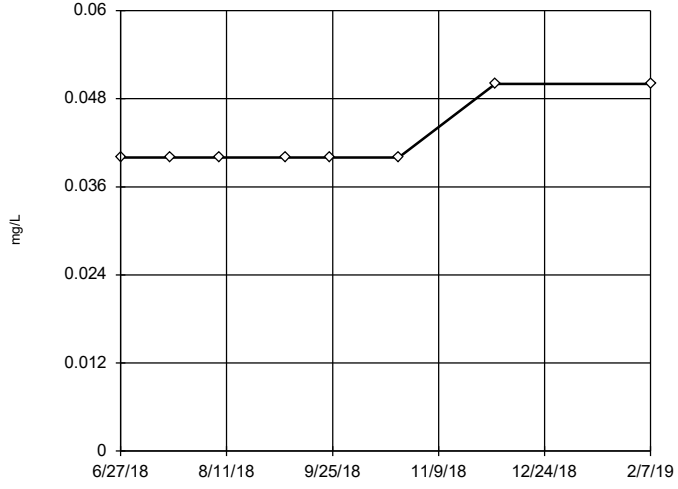
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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 = 0.06111, low cutoff = 0.02709, based on IQR multiplier of 3.

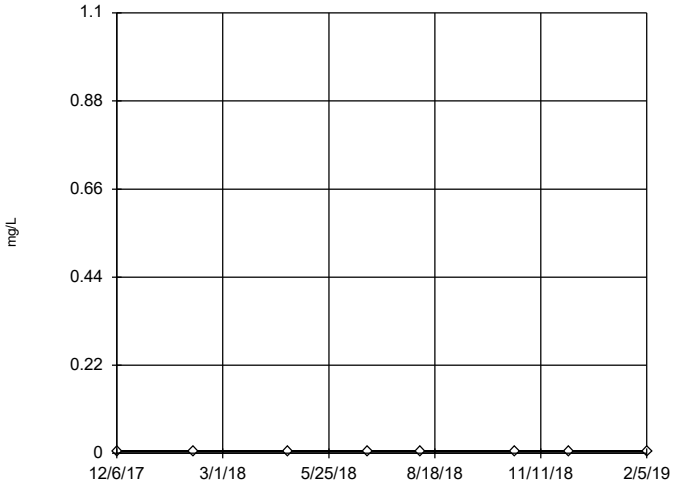
Constituent: Fluoride Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

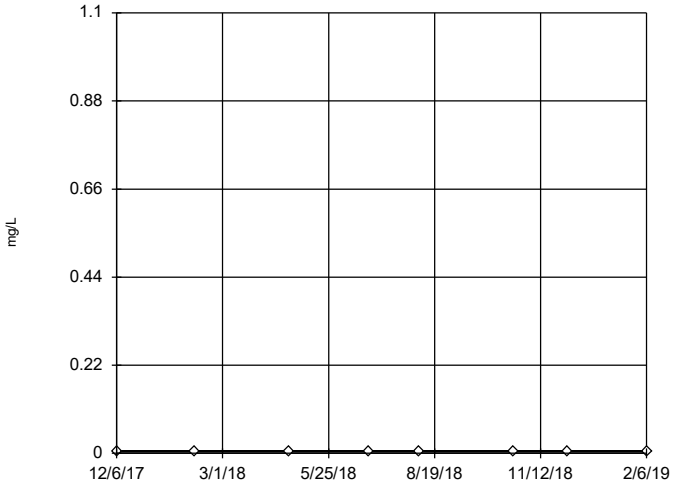
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

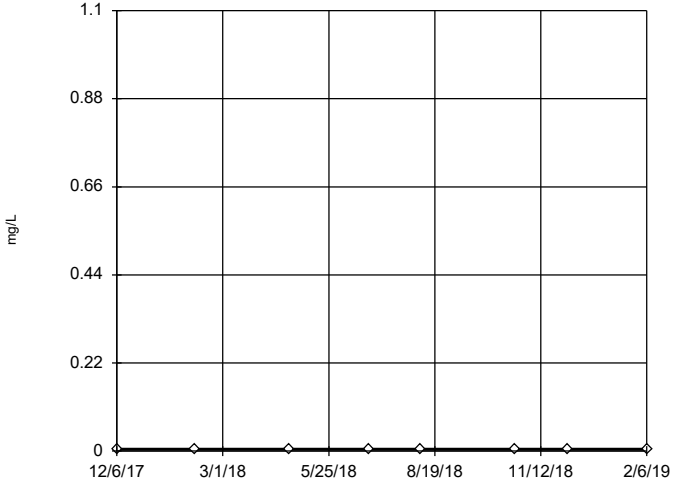
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

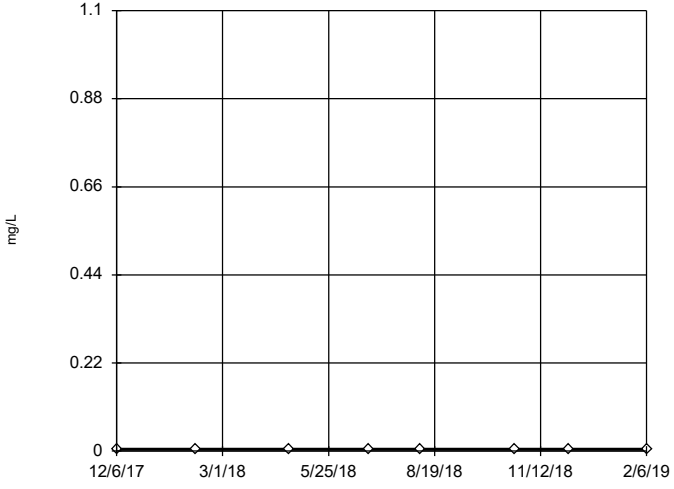
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

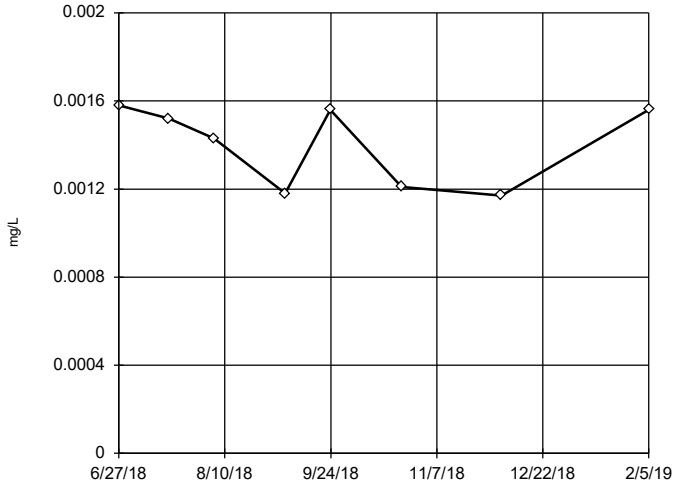
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-14 (bg)




n = 8

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 = 0.001912, low cutoff = -0.001778, based on IQR multiplier of 3.

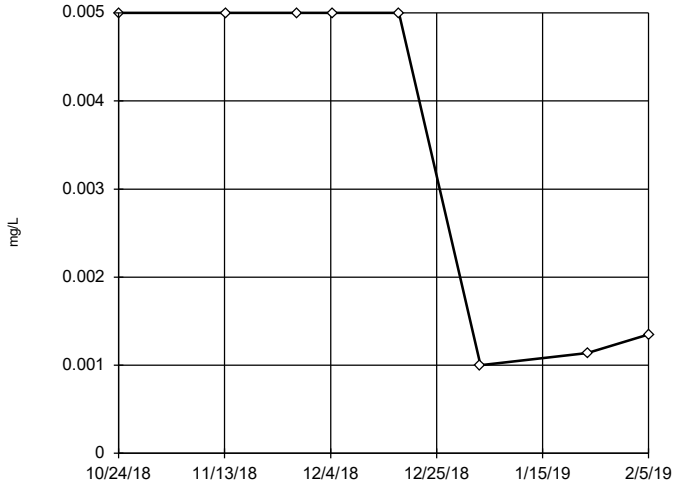
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-16 (bg)




n = 8

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 = 0.3274, low cutoff = 0.00001895, based on IQR multiplier of 3.

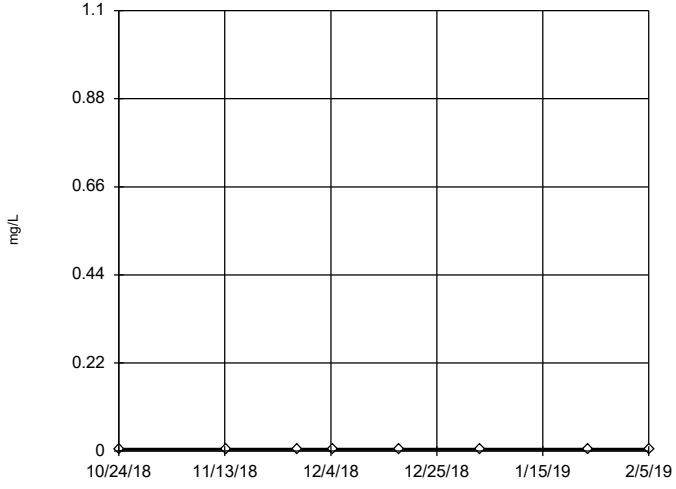
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

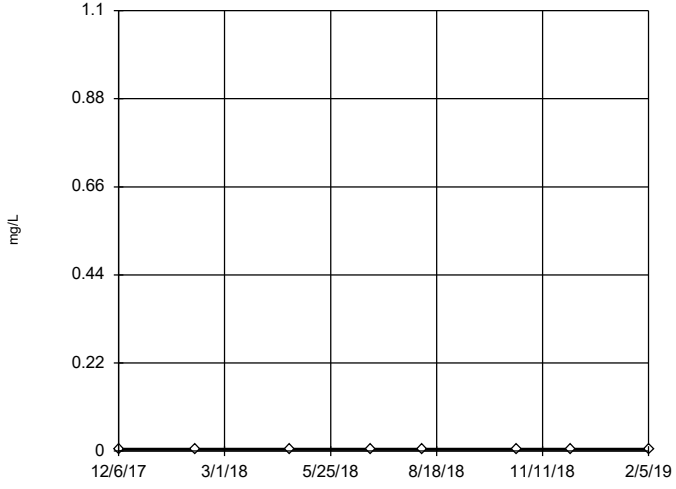
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-2




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

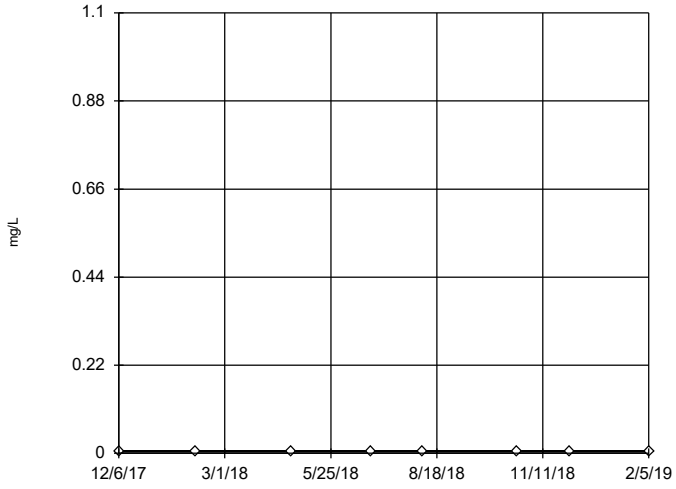
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

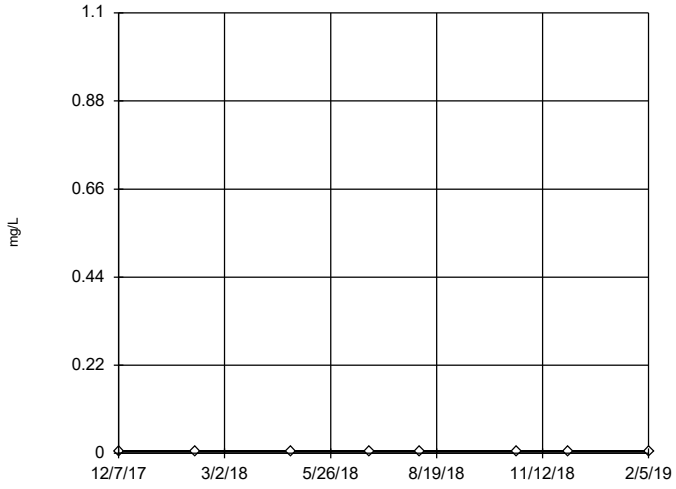
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

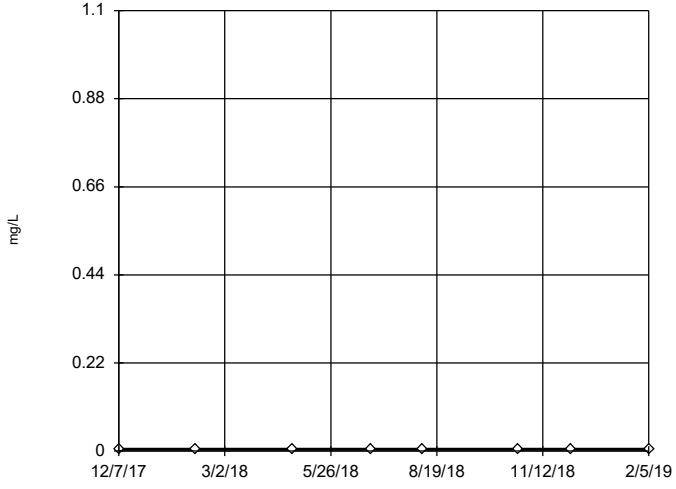
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

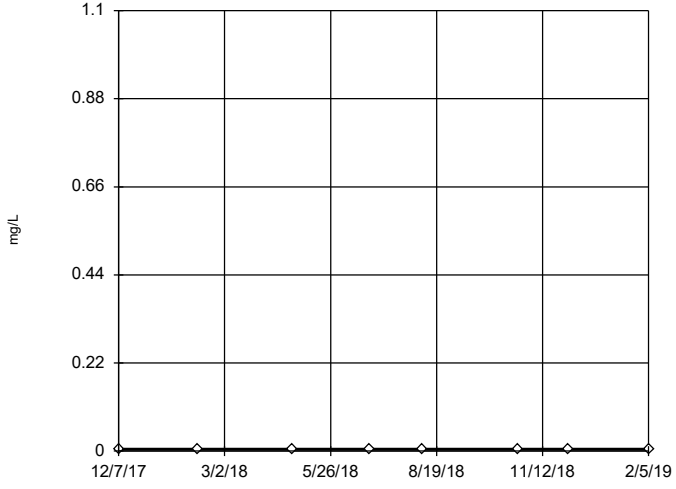
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

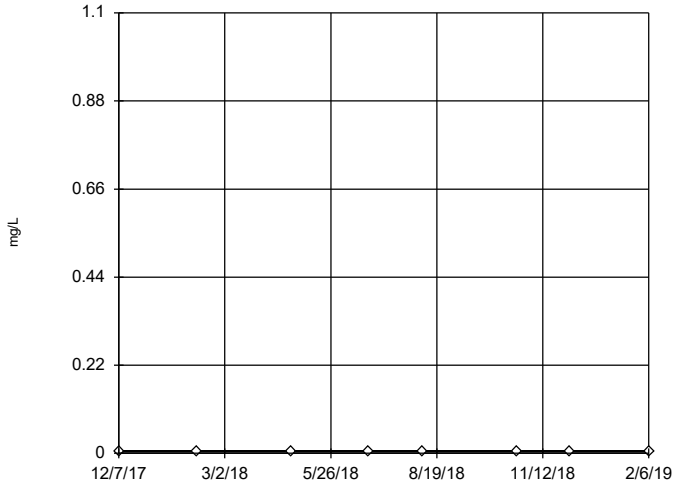
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

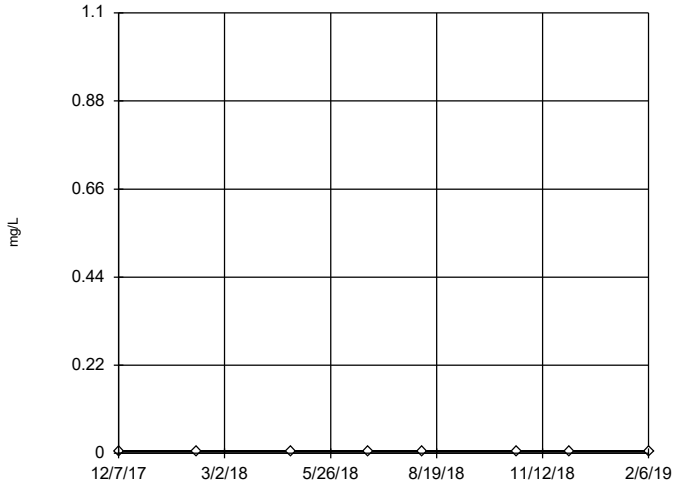
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

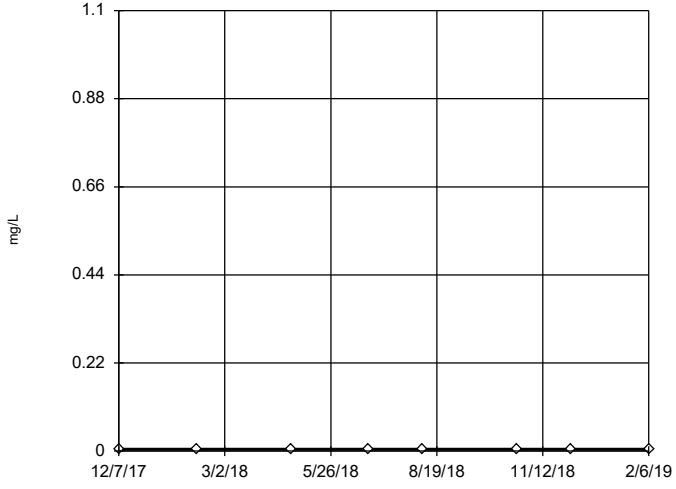
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

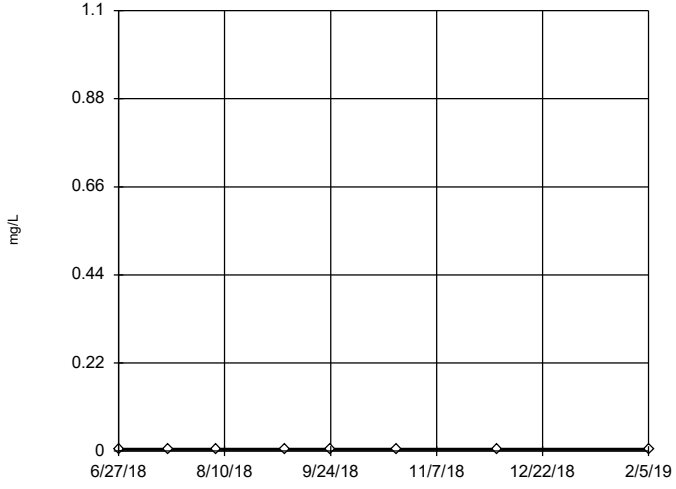
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

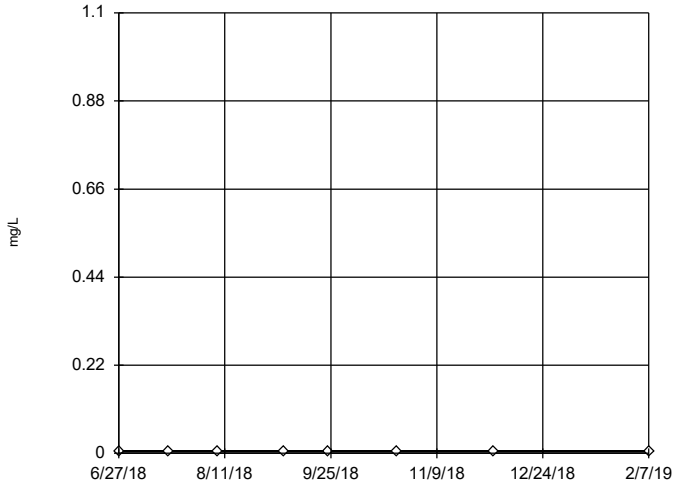
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

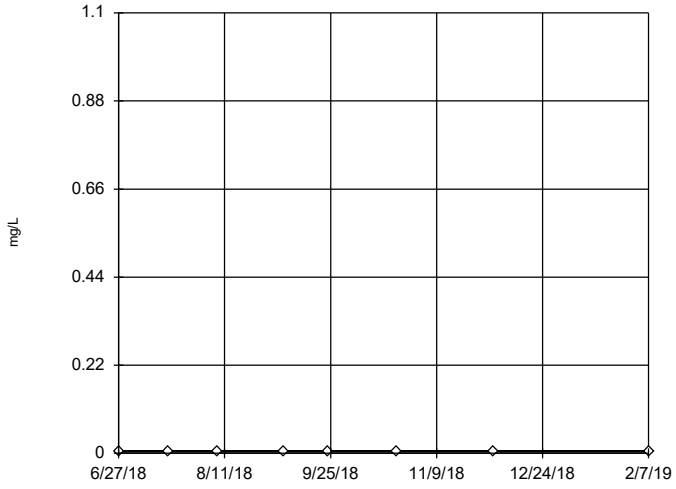
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

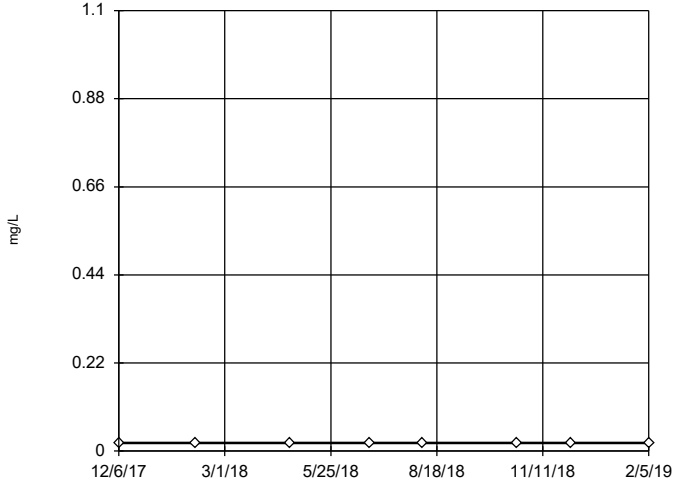
Constituent: Lead Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

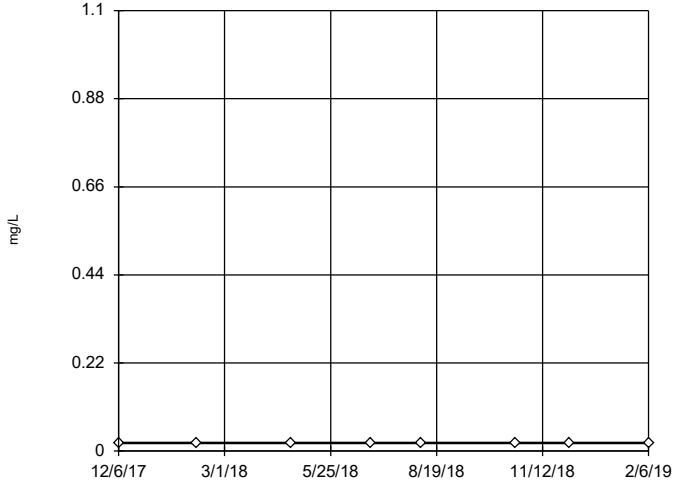
Constituent: Lithium Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

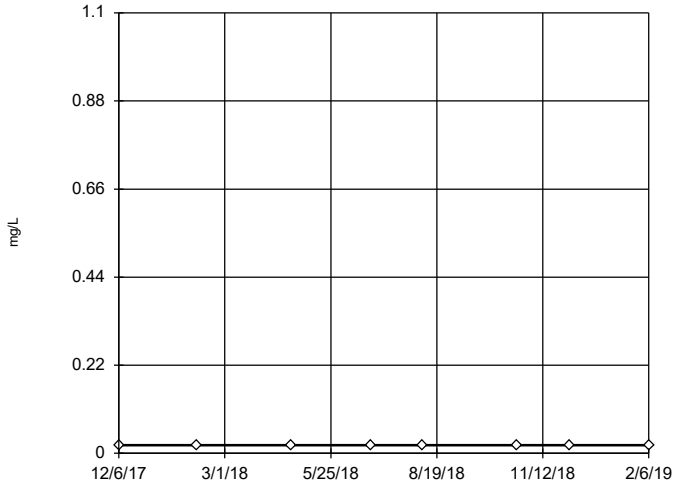
Constituent: Lithium Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

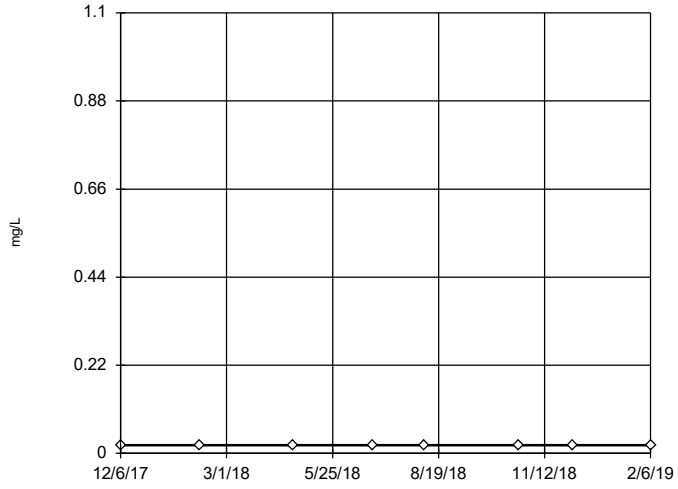
Constituent: Lithium Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

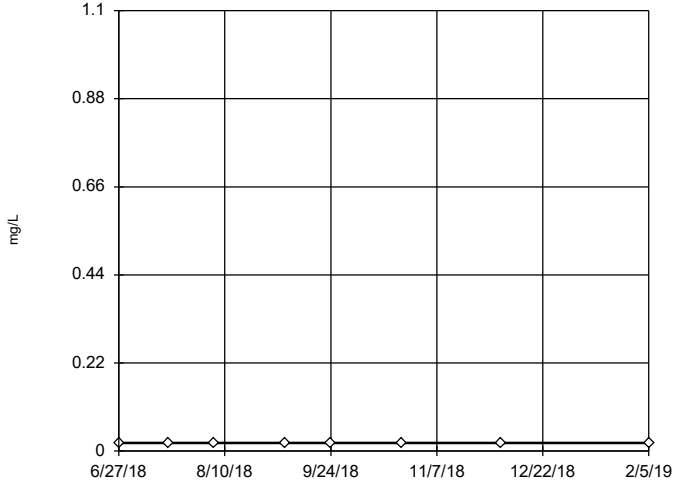
Constituent: Lithium Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

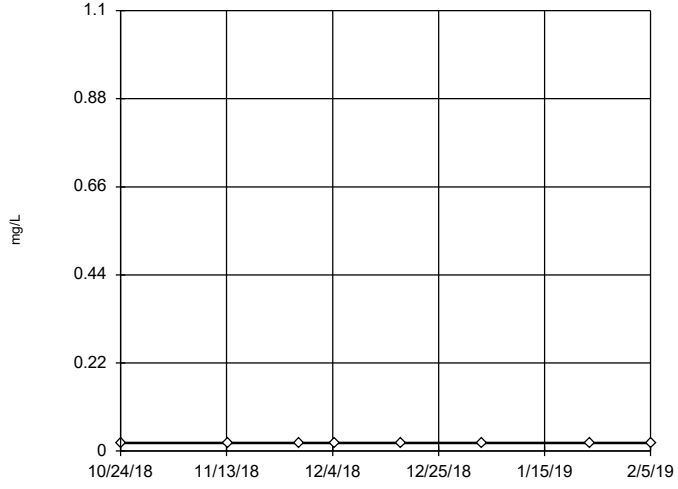
Constituent: Lithium Analysis Run 4/2/2019 2:57 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

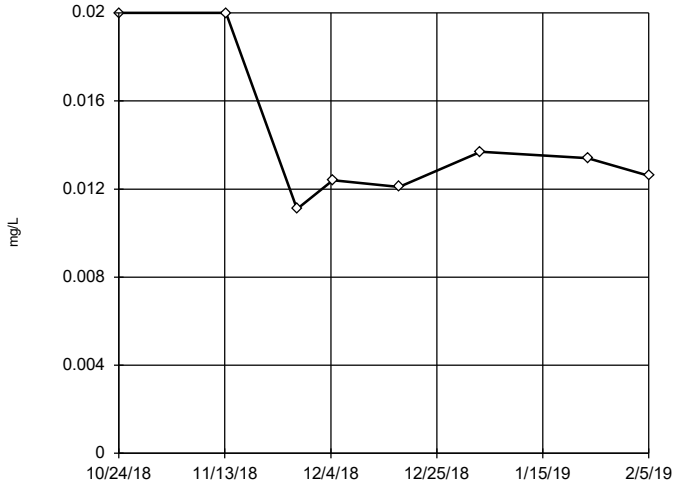
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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 = 0.04085, low cutoff = 0.004964, based on IQR multiplier of 3.

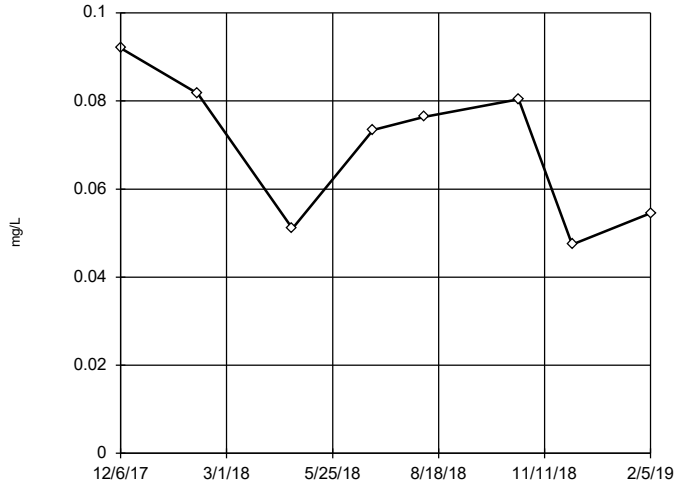
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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 = 0.1191, low cutoff = -0.1003, based on IQR multiplier of 3.

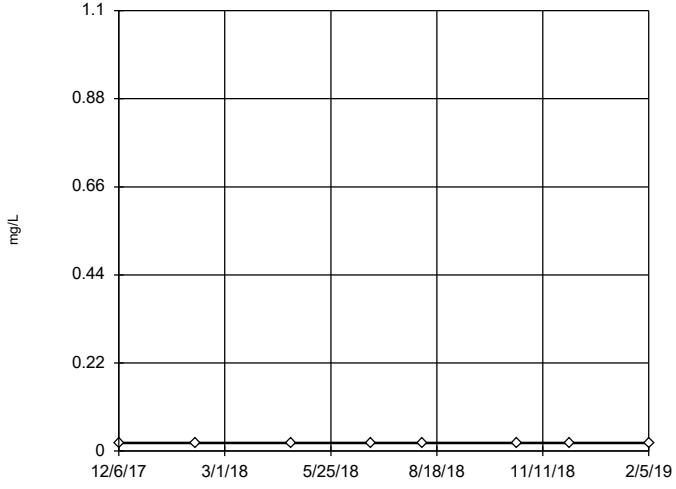
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

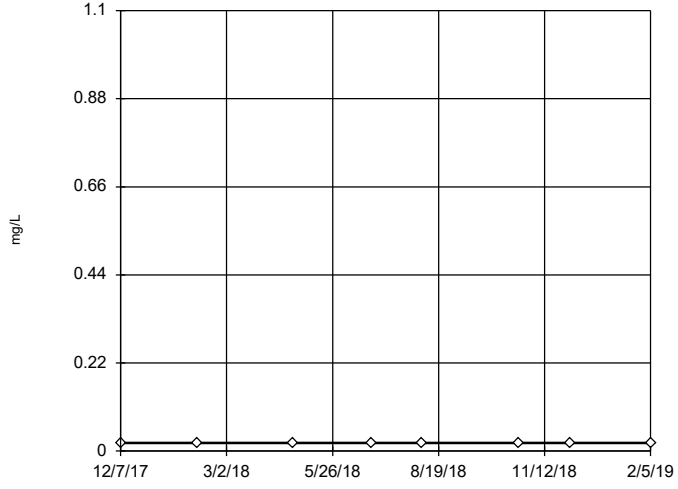
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

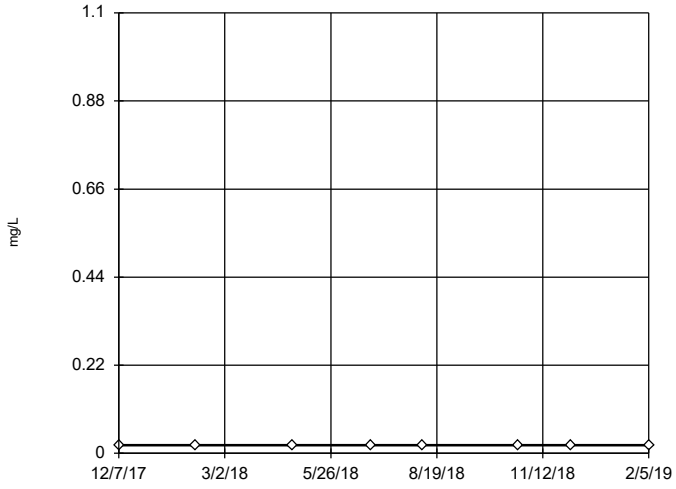
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

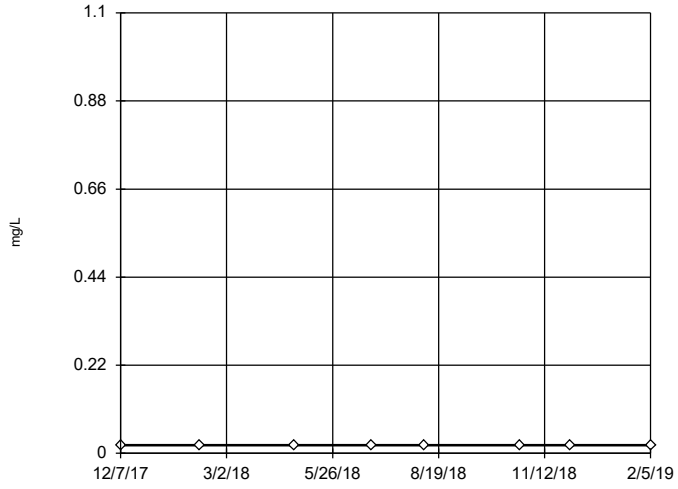
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

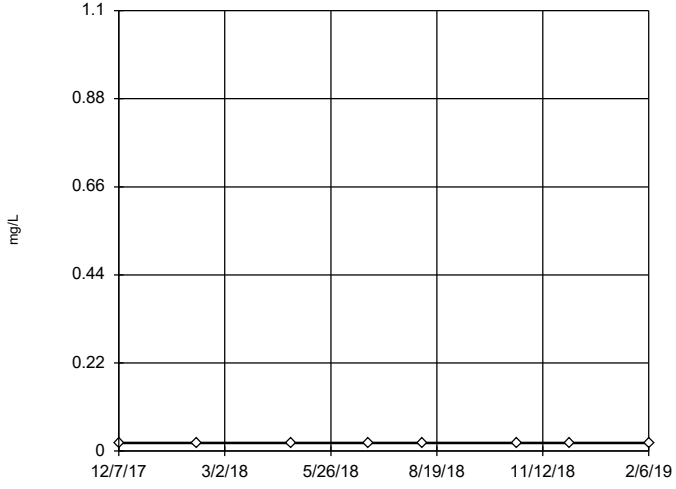
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

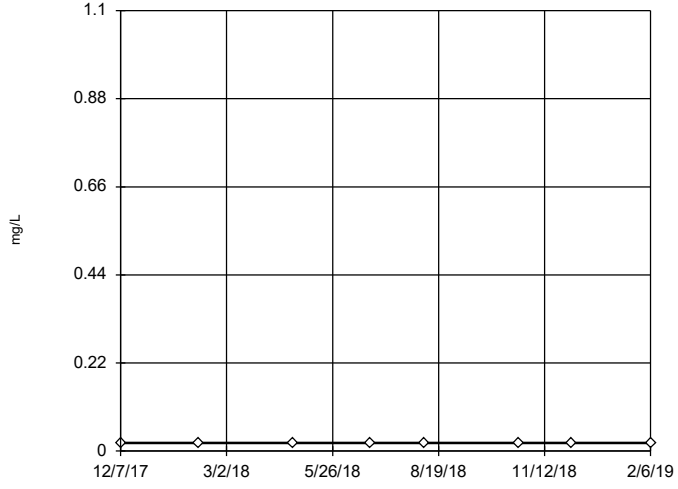
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

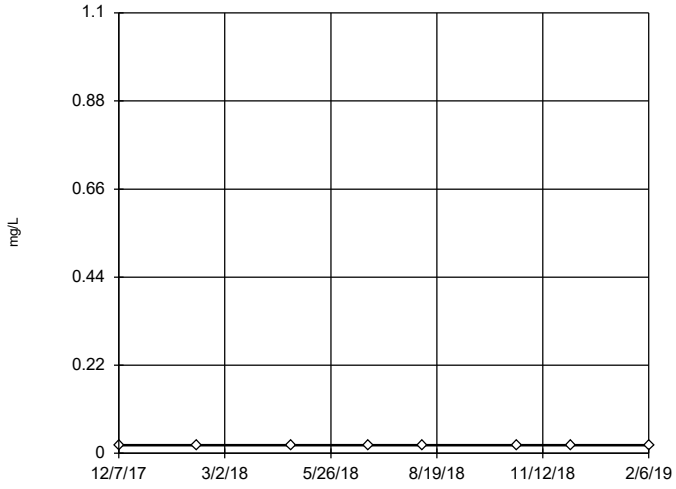
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

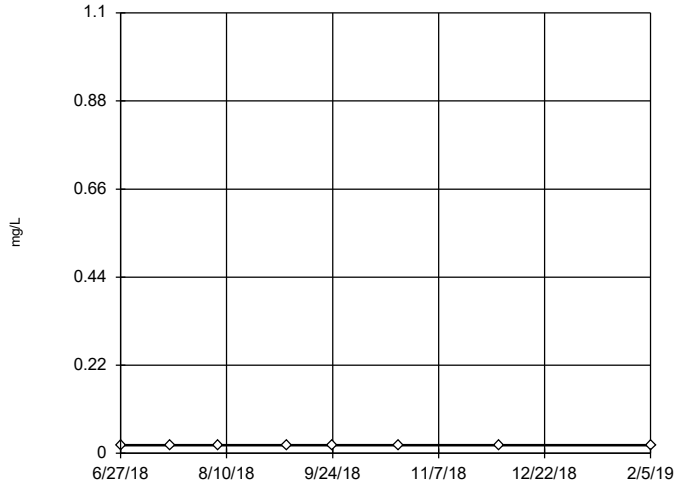
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

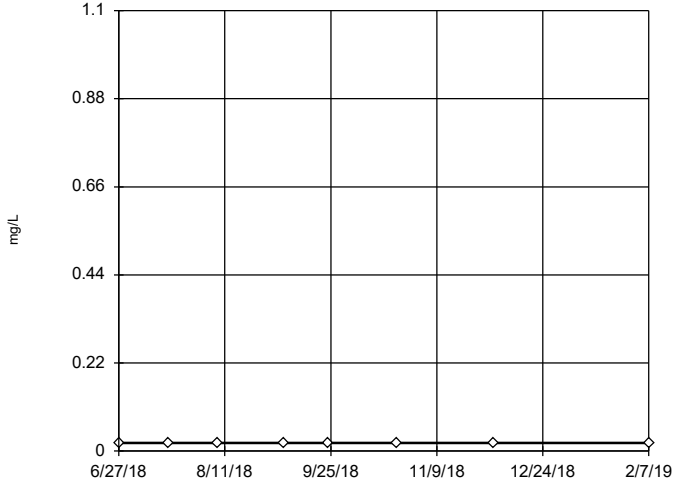
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

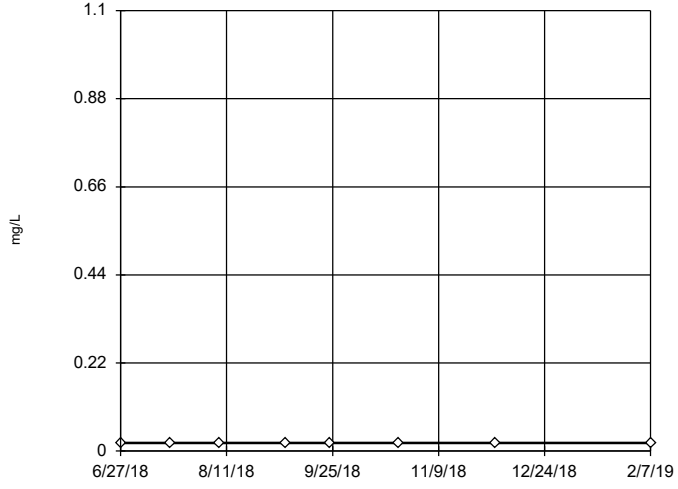
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

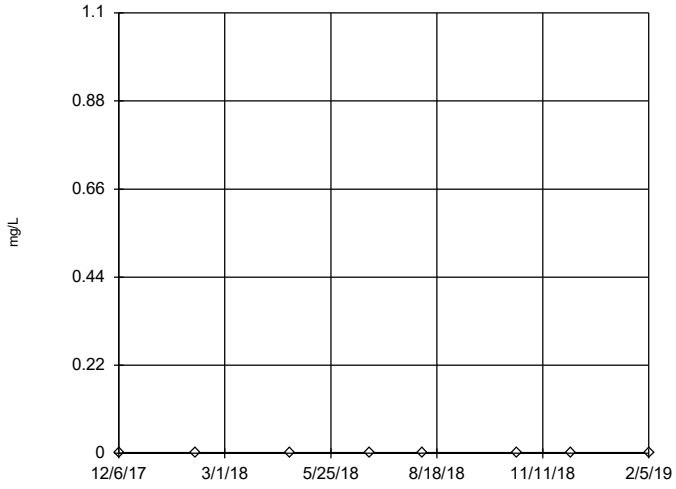
Constituent: Lithium Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

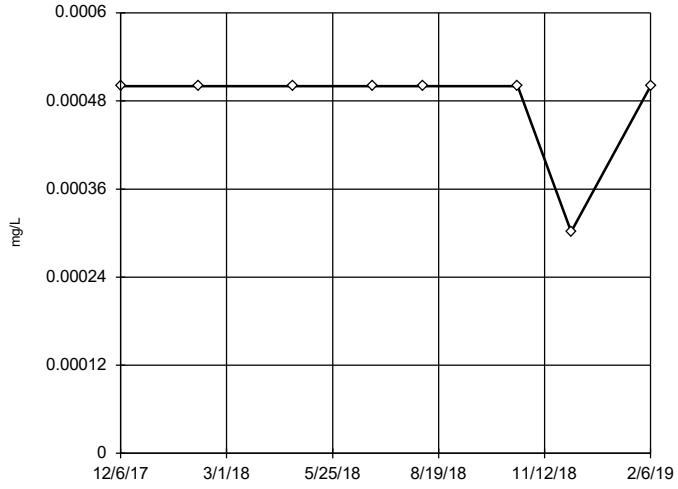
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

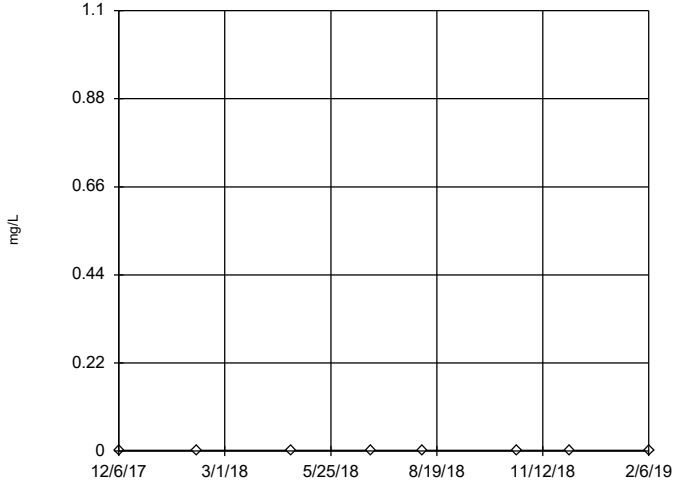
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

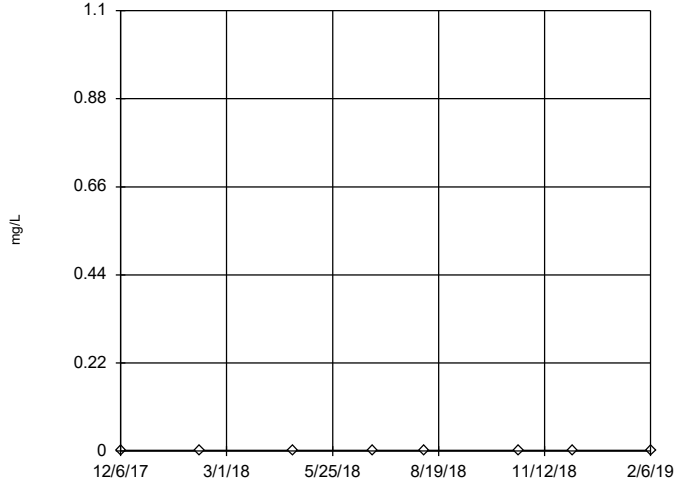
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

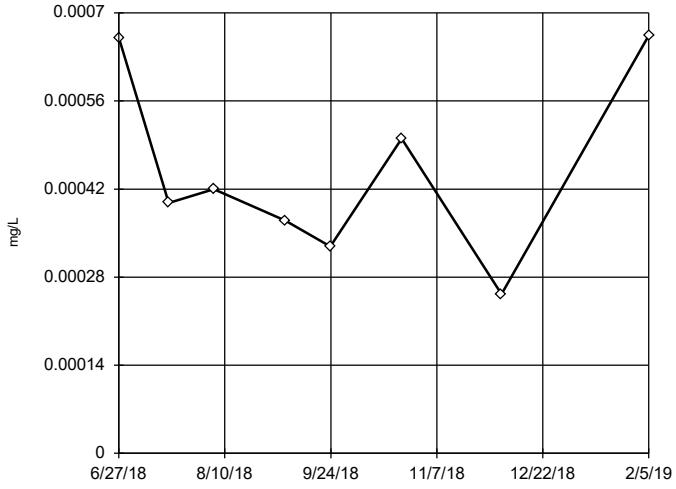
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-14 (bg)




n = 8

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 = 0.002572, low cutoff = 0.00007799, based on IQR multiplier of 3.

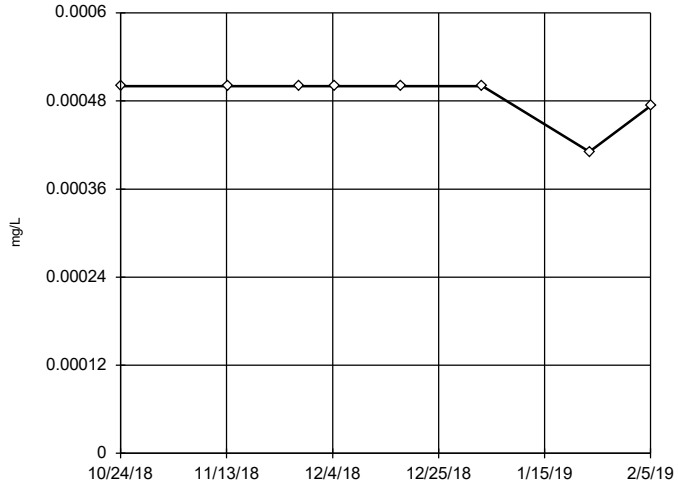
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-16 (bg)




n = 8

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

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

The results were invalidated, because both the lower and upper quartiles represent reporting limits.

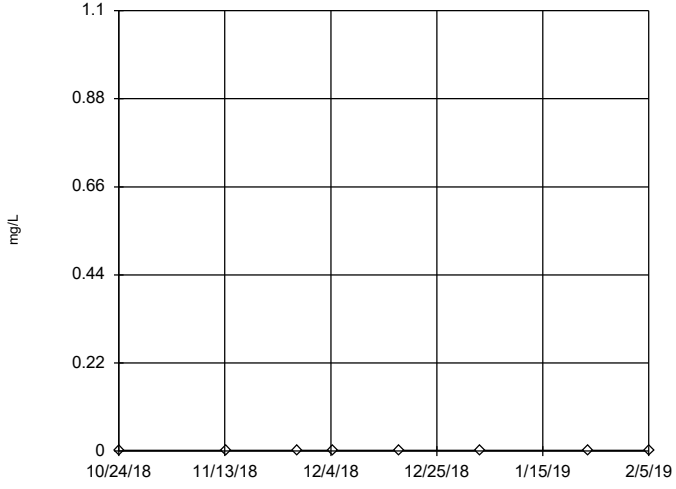
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

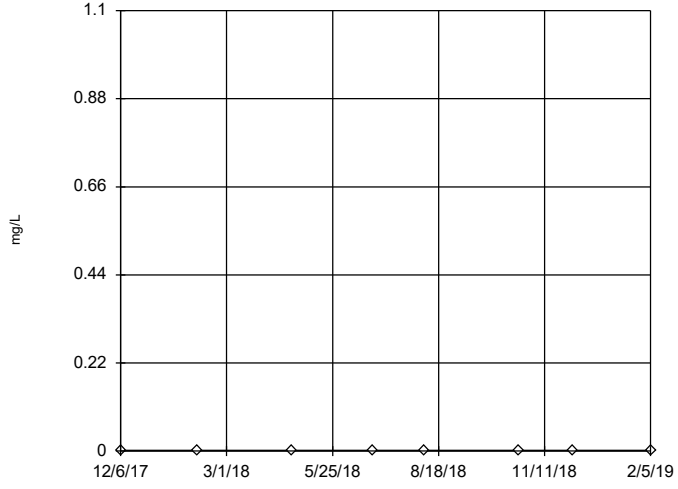
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-2




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

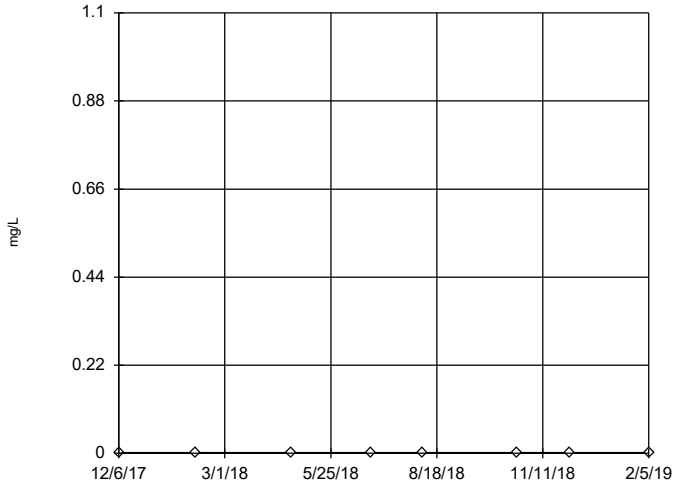
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

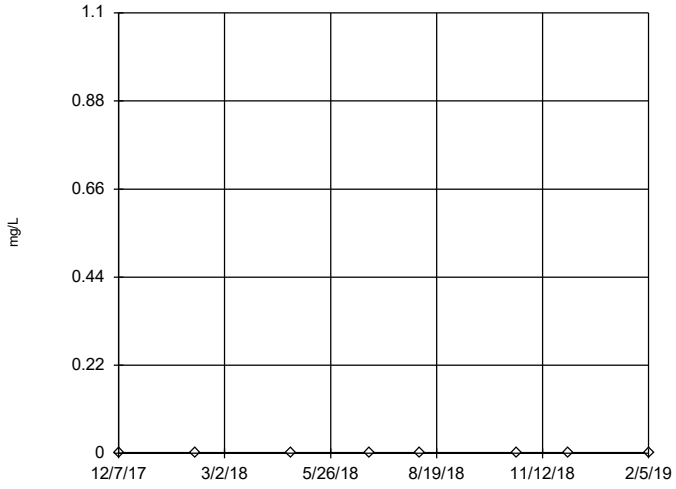
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

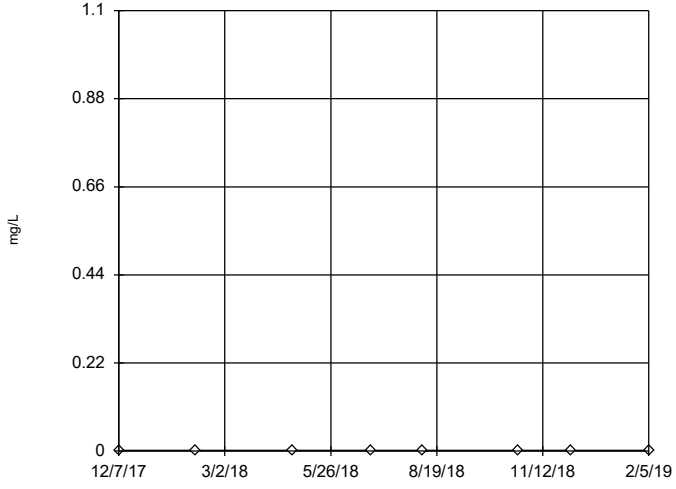
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

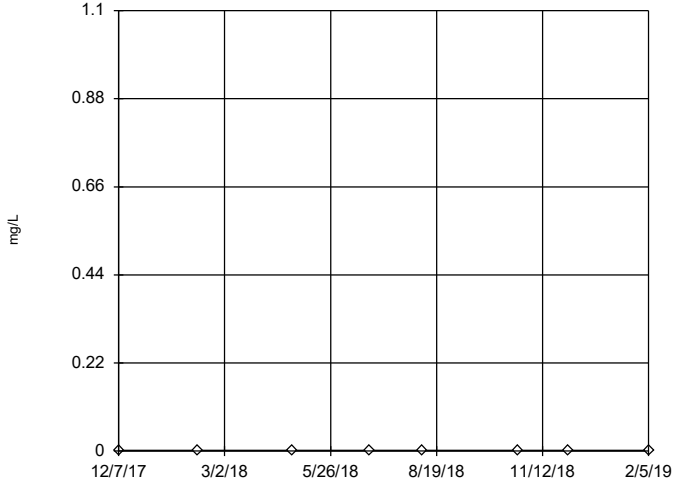
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

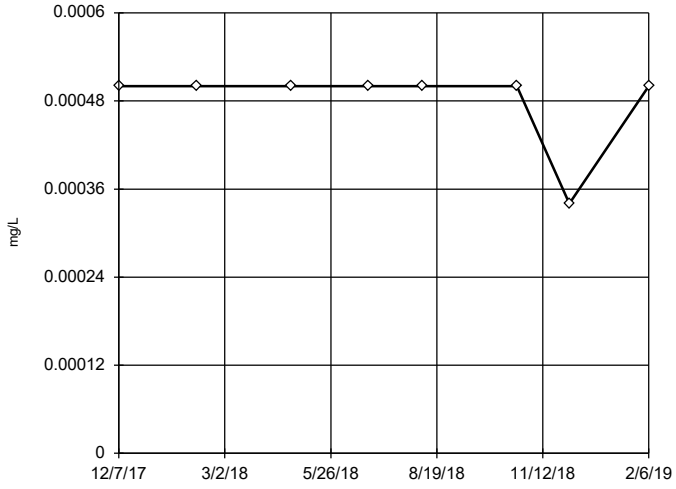
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

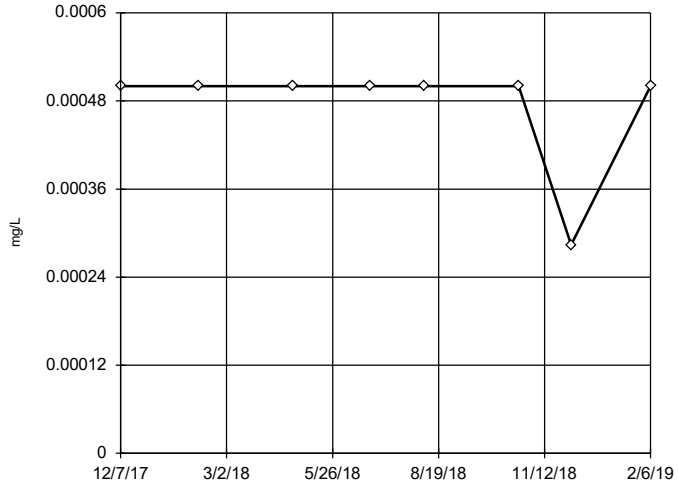
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

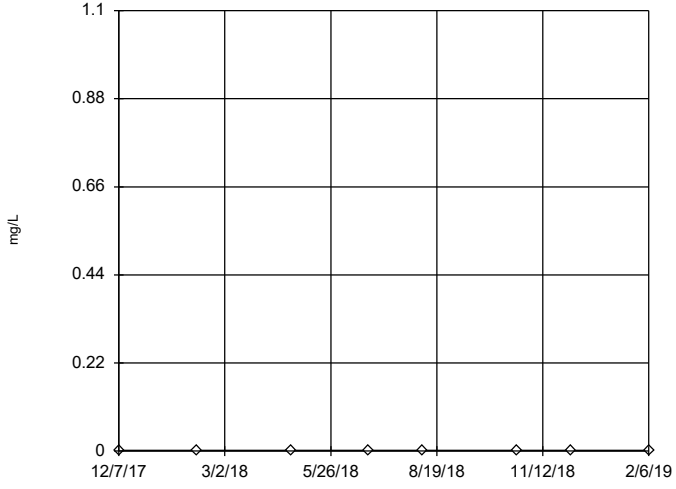
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

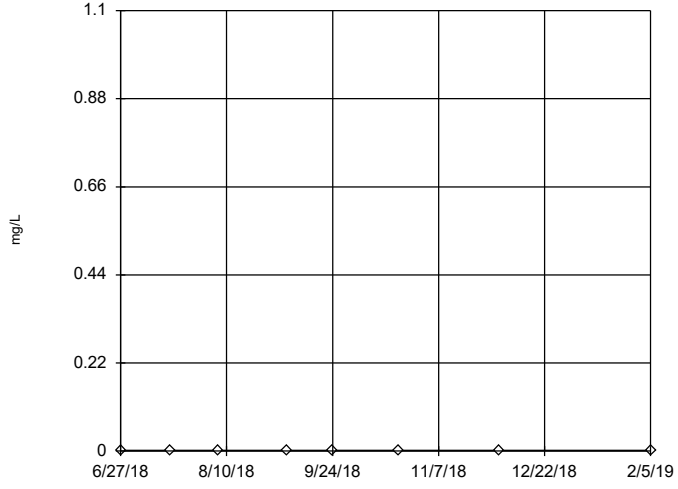
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

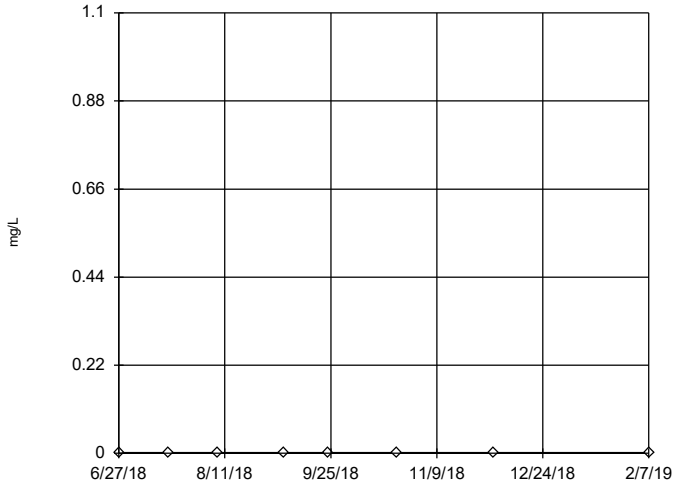
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

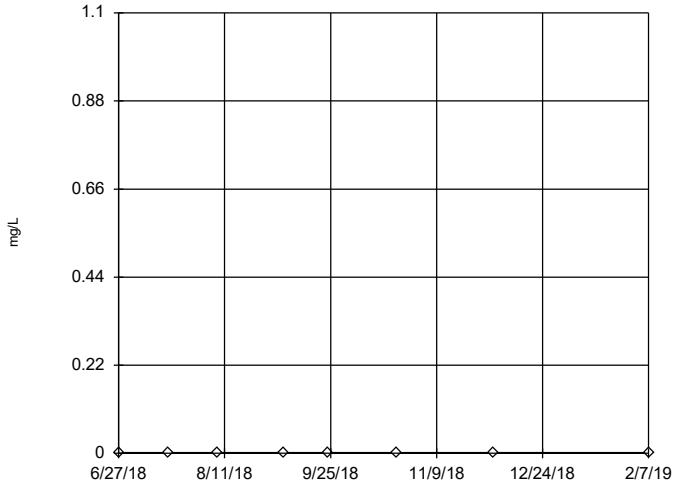
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

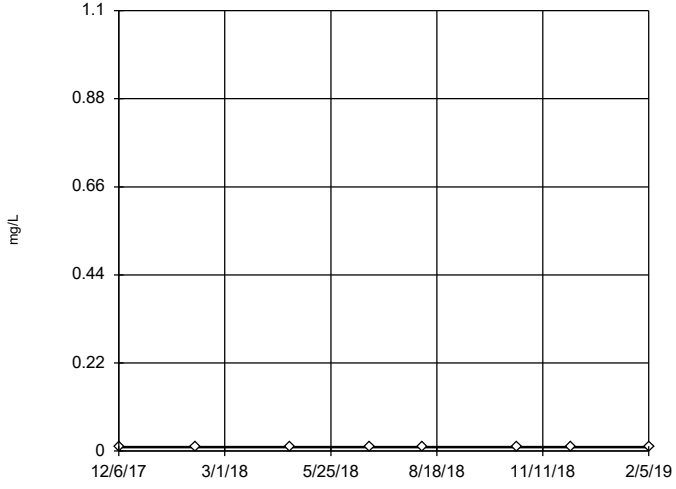
Constituent: Mercury Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

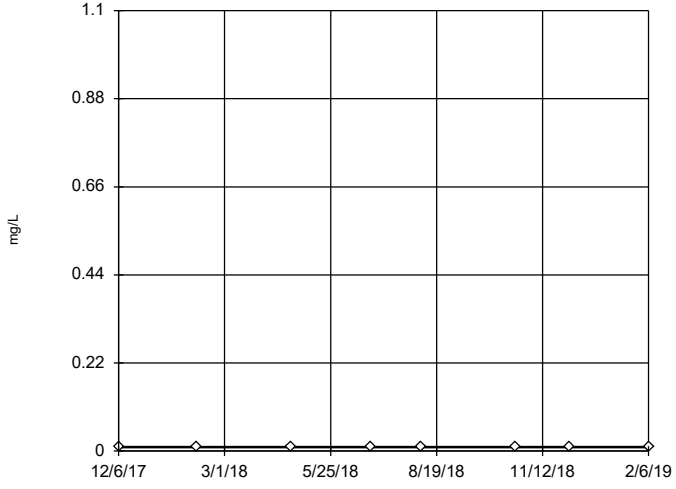
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

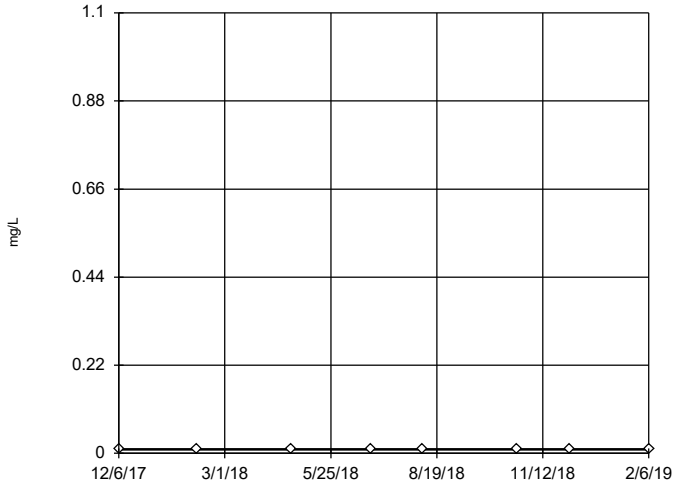
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

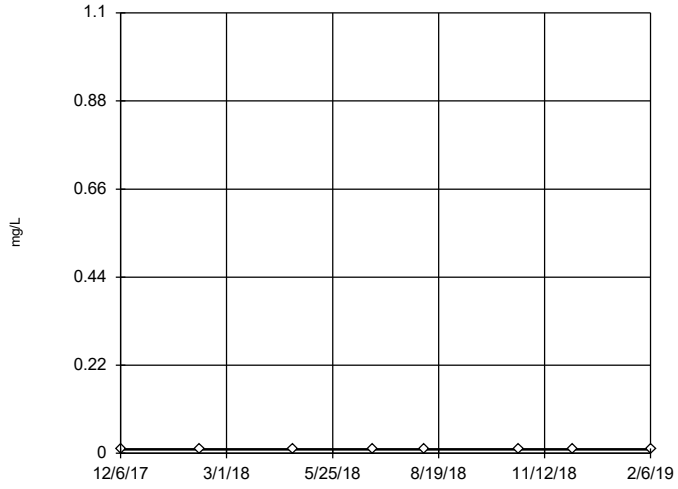
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

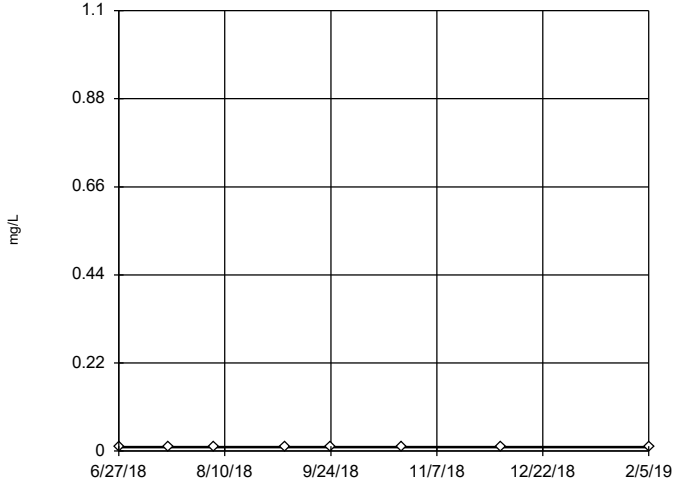
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

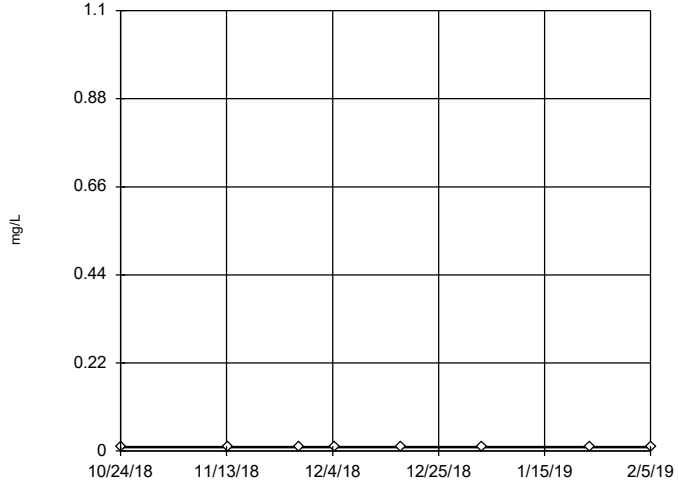
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

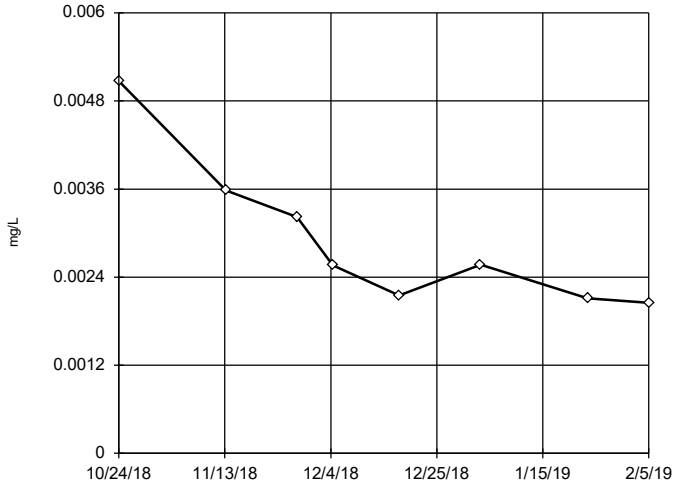
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-17 (bg)




n = 8

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 = 0.01375, low cutoff = 0.0005258, based on IQR multiplier of 3.

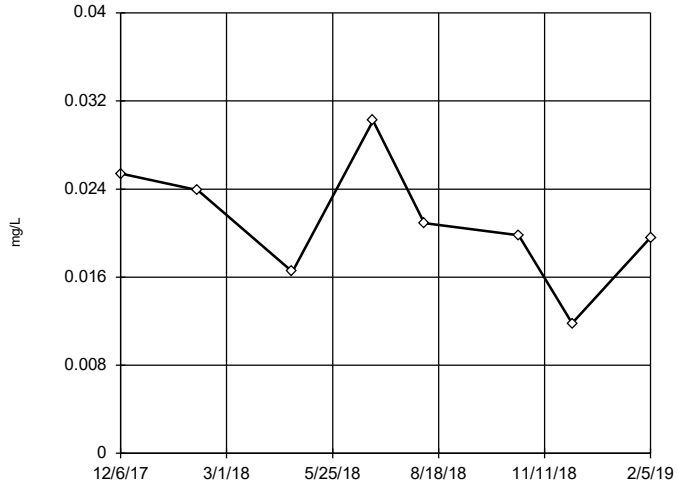
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-2




n = 8

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

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

High cutoff = 0.04445, low cutoff = -0.00175, based on IQR multiplier of 3.

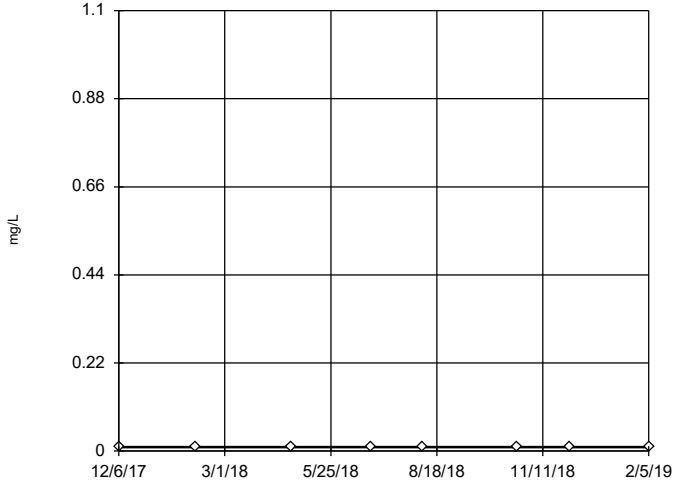
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

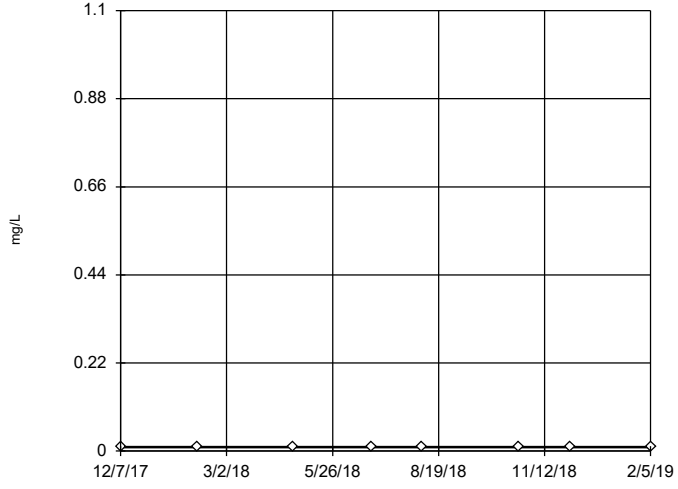
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

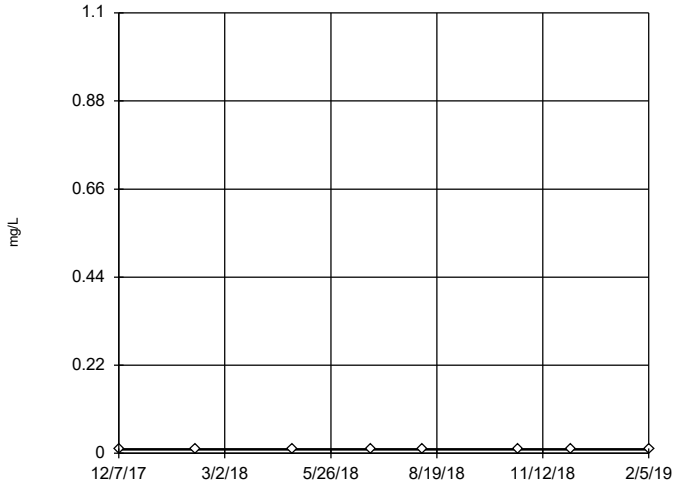
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

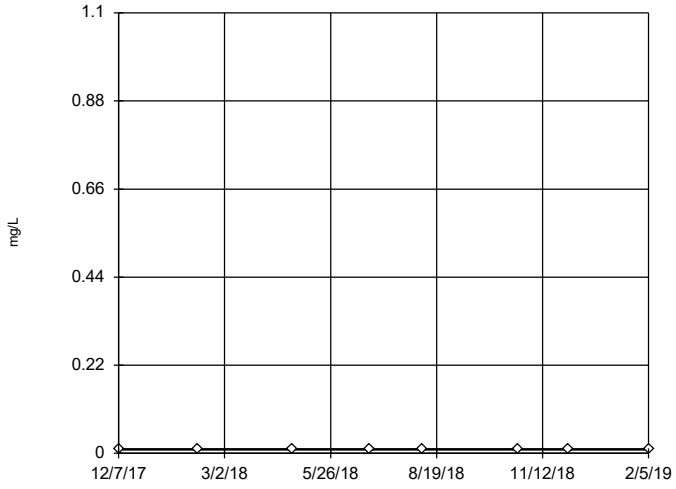
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

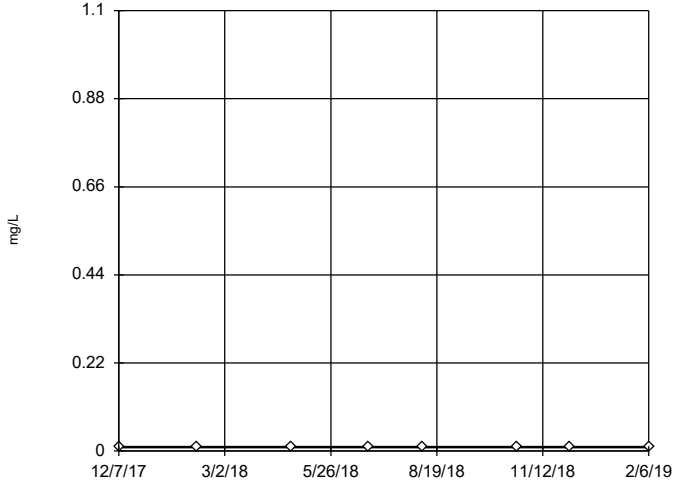
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

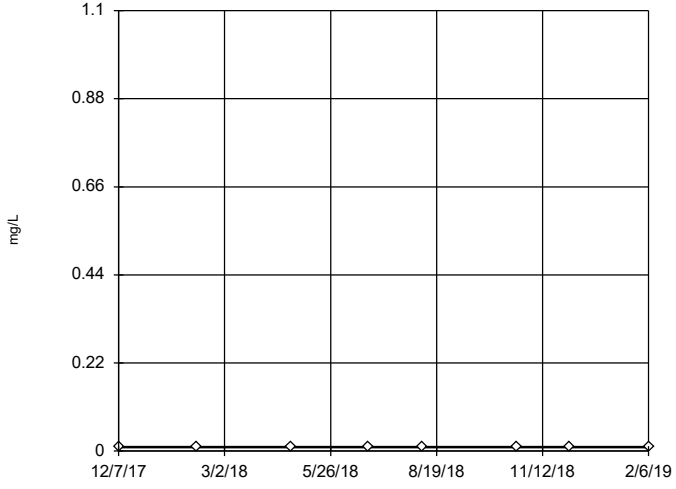
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

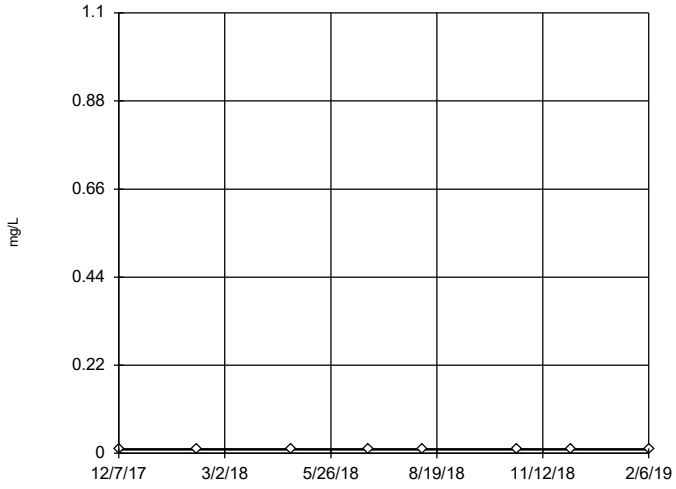
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

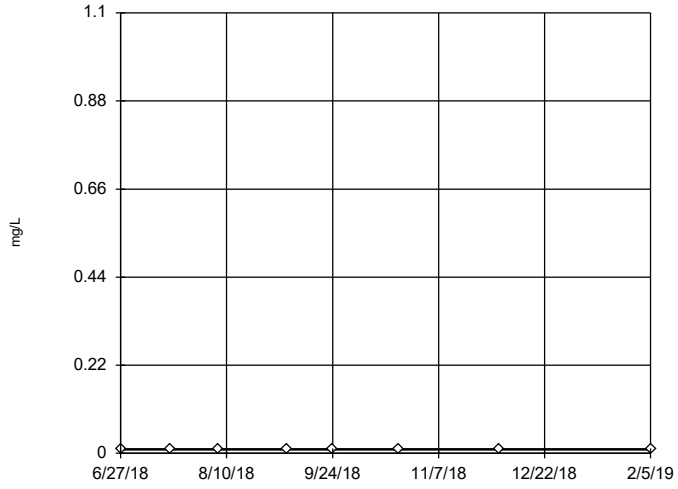
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

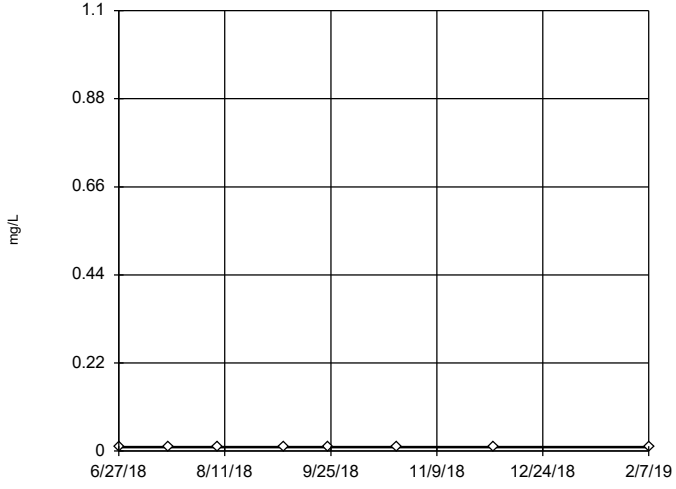
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

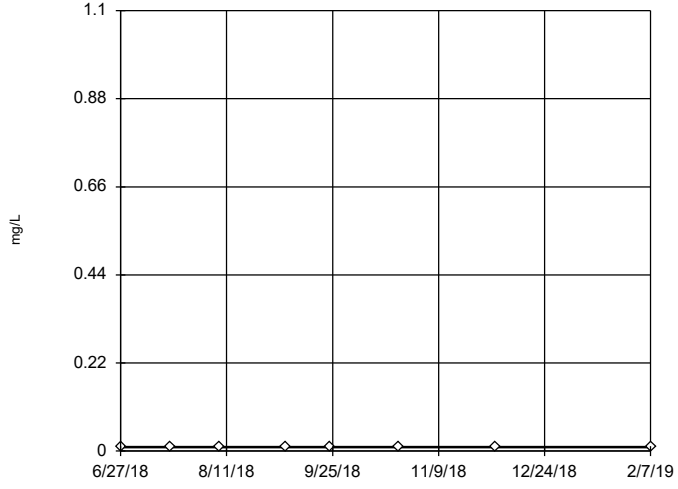
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

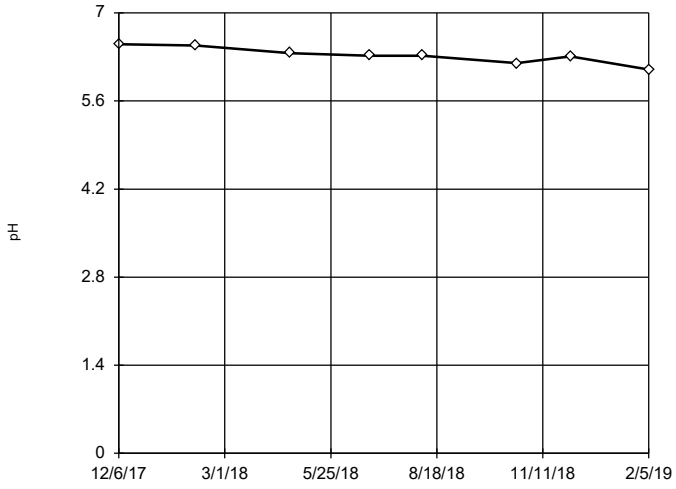
Constituent: Molybdenum Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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 = 6.835, low cutoff = 5.615, based on IQR multiplier of 3.

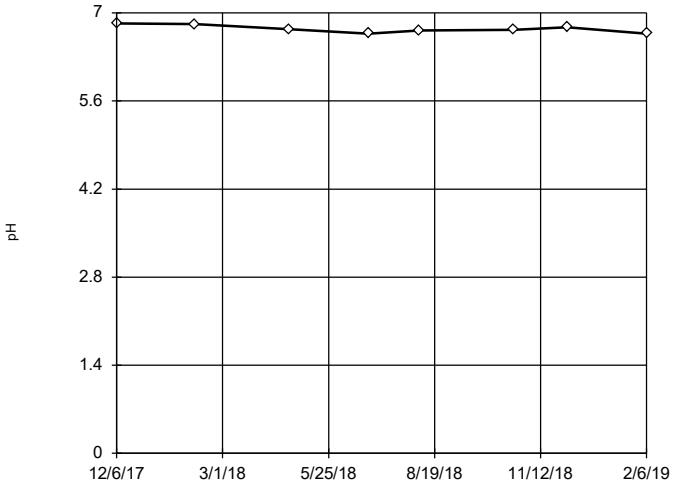
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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 = 7.104, low cutoff = 6.404, based on IQR multiplier of 3.

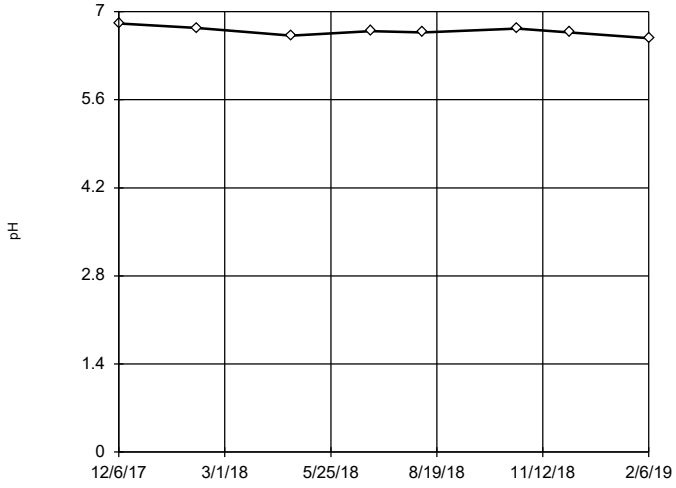
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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 = 7.013, low cutoff = 6.382, based on IQR multiplier of 3.

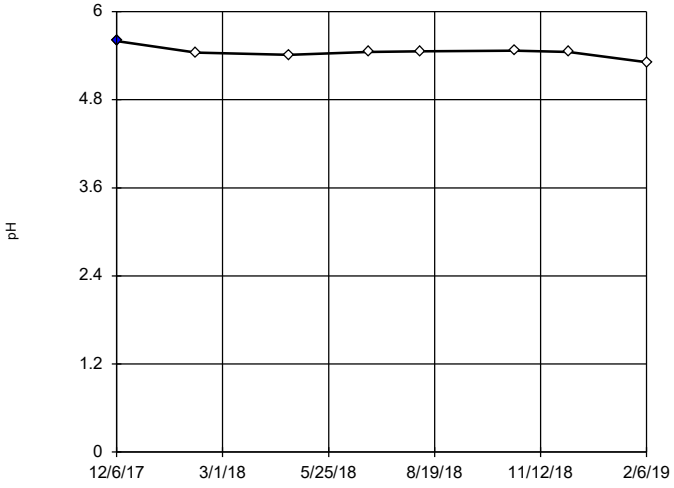
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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 = 5.587, low cutoff = 5.307, based on IQR multiplier of 3.

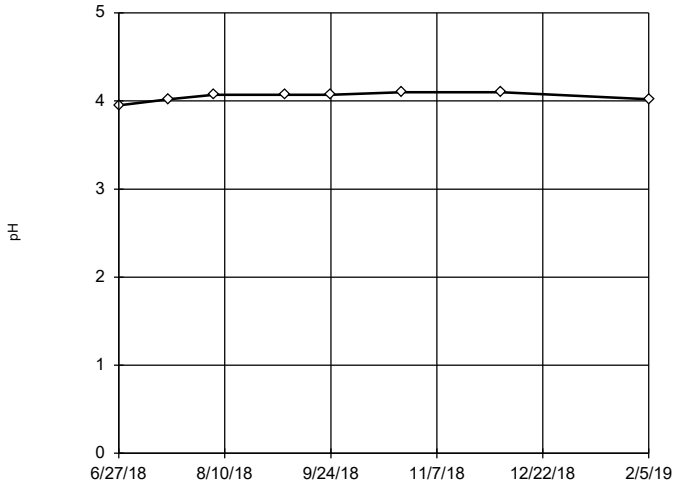
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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 = 4.254, low cutoff = 3.785, based on IQR multiplier of 3.

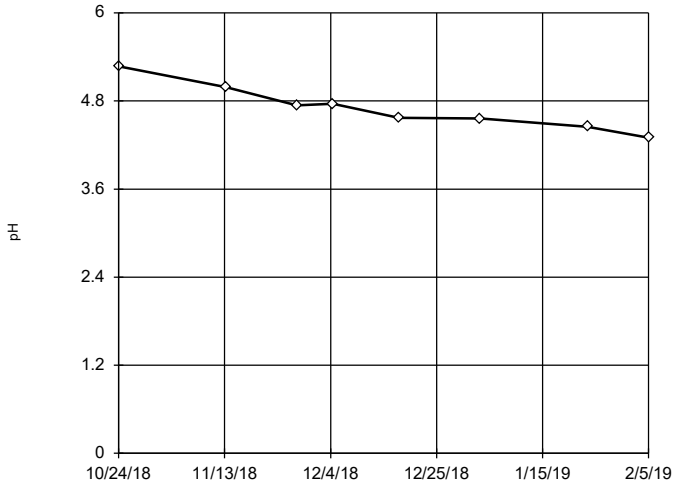
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 6.172, low cutoff = 3.557, based on IQR multiplier of 3.

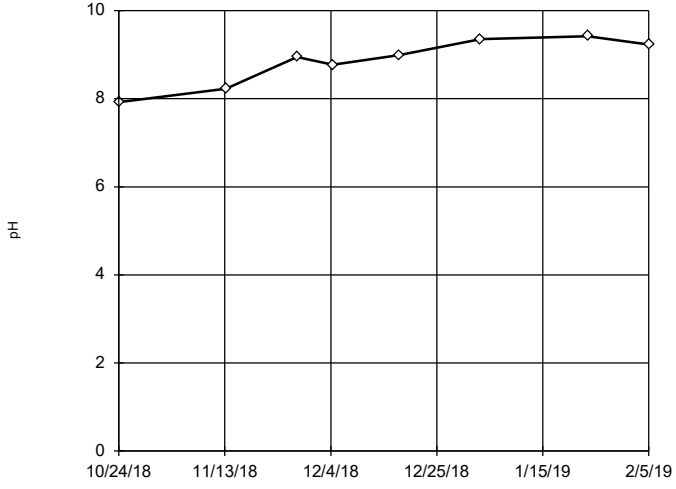
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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 = 10.61, low cutoff = -8.577, based on IQR multiplier of 3.

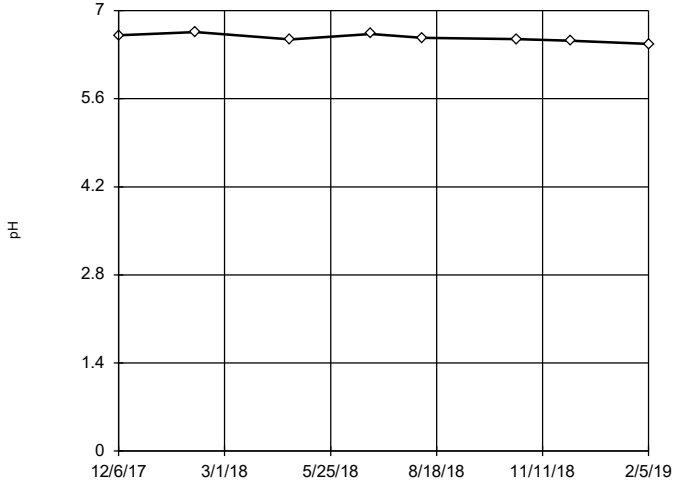
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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

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

High cutoff = 6.89, low cutoff = 6.26, based on IQR multiplier of 3.

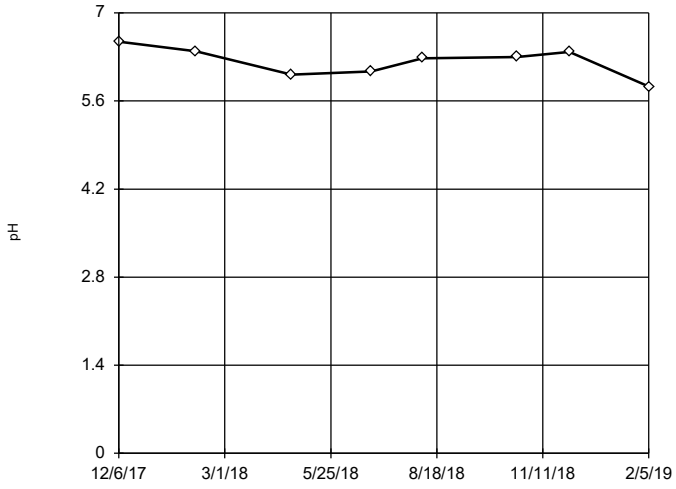
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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 = 7.067, low cutoff = -4.476, based on IQR multiplier of 3.

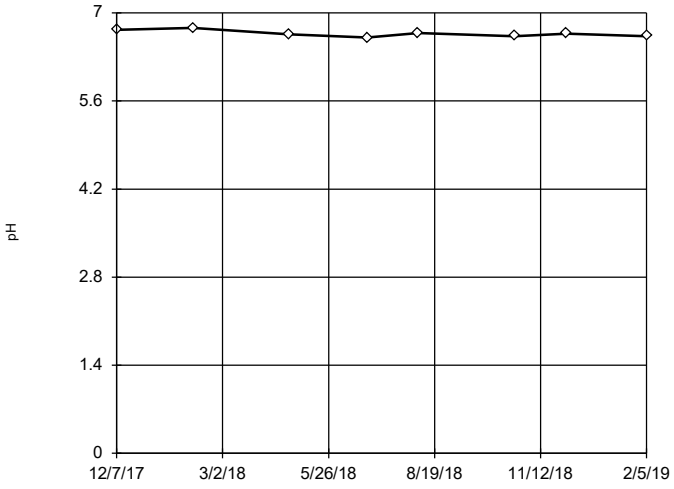
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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 = 6.935, low cutoff = 6.41, based on IQR multiplier of 3.

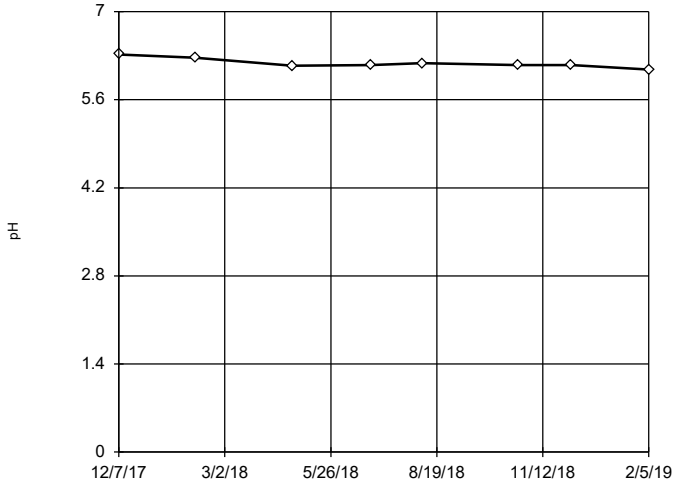
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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 = 6.471, low cutoff = 5.912, based on IQR multiplier of 3.

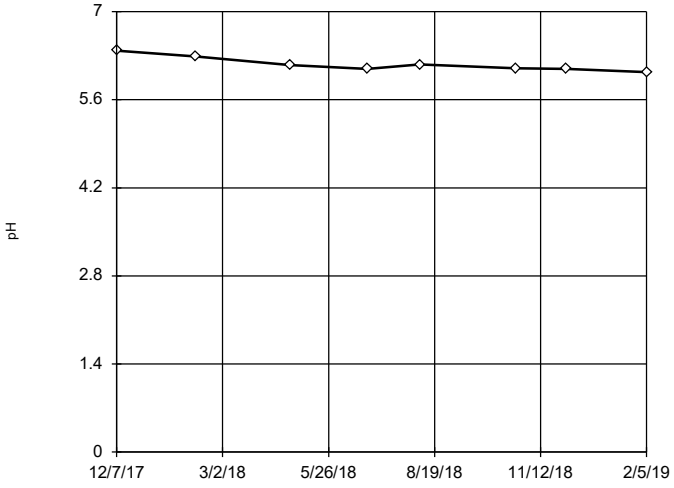
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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 = 6.647, low cutoff = 5.703, based on IQR multiplier of 3.

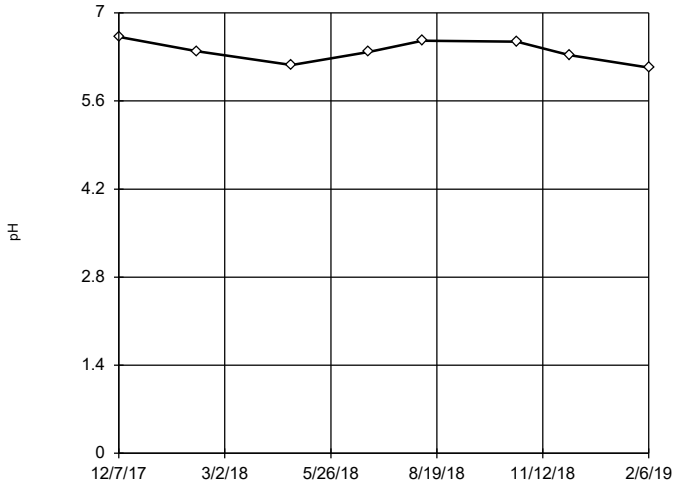
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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 = 7.177, low cutoff = 3.577, based on IQR multiplier of 3.

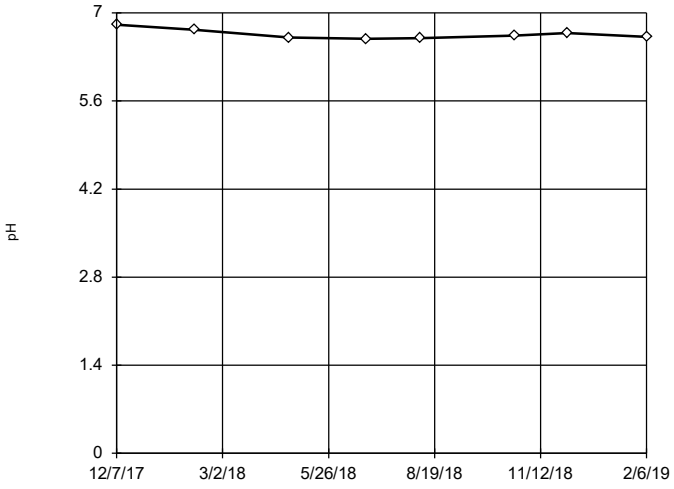
Constituent: pH Analysis Run 4/2/2019 2:58 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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 = 7.014, low cutoff = 6.314, based on IQR multiplier of 3.

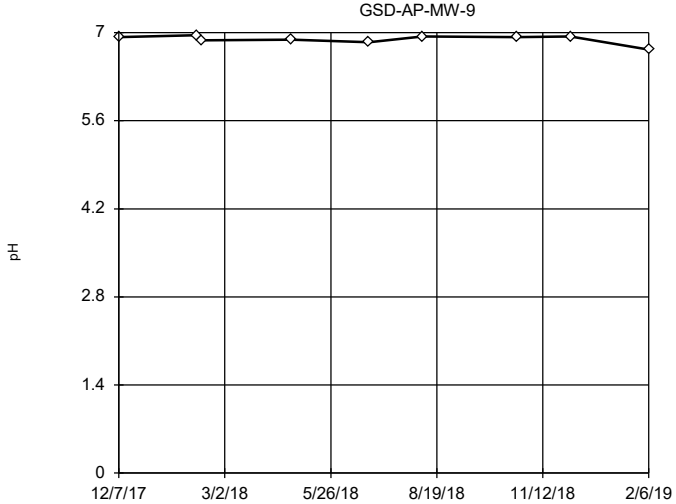
Constituent: pH Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 9

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 = 7.143, low cutoff = 6.612, based on IQR multiplier of 3.

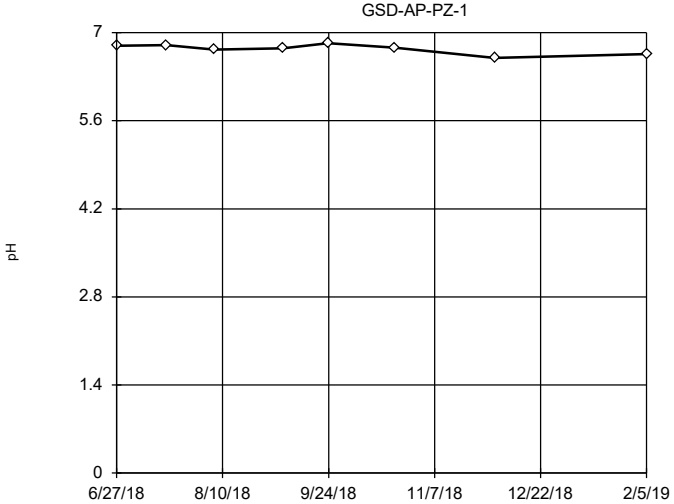
Constituent: pH Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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 = 7.056, low cutoff = 6.342, based on IQR multiplier of 3.

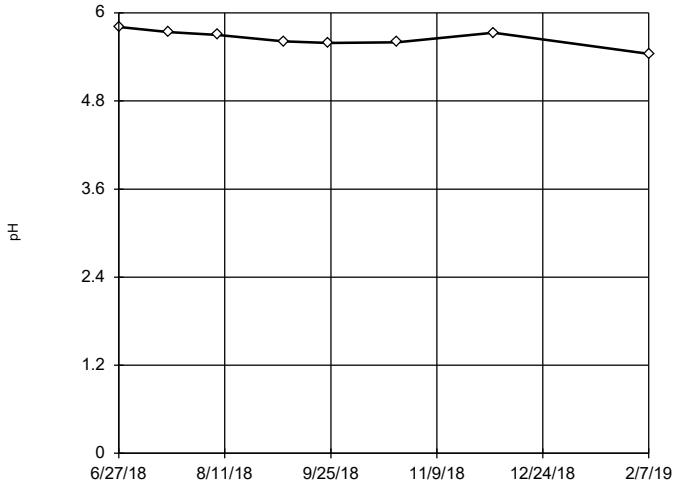
Constituent: pH Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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 = 6.075, low cutoff = 5.018, based on IQR multiplier of 3.

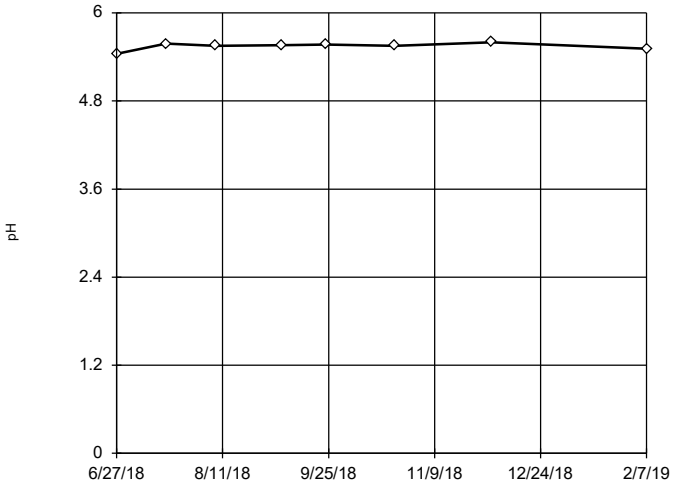
Constituent: pH Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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 = 5.7, low cutoff = 5.384, based on IQR multiplier of 3.

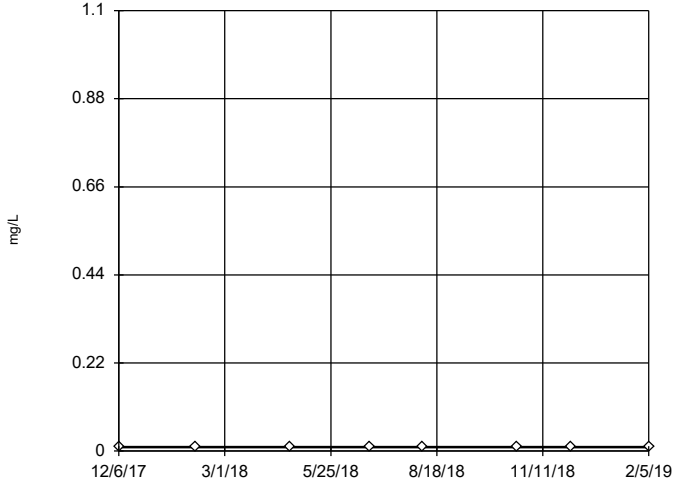
Constituent: pH Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

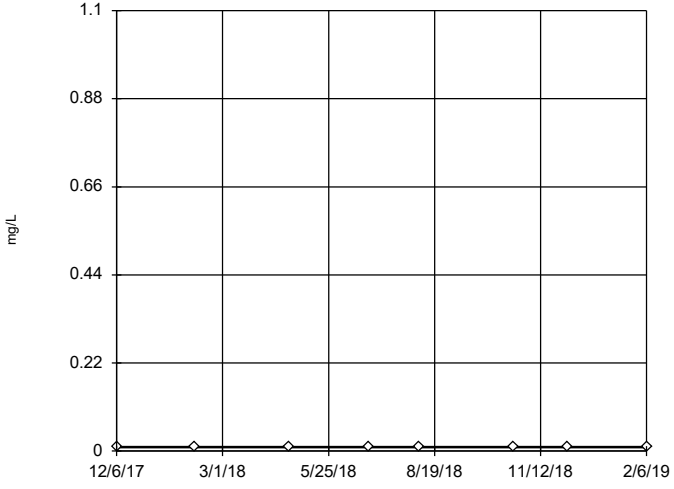
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

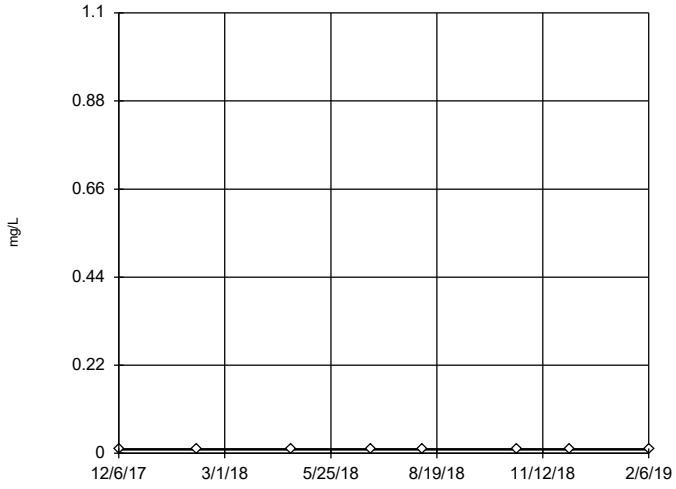
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

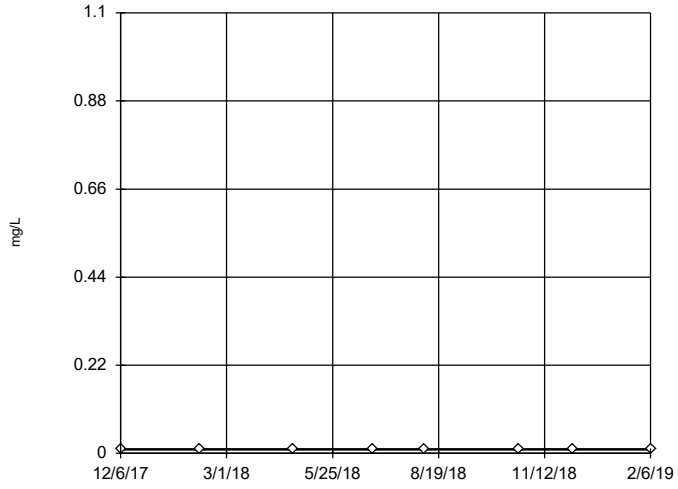
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

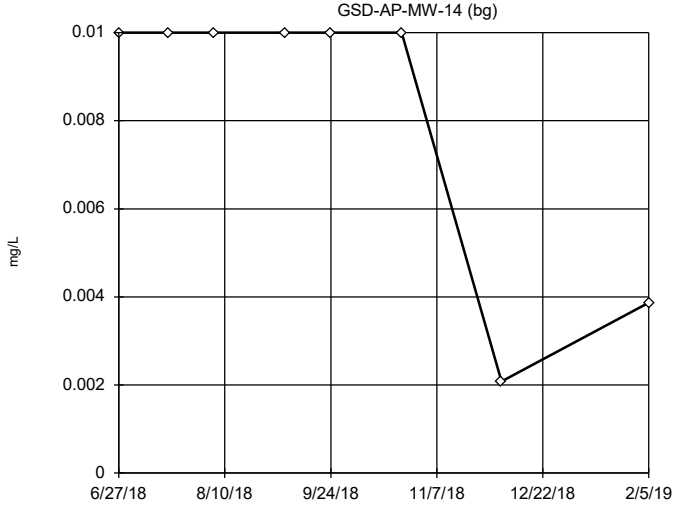
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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 = 0.04154, low cutoff = 0.001498, based on IQR multiplier of 3.

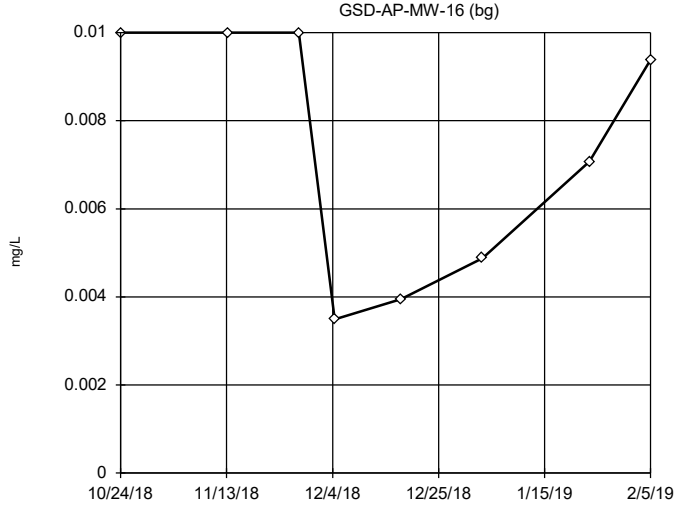
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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

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

High cutoff = 0.05075, low cutoff = 7.4e-7, based on IQR multiplier of 3.

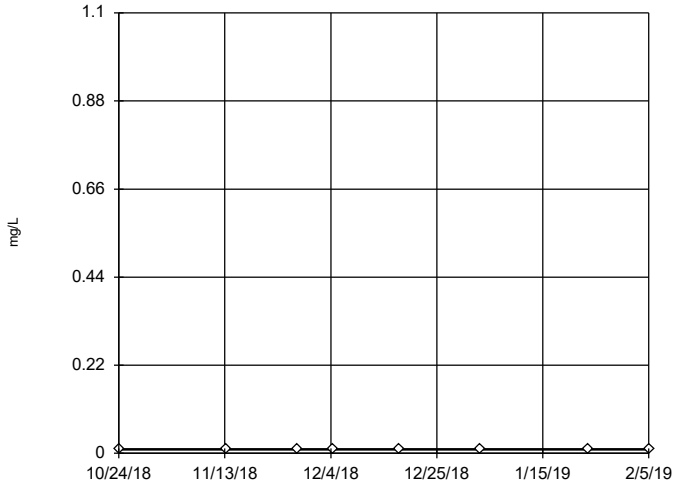
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

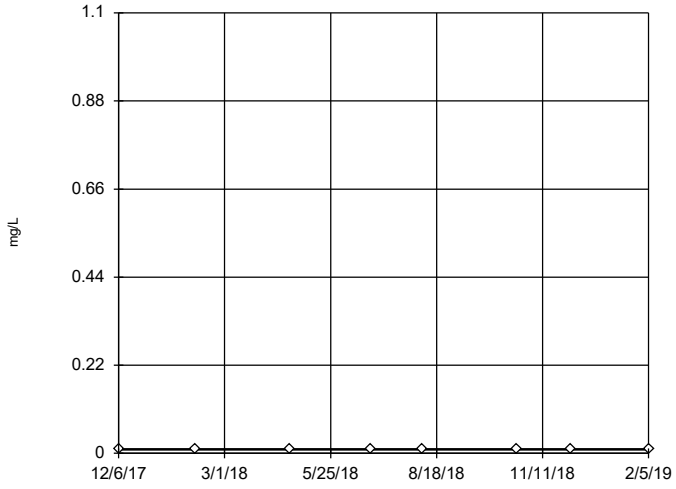
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

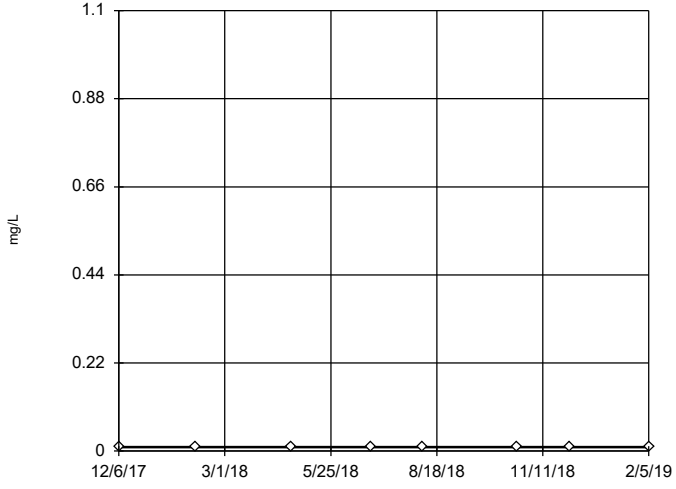
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

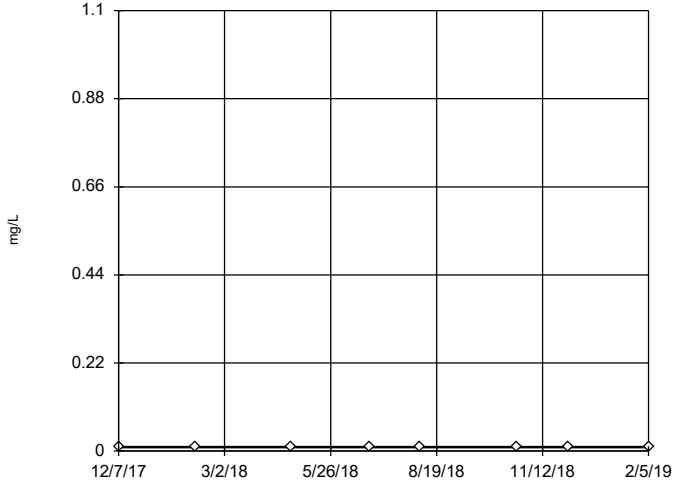
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

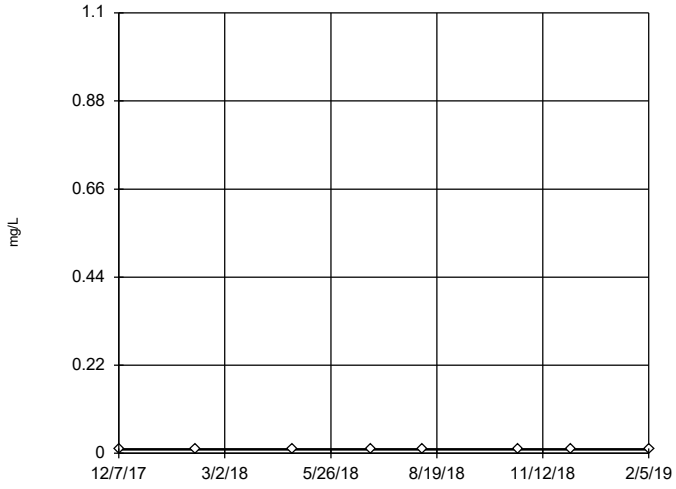
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

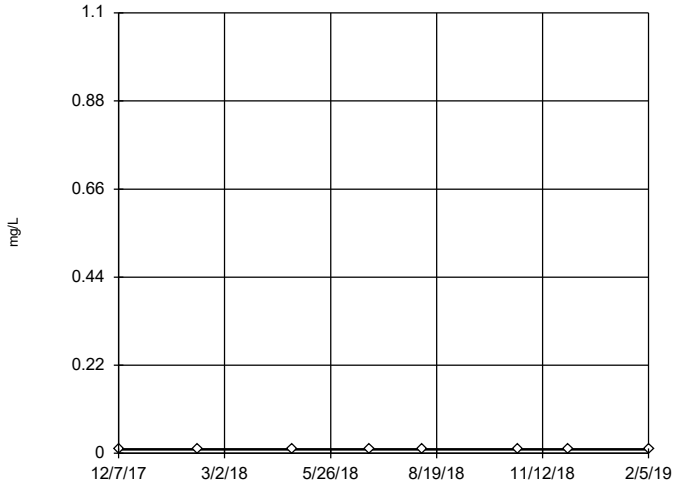
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

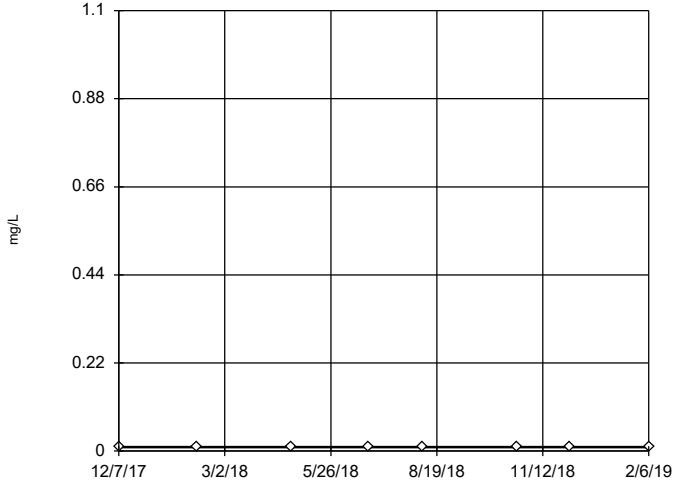
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

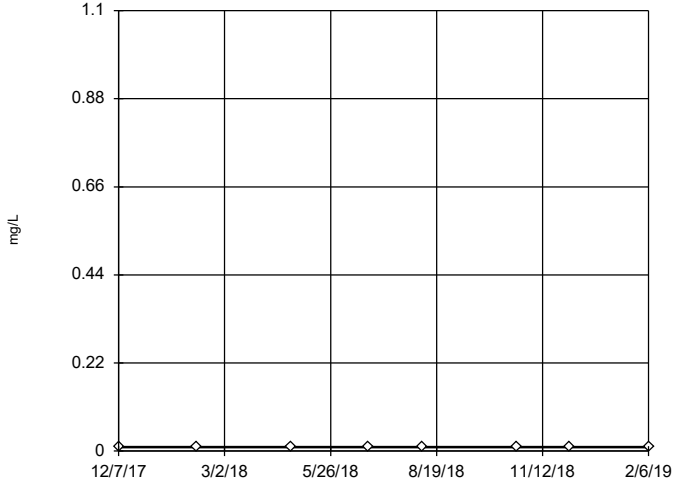
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

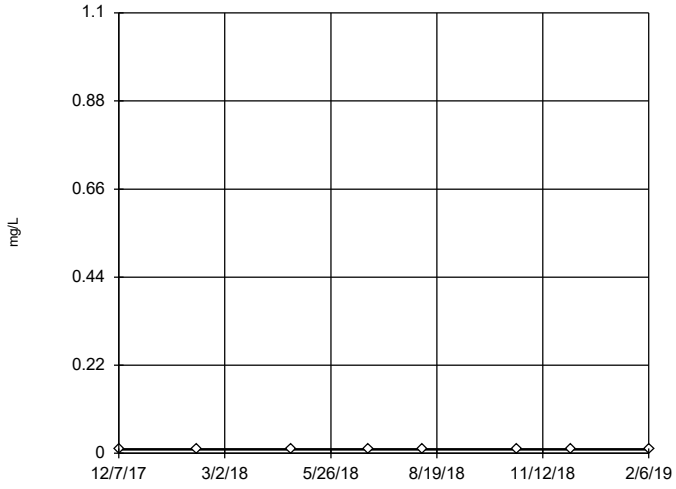
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

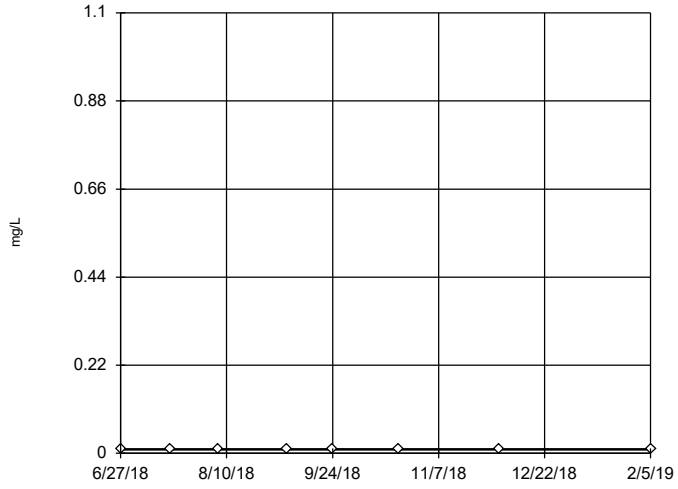
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

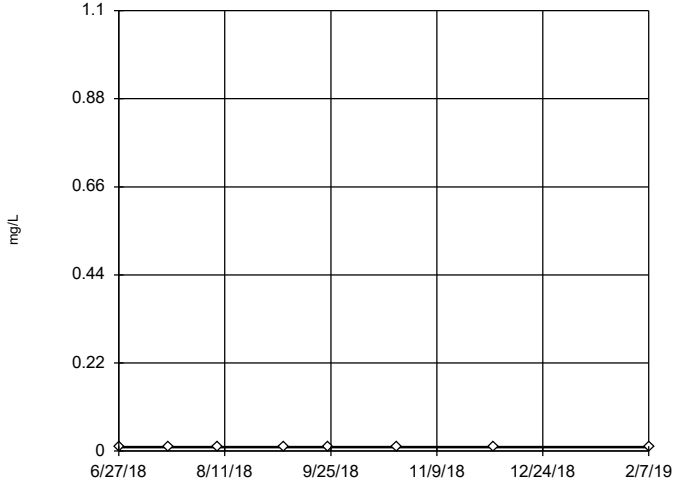
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

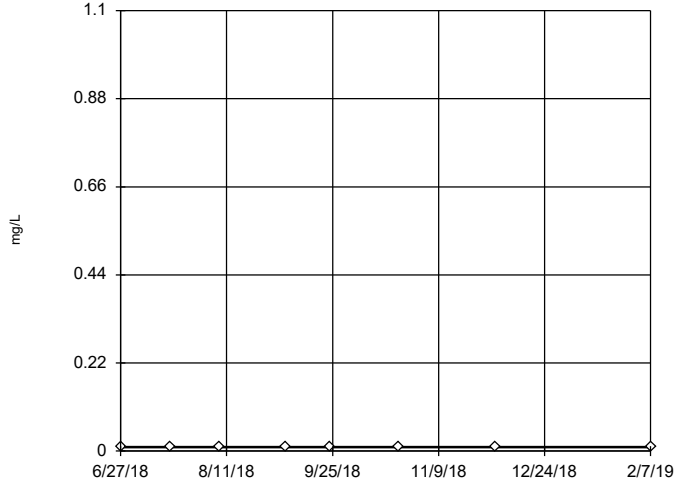
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

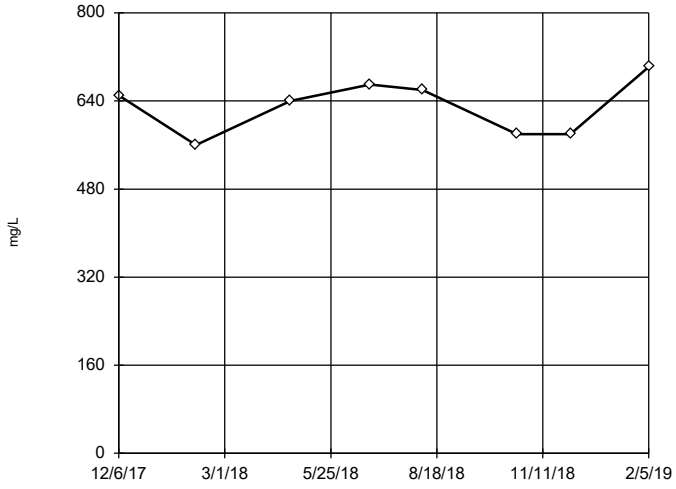
Constituent: Selenium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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 = 798, low cutoff = -662.7, based on IQR multiplier of 3.

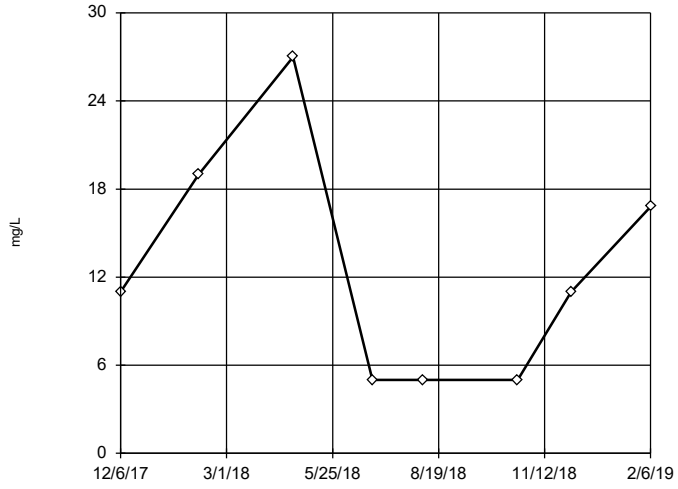
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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 = 104.2, low cutoff = -14, based on IQR multiplier of 3.

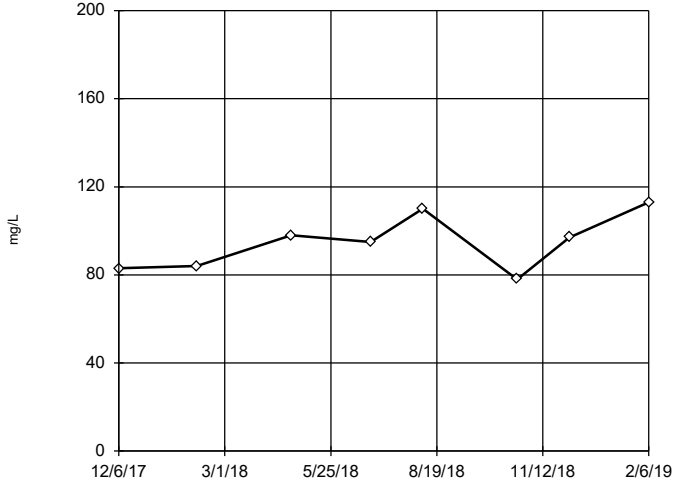
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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 = 199.6, low cutoff = 43.43, based on IQR multiplier of 3.

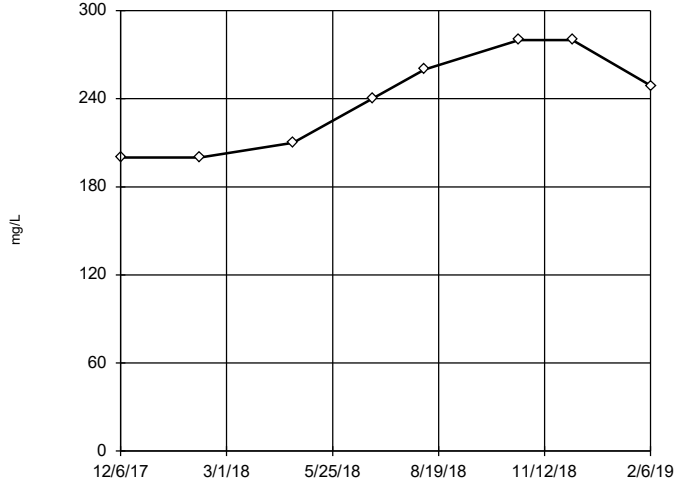
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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 = 407.2, low cutoff = -225.4, based on IQR multiplier of 3.

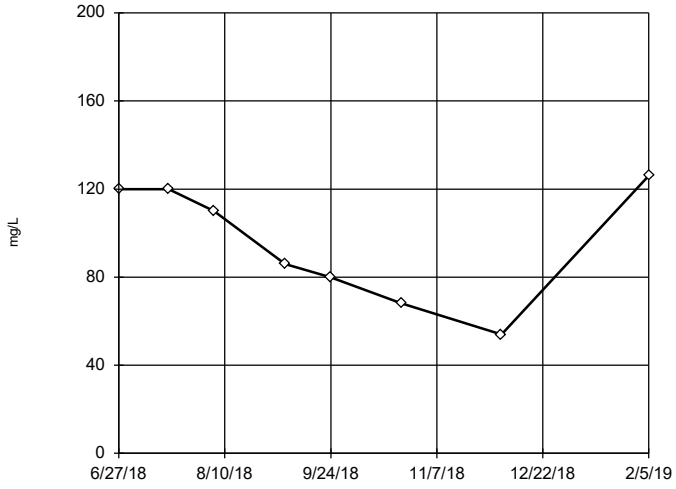
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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

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

High cutoff = 258, low cutoff = -64, based on IQR multiplier of 3.

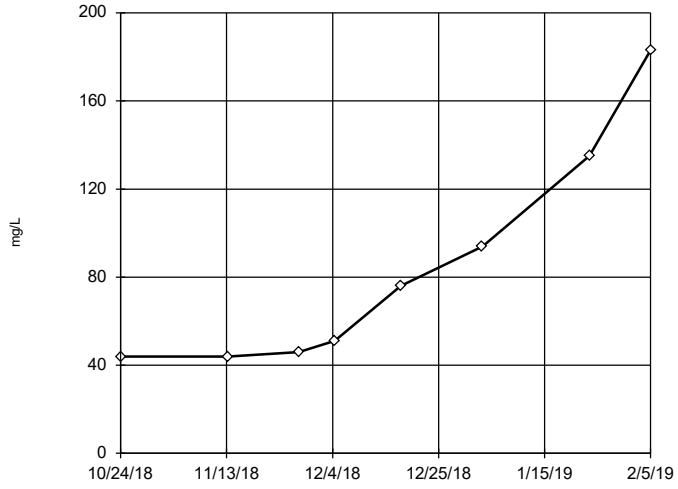
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 1769, low cutoff = 2.866, based on IQR multiplier of 3.

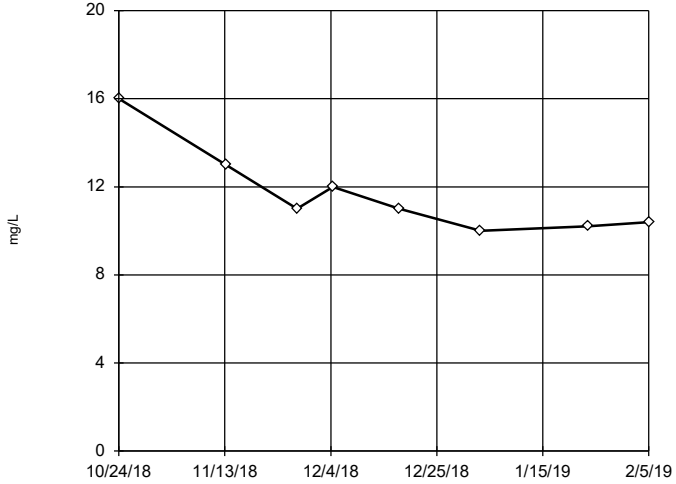
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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 = 22.27, low cutoff = 5.775, based on IQR multiplier of 3.

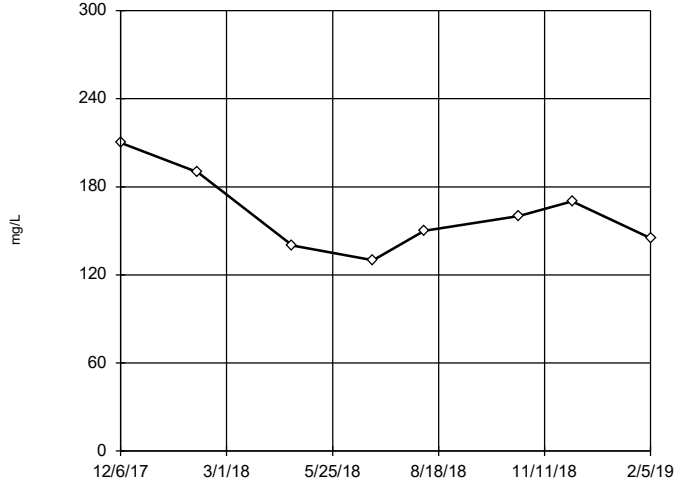
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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 = 360.7, low cutoff = 70.99, based on IQR multiplier of 3.

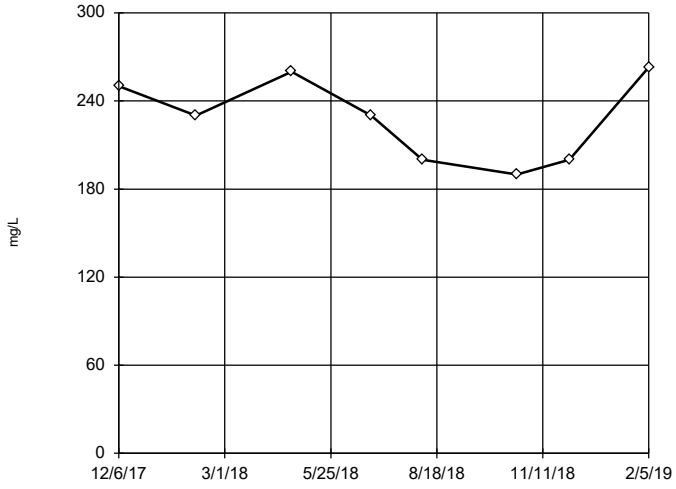
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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 = 374.4, low cutoff = -187.5, based on IQR multiplier of 3.

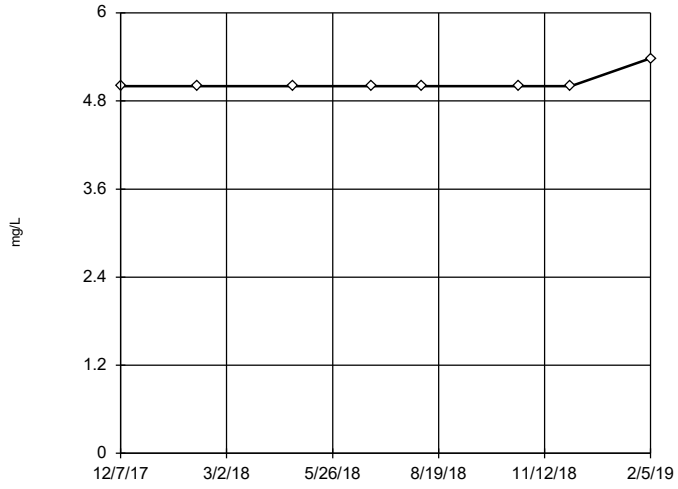
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

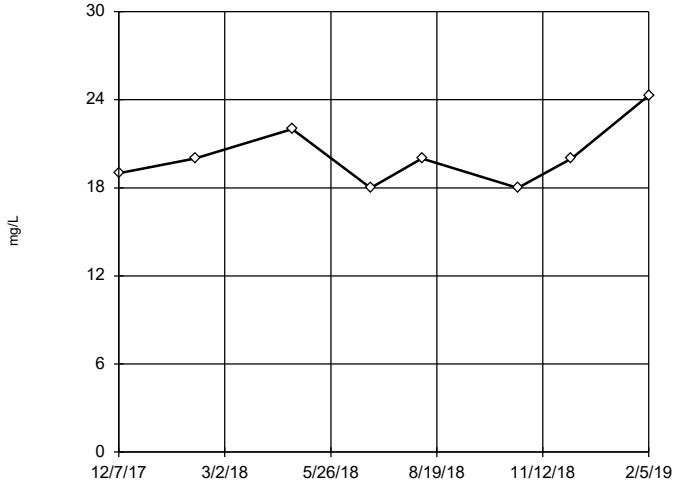
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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 = 30.61, low cutoff = 12.67, based on IQR multiplier of 3.

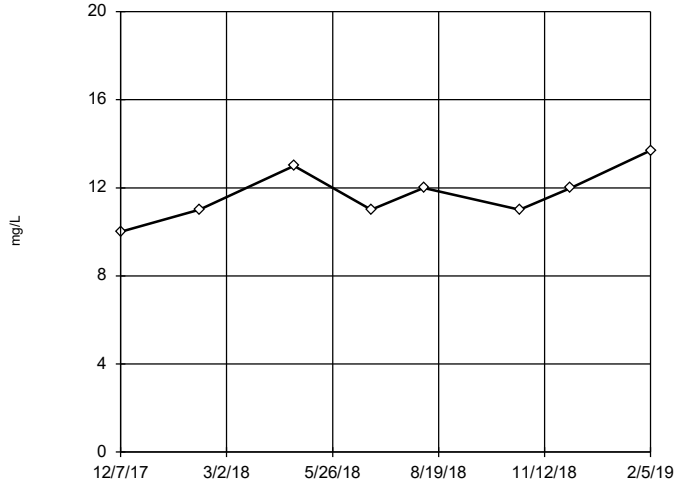
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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 = 18.28, low cutoff = 7.514, based on IQR multiplier of 3.

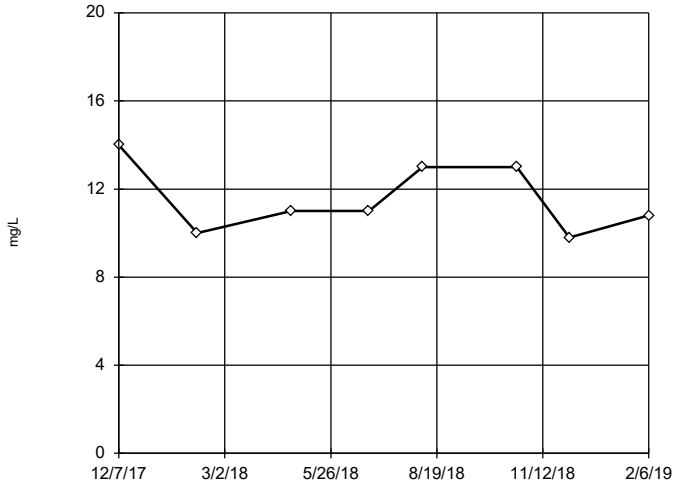
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-7




n = 8

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 = 25.45, low cutoff = 5.309, based on IQR multiplier of 3.

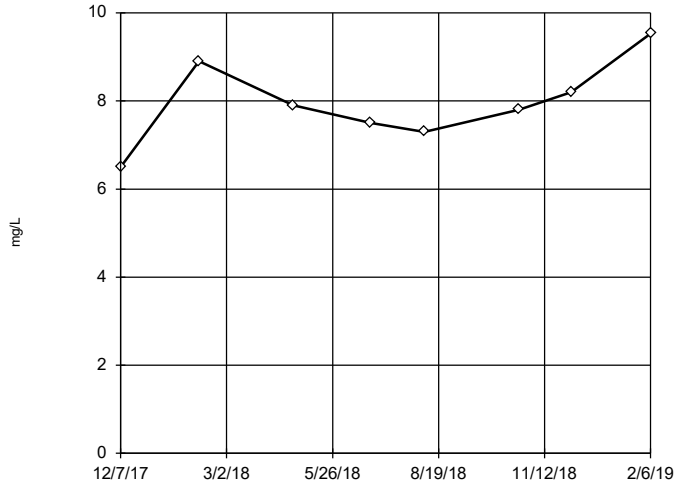
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-8




n = 8

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 = 13.15, low cutoff = 4.808, based on IQR multiplier of 3.

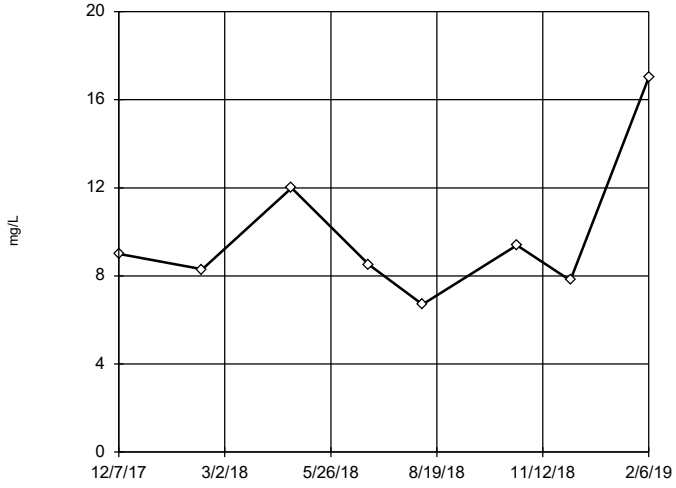
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-9




n = 8

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 = 24.43, low cutoff = 3.498, based on IQR multiplier of 3.

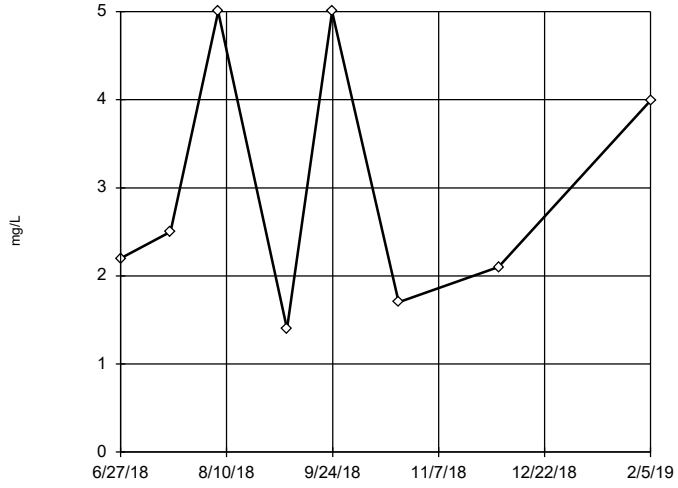
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-1




n = 8

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 = 59, low cutoff = 0.143, based on IQR multiplier of 3.

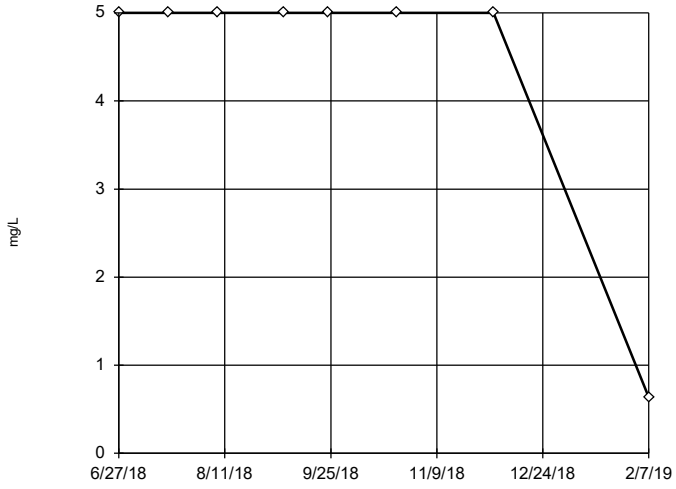
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

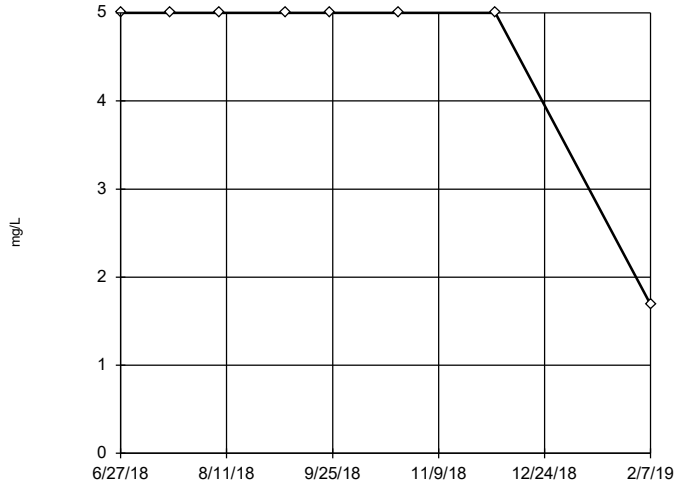
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

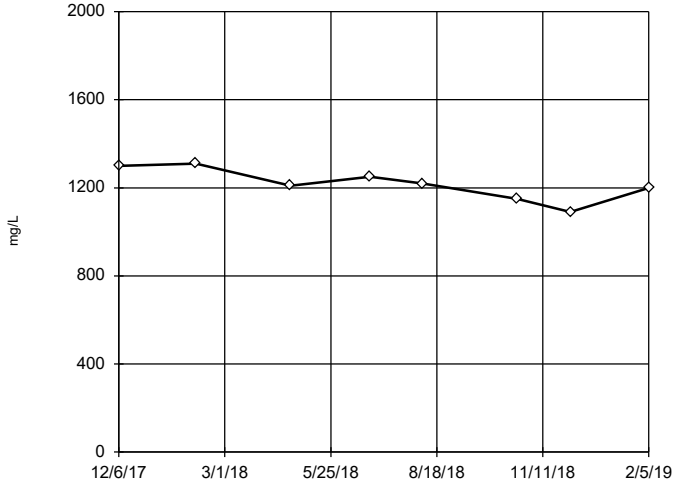
Constituent: Sulfate Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-1




n = 8

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 = 1508, low cutoff = 648.4, based on IQR multiplier of 3.

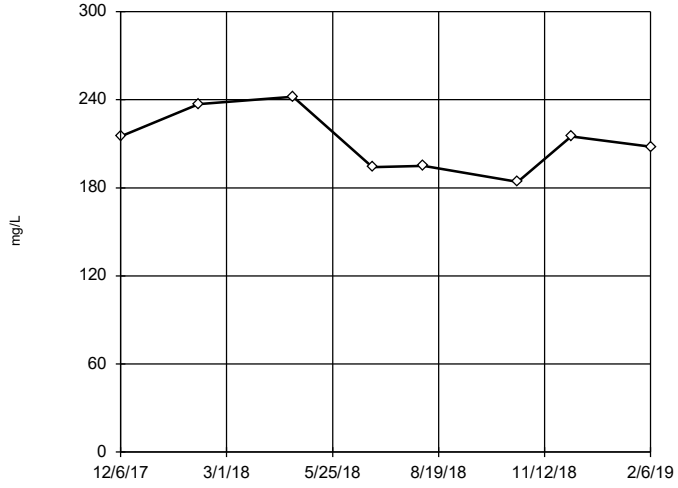
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-10




n = 8

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 = 352.9, low cutoff = 124.4, based on IQR multiplier of 3.

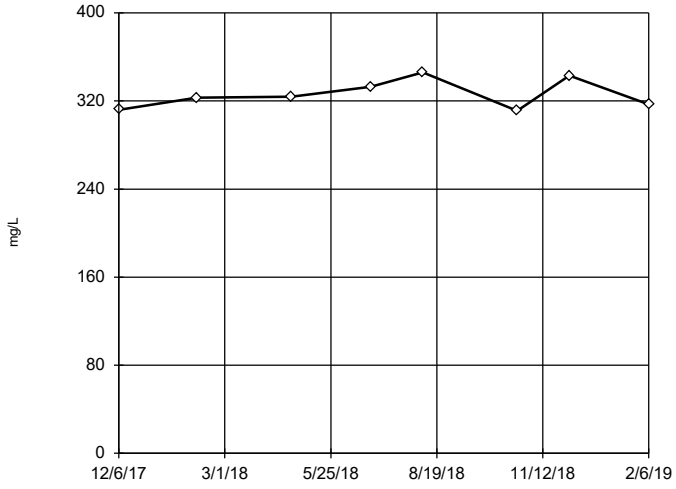
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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 = 419.4, low cutoff = 253.4, based on IQR multiplier of 3.

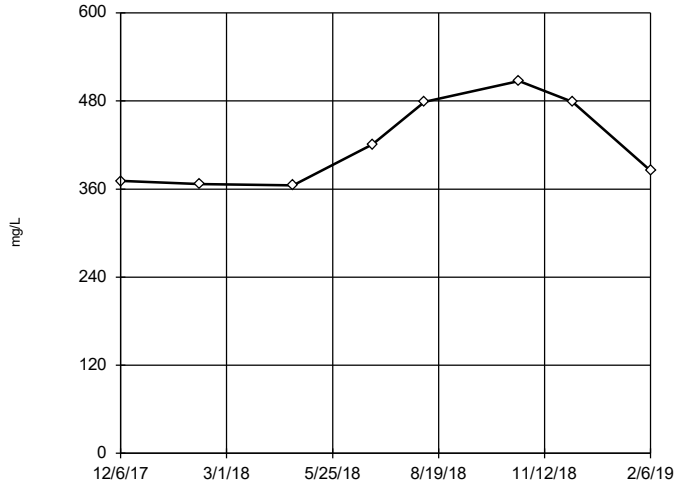
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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 = 1048, low cutoff = 168.7, based on IQR multiplier of 3.

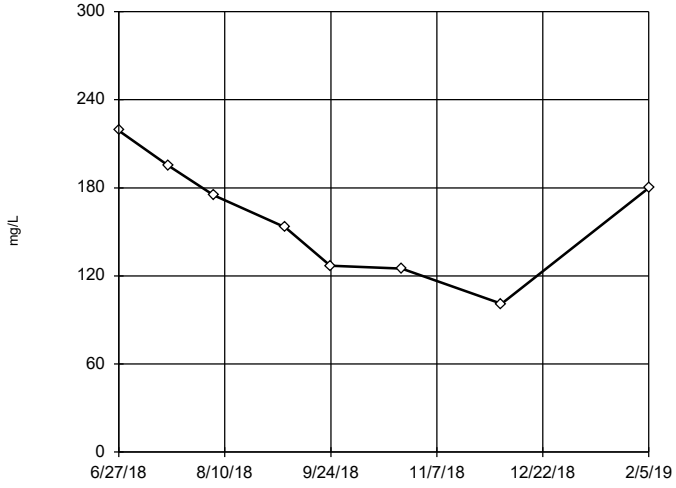
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-14 (bg)




n = 8

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

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

High cutoff = 372, low cutoff = -58.5, based on IQR multiplier of 3.

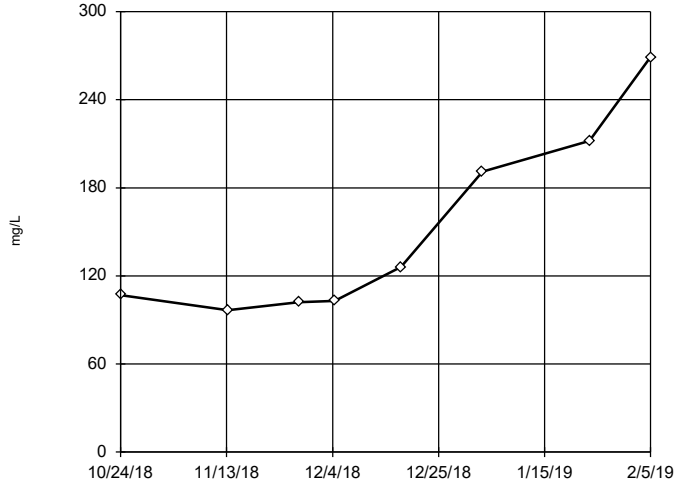
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-16 (bg)




n = 8

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 = 1523, low cutoff = 13.55, based on IQR multiplier of 3.

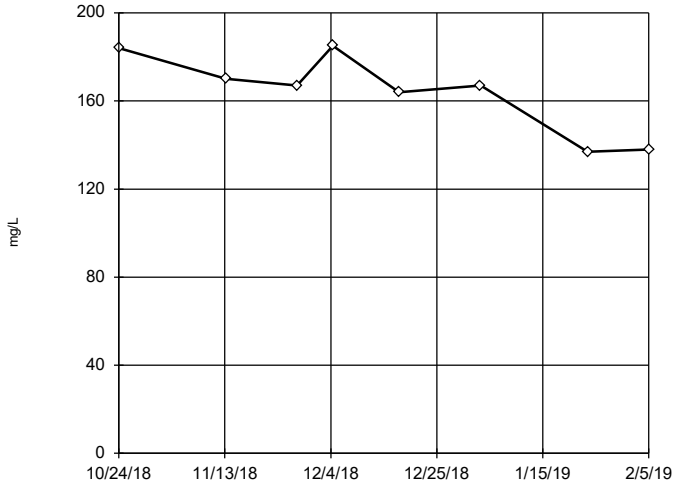
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-17 (bg)




n = 8

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 = 214.4, low cutoff = -180.6, based on IQR multiplier of 3.

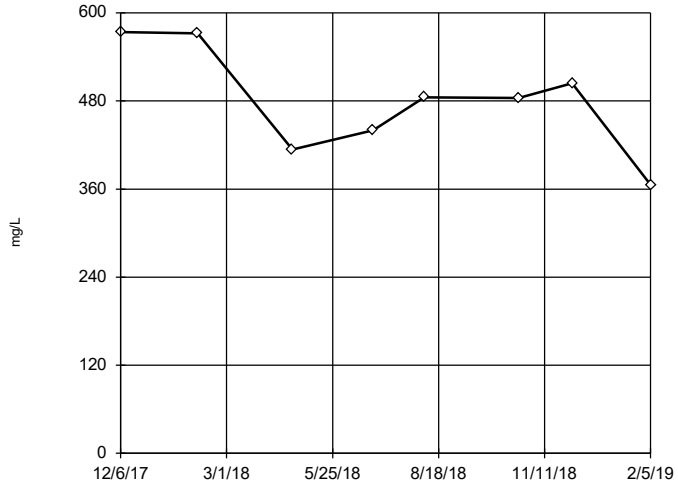
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-2




n = 8

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 = 945.5, low cutoff = 171.5, based on IQR multiplier of 3.

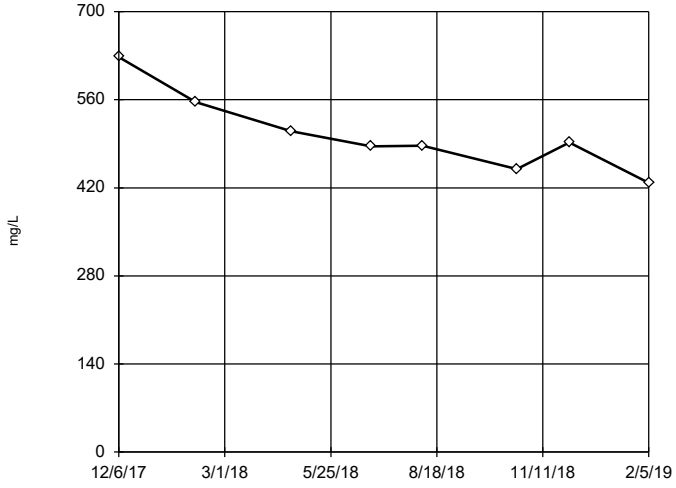
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-3




n = 8

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 = 786.2, low cutoff = 316.8, based on IQR multiplier of 3.

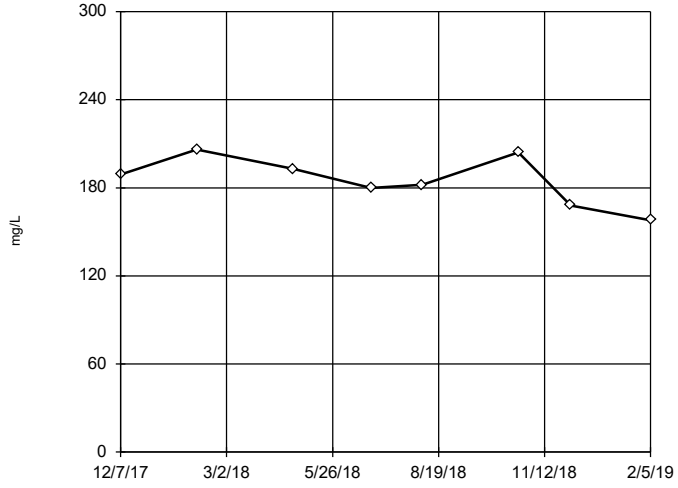
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-4




n = 8

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 = 258.4, low cutoff = 54.32, based on IQR multiplier of 3.

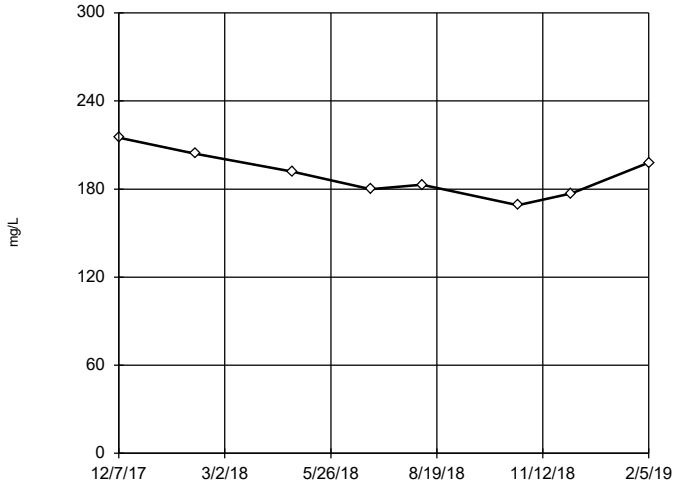
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-5




n = 8

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 = 286.9, low cutoff = 125, based on IQR multiplier of 3.

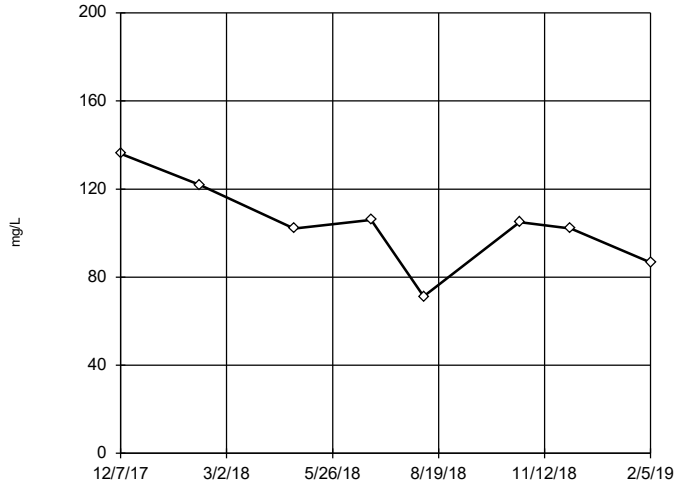
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-6




n = 8

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

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

High cutoff = 173, low cutoff = 35.4, based on IQR multiplier of 3.

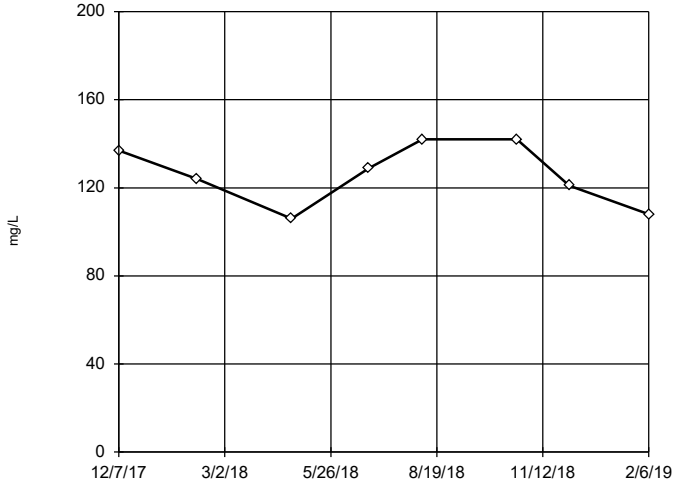
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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 = 184.9, low cutoff = -127.8, based on IQR multiplier of 3.

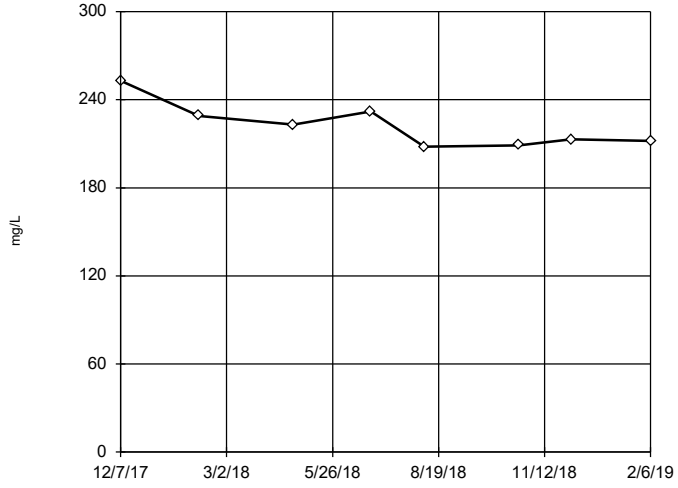
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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 = 302.6, low cutoff = 160.3, based on IQR multiplier of 3.

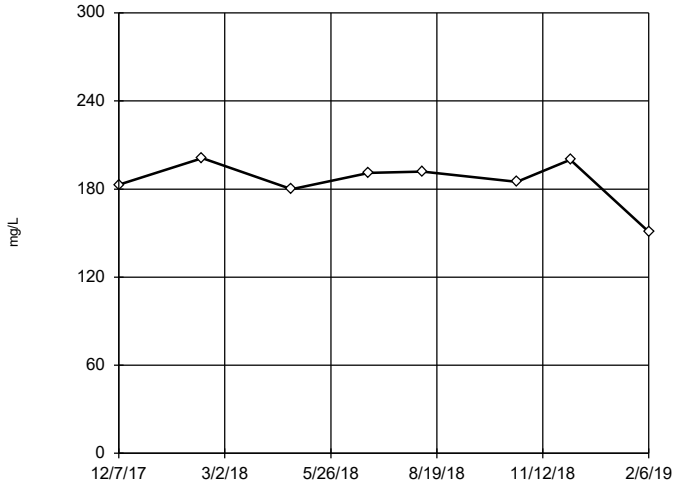
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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 = 222.3, low cutoff = -174.3, based on IQR multiplier of 3.

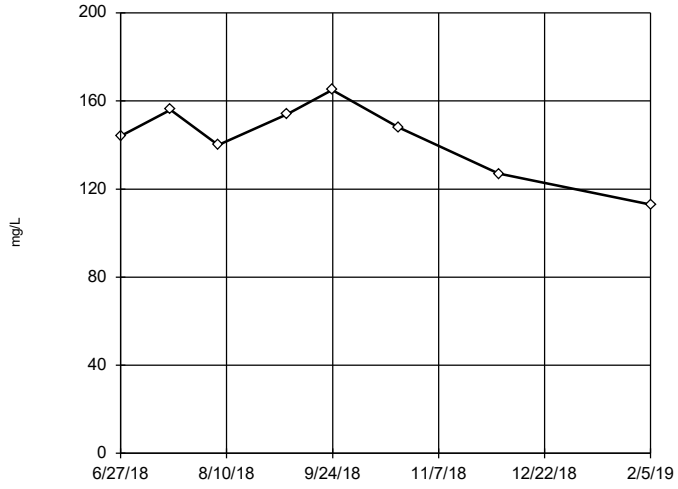
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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 = 191.4, low cutoff = -145.1, based on IQR multiplier of 3.

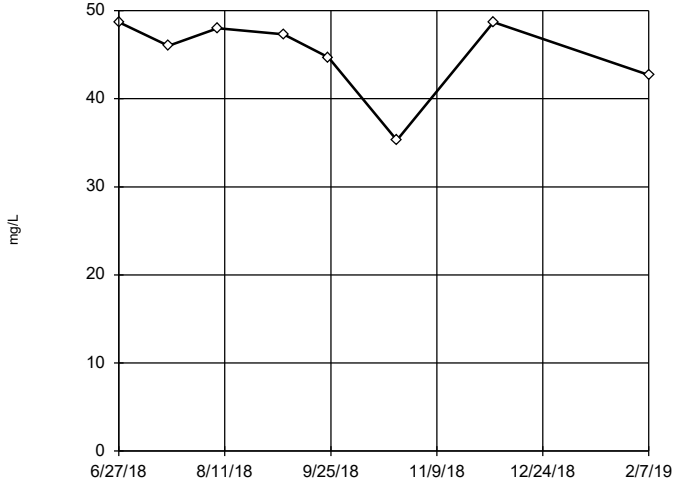
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-5




n = 8

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 = 55.77, low cutoff = -46.63, based on IQR multiplier of 3.

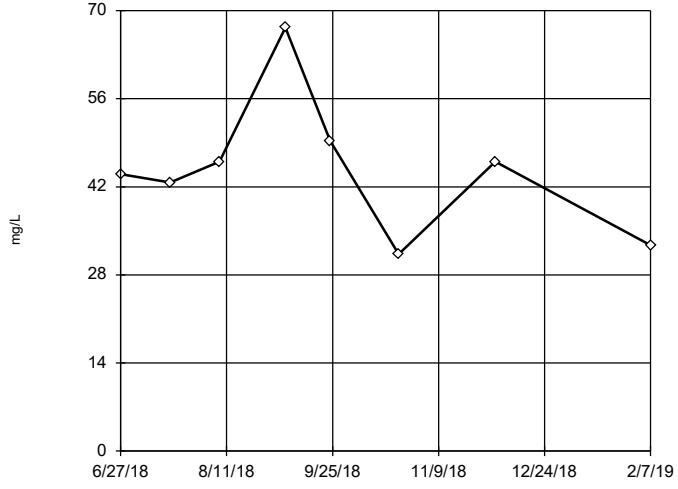
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-6




n = 8

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 = 98.57, low cutoff = 18.05, based on IQR multiplier of 3.

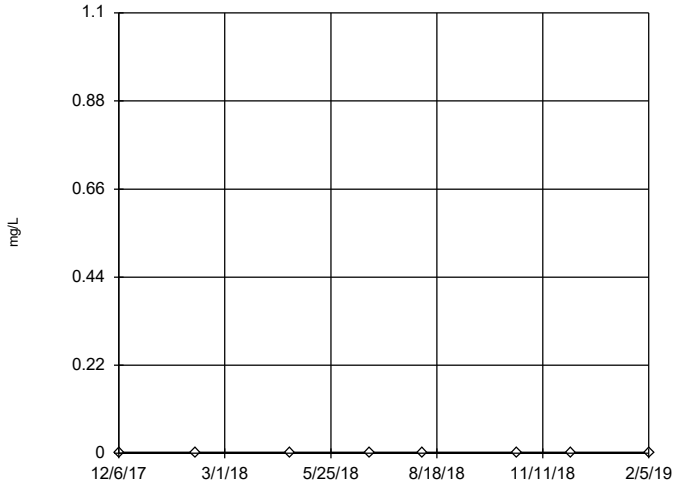
Constituent: TDS Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-1




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

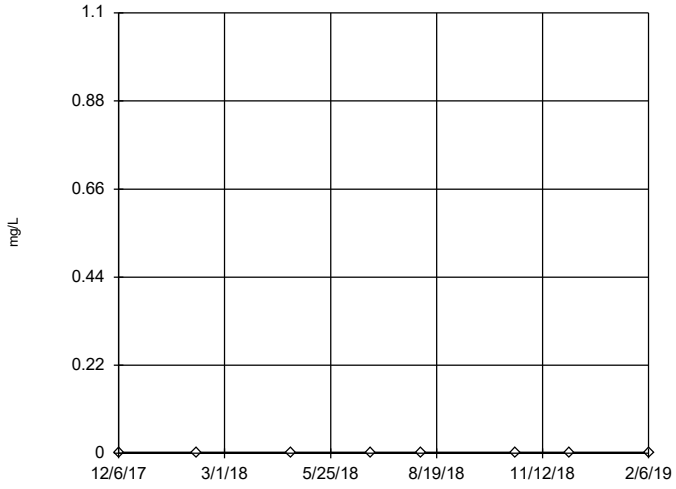
Constituent: Thallium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-10




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

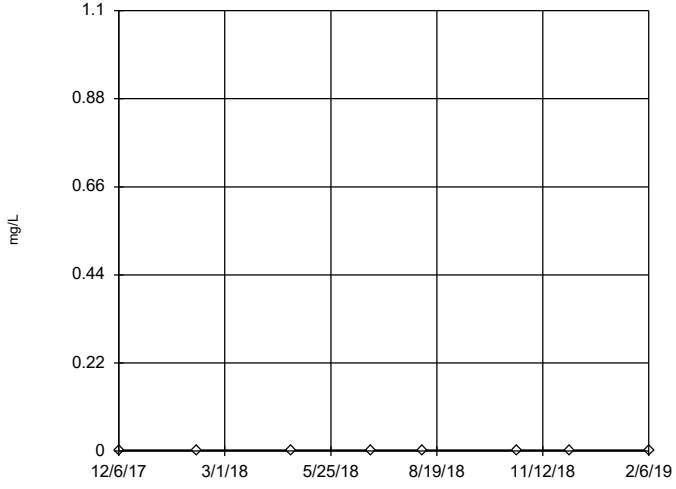
Constituent: Thallium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-11




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

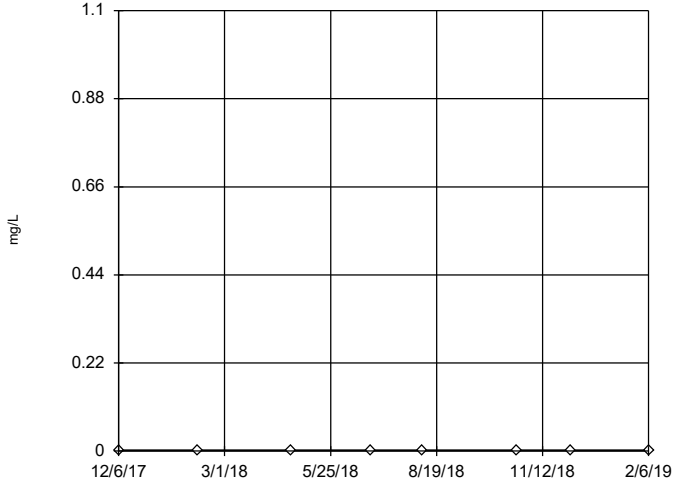
Constituent: Thallium Analysis Run 4/2/2019 2:59 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-12




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

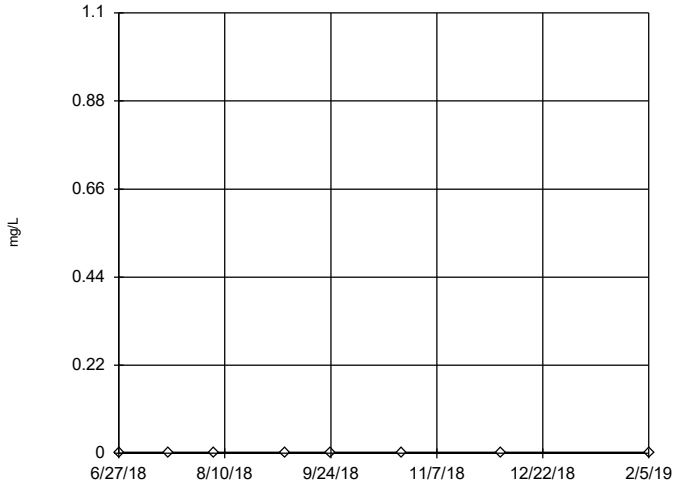
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-14 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

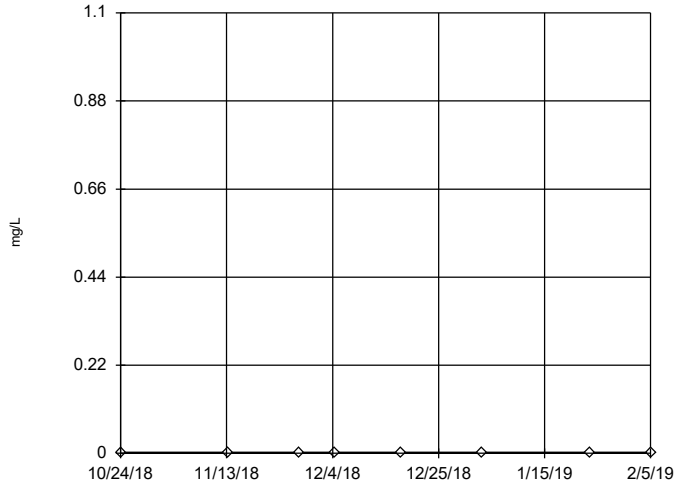
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-16 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

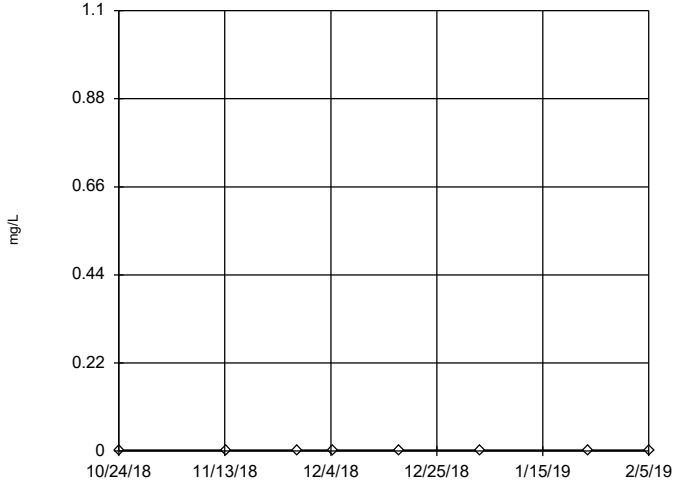
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-17 (bg)




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

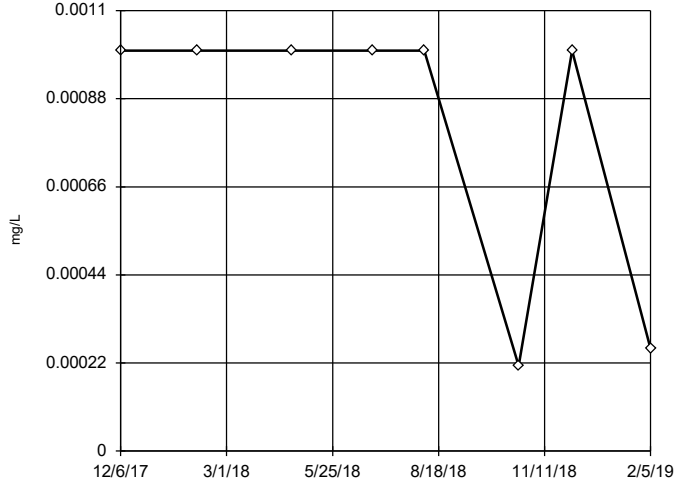
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-2




n = 8

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 = 0.00772, low cutoff = 0.00006554, based on IQR multiplier of 3.

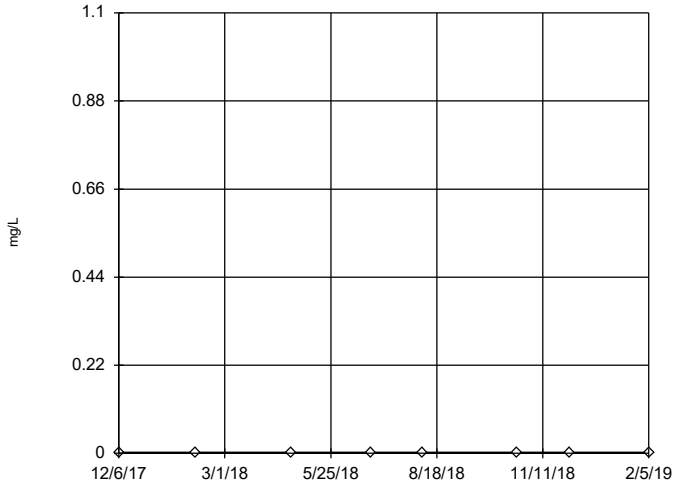
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-3




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

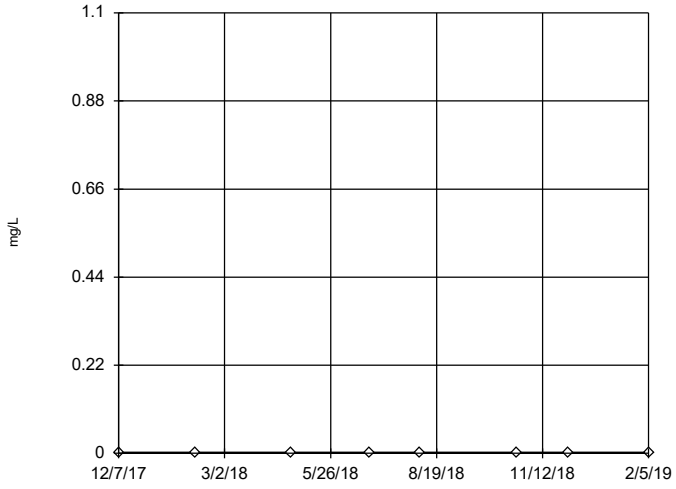
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-4




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

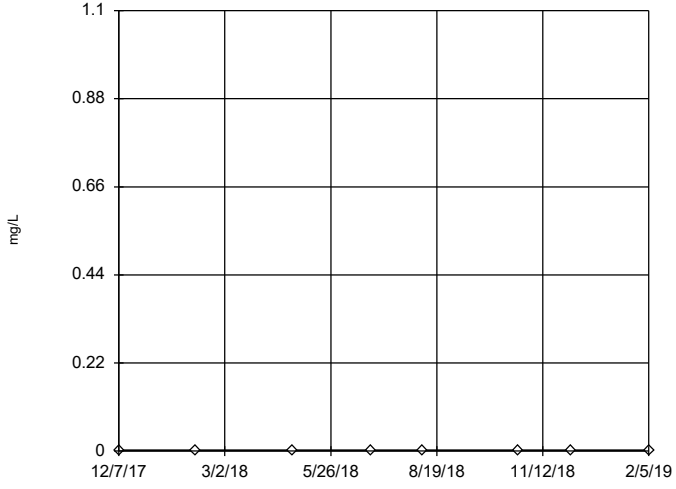
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-5




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

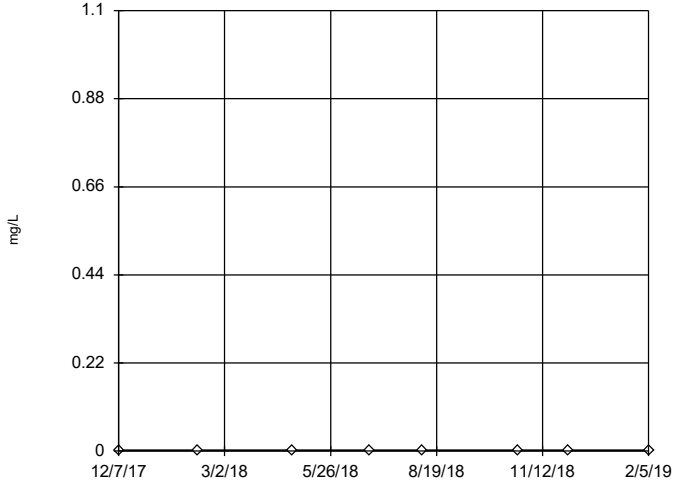
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-MW-6




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

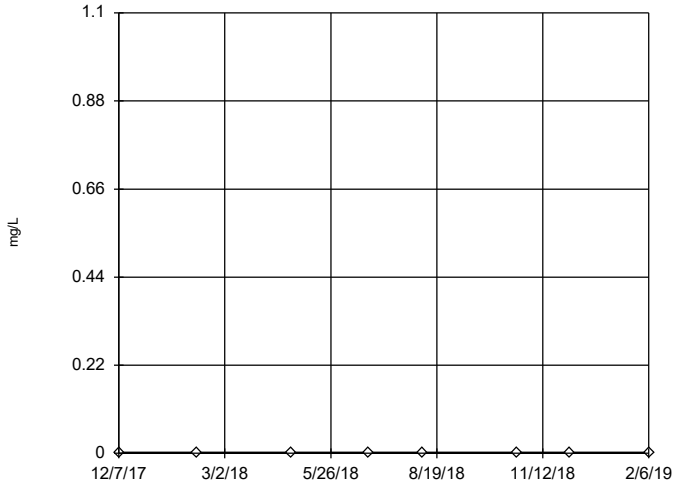
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-7




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

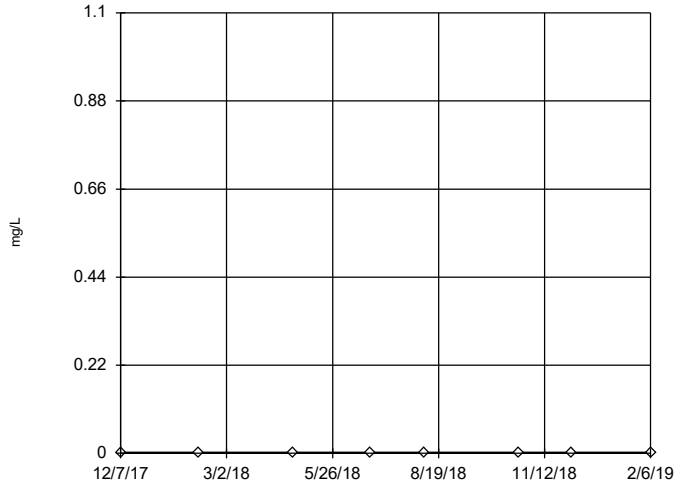
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-8




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

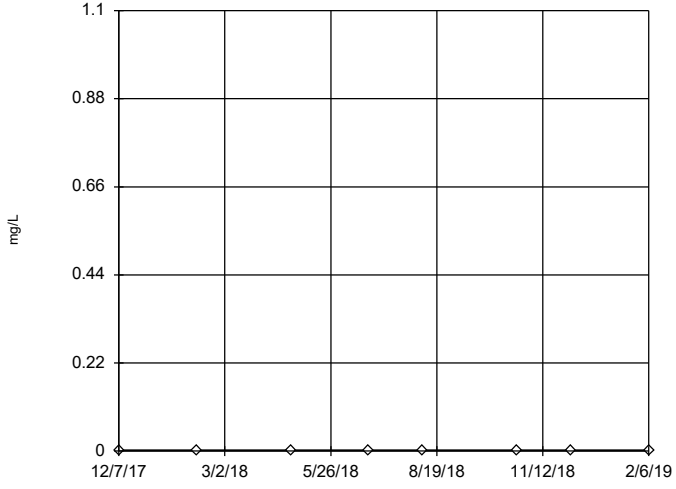
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-MW-9




n = 8

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

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

The results were invalidated, because the lower and upper quartiles are equal.

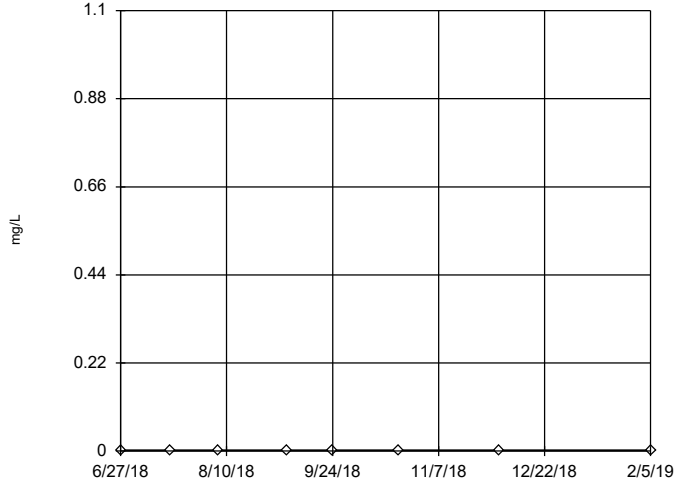
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

### GSD-AP-PZ-1




n = 8

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

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

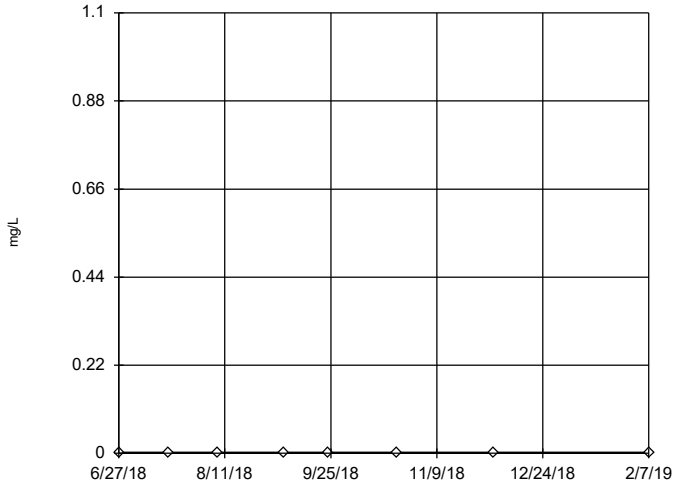
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

## Tukey's Outlier Screening

GSD-AP-PZ-5




n = 8

No outliers found.
Tukey's method select-
ed by user.

Data were cube root trans-
formed to achieve best
W statistic (graph shown
in original units).

The results were invalid-
ated, because the lower
and upper quartiles are
equal.

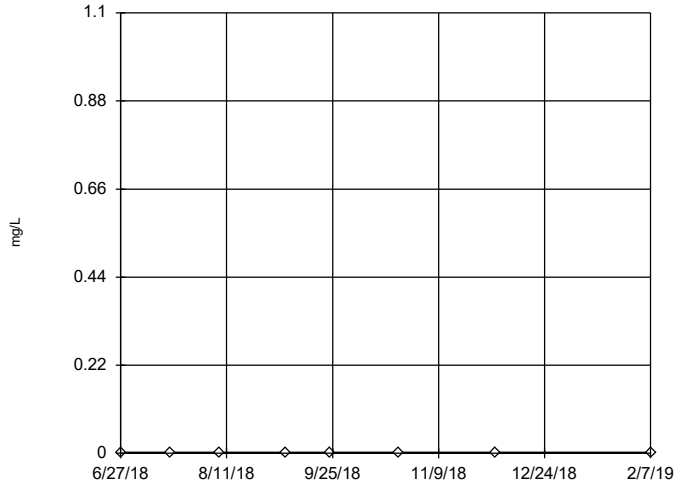
Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Tukey's Outlier Screening

GSD-AP-PZ-6




n = 8

No outliers found.
Tukey's method select-
ed by user.

Data were cube root trans-
formed to achieve best
W statistic (graph shown
in original units).

The results were invalid-
ated, because the lower
and upper quartiles are
equal.

Constituent: Thallium Analysis Run 4/2/2019 3:00 PM View: Descriptive

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# FIGURE D.

# Trend Test Summary Table - Significant Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:10 PM

| Constituent | Well | Slope | Calc. | Critical | Sig. | N | %NDs | Normality | Xform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Calcium (mg/L)** | **GSD-AP-MW-17 (bg)** | **-42.07** | **-22** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| **Calcium (mg/L)** | **GSD-AP-MW-6** | **-10.88** | **-24** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| **Chloride (mg/L)** | **GSD-AP-MW-17 (bg)** | **-2.835** | **-25** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| **pH (pH)** | **GSD-AP-MW-1** | **-0.3274** | **-25** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| **pH (pH)** | **GSD-AP-MW-16 (bg)** | **-3.068** | **-26** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| **pH (pH)** | **GSD-AP-MW-17 (bg)** | **5.067** | **22** | **21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| **Sulfate (mg/L)** | **GSD-AP-MW-16 (bg)** | **487.3** | **27** | **21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| **TDS (mg/L)** | **GSD-AP-MW-16 (bg)** | **619.3** | **22** | **21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |

# Trend Test Summary Table - All Results

Plant Gadsden  Client: Southern Company  Data: Plant Gadsden CCR  Printed 4/2/2019, 3:10 PM

| Constituent | Well | Slope | Calc. | Critical | Sig. | N | %NDs | Normality | Xform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Boron (mg/L) | GSD-AP-MW-1 | -0.09152 | -17 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-10 | -0.02316 | -12 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-11 | 0.002319 | 3 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-12 | 0.004657 | 6 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-14 (bg) | 0 | 0 | 21 | No | 8 | 100 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-16 (bg) | 0.001587 | 2 | 21 | No | 8 | 25 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-17 (bg) | -0.01789 | -12 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-2 | -0.05692 | -6 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-3 | 0.04917 | 14 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-4 | -0.04747 | -10 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-5 | -0.1038 | -14 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-6 | -0.0003422 | -1 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-7 | -0.002778 | -2 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-8 | -0.01177 | -12 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-MW-9 | 0.003052 | 6 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-PZ-1 | 0 | 0 | 21 | No | 8 | 100 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-PZ-5 | 0 | 0 | 21 | No | 8 | 100 | n/a | n/a | 0.01 | NP |
| Boron (mg/L) | GSD-AP-PZ-6 | 0 | 0 | 21 | No | 8 | 100 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-1 | -17.52 | -10 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-10 | -4.923 | -6 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-11 | 2 | 11 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-12 | 14.23 | 16 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-14 (bg) | -15.48 | -18 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-16 (bg) | 25.05 | 13 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| **Calcium (mg/L)** | **GSD-AP-MW-17 (bg)** | **-42.07** | **-22** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| Calcium (mg/L) | GSD-AP-MW-2 | -21.67 | -7 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-3 | -31.27 | -12 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-4 | -2.836 | -8 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-5 | -11.07 | -20 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| **Calcium (mg/L)** | **GSD-AP-MW-6** | **-10.88** | **-24** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| Calcium (mg/L) | GSD-AP-MW-7 | -2.124 | -4 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-8 | -8.838 | -16 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-MW-9 | 1.8 | 6 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-PZ-1 | -12.76 | -4 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-PZ-5 | -2.056 | -20 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Calcium (mg/L) | GSD-AP-PZ-6 | -0.1851 | -14 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-1 | -0.326 | -12 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-10 | -0.7224 | -8 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-11 | -0.2893 | -7 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-12 | -0.2199 | -8 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-14 (bg) | -0.7131 | -6 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-16 (bg) | 1.908 | 14 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| **Chloride (mg/L)** | **GSD-AP-MW-17 (bg)** | **-2.835** | **-25** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| Chloride (mg/L) | GSD-AP-MW-2 | -0.6839 | -7 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-3 | -0.738 | -17 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-4 | 0.9626 | 12 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-5 | -1.624 | -19 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-6 | -0.918 | -15 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-7 | -0.1017 | -1 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-8 | -0.4808 | -2 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-MW-9 | -0.4435 | -2 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-PZ-1 | -0.1819 | -6 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-PZ-5 | -0.6493 | -8 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Chloride (mg/L) | GSD-AP-PZ-6 | -0.0671 | -2 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-1 | -0.03842 | -20 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |

# Trend Test Summary Table - All Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:10 PM

| Constituent | Well | Slope | Calc. | Critical | Sig. | N | %NDs | Normality | Xform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fluoride (mg/L) | GSD-AP-MW-10 | 0.01297 | 4 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-11 | 1.1e-9 | 7 | 21 | No | 8 | 12.5 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-12 | 0 | -3 | -21 | No | 8 | 87.5 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-14 (bg) | -0.3206 | -19 | -21 | No | 8 | 12.5 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-16 (bg) | -0.05214 | -3 | -21 | No | 8 | 25 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-17 (bg) | -0.1507 | -11 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-2 | -0.07406 | -15 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-3 | -0.01943 | -5 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-4 | 0 | 2 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-5 | 0.006364 | 6 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-6 | 0.01289 | 7 | 21 | No | 8 | 12.5 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-7 | -0.01429 | -5 | -21 | No | 8 | 12.5 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-8 | -0.05535 | -16 | -21 | No | 8 | 12.5 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-MW-9 | -0.02724 | -4 | -21 | No | 8 | 12.5 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-PZ-1 | -0.015 | -7 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-PZ-5 | 0 | 5 | 21 | No | 8 | 25 | n/a | n/a | 0.01 | NP |
| Fluoride (mg/L) | GSD-AP-PZ-6 | 0 | 12 | 21 | No | 8 | 25 | n/a | n/a | 0.01 | NP |
| **pH (pH)** | **GSD-AP-MW-1** | **-0.3274** | **-25** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| pH (pH) | GSD-AP-MW-10 | -0.09422 | -13 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-11 | -0.1406 | -15 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-12 | -0.1287 | -5 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-14 (bg) | 0.1453 | 13 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| **pH (pH)** | **GSD-AP-MW-16 (bg)** | **-3.068** | **-26** | **-21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| **pH (pH)** | **GSD-AP-MW-17 (bg)** | **5.067** | **22** | **21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| pH (pH) | GSD-AP-MW-2 | -0.1545 | -18 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-3 | -0.2311 | -8 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-4 | -0.08065 | -11 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-5 | -0.17 | -15 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-6 | -0.2578 | -21 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-7 | -0.1047 | -12 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-8 | -0.08974 | -6 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-MW-9 | -0.04147 | -6 | -25 | No | 9 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-PZ-1 | -0.2137 | -10 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-PZ-5 | -0.5318 | -18 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| pH (pH) | GSD-AP-PZ-6 | 0.08323 | 3 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-1 | 26.27 | 5 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-10 | 0 | -2 | -21 | No | 8 | 37.5 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-11 | 20.29 | 12 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-12 | 84.8 | 20 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-14 (bg) | -140 | -13 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| **Sulfate (mg/L)** | **GSD-AP-MW-16 (bg)** | **487.3** | **27** | **21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| Sulfate (mg/L) | GSD-AP-MW-17 (bg) | -15.89 | -19 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-2 | -41.33 | -6 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-3 | -42.26 | -6 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-4 | 0 | 7 | 21 | No | 8 | 87.5 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-5 | 1.254 | 6 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-6 | 2.025 | 14 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-7 | -0.2894 | -6 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-8 | 1.535 | 10 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-MW-9 | 0.5005 | 2 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-PZ-1 | 1.165 | 1 | 21 | No | 8 | 25 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-PZ-5 | 0 | -7 | -21 | No | 8 | 87.5 | n/a | n/a | 0.01 | NP |
| Sulfate (mg/L) | GSD-AP-PZ-6 | 0 | -7 | -21 | No | 8 | 87.5 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-1 | -163.8 | -18 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-10 | -29.5 | -7 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |

# Trend Test Summary Table - All Results

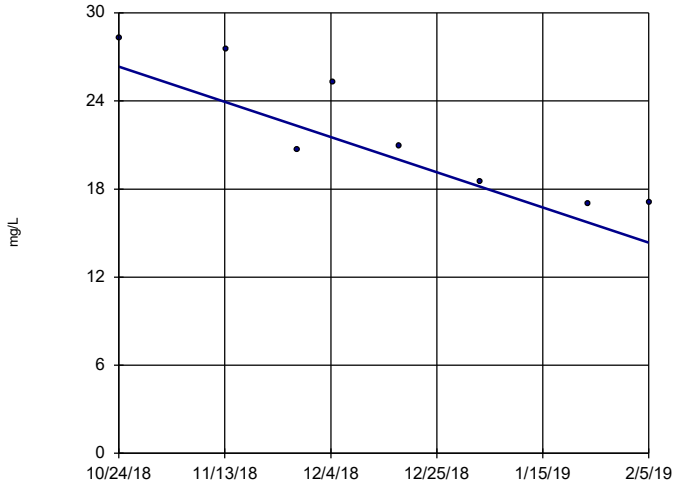
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:10 PM

| Constituent | Well | Slope | Calc. | Critical | Sig. | N | %NDs | Normality | Xform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TDS (mg/L) | GSD-AP-MW-11 | 21.74 | 6 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-12 | 119.9 | 11 | 21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-14 (bg) | -238 | -18 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| **TDS (mg/L)** | **GSD-AP-MW-16 (bg)** | **619.3** | **22** | **21** | **Yes** | **8** | **0** | **n/a** | **n/a** | **0.01** | **NP** |
| TDS (mg/L) | GSD-AP-MW-17 (bg) | -157.4 | -17 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-2 | -92.56 | -10 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-3 | -132.6 | -20 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-4 | -37.23 | -14 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-5 | -33.33 | -14 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-6 | -34.87 | -17 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-7 | -9.095 | -3 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-8 | -28.61 | -14 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-MW-9 | -4.555 | -2 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-PZ-1 | -43.4 | -10 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-PZ-5 | -8.213 | -11 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |
| TDS (mg/L) | GSD-AP-PZ-6 | -17.55 | -3 | -21 | No | 8 | 0 | n/a | n/a | 0.01 | NP |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Sen's Slope Estimator

GSD-AP-MW-17 (bg)




n = 8

Slope = -42.07 units per year.

Mann-Kendall statistic = -22 critical = -21

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

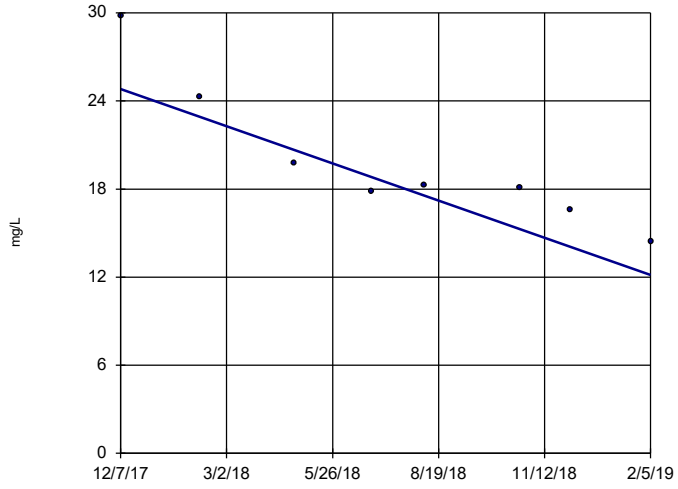
Constituent: Calcium Analysis Run 4/2/2019 3:05 PM View: Trend Testing

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Sen's Slope Estimator

GSD-AP-MW-6




n = 8

Slope = -10.88 units per year.

Mann-Kendall statistic = -24 critical = -21

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

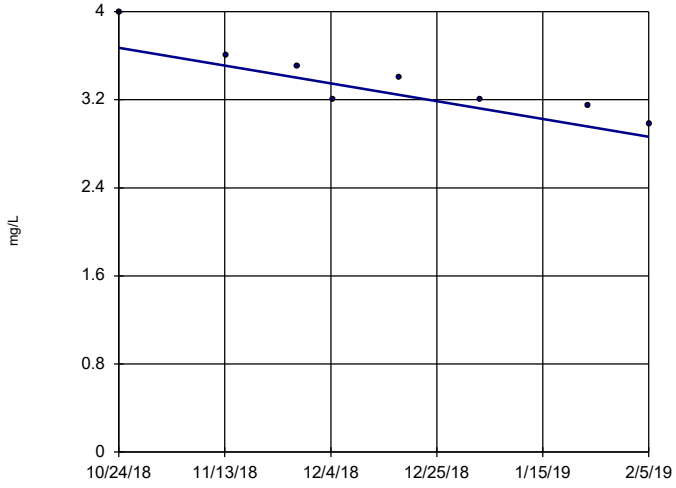
Constituent: Calcium Analysis Run 4/2/2019 3:05 PM View: Trend Testing

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Sen's Slope Estimator

GSD-AP-MW-17 (bg)




n = 8

Slope = -2.835 units per year.

Mann-Kendall statistic = -25 critical = -21

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

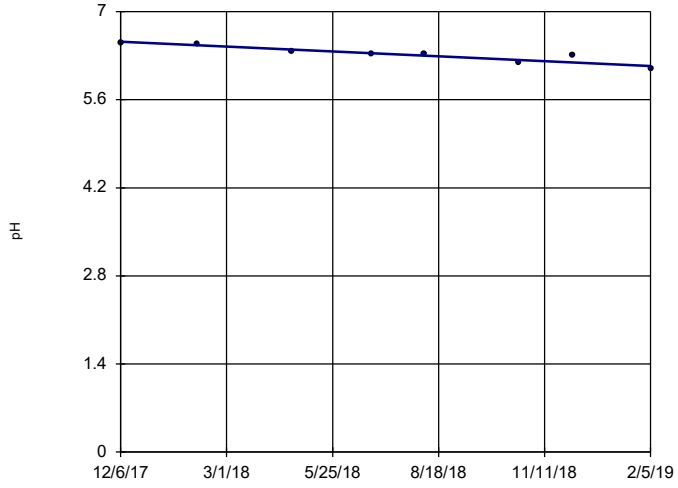
Constituent: Chloride Analysis Run 4/2/2019 3:05 PM View: Trend Testing

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Sen's Slope Estimator

GSD-AP-MW-1




n = 8

Slope = -0.3274 units per year.

Mann-Kendall statistic = -25 critical = -21

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

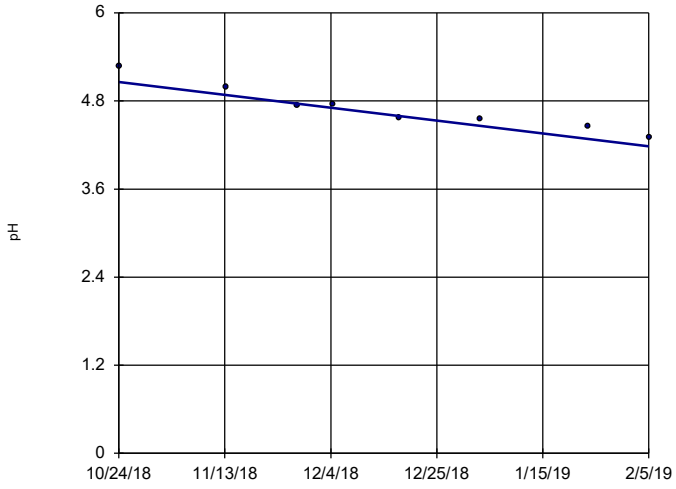
Constituent: pH Analysis Run 4/2/2019 3:06 PM View: Trend Testing

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Sen's Slope Estimator

GSD-AP-MW-16 (bg)




n = 8

Slope = -3.068 units per year.

Mann-Kendall statistic = -26 critical = -21

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

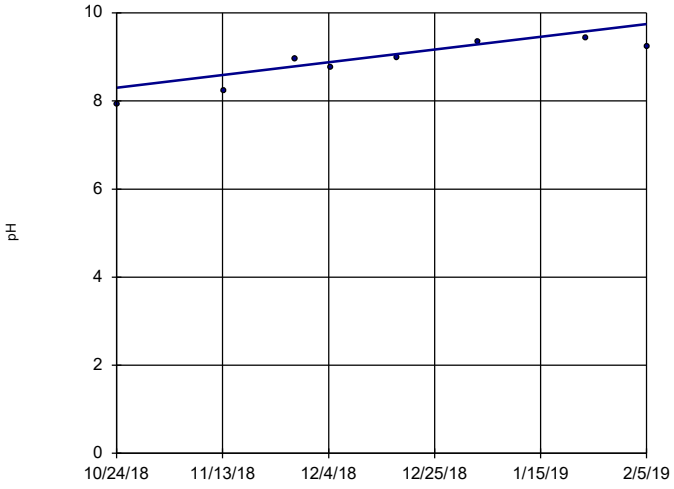
Constituent: pH Analysis Run 4/2/2019 3:06 PM View: Trend Testing

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Sen's Slope Estimator

GSD-AP-MW-17 (bg)




n = 8

Slope = 5.067 units per year.

Mann-Kendall statistic = 22 critical = 21

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

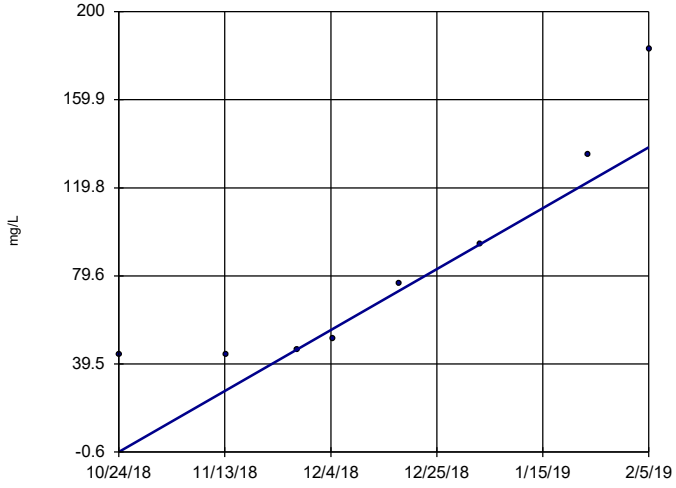
Constituent: pH Analysis Run 4/2/2019 3:06 PM View: Trend Testing

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Sen's Slope Estimator

GSD-AP-MW-16 (bg)




n = 8

Slope = 487.3 units per year.

Mann-Kendall statistic = 27 critical = 21

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

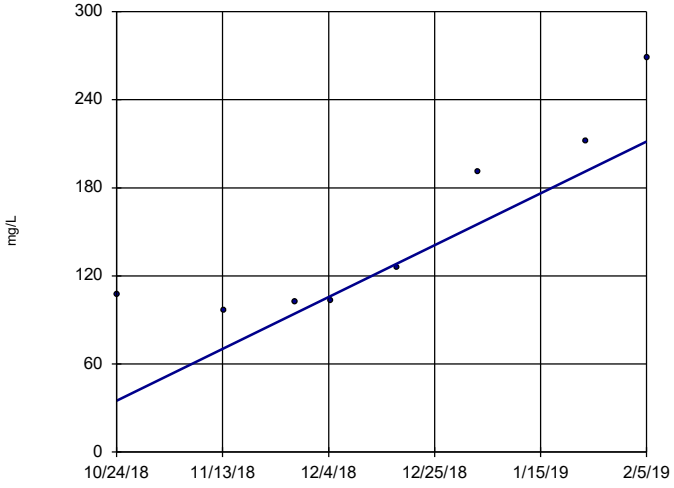
Constituent: Sulfate Analysis Run 4/2/2019 3:06 PM View: Trend Testing

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Sen's Slope Estimator

GSD-AP-MW-16 (bg)




n = 8

Slope = 619.3 units per year.

Mann-Kendall statistic = 22 critical = 21

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: TDS Analysis Run 4/2/2019 3:06 PM View: Trend Testing

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# FIGURE E.

# Analysis of Variance

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:15 PM

| Constituent | Well | Calc. | Crit. | Sig. | Alpha | Transform | ANOVA Sig. | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|
| Boron (mg/L) | n/a | n/a | n/a | n/a | n/a | No | Yes | 0.05 | NP (normality) |
| Calcium (mg/L) | n/a | n/a | n/a | n/a | n/a | sqrt(x) | Yes | 0.05 | Param. |
| Chloride (mg/L) | n/a | n/a | n/a | n/a | n/a | No | Yes | 0.05 | Param. |
| Fluoride (mg/L) | n/a | n/a | n/a | n/a | n/a | No | Yes | 0.05 | NP (eq. var.) |
| pH (pH) | n/a | n/a | n/a | n/a | n/a | No | Yes | 0.05 | NP (eq. var.) |
| Sulfate (mg/L) | n/a | n/a | n/a | n/a | n/a | No | Yes | 0.05 | NP (eq. var.) |
| TDS (mg/L) | n/a | n/a | n/a | n/a | n/a | No | No | 0.05 | NP (eq. var.) |

# Non-Parametric ANOVA

Constituent: Boron Analysis Run 4/2/2019 3:15 PM View: ANOVA
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

For observations made between 6/27/2018 and 2/5/2019, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 13.45

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 2 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 12.48
Adjusted Kruskal-Wallis statistic (H') = 13.45

# Parametric ANOVA

Constituent: Calcium Analysis Run 4/2/2019 3:15 PM View: ANOVA
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

For observations made between 6/27/2018 and 2/5/2019 the parametric analysis of variance test (after square root transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 15.06

Tabulated F statistic = 3.47 with 2 and 21 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

| Source of Variation | Sum of Squares | Degrees of Freedom | Mean Squares | F |
|---|---|---|---|---|
| Between Groups | 0.2669 | 2 | 0.1335 | 8.886 |
| Error Within Groups | 0.3154 | 21 | 0.01502 | |
| Total | 0.5823 | 23 | | |

The Shapiro Wilk normality test on the residuals passed after square root transformation. Alpha = 0.05, calculated = 0.947, critical = 0.916. Levene's Equality of Variance test passed. Calculated = 1.534, tabulated = 3.47.

# Parametric ANOVA

Constituent: Chloride Analysis Run 4/2/2019 3:15 PM View: ANOVA
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

For observations made between 6/27/2018 and 2/5/2019 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 9.242

Tabulated F statistic = 3.47 with 2 and 21 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

| Source of Variation | Sum of Squares | Degrees of Freedom | Mean Squares | F |
|---|---|---|---|---|
| Between Groups | 0.2669 | 2 | 0.1335 | 8.886 |
| Error Within Groups | 0.3154 | 21 | 0.01502 | |
| Total | 0.5823 | 23 | | |

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9808, critical = 0.916. Levene's Equality of Variance test passed. Calculated = 0.3234, tabulated = 3.47.

# Non-Parametric ANOVA

Constituent: Fluoride Analysis Run 4/2/2019 3:15 PM View: ANOVA
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

For observations made between 6/27/2018 and 2/5/2019, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 9.225

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 7 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 9.161
Adjusted Kruskal-Wallis statistic (H') = 9.225

# Non-Parametric ANOVA

Constituent: pH Analysis Run 4/2/2019 3:15 PM View: ANOVA
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

For observations made between 6/27/2018 and 2/5/2019, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 20.53

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 3 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 20.48
Adjusted Kruskal-Wallis statistic (H') = 20.53

# Non-Parametric ANOVA

Constituent: Sulfate Analysis Run 4/2/2019 3:15 PM View: ANOVA
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

For observations made between 6/27/2018 and 2/5/2019, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 15.88

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 3 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 15.86
Adjusted Kruskal-Wallis statistic (H') = 15.88

# Non-Parametric ANOVA

Constituent: TDS Analysis Run 4/2/2019 3:15 PM View: ANOVA
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

For observations made between 6/27/2018 and 2/5/2019, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 0.7803

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 0.78
Adjusted Kruskal-Wallis statistic (H') = 0.7803

# FIGURE F.

# UTL's - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:16 PM

| Constituent | Well | Upper Lim. | Lower Lim. | Bg N | Bg Mean | Std. Dev. | %NDs | ND Adj. | Transform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Boron (mg/L) | n/a | 0.1 | n/a | 24 | n/a | n/a | 41.67 | n/a | n/a | 0.292 | NP Inter(normality) |
| Calcium (mg/L) | n/a | 30.49 | n/a | 24 | 17.43 | 4.905 | 0 | None | No | 0.01 | Inter |
| Chloride (mg/L) | n/a | 4.379 | n/a | 24 | 3.288 | 0.4099 | 0 | None | No | 0.01 | Inter |
| Fluoride (mg/L) | n/a | 0.3108 | n/a | 24 | 0.1521 | 0.05959 | 12.5 | None | No | 0.01 | Inter |
| pH (pH) | n/a | 9.42 | 3.95 | 24 | n/a | n/a | 0 | n/a | n/a | 0.6608 | NP Inter(normality) |
| Sulfate (mg/L) | n/a | 195.8 | n/a | 24 | 63.78 | 49.58 | 0 | None | No | 0.01 | Inter |
| TDS (mg/L) | n/a | 274.1 | n/a | 24 | 158.1 | 43.56 | 0 | None | No | 0.01 | Inter |

# FIGURE G.

# Confidence Interval Summary Table - Significant Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:21 PM

| Constituent | Well | Upper Lim. | Lower Lim. | Compliance | Lower Compl. | Sig. | N | %NDs | Transform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Boron (mg/L) | GSD-AP-MW-1 | 1.286 | 1.149 | 0.1 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Boron (mg/L) | GSD-AP-MW-11 | 0.128 | 0.1093 | 0.1 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Boron (mg/L) | GSD-AP-MW-2 | 0.7628 | 0.6074 | 0.1 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Boron (mg/L) | GSD-AP-MW-3 | 1.056 | 0.969 | 0.1 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Boron (mg/L) | GSD-AP-MW-4 | 0.5251 | 0.4462 | 0.1 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Boron (mg/L) | GSD-AP-MW-5 | 0.614 | 0.436 | 0.1 | n/a | Yes | 8 | 0 | No | 0.004 | NP (normality) |
| Boron (mg/L) | GSD-AP-PZ-1 | 0.1 | 0.1 | 0.1 | n/a | Yes | 8 | 100 | No | 0.004 | NP (NDs) |
| Boron (mg/L) | GSD-AP-PZ-5 | 0.1 | 0.1 | 0.1 | n/a | Yes | 8 | 100 | No | 0.004 | NP (NDs) |
| Boron (mg/L) | GSD-AP-PZ-6 | 0.1 | 0.1 | 0.1 | n/a | Yes | 8 | 100 | No | 0.004 | NP (NDs) |
| Calcium (mg/L) | GSD-AP-MW-1 | 282.3 | 249.7 | 30.49 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-MW-10 | 47.03 | 36.44 | 30.49 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-MW-11 | 74.71 | 70.57 | 30.49 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-MW-12 | 65.4 | 48.7 | 30.49 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-MW-2 | 126.4 | 90.57 | 30.49 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-MW-3 | 113.8 | 76.09 | 30.49 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-MW-5 | 48.2 | 35.3 | 30.49 | n/a | Yes | 8 | 0 | No | 0.004 | NP (normality) |
| Calcium (mg/L) | GSD-AP-MW-8 | 61.2 | 50.58 | 30.49 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-MW-9 | 42.61 | 37.02 | 30.49 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-PZ-1 | 44.6 | 33.25 | 30.49 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-MW-1 | 6.051 | 5.499 | 4.38 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-MW-10 | 6.694 | 5.291 | 4.38 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-MW-11 | 5.964 | 5.184 | 4.38 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-MW-12 | 6.161 | 5.519 | 4.38 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-MW-3 | 7.6 | 6.8 | 4.38 | n/a | Yes | 8 | 0 | No | 0.004 | NP (normality) |
| Chloride (mg/L) | GSD-AP-MW-4 | 11 | 8.4 | 4.38 | n/a | Yes | 8 | 0 | No | 0.004 | NP (normality) |
| Chloride (mg/L) | GSD-AP-MW-5 | 8.259 | 6.601 | 4.38 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-MW-6 | 9.832 | 8.783 | 4.38 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-MW-7 | 7.852 | 6.708 | 4.38 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-MW-9 | 7.201 | 5.914 | 4.38 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-MW-1 | 684.1 | 576.4 | 195.8 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-MW-12 | 275.2 | 204.5 | 195.8 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-MW-3 | 258.3 | 197.5 | 195.8 | n/a | Yes | 8 | 0 | No | 0.01 | Param. |

# Confidence Interval Summary Table - All Results

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:21 PM

| Constituent | Well | Upper Lim. | Lower Lim. | Compliance | Lower Compl. | Sig. | N | %NDs | Transform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Boron (mg/L)** | **GSD-AP-MW-1** | **1.286** | **1.149** | **0.1** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Boron (mg/L) | GSD-AP-MW-10 | 0.1328 | 0.09477 | 0.1 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Boron (mg/L)** | **GSD-AP-MW-11** | **0.128** | **0.1093** | **0.1** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Boron (mg/L) | GSD-AP-MW-12 | 0.06631 | 0.04974 | 0.1 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Boron (mg/L)** | **GSD-AP-MW-2** | **0.7628** | **0.6074** | **0.1** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Boron (mg/L)** | **GSD-AP-MW-3** | **1.056** | **0.969** | **0.1** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Boron (mg/L)** | **GSD-AP-MW-4** | **0.5251** | **0.4462** | **0.1** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Boron (mg/L)** | **GSD-AP-MW-5** | **0.614** | **0.436** | **0.1** | **n/a** | **Yes** | **8** | **0** | **No** | **0.004** | **NP (normality)** |
| Boron (mg/L) | GSD-AP-MW-6 | 0.06178 | 0.05194 | 0.1 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Boron (mg/L) | GSD-AP-MW-7 | 0.1038 | 0.07504 | 0.1 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Boron (mg/L) | GSD-AP-MW-8 | 0.07415 | 0.05715 | 0.1 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Boron (mg/L) | GSD-AP-MW-9 | 0.06076 | 0.05304 | 0.1 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Boron (mg/L)** | **GSD-AP-PZ-1** | **0.1** | **0.1** | **0.1** | **n/a** | **Yes** | **8** | **100** | **No** | **0.004** | **NP (NDs)** |
| **Boron (mg/L)** | **GSD-AP-PZ-5** | **0.1** | **0.1** | **0.1** | **n/a** | **Yes** | **8** | **100** | **No** | **0.004** | **NP (NDs)** |
| **Boron (mg/L)** | **GSD-AP-PZ-6** | **0.1** | **0.1** | **0.1** | **n/a** | **Yes** | **8** | **100** | **No** | **0.004** | **NP (NDs)** |
| **Calcium (mg/L)** | **GSD-AP-MW-1** | **282.3** | **249.7** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Calcium (mg/L)** | **GSD-AP-MW-10** | **47.03** | **36.44** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Calcium (mg/L)** | **GSD-AP-MW-11** | **74.71** | **70.57** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Calcium (mg/L)** | **GSD-AP-MW-12** | **65.4** | **48.7** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Calcium (mg/L)** | **GSD-AP-MW-2** | **126.4** | **90.57** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Calcium (mg/L)** | **GSD-AP-MW-3** | **113.8** | **76.09** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Calcium (mg/L) | GSD-AP-MW-4 | 30.93 | 26 | 30.49 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Calcium (mg/L)** | **GSD-AP-MW-5** | **48.2** | **35.3** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.004** | **NP (normality)** |
| Calcium (mg/L) | GSD-AP-MW-6 | 25.09 | 14.68 | 30.49 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-MW-7 | 24.85 | 17.43 | 30.49 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Calcium (mg/L)** | **GSD-AP-MW-8** | **61.2** | **50.58** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Calcium (mg/L)** | **GSD-AP-MW-9** | **42.61** | **37.02** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Calcium (mg/L)** | **GSD-AP-PZ-1** | **44.6** | **33.25** | **30.49** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Calcium (mg/L) | GSD-AP-PZ-5 | 4.131 | 3.064 | 30.49 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Calcium (mg/L) | GSD-AP-PZ-6 | 3.865 | 3.74 | 30.49 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Chloride (mg/L)** | **GSD-AP-MW-1** | **6.051** | **5.499** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Chloride (mg/L)** | **GSD-AP-MW-10** | **6.694** | **5.291** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Chloride (mg/L)** | **GSD-AP-MW-11** | **5.964** | **5.184** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Chloride (mg/L)** | **GSD-AP-MW-12** | **6.161** | **5.519** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Chloride (mg/L) | GSD-AP-MW-2 | 3.924 | 2.366 | 4.38 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Chloride (mg/L)** | **GSD-AP-MW-3** | **7.6** | **6.8** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.004** | **NP (normality)** |
| **Chloride (mg/L)** | **GSD-AP-MW-4** | **11** | **8.4** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.004** | **NP (normality)** |
| **Chloride (mg/L)** | **GSD-AP-MW-5** | **8.259** | **6.601** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Chloride (mg/L)** | **GSD-AP-MW-6** | **9.832** | **8.783** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| **Chloride (mg/L)** | **GSD-AP-MW-7** | **7.852** | **6.708** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Chloride (mg/L) | GSD-AP-MW-8 | 5.491 | 4.219 | 4.38 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Chloride (mg/L)** | **GSD-AP-MW-9** | **7.201** | **5.914** | **4.38** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Chloride (mg/L) | GSD-AP-PZ-1 | 3.79 | 3.255 | 4.38 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-PZ-5 | 4.127 | 3.503 | 4.38 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Chloride (mg/L) | GSD-AP-PZ-6 | 4.243 | 3.845 | 4.38 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-MW-1 | 0.08955 | 0.05108 | 0.31 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-MW-10 | 0.104 | 0.06021 | 0.31 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-MW-11 | 0.0678 | 0.05 | 0.31 | n/a | No | 8 | 12.5 | No | 0.004 | NP (normality) |
| Fluoride (mg/L) | GSD-AP-MW-12 | 0.05 | 0.04 | 0.31 | n/a | No | 8 | 87.5 | No | 0.004 | NP (NDs) |
| Fluoride (mg/L) | GSD-AP-MW-2 | 0.2877 | 0.1815 | 0.31 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-MW-3 | 0.1115 | 0.05704 | 0.31 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-MW-4 | 0.2517 | 0.2106 | 0.31 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-MW-5 | 0.06709 | 0.04669 | 0.31 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-MW-6 | 0.05963 | 0.04244 | 0.31 | n/a | No | 8 | 12.5 | No | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-MW-7 | 0.09873 | 0.05877 | 0.31 | n/a | No | 8 | 12.5 | No | 0.01 | Param. |

# Confidence Interval Summary Table - All Results

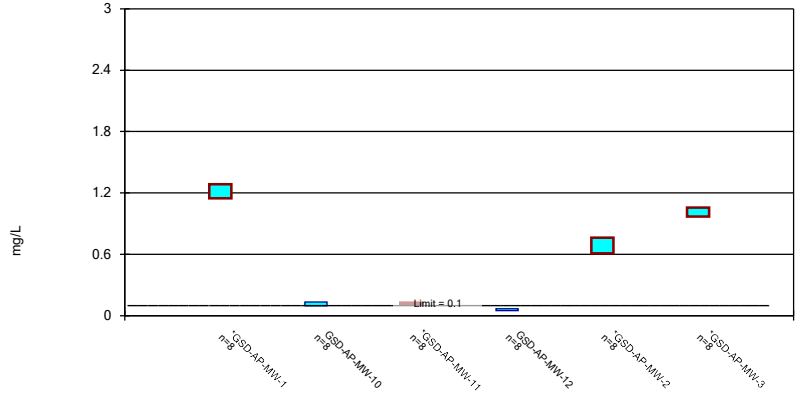
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:21 PM

| Constituent | Well | Upper Lim. | Lower Lim. | Compliance | Lower Compl. | Sig. | N | %NDs | Transform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fluoride (mg/L) | GSD-AP-MW-8 | 0.1251 | 0.06989 | 0.31 | n/a | No | 8 | 12.5 | No | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-MW-9 | 0.1292 | 0.08842 | 0.31 | n/a | No | 8 | 12.5 | x^5 | 0.01 | Param. |
| Fluoride (mg/L) | GSD-AP-PZ-1 | 0.13 | 0.08 | 0.31 | n/a | No | 8 | 0 | No | 0.004 | NP (normality) |
| Fluoride (mg/L) | GSD-AP-PZ-5 | 0.05 | 0.04 | 0.31 | n/a | No | 8 | 25 | No | 0.004 | NP (normality) |
| Fluoride (mg/L) | GSD-AP-PZ-6 | 0.05 | 0.04 | 0.31 | n/a | No | 8 | 25 | No | 0.004 | NP (normality) |
| pH (pH) | GSD-AP-MW-1 | 6.487 | 6.16 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-10 | 6.819 | 6.669 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-11 | 6.778 | 6.6 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-12 | 5.547 | 5.35 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-2 | 6.646 | 6.492 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-3 | 6.515 | 5.938 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-4 | 6.735 | 6.607 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-5 | 6.276 | 6.084 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-6 | 6.305 | 6.02 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-7 | 6.611 | 6.169 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-8 | 6.754 | 6.566 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-MW-9 | 6.96 | 6.73 | 9.42 | 3.95 | No | 9 | 0 | No | 0.002 | NP (normality) |
| pH (pH) | GSD-AP-PZ-1 | 6.834 | 6.646 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-PZ-5 | 5.796 | 5.509 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| pH (pH) | GSD-AP-PZ-6 | 5.607 | 5.483 | 9.42 | 3.95 | No | 8 | 0 | No | 0.005 | Param. |
| **Sulfate (mg/L)** | **GSD-AP-MW-1** | **684.1** | **576.4** | **195.8** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Sulfate (mg/L) | GSD-AP-MW-10 | 21.77 | -2.617 | 195.8 | n/a | No | 8 | 37.5 | No | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-MW-11 | 108.1 | 81.37 | 195.8 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Sulfate (mg/L)** | **GSD-AP-MW-12** | **275.2** | **204.5** | **195.8** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Sulfate (mg/L) | GSD-AP-MW-2 | 190.5 | 133.3 | 195.8 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| **Sulfate (mg/L)** | **GSD-AP-MW-3** | **258.3** | **197.5** | **195.8** | **n/a** | **Yes** | **8** | **0** | **No** | **0.01** | **Param.** |
| Sulfate (mg/L) | GSD-AP-MW-4 | 5.38 | 5 | 195.8 | n/a | No | 8 | 87.5 | No | 0.004 | NP (NDs) |
| Sulfate (mg/L) | GSD-AP-MW-5 | 22.4 | 17.92 | 195.8 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-MW-6 | 12.99 | 10.43 | 195.8 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-MW-7 | 13.22 | 9.931 | 195.8 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-MW-8 | 8.952 | 6.955 | 195.8 | n/a | No | 8 | 0 | No | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-MW-9 | 13.07 | 6.722 | 195.8 | n/a | No | 8 | 0 | sqrt(x) | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-PZ-1 | 5.141 | 1.309 | 195.8 | n/a | No | 8 | 25 | No | 0.01 | Param. |
| Sulfate (mg/L) | GSD-AP-PZ-5 | 5 | 0.639 | 195.8 | n/a | No | 8 | 87.5 | No | 0.004 | NP (NDs) |
| Sulfate (mg/L) | GSD-AP-PZ-6 | 5 | 1.69 | 195.8 | n/a | No | 8 | 87.5 | No | 0.004 | NP (NDs) |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



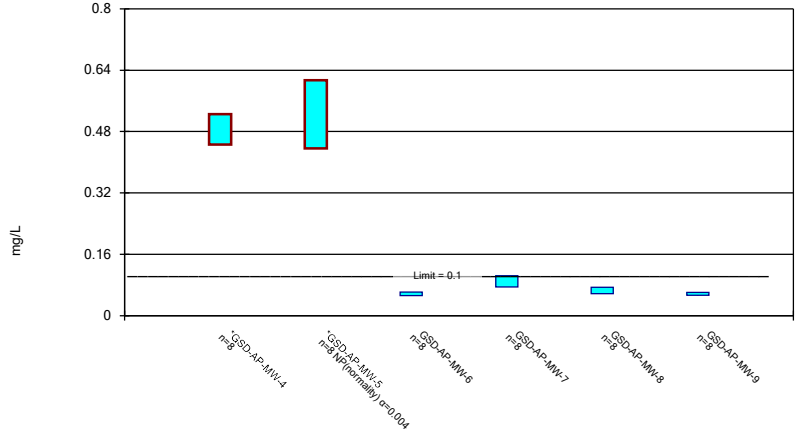

Constituent: Boron Analysis Run 4/2/2019 3:19 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



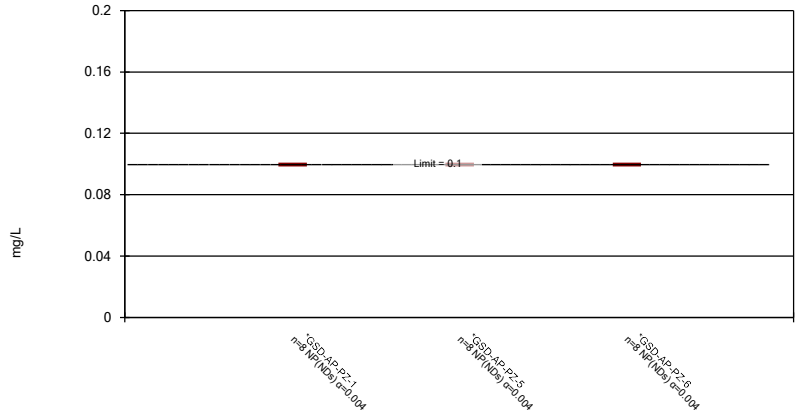

Constituent: Boron Analysis Run 4/2/2019 3:19 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Non-Parametric Confidence Interval

Compliance limit is exceeded.*



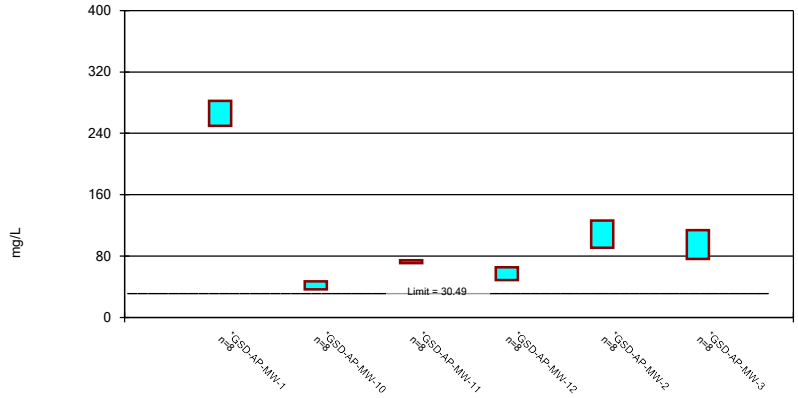

Constituent: Boron Analysis Run 4/2/2019 3:19 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



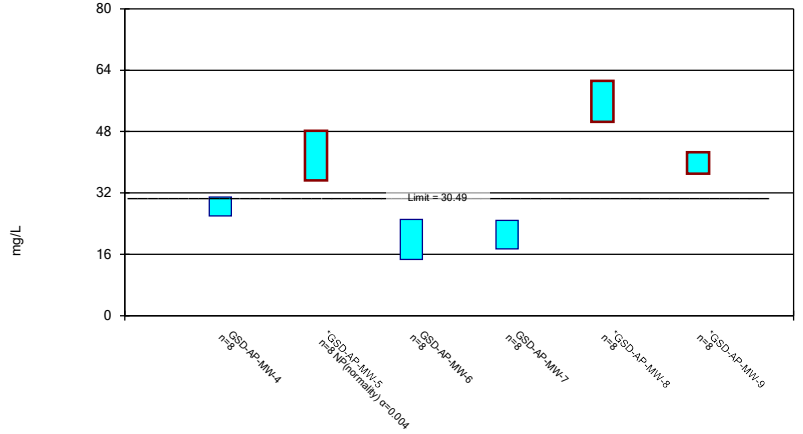

Constituent: Calcium Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



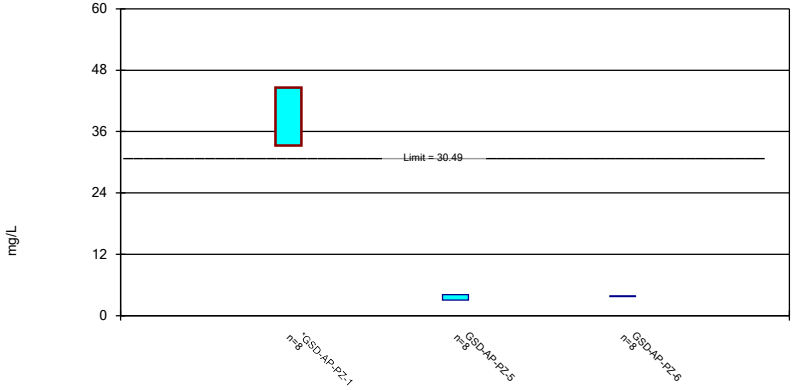

Constituent: Calcium Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



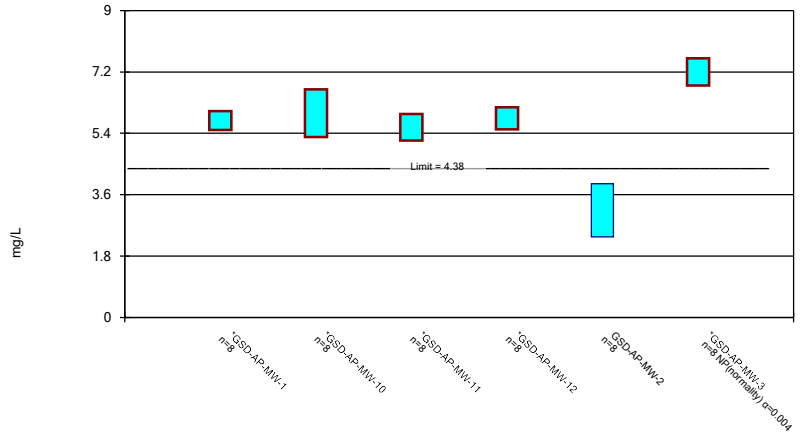

Constituent: Calcium Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



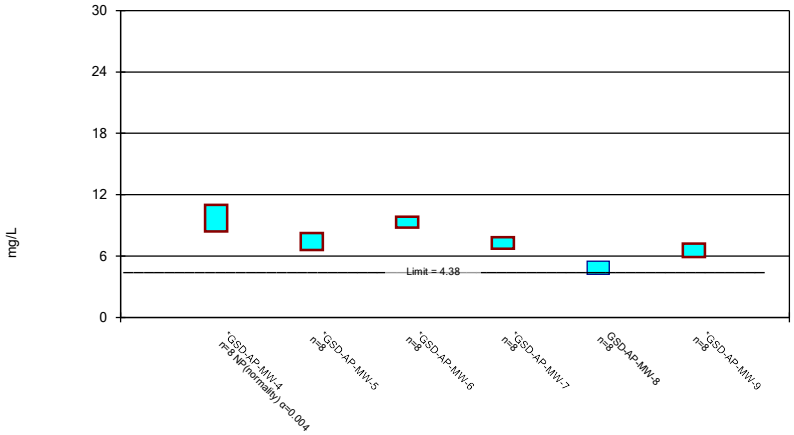

Constituent: Chloride Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



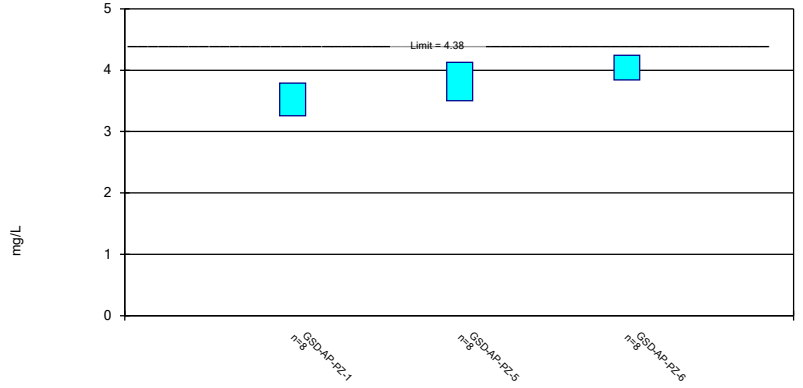

Constituent: Chloride Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



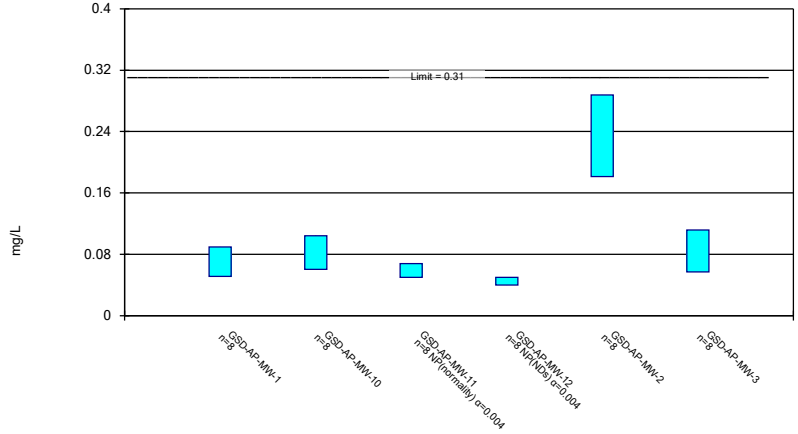

Constituent: Chloride Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



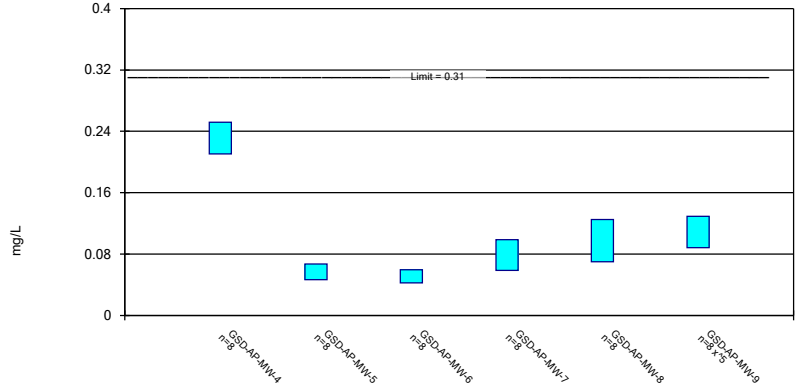

Constituent: Fluoride Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



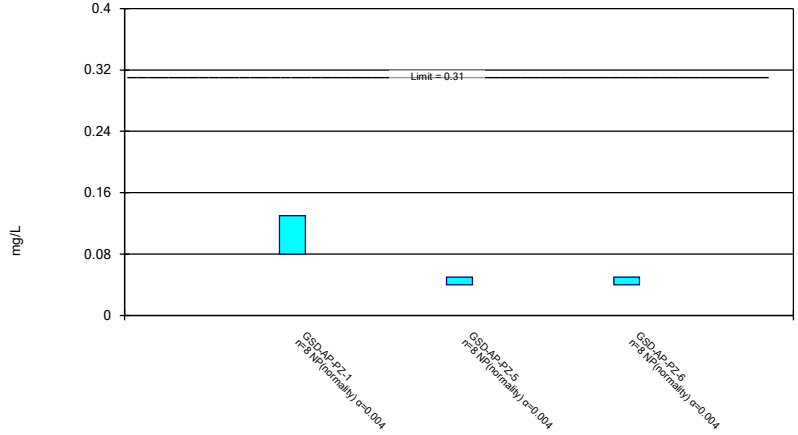

Constituent: Fluoride Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



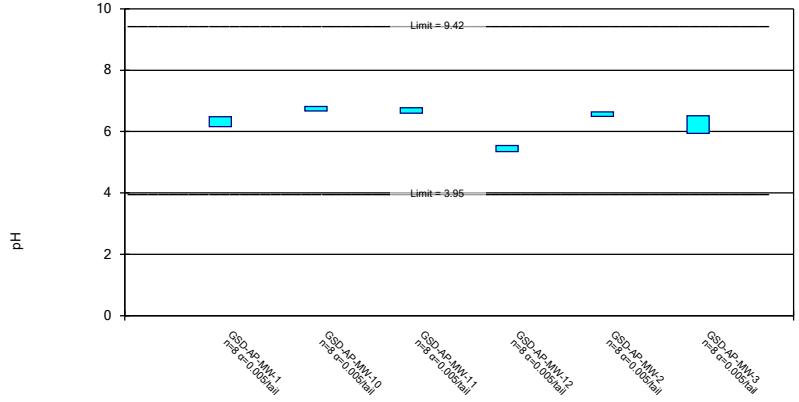

Constituent: Fluoride Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric Confidence Interval

Compliance Limit is not exceeded. Normality Test: Shapiro Wilk, alpha based on n.



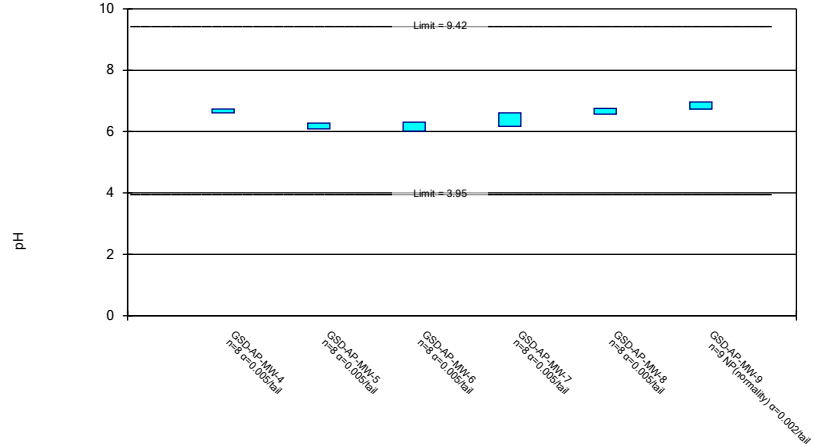

Constituent: pH Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Normality Test: Shapiro Wilk, alpha based on n.



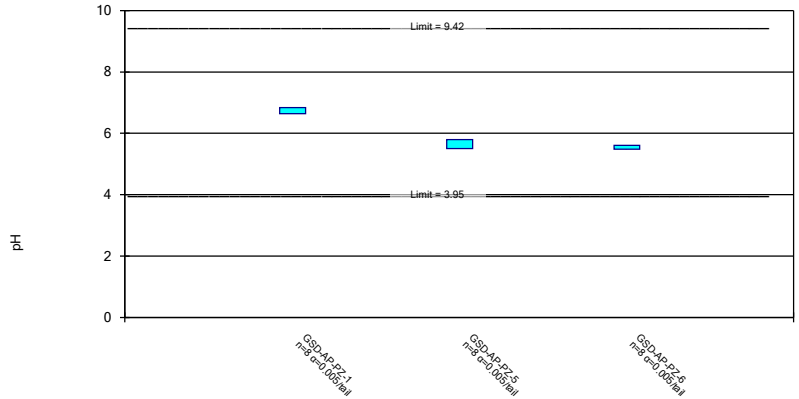

Constituent: pH Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric Confidence Interval

Compliance Limit is not exceeded. Normality Test: Shapiro Wilk, alpha based on n.



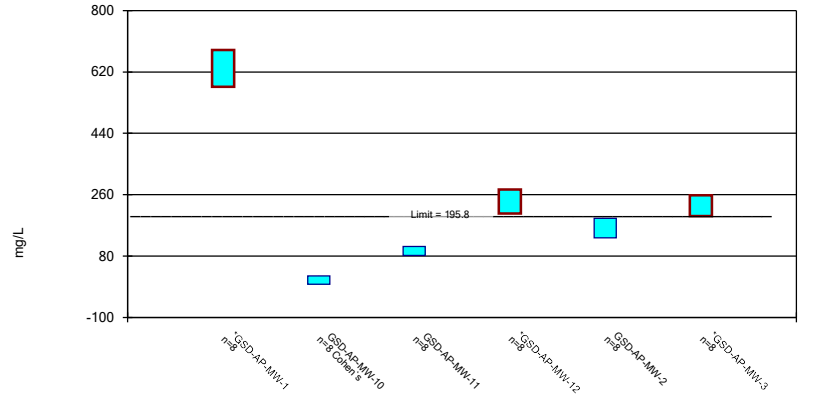

Constituent: pH Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



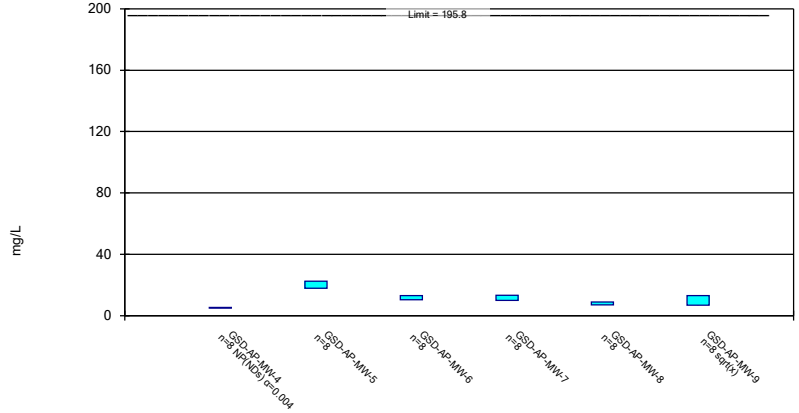

Constituent: Sulfate Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



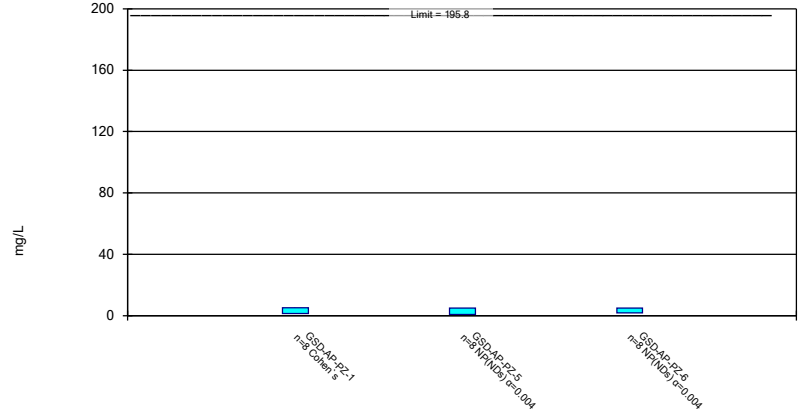

Constituent: Sulfate Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.




Constituent: Sulfate Analysis Run 4/2/2019 3:20 PM View: Confidence Intervals - Appendix III

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# FIGURE H.

# Intrawell Prediction Limit Summary

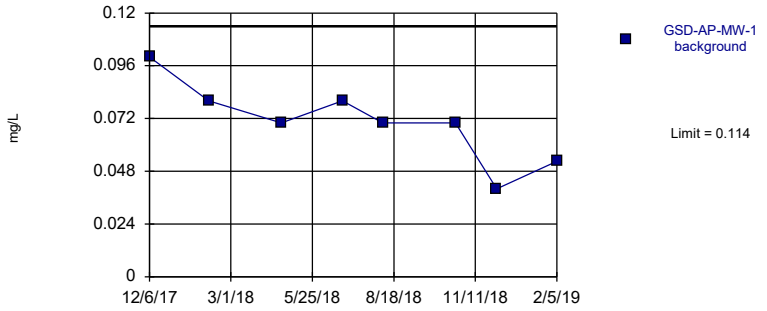
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:26 PM

| Constituent | Well | Upper Lim. | Lower Lim. | Bg N | Bg Mean | Std. Dev. | %NDs | ND Adj. | Transform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fluoride (mg/L) | GSD-AP-MW-1 | 0.114 | n/a | 8 | 0.07031 | 0.01815 | 0 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-10 | 0.1319 | n/a | 8 | 0.08213 | 0.02068 | 0 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-11 | 0.07296 | n/a | 8 | 0.05723 | 0.006538 | 12.5 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-12 | 0.05 | n/a | 8 | n/a | n/a | 87.5 | n/a | n/a | 0.005912 | NP Intra (NDs) 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-14 | 0.3371 | n/a | 8 | 0.165 | 0.07151 | 12.5 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-16 | 0.1661 | n/a | 8 | 0.1138 | 0.02176 | 25 | Kaplan-Meier | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-17 | 0.2447 | n/a | 8 | 0.1888 | 0.02322 | 0 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-2 | 0.3552 | n/a | 8 | 0.2346 | 0.05008 | 0 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-3 | 0.146 | n/a | 8 | 0.08425 | 0.02567 | 0 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-4 | 0.2778 | n/a | 8 | 0.2311 | 0.01939 | 0 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-5 | 0.08006 | n/a | 8 | 0.05689 | 0.009625 | 0 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-6 | 0.07056 | n/a | 8 | 0.05104 | 0.008109 | 12.5 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-7 | 0.1241 | n/a | 8 | 0.07875 | 0.01885 | 12.5 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-8 | 0.1602 | n/a | 8 | 0.0975 | 0.02605 | 12.5 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-MW-9 | 0.1625 | n/a | 8 | 0.01165 | 0.006127 | 12.5 | None | x^2 | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-PZ-1 | 0.1609 | n/a | 8 | 0.1142 | 0.01941 | 0 | None | No | 0.0005016 | Param Intra 1 of 3 |
| Fluoride (mg/L) | GSD-AP-PZ-5 | 0.05 | n/a | 8 | n/a | n/a | 25 | n/a | n/a | 0.005912 | NP Intra (normality) ... |
| Fluoride (mg/L) | GSD-AP-PZ-6 | 0.05 | n/a | 8 | n/a | n/a | 25 | n/a | n/a | 0.005912 | NP Intra (normality) ... |
| pH (pH) | GSD-AP-MW-1 | 6.642 | 6.005 | 8 | 6.324 | 0.1322 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-10 | 6.889 | 6.598 | 8 | 6.744 | 0.06046 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-11 | 6.862 | 6.515 | 8 | 6.689 | 0.072 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-12 | 5.64 | 5.257 | 8 | 5.449 | 0.07954 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-14 | 4.172 | 3.928 | 8 | 4.05 | 0.05071 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-16 | 5.451 | 3.959 | 8 | 4.705 | 0.3101 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-17 | 10.15 | 7.57 | 8 | 8.858 | 0.5351 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-2 | 6.718 | 6.419 | 8 | 6.569 | 0.06221 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-3 | 6.788 | 5.665 | 8 | 6.226 | 0.2334 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-4 | 6.796 | 6.547 | 8 | 6.671 | 0.05167 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-5 | 6.366 | 5.994 | 8 | 6.18 | 0.07746 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-6 | 6.44 | 5.885 | 8 | 6.163 | 0.1154 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-7 | 6.821 | 5.959 | 8 | 6.39 | 0.1789 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-8 | 6.844 | 6.476 | 8 | 6.66 | 0.07635 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-MW-9 | 7.055 | 6.734 | 9 | 6.894 | 0.07091 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-PZ-1 | 6.924 | 6.556 | 8 | 6.74 | 0.07635 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-PZ-5 | 5.932 | 5.373 | 8 | 5.653 | 0.1161 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |
| pH (pH) | GSD-AP-PZ-6 | 5.665 | 5.425 | 8 | 5.545 | 0.04986 | 0 | None | No | 0.0002508 | Param Intra 1 of 3 |

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-1




Background Data Summary: Mean=0.07031, Std. Dev.=0.01815, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9482, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

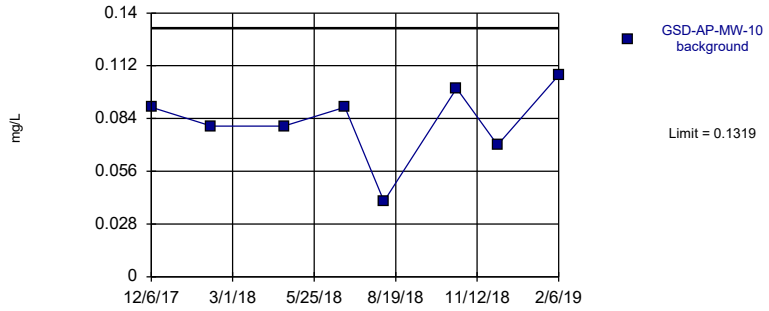
Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-10




Background Data Summary: Mean=0.08213, Std. Dev.=0.02068, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9155, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell

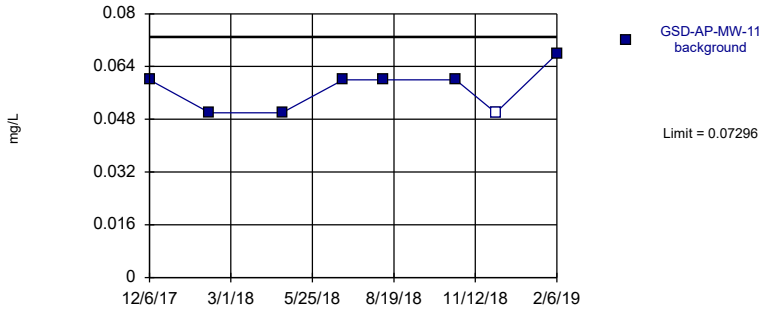
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-11




Background Data Summary: Mean=0.05723, Std. Dev.=0.006538, n=8, 12.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8216, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell

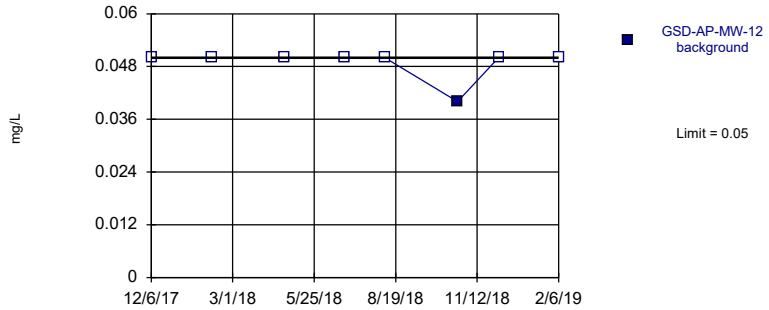
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Non-parametric, GSD-AP-MW-12




Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 87.5% NDs. Well-constituent pair annual alpha = 0.01179. Individual comparison alpha = 0.005912 (1 of 3). Assumes 1 future value.

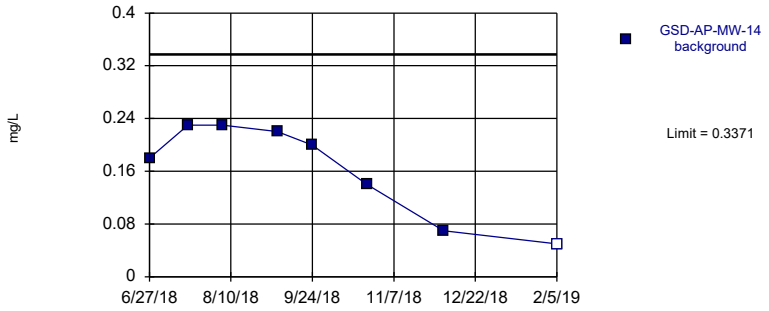
Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-14 (bg)



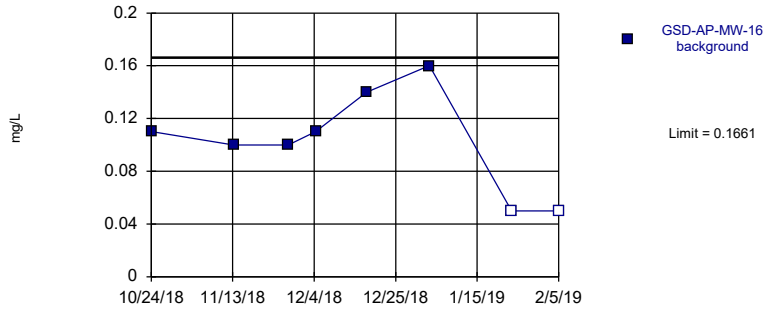

Background Data Summary: Mean=0.165, Std. Dev.=0.07151, n=8, 12.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8518, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-16 (bg)



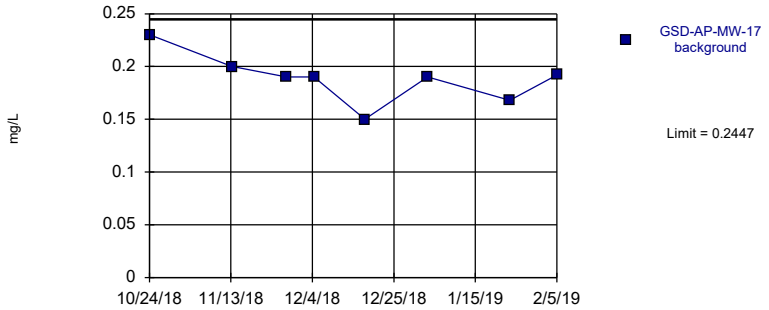

Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.1138, Std. Dev.=0.02176, n=8, 25% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9157, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-17 (bg)



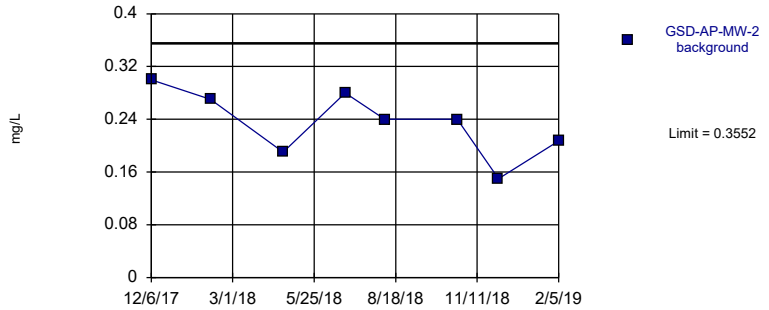

Background Data Summary: Mean=0.1888, Std. Dev.=0.02322, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9185, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-2



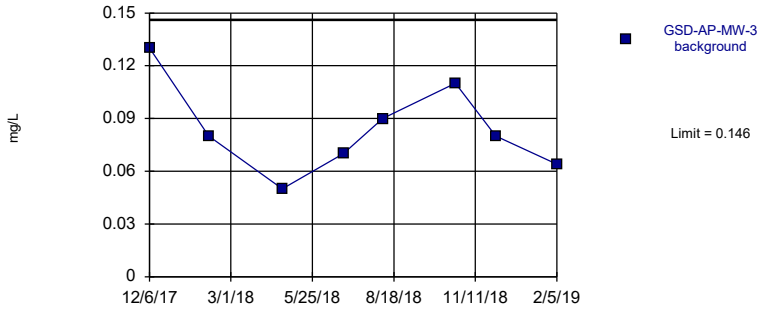

Background Data Summary: Mean=0.2346, Std. Dev.=0.05008, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.966, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-3




Background Data Summary: Mean=0.08425, Std. Dev.=0.02567, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9577, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

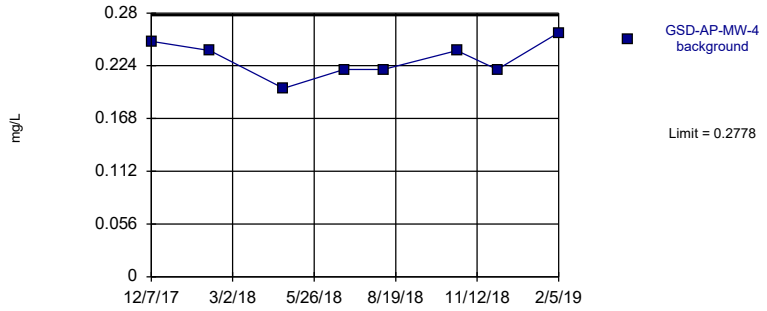
Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-4




Background Data Summary: Mean=0.2311, Std. Dev.=0.01939, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9429, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

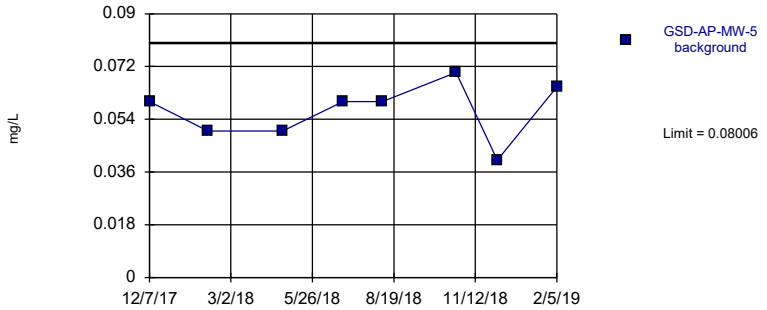
Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-5




Background Data Summary: Mean=0.05689, Std. Dev.=0.009625, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.939, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell

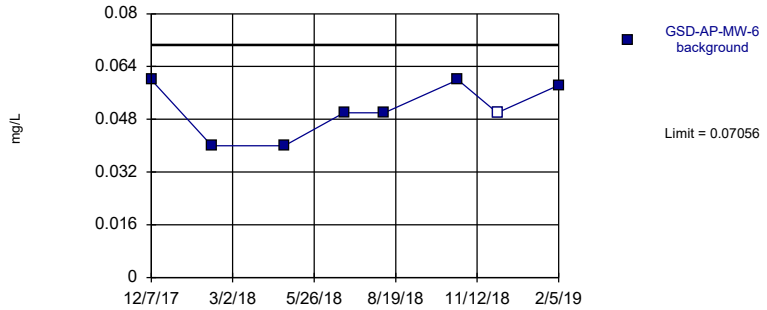
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-6




Background Data Summary: Mean=0.05104, Std. Dev.=0.008109, n=8, 12.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8585, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

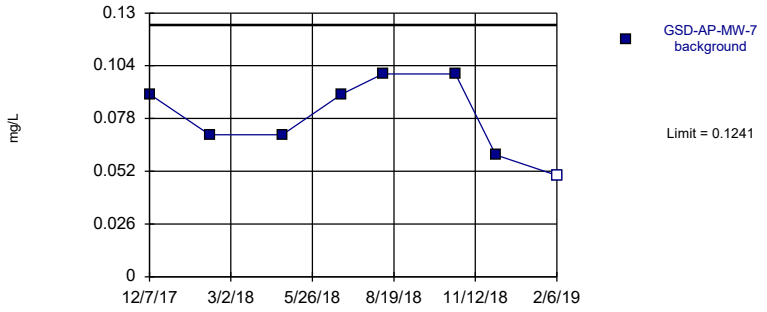
Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-7



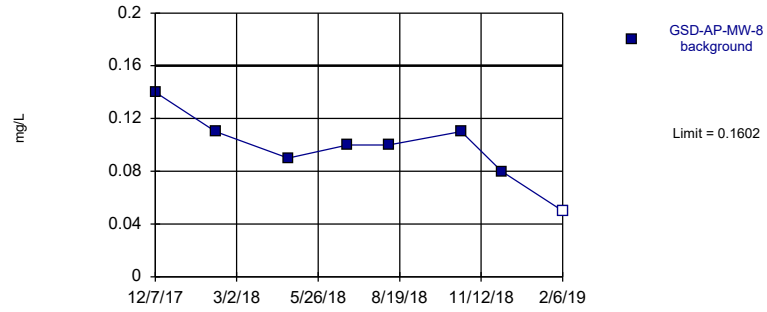

Background Data Summary: Mean=0.07875, Std. Dev.=0.01885, n=8, 12.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.908, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-8



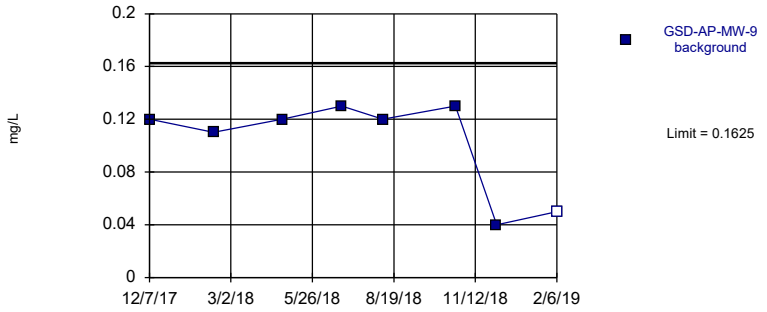

Background Data Summary: Mean=0.0975, Std. Dev.=0.02605, n=8, 12.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9577, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-9



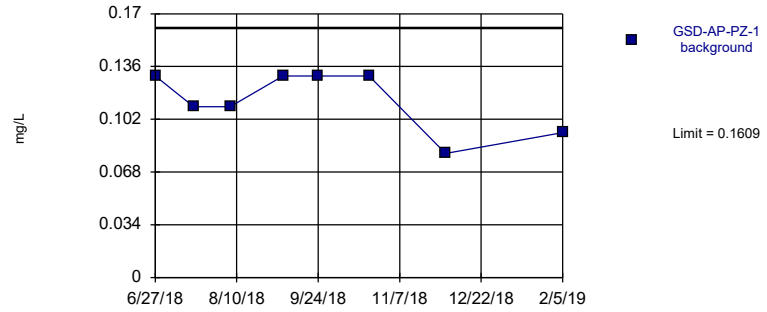

Background Data Summary (based on square transformation): Mean=0.01165, Std. Dev.=0.006127, n=8, 12.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7692, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-PZ-1



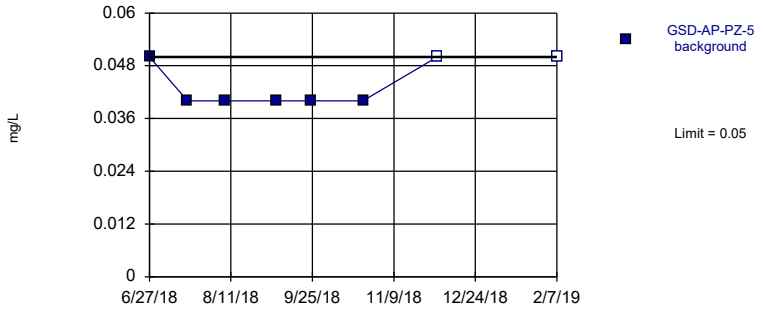

Background Data Summary: Mean=0.1142, Std. Dev.=0.01941, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8184, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Non-parametric, GSD-AP-PZ-5



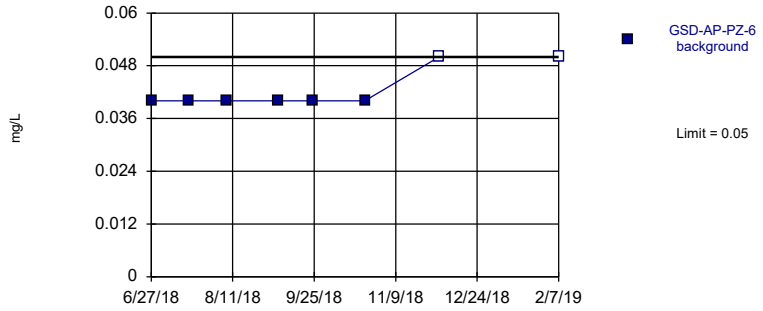

Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. 25% NDs. Well-constituent pair annual alpha = 0.01179. Individual comparison alpha = 0.005912 (1 of 3). Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

## Prediction Limit

Intrawell Non-parametric, GSD-AP-PZ-6



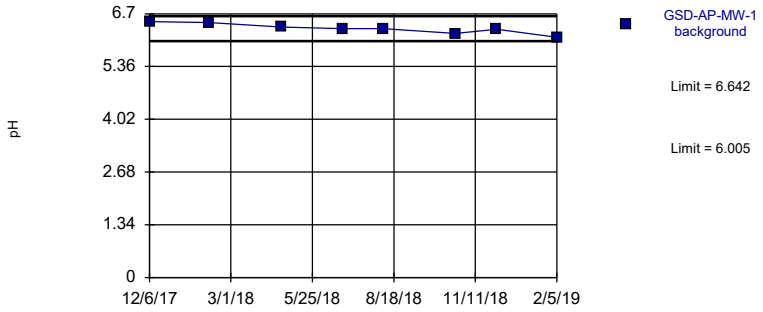

Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. 25% NDs. Well-constituent pair annual alpha = 0.01179. Individual comparison alpha = 0.005912 (1 of 3). Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-1



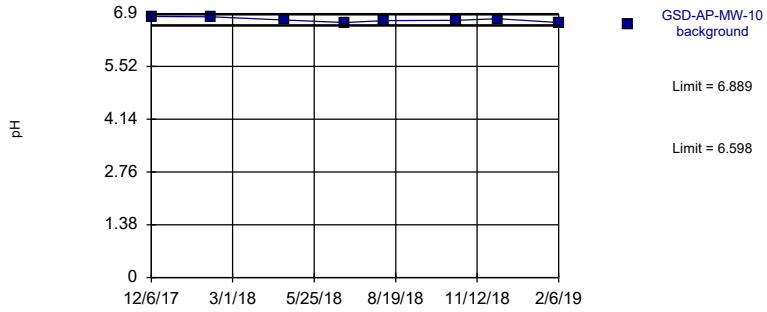

Background Data Summary: Mean=6.324, Std. Dev.=0.1322, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9411, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: pH Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-10



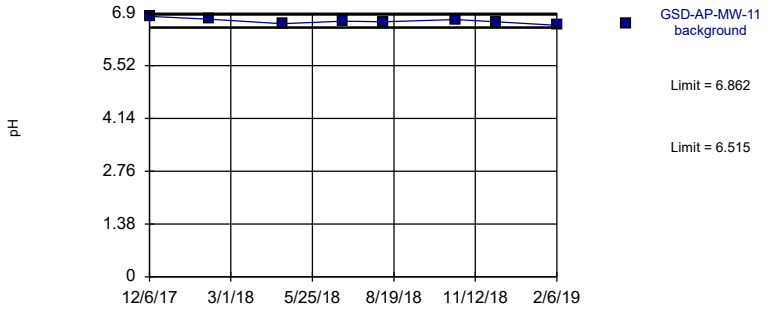

Background Data Summary: Mean=6.744, Std. Dev.=0.06046, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9217, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: pH Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell
Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-11




Background Data Summary: Mean=6.689, Std. Dev.=0.072, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9817, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

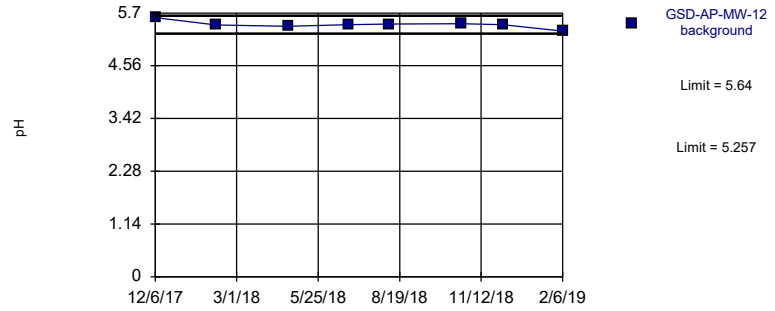
Constituent: pH Analysis Run 4/2/2019 3:25 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-12




Background Data Summary: Mean=5.449, Std. Dev.=0.07954, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.885, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

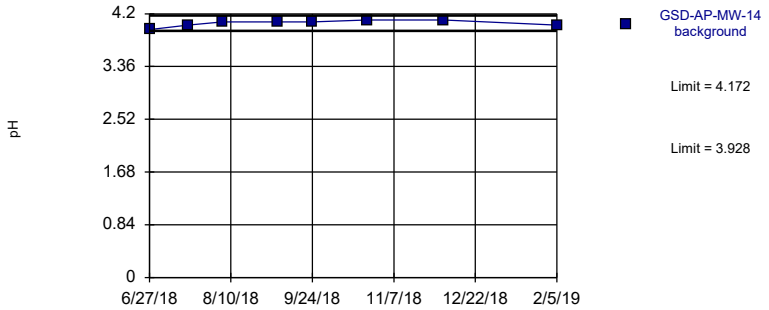
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-14 (bg)




Background Data Summary: Mean=4.05, Std. Dev.=0.05071, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8654, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

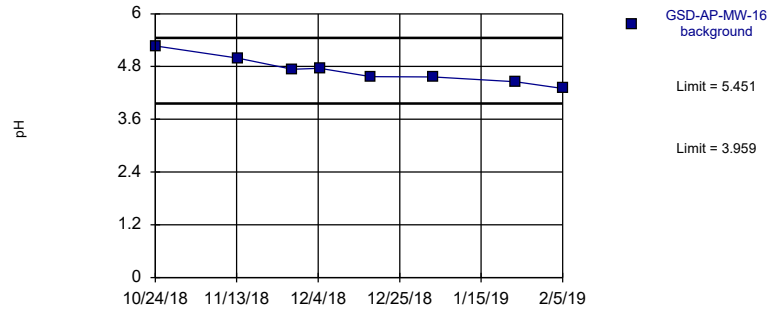
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-16 (bg)




Background Data Summary: Mean=4.705, Std. Dev.=0.3101, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9564, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

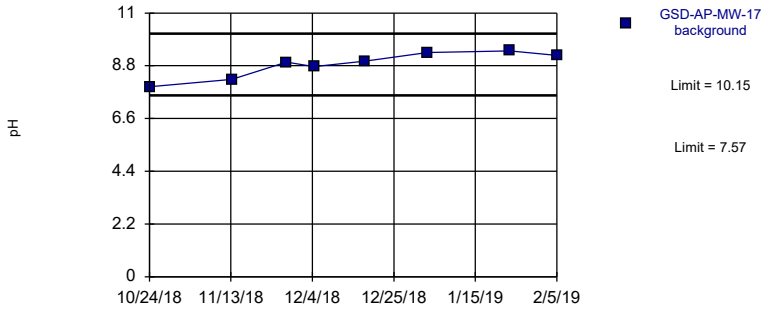
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-17 (bg)




Background Data Summary: Mean=8.858, Std. Dev.=0.5351, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9021, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

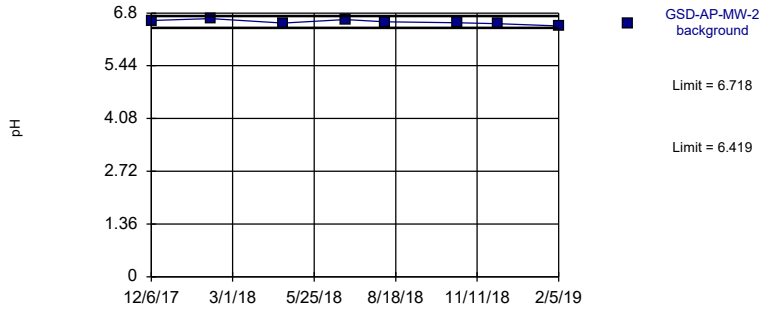
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-2




Background Data Summary: Mean=6.569, Std. Dev.=0.06221, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9822, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

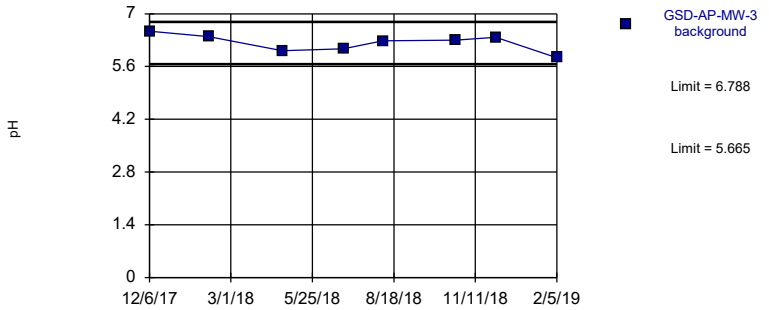
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-3




Background Data Summary: Mean=6.226, Std. Dev.=0.2334, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9505, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

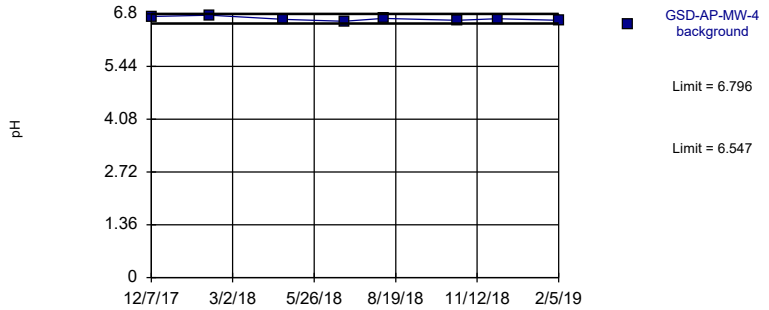
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-4




Background Data Summary: Mean=6.671, Std. Dev.=0.05167, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9281, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

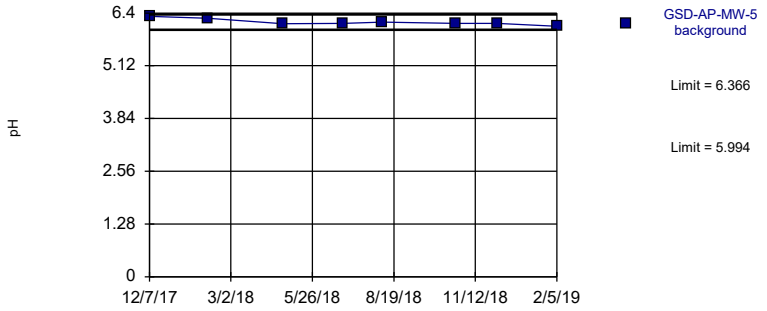
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-5




Background Data Summary: Mean=6.18, Std. Dev.=0.07746, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8741, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

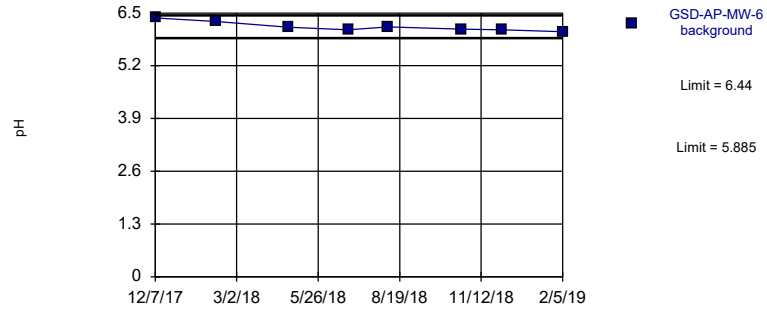
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-6




Background Data Summary: Mean=6.163, Std. Dev.=0.1154, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8662, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

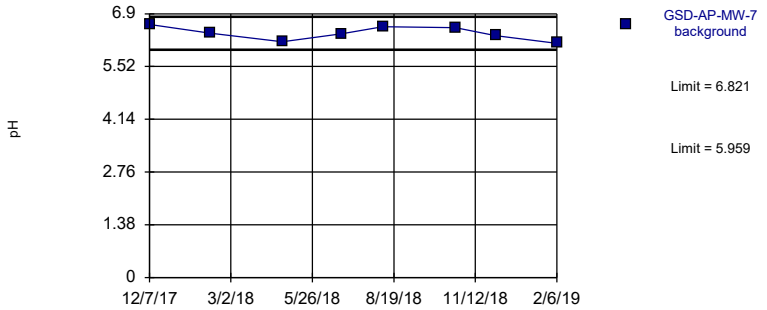
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-7




Background Data Summary: Mean=6.39, Std. Dev.=0.1789, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9328, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

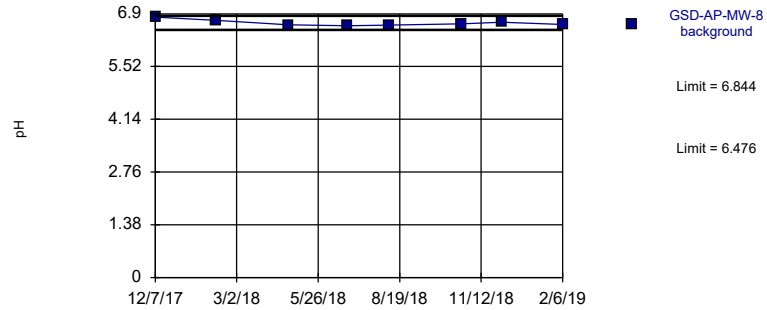
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-8




Background Data Summary: Mean=6.66, Std. Dev.=0.07635, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8626, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

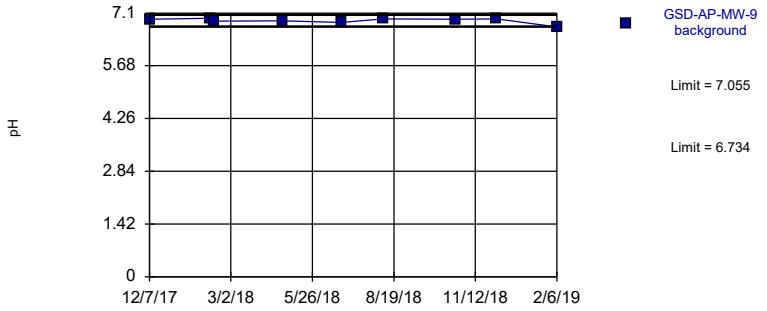
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-MW-9




Background Data Summary: Mean=6.894, Std. Dev.=0.07091, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8079, critical = 0.764. Kappa = 2.268 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

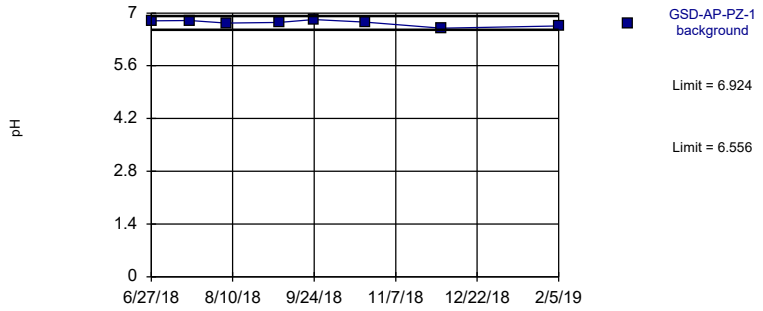
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-PZ-1




Background Data Summary: Mean=6.74, Std. Dev.=0.07635, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9273, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

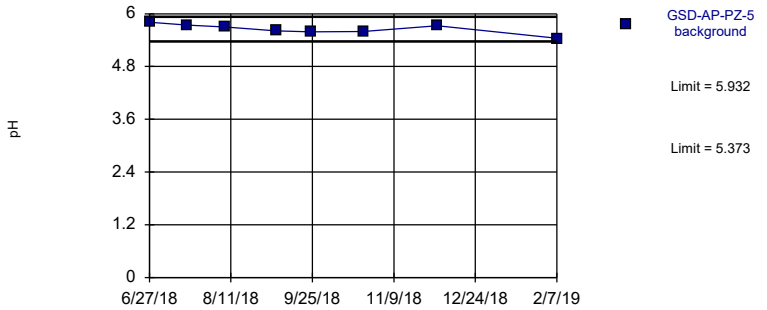
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-PZ-5




Background Data Summary: Mean=5.653, Std. Dev.=0.1161, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9481, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

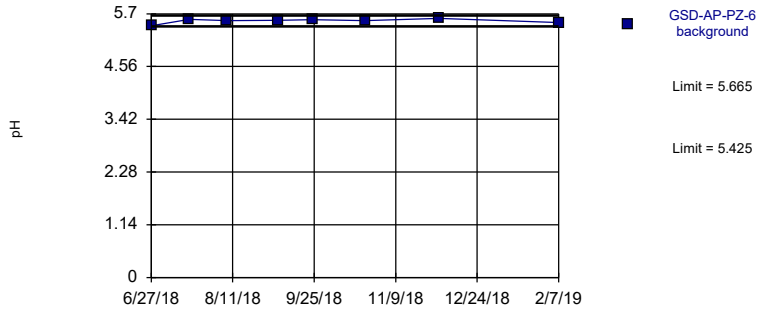
Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

## Prediction Limit

Intrawell Parametric, GSD-AP-PZ-6




Background Data Summary: Mean=5.545, Std. Dev.=0.04986, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8699, critical = 0.749. Kappa = 2.407 (c=7, w=15, 1 of 3, event alpha = 0.05132). Report alpha = 0.0005016. Assumes 1 future value.

Constituent: pH Analysis Run 4/2/2019 3:26 PM View: PL - Intrawell

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR

# FIGURE I.

# Interwell Prediction Limit Summary

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:28 PM

| Constituent | Well | Upper Lim. | Bg N | Bg Mean | Std. Dev. | %NDs | ND Adj. | Transform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|
| Boron (mg/L) | n/a | 0.1 | 24 | n/a | n/a | 41.67 | n/a | n/a | 0.002673 | NP Inter (normality) ... |
| Calcium (mg/L) | n/a | 28.79 | 24 | 17.43 | 4.905 | 0 | None | No | 0.0005016 | Param Inter 1 of 2 |
| Chloride (mg/L) | n/a | 4.237 | 24 | 3.288 | 0.4099 | 0 | None | No | 0.0005016 | Param Inter 1 of 2 |
| Sulfate (mg/L) | n/a | 178.6 | 24 | 63.78 | 49.58 | 0 | None | No | 0.0005016 | Param Inter 1 of 2 |
| TDS (mg/L) | n/a | 259 | 24 | 158.1 | 43.56 | 0 | None | No | 0.0005016 | Param Inter 1 of 2 |

# FIGURE J.

# UTL's - Appendix IV

Plant Gadsden Client: Southern Company Data: Plant Gadsden CCR Printed 4/2/2019, 3:31 PM

| Constituent | Well | Upper Lim. | Bg N | Bg Mean | Std. Dev. | %NDs | ND Adj. | Transform | Alpha | Method |
|---|---|---|---|---|---|---|---|---|---|---|
| Antimony (mg/L) | n/a | 0.003 | 24 | n/a | n/a | 95.83 | n/a | n/a | 0.292 | NP Inter(NDs) |
| Arsenic (mg/L) | n/a | 0.005 | 24 | n/a | n/a | 58.33 | n/a | n/a | 0.292 | NP Inter(normality) |
| Barium (mg/L) | n/a | 0.218 | 24 | n/a | n/a | 0 | n/a | n/a | 0.292 | NP Inter(normality) |
| Beryllium (mg/L) | n/a | 0.003 | 24 | n/a | n/a | 45.83 | n/a | n/a | 0.292 | NP Inter(normality) |
| Cadmium (mg/L) | n/a | 0.00101 | 24 | n/a | n/a | 33.33 | n/a | n/a | 0.292 | NP Inter(normality) |
| Chromium (mg/L) | n/a | 0.01 | 24 | n/a | n/a | 100 | n/a | n/a | 0.292 | NP Inter(NDs) |
| Cobalt (mg/L) | n/a | 0.064 | 24 | 0.01653 | 0.02056 | 33.33 | Cohen`s | No | 0.05 | Inter |
| Combined Radium 226 + 228 (pCi/L) | n/a | 1.258 | 19 | 0.594 | 0.2739 | 0 | None | No | 0.05 | Inter |
| Fluoride (mg/L) | n/a | 0.2897 | 24 | 0.1521 | 0.05959 | 12.5 | None | No | 0.05 | Inter |
| Lead (mg/L) | n/a | 0.005 | 24 | n/a | n/a | 54.17 | n/a | n/a | 0.292 | NP Inter(normality) |
| Lithium (mg/L) | n/a | 0.02 | 24 | n/a | n/a | 75 | n/a | n/a | 0.292 | NP Inter(normality) |
| Mercury (mg/L) | n/a | 0.000664 | 24 | n/a | n/a | 62.5 | n/a | n/a | 0.292 | NP Inter(normality) |
| Molybdenum (mg/L) | n/a | 0.01 | 24 | n/a | n/a | 66.67 | n/a | n/a | 0.292 | NP Inter(normality) |
| Selenium (mg/L) | n/a | 0.01 | 24 | n/a | n/a | 70.83 | n/a | n/a | 0.292 | NP Inter(normality) |
| Thallium (mg/L) | n/a | 0.001 | 24 | n/a | n/a | 100 | n/a | n/a | 0.292 | NP Inter(NDs) |

# FIGURE K.

| PLANT GADSDEN LANDFILL GWPS TABLE | | | | |
|---|---|---|---|---|
| **Constituent Name** | **MCL** | **RSL** | **Background Limit** | **GWPS** |
| Antimony, Total (mg/L) | 0.006 | | 0.003 | 0.006 |
| Arsenic, Total (mg/L) | 0.01 | | 0.005 | 0.01 |
| Barium, Total (mg/L) | 2 | | 0.22 | 2 |
| Beryllium, Total (mg/L) | 0.004 | | 0.003 | 0.004 |
| Cadmium, Total (mg/L) | 0.005 | | 0.001 | 0.007 |
| Chromium, Total (mg/L) | 0.1 | | 0.01 | 0.1 |
| Cobalt, Total (mg/L) | n/a | 0.006 | 0.064 | 0.064 |
| Combined Radium, Total (pCi/L) | 5 | | 1.26 | 5 |
| Fluoride, Total (mg/L) | 4 | | 0.29 | 4 |
| Lead, Total (mg/L) | n/a | 0.015 | 0.005 | 0.015 |
| Lithium, Total (mg/L) | n/a | 0.04 | 0.02 | 0.04 |
| Mercury, Total (mg/L) | 0.002 | | 0.00066 | 0.002 |
| Molybdenum, Total (mg/L) | n/a | 0.1 | 0.01 | 0.1 |
| Selenium, Total (mg/L) | 0.05 | | 0.01 | 0.05 |
| Thallium, Total (mg/L) | 0.002 | | 0.001 | 0.002 |

**Grey cell indicates background is higher than MCL.*

**MCL = Maximum Contaminant Level*

**RSL = Regional Screening Level*

# 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*****

# APPENDIX 8

# WRITTEN CLOSURE AND POST-CLOSURE CARE PLAN

# CLOSURE/POST-CLOSURE PLAN

# FOR THE

# ASH POND

# AT

# ALABAMA POWER COMPANY'S

# PLANT GADSDEN

Prepared By

**Environmental Systems and Field Support**
**Southern Company Services**
**Birmingham, Alabama**

Revision 1
September 15, 2016*

*As originally submitted to ADEM in 2016

ALABAMA LICENSED 16516 PROFESSIONAL ENGINEER JAMES C. [illegible], JR.

**CLOSURE/POST-CLOSURE PLAN**
**FOR THE**
**ASH POND**
**AT**
**ALABAMA POWER COMPANY'S**
**PLANT GADSDEN**

## Contents


1.0 INTRODUCTION ..... 1
2.0 CLOSURE PLAN ..... 2
2.1 SITE ACCESS AND SIGNAGE ..... 2
2.2 DEWATERING FOR CLOSURE ..... 2
2.3 FINAL GRADES ..... 2
2.4 COVER DESIGN ..... 2
2.5 CERTIFICATION OF FINAL COVER ..... 4
2.6 SURVEY PLAT – PROPERTY DOCUMENTATION ..... 4
3.0 POST-CLOSURE PLAN ..... 4
3.1 POST-CLOSURE USE ..... 4
3.2 SITE INSPECTIONS AND MAINTENANCE ..... 4
4.0 SCHEDULE ..... 5

Appendix A Drawings

Appendix B Infiltration Equivalency Demonstration

Appendix C ClosureTurf Technical Information

Appendix D Additional Technical Information Requested by ADEM (ClosureTurf QA/QC, Post-Closure Cover Stability, Slope Drainage)

Appendix E Technical Specification for Ash Pond Closure

# CLOSURE/POST-CLOSURE PLAN
# FOR THE
# ASH POND
# AT
# ALABAMA POWER COMPANY'S
# PLANT GADSDEN

## 1.0 INTRODUCTION

This plan is for the closure and post-closure care of the ash pond at Alabama Power Company's Plant Gadsden in Gadsden, Etowah County, Alabama. While the ash pond is not permitted under Alabama Department of Environmental Management (ADEM) regulations governing the disposal of Municipal Solid Waste ("the Regulations"), Alabama Power Company has elected to close the ash pond in compliance with the Regulations. The closure and post-closure care plan presented here is intended to comply with the most recent amendment to the Regulations, dated April 3, 2012.

Plant Gadsden's ash pond is located at 101 Delilah Street Gadsden, AL 35903 in Gadsden, Alabama, and is owned and operated by Alabama Power Company. Prior to April 2015, Plant Gadsden utilized coal-fired generators to produce power. Ash from the coal combustion process was sluiced into the ash pond for management and storage. Plant Gadsden completed conversion to natural gas-fired generation in April 2015, after which time no more ash was generated.

The 75-acre ash pond is located north of the plant across the Coosa River (see Appendix A). The pond was constructed in 1949 and was expanded laterally in 1973 and again in 1976 to create a settling area for sluice water prior to discharge. The original ash pond became what is currently known as the Upper Pond, while the areas added in the 1970's became known as the Lower Pond. An interior dike separates the Upper Pond and the Lower Pond. Currently, the Upper Pond consists of a dry ash stack encompassing an area of about 10 acres with the remaining areas comprised of about 8 acres of semi-solid ash deposits and 7 acres of water-filled finger dikes, constructed to create a serpentine flow path for sediment removal. The Lower Pond is approximately 40 acres in size with a water surface elevation of 523 feet above mean sea level (AMSL) and an average water depth of about 10 feet. Gadsden Steam Plant is currently permitted to discharge the ash pond water via DSN002, located in the southeastern corner of the Lower Pond, under the NPDES Permit AL-0002887.

The current volume of ash stored in the pond is estimated to be 1.2 million cubic yards. Initially, ash was sluiced into the eastern end of the original pond and allowed to decant naturally before being discharged from DSN002. After the lateral expansions were completed, ash was sluiced to various locations, and various settlement configurations were utilized within the pond. The discharge point has remained in the same location.

## 2.0 CLOSURE PLAN

### 2.1 SITE ACCESS AND SIGNAGE

The ash pond is located on the Plant Gadsden property. Land access is controlled by a perimeter fence with a single gate that is guarded during daylight hours. Delilah Road, owned by the City of Gadsden, runs through a small residential area and provides the only access to the ash pond. Once the pond has been closed, information signs will be placed at the point of access and at other various convenient locations around the closed pond, signifying that the area is a permanently closed CCR surface impoundment pond maintained by Alabama Power Company. The road leading to the closed impoundment is Delilah Street, a public road serving a residential community, and will thus provide access to facilitate inspections and future maintenance of the area.

### 2.2 DEWATERING FOR CLOSURE

Free water in the clear pool will be removed through pumping, maintaining compliance with the NPDES discharge limits. The saturated ash will be dewatered to the extent necessary to allow a stable working surface for earthwork equipment. Interstitial water will be removed through one or a combination of trenching, ditching, or well point removal. All water will be sent to an on-site water treatment system prior to discharge to ensure compliance with the NPDES discharge limits.

### 2.3 FINAL GRADES

The ash will be placed, compacted, and graded to the final grades shown on the drawings in Appendix A. In general, the surface of the ash pond will slope at 3% to 5% from the crest in the center to a perimeter ditch around the exterior. Side slopes range from 3H:1V to 4H:1V. The perimeter ditch will convey runoff water to discharge points around the pond. This will ensure positive drainage over the entire closed pond surface and prevent the pooling of water on the cover.

### 2.4 COVER DESIGN

The final cover for the closed pond will be the ClosureTurf® system developed by WatershedGeo®. Composed of an impermeable geomembrane, engineered turf, and sand infill, the system is designed to meet or exceed all of the requirements for landfill covers outlined in RCRA Subtitle D. The system incorporates an integrated drainage layer between the geomembrane and engineered turf to remove water and prevent the buildup of head on the cover. A schematic of the ClosureTurf system is show in Figure 1 below.

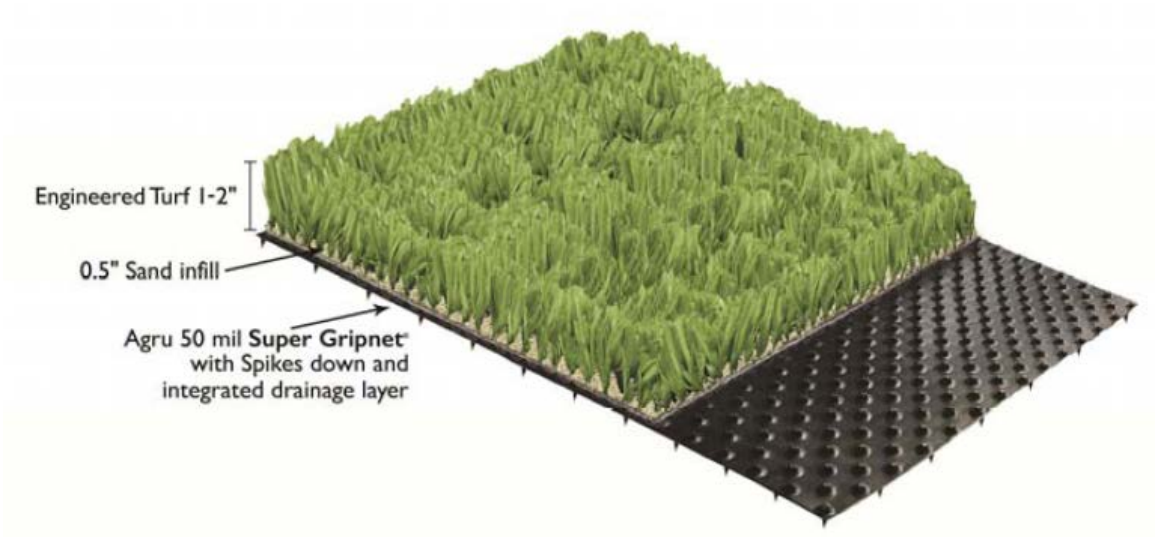



**Figure 1:** ClosureTurf Cover System Section (Agru America)

The impermeable geomembrane barrier for the system is Super Gripnet® produced by Agru America. Super Gripnet is a 50 mil linear low density polyethylene (LLDPE) structured geomembrane. It contains spikes on the bottom to increase interface friction with the underlying subgrade, while the top contains raised studs that create the integrated drainage layer. Geomembrane panels are welded together to form an uninterrupted barrier.

The engineered turf is composed of high-density polyethylene (HDPE) grass blades tufted through two layers of polypropylene geotextile backing. The turf is designed to go on top of the structured geomembrane and is stitched or welded together at the seams. A half inch of sand infill is placed between the blades of the turf to provide additional weathering protection and also to allow limited equipment loads on the system. The sand infill will be specified to comply with the ASTM C33 standard for well-graded sand. This sand specification has been shown to be resistant to erosion and particle loss. The turf and sand provide aesthetics to the system while protecting the geomembrane from weathering.

As an impermeable barrier system with a non-erodible cover layer, the ClosureTurf system exceeds the requirements for an alternate cover system for both infiltration rate and erosion protection, as allowed for in the Regulations. Appendix B contains an equivalency calculation demonstrating that ClosureTurf also exceeds the infiltration rate of a geomembrane/soil composite cover system. Appendix C contains additional technical information and testing performed on the ClosureTurf system, including UV resistance, stability, slope erosion, wind uplift, and drivability testing. Also contained in Appendix C is the Installation Guidelines Manual for the ClosureTurf system, which will be used to direct the installation. Appendix D contains additional technical information including Quality Assurance/Quality Control procedures for the components of ClosureTurf, static and seismic slope stability analysis of the post-closure critical section of the final closed footprint, static and seismic cover stability analysis of the closed footprint, and hydraulic performance of ClosureTurf with the 3 percent design slope of the top

design slope of the top of the closure footprint. Appendix D contains the Technical Specification for Ash Pond Closure, detailing the QA/QC data and procedures for ClosureTurf material as required by Southern Company.

## 2.5 CERTIFICATION OF FINAL COVER

For purposes herein, the term "completion of final cover" means completion of the placement of the turf component of the cover system.

No more than sixty days after completion of the final cover over the entire closed pond area, Alabama Power Company will submit to the ADEM a written certification signed by a qualified and experienced registered professional engineer that the final cover was completed in accordance with the closure plan and associated specifications. Pictures will also be furnished for the record as a supplement to the certification documenting the stages of closure.

## 2.6 SURVEY PLAT – PROPERTY DOCUMENTATION

Within ninety days after completion of the final cover over the entire closed pond area, Alabama Power Company will submit to the Etowah County Probate Office a survey plat indicating the location and dimensions of the closed pond area with respect to permanently surveyed benchmarks or section corners. The plat will contain a legal property description, prepared by an Alabama registered land surveyor, and will indicate the name of the permitter or owner, the type of disposal facility and the beginning and closure dates of disposal activities.

# 3.0 POST-CLOSURE PLAN

## 3.1 POST-CLOSURE USE

Post-closure use of the closed ash pond will be limited to activities that will not disturb the integrity of the cover. There are currently no plans for post-closure use of the ash pond area beyond inspections and maintenance. If sand roadways are required on the cover to facilitate access and maintenance, they will be constructed according to the ClosureTurf manufacturer's recommendations to avoid damaging the cover.

## 3.2 SITE INSPECTIONS AND MAINTENANCE

In order to ensure the integrity of the facility and closure, Alabama Power Company will conduct post-closure inspections once every three months for the first year and once yearly thereafter or as deemed necessary to ensure the integrity of the closure. Inspections will include, but will not be limited to, checking for damage to the turf, sand infill movement, and subsidence of top surface, slopes, and ditches. Maintenance of these areas will be conducted as necessary and as required.

Within sixty days following each inspection during the post-closure period, Alabama Power Company will prepare and submit a post-closure inspection report to the Alabama Department of Environmental Management, describing the condition of the site and any actions taken as needed to correct noted problems. After this period, inspections and required maintenance will continue as necessary to ensure the integrity of the site.

## 4.0 SCHEDULE

The following is a tentative schedule for the closure of the ash pond. Dewatering for closure and grading of the ash pond began in February 2016 and will extend through approximately September 2017. Capping operations are projected to begin in April 2017 and to be completed by April 2018. Though the schedule for closure is tentative based on present project schedules, the ADEM will be appropriately notified of any changes in the schedule as construction proceeds.

As required by 40 CFR Part 257, Alabama Power Company will prepare annual progress reports summarizing the progress of closure implementation. These reports will include a description of the work completed to date, any problems encountered and a description of corrective actions, and projected closure activities for the coming year. Progress reports will published on the Alabama Power Company CCR Rule Compliance Data and Information website in January of each year of closure, beginning in 2017. Alabama Power Company will notify the ADEM within thirty days of a progress report being published.

As final design activities will be conducted concurrently with regulatory review, any discussions or comments that the ADEM might have which may affect the completion of final design would be appreciated.

# APPENDIX A

DRAWINGS

# PLANT GADSDEN ASH POND CLOSURE

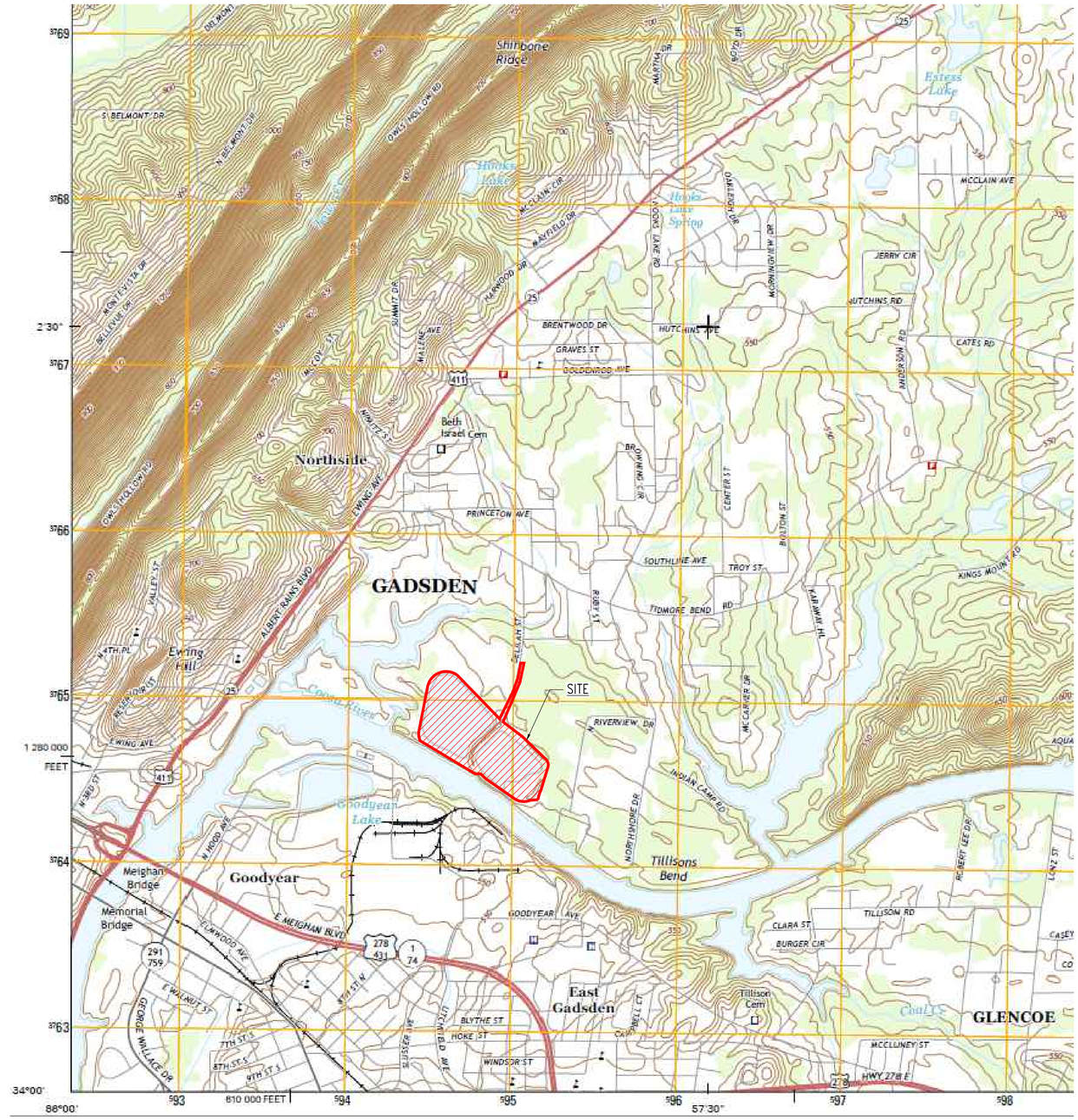
## (CBMPP AND GRADING AND DRAINAGE PLANS)

### ETOWAH COUNTY, ALABAMA

SECTION 2, TOWNSHIP 12 SOUTH, RANGE 6 EAST

DRAWING INDEX


E523619 COVER SHEET, DRAWING INDEX, VICINITY MAP AND CONTACTS
E523620 GENERAL NOTES, LEGEND AND ABBREVIATIONS
E523621 EXISTING TOPOGRAPHIC MAP
E523622 SPARE
E523623 SPARE
E523624 SPARE
E523625 SPARE
E523626 SPARE
E523627 SPARE
E523628 SPARE
E523629 SPARE
E523630 SPARE
E523631 SPARE
E523632 SPARE
E523633 SPARE
E523634 SPARE
E523635 GENERAL ARRANGEMENT PLAN FOR GRADING AND DRAINAGE PLANS
E523636 GRADING AND STORM DRAINAGE PLAN, STAGE 1, SHEET 1
E523637 GRADING AND STORM DRAINAGE PLAN, STAGE 1, SHEET 2
E523638 GRADING AND STORM DRAINAGE PLAN, STAGE 1, SHEET 3
E523639 GRADING AND STORM DRAINAGE PLAN, STAGE 1, SHEET 4
E523640 GRADING AND STORM DRAINAGE PLAN, STAGE 1, SHEET 5
E523641 GRADING AND STORM DRAINAGE PLAN, STAGE 1, SHEET 6
E523642 GRADING AND STORM DRAINAGE PLAN, STAGE 2, SHEET 1
E523643 GRADING AND STORM DRAINAGE PLAN, STAGE 2, SHEET 2
E523644 GRADING AND STORM DRAINAGE PLAN, STAGE 2, SHEET 3
E523645 GRADING AND STORM DRAINAGE PLAN, STAGE 2, SHEET 4
E523646 GRADING AND STORM DRAINAGE PLAN, STAGE 2, SHEET 5
E523647 GRADING AND STORM DRAINAGE PLAN, STAGE 2, SHEET 6
E523648 GRADING AND STORM DRAINAGE PLAN, STAGE 3, SHEET 1
E523649 GRADING AND STORM DRAINAGE PLAN, STAGE 3, SHEET 2
E523650 GRADING AND STORM DRAINAGE PLAN, STAGE 3, SHEET 3
E523651 GRADING AND STORM DRAINAGE PLAN, STAGE 3, SHEET 4
E523652 GRADING AND STORM DRAINAGE PLAN, STAGE 3, SHEET 5
E523653 GRADING AND STORM DRAINAGE PLAN, STAGE 3, SHEET 6
E523654 GRADING AND STORM DRAINAGE PLAN, STAGE 4, SHEET 1
E523655 GRADING AND STORM DRAINAGE PLAN, STAGE 4, SHEET 2
E523656 GRADING AND STORM DRAINAGE PLAN, STAGE 4, SHEET 3
E523657 GRADING AND STORM DRAINAGE PLAN, STAGE 4, SHEET 4
E523658 GRADING AND STORM DRAINAGE PLAN, STAGE 4, SHEET 5
E523659 GRADING AND STORM DRAINAGE PLAN, STAGE 4, SHEET 6
E523660 SPARE
E523661 SECTIONS AND DETAILS, SHEET 1
E523662 SECTIONS AND DETAILS, SHEET 2
E523663 SECTIONS AND DETAILS, SHEET 3
E523664 SECTIONS AND DETAILS, SHEET 4
E523665 SPARE
E523666 SPARE


GADSDEN EAST, AL QUADRANGLE
2014

GRAPHIC SCALE

1000 0 500 1000 2000 4000

( IN FEET )
1 inch = 1000 ft.

VICINITY MAP
NO SCALE

LEGEND:

PROJECT AREA

PERMITTEE:

ALABAMA POWER COMPANY
600 18TH STREET NORTH
BIRMINGHAM, ALABAMA 35203

PROJECT STREET/LOCATION

PLANT GADSDEN
101 DELILAH STREET
GADSDEN, ALABAMA 35903
ATTN: RON ROBINSON

PREPARED BY:

SOUTHERN COMPANY SERVICES, INC.
42 INVERNESS CENTER PARKWAY
BIRMINGHAM, ALABAMA 35242
TEL.: (205) 992-6961

CBMPP CONTACT/QCP:

ALABAMA POWER COMPANY
PAMELA R. McDANIEL, P.E.
P.O. BOX 2641
BIRMINGHAM, ALABAMA 35291
TEL.: (205) 257-4190
EMAIL: PJMCDANI@SOUTHERNCO.COM

NOTES

1. SEE DRAWING E523620 FOR GENERAL NOTES, SPECIFICATIONS AND ABBREVIATIONS.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| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040 ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| DSM | RCB | THB | LED | CJM | MPB | RMP |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
COVER SHEET, DRAWING INDEX,
VICINITY MAP AND CONTACTS

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| AS SHOWN | E523619 | 1 | FINAL | A |

ANSI E: 44x34

## TECHNICAL SPECIFICATION REFERENCE FOR PLANT GADSDEN ASH POND CLOSURES

1. REFER TO THE PROJECT TECHNICAL SPECIFICATIONS SECTION 31 23 00 FOR EXCAVATION AND BACKFILL FOR PLANT GADSDEN ASH POND CLOSURES. REFER TO THE EXCAVATION AND GRADING NOTES FOR EXCAVATION AND BACKFILL REQUIREMENTS.

## GENERAL CONSTRUCTION NOTES

1. ALL EROSION CONTROL MEASURES SHALL BE IN CONFORMANCE WITH THE "ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS", CURRENT EDITION.
2. EXISTING ACCESS AND ROADS SHALL BE MAINTAINED AND REPAIRED AS NECESSARY DURING CONSTRUCTION BY THE CONTRACTOR TO THE SATISFACTION OF THE PURCHASER'S PROJECT CONSTRUCTION MANAGER, PCM.
3. THE CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING HIS OWN STANDARD QUALITY CONTROL AND QUALITY ASSURANCE PROGRAM OR PRACTICES AND SHALL INSTITUTE ANY ADDITIONAL CONTROLS OR PROCEDURES IN ACCORDANCE WITH PROVEN INDUSTRY PRACTICE TO ASSUME COMPLIANCE WITH THESE DRAWINGS AND TECHNICAL SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PLANNING AND OPERATING ANY DEWATERING, SURFACE WATER RUNOFF CONTROL, AND PROVISIONS FOR DRAINAGE FOR EXCAVATIONS, AND FOR THE PLACEMENT OF MATERIALS. SUCH WORK SHALL BE AT NO ADDITIONAL EXPENSE TO THE PURCHASER.
5. ALL WORK SHALL BE IN STRICT COMPLIANCE WITH CURRENT OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) REGULATIONS. CONTRACTOR IS RESPONSIBLE FOR ALL SHORING/CRIBBING REQUIRED FOR INSTALLATION OF PIPES AND APPURTENANCES INCLUDING ANY DEEP EXCAVATIONS REQUIRING AN ENGINEER'S DESIGN.
6. CONSTRUCTION ACTIVITIES INCLUDING MATERIAL STOCKPILING IS NOT PERMITTED IN AREAS OUTSIDE OF THE DESIGNATED LIMITS OF DISTURBANCE UNLESS OTHERWISE SHOWN ON THE DRAWINGS AND AS APPROVED BY THE PCM.
7. STAGING AREAS AND EQUIPMENT MAINTENANCE AREAS SHALL BE LOCATED AT LEAST 200 FEET FROM STREAM BANKS TO MINIMIZE THE POTENTIAL FOR WASH WATER, PETROLEUM PRODUCTS, OR OTHER CONTAMINANTS FROM CONSTRUCTION EQUIPMENT ENTERING THE STREAMS.
8. CONSTRUCTION DEBRIS, FLOWABLE FILL, OLD SUPPORT MATERIALS AND OTHER REFUSE SHALL BE DISPOSED OF IN APPROVED LANDFILLS OFFSITE.
9. SEE EROSION CONTROL PLANS FOR BEST MANAGEMENT PRACTICES (BMP'S) NECESSARY FOR THE THE CONSTRUCTION OF THIS PROJECT. THESE PLANS REPRESENT THE MINIMUM REQUIRED TO CONSTRUCT THIS PROJECT. ADDITIONAL BMP'S MAY BE NECESSARY AS THE PROGRESS OF CONSTRUCTION REQUIRES. ALL WORK SHALL BE IN ACCORDANCE WITH THE ALABAMA NPDES CONSTRUCTION STORMWATER DISCHARGE GENERAL PERMIT FOR STAND ALONE CONSTRUCTION PROJECTS AND THE "ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS" (CURRENT EDITION).
10. SIX INCHES OF UNSETTLED TOPSOIL SHALL BE PLACED ON ALL AREAS THAT REQUIRE PERMANENT GRASSING PRIOR TO APPLICATION OF SEEDING. THE CONTRACTOR SHALL ADHERE TO PROPER SEEDING PROCEDURES AND SPECIFICATIONS, SPECIFICALLY, PAGE 119 THROUGH 127 OF THE "ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS," LATEST EDITION. THE CONTRACTOR SHALL PERFORM SOIL TESTS TO IDENTIFY AND IMPLEMENT SITE-SPECIFIC FERTILIZER NEEDS OR OTHER SOIL AMENDMENTS FOR ALL AREAS THAT REQUIRE PERMANENT SEEDING.
11. SEVERAL APPLICATIONS OF TEMPORARY OR PERMANENT VEGETATION MAY BE REQUIRED DURING CONSTRUCTION IN ORDER TO ESTABLISH AN ACCEPTABLE FINAL VEGETATIVE COVER. THE CONTRACTOR SHALL ADJUST HIS/HER BID ACCORDINGLY TO ACCOUNT FOR THIS DURING CONSTRUCTION.
12. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO EXISTING IMPROVEMENTS ON OR OFF SITE DUE TO THE DEMOLITION OR CONSTRUCTION OF THIS PROJECT. ANY DAMAGE WILL BE REPAIRED AT THE CONTRACTOR'S EXPENSE.
13. THE CONTRACTOR SHALL PROTECT ALL STORM SEWER STRUCTURES (PIPES, CULVERTS, INLETS, JUNCTION BOXES, ETC.) FROM DAMAGE AND ENSURE THEY REMAIN OPERATIONAL UNLESS SPECIFIED OTHERWISE. ANY DAMAGE TO THESE SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE.

## FLOWABLE FILL

1. A FLY ASH/CEMENT FLOWABLE FILL MIX SHALL CONSIST OF THE FOLLOWING:
   2000 LBS OF CLASS "F" FLY ASH
   150 LBS OF CEMENT
   200 LBS OF CONCRETE SAND(OPTIONAL)
   87 GALLONS OF WATER(POTABLE)
2. ALL FLOWABLE FILL TO SET 72 HOURS PRIOR TO PLACING COMPACTED SOIL BACKFILL ON FLOWABLE FILL.
3. COMPRESSION TESTING OF FLOWABLE FILL INCLUDING MAKING OF TEST CYLINDERS IS NOT REQUIRED FOR THIS PROJECT.

## STORM DRAINAGE PIPE AND STRUCTURE GENERAL INFORMATION & NOTES

1. PIPE LENGTHS AND SLOPES ARE CALCULATED FROM THE WORK POINTS OF THE PIPES/STRUCTURES.
   WORK POINTS FOR PIPES/STRUCTURES:
   MANHOLES – CENTER OF MANHOLE
   PIPES WITH SLOPE PAVED HEADWALL – END OF PIPE/FACE OF CONCRETE.
2. ALL MANHOLES SHALL CONTAIN STEPS INSTALLED IN ACCORDANCE WITH OSHA REGULATIONS AND SHALL BE SEALED AT JOINTS AND PIPE ENTRY/EXIT POINTS TO PROVIDE A WATERTIGHT STRUCTURE.
3. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS ON ALL STORM PIPE MATERIALS TO THE PROJECT CONSTRUCTION MANAGER PRIOR TO INSTALLATION AND/OR FABRICATION.
4. STORM DRAINAGE SYSTEMS SHALL BE CONSTRUCTED FROM DOWNSTREAM TO UPSTREAM. VERIFY ALL PIPE GRADES, INVERT ELEVATIONS, AND CONNECTION POINTS PRIOR TO CONSTRUCTION. NOTIFY THE PROJECT CONSTRUCTION MANAGER OF ANY AND ALL DISCREPANCIES.
5. THE CONTRACTOR SHALL VERIFY ALL EXISTING AND NEW STORM PIPE GRADES AND CONNECTION POINTS PRIOR TO INSTALLATION. THE PURCHASER SHALL BE NOTIFIED OF ANY DEVIATIONS PRIOR TO CONSTRUCTION.
6. ALL STORM PIPES SHALL BE BEDDED IN A MINIMUM OF 6" OF CRUSHED AGGREGATE.
7. ALL STORM PIPES SHALL BE SOLID WALL HIGH DENSITY POLYETHYLENE (HDPE) PIPE, UNLESS OTHERWISE NOTED. PIPE SHALL BE SMOOTH EXTERIOR AND INTERIOR WALLS, OR APPROVED EQUAL, AND INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.

## EXCAVATION AND GRADING NOTES

1. ALL EXISTING UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE AND SHALL BE FIELD VERIFIED PRIOR TO CONSTRUCTION. ANY DISCREPANCIES SHALL BE REPORTED TO THE PURCHASER.
2. ALL EXISTING IMPROVEMENTS SHALL REMAIN UNLESS SPECIFICALLY NOTED, "TO BE REMOVED".
3. SUBGRADE SHALL BE PROOF ROLLED WITH A HEAVILY LOADED TANDEM AXLE DUMP TRUCK AND APPROVED BY THE GEOTECHNICAL ENGINEER PRIOR TO PLACING FILL. ANY AREAS SHOWING SIGNS OF PUMPING, RUTTING, OR ANY UNSUITABLE (ORGANIC, SOFT, WET, LOOSE) MATERIAL FOUND IN PLACE SHALL BE UNDERCUT AND REPLACED.
4. ALL AREAS TO RECEIVE FILL SHALL BE SCARIFIED TO A DEPTH OF APPROXIMATELY 6" AND COMPACTED TO A MINIMUM 95% OF THE RELATIVE MINIMUM DRY DENSITY BY THE STANDARD PROCTOR COMPACTION TEST (ASTM D698).
5. FILL MATERIAL SHALL HAVE THE FOLLOWING PROPERTIES: FREE OF ORGANICS AND ANY DELETERIOUS MATTER, NO ROCK FRAGMENTS GREATER THAN 2" WITHIN 4' OF FINISH GRADE, LIQUID LIMIT NOT EXCEEDING 50, PLASTICITY INDEX NOT EXCEEDING 30, PLACED IN 8" LOOSE LIFTS, AND WITHIN ±3.0% OF OPTIMUM MOISTURE CONTENT.
6. COMPACTION TESTS SHALL BE TAKEN ONCE PER ACRE PER 8" COMPACTED LIFT, OR MORE FREQUENTLY AS DETERMINED BY THE QC INSPECTOR.
7. COORDINATE THE SEQUENCING OF ALL GRADING OPERATIONS WITH THE CBMPP PLAN.
8. NEW GRADES INDICATED ON THESE PLANS ARE TO FINISH GRADE. THE CONTRACTOR SHALL MAKE SUBGRADE ADJUSTMENTS FOR TOPSOIL, PAVING, ETC.
9. CONTRACTOR SHALL NOT CONDUCT ANY CONSTRUCTION OPERATIONS INSIDE OF DELINEATED WETLANDS, STREAM BUFFERS, AND ENVIRONMENTALLY PROTECTED AREAS WITHOUT PRIOR APPROVAL. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE TO ENVIRONMENTALLY SENSITIVE AREAS DUE TO THE CONSTRUCTION OF THIS PROJECT. ANY DAMAGES SHALL BE REPAIRED OR REMEDIED AT THE CONTRACTOR'S EXPENSE.
10. CONTRACTOR MAY ADJUST DESIGN COORDINATES AND ELEVATIONS OF THE FLAT BOTTOM STORMWATER DRAINAGE CHANNELS/SWALES TO AVOID UTILITIES AND/OR BEST FIT THE DRAINAGE CHANNELS TO EXISTING FIELD CONDITIONS. CONTRACTOR SHALL RECEIVE PRIOR REVIEW AND APPROVAL FROM THE PURCHASER'S PCM AND AND ENGINEER BEFORE ATTEMPTING ANY FIELD ADJUSTMENTS TO ANY ASPECT OF THE GRADING PLAN.
11. ALL EARTHWORK CONSTRUCTION SHALL BE DONE TO THE LINES, GRADES, AND CROSS SECTIONS SHOWN ON THE DRAWINGS. THE CONTRACTOR WILL ESTABLISH ALL NECESSARY BENCHMARKS AND BASE LINES REQUIRED FOR THE WORK.
12. ALL SLOPES SHALL BE 3-FEET HORIZONTAL TO 1-FOOT VERTICAL UNLESS SHOWN OTHERWISE.

## SURVEY AND TOPOGRAPHY NOTES:

1. GRID COORDINATE SYSTEM IS ALABAMA STATE PLANE NAD83 EAST ZONE.
2. CONTOURS ARE A COMPOSITE OF AERIAL LIDAR AND GROUND SURVEY BY SOUTHERN COMPANY CIVIL FIELD SERVICES AND SOUNDING DATA.
3. CONTOUR INTERVAL 1 FOOT.
4. PORTIONS OF THE GADSDEN ASH POND CLOSURE PROJECT IS LOCATED WITHIN A FLOOD PRONE AREA, ZONE AE, AS SHOWN ON NFIP FLOOD INSURANCE RATE MAP FOR ETOWAH COUNTY, ALABAMA, PANEL 0215D, PANEL 215 OF 475, EFFECTIVE DATE SEPTEMBER 26, 2008, MAP NUMBER 01055C0215D. SEE FLOOD MAP FIRMETTE ON DRAWING E523624.

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| x530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| x | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| x531.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| x | FENCE |
| | STORM PIPE |
| | STORM PIPE AND SLOPED CONC. HEADWALL |
| | RIPRAP |
| | W-BLOCK WALL |

## EROSION CONTROL LEGEND

| | |
|---|---|
| DC | DUST CONTROL |
| MU | MULCHING |
| TS | TEMPORARY SEEDING |
| PS | PERMANENT SEEDING |
| CEP | CONSTRUCTION EXIT PAD |
| LG | LAND GRADING |
| SB | SEDIMENT BARRIER (TYPE A SILT FENCE) |
| SB | SEDIMENT BARRIER (COMPOST FILTER SOCK) |
| SBN | SEDIMENT BASIN |
| GS | GRASS SWALE |
| TSG | TOPSOILING |
| CD | CHECK DAM |
| OP | OUTLET PROTECTION |
| RS | RIPRAP-LINED SWALE |
| ECB | EROSION CONTROL BLANKET |

## ABBREVIATIONS

| | |
|---|---|
| A.A.S.H.T.O. | AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS |
| A.S.T.M. | AMERICAN SOCIETY OF TESTING MATERIALS |
| B/C | BACK OF CURB |
| B.C.C.M.P. | BITUMINOUS COATED CORRUGATED METAL PIPE |
| B.O.P. | BOTTOM OF PIPE |
| ℄ | CENTERLINE |
| CL. | CLASS (OF PIPE) |
| CBMPP | CONSTRUCTION BEST MANAGEMENT PRACTICES PLAN |
| CMP | CORRUGATED METAL PIPE |
| CONC. | CONCRETE |
| COR. | CORNER |
| C.P.V.C. | CORRUGATED POLYVINYL CHLORIDE PIPE |
| C & G | CURB & GUTTER |
| C.F. | CUBIC FEET |
| DIA. | DIAMETER |
| D.I.P. | DUCTILE IRON PIPE |
| D.O.T. | DEPARTMENT OF TRANSPORTATION |
| D.I. | DROP INLET |
| e | DISTANCE FROM P.V.I. TO V.C. @ P.V.I. |
| EL. | ELEVATION |
| E.O.C. | EDGE OF CONCRETE |
| E.O.P. | EDGE OF PAVEMENT |
| E.W. | EACH WAY |
| F.B. | FLAT BOTTOM |
| F/C | FACE OF CURB |
| F.H. | FIRE HYDRANT |
| FES | FLARED END SECTION |
| F.F.E. | FINISHED FLOOR ELEVATION |
| G.C.M.P. | GALVANIZED CORRUGATED METAL PIPE |
| GRD. BRK. | GRADE BREAK |
| G.I. | GRATE INLET |
| H.D.P.E. | HIGH DENSITY POLYETHYLENE PIPE |
| H.P. | HIGH POINT |
| I.E. | INVERT ELEVATION |
| J.B. | JUNCTION BOX |
| LB. | POUND |
| L.O.D. | LIMITS OF DISTURBANCE |
| L.F. | LINEAR FEET |
| L.P. | LOW POINT |
| M.H. | MANHOLE |
| MIN. | MINIMUM |
| N.T.S. | NOT TO SCALE |
| O.F.B. | OUTSIDE FACE OF BUILDING |
| P.I. | POINT OF INTERSECTION |
| P.I.V. | POST INDICATOR VALVE |
| P.C. | POINT OF CURVE |
| PCC | POINT OF COMPOUND CURVE |
| PCM | PROJECT CONSTRUCTION MANAGER |
| ℙ | PROPERTY LINE |
| P.P. | POWER POLE |
| P.S. | POINT OF SWITCH |
| P.S.F. | POUNDS PER SQUARE FOOT |
| P.S.I. | POUNDS PER SQUARE INCH |
| P.T. | POINT OF TANGENT |
| P.V.I. | POINT OF VERTICAL INTERSECTION |
| P.O.C. | POINT ON CURVE |
| PVC | POLYVINYL CHLORIDE PIPE |
| P.V.C. | POINT OF VERTICAL CURVE |
| P.V.T. | POINT OF VERTICAL TANGENT |
| R | RADIUS |
| R.C.A.P. | REINFORCED CONCRETE ARCH PIPE |
| R.C.P. | REINFORCED CONCRETE PIPE |
| R.O.W. | RIGHT OF WAY |
| SCH. | SCHEDULE |
| SHLD. | SHOULDER |
| TOE | TOE OF SLOPE |
| T & B | TOP AND BOTTOM |
| T/C | TOP OF CURB |
| T.O.P. | TOP OF PIPE |
| T/R | TOP OF RAIL |
| T/S | TOP OF SLOPE |
| TYP. | TYPICAL |
| V.C. | VERTICAL CURVE |
| V.G. | VALLEY GUTTER |
| W.P. | WORKING POINT |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX.

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| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

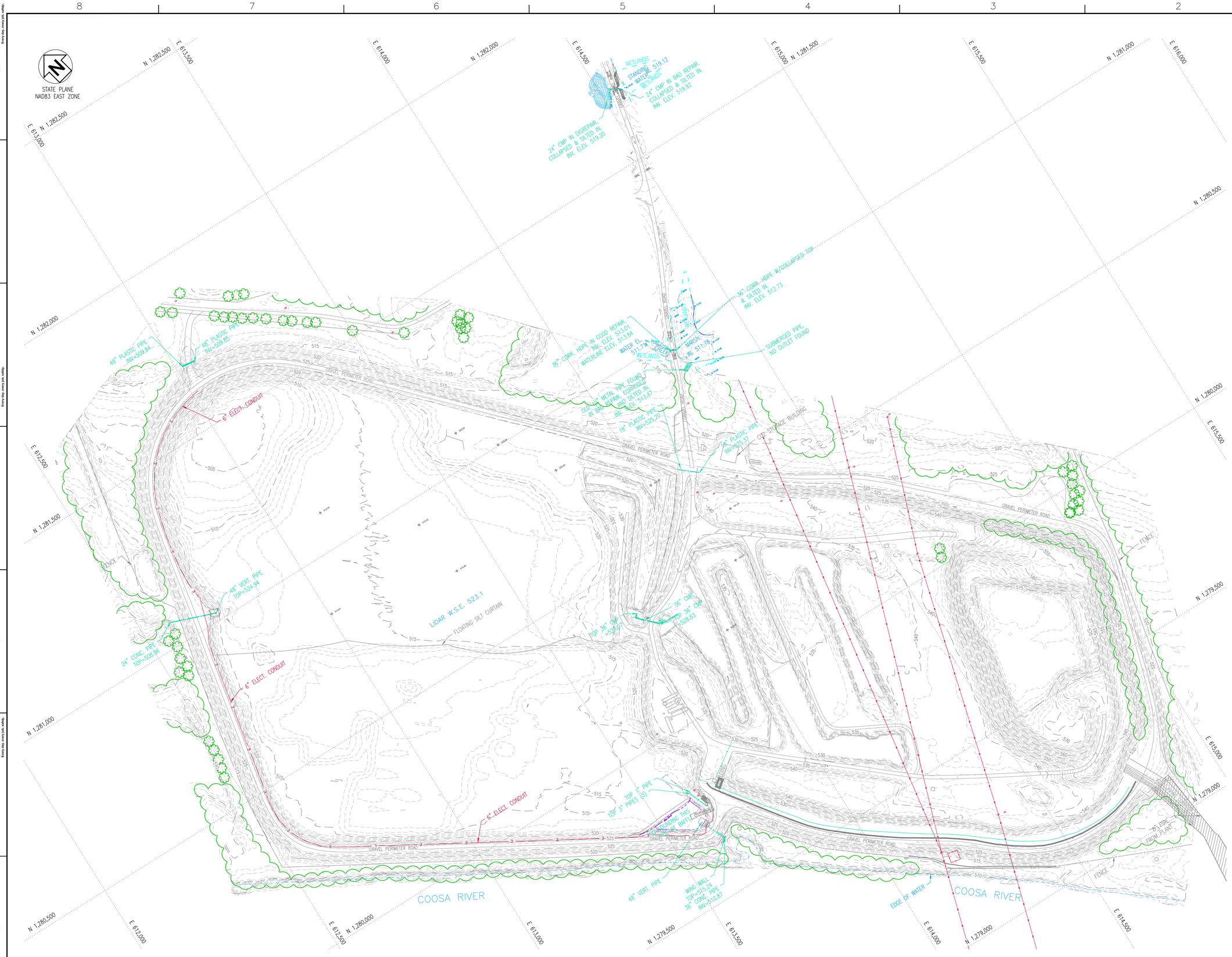
| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| DSM | RCB | THB | LED | CJM | MPB | RMP |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
GENERAL NOTES, LEGENDS, AND ABBREVIATIONS

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| NONE | E523620 | 1 | FINAL | A |

ANSI E: 44x34




## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| ×WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| x | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| x x x x x | EXISTING FENCE |
| | EXISTING TREELINE |
| SS SS | EXISTING STORM PIPE |
| SS SS | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E E E E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |

## GENERAL NOTES:

1. FOR DRAWING INDEX, SEE DRAWING E523619.
2. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS, SEE DRAWING E523620.

GRAPHIC SCALE

100 0 50 100 200 400

( IN FEET )
1 inch = 100 ft.

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PROJ. I.D.: GAD15003
MWO: APC368037,
APC368039,
APC368040

ASH POND CLOSURE PROJECT

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

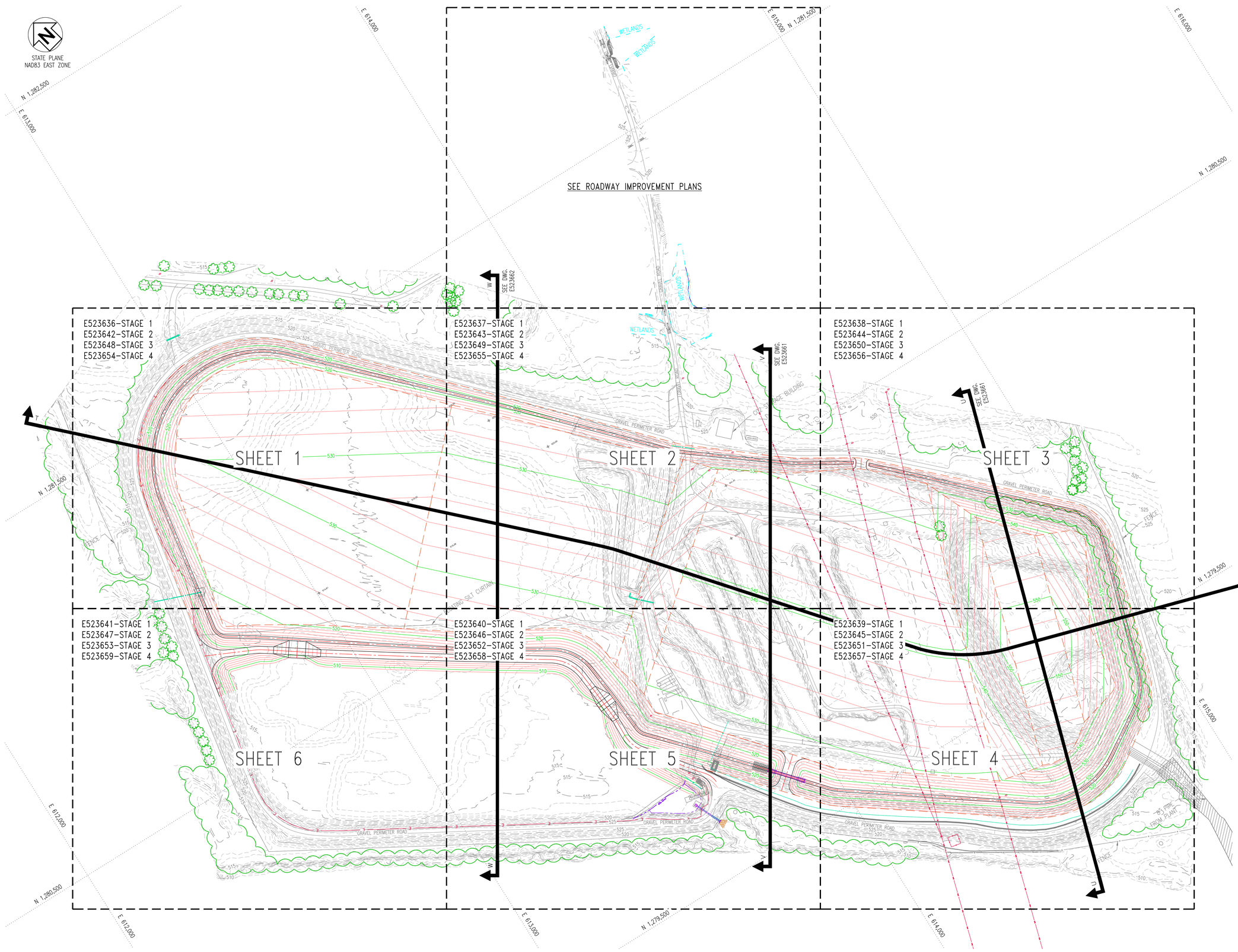
PLANT GADSDEN
EXISTING TOPOGRAPHIC MAP

As-Built Record

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=100' | E523621 | 1 | FINAL | A |

ANSI E: 44x34




## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| x530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |
| | STORM PIPE |
| | STORM PIPE AND SLOPED CONC. HEADWALL |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE

100 0 50 100 200 400

( IN FEET )
1 inch = 100 ft.

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**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
GENERAL ARRANGEMENT PLAN
FOR GRADING AND DRAINAGE PLANS

Record

| REVISION | DATE |
|---|---|
| A | 3-14-16 |

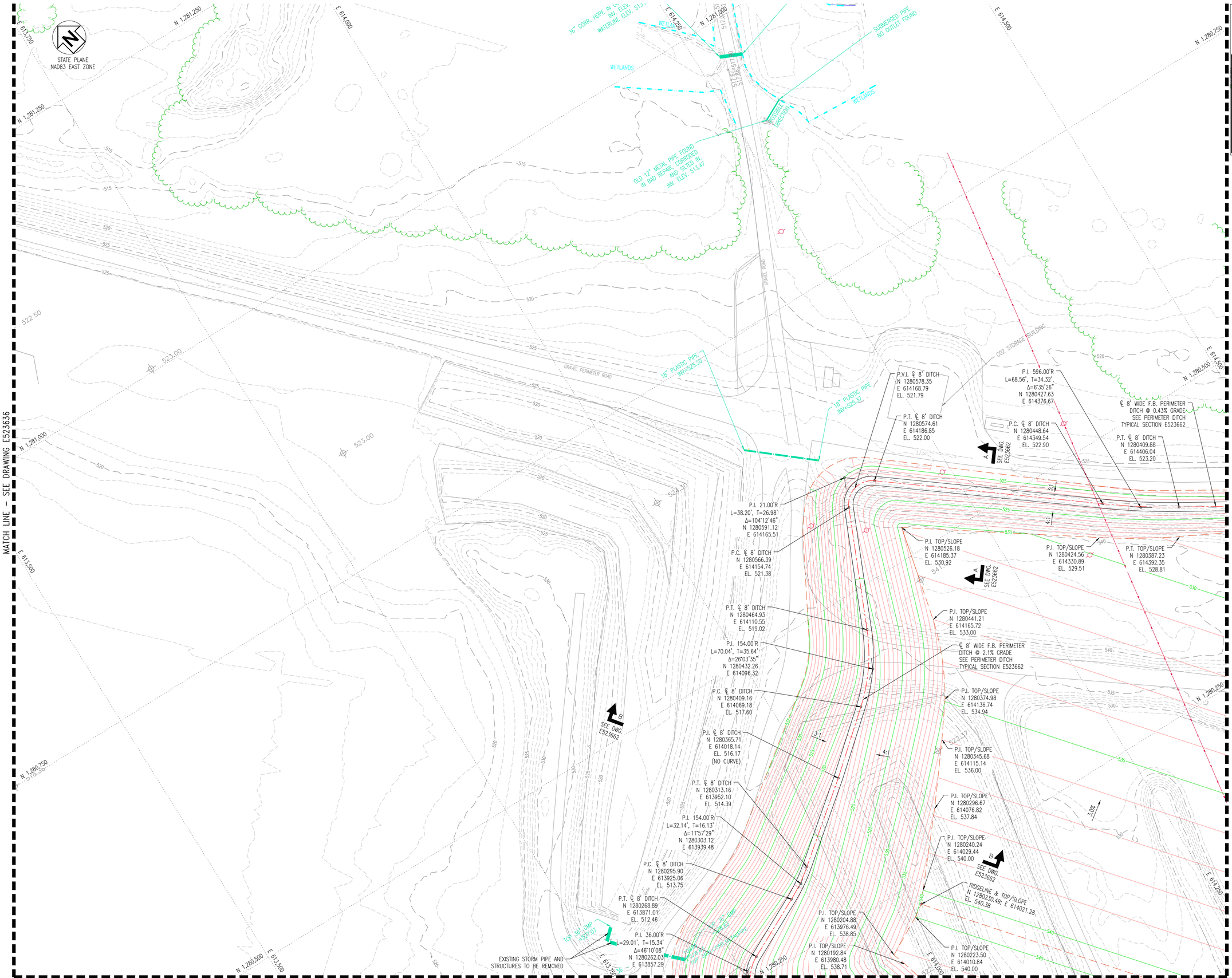
ISSUED FOR INQUIRY

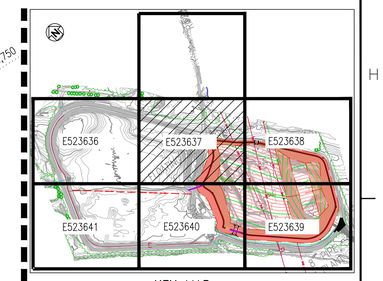
PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC368040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR | SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP | 1"=100' | E523635 | 1 | FINAL | A |

ANSI E: 44x34




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | EXISTING UNDERGROUND ELECTRIC CONDUIT |
| | LIMITS OF DISTURBANCE |
| 720 | CONTOURS (MAJOR) |
| 719 | CONTOURS (MINOR) |
| ×521.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |
| | RIPRAP |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE

30 0 15 30 60 120

( IN FEET )
1 inch = 30 ft.

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| REVISION | DATE |
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| A | 3-14-16 |

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 1
SHEET 2

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523637 | 1 | FINAL | A |

ANSI E: 44x34

STATE PLANE
NAD83 EAST ZONE

MATCH LINE – SEE DRAWING E523637

MATCH LINE – SEE DRAWING E523639

BEGIN ℄ 30' WIDE RAMP
N 1280336.15
E 614551.27

H.P. & P.T. ℄ 8' DITCH
N 1280337.67
E 614524.26
EL. 523.81

H.P. & P.C. ℄ 8' DITCH
N 1280308.94
E 614560.26
EL. 523.84

P.I. 334.00'R
L=20.30', T=10.16'
Δ=3°28'59"
N 1280343.45
E 614515.90

P.I. 334.00'R
L=13.43', T=6.72'
Δ=2°18'09"
N 1280304.39
E 614565.21

P.C. ℄ 8' DITCH
N 1280348.70
E 614507.21
EL. 523.71

P.T. ℄ 8' DITCH
N 1280299.66
E 614569.97
EL. 523.80

SEE DWG. E523662

℄ 8' WIDE F.B. PERIMETER
DITCH 0.43% GRADE
SEE PERIMETER DITCH
TYPICAL SECTION E523663

P.I. TOP/SLOPE
N 1280331.84
E 614498.75
527.42

P.I. TOP/SLOPE
N 1280294.02
E 614552.29
EL. 526.91

END ℄ 30' WIDE RAMP
& GRADE BREAK
N 1280310.43
E 614533.16
EL. 527.04

P.I. TOP/SLOPE
& GRADE BREAKS
N 1280172.00
E 614673.52
EL. 526.46

GRAVEL PERIMETER ROAD

P.C. ℄ 8' DITCH
N 1279880.55
E 614991.21
EL. 521.27

P.I. 119.00'R
L=128.98', T=71.64'
Δ=62°05'21"
N 1279830.04
E 615041.98

P.T. ℄ 8' DITCH
N 1279761.49
E 615021.10
EL. 520.64

FENCE

P.I. GRADE BREAKS
N 1280013.30
E 614742.88
EL. 541.67

P.I. GRADE BRK.
N 1280040.71
E 614626.78
EL. 530.00

CONTRACTOR NOT
RESPONSIBLE FOR THE
DEMOLITION OF THESE
STRUCTURES.

P.I. GRADE BREAKS
N 1279877.92
E 614858.38
EL. 544.55

P.I. GRADE BREAKS
N 1279837.51
E 614952.24
EL. 534.73

P.I. GRADE BREAKS
N 1279799.06
E 614977.49
EL. 532.04

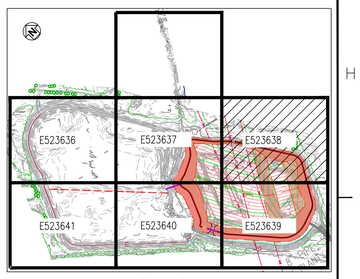
P.I. GRADE BREAKS
N 1279776.77
E 614971.00
EL. 532.74

P.I. GRADE BRK.
N 1279968.07
E 614601.44
EL. 532.00

P.I. GRADE BRK.
N 1279865.28
E 614567.43
EL. 535.00

10.44%
10.51%
3.0%
3:1
4:1

℄ 8' WIDE F.B. PERIMETER
DITCH 0.43% GRADE
SEE PERIMETER DITCH
TYPICAL SECTION E523663




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E E E | EXISTING UNDERGROUND ELECTRIC CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| ×531.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

| REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

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

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REVISION A DATE 3-14-16

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 1
SHEET 3

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523638 | 1 | FINAL | A |

ANSI E: 44x34

MATCH LINE – SEE DRAWING E523638

MATCH LINE – SEE DRAWING E523640

STATE PLANE
NAD83 EAST ZONE

END GRADE BRK.
N 1279732.78
E 614525.19
EL. 539.00

P.C. RIDGELINE
N 1279797.97
E 614381.45
EL. 540.38

RIDGELINE & BEGIN RAMP (POINT ON CURVE)
N 1279686.35; E 614513.96
EL. 540.38

P.I. 493.71'R
A=286.40', T=147.36'
Δ=33°14'14"
N 1279684.73
E 614475.74

P.I. GRADE BRK.
N 1279646.08
E 614492.14
EL. 539.00

P.I. GRADE BRK.
N 1279614.45
E 614480.24
EL. 538.00

P.T. RIDGELINE
N 1279641.06
E 614618.82
EL. 552.06

GRADE BREAK
N 1279684.03
E 614642.45

RIDGELINE GRADE BRK. & TOP OF RAMP
N 1279637.08
E 614632.08
EL. 553.45

GRADE BREAK
N 1279640.12
E 614785.80

RIDGELINE GRADE BRK. & TOP OF RAMP
N 1279596.18
E 614768.28
EL. 553.45

GRADE BREAK
N 1279548.35
E 614757.76

GRADE BREAK
N 1279592.15
E 614614.29

BEGIN RIDGELINE AND RAMP
N 1279569.35
E 614857.59
EL. 543.75

P.C. ℄ 8' DITCH
N 1279377.52
E 614904.05
EL. 518.93

P.I. 134.00'R
L=95.70', T=49.99'
Δ=40°55'13"
N 1279329.70
E 614889.47

P.T. ℄ 8' DITCH
N 1279303.11
E 614847.13
EL. 518.49

P.I. GRADE BREAKS
N 1279399.85
E 614831.10
EL. 537.00

P.I. GRADE BREAKS
N 1279372.73
E 614807.54
EL. 537.50

P.I. GRADE BREAKS
N 1279342.29
E 614694.84
EL. 545.54

P.I. GRADE BREAKS
N 1279310.35
E 614651.78
EL. 544.24

P.I. GRADE BREAKS
N 1279300.45
E 614525.23
EL. 542.85

P.I. GRADE BREAKS
N 1279287.32
E 614585.33
EL. 543.00

P.I. GRADE BREAKS
N 1279304.60
E 614493.62
EL. 539.50

P.I. GRADE BREAKS
N 1279327.16
E 614394.09
EL. 529.14

P.C. ℄ 8' DITCH
N 1279217.18
E 614710.28
EL. 517.74

P.I. EDGE/STONE & EDGE OF EXIST. ROAD
N 1279213.80
E 614861.84

P.I. EDGE/STONE & EDGE OF EXIST. ROAD
N 1279200.14
E 614883.70

P.I. EDGE/STONE & EDGE OF EXIST. ROAD
N 1279122.36
E 614872.96

AREA TO RECEIVE 8" THICK NO. 2 STONE

EDGE OF EXIST. ROAD (TYP.)

P.I. EDGE/STONE & EDGE OF EXIST. ROAD
N 1279100.85
E 614772.92

P.I. EDGE/STONE & EDGE OF EXIST. ROAD
N 1279126.76
E 614764.15

P.I. EDGE/STONE & EDGE OF EXIST. ROAD
N 1279116.67
E 614735.02

P.I. EDGE/STONE & EDGE OF EXIST. ROAD
N 1279128.08
E 614731.31

P.I. 244.00'R
L=290.48', T=165.23'
Δ=68°12'40"
N 1279129.32
E 614570.35

8" PIPE FROM PLANT

EXISTING PIPE TO BE REMOVED

P.I. TOP/SLOPE
N 1279611.26
E 614009.80
EL. 528.22

P.I. TOP/SLOPE
N 1279601.10
E 614021.35
EL. 528.29

P.I. TOP/SLOPE
N 1279549.64
E 614095.00
EL. 529.00

CONTRACTOR NOT RESPONSIBLE FOR DEMOLITION OF SPRINKLER PUMP HOUSE.

P.I. TOP/SLOPE
N 1279433.86
E 614255.16
EL. 529.75

SEE DWG. E523662

P.C. ℄ 8' DITCH
N 1279551.54
E 613985.66
EL. 514.03

GRAVEL PERIMETER ROAD

P.I. 150.00'R
L=33.85', T=17.00'
Δ=12°55'49"
N 1279561.48
E 613971.87

P.T. ℄ 8' DITCH
N 1279574.24
E 613960.64
EL. 513.88

℄ 8' WIDE F.B. PERIMETER DITCH @ 0.43% GRADE
SEE PERIMETER DITCH TYPICAL SECTION DWG E523662

P.T. ℄ 8' DITCH
N 1279226.64
E 614436.81
EL. 516.43

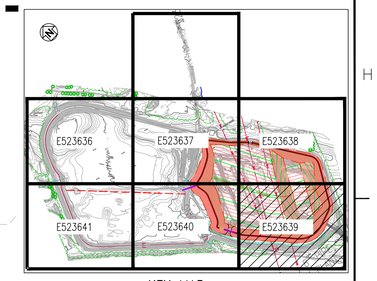
CONTRACTOR SHALL CONSULT PURCHASER PRIOR TO REMOVING 6" FRENCH DRAIN.

EXISTING W-BLOCK WALLS (TYP.). EXISTING W-BLOCK WALLS TO BE REMOVED AND REPURPOSED AS A SEDIMENT BARRIER WALL IN THE LOWER ASH CLOSURE AREA. (SEE THIS DWGS. E52340 AND E52341 FOR EXACT LOCATION; SEE DWG. E523662 FOR W-BLOCK SEDIMENT BARRIER WALL DETAILS)

FENCE

EDGE OF WATER

COOSA RIVER




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | EXISTING UNDERGROUND ELECTRIC CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| ×531.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

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| REVISION | DATE |
|---|---|
| | |

REVISION A — DATE 3-14-16

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

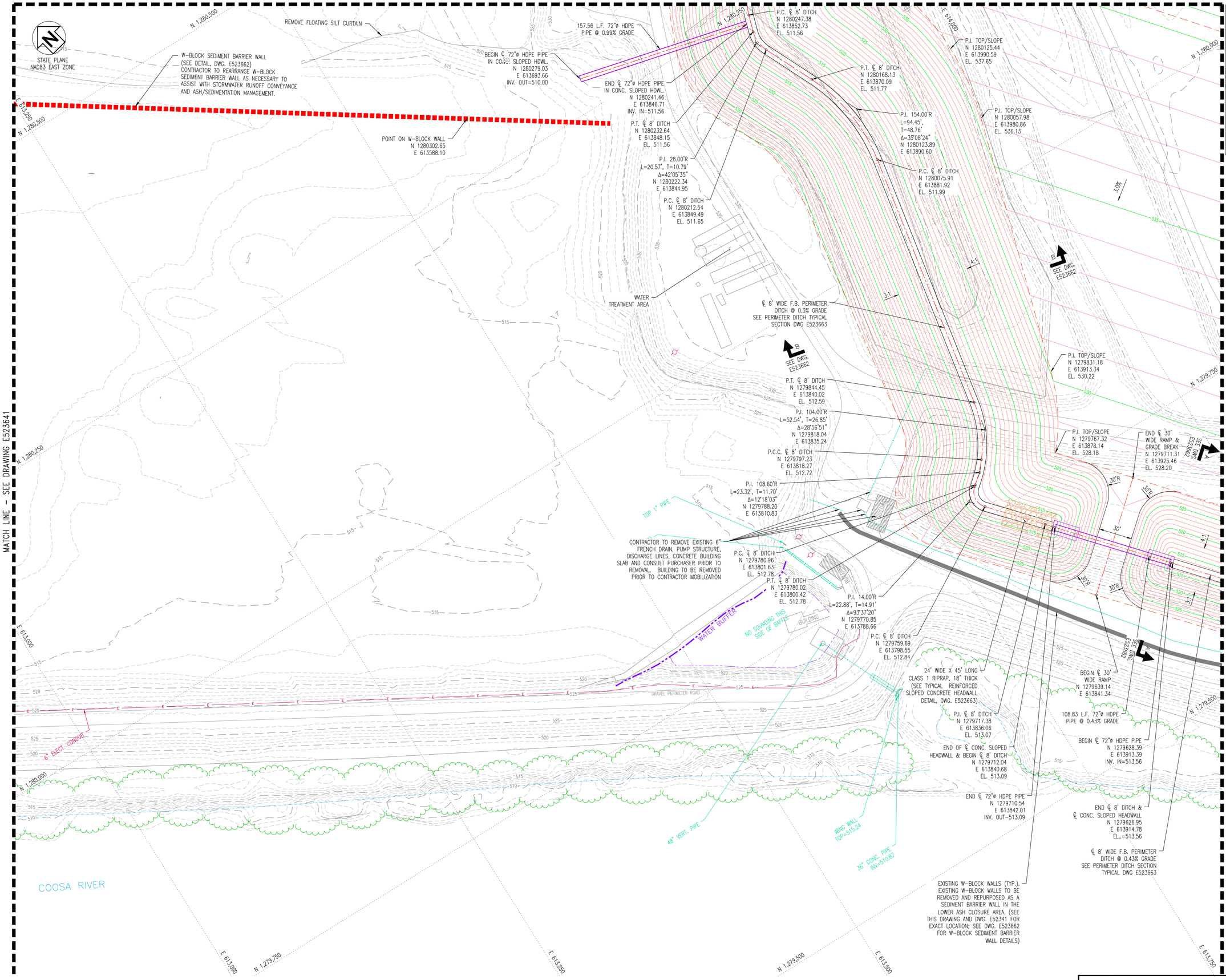
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 1
SHEET 4

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523639 | 1 | FINAL | A |

ANSI E: 44x34

MATCH LINE – SEE DRAWING E523637



KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| x530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | EXISTING UNDERGROUND ELECTRIC CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| x521.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |
| | STORM PIPE |
| | STORM PIPE AND CONC. SLOPED HEADWALL |
| | RIPRAP |
| | W-BLOCK WALL |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

| REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

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

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REVISION A DATE 3-14-16

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

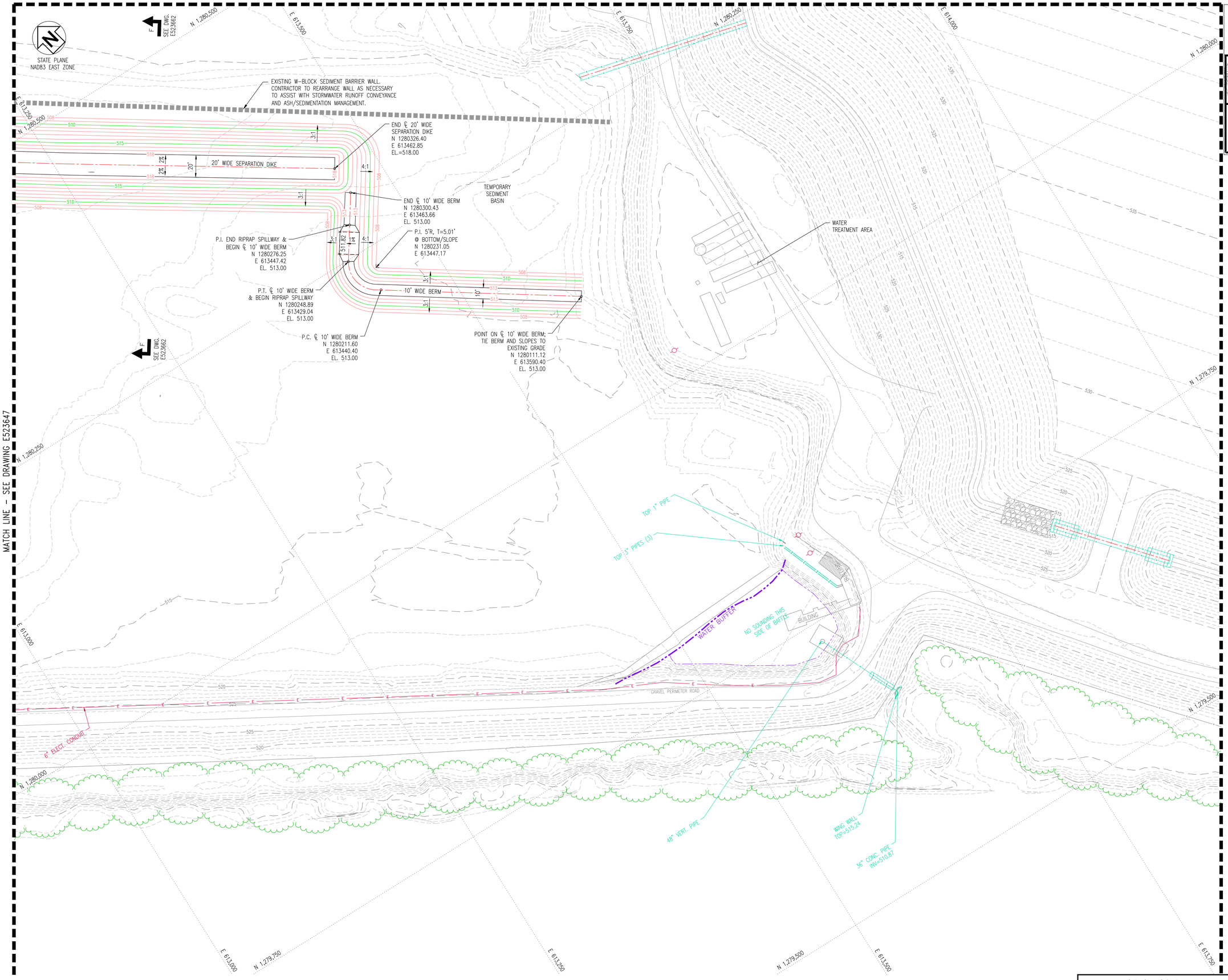
**Southern Company Generation Engineering and Construction Services**
FOR
**Alabama Power Company**

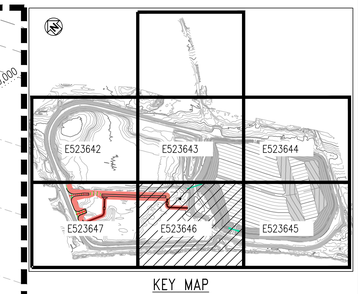
PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 1
SHEET 5

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523640 | 1 | FINAL | A |

ANSI E: 44x34

MATCH LINE – SEE DRAWING E523643




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 519 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| ×731.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

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| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

**Southern Company Generation Engineering and Construction Services**
FOR
**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 2
SHEET 5

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523646 | 1 | FINAL | A |

ANSI E: 44x34

MATCH LINE – SEE DRAWING E523642

STATE PLANE
NAD83 EAST ZONE

24" CONC. PIPE
IOP=508.00

P.T. DIKE @ N 1280929.38
E 612664.32

P.C. DIKE
N 1280842.22
E 612689.53

P.C. ℄ DIKE
& GRADE BREAK
N 1280799.31
E 612757.26
EL. 519.26

P.I. 140.00'R
L=21.26', T=10.62'
Δ=8°40'45"
N 1280794.78
E 612766.90

P.T. ℄ DIKE
N 1280788.84
E 612775.74
EL. 518.52

END ℄ 20' WIDE
SEPARATION DIKE
N 1280767.92
E 612806.94
EL.=517.20

BEGIN ℄ 20' WIDE
SEPARATION DIKE
N 1280689.88
E 612915.95
EL.=517.20

GRADE BREAK
N 1280678.24
E 612933.08
EL. 517.20

EXISTING W-BLOCK SEDIMENT BARRIER WALL.
CONTRACTOR TO REARRANGE WALL AS NECESSARY
TO ASSIST WITH STORMWATER RUNOFF CONVEYANCE
AND ASH/SEDIMENTATION MANAGEMENT.

SEE DWG. E523662

P.I. 85'R, T=61.47'
N 1280868.37
E 612633.91

BEGIN ℄ SEPARATION DIKE
N 1280860.93
E 612626.24
EL. 526.00

GRADE BREAK
℄ SEPARATION BERM
N 1280841.65
E 612667.22
EL.=525..00

P.I. 50'R, T=64.29'
N 1280851.48
E 612622.82

P.T. DIKE EDGE @ N 1280824.12
E 612681.02

6" ELECT. CONDUIT

P.C. DIKE EDGE @ N 1280788.36
E 612610.63

P.T. RAMP @ N 1280718.68
E 612597.16

P.I. 40'R, T=40.26'
N 1280679.15
E 612589.53

P.C. RAMP @ N 1280671.77
E 612629.11

BEGIN ℄ 40' WIDE RAMP
N 1280659.51
E 612585.75

P.I. 40'R, T=39.83'
N 1280639.88
E 612581.90

P.T. RAMP @ N 1280632.60
E 612620.97

P.C. RAMP @ N 1280600.77
E 612574.35

20' WIDE
SEPARATION DIKE

20' WIDE SEPARATION DIKE

P.I. 5'R (T=5.57')
N 1280782.50
E 612664.85

P.I. BOT/POND
N 1280760.33
E 612738.93

P.I. BOT/POND
N 1280755.33
E 612753.24

P.I. BOT/POND
N 1280723.60
E 612849.07

P.I. BOT/POND
N 1280735.77
E 612788.92

P.I. BOT/POND
N 1280745.56
E 612768.42

P.I. BOT/POND
N 1280663.30
E 612890.49

P.I. BOT/POND
N 1280716.23
E 612861.13

P.I. 12'R (T=6.93')
N 1280699.71
E 612649.45

P.I. N 1280659.15
E 612696.83

TEMPORARY
SEDIMENT
BASIN
EL. 508.00

END ℄ RAMP
N 1280639.49
E 612693.16
EL. 508.00

P.I. 12'R (T=10.05')
N 1280653.33
E 612900.82

END ℄ 10' WIDE BERM AT EL. 513.00
N 1280653.49
E 612925.02

BEGIN ℄ 10' WIDE BERM AT EL. 513.00
N 1280574.96
E 612872.28

20' WIDE RIPRAP SPILLWAY

END ℄ 10' WIDE BERM AT EL. 513.00
N 1280547.60
E 612853.90

P.T. ℄ 10' BERM
N 1280521.84
E 612836.59

P.I. ℄ CURVE, 32.00'R
L=37.23',T=21.04'
Δ=66°39'30"
N 1280504.37
E 612824.86

P.C. ℄ 10' BERM
N 1280508.22
E 612804.17

P.I. 12'R (T=7.89')
N 1280526.44
E 612815.59

P.I. 12'R (T=8.93')
N 1280599.09
E 612630.71

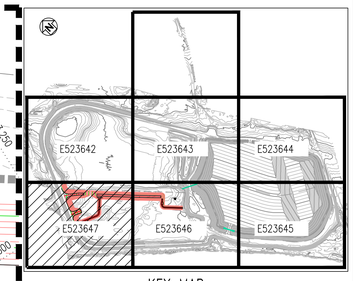
P.I. 12'R (T=12.00')
N 1280562.14
E 612623.83

10' WIDE BERM

BEGIN ℄ 10' WIDE BERM
AT EL. 513.00
N 1280545.22
E 612605.43

TIE TO EXISTING GRADE

GRAVEL PERIMETER ROAD




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 519 | EXISTING CONTOURS (MINOR) |
| x530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E E E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| x731.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| | RIPRAP |

MATCH LINE – SEE DRAWING E523646

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.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| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

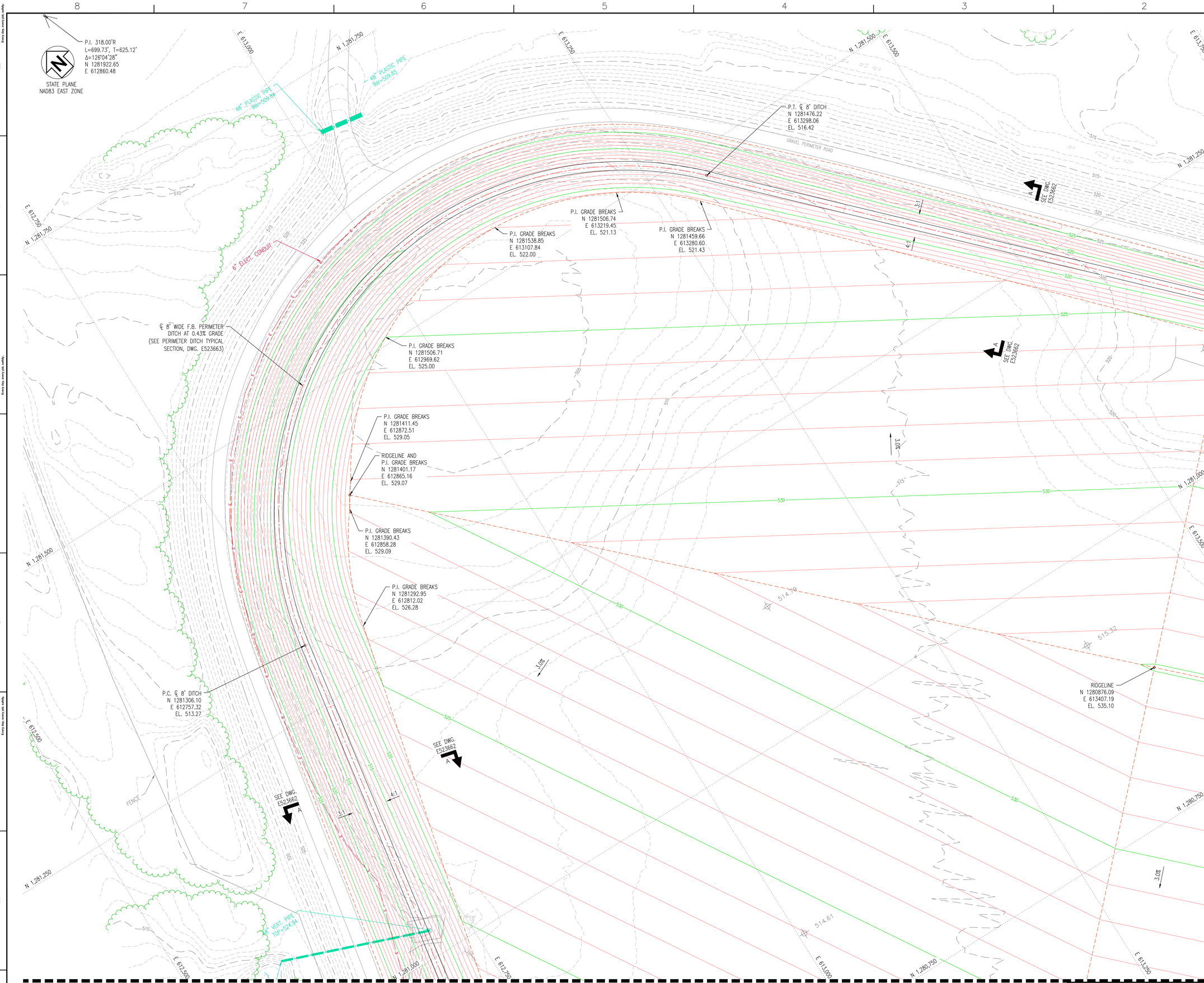
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

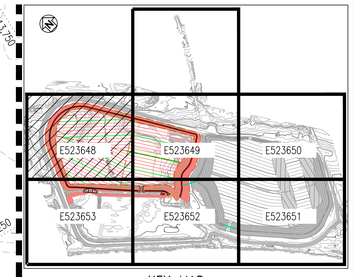
**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 2
SHEET 6

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523647 | 1 | FINAL | A |

ANSI E: 44x34




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 520 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 730 | CONTOURS (MAJOR) |
| 729 | CONTOURS (MINOR) |
| ×731.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |
| | STORM PIPE |
| | STORM PIPE & HEADWALL |
| | RIPRAP |

MATCH LINE – SEE DRAWING E523649

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

MATCH LINE – SEE DRAWING E523653

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| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC368040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 3
SHEET 1

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523648 | 1 | FINAL | A |

ANSI E: 44x34

STATE PLANE
NAD83 EAST ZONE

MATCH LINE – SEE DRAWING E523652

MATCH LINE – SEE DRAWING E523650

MATCH LINE – SEE DRAWING E523652

P.I. ℄ 8' WIDE DITCH
N 1281007.35
E 613758.46
EL. 519.32

℄ 8' WIDE F.B. PERIMETER DITCH AT 0.44% GRADE (SEE PERIMETER DITCH TYPICAL SECTION, DWG. E523663)

P.I. GRADE BREAKS
N 1281098.78
E 613622.94
EL. 525.80

P.I. GRADE BREAKS
N 1280872.77
E 613846.52
EL. 526.00

P.I. GRADE BREAKS
N 1280643.96
E 614068.24
EL. 526.07

P.I. GRADE BREAKS
N 1280640.96
E 614068.24
EL. 526.14

P.I. GRADE BREAKS
N 1280621.82
E 614038.46
EL. 527.19

P.I. GRADE BREAKS
N 1280578.48
E 613985.25
EL. 529.24

P.I. GRADE BREAKS
N 1280546.69
E 613935.31
EL. 531.00

P.I. GRADE BREAKS
N 1280531.72
E 613904.38
EL. 532.00

P.I. 1000.00'R
A=54.37', T=27.19'
Δ=3°06'55"
N 1280511.06
E 613784.00

P.I. GRADE BREAKS
N 1280498.92
E 613842.75
EL. 534.05

P.C. RIDGELINE
N 1280529.98
E 613764.47
EL. 535.10

P.I. GRADE BRKS.
N 1280496.06
E 613835.41
EL. 534.27

P.I. GRADE BREAKS
N 1280494.35
E 613816.48
EL. 534.72

END RIDGELINE
AND P.T. CURVE
N 1280491.11
E 613802.47
EL. 535.10

P.I. GRADE BREAKS
N 1280487.86
E 613788.41
EL. 534.72

P.I. GRADE BREAKS
N 1280479.91
E 613765.48
EL. 534.06

P.I. GRADE BREAKS
N 1280392.07
E 613662.03
EL. 530.00

P.C. ℄ 8' DITCH
N 1280658.23
E 614086.33
EL. 521.42

GRADE BREAK
N 1280639.79
E 614093.07
EL. 521.34

P.I. 25.00'R
L=40.35', T=26.11'
Δ=92°29'00"
N 1280639.19
E 614104.20

P.T. ℄ 8' DITCH
N 1280622.16
E 614084.41
EL. 520.94

P.C. ℄ 8' DITCH
N 1280612.77
E 614073.50
EL. 520.66

P.I. 104.00'R
L=17.86', T=8.95'
Δ=9°50'22"
N 1280606.93
E 614066.72

P.T. ℄ 8' DITCH
N 1280600.02
E 614061.03
EL. 520.33

P.C. ℄ DITCH
N 1280547.43
E 614017.76
EL. 518.97

P.I. 300.00'R
L=74.43', T=37.41'
Δ=14°12'55"
N 1280518.54
E 613994.00

P.T. ℄ 8' DITCH
N 1280496.37
E 613963.87
EL. 517.49

P.C. ℄ 8' DITCH
N 1280487.96
E 613952.44
EL. 517.21

P.I. 308.00'R
L=15.49', T=7.75'
Δ=2°52'54"
N 1280483.37
E 613946.20

P.T. ℄ 8' DITCH
N 1280478.47
E 613940.20
EL. 516.91

℄ 8' WIDE F.B. PERIMETER DITCH AT 1.97% GRADE (SEE PERIMETER DITCH TYPICAL SECTION, DWG. E523663)

P.C. ℄ 8' DITCH
N 1280435.05
E 613887.00
EL. 515.56

P.I. 100.00'R
L=37.98', T=19.22'
Δ=21°45'35"
N 1280422.90
E 613872.11

P.T. ℄ 8' DITCH
N 1280417.13
E 613853.78
EL. 514.76

P.C. ℄ 8' DITCH
N 1280395.52
E 613785.11
EL. 513.34

P.I. 110.00'R
L=85.24', T=44.89'
Δ=44°23'50"
N 1280382.05
E 613742.29

P.T. ℄ 8' DITCH
N 1280342.47
E 613721.12
EL. 511.78

8' WIDE
PERIMETER DITCH

36" CORR. HDPE IN C...
INV. ELEV.
WATERLINE ELEV. 51...

SUBMERGED PIPE,
NO OUTLET FOUND

OLD 12" METAL PIPE FOUND
IN BAD REPAIR, CORRODED
AND SILTED IN,
INV. ELEV. 513.47

18" PLASTIC PIPE
INV=525.20

18" PLASTIC PIPE
INV=525.37

WETLANDS

GRAVEL ROAD

GRAVEL PERIMETER ROAD

CO2 STORAGE BUILDING

SEE DWG. E523662

SEE DWG. E523663

## KEY MAP
NOT TO SCALE

E523648 | E523649 | E523650
E523653 | E523652 | E523651

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 520 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 730 | CONTOURS (MAJOR) |
| 729 | CONTOURS (MINOR) |
| ×731.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |
| | STORM PIPE |
| | STORM PIPE & HEADWALL |
| | RIPRAP |

## NOTES:
1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

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| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

**Southern Company Generation**
**Engineering and Construction Services**
FOR

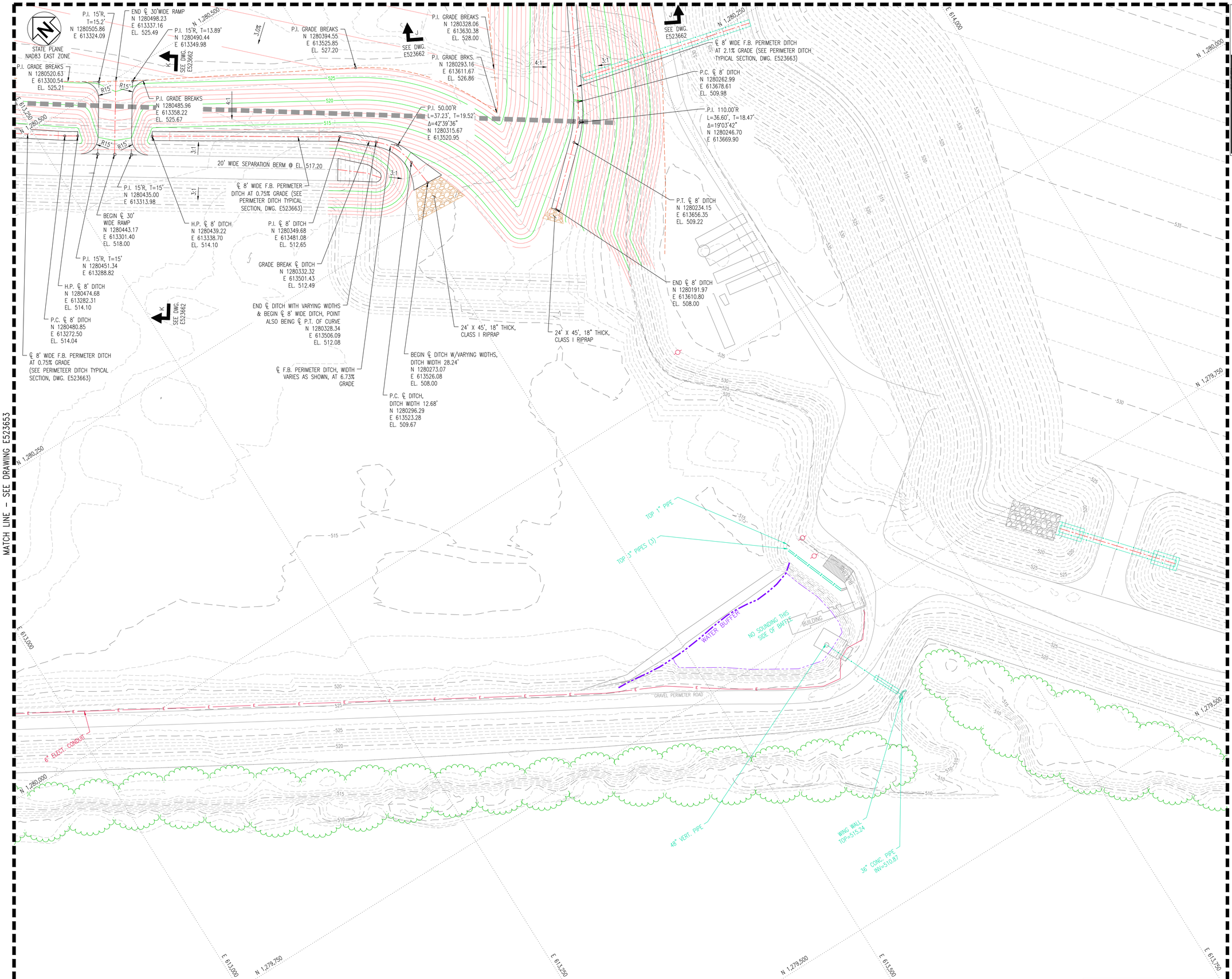
**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 3
SHEET 2

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523649 | 1 | FINAL | A |

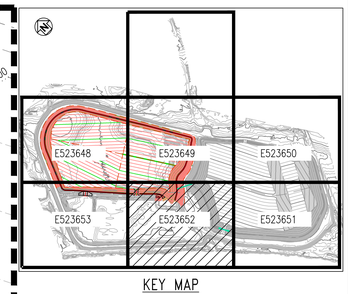
ANSI E: 44x34

MATCH LINE – SEE DRAWING E523649




MATCH LINE – SEE DRAWING E523653

MATCH LINE – SEE DRAWING E523651




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 520 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 × | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| × | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| SS | EXISTING STORM PIPE |
| SS | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| | RIPRAP |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE

30 0 15 30 60 120

( IN FEET )
1 inch = 30 ft.

| REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |

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

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REVISION A DATE 3-14-16

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 3
SHEET 5

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | **E523652** | 1 | FINAL | A |

ANSI E: 44x34

MATCH LINE – SEE DRAWING E523648

STATE PLANE
NAD83 EAST ZONE

24" CONC. PIPE
IOP=508.36'

P.I. GRADE BREAKS
N 1280899.33
E 612726.61
EL. 517.61

P.I. GRADE BREAK
N 1280858.68
E 612800.53
EL. 518.87

P.I. GRADE BREAKS
N 1280803.49
E 612891.18
EL. 520.36

P.I. GRADE BREAKS
N 1280786.21
E 612918.39
EL. 520.80

P.I. GRADE BREAKS
N 1280621.48
E 613160.54
EL. 524.46

SEE DWG. E523652

P.I. GRADE BREAKS
N 1280913.55
E 612720.83
EL. 517.69

P.T. ℄ 8' DITCH
N 1280918.26
E 612692.61
EL. 511.54

P.I. 44.00'R
L=49.34', T=27.63'
Δ=64°15'08"
N 1280891.01
E 612688.05

P.C. ℄ 8' DITCH
N 1280875.06
E 612710.61
EL. 511.33

℄ 8' WIDE F.B. PERIMETER DITCH
AT 0.43% GRADE (SEE PERIMETER DITCH
TYPICAL SECTION, DWG. E523663)

OUT

P.I. ℄ 8' DITCH
N 1280829.01
E 612781.05
EL. 511.01

LOW PT. ℄ 8' DITCH
N 1280768.91
E 612865.53
EL. 510.61

P.I. BEGIN
SPILLWAY
N 1280765.65
E 612863.19
EL. 510.62

P.I. END OF
SPILLWAY
N 1280732.39
E 612839.37
EL. 510.20

40.00'

4:1

LOW PT. ℄ 8' DITCH
N 1280745.70
E 612898.10
EL. 510.61

P.I. BEGIN
SPILLWAY
N 1280742.40
E 612895.74
EL. 510.62

P.I. END OF
SPILLWAY
N 1280709.10
E 612871.89
EL. 510.20

℄ 40.0' WIDE SPILLWAY
AT 1.0% GRADE

20' WIDE SEPARATION BERM @ EL. 517.20

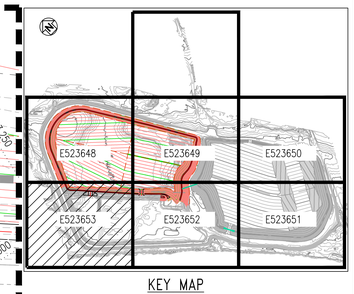
P.I. ℄ 8' DITCH
N 1280611.86
E 613085.77
EL. 512.34

℄ 8' WIDE F.B. PERIMETER DITCH
AT 0.75% GRADE (SEE PERIMETER DITCH
TYPICAL SECTION, DWG. E523663)

SEE DWG. E523652

GRAVEL PERMETER ROAD

N 1,281,000
N 1,280,750
N 1,280,500
N 1,280,250
N 1,280,000
E 612,000
E 612,250
E 612,500
E 612,750
E 613,000
E 613,250
E 613,500




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 520 | EXISTING CONTOURS (MINOR) |
| x530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| x | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| SS | EXISTING STORM PIPE |
| SS | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 730 | CONTOURS (MAJOR) |
| 729 | CONTOURS (MINOR) |
| x731.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| x | FENCE |
| | RIPRAP |

MATCH LINE – SEE DRAWING E523652

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

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| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 3
SHEET 6

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523653 | 1 | FINAL | A |

ANSI E: 44x34

STATE PLANE
NAD83 EAST ZONE

36" CORR. HDPE IN
INV. ELEV.
WATERLINE ELEV. 51...

SUBMERGED PIPE
NO OUTLET FOUND

WETLANDS

POSSIBLE FLOW DIRECTION

OLD 12" METAL PIPE FOUND
IN BAD REPAIR, CORRODED
AND SILTED IN.
INV. ELEV. 513.47

GRAVEL ROAD

HOLD INSIDE EDGE
OF EXISTING GAB
PERIMETER ROAD

14'

MIN. 14' G.A.B. PERIMETER ROAD

GRAVEL PERIMETER ROAD

CONTRACTOR TO CONSULT
PURCHASER PRIOR TO
REMOVING EXISTING PIPE.

18" PLASTIC PIPE
INV=525.20

18" PLASTIC PIPE
INV=525.37

P.I. 396.52'R
L=60.31', T=30.21'
Δ=8°42'54"
N 1280636.32
E 614107.14

P.T. ℄ DITCH
N 1280617.82
E 614131.03
EL. 521.68

CO2 STORAGE BUILDING

℄ 8' WIDE PERIMETER DITCH
@ 0.43% GRADE
SEE PERIMETER DITCH TYPICAL
SECTION DWG E523663

HOLD INSIDE EDGE
OF EXISTING GAB
PERIMETER ROAD

MIN. 14' G.A.B. PERIMETER ROAD

P.I. ℄ 8' WIDE DITCH
(STAGE 3)
N 1280660.15
E 614084.52
EL. 521.41

P.C. ℄ DITCH
N 1280658.23
E 614086.33
EL. 521.42

P.I. GRADE BREAK
N 1280630.35
E 614082.97
EL. 526.00

P.I. GRADE BREAKS
N 1280608.22
E 614109.75
EL. 525.81

P.I. ℄ 8' WIDE DITCH
(STAGE 1)
N 1280574.61
E 614186.85
EL. 521.99

P.I. GRADE BREAKS
N 1280529.68
E 614180.37
EL. 530.96

SEE DWG.
E523663

P.C. RIDGELINE
(STAGE 3)
N 1280529.98
E 613764.47
EL. 535.10

P.I. 1000'R
L=109.97', T=54.91'
Δ=6°17'09"
N 1280491.78
E 613803.91

P.T. RIDGELINE
N 1280449.48
E 613838.92
EL. 535.10

RIDGELINE GRADE BREAK
N 1280410.09
E 613871.73
EL. 535.10

RIDGELINE GRADE BREAK
N 1280328.94
E 613939.30
EL. 540.38

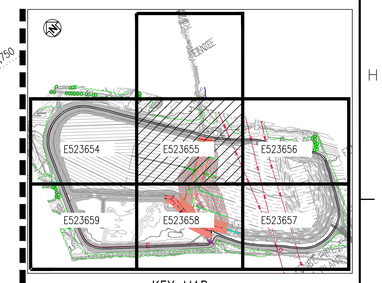
RIDGELINE (PHASE 1)
N 1280230.49; E 614021.28
EL. 540.38

SEE DWG.
E523663

MATCH LINE – SEE DRAWING E523654

MATCH LINE – SEE DRAWING E523656

MATCH LINE – SEE DRAWING E523658




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| x530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| OHE | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| E | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| x 531.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |
| | STORM PIPE |
| | STORM PIPE & HEADWALL |
| | NEW RIPRAP |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

| REVISION | DATE |
|---|---|
| | |

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

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REVISION A DATE 3-14-16

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ / DSM | RCB | THB | LED | CJM | MPB | RMP |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 4
SHEET 2

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523655 | 1 | FINAL | A |

ANSI E: 44x34

MATCH LINE – SEE DRAWING E523655

MATCH LINE – SEE DRAWING E523659

MATCH LINE – SEE DRAWING E523657

STATE PLANE
NAD83 EAST ZONE

CONTRACTOR TO REMOVE EXISTING STORM PIPE AND CONSULT PURCHASER PRIOR TO REMOVAL

P.T. ℄ DITCH
N 1280340.51
E 613495.60
EL. 512.98

℄ 8' WIDE PERIMETER DITCH
@ 0.75% GRADE
SEE PERIMETER DITCH TYPICAL
SECTION DWG E523663

P.I. GRADE BREAK
(STAGE 3)
N 1280293.15
E 613611.66
EL. 526.87

P.I. GRADE BREAKS
N 1280214.29
E 613801.62
EL. 535.00

P.I. 149.00'R
L=131.85', T=70.59'
Δ=50°41'59"
N 1280301.62
E 613554.10

P.I. GRADE BREAK
N 1280266.56
E 613619.24
EL. 526.52

P.I. GRADE BREAK
N 1280242.74
E 613622.66
EL. 526.14

P.I. GRADE BREAK
N 1280242.74
E 613622.66
EL. 526.14

P.I. GRADE BREAKS
N 1280149.44
E 613640.81
EL. 527.39

END ℄ 20' WIDE
SEPARATION DIKE
(STAGE 2)
N 1280325.69
E 613463.95
EL. 518.20

P.C. ℄ DITCH
N 1280231.46
E 613561.83
EL. 511.68

P.I. GRADE BREAK
N 1280149.44
E 613640.81
EL. 527.39

P.I. GRADE BREAK
N 1280129.48
E 613645.21
EL. 528.02

WATER TREATMENT EQUIPMENT
AND FACILITIES
(SEE SPECIAL NOTE FOR DETAILS)

P.T. ℄ DIKE
N 1280318.62
E 613474.82
EL. 518.20

P.I. 120.00'R
L=107.63', T=57.74'
Δ=51°23'24"
N 1280287.17
E 613523.29

P.C. ℄ DIKE
N 1280229.71
E 613528.89
EL. 518.20

℄ 25' WIDE
CONCRETE SPILLWAY
N 1280129.13
E 613569.77
EL. 511.07

P.I. GRADE BREAKS
N 1280089.70
E 613652.00
EL. 529.16

CONTRACTOR SHALL REMOVE
TEMPORARY SEDIMENT BASIN
BERM FOLLOWING COMPLETION
OF STAGE 4 GRADING. GRADE
POND BOTTOM TO POSITIVELY
DRAIN TO NPDES STRUCTURE.

P.I. ℄ DIKE &
END ℄ SPILLWAY
N 1280183.38
E 613533.44
EL. 517.41

P.I. GRADE BREAK
N 1280028.35
E 613650.42
EL. 527.94

P.T. ℄ DITCH
N 1280016.28
E 613580.82
EL. 511.40

P.I. 46.00'R
L=30.79', T=16.00'
Δ=38°21'09"
N 1280000.32
E 613581.93

SEE DWG. E523662

℄ 25' WIDE
CONCRETE SPILLWAY
N 1280125.87
E 613528.06
EL. 508.00

P.C. ℄ DITCH
N 1279988.49
E 613592.70
EL. 511.53

℄ 8' WIDE PERIMETER DITCH
@ 0.43% GRADE
SEE PERIMETER DITCH TYPICAL
SECTION DWG E523663

P.I. GRADE BREAK
(STAGE 1)
N 1279767.32
E 613878.14
EL. 528.18

P.I. ℄ DITCH
N 1279864.57
E 613705.56
EL. 512.23

P.I. ℄ DIKE &
BEGIN ℄ SPILLWAY
N 1280070.49
E 613542.28
EL. 517.59

BEGIN ℄ 20' WIDE
SEPARATION DIKE
N 1279801.74
E 613678.80
EL. 528.39

PT. ON ℄ 8' WIDE
DITCH (STAGE 1)
N 1279759.69
E 613798.55
EL. 512.83

P.T. ℄ DIKE
N 1280016.48
E 613540.94
EL.=520.07

P.T. CURVE
N 1279802.64
E 613691.34

P.I. 100.00'R
L=66.94', T=34.78'
Δ=38°21'15"
N 1279981.71
E 613540.08

P.C. CURVE
N 1279786.20
E 613702.17

P.C. ℄ DIKE
N 1279953.91
E 613560.98
EL. 522.41

P.I. ℄ DIKE
N 1279818.63
E 613663.88
EL. 528.17

TOP 4" PIPE

TOP 3" PIPES (3)

SEE DWG. E523662

CONTRACTOR SHALL
EXCAVATE TO THE BOTTOM
OF ASH/TOP OF IN-SITU
MATERIAL PLUS 6 INCHES
PRIOR TO BEGINNING
CONSTRUCTION OF
SEPARATION DIKE

P.T. CURVE
N 1279803.66
E 613663.76

CONTRACTOR TO CONSULT WITH
PURCHASER REGARDING
DEMOLITION OF PUMP HOUSE
AND WATER TREATMENT PIPING

WATER BUFFER

NO SOUNDING THIS
SIDE OF BAFFLE

BUILDING

P.C. CURVE
N 1279743.08
E 613668.05

PERIMETER DIKE ACCESS ROAD
SEE DETAIL DWG. E523662

LIMITS OF EXISTING ASH

HOLD OUTSIDE
EDGE OF
EXISTING GAB
PERIMETER ROAD

PERIMETER DIKE ACCESS ROAD
SEE DETAIL DWG. E523662

GRAVEL PERIMETER ROAD

14' MIN.

6" ELECT. CONDUIT

HOLD INSIDE EDGE
OF EXISTING GAB
PERIMETER ROAD

OUTLET RISER STRUCTURE
(WITH CANAL C-10 OUTLET CONTROL GATE)
TOP=513.00
36" INV. OUT=509.41
N 1279735.49
E 613608.51

48" VERT. PIPE
(REMOVE)

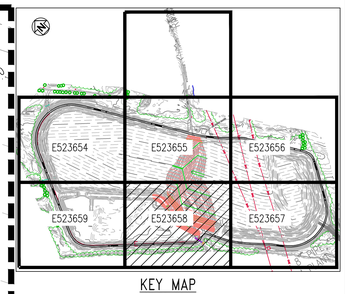
℄ 82 L.F. 36" HDPE
PIPE @ 0.50% GRADE

WING WALL
TOP=515.24
(REMOVE)

36" CONC. PIPE
INV=510.87
(REMOVE)

36" VERTICAL CONC.
HEADWALL
36" INV. OUT=509.00
N 1279658.48
E 613643.29

N 1,280,500
N 1,280,250
N 1,280,000
N 1,279,750
N 1,279,500
N 1,280,050
E 613,250
E 613,000
E 614,000
E 613,500
E 613,750




KEY MAP
NOT TO SCALE

## LEGEND

| | |
|---|---|
| 520 | EXISTING CONTOURS (MAJOR) |
| 521 | EXISTING CONTOURS (MINOR) |
| ×530.20 | EXISTING SPOT ELEV. |
| WL 519.30 | EXISTING WATER LEVEL |
| | EXISTING ROADS |
| | EXISTING FENCE |
| BUILDING | EXISTING BUILDING |
| | EXISTING RIPRAP |
| | EXISTING TREELINE |
| | EXISTING STORM PIPE |
| | EXISTING STORM PIPE AND WINGWALL |
| | EXISTING POWER POLE AND OVERHEAD ELECTRIC LINES |
| | EXISTING UNDERGROUND ELECTRICAL CONDUIT |
| | LIMITS OF DISTURBANCE |
| 530 | CONTOURS (MAJOR) |
| 529 | CONTOURS (MINOR) |
| ×531.10 | SPOT ELEV. |
| | RIDGELINE OR GRADE BREAK |
| | FENCE |
| | STORM PIPE |
| | STORM PIPE AND CONC. VERTICAL HEADWALL |
| | RIPRAP |

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.
3. SPECIAL NOTE: CONTRACTOR SHALL COORDINATE WITH PURCHASER REGARDING PORTABLE WATER TREATMENT SYSTEM RELOCATION PRIOR TO COMPLETION OF STAGE 4 GRADING AND CONSTRUCTION ACTIVITIES.

GRAPHIC SCALE
30 0 15 30 60 120
( IN FEET )
1 inch = 30 ft.

| REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE | REVISION | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

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

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REVISION A DATE 3-14-16

ISSUED FOR INQUIRY

PROJ. I.D.: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| EEJ DSM | RCB | THB | LED | CJM | MPB | RMP |

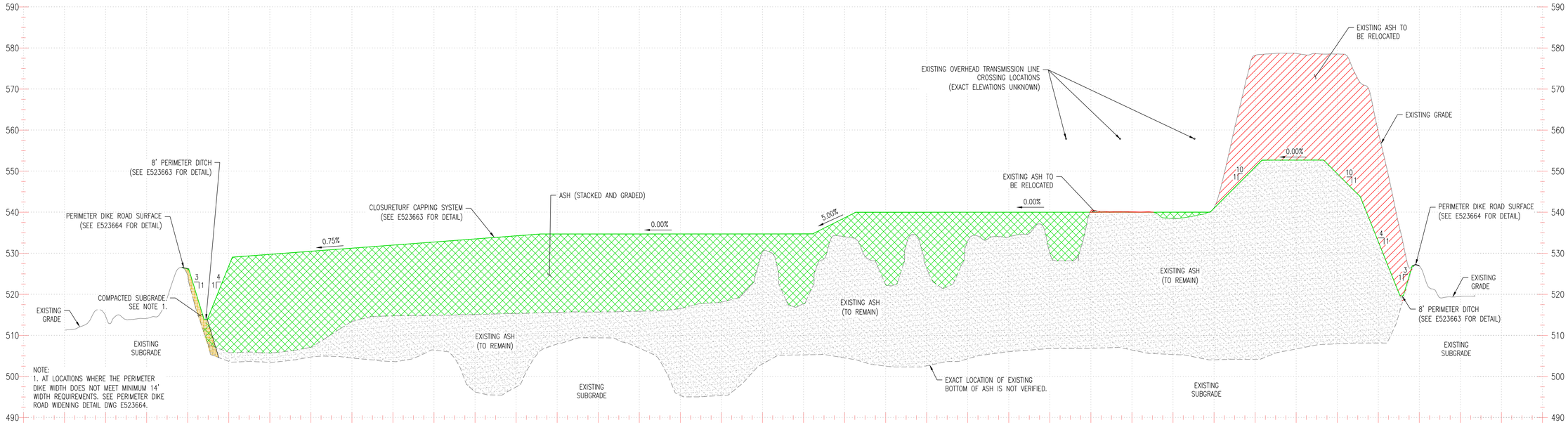
**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
GRADING AND DRAINAGE PLAN
STAGE 4
SHEET 5

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| 1"=30' | E523658 | 1 | FINAL | A |

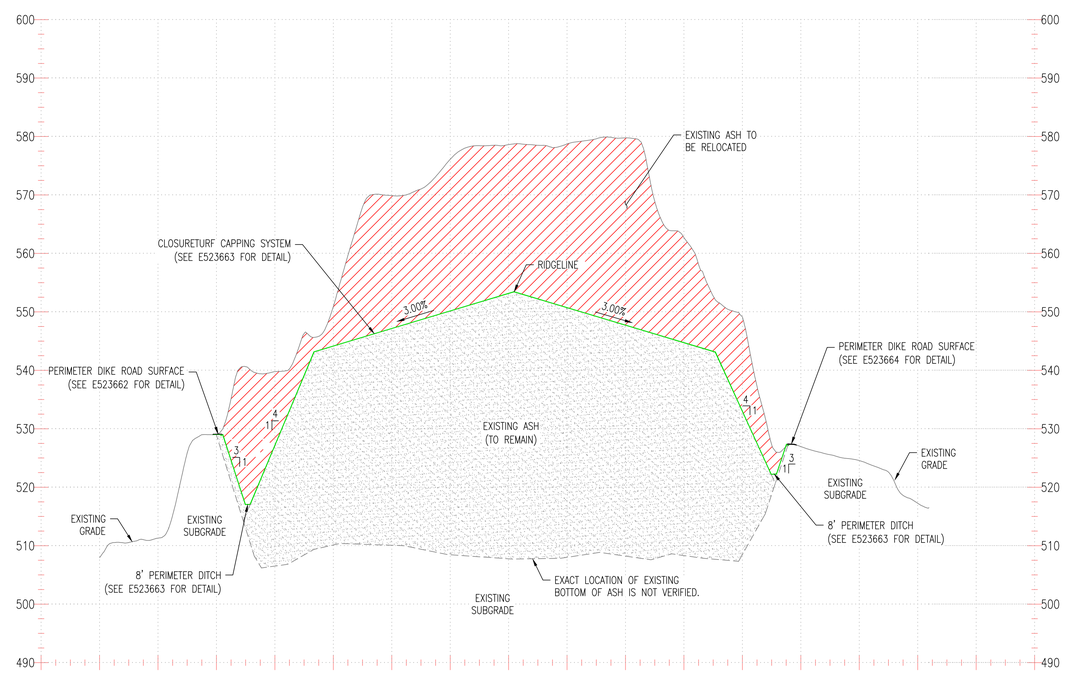
ANSI E: 44x34




## SECTION T–T

SCALE: 1"=100' HORIZ.
1"=10' VERT.
(E523635)

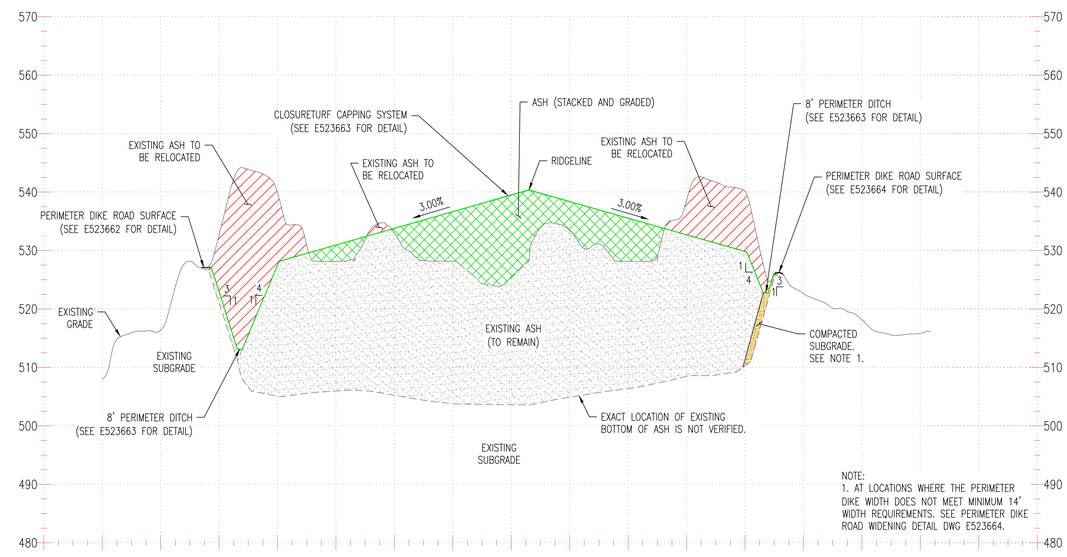
EXISTING ASH (TO REMAIN)
ASH (STACKED AND GRADED)
EXISTING ASH (TO BE RELOCATED)
COMPACTED SUBGRADE




## SECTION U–U

SCALE: 1"=100' HORIZ.
1"=10' VERT.
(E523635)

EXISTING ASH (TO REMAIN)
EXISTING ASH (TO BE RELOCATED)




## SECTION V–V

SCALE: 1"=100' HORIZ.
1"=10' VERT.
(E523635)

EXISTING ASH (TO REMAIN)
ASH (STACKED AND GRADED)
EXISTING ASH (TO BE RELOCATED)
COMPACTED SUBGRADE

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

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**Southern Company Generation Engineering and Construction Services**
FOR
**Alabama Power Company**

REVISION A DATE 3-14-16

ISSUED FOR INQUIRY

PROJ ID: GAD15003
MWO: APC368037
APC368039
APC358040

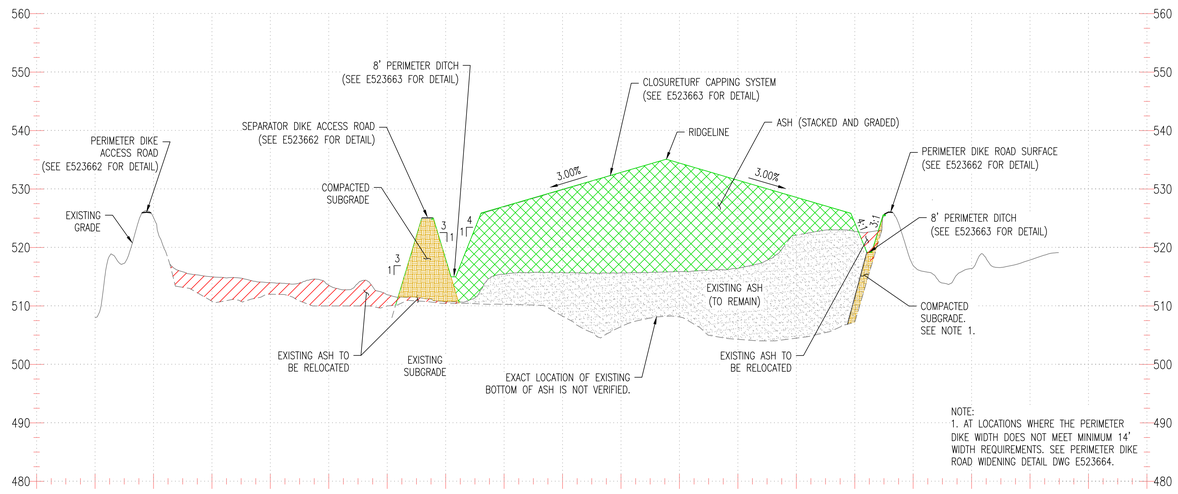
ASH POND CLOSURE PROJECT

PLANT GADSDEN
SECTIONS AND DETAILS
SHEET 1

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| DSM | RCB | THB | LED | CJM | MPB | RMP |

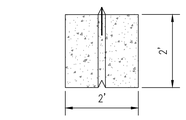
| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| AS SHOWN | E523661 | 1 | FINAL | A |

ANSI E: 44x34

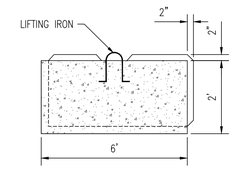



## SECTION W-W

SCALE: 1"=100' HORIZ.
1"=10' VERT.
(E523635)



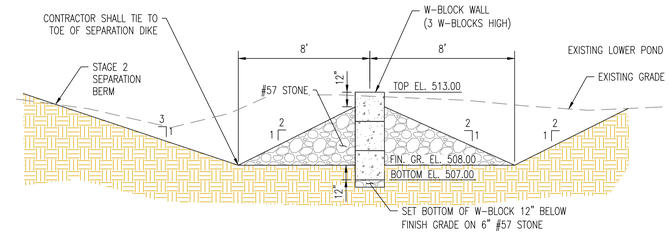

## END VIEW



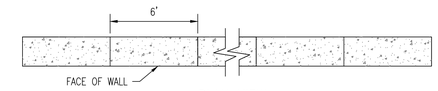

## FULL BLOCK

## W-BLOCK DETAILS

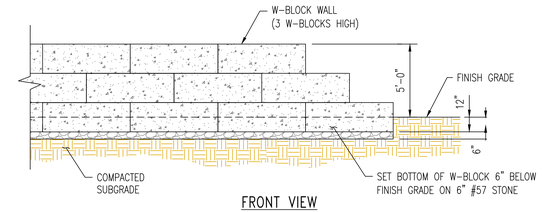
NOT TO SCALE




## SIDE VIEW



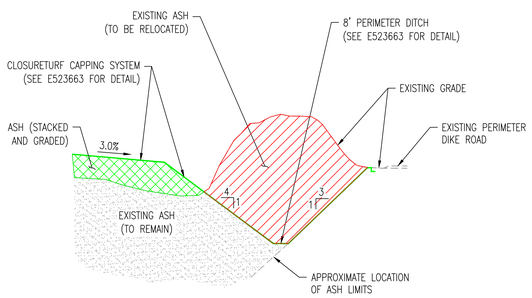

## PLAN VIEW




## FRONT VIEW

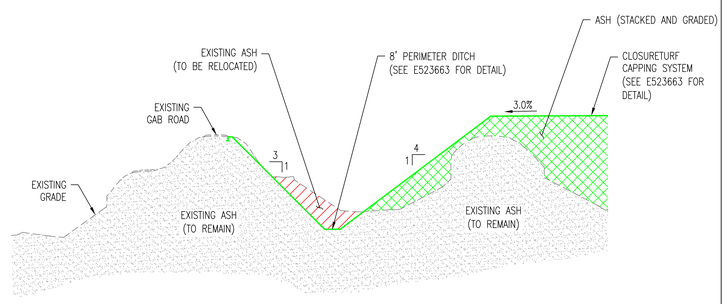
## TEMPORARY SEDIMENT BARRIER DETAILS

NOT TO SCALE
(E523640, E523641)



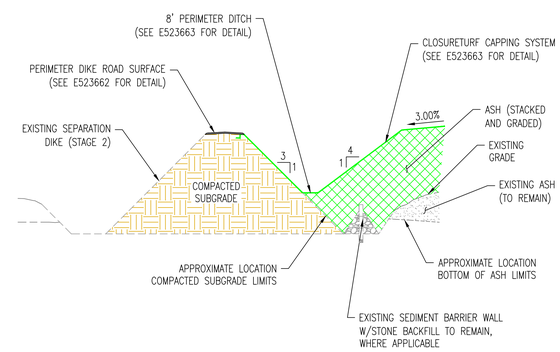

## SECTION A-A
## (STAGE 1)

NO SCALE
(E523637, E523638, E523639, E523640)



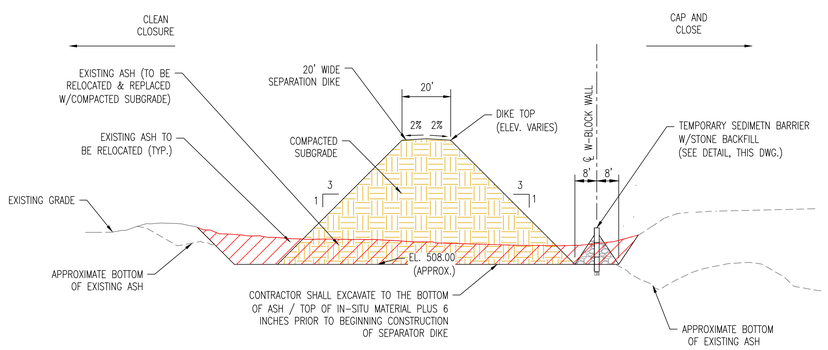

## SECTION B-B
## (STAGE 1)

NO SCALE
(E523637, E523640)



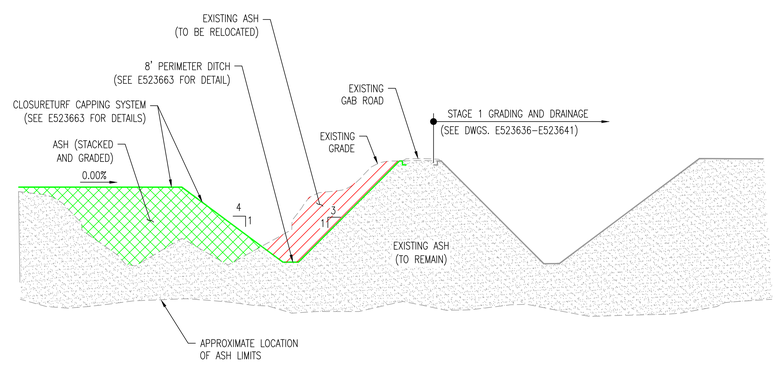

## SECTION K-K
## (STAGE 3, STAGE 4)

NO SCALE
(E523652, E523653, E523658)




## SECTION F-F
## (STAGE 2)

SCALE: 1"=30' HORIZ.
1"=10' VERT.
(E523646, E523647)




## SECTION J-J
## (STAGE 3)

NO SCALE
(E523649, E523652)

## NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

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**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
SECTIONS AND DETAILS
SHEET 2

| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

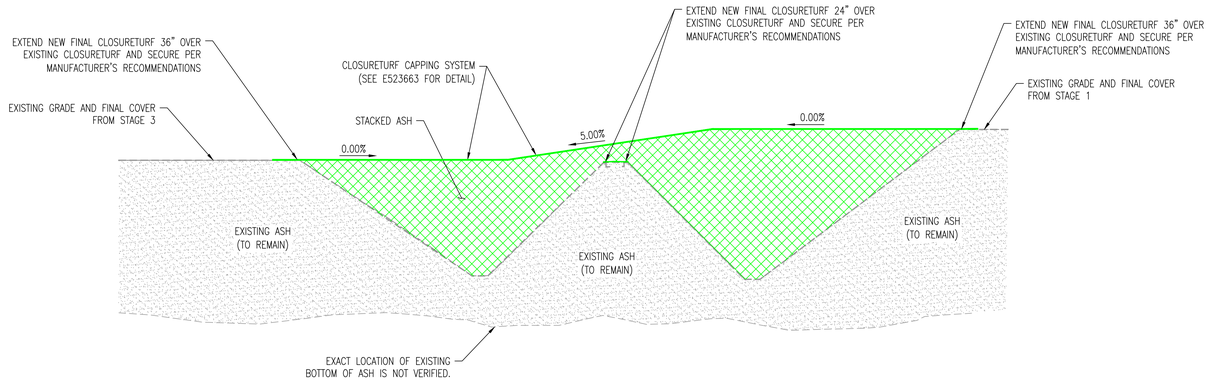
PROJ ID: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

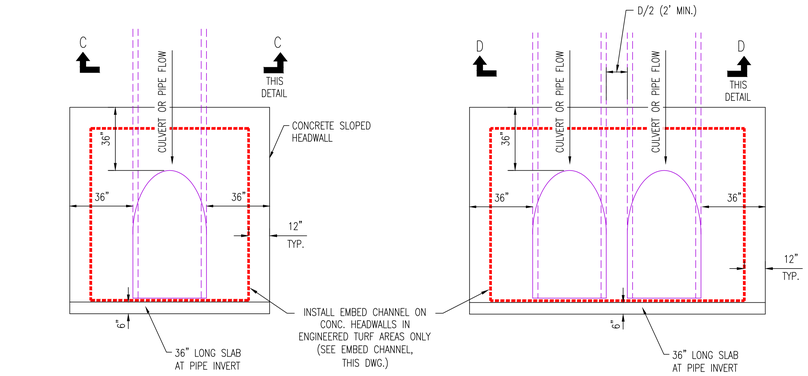
| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| DSM | RCB | THB | LED | CJM | MPB | RMP |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| AS SHOWN | E523662 | 1 | FINAL | A |

ANSI E: 44x34

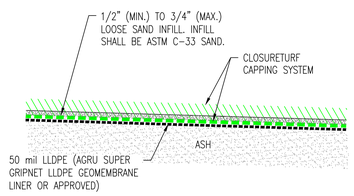



SECTION N–N
(STAGE 4)
NO SCALE
(E523655, E523658)

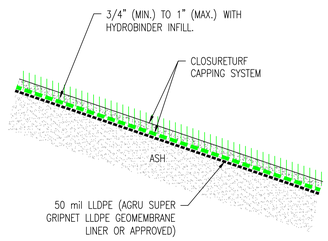



SINGLE PIPE CONCRETE SLOPED HEADWALL PLAN
N.T.S.

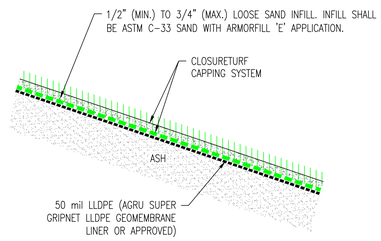
MULTIPLE PIPE CONCRETE SLOPED HEADWALL PLAN
N.T.S.



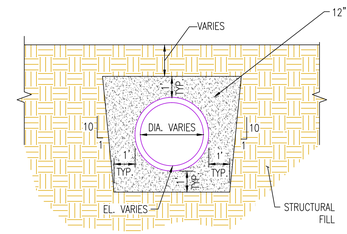

CLOSURETURF CAPPING SYSTEM
DETAIL
N.T.S.




CLOSURETURF CAPPING SYSTEM
W/HYDROBINDER INFILL
N.T.S.




CLOSURETURF CAPPING SYSTEM
W/ARMORFILL 'E' INFILL
N.T.S.




TYPICAL SINGLE PIPE SECTION C–C
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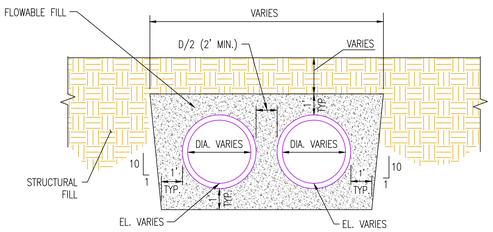
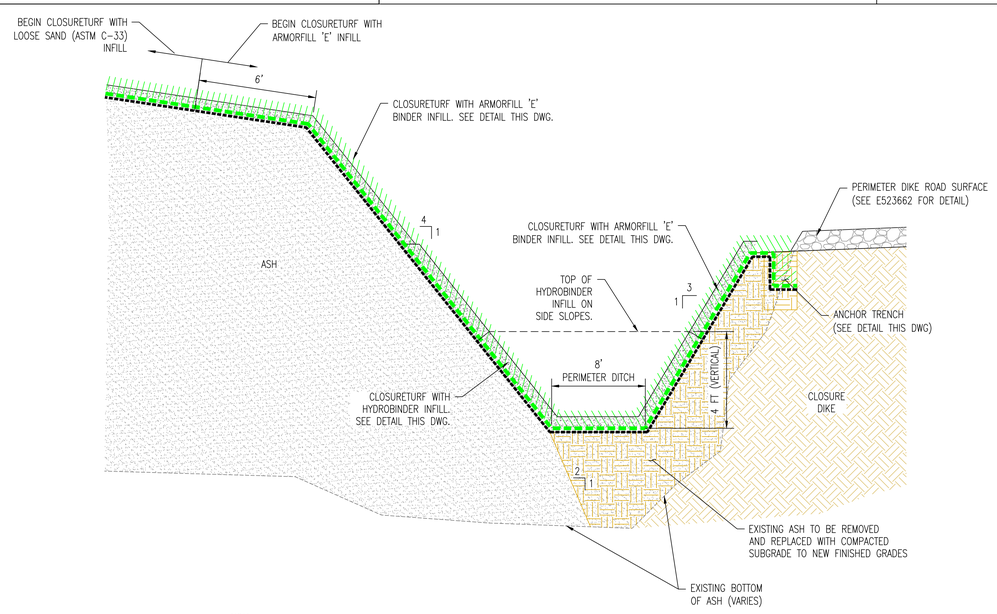


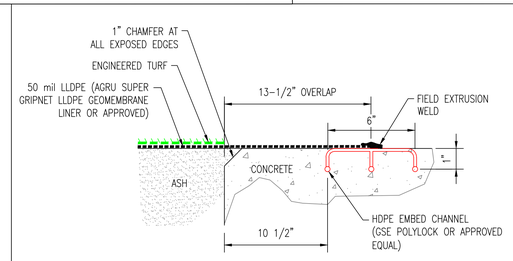

TYPICAL MULTIPLE PIPE SECTION D–D
N.T.S.

PIPE SECTIONS INSTALLED IN LINED AND UNLINED AREAS
N.T.S.




NOTE:
1. CONTRACTOR SHALL INSTALL HYDROBINDER INFILL TO TOP OF SLOPE ON BOTH DITCH FACES IN PLACES WHERE THE TOTAL DITCH DEPTH IS 4 FEET OR LESS. HYDROBINDER INFILL SHALL ALSO BE PLACED IN AREAS DESIGNATED FOR ARMORFILL 'E' ABOVE THE GRADE BREAK BETWEEN THE TOP SLOPE AND THE DITCH FACE WHERE THE DITCH DEPTH IS LESS THAN OR EQUAL TO 4 FEET.

ASH CLOSURE CELL
PERIMETER DITCH
TYPICAL SECTION
N.T.S.




SINGLE HDPE LINER EMBED CHANNEL
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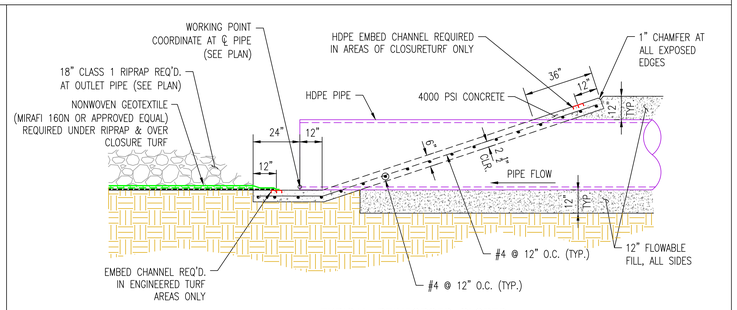
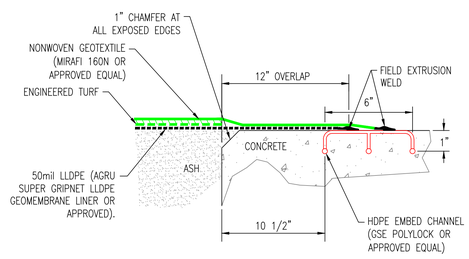



TYPICAL REINFORCED SLOPED
CONCRETE HEADWALL
N.T.S.




DOUBLE HDPE LINER EMBED CHANNEL
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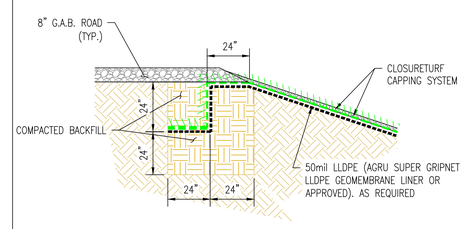


ANCHOR TRENCH DETAIL
N.T.S.

NOTES:
1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

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**Southern Company Generation**
**Engineering and Construction Services**
**FOR**
**Alabama Power Company**

PLANT GADSDEN
SECTIONS AND DETAILS
SHEET 3

| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

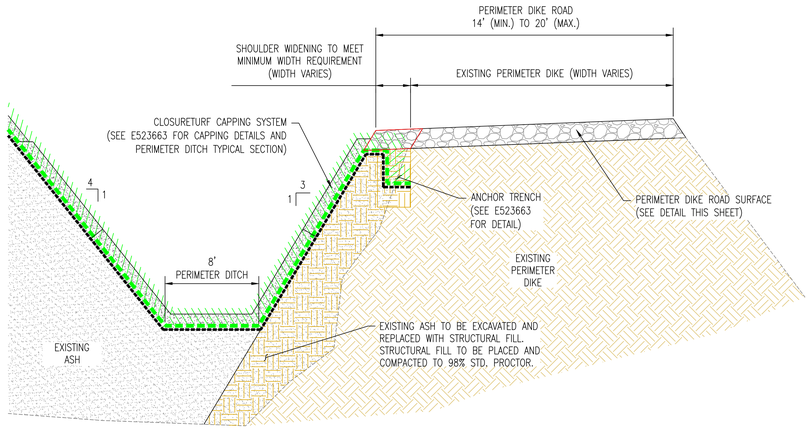
PROJ ID: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| DSM | RCB | THB | LED | CJM | MPB | RMP |

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| AS SHOWN | E523663 | 1 | FINAL | A |

ANSI E: 44x34




## PERIMETER DIKE ROAD WIDENING DETAIL

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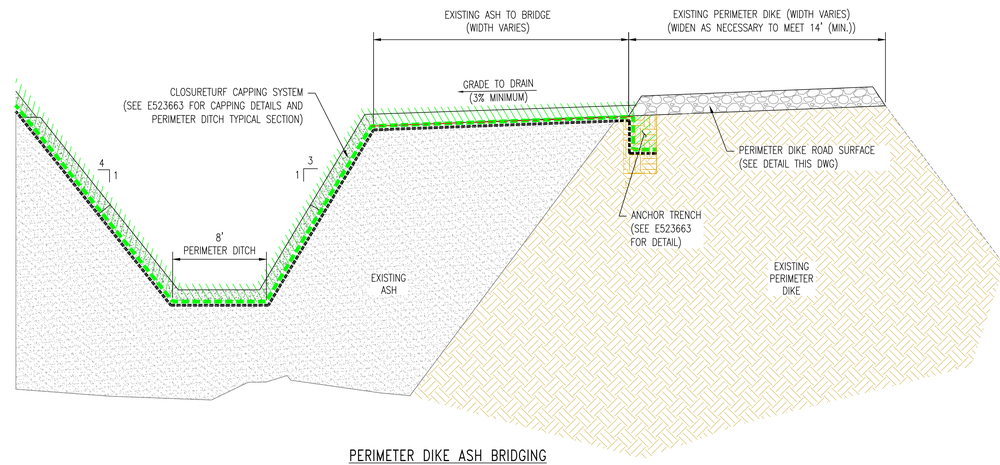
(E523661, E523662)




## PERIMETER DIKE ASH BRIDGING DETAIL

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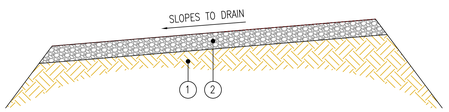
(E523661, E523662)




1. SUBGRADE (COMPACTED TO 95% STANDARD PROCTOR)
2. 8" DENSE GRADED AGGREGATE BASE (PER ALDOT SPEC. SEC. 825, TYPE B) COMPACTED TO 100% STANDARD PROCTOR

## PERIMETER DIKE ROAD SURFACE

NO SCALE

NOTES:

1. SEE DRAWING E523619 FOR DRAWING INDEX, VICINITY MAP AND CONTACTS.
2. SEE DRAWING E523620 FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS.

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| REVISION | DATE |
|---|---|
| A | 3-14-16 |

ISSUED FOR INQUIRY

PROJ ID: GAD15003
MWO: APC368037
APC368039
APC358040

ASH POND CLOSURE PROJECT

| BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|
| DSM | RCB | THB | LED | CJM | MPB | RMP |

**Southern Company Generation**
**Engineering and Construction Services**
**FOR**

**Alabama Power Company**

PLANT GADSDEN
SECTIONS AND DETAILS
SHEET 4

| SCALE | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|
| AS SHOWN | E523664 | 1 | FINAL | A |

ANSI E: 44x34

# APPENDIX B

INFILTRATION EQUIVALENCY DEMONSTRATION

**Infiltration Equivalency Calculation for ClosureTurf on Fly Ash**

| | |
|---|---|
| $k_{UM}$ | Hydraulic conductivity of medium underlying geomembrane |
| $t_{UM}$ | Thickness of medium underlying geomembrane |
| d | Diameter of hole |
| $C_{qo}$ | Contact Quality Factor [0.21 (good contact) ≤ $C_{qo}$ ≤ 1.15 (poor contact)] |
| h | Head of liquid on top of geomembrane |

| | Prescriptive Cover | | ClosureTurf | |
|---|---|---|---|---|
| Topsoil | 24 in | 0.6096 m | 0.5 in | 0.0127 m |
| Foundation Layer, $t_{UM}$ | 12 in | 0.3048 m | 12 in | 0.3048 m |
| Diameter of Hole, d | 1 cm | 0.01 m | 1 cm | 0.01 m |
| h | 12 in | 0.3048 m | 0.5 in | 0.0127 m |
| $C_{qo}$ | | 0.21 | | 0.21 |
| $k_{UM}$ (Fly Ash) | 1.00E-05 cm/s | 1.00E-07 m/s | 1.00E-05 cm/s | 1.00E-07 m/s |
| Flow | | 2.04E-07 $m^3/s$ | | 1.06E-08 $m^3/s$ |
| | | 4.65 Ga/day | | 0.24 Ga/day |

SYSTEM DESCRIPTIONS:

Prescriptive Cover

6" topsoil over 18" soil over geomembrane over prepared subgrade

ClosureTurf

Engineered turf with 1/2" sand infill over geomembrane over prepared subgrade

FLOW EQUATION (Giroud '97, Eq. 15):

$$Q = 0.976 C_{qo} \left[ 1 + 0.1 \left( \frac{h}{t_{UM}} \right)^{0.95} \right] d^{0.2} h^{0.9} {k_{UM}}^{0.74}$$

REFERENCE:

Rate Of Liquid Migration Through Defects In A Geomembrane Placed On A Semi-Permeable Medium, J.P. Giroud, T.D. King, T.R. Sanglerat, T. Hadj-Hamou and M.V. Khire, Geosynthetics International 1997, Vol. 4, Nos. 3-4.

# APPENDIX C

CLOSURETURF TECHNICAL INFORMATION

ClosureTurf®

Brought to you by Agru America

# Installation Guidelines Manual

**February 2015**

**Before utilizing this document as an installation tool, Installer should download the latest version of the Installation Guidelines Manual from the website at www.watershedgeo.com.**

WG Watershed Geo™ Unearthing Solutions

# Table of Contents


1.0 Introduction ..... 3

1.1 Purpose and Scope ..... 3

2.0 Disclaimer ..... 3

3.0 Definitions ..... 3

4.0 Subgrade Preparation ..... 8

5.0 Installation – Surficial Gas Management System ..... 8

5.1 Minimum Requirements ..... 8

5.2 Surficial Collection Design ..... 8

5.2.1 Surficial Strips (Where Applicable) ..... 8

5.2.2 ClosureTurf® Malfunction Relief Valve ..... 10

5.2.3 ClosureTurf® Collection Foot ..... 11

6.0 Installation - Geomembrane Liner ..... 11

6.1 Delivery – Geomembrane Liner ..... 11

6.2 Installation - Panel Deployment and Field Seaming ..... 12

6.3 Anchor Trench Backfill ..... 13

6.4 Equipment on ClosureTurf® Geomembrane ..... 13

6.5 Wrinkles ..... 13

7.0 Installation – Engineered Turf ..... 14

7.1 Delivery – Engineered Turf ..... 14

7.2 Installation – Engineered Turf - Surface Preparation ..... 14

7.2.1 Installation – Engineered Turf – Deployment & Field Seaming ..... 14

7.2.2 Installation – Engineered Turf Repairs and Tie-In Procedures ..... 15

7.2.3 Installation – Equipment on Engineered Turf ..... 15

8.0 Installation – Sand Infill ..... 15

8.1 Submittals and Testing – Sand Infill ..... 15

8.2 Installation – Sand Infill Deployment ..... 16

8.3 - Alternate Infill - ClosureTurf® with HydroBinder™ Infill for Ditches and Downslope Channels ..... 16

8.4 Installation – Alternate Infill - HydroBinder™ ..... 17

8.5 Installation – Coverage - HydroBinder™ ..... 18

# 1.0 Introduction

ClosureTurf® is a patented, 3 Component System* that serves as the final cover system on landfills. The 3 components of this unique system are:

Component 1 - An Agru Super Gripnet® LLDPE (or HDPE) geomembrane liner

Component 2 - An Engineered Turf

Component 3 - A sand infill (and/or alternatively, Hydrobinder™ infill)

*A Watershed Geosynthetics patented (patent no. 8,585,322) gas collection system is a separate component to be utilized on sites that produce gas emissions. Malfunction Relief Valves are provided at one per acre of ClosureTurf® on landfills where gas emissions are expected.

# 1.1 Purpose and Scope

The ClosureTurf® Installation Guidelines document has been prepared to provide the Contractor / Installer general guidance to the proper installation of the ClosureTurf® System. This document should be used in conjunction with the ClosureTurf® CSI (Construction Standards Institute) Specifications for the proper installation of the product.

# 2.0 Disclaimer

This manual is meant as a guideline only. Watershed Geosynthetics LLC cannot anticipate the many ways this product may be applied either in design or installation. Varying site conditions will require close coordination between the engineer and the installer to account for site conditions and adjust accordingly. When required by state and/or local regulations, a licensed professional engineer or architect will be required.

ClosureTurf® (US Patent Nos. 7,682,105, 8,585,322; Canadian Patent No. 2,663,170; and other Patents Pending) and trademark are the property of Watershed Geosynthetics LLC. All information, recommendations and suggestions appearing in this literature concerning the use of our products are based upon tests and data believed to be reliable; however, this information should not be used or relied upon for any specific application without independent professional examination and verification of its accuracy, suitability and applicability. Since the actual use by others is beyond our control, no guarantee or warranty of any kind, expressed or implied, is made by Watershed Geosynthetics LLC as to the effects of such use or the results to be obtained, nor does Watershed Geosynthetics LLC assume any liability in connection herewith. Any statement made herein may not be absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations. Nothing herein is to be construed as permission or as a recommendation to infringe any patent.

# 3.0 Definitions

Whenever the terms listed below are used, the intent and meaning will be interpreted as indicated.

**Acclimation**

Physiological/thermal adjustment. Required in the geomembrane deployment process.

**ASTM**

ASTM International, known until 2001 as the American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

**ClosureTurf®**

ClosureTurf® is a patented, 3 Component System that serves as the final cover system on landfills. The 3 components of this unique system are:

Component 1 - An Agru Super Gripnet® LLDPE (or HDPE) geomembrane liner

Component 2 - An Engineered Turf

Component 3 - A sand infill (and/or alternatively, Hydrobinder™ infill)

**Construction Quality Assurance (CQA)**

Construction Quality Assurance includes but is not limited to observations and documentation of materials and workmanship necessary to show that a particular project is being constructed according to contract specifications and within regulatory guidelines.

**Construction Quality Assurance (CQA) Personnel**

Construction Quality Assurance (CQA) personnel are representatives of the Professional of Record (POR) who work under direct supervision of the POR. The CQA personnel are responsible for quality assurance monitoring, applicable conformance sampling and performing onsite tests and observations.

**Construction Quality Assurance Professional of Record (POR)**

The POR is an authorized representative of the Owner and has overall responsibility for CQA efforts and to confirm the project was constructed in general accordance with contract specifications approved by the regulatory authority and contract documents. The POR must be licensed as a Professional Engineer in the State the project is located and experienced in geosynthetics.

**Construction Quality Control (CQC) Personnel**

CQC Personnel are representatives of the Geosynthetics Installer who work under direct supervision of the Geosynthetics Installer. The Geosynthetics Installers' CQC Personnel are responsible for construction quality control, applicable conformance sampling and performing onsite tests and observations.

**Contract Documents**

Written, printed, or electronic matter that provides information or evidence that serves as an official record and are issued by the owner or operator. The documents include bidding requirements that include but are not limited to, contract forms, contract conditions, contract specifications, CQA plan, contract drawings, addenda, and contract modifications.

**Contract Specifications**

The written site-specific documents that are to be followed to ensure that the ClosureTurf® System is properly installed. The contract documents, supplemental specifications, special provisions, and all

written or printed agreements and instructions that pertain to the method and manner of performing the work.

**Contractor**

One that agrees to furnish materials or perform services at a specified price.

**Design Engineer**

An individual licensed to practice as a Professional Engineer or a Professional Service Firm that is responsible for the preparation of the project construction drawings and specifications.

**Earthwork**

A general engineering term relating to the relocation and utilization of soil during the process of construction.

**Engineered Turf**

Component 3 of the ClosureTurf® System. A synthetic structured material consisting of one or more geotextiles tufted with polyethylene yarns that resemble grass blades.

**Final Cover System Evaluation Report (FCSER)**

Upon substantial completion of closure activities, the POR is responsible for the documentation of construction activities relating to the project, and any other inspections or verifications required by the regulatory authority. The FCSER will be signed and stamped by the POR and include documentation necessary for certification closure.

**Fish Mouth**

A semi-conical opening of the seam that is formed by an edge wrinkle in one sheet of the geomembrane component.

**Geomembrane**

A synthetic lining material that is also known as Component 2 and/or Agru Super Gripnet® LLDPE (or HDPE) Geomembrane Liner as it relates to the ClosureTurf® System. Used as the primary barrier to infiltration and exfiltration of covered materials. Also referred to as the geomembrane component throughout this document.

**GSI**

Geosynthetic Institute

475 Kedron Avenue

Folsom, PA 19033-1208 USA

TEL (610) 522-8440

FAX (610) 522-8441

**HydroBinder™**

A proprietary pozzolanic infill utilized where higher surface water velocities may occur as well as in anchor trenches where specified.

**Geosynthetics Contractor / Installer**

The entity responsible for geosynthetic installation.

**Independent Testing Laboratory**

An organization, person, or company that tests products and materials, etc. according to agreed requirements. The entity shall be independent of ownership or control by the Owner or any party to the construction of the final cover or the manufacturer of the final cover products used. The entity shall also have proper legal authority where required to issue opinions and document the results of tests requested by the Owner.

**Installation Supervisor**

The person on-site who works for the Geosynthetics Installer and is in charge of the Geosynthetics Personnel and following the site specifications for the installation of the geosynthetics.

**Nonconformance**

A deficiency in characteristics, documentation, or procedures that render the quality of an item or activity unacceptable or indeterminate. Examples of non-conformances include, but are not limited to, physical defects, test failures, and inadequate documentation.

**Operator**

The entity in control and responsible for the facility.

**Owner**

The entity that owns facility and land.

**Owner's or Operators Representative**

An official representative of the Owner or Operator responsible for planning, organizing, and controlling construction activities.

**Panel**

A general reference to a unit area of either Component 2 – Geomembrane Liner or Component 3 – Engineered Turf.

**Quality Assurance**

A planned and systematic pattern of procedures and documentation to ensure that items of work or services meet the requirements of the contract documents.

**Quality Control**

These actions provide a means to measure and regulate the characteristics of an item or service to comply with the requirements of the contract documents.

**Relief Valve**

A ClosureTurf® component used specifically to relieve gas pressure underneath the ClosureTurf® system.

**Representative Sample**

(With respect to geomembrane destructive testing) - A random specimen of either Component 2 – Geomembrane Liner or Component 3 – Engineered Turf material consisting of 1 or more cut pieces (commonly referred to as coupons) from the same rectangular portion of material, oriented along a seam that is removed for field or laboratory testing purposes.

**Ripple**

Smaller in nature than a wrinkle. A result of thermal forces or manufacturing that cannot be folded over.

**Snapping**

A mandatory procedure applied to geosynthetic panels (both engineered turf and geomembrane) to remove slack and create equalized tension within the panel.

**Spike**

A systematic design for interface friction located on the bottom of the Super Gripnet®.

**Specimen**

(With respect to geomembrane destructive testing) - A specimen is the individual test strip (sometimes called coupon) from a sample location. A sample location can consist of many specimens.

**Studs**

A systematic design for drainage located on the top side of the Super Gripnet®.

**Surficial Collection Foot**

A manufactured device utilized specifically for collection of gas beneath the Super Gripnet®.

**Surficial Strip**

A strip of geosynthetic material used for gas conveyance below the ClosureTurf® system.

**Tenting**

A vertical ridge that is caused by wedge welding geomembrane.

**Wrinkle**

A portion of the geomembrane that does not lay relatively flat and is not a result of subgrade irregularity and which can be folded over.

# 4.0 Subgrade Preparation

Prior to ClosureTurf® system installation, the subgrade (e.g., protective cover soil) will be inspected. Observe the following:

- The protective cover soil is substantially free of surface irregularities and protrusions.
- The protective cover soil surface does not contain stones or other objects that could damage any of the ClosureTurf® components.
- The surface will be smooth and free of foreign and organic material, sharp objects, particles or other deleterious material.
- Maximum particle size (e.g. rocks) will be specified by the by the design and contract specifications.
- The anchor trench dimensions have been checked, and the trenches are free of sharp objects and other deleterious material.
- Construction stakes and hubs have been removed and the resultant holes have been backfilled.
- The geosynthetics contractor, POR or his representative, and the permittee or his representatives have certified in writing that the surface on which the ClosureTurf® System will be installed is acceptable.
- Final grades on the slopes as well as benches dimensions and grades conform to the design grades.
- Survey shots and as-built drawings will be carefully reviewed and evaluated to insure the surface grades will drain as intended in the design drawings.

# 5.0 Installation – Surficial Gas Management System

## 5.1 Minimum Requirements

The gas management plan will include at a minimum, the use of provided ClosureTurf® Malfunction Relief Valves, (See Figure 3) to meet the specific needs of the intended site. The minimum required gas emission venting device will be installed at a rate of at least one vent per acre of installed ClosureTurf® (See Figure 1). Watershed Geosynthetics LLC supplies the minimum number of Malfunction Relief Valves with delivery of the ClosureTurf® product.

## 5.2 Surficial Collection Design (Where Applicable)

While it should be noted that not all projects will incorporate a surficial collection design, the ClosureTurf® system serves as an effective tool for control of fugitive emissions and can be incorporated into a conventional gas collection system or in some cases as a standalone gas collection and control system. A ClosureTurf® surficial collection design will incorporate the use of surficial collection strips (See Figure 1) that provide high flow capacity (See Figure 2) and a larger radius of influence. The system design will also incorporate the surficial collection foot (See Figure 4) that serves as a wellhead base, geomembrane interface and gas conveyance path from the strips to the collection wellhead (not provided).

### 5.2.1 Surficial Strips (Where Applicable)

Surficial strips are to be placed prior to the placement of geomembrane. Surficial Strips may consist of SuperGripnet®, single sided geocomposite or other techniques that will allow for the proper flow of gas without causing ballooning. The placement of the strips will be determined by the design engineer and included in the gas management plan.

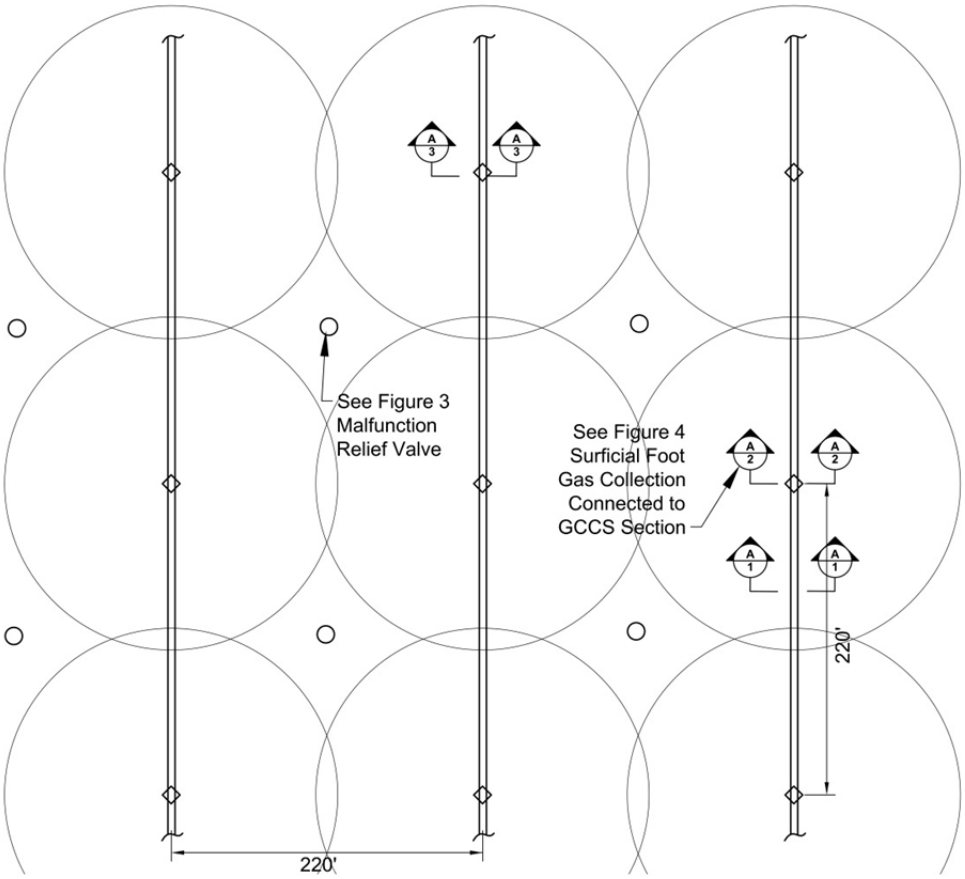


Figure 1: Typical Surficial Collection Strip Placement

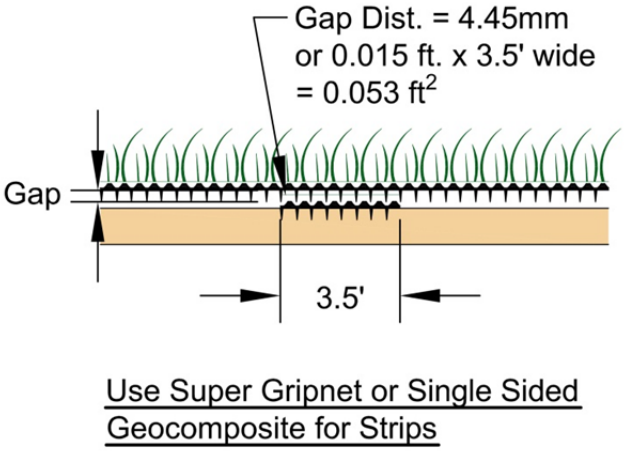


Figure 2: Effective Cross Sectional Area: Surficial Strips

## 5.2.2 ClosureTurf® Malfunction Relief Valve

The Malfunction Relief Valve is a mandatory component of the ClosureTurf® System. The primary purpose of this component is to provide for necessary release of pressure in the event the gas collection system malfunctions. The Malfunction Relief Valves will be placed at one per acre as indicated by the site's gas management plan and installed during construction of the ClosureTurf® system.

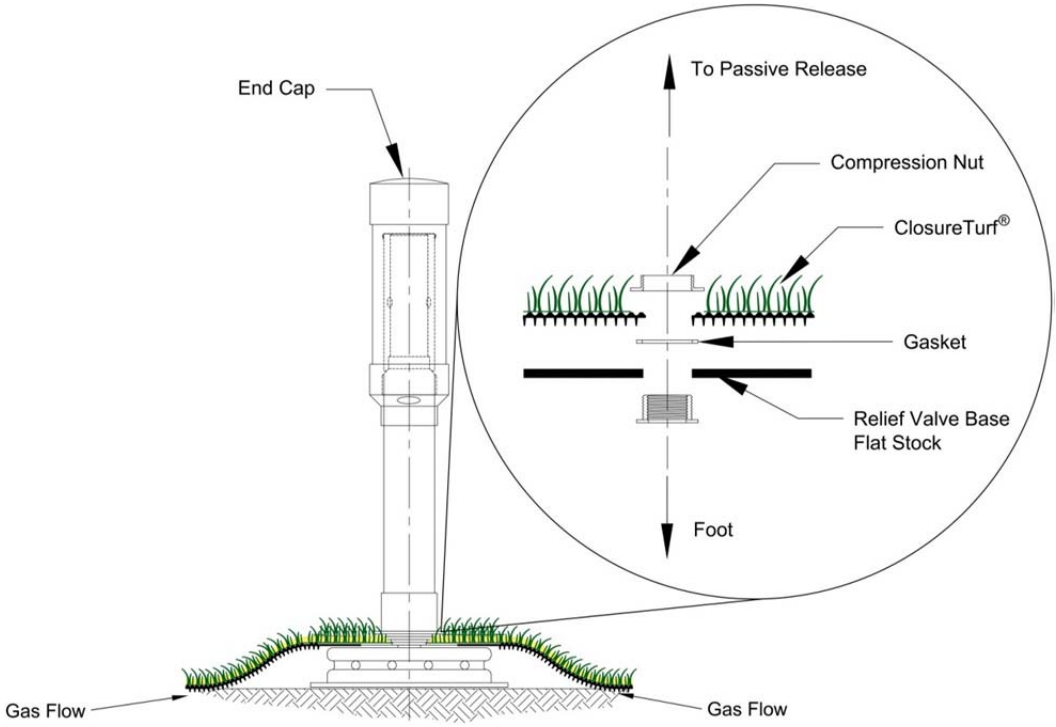


Figure 3: ClosureTurf® Malfunction Relief Valve (Patent Pending)

### 5.2.3 ClosureTurf® Collection Foot

This device is designed to be the interface between the surficial collection strips, the geomembrane and a gas collection wellhead (not provided). The unit allows vacuum to flow in from beneath the geomembrane and from the surficial collection strips to create a larger radius of influence for gas collection. Placement will be determined by the gas collection system design.

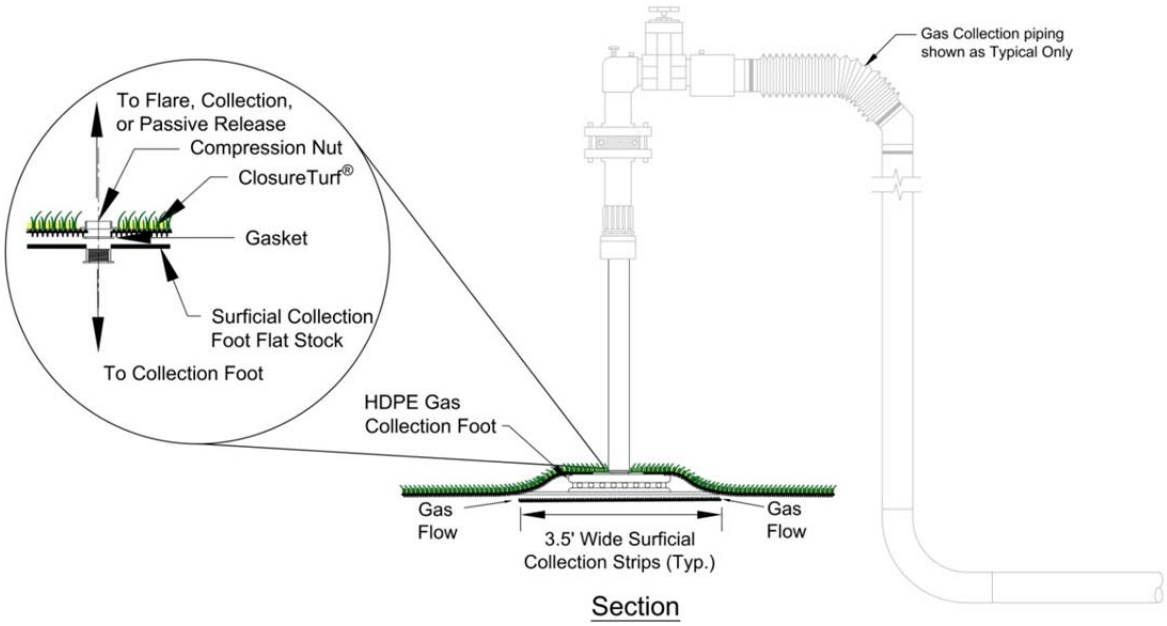


Figure 4: ClosureTurf® Surficial Collection Foot Connection to GCCS System

## 6.0 Installation - Geomembrane Liner

Installation of the Geomembrane Liner must be completed by a geosynthetics contractor approved by Watershed Geosynthetics. Each component of the ClosureTurf® system will require specific testing and submittals before, during and after installation of the component. For information concerning submittals, see contract specifications. It is the responsibility of the contractor to ensure that each prior component installation has been approved by the POR before continuing with installation of the next ClosureTurf® component.

### 6.1 Delivery – Geomembrane Liner

Upon delivery of the geomembrane, observe that:

- The geomembrane is delivered in rolls and not folded. Any evidence of folding or other shipping damage is cause for rejection of the material.
- Equipment used to unload and store the rolls or pallets does not damage the geomembrane component.
- The geomembrane is stored in an acceptable location in accordance with the specifications and stacked no more than five rolls high.
- The geomembrane component is protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.
- Manufacturing documentation required by the specifications has been received and reviewed for compliance with the technical specifications. This documentation will be included in the FCSER.

- The geosynthetics receipt log form has been completed for materials received.
- Geomembrane component that is damaged or has been rejected due to improper manufacturer documentation will be removed from the site or stored at a location separate from the accepted geomembrane component.

## 6.2 Installation - Panel Deployment and Field Seaming

ClosureTurf® installation requires some additional care and techniques beyond those of the typical geomembrane installation. General panel deployment techniques as well as special techniques are listed below.

### General

- Observe that the geomembrane component is placed in direct and uniform contact with underlying protective cover soil or subgrade soil.
- Observe the sheet surface as it is deployed and record panel defects and repair of the defects (e.g. panel rejected, patch installed, etc.) on the repair sheet. Repairs must be made in accordance with the contract specifications and located on a repair drawing.
- Observe that support equipment is not allowed on the geomembrane component during handling (See Section 6.4).
- Observe that the subgrade beneath the geomembrane component has not deteriorated since previous acceptance.
- Observe that there are no stones, construction debris, soil clogs or other deleterious items on the subgrade that could cause damage to the geomembrane component.
- The geomembrane component will not be deployed during inclement weather conditions as defined in the site specific specifications.
- Observe that people working on the geomembrane component do not smoke, wear boots/shoes that could damage the ClosureTurf® system components, or engage in activities that could damage the ClosureTurf® system components.
- Observe that the method used to deploy the sheet reduces wrinkles but does not cause bridging and that the sheets are anchored to prevent lifting or movement by the wind (geosynthetics contractor is responsible for any damage to or from windblown geomembrane).
- Observe that horizontal or cross seams on the side slopes are staggered so that long horizontal seams across the slope are not produced.
- The POR shall be responsible for approving the integrity of horizontal seams.

### Acclimation

- The geomembrane component requires acclimation to ambient temperature after being deployed and before seaming operations begin.
- Acclimation time is dependent on the current weather conditions.
- By allowing the panels to acclimate, excessive wrinkling can be avoided.
- Final panel adjustments can be completed after the panel has properly acclimated to ambient temperature.
- After the panel has acclimated and before seaming operations begin, wrinkles may be worked toward the toe of slope.

### Wedge Welding

- After proper acclimation and final adjustments/wrinkle removal, wedge welding may proceed.
- Wedge welding machines will be low profile with a vertical height (height of wedge) not to exceed 3 inches.
- Wedge welding will be completed in accordance with the contract specifications.

### Snapping

- As a result of wedge welding, "ridges" or "tenting" of the seams may occur. A process called "snapping" must be employed to remove the excess slack caused by the welding process.
- Normally, this technique requires several people lined up along the open seam at the edge of the geomembrane and applying clamps to the edge. The panel is then "snapped" into positon and when applied properly, the excess slack is removed.
- The snapping technique will be applied while the welding seam is still warm.

## 6.3 Anchor Trench Backfill

ClosureTurf® only relies on the anchor trenches to serve as a termination point. Top anchor trenches should be backfilled as quickly as practical after Engineered Turf Component is installed (prior to sand infill placement).

Vertical anchor trenches as well as anchor trenches along the toe will not be backfilled until sand infill of the engineered turf is in place. Anchor trench dimensions will be shown in the drawings.

## 6.4 Equipment on ClosureTurf® Geomembrane

Construction equipment on the ClosureTurf® geomembrane component will be limited to reduce the potential for geosynthetics damage. Observe/provide the following:

- Use power source generators capable of providing constant voltage to all required equipment under combined-line load.
- Secondary containment to catch spilled fuel under equipment where applicable.
- No equipment with tire or track pressures exceeding 5psi will be allowed on the partially constructed ClosureTurf® system until after the completed installation of the sand infill component.
- No equipment will be left running and unattended over the constructed geomembrane component.
- Equipment operators shall check for sharp edges, embedded rocks, or other foreign materials stuck into or protruding from tires prior to operating equipment on the geomembrane component.
- Path driven on geomembrane component will be as straight as possible with no sharp turns, sudden stops or quick starts.

## 6.5 Wrinkles

Wrinkles occur during the geomembrane installation due to changes in geomembrane temperatures and deployment methods. The wrinkles may interfere with the installation of the engineered turf layer as well as the final appearance of the ClosureTurf® system. Observe that:

- Snapping procedures are followed.

- Wrinkles are repaired if they can be folded over.

# 7.0 Installation – Engineered Turf

## 7.1 Delivery – Engineered Turf

Box trucks will deliver 27 rolls per truck. Rolls will be strapped in groups of 9 allowing equipment (i.e. pick-up truck, skid steer) to pull the grouped rolls to the front of the truck. Rolls can be pulled directly to the ground or carpet stingers can move the rolls to a designated area. Observe the following:

Observe the following:

- The engineered turf is wrapped in rolls with protective covering.
- The rolls are not stacked more than 3 high.
- The rolls are not damaged during unloading.
- Protect the engineered turf from mud, soil, dirt, dust, debris, cutting, or impact forces.
- Each roll must be marked or tagged with proper identification.
- Rolls that have been rejected due to damage are be removed from the site or stored at a location separate from accepted rolls, designated by the Owner/Operator.
- Rolls that do not have proper manufacturer's documentation will be stored at a separate location until documentation has been received and approved.

## 7.2 Installation – Engineered Turf - Surface Preparation

Prior to installation of Engineered Turf, observe the following:

- ClosureTurf® geomembrane has been installed in accordance with the contract specifications.
- The geomembrane installation documentation has been completed and approved by the POR for areas were the Engineered Turf is to be installed.
- The supporting surface (i.e., the geomembrane) does not contain stones, debris or large scraps left over from the installation process that could damage or impede surface water flow through the Engineered Turf.

### 7.2.1 Installation – Engineered Turf – Deployment & Field Seaming

During deployment of Engineered Turf, observe the following:

- Observe the turf as it is deployed.
- Verify that equipment used does not damage the turf or underlying geomembrane by handling, trafficking, leakage of hydrocarbons, or by other means.
- Verify that during deployment, the Engineered Turf filaments point upslope a majority of the time.
- Verify that the turf is anchored to prevent movement by the wind (the contractor is responsible for any damage resulting to or from windblown Engineered Turf).
- Verify that the turf remains free of contaminants such as soil, grease, fuel, etc.
- Observe that the turf is laid substantially smooth and substantially free of tension, stress, folds, wrinkles, or creases.

- Observe the deployment of the panels to insure proper flipping in order to expose the turf surface up after seaming operations. After the first panel of the project is deployed, deployment will be done on the adjacent turf panel to avoid damage.
- A single stitch prayer type seam is constructed using a Nulong sewing machine or equivalent.
- The thread will be Polyester or equivalent.
- Sewing will occur between the 1st and 2nd stitch rows.

### 7.2.2 Installation – Engineered Turf Repairs and Tie-In Procedures

When Repairs and Tie-Ins to Engineered Turf occur, observe the following:

- Repairs to Engineered Turf will be completed by using a heat-bonded seam.
- Tie-in seams along flatter slopes (i.e. 15% or less) may use an approved heat bonded seam.
- Seaming equipment for Engineered Turf includes a Leister (Varimat V2), hand held Leister or DemTech welder.
- A hand held heat gun or Leister should be used in smaller/concentrated areas.

### 7.2.3 Installation – Equipment on Engineered Turf

No equipment will be allowed on slopes exceeding 15% until Sand Infill is in place. On slopes less than 15%, such as top decks, ATV type vehicles will be allowed prior to infill placement if the tire or track pressure is less than 5 psi. Post construction (full specified sand infill thickness) drivability tire pressures on slopes greater than 10% should be limited on the ClosureTurf® system to less than 35 psi. Allowable tire or track pressures on top decks may increase to as much as 120psi as long as sustained traffic load is not expected.
In all phases of construction, equipment used on the ClosureTurf product will not be allowed to change speed or direction in a manner that could displace or damage the ClosureTurf system.

## 8.0 Installation – Sand Infill

This component of the ClosureTurf® system is a specialized mixture of sand infill that is placed between the tufts of the Engineered Turf component.

Observe that the following general requirements regarding Sand Infill are met:

- Sand Infill will meet ASTM C-33 specifications.
- Areas that are to receive sand infill must be inspected and accepted by the POR or CQA Personnel before placement of sand infill takes place.

## 8.1 Submittals and Testing – Sand Infill

See contract specifications for Sand Infill MQC Submittals and submittal/testing requirements regarding the Sand Infill.

## 8.2 Installation – Sand Infill Deployment

Observe that the following installation guidelines regarding the Sand Infill:

- The sand infill layer will be at a 5/8” in thickness with 1/8” tolerance plus or minus.
- The sand infill will be worked into Engineered Turf as infill between the synthetic yarn blades.
- No equipment will be allowed on slopes exceeding 15% until the sand infill is in place.
- Conveyor systems and/or Express Blowers are the preferred method to spread and place the sand infill.
- Contractor shall explain in detail in the pre-construction meeting the method of sand infill deployment to be used.
- The sand infill deployment method will be approved prior to installation of the sand infill.
- For slopes 3H: 1V or steeper the sand infill shall be placed using long reach conveyor belts or using water or air express blower methods that demonstrate achievable results.
- The sand infill placement will be done in front of the deployment equipment to improve the bearing capacity of the previously installed ClosureTurf® components.
- Sand infill placement cannot occur with snow or ice on the Engineered Turf component.
- Verify that underlying geosynthetic installations are not damaged during placement operations. Mark damaged geosynthetics and verify that damage is repaired.
- Sand infill thickness will be verified at a frequency of 20 measurements per acre of final cover installed.

The method for measuring the Sand Infill thickness will be performed utilizing a digital caliper with depth rod capabilities, or a POR approved alternate measuring device. A standard washer will be utilized as a plate for the point of entry into the sand infill for consistent depth control.

## 8.3 - Alternate Infill - ClosureTurf® with HydroBinder™ Infill for Ditches and Downslope Channels

Alternate Infill - HydroBinder™ is provided by Watershed Geosynthetics or approved supplier. When the ClosureTurf® system is installed and HydroBinder™ infill is placed in lieu of sand infill, it creates a ditch/downslope lining armor that will allow high flow velocities to convey without damage or maintenance to the underlying ClosureTurf® components. Typical ClosureTurf® installation procedures are used for the first three ClosureTurf® components, and then the HydroBinder™ infill is placed dry and hydrated after placement. Figure 4 shows a typical ClosureTurf® with HydroBinder™ infilled ditch section.

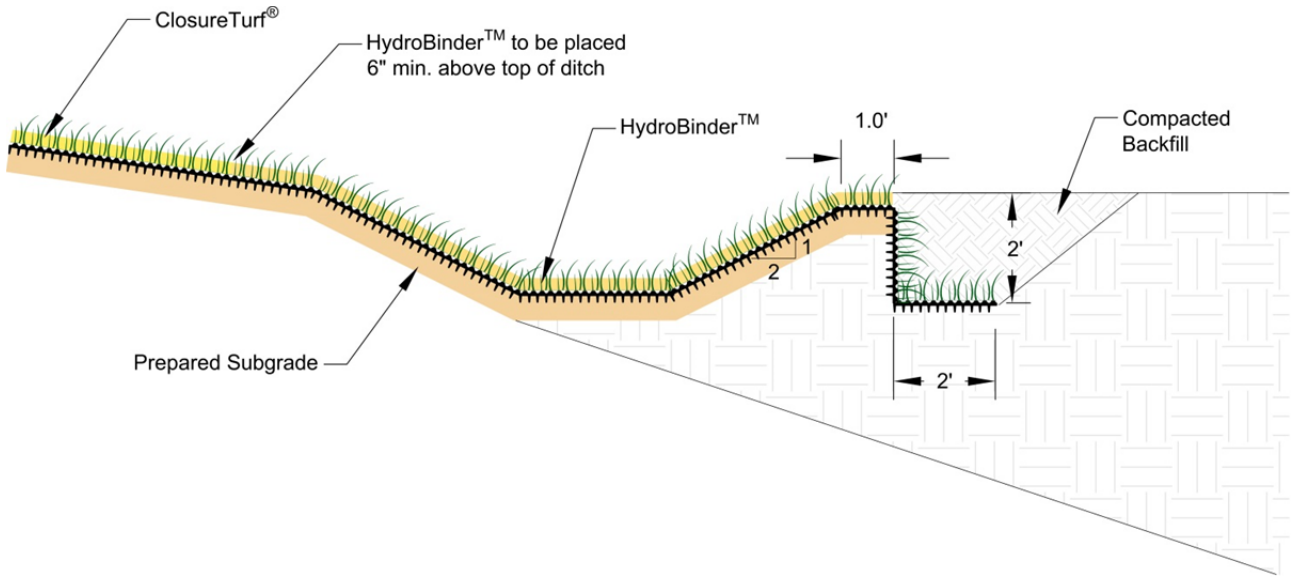


Figure 4: Typical ClosureTurf® with HydroBinder™ Infilled Ditch Section

## 8.4 Installation – Alternate Infill - HydroBinder™

Verify the following regarding installation of HydroBinder™ Infill:

- The HydroBinder™ infill layer may be placed using any appropriate equipment capable of completing the work while meeting loading requirements specified herein.
- Manual hand spreading is acceptable when equipment isn't practical.
- Contractor / Installer will explain in detail in the pre-construction meeting the method of HydroBinder™ infill deployment.
- Installation of HydroBinder™ infill will only be performed by a Watershed Geosynthetics' licensed and approved installer using techniques and equipment approved by Watershed Geosynthetics.
- The HydroBinder™ will be installed into the turf while it is in a dry state.
- The HydroBinder™ will be worked into the tufts so the tufts are in an upright position.
- The HydroBinder™ infill will be placed dry at 7/8 inch thickness with 1/8 inch tolerance plus or minus.
- Do not backfill anchor trenches until turf has been installed with HydroBinder™ infill.
- The hydration process must occur the day of the HydroBinder™ infill placement.
- The desired HydroBinder™ infill thickness will be achieved prior to the hydration process.
- The cemented infill is hydrated thoroughly however care must be taken to avoid displacement of the non-hydrated infill.
- The objective is to soak the area to start the hydration process but not to inundate with water beyond saturation.
- Once hydration is completed as described, backfill and compaction of the vertical anchor trenches should take place.
- The HydroBinder™ will be at minimum performance levels within 24 hours.

## 8.5 Installation – Coverage - HydroBinder™

**Table 1**

Watershed Geosynthetics™

**Approximate Coverage Area for HydroBinder™ Infill**

| Product | Bag Size | Yield (CF)[1] | Coverage in SF for 3/4-in Thick[1] | Coverage in SF for 1-in Thick[1] | Amount of Water to Mix per Bag (gal) | Amount of Water (gal) to Apply per SF (3/4-in Thick)[1] | Amount of Water (gal) to Apply per SF (1-in Thick)[1] |
|---|---|---|---|---|---|---|---|
| HydroBinder™ Infill | 40 lbs. | 0.3 | 4.8 | 3.6 | 0.6 | 0.12 | 0.16 |
| | 60 lbs. | 0.45 | 7.2 | 5.4 | 0.9 | 0.12 | 0.16 |
| | 80 lbs. | 0.6 | 9.6 | 7.2 | 1.2 | 0.12 | 0.16 |
| | 1 Cubic Yard (SuperSak) | 27 | 432 | 324.0 | 55 | 0.13 | 0.17 |

[1] Values are approximate.

HydroTurf™ Revetment system is a patented product. All information, recommendations and suggestions appearing in this document concerning the use of our products are based upon tests and/or data believed to be reliable; however, this information should not be used or relied upon for any specific application without independent professional examination and verification of its accuracy, suitability and applicability. Since the actual use by others is beyond our control, no guarantee or warranty of any kind, expressed or implied, is made by Watershed Geosynthetics LLC as to the effects of such use or the results to be obtained, nor does Watershed Geosynthetics LLC assume any liability in connection herewith. Any statement made herein may not be absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations.

Geosyntec consultants

1255 Roberts Boulevard, Suite 200
Kennesaw, Georgia 30144
PH 678.202.9500
FAX 678.202.9501
www.geosyntec.com

15 May 2015

José Urrutia, P.E.
Vice President of Engineering
Watershed Geosynthetics
11400 Atlantis Place, Suite 200
Alpharetta, GA 30022

**Subject: Literature Review and Assessment of ClosureTurf® UV Longevity**

Dear Mr. Urrutia:

Watershed Geosynthetics, Inc. (Watershed) has patented an alternative landfill closure system termed, ClosureTurf®. ClosureTurf® consists of high-density polyethylene (HDPE) grass blades tufted through a polypropylene (PP) geotextile backing which overlies Super Gripnet®, an HDPE or linear low-density polyethylene (LLDPE) geomembrane manufactured by AGRU America Inc. The addition of a layer of sand ballast during installation completes the system. The sand ballast provides cover for the lower portion of the HDPE grass blades, the PP geotextile backing, and the Super Gripnet® (Figure 1). The ClosureTurf® system, therefore, is a "hybrid" closure system in the sense that it is neither a traditional soil cover or an exposed geomembrane. ClosureTurf® has been used to close a number of landfills throughout the United States. A select list of sites where it has been used is shown in Table 1. Applications extend to other facilities as well, such as capping of coal ash ponds.

Watershed has requested that Geosyntec Consultants, Inc. (Geosyntec) provide an assessment of the longevity of the ClosureTurf® system with regard to UV degradation. Since ClosureTurf® has elements (i.e., the HDPE grass blades) that are permanently exposed to UV radiation, this assessment will be particularly focused on the exposed portion of the system. However, the UV longevity of the PP geotextile backing and HDPE geomembrane will also be addressed by reference.

Geosyntec's approach to this assessment has been to conduct a literature review of pertinent documents available (journal papers, white papers, presentations, etc.), distill the results of the review, and perform limited analysis. This report concludes with a summary of the review and analysis along with brief discussion for recommendations.

## EXECUTIVE SUMMARY

The UV longevity assessment of the ClosureTurf® system (Figure 1) began with a literature review. In general, relatively little published information was discovered regarding exposed HDPE grass blade degradation. The information that is available consists of retained tensile strength test results of HDPE grass blades after exposure (1, 5, 7 and 10 years) at a field test facility in New River, Arizona (Watershed, 2014). Extrapolation of this data by Watershed (2014) resulted in a prediction of 65% retained tensile strength after 100 years of service. In addition, Richgels *et al* (2015) published half-life (i.e., 50% retained tensile strength) predictions of exposed HDPE grass blades using a laboratory data release from the Geosynthetics Institute (GSI) on HDPE geomembrane strips exposed to UV lamp irradiation. Richgels *et al* (2015) obtains an upper bound and lower bound half-life predictions of 247 years and 176 years, respectively. Extrapolation of the field data from New River, Arizona yielded a half-life of 216 years.

Geosyntec checked the calculations shown in Richgels *et al* (2015) and obtained 277 years and 214 years for the upper and lower bound estimates of HDPE grass blade half-life. Differences in the results between Geosyntec and Richgels *et al* (2015) are attributed to rounding. Geosyntec attempted to repeat these calculations for actual performance requirements (i.e., 12.5% of original tensile strength) of the HDPE grass blades rather than a randomly assigned half-life, however the predictions resulted in service lives that were too lengthy to be reasonable. The most likely explanation is that the laboratory data has not degraded enough to allow for service life predictions using 12.5% retained tensile strength. Future data releases from GSI will aid in providing more accurate predictions below the half-life.

Based on Richgels *et al* (2015) predictions, as well as the prediction given in Watershed (2014) it appears that the half-life of the HDPE grass blades exposed to Arizona-like conditions is on the order of 100 years. These results are promising; however additional field test data is needed to improve the half-life predictions, particularly since half-life predictions for exposed HDPE geomembrane are also approximately 100 years (Koerner *et al*, 2015). Understanding the differences in weathering between HDPE grass blades in a synthetic turf and an HDPE geomembrane will provide additional insight into the similar half-life predictions of the two geosynthetics. Finally, the service life of the HDPE grass blades in the ClosureTurf® system should ideally be based on its performance requirements rather than a half-life which will result in a longer service life prediction.

In addition to the HDPE grass blades, there are two unexposed elements of the ClosureTurf® system: (i) the PP geotextile backing for turf component; and (ii) the Super Gripnet® which consist of a HDPE geomembrane (see Figure 1).

Watershed has incorporated UV degradation inhibitors into the PP geotextile backing which, according to Watershed has lead to an improvement in UV resistance by a factor of 14 over the original prediction of 65% retained tensile strength after 100 years (Watershed, 2014). Koerner (2011) has estimated that covered HDPE geomembrane will have a half-life of 446 years at 20 degrees Celsius and 265 years at 25 degrees Celsius.

Therefore, the most critical component of the ClosureTurf® appears to be the exposed HDPE grass blades when it comes to UV degradation. However, degradation of the HDPE grass blades to unserviceable levels can be remediated by replacement of the turf component of the ClosureTurf® system.

## BACKGROUND AND LITERATURE REVIEW SUMMARY

In total, Geosyntec has reviewed approximately 40 technical documents to date. The database is a combination of documents provided to Geosyntec by Watershed as well as documents collected by Geosyntec. A complete reference list of the documents in the database can be made available upon request.

In general, relatively little information was found on the topic of exposed HDPE grass blades with respect to degradation due to UV radiation. The documents that were obtained and reviewed are listed below.

1. Field test data provided by Watershed from the New River, Arizona testing facility on the HDPE grass blades (Watershed, 2014).

2. Testing results (Atlas-MTS) discussing the UV longevity of polyethylene and polypropylene grass used for outdoor European athletic facilities.

3. Technical paper by Richgels, *et al.* (2015a) published in the conference proceedings for Geosynthetics 2015 in Portland, Oregon.

4. Presentation by Richgels., C. at the Geosynthetics Conference for 2015 in Portland, Oregon (Richgels, 2015b).

5. Presentation by Diguilio, D. at the Northern New England SWANA Conference on 25 September 2013 (Diguilio, 2013).

The following documents on the topic of HDPE Geomembrane degradation due to UV exposure were reviewed and found to contain useful information regarding this assessment.

1. Geosynthetic Research Institute (GRI) White Paper #6 (Koerner *et al.*, 2011). This white paper contained degradation data (% retained strength and elongation) on laboratory aged samples of 1.5 mm HDPE geomembrane. Aging was completed using a UV Fluorescent device per ASTM D7238 at 70 degrees Celsius ($^{o}$C).

2. Geosynthetic Institute (GSI) webinar presentation by Koerner *et al.*, (2015). This presentation contained a slide that compared predicted (laboratory vs. field) half-life of geomembranes of various resins, including HDPE, as well as a suggestion for estimating lower bound half-life.

3. Journal paper authored by Rowe *et al.* (2010) published in the Journal of Geotechnical and Geoenvironmental Engineering.

## DISCUSSION OF DOCUMENTS AND DATA

The data from the New River, AZ testing facility on the artificial grass component of ClosureTurf® (Watershed, 2014) appears to be the only data set of its kind in our compiled database. The data consists of tensile property testing from field samples exposed to the Arizona environment at approximate exposure periods of 1, 5, 7 and 10 years. At each of the four exposure periods, 20 samples were tested for a total of 80 tests. The average values for tensile strength retained at each corresponding time period is 97%, 90%, 84% and 83%, respectively (Figure 2).

One additional data point was found in the Atlas-MTS document. That data point indicated that approximately 90% of tensile strength of polyethylene grass would be available after 20 years of field exposure assuming average European climatic conditions (temperature, irradiance, etc.). However, the average European irradiance is approximately one-half to one-third that of Arizona (Figure 3) notwithstanding temperature effects. Therefore, the Atlas-MTS data point will be consistent with the data from the New River, AZ facility in the 7 to 10 year time frame once adjusted for the relative levels of exposure and temperature between Europe and Arizona. As such, this data point will not extend the exposure duration covered by the New River, AZ data.

The paper and corresponding presentation by Richgels (2015a, 2015b) utilized the laboratory data released from the GSI on UV degradation of HDPE samples to make upper and lower bound estimates of the field half-life of the HDPE grass blades. The upper bound method utilizes Arrhenius

modeling of lab data to project exposure times at half-life to site temperatures combined with ratios of UV irradiance between the laboratory lamp and monthly average irradiance at New River, AZ to develop half-life loss per month. A similar procedure using a linear extrapolation (rather than Arrhenius) was demonstrated for a lower bound estimate. The Watershed (2014) field data set was plotted in between the upper and lower bound estimates. This method is further discussed in the section below titled, "HDPE Grass Blade Service Life Calculations".

Koerner *et al.* (2011) discusses the UV longevity of both exposed and unexposed geomembranes made from various resins, including HDPE based on GSI's laboratory testing program. This document is particularly useful in regard to the ClosureTurf® elements that are considered non-exposed (i.e., the PP geotextile backing for the turf component and the underlying HDPE geomembrane).

The presentation by Koerner *et al.* (2015) includes estimates of half-life of exposed HDPE geomembranes as well as a recommendation for linear data extrapolation as a lower bound limit that was implemented by Richgels (2015b).

## PERFORMANCE REQUIREMENTS

The definition of service life of an HDPE (or other resin) geosynthetic (grass blades and geotextiles/geomembranes) typically invokes the half-life criteria. However, the half-life criteria is arbitrary and while useful as a general indicator for comparison it does not directly relate to any aspect of field performance for ClosureTurf® or any other geosynthetic. Therefore it is more appropriate to define the service life in terms of field requirements placed on the material.

### HDPE Grass Blades

For the case of the HDPE grass blades on the ClosureTurf® system, tensile strength requirements fall in the range of 2.5 to 3.5 lbs, based on applied loads of pullout forces from equipment operation and water runoff forces (Diguilo, 2013). The ClosureTurf® HDPE grass blades are manufactured with 20 lbs. of tensile strength immediately following the process (Diguilo, 2013). Therefore, without considering a factor of safety, the required tensile strength of the HDPE grass blade is equal to approximately 12.5% to 17.5% of original strength capacity.

### PP Geotextile Backing and HDPE Geomembrane

Performance requirements for the PP geotextile backing and HDPE geomembrane depend on more site-specific parameters (e.g., steepness of slopes, seismicity, etc.) than the HDPE grass blades. Therefore until a parametric study is completed which will define the performance requirements over a range of expected conditions, the half-life will have to be used as a benchmark for degradation of the PP geotextile and HDPE geomembrane.

## HDPE GRASS BLADE SERVICE LIFE CALCULATIONS

In order to develop a prediction for the longevity of the HDPE grass blades with respect to UV degradation, Geosyntec implemented the method found in Richgels (2015a, 2015b) for two levels of retained tensile strength. The first level is the 50% of tensile strength, or half-life, criterion that is commonly used as a benchmark for geosynthetic service life. Geosyntec performed this calculation to compare our results with the results presented by Richgels (2015a, 2015b). Once the half-life estimates were calculated, Geosyntec attempted to repeat the calculations using a retained tensile strength of 12.5% of an HPDE grass blade.

### Half-Life Estimation (50% of Retained Strength)

The assessment utilized by Richgels (2015a, 2015b) begins with a laboratory data release from GSI (Figure 4). The data includes retained tensile strength of HDPE samples that have been incubated under a UV lamp at elevated temperatures, which accelerates the UV weathering process in accordance with ASTM D7238.

As mentioned, the GSI data includes samples tested at three elevated temperatures: (i) 80 degrees Celsius ($^{o}$C); (ii) 70$^{o}$C; and (iii) 60$^{o}$C. The testing program appears to have originally included only the 70$^{o}$C data, with the 80 $^{o}$C and 60$^{o}$C testing added at a later date (therefore, weathering is not as advanced). The 70$^{o}$C data set has reached approximately 66%, while the 80$^{o}$C and 60$^{o}$C data sets have reached approximately 78% and 86%, respectively. Nonetheless, logarithmic extrapolations to 50% retained strength were performed for each data set. The amount of exposure time (on a log scale) corresponding to the 50% retained strength plotted vs. the inverse of the corresponding temperature (80$^{o}$C, 70$^{o}$C and 60$^{o}$C) is shown in Figure 5. Figure 5 allows for extrapolation to find the laboratory exposure time required to achieve 50% retained strength at temperatures lower than the test temperatures (i.e., actual field temperatures).

Once the curve is defined relating any temperature to a level of laboratory lamp exposure, the remaining task is to develop a relationship between laboratory exposure and field exposure for a

particular site. In this case, the testing site in New River, AZ where Watershed has performed tests on HDPE grass blades, was selected.

Richgels (2015a, 2015b) presents monthly averages at the site for: (i) peak turf temperature; and (ii) irradiance as a fraction of the laboratory lamp irradiance. Using these two values for a given month combined with the Arrhenius model, an estimate of half-life loss per month is obtained. Summation of the half-life lost per month over a year yields the annual half-life loss. The inverse of the annual half-life loss is the predicted half-life in years. Using this method, Richgels obtains a half-life of approximately 247 years, while Geosyntec obtained a half-life of 277 years using the same data (Table 2). The difference is attributable to rounding errors in the logarithmic projections.

Following the suggestion of Koerner *et al.* (2015), Richgels (2015b) treated the results of the half-life mentioned above as an upper bound estimate. For the lower bound estimate, Koerner *et al.* (2015) suggests performing a linear extrapolation of the laboratory data to lower field temperatures, rather than using the Arrhenius model.

With the linear extrapolation, the ratio of monthly irradiance to laboratory lamp irradiance is scaled linearly to calculate the number of months required to reach half-life at 80C, 70C and 60C. Linear extrapolations per month are made from the elevated temperatures to the corresponding peak turf temperature in that month. The resulting half-life loss per month is summed to obtained half-life loss per year. The inverse of that result is the half-life in years. Richgels (2015b) calculates a half-life of 176 years using this linear model. Geosyntec's calculation using the same data resulted in a half-life of 214 years (Table 3 and Figure 6). The difference in the calculations is approximately the same as with the calculation using the Arrhenius (logarithmic) model.

Figure 7 shows the calculated upper (Arrhenius - logarithmic) and lower (linear) bound curves calculated by Richgels (2015b) along with the field data on the HDPE grass blades provided by Watershed (2014). As shown in Figure 7, the trend line fit to the field data falls in between the upper and lower bound curves produced by Richgels (2015b). Note that the first point from the field data at approximately 1 year is omitted from the trend line. This is because the first data point is assumed to be within the anti-oxidant phase of degradation rather than the polymer oxidation stage as suggested by Rowe *et al.* (2010). Additional discussion regarding the stages of degradation for polyolefin materials can be found in CUR 243 (2012).

**Service Life Estimation Based on Performance Requirements (12.5% of Retained Strength)**

Geosyntec repeated the calculations discussed above for the estimation of half-life, but extrapolated the GSI laboratory data down to 12.5% rather than 50% at 80C, 70C and 60C. Upper bound

(Arrhenius – logarithmic) and lower bound (linear) estimates were 2,500 years and 2,043 years, respectively.

These estimates of service life are simply too large to be reasonable. A likely explanation is that the samples tested at 80C, 70C and 60C have not degraded enough to produce accurate predictions at 12.5% retained strength. As previously mentioned, the data for 80C has reached 78% retained strength; the data for 70C has reached 66% retained strength; and the data for 60C has reached 86% retained strength. Therefore, the extrapolation for each of these data sets to 50% retained strength will be much more accurate than extrapolations to 12.5%. In addition, small uncertainties in log-based extrapolations will greatly influence results.

For these reasons, it is not practical or useful at this time to quantitatively assess service life in terms of actual performance requirements when those requirements are substantially below the half-life. There is some value, however in a qualitative use of performance requirements in comparisons with half-life estimates (i.e., to establish the factor of safety remaining at 50% degradation).

## SUMMARY AND CONCLUSIONS

Geosyntec's literature review of approximately 40 documents yielded few sources of UV degradation data for exposed HDPE grass blades. Relevant data that was found included the field test data from the New River, AZ testing facility provided by Watershed (2014) and one data point from Atlas-MTS. The Atlas-MTS data point indicated that HDPE grass blades in average European climatic conditions would retain approximately 90% of its original strength after 20 years of field exposure. Taking into account the differences in temperature and UV irradiance between New River, AZ and European averages, the data point is consistent with the New River, AZ test data in the 7 to 10 year range.

Following the method presented in Richgels (2015a, 2015b) for HDPE grass blades, Geosyntec calculated an upper bound half-life of 277 years compared with Richgels 247 years using the Arrhenius (semi-log) extrapolations to site temperatures and ratio of laboratory lamp to field irradiance. Geosyntec calculated a lower bound half-life based on linear temperature extrapolations, as suggested by Koerner *et al.* (2015), of 214 years compared with 176 years obtained by Richgels (2015b). The differences between Geosyntec and Richgels calculations were attributed to rounding. As shown in Figure 7, the field data from New River, AZ suggests a half-life of 216 years when considering only the last three data points (i.e., polymer oxidation stage).

Another prediction of HDPE grass blade degradation is included in Watershed (2014) using the same (New River, AZ) field data. That prediction of retained tensile strength at 100 years of service life is 65%.

Therefore, it appears that the half-life of the HDPE grass blades will be on the order of 100 years based on the existing field data set and extrapolation methods found in the literature and presented herein. The results are promising; however additional field test data is needed to improve the half-life prediction, particularly since the half-life predictions for exposed HDPE geomembranes are also approximately 100 years (Koerner, 2015). Half-life predictions presented herein will also need to be revisited when additional labratory data is released from the GSI testing program.

Geosyntec attempted to calculate the service life of the HDPE grass blades using 12.5% of retained strength, rather than an arbitrarily assigned half-life. However, the calculation resulted in unreasonably long service life. This result is likely due to uncertainties in extrapolating the laboratory data released from GSI down to the 12.5% retained strength level. The data release has degraded to 78%, 66% and 86% for the 80 $^{o}$C, 70 $^{o}$C, and 60 $^{o}$C test temperatures. Therefore, extrapolations to 50% may be warranted while extrapolations to 12.5% may not be until additional lab data is available. That being said, it should be recognized that half-life, or 50% of retained strength, has a factor of safety of 2.8 to 4.0 when considering the tensile capacity performance requirements of HDPE grass blades.

With regard to the unexposed elements of the ClosureTurf® system, Watershed (2014) indicates that the retained tensile strength of the PP geotextile backing prior to the addition of UV inhibitors is 65% after 100 years. This estimate is based on exhumed samples of the geotextile from the LaSalle-Grant Landfill in Louisiana. According to Watershed (2014), the addition of proprietary UV inhibitors to the PP geotextile backing has led to an improvement in UV resistance by a factor of 14. The final geosynthetic in the ClosureTurf® system is the covered HDPE geomembrane. Koerner (2011) estimates that the half-life of a covered HDPE geomembrane is 446 years at 20C, and 265 years at 25C. Furthermore, the degradation of the unexposed elements of the ClosureTurf® system invoke the half-life criteria. As discussed with regard the exposed HPDE grass blades, actual performance requirements should ideally be used to determine system longevity. However, the existing testing programs need to be allowed to degrade further before projections to lower values are made.

It is worth reiterating that applications of ClosureTurf® in areas of the United States where the UV irradiance and the temperatures are lower will result in longer half-life predictions than discussed above. In some cases (e.g., the Northeastern States), the differences will likely be quite large when compared with Arizona.

Finally, once UV degradation of the most susceptible component of ClosureTurf® (i.e., the exposed HDPE grass blades) does result in a tensile break, replacement of the HDPE grass and PP geotextile backing can be performed.

**CLOSING**

Geosyntec appreciates the opportunity to assist Watershed in the development of its ClosureTurf® products. Questions and comments may be directed to either of the undersigned at 678-202-9500.

Sincerely,

Will Tanner, P.E.
Project Engineer

Ming Zhu, Ph.D., P.E.
Senior Engineer

Attachments: References
Tables
Figures

Copies to: Bill Gaffigan (Geosyntec)
Mike Ayers (Watershed)

## REFERENCES


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CUR 243, (2012) “Durability of Geosynthetics”. Stichting CURNET, Gouda, The Netherlands.

Diguilo, D. (2013), “ClosureTurf™ – The Next Generation Closure System”. Northern New England SWANA Conference, Lebanon, New Hampshire, September 25, 2013.

Koerner, R., Hsuan, Y., Koerner, G., (2011) “GSI White Paper 6 - Geomembrane Lifetime Prediction: Unexposed and Exposed Conditions”. Geosynthetics Institute, Folsom, Pa., February 8, 2011.

Koerner, R., Koerner, G., and Hsuan, Y. (2015) “Lifetime Predictions of Covered and Exposed Geomembranes”. Webinar GSI-W14, January 14, 2015.

Richgels, C., Ayers, M., and Urrutia, J., (2015a) “Estimation of Geographic Ultraviolet Radiation Levels and Impact on Geosynthetic Cover Systems”. Proceedings of Geosynthetics 2015, Portland Oregon, February 15-18, 2015.

Richgels, C. (2015b) “Estimation of Geographic Ultraviolet Radiation Levels and Impact on Geosynthetic Cover Systems”. Geosynthetics 2015, Portland, Oregon, February 15-18, 2015.

Rowe, K., Islam, M., Hsuan, Y., (2010) “Effects of Thickness of the Aging of HDPE Geomembranes”. Journal of Geotechnical and Geoenvironmental Engineering, ASCE, 136(2), p.299-309.

Watershed Geosynthetics, (2014) “Technical Submittal for ClosureTurf™ – Alternative Final Cover, Closure of Municipal Soild Waste Landfill Units”, December 2, 2014.

# TABLES

**Table 1. Selected Sites where ClosureTurf® has been Installed.**

| Select ClosureTurf® Installations | | | | |
|---|---|---|---|---|
| **Installation** | **Type** | **Acres** | **State** | **Year** |
| Progressive - Weatherford | Public – MSW | 8.5 | Texas | 2010 |
| Progressive - Timberland | Public - MSW | 4 | Louisiana | 2011 |
| Crazy Horse (Salinas SWA – Monterey) | City – MSW | 65 | California | 2012 |
| Saufley Landfill (Escambia) | Public – C&D | 22.5 | Florida | 2012 |
| Georgia Pacific | Independent | 70 | Georgia | 2013 |
| Berkeley County Landfill | City - MSW | 12 | South Carolina | 2013 |
| Lanchester Landfill (Chester) | City - MSW | 7 | Pennsylvania | 2013 |
| Tangipahoa Parish | City – MSW | 22 | Louisiana | 2013 |
| Sandtown – (Berkeley County) | City – MSW | 4 | Delaware | 2013 |
| Si-County Landfill | EPA – Region 6 | 5 | Texas | 2014 |
| Holcim Cement Landfill (Kiln Dust) | Independent | 46 | New York | 2015 |

**Table 2. HDPE Grass Blade Upper Bound Half-Life Calculations (Geosyntec)**

| Month | UV Lamp On(1) (hrs/day) | Peak Turf Temp(2) (C) | Peak Turf Temp (K) | Peak Turf Temp (1/K) | Reaction Rate(3) | Lab Half-Life(4) (lamp hrs) | Field Equivalent(5) (days) | Field Equivalent(6) (months) | Half Life Loss per Month(7) |
|---|---|---|---|---|---|---|---|---|---|
| January | 4.00 | 27.99 | 301.14 | 0.0033 | -15.67 | 6385286 | 1596322 | 51494 | 1.94196E-05 |
| February | 4.94 | 27.96 | 301.11 | 0.0033 | -15.67 | 6401982 | 1296604 | 46307 | 2.15949E-05 |
| March | 6.13 | 33.94 | 307.09 | 0.0033 | -15.11 | 3632197 | 593012 | 19129 | 5.22755E-05 |
| April | 6.94 | 40.58 | 313.73 | 0.0032 | -14.50 | 1983742 | 285945 | 9531 | 0.000104915 |
| May | 7.25 | 51.21 | 324.36 | 0.0031 | -13.58 | 792646 | 109330 | 3527 | 0.000283544 |
| June | 7.31 | 61.52 | 334.67 | 0.0030 | -12.75 | 344593 | 47124 | 1571 | 0.00063662 |
| July | 6.94 | 66.82 | 339.97 | 0.0029 | -12.34 | 228887 | 32993 | 1064 | 0.000939599 |
| August | 7.00 | 64.80 | 337.95 | 0.0030 | -12.50 | 267230 | 38176 | 1273 | 0.000785841 |
| September | 6.94 | 59.43 | 332.58 | 0.0030 | -12.91 | 406208 | 58553 | 1889 | 0.000529439 |
| October | 5.88 | 47.74 | 320.89 | 0.0031 | -13.88 | 1062504 | 180852 | 5834 | 0.000171411 |
| November | 4.56 | 36.38 | 309.53 | 0.0032 | -14.88 | 2899472 | 635501 | 21183 | 4.72069E-05 |
| December | 3.69 | 24.68 | 297.83 | 0.0034 | -15.99 | 8826208 | 2393548 | 77211 | 1.29515E-05 |
| Lab | 20 | | | | | | | **Yearly Half-life Loss(8)** | 0.003604818 |
| | | | | | | | | **Half-life(9) (years)** | 277.41 |

Notes:

(1) UV Lamp On (hours per day) is given in Richgels (2015a, 2015b).
(2) Peak Turf Temps for New River, AZ given in Richgels (2015a, 2015b).
(3) Reaction Rate is calculated from the regression curve shown in Figure 4 for the upper bound (logarithmic) case.
(4) Lab half-life in hours is equal to 1/e^(Reaction Rate).
(5) Field equivalent (days) is calculated by dividing the lab half-life in hours by the UV lamp on hours per day.
(6) Field equivalent in days is converted to months using the given days in that particular month.
(7) Half-life loss per month is the inverse of the corresponding field equivalent in months.
(8) The yearly half-life loss is the sum of each individual months half-life loss.
(9) The half-life in years is the inverse of the yearly half-life loss.

**Table 3. HDPE Grass Blade Lower Bound Half-Life Calculations (Geosyntec)**

| Month | UV Lamp On[1] (hours/day) | Months @ 80 C[2] | Months @ 70 C[2] | Months @ 60 C[2] | Peak Turf Temp[3] (C.) | Half-life Months (from Regression) | Half-life Loss per month |
|---|---|---|---|---|---|---|---|
| January | 4.00 | 692 | 1507 | 3078 | 27.99 | 6948 | 0.000143933 |
| February | 4.94 | 620 | 1352 | 2761 | 27.96 | 6256 | 0.000159849 |
| March | 6.13 | 452 | 984 | 2010 | 33.94 | 4059 | 0.00024637 |
| April | 6.94 | 412 | 898 | 1834 | 40.58 | 3213 | 0.000311281 |
| May | 7.25 | 382 | 832 | 1698 | 51.21 | 2248 | 0.000444747 |
| June | 7.31 | 391 | 852 | 1740 | 61.52 | 1580 | 0.000633027 |
| July | 6.94 | 399 | 869 | 1775 | 66.82 | 1237 | 0.00080834 |
| August | 7.00 | 395 | 861 | 1759 | 64.80 | 1371 | 0.000729293 |
| September | 6.94 | 412 | 898 | 1834 | 59.43 | 1826 | 0.000547629 |
| October | 5.88 | 471 | 1026 | 2095 | 47.74 | 3070 | 0.000325779 |
| November | 4.56 | 627 | 1365 | 2788 | 36.38 | 5321 | 0.000187929 |
| December | 3.69 | 750 | 1635 | 3339 | 24.68 | 7945 | 0.000125871 |
| Lab | 20 | | | | | **Yearly Half-life Loss** | 0.00466405 |
| | | | | | | **Half-life (years)** | 214.41 |

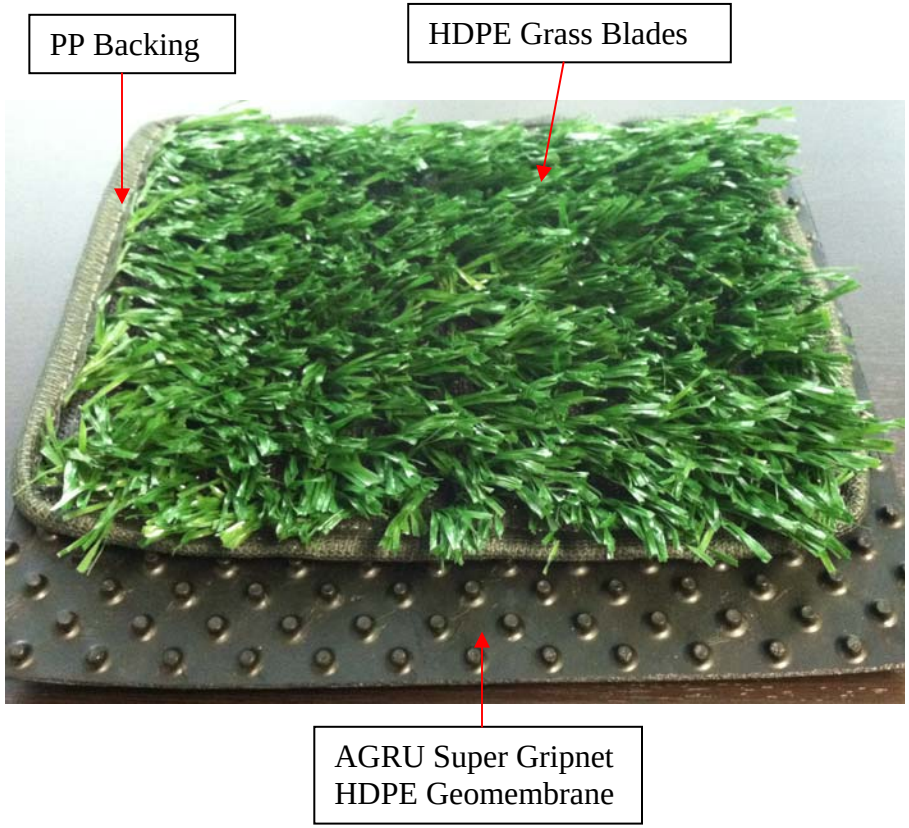
Notes:

(1) UV Lamp On (hours per day) is given in Richgels (2015a, 2015b).

(2) The months required at each temperature is calculated using the regressions from Figure 4 for each temperature, projected down to half-life, then dividing the lamp-hours at half-life by the UV lamp on hours per day for a given month. Once this calculation is done for 80, 70 and 60 C, a linear regression (as shown in Figure 5) is used to obtain the half-life months at the corresponding peak turf temp.

(3) Peak turf temperatures given in Richgels (2015a, 2015b).

# FIGURES



Note: The sand ballast infill is not shown in the sample photo on the left, but is shown in a field application photo on the right.

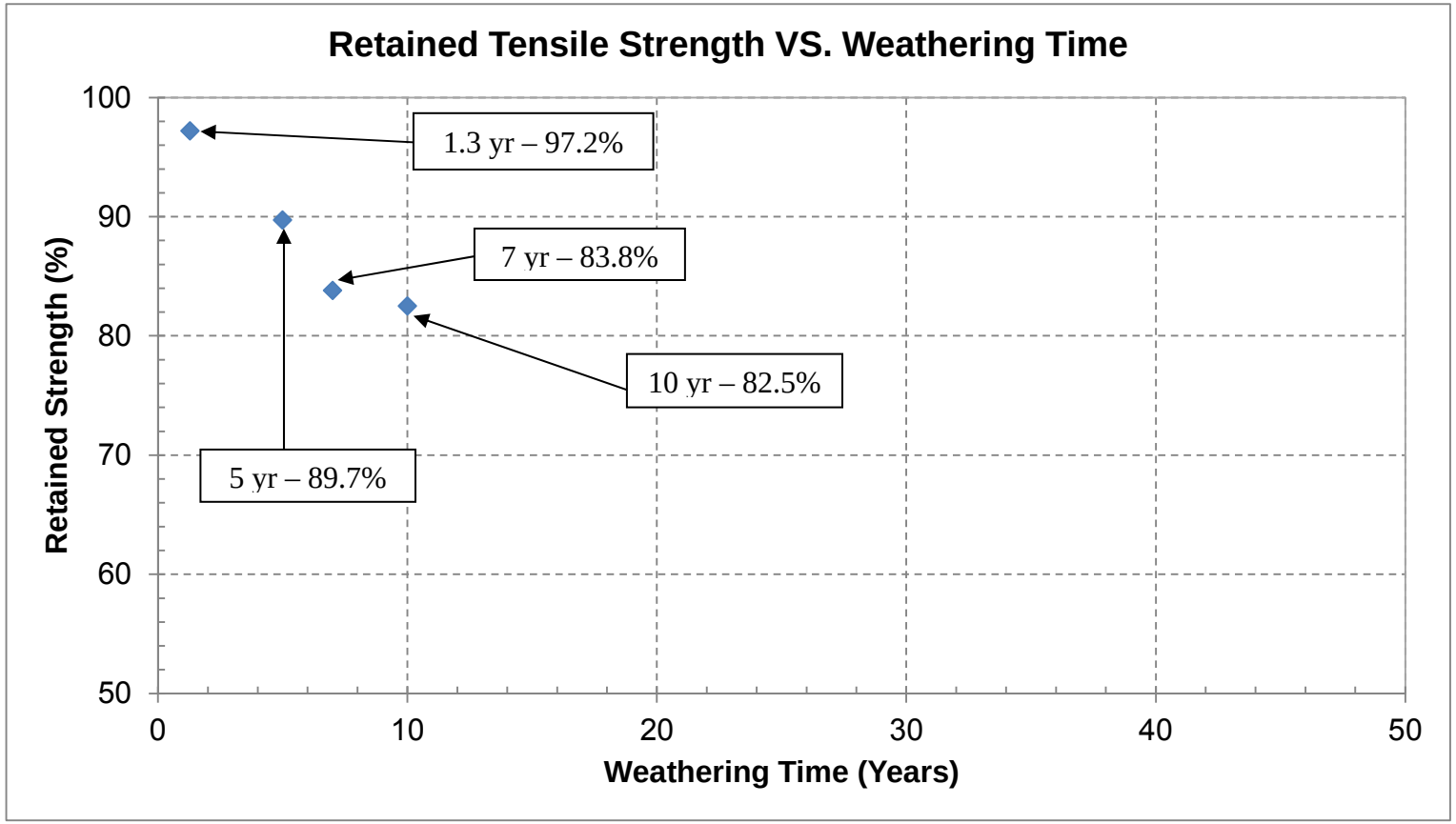
**ClosureTurf®Components**

Watershed Geosynthetics – ClosureTurf® UV Assessment

Geosyntec consultants

Figure 1

Kennesaw, GA | 23-April-2015




Notes:

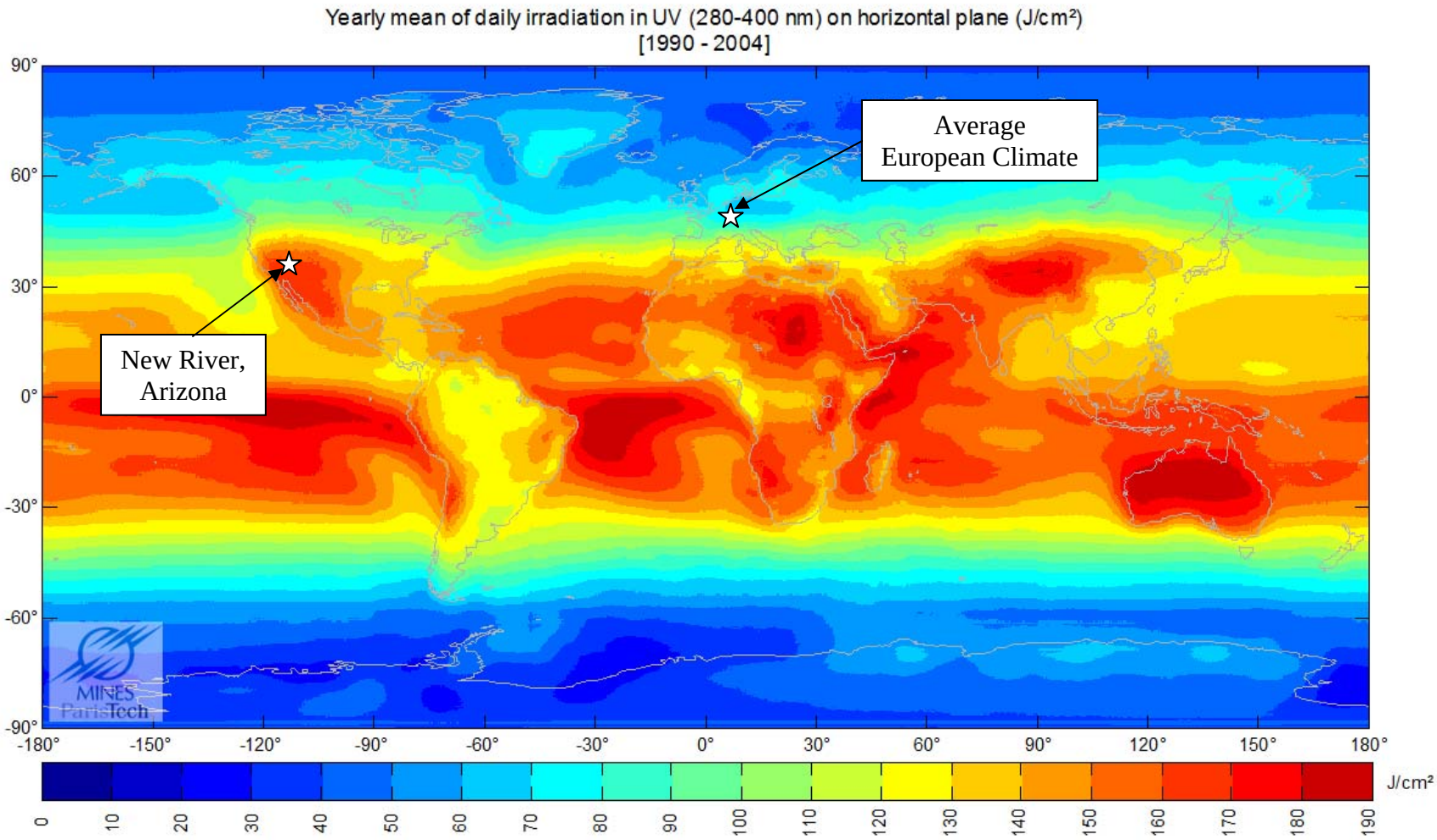
1. The first data point at Weathering Time of 1.3 years is considered to be within the initial stage of UV degradation (i.e., anti-oxidant depletion), rather than polymer oxidation which is represented by the final three data points.
2. Each data point represents the average result of 20 tensile break tests.

**Field Test Data (Watershed, 2014)**
**New River, AZ Atlas Testing Facility**
Watershed Geosynthetics – ClosureTurf® UV Assessment

Geosyntec consultants

Figure **2**

Kennesaw, GA | 25-April-2015




1 J/cm$^2$ = 4.755 ft-lbs/in$^2$

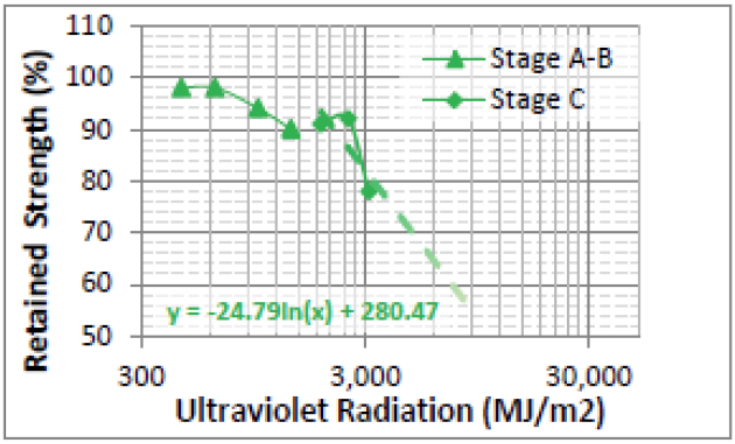
**Yearly Irradiation in the Ultraviolet Range**

Watershed Geosynthetics – ClosureTurf® UV Assessment

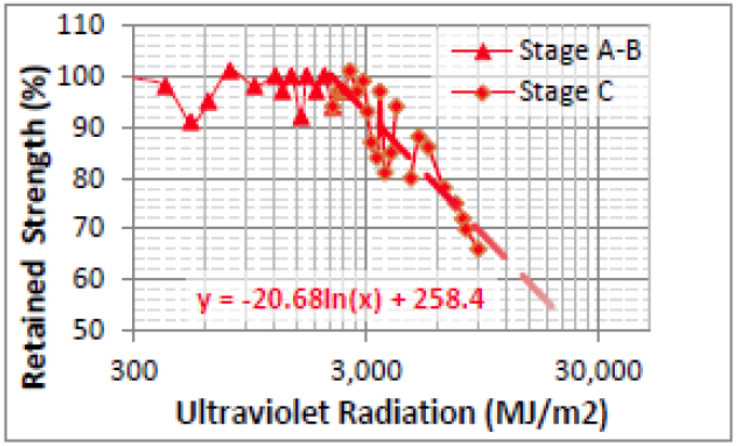
Geosyntec consultants

Figure 3

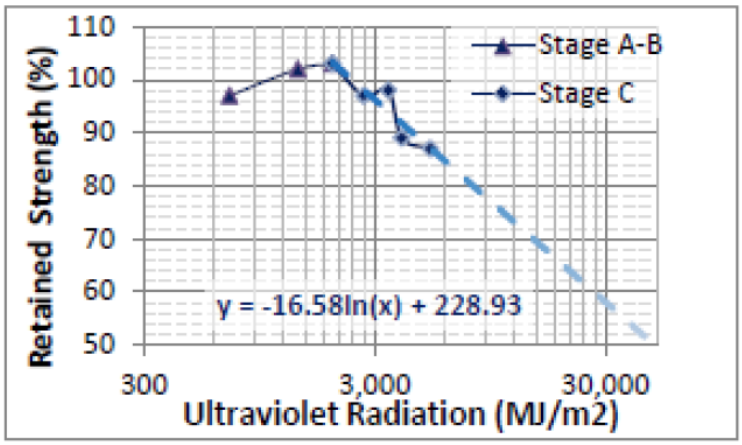
Kennesaw, GA | 23-April-2015




a) 80°C Temperature Dataset




b) 70°C Temperature Dataset




c) 60°C Temperature Dataset

**GSI Data Release - Three Stage Oxidation of HDPE for Different Temperatures**

Watershed Geosynthetics – ClosureTurf® UV Assessment

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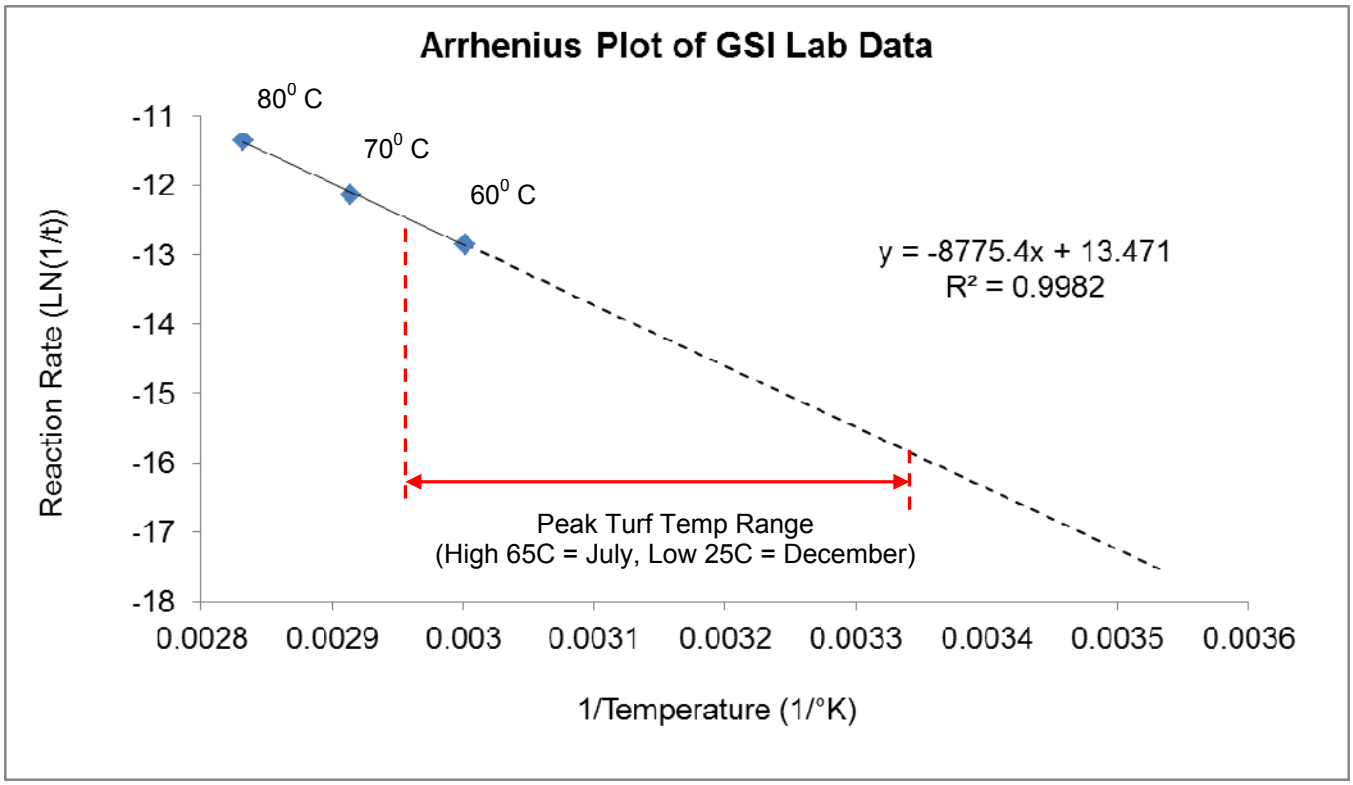
Figure 4

Kennesaw, GA | 23-April-2015




Note: Richgels (2015b) mentions that the use of peak turf temperature is conservative since it only occurs for approximately one hour per day.

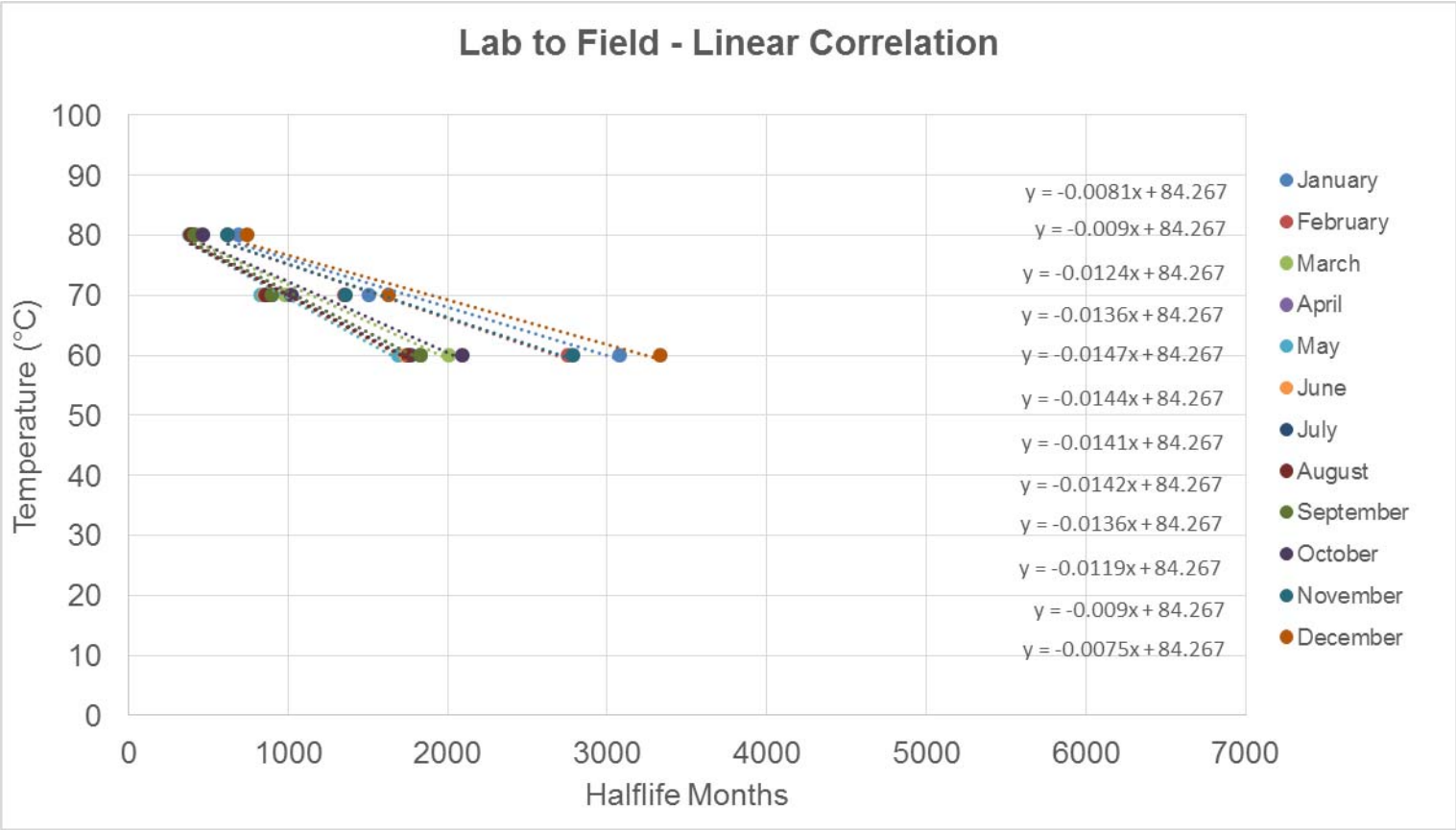
**Arrhenius Plot of Lab Data**

Watershed Geosynthetics – ClosureTurf® UV Assessment

Geosyntec consultants

Figure 5

Kennesaw, GA | 23-April-2015




Note: Each month was projected down to the peak turf temperature given in Table 3 to get the half-life months. The inverse of half-life months is half-life loss per month. The sum of all the half-life losses for each month in a year is the yearly half-life loss, the inverse of which is the half-life.

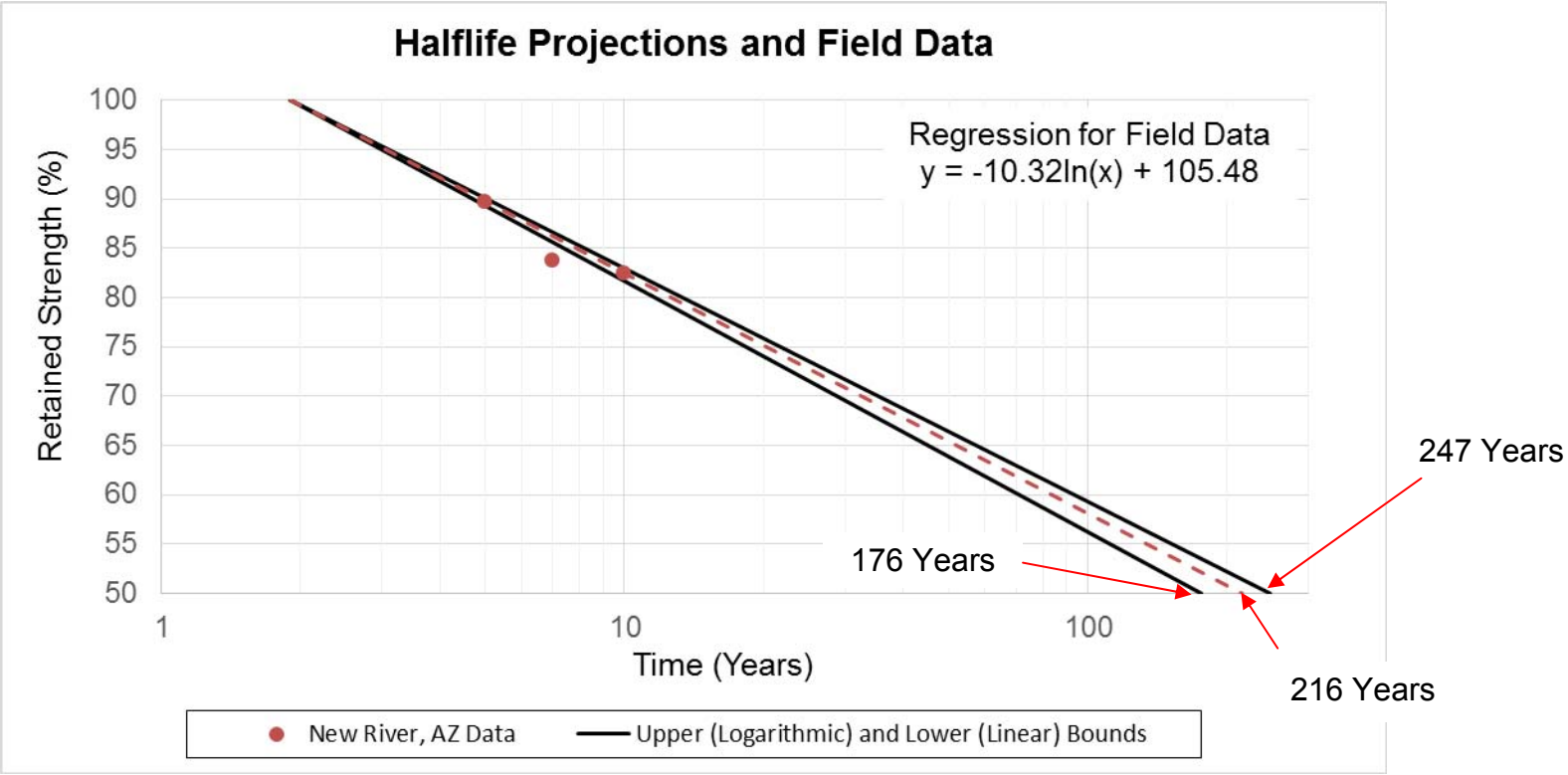
**Linear Extrapolations for Half-life Months**

Watershed Geosythetics – ClosureTurf® UV Assessment

Geosyntec consultants

Figure 6

Kennesaw, GA | 23-April-2015




Note: Geosyntec calculated an upper bound half-life of 277 years and a lower bound half-life of 214 years using the same data and method. Difference between Geosyntec and Richgels calculations are attributed to rounding.

**Halflife Projections (Richgels, 2015a, 2015b)**
**Upper and Lower Bound Estimates**
Watershed Geosythetics – ClosureTurf® UV Assessment

Geosyntec consultants

Figure **7**

Kennesaw, GA | 23-March-2015

July 8, 2010

Mr. Michael R. Ayres, P.E.
Closure Turf, LCC
3005 Breckinridge Blvd.
Duluth, GA 30096

Subject: **Aerodynamic Evaluations of Closure Turf Ground Cover Materials**

References: **1: Contract # AGR DTD 5/14/10**

Dear Mr. Ayres and Closure Turf LCC affiliates:

The Georgia Tech Research Institute is pleased to submit the attached Report, covering the period from May 14 to July 8, 2010, in fulfillment of Reference. This document details the tasks and analysis made on contracted work performed by the GTRI Aerospace, Transportation and Advanced Systems Laboratory and its team members on Phase I of the Project entitled "Aerodynamic Evaluations of Closure Turf Ground Cover Materials".

We look forward to continuation of this work for/with Closure Turf, LCC upon the adoption of Phase II activities related to aerodynamic investigation of Closure Turf Material or other desired evaluations.

Sincerely,

Graham M. Blaylock
Principal Investigator

# Aerodynamic Evaluations of Closure Turf Ground Cover

**Phase I REPORT**
**May 14 – July 8, 2010**

**Project Expires: August 14, 2010**

**Contract No. AGR DTD 5/14/10**
**Proposal No. ATASL-AATD-10-1119**

**GTRI Project No. D-6244**

**Prepared for:**
Mr. Michael R. Ayres, P.E.
Closure Turf, LCC
3005 Breckinridge Blvd.
Duluth, GA 30096

Prepared by:
Graham M. Blaylock, Research Engineer II
Aerospace, Transportation and Advanced Systems Laboratory
Georgia Tech Research Institute
Georgia Institute of Technology
Atlanta, GA 30332-0844
gb62@gtri.gatech.edu

**Principal Investigator:** Graham M. Blaylock, Research Engineer II
Georgia Tech Research Institute
Aerospace, Transportation & Advanced Systems Laboratory
CCRF, Code 0844
Atlanta, GA 30332-0844
(404) 407-6469, Office
(404) 407-8077, Fax
(404) 407-7586, Wind Tunnel
gb62@gtri.gatech.edu

## Introduction

GTRI has been contracted by Closure Turf, LCC to **experimentally evaluate the aerodynamic properties and ballast requirements** of a novel synthetic ground-cover system under a range of wind speed conditions ($V_{inf}$). The Closure Turf Material was tested full-scale in **GTRI's subsonic Model Test Facility (MTF) wind tunnel** wherein the normal force loading ($lb_f/ft^2$) and the shear stress ($lb_f/ft^2$) were determined for a suitable section of the material. The turf material was tested in two configurations, one representing the perimeter of the turf installation (Fig 5) and the 2nd at a representative interior section (Fig 6). Both installations were evaluated on a **flat level surface**. The installation is shown in Figures 1a-d below.

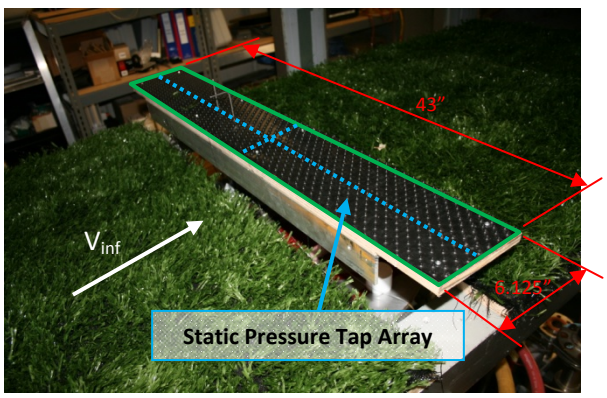



**Figure 1a – Model Before Final Turf Layer**

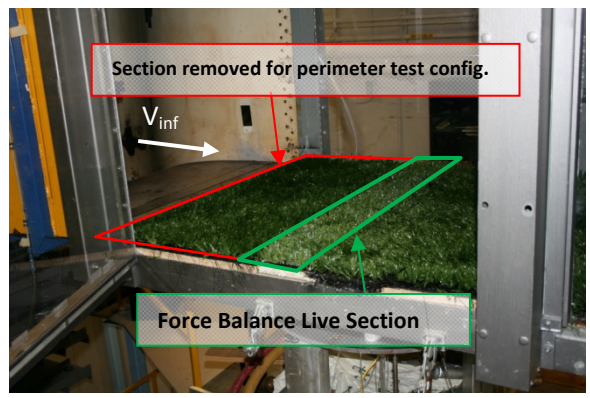



**Figure 1b – Turf Installed & Model Lowered**

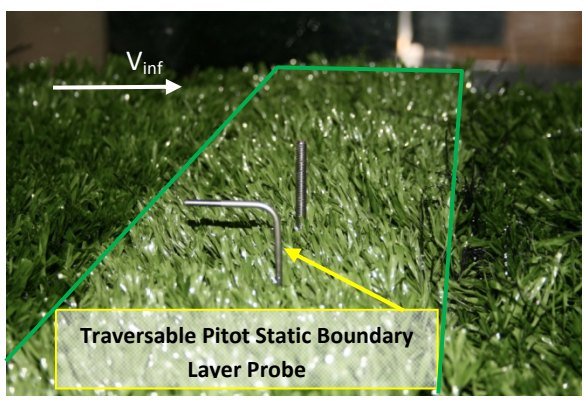



**Figure 1c - Pitot Static Boundary Layer Probe**

**Figure 1d – Full Installation Looking Downstream**

## Program Description

**Closure Turf system -** The Closure Turf ground cover system consists of two independent layers. The first layer is a **geomembrane** to cap the upper soil layer. This is then covered with a **geotextile** turf layer (Fig 2a and 2b)

**Geomembrane Layer** -The impermeable geomembrane is made from Agru 50-mil LLDPE Super Gripnet® material and is used to cap the terrain being covered. It has an array of spikes to interface to the soil below and an array of studs to interface with the turf covering above. Throughout the testing and subsequent analysis of the Closure Turf system, **it was assumed that the geomembrane will be sufficiently installed to prevent movement of that layer.**

**Geotextile Turf Layer –** This component is designed to be installed on top of the geomembrane. The turf is intended to remain in place without an anchoring system linking it to the geomembrane below. It relies on the interface friction and sand ballast added on top of the turf to ensure that it remains immobile under all environmental conditions. It is constructed of two permeable sheets of woven HDPE mesh material which are linked together with synthetic blades of grass that are looped through the two HDPE substrates (Fig 2a).

**Figure 2a – Closure Turf Synthetic Ground Cover System**

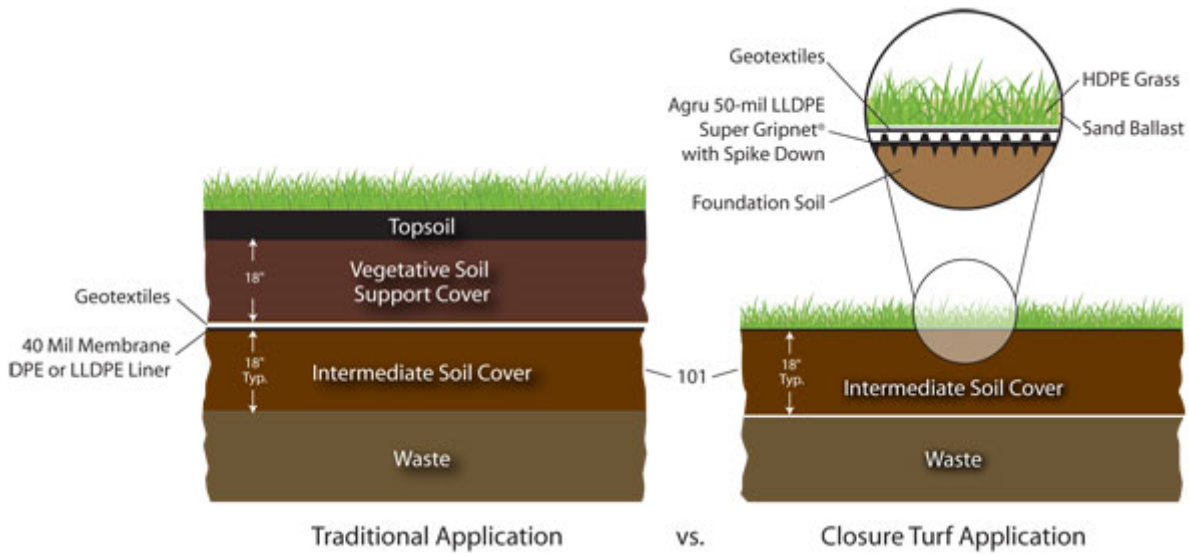



**Figure 2b – Installation of Closure Turf**

**Purpose –** The scope of this program was to conduct a full-scale wind tunnel test and experimentally isolate and measure the aerodynamic forces acting on a section of the permeable upper geotextile turf layer alone as installed above the impermeable geomembrane. The wind tunnel install configuration would simulate a wide range of wind speeds flowing over a **flat and level terrain installation** of the Closure Turf ground cover system (Fig 1a-d). The sand ballast requirements needed to counteract the resulting aerodynamic forces could then be determined. The purpose of the ballast is twofold. It serves to prevent both lift-off and tangential motion of the turf material along the geomembrane underlayment **resulting from aerodynamic lift and drag acting on the turf layer**.

## Methodology

**Model Design –** The model represented a full-scale 2D section of the Closure Turf material with a 6.125" chord (stream-wise dimension) with a width of 43" that spanned the tunnel wall to wall. This area constituted the live balance section upon which the total sum of all aerodynamic forces could be measured by a 6 component force balance located under the test section. The model consisted of 4 layers listed below from the lower to uppermost turf layer

1) ¾" Furniture grade plywood support base – This incorporated several pressure taps on the underside in order to measure the ambient pressure ($P_{amb}$) to determine the vertical force ($F_{amb}$) due to pressure acting upward on the lower surface of the model.
2) Foam Filler Layer – This represented the soil layer surrounding the lower geomembrane spikes.
3) Impermeable Goemembrane Layer – This was fixed rigidly to the base. An array of static pressure taps was installed on the upper side of this layer, shown schematically in Fig. 1a. These

pressures were integrated numerically to determine the force ($F_{geo}$) due to pressure acting down on the membrane.

4) Geotextile Turf Layer – The turf was first mounted to a thin wire support frame to maintain the geometry and to provide a safety measure to prevent material from dislodging in the tunnel. The frame was then mounted rigidly on top of the lower construction flush with the top of the geomembrane upper surface studs.

**Pitot Static Boundary Layer Probe –** In general, pressure variation through the height of the boundary layer is due to viscous forces which cause deficits in the total pressure as the bounding flat and level surface is approached. The static pressure remains constant. However, the unique characteristics of the flexible and permeable turf layer warranted investigating the boundary layer formation on the Closure Turf system. To accomplish this, a traverse system was built into the model to actuate a Pitot static probe vertically through the boundary layer (Fig 1c). This allows the measurement of the total and static pressure as a function of the probe height, defined as h = 0" at the upper surface of the turf HDPE woven mesh. From these measurements the flow velocity distribution was determined. This characterizes the shape of the boundary layer which is by its nature a transition from the no slip condition at the surface ($V = 0$) to free stream conditions ($V = V_{inf}$). The characteristics of this boundary layer profile such as the BL thickness, the height required for the flow to reach free stream velocity, provide valuable insight into the observed results.

**Force Balance –** An under floor 6 component force balance was utilized to measure the aerodynamic lift ($L$) and the total drag ($D$) of the model. These forces were transmitted to the balance through a vertical strut which mounted to the underside of the model base. It should be noted that these forces represent the total sum of all pressure distributions acting on the model resolved vertically and tangentially. As such the isolated vertical force acting on just the turf layer ($L_{turf}$) is found by Equation 1.

$$L_{turf} = L - L_{amb} + L_{geo} \qquad \text{(Eq 1)}$$

Under the confines of this program, it was not feasible to separate the drag acting on just the turf from skin friction and pressure drag acting on the geomembrane. That being the case, the total drag as measured from the force balance was taken as the drag acting on the turf. This results in a conservative overestimation of the actual turf drag force present.

**Installation Conditions –** Two installation conditions were examined separately. To more accurately simulate the actual installation conditions, both geomembrane and turf layers were installed upstream and downstream of the balance live model (Fig 1b and 1d). This represents an **interior** condition and in this case the model was located approximately 18" inboard of the **perimeter**. It was also suspected that the perimeter, if unaccounted for, could lead to a worse case situation. To determine the nature of this the upstream turf was removed leaving just the geomembrane as a stand in for a typical surface soil roughness that could be expected at the edge of a real world installation. This left the model mounted turf exposed at the leading edge.

## Results and Discussion

These results represent the required thickness of sand for the Closure Turf system as installed on **flat and level terrain**. The density of the sand was provided by Closure Turf. If a different material density is to be used as ballast, the results can be recalculated via Equation 2.

In all cases, **the driving parameter for the depth of the sand is tangential slip due to the aerodynamic formation of shear stress**. The sand ballast requirements have been illustrated in Figures 5 and 6 for several assumed representative interface coefficients of static friction ($\mu_s$). The **minimum** required sand ballast height is found by Equation 2.

$$h_{sand}(in) = \frac{1}{\rho_{sand}}\left(\frac{\tau}{\mu_s} + P\right)\frac{12in}{ft} \qquad \text{(Eq 2)}$$

Where:

$$\rho_{sand} = Weight\ Density\ of\ Ballast(sand) = 110\ \frac{lb_f}{ft^3}$$

$$\tau = \frac{D}{Area} = Shear\ Stress, \frac{lb_f}{ft^2}$$

$$P = \frac{L_{turf}}{Area} = Normal\ Force\ Loading, \frac{lb_f(+tve\ up)}{ft^2}$$

The measured data for determining the sand depth are shown in Table I and Table II and plotted in Figures 5 and 6 for the perimeter and interior configurations respectively. The last column of each table gives the resulting sand height requirement, based on Equation 2, for $\mu_s$ = 0.93. This value was determined independently from the efforts of this program by Closure Turf affiliates and supplied for use in this analysis.

**Perimeter Condition (PC) –** The ballast requirement resulting from this configuration are substantially greater than the interior condition. For the given $\mu_s$ =0.93 a **minimum** sand height of 0.4" or 3.6 $lb_f/ft^2$ is needed to provide the ballast based on the resulting shear at 175 ft/s. The lifting pressure will be satisfied by this loading as shown in Figure 4. It should be noted that the required ballast height due to uplift goes from positive to negative at around 115 ft/s. There are several factors contributing to these results.

**PC Boundary Layer (BL) –** The profile for the perimeter condition is shown in Figure 4 (Red Curve). One characteristic to note is that the boundary layer thickness reaches 99% of free stream velocity at a height of approximately 2". This subjects the turf to up to 89% of the total free stream based on a max vertical blade height of 1.25". This has several resulting effects which can be followed in Figures 3a to 3f. The cascade of effects proceeds as follows.

The blades are subject to higher velocities and thus higher increasing drag as the wind speed increases. The higher drag increases the bending of the blades back onto the mesh substrate. The effect of this has 2 **counteracting effects on the net lift**. At lower velocities (Fig3a-b) the blades are bent slightly with the

flow being deflected and accelerated of over the perimeter as shown by the tufts. This flow acceleration increases the **local** velocity and lowers the local static pressure **below** that of free stream static which creates the pressure differential building up in 3a and b Additionally, in this installation, the perimeter exposes the gap between the turf and the geomembrane which allows for some uplift pressure recovery beneath the turf. However, as the free stream velocity increases, the drag is increased further by virtue of greater velocity exposure in the relatively thin boundary layer, the bending angle of the turf also increases (Fig 3b-c). This bending produces an increasing down force reaction which starts to counteract the suction created by the local flow acceleration. Simultaneously, the slightly reduced turf profile geometry (caused by the increased bending) shown in Figure 3c-d begins to reduce the relative local flow acceleration and thus also reduces the suction. This continues until the net vertical force becomes zero at about 110 ft/s (Fig 3d) and continues to decrease through Figure 3f.

**Interior Condition (IC) –** This condition owes its behavior to the formation of a drastically different boundary layer than the perimeter as shown by the blue profile in Figure 4. Compared to the Perimeter profile it is 25% thicker with no measurable velocity until the height is greater than 50% of the turf length (0.75”). The blades thusly experience a maximum velocity of 45% of free stream. This reduces the drag acting on the turf layer. Furthermore, the static pressure remains constant as a function of height through the BL which effectively prevents the formation of a pressure differential on the flat and level permeable turf membrane.

The cause for the deficient boundary layer is created by longer flow paths over a given surface and all boundaries grow in thickness and increase in turbulence with increasing distance. In the case of Closure Turf, the interaction of the flow with the flexible blades causes this growth to occur quite rapidly. The distance producing the profile in Fig 4 was 18” however, the effect of the growing boundary layer can be seen even in the perimeter condition development in Figures 3a –f. The Model section (highlighted in yellow) is 6.125” wide. It is clearly seen that little to no defection occurs in the turf at a distance just over 6 inches behind the perimeter edge. Thus the boundary layer at further distances than 18” and greater from the perimeter can be expected to have minimal interaction with the turf. Figure 6 shows these results by producing measurements requiring minimal ballast.

## Final Comments and Executive Summary

GTRI was contracted by Closure Turf to determine the effective required ballast in terms of sand thickness needed to counteract the aerodynamic forces versus wind velocity acting on a permeable geotextile synthetic turf ground covering material that is to be overlaid onto an impermeable geomembrane underlayment. *It was found that in both perimeter and interior loading conditions, the shear acting on the material serves as the more demanding factor for determining the ballast.*

- **The resulting measurements represent the forces acting on the permeable Turf Layer *only*. The impermeable geomembrane layer was to be assumed immobile as a founding assumption of this program**

- **If it is determined that the static interface friction coefficient ($\mu_s$) between the soil and the lower side of the membrane is lower than that occurring between the turf and the membrane upper surface studs, the lower $\mu_s$ should be used in Equation 2 to recalculate the sand depth required by shear. The same shear data given in Tables I & II will apply because, as discussed within the methodology section, the measured shear could not be feasibly separated between the two layers independently and thus represents their combined effect.**
- **The sand ballast depths represented in Figures 5 & 6 and Tables I & II are the Minimum depths required, the proper factor of safety has been left to be determined by Closure Turf, LCC and the authorized building permit issuing agencies.**
- **The perimeter of the turf installation is much more demanding than interior sections.**
- **All measurements were made on a rigidly constrained system. It was not within the scope of this investigation to determine what dynamic effects might occur, including gusts or erosion of sand ballast or any possible unstable perturbations.**
- **All configurations consisted of flat and level terrain installation.**
- **All calculations and measurements assume that the blade length is increased to account for any added ballast material. This is to ensure that the installation matches the conditions as tested.**

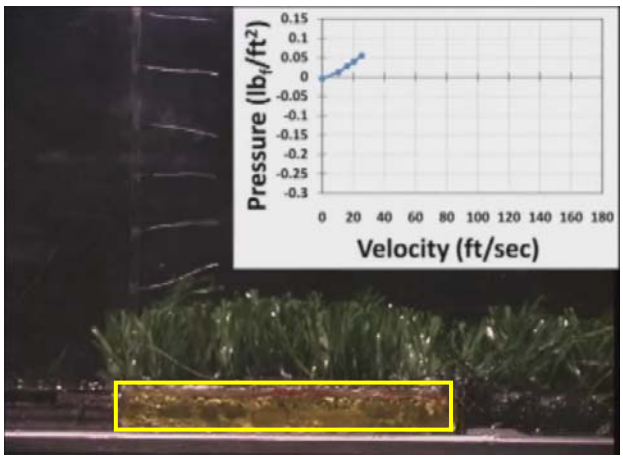



**Figure 3a: Vinf = 25 ft/sec**

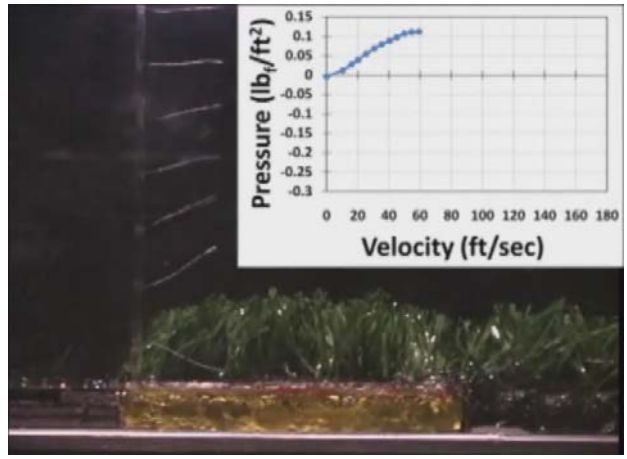



**Figure 3b: Vinf = 60 ft/sec**

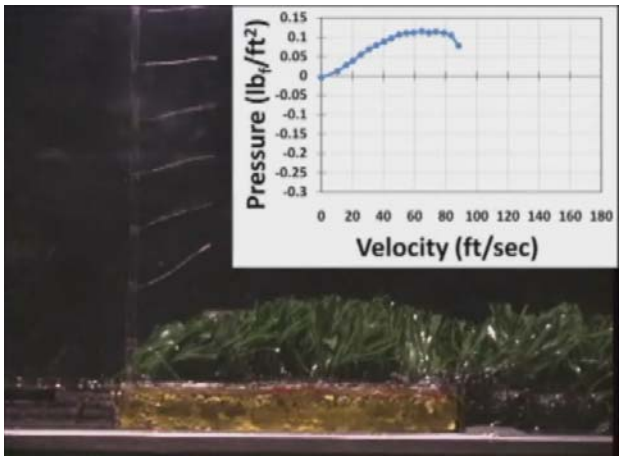



**Figure 3c: Vinf = 90 ft/sec**

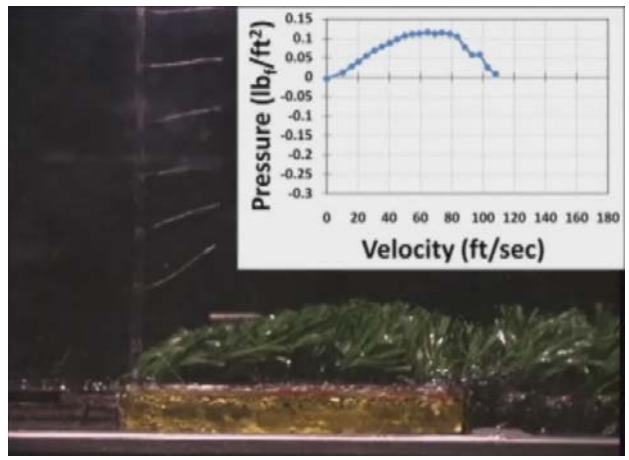



**Figure 3d: Vinf = 110 ft/sec**

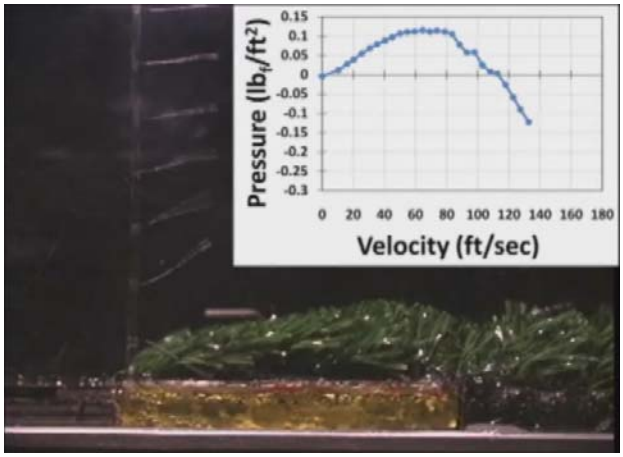



**Figure 3e: Vinf = 135 ft/sec**

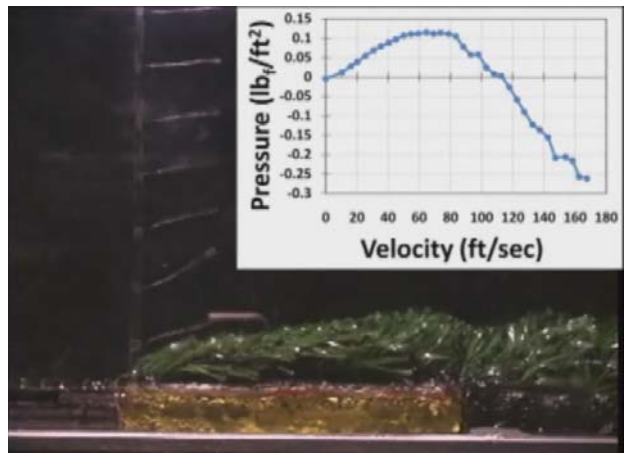



**Figure 3f: Vinf = 170 ft/sec**

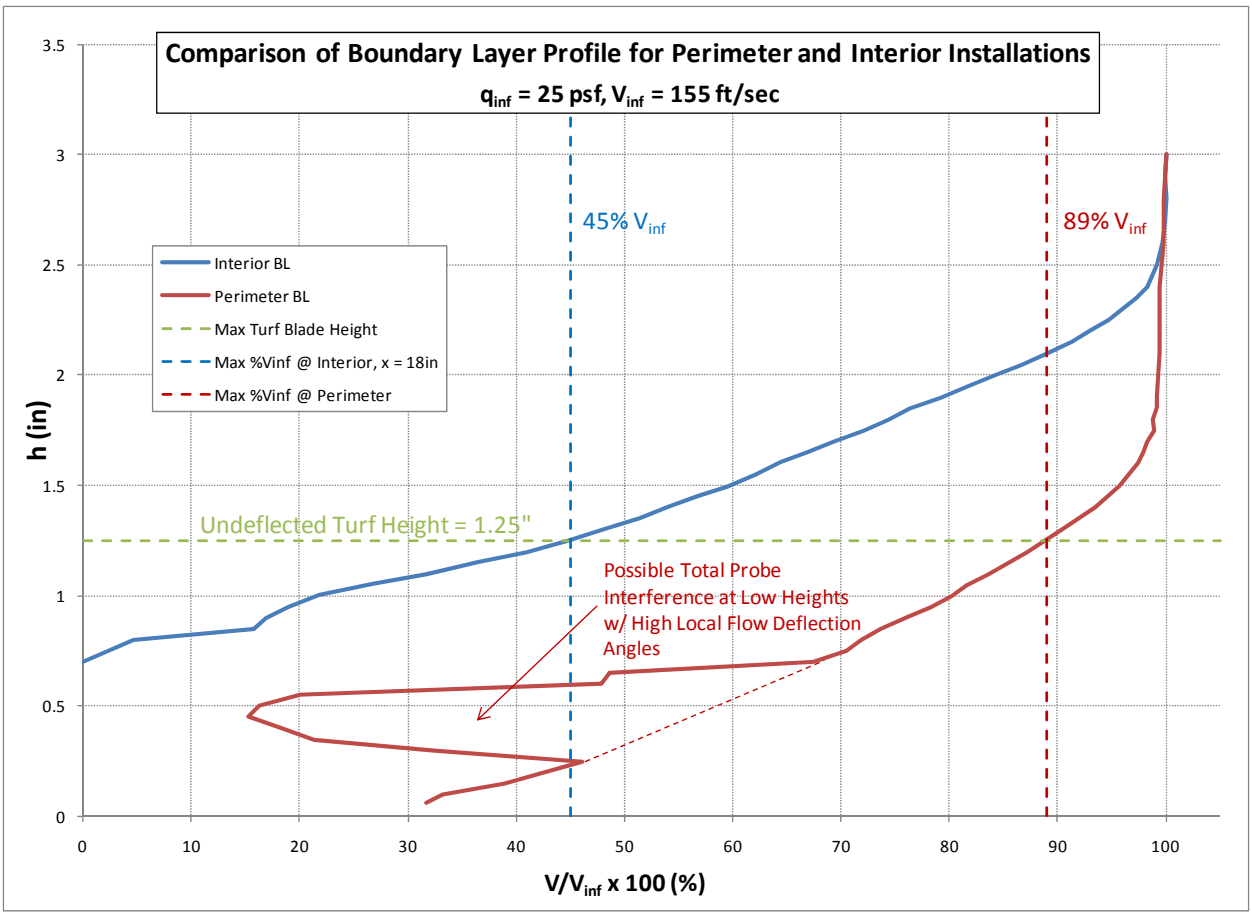



**Figure 4 – Non-Dimensional Boundary Layer Profiles for Perimeter and Interior Installations**

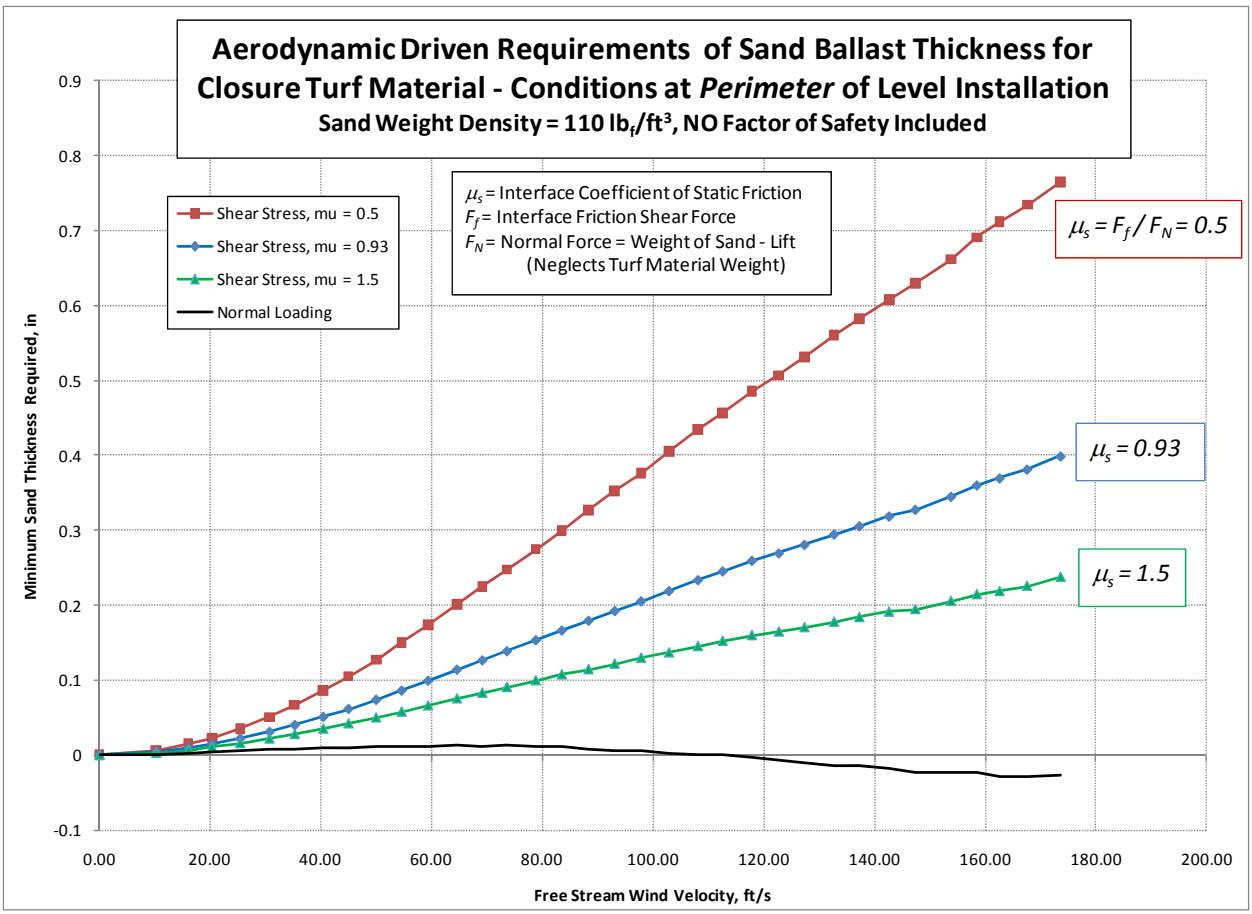



**Figure 5 – Sand Ballast Minimum Requirement at the *Perimeter* of Turf Installation**

| **Table I - Perimeter Installation** | | | | |
|---|---|---|---|---|
| Wind Speed (*ft/s*) | Wind Speed (*mi/hr*) | Turf Normal Force Loading ($lb_f/ft^2$) | Turf Shear Stress ($lb_f/ft^2$) | Sand Height Due to Shear (*in*) |
| 0.00 | 0.00 | 0 | 0 | 0 |
| 10.26 | 6.99 | 0.011689 | 0.023784 | 0.0040651 |
| 16.06 | 10.95 | 0.027798 | 0.053106 | 0.009262 |
| 20.31 | 13.84 | 0.039396 | 0.086922 | 0.0144939 |
| 25.40 | 17.32 | 0.054936 | 0.136103 | 0.0219582 |
| 30.70 | 20.93 | 0.06927 | 0.198423 | 0.0308322 |
| 35.26 | 24.04 | 0.078777 | 0.266915 | 0.0399035 |
| 40.42 | 27.56 | 0.088429 | 0.351918 | 0.0509275 |
| 44.97 | 30.66 | 0.096783 | 0.434606 | 0.0615383 |
| 49.97 | 34.07 | 0.10646 | 0.529776 | 0.0737576 |
| 54.57 | 37.21 | 0.110561 | 0.630469 | 0.0860165 |
| 59.36 | 40.47 | 0.111817 | 0.741903 | 0.099225 |
| 64.58 | 44.03 | 0.115373 | 0.865046 | 0.1140578 |
| 69.15 | 47.15 | 0.111526 | 0.975305 | 0.1265718 |
| 73.60 | 50.18 | 0.114496 | 1.076528 | 0.1387694 |
| 78.82 | 53.74 | 0.111457 | 1.204017 | 0.1533926 |
| 83.52 | 56.94 | 0.104976 | 1.320714 | 0.1663744 |
| 88.34 | 60.23 | 0.077354 | 1.458158 | 0.1794835 |
| 93.08 | 63.46 | 0.057303 | 1.588598 | 0.192597 |
| 97.86 | 66.72 | 0.058201 | 1.697814 | 0.2055063 |
| 102.89 | 70.15 | 0.024978 | 1.844449 | 0.2190825 |
| 108.12 | 73.72 | 0.007601 | 1.985703 | 0.2337562 |
| 112.58 | 76.76 | 0.002646 | 2.090641 | 0.2455251 |
| 117.87 | 80.37 | -0.026041 | 2.237684 | 0.2596441 |
| 122.74 | 83.69 | -0.058742 | 2.352732 | 0.2695721 |
| 127.36 | 86.84 | -0.089852 | 2.479185 | 0.2810115 |
| 132.72 | 90.49 | -0.122289 | 2.627843 | 0.2949108 |
| 137.29 | 93.61 | -0.135769 | 2.734267 | 0.305924 |
| 142.65 | 97.26 | -0.155489 | 2.863465 | 0.3189279 |
| 147.40 | 100.50 | -0.208034 | 2.98848 | 0.3278602 |
| 153.84 | 104.89 | -0.206002 | 3.134988 | 0.3452676 |
| 158.51 | 108.08 | -0.21588 | 3.274285 | 0.3605298 |
| 162.63 | 110.88 | -0.256805 | 3.392572 | 0.3699406 |
| 167.59 | 114.26 | -0.261535 | 3.496667 | 0.3816351 |
| 173.66 | 118.41 | -0.23928 | 3.626641 | 0.3993092 |

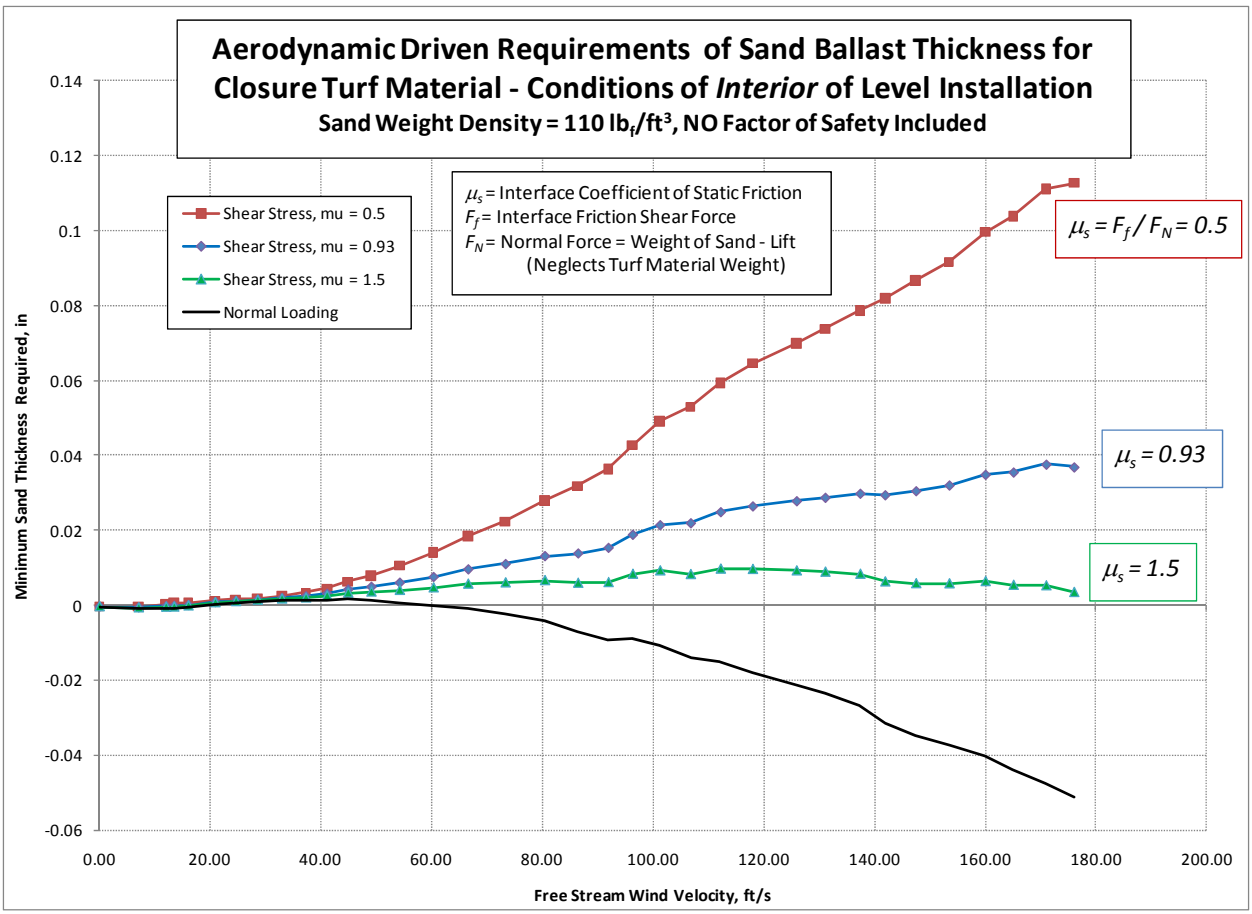



**Figure 6 – Minimum Sand Ballast Requirement in the *Interior* of Turf Installation**

| **Table I - Interior Installation** | | | | |
|---|---|---|---|---|
| Wind Speed (ft/s) | Wind Speed (mi/hr) | Turf Normal Force Loading ($lb_f/ft^2$) | Turf Sheer Stress ($lb_f/ft^2$) | Sand Height Due to Shear (*in*) |
| 0.00 | 0.00 | -0.00419 | 0.000471 | 0 |
| 7.07 | 4.82 | -0.00858 | 0.002819 | -0.000605326 |
| 12.02 | 8.20 | -0.00858 | 0.005658 | -0.000272305 |
| 13.47 | 9.18 | -0.009201 | 0.006927 | -0.000191194 |
| 16.05 | 10.94 | -0.005314 | 0.005174 | 2.72117E-05 |
| 20.91 | 14.26 | 0.003753 | 0.0034 | 0.000808245 |
| 24.64 | 16.80 | 0.006062 | 0.004099 | 0.00114213 |
| 28.56 | 19.47 | 0.009925 | 0.003388 | 0.001480147 |
| 32.94 | 22.46 | 0.011669 | 0.005393 | 0.001905592 |
| 37.27 | 25.41 | 0.011221 | 0.009767 | 0.002369798 |
| 41.09 | 28.01 | 0.013608 | 0.013502 | 0.003068321 |
| 44.90 | 30.61 | 0.015886 | 0.02088 | 0.004182285 |
| 49.08 | 33.47 | 0.011842 | 0.03072 | 0.004895374 |
| 54.21 | 36.96 | 0.006407 | 0.045273 | 0.006009561 |
| 60.31 | 41.12 | -0.000648 | 0.064883 | 0.007540218 |
| 66.57 | 45.39 | -0.006394 | 0.087581 | 0.009575904 |
| 73.32 | 49.99 | -0.019878 | 0.112271 | 0.01100111 |
| 80.43 | 54.84 | -0.037311 | 0.146631 | 0.013129826 |
| 86.42 | 58.92 | -0.06477 | 0.178237 | 0.013841748 |
| 91.90 | 62.66 | -0.083261 | 0.208285 | 0.01534924 |
| 96.30 | 65.66 | -0.081403 | 0.236369 | 0.018846242 |
| 101.24 | 69.02 | -0.097454 | 0.273298 | 0.021427071 |
| 106.76 | 72.79 | -0.129489 | 0.30751 | 0.021945482 |
| 112.17 | 76.48 | -0.138401 | 0.341067 | 0.024909568 |
| 117.97 | 80.43 | -0.163997 | 0.378085 | 0.026459565 |
| 125.89 | 85.83 | -0.193612 | 0.417441 | 0.027845377 |
| 131.07 | 89.36 | -0.215792 | 0.445855 | 0.028758761 |
| 137.38 | 93.67 | -0.245542 | 0.482763 | 0.029842691 |
| 141.88 | 96.73 | -0.289393 | 0.520185 | 0.029448623 |
| 147.46 | 100.54 | -0.317409 | 0.555461 | 0.030530279 |
| 153.47 | 104.64 | -0.340708 | 0.59023 | 0.032067045 |
| 159.99 | 109.08 | -0.369093 | 0.641021 | 0.034928388 |
| 165.05 | 112.53 | -0.4029 | 0.677722 | 0.035545455 |
| 170.96 | 116.56 | -0.437374 | 0.727691 | 0.037646121 |
| 176.00 | 120.00 | -0.469865 | 0.751682 | 0.036915842 |

SGI TESTING SERVICES
A Georgia Limited Liability Company

20 October 2009

Mr. Jose Urrutia
ClosureTurf L.L.C.
3005 Breckinridge Blvd., Suite 240
Duluth, Georgia 3096

Subject: Final Report
Critical Slope Length and
Influence of Seepage Force on Slope Stability
Landfill Cover System

Dear Mr. Urrutia,

## TEST RESULTS

SGI Testing Services, LLC (SGI) is pleased to present the attached test results for the above-mentioned testing program in Attachment A.

## CRITICAL SLOPE LENGTH

The proposed landfill cover system is schematically shown in Figure B-1. The function of drain liner (Agru 50-mil LLDPE Super Gripnet geomembrane) is to transmit water from rainfall down the slope. Assuming the water of rainfall permeates through the sand and artificial grass layers into the spaces between studs of drain liner, using a rainfall intensity R (ft/hour), and considering a unit width of 1 ft, the following equation is then established,

$$q.t. \geq R.t.L.\cos\alpha \tag{1}$$

where:

$q$ = flow rate of the drain liner at i = sin$\alpha$;
$t$ = duration;
$\alpha$ = angle of landfill cover slope as defined in Figure B-2;



Mail To: SGI Testing Services, LLC
P.O. Box 2427
Lilburn, Georgia 30048-2427

Web Site: www.interactionspecialists.com

Facility Location
4405 International Boulevard
Suite B-117
Norcross, Georgia 30093

Phone: 770.931.8222 Fax: 770.931.8240

R = rainfall intensity (ft/four); and
L = length measured from the slope crest (Figure B-2).

Equation (1) can be rewritten as,

$$L \leq \frac{q}{R.\cos\alpha} \tag{2}$$

The critical slope length is defined as,

$$L_{CR} = \frac{q}{R.\cos\alpha} \tag{3}$$

Based on the transmissivity test results (Figure A-3), values of $L_{CR}$ were calculated using a rainfall intensity R = 4 in/hour (0.333 ft/hour) at three different slope angles and are summarized in Figure B-3.

**SEEPAGE PARALLEL TO SLOPE WITHIN SAND LAYER**

As shown in Figure B-4, seepage parallel to the slope within the sand layer can occur when the actual slope length is longer than $L_{CR}$. In this case (flow conditions over the slope length $L_{S2}$), the flow lines are parallel to the slope surface and the seepage force J acting on the soil volume of $L_{CR}$ x h x 1 (Figure 5) is equal to,

$$J = V.\gamma_w \sin\alpha \tag{4}$$

Assuming the sand-artificial grass interface has an effective friction angle = δ' and no adhesion, then the following force equilibrium equation is established,

$$V\gamma_b \cos\alpha \tan\delta' = V.\gamma_w \sin\alpha + V.\gamma_b \sin\alpha \tag{5}$$

Equation (5) can be rearranging as,

$$\tan\alpha = \frac{\gamma_b}{\gamma_b + \gamma_w}\tan\delta' \tag{6}$$

where:

| | | |
|---|---|---|
| $\alpha$ | = | slope angle; |
| $\gamma_b$ | = | buoyant soil unit weight; |
| $\gamma_w$ | = | water unit weight; and |
| $\delta'$ | = | effective friction angle of the sand-artificial grass layer interface. |

It is noted that $\gamma_b$ for a typical sand is approximately equal to $\gamma_w$ and the maximum possible stable slope angle is about half of $\delta'$. In other words, seepage reduces the maximum stable slope angle to about half of that for no water flowing parallel to the slope surface.

SGI appreciates the opportunity to provide laboratory testing services to ClosureTurf LLC. Should you have any questions regarding the attached document(s), or if you require additional information, please do not hesitate to contact the undersigned.

Sincerely,

Zehong Yuan, Ph.D., P.E.
Laboratory Manager

Attachment

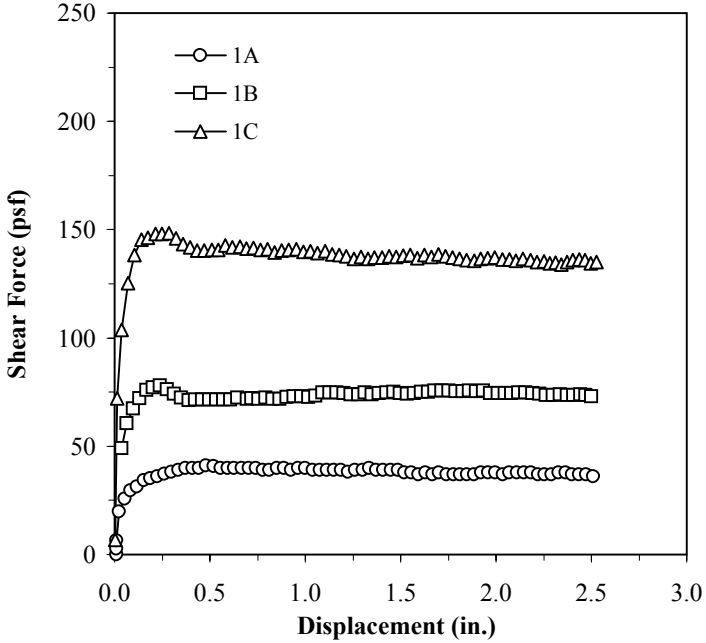
Notes:
(1) Unless otherwise noted in the test results the sample(s)/specimen(s) were prepared in accordance with the applicable test standards or generally accepted sampling procedures.
(2) Contaminated/chemical samples and all related laboratory generated waste (i.e., test liquids, PPE, absorbents, etc.) will be returned to the client or designated representative(s), at the client's cost, within 60 days following the completion of the testing program, unless special arrangements for proper disposal are made with SGI$_{sm}$.
(3) Materials that are not contaminated will be discarded after test specimens and archived specimens are obtained. All of the tested and archived specimens will be discarded 30 days after the completion of testing, unless long-term storage arrangements are specifically made with the laboratory.
(4) The reported results apply only to the materials and test conditions used in the laboratory testing program. The results do not necessarily apply to other materials or test conditions. The test results should not be used in engineering analysis unless the test conditions model the anticipated field conditions. The testing was performed in accordance with general engineering testing standards and requirements. The reported results are submitted for the exclusive use of the client to whom they are addressed.

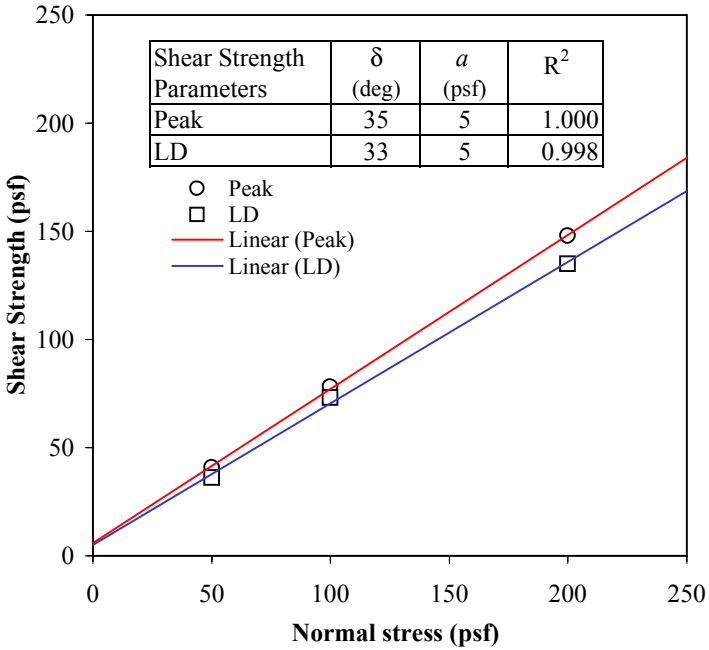
# ATTACHMENT A

# TEST RESULTS

# CLOSURETURF LLC -LANDFILL COVER SYSTEM
# INTERFACE DIRECT SHEAR TESTING (ASTM D 5321)

Test Series No. 1: Concrete sand nominally compacted against grass side of SRS artificial grass under soaked conditions




| Shear Strength Parameters | δ (deg) | *a* (psf) | $R^2$ |
|---|---|---|---|
| Peak | 35 | 5 | 1.000 |
| LD | 33 | 5 | 0.998 |

| Test No. | Shear Box Size (in. x in.) | Normal Stress (psf) | Shear Rate (in./min) | Soaking | | Consolidation | | Lower Soil | | | Upper Soil | | | GCL | | Shear Stress | | Failure Mode |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Stress (psf) | Time (hour) | Stress (psf) | Time (hour) | $\gamma_d$ (pcf) | $\omega_i$ (%) | $\omega_f$ (%) | $\gamma_d$ (pcf) | $\omega_i$ (%) | $\omega_f$ (%) | $\omega_i$ (%) | $\omega_f$ (%) | $\tau_P$ (psf) | $\tau_{LD}$ (psf) | |
| 1A | 12 x 12 | 50 | 0.040 | 50 | 1.0 | - | - | - | - | - | - | - | - | - | - | 41 | 36 | (1) |
| 1B | 12 x 12 | 100 | 0.040 | 100 | 1.0 | - | - | - | - | - | - | - | - | - | - | 78 | 73 | (1) |
| 1C | 12 x 12 | 200 | 0.040 | 200 | 1.0 | - | - | - | - | - | - | - | - | - | - | 148 | 135 | (1) |

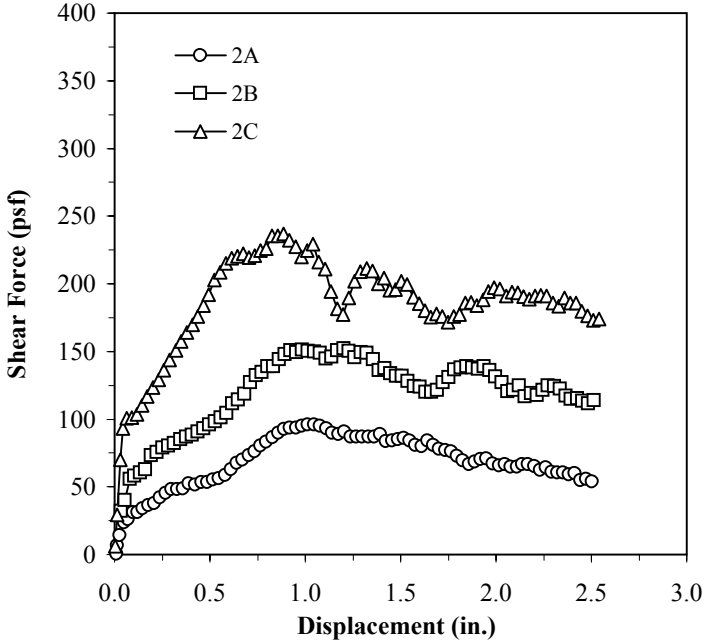
**NOTES:**
(1) Sliding (i.e., shear failure) occurred at the intended interface in each test.
(2) The reported total-stress parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using these strength parameters for applications involving normal stresses outside the range of the stresses covered by the test series. The large-displacement (LD) shear strength was calculated using the shear force measured at the end of the test.

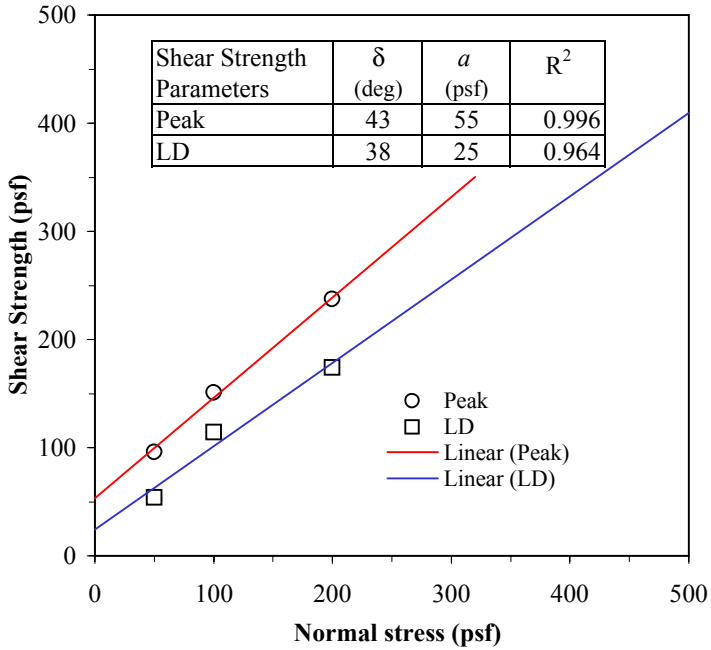
| | |
|---|---|
| DATE OF TEST: | 2/1 to 2/7/2007 |
| FIGURE NO. | A-1 |
| PROJECT NO. | SGI7011 |
| DOCUMENT NO. | |
| FILE NO. | |

SGI TESTING SERVICES, LLC

# CLOSURETURF LLC -LANDFILL COVER SYSTEM
# INTERFACE DIRECT SHEAR TESTING (ASTM D 5321)

Test Series No. 2: Geotextile side of SRS artificial grass layer against stud side of Agru 50 mil LLDPE Super Gripnet geomembrane under soaked conditions




| Shear Strength Parameters | δ (deg) | *a* (psf) | $R^2$ |
|---|---|---|---|
| Peak | 43 | 55 | 0.996 |
| LD | 38 | 25 | 0.964 |

| Test No. | Shear Box Size (in. x in.) | Normal Stress (psf) | Shear Rate (in./min) | Soaking | | Consolidation | | Lower Soil | | | Upper Soil | | | GCL | | Shear Stress | | Failure Mode |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Stress (psf) | Time (hour) | Stress (psf) | Time (hour) | $\gamma_d$ (pcf) | $\omega_i$ (%) | $\omega_f$ (%) | $\gamma_d$ (pcf) | $\omega_i$ (%) | $\omega_f$ (%) | $\omega_i$ (%) | $\omega_f$ (%) | $\tau_P$ (psf) | $\tau_{LD}$ (psf) | |
| 2A | 12 x 12 | 50 | 0.040 | 50 | 1.0 | - | - | - | - | - | - | - | - | - | - | 96 | 54 | (1) |
| 2B | 12 x 12 | 100 | 0.040 | 100 | 1.0 | - | - | - | - | - | - | - | - | - | - | 151 | 114 | (1) |
| 2C | 12 x 12 | 200 | 0.040 | 200 | 1.0 | - | - | - | - | - | - | - | - | - | - | 237 | 174 | (1) |

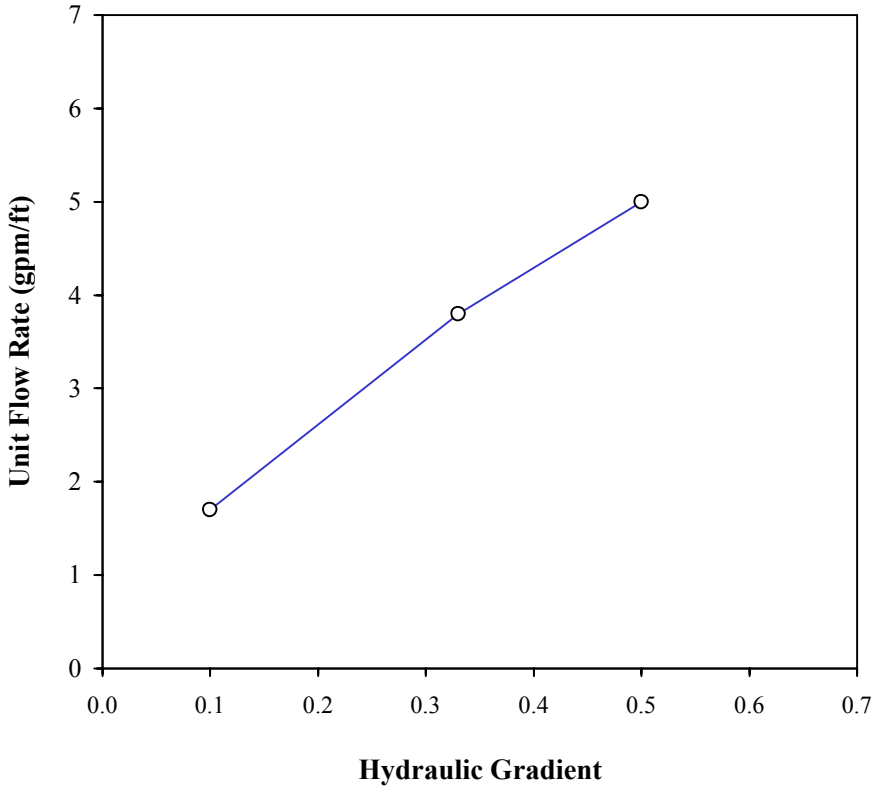
**NOTES:**
(1) Sliding (i.e., shear failure) occurred at the intended interface in each test.
(2) The reported total-stress parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using these strength parameters for applications involving normal stresses outside the range of the stresses covered by the test series. The large-displacement (LD) shear strength was calculated using the shear force measured at the end of the test.

SGI TESTING SERVICES, LLC

| | |
|---|---|
| DATE OF TEST: | 2/1 to 2/7/2007 |
| FIGURE NO. | A-2 |
| PROJECT NO. | SGI7011 |
| DOCUMENT NO. | |
| FILE NO. | |

**CLOSURETURF LLC -LANDFILL COVER SYSTEM**
**HYDRAULIC TRANSMISSIVITY TESTING (ASTM D 4716)**

Test Configuration (from Top to Bottom):
Sand Layer/
Artificial Grass Layer with Geotextile Side Down/
Agru 50-mil Super Gripnet LLDPE Geomembrane with Studs Side Up




| Test No. | Flow Direction | Specimen Size Width x Length (in. x in.) | Normal Stress (psf) | Seating Time (hour) | Hydraulic Gradient ( - ) | Transmissivity ($m^2$/sec) | Flow Rate (gpm/ft) | Flow Rate (l/min/m) |
|---|---|---|---|---|---|---|---|---|
| 1 | MD | 12 x12 | 50 | 0.25 | 0.10 | 3.52E-03 | 1.7 | 21.1 |
| 2 | MD | 12 x12 | 50 | 0.25 | 0.33 | 2.38E-03 | 3.8 | 47.2 |
| 3 | MD | 12 x12 | 50 | 0.25 | 0.50 | 2.07E-03 | 5.0 | 62.1 |

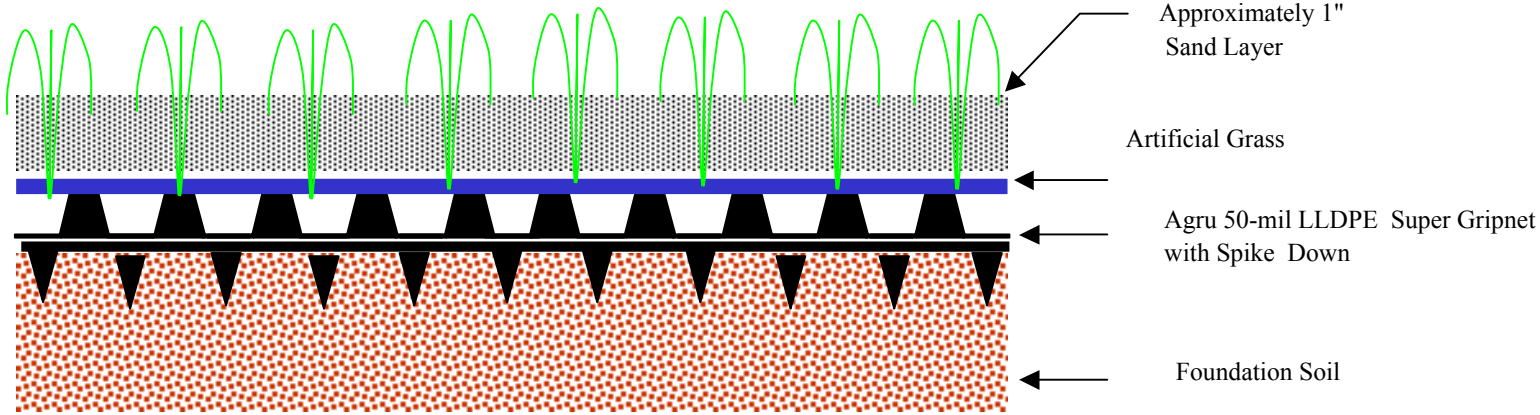
| | |
|---|---|
| DATE TESTED: | 2/1 to 2/7/2007 |
| FIGURE NO. | A-3 |
| PROJECT NO. | SGI7011 |
| DOCUMENT NO. | |
| FILE NO. | |

SGI TESTING SERVICES, LLC

# ATTACHMENT B

# SCHEMATIC DIAGRAMS

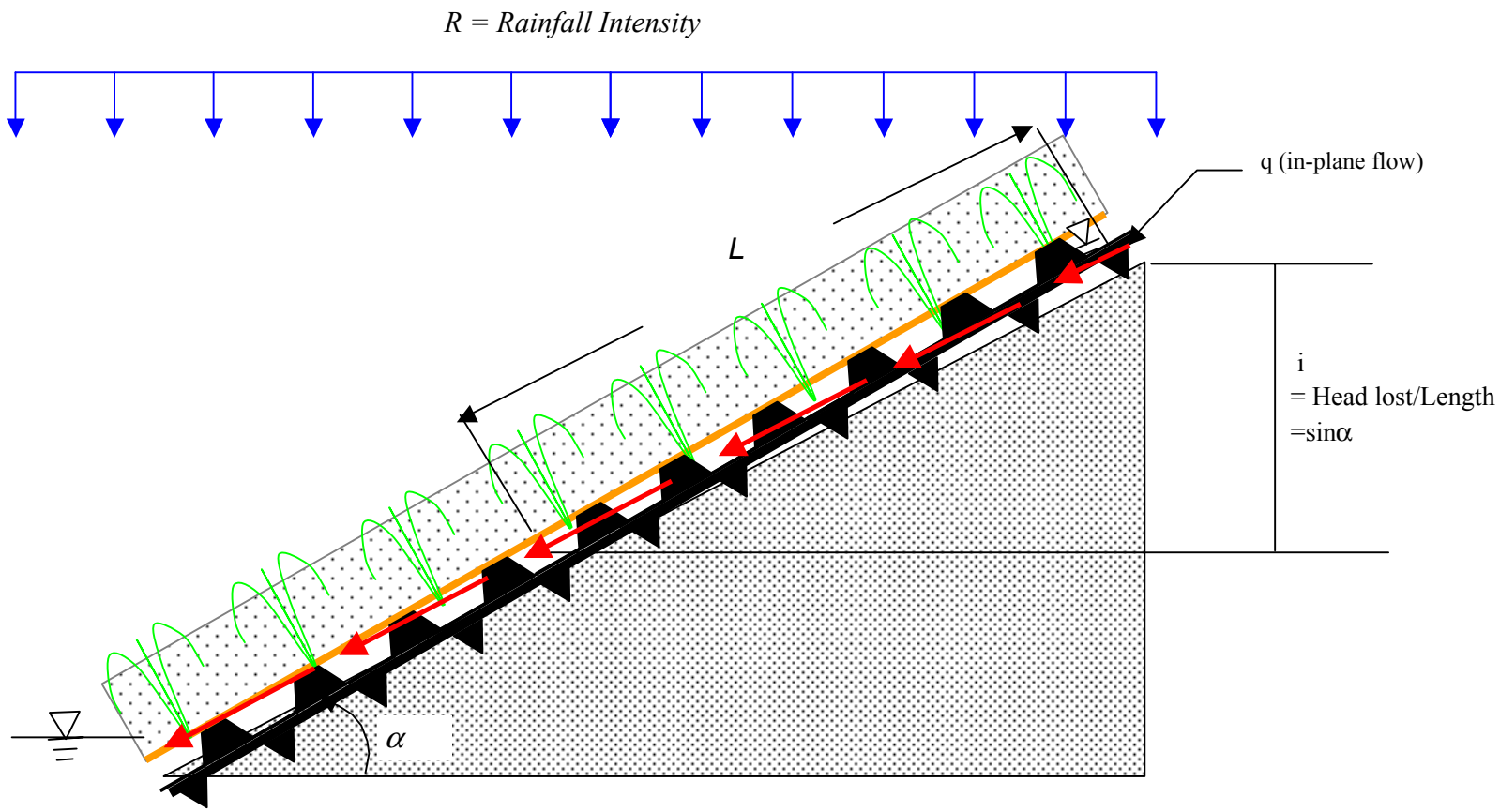
# CLOSURETURF LLC -LANDFILL COVER SYSTEM
# MAXIMUM SLOPE LENGTH BASED LABORATORY MEASURED IN-PLANE FLOW RATE
# CROSS-SECTION OF PROPOSED LANDFILL COVER SYSTEM




| | |
|---|---|
| DATE OF REPORT: | 2/26/2007 |
| FIGURE NO. | B-1 |
| PROJECT NO. | SGI7011 |
| DOCUMENT NO. | |
| FILE NO. | |

SGI TESTING SERVICES, LLC

**CLOSURETURF LLC -LANDFILL COVER SYSTEM**
**CRITICAL SLOPE LENGTH**
**LANDFILL COVER SYSTEM**

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|---|---|
| DATE OF REPORT: | 2/26/2007 |
| FIGURE NO. | B-2 |
| PROJECT NO. | SGI7011 |
| DOCUMENT NO. | |
| FILE NO. | |

SGI TESTING SERVICES, LLC

**CLOSURETURF LLC -LANDFILL COVER SYSTEM**
**SUMMARY OF CALCULATED CRITICAL SLOPE LENGTH ($L_{CR}$)**
**LANDFILL COVER SYSTEM**

| Flow Direction | Hydraulic Gradient $i$ ( - ) | Transmissivity ($m^2$/sec) | Flow Rate $q$ (gpm/ft) | Flow Rate $q$ ($ft^3$/hr/ft) | Rainfall Intensity $R$ (ft/hr) | Slope Angle $\alpha$ (degree) | Critical Slope Length $L_{CR} = q/R \cos\alpha$ (ft) |
|---|---|---|---|---|---|---|---|
| MD | 0.10 | 3.52E-03 | 1.7 | 13.6 | 0.333 | 5.7 | 41 |
| MD | 0.33 | 2.38E-03 | 3.8 | 30.5 | 0.333 | 19.3 | 97 |
| MD | 0.50 | 2.07E-03 | 5.0 | 40.1 | 0.333 | 30.0 | 139 |

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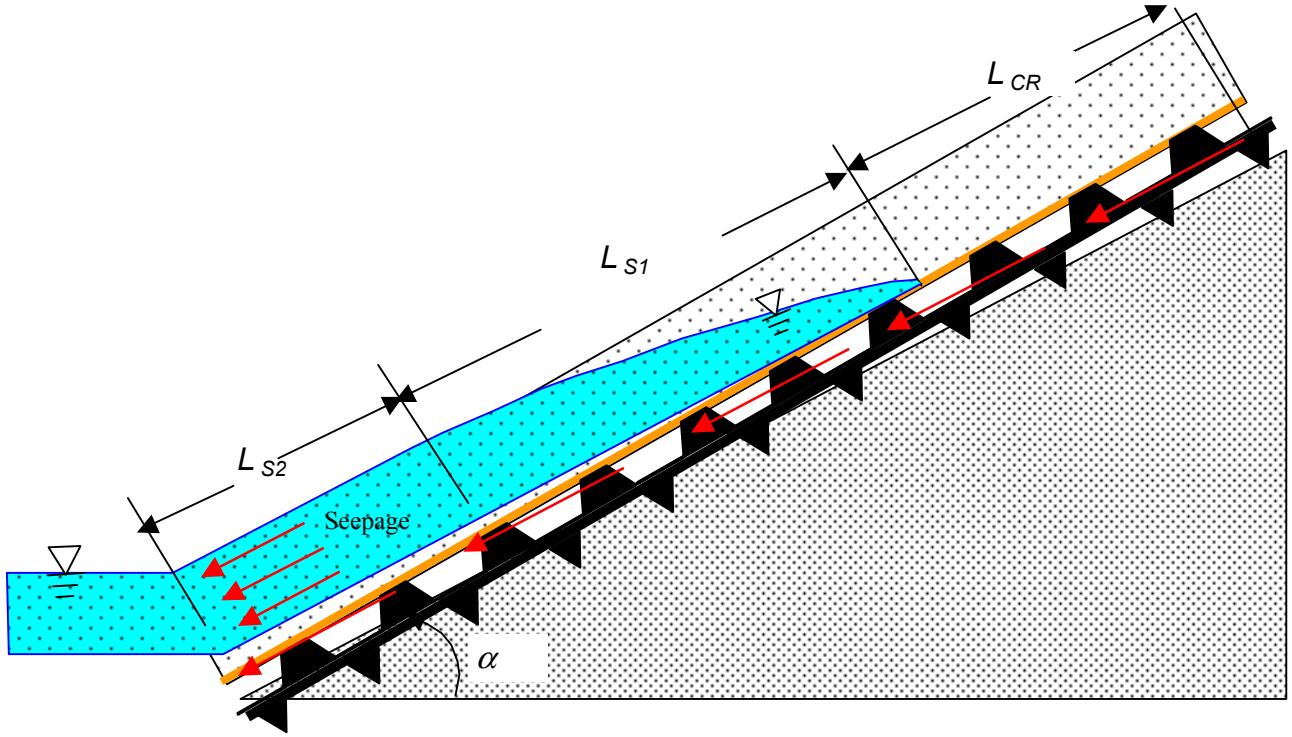
| | |
|---|---|
| DATE OF REPORT: | 2/26/2007 |
| FIGURE NO. | B-3 |
| PROJECT NO. | SGI7011 |
| DOCUMENT NO. | |
| FILE NO. | |

**CLOSURETURF LLC -LANDFILL COVER SYSTEM**
**SEEPAGE PARALLEL TO SLOPE**
**LANDFILL COVER SYSTEM**

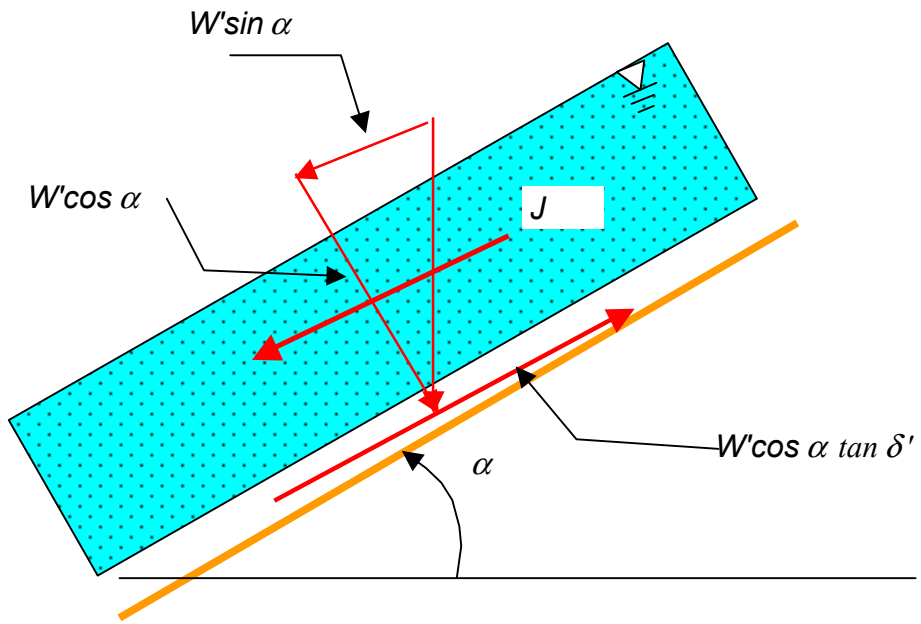



| | |
|---|---|
| DATE OF REPORT: | 2/26/2007 |
| FIGURE NO. | B-4 |
| PROJECT NO. | SGI7011 |
| DOCUMENT NO. | |
| FILE NO. | |

SGI TESTING SERVICES, LLC

**CLOSURETURF LLC -LANDFILL COVER SYSTEM**
**SEEPAGE PARALLEL TO SLOPE**
**LANDFILL COVER SYSTEM**

*Volume of Sand Under Consideration (V) = $L_{CR}$ (length) x h (sand layer thickness) x 1 (unit width)*
*W' = Buoyant Weight of Soil Mass = V x buoyant soil unit weight ( $\gamma_b$)*




| | |
|---|---|
| DATE OF REPORT: | 2/26/2007 |
| FIGURE NO. | B-5 |
| PROJECT NO. | SGI7011 |
| DOCUMENT NO. | |
| FILE NO. | |

SGI TESTING SERVICES, LLC

SGI TESTING SERVICES
A GEORGIA LIMITED LIABILITY COMPANY

8 July 2010

Mr. Jose Urrutia
Closure Turf, LLC
3005 Breckinridge Blvd., Suite 240
Duluth, Georgia 3096

Subject: Evaluation of Drivability
Light Weight Construction Equipment on
Closure Turf™ System

Dear Mr. Urrutia,

**DEFINITION OF CLOSURE TURF™ SYSTEM**

As shown in Figure 1, the installed Closure Turf™ system from top to bottom consists of:

- A thin sand layer;
- Artificial grass with geotextile down;
- Agru 50-mil Super Gripnet with spike sides down; and
- Subgarde (foundation) soil.

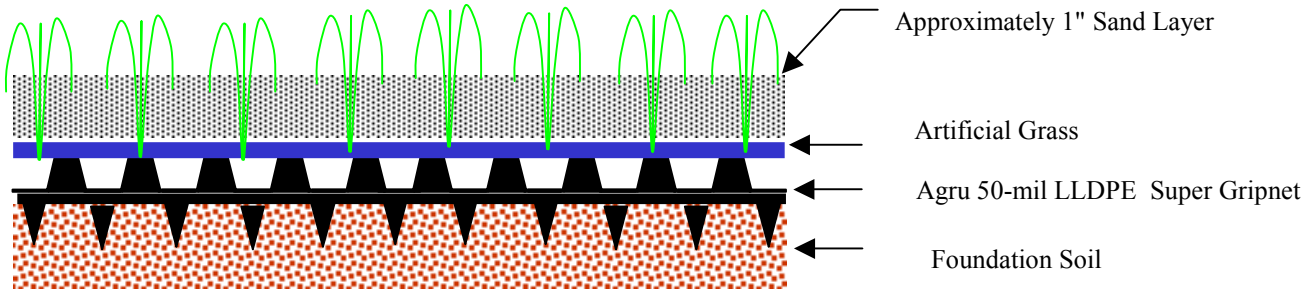



Figure 1. Cross-section of the Closure Turf system

SGI10007.REPORT.2010.04

MAIL TO: SGI TESTING SERVICES, LLC
P.O. BOX 2427
LILBURN, GA 30048-2427

FACILITY LOCATION
4405 INTERNATIONAL BLVD., SUITE B-117
NORCROSS, GA 30093

WEB SITE: WWW.INTERACTIONSPECIALISTS.COM

PHONE: 770.931.8222 FAX: 770.931.8240

## DEFINITION OF POST-CONSTRUCTION DRIVABILITY

Drivability of rubber-tired construction equipment (RTCE) on the Closure Turf™ system is a rather broad subject including: (i) stability - potential sliding (shear failure) within the Turf Closure system; (ii) bearing capacity of the subgrade soil; (iii) localized settlement after construction due to waste decomposing and compression under gravity force; and (iv) rut depth. The purpose of this report is to evaluate the stability within the Turf Closure system and bearing capacity of the subgrade soil.

## STABILITY

As shown in Figure 2, when a RTCE moves at a constant speed on the Closure Turf system, its gravity load is transferred to the Closure Turf system through the tire-soil contact.

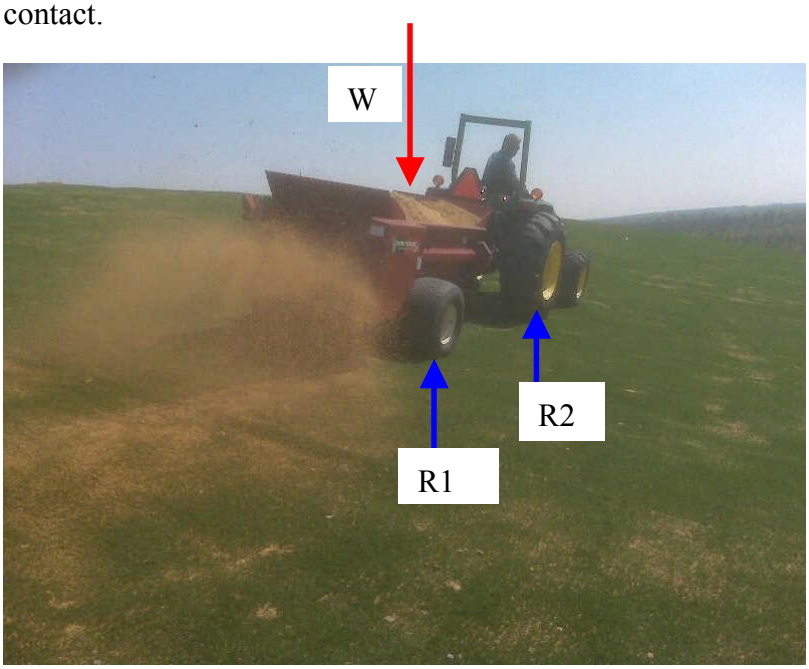



Figure 2. Rubber-tired construction equipment on the Closure Turf system.

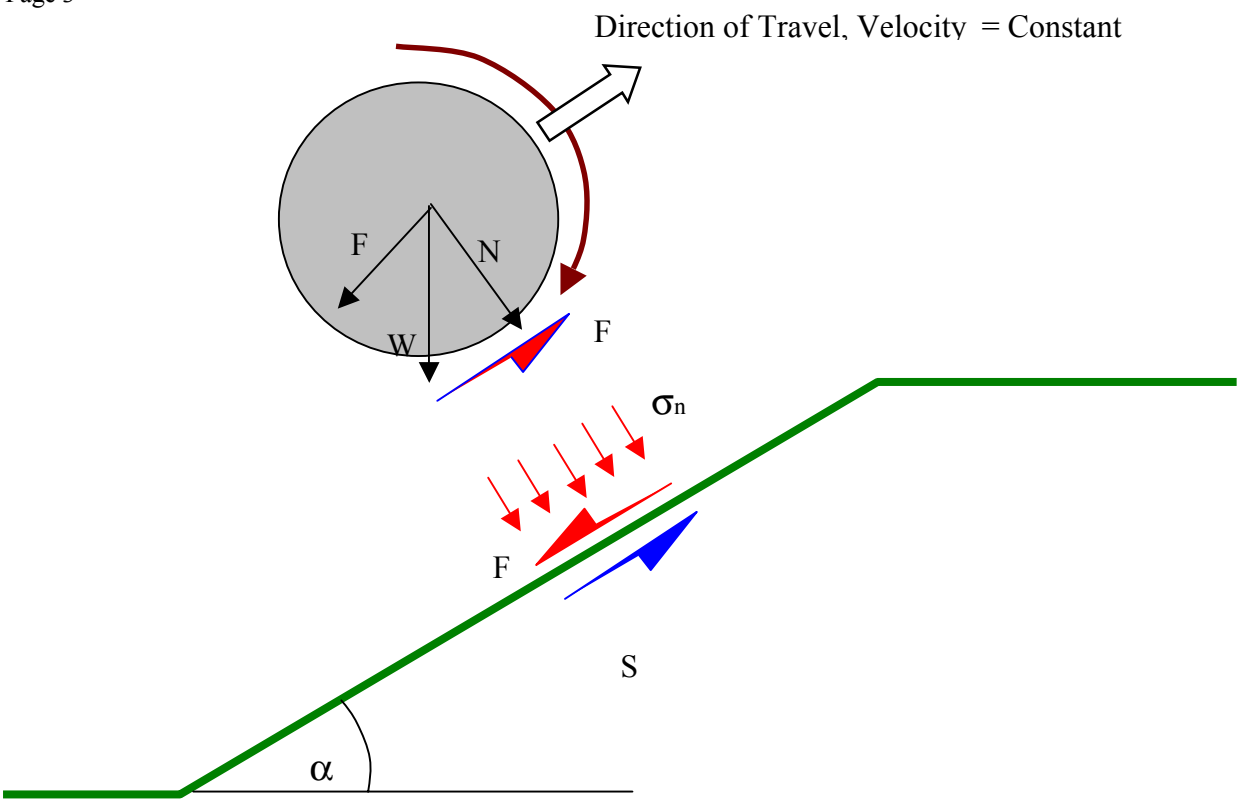



Figure 3. Tire-soil contact loading conditions on a slope. (NOTE: not to scale).

Assuming the gravity force of RTCE is evenly distributed to four tires, the contact normal stress at the tire-sand contact area as shown in Figure 3 can be estimated by the following equation:

$$\sigma_n = \frac{W \cos \alpha}{4A} \tag{1}$$

where:

$\alpha$ = the slope angle;

$\sigma_n$ = contact normal stress between the tire and sand;

W = total gravity force of equipment; and

A = contact area between a tire and sand layer.

Assuming: (i) the tire-soil contact area is approximately equivalent to a 10 inch diameter circular area and (ii) the total weight of a RTCE is 8000 lbs, then the contact normal stress in the unit of psi is:

$$\sigma_n = \frac{8000\cos\alpha}{4(3.14)(5^2)} = 25.5\cos\alpha \qquad (2)$$

Equation (2) is also applicable to a level surface by setting $\alpha = 0$. This gives the maximum contact normal stress of 25.5 psi. It is noted that the tire-sand contact normal stress over a 10-inch diameter area is much higher than the overburden pressure of 1 inch thick cover sand. Therefore, it is necessary to evaluate the stability of the Closure Turf system in the tire-sand contact area under the high normal stress conditions. The shear strength parameters for this localized stability analysis should be determined from the interface direct shear tests at high normal stresses (2000 to 5000 psf). Based on the test results in Attachment 1, the peak friction angle and adhesion of the sand/artificial grass/Agru 50-mil Super Gripnet LLDPE geomemebrane system is 34 degree and 39 psf, respectively for the normal stress range of 2000 to 5000 psf. Under the drained conditions (i.e., no pore pressure induced by RTCE), neglecting the adhesion for the conservative reason, the safety factor (FS) against the localized shear failure within the tire-soil contact area is:

$$FS = \frac{A\sigma_n \tan\delta}{0.25(W)\sin\alpha} \qquad (3)$$

where:

$\alpha$ = the slope angle;

$\sigma_n$ = contact normal stress between the tire and sand;

$\delta$ = the peak friction angle of the Closure Turf system;

W = total gravity force of equipment; and

A = contact area between a tire and sand layer.

Substituting Equation (1) into (3), Equation (3) is reduced to:

$$FS = \frac{\tan\delta}{\tan\alpha} \tag{4}$$

For the given Closure Turf system, the peak friction angle is constant. It is obvious that FS decreases with increasing the slope angle. Based on the information provided by Closure Turf LLC, the maximum allowable slope angle is 18 degree (3:1 slope).

At $\alpha = 18.4$ degree,

$$FS = \frac{\tan 34}{\tan 18} = 2.0 \tag{5}$$

This indicates that there is sufficient shear resistance in the Closure Turf system against the localized shear failure within the tire-soil area. It is not expected the localized internal shear failure to occur within the tire-soil contact area of Closure Turf system when it subjected to the gravity force from a typical lightweight RTCE traveling at a constant velocity.

**BEARING CAPACITY**

For a given RTCE, W and A are constant, therefore the maximum contact normal stress occurs when the RTCE travels on the level surface (Equation 1). The contact normal stress is transferred to the subgade soil as shown in Figure 4.

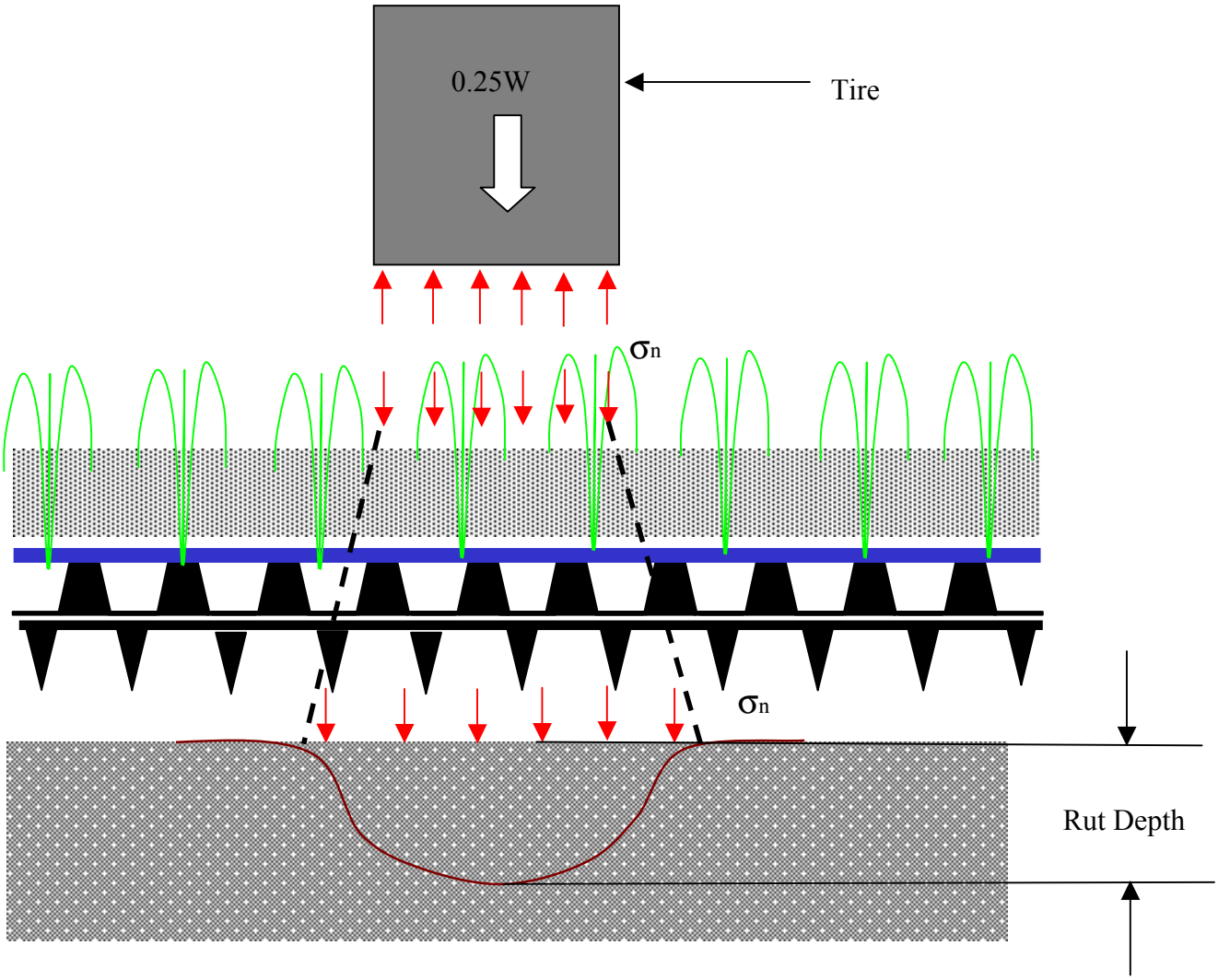



Figure 4. Normal stress acting on top of the subgrade (foundation) soil

Based on soil mechanics, the contact load (0.25W) distributes to a larger area as depth increases (depth starting from the top surface of the cover sand). However, due to the fact that the cover sand layer is only 1 inch thick, and the artificial grass and geomembrane are flexible, the load spreading angle (factor) is insignificant. The normal stress transferred to the top of subgrade soil is considered the same as the tire-sand contact stress for the conservative reason.

As shown previously (Equation 2), assuming (i) the tire-soil contact area is approximately a 10 inch diameter circular area and (ii) the total weight of a RTCE is 8000 lbs, then the maximum contact normal stress is:

$$\sigma_n = \frac{8000\cos\alpha}{4(3.14)(5^2)} = 25.5\,psi \qquad (6)$$

Under the action of tire-sand contact normal stress over the contact area (10 in diameter), there are two major concerns:

- Excessive rut depth, which is not defined for the Closure Turf system at the present time. Generally speaking, the subgrade soil settles and rut forms when it is subjected a normal stress. As number of vehicle passes increases, the rut depth increases. Eventually the surface may reach such a condition that driving is difficult if the accumulated pass is larger than some critical number. Therefore, for the given type of equipment (W and A are fixed), one way to reduce rut depth is to limit the number of passes. This may be achieved by not driving over the same area when a significant rut depth is already developed. The other way is to compact subgrade soil to high density to improve the stiffness for the subgrade soil.

- Bearing capacity failure because the contact normal stress is greater than the bearing capacity of the subgrade soil.

In the case of soft subgrade soil (worst case), the bearing capacity is estimated by the following equation:

$$q_u = c_u N_C \qquad (7)$$

where:

$c_u$ = undrained shear strength of soft subgrade soil

$N_c$ = bearing capacity factor (6.2 for a circular loading area)

$$q_u = 6.2c_u \tag{8}$$

For the soft subgrade soil, the safety factor against bearing capacity failure is:

$$FS = \frac{6.2c_u}{\sigma_n} \tag{9}$$

Typically, the acceptable bearing capacity safety factor is 2.0. The required undrained shear strength for the subgrade soil is,

$$c_u \geq \frac{2(25.5)}{6.2} = 8.2\,psi \tag{10}$$

The value of $c_u$ can be estimated from the widely used CBR value for soft subgrade soil with CBR < 5 using the following equation (Giroud and Noiray 1981):

$$c_u = 4.3CBR \tag{11}$$

Substituting Equation 11 into 10 gives the following equation:

$$CBR \geq 1.9 \tag{12}$$

Therefore, under the action of the gravity force from a typical RTCE (W = 8000 lbs, A = 79 square inch), the required minimum CBR value for the subgrade is 2. In reality, a well-compacted subgarde soil for the Closure Turf system should have a CBR value significantly higher than 2. It is expected that a well-compacted subgarde soil layer (SM or SC, typically used as subgarde soil for the landfill cover system) should have sufficient bearing capacity to support the lightweight RTCE.

## CLOSURE

SGI appreciates the opportunity to provide technical services to Closure Turf, LLC. Should you have any questions regarding the attached document(s), or if you require additional information, please do not hesitate to contact the undersigned.

Sincerely,

Zehong Yuan, Ph.D., P.E.
Laboratory Manager

## REFERENCES

Giroud, J.P., and Noiray, L. (1981) "Geotextile-reinforced unpaved road design." Journal of Geotechnical Engineering 107(9), 1233-1254.

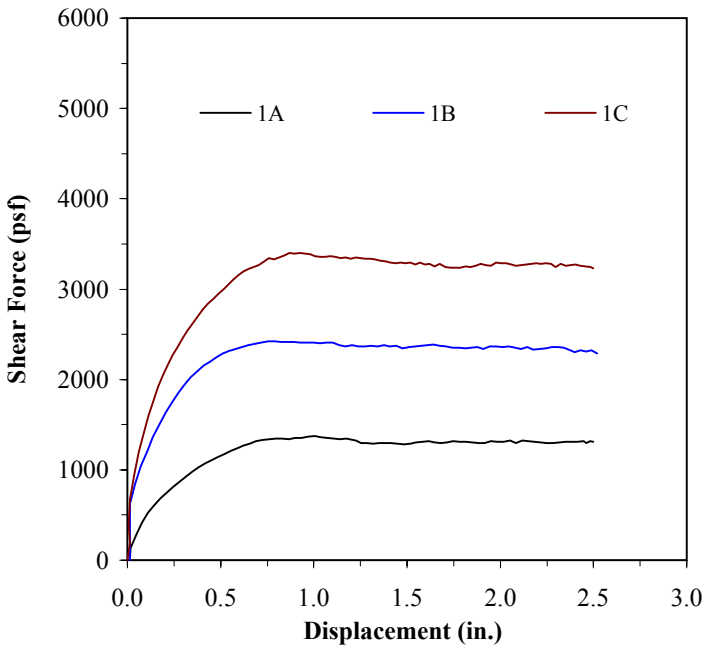
NOTES:
(1) Unless otherwise noted in the test results the sample(s)/specimen(s) were prepared in accordance with the applicable test standards or generally accepted sampling procedures.
(2) Contaminated/chemical samples and all related laboratory generated waste (i.e., test liquids, PPE, absorbents, etc.) will be returned to the client or designated representative(s), at the client's cost, within 60 days following the completion of the testing program, unless special arrangements for proper disposal are made with SGI.
(3) Materials that are not contaminated will be discarded after test specimens and archived specimens are obtained. Archived specimens will be discarded 30 days after the completion of the testing program, unless long-term storage arrangements are specifically made with SGI.
(4) The reported results apply only to the materials and test conditions used in the laboratory testing program. The results do not necessarily apply to other materials or test conditions. The test results should not be used in engineering analysis unless the test conditions model the anticipated field conditions. The testing was performed in accordance with general engineering testing standards and requirements. The reported results are submitted for the exclusive use of the client to whom they are addressed.

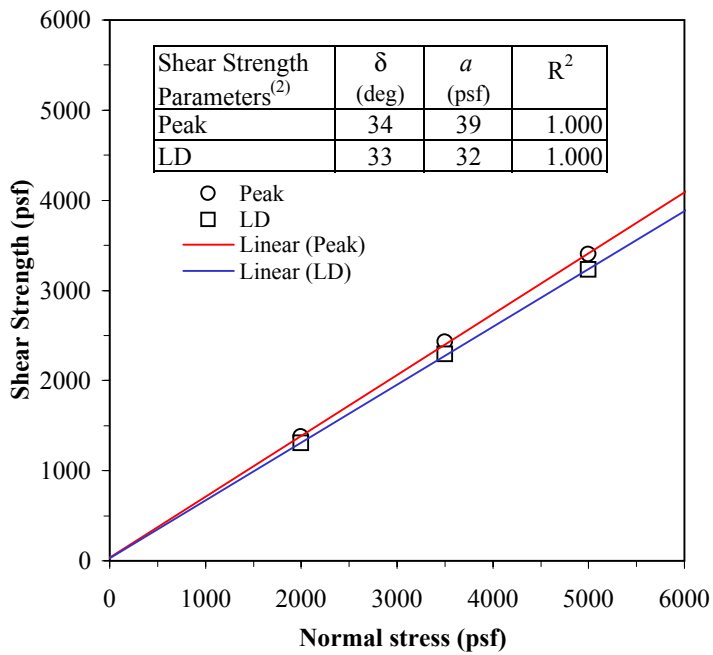
# ATTACHMENT 1

# INTERFACE DIRECT SHEAR TEST RESULTS

# CLOSURETURF LLC -LANDFILL COVER SYSTEM
# INTERFACE DIRECT SHEAR TESTING (ASTM D 5321)

**Upper Shear Box:** Concrete sand nominally compacted
Artificial grass with grass side (green yarns) up/
Agru 50 mil LLDPE Super Gripnet geomembrane with studs side up/
**Lower Shear Box:** Concrete sand




| Shear Strength Parameters(2) | δ (deg) | *a* (psf) | $R^2$ |
|---|---|---|---|
| Peak | 34 | 39 | 1.000 |
| LD | 33 | 32 | 1.000 |

| Test No. | Shear Box Size (in. x in.) | Normal Stress (psf) | Shear Rate (in./min) | Soaking | | Consolidation | | Lower Soil | | | Upper Soil | | | GCL | | Shear Strengths | | Failure Mode |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Stress (psf) | Time (hour) | Stress (psf) | Time (hour) | $\gamma_d$ (pcf) | $\omega_i$ (%) | $\omega_f$ (%) | $\gamma_d$ (pcf) | $\omega_i$ (%) | $\omega_f$ (%) | $\omega_i$ (%) | $\omega_f$ (%) | $\tau_P$ (psf) | $\tau_{LD}$ (psf) | |
| 1A | 12 x 12 | 2000 | 0.04 | 10 | 24 | - | - | - | - | - | - | - | - | - | - | 1376 | 1308 | (1) |
| 1B | 12 x 12 | 3500 | 0.04 | 20 | 24 | - | - | - | - | - | - | - | - | - | - | 2425 | 2291 | (1) |
| 1C | 12 x 12 | 5000 | 0.04 | 50 | 24 | - | - | - | - | - | - | - | - | - | - | 3400 | 3233 | (1) |

**NOTES:**
(1) Sliding (i.e., shear failure) occurred at the interface between the cover (upper) sand and artificial grass.
(2) The reported total-stress parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using these strength parameters for applications involving normal stresses outside the range of the stresses covered by the test series. The large-displacement (LD) shear strength was calculated using the shear force measured at the end of the test.

| | |
|---|---|
| DATE OF TEST: | 6/21/2010 |
| FIGURE NO. | C-1 |
| PROJECT NO. | SGI10007 |
| DOCUMENT NO. | |
| FILE NO. | |

SGI TESTING SERVICES, LLC

# APPENDIX D

## Additional Technical Information

ClosureTurf QA/QC, Post-Closure Cover Stability, Slope Drainage

July 25, 2016

Mr. Dustin Brooks
Alabama Power Company
Environmental Affairs - Land
P.O. Box 2641
Birmingham, AL 35291

Re: Response to ADEM Comments
Closure Plan for Plant Gadsden Ash Pond
Gadsden, Alabama

Dear Mr. Brooks:

Southern Company Services, Inc. (SCS) is in receipt of the Alabama Department of Environmental Management's (ADEM's) comments (dated May 13, 2016) pertaining to the SCS Closure Plan for the Plant Gadsden Ash Pond. The plan details the use of the proprietary ClosureTurf® capping system was submitted to ADEM. The following documents ADEM's comments, followed by the SCS response.

1. ***Please provide a quality assurance/quality control (QA/QC) plan for the components of the closure cap.***

Composed of a structured geomembrane, engineered turf, and sand infill, the ClosureTurf® capping system is designed to meet or exceed all of the requirements for landfill covers outlined in RCRA Subtitle D. The infill comprises a manufactured sand meeting gradation specifications for ASTM C-33 sand. The two remaining ClosureTurf® components, structured geomembrane and the engineered turf, are subject to QA/QC methods during the manufacturing process, prior to shipment, and during installation. QA/QC procedures are summarized in Attachment A.

2. ***Please provide a slope stability analysis and a seismic analysis for the closure cap.***

Southern Company evaluated both the slope stability and a cover stability analysis of the components of the cover system on the steepest "worst-case" section of the final closed footprint. In this critical section, located in the southwest corner of the final closed area, the maximum slope of the ash stack is 4H:1V and the vertical height to the top of the stack is about 24 feet. The stormwater ditches surrounding the final closed area are sloped at 3H:1V. The following critical section assumptions were common to both the slope stability analysis and the cover system stability analysis:

- The slope length of the critical section is 104 feet, based on a 4H:1V slope and a maximum vertical height of about 24 feet.

- The critical slope location and cross section was determined from civil design drawings being used for construction.

- An earthquake loading of 0.06g based on the Peak Horizontal Acceleration map with 10% probability of exceedance in 50 years (USGS Seismic Hazard Mapping Program, 2014) was used for seismic analysis.

- Minimum factors of safety for slope stability were taken from minimums based on criteria established by the U.S. Army Corps of Engineers and recognized by FEMA, FERC and standard engineering practice. Minimum factors of safety for cover sliding stability are based on standard engineering practices for the industry.

- Groundwater, soil, and ash configurations and engineering characteristics were taken from historical borings and analyses performed in the area surrounding the critical section.

Slope Stability

The slope stability analysis was evaluated using a normal phreatic surface based on groundwater elevations in piezometers and borings surrounding the critical section area. Appendix B contains the graphical output of the stability analysis. The resulting factors of safety for the static case and the seismic case were as follows:

| Analysis State | Calculated Factor of Safety | Required Minimum Factor of Safety |
|---|---|---|
| Static | 2.3 | 1.5 |
| Seismic | 1.9 | 1.1 |

Cover System Stability

Of the two interface surfaces of the ClosureTurf® system, the interface having the least resistance to sliding is the contact of the top of the structured geomembrane and the geotextile of the bottom of the engineered turf. The top of the structured geomembrane is embedded with studs that are designed to convey the shear forces of water onto the geotextile at the bottom of the engineered turf layer. Watershed Geosynthetics has performed direct shear testing of this interface, and established recommended shear strength values to be used in stability calculations (see Figure 1). Southern Company has evaluated the factor of safety against sliding for both the critical section (4H:1V) and the perimeter ditch section (3H:1V) for both static and seismic cases, using the following assumptions:

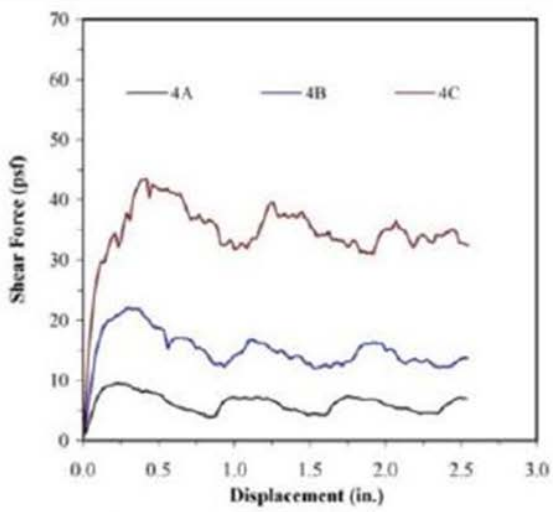
- The critical interface on the ash stack is assumed to be saturated.
- The shear strength values used in the stability analysis of the cover system were as follows:
    - Interface friction angle: 33 degrees
    - Adhesion: 1 psf

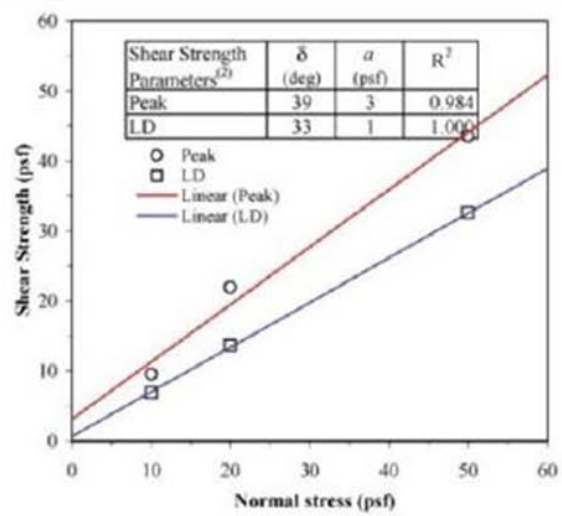
The resulting factors of safety for the static case and the seismic case were as follows:

| Location and Analysis State | Calculated Factor of Safety | Required Minimum Factor of Safety |
|---|---|---|
| Perimeter Ditch - Static | 2.3 | 1.5 |
| Perimeter Ditch - Seismic | 2.2 | 1.2 |
| Stack Slope – Static | 1.8 | 1.5 |
| Stack Slope - Seismic | 1.8 | 1.2 |

**CLOSURETURF LANDFILL COVER SYSTEM**
**INTERFACE DIRECT SHEAR TESTING (ASTM D 5321)**

**Upper Shear Box:** Concrete sand nominally compacted
**Engineered Turf** with grass side (green yarns) up/
Agru 50 mil LLDPE Super Gripnet geomembrane with studs side up/
**Lower Shear Box:** Concrete sand




| Test No. | Shear Box Size (in. x in.) | Normal Stress (psf) | Shear Rate (in./min) | Soaking Stress (psf) | Soaking Time (hour) | Consolidation Stress (psf) | Consolidation Time (hour) | Lower Soil $\gamma_d$ (pcf) | Lower Soil $\omega_i$ (%) | Lower Soil $\omega_f$ (%) | Upper Soil $\gamma_d$ (pcf) | Upper Soil $\omega_i$ (%) | Upper Soil $\omega_f$ (%) | GCL $\omega_i$ (%) | GCL $\omega_f$ (%) | Shear Strengths $\tau_p$ (psf) | Shear Strengths $\tau_{LD}$ (psf) | Failure Mode |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4A | 12 x 12 | 10 | 0.04 | 10 | 24 | - | - | - | - | - | - | - | - | - | - | 10 | 7 | (1) |
| 4B | 12 x 12 | 20 | 0.04 | 20 | 24 | - | - | - | - | - | - | - | - | - | - | 22 | 14 | (1) |
| 4C | 12 x 12 | 50 | 0.04 | 50 | 24 | - | - | - | - | - | - | - | - | - | - | 44 | 33 | (1) |

**NOTES:**
(1) Sliding (i.e., shear failure) occurred at the interface between the geotextile of the artificial grass and studs side of the geomembrane.
(2) The reported total-stress parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using these strength parameters for applications involving normal stresses outside the range of the stresses covered by the test series. The large-displacement (LD) shear strength was calculated using the shear force measured at the end of the test.

DATE OF TEST: 5/15/2010
FIGURE NO. C-4
PROJECT NO. SGI10007
DOCUMENT NO.
FILE NO.

SGI TESTING SERVICES, LLC

**FIGURE 1**. ClosureTurf® Interface Direct Shear Testing (ASTM D5321)

3. ***Please evaluate slopes to verify they are sufficient to allow water to properly drain from the closure cap. There are slopes within the capping system that are less than five percent.***

Southern Company has evaluated the hydraulic performance of the closure cap to ensure that the slopes are sufficient to provide adequate drainage and that the flow velocity in the sand layer is low enough to maintain the integrity of the sand infill. Our evaluation focused on the top of the closure cap where slopes of 3% are planned, and was based on the 100-year 1-hour maximum rainfall intensity of 3.7 inches as indicated by NOAA Atlas 14.

This maximum rainfall intensity was used to model the drainage of the cap using the TR-55 method. The modeling indicated that the maximum flow depth over the cap would be approximately 1 inch, with most of that flow occurring in the ¾ inch thick sand infill. The maximum flow velocity was calculated to be less than 1 foot/second (fps). This flow velocity is well below the 3 fps limit determined by Watershed Geosynthetics to be the minimum threshold at which sand infill migration might occur.

Additionally, we referenced the slope gradient and rainfall intensity against the Closure Turf Maximum Drainage Length chart found on Page 20 of the *Closure Turf Design Guidelines Manual*. This manual was included in the Appendices of the closure plan, and the chart is reproduced below. The chart indicates that for a slope gradient of 3% and a rainfall intensity of 3.7 inches/hour, the maximum allowable drainage length is approximately 850 feet. This allowable drainage length is well above the actual maximum drainage on the top of the designed cap, which is approximately 360 feet.

Based on these considerations, we feel that the cap design submitted in the closure plan is sufficient to both adequately drain the cap and to protect the integrity of the sand infill layer.

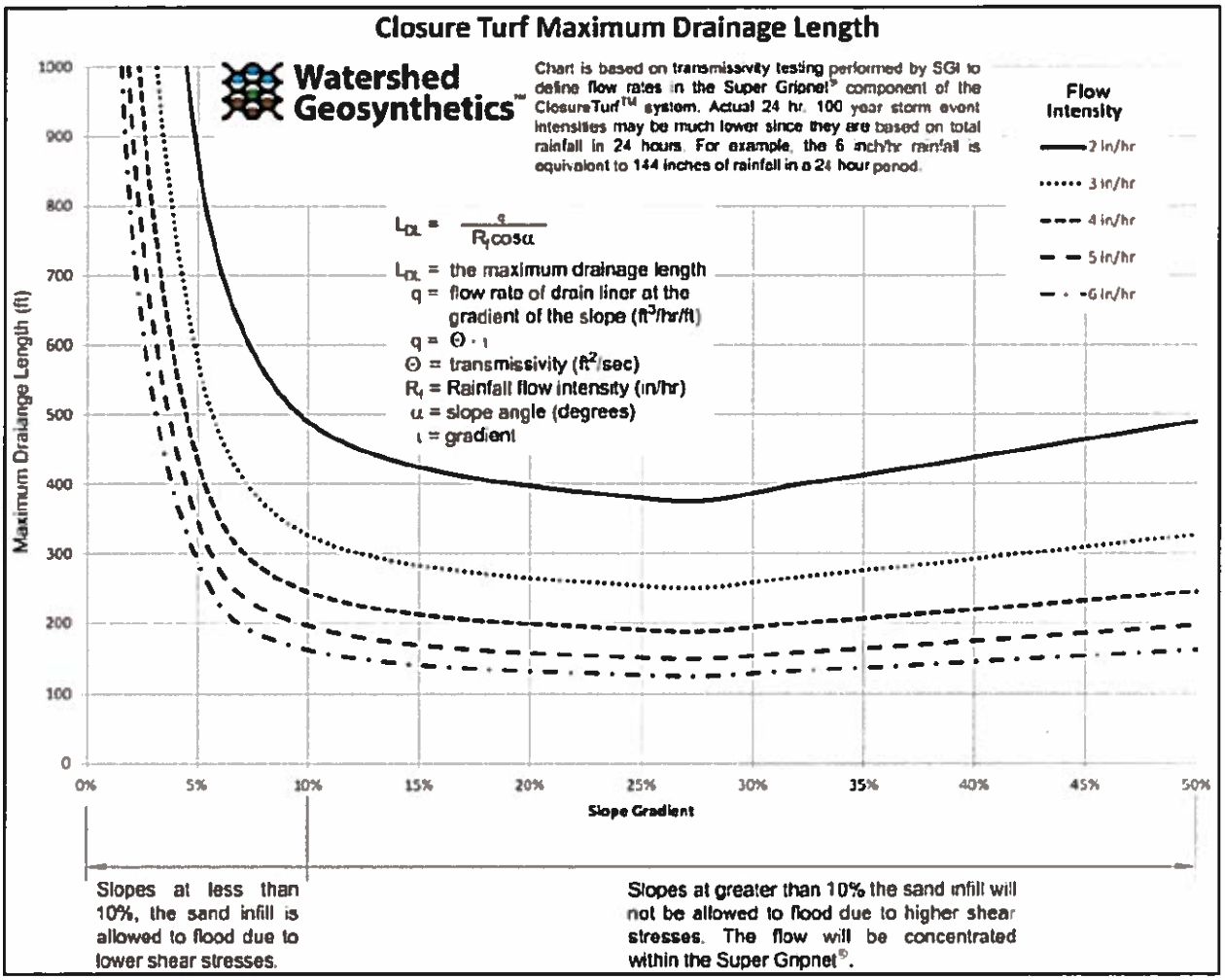



**FIGURE 2.** ClosureTurf® Maximum Drainage Length

I trust that the information provided above is sufficient to answer ADEM's comments. If you should you have any questions, please feel free to contact me at (205) 992-6089 or at shsimpso@southernco.com.

Sincerely,

Stacey H. Simpson, P.E.
Senior Engineer
Technical Services, Land & CCR Group

Attachment A: Summary of QA/QC Methods for ClosureTurf®
Attachment B: Graphical Output Slope Stability Analyses

# ATTACHMENT A

***Summary of QA/QC Methods for ClosureTurf®***

## QUALITY ASSURANCE/QUALITY CONTROL

### Summary of Procedures for the ClosureTurf® Capping System

The ClosureTurf® capping system consists of a structured geomembrane (either high density polypropylene (HDPE) or linear low density polypropylene (LLDPE)) called Super Gripnet® overlain by an engineered turf comprised of a polypropylene geotextile backing tufted with HDPE grass blades. A layer of engineered sand (ASTM C-33) on top of the engineered turf protects the structured geomembrane from ultra-violet radiation.

**<u>QA/QC – Manufacturing</u>**

**1. Structured Geomembrane:**

This component of the ClosureTurf® system is a 50-mil low density polyethylene (LLDPE) product manufactured by AGRU America called Super Gripnet®. QA/QC measures followed during the manufacturing process are contained in its AGRU America "*Manufacturing Quality Control Geomembranes and Drainage Products"* which is included as Attachment 1 and summarized below:

- Raw Materials: Prior to bulk shipment of resin to AGRU's manufacturing facilities, the resin supplier submits a certificate of analysis for AGRU approval. Resin from each rail car is sampled and tested by AGRU for Melt Index and Density in accordance with the applicable ASTM procedure. Any resin not meeting specification is returned to the supplier.

- During extrusion, one side of the geomembrane is marked with thickness, resin type, the AGRU America name, and year of manufacture at every meter of length.

- The following physical properties of the extruded geomembrane are tested on every roll of geomembrane, at frequencies that either meet or exceed those specified by GRI GM-17: Thickness, asperity height, density, melt flow index, carbon black content, tensile strength, tear resistance, puncture resistance, notched constant tensile load, oxidative induction time.

- Each roll receives a unique identification number indicating the manufacturing plant location, date of production, machine identification number, and a weekly counter number.

- A Quality Certificate is issued by the Quality Control manager, who as a matter of accountability reports directly to the President of AGRU.

*a) SCS Quality Assurance – Structured Geomembrane*

Southern Company Services' (SCS) technical specifications contain quality assurance measures that require the following for both the geomembrane and extrudate beads or welding rods used for seaming the geomembrane:

- AGRU submission of a certification that raw materials, and finished geomembrane rolls, meet the physical property requirements indicated in the technical specifications.
- SCS Technical Services inspection of each production facility that will be providing material to the project, prior to manufacture of material that will be used on the project.
- SCS approval of AGRU's MQC, including any changes requested by SCS to test procedures and test frequency.
- Submission of AGRU's test results indicating the geomembrane meets the SCS technical specification requirements. Submittal must be made a minimum of seven calendar days prior to geomembrane shipment.
- Prior to product delivery, submission of AGRU's quality control certificates including certificates for roll numbers and identification, and results of quality control tests, including descriptions of the test methods used.
- Prior to product delivery, submission of AGRU's certification stating that all geomembrane rolls are furnished by one manufacturer, and all rolls are manufactured from one resin type.

*b) SCS Quality Assurance – Installation of Geomembrane*

- The Installer must provide a one-year warranty against defects in workmanship. Warranty conditions concerning limits of liability will be evaluated and must be acceptable to the Owner.
- After installation of the geomembrane, the Contractor shall submit a certification, signed by the Contractor and signed and sealed by the CQC Firm's Professional Engineer, that the geomembrane and ClosureTurf® cover system was placed in accordance with these Specifications.

**c) Engineered Turf:**

The engineered turf component of the ClosureTurf® system is manufactured by Shaw Industries and consists of two polypropylene 3.5-oz/sq yd woven geotextiles tufted with high density polyethylene (HDPE) yarns. While Shaw manufactures the geotextile component of the engineered turf, Bonar Yarns manufactures the HDPE yarns that Shaw uses for the tufted grass blades.

- Woven Geotextile
    - Shaw maintains procedures for quality control testing for appearance, construction, weight, width, warp tensile and elongation, fill tensile and elongation, shrink, warp crimp and extraction at frequencies detailed in the attached *"Sampling & Testing Frequencies"* document for Shaw Industries Group, Inc. (Attachment 2).

- HDPE Grass Blades
    - Bonar Yarns supplies AGRU with the HDPE yarns used to make the tufted grass blades. Bonar maintains quality control testing procedures for density, residual hear shrinkage, and lubricant content at frequencies detailed in the attached *"Summary of Bonar Quality Control Methods"* document containing details of testing performed on the HDPE yarn (Attachment 3).

- Engineered Turf Product

  In general, Shaw requires the following in their *Manufacturing Quality Control (MQC) Procedures for Geosynthetic Products Manufactured by Shaw Industries* (included as Attachment 4):

    - Shaw employs site quality assurance managers and tufting managers the share responsibility for the quality of biosynthetic materials produced at Shaw Industry plants.

    - For every 9,900 linear feet (150,000 square feet), of manufactured turf, Shaw obtains a full size sample of turf for weight check and check of pile height with the tufting gauge.

    - Samples are also tested for yarn tensile strength and wide-width tensile strength (machine-direction and cross-direction)

    - Each roll is labeled with roll number, date of production, dye lot and roll length before being wrapped in a weather-resistant material for storage or shipping.

*a) SCS Quality Assurance – Engineered Turf*

Southern Company Services' (SCS) technical specifications contain quality assurance measures that require the following for engineered turf:

- Shaw must provide inspection records of the tufting procedures for the turf material. These will include visual inspection records of the tufting gauge, pile height, and roll length and numbers at the frequency listed in the technical specifications.
- Shaw must provide documentation on the geotextile product and yarn manufacturer minimum properties for the engineered turf.

**QA/QC – Installation of Structured Geomembrane and Engineered Turf**

**1. Installation Contractor:**

Southern Company Services' (SCS) technical specifications contain quality assurance measures that reinforce Shaw's MQC by requiring the following:

- Installers of the ClosureTurf® system must be trained on installation procedures by the manufacturer (Watershed Geotextile).
- The installer's superintendent, the master seamer, and all other seaming personnel are required to have experience with installing minimum amounts, detailed in the technical specification, of polyethylene geomembrane and geotextile.

**2. Third Party Inspection:**

Per SCS technical specifications, the contractor must provide a third-party inspector for construction quality control (CQC) of the structured geomembrane installation. The geomembrane inspector shall be an individual or company who will be responsible for monitoring and documenting activities related to the CQC of the geomembrane throughout installation. The third-party inspection service must be independent of the geomembrane/engineered turf manufacturer and installer, and must meet the following requirements:

- Must have provided CQC services for the installation of the proposed or similar products for at least five completed projects totaling not less than 1,000,000 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 third-party inspection contractor must provide

a statement of qualifications (SOQ) for the geomembrane inspector prior to starting work.

**3. Inspection of Structured Geomembrane and Engineered Turf:**

The CQC inspector will include the following in his inspections and observations of the structured geomembrane:

- Verify the geomembrane surface is free of striations, roughness, pinholes, bubbles holes, blisters, undispersed raw materials, contamination by foreign matter.
- Ensure geomembrane is supplied in rolls and not folded. Identify each roll with labels indicating lot number, roll number, thickness, length, width, manufacturer, and plant location.
- Verify that extrudate rod or bead shall be made from same resin as the geomembrane. Additives shall be thoroughly dispersed. The rods or beads shall be free of contamination by moisture or foreign matter.

The CQC inspector will include the following in his inspections and observations of the engineered turf:

- The engineered turf is supplied in rolls wrapped with protective covering.
- The rolls are not damaged during unloading.
- Engineered turf is protected from mud, soil, dirt, grease, dust, debris, puncture, cutting, mechanical abrasions, excessive heat, impact forces and other damage.
- Each roll is marked or tagged with proper, original, manufacturer - applied identification.
- Damaged rolls are separated from undamaged rolls and stored at locations designated by the owner until proper disposition of material is determined by the Purchaser.
- Rolls without proper documentation are separated and stored until the owner’s approval is received.
- The materials are stored on a level prepared surface (not on wooden pallets).
- The materials are stacked per manufacturer's recommendation but no more than three rolls high.
- Appropriate handling equipment is used to load, move or deploy geomembrane rolls.

# ATTACHMENT 1

## *AGRU*

## *Manufacturing Quality Control (MQC) Manual for Geomembranes and Drainage Products*

# MANUFACTURING QUALITY CONTROL
## GEOMEMBRANES AND DRAINAGE PRODUCTS

**AGRU AMERICA, INC.**

**500 Garrison Road**

**Georgetown, SC 29440**

**Toll Free: (800) 373-2478**

**Telephone: (843) 546-0600**

**Fax: (843) 527-2738**

**salesmkg@agruamerica.com**

**www.agruamerica.com**

**01/01/2015**

## AGRU AMERICA, INC. - QA/QC

### Manufacturing – Quality Assurance/Quality Control

**AGRU AMERICA, Inc.** extrudes high density polyethylene (HDPE) and linear low density polyethylene (LLDPE) geomembrane, HDPE Geonet, Geocomposite, geotextile and GCL products at its three production plants located at 500 Garrison Road, Georgetown, South Carolina, 29440, 2000 East Newlands Drive, Fernley, Nevada, 89408 and 181 Hwy 521, Andrews SC 29510.

Our USA Manufacturing Quality Assurance Program is dependent on the utilization of in-house laboratories in each plant which are, when necessary, complemented with testing performed by certified outside laboratories such as:

- TRI/Environmental California; Anaheim, CA
  Telephone (714) 520-9631; Fax (714) 520-9637
- TRI/Environmental, Inc.; Austin, Texas
  Telephone (512) 263-2101; Fax (512) 263-2558

  And other GRI-LAP accredited laboratories.

### Raw Material – Manufacturer's Certificate of Conformity

HDPE and LLDPE resin is supplied to our plants in bulk and subjected to the following procedures:

- Prior to shipment, our resin supplier submits a certificate of analysis. Once approved, the resin is released for shipment to our plant.
- One sample is taken from each rail car after arrival and tested as follows:
  Melt Index ASTM D1238 190°C, 2.16kg, and Density ASTM D792 Method B.
- Once the tests have been completed and results found to be in compliance with our requirements, the resin is then unloaded into our silo system.
- At this stage, our supplier has performed one battery of tests and Agru America has performed one to verify the manufacturer's certificate of analysis.
- Off specification resin is returned to the supplier.
- The Manufacturer's MFI Test Data is reported on the Geomembrane Quality Certificate (Agru America's MFI Testing is done to verify the resin manufacturer's reported data).

**GEOMEMBRANE**

**The Extrusion Process**

The resin is conveyed through a vacuum pump system and flexible hoses to a dryer hopper, feeding the resin by gravity into an 8-inch barrel. This barrel is divided into five heating zones, each heating zone being computer controlled and constantly monitored.

A screw in the barrel turns at a prescribed and monitored speed. It conveys the resin slowly to full plastication, and then the plasticated resin is fed through a manifold into a coat hanger die having a width of approximately 24 feet. The die lips are open to a prescribed distance governed by the thickness of the geomembrane to be extruded.

Exiting the die, the plasticated resin forms a controlled and monitored bead, which feeds into a chrome three-roll stack in a prescribed pattern. Each chrome roll is set at a prescribed temperature, controlled by water circulation.

Exiting the controlled cooling of the roll stack, the geomembrane travels down the take off haulers towards the winder. On the way to the take off, the liner is trimmed to bring the finished width to the applicable standard. Trimmings are granulated.

The trimmed edge of one side of the geomembrane is marked every meter (3.28 ft) with thickness, resin type (HDPE or LLDPE), Agru America name, and year of manufacture. This marking also serves as product identification.

The geomembrane is visually inspected for surface defects as it travels down the take off by both the extruder and the winder operators.

The geomembrane is wound on a recycled HDPE core having 6” ID (150mm), 7” OD (175mm) and 22’8” (6.8m) length.

Each standard length roll weighs approximately 3,900 pounds (1770 kg.). Rolls are fitted with two nylon slings when shipped.

**Post Extrusion Quality Control**

Once start-up conditions are over and commercial extrusion is initiated, post-production quality control comes into operation. A series of test procedures are performed based upon either our standard frequency of testing (attached), or frequencies required by customer specifications.

A sample approximately 11” by the full width of the geomembrane is taken from every roll. Based on the specified test frequencies, certain specimens are die cut, tested, and the results summarized on the Quality Certificate issued by our Quality Control Department. The certificate is signed electronically by the Quality Control Manager. The Quality Control Manager reports directly to the President of the Company.

Rolls failing to comply with either customer project specifications and/or our own latest revision to our published data sheets are set aside and re-classified as off-spec (Class B rolls).

Quality Certificates are provided for all rolls of geomembrane (sample smooth & Microspike® certificates are attached) with the exception of off-spec (Class B rolls).

Sometimes a third party quality assurance representative is mandated by the owner of a project to oversee our manufacturing QA. We gladly subscribe to this procedure and make all our records available 24 hours a day for the duration of the mandate. The following roll identification items are reported in our Quality Certificate:

**Roll number (Prior to Sept 2013)**

(example) **202366 -13**

| | | | | | |
|---|---|---|---|---|---|
| **2** | **0 2** | **3** | **6 6** | **-** | **1 3** |
| **MACH ID** | **WEEK** | **DAY OF WEEK (MON = 1)** | **COUNTER FOR WEEK** | | **YEAR** |

| | |
|---|---|
| First digit | machine |
| Second and third digits | week of year |
| Fourth digit | day of week (Monday=1, Sunday=7) |
| Last two digits | roll number (first roll of week is 01, etc.) |

The two last digits separated from the others indicate the year the roll was produced. Using the above key:
Roll #202366 -13 was produced on Machine #2 on Wed. in the second week in 2013 (1/16/13).

**Roll number (After Sept 2013)**

(example) **G13E383069**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **G** | **1 3** | **E** | **3 8** | **3** | **0** | **6** | **9** |
| **PLANT ID** | **YEAR** | **MACHINE ID** | **WEEK** | **DAY OF WEEK (MONDAY = 1)** | **COUNTER FOR WEEK** | | |

| | |
|---|---|
| First digit | Plant (G=Georgetown / F=Fernley) |
| Second and Third digits | Year (13 = 2013) |
| Fourth digit | Machine ID |
| Fifth & Sixth digits | Week in the current year |
| Seventh digit | day of week (Monday=1, Sunday=7) |
| Last three digits | counter for the week (starts at 001) |

Using the above key:
Roll #G13E383069 was produced on Georgetown, on Machine E on Wed. in the 38th week in 2013 (9/18/13).

**Product Description** (liner type: Smooth, Microspike®, Drain®, Super Gripnet®, etc.)

**Roll Length & Width in feet / meters, thickness in mils / mm.**

**Raw material lot and/or batch number and supplier/product identification** (from resin manufacturer's Certificate of Analysis – sample attached)

All geomembrane rolls are labeled as follows:

- roll stickers on the cores for each roll
- roll stickers on the outside of the finished roll
- written (Paint Pen) roll numbers on each face (flat ends)
- written (Paint Pen) roll numbers on the outside of the finished roll.

The following test results are reported in the Geomembrane Quality Certificate, derived from our standard test frequency (attached) and/or supplied raw material manufacturer Certificates of Analysis. Tests performed are the latest revisions of the standards listed. At a minimum this meets or exceeds GRI GM 13/17 requirements:

| Test / Method | Results Reported & Modifications to Standard (if any) |
|---|---|
| Thickness<br>†ASTM D5199(Smooth)<br>†ASTM D5994(Textured)<br>**(Both Modified)** | Minimum, Maximum, and Average Sheet Thickness in mm and mils.<br>**Modification from Standard** = Measurements are taken upon sample reaching Lab Temperature Equilibrium. |
| Asperity Height<br>†ASTM D7466 **(Modified)**<br>Textured liner only | Asperity height in mils<br>**Modifications from Standard** = Edge samples are collected from the smooth/textured junction, **not** 1 foot from edge. ASTM D5994 specimens are used for this test, not direct placement. |
| Density<br>†ASTM D792 method B | Density in g/cc |
| Melt Flow Index<br>†ASTM D1238 | g/10minutes (Conditions =190°C, 2.16kg).<br>**NOTE:** Resin Manufacturer's **Certificate of Analysis result** is reported. Our testing |
| Carbon Black Content<br>†ASTM D4218 | % Carbon Black by weight |
| Carbon Black Dispersion<br>†ASTM D5596 | Category (Only near spherical agglomerates per GRI GM 13 & 17) |
| Tensile Strength<br>†ASTM D6693<br>Type IV, 2 inches / minute<br>**(Modified)** | Average Strength @ Yield & Break in psi, ppi, & N/mm<br>Average Elongation @ Yield & Break in %<br>**Modification from Standard** = Average of MD & TD results are reported<br>**NOTE 1:** The D6693 results equate to the following<br>**NOTE 2:** Yield data not reported for LLDPE |
| Tear Resistance<br>†ASTM D1004 **(Modified)** | Tear Resistance in Lbs & N.<br>**Modifications from Standard** = Test is run upon sample reaching Lab Temperature Equilibrium. Average Tear Resistance of MD & TD is reported. |
| Puncture Resistance<br>†ASTM D4833<br>**(Both Modified)** | Puncture Resistance in Lbs & N.<br>**Modification from Standard** = Test is run upon sample reaching Lab Temperature Equilibrium. |
| Notched Constant Tensile Load<br>†ASTM D5397 (Single Point, Appx.) | Pass / Fail at 500 hours (or as required by customer specifications). First roll of new resin lot tested.<br>This test is run on HDPE only, and on smooth edge of textured liners. |
| Oxidative Induction Time (OIT)<br>†ASTM D3895<br>Standard, 200°C, 1atm. | OIT Time in minutes. **Modification from Standard** = One run only – if result is below 140 minutes, a second run is done to verify the first. |

The following test methods are now certified by Agru America based on historical results, as they are not required by the GRI GM13 / 17, and are not considered typical MQC tests.

| Test / Method | Results Certified |
|---|---|
| Low Temperature Brittleness ASTM D746 | Pass / Fail for each specimen (5 specimens in both MD & TD), 100 % of samples passing. Results Certified to -80°C (-112°F) |
| ESCR †ASTM D1693 | Pass / Fail for each specimen (5 specimens in both MD & TD), 100 % of samples passing. Results Certified to 2,000 hours |
| Dimensional Stability †ASTM D1204 **(Modified)** | 15 minutes or 1 hour at 100°C Results Certified to ± 2% for all geomembranes |

**†GRI-LAP Accredited for this method (INCLUDING Modifications)**

In addition to the testing described above, an in-house procedure is performed within the smooth edges of Textured (Microspike DS & SS) and Structured (Supergrip, Grip, Drain, MicroDrain) liner by the QC Lab in both plants.

Summarized, the procedure is a modified Graves Tear test (ASTM D1004), testing 2 specimens taken in the cross machine direction, and 2 specimens from the machine direction from within the smooth edges. Both the individual specimen results and the specimens themselves are checked. This test is currently being performed on each test roll (each time a tensile test is performed) produced in both plants.

The average result will be reported on the geomembrane roll Quality Certificates.

In addition to our MQC testing, Agru America will continually strive to produce superior products with isotropic characteristics.

**Drainage Net (Geonet)**

AGRU America drainage net is made from a blend of high quality HDPE resin and a carbon black masterbatch. The purpose of the carbon black is to protect the plastic from UV damage in the field application.

All raw materials as well as the finished products are consistently monitored by specially trained lab technicians. Raw materials are tested as above for Geomembrane.

The blend of raw materials is plasticized by an extruder, which presses the melt through a screen changer to filter out impurities. The plastic is then fed into a rotating die which creates the net. The cooling of the net takes place in a water tank at a tightly controlled temperature. A series of nip rollers pull the net out of the tank and through the downstream equipment to the winders. The net is cut to length automatically and wound onto a 4" OD cardboard core.

Before the finished rolls are taken out of the winder frame, the quality control technician either releases the material into stock or classifies the material as scrap.

When approved by QC, the rolls are transferred to the storage yard.

**Geocomposite**

In addition to the drainage net, AGRU America offers geocomposites which consist of geotextiles laminated to one or both sides of the net.

All geotextiles used for this lamination process are being inspected to meet AGRU America's (or project) specifications.

The lamination process takes place just before the net reaches the winders at the end of the extrusion line. After melting the surface of the HDPE drainage net, a geotextile is pressed into the net by means of a calender. The outer 6 inches of net are not laminated and the geotextile overlaps the net by an additional 6 inches on both sides of the product.

Before the finished rolls are taken out of the winder frame, the quality control technician either releases the material into stock or classifies the material as scrap.

When approved by QC, the rolls are stretch wrapped and transferred to the storage yard. All drainage net and geocomposite rolls are labeled as follows:

- one label on each face of the roll
- two hand written roll numbers on the stretch wrap packaging
- one label on the laboratory sample
- numbering system is as above for geomembrane

The following test results are reported in the Geonet/Composite Quality Certificate, derived from our test results and/or supplied raw material manufacturer Certificates of Analysis. Tests performed are the latest revisions of the Standards listed:

| Test / Method | Results Reported & Modifications to Standard (if any) |
|---|---|
| Thickness (Geonet)<br>†ASTM D5199 | Minimum, Maximum, and Average Geonet Thickness in mm and mils. **Modification from Standard** = Measurements are taken upon sample reaching Lab Temperature Equilibrium. English Units reported |
| Density (Geonet)<br>†ASTM D792 | Geonet Density in g/cc |
| Melt Flow Index (Geonet)<br>†ASTM D1238 | g/10minutes (Conditions =190°C, 2.16kg).<br>**NOTE:** Resin Manufacturer's **Certificate of Analysis result** is reported. Our testing verifies this result. |
| Carbon Black Content (Geonet)<br>†ASTM D4218 | % Carbon Black by weight |
| Peak Tensile Strength (Geonet)<br>†ASTM D5035 or<br>†ASTM D7179<br>**(Both Modified)** | MD Only tested, TD upon request only. Peak Strength @ Break in ppi<br>**Modification from Standard** = English Units reported |
| Mass Per Unit Area (Geonet)<br>†ASTM D5261 | Average Mass per Unit Area in $lb/ft^2$<br>**Modification from Standard** = English Units reported |
| Transmissivity (Geonet)<br>†ASTM D4716 | Transmissivity, $m^2$ / sec<br>Plate to Plate , 21°C, **gradient = 0.1, load = 10,000psf, seat time = 15 minutes** is Agru America's Standard Geonet MQC Transmissivity test (may be changed per project MQC specs) |
| Transmissivity (Geocomposite)<br>†ASTM D4716 | Transmissivity, $m^2$ / sec<br>Plate to Plate , 21°C, **gradient = 0.1, load = 10,000psf, seat time = 15 minutes** is Agru America's Standard Geocomposite MQC Transmissivity test (may be changed per project MQC specs) |
| Ply Adhesion (Geocomposite)<br>†ASTM D7005 | Peel Strength, lbs/in, min. ave. |

**†GRI-LAP Accredited for this method (INCLUDING Modifications)**

# Geomembrane
# Standard Frequency of Testing

## Product Data

| Property | Test Method | Frequency of testing (minimum)* |
|---|---|---|
| Thickness (min. ave.), mil | ASTM D5994/D5199 | per roll |
| Asperity Height (min. ave.), mil | ASTM D7466 | per roll, for textured liner |
| Density, g/cc, minimum | ASTM D792, Method B | 200,000 lbs (railcar) on finished liner & incoming resin |
| Tensile Properties (ave. both directions) | ASTM D6693, Type IV | |
| Strength @ Yield (min. ave.), lb/in width | 2 in/minute | 20,000 lbs |
| Elongation @ Yield (min. ave.), % (GL=1.3in) | 5 specimens in each direction | 20,000 lbs |
| Strength @ Break (min. ave.), lb/in width | | 20,000 lbs |
| Elongation @ Break (min. ave.), % (GL=2.0in) | | 20,000 lbs |
| Tear Resistance, lbs. (min. ave.) | ASTM D1004 | 45,000 lbs |
| Puncture Resistance, lbs. (min. ave.) | ASTM D4833 | 45,000 lbs |
| Carbon Black Content (range in %) | ASTM D4218 | 20,000 lbs |
| Carbon Black Dispersion (Category) | ASTM D5596 | 45,000 lbs |
| Stress Crack Resistance (NCTL), hours | ASTM D5397, Appendix | 200,000 lbs (railcar) |
| Oxidative Induction Time, minutes | ASTM D3895, 200°C, 1 atm $O_2$ | 200,000 lbs (railcar) on finished liner |
| Melt Flow Index, g/10 minutes | ASTM D1238, 190°C, 2.16kg | 200,000 lbs (railcar) on incoming resin |
| Oven Aging<br>with HP OIT, (% retained after 90 days) | ASTM D5721<br>ASTM D5885, 150°C, 500psi $O_2$ | per resin formulation |
| UV Resistance<br>with HP OIT, (% retained after 1600 hours) | ASTM D7238<br>ASTM D5885, 150°C, 500psi $O_2$ | per resin formulation |
| 2% Secant Modulus, lb/in. (max.) | ASTM D5323 | per resin formulation-**for LLDPE liner only** |
| Axi-Symmetric Break Resistance Strain, % (min.) | ASTM D5617 | per resin formulation-**for LLDPE liner only** |

**These test frequencies meet or exceed GRI's GM13 and GM17.**
***Theses test frequencies may be changed based on project specifications, and represent the minimum MQC testing performed.**
**Additional costs may be incurred if required testing is greater than listed above**

All information, recommendations and suggestions appearing in this literature concerning the use of our products are based upon tests and data believed to be reliable; however, it is the users responsibility to determine the suitability for their own use of the products described herein. Since the actual use by others is beyond our control, no guarantee or warranty of any kind, expressed or implied, is made by Agru America as to the effects of such use or the results to be obtained, nor does Agru America assume any liability in connection herewith. Any statement made herein may not be absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations. Nothing herein is to be construed as permission or as a recommendation to infringe any patent.

500 Garrison Road, Georgetown, South Carolina 29440 843-546-0600 800-373-2478 Fax: 843-527-2738
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# Geonet, Geotextile and Geocomposite Standard Frequency of Testing

## Geonet Component[4]

| Property | Test Method | Frequency of Testing (min.)* |
|---|---|---|
| Thickness, (mm) | ASTM D5199 | per 50,000 $ft^2$ |
| Peak Tensile Strength, lbs./in. (MD) | ASTM D5035/ASTM D7179 | per 50,000 $ft^2$ |
| Melt Flow Index, g/10 minutes (max.) | ASTM D1238, 190°C, 2.16 kg | per resin lot (railcar) on incoming resin |
| Density, $g/cm^3$ | ASTM D792, Method B | per 50,000 $ft^2$ on finished net<br>per resin lot (railcar) on incoming resin |
| Carbon Black Content | ASTM D4218 | per 50,000 $ft^2$ |
| Transmissivity[1], $m^2$/sec. | ASTM D4716 | per 500,000 $ft^2$ |

## Geotextile Component[4]

| Property | Test Method | Frequency of Testing (min.)* |
|---|---|---|
| Mass per Unit Area, oz./sq. yd. | ASTM D5261 | per 100,000 $ft^2$ |
| Grab Tensile Strength, lbs. | ASTM D4632 | per 100,000 $ft^2$ |
| Grab Elongation, % | ASTM D4632 | per 100,000 $ft^2$ |
| Trapezoidal Tear, lbs. | ASTM D4533 | per 100,000 $ft^2$ |
| Puncture, lbs. | ASTM D4833 | per 100,000 $ft^2$ |
| Permittivity[2], $sec.^{-1}$ | ASTM D4491 | per 540,000 $ft^2$ |
| Water Flow[2], gpm./$ft^2$ | ASTM D4491 | per 540,000 $ft^2$ |
| Apparent Opening Size,[2] U.S. Stnd Sieve Size (max.) | ASTM D4751 | per 540,000 $ft^2$ |
| UV Resistance after 500 hours, % Strength Retained | ASTM D4355 | per resin formulation |

## Geocomposite

| Property | Test Method | Frequency of Testing (min.)* |
|---|---|---|
| Laminated Strength (Ply Adhesion), lbs./in. | ASTM D7005 | per 50,000 $ft^2$ |
| Transmissivity[3], $m^2$/sec. | ASTM D4716 | per 500,000 $ft^2$ |

***These test frequencies may be changed based on project specifications, and represent the minimum MQC testing performed. Additional costs may be incurred if required testing is greater than listed above.**

**Notes:**
1. **Geonet Transmissivity at a temp. of 21°C, gradient of 0.1 and a load of 10,000psf: seating time 15 min. between steel plates.**
2. **At time of manufacture. Handling may change these properties.**
3. **Geocomposite Transmissivity at a temp. of 21°C, gradient of 0.1 and a load of 10,000psf: seating time 15 min. between steel plates.**
4. **Component Properties are prior to Lamination**

All information, recommendations and suggestions appearing in this literature concerning the use of our products are based upon tests and data believed to be reliable; however, it is the users responsibility to determine the suitability for their own use of the products described herein. Since the actual use by others is beyond our control, no guarantee or warranty of any kind, expressed or implied, is made by Agru America as to the effects of such use or the results to be obtained, nor does Agru America assume any liability in connection herewith. Any statement made herein may not be absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations. Nothing herein is to be construed as permission or as a recommendation to infringe any patent.

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CoA Date: 04/11/2014

# Certificate of Analysis

Shipped To: AGRU AMERICA INC:GEORGETOWN
500 GARRISON RD
GEORGETOWN SC 29440-9688
USA

Recipient: PALMER
Fax:

Delivery #: 88834459
PO #: 8206
Weight: 185400 LB
Ship Date: 04/11/2014
Package: BULK
Mode: Hopper Car
Car #: PSPX002181
Seal No: 322565

Product:
MARLEX POLYETHYLENE K307 BULK

Lot Number: H7240417

| Property | Test Method | Value | Unit |
|---|---|---|---|
| Melt Index | ASTM D1238 | 0.22 | g/10mi |
| HLMI Flow Rate | ASTM D1238 | 21 | g/10mi |
| Density | D1505 or D4883 | 0.938 | g/cm3 |
| Pellet Count | P02.08.03 | 27 | pel/g |
| Production Date | | 03/29/2014 | |

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP (CPChem).
**However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Troy Griffin
Quality Systems Coordinator

For CoA questions contact Customer Service Representative at +1-832-813-4806

SAMPLE

# ATTACHMENT 2

## *Shaw Industries – Engineered Turf Geotextile Backing*

## *Sampling & Testing Frequencies*

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# Sampling & Testing Frequencies

## 1.0 Purpose / Scope

This procedure covers sample size and delivery, sample preparation and testing frequency.

## 2.0 Responsibilities

The Quality Assurance Department is responsible for maintenance of this procedure.

## 3.0 Definitions:

**3.1 Full Physicals:** The term "full physicals" refers to the combination of the following tests: appearance, construction (fill), weight, width, warp tensile and elongation, fill tensile and elongation, shrink (w & f) and extractions.

## 4.0 Procedure/Requirements

### 4.1 Apparatus:

Calibrated 25' Tape measure, Calibrated 6" ruler, pen, scissors, tensile testing machine (Instron), calibrated scale measurable to .01 grams, heat cutting gun, 6¾in. x 6¾in. Template for weight, 10in. x 10in. template for shrink, Blue M oven, weight to place on templates for cutting, NMR for extractions, network computer to enter test results into the Infinity QS Proficient Application.

### 4.2 Fabric samples from Primary Weaving:

4.2.1 All samples from weaving will be cut by the Primary Weave Doffer.
4.2.2 Sample length will be approximately 12" for samples over 100" wide and approximately 12" for samples under 100" wide.
4.2.3 The pertinent information representing the sample will be present with sample.
4.2.4 Samples will be placed in a buggy marked 'Primary Backing Samples Only'. This buggy will be located in the Primary Weave Dept.
4.2.5 Samples will be retrieved by the lab technician at least every 2 hours with the last pick-up being at 6:00.
4.2.6 Samples should be free of defects.

### 4.3 Fabric samples from the Finishing Department/Heat Set:

4.3.1 All samples will be pulled by Finishing Department Personnel.
4.3.2 An approximately 12" sample will be taken from each roll ran on heatset.
4.3.3 The doff ticket representing the sample will be stapled to it.
4.3.4 Samples will be picked retrieved by the lab technician at least every 2 hours with the last pick-up being at 6:00.
4.3.5 The lab tech will initial and document the time on the Heat-set Log sheet as verification of when the samples were picked up.
4.3.6 Samples should be free of defects which are attributed to end of roll pieces.

4.3.7 Do not sign the Heat-Set log for any sample not received or any sample not properly identified.

### 4.4 Testing Frequencies:

4.4.1 The specification sheets for each style will list the tests that are required.

4.4.2 The following list of tests relates how often each test is to be performed.

**Primary Fabric Testing Frequency:**

| Test | # of Tests per Sample | Frequency |
| --- | --- | --- |
| Appearance | 1 | Every Roll |
| Construction (Fill) | 1 | Every Roll |
| Weight | 1 | Every Roll |
| Width | 1 | Every Roll |
| Warp Tensile & Elongation | 3 | One (1) roll per pick classification per shift |
| Fill Tensile & Elongation | 4 | One (1) roll per pick classification per shift |
| Shrink (W x F) | 1 | One (1) roll per pick classification per shift |
| Warp Crimp (LB) | 1 | on request |
| Extraction (LB) | 3 | Every Roll |

4.4.3 Heat Set Samples:

4.4.4 Full physicals will be performed on samples retrieved from the Heat-set as follows: One (1) roll per pick classification per shift (ex. one 10 pick roll per shift, one 11 pick roll per shift, one 13 pick roll per shift, etc.) unless otherwise requested.

4.4.5 All samples will be tested for appearance, construction, width, weight and extractions.

**Lab Technician Duties/Frequency**

| Test | Frequency |
| --- | --- |
| Style Changes | every occurrence |

### 4.5 Sample Preparation

4.5.1 Classifications are divided into each pick count.

4.5.2 Each sample should be measured to the nearest 1/16 of an inch. (Refer to On-Loom Width Checks (SI-4400-212-P) and Determining Fabric Width (In Labs) (SI-4400-218-TM).

4.5.3 Filling picks are counted on five (5) inches. Refer to Fabric Construction (SI-4400-217-TM).

4.5.4 Follow the diagram below to determine the correct location for cutting individual samples for the following tests (refer to test methods to determine sample measurements):

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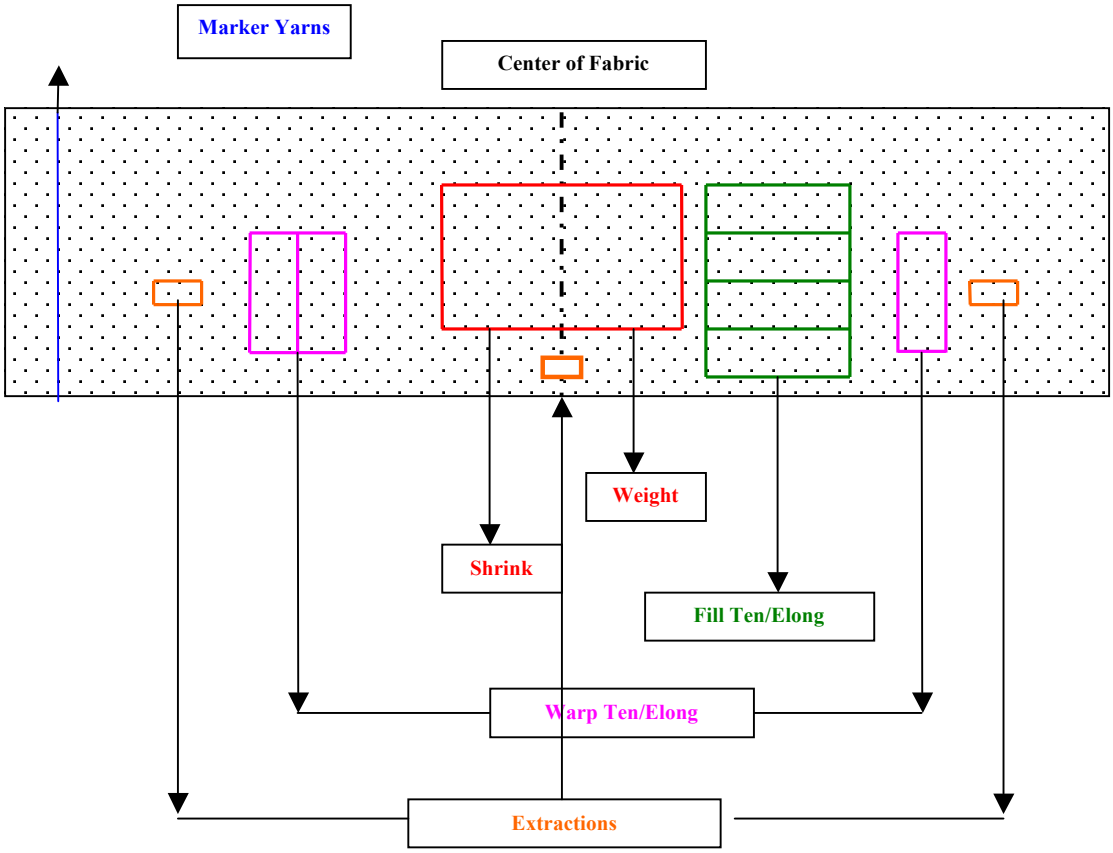
4.5.4.1 1 Shrink (reference Fabric Shrinkage (SI-4400-335-TM)
4.5.4.2 1 Fabric weight (reference Determining Fabric Weight (Mass/Unit) (SI-4400-224-TM))
4.5.4.3 3 Extractions (reference Determining Lube Percent Finish on Fabric (NMR) (SI-4400-230-TM))
4.5.4.4 3 Warp samples for tensile & elongation (reference Tensile & Elongation of Woven Fabric (SI-4400-220-TM)).
4.5.4.5 4 Fill samples for tensile & elongation (reference Tensile & Elongation of Woven Fabric (SI-4400-220-TM)).




## 4.6 Test Results

4.6.1 Test results are to be compared to the specifications for the fabric tested, fabric specification produced by the Process Engineer of the product group being tested and are kept in the fabric testing area of the Primary Lab. Data for every roll tested is to be entered into the Infinity QS Proficient Application (refer Data Entry for Infinity QS Proficient Software (SI-4400-201-P)).

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## 4.7 Disposition of Rolls

Rolls will be dispositioned using the following guidelines:

4.7.1 Extraction Failures:

4.7.1.1 PatterenLok Products:

If **either** of the 3 extractions results fails to meet the specs, the roll will placed on HOLD for Management review. The roll must be tagged with a completed Nonconforming tag and placed on Hold in USF, and the rest of the warp will be placed on hold for heatset.

4.7.1.2 NON-PatternLok Products:

If either of the 3 extractions results fail to meet the specs, the roll will be designated for the Heat-set. The roll must be tagged with a completed nonconforming tag and placed in the Heat-Set bin in Finishing, and the rest of the warp will be placed on hold for heatset.

4.7.1.3 Tensile, Elongation Failures:

If the **average** of the Tensile or Elongation tests fail to meet the specs, the roll must be tagged with a completed Nonconforming tag and placed on Hold in USF.

4.7.1.4 Shrink Failures:

If **either** of the individual shrink tests fails to meet the spec, the roll must be tagged with a completed Nonconforming tag and placed on Hold in USF.

## 5.0 Appendix – Attachments:

| | |
| --- | --- |
| SI-4400-212-P | On-Loom Width Checks |
| SI-4400-218-TM | Determining Fabric Width (In Labs) |
| SI-4400-217-TM | Fabric Construction |
| SI-4400-335-TM | Fabric Shrinkage |
| SI-4400-224-TM | Determining Fabric Weight (Mass/Unit) |
| SI-4400-230-TM | Determining Lube Percent Finish on Fabric (NMR) |
| SI-4400-220-TM | Tensile & Elongation of Woven Fabric |
| SI-F1103-01-F3 | Heat-Set Sample Log |
| SI-4400-201-P | Data Entry for Infinity QS Proficient Software |

# ATTACHMENT 3

## *Summary of Bonar Yarns Quality Control Methods*

# WORK INSTRUCTION

| QC Dept | Testroom | | |
|---|---|---|---|
| TASK | dTex test (g/10 000meter) | REF NO | WI-QC |
| ISSUE DATE | | ISSUE NO | 001 |
| NO OF PAGES | 7 | APPROVED BY | |

## SCOPE

This document specifies a method to determine the dTex of a given yarn sample.
The test method complies with BS 4611:1989 and forms part of our BS EN ISO 9001:2008 documentation.

## Apparatus Required

1 wrap reel – ***note*** *the plant (Fig 14) and Testroom wrap reels (Fig 15) measure in 1meter (m) lengths the QC Lab wrap reel (Fig 16) measures in 2m lengths.*
1 calibrated laboratory balance (Fig 17)
1 pair scissors/snips

Fig 14

Fig 15

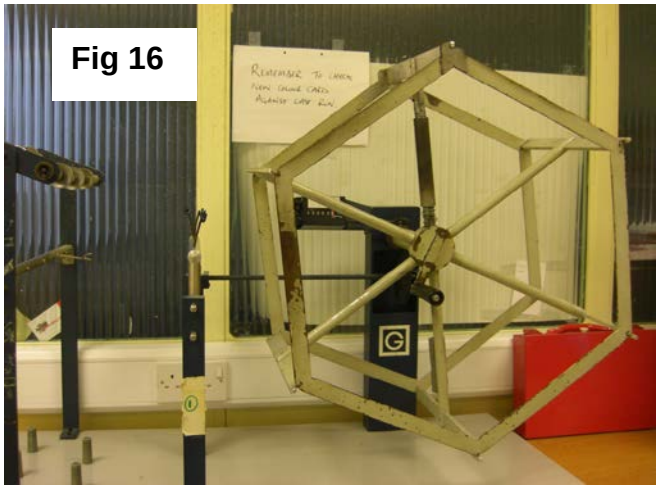


Fig 16

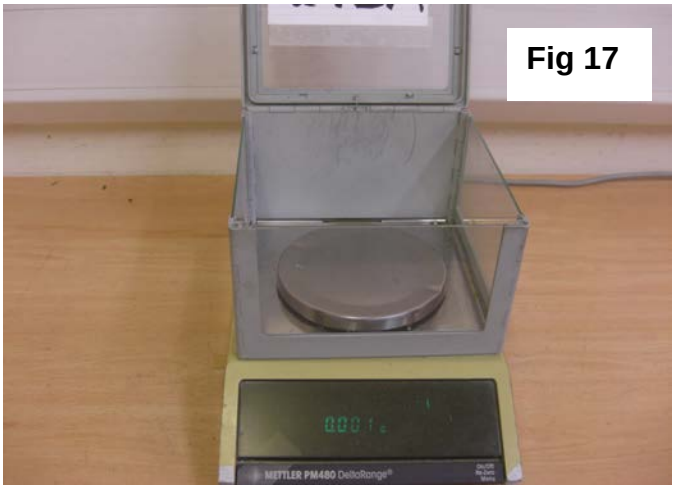
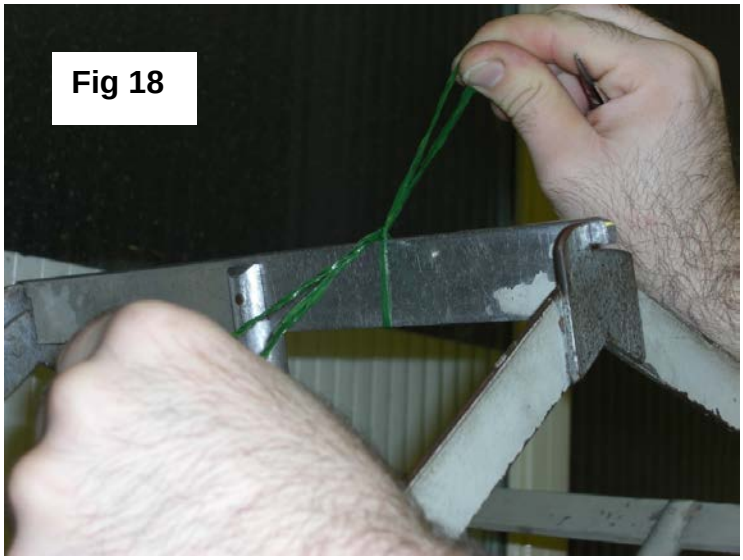


Fig 17

**Procedure**

1. Using the correct lifting technique which can be found in the red book titled "What you should know about SAFE MANUAL HANDLING" lift the spool to be tested onto the wrap reel trolley or the lab bench.

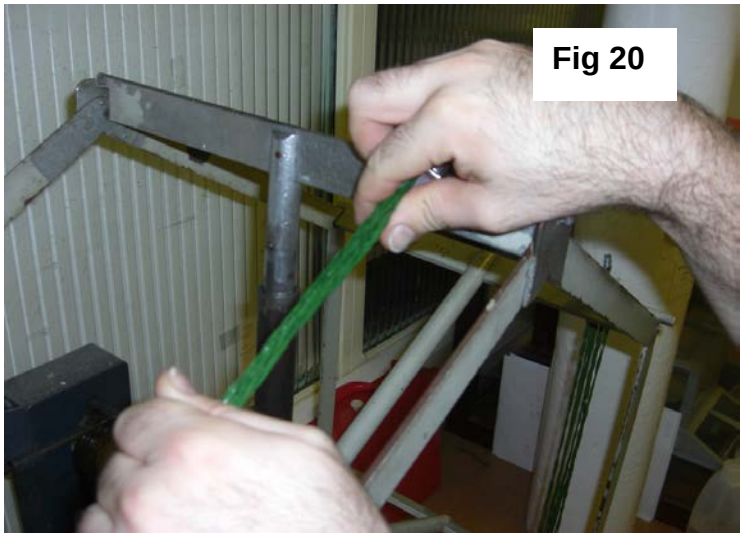


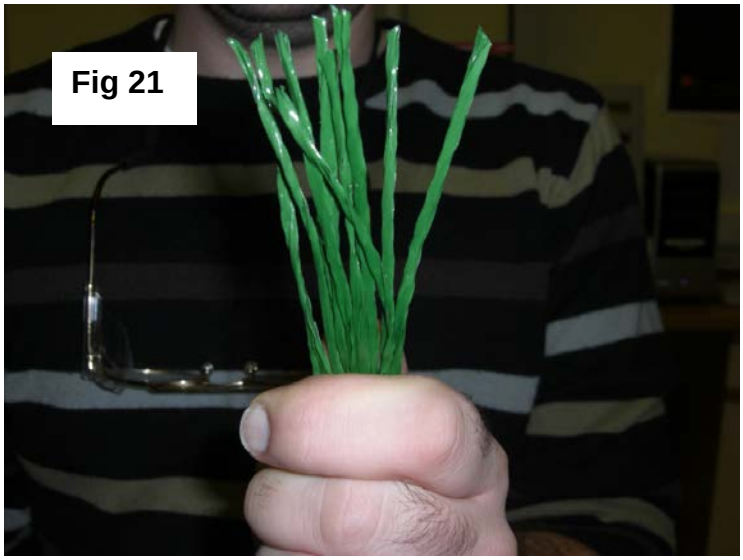

2. Attach the end of the yarn to the top bar on the wrap reel – make sure it is secure using either a bow or a knot. (Fig 18)

3. Holding onto the yarn firmly with one hand, make sure there is no slack in the yarn. Then turn wrap reel handle (Fig 19).

4. If using the testroom or plant wrap reels turn the handle in a clockwise direction 10 times.
    a. If using the QC Lab wrap reel turn the handle in a clockwise direction 5 times.
5. Ensure that the knot is in the same position as when you started.

6. Hold the lengths of yarn together and in a **smooth and safe motion** make sure you cut all lengths at the same time (Fig 20).
    a. This will make sure each length is exactly the same size.

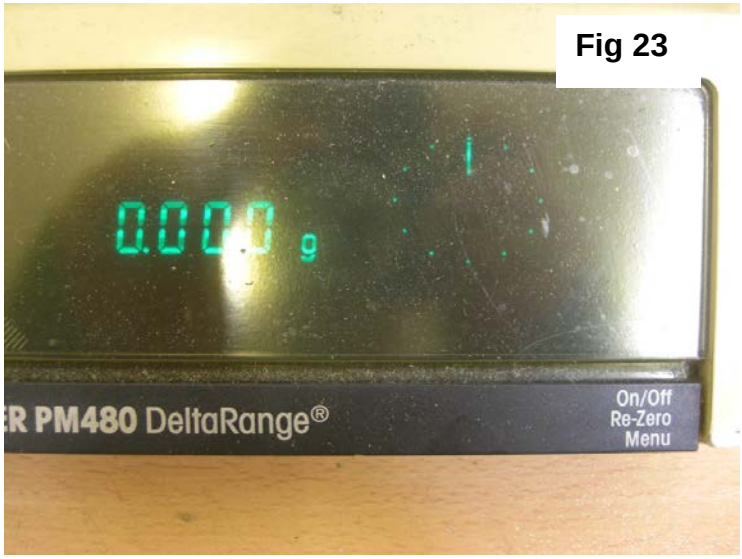





b. When using the testroom or plant wrap reels you should have 10 lengths (Fig 21).

c. When using the QC Lab wrap reel you should have 5 lengths.

7. Wrap the ends around your hand and tie into a hank – ensure there are no long lengths of yarn sticking out which would touch the balance walls (Fig 22).



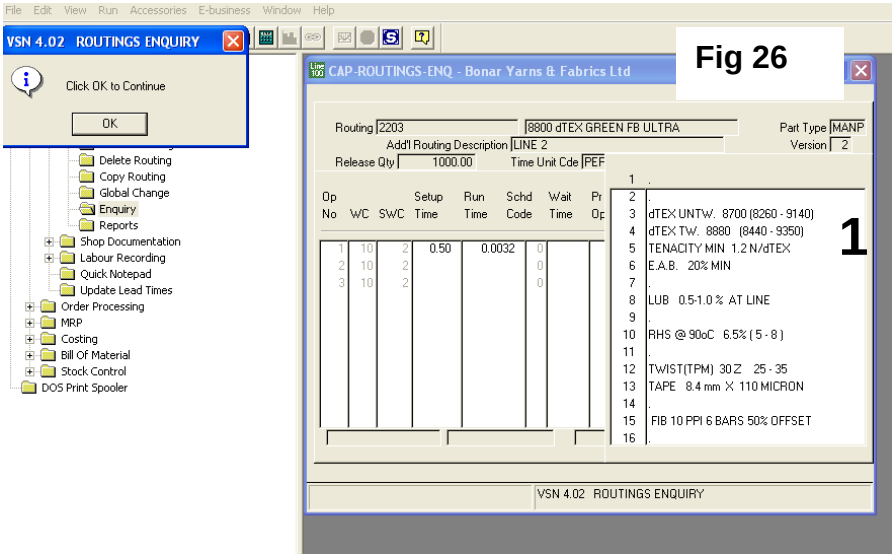

8. Make sure the balance is reading zero before placing the hank gently on the pan (Fig 23).

   a. If balance is not reading zero then press the re-zero button once.
   b. If there is a draft or persons walking in front of the balance this will cause the scale to be inaccurate and the balance will not settle.

c. Ensure all the hank is sitting on the pan (Fig 24) and not touching the sides or the base of the balance (Fig 25).

9. Once the balance has settled note the weight, this is the weight in grams of 10m of yarn.
10. For the dTex we require the weight in grams of 10 000m of yarn, in order to convert to dTex move the decimal place 3 places to the right.
    a. For example if the scales reads 6.932g – this is 6.932g/10m
    b. To convert to dtex move the decimal place 3 places to the right this now gives a dTex of 6932g/10 000m.
    c. We record this for ease as 6932 dTex.

11. Check the result in the Swan routing computer system, this will give you the nominal dTex and the tolerance limits for each product (Fig 26 - 1).



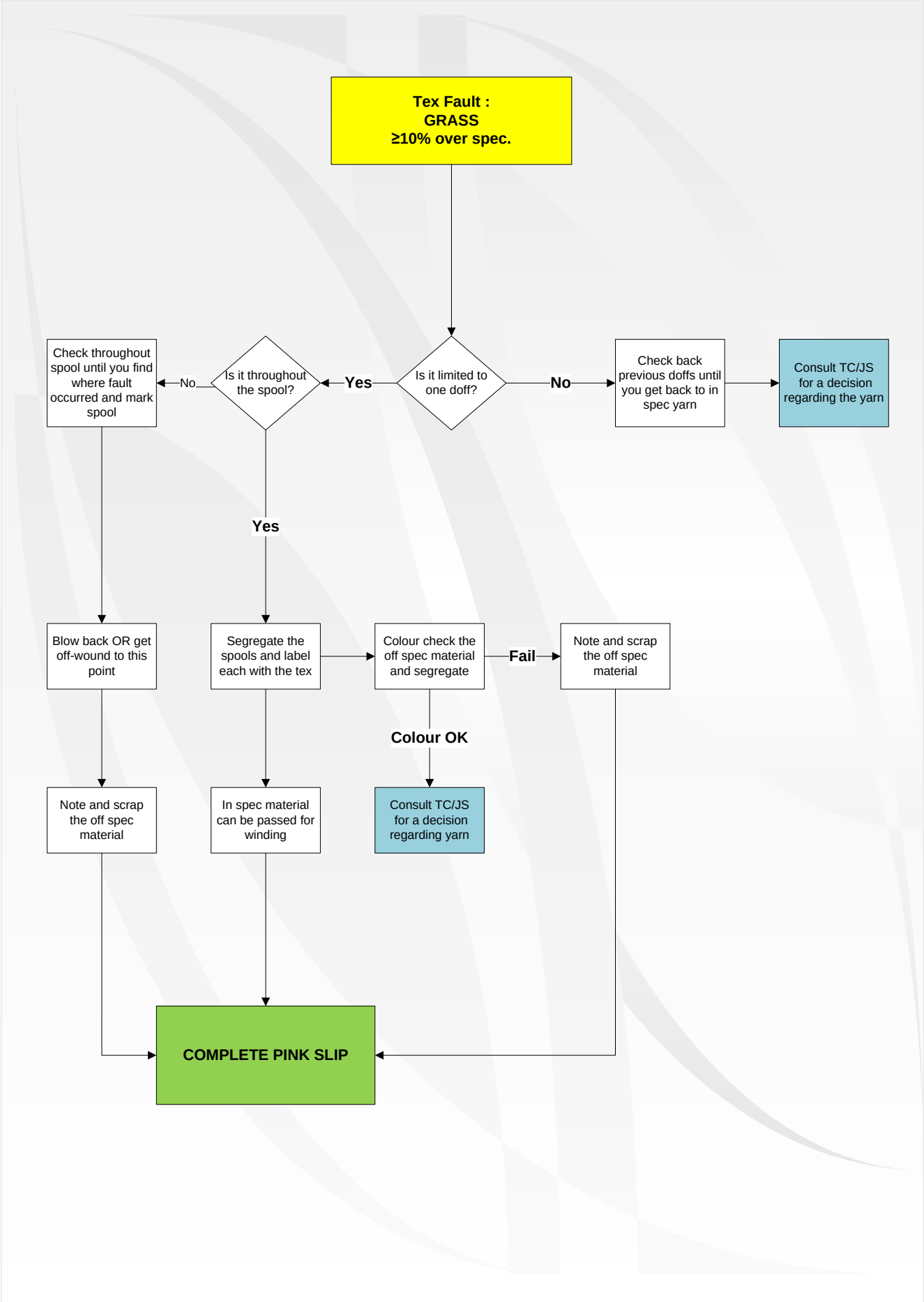
**Results & Reporting**

- The specification for the dTex can be found in the Swan routing computer system.
- Results are reported as whole numbers only, the units are dTex.
- If the yarn is out with the tolerance you will be required to fill in a yarn withdrawal form from the testroom and attach it to the pallet and follow the procedure for issuing a yarn withdrawal form. See WI QC Yarn Withdrawal Form.
    - Follow flow chart for out of specification yarn.
    - These can be found at the end of this work instruction.
- Ensure that the supervisor is informed of any non-conformance.

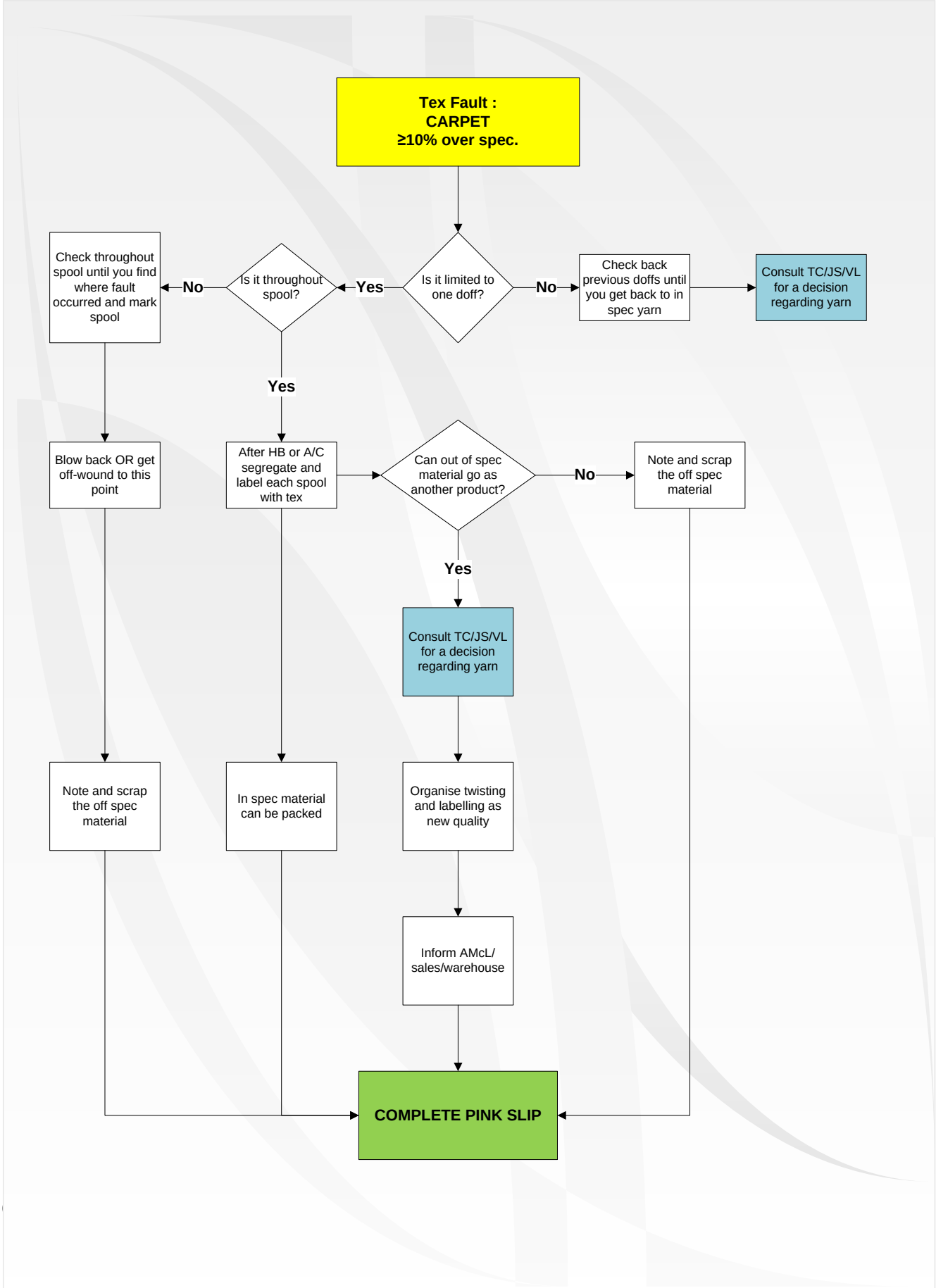
The dTex test results are reported as part of the following documentation.

| Document Reference Number | **Document Title** |
|---|---|
| D18 | **Start-up Check Extrusion** |
| D23 | **dTex & RHS Sheets** |
| D25 | **Summary of Full Test results Sheet** |
| D26 | **Full test Printout Sheet** |
| D27 | **Shrink Tests after Hot-box/Autoclave** |
| PA01 | **Machine Start-up – dTex, Shrinkage & Fib Check** |
| PA03a | **Graphical dTex Record Sheet** |
| PA04 | **First and Last Tape Test for Extrusion Lines** |
| PA13 | **dTex/RHS Profile Check Sheet** |
| D16 | **Withdrawal Form for Products not Conforming to Standards** |
| **PA28** | **Withdrawal Slip Record Sheet** |

## Flow Charts For Yarns Out Of Specification



# QUALITY CONTROL DEPARTMENT



# WORK INSTRUCTION

| QC Dept | Testroom | | |
|---|---|---|---|
| TASK | Shrinkage (RHS) test | REF NO | WI-QC |
| ISSUE DATE | | ISSUE NO | 001 |
| NO OF PAGES | | APPROVED BY | |

## SCOPE

This document specifies a method to determine the Residual Heat Shrinkage (RHS) or shrinkage of a given yarn sample.
The test method complies with BS 4611:1989 and forms part of our BS EN ISO 9001:2008 documentation.

## Apparatus Required (Fig 61)

1 Testrite shrinkage oven
1 Set of clip on weights (as supplied by Testrite)
1 Calibrated digital thermometer
1 Pair scissors/snips

**Fig 61**

**Procedure**

- There are 3 Testrite shrinkage ovens in the testroom and the QC Lab and 1 in the Winding area.
- In the testroom and QC Lab these are set at 90ºC, 130ºC & 150ºC
- In the winding area the Testrite is set at 150ºC

1. Before use, check the Testrite is at the temperature required for the yarn being tested.
   a) For carpet yarns made of polypropylene (PP) yarn should be tested at 130ºC & 150ºC unless otherwise stated in the Swan routing system.
   b) For grass yarns made of PP yarn should be tested at 130ºC unless otherwise stated by the Swan routing system.
   c) For grass yarns made of polyethylene (PE) yarn should be tested at 90ºC unless otherwise stated in the Swan routing system.

2. Using the digital thermometer (Fig 62) check the Testrite temperature, by attaching the probe into the housing at the top of the Comark. Press the power button and wait until the temperature settles. The reading should be within +/-2ºC.

**Fig 62**

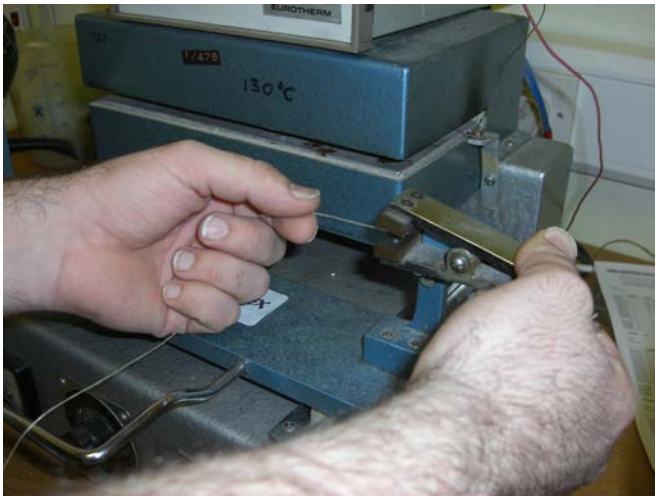



**Fig 63**

3. Take your yarn sample. This will either be a 1m length from one of the test hanks or, A test spool.
4. Clamp one end into the clamp (Fig 63).

**Fig 64**

5. Attach the appropriate weight to the other end (Fig 64).

a) The small weight should be used for yarns with a dTex of 0 – 1890 (Fig 65 – 1).
b) The large weight should be used for yarns with a dTex of 1900 upwards (Fig 65 – 2)

6. Do not pull or stretch the yarn sample.

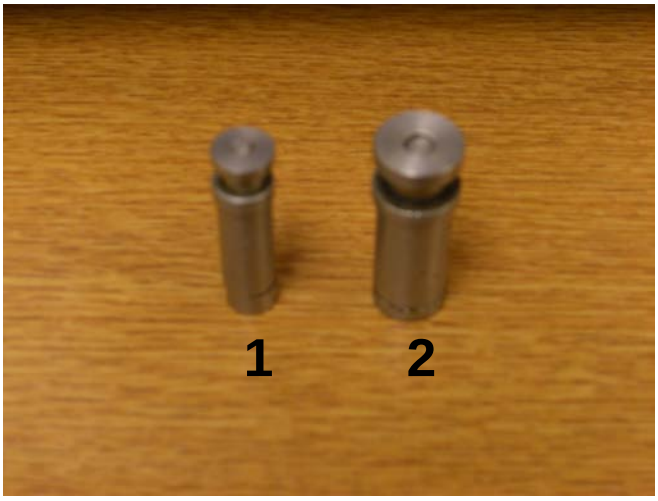



**Fig 65**

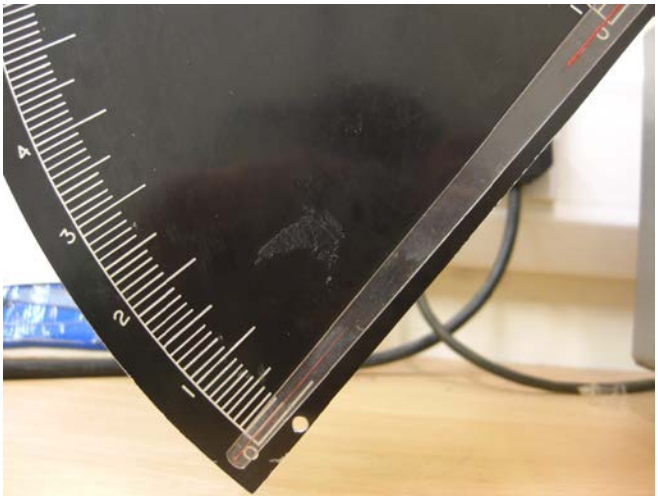


**Fig 66**

7. Make sure the indicator arm is positioned at zero (Fig 66) then slowly and carefully slide the tray containing the yarn sample into the hot air oven making sure the sample does not touch the oven (Fig 67). **Take care not to touch the oven at anytime.**

8. Leave the yarn sample in the oven for 2 minutes.

**Fig 67**

9. Note and record where the indicator arm is pointing, this is the RHS or shrinkage of the yarn and is measured as a percentage (%) (Fig 68).

10. Remove the sample from the oven and discard.
11. If testing yarns from the hot-box or autoclave due to the low shrinkage levels it is best to position the indicator arm at 1.0 rather than zero.

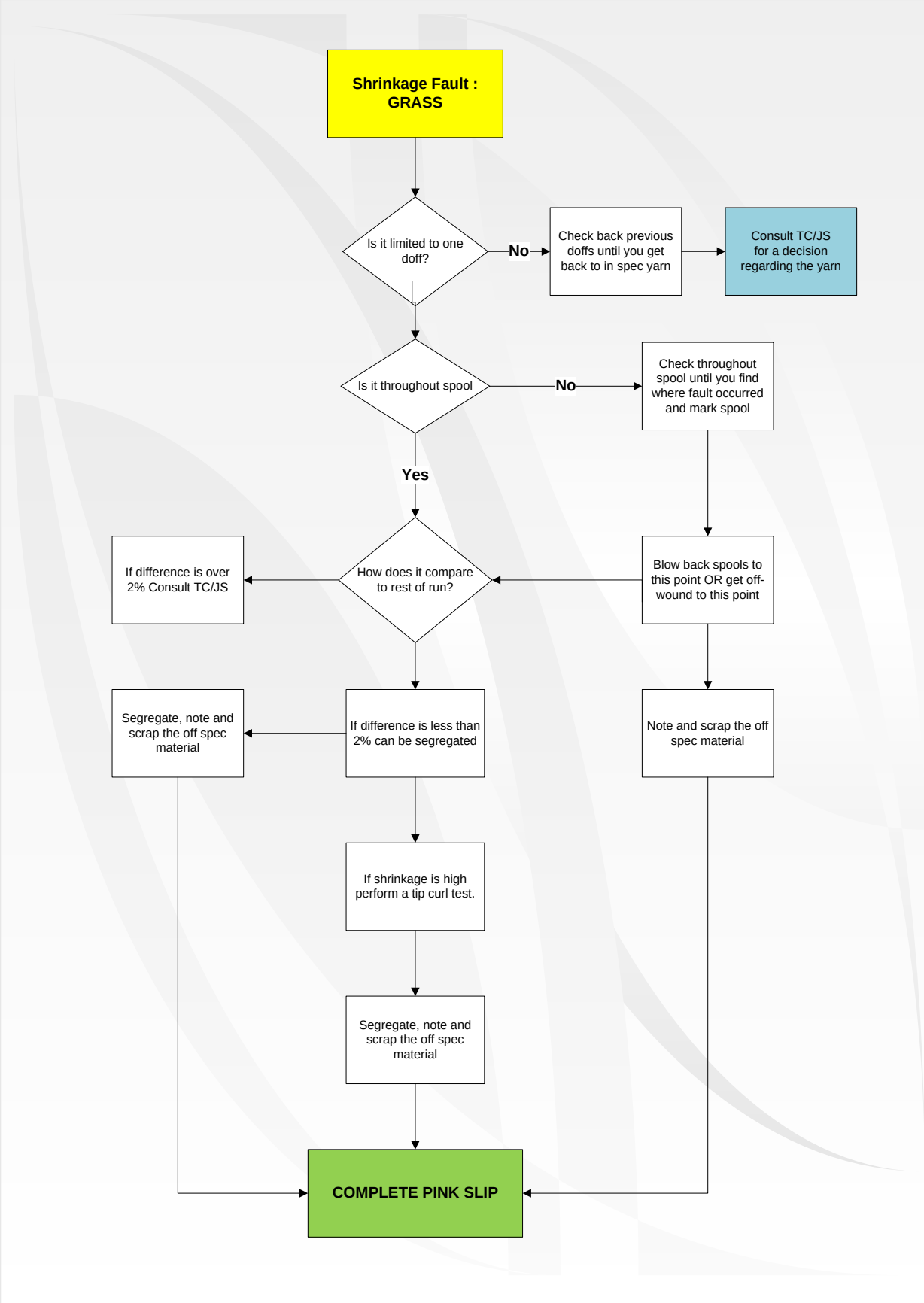
**Fig 68**

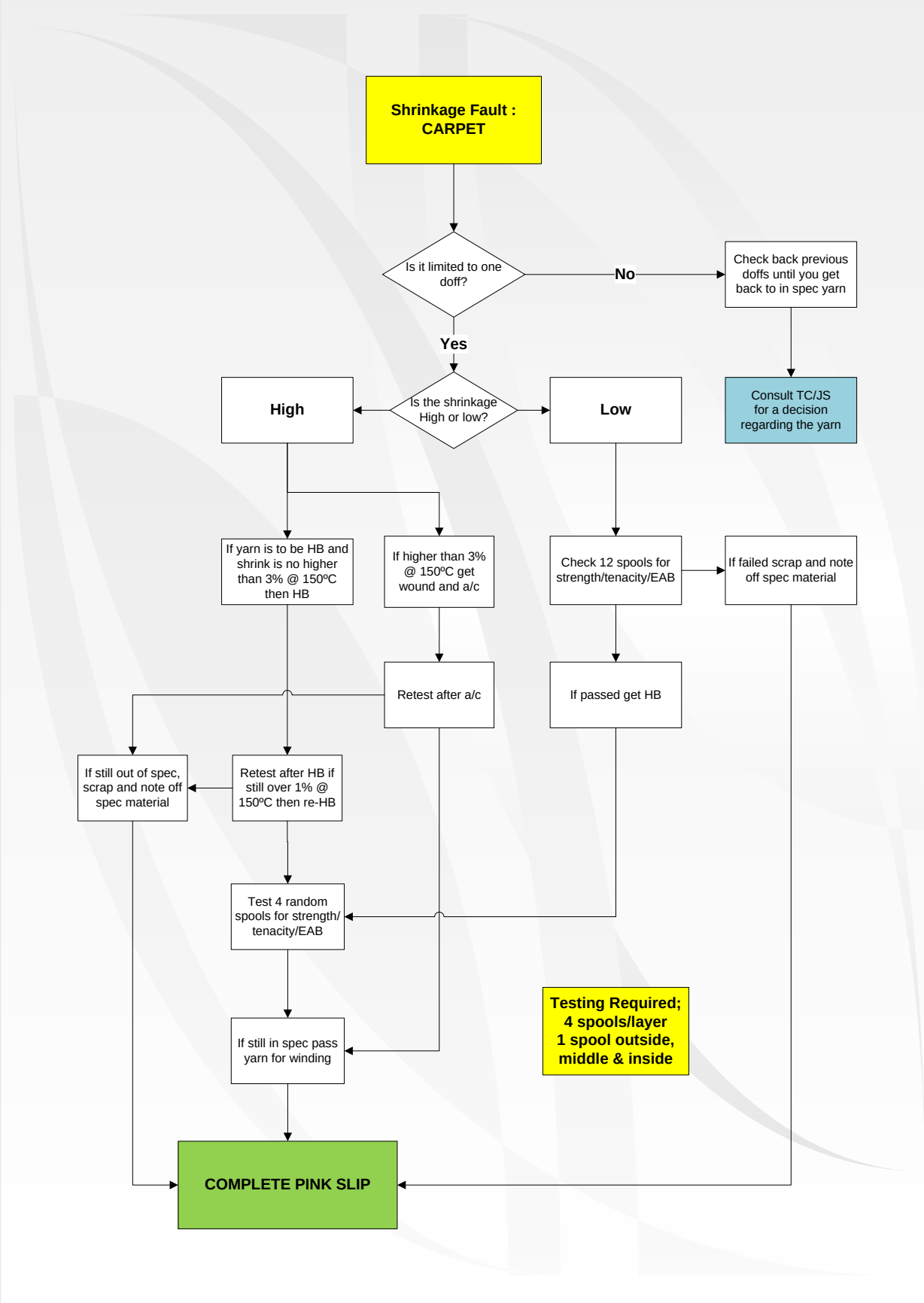
**Results & Reporting**

- The specification for the shrinkage can be found in the Swan routing computer system.
- Results are reported to one decimal place only; the units are percent (%).
    - E.g. 1.2%
- If the yarn is out with the tolerance you will be required to fill in a yarn withdrawal form from the testroom and attach it to the pallet and follow the procedure for issuing a yarn withdrawal form. See WI QC Yarn Withdrawal Form.
    - Follow flow chart for out of specification yarn.
    - These can be found at the end of this work instruction.
- Ensure that the supervisor is informed of any non-conformance.

The shrinkage test results are reported as part of the following documentation.

| Document Reference Number | **Document Title** |
|---|---|
| D18 | **Start-up Check Extrusion** |
| D22 | **Verdol Twist/RHS Checks** |
| D23 | **dTex & RHS Sheets** |
| D25 | **Summary of Full Test results Sheet** |
| D26 | **Full test Printout Sheet** |
| D27 | **Shrink Tests after Hot-box/Autoclave** |
| PA01 | **Machine Start-up – dTex, Shrinkage & Fib Check** |
| PA04 | **First and Last Tape Test for Extrusion Lines** |
| PA13 | **dTex/RHS Profile Check Sheet** |
| PA15 | **12141 Shrinkage Tests for Anker After A/C** |
| D16 | **Withdrawal Form for Products not Conforming to Standards** |
| **PA28** | **Withdrawal Slip Record Sheet** |


Shrinkage Fault : GRASS
Is it limited to one doff?
No
Check back previous doffs until you get back to in spec yarn
Consult TC/JS for a decision regarding the yarn
Is it throughout spool
No
Check throughout spool until you find where fault occurred and mark spool
Yes
How does it compare to rest of run?
If difference is over 2% Consult TC/JS
Blow back spools to this point OR get off-wound to this point
Segregate, note and scrap the off spec material
If difference is less than 2% can be segregated
Note and scrap the off spec material
If shrinkage is high perform a tip curl test.
Segregate, note and scrap the off spec material
COMPLETE PINK SLIP


Shrinkage Fault : CARPET
Is it limited to one doff?
No
Check back previous doffs until you get back to in spec yarn
Consult TC/JS for a decision regarding the yarn
Yes
Is the shrinkage High or low?
High
Low
If yarn is to be HB and shrink is no higher than 3% @ 150ºC then HB
If higher than 3% @ 150ºC get wound and a/c
Check 12 spools for strength/tenacity/EAB
If failed scrap and note off spec material
Retest after a/c
If passed get HB
If still out of spec, scrap and note off spec material
Retest after HB if still over 1% @ 150ºC then re-HB
Test 4 random spools for strength/ tenacity/EAB
Testing Required; 4 spools/layer 1 spool outside, middle & inside
If still in spec pass yarn for winding
COMPLETE PINK SLIP

## Apparatus Required:

MQA Lube Test MACHINE 7020
Laboratory Test tube

**Procedure:**

The MQA 7020 lubricant testing machine is set up to test Grass yarn as well as the Carpet yarn to ensure the correct additional levels of lube/spin finish add-on.

The QC Personnel are required to test each Line that is running with lube add-on TWICE PER SHIFT and is now part of the test procedures in line with colour, checking tip curl, dTex tests and RHS tests etc

To test Carpet yarn go into the Antelin 100-carpet

To test PP Grass yarn go into Lurol PP11111 (PP-Grass)

To test PE Grass yarn go into Lurol PP11111 (PE-Grass)

The tests can be found in the MQA Methods

Useful Information

Password if the system fails – DIAG999

SUS refers to the samples which are colour coded within the test tube box

☑ Frequency (Tested Daily)

Pulse (Tested Weekly by Lab)

Gain

When using the PULSE this displays a graph

## MQA LUBE TEST MACHINE

### Setting up for a new Lube

Highlight Oxford non weighing spin finish

*click* system

*click* Installed methods

*click* Oxford non weighing spin finish

*click* Copy

Name New name CHT HANSA (eg)

*click* OK

*click* ✓

Installed methods (New name) CARPET ANTELIN (eg),
(Optimise), (Frequency tick), (Pulse Tick), (Gain tick)

*click* Green play

*click* ✓ Insert sample QT 827 from black box after test stops

*click* x 2

Number of samples x 2 high + low, *click* ✓ Insert sample

(*click*

Insert sample 2 will test straight away after test stops

*click* ✓ to accept)

*click* on new test calibrate (new data set x 2)

Step 1

Name CARPET ANTELIN (eg) *click* ✓ insert sample 2 (*click* F5) wait 64s put ID Sample No.

(Example 1) Ref value 0.3 etc (*click* ✓ F2) - Insert sample 2 and repeat step 1 and carry on until all four samples are done

Insert red SUS from black box and *click* on (F6) with T (*click* on ✓ )

if ADC comes up first *click* ✓ to continue.

Wait 64 secs *click* F11 with blue and yellow dot

ID Box red SUS *click* ✓ , Insert Blue repeat F6 onwards as per red sample

## MQA LUBE TEST MACHINE

**New Carpet Antelin example etc (Daily tests)**

*click* Optimise 'Uncheck' pulse + gain as ONLY frequency must have a tick

*click*

Insert **QT 827** test tube

*click* Check numbers are compatible to three digits after the point (i.e.20.**197**)

*click* ✓ When completing the test

**Analyse**
**Put sample in test tube & poke it with rod until below the line marked on the test tube**
(0.5 to 2mtr of yarn required to fit test tube depending on dTex)

Pick test required (i.e. Carpet Antelin, Grass PP, Grass PE)

*click* ✓ Highlight test (e.g Carpet Antelin).

Insert sample ID analysing Product Code + Date + Shift (e.g 26236-161111-4)

*click* ,

Wait 64 secs, Finish *click* ✓ , Repeat x 4, Exit by door

Lube roller adjustments = Low Lube – Speed up Roller

High Lube - Slow down Roller

# ATTACHMENT 4

## *Manufacturing Quality Control (MQC) Procedures for Geosynthetic Products Manufactured by Shaw Industries*

# Manufacturing Quality Control
# (MQC)
# Procedures for Geosynthetic Products

## Manufactured by

## Shaw Industries

# Manufacturing Quality Control (MQC) Program
# For
# Geosynthetic Products Manufactured by

# Shaw Industries

## Prepared by:

Katelyn Day – Assistant Department Manger, Tufting

## Approved by:

Dan Wright-Director of Quality, Specialty Markets

## 1. Responsibilities and Authority:

The Site Quality Assurance Managers and Tufting Managers share the responsibility for the quality of the geosynthetic products produced within Shaw Industry Plants.

The Raw Material Technician on each shift within the manufacturing facility completes the testing process.

## 2. Obtaining Samples:

Manufacturing personnel continually monitor production lines for visual defects in geosynthetic products. All process conditions are monitored to insure consistency. All manufacturing jobs and processes are carried out in accordance with written job descriptions and standard work procedures.

Manufacturing personnel and quality assurance constantly monitors product property conformance. Should a nonconforming product be produced, the QA group initiates containment and corrective action procedures immediately. Both departments work together in solving the problem. The control of nonconforming products is done in accordance with written procedures to insure proper labeling, segregation and dispositioning.

The Raw Material Technician will obtain a 2-foot sample of Closure Turf and a 10' x 10' piece of Closure turf for a weight check every 9,900 linear feet (every 150,000 square feet). This will be ensured through paperwork the operator keeps on the machine. Each roll is recorded and thus flags the operator when it is time to get a test cut.

## 3. Quality Control Testing:

The Raw Material Technician should perform a standard weight check on the 10 x 10 piece of Closure Turf. The piece should be placed on a scale to obtain total product weight (backing and fiber). A tufting pile height gauge should be used to check the products pile height. All data from the weight check should be recorded on the 'Tufting Set up Sheet' and filed in the Quality Control office.

The Tufting Department Manager, Turf Manager, or Tufting Process Engineer should be alerted if any weight check comes up out of tolerance. The machine should be placed on hold for members of maintenance to adjust. Once adjusted, another weight check should be performed until the product is back in spec.

Any additional tests requested for testing that not performed internally are outsourced to an independent 3rd party laboratory.

| Property | Units | Test Method | Minimum Frequency |
|---|---|---|---|
| Total Product Weight | Oz/sq. | ASTM D 5261 | 150,000 sq. ft. |
| Yarn Tensile Strength | Lbs. | ASTM D 2256 | 150,000 sq. ft. |
| *Wide Width Tensile | Lbs. | ASTM D 4595 | 150,000 sq. ft. |

***Machine and Cross Direction are Tested**

## 4. Record Keeping and Document Control:

Procedures have been established and are maintained to control all documentation relating to the requirements of our quality management system. Documents are reviewed and approved by authorized personnel.

At the end of each week a member of Tufting Management will obtain production and testing records for Closure Turf and record into a Google Doc shared between Customer Service, Manufacturing, Corporate Quality, and Closure Turf Project Manager. This will allow Customer Service and the Closure Turf Project Manager to assign rolls to specific projects and jobs.

## 5. Packaging:

All rolls are wrapped with a resistant bag allowing for protection from the elements should a roll have to be stored temporarily on site. Each roll has a label applied to it with appropriate information in order to facilitate product identification.

Rolls labels include the following:

-Roll Numbers
-Date of Production
-Dye Lot
-Roll Length

## 6. Handling, Storage and Delivery:

Handling, storage and delivery procedures are maintained to designate methods and means of handling our products in order to prevent damage and deterioration.

Proper storage facilities are utilized for the holding products and procedures are maintained for the receipt and dispatch of products to and from the storage location. The condition of the products is assessed at regular intervals in accordance with documented procedures.

## 7. Certification:

Shaw Industries can provide certification letters for finished and delivered geosynthetics as requested by the customer. The standard certification includes a letter of certification covering the product shipped on a particular bill of lading. Actual test data can be provided at the time of shipment, when requested. Per above testing frequencies not all rolls are tested but test data can be provided which is representative of the rolls in a particular shipment in addition to test data for the rolls in the shipment, which were tested.

# ATTACHMENT B

***Graphical Output of Slope Stability Analyses***

Unit Weight: 98 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °
Piezometric Line: 1

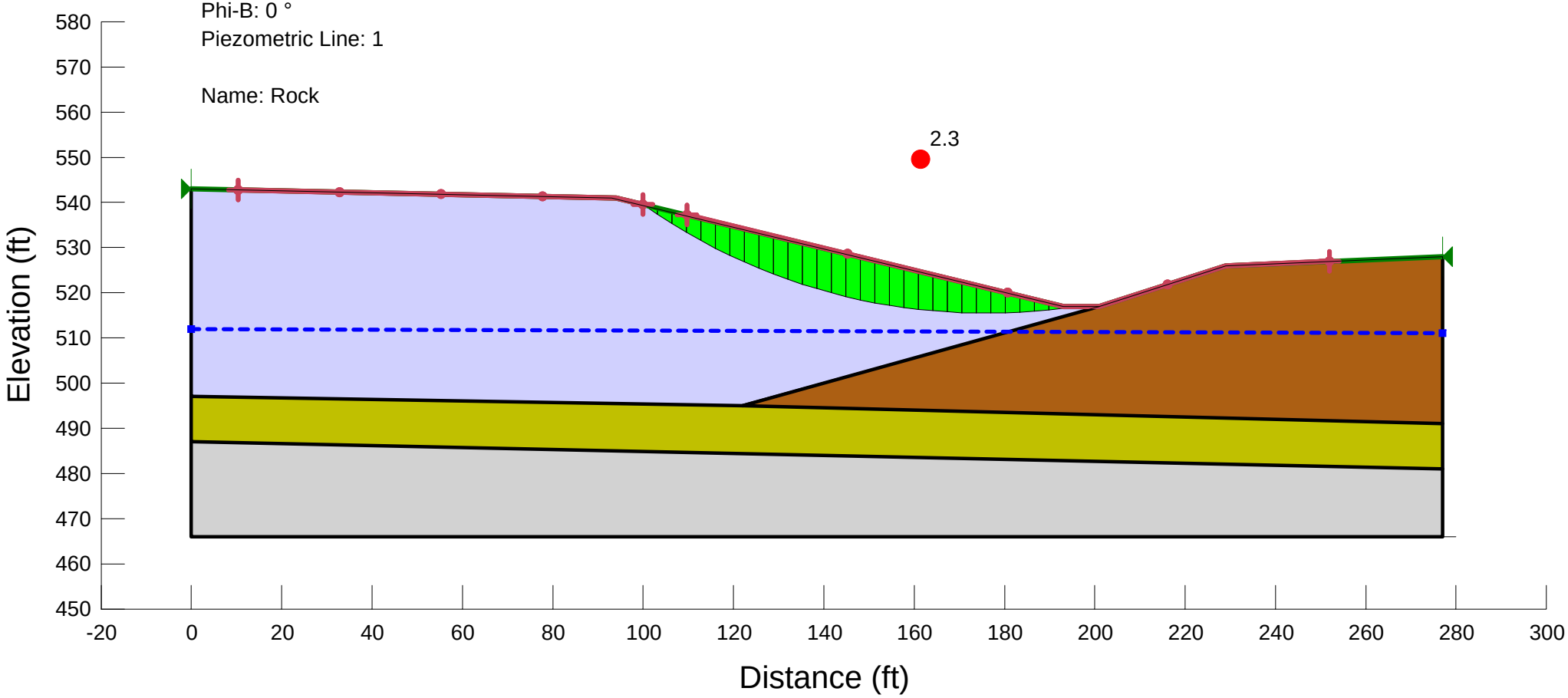
Name: Clay
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 5 °
Phi-B: 0 °
Piezometric Line: 1

Name: Berm (silty clay)
Unit Weight: 128 pcf
Cohesion': 350 psf
Phi': 27 °
Phi-B: 0 °
Piezometric Line: 1

Name: Rock

# PLANT GADSDEN ASH POND CLOSURE
# SLOPE STABILITY

## STATIC ANALYSIS



Unit Weight: 98 pcf
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Piezometric Line: 1

Name: Clay
Unit Weight: 125 pcf
Cohesion': 500 psf
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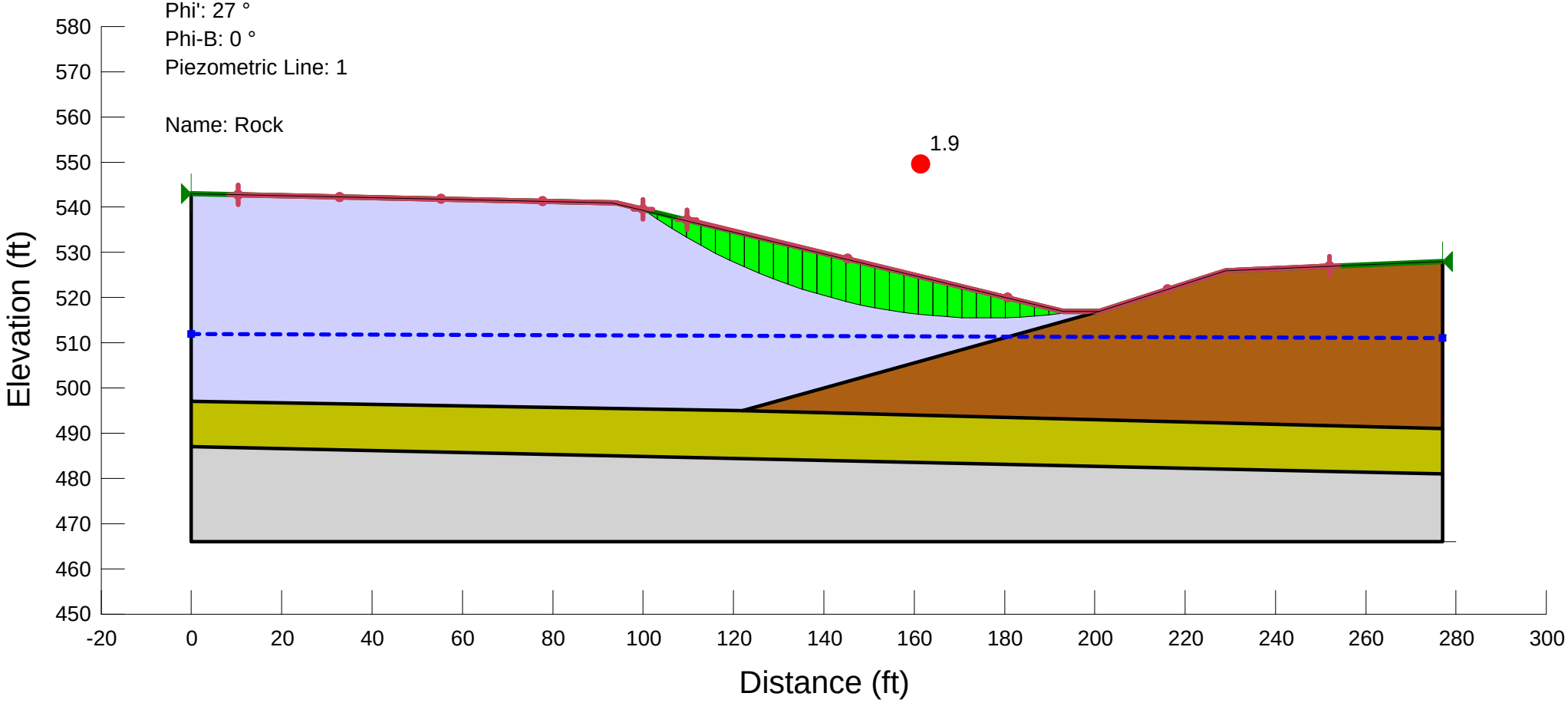
Unit Weight: 128 pcf
Cohesion': 350 psf
Phi': 27 °
Phi-B: 0 °
Piezometric Line: 1

Name: Rock

# PLANT GADSDEN ASH POND CLOSURE
# SLOPE STABILITY

## SEISMIC ANALYSIS



# APPENDIX E

Technical Specification for  Ash Pond Closure

**INQUIRY NUMBER A57207**

**SOUTHERN COMPANY GENERATION**
**ENGINEERING AND CONSTRUCTION SERVICES**

**TECHNICAL SPECIFICATIONS**
**SECTION 312300**

**FOR**

# EARTHWORK AND FINAL COVER INSTALLATION FOR ASH POND CLOSURE

**FOR**

**PLANT GADSDEN**

**ALABAMA POWER COMPANY**

Prepared By: Stacey H. Simpson Date: 3/14/2016

Reviewed By:

| Name - Discipline | Initials | Date |
|---|---|---|
| A. Joshua A. Lippert – ESFS Land & CCR | JAL | 3/16/2016 |
| B. Thomas Bordelon – Civil Design | TFB | 3/16/2016 |
| C. Charlie Foster - Construction | CF | 3/17/2016 |
| D. Marty Mingus – Construction Quality Control | WMM | 3/15/2016 |

Approved By: James C. Pegues-ESFS Consulting Engineer Date: 3/17/2016

REVISIONS

| NO. | DESCRIPTION | BY | REVIEWED | APPROVED | DATE |
|---|---|---|---|---|---|
| A | Issued For Inquiry | SHS | JAL/TFB/CF/WMM | JAL/TFB/CF/WMM | 3/7/2016 |
| B | Revised for Inquiry | SHS | JAL/TFB/CF/WMM | JAL/TFB/CF/WMM | 3/17/2016 |
| | | | | | |
| | | | | | |
| | | | | | |

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TABLE OF CONTENTS

**1.0 GENERAL ..... 4**
**2.0 COVER SYSTEMS AND CERTIFICATION ..... 6**
2.1 Cover Systems ..... 6
2.2 Certification ..... 7
**3.0 APPLICABLE DOCUMENTS ..... 7**
3.1 Drawings ..... 7
3.2 Codes and Standards ..... 7
**4.0 SITE CONDITIONS ..... 11**
**5.0 THIRD PARTY QUALITY CONTROL ..... 11**
**6.0 LINES AND GRADES ..... 11**
**7.0 CLEAR, GRUBBING, AND STRIPPING ..... 12**
**8.0 FOUNDATION AND SUBGRADE PREPARATION ..... 12**
8.1 Areas to Receive Fill ..... 12
8.2 Geomembrane Subgrade ..... 12
**9.0 BRIDGING LAYER ..... 13**
**10.0 STRUCTURAL EARTH FILL AND ASH FILL ..... 13**
**11.0 ASH EXCAVATION ..... 15**
**12.0 GEOMEMBRANE LINER, ENGINEERED TURF & SAND BALLAST (CLOSURETURF® COVER SYSTEM) ..... 15**
12.1 General ..... 15
12.2 Submittals ..... 16
12.3 Installation Contractor Qualifications ..... 18
12.4 Materials, Delivery and Storage ..... 18
12.5 Equipment ..... 22
12.6 Geomembrane Installation ..... 22
12.7 Geomembrane Field Seaming ..... 24
12.8 Geomembrane Field Trial Seams ..... 25
12.9 Geomembrane Destructive Seam Testing for Fusion and Extrusion Seaming ..... 25
12.10 Geomembrane Repair Procedures ..... 26
12.11 Verification of Repairs ..... 27
12.12 Engineered Turf Deployment ..... 27
12.13 Equipment on Engineered Turf ..... 28
12.14 Engineered Turf Repair Procedure ..... 29
12.15 Sand Ballast Infill ..... 29
12.16 ArmorFill™ E Application ..... 30
12.17 HydroBinder™ Infill Installation ..... 30
12.18 HydroBinder™ Repair Procedures ..... 32
12.19 Anchor Trench ..... 33
12.20 Geomembrane Acceptance ..... 33
**13.0 COMPOSITE COVER SYSTEM ..... 34**
13.1 General ..... 34
13.2 Submittals ..... 34
13.3 Geomembrane Contractor Qualifications ..... 35

13.4 Geomembrane Material ..... 35
13.5 Equipment ..... 37
13.6 Geomembrane Installation ..... 37
13.7 Geomembrane Field Seaming ..... 39
13.8 Geomembrane Field Trial Seams ..... 39
13.9 Geomembrane Destructive Seam Testing for Fusion and Extrusion Seaming ..... 40
13.10 Geomembrane Repair Procedures ..... 41
13.11 Verification of Repairs ..... 42
13.12 Geocomposite Contractor Qualifications ..... 42
13.13 Geocomposite Labeling, Delivery, Storage, and Handling Requirements ..... 43
13.14 Geocomposite Material Properties ..... 43
13.15 Geocomposite Placement ..... 44
13.16 Anchor Trenches ..... 45
13.17 Protective Cover Soils ..... 45
13.18 Topsoil ..... 46
**14.0 SEDIMENT AND EROSION CONTROL ..... 46**
**15.0 VEGETATION ..... 46**
**16.0 RECORDS ..... 47**
16.1 Quality Control Records ..... 47
16.2 Record Topographic Survey ..... 48

# INQUIRY NUMBER A57207

# TECHNICAL SPECIFICATIONS

# EARTHWORK AND FINAL COVER INSTALLATION FOR ASH POND CLOSURE

## 1.0 GENERAL

1.1 Plant Gadsden located in Gadsden, Etowah County, Alabama has decommissioned its coal fuel infrastructure. As a result, the ash pond will be closed under the requirements of Section 257.100 of 40 CFR Part 257 Subpart D, known hereafter as the “CCR Rule”. The ash pond closure strategy at Plant Gadsden comprises re-grading the dry ash stack in the Upper Pond as needed to achieve a minimum 3% slope, consolidating the ash in the Lower Pond to about 30 acres in the northern portion of the pond and clean closing the remaining portion of Lower Pond. A continuous cover will be constructed over the re-graded Upper Pond and consolidated ash in the Lower Pond.

1.2 These Specifications, all related attachments and associated documents cover the furnishing of all materials (unless otherwise noted), labor, and supervision required for the in-place closure of the ash pond, including installation of a final cover system for the ash pond as described herein and presented on the Closure Drawings, and the technical and construction requirements, including notes, specifications, and design data contained in the Drawings. The Drawings and Notes are an integral part of these Specifications.

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, and to construct the final cover system as specified in the contract documents.

c) The term “Construction Site Manager” (CSM) 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 CSM 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 CSM or his authorized representative.

f) The terms “CQC Firm”, “CQC Inspector”, and “CQC Professional Engineer” refer to the Contractor’s third party firm responsible for construction quality control monitoring, testing and documentation for all work performed during the construction of the facility.

1.4 Any discrepancies between the Drawings noted in Section 3.1 and the provisions of 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 written dimensions, the written dimensions shall govern.

1.5 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).

1.6 As necessary, the Purchaser will file for a National Pollutant Discharge Elimination System (NPDES) Construction General Permit for storm water discharge under ALR100000 (discharges from construction activities that result in a total land disturbance of one acre or greater and sites less than one acre but are part of a common plan of development or sale) from the Alabama Department of Environmental Management (ADEM). The Contractor shall be responsible for obtaining any other necessary permits for conducting the work covered by these Specifications.

1.7 All land disturbing activities shall be consistent with the minimum standards in the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas*, latest revision.

1.8 Installation and maintenance of erosion and sediment control measures (e.g. “BMPs”) and monitoring of surface waters during construction, if required, shall be performed by the Contractor in accordance with the NPDES Construction General Permit (Permit Number ALR100000) and the Construction Best Management Practices Plan (CBMPP), respectively.

1.9 The Contractor shall provide methods, means, and facilities to prevent contamination of the soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by the construction activities. Toxic liquids, chemicals, fuels, and lubricants shall be deposited into containers for subsequent removal offsite in accordance with all applicable federal, state, and local codes and standards.

1.10 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. The Purchaser’s acceptance of the Contractor’s list of equipment shall not be construed to mean that the listed equipment is adequate or sufficient to perform the work or that additional equipment shall not be required to maintain the schedule or perform the work specified herein.

1.11 The Contractor shall furnish appropriate equipment for minimizing fugitive dust. The Contractor shall continually take steps necessary to minimize dust created by all equipment, vehicles, work activities, or storage areas. These steps shall include, but not be limited to, watering roads and work areas. Open-bodied trucks handling sand, stone, gravel, or earth shall be covered if the truck is traveling off site. The Contractor shall not deposit dirt, mud, or debris on public roads, plant roads, or adjacent properties.

1.12 The Contractor is responsible for the unloading, handling, and storage of all materials supplied by him and shall ensure that all materials are handled and stored so as to prevent any damage. Materials damaged during handling, shipping, or storage shall be replaced at no cost to the Purchaser. The Contractor shall store materials only in areas as directed by the Purchaser. Any security measures taken for the protection of the Contractor's equipment shall be at the Contractor's expense.

1.13 The Contractor shall have the responsibility for obtaining a third party CQC Firm for testing for all work performed during the construction of the facility. The Contractor

should submit all certifications and inspector qualifications required by this Specification to the Purchaser to be reviewed and approved prior to the start of work.

1.14 All measuring and testing equipment (M&TE) calibration documentation, for both contractor equipment and third-party CQC equipment, should be submitted to the Purchaser for review and approval prior to the start of work.

1.15 All earthwork, including ramps and access roads, done for the convenience of the Contractor, shall be done at his expense unless instructed to be completed by the purchaser. Such work will be restored to its original elevation, or the elevation indicated on the drawings, at the Contractor's expense if the Purchaser so desires.

1.16 The Contractor shall install, at his expense unless expected to be completed by the Purchaser, any drainage piping required because of the Contractor's mode of operation including ramps and roads.

1.17 The Contractor and the CSM, or his representative, shall mutually determine a designated path for vehicles that are used by the Contractor or that haul material to and within the site for the Contractor. The Contractor's vehicles outside the designated traffic path must not obstruct or hinder traffic flow on the site. The Contractor shall provide traffic control during roadway related construction activities and material deliveries. This shall be coordinated with other activities at the site. If within active and congested areas, traffic control shall include flag persons, barriers, and other control aids to provide for the safe routing of traffic in the affected area.

1.18 At all times, the Contractor shall provide protection to prevent damage to existing facilities, roads, underground pipes, and other Purchaser's equipment and property that may be on site. The Contractor will be liable for any damages to APC property caused by the Contractor.

1.19 The Purchaser shall have the right to inspect the Contractor's work as deemed necessary. The Purchaser shall have the right to inspect the Contractor's work locations, to inspect the materials in use, to meet and discuss with the Contractor the progress of the work and the manner in which it is being done. The Purchaser shall have the authority to reject materials or suspend any work not performed in accordance with these Specifications. The Contractor shall be responsible for performing the work in strict accordance with these Specifications, and the presence of the Purchaser's Representative shall not relieve the Contractor and his subcontractors of that responsibility.

1.20 Piezometers and groundwater monitoring wells located in the site area shall not be damaged or destroyed by construction activities. The Contractor shall provide Purchaser approved measures to protect the piezometers and wells in the site area. Any monitoring well(s) damaged or destroyed by the Contractor and/or his activities shall be replaced at no cost to the Purchaser, within a timeframe acceptable to the Purchaser.

## 2.0 COVER SYSTEMS AND CERTIFICATION

### 2.1 Cover Systems

2.1.1 Closure of the Ash Pond shall be accomplished by the installation of a final cover system designed to minimize infiltration and erosion. Two alternate final cover systems are presented:

a) Final Cover System, Alternative 1, will consist of the ClosureTurf® system as

manufactured by Watershed Geosynthetics and Agru America. This system consists of an Agru 50 mil linear low density polyethylene (LLDPE) SuperGripnet® geomembrane, engineered turf, and sand ballast.

b) Final Cover System, Alternative 2, a composite cover system consisting of a 40 mil linear low density polyethylene (LLDPE) textured geomembrane overlain by a geocomposite drainage material, a minimum 18 inches of protective cover soil, and a minimum 6 inches of topsoil supporting a permanent vegetative cover.

### 2.2 Certification

The installation of the final cover system for the ash pond shall be certified as being constructed in accordance with the CCR Rule. This certification shall be performed by a professional engineer registered to practice in the State of Alabama and placed in the ash pond operating record within 60 days of the completion of all construction activities. This Certification will be provided by the Purchaser or the Purchaser's Representative.

## 3.0 APPLICABLE DOCUMENTS

### 3.1 Drawings

The Drawing List is contained on the Drawings.

### 3.2 Codes and Standards

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.

If codes or standards are found to conflict with each other, it should be brought to the attention of the Purchaser to determine which is most applicable.

Occupational Safety and Health Administration

- Occupational Safety and Health Act of 1970

ASTM International (ASTM)

- ASTM C 33 – Standard Specification for Concrete Aggregates
- ASTM C 117 – Standard Test Method for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 136 – Standard Test Method for Sieve Analysis of fine and Coarse Aggregates
- 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 (12 400 ft-lbf/ft$^3$ (600 kN-m/m$^3$))
- 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 (Graves Tear) 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 1556 – Standard Test Method for Density and Unit Weight of Soil In - Place by the Sand Cone Method
- ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m$^3$))
- ASTM D 1587 - Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
- 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 2937 - Standard Test Method for Density of Soil In Place by the Drive Cylinder Method
- ASTM D 3017 – Standard Test Method for Water Content of Soil and Rock In Place Nuclear Methods (Shallow Depth)
- 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 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

- 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 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
- 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 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- ASTM D 4959 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method
- 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 5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- 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 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 6938 Rev B - Standard Test Method for In-Place Density and Water Content of Soil and Soil – Aggregate In Place by Nuclear Methods (Shallow Depth)
- ASTM D 7005 - Determining the Bond Strength (Ply Adhesion) of Geocomposites
- ASTM D1204 -Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
- ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- ASTM D1907 - Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method
- ASTM D2256 -Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method
- ASTM D3218 -Standard Specification for Polyolefin Monofilaments
- ASTM D5323 – Standard Test Method for Determination of 2% Secant Modulus for Polyethylene Geomembranes
- ASTM D5617 – Standard Test Method for Multi-Axial Tension Test for Geosynthetics
- ASTM D6913 -Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D7007 – Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials

Geosynthetic Research Institute (GRI) Standards

- GM 11 - Accelerated Weathering of Geomembranes using a Fluorescent UVA Device
- GM 12 - Asperity Measurement of Textured Geomembranes Using a Depth Gage
- GM 19 – Seam Strength and Related Properties of Thermally Bonded

Polyolefin Geomembranes

- GRI-GM17 – Test Methods, Test Properties, and Testing Frequency and for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

United States Environmental Protection Guidance

- Environmental Protection Agency (EPA) regulations
- EPA/600/R-93/182, September 1993, 305 pgs.
- U. S. EPA Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities"

Corps of Engineers EM-LST, Appendix VII, Falling-Head Permeability Test

Alabama Department of Environmental Management (ADEM) regulations

Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas

## 4.0 SITE CONDITIONS

4.1 The Contractor shall visit the site and acquaint himself with site conditions, utility locations, and the proposed scope of work.

4.2 The Contractor is responsible for acquiring and maintaining an excavation permit per Alabama state law.

4.3 Vibratory equipment shall have vibratory devices mechanically disengaged and rendered inoperable while operating on dikes or the ash pond.

## 5.0 THIRD PARTY QUALITY CONTROL

5.1 The Contractor shall provide to the Purchaser, for the Purchaser's acceptance and approval, the following documentation indicating that the Contractor's Third Party Quality Control firm and personnel that will participate in this Project meet the minimum experience and qualifications indicated herein:

a) Qualifications of a third-party construction quality control (CQC) Inspector for the placement and compaction of the compacted structural fill.

c) Qualifications of a third-party CQC Inspector for installation of the ClosureTurf® Final Cover System documenting the minimum requirements of Section 12.3.5 of these Specifications.

d) Statement of qualifications of a third-party CQC Inspector for installation of the geomembrane liner and drainage geocomposite installation documenting the minimum requirements of Section 13.3.3 of these Specifications.

e) Qualifications of the third party's soil testing laboratory contracted to perform the CQC testing for the structural earth fill.

## 6.0 LINES AND GRADES

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 such 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 the changes in plan and/or sections resulting in changes in quantities of materials.

## 7.0 CLEAR, GRUBBING, AND STRIPPING

7.1 Prior to any clearing or grubbing operations, initial BMPs shall be installed. Erosion control measures and best management practices shown in the CBMPP shall be followed.

7.2 The footprint of the ash pond shall be cleared of any woody vegetation prior to excavation and/or fill operations.

7.3 Ash-laden roots on grubbed and stripped material shall be disposed of in an off-site landfill approved by the Purchaser.

7.4 Spoil material shall be disposed of in an off-site landfill approved by the Purchaser.

## 8.0 FOUNDATION AND SUBGRADE PREPARATION

### 8.1 Areas to Receive Fill

8.1.1 The Contractor shall prepare, install and maintain erosion and sediment control measures, as required by the CBMPP. If measures beyond those in the CBMPP are deemed necessary, contact the CSM to have those reviewed and approved by the CBMPP engineer and the CBMPP updated PRIOR to the measures being installed.

8.1.2 Topsoil material and the material to be used as structural earth fill shall be stockpiled separately in a location specified by the Purchaser's Representative.

8.1.3 Proof-roll the entire subgrade utilizing loaded, off-road trucks with a gross machine weight, including payload, of 40 tons. The subgrade is considered to have passed the proof-roll if minimal heaving is observed and the subsequent lift of fill is able to achieve the applicable compaction standard. Any areas failing proof-roll shall be undercut and replaced with structural soil fill and re-rolled, or modified through the use of bridging layer as described in section 9.0.

8.1.4 Prior to receiving structural earth fill, the foundation areas shall be scarified by harrowing or other suitable means. The moisture content of the roughened surface shall be adjusted to within the limits provided in section 10.1.9. No fill shall be placed on any part of the subgrade until such areas have been conditioned, proof-rolled, inspected, and approved in writing by the Contractor's CQC Inspector and the Purchaser.

8.1.5 Work flow shall be planned such that the first embankment fill lift is placed soon after subgrade compaction to minimize subgrade exposure to inclement weather.

### 8.2 Geomembrane Subgrade

8.2.1 The Contractor shall maintain the subgrade suitability and integrity until the geomembrane installation is completed and accepted.

8.2.2 The Contractor shall repair rough areas and any damage to the subgrade caused by installation of the geomembrane.

8.2.3 Subgrade shall be smooth, uniform, firm and free from rocks or other debris. For deployment over soil subgrade, no rocks or protrusions greater than 1/2-inch in diameter shall be exposed at the subgrade surface.

8.2.4 The Contractor shall verify that the surface on which the geomembrane will be installed

is acceptable. In so doing the Contractor shall assume full liability for the accepted surface.

8.2.5 The Contractor shall submit written certificates of subgrade acceptance, signed by the Contractor, CQC Inspector, and the Purchaser's Representative, for each area prepared for geomembrane placement.

8.2.6 The beginning of installation means acceptance of existing conditions. The Contractor shall be responsible for maintenance of the geomembrane covered subgrade once installation of geomembrane begins.

## 9.0 BRIDGING LAYER

9.1 Where it can be demonstrated that it is impracticable to proof-roll the subgrade as specified in section 8.1 or achieve the degree of compaction specified in section 10.1, a bridging layer may be placed.

9.2 The bridging layer shall be of sufficient thickness to allow the passage of earthmoving equipment with minimal surface heaving, but no more than four (4) feet in thickness.

9.3 The bridging layer shall be end-dumped and spread in a single layer. The compaction requirements of Section 10.1 will not apply to the bridging layer.

9.4 Acceptable materials for the construction of the bridging layer include structural earth fill as defined in Section 10.1, ash fill, sand, and rock fill materials.

9.5 Any ash fill used in the bridging lift must have been excavated from the ash pond and not at any point been transported out of the pond.

9.6 Geogrid reinforcement may be used as part of the bridging layer. All geogrid should be placed in accordance with the manufacturer's recommendations.

## 10.0 STRUCTURAL EARTH FILL AND ASH FILL

10.1 The Contractor shall provide third party CQC testing for all earth work performed for the closure of the Ash Pond.

10.2 Compacted earth fill should generally consist of sandy clays (CL), clayey silts (ML), clayey sands (SC), and clayey to silty sands (SC/SM) from an off-site borrow area that is permitted by the Alabama Department of Environmental Management (ADEM).

10.3 No earth fill or ash shall be placed on any part of the subgrade until such areas have proof-rolled, inspected, and approved in writing by the soils CQC Inspector and the Purchaser's Representative.

10.4 Ash shall be placed in uniform layers of 8 inches, nominal thickness, loose measurement. The thickness of each layer shall be kept uniform with the necessary grading equipment. Particular care must be used to obtain the required compaction along the edges of fill slopes.

10.5 Structural fill should be placed in uniform layers of 8 inches, nominal thickness, loose measurement. The thickness of each layer shall be kept uniform 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 fill slopes.

10.6 Vibratory compaction equipment is not permitted to operate on the dike or ash pond. Equipment that has vibratory capability must have the vibratory component mechanically disengaged and rendered inoperable while operating on the dike or ash pond.

10.7 Contractor shall not use construction equipment that results in contact pressures exceeding 3,000 psf on top of the dike. Exceptions may be allowed with the approval of the Purchaser.

10.8 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 Purchaser's Representative, before the succeeding layer is placed.

10.9 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 earth fill materials and all stones and clay clods greater than three inch maximum. Clay clod size may be reduced in size to meet this Specification by disking, tilling or other means. The distribution of materials throughout the structural fill shall be essentially uniform and free of any lenses, pockets, streaks, or layers of materials differing substantially in texture, moisture content, or gradation from the surrounding material.

10.10 The compacted structural fill and ash subgrade beneath the LLDPE component of the final cover shall be free of roots, debris, and all stones and clay clods greater than ½-inch maximum dimension. Clay clod size may be reduced in size to meet this Specification by disking, tilling or other means.

10.11 Structural earth fill and ash material shall be compacted to a minimum of 95% of the relative maximum dry density as determined by the standard Proctor compaction test (ASTM D 698). The moisture content of the earth fill at the time of placement shall be within -3% and +3% of the optimum moisture obtained by standard Proctor compaction test.

10.12 When moisture content is too low, the moisture content shall be adjusted to within the above limits prior to compaction. Moisture adjustment shall be achieved by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and harrowing of the layer shall be done after deposition, but before compaction.

10.13 If the moisture content is too high, the Contractor will be permitted to disk in place or stockpile and disk the earth fill material to promote drying to bring it back within the allowable moisture range.

10.14 The Contractor will be required to remove any compacted material that does not comply with the compaction requirements and replace the compacted earth fill to comply with this Specification at his own expense.

10.15 Structural earth fill or ash which cannot be compacted with roller equipment because of inadequate clearances shall be spread in four-inch layers and compacted with hand-guided power tampers to the extent required by these Specifications. Rocks two inches and greater, in any dimension, roots, and debris shall be removed from the fill and disposed of in an approved manner.

10.16 Field density and moisture content tests shall be performed daily in all types of material being placed. At a minimum, one in place density test shall be performed for each lift for each day fill material is placed.

10.17 For earth fill and ash material, at least one field moisture content and density test shall be performed for every 1,000 cy of fill (1 test per acre of lift area) or more often if deemed necessary in the opinion of the Purchaser's Representative.

10.18 If an in-place density or moisture test fails to meet the requirements for compaction and/or moisture, the area shall be reworked and then retested. If, however, the second

test fails to meet the criteria, the area failing the criteria shall be delineated, and reworked or removed, and then retested. The areas requiring reworking/recompacting shall be noted on record drawings and reported.

10.19 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 Purchaser's Representative, to require one or two-point Proctor checks 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.

10.20 The surveyed location, lift designation, and elevation or depth of the field density and moisture tests (passing, failing, and retests) shall be recorded and noted on the respective test records. The locations of these tests shall be shown on a figure or drawing.

10.21 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 above.

10.22 If the construction of the embankment 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.

10.23 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to ensure that the correct reference Proctor curves are being used for compaction check.

10.24 Earth fill areas, ditches, and other disturbed areas outside the cover area shall be grassed upon reaching final grade in accordance with these Specifications, the CBMPP and the Vegetation Schedule shown on the Drawings.

## 11.0 ASH EXCAVATION

11.1 All ash and visibly ash-impacted material should be removed from areas to be clean-closed. Excavation should continue to a minimum depth of 6 inches below visibly-impacted materials.

11.2 The excavated grades shall be inspected by the Purchaser's Representative upon completion of excavation to verify that the complete removal of ash and ash/soil mixtures has been accomplished.

11.3 If ash or ash/soil mixtures are identified during the inspection of the excavation grades, the Contractor shall excavate the identified areas until complete removal has been accomplished.

11.4 Ash shall not be allowed to discharge to State waters or the environment during ash pond closure activities.

## 12.0 GEOMEMBRANE LINER, ENGINEERED TURF & SAND BALLAST (CLOSURETURF® COVER SYSTEM)

### 12.1 General

12.1.1 Closure Turf™ is one of two final cover systems being considered for the Plant Gadsden ash pond.

12.1.2 ArmorFill™ E, a specialty component of the ClosureTurf® system, is a proprietary polymer-based product developed by Watershed Geosynthetics specifically to bind the ASTM-C33 sand infill component of the ClosureTurf® system for long-term performance applications.

12.1.3 HydroBinder™, a specialized component of the ClosureTurf® system, is a proprietary cementitious product used as an infill component of the ClosureTurf® system for high-velocity applications in swales and drainage channels.

12.1.4 HydroBinder™ shall be used for the slope drainage system at locations shown on the drawings.

12.1.5 ArmorFill™ E shall be used at transitions between Closure Turf® and HydroBinder™ as specified on the drawings.

12.1.6 The structured geomembrane shall be comprised of 50 mil linear low density polyethylene (LLDPE) Super Gripnet® structured geomembrane material as manufactured by Agru America. Product properties are listed in Table 1 in section 12.4.

12.1.7 The Engineered Turf layer consists of two polypropylene 3.5 oz/sq yd woven geotextiles tufted with polyethylene yarns overlying the 50 mil LLDPE structured geomembrane. Product properties are listed in Table 2 in section 12.4.

12.1.8 Color of the Engineered Turf layer shall be of standard color (100% green), or enhanced color (75% green + 25% tan).

12.1.9 The structured geomembrane and the engineered turf must be purchased as a system from the same supplier to ensure desired performance.

12.1.10 The sand infill for the Engineered Turf ballast shall consist of grain size distributions that are shown in Table 3 in section 12.4. Optimum infill sand for ClosureTurf® would be a medium particle size sand meeting ASTM C33 for fine aggregates. All infill material shall meet ASTM C33 specifications unless otherwise approved by the Purchaser.

12.1.11 The HydroBinder® infill for the Engineered Turf ballast shall consist of the proprietary cementitious product and meet the requirements as shown in Table 4 of this Section. All cementitious infill mix design shall meet ASTM C387 specifications for high strength mortars unless otherwise approved by the Purchaser.

12.1.12 A Manufacturer's Representative shall be on site during the initial phase of the ClosureTurf® installation and ArmorFill/HydroBinder application to provide assistance to the Contractor.

12.1.13 At the request of the Purchaser or the Purchaser's Representative, representative product samples of the materials used on this project shall be provided for the Purchaser's use in confirmation testing for material properties.

## 12.2 Submittals

12.2.1 The ClosureTurf® installation contractor shall be an experienced and trained ClosureTurf® installer and be able to provide documentation that they have manufacturer's approval status. The ClosureTurf® installation contractor shall also utilize a licensed installer for the sand infill installation and ArmorFill/HydroBinder application of ClosureTurf® if not licensed to install the infill themselves. A Copy of Installer's Letter of Approval or License issued by the Manufacturer shall be provided to the Purchaser.

12.2.2 The Contractor shall provide to the Purchaser qualification statements from the geomembrane Installation Contractor, and a Statement of Qualifications for the CQC Inspector and laboratory documenting the minimum requirements of section 12.3 of these Specifications.

12.2.3 The Contractor shall provide the manufacturer product data sheets for all material to be provided for the project.

12.2.4 The Contractor shall provide to the Purchaser the Manufacturer's Quality Control (CQC) Program, including tests, test procedures, and frequencies, for manufacture of all materials for this project.

12.2.5 A copy of the manufacturer's quality control results shall be submitted to the Purchaser's Representative a minimum of seven calendar days prior to geomembrane shipment to the site. Quality control testing shall be performed by the manufacturer in accordance with the test procedures, and frequency listed in the Quality Control Program and as approved by the Purchaser's Representative. Prior to delivery the following shall be submitted to the Owner's Representative for Review:

a) Certification stating all geomembrane rolls are furnished by one manufacturer, and all rolls are manufactured from one resin type.

b) Copies of quality control certificates issued by the Manufacturer. The quality control certificates shall include:

1. Roll numbers and identification;
2. Sampling procedures; and
3. Results of quality control tests, including descriptions of the test methods used.
4. The results of the manufacturing quality control tests shall meet or exceed the property values listed in section 12.4.
5. Geomembrane delivery, storage, handling and installation instructions.

12.2.6 Extrudate Beads and/or Welding Rods:

a) Statement of production dates.

b) Certification stating all extrudate is from one manufacturer and is the same resin type as the resin used to manufacture the geomembrane rolls.

c) Copies of quality control certificates issued by the Manufacturer.

12.2.7 The Engineered Turf manufacturer shall provide inspection records of the tufting procedures for the Turf material. These will include visual inspection records of the following properties every 150,000 sq. ft:

a) Tufting Gauge

b) Pile height

c) Roll Length and roll numbers.

12.2.8 The Manufacturer shall also provide documentation on the geotextile product and yarn manufacturer minimum properties for the Engineered Turf.

12.2.9 The Engineered Turf manufacturer shall provide pantone color codes available for Engineered Turf component.

12.2.10 Prior to mobilization of the Installer to the site, Contractor shall submit shop drawings indicating panel layout and field seams 14 calendar days prior to installation of geomembrane.

12.2.11 The Contractor shall furnish the Purchaser upon completion of the project:

a) A one-year warranty provided by the Geosynthetics Installer against defects in

workmanship. Warranty conditions concerning limits of liability will be evaluated and must be acceptable to the Owner.

b) As-built Geomembrane Panel Drawings. As-built Drawings shall include panel locations, panel identification numbers, geomembrane roll numbers for each panel, seam caps, destructive sample locations, and repairs.

12.2.12 The Contractor shall submit a certification from the manufacturer of the geomembrane that the raw materials, and finished geomembrane rolls, meet the physical property requirements indicated in these Specifications.

12.2.13 After installation, the Contractor shall submit a certification, signed by the Contractor and signed and sealed by the CQC Firm's Professional Engineer, that the geomembrane and ClosureTurf® cover system was placed in accordance with these Specifications.

## 12.3 Installation Contractor Qualifications

12.3.1 The Superintendent shall have supervised the installation of a minimum of 2,000,000 square feet of polyethylene geomembrane and 500,000 square feet of geotextile.

12.3.2 The master seamer shall have experience seaming a minimum of 1,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site.

12.3.3 All other seaming personnel shall have seamed at least 100,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Personnel who have seamed less than 100,000 square feet of polyethylene geomembrane shall be allowed to seam only under the direct supervision of the master seamer or Superintendent.

12.3.4 The installation crew shall attend the manufacturer's course on installation procedures for the ClosureTurf® system. Certificates of course completion by members of the installation crew shall be submitted by the Contractor.

12.3.5 The Contractor shall provide a third-party inspector for construction quality control (CQC) of the LLDPE installation. The LLDPE inspector shall be an individual or company who is independent from the geomembrane manufacturer and installer, who shall be responsible for monitoring and documenting activities related to the CQC of the LLDPE throughout installation. The inspector who is on site monitoring the installation activities every day that they are taking place, shall have provided CQC services for the installation of the proposed or similar products for at least five completed projects totaling not less than 1,000,000 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 LLDPE inspector prior to starting work.

## 12.4 Materials, Delivery and Storage

12.4.1 The geomembrane shall be textured 50 mil thick, linear low density polyethylene (LLDPE), with a minimum 23 feet seamless width. There shall be no factory seams. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.

12.4.2 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 raw materials meet the physical property requirements indicated in the following table.

12.4.3 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.

12.4.4 The geomembrane shall be supplied in rolls; folds will not be permitted. Identify each roll with labels indicating lot number, roll number, thickness, length, width, manufacturer, and plant location.

12.4.5 Resin shall be LLDPE, new, first quality, compounded and manufactured specifically for producing LLDPE geomembrane.

12.4.6 Extrudate Rod or Bead shall be made from same resin as the geomembrane. Additives shall be thoroughly dispersed. The rods or beads shall be free of contamination by moisture or foreign matter.

12.4.7 All rolls of Engineered Turf delivered to the site shall be inspected for the following:

a) The Engineered Turf is wrapped in rolls with protective covering.
b) The rolls are not damaged during unloading.
c) Protect the Engineered Turf from mud, soil, dirt, dust, debris, cutting, or impact forces.
d) Each roll must be marked or tagged with proper, original, manufacturer - applied identification.
e) Separate damaged rolls from undamaged rolls and store at locations designated by the Purchaser until proper disposition of material is determined by the Purchaser.
f) The Purchaser will be the final authority regarding damage.
g) Separate rolls without proper documentation and store until the Purchaser's Representative approval is received.

12.4.8 The materials shall be stored in space allocated by the Purchaser.

12.4.9 The materials shall be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

12.4.10 The materials shall be stored on level prepared surface (not on wooden pallets).

12.4.11 The materials shall be stacked per Manufacturer's recommendation but no more than three rolls high.

12.4.12 Appropriate handling equipment shall be used to load, move or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader and roll bars for deployment. Dragging panels on ground surface will not be permitted.

12.4.13 The Installer is responsible for storage, and transporting material from storage area to installation area.

12.4.14 Damaged geomembrane will be documented by the Purchaser's Representative.

12.4.15 Damaged geomembrane may be repaired, if approved by the Purchaser's Representative, in accordance with these Specifications or shall be replaced at no additional cost to the Owner.

| TABLE 1 - TEXTURED LLDPE GEOMEMBRANE - 50 MIL Super GripNet by Agru America | | | |
|---|---|---|---|
| Property | Frequency | Test Method | Minimum Average Value |
| Raw Materials:<br>Density<br><br>Melt Index<br><br>Oxidative Induction Time (OIT)<br>Standard OIT<br>Or<br>High Pressure OIT | <br>Once per 200,000 lbs of resin<br>Once per 200,000 lbs resin<br>Once per 200,000 lbs resin | <br>ASTM D 1505<br>ASTM D 792<br>ASTM D 1238,190˚C, 2.16kg<br><br><br>ASTM D 3895<br><br>ASTM D 5885 | <br>Max. 0.939 g/cc<br><br>≤ 1.0 g/10 min.<br><br><br>100 min. (min. avg.)<br><br>400 min. (min. avg.) |
| Thickness<br>Minimum Average, mils<br>Lowest individual of 8 of 10 readings, mils | per roll | ASTM D 5994 | <br>50<br>45 |
| Drainage Stud Height (min. avg) | ASTM D7466 | | 130 mil |
| Friction Spike Height (min. avg) | ASTM D7466 | | 175 mil |
| Asperity Height | Every 2nd Roll | ASTM D 7466<br>GRI GM12 | 10 mil |
| Density | Once per 200,000 lbs of resin | ASTM D 1505<br>ASTM D 792 | Max. 0.939 g/cc |
| Tensile Properties (avg. both directions) (min. avg)<br>Yield Strength<br>Break Strength<br>Yield Elongation<br>Break Elongation | 20,000 lbs. | ASTM D 6693, Type IV | <br><br>N/A<br>110 lb/in<br>N/A<br>300 % |
| Tear Resistance | 45,000 lbs | ASTM D 1004 | 30 lb (min. avg.) |
| Puncture Resistance | 45,000 lbs | ASTM D 4833 | 55 lb (min. avg.) |
| 2% Modulus lb/in (max) | Per formulation | D5323 | 3000 (max) |
| Axi-Symmetric Break Resistance Strain - % (min.) | Per formulation | D5617 | 30 |
| Carbon Black Content | 20,000 lbs. | ASTM D 4218 | 2.0 % - 3.0 % |
| Carbon Black Dispersion[1] | 45,000 lbs. | ASTM D 5596 | Note (1) |
| Oxidative Induction Time (OIT)<br>Standard OIT, minutes | 200,000 lbs | ASTM D 3895, 200˚C, 1 atm $0_2$ | <br>≥140 min. |
| Oven Aging @ 85ºC<br>High Pressure OIT (min. avg.) - % retained after 90 days | Per Each Formulation | ASTM D5721<br>ASTM D5885, 150˚C, 500psi $0_2$ | <br>60% |
| UV Resistance<br>High Pressure OIT - % retained after 1600 hours[10] | Per Each Formulation | ASTM D7238<br><br>ASTM D5885, 150˚C, 500psi $0_2$ | (20hr. cycle @ 75˚C/4hr. dark condensation @60˚)<br>35% |

Notes:

1 Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than one (1) view from Category 3.

| TABLE 2 - ENGINEERED TURF COMPONENT | | | |
|---|---|---|---|
| Property | Frequency | Test Method | Minimum Average Value |
| CBR Puncture | Once per 100,000 sf | ASTM D 6241 | 900 lbs (MARV) |
| Tensile Product (MD/XD) | Once per 100,000 sf | ASTM D 4595 | 1000 lb/ft min. (MARV) |
| Rainfall Induced Erosion | N/A | ASTM D 6459 | <0.45% Infill Loss 6 in/hr |
| Aerodynamic Evaluation | N/A | GTRI Wind Tunnel | 120 mph with max. uplift of 0.12 psf |
| Turf Fiber UV Stability | N/A | ASTM G147 | >60% retained tensile strength @ 100 yrs (projected) |
| Backing system UV Stability (Exposed) | N/A | ASTM G154 Modified Cycle 1, UVA340 | 110 lb/ft retained tensile strength @ 6500 hrs (projected) |
| Steady State Hydraulic Overtopping (ClosureTurf® with HydroBinder™) | N/A | ASTM D7277<br>ASTM D7276 | 5 ft overtopping resulting in 29 fps velocity & 8.8 psf shear stress for Manning N Value of 0.02 |
| Full Scale Wave Overtopping Test – Cumulative Volume (ClosureTurf® with HydroBinder™) | N/A | CSU Wave Simulator | 165,000 $ft^3$/ft |
| Full Scale Wave Overtopping Test – Max. Avg. Wave Overtopping Discharge (ClosureTurf® w/ HydroBinderTM) | | CSU Wave Simulator | 4.0 $ft^3$/s/ft |
| Transmissivity w/ underlying structured geomembrane, Normal Stress @ 50 psf & 0.33$m^2$/sec | NA | ASTM D4716 | 2.5 x $10^{-3}$ $m^2$/sec, min. |
| Internal Friction of combined components | N/A | ASTM D5321 | 35˚, min. |
| | | | |

| TABLE 3 - ENGINEERED TURF INFILL & BALLAST SAND | |
|---|---|
| ASTM C33 | |
| Sieve | Percent Passing |
| 3/8 in. (9.5mm) | 100 |
| No. 4 (4.75 mm) | 95 – 100 |
| No. 8 (2.36 mm) | 80 – 100 |
| No. 16 (1.18 mm) | 50 – 85 |
| No. 30 (600 µm) | 25 – 60 |
| No. 50 (300 µm) | 5 – 30 |
| No. 100 (150 µm) | 0 - 10 |
| | |

| TABLE 4 – ENGINEERED TURF HydroBinder™ INFILL & BALLAST | |
|---|---|
| Product | 80 lb. bags or 3000 lb. bulk super sacks |
| Cement | Portland Cement Brand meeting ASTM C150, Type I or II. Only one brand used throughout project. |
| Cementitious Infill Mix | ASTM C387 for high strength mortars. Min. 28 day compressive strength of 5000 psi. |

## 12.5 Equipment

12.5.1 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 6 psi.

12.5.2 In areas of heavy traffic, the geomembrane shall be protected by placing protective cover, with a minimum thickness of 3 feet, over the geomembrane.

12.5.3 If the geomembrane is damaged by vehicular traffic, it shall be replaced at the Contractor's expense.

## 12.6 Geomembrane Installation

12.6.1 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, solvents, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. Stacking of the rolls is allowed following manufacturer's recommendations.

12.6.2 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.

12.6.3 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 installation procedure for the Purchaser's review fourteen days prior to installation.

12.6.4 All seam and non-seam areas of the geomembrane shall be inspected by the CQC 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.

12.6.5 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.

12.6.6 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.

12.6.7 The geomembrane shall not be deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, in the presence of excessive winds, or in excessive heat or cold.

12.6.8 Each panel shall be marked with an "identification code" (number or letter) consistent

with the layout plan. The identification code shall be simple and logical. Markings shall not be used that permanently alter the line, such as stampings, weld marks, hydrocarbon marks, etc. The number of panels deployed in one day shall be limited by the number of panels which can be seamed on the same day. All deployed panels shall be seamed to adjacent panels by the end of each day.

12.6.9 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. The equipment shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons, deployment or other means. The placement shall be observed by the CQC Inspector and the Purchaser's Representative.

12.6.10 The Contractor shall inspect the subgrade preparation prior to liner installation. The subgrade shall be compacted in accordance with the Specifications. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with properly compacted clay liner material. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than one-half inch in diameter, or debris of any kind. The subgrade shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. The surface shall contain no rutting, cracks or tire tracks. Standing water or excessive moisture shall not be allowed.

12.6.11 The Contractor, on a daily basis, shall approve the surface on which the geomembrane 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.

12.6.12 The Contractor shall submit written Certificates of Subgrade Acceptance, signed by the Contractor, CQC Inspector, and Purchaser's Representative, for each area prepared for geomembrane installation. This shall be done prior to commencing work.

12.6.13 Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

12.6.14 Personnel working on the geomembrane shall not smoke or wear damaging shoes.

12.6.15 The method used to unroll the panels shall not cause scratches, crimps, or creases in the geomembrane.

12.6.16 Unroll panels with the spike down and the stud side up for the structured geomembrane to assure that the deployment method protects the geomembrane from scratches and crimps and protects soil surface.

12.6.17 Unroll panels with adequate tension to prevent undulations or wrinkles when placed on the ground. The spike side down prevents easy movement of the panel. Individual panels placed with more than 5 undulations greater than 2 inches in height shall be deployed again.

12.6.18 Use a method to minimize wrinkles, especially differential wrinkles between adjacent panels.

12.6.19 Place adequate hold-downs to prevent uplift by wind. 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).

12.6.20 Protect geomembrane in heavy traffic areas by geotextile, extra geomembrane or other suitable materials.

12.6.21 Do not allow vehicular traffic on unprotected geomembrane surface.

12.6.22 Panels deployed on grades steeper than 12% shall extend a minimum of 3 feet beyond the crest or toe of that grade with no cross seams.

12.6.23 Visually inspect sheet surface during unrolling of geomembrane and mark faulty or suspect areas for repair or test. Replace faulty (requires more than one patch per 200 square feet) geomembrane stock at no additional cost to the Owner.

12.6.24 Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F measured 6 inches above the membrane surface. Placement can proceed below 32° F only after it has been verified by the CQC 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.

12.6.25 After panel deployment and before welding, any horizontal wrinkles must be walked down or wiggled down the slope to minimize wrinkles after welding.

12.6.26 Limit maximum wrinkle height to 4 inches during warmer ambient temperatures and 2 to 3 inches in cooler temperatures.

12.6.27 Geomembrane wrinkles shall not be folded over.

12.6.28 After each panel welding, the sheet should be hand pulled in order to avoid the formation of ridging along the seams (snapping).

12.6.29 Physically remove wrinkles by walking them or by pretension pulling on the sheet after welding each panel.

## 12.7 Geomembrane Field Seaming

12.7.1 Field seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit a copy of the proposed seaming procedures (both fusion and extrusion welding, including preparation procedures), prior to commencement of seaming, for the Purchaser's review and approval.

12.7.2 Remove studs and spikes from the structured geomembrane at butt weld locations. During the stud/spike removal operation, do not reduce the thickness of the barrier section of the geomembrane to less than the minimum thickness listed in section 12.4.

12.7.3 The only 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 shall be kept to the lower half of the slope. No more than one cross seam will be allowed per panel slope length.

12.7.4 No seam of any kind shall be closer than five 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.

12.7.5 Geomembrane panels must have a finished minimum overlap of four inches for fusion welding and six inches for extrusion welding.

12.7.6 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

12.7.7 Generators used to power welding/grinding apparatus shall be placed on a rub sheet and/or in a HDPE tub to prevent damages caused by vibrations/equipment leaks and to

protect the liner during refueling of these generators.

12.7.8 The Installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing for extrusion welds or Air Pressure Testing for double fusion seams.

## 12.8 Geomembrane Field Trial Seams

12.8.1 Field trial seams shall be made in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall submit a copy of the proposed testing procedures for the Purchaser's review and approval.

12.8.2 Field trial seams shall be conducted, per seaming apparatus and per seamer, on the liner to verify that seaming conditions are satisfactory. Trial seams shall be conducted at the beginning of each seaming period, at least once every four hours for each seaming apparatus and personnel used that day. Additional field trial seams may be requested by and at the discretion of the Purchaser's Representative.

12.8.3 All trial 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.

12.8.4 Field trial seaming shall be conducted under the same ambient temperature and preheating conditions as the production seams.

12.8.5 Field trial seams shall be destructively tested in accordance with section 12.9.

## 12.9 Geomembrane Destructive Seam Testing for Fusion and Extrusion Seaming

12.9.1 Destructive seam testing should be minimized to preserve the integrity of the liner. The Contractor shall take 1 destructive test sample once per 500 cumulative feet of fusion seam length, per fusion welding device, from a location specified by the CQC Inspector. This frequency applies to extrusion seams as well. If the amount of extrusion seaming is < 500 feet then a minimum of 1 extrusion destructive test shall be performed.

12.9.2 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.

12.9.3 The samples shall be a minimum of 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 Installer, one to be given to the Contractor's CQC Inspector, and one to the Purchaser.

12.9.4 The Installer shall test 10 1-inch wide specimens from his sample; 5 specimens for shear strength and 5 for peel strength. The CQC Inspector shall submit samples to an independent laboratory for confirmation testing. Seam test results shall be evaluated using the current GRI Test Method GM19 which allows for 4 of 5 specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel separation shall not exceed 25%.

12.9.5 Seams shall be tested according to the following methodology:

| **Property** | **Test Method** | **Minimum Average Value** |
|---|---|---|
| Seam Properties | ASTM D 6392 | |
| 1. Shear Strength | GM19 | 75 lb/in |
| 2. Peel Strength | | |
| • Hot Wedge | | 63 lb/in |
| • Extrusion Fillet | | 57 lb/in |

12.9.6 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.

12.9.7 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 shall retrace the welding path to a location (initially a minimum of 10 feet on each side of the failed seam location) to identify and isolate the failed seam in both previous and next direction of failed destructive, by taking two new samples, one from each direction. If these tests pass, then the seam shall be cap stripped between the passing tests. 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.

d) 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.

e) 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.

## 12.10 Geomembrane Repair Procedures

12.10.1 The geomembrane will be inspected before and after seaming for evidence of 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. The geomembrane surface shall be swept or washed by the Installer if surface contamination inhibits inspection. The Installer shall ensure that an inspection of the geomembrane precedes any seaming of that section.

12.10.2 Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

12.10.3 Repair, removal and replacement shall be at the Installers expense if the damage results from the Installer’s activities.

12.10.4 Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. The Installer shall be responsible for repair of damaged or

defective areas. Agreement upon the appropriate repair method shall be decided between the Purchaser's Representative and the Installer.

12.10.5 The following repair procedures shall apply:

a) Defective seams shall be cap stripped or replaced.
b) All holes of any size shall be patched.
c) 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.
d) Blisters, large cuts and undispersed raw materials shall be repaired by patches.
e) 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 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.
f) Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects.
g) All T's and intersections shall be patched. Welding the excess overlap is not permitted.
h) Geomembrane surfaces to be repaired shall be abraded (extrusion welds only) no more than ½ hour prior to the repair.
i) All geomembrane surfaces shall be clean and dry at the time of repair.
j) The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the Owner's Representative.
k) Extend patches or caps at least 6 inches beyond the edge of the defect, i.e., be a minimum of 12 inches in diameter, and round all corners of material to be patched.
l) Bevel the edge of the patch and do not cut patch with repair sheet in contact with geomembrane. Temporarily bond the patch to the geomembrane with an approved method, extrusion weld the patch and then vacuum test the repair.

## 12.11 Verification of Repairs

12.11.1 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.

12.11.2 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. (i.e., Test 1 followed by Test 1R1).

## 12.12 Engineered Turf Deployment

12.12.1 After geomembrane installation, including required documentation, has been completed, the geomembrane surface shall be cleared of all significant deposits of stones, soil and debris that could damage the geomembrane or impede the hydraulic function between the stud side of the structured geomembrane and the Engineered Turf component. Any soil or debris washed down to the toe of slope during cleaning

procedures shall be physically removed from the geomembrane surface without damage to the geomembrane.

12.12.2 The Engineered Turf shall be deployed without damage to the geotextile component and minimal loss of the synthetic grass component. Deployment equipment shall not damage the Engineered Turf geotextile, cause synthetic grass loss, or damage underlying geomembrane by handling, trafficking, leakage of hydrocarbons, or by other means.

12.12.3 The Engineered Turf shall be deployed smooth and free of tension, stress, folds, wrinkles, creases, and free of contaminants such as soil, grease, fuel, etc.

12.12.4 The Engineered Turf shall be deployed with the synthetic grass blades pointing towards the top of the slope on sideslopes greater than 12%.

12.12.5 Engineered Turf shall be secured with sand bag anchoring at the top of the slope and then rolled down the slope.

12.12.6 Seaming operations shall be performed using a 4-inch overlap and fastened with heavy-duty textile stitching machine. A prayer type seam is to be constructed using a Nulong sewing machine or equivalent. Stitching operations shall be performed such that the woven geotextiles are not exposed. Sewing shall occur between the 1st and 2nd row of stiches to avoid exposure of the black geotextile after flipping the panel.

12.12.7 After seaming operations, the ends of the Engineered Turf panels shall be permanently anchored in the perimeter and bench roadways.

12.12.8 Construction equipment on the deployed Engineered Turf shall be minimized to reduce the potential for geosynthetic material puncture. Equipment travel on exposed structured geomembrane is prohibited. Small equipment such as generators shall be placed on scrap geomembrane material (rub sheets) above geosynthetic materials in the ClosureTurf® Final Cover System.

## 12.13 Equipment on Engineered Turf

12.13.1 No equipment shall be allowed on slopes exceeding 15% until the sand infill is in place. On flatter slopes, such as top decks, ATV and vehicles will be allowed prior to infill placement if the tire pressure is less than 30 psi. Post construction drivability tire pressures should be limited on the slopes to 30 to 60 psi based on slope angle. Allowable tire pressures may be increased to 80 psi depending on subgrade conditions and engineer of record approval.

12.13.2 The sand ballast infill may be placed over the Engineered Turf with an equipment ground pressure less than 15 psi. No equipment will be left running and unattended over the constructed geosynthetics. Light rubber tired or tracked vehicles can be allowed to operate in slopes shallower than or equal to 3H:1V and a sand infill of a minimum of ½ inches in thickness. Equipment operation on slopes steeper than 3H:1V is not permitted.

12.13.3 Equipment operators shall inspect equipment rubber tires or tracks for sharp protrusions from foreign matter or tire/track damage, embedded rocks, or other foreign materials protruding from tires/track and remove such protrusions and foreign matter prior to driving on the geomembrane or Engineered Turf. Equipment travel paths driven on geomembrane and Engineered Turf shall be as straight as possible with no sharp turns, sudden stops or quick starts.

## 12.14 Engineered Turf Repair Procedure

12.14.1 All Turf repairs will be completed by using a heat bonded seam. This can be accomplished by using a hand held leister or a Varimat V2 leistering machine.

12.14.2 All seams with considerable length should use the Varimat V2 leistering machine. This gives consistent pressure (77 lbs) throughout the seam. Seam strength is a combination between weight and temperature. The temperature of the Varimat V2 leistering machine should be discussed prior to use because temperature control is a variable that can be increased/decreased depending on weather conditions.

12.14.3 A hand held leister should be used in smaller/concentrated areas. This may include areas around well heads or patches where Turf was cut.

## 12.15 Sand Ballast Infill

12.15.1 The sand layer will be a minimum ½-inch thick, but not greater than ¾-inches thick, and shall be worked into the Engineered Turf layer as in-fill between the synthetic yarn blades. The physical characteristics of the sand layer will be evaluated through visual observation (and laboratory testing if deemed necessary by the CQC Inspector) before construction and visual observation during construction. Additional testing during construction will be at the discretion of the CQC Inspector.

12.15.2 The sand may be spread using low ground pressure equipment and a pull-behind spreader bar. Rotary brush equipment may be used to evenly distribute the sand infill into the synthetic grass matrix. The sand spreading operation shall be done in front of deployment equipment travel to improve the bearing capacity of the cover system below. Use of rotary brush equipment shall be performed in a manner that does not result in removal of the synthetic grass blades from the underlying woven geotextile.

12.15.3 Conveyor systems and or blower equipment may be used to spread and place the sand in-fill on slopes too steep for equipment contact. These deployment systems shall not be used during wind speed conditions higher than 15 miles per hour. Dust generation may be mitigated by maintaining the sand infill at a moisture content sufficient to control dust but not impede the placement operation.

12.15.4 Contractor shall explain in detail in the pre-construction meeting the method of sand deployment to be used. The method shall be approved by the Purchaser. For slopes steeper than 3H:1V the sand infill shall be placed using long reach conveyors belts or using water or air express blower methods. The sand layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability.

12.15.5 Sand ballast infill shall completely cover the double-layer woven geotextile of the Engineered Turf component. Areas of exposed geotextile or thin layering of sand ballast unsatisfactory to the requirements of Table 3, shall receive additional sand ballast. If the cause of poor sand ballast placement and resulting geotextile exposure is wrinkles in the underlying structure geomembrane, the Engineered Turf component shall be pulled back from the geomembrane component, the geomembrane wrinkle removed and the geomembrane shall repaired per the requirements in these specifications. The Engineered Turf shall be re-deployed and ballasted with sand infill satisfactory to the requirements section 12.4.

12.15.6 The CQC Inspector shall verify that a minimum thickness of ½ inch of sand is placed on the Turf. Frequency will be 20 measurements per acre of final cover installed.

12.15.7 The Contractor shall provide to the Purchaser the grain size distribution, from the source of the sand infill/ballast, for every 1500 cy of material.

## 12.16 ArmorFill™ E Application

12.16.1 ArmorFill™ E is a proprietary polymer-based product developed by Watershed Geosynthetics specifically to bind the ASTM-C33 sand infill component of the ClosureTurf® system for long-term performance applications.

12.16.2 Application of ArmorFill™ E will be performed by an installer certified by Watershed Geosynthetics.

12.16.3 To obtain the proper ratio, mix ArmorFill™ E at a rate of 5 parts water to 1 part ArmorFill™ E by volume.

12.16.4 Apply ArmorFill™ E under dry weather conditions and when precipitation is not expected for at least 24 hours after installation.

12.16.5 Apply ArmorFill™ E on a previously installed ClosureTurf® system that is free of leaves and other material that may inhibit the penetration of the ArmorFill™ E into the sand component.

12.16.6 Apply ArmorFill™ E only after approval of the finished ClosureTurf® product installation.

12.16.7 Mix in a hydraulic conveyance system such as a hydro seeding device that contains a mechanical agitator/auger type mixer that is sized appropriately for the project. (Example: Finn T-Series Hydro Seeder or equivalent).

12.16.8 Place water into tank before mixing ArmorFill™ E.

12.16.9 Fully agitate the ArmorFill™ E throughout the application process.

12.16.10 ArmorFill™ E application equipment will have a 2-inch diameter hose with a spray adjustment nozzle and cut off function in the nozzle head.

12.16.11 Reduce the number of equipment set-ups required and take care with the application hose so as previously applied ArmorFill™ E is not displaced by dragging.

12.16.12 Spray product evenly.

12.16.13 Apply ArmorFill™ E at a rate of approximately 2,600 gallons of the mix per acre.

12.16.14 All waste products will be disposed of in accordance with site regulations and as approved by Purchaser.

12.16.15 Do not apply ArmorFill™E in inclement weather or in freezing temperatures. Inclement weather shall mean the existence of rain or lightening, or abnormal climatic conditions (whether they be those of hail, snow, cold, high wind, extreme high temperature or the like or any combination thereof) by virtue of which it is either not reasonable or not safe for employees exposed to continue working.

12.16.16 Avoid unnecessary foot traffic on the applied product for 24 hours.

12.16.17 No vehicle traffic is allowed on the applied product for 7 calendar days.

## 12.17 HydroBinder™ Infill Installation

12.17.1 Installation of the HydroBinder™ infill for the engineered turf shall be performed by a licensed installer.

12.17.2 The HydroBinder™ infill layer shall be have a minimum thickness of ¾ inch, but not greater than 1 inch, in dry thickness. The desired thickness will be achieved prior to the hydration process. At grade breaks and drainage benches, the thickness of the HydroBinder™ shall be increased as specified on the drawings or as directed by

Purchaser's Representative.

12.17.3 If weep holes are required for draining the internal drainage layer through the engineered turf, remove the HydroBinder™ in the areas of the weep holes prior to hydration or block the weep hole locations prior to infilling. Blocks may consist of pipe, dowels, etc. Weep hole diameters shall be 1 inch and be located at the toe of slope on 2-foot centers.

12.17.4 The infill shall be installed into the engineered turf while it is in a dry state. The engineered turf shall be dry. If the engineered turf is wet from rain or dew, the installer shall wait until it is dry. The installer may attempt to speed up the drying process by using a blower. In addition, the infill shall not be installed in inclement, wet or rainy weather, or the threat of inclement weather. Also, the infill shall not be installed in freezing temperatures.

12.17.5 The infill shall be worked into the engineered turf layer between the synthetic yarn blades so that the tuffs are in an upright position. The physical characteristics of the infill layer will be evaluated through visual observation (and laboratory testing if deemed necessary by the CQC Inspector) before construction and visual observation during construction. Additional testing during construction will be at the discretion of the CQC Inspector.

12.17.6 The hydration process must occur the day of the infill placement.

12.17.7 Personnel access on the engineered turf shall be prohibited for 24 hours following the hydration of the HydroBinder™.

12.17.8 The infill shall be thoroughly hydrated; however, care must be taken to avoid displacement of the non-hydrated infill. The Installer shall not overhydrate the infill so that water begins to run-off and cause erosion of the cement infill. The objective is to soak the area to start the hydration process but not to inundate with water beyond saturation.

12.17.9 Once hydration is completed as described, backfill and compaction of the anchor trenches should take place.

12.17.10 The HydroBinder™ shall be at minimum performance levels within 24 hours listed in Table 3 of this Section. HydroBinder™ not meeting the performance levels will be removed and replaced.

12.17.11 The infill may be spread using low ground pressure equipment and a pull-behind spreader bar. Rotary brush equipment may be used to evenly distribute the infill into the synthetic grass matrix. The infill spreading operation shall be done in front of deployment equipment travel to improve the bearing capacity of the cover system below. Use of rotary brush equipment shall be performed in a manner that does not result in removal of the synthetic grass blades from the underlying woven geotextile. In addition, hand spreading and rakes maybe be used to spread the infill material. If rakes are used, only plastic rakes shall be allowed.

12.17.12 Conveyor systems and or blower equipment may be used to spread and place the infill on slopes too steep for equipment contact. These deployment systems shall not be used during wind speed conditions higher than 15 miles per hour. Dust generation may be mitigated by maintaining the infill at a moisture content sufficient to control dust but not impede the placement operation.

12.17.13 Contractor shall explain in detail in the pre-construction meeting the method of infill deployment to be used. The method shall be approved by the Purchaser. For slopes

steeper than 3H:1V the infill shall be placed using long reach conveyors belts or using water or air express blower methods. The infill layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability.

12.17.14 HydroBinder™ infill shall completely cover the double-layer woven geotextile of the engineered turf component. Areas of exposed geotextile or thin layering of infill unsatisfactory to the requirements of this Section shall receive additional infill. If the cause of poor infill placement and resulting geotextile exposure is wrinkles in the underlying structure geomembrane, the engineered turf component shall be pulled back from the geomembrane component, the geomembrane wrinkle removed and the geomembrane repaired per the requirements of Section 12.10. The Engineered Turf shall be re-deployed and ballasted with infill satisfactory to the requirements of this Section

12.17.15 For areas with exposed geotextile due to wrinkles and isolated small voids, a UV resistant coating shall be applied to the exposed area and additional infill material shall be applied immediately to the coating and hydrated. The UV coating product shall be manufactured by Quikrete product #8640, Sakrete product #60205006, or approved equivalent.

12.17.16 The QC Inspector shall verify that a minimum thickness of ¾ inch of infill (dry) is placed on the synthetic turf. Frequency shall be 1 test per 100 linear feet of ditch and 20 measurements per acre of final cover installed. Thickness measurements shall be taken using a caliper or equivalent device. CQC shall also inspect to confirm full hydration buy excavating with a small tool into the infill.

12.17.17 The Contractor shall provide to the Purchaser the manufacturers certifications for the HydroBinderTM infill properties listed in Table 3 of this Section. Upon delivery, or as determined by the Purchaser and/or the Purchaser's Representative, a representative sample of the HydroBinder™ mix shall be taken by the Purchaser for verification of the compressive strength.

## 12.18 HydroBinder™ Repair Procedures

12.18.1 Areas where the HydroBinder™ has cracked, crushed, or has voids shall be repaired accordingly as per the manufacturers specifications.

12.18.2 Affected areas shall be cleaned by removing the loose infill. Confirm that the Engineering Turf and underlying components are not damaged. If damage is observed, repair procedures for the specific component shall be followed as per Sections 12.10 and/or 12.16. The owner shall be notified of any damage prior to repair.

12.18.3 Cracks in the HydroBinder™ shall be sealed by applying concrete crack sealants such as Quikrete product #8640, Sakrete Product #60205006, or an approved equivalent.

12.18.4 For areas of concern that are larger than cracks, new HydroBinder™ E infill shall be applied to the affected area. The infill material shall be applied dry to a minimum thickness of ¾ inch, or thicker for grade breaks, drainage benches, and traffic ways, and shall match the thickness of the intact HydroBinder™. Installation of the infill shall follow guidelines set forth in Section 12.18.

12.18.5 The area shall be raked or broomed to pull the engineered turf fibers up through the dry infill mix without causing damage to the existing geomembrane and Turf components.

12.18.6 The CQC inspector shall keep daily documentation of all repairs. This documentation

shall identify all repairs, areas, size, location, and procedures and include before and after photographs.

## 12.19 Anchor Trench

12.19.1 Avoid backfilling the anchor trenches until the synthetic grass and sand infill placement of the ClosureTurf® component has been completed. This will allow corrections in the field during the deployment of both the geomembrane and the synthetic grass component. Note that wrinkles will travel down the slopes and cannot be redistributed up slopes, so is important that both top and bottom anchor trenches remain open so that pulling adjustments can be made.

12.19.2 The geomembrane anchor trench shall be left open until seaming is completed.

12.19.3 Expansion and contraction of the geomembrane should be accounted for in the geomembrane placement. Prior to backfilling, the depth of penetration of the geomembrane into the anchor trench will be verified by the CQC Inspector at a minimum of 100 foot spacing along the anchor trench. The anchor trench should be filled in the morning when temperatures are coolest to reduce bridging of the geomembrane.

12.19.4 General fill material placed in anchor trenches will be placed in uniform lifts, which do not exceed 12 inches in loose thickness and are compacted. In-place moisture/density tests may be taken at the discretion of the CQC Inspector to evaluate the quality of the backfill. The test results will not be required as part of the final documentation. Slightly rounded corners will be provided in anchor trenches where the geomembrane enters the trench so as to avoid sharp bends in the geomembrane. No loose soil (e.g., excessive water content) will be allowed to underlie the anchored components of ClosureTurf® Final Cover System.

12.19.5 The geomembrane and the Engineered Turf should cover the entire trench floor.

12.19.6 The anchor trench shall be backfilled with soil meeting the requirements of Structural fill as described in section 10.0 with the exception that the maximum particle size shall be limited to ½-inch in the largest dimension.

12.19.7 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane or Engineered Turf. If damage occurs, it shall be repaired prior to backfilling and at the Contractor's expense.

## 12.20 Geomembrane Acceptance

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:

a) Installation is finished;
b) All submittals completed;
c) Verification of the adequacy of all field seams and repairs, including associated testing, is complete;
d) Receipt of approved, final panel layout drawing (as-builts);
e) Construction area cleaned;
f) Final field inspection completed (all punch list items from previous inspections shall be complete);

g) Sign-off of acceptance of the geomembrane has been made by the Purchaser;
h) Warranty signed over to Purchaser.

## 13.0 COMPOSITE COVER SYSTEM

### 13.1 General

13.1.1 A composite cover system is one of two alternate final cover systems being considered for the Plant Gadsden ash pond. For the composite cover system, the final ash subgrade shall be covered with a 40 mil double-sided textured LLDPE geomembrane overlain by a double sided geocomposite drainage layer with a minimum 18-inch protective soil cover. An erosion control layer consisting of a minimum of 6 inches of topsoil that will support vegetative growth shall be placed over the soil cover.

13.1.2 The LLDPE and drainage material shall be placed in accordance with these Specifications, the manufacturer's recommendations, and the details indicated on the Drawings.

### 13.2 Submittals

13.2.1 The Contractor shall provide to the Purchaser the Manufacturer's Quality Control (CQC) Program and Manual, or descriptive documentation for manufacture of the geomembrane and geocomposite from the manufacturer.

13.2.2 The Contractor shall provide to the Purchaser, for review and approval, qualification statements from the LLDPE and geocomposite manufacturer, certified installer, and CQC Inspector documenting the minimum requirements of sections 13.3 and 13.12 of these Specifications.

13.2.3 The Contractor shall provide to Purchaser placement procedures and a panel layout for placement of the geomembrane and geocomposite panels over the area of installation 14 days prior to the start of liner installation.

13.2.4 Upon each shipment, the Contractor shall furnish the geomembrane and geocomposite manufacturer's Quality Assurance/Quality Control (QA/QC) roll certifications, signed by a responsible party employed by the manufacturer, to verify that the materials supplied for the project are in accordance with the requirements of sections 13.4 and 13.13 of this Specification. The certifications shall reference the lot and roll number as well as the manufacturer's name and address.

13.2.5 As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor, the CQC Inspector, and the Purchaser's Representative for each area that is covered by the geomembrane.

13.2.6 After installation, the Contractor shall submit a certification, signed by the Contractor and signed and sealed by the CQC Firm's Professional Engineer, that the geomembrane and geocomposite was placed in accordance with these Specifications.

13.2.7 The Contractor shall provide certification that all resin used in the manufacture of the geocomposite drainage geonet for this job meets the Specifications and provide a copy of the quality control certificates issued by the resin supplier.

## 13.3 Geomembrane Contractor Qualifications

13.3.1 The manufacturer of the geomembrane (LLDPE) must have produced at least 10,000,000 square feet of product, with at least 8,000,000 square feet installed.

13.3.2 The geomembrane installer must either have installed at least 1,000,000 square feet of product or must provide to Alabama Power satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the geomembrane will be installed in a competent, professional manner.

13.3.3 The Contractor shall provide a third-party inspector for construction quality control (CQC) of the geomembrane 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 geomembrane throughout installation. The inspector shall have provided CQC services for the installation of the proposed or similar products for at least 5 completed projects totaling not less than 1,000,000 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 a statement of the inspector's qualifications, for approval, to the Purchaser prior to the installation of geomembrane.

13.3.4 A Manufacturer’s Representative shall be on site during the initial phase of the geomembrane installation to provide assistance to the Contractor.

## 13.4 Geomembrane Material

13.4.1 The geomembrane shall be a 40 mil double-sided textured linear low density polyethylene (LLDPE) with a minimum 23 feet seamless width. There shall be no factory seams. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.

13.4.2 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 raw materials meet the physical property requirements indicated in the following table.

13.4.3 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.

13.4.4 The geomembrane shall be supplied in rolls; folds will not be permitted. Identify each roll with labels indicating lot number, roll number, thickness, length, width, manufacturer, and plant location.

13.4.5 Resin shall be LLDPE, new, first quality, compounded and manufactured specifically for producing LLDPE geomembrane.

13.4.6 Extrudate Rod or Bead shall be made from same resin as the geomembrane. Additives shall be thoroughly dispersed. The rods or beads shall be free of contamination by moisture or foreign matter.

13.4.7 The materials shall be stored in space allocated by the Purchaser.

13.4.8 The materials shall be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

13.4.9 The materials shall be stored on level prepared surface (not on wooden pallets).

13.4.10 The materials shall be stacked per Manufacturer's recommendation but no more than three rolls high.

13.4.11 Appropriate handling equipment shall be used to load, move or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader and roll bars for deployment. Dragging panels on ground surface will not be permitted.

13.4.12 The Installer is responsible for storage, and transporting material from storage area to installation area.

13.4.13 Damaged geomembrane will be documented by the Purchaser's Representative.

13.4.14 Damaged geomembrane may be repaired, if approved by the Purchaser's Representative, in accordance with these Specifications or shall be replaced at no additional cost to the Owner.

13.4.15 The geomembrane shall have the following properties:

| **TABLE 5 – DOUBLE-SIDED TEXTURED LLDPE GEOMEMBRANE - 40 MIL** | | | |
|---|---|---|---|
| Property | Frequency | Test Method | Minimum Average Value |
| Density | Once per 200,000 lbs of resin | ASTM D 792 | Max. 0.939 g/cc |
| Melt Index | Once per 200,000 lbs of resin | ASTM D 1238,190˚C, 2.16kg | ≤ 1.0 g/10 min. |
| Oxidative Induction Time (OIT)<br>Standard OIT<br>Or<br>High Pressure OIT | Once per 200,000 lbs resin | ASTM D 3895<br><br>ASTM D 5885 | 100 min. (min. avg.)<br><br>400 min. (min. avg.) |
| Thickness:<br>Nominal<br>Minimum Average<br>Minimum 8 of 10<br>Lowest individual | per roll | ASTM D 5994 | <br>40 mil<br>38 mil<br>36 mil<br>34 mil |
| Asperity Height | Every 2nd Roll | ASTM D 7466<br>GRI GM12 | 20 mil |
| Tensile Properties (avg. both directions) (min. avg)<br>Break Strength<br>Break Elongation | 20,000 lbs. | ASTM D 6693, Type IV | <br><br>112 lb/in<br>400 % |
| Tear Resistance | 45,000 lbs | ASTM D 1004 | 25 lb (min. avg.) |
| Puncture Resistance | 45,000 lbs | ASTM D 4833 | 50 lb (min. avg.) |
| 2% Modulus lb/in (max) | Per formulation | D5323 | 3000 (max) |
| Axi-Symmetric Break Resistance Strain - % (min.) | Per formulation | D5617 | 30 |
| Carbon Black Content | 20,000 lbs. | ASTM D 4218 | 2.0 % - 3.0 % |
| Carbon Black Dispersion[1] | 45,000 lbs. | ASTM D 5596 | See Note (1) |
| Oxidative Induction Time (OIT) Standard OIT, minutes | 200,000 lbs | ASTM D 3895, 200˚C, 1 atm $0_2$ | ≥140 min. |

**Notes:**

(1) Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than one (1) view from Category 3.

## 13.5 Equipment

13.5.1 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 6 psi.

13.5.2 In areas of heavy traffic, the geomembrane shall be protected by placing protective cover, with a minimum thickness of 3 feet, over the geomembrane.

13.5.3 If the geomembrane is damaged by vehicular traffic, it shall be replaced at the Contractor's expense.

## 13.6 Geomembrane Installation

13.6.1 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, solvents, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. Stacking of the rolls is allowed following manufacturer's recommendations.

13.6.2 The manufacturer assumes responsibility for initial loading of 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.

13.6.3 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 installation procedure for the Purchaser's review fourteen days prior to installation.

13.6.4 All seam and non-seam areas of the geomembrane shall be inspected by the CQC 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.

13.6.5 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.

13.6.6 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.

13.6.7 The geomembrane shall not be deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, in the presence of excessive winds, or in excessive heat or cold.

13.6.8 Each panel shall be marked with an "identification code" (number or letter) consistent with the layout plan. The identification code shall be simple and logical. Markings shall not be used that permanently alter the line**r**, such as stampings, weld marks, hydrocarbon marks, etc. The number of panels deployed in one day shall be limited by the number of panels which can be seamed on the same day. All deployed panels shall be seamed to adjacent panels by the end of each day.

13.6.9 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. The equipment shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons,

deployment or other means. The placement shall be observed by the CQC Inspector and the Purchaser's Representative.

13.6.10 The Contractor shall inspect the subgrade preparation prior to liner installation. The subgrade shall be compacted in accordance with the project specifications. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with properly compacted clay liner material. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than one-half inch in diameter, or debris of any kind. The subgrade shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. The surface shall contain no rutting, cracks or tire tracks. Standing water or excessive moisture shall not be allowed.

13.6.11 The Contractor, on a daily basis, shall approve the surface on which the geomembrane 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.

13.6.12 The Contractor shall submit written Certificates of Subgrade Acceptance, signed by the Contractor, CQC Inspector, and Purchaser's Representative, for each area prepared for geomembrane installation. This shall be done prior to commencing work.

13.6.13 Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

13.6.14 Personnel working on the geomembrane shall not smoke or wear damaging shoes.

13.6.15 The method used to unroll the panels shall not cause scratches, crimps, or creases in the geomembrane.

13.6.16 Unroll panels with the spike down and the stud side up for the structured geomembrane to assure that the deployment method protects the geomembrane from scratches and crimps and protects soil surface.

13.6.17 Unroll panels with adequate tension to prevent undulations or wrinkles when placed on the ground. The spike side down prevents easy movement of the panel. Individual panels placed with more than 5 undulations greater than 2-inches in height shall be deployed again.

13.6.18 Use a method to minimize wrinkles, especially differential wrinkles between adjacent panels.

13.6.19 Place adequate hold-downs to prevent uplift by wind. 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).

13.6.20 Protect geomembrane in heavy traffic areas by geotextile, extra geomembrane or other suitable materials.

13.6.21 Do not allow vehicular traffic on unprotected geomembrane surface.

13.6.22 Panels deployed on grades steeper than 12% shall extend a minimum of 3 feet beyond the crest or toe of that grade with no cross seams.

13.6.23 Visually inspect sheet surface during unrolling of geomembrane and mark faulty or suspect areas for repair or test. Replace faulty (requires more than 1 patch per 200 square feet) geomembrane stock at no additional cost to the Owner.

13.6.24 Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F measured 6 inches above the membrane surface. Placement can proceed below

32° F only after it has been verified by the CQC 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.

13.6.25 After panel deployment and before welding, any horizontal wrinkles must be walked down or wiggled down the slope to minimize wrinkles after welding.

13.6.26 Limit maximum wrinkle height to 4 inches during warmer ambient temperatures and 2 to 3 inches in cooler temperatures.

13.6.27 Geomembrane wrinkles shall not be folded over.

13.6.27.1.1 After each panel welding, the sheet should be hand pulled in order to avoid the formation of ridging along the seams (snapping).

13.6.27.2 Physically remove wrinkles by walking them or by pretension pulling on the sheet after welding each panel.

## 13.7 Geomembrane Field Seaming

13.7.1 Field seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit a copy of the proposed seaming procedures (both fusion and extrusion welding, including preparation procedures), prior to commencement of seaming, for the Purchaser's review and approval.

13.7.2 Remove studs and spikes from the structured geomembrane at butt weld locations. During the stud/spike removal operation, do not reduce the thickness of the barrier section of the geomembrane to less than the minimum thickness listed in section 13.4.

13.7.3 The only 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 shall be kept to the lower half of the slope. No more than one cross seam will be allowed per panel slope length.

13.7.4 No seam of any kind shall be closer than five 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.

13.7.5 Geomembrane panels must have a finished minimum overlap of four inches for fusion welding and six inches for extrusion welding.

13.7.6 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

13.7.7 Generators used to power welding/grinding apparatus shall be placed on a rub sheet and/or in a HDPE tub to prevent damages caused by vibrations/equipment leaks and to protect the liner during refueling of these generators.

13.7.8 The Installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing for extrusion welds or Air Pressure Testing for double fusion seams.

## 13.8 Geomembrane Field Trial Seams

13.8.1 Field trial seams shall be made in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall submit a copy of the

proposed testing procedures for the Purchaser's review and approval.

13.8.2 Field trial seams shall be conducted, per seaming apparatus and per seamer, on the liner to verify that seaming conditions are satisfactory. Trial seams shall be conducted at the beginning of each seaming period, at least once every four hours for each seaming apparatus and personnel used that day. Additional field trial seams may be requested by and at the discretion of the Purchaser's Representative.

13.8.3 All trial 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.

13.8.4 Field trial seaming shall be conducted under the same ambient temperature and preheating conditions as the production seams.

13.8.5 Field trial seams shall be destructively tested in accordance with section 13.9.

## 13.9 Geomembrane Destructive Seam Testing for Fusion and Extrusion Seaming

13.9.1 Destructive seam testing should be minimized to preserve the integrity of the liner. The Contractor shall take 1 destructive test sample once per 500 cumulative feet of seam length, per fusion welding device, from a location specified by the CQC Inspector. This frequency applies to extrusion seams as well. If the amount of extrusion seaming is < 500 feet then a minimum of 1 extrusion destructive test shall be performed.

13.9.2 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.

13.9.3 The samples shall be a minimum of 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 Installer, one to be given to the Contractor's CQC Inspector, and one to the Purchaser.

13.9.4 The Installer shall test ten one-inch wide specimens from his sample; five specimens for shear strength and five for peel strength. The CQC Inspector shall submit samples to an independent laboratory for confirmation testing. Seam test results shall be evaluated using the current GRI Test Method GM19 which allows for four of five specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel separation shall not exceed 25%.

13.9.5 Seams shall be tested according to the following methodology:

| **Property** | **Test Method** | **Minimum Average Value** |
|---|---|---|
| Seam Properties | ASTM D 6392 | |
| 1. Shear Strength | GM19 | 75 lb/in |
| 2. Peel Strength | | |
| • Hot Wedge | | 63 lb/in |
| • Extrusion Fillet | | 57 lb/in |

13.9.6 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.

13.9.7 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 shall retrace the welding path to a location (initially a minimum of 10 feet on each side of the failed seam location) to identify and isolate the failed seam in both previous and next direction of failed destructive, by taking two new samples, one from each direction. If these tests pass, then the seam shall be cap stripped between the passing tests. 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.

d) 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.

e) 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.

## 13.10 Geomembrane Repair Procedures

13.10.1 The geomembrane will be inspected before and after seaming for evidence of 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. The geomembrane surface shall be swept or washed by the Installer if surface contamination inhibits inspection. The Installer shall ensure that an inspection of the geomembrane precedes any seaming of that section.

13.10.2 Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

13.10.3 Repair, removal and replacement shall be at the Installers expense if the damage results from the Installer’s activities.

13.10.4 Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. The Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the Purchaser’s Representative and the Installer.

13.10.5 The following repair procedures shall apply:

a) Defective seams shall be cap stripped or replaced.

b) All holes of any size shall be patched.

c) 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.

d) Blisters, large cuts and undispersed raw materials shall be repaired by patches.

e) 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 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.

f) Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects.

g) All T's and intersections shall be patched. Welding the excess overlap is not permitted.

h) Geomembrane surfaces to be repaired shall be abraded (extrusion welds only) no more than 1/2 hour prior to the repair.

i) All geomembrane surfaces shall be clean and dry at the time of repair.

j) The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the Owner's Representative.

k) Extend patches or caps at least 6 inches beyond the edge of the defect, i.e., be a minimum of 12 inches in diameter, and round all corners of material to be patched.

l) Bevel the edge of the patch and do not cut patch with repair sheet in contact with geomembrane. Temporarily bond the patch to the geomembrane with an approved method, extrusion weld the patch and then vacuum test the repair.

## 13.11 Verification of Repairs

13.11.1 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.

13.11.2 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. (i.e., Test 1 followed by Test 1R1).

## 13.12 Geocomposite Contractor Qualifications

13.12.1 The drainage material manufacturer shall have successfully manufactured 5,000,000 million square feet of polyethylene drainage material.

13.12.2 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 1,000,000 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.

13.12.3 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.

13.12.4 The Contractor shall provide 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 who is on site monitoring the installation activities every day that they are taking place, shall have provided CQC services for the installation of the proposed or similar products for at least 5 completed projects totaling not less than 1,000,000 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 a statement of the inspector's qualifications, for approval, to the Purchaser prior to the installation of geomembrane.

13.12.5 A Manufacturer's Representative may be on site during the initial phase of the geocomposite installation to provide assistance to the Contractor.

## 13.13 Geocomposite Labeling, Delivery, Storage, and Handling Requirements

13.13.1 Each roll of material delivered to the site shall be wrapped and labeled by the manufacturer. The label shall contain the following information:

a) manufacturer's name
b) product identification
c) length and width
d) roll number

13.13.2 The material shall 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.

13.13.3 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.

13.13.4 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.

## 13.14 Geocomposite Material Properties

13.14.1 The geocomposite shall consist of one layer of HDPE drainage net (geonet) connected between two layers of non-woven geotextile to create a double-sided geocomposite.

13.14.2 The drainage net shall be manufactured of new first quality polyethylene resin and shall be compounded and manufactured specifically for the intended application.

13.14.3 The Contractor shall provide written certification from the manufacturer that all resin used in the manufacture of the drainage net for this job meets the Specifications which shall include a copy of the quality control certificates issued by the resin supplier.

13.14.4 The Contractor shall provide written certification from the manufacturer that the material was manufactured in accordance with this Specification, together with a report of test results, prior to material shipment.

13.14.5 The minimum average properties of the geocomposite shall be as follows:

| TABLE 6 - DOUBLE-SIDED DRAINAGE GEOCOMPOSITE | | | | |
|---|---|---|---|---|
| **Tested Property** | **Test Method** | **Frequency** | **Value[1]** | **Units** |
| **Geonet Core [2]** | | | | |
| Raw Materials:<br>Density<br><br>Melt Index | <br>ASTM D792, B<br>ASTM D1505<br>ASTM D1238 | <br>Per lot<br><br>Per lot | <br>0.94<br><br>≤ 1.0 | <br>g/cc<br><br>g/ 10 min. |
| Thickness | ASTM D 5199 | 1/50,000 $ft^2$ | 250 | mil |
| Density | ASTM D 1505 | 1/50,000 $ft^2$ | 0.94 | g/cc |
| Carbon Black Content | ASTM D 4218 | 1/50,000 $ft^2$ | 2.0 – 3.0 | % |
| Tensile Strength | ASTM D 5035 | 1/50,000 $ft^2$ | 55 | lbs/inch |
| Transmissivity[3] | ASTM D 4716 | 1/50,000 $ft^2$ | $3 \times 10^{-3}$ | $m^2$/sec |
| **Geotextile (prior to lamination)[4]** | | | | |
| Mass per Unit Area | ASTM D 5261 | 1/100,000 $ft^2$ | 6.0 | oz/$yd^2$ |
| Grab Tensile | ASTM D 4632 | 1/100,000 $ft^2$ | 170 | lbs |
| Flow Rate | ASTM D 4491 | 1/100,000 $ft^2$ | 125 | gpm/ $ft^2$ |
| Puncture Strength | ASTM D 4833 | 1/100,000 $ft^2$ | 95 | lbs |
| Permittivity | ASTM D 4491 | 1/100,000 $ft^2$ | 1.6 | $Sec^{-1}$ |
| AOS | ASTM D 4751 | 1/100,000 $ft^2$ | 70 sieve | US Sieve |
| UV Resistance | ASTM D 4355 | once per formulation | 70 | % retained (500 hr) |
| **Geocomposite** | | | | |
| Transmissivity[3] | ASTM D 4716 | 1/500,000 $ft^2$ | $3.5 \times 10^{-4}$ | $m^2$/sec |
| Peel Adhesion | ASTM D 7005 | 1/50,000 $ft^2$ | 1.0 | lbs/in |

Notes

1. These are minimum average roll values (MARV values) and are based on the cumulative results of specimens tested. AOS in mm units is a maximum average roll value.
2. Component properties prior to lamination.
3. Gradient of 0.1, normal load of 10,000 psf, water at 70° F, between stainless steel plates for 15 minutes
4. Refer to geotextile product data sheet for additional specifications.

## 13.15 Geocomposite Placement

13.15.1 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.

13.15.2 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.

13.15.3 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 5 feet along the roll length, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

13.15.4 Adjoining geocomposite 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 a minimum of 12 inches across the roll width. The overlaps shall be joined by tying the geonet structure with plastic cable ties spaced every 12 inches along the roll width, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

13.15.5 The geonet portion shall be tied every 6 inches in the anchor trench, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

13.15.6 Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.

13.15.7 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 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 joined in accordance with sections 13.14.3 and 13.14.4 above.

13.15.8 All geocomposite geotextile overlaps shall be sewn at the seams.

## 13.16 Anchor Trenches

13.16.1 As directed by the project Drawings and Specifications, the end of the geomembrane and geocomposite rolls shall be placed in an anchor trench. 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.

13.16.2 The geomembrane and geocomposite should cover the entire trench floor.

13.16.3 The anchor trench shall be backfilled by the earthwork contractor. Trench backfill material shall be well compacted by approved methods to minimize water intrusion or material pull-out.

13.16.4 The anchor trench shall be backfilled with soil meeting the requirements of Structural Fill as described in section 10.0 with the exception that the maximum particle size shall be limited to 1 inch in the largest dimension.

13.16.5 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane or geocomposite. If damage occurs, it shall be repaired prior to backfilling and at the Contractor's expense.

## 13.17 Protective Cover Soils

13.17.1 The protective soil cover material shall be free of angular stones, particles in excess of ½-inch in maximum diameter, or other foreign matter that could damage the geocomposite and the geomembrane.

13.17.2 In applying the protective cover 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.

13.17.3 The protective soil cover shall be placed on the geocomposite in a manner that prevents damage to the geocomposite.

13.17.4 Soil cover should be placed in a manner that prevents the soil from entering the

geocomposite overlap zones. Soil cover shall be pushed from the toe of slopes up, not from top of slopes down, to minimize tensile forces on the geocomposite and geomembrane.

13.17.5 The protective cover shall be placed over the geocomposite using low contact pressure, wide-tracked construction equipment that minimizes stresses on the geocomposite. The cover shall be placed and spread by making a minimum of four complete passes with the tracks of the equipment. Special care and attention shall be made by the Contractor to ensure that the underlying geocomposite is not damaged.

13.17.6 The protective cover soil shall be a minimum 18 inches thick. This thickness does not apply to frequently trafficked areas or roadways, for which a minimum thickness of 3 feet is required.

### 13.18 Topsoil

13.18.1 Topsoil material is generally defined as the upper surface of dark fertile soil, which contains decaying matter and roots. Topsoil shall be free of subsoil, clay, weeds, large roots, or foreign material that would interfere with seeding or maintenance.

13.18.2 Testing of samples of topsoil may be required to determine if any nutrients should be added to the soil in addition to the application of fertilizer and lime.

13.18.3 The topsoil cover shall be placed in a minimum loose lift thickness of 6 inches and then grassed. If erosion occurs before grassing operations, the area shall be repaired to the satisfaction of the CSM.

## 14.0 SEDIMENT AND EROSION CONTROL

14.1 Minimum sediment and erosion control measures are shown on the Drawings and in the CBMPP for the Plant Gadsden Ash Pond Closure. Additional measures shall be taken as required or as directed by the Purchaser to minimize erosion of soil.

14.2 During the course of this project, the Contractor shall plan and coordinate his work to minimize the amount of suspended soil particles entering rivers and streams or leaving the general work area and being deposited in undesirable places. Any property damage or fines resulting from the Contractor's negligence shall be borne by the Contractor.

14.3 The Contractor shall not excavate, uncover or denude areas of work until adequate erosion and sediment control measures are installed. The Contractor's earthmoving operations shall at all times be in full compliance with the requirements of the Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas.

14.4 The Purchaser will inspect the sediment and erosion control practices (e.g. "BMPs") employed to evaluate their effectiveness. Any deficiencies shall be immediately corrected by the Contractor at no cost to the Purchaser.

14.5 Erosion and sediment control measures shall be utilized and maintained as indicated in the Plans.

## 15.0 VEGETATION

15.1 A minimum 6-inch layer of topsoil shall be placed on all areas to be grassed.

15.2 Earth fill areas and other disturbed areas shall be grassed. Hydroseeding methods may be used.

15.3 The Contractor shall produce a satisfactory stand of perennial grass in accordance with the Vegetation Schedule as 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.

15.4 A satisfactory stand of grass is defined as 100% of soil surface being uniformly covered in permanent vegetation with a density of 70% or greater, or landscaped according to the Plan (uniformly covered with landscaping materials in planned landscaped areas), or equivalent permanent stabilization measures as defined in the Handbook (excluding a crop of annual vegetation and a seeding of target crop perennials appropriate for the region).

15.5 Measures shall be taken to prevent erosion of the topsoil layer and vegetation until a full vegetative growth has been obtained. After seeding, an erosion control biodegradable straw blanket shall be installed on any slopes equal to or steeper than 3H:1V. This material shall be as indicated on the Drawings. 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 affected area be re-grassed.

15.6 Water required to promote a satisfactory growth shall be furnished and applied by the Contractor as often as necessary to achieve the results outlined above.

15.7 The Contractor shall make daily inspections of the seeded areas and repair all eroded areas to the satisfaction of the Purchaser.

## 16.0 RECORDS

### 16.1 Quality Control Records

16.1.1 The quality control records of inspection and field quality control records shall be compiled by the Contractor's CQC Inspector and provided to the Purchaser on an on-going basis or as directed. The final records will provide the background data necessary for the certification of the final cover construction. All records shall be forwarded to the Plant's permanent file to be retained as a permanent record of the project.

16.1.2 At the completion of the construction of the final cover for the ash pond, a Construction Quality Assurance Report (Construction Certification), prepared by the Purchaser, will be submitted along with a registered engineer's certification that the final cover was constructed in accordance with the approved Closure/Post Closure drawings and the Alabama Rules for Solid Waste Management. The Contractor shall provide, at a minimum, the following information for preparation of the Certification Report:

a) Elevation Contour Drawings of the subgrade on a maximum 100ft. by 100ft. grid. Drawings to be signed and sealed by a land surveyor registered to practice in the state of Alabama.

b) For the Composite Cover System:

1. Final geomembrane panel layout
2. Final geocomposite panel layout
3. Elevation Contour Drawings of the top surface of the 18 inch Protective Soil Layer on a maximum 100ft. by 100ft. grid (as used for the

subgrade). Protective Soil Cover thickness relative to the subgrade shall be indicated at the grid points. Drawings to be signed and sealed by a land surveyor registered to practice in the state of Alabama.

4. Finished Grade - elevation contour drawings with thickness of topsoil indicated on the same maximum 100 ft. x 100 ft. grid as the Protective Cover Soil Elevation Contour Drawing. Drawings to be signed and sealed by a land surveyor registered to practice in the state of Alabama.

c) For the ClosureTurf® cover system:
   1. As-built drawings indicating panel locations, panel identification numbers, geomembrane roll numbers for each panel, seam caps, destructive sample locations, and repair locations.
   2. Finished Grade - elevation contour drawings on the same maximum 100 ft. x 100 ft. grid as the Subgrade Elevation Contour Drawing. Drawings to be signed and sealed by a land surveyor registered to practice in the state of Alabama.

d) All survey shots shall be "stacked" in order to properly verify the given layer's thickness. The use of interpolation or other computer generated methods to achieve point stacking are not acceptable.

e) Thickness determinations obtained at grid points on slopes shall be made normal to the slopes.

f) All survey and topographic information shall be submitted in both "pdf" and "dwg" file formats which are compatible with AutoCAD 2010.

g) A summary of major construction activities which shall include a description of the activity and schedule dates. This summary shall be based on daily logs provided by the on-site inspector. This shall also serve to document the presence of a qualified member of the inspection team during any construction activity involving structural fill or any component of the liner.

h) Project CQC summary reports including all field testing and inspection results. This summary shall be inclusive of all passing tests as well as failing tests and retests. This shall include at a minimum, all field moisture content and density tests, Proctor curves, Atterberg limits, particle size distribution, CQC resumes, CQC welding rod certificates, subgrade acceptance forms, LLDPE panel deployment logs, fusion and extrusion trial seam logs, fusion and extrusion seam logs, LLDPE repair logs, pressure and vacuum test logs, fusion and extrusion destructive test logs, concrete cylinder break reports, concrete pour cards, concrete tickets, rebar mill certification reports, and all daily field reports.

i) Copies of all field CQC reports for structural fill, ash fill, and geosynthetic installation.

## 16.2 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. Drawings to be signed and sealed by a land surveyor registered to practice in the state of Alabama.

# APPENDIX 9

## SUPPLEMENTAL INFORMATION REQUESTED BY THE DEPARTMENT

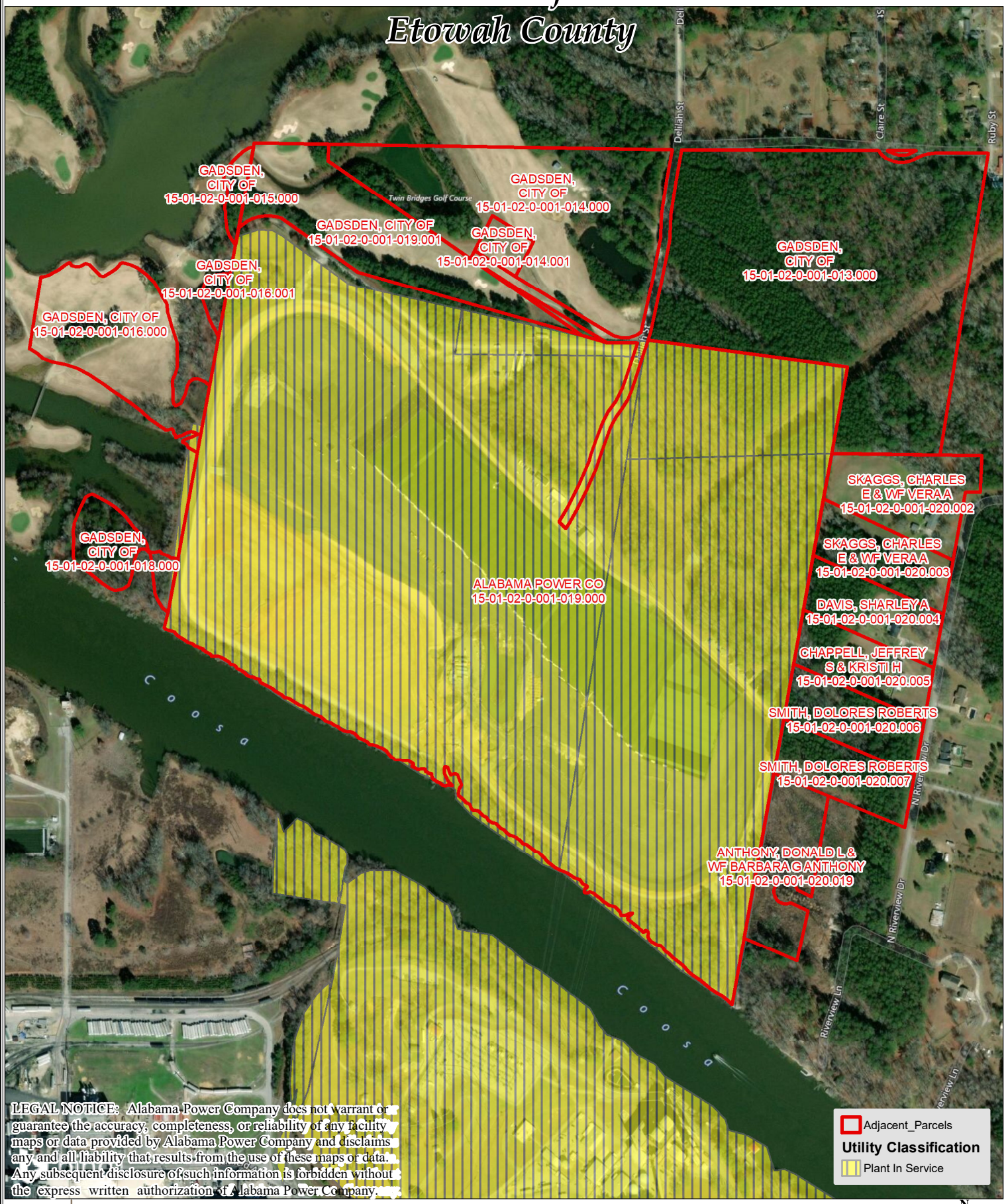
# APPENDIX 10

# ADJACENT PROPERTY OWNERS

| Parcel Number | Owner | Owner 2 | Mailing Address | Mailing City | Mailing State | Mailing Zip |
|---|---|---|---|---|---|---|
| 15-01-02-0-001-013.000 | GADSDEN, CITY OF | | 90 BROAD ST | GADSDEN | AL | 35901 |
| 15-01-02-0-001-014.000 | GADSDEN, CITY OF | | 90 BROAD ST | GADSDEN | AL | 35901 |
| 15-01-02-0-001-014.001 | GADSDEN, CITY OF | | 90 BROAD ST | GADSDEN | AL | 35901 |
| 15-01-02-0-001-015.000 | GADSDEN, CITY OF | | 90 BROAD ST | GADSDEN | AL | 35901 |
| 15-01-02-0-001-016.000 | GADSDEN, CITY OF | | 90 BROAD ST | GADSDEN | AL | 35901 |
| 15-01-02-0-001-016.001 | GADSDEN, CITY OF | | 90 BROAD ST | GADSDEN | AL | 35901 |
| 15-01-02-0-001-018.000 | GADSDEN, CITY OF | | 90 BROAD ST | GADSDEN | AL | 35901 |
| 15-01-02-0-001-019.001 | GADSDEN, CITY OF | | 90 BROAD ST | GADSDEN | AL | 35901 |
| 15-01-02-0-001-020.002 | SKAGGS, CHARLES E & WF VERA A | SKAGGS, VERA L | 201 N RIVERVIEW DR | GADSDEN | AL | 35901 |
| 15-01-02-0-001-020.003 | SKAGGS, CHARLES E & WF VERA A | | 201 N RIVERVIEW DR | GADSDEN | AL | 35901 |
| 15-01-02-0-001-020.004 | DAVIS, SHARLEY A | DAVIS, KATHRYN Y | 211 N RIVERVIEW DR | GADSDEN | AL | 35901 |
| 15-01-02-0-001-020.005 | CHAPPELL, JEFFREY S & KRISTI H | CHAPPELL, KRISTI H | 213 N RIVERVIEW DR | GADSDEN | AL | 35901 |
| 15-01-02-0-001-020.006 | SMITH, DOLORES ROBERTS | C/O CHARLENE MCEACHERN | 1390 OLDE DOUBLOON DRIVE | VERO BEACH | FL | 32963 |
| 15-01-02-0-001-020.007 | SMITH, DOLORES ROBERTS | C/O CHARLENE MCEACHERN | 1390 OLDE DOUBLOON DRIVE | VERO BEACH | FL | 32963 |
| 15-01-02-0-001-020.019 | ANTHONY, DONALD L & WF BARBARA G ANTHONY | | 301 CASEY DR | GADSDEN | AL | 35903 |

# Plant Gadsden - Adjacent Owners

## Etowah County

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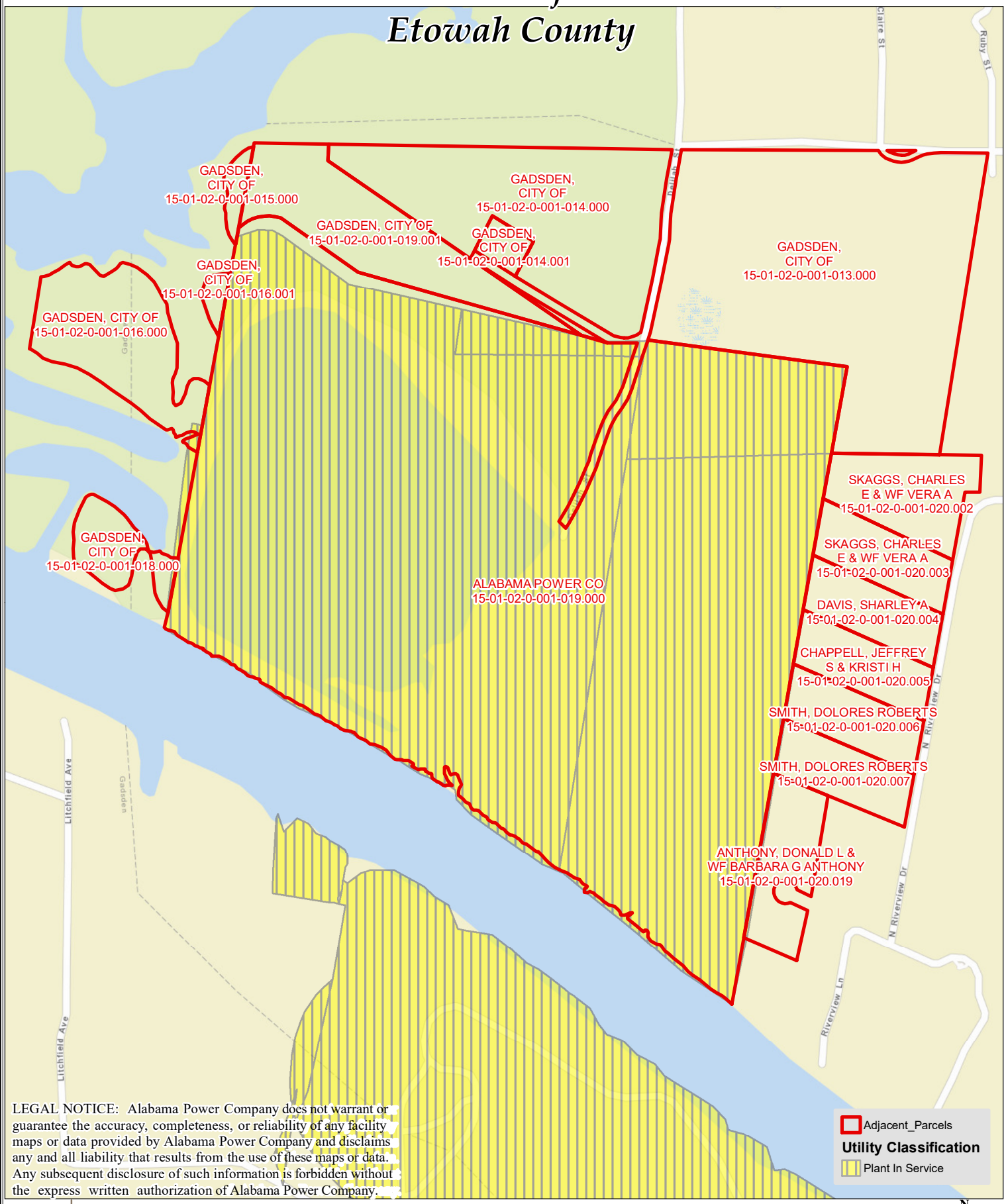
# Etowah County

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