Alabama Power

Dustin G. Brooks
Environmental Affairs Supervisor
Environmental Compliance

600 North 18th Street
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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 Gorgas Ash Pond

Dear Mr. Story:

Alabama Power Company is the owner and operator of the Plant Gorgas Ash Pond, located at Parrish, 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 Gorgas 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 version of the Amended Closure Plan initially submitted to the Department on July 15, 2019 and a revised groundwater monitoring plan submitted on April 15, 2020 have been incorporated into the Plant Gorgas Ash Pond closure permit application package.

Alabama Power is seeking a closure permit for the Plant Gorgas Ash Pond pursuant to rule 335-13-15-.09(1)(c). That rule requires submission of “all the information as required for an existing CCR surface impoundment in 335-13-15-.09(1)(a), except for the requirements of 335-13-15.09(1)(a)3., 4. and 5.” Thus, to the extent any materials fall within those exceptions, we have not included them in our submissions to the Department.

In response to your comment on the closure plan, please note that we revised Section 4.3.4 of the Amended Closure Plan. As before, the procedure calls for repeated verification of excavation of relatively small areas. Because the area to be excavated at the Plant Gorgas Ash Pond covers hundreds of acres, we anticipate extended periods of daily verification events over the course of the project. In addition, a comparable number and frequency of verification events will be occurring within the same general time frame at four other Alabama Power facilities. We will be pleased to work with ADEM to schedule as many instances of in-person observation and participation as ADEM finds necessary to discharge its duties of regulation and oversight. In addition, new language in Section 4.3.4 provides that photographs will be taken once removal of CCR from a given area outside the consolidated footprint is deemed complete by the Construction Quality Assurance engineer. These photographs will be maintained at the site and will be available for review by ADEM personnel. Accordingly, our modified procedures establish transparency and provide ADEM the opportunity for complete and thorough oversight of the process.

Finally, per your request and in accordance with rule 335-13-15-.08(3)(i)4., we have uploaded both the Amended Closure Plan submitted on July 15, 2019 and the revised Amended Closure Plan that is incorporated in the revised permit application to Plant Gorgas's CCR website.

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

Dustin Brooks

Enclosures

PERMIT APPLICATION FOR CCR SURFACE IMPOUNDMENT

PLANT GORGAS ASH POND

PARRISH, ALABAMA

ALABAMA POWER COMPANY

PERMIT APPLICATION FOR CCR SURFACE IMPOUNDMENT

PLANT GORGAS ASH POND

ADEM Admin. Code r. 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).

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

The Plant Gorgas Ash Pond will begin the process of physical closure activities and completing the regulatory requirements of 335-13-15-.07(3) in 2019. Currently the pond receives ash through sluicing but will no longer receive waste in early 2019. In the unlikely event of failure, the Plant Gorgas Ash Pond was deemed to have a High Hazard Potential Classification, in that failure or mis-operation of the CCR unit could potentially result in loss of human life. A copy of the Initial and Updated Hazard Potential Classification document has been previously posted to Alabama Power Company's CCR website.

The Updated Hazard Potential Classification and Emergency Action Plan for the Plant Gorgas Ash Pond can be found it Appendix 3.

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

i. History of Construction [r. 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 4.

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

The Structural Stability Assessment document can be found in Appendix 5.

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

The Safety Factor Assessment document, including the applicable calculation, can be found in Appendix 6.

5. On-site Control Points

Control Points are shown on Figure 9 found in Appendix 7.

6. Topographical Maps, Grading Plans and Details

Drawings showing existing topographic maps, final grades of the consolidated ash stack in the and cross sections are shown in Appendix 8.

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

A draft QA/QC plan for the final cover system can be found in Appendix 9. Once completed, APC will provide the final QA/QC plan to the Department.

8. Operation Plan

An Operation Plan for the facility can be found in Appendix 10. Attachments to this Operation Plan includes the following, unless as noted otherwise:

i. A CCR fugitive dust control plan [r. 335-13-15-.05(1).]
ii. An inflow design flood control system [r.335-13-15-.05(3).]
iii. Groundwater monitoring and analysis program [r. 335-13-15-.06.]
iv. Recordkeeping and Notification Compliance Procedures [r.335-13-15-.08.
v. Procedures for updating all plans and assessments periodically as required by this chapter.

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

The Gorgas Ash Pond will be closed in place. A written closure plan can be found in Appendix 11. As the facility will be closed in place, a written post-closure care plan is included with this permit.

10. Supplemental Information

Reserved

11. Adjacent Property Owners

A list of adjoining property owners can be found in Appendix 12.

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.

ALABAMA LICENSE No. 16516 PROFESSIONAL ENGINEER JAMES C. PEGUES, JR.

12/3/18

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 Gorgas Ash Pond

3. **Applicant:**

   Name: Mr Mike Godfrey (Physical Address)

   Address: Alabama Power Company — Plant Gorgas

   Post Office Box 2641 — 460 Gorgas Road

   Birmingham, Alabama 35291 — Parrish, AL 35580-5715

   Telephone: (205) 257-6131

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

   Township 16-South **Range** 06-West
   Section 20, 21, 28, 29 **County** Walker

5. **Land Owner:**

   Name: Alabama Power Company

   Address: Post Office Box 2641

   Birmingham, AL 35291-0830

   Telephone: (205) 257-4194

   (Attach copy of agreement from landowner if applicable.)

6. **Contact Person:**

Name James Douglas — Che George

Position or Affiliation Environmental Affairs Specialist — Senior Compliance Specialist

Address: Post Office Box 2641, Birmingham, AL 35291-0831 — 460 Gorgas Road, Parrish, AL 35580-5716

Telephone: (205) 257-6782 — (205) 686-2324

7. **Size of Facility:** 1,467.01 **Acres**

   Size of Disposal Area(s): 423.32 **Acres**

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

The CCRSI service area was limited to waste generated only from Alabama Power Company.

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 CCRSI will undergo closure and it contains CCR Related materials.

[signature] 11/26/18
SIGNATURE **DATE**

APPENDIX 2

BOUNDARY PLAT AND LEGAL DESCRIPTION

WALKER/JEFFERSON COUNTY, ALABAMA
SECTION 16,17,20,21,29,28,32 & 33 TWN-16-S, RNG-6-W

ABBREVIATIONS

P.O.C.	POINT OF COMMENCEMENT	T16S	TOWNSHIP 16 SOUTH
P.O.B.	POINT OF BEGINNING	R6W	RANGE 6 WEST
(M)	MEASURED	SEC.	SECTION
(C)	CALCULATED	APCO	ALABAMA POWER COMPANY
(D)	DEED BOOK 2467 PAGE 647	CONC.	CONCRETE

NOTES

1. All easements and rights of way of which the surveyor has knowledge are shown hereon; others may exist of which the surveyor has no knowledge and of which there is no observable evidence. No Title Commitment performed, certified to or supplied by client. Without said Title Commitment no guarantee can be made by the surveyor as to the location of easements.

2. No attempt made by Surveyor to locate underground utilities. All utilities shown hereon were drawn based on field evidence only which should be considered approximate and should be marked on the ground by the utility companies prior to construction. the telephone numbers for the Alabama Line Location Center (MISSALL) are 252–4444 (Birmingham area) and (800) 292–8525 (elsewhere).

3. No attempt has been made and no guarantees are hereby given as to the location of sub–surface foundations.

4. According to the Flood Insurance Rate Map (FIRM) for Walker County, Alabama (community–panel number 01127C 0495E and 01127C 0490E, dated October 02, 2014), the subject property lies within (Zone X) unshaded defined as "areas outside of minimal flooding", Zone AE defined as base floods elevations determined.

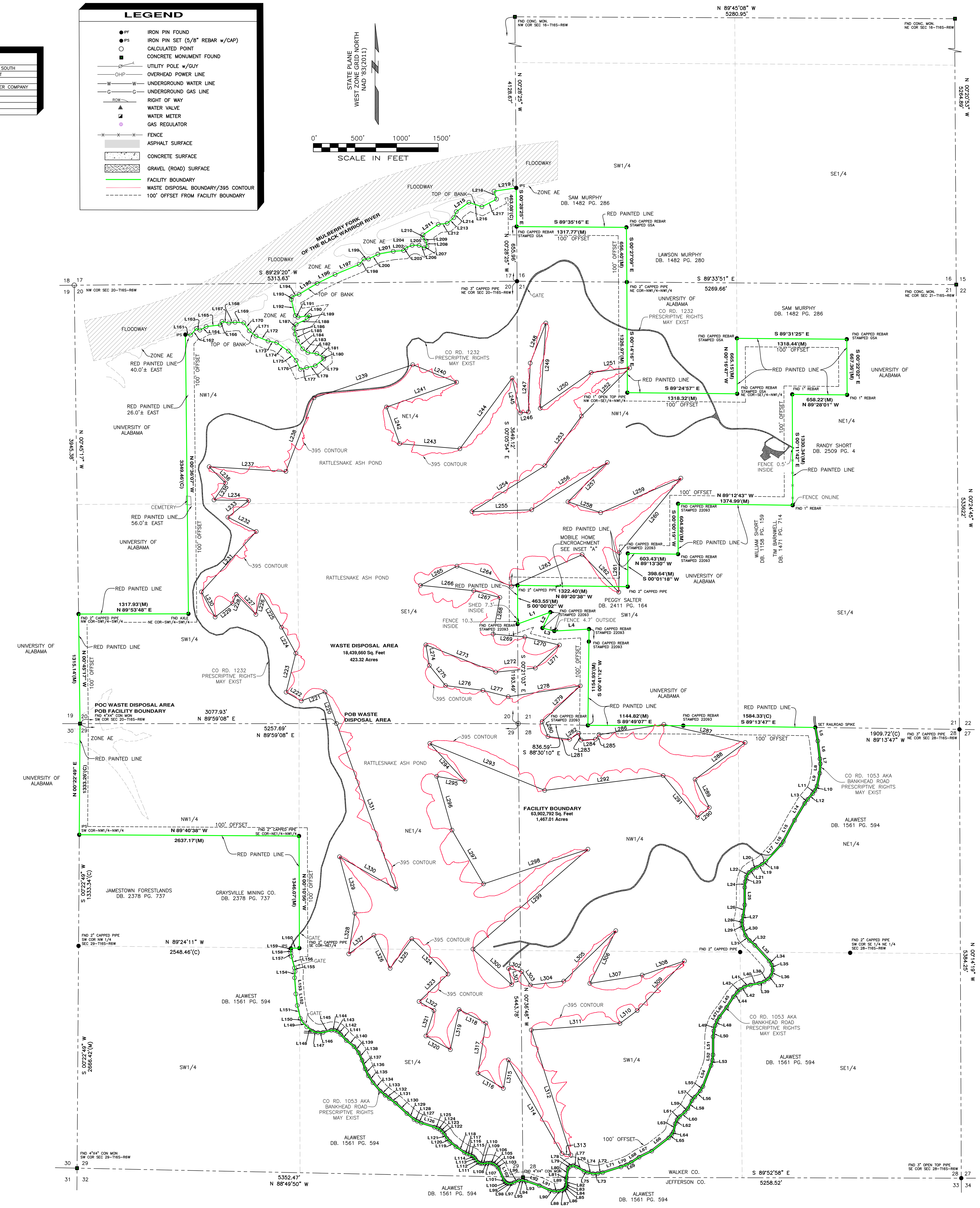
5. North arrow and bearings shown hereon are based on Transverse Mercator Projection –Alabama West Zone – NAD 83 adjusted 2011. Using Global Positional System (GPS) and derived by static observation. Using Base Station: Designation: AL30 CORS ARP, PID DI2226 Combined Factor: 0.99995426 Convergence Factor: +0 21 25.9

6. County Road 1232 & 1053 are gravel roads that have been gated in multiple locations. Tax records show this road to be a County Road however the surveyor found no eviedence that it was ever a formally dedicated right of way, prescriptive rights may exist.

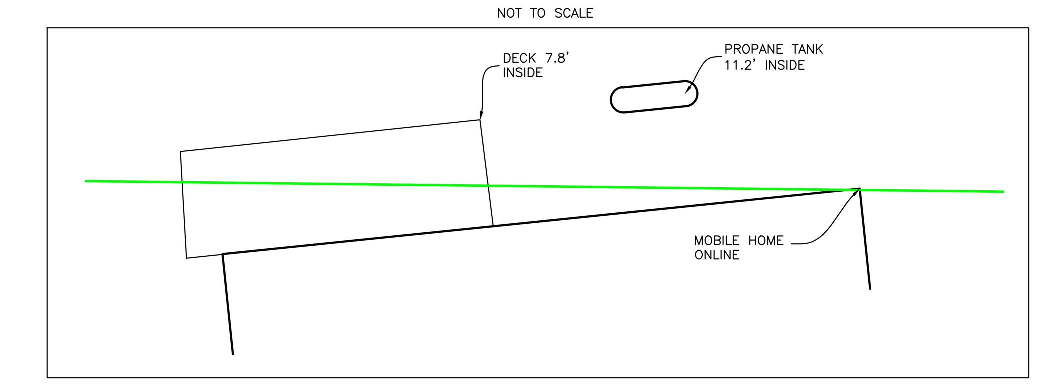
7. The edge of water and the 395.00 contour shown hereon for Rattlesnake lake and Mulberry Fork were taken from Lidar data, provided by the client.

LEGEND

IPF	IRON PIN FOUND
IPS	IRON PIN SET (5/8" REBAR w/CAP)
	CALCULATED POINT
	CONCRETE MONUMENT FOUND
	UTILITY POLE w/GUY
OHP	OVERHEAD POWER LINE
W	UNDERGROUND WATER LINE
G	UNDERGROUND GAS LINE
ROW	RIGHT OF WAY
	WATER VALVE
	WATER METER
	GAS REGULATOR
	FENCE
	ASPHALT SURFACE
	CONCRETE SURFACE
	GRAVEL (ROAD) SURFACE
	FACILITY BOUNDARY
	WASTE DISPOSAL BOUNDARY/395 CONTOUR
	100' OFFSET FROM FACILITY BOUNDARY



INSET "A"
NOT TO SCALE



LINE TABLE

LINE	BEARING	DISTANCE	LINE	BEARING	DISTANCE	LINE	BEARING	DISTANCE
L1	N 70°08'22" E	419.47'	L111	N 63°05'08" W	28.22'	L221	S 69°14'17" W	305.86'
L2	S 26°48'23" W	213.04'	L112	N 42°01'04" W	38.82'	L222	N 59°59'04" W	209.75'
L3	S 75°43'43" E	146.81'	L113	N 33°43'07" W	29.72'	L223	N 13°53'32" E	481.07'
L4	N 86°47'38" E	417.39'	L114	N 47°48'35" W	30.06'	L224	N 28°55'02" W	355.30'
L5	S 10°17'11" E	164.80'	L115	N 65°58'14" W	35.37'	L225	N 30°30'38" W	472.87'
L6	S 06°46'26" E	216.35'	L116	N 70°09'52" W	38.48'	L226	S 14°37'45" W	261.32'
L7	S 05°36'45" E	60.22'	L117	N 63°49'28" W	35.29'	L227	N 44°34'32" W	336.50'
L8	S 03°57'40" W	112.87'	L118	N 55°25'24" W	122.10'	L228	S 21°58'54" W	114.42'
L9	S 12°06'00" W	156.40'	L119	N 49°42'31" W	98.16'	L229	S 51°44'56" W	267.41'
L10	S 24°21'52" W	60.53'	L120	N 42°34'36" W	46.68'	L230	N 28°33'01" W	344.28'
L11	S 36°16'18" W	45.64'	L121	N 31°50'31" W	59.86'	L231	N 42°13'12" E	978.51'
L12	S 40°48'08" W	91.90'	L122	N 37°43'27" W	39.29'	L232	N 63°19'08" W	381.59'
L13	S 36°55'34" W	58.62'	L123	N 47°57'18" W	37.03'	L233	N 51°18'57" E	319.99'
L14	S 30°46'58" W	237.07'	L124	N 60°24'10" W	31.02'	L234	N 89°04'16" W	415.88'
L15	S 28°05'33" W	288.88'	L125	N 69°37'31" W	44.00'	L235	N 34°19'49" E	244.93'
L16	S 33°21'43" W	48.13'	L126	N 72°26'47" W	166.40'	L236	N 44°50'00" W	277.79'
L17	S 42°48'08" W	268.20'	L127	N 65°49'20" W	51.59'	L237	S 86°27'30" E	922.68'
L18	S 51°36'03" W	57.88'	L128	N 61°54'45" W	43.76'	L238	N 20°50'52" E	944.55'
L19	S 59°38'01" W	77.16'	L129	N 50°23'06" W	112.30'	L239	N 71°27'56" E	1249.83'
L20	S 62°50'38" W	53.24'	L130	N 47°22'40" W	182.54'	L240	S 68°15'33" E	566.94'
L21	S 51°52'22" W	56.96'	L131	N 53°05'53" W	93.75'	L241	S 70°33'23" W	892.22'
L22	S 30°22'13" W	60.78'	L132	N 52°56'50" W	64.42'	L242	S 19°40'34" E	467.37'
L23	S 13°16'48" W	57.49'	L133	N 49°03'01" W	78.36'	L243	S 85°11'48" E	725.55'
L24	S 05°09'27" W	70.47'	L134	N 40°47'30" W	133.32'	L244	N 36°28'00" E	1054.92'
L25	S 00°05'28" E	209.89'	L135	N 34°18'56" W	98.74'	L245	S 13°16'29" E	431.15'
L26	S 07°33'02" W	132.99'	L136	N 24°51'10" W	91.24'	L246	N 82°48'27" E	96.61'
L27	S 13°30'35" W	61.48'	L137	N 19°40'24" W	110.24'	L247	N 02°12'31" E	586.44'
L28	S 01°34'07" W	41.13'	L138	N 24°50'43" W	100.91'	L248	N 21°17'51" E	516.36'
L29	S 12°19'15" E	45.08'	L139	N 36°34'28" W	89.45'	L249	S 03°46'42" W	1024.33'
L30	S 19°04'36" E	93.21'	L140	N 51°45'25" W	117.42'	L250	N 54°51'48" E	745.40'
L31	S 38°03'26" E	79.33'	L141	N 42°34'23" W	100.05'	L251	N 83°21'06" E	466.42'
L32	S 49°25'45" E	88.66'	L142	N 45°58'12" W	50.89'	L252	S 45°04'20" W	817.03'
L33	S 42°11'33" E	254.03'	L143	N 66°26'52" W	35.40'	L253	S 36°24'06" W	739.24'
L34	S 33°43'07" E	56.05'	L144	N 88°29'39" W	44.86'	L254	S 57°47'32" W	1034.38'
L35	S 09°52'35" E	64.03'	L145	S 74°47'21" W	103.35'	L255	N 88°14'11" E	717.34'
L36	S 16°03'56" W	69.45'	L146	S 88°06'29" W	60.95'	L256	N 57°57'44" E	1069.96'
L37	S 41°01'10" W	50.43'	L147	N 75°54'05" W	68.55'	L257	S 45°01'38" W	666.91'
L38	S 55°49'59" W	62.03'	L148	N 51°43'27" W	85.14'	L258	S 71°33'50" E	413.00'
L39	S 72°22'04" W	60.76'	L149	N 43°32'49" W	76.63'	L259	N 66°43'49" E	1047.77'
L40	S 79°23'29" W	107.11'	L150	N 27°53'11" W	51.84'	L260	S 39°36'25" W	1160.80'
L41	S 72°31'01" W	76.58'	L151	N 13°39'32" W	159.36'	L261	S 00°32'43" W	472.02'
L42	S 58°25'12" W	60.25'	L152	N 06°57'38" W	139.35'	L262	N 44°21'10" W	627.99'
L43	S 45°45'36" W	47.46'	L153	N 04°15'34" W	195.32'	L263	S 65°53'26" W	925.76'
L44	S 40°16'01" W	71.57'	L154	N 04°16'50" E	75.49'	L264	N 69°58'12" W	700.36'
L45	S 32°29'57" W	150.66'	L155	N 10°17'21" W	43.45'	L265	S 62°20'14" W	494.91'
L46	S 37°14'16" W	142.46'	L156	N 15°13'05" W	142.45'	L266	S 84°15'14" E	643.57'
L47	S 32°15'24" W	57.12'	L157	N 08°17'05" W	41.52'	L267	S 75°23'32" E	323.41'
L48	S 20°51'25" W	59.35'	L158	N 02°31'19" W	34.51'	L268	S 10°27'20" W	446.08'
L49	S 14°56'49" W	65.22'	L159	N 05°35'02" E	24.56'	L269	S 84°43'55" E	383.62'
L50	S 06°48'59" W	70.86'	L160	S 89°24'11" E	101.94'	L270	S 76°49'17" E	425.90'
L51	S 00°16'33" W	218.44'	L161	S 86°28'28" E	63.70'	L271	S 46°23'42" W	400.06'
L52	S 05°42'29" W	64.21'	L162	N 40°20'07" E	102.68'	L272	S 84°09'32" W	478.48'
L53	S 14°42'45" W	66.23'	L163	S 64°48'09" E	47.84'	L273	N 68°40'35" W	899.58'
L54	S 21°12'08" W	270.34'	L164	N 60°06'57" E	86.79'	L274	S 09°38'48" E	251.06'
L55	S 31°25'39" W	60.40'	L165	N 83°38'34" E	169.38'	L275	S 38°49'29" E	309.33'
L56	S 40°52'36" W	99.82'	L166	N 26°52'30" E	48.83'	L276	S 82°45'36" E	452.61'
L57	S 39°19'11" W	55.89'	L167	S 75°50'54" E	84.69'	L277	S 75°59'07" E	313.33'
L58	S 26°58'15" W	105.86'	L168	N 82°15'50" E	75.15'	L278	N 81°26'48" E	873.72'
L59	S 39°33'27" W	55.84'	L169	S 86°12'07" E	105.17'	L279	S 46°49'51" W	626.60'
L60	S 49°32'40" W	84.82'	L170	S 34°03'32" E	115.88'	L280	S 20°58'00" E	192.83'
L61	S 41°24'33" W	44.03'	L171	S 51°18'10" E	104.72'	L281	S 82°55'47" E	263.00'
L62	S 24°23'59" W	55.25'	L172	S 68°31'55" E	154.45'	L282	N 56°15'42" E	131.08'
L63	S 12°08'42" W	101.06'	L173	S 78°49'20" E	106.72'	L283	S 18°46'13" E	87.02'
L64	S 33°08'23" W	36.94'	L174	S 54°02'45" E	171.71'	L284	N 86°44'43" E	173.28'
L65	S 42°01'04" W	54.31'	L175	S 39°59'36" E	144.22'	L285	N 36°34'54" E	68.80'
L66	S 52°12'26" W	258.98'	L176	S 24°57'46" E	119.13'	L286	N 81°00'08" E	788.71'
L67	S 63°55'58" W	168.19'	L177	N 74°41'40" E	79.86'	L287	S 77°24'18" E	999.53'
L68	S 56°20'18" W	112.45'	L178	N 78°40'49" E	105.45'	L288	S 53°44'59" W	745.47'
L69	S 63°57'04" W	63.83'	L179	N 50°46'54" E	129.85'	L289	S 26°41'54" E	380.58'
L70	S 69°27'51" W	71.03'	L180	N 04°12'47" W	21.60'	L290	S 50°24'07" W	185.96'
L71	S 72°25'49" W	231.13'	L181	N 61°31'49" W	91.15'	L291	N 39°11'48" W	648.75'
L72	S 79°38'06" W	60.02'	L182	N 84°23'56" W	108.81'	L292	S 82°53'18" W	1433.02'
L73	S 88°15'58" W	54.90'	L183	N 53°46'24" W	77.01'	L293	N 67°46'49" W	1489.23'
L74	N 79°08'19" W	65.22'	L184	N 33°23'04" W	113.77'	L294	S 42°49'26" E	620.36'
L75	N 69°04'41" W	47.63'	L185	N 18°55'34" W	88.18'	L295	N 79°54'18" W	343.36'
L76	N 59°42'12" W	101.14'	L186	N 10°43'29" W	72.37'	L296	S 15°49'31" E	670.60'
L77	N 67°36'20" W	47.52'	L187	N 29°10'14" E	52.93'	L297	S 30°15'04" E	747.84'
L78	S 74°11'02" W	38.25'	L188	N 64°13'15" E	147.77'	L298	N 71°37'47" E	1321.73'
L79	S 43°45'28" W	34.94'	L189	N 36°45'37" E	50.02'	L299	S 49°01'07" W	1827.59'
L80	S 09°43'53" W	111.71'	L190	S 81°48'55" W	142.45'	L300	S 47°28'20" E	630.23'
L81	S 09°43'53" W	28.01'	L191	N 58°35'05" W	36.85'	L301	N 10°57'37" W	198.58'
L82	S 02°52'51" E	55.85'	L192	N 14°03'32" W	198.96'	L302	S 76°36'35" E	163.91'
L83	S 02°29'32" W	11.85'	L193	N 15°19'47" E	34.22'	L303	S 32°29'41" E	190.88'
L84	S 16°07'47" W	24.11'	L194	N 70°35'06" E	90.25'	L304	N 83°21'29" E	403.71'
L85	S 36°11'16" W	16.58'	L195	N 58°45'21" E	252.56'	L305	N 45°54'07" E	868.90'
L86	S 46°14'59" W	17.12'	L196	N 63°41'00" E	240.63'	L306	S 26°14'51" W	705.06'
L87	S 66°03'38" W	25.37'	L197	N 67°14'11" E	314.50'	L307	N 81°03'23" E	636.55'
L88	S 77°55'04" W	44.26'	L198	N 40°51'08" E	85.61'	L308	N 71°28'24" E	535.14'
L89	S 89°22'40" W	47.41'	L199	S 88°59'29" E	55.01'	L309	S 43°39'14" W	821.97'
L90	N 77°59'25" W	56.90'	L200	N 62°41'52" E	126.04'	L310	S 53°20'24" W	258.04'
L91	N 65°46'57" W	136.99'	L201	N 79°24'33" E	188.21'	L311	S 85°44'34" W	1067.10'
L92	N 71°11'23" W	171.14'	L202	N 85°27'01" E	123.97'	L312	S 17°32'25" E	1572.09'
L93	N 76°37'17" W	34.38'	L203	N 41°25'50" E	41.44'	L313	N 82°11'12" W	106.63'
L94	N 76°37'17" W	5.81'	L204	N 67°40'14" E	82.16'	L314	N 29°44'33" W	1297.09'
L95	S 86°49'25" W	44.76'	L205	S 88°39'22" E	83.46'	L315	S 09°50'36" W	348.12'
L96	S 66°51'42" W	61.73'	L206	S 63°57'14" E	67.68'	L316	N 59°17'26" W	354.75'
L97	S 67°24'07" W	36.63'	L207	N 64°12'42" E	36.78'	L317	N 08°57'55" E	609.61'
L98	S 88°49'55" W	27.62'	L208	N 10°11'54" W	69.80'	L318	N 63°04'07" W	360.05'
L99	N 73°42'10" W	24.08'	L209	N 45°25'53" W	53.61'	L319	S 12°18'17" W	492.70'
L100	N 56°20'18" W	24.38'	L210	N 05°49'51" E	35.71'	L320	N 60°46'00" W	336.36'
L101	N 39°59'16" W	27.19'	L211	N 55°37'11" E	221.20'	L321	N 17°37'52" E	321.08'
L102	N 24°12'49" W	158.03'	L212	N 83°02'36" E	109.41'	L322	N 58°54'50" W	209.17'
L103	N 39°25'24" W	28.99'	L213	N 49°00'53" E	102.16'	L323	N 46°32'39" E	478.34'
L104	N 51°52'22" W	44.05'	L214	N 22°36'19" E	79.07'	L324	N 45°40'35" W	606.41'
L105	N 64°25'19" W	21.95'	L215	N 53°43'02" E	187.90'	L325	S 36°12'35" W	440.12'
L106	N 77°58'55" W	25.73'	L216	S 71°09'12" E	164.86'	L326	N 26°08'24" W	442.61'
L107	S 86°42'51" W	35.95'	L217	N 62°23'38" E	197.79'	L327	S 53°27'06" W	375.92'
L108	S 79°29'25" W	29.37'	L218	N 17°13'05" W	100.28'	L328	N 08°24'34" E	493.24'
L109	S 87°20'23" W	35.51'	L219	N 81°47'47" E	269.44'	L329	N 15°06'56" W	701.26'
L110	N 80°11'28" W	21.77'	L220	N 19°48'00" W	404.27'	L330	S 60°23'04" E	779.57'
						L331	N 19°48'00" W	2108.00'

STATE OF ALABAMA
JEFFERSON/WALKER COUNTY

I, hereby certify that all parts of this survey and drawing have been completed in accordance with the current requirements of the Standards of Practice for Surveying in the State of Alabama to the best of my knowledge, information and belief.

ALABAMA LICENSED No. 29996 PROFESSIONAL SURVEYOR DEREK S. MEADOWS

Date:

PRELIMINARY

Derek S. Meadows, PLS
Alabama License No. 29996
dmeadows@gonzalez–strength.com

GONZALEZ - STRENGTH & ASSOCIATES, INC.
CIVIL ENGINEERING, LAND SURVEYING, PLANNING, TRAFFIC & TRANSPORTATION
2176 PARKWAY LAKE DRIVE
HOOVER, ALABAMA 35244
PHONE: (205) 942-2486
FAX: (205) 942-3033
www.Gonzalez-Strength.com

GSA JOB #18-0508

BOUNDARY PERMIT DRAWING

Southern Company Generation Engineering and Construction Services FOR

Alabama Power Company

Gorgas Steam Plant
Rattle Snake Ash Pond
Property Survey

REVISION	DATE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
			XXX	XXX	XXX		1"=500'	4347GOR	1	FINAL	0

ALL PARTS OF THIS SURVEY AND DRAWING HAVE BEEN COMPLETED IN ACCORDANCE WITH THE CURRENT REQUIREMENTS OF THE STANDARDS OF PRACTICE FOR SURVEYING IN THE STATE OF ALABAMA.

811 Know what's below. Call before you dig. Dial 811 Or Call 800-292-7411

ANSI E: 44x34

WALKER/JEFFERSON COUNTY, ALABAMA
SECTION 16,17,20,21,29,28,32 & 33 TWN-16-S, RNG-6-W

GORGAS STEAM PLANT RATTLE SNAKE ASH POND FACILITY BOUNDARY LEGAL DESCRIPTION

A parcel of land situated partly in Sections 16,17,20,21,29,28,32 and 33, Township 16 South, Range 6 West Jefferson and Walker County, Alabama. Said parcel being more particularly described as follows:

Begin at a found 4 inch by 4 inch concrete monument marking the Southwest corner of the above mentioned Section 20; thence run North 00 Degrees 45 Minutes 17 Seconds West along the West line of said Section for a distance of 1315.14 feet to a found 2 inch capped pipe marking the Northwest corner of the Southwest one quarter of the Southwest one quarter of said Section 20; thence leaving said West line run North 89 Degrees 53 Minutes 48 Seconds East along the North line of said quarter section for a distance of 1317.93 feet to a found axle marking the Northeast corner of the Southwest one quarter of the Southwest one quarter; thence leaving said North line run North 00 Degrees 36 Minutes 07 Seconds West along the West line of the Northeast one quarter of the Southwest one quarter and the extension thereof for a distance of 3349.46 feet to a set 5/8 inch capped rebar stamped CA–560–LS, said point lying on the South bank of the Mulberry Fork; thence leaving said West line run along said South bank for the following calls:

South 86 Degrees 28 Minutes 28 Seconds East for a distance of 63.70 feet to a point;
thence run North 40 Degrees 20 Minutes 07 Seconds East for a distance of 102.68 feet to a point;
thence run South 64 Degrees 48 Minutes 09 Seconds East for a distance of 47.84 feet to a point;
thence run North 60 Degrees 06 Minutes 57 Seconds East for a distance of 86.79 feet to a point;
thence run North 83 Degrees 38 Minutes 34 Seconds East for a distance of 169.38 feet to a point;
thence run North 26 Degrees 52 Minutes 30 Seconds East for a distance of 48.83 feet to a point;
thence run South 75 Degrees 50 Minutes 54 Seconds East for a distance of 84.69 feet to a point;
thence run North 82 Degrees 15 Minutes 50 Seconds East for a distance of 75.15 feet to a point;
thence run South 86 Degrees 12 Minutes 07 Seconds East for a distance of 105.17 feet to a point;
thence run South 34 Degrees 03 Minutes 32 Seconds East for a distance of 115.88 feet to a point;
thence run South 51 Degrees 18 Minutes 10 Seconds East for a distance of 104.72 feet to a point;
thence run South 68 Degrees 31 Minutes 55 Seconds East for a distance of 154.45 feet to a point;
thence run South 78 Degrees 49 Minutes 20 Seconds East for a distance of 106.72 feet to a point;
thence run South 54 Degrees 02 Minutes 45 Seconds East for a distance of 171.71 feet to a point;
thence run South 39 Degrees 59 Minutes 36 Seconds East for a distance of 144.22 feet to a point;
thence run South 24 Degrees 57 Minutes 46 Seconds East for a distance of 119.13 feet to a point;
thence run North 74 Degrees 41 Minutes 40 Seconds East for a distance of 79.86 feet to a point;
thence run North 78 Degrees 40 Minutes 49 Seconds East for a distance of 105.45 feet to a point;
thence run North 50 Degrees 46 Minutes 54 Seconds East for a distance of 129.85 feet to a point;
thence run North 04 Degrees 12 Minutes 47 Seconds West for a distance of 21.60 feet to a point;
thence run North 61 Degrees 31 Minutes 49 Seconds West for a distance of 91.15 feet to a point;
thence run North 84 Degrees 23 Minutes 56 Seconds West for a distance of 108.81 feet to a point;
thence run North 53 Degrees 46 Minutes 24 Seconds West for a distance of 77.01 feet to a point;
thence run North 33 Degrees 23 Minutes 04 Seconds West for a distance of 113.77 feet to a point;
thence run North 18 Degrees 55 Minutes 34 Seconds West for a distance of 88.18 feet to a point;
thence run North 10 Degrees 43 Minutes 29 Seconds West for a distance of 72.37 feet to a point;
thence run North 29 Degrees 10 Minutes 14 Seconds East for a distance of 52.93 feet to a point;
thence run North 64 Degrees 13 Minutes 15 Seconds East for a distance of 147.77 feet to a point;
thence run North 36 Degrees 45 Minutes 37 Seconds East for a distance of 50.02 feet to a point;
thence run South 81 Degrees 48 Minutes 55 Seconds West for a distance of 142.45 feet to a point;
thence run North 58 Degrees 35 Minutes 05 Seconds West for a distance of 36.85 feet to a point;
thence run North 14 Degrees 03 Minutes 32 Seconds West for a distance of 198.96 feet to a point;
thence run North 15 Degrees 19 Minutes 47 Seconds East for a distance of 34.22 feet to a point;
thence run North 70 Degrees 35 Minutes 06 Seconds East for a distance of 90.25 feet to a point;
thence run North 58 Degrees 45 Minutes 21 Seconds East for a distance of 252.56 feet to a point;
thence run North 63 Degrees 41 Minutes 00 Seconds East for a distance of 240.63 feet to a point;
thence run North 67 Degrees 14 Minutes 11 Seconds East for a distance of 314.50 feet to a point;
thence run North 40 Degrees 51 Minutes 08 Seconds East for a distance of 85.61 feet to a point;
thence run South 88 Degrees 59 Minutes 29 Seconds East for a distance of 55.01 feet to a point;
thence run North 62 Degrees 41 Minutes 52 Seconds East for a distance of 126.04 feet to a point;
thence run North 79 Degrees 24 Minutes 33 Seconds East for a distance of 188.21 feet to a point;
thence run North 85 Degrees 27 Minutes 01 Seconds East for a distance of 123.97 feet to a point;
thence run North 41 Degrees 25 Minutes 50 Seconds East for a distance of 41.44 feet to a point;
thence run North 67 Degrees 40 Minutes 14 Seconds East for a distance of 82.16 feet to a point;
thence run South 88 Degrees 39 Minutes 22 Seconds East for a distance of 83.46 feet to a point;
thence run South 63 Degrees 57 Minutes 14 Seconds East for a distance of 67.68 feet to a point;
thence run North 64 Degrees 12 Minutes 42 Seconds East for a distance of 36.78 feet to a point;
thence run North 10 Degrees 11 Minutes 54 Seconds West for a distance of 69.80 feet to a point;
thence run North 45 Degrees 25 Minutes 53 Seconds West for a distance of 53.61 feet to a point;
thence run North 05 Degrees 49 Minutes 51 Seconds East for a distance of 35.71 feet to a point;
thence run North 55 Degrees 37 Minutes 11 Seconds East for a distance of 221.20 feet to a point;
thence run North 83 Degrees 02 Minutes 36 Seconds East for a distance of 109.41 feet to a point;
thence run North 49 Degrees 00 Minutes 53 Seconds East for a distance of 102.16 feet to a point;
thence run North 22 Degrees 36 Minutes 19 Seconds East for a distance of 79.07 feet to a point;
thence run North 53 Degrees 43 Minutes 02 Seconds East for a distance of 187.90 feet to a point;
thence run South 71 Degrees 09 Minutes 12 Seconds East for a distance of 164.86 feet to a point;
thence run North 62 Degrees 23 Minutes 38 Seconds East for a distance of 197.79 feet to a point;
thence run North 17 Degrees 13 Minutes 05 Seconds West for a distance of 100.28 feet to a point;
thence run North 81 Degrees 47 Minutes 47 Seconds East for a distance of 269.44 feet to a set 5/8 inch capped rebar stamped CA–560–LS, said point lying on the West line of the above mentioned Section 16; thence leaving said South bank run South 00 Degrees 28 Minutes 25 Seconds East along said West line for a distance of 463.08 feet to a found capped rebar stamped GSA; thence leaving said West line run South 89 Degrees 35 Minutes 16 Seconds East for a distance of 1317.77 feet to a found capped rebar stamped GSA, said point lying on the East line of the Southwest one quarter of the Southwest one quarter of said Section 16; thence run South 00 Degrees 27 Minutes 09 Seconds East along said East line for a distance of 656.40 feet to a found 2 inch capped pipe marking the Northeast corner of the Northwest one quarter of the Northwest one quarter of the above mentioned Section 21; thence run South 00 Degrees 14 Minutes 16 Seconds East along the East line of said quarter quarter for a distance of 1326.97 feet to a found 1 inch open pipe marking the Northwest corner of the Southeast one quarter of the Northwest one quarter; thence run South 89 Degrees 24 Minutes 57 Seconds East along the North line of said quarter quarter for a distance of 1318.32 feet to a found capped rebar stamped GSA marking the Northeast corner of the Southeast one quarter of the Northwest one quarter; thence leaving said North line run North 00 Degrees 16 Minutes 47 Seconds West along the West line of the Northeast one quarter of said Section 21 for a distance of 665.15 feet to a found capped rebar stamped GSA; thence leaving said West line run South 89 Degrees 31 Minutes 25 Seconds East for a distance of 1318.44 feet to a found capped rebar stamped GSA; thence run South 00 Degrees 22 Minutes 02 Seconds East for a distance of 667.36 feet to a found 1 inch rebar; thence run North 89 Degrees 28 Minutes 01 Seconds West for a distance of 658.22 feet to a found 1 inch rebar; thence run South 00 Degrees 11 Minutes 42 Seconds East for a distance of 1330.34 feet to a found 1 inch rebar; thence run North 89 Degrees 12 Minutes 43 Seconds West for a distance of 1374.99 feet to a found capped rebar stamped 22093; thence run South 00 Degrees 00 Minutes 19 Seconds West for a distance of 604.99 feet to a found capped rebar stamped 22093; thence run North 89 Degrees 13 Minutes 30 Seconds West for a distance of 603.43 feet to a found capped rebar stamped 22093; thence run South 00 Degrees 01 Minutes 18 Seconds West for a distance of 398.64 feet to a found 2 inch capped pipe; thence run North 89 Degrees 20 Minutes 38 Seconds West for a distance of 1322.40 feet to a found 2 inch capped pipe; thence run South 00 Degrees 00 Minutes 02 Seconds West for a distance of 463.55 feet to a found capped rebar stamped 22093; thence run North 70 Degrees 08 Minutes 22 Seconds East for a distance of 419.47 feet to a found capped rebar stamped 22093; thence run South 26 Degrees 48 Minutes 23 Seconds West for a distance of 213.04 feet to a found capped rebar stamped 22093; thence run South 75 Degrees 43 Minutes 43 Seconds East for a distance of 146.81 feet to a found capped rebar stamped 22093; thence run North 86 Degrees 47 Minutes 38 Seconds East for a distance of 417.39 feet to a found capped rebar stamped 22093; thence run South 00 Degrees 41 Minutes 12 Seconds West for a distance of 1154.93 feet to a found capped rebar stamped 22093; thence run South 89 Degrees 49 Minutes 07 Seconds East for a distance of 1144.82 feet to a found capped rebar stamped 22093; thence run South 89 Degrees 13 Minutes 47 Seconds East for a distance of 1584.33 feet to a set Railroad Spike said point lying in the centerline of Bankhead Road; thence run along the centerline of said Bankhead Road for the following calls:
thence run South 10 Degrees 17 Minutes 11 Seconds East for a distance of 164.80 feet to a point;
thence run South 06 Degrees 46 Minutes 26 Seconds East for a distance of 216.35 feet to a point;
thence run South 05 Degrees 36 Minutes 45 Seconds East for a distance of 60.22 feet to a point;
thence run South 03 Degrees 57 Minutes 40 Seconds West for a distance of 112.87 feet to a point;
thence run South 12 Degrees 06 Minutes 00 Seconds West for a distance of 156.40 feet to a point;
thence run South 24 Degrees 21 Minutes 52 Seconds West for a distance of 60.53 feet to a point;
thence run South 36 Degrees 16 Minutes 18 Seconds West for a distance of 45.64 feet to a point;
thence run South 40 Degrees 48 Minutes 08 Seconds West for a distance of 91.90 feet to a point;
thence run South 36 Degrees 55 Minutes 34 Seconds West for a distance of 58.62 feet to a point;
thence run South 30 Degrees 46 Minutes 58 Seconds West for a distance of 237.07 feet to a point;
thence run South 28 Degrees 05 Minutes 33 Seconds West for a distance of 288.88 feet to a point;
thence run South 33 Degrees 21 Minutes 43 Seconds West for a distance of 48.13 feet to a point;
thence run South 42 Degrees 48 Minutes 08 Seconds West for a distance of 268.20 feet to a point;
thence run South 51 Degrees 36 Minutes 03 Seconds West for a distance of 57.88 feet to a point;
thence run South 59 Degrees 38 Minutes 01 Seconds West for a distance of 77.16 feet to a point;
thence run South 62 Degrees 50 Minutes 38 Seconds West for a distance of 53.24 feet to a point;
thence run South 51 Degrees 52 Minutes 22 Seconds West for a distance of 56.96 feet to a point;
thence run South 30 Degrees 22 Minutes 13 Seconds West for a distance of 60.78 feet to a point;
thence run South 13 Degrees 16 Minutes 48 Seconds West for a distance of 57.49 feet to a point;
thence run South 05 Degrees 09 Minutes 27 Seconds West for a distance of 70.47 feet to a point;
thence run South 00 Degrees 05 Minutes 28 Seconds East for a distance of 209.89 feet to a point;
thence run South 07 Degrees 33 Minutes 02 Seconds West for a distance of 132.99 feet to a point;
thence run South 13 Degrees 30 Minutes 35 Seconds West for a distance of 61.48 feet to a point;
thence run South 01 Degrees 34 Minutes 07 Seconds West for a distance of 41.13 feet to a point;
thence run South 12 Degrees 19 Minutes 15 Seconds East for a distance of 45.08 feet to a point;
thence run South 19 Degrees 04 Minutes 36 Seconds East for a distance of 93.21 feet to a point;
thence run South 38 Degrees 03 Minutes 26 Seconds East for a distance of 79.33 feet to a point;
thence run South 49 Degrees 25 Minutes 45 Seconds East for a distance of 88.66 feet to a point;
thence run South 42 Degrees 11 Minutes 33 Seconds East for a distance of 254.03 feet to a point;
thence run South 33 Degrees 43 Minutes 07 Seconds East for a distance of 56.05 feet to a point;
thence run South 09 Degrees 52 Minutes 35 Seconds East for a distance of 64.03 feet to a point;
thence run South 16 Degrees 03 Minutes 56 Seconds West for a distance of 69.45 feet to a point;
thence run South 41 Degrees 01 Minutes 10 Seconds West for a distance of 50.43 feet to a point;
thence run South 55 Degrees 49 Minutes 59 Seconds West for a distance of 62.03 feet to a point;
thence run South 72 Degrees 22 Minutes 04 Seconds West for a distance of 60.76 feet to a point;
thence run South 79 Degrees 23 Minutes 29 Seconds West for a distance of 107.11 feet to a point;
thence run South 72 Degrees 31 Minutes 01 Seconds West for a distance of 76.58 feet to a point;
thence run South 58 Degrees 25 Minutes 12 Seconds West for a distance of 60.25 feet to a point;
thence run South 45 Degrees 45 Minutes 36 Seconds West for a distance of 47.46 feet to a point;
thence run South 40 Degrees 16 Minutes 01 Seconds West for a distance of 71.57 feet to a point;
thence run South 32 Degrees 29 Minutes 57 Seconds West for a distance of 150.66 feet to a point;
thence run South 37 Degrees 14 Minutes 16 Seconds West for a distance of 142.46 feet to a point;
thence run South 32 Degrees 15 Minutes 24 Seconds West for a distance of 57.12 feet to a point;
thence run South 20 Degrees 51 Minutes 25 Seconds West for a distance of 59.35 feet to a point;
thence run South 14 Degrees 56 Minutes 49 Seconds West for a distance of 65.22 feet to a point;
thence run South 06 Degrees 48 Minutes 59 Seconds West for a distance of 70.86 feet to a point;
thence run South 00 Degrees 16 Minutes 33 Seconds West for a distance of 218.44 feet to a point;
thence run South 05 Degrees 42 Minutes 29 Seconds West for a distance of 64.21 feet to a point;
thence run South 14 Degrees 42 Minutes 45 Seconds West for a distance of 66.23 feet to a point;
thence run South 21 Degrees 12 Minutes 08 Seconds West for a distance of 270.34 feet to a point;
thence run South 31 Degrees 25 Minutes 39 Seconds West for a distance of 60.40 feet to a point;
thence run South 40 Degrees 52 Minutes 36 Seconds West for a distance of 99.82 feet to a point;
thence run South 39 Degrees 19 Minutes 11 Seconds West for a distance of 55.89 feet to a point;
thence run South 26 Degrees 58 Minutes 15 Seconds West for a distance of 105.86 feet to a point;
thence run South 39 Degrees 33 Minutes 27 Seconds West for a distance of 55.84 feet to a point;
thence run South 49 Degrees 32 Minutes 40 Seconds West for a distance of 84.82 feet to a point;
thence run South 41 Degrees 24 Minutes 33 Seconds West for a distance of 44.03 feet to a point;
thence run South 24 Degrees 23 Minutes 59 Seconds West for a distance of 55.25 feet to a point;
thence run South 12 Degrees 08 Minutes 42 Seconds West for a distance of 101.06 feet to a point;
thence run South 33 Degrees 08 Minutes 23 Seconds West for a distance of 36.94 feet to a point;
thence run South 42 Degrees 01 Minutes 04 Seconds West for a distance of 54.31 feet to a point;
thence run South 52 Degrees 12 Minutes 26 Seconds West for a distance of 258.98 feet to a point;
thence run South 63 Degrees 55 Minutes 58 Seconds West for a distance of 168.19 feet to a point;
thence run South 56 Degrees 20 Minutes 18 Seconds West for a distance of 112.45 feet to a point;
thence run South 63 Degrees 57 Minutes 04 Seconds West for a distance of 63.83 feet to a point;
thence run South 69 Degrees 27 Minutes 51 Seconds West for a distance of 71.03 feet to a point;
thence run South 72 Degrees 25 Minutes 49 Seconds West for a distance of 231.13 feet to a point;
thence run South 79 Degrees 38 Minutes 06 Seconds West for a distance of 60.02 feet to a point;
thence run South 88 Degrees 15 Minutes 58 Seconds West for a distance of 54.90 feet to a point;
thence run North 79 Degrees 08 Minutes 19 Seconds West for a distance of 65.22 feet to a point;
thence run North 69 Degrees 04 Minutes 41 Seconds West for a distance of 47.63 feet to a point;
thence run North 59 Degrees 42 Minutes 12 Seconds West for a distance of 101.14 feet to a point;
thence run North 67 Degrees 36 Minutes 20 Seconds West for a distance of 47.52 feet to a point;
thence run South 74 Degrees 11 Minutes 02 Seconds West for a distance of 38.25 feet to a point;
thence run South 43 Degrees 45 Minutes 28 Seconds West for a distance of 34.94 feet to a point;
thence run South 09 Degrees 43 Minutes 53 Seconds West for a distance of 111.71 feet to a point;
thence run South 09 Degrees 43 Minutes 53 Seconds West for a distance of 28.01 feet to a point;
thence run South 02 Degrees 52 Minutes 51 Seconds East for a distance of 55.85 feet to a point;
thence run South 02 Degrees 29 Minutes 32 Seconds West for a distance of 11.85 feet to a point;
thence run South 16 Degrees 07 Minutes 47 Seconds West for a distance of 24.11 feet to a point;
thence run South 36 Degrees 11 Minutes 16 Seconds West for a distance of 16.58 feet to a point;
thence run South 46 Degrees 14 Minutes 59 Seconds West for a distance of 17.12 feet to a point;
thence run South 66 Degrees 03 Minutes 38 Seconds West for a distance of 25.37 feet to a point;
thence run South 77 Degrees 55 Minutes 04 Seconds West for a distance of 44.26 feet to a point;
thence run South 89 Degrees 22 Minutes 40 Seconds West for a distance of 47.41 feet to a point;
thence run North 77 Degrees 59 Minutes 25 Seconds West for a distance of 56.90 feet to a point;
thence run North 65 Degrees 46 Minutes 57 Seconds West for a distance of 136.99 feet to a point;
thence run North 71 Degrees 11 Minutes 23 Seconds West for a distance of 171.14 feet to a point;
thence run North 76 Degrees 37 Minutes 17 Seconds West for a distance of 34.38 feet to a point;
thence run North 76 Degrees 37 Minutes 17 Seconds West for a distance of 5.81 feet to a point;
thence run South 86 Degrees 49 Minutes 25 Seconds West for a distance of 44.76 feet to a point;
thence run South 66 Degrees 51 Minutes 42 Seconds West for a distance of 61.73 feet to a point;
thence run South 67 Degrees 24 Minutes 07 Seconds West for a distance of 36.63 feet to a point;
thence run South 88 Degrees 49 Minutes 55 Seconds West for a distance of 27.62 feet to a point;
thence run North 73 Degrees 42 Minutes 10 Seconds West for a distance of 24.08 feet to a point;
thence run North 56 Degrees 20 Minutes 18 Seconds West for a distance of 24.38 feet to a point;
thence run North 39 Degrees 59 Minutes 16 Seconds West for a distance of 27.19 feet to a point;
thence run North 24 Degrees 12 Minutes 49 Seconds West for a distance of 158.03 feet to a point;
thence run North 39 Degrees 25 Minutes 24 Seconds West for a distance of 28.99 feet to a point;
thence run North 51 Degrees 52 Minutes 22 Seconds West for a distance of 44.05 feet to a point;
thence run North 64 Degrees 25 Minutes 19 Seconds West for a distance of 21.95 feet to a point;
thence run North 77 Degrees 58 Minutes 55 Seconds West for a distance of 25.73 feet to a point;
thence run South 86 Degrees 42 Minutes 51 Seconds West for a distance of 35.95 feet to a point;
thence run South 79 Degrees 29 Minutes 25 Seconds West for a distance of 29.37 feet to a point;
thence run South 87 Degrees 20 Minutes 23 Seconds West for a distance of 35.51 feet to a point;
thence run North 80 Degrees 11 Minutes 28 Seconds West for a distance of 21.77 feet to a point;
thence run North 63 Degrees 05 Minutes 08 Seconds West for a distance of 28.22 feet to a point;
thence run North 42 Degrees 01 Minutes 04 Seconds West for a distance of 38.82 feet to a point;
thence run North 33 Degrees 43 Minutes 07 Seconds West for a distance of 29.72 feet to a point;
thence run North 47 Degrees 48 Minutes 35 Seconds West for a distance of 30.06 feet to a point;
thence run North 65 Degrees 58 Minutes 14 Seconds West for a distance of 35.37 feet to a point;
thence run North 70 Degrees 09 Minutes 52 Seconds West for a distance of 38.48 feet to a point;
thence run North 63 Degrees 49 Minutes 28 Seconds West for a distance of 35.29 feet to a point;
thence run North 55 Degrees 25 Minutes 24 Seconds West for a distance of 122.10 feet to a point;
thence run North 49 Degrees 42 Minutes 31 Seconds West for a distance of 98.16 feet to a point;
thence run North 42 Degrees 34 Minutes 36 Seconds West for a distance of 46.68 feet to a point;
thence run North 31 Degrees 50 Minutes 31 Seconds West for a distance of 59.86 feet to a point;
thence run North 37 Degrees 43 Minutes 27 Seconds West for a distance of 39.29 feet to a point;
thence run North 47 Degrees 57 Minutes 18 Seconds West for a distance of 37.03 feet to a point;
thence run North 60 Degrees 24 Minutes 10 Seconds West for a distance of 31.02 feet to a point;
thence run North 69 Degrees 37 Minutes 31 Seconds West for a distance of 44.00 feet to a point;
thence run North 72 Degrees 26 Minutes 47 Seconds West for a distance of 166.40 feet to a point;
thence run North 65 Degrees 49 Minutes 20 Seconds West for a distance of 51.59 feet to a point;
thence run North 61 Degrees 54 Minutes 45 Seconds West for a distance of 43.76 feet to a point;
thence run North 50 Degrees 23 Minutes 06 Seconds West for a distance of 112.30 feet to a point;
thence run North 47 Degrees 22 Minutes 40 Seconds West for a distance of 182.54 feet to a point;
thence run North 53 Degrees 05 Minutes 53 Seconds West for a distance of 93.75 feet to a point;
thence run North 52 Degrees 56 Minutes 50 Seconds West for a distance of 64.42 feet to a point;
thence run North 49 Degrees 03 Minutes 01 Seconds West for a distance of 78.36 feet to a point;
thence run North 40 Degrees 47 Minutes 30 Seconds West for a distance of 133.32 feet to a point;
thence run North 34 Degrees 18 Minutes 56 Seconds West for a distance of 98.74 feet to a point;
thence run North 24 Degrees 51 Minutes 10 Seconds West for a distance of 91.24 feet to a point;
thence run North 19 Degrees 40 Minutes 24 Seconds West for a distance of 110.24 feet to a point;
thence run North 24 Degrees 50 Minutes 43 Seconds West for a distance of 100.91 feet to a point;
thence run North 36 Degrees 34 Minutes 28 Seconds West for a distance of 89.45 feet to a point;
thence run North 51 Degrees 45 Minutes 25 Seconds West for a distance of 117.42 feet to a point;
thence run North 42 Degrees 34 Minutes 23 Seconds West for a distance of 100.05 feet to a point;
thence run North 45 Degrees 58 Minutes 12 Seconds West for a distance of 50.89 feet to a point;
thence run North 66 Degrees 26 Minutes 52 Seconds West for a distance of 35.40 feet to a point;
thence run North 88 Degrees 29 Minutes 39 Seconds West for a distance of 44.86 feet to a point;
thence run South 74 Degrees 47 Minutes 21 Seconds West for a distance of 103.35 feet to a point;
thence run South 88 Degrees 06 Minutes 29 Seconds West for a distance of 60.95 feet to a point;
thence run North 75 Degrees 54 Minutes 05 Seconds West for a distance of 68.55 feet to a point;
thence run North 51 Degrees 43 Minutes 27 Seconds West for a distance of 85.14 feet to a point;
thence run North 43 Degrees 32 Minutes 49 Seconds West for a distance of 76.63 feet to a point;
thence run North 27 Degrees 53 Minutes 11 Seconds West for a distance of 51.84 feet to a point;
thence run North 13 Degrees 39 Minutes 32 Seconds West for a distance of 159.36 feet to a point;
thence run North 06 Degrees 57 Minutes 38 Seconds West for a distance of 139.35 feet to a point;
thence run North 04 Degrees 15 Minutes 34 Seconds West for a distance of 195.32 feet to a point;
thence run North 04 Degrees 16 Minutes 50 Seconds East for a distance of 75.49 feet to a point;
thence run North 10 Degrees 17 Minutes 21 Seconds West for a distance of 43.45 feet to a point;
thence run North 15 Degrees 13 Minutes 05 Seconds West for a distance of 142.45 feet to a point;
thence run North 08 Degrees 17 Minutes 05 Seconds West for a distance of 41.52 feet to a point;
thence run North 02 Degrees 31 Minutes 19 Seconds West for a distance of 34.51 feet to a point;
thence run North 05 Degrees 35 Minutes 02 Seconds East for a distance of 24.56 feet to a set 5/8 inch capped rebar stamped CA–560–LS, said point lying on the North line of the Southwest one quarter if the above mentioned Section 29 ; thence leaving said centerline run South 89 Degrees 24 Minutes 11 Seconds East along said North line for a distance of 101.94 feet to a found 2 inch capped pipe marking the Southeast corner of the Northeast one quarter of said Section 29; thence leaving said North line run North 00 Degrees 10 Minutes 56 Seconds West along the West line of the Northeast one quarter of said Section 29 for a distance of 1346.07 feet to a found 2 inch capped pipe marking the Southeast corner of the Northeast one quarter of the Northwest one quarter; thence leaving said West line run North 89 Degrees 40 Minutes 38 Seconds West along the South line of the North half of the Northwest one quarter of said Section 29 for a distance of 2637.17 feet to a set 5/8 inch capped rebar stamped CA–560–LS, said point lying on the West line of said Section 29; thence run North 00 Degrees 22 Minutes 49 Seconds East along said West line for a distance of 1333.26 feet to the POINT OF BEGINNING. Said parcel contains 63,902,792 square feet or 1,467.01 acres more or less.

Less and except any portion lying within public rights of way.

Less and except any portion lying below the 320.00' contour.

GORGAS STEAM PLANT RATTLE SNAKE ASH POND WASTE DISPOSAL AREA LEGAL DESCRIPTION

A parcel of land situated partly in Sections 20,21,28 and 29, Township 16 South, Range 6 West Walker County, Alabama. Said parcel being more particularly described as follows:

Commence at a found 4 inch by 4 inch concrete monument marking the Southwest corner of the above mentioned Section 20; thence run North 89 Degrees 59 Minutes 08 Seconds East along the South line of said Section 20 for a distance of 3077.93 feet to a point, said point lying on the 395.00 contour and marking the POINT OF BEGINNING of the parcel herein described; said parcel being bound by the meanderings of the 395.00 contour; thence from said Point of Beginning run along a reference line with each point lying on the 395.00 contour the following calls:

thence run North 19 Degrees 48 Minutes 00 Seconds West for a distance of 404.27 feet to a point;
thence run South 69 Degrees 14 Minutes 17 Seconds West for a distance of 305.86 feet to a point;
thence run North 59 Degrees 59 Minutes 04 Seconds West for a distance of 209.75 feet to a point;
thence run North 13 Degrees 53 Minutes 32 Seconds East for a distance of 481.07 feet to a point;
thence run North 28 Degrees 55 Minutes 02 Seconds West for a distance of 355.30 feet to a point;
thence run North 30 Degrees 30 Minutes 38 Seconds West for a distance of 472.87 feet to a point;
thence run South 14 Degrees 37 Minutes 45 Seconds West for a distance of 261.32 feet to a point;
thence run North 44 Degrees 34 Minutes 32 Seconds West for a distance of 336.50 feet to a point;
thence run South 21 Degrees 58 Minutes 54 Seconds West for a distance of 114.42 feet to a point;
thence run South 51 Degrees 44 Minutes 56 Seconds West for a distance of 267.41 feet to a point;
thence run North 28 Degrees 33 Minutes 01 Seconds West for a distance of 344.28 feet to a point;
thence run North 42 Degrees 13 Minutes 12 Seconds East for a distance of 978.51 feet to a point;
thence run North 63 Degrees 19 Minutes 08 Seconds West for a distance of 381.59 feet to a point;
thence run North 51 Degrees 18 Minutes 57 Seconds East for a distance of 319.99 feet to a point;
thence run North 89 Degrees 04 Minutes 16 Seconds West for a distance of 415.88 feet to a point;
thence run North 34 Degrees 19 Minutes 49 Seconds East for a distance of 244.93 feet to a point;
thence run North 44 Degrees 50 Minutes 00 Seconds West for a distance of 277.79 feet to a point;
thence run South 86 Degrees 27 Minutes 30 Seconds East for a distance of 922.68 feet to a point;
thence run North 20 Degrees 50 Minutes 52 Seconds East for a distance of 944.55 feet to a point;
thence run North 71 Degrees 27 Minutes 56 Seconds East for a distance of 1249.83 feet to a point;
thence run South 68 Degrees 15 Minutes 33 Seconds East for a distance of 566.94 feet to a point;
thence run South 70 Degrees 33 Minutes 23 Seconds West for a distance of 892.22 feet to a point;
thence run South 19 Degrees 40 Minutes 34 Seconds East for a distance of 467.37 feet to a point;
thence run South 85 Degrees 11 Minutes 48 Seconds East for a distance of 725.55 feet to a point;
thence run North 36 Degrees 28 Minutes 00 Seconds East for a distance of 1054.92 feet to a point;
thence run South 13 Degrees 16 Minutes 29 Seconds East for a distance of 431.15 feet to a point;
thence run North 82 Degrees 48 Minutes 27 Seconds East for a distance of 96.61 feet to a point;
thence run North 02 Degrees 12 Minutes 31 Seconds East for a distance of 586.44 feet to a point;
thence run North 21 Degrees 17 Minutes 51 Seconds East for a distance of 516.36 feet to a point;
thence run South 03 Degrees 46 Minutes 42 Seconds West for a distance of 1024.33 feet to a point;
thence run North 54 Degrees 51 Minutes 48 Seconds East for a distance of 745.40 feet to a point;
thence run North 83 Degrees 21 Minutes 06 Seconds East for a distance of 466.42 feet to a point;
thence run South 45 Degrees 04 Minutes 20 Seconds West for a distance of 817.03 feet to a point;
thence run South 36 Degrees 24 Minutes 06 Seconds West for a distance of 739.24 feet to a point;
thence run South 57 Degrees 47 Minutes 32 Seconds West for a distance of 1034.38 feet to a point;
thence run North 88 Degrees 14 Minutes 11 Seconds East for a distance of 717.34 feet to a point;
thence run North 57 Degrees 57 Minutes 44 Seconds East for a distance of 1069.96 feet to a point;
thence run South 45 Degrees 01 Minutes 38 Seconds West for a distance of 666.91 feet to a point;
thence run South 71 Degrees 33 Minutes 50 Seconds East for a distance of 413.00 feet to a point;
thence run North 66 Degrees 43 Minutes 49 Seconds East for a distance of 1047.77 feet to a point;
thence run South 39 Degrees 36 Minutes 25 Seconds West for a distance of 1160.80 feet to a point;
thence run South 00 Degrees 32 Minutes 43 Seconds West for a distance of 472.02 feet to a point;
thence run North 44 Degrees 21 Minutes 10 Seconds West for a distance of 627.99 feet to a point;
thence run South 65 Degrees 53 Minutes 26 Seconds West for a distance of 925.76 feet to a point;
thence run North 69 Degrees 58 Minutes 12 Seconds West for a distance of 700.36 feet to a point;
thence run South 62 Degrees 20 Minutes 14 Seconds West for a distance of 494.91 feet to a point;
thence run South 84 Degrees 15 Minutes 14 Seconds East for a distance of 643.57 feet to a point;
thence run South 75 Degrees 23 Minutes 32 Seconds East for a distance of 323.41 feet to a point;
thence run South 10 Degrees 27 Minutes 20 Seconds West for a distance of 446.08 feet to a point;
thence run South 84 Degrees 43 Minutes 55 Seconds East for a distance of 383.62 feet to a point;
thence run South 76 Degrees 49 Minutes 17 Seconds East for a distance of 425.90 feet to a point;
thence run South 46 Degrees 23 Minutes 42 Seconds West for a distance of 400.06 feet to a point;
thence run South 84 Degrees 09 Minutes 32 Seconds West for a distance of 478.48 feet to a point;
thence run North 68 Degrees 40 Minutes 35 Seconds West for a distance of 899.58 feet to a point;
thence run South 09 Degrees 38 Minutes 48 Seconds East for a distance of 251.06 feet to a point;
thence run South 38 Degrees 49 Minutes 29 Seconds East for a distance of 309.33 feet to a point;
thence run South 82 Degrees 45 Minutes 36 Seconds East for a distance of 452.61 feet to a point;
thence run South 75 Degrees 59 Minutes 07 Seconds East for a distance of 313.33 feet to a point;
thence run North 81 Degrees 26 Minutes 48 Seconds East for a distance of 873.72 feet to a point;
thence run South 46 Degrees 49 Minutes 51 Seconds West for a distance of 626.60 feet to a point;
thence run South 20 Degrees 58 Minutes 00 Seconds East for a distance of 192.83 feet to a point;
thence run South 82 Degrees 55 Minutes 47 Seconds East for a distance of 263.00 feet to a point;
thence run North 56 Degrees 15 Minutes 42 Seconds East for a distance of 131.08 feet to a point;
thence run South 18 Degrees 46 Minutes 13 Seconds East for a distance of 87.02 feet to a point;
thence run North 86 Degrees 44 Minutes 43 Seconds East for a distance of 173.28 feet to a point;
thence run North 36 Degrees 34 Minutes 54 Seconds East for a distance of 68.80 feet to a point;
thence run North 81 Degrees 00 Minutes 08 Seconds East for a distance of 788.71 feet to a point;
thence run South 77 Degrees 24 Minutes 18 Seconds East for a distance of 999.53 feet to a point;
thence run South 53 Degrees 44 Minutes 59 Seconds West for a distance of 745.47 feet to a point;
thence run South 26 Degrees 41 Minutes 54 Seconds East for a distance of 380.58 feet to a point;
thence run South 50 Degrees 24 Minutes 07 Seconds West for a distance of 185.96 feet to a point;
thence run North 39 Degrees 11 Minutes 48 Seconds West for a distance of 648.75 feet to a point;
thence run South 82 Degrees 53 Minutes 18 Seconds West for a distance of 1433.02 feet to a point;
thence run North 67 Degrees 46 Minutes 49 Seconds West for a distance of 1489.23 feet to a point;
thence run South 42 Degrees 49 Minutes 26 Seconds East for a distance of 620.36 feet to a point;
thence run North 79 Degrees 54 Minutes 18 Seconds West for a distance of 343.36 feet to a point;
thence run South 15 Degrees 49 Minutes 31 Seconds East for a distance of 670.60 feet to a point;
thence run South 30 Degrees 15 Minutes 04 Seconds East for a distance of 747.84 feet to a point;
thence run North 71 Degrees 37 Minutes 47 Seconds East for a distance of 1321.73 feet to a point;
thence run South 49 Degrees 01 Minutes 07 Seconds West for a distance of 1827.59 feet to a point;
thence run South 47 Degrees 28 Minutes 20 Seconds East for a distance of 630.23 feet to a point;
thence run North 10 Degrees 57 Minutes 37 Seconds West for a distance of 198.58 feet to a point;
thence run South 76 Degrees 36 Minutes 35 Seconds East for a distance of 163.91 feet to a point;
thence run South 32 Degrees 29 Minutes 41 Seconds East for a distance of 190.88 feet to a point;
thence run North 83 Degrees 21 Minutes 29 Seconds East for a distance of 403.71 feet to a point;
thence run North 45 Degrees 54 Minutes 07 Seconds East for a distance of 868.90 feet to a point;
thence run South 26 Degrees 14 Minutes 51 Seconds West for a distance of 705.06 feet to a point;
thence run North 81 Degrees 03 Minutes 23 Seconds East for a distance of 636.55 feet to a point;
thence run North 71 Degrees 28 Minutes 24 Seconds East for a distance of 535.14 feet to a point;
thence run South 43 Degrees 39 Minutes 14 Seconds West for a distance of 821.97 feet to a point;
thence run South 53 Degrees 20 Minutes 24 Seconds West for a distance of 258.04 feet to a point;
thence run South 85 Degrees 44 Minutes 34 Seconds West for a distance of 1067.10 feet to a point;
thence run South 17 Degrees 32 Minutes 25 Seconds East for a distance of 1572.09 feet to a point;
thence run North 82 Degrees 11 Minutes 12 Seconds West for a distance of 106.63 feet to a point;
thence run North 29 Degrees 44 Minutes 33 Seconds West for a distance of 1297.09 feet to a point;
thence run South 09 Degrees 50 Minutes 36 Seconds West for a distance of 348.12 feet to a point;
thence run North 59 Degrees 17 Minutes 26 Seconds West for a distance of 354.75 feet to a point;
thence run North 08 Degrees 57 Minutes 55 Seconds East for a distance of 609.61 feet to a point;
thence run North 63 Degrees 04 Minutes 07 Seconds West for a distance of 360.05 feet to a point;
thence run South 12 Degrees 18 Minutes 17 Seconds West for a distance of 492.70 feet to a point;
thence run North 60 Degrees 46 Minutes 00 Seconds West for a distance of 336.36 feet to a point;
thence run North 17 Degrees 37 Minutes 52 Seconds East for a distance of 321.08 feet to a point;
thence run North 58 Degrees 54 Minutes 50 Seconds West for a distance of 209.17 feet to a point;
thence run North 46 Degrees 32 Minutes 39 Seconds East for a distance of 478.34 feet to a point;
thence run North 45 Degrees 40 Minutes 35 Seconds West for a distance of 606.41 feet to a point;
thence run South 36 Degrees 12 Minutes 35 Seconds West for a distance of 440.12 feet to a point;
thence run North 26 Degrees 08 Minutes 24 Seconds West for a distance of 442.61 feet to a point;
thence run South 53 Degrees 27 Minutes 06 Seconds West for a distance of 375.92 feet to a point;
thence run North 08 Degrees 24 Minutes 34 Seconds East for a distance of 493.24 feet to a point;
thence run North 15 Degrees 06 Minutes 56 Seconds West for a distance of 701.26 feet to a point;
thence run South 60 Degrees 23 Minutes 04 Seconds East for a distance of 779.57 feet to a point;
thence run North 19 Degrees 48 Minutes 00 Seconds West for a distance of 2108.00 feet to the POINT OF BEGINNING. Said parcel contains 18,439,660 square feet or 423.32 acres more or less.

Know what's below
Call before you dig.
Dial 811
Or Call 800-292-7411

ALL PARTS OF THIS SURVEY AND DRAWING HAVE BEEN COMPLETED IN ACCORDANCE WITH THE CURRENT REQUIREMENTS OF THE STANDARDS OF PRACTICE FOR SURVEYING IN THE STATE OF ALABAMA.

GONZALEZ - STRENGTH & ASSOCIATES, INC.
CIVIL ENGINEERING, LAND SURVEYING, PLANNING, TRAFFIC & TRANSPORTATION

GSA JOB #18-0508

BOUNDARY PERMIT DRAWING

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

Gorgas Steam Plant
Rattle Snake Ash Pond
Property Survey

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1"=500'	4347GOR	2	FINAL	0

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

ANSI E: 44x34

APPENDIX 3

HAZARD POTENTIAL CLASSIFICATION

&

EMERGENCY ACTION PLAN

The Initial Hazard Potential Classification for the Plant Gorgas Ash Pond was initially prepared to satisfy federal standards. It also satisfies 335-13-15-.04(4)(a)2. and 335-13-15-.09(1)(a)6. and is included for that purpose. Likewise, the Emergency Action Plan for the Plant Gorgas Ash Pond was initially prepared to satisfy federal standards. It also satisfies 335-13-15-.04(4)(a)3. and 335-13-15-.09(1)(a)6. and is included for that purpose.

UPDATED HAZARD POTENTIAL ASSESSMENT
PLANT GORGAS ASH POND
ALABAMA POWER COMPANY

Section §257.73(a)(2) of EPA's regulations requires the owner or operator of an existing CCR surface impoundment to conduct periodic hazard potential classification assessments. The owner or operator must document the hazard potential of each surface impoundment as a high hazard potential CCR unit, a significant hazard potential CCR unit or a low hazard potential CCR unit.

The CCR surface impoundment located at Alabama Power Company's Plant Gorgas, also referred to as the Plant Gorgas Ash Pond, is located near Parrish, Walker County, Alabama. The CCR surface impoundment is formed by an engineered cross-valley embankment on the north side of the impoundment. The Mulberry Fork of the Black Warrior River is located downstream of the embankment and impoundment. In the unlikely event of an embankment failure, water and CCR could potentially impact the Mulberry Fork of the Black Warrior River to the north of the impoundment.

Based on the dam breach models prepared for development of the Emergency Action Plan for the Ash Pond, the hazard potential classification for the Plant Gorgas Ash Pond has been determined to be High Hazard Potential, in that failure or mis-operation of the CCR unit could potentially result in loss of human life due to a sudden rise in river levels.

I hereby certify that the hazard potential classification was conducted in accordance with 40 C.F.R. Part 257.73 (a)(2).

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

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

CCR SURFACE IMPOUNDMENT EMERGENCY ACTION PLAN

Plant Gorgas Ash Pond

I hereby certify that this Emergency Action Plan has been prepared in accordance with the requirements of 40 C.F.R. Part 257.73.

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

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

ISSUE DATE: **April 17, 2017**
REVISION #: **0**

REVISION RECORD

In accordance with 40 C.F.R. Part 257.73, this Emergency Action Plan (EAP) must be amended whenever there is a change in conditions that would substantially affect the EAP in effect. Additionally, the EAP must be evaluated, at a minimum, every five years to ensure the information is accurate. As necessary, this EAP must be updated and a revised EAP placed in the facility's operating record as required by 40 C.F.R. Part 257.105(f)(6).

Revision Number	**Date**	**Sections Affected/Reason**
0	04/17/2017	Creation of EAP

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ACRONYMS AND ABBREVIATIONS

ADEM	Alabama Department of Environmental Management
AEMA	Alabama Emergency Management Agency
ALDOT	Alabama Department of Transportation
APC	Alabama Power Company
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
E&CS	Engineering & Construction Services
EAP	Emergency Action Plan
EMA	Emergency Management Agency
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
H:V	Horizontal:Vertical
HDPE	High-Density Polyethylene
ID	Inside Diameter
SCS	Southern Company Services

DEFINITIONS

Adverse Consequences. Negative impacts that may result from the failure of a dam. The primary concerns are loss of life, economic loss (including property damage), lifeline disruption and environmental impact.

Coal Combustion Residuals (CCR). Fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers.

CCR Surface Impoundment . A natural topographic depression, man-made excavation, or diked area which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR.

Dam/Dike/Embankment. An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage.

Dam Failure. Catastrophic type of failure characterized by the sudden, rapid and uncontrolled release of impounded water or the likelihood of such an uncontrolled release. It is recognized that there are lesser degrees of failure and that any malfunction or abnormality outside the design assumptions and parameters that adversely affect a dam's primary function of impounding water is properly considered a failure. These lesser degrees of failure can progressively lead to or heighten the risk of catastrophic failure. They are, however, normally amenable to corrective action.

> **Imminent Failure (Condition A Emergency).** Failure of a dam/dike/embankment is imminent or has occurred.
>
> **Potential Failure (Condition B Emergency).** A potential failure condition of a dam/dike/embankment is a developing condition, but adequate time is available to properly evaluate the problem and implement corrective actions that may alleviate or prevent failure.
>
> **Non-Failure Condition.** A condition that will not, by itself, lead to a failure, but that requires investigation and notification of internal and/or external personnel.

Emergency. A condition that develops unexpectedly, endangers the structural integrity of the dam, and requires immediate action. An emergency can lead to Adverse Consequences in the event of Imminent Failure.

Filter. One or more layers of granular material graded so as to allow seepage through or within the layers while preventing the migration of material from adjacent zones.

Inundation Map. A graphic representation of the inundation zone that shows the potential impact area due to a breach of the Gypsum Pond. The inundation maps in this procedure are based on a specific computer-modeled dam breach scenario; therefore, the boundaries depicted are estimates for that particular model. *The models are considered conservative but larger floods could potentially occur.* Please refer to Appendix B.

Inundation Zone. Area subject to flooding in the event of increased flows due to a dam/dike/embankment failure.

Piping. The progressive development of internal erosion of the dam/dike/embankment or foundation material by seepage.

Probable Maximum Flood. The flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the drainage basin.

Sunny Day Failure. A night or day failure that occurs during fair weather or when weather-related flooding is not occurring.

1.0 STATEMENT OF PURPOSE

This Emergency Action Plan (EAP) has been prepared for the Plant Gorgas Ash Pond to meet the requirements of 40 C.F.R. Part 257.73(a)(3). The EAP identifies potential safety emergency conditions at the Plant Gorgas Ash Pond and specifies actions to be followed to minimize potential loss of life and property damage if such conditions exist.

This EAP will provide responding personnel with:

- Pertinent information and description related to Plant Gorgas Ash Pond;
- Definition of events or circumstances that represent a safety emergency;
- Procedures that will be followed to detect a safety emergency;
- Notification procedures in the event of a safety emergency;
- Information to assist in decision making;
- A list of responsible persons and their respective responsibilities;
- Provisions for an annual face-to-face meeting with local emergency responders;
- Contact information for emergency agencies and emergency responders
- A map that delineates the downstream area that could be affected in the event of a failure.

2.0 FACILITY DESCRIPTION

Plant Gorgas is a coal-fired power plant located near Parrish, Alabama. This EAP covers emergency response procedures for the Plant Gorgas Ash Pond (the Ash Pond), which is designed to receive and store coal combustion residuals produced during the electric generating process at Plant Gorgas. An overview of Plant Gorgas and the surrounding area is shown in Appendix A – Figure 1.

The Ash Pond is approximately 420 acres in size at its normal pool elevation of 382 feet (Appendix A – Figure 2). It should be noted that the Ash Pond has a contributing drainage area of approximately 1,300 acres. The Ash Pond has a cross valley embankment along the northern end of the pond with a top of embankment elevation of 395.0 feet. The embankment was originally constructed as a rockfill structure in 1953 using local borrow and quarried materials. In the mid-1970's, the dam was raised to an elevation of 375 feet. In 2007, the dam was raised to an elevation of 395 feet. During this project, a 10-foot wide roller compacted concrete upstream facing block designed with a slope of 0.75H: 1V; a 30-foot thick clay core section; a 10-foot thick fine and coarse filter section; and additional downstream rockfill were used to accommodate the raising of the dam. The discharge system of the Ash Pond is located in the northeast portion of the pond and consists of the following features:

1. The primary spillway consists of a sharp crested riser weir of 12-foot length which conveys flow to a corrugated metal conduit. The top of the weir box coincides with the normal pool elevation of 382.0 feet. The conduit is 48-inches in diameter and has a length of approximately 190 feet divided into three segments.

2. The auxiliary spillway consists of two 7' x 5' box culverts with a 1% slope and an invert elevation of 385.0 feet. The receiving spillway is a 15' x 5' rectangular flume on a 55% slope.

The Ash Pond is included in the National Inventory of Dams with NID ID Number AL01662. There is no Safe Dams Program in the State of Alabama. The Ash Pond has been assigned a High Hazard Potential classification under 40 C.F.R. Part 257.73 of the Environmental Protection Agency's (EPA's) Coal Combustion Residuals (CCR) Rule. This classification, by definition, indicates that there is a probable loss of human life in the event of a dam/dike failure or misoperation of the facility. As displayed on the inundation maps included in Appendix B, there are many structures that could be impacted by the failure of the Ash Pond dam/dike or mis-operation of the surface impoundment. The flooding impacts are limited to an inundation area that is less than or equal to the 100-year floodplain indicated on FEMA's Flood Insurance Rate Maps. Bankhead Lock and Dam is located downstream of the Plant Gorgas Ash Pond along the Mulberry Fork of the Black Warrior River. Impacts due to a breach wave are unlikely to result in overtopping issues at this dam due to the impacts being less than the 100-year flood. There are no roads likely to be overtopped as a result of a sudden failure of the Ash Pond. The Ash Pond is located just above the Mulberry Fork of the Black Warrior River.

As stated previously, the limits of potential flooding in the event of failure of the Ash Pond dam/dike can be seen on the Inundation Maps, which are included as Appendix B. The provided inundation maps were developed based on the results of routing the breach wave downstream using the computer software, HEC-RAS. HEC-RAS is a general application one-dimensional hydraulic model that can perform unsteady flow routing through an open channel system that may also include culverts, bridges, levees, tributaries, storage areas, and other dams. Unsteady flow analyses allow for flow conditions that vary temporally and spatially such as a dam breach simulation. Breach parameters such as failure time, breach width, and breach side slopes were selected from industry accepted empirical formulas. Water surface elevation data was extracted from the hydraulic model and plotted on best available LiDAR topographic information for the downstream areas.

Normal river/lake levels and the flow from simulated dam breaches were superimposed over topographical maps to identify areas subject to flooding. ***These flood extents are provided for planning purposes only; actual flooding can vary due to actual conditions present at the time of the failure.***

3.0 DETECTION, EVALUATION, AND CLASSIFICATION PROCEDURES FOR EMERGENCIES

3.1 Inspection Schedule and Condition Detection/Evaluation

Trained personnel from Plant Gorgas inspect the Ash Pond dams/dike on a regular basis to pre-emptively detect conditions, in a timely manner, that could indicate a potential issue so that it can be addressed. Trained personnel from the Plant's Environmental Compliance group perform weekly inspections; and SCS E&CS Dam Safety (Fossil Dam Safety) personnel perform annual inspections.

Plant personnel conducting inspections of the dams/dikes are trained on an annual basis by engineers from Fossil Dam Safety on the appropriate surveillance and monitoring requirements.

Any issues discovered during an inspection are reported to Fossil Dam Safety as prescribed in the Safety Procedure for Dams and Dikes at Fossil Generation Plants (GEN10004). The Fossil Dam Safety Engineer(s) working with plant personnel will recommend a corrective course of action, as needed.

3.2 Condition Severity Classifications

Ash Pond dam/dike conditions will be classified based on the type of event, severity of the situation, and the time required to take corrective measures. This procedure covers the following severity classifications:

LEVEL OF SEVERITY

NON-FAILURE CONDITION (NFC)

A situation that will not, by itself, lead to a failure and is not considered an emergency. However, an NFC does require investigation and notification of Fossil Dam Safety personnel and may require corrective action in order to prevent conditions that may lead to an emergency.

POTENTIAL FAILURE – Condition B Emergency (B)

A developing situation where failure of a dam/dike may occur but implementation of pre-planned actions may alleviate or prevent failure. In general, adequate time is considered available to properly evaluate and implement corrective actions. *Should conditions worsen, an Imminent Failure emergency may be declared.*

IMMINENT FAILURE – Condition A Emergency (A)

A situation where failure of the dam/dike is imminent or has already occurred.

3.3 Guidance for Determining the Emergency Level

The following table details potential situations that could occur at the Ash Pond dam/dike. *The Condition Level indicated in the right-most column corresponds with the Condition Severity Classifications in Section 3.2 above.*

Event	Situation	Condition Level
Discharge Structure Flow	Spillway flow that could result in flooding of people downstream if the reservoir level continues to rise	B
	Spillway flow that is flooding people downstream	A
Embankment Overtopping	Reservoir level is 1 foot below the top of the dam/dike	B
	Water from the reservoir is flowing over the top of the dam/dike	A
Seepage	New seepage areas in or near the dam/dike	NFC
	New seepage areas with cloudy discharge or increasing flow rate	B
	Seepage with discharge greater than 10 gallons per minute	A
Dropouts	Observation of new sinkhole in reservoir area or on embankment	B
	Rapidly enlarging sinkhole	A
Embankment Cracking	New cracks in the embankment greater than ¼-inch wide without seepage	NFC
	Cracks in the embankment with seepage	B
Embankment Movement	Visual movement/slippage of the embankment slope	NFC
	Sudden or rapidly proceeding slides of the embankment slopes	A
Earthquake	Measurable earthquake felt or reported on or within 50 miles of the dam/dike	NFC
	Earthquake resulting in visible damage to the dam/dike or appurtenances	B
	Earthquake resulting in uncontrolled release of water from the dam/dike	A
Security Threat	Verified bomb threat that, if carried out, could result in damage to the dam/dike	B
	Detonated bomb that has resulted in damage to the dam/dike or appurtenances	A
Sabotage / Vandalism	Damage to dam/dike or appurtenances that could adversely impact the functioning of the dam/dike	NFC
	Modification to the dam/dike or appurtenances that could adversely impact the functioning of the dam/dike	NFC
	Damage to dam/dike or appurtenances that has resulted in seepage flow	B
	Damage to dam/dike or appurtenances that has resulted in uncontrolled water release	A

4.0 INCIDENT RESPONSE

The following situations and conditions should be evaluated when performing condition severity detections and evaluations.

Overtopping. The Ash Pond reservoir has a drainage area of approximately 1,300 acres compared to a pond size of 420 acres. The Ash Pond receives and/or contains rainfall/stormwater runoff water used for sluicing ash, other process and drainage flows pumped from the plant, and submerged CCR. The spillway is designed to safely pass the Probable Maximum Flood.

Seepage. Failures due to internal erosion and/or piping resulting from seepage would be detected in the early stages during the regular inspections conducted by plant personnel. Inspectors are trained to look for evidence of seepage. In addition, piezometer readings will reveal changes in subsurface water pressure. Inspection reports, including piezometer readings, are transmitted to trained dam safety engineers for evaluation. Therefore, the conditions that could lead to failures of this type would likely be discovered and corrected, making an actual failure a remote possibility.

Slope Instability. Slope instability would be demonstrated by sloughing of dam/dike slopes, which would be detected by Environmental Compliance personnel in their weekly inspections. The conditions that could potentially lead to a failure of this type would also be detected in advance and corrected making an actual failure a remote possibility.

In the event that conditions are detected that could potentially lead to a dam/dike failure, the flowcharts in Appendices C (Incident Response) and D (Response Notification) will be used to respond to the situation and alert applicable personnel and emergency agencies. In that situation, local emergency management agencies (EMAs) would respond and begin warnings and evacuations as soon as possible following the declaration of a safety emergency.

4.1 Access to the Site

Figures 1 and 2 in Appendix A illustrate the location of the Ash Pond.

4.2 Response during Periods of Darkness

Plant Gorgas is operational and/or manned 24 hours a day every day, and personnel and equipment are able to access the site at any time. Response times would not vary significantly from daylight conditions.

4.3 Response during Weekends and Holidays

Plant Gorgas is operational and manned 24 hours a day every day, and personnel and equipment will be able to access the site at any time. The response times of certain personnel may be affected.

4.4 Response during Adverse Weather

The dam/dike is accessed by gravel-surfaced roads and is accessible during periods of adverse weather. If severe flooding causes road closures, response times may be adversely affected.

5.0 RESPONSIBLE PERSONS AND RESPONSIBILITIES

Designated personnel have been trained in the use of these response procedures and are aware of their responsibilities in making the procedures effective. The chain of command and the individual responsibilities for plant personnel, public officials, and agencies are outlined below.

5.1 Incident Commander

The Incident Commander is the 24-hour point of contact for all plant emergencies. The Primary Incident Commander is the Operations Team Leader on-shift. The Secondary Incident Commander is the Fuels Team Leader on-shift, and should be contacted if the Primary Incident Commander cannot be reached.

The Incident Commander is responsible for ensuring the following functions are addressed as required for emergency response situations:

1. Verifying that an emergency condition exists.

2. Assessing and declaring the emergency condition.

3. Consulting with Fossil Dam Safety to evaluate conditions and determine remediation actions.

4. Emergency Actions
   a. If necessary, implement actions to lower the water level in the impoundment in consultation with Fossil Dam Safety.
   b. Call-out of personnel necessary to perform the work required on plant site during the emergency.

5. Ensure the notification process as outlined in the Response Notification Flowchart (Appendix D) is completed in an expedient manner.

6. Other responsibilities include:
   a. Establishing lines of communication from the plant to the local and state EMAs.
   b. Ensuring emergency sources of power are available for the operation of essential equipment such as emergency lighting.
   c. Ensuring the availability of heavy equipment and trained operators to aid in the mitigation effort.

5.2 Dam Emergency Response Team Leader

Dam Emergency Response Team Leader

The Incident Commander shall assign a Dam Emergency Response Team Leader as appropriate for the type of emergency incident. Duties include reporting matters relating to potential emergency action directly to the Incident Commander, accounting for his/her crew personnel and directing their actions.

5.3 Plant Security Department

The Plant Security Department is responsible for securing company property and controlling access to company facilities. The Plant Security Department will relay information to the Incident Commander. The Incident Commander will determine the appropriate people and agencies to notify. The Plant Security Department will perform emergency notifications to Plant departments as appropriate.

5.4 Plant Environmental Compliance

Environmental Compliance personnel are responsible for assessing conditions, contacting the Plant Manager, obtaining assistance from Fossil Dam Safety, and for providing technical updates to the Incident Commander. Compliance personnel can also request assistance from APC Environmental Affairs, if conditions warrant.

5.5 Alabama Control Center

The Alabama Control Center contacts the National Weather Service to inform them of conditions at the plant that may lead to potential flooding downstream.

5.6 SCS Fossil Dam Safety

Fossil Dam Safety is responsible for coordinating and providing the technical support necessary to mitigate the emergency condition and for notifying APC Corporate Communications and the Hydro General Manager (if the failure could impact a FERC regulated reservoir downstream of the surface impoundment) of the emergency condition. The Fossil Dam Safety Manager shall notify the APC Supply Chain Management as shown on the Response Notification Flowchart (Appendix D).

5.7 APC Personnel

Environmental Affairs

APC Environmental Affairs is responsible for coordinating long-term environmental response (after the initial response) and to remediate environmental issues and provide the technical support necessary for any remediation needs. Environmental Affairs is also responsible for all communications with environmental regulatory agencies for appropriate reporting of releases to the environment and for securing variances to existing permits, if needed.

If necessary, Environmental Affairs will also help secure approved remediation contractors for the specific emergency condition that may exist. They will also provide additional support, such as emergency manpower, material, equipment, and expertise to assist in mitigation efforts, if needed.

Corporate Communications

APC Corporate Communications is responsible for coordinating the APC media response and will schedule news briefings and prepare news releases, as required. APC Corporate Communications will also work with local and State Public Information Officers to ensure that timely, accurate, and consistent information is made available to media outlets.

Corporate Security
APC Corporate Security is responsible for supporting Plant Security personnel and contracting with local law enforcement for additional security personnel as needed.

Supply Chain Management
Supply Chain Management is responsible for obtaining additional equipment and materials necessary to mitigate the emergency condition and begin the recovery process.

5.8 Emergency Agencies

Local EMAs are responsible for planning and implementing evacuation and sheltering plans as well as directing search, rescue, and recovery efforts. If additional resources are required, the local agencies can contact the Alabama Emergency Management Agency (Alabama EMA) for assistance.

The local EMAs are the point of contact between plant personnel and local jurisdictions. The EMAs are responsible for the direction and control of emergency operations at the local level and keeping local government officials informed of the status of emergency operations.

Alabama EMA generally becomes involved in an emergency situation if the local agencies are not capable of handling the situation or if assistance is requested by a local agency or by the Governor. Refer to the "Alabama Emergency Operations Plan" (AEOP) for an explanation of specific functions. Alabama EMA has responsibilities similar to the local EMAs but is also responsible for mobilizing state military support as well as State Disaster Center operations.

5.9 Law Enforcement

Local Law Enforcement agencies are notified by the appropriate EMA. Alabama EMA notifies the State Patrol as well as the Alabama Department of Transportation (ALDOT). Law Enforcement is responsible for traffic control and can assist with evacuation, mitigation, and rescue activities.

6.0 NOTIFICATION PROCEDURES

Communication during an emergency event will primarily be by company phone. In the event of system failure, Southern Linc radios and cell phones would be utilized as an alternate method of communication.

Local and state EMA will be notified in the event of an emergency, and these agencies will be responsible for notifying the public. In the event of an imminent failure, local and state EMA's will be notified to immediately begin evacuation procedures. APC Corporate Communications will provide information for media outlets and will be responsible for communicating relevant information to the public.

6.1 Incident Response Flowchart for Imminent Failure and Potential Failure Emergencies

Personnel responsible for executing mitigation and/or emergency actions shall be thoroughly familiar with their responsibilities under this EAP.

A. When a Condition B or Condition B situation is detected, notify plant personnel in accordance with the Incident Response Flowchart (below and in Appendix C). Plant Environmental Compliance should contact Fossil Dam Safety immediately for technical consultation. Fossil Dam Safety will provide the evaluation of the conditions and provide a determination if there is an immediate threat to the dam/dike. If there is an immediate threat of dam/dike or dike failure, declare an **Imminent Failure Emergency** and proceed to Step I.

B. If no immediate threat is detected, determine if the problem detected could possibly lead to failure of the dam/dike. If there is a potential for failure but corrective measures may be taken to moderate or alleviate failure, declare a **Potential Failure Emergency** (Condition B) and proceed to Step C.

C. If a **Potential Failure Emergency** has been declared, notify personnel and agencies listed on the Response Notification Flowchart (Appendix D). Document all communications using the appropriate forms contained in Appendix E. Once outside agencies have been notified of an issue or potential problem, plant management is responsible for keeping local EMAs informed of any change in conditions.

D. Begin corrective measures to attempt to alleviate or prevent failure.

E. Evaluate the effectiveness of the corrective measures. If the corrective actions are successful, update all personnel/agencies previously contacted of the status of the improved conditions and document relevant communications using the forms provided in Appendix E. At this time, the Incident Commander will end the emergency condition. Fossil Dam Safety will be responsible for preparing the after-action report.

F. If the corrective measures are not effective, Fossil Dam Safety will determine if there is time to take additional corrective measures.

G. If there is not time to take additional corrective measures and failure is imminent, declare an **Imminent Failure Emergency** (Condition A) and proceed to Step I.

H. If there is time to implement additional corrective measures, return to Step E. Additional support can be requested from Civil Field Services or outside contractors, as needed.

I. If an **Imminent Failure Emergency** has been declared by the Incident Commander or his designee, ensure that all personnel have been moved to a safe area and perform notifications per the Response Notification Flowchart (Appendix D). Document all communications using the appropriate forms contained in Appendix E. Once outside agencies have been notified of a problem or potential problem, the Incident Commander or his designee is responsible for keeping local EMAs informed of any change in conditions. Fossil Dam Safety will be responsible for preparing the after-action report.

6.2 Additional Considerations

All communication shall be documented using the *Data Recording Sheet* located in Appendix E.

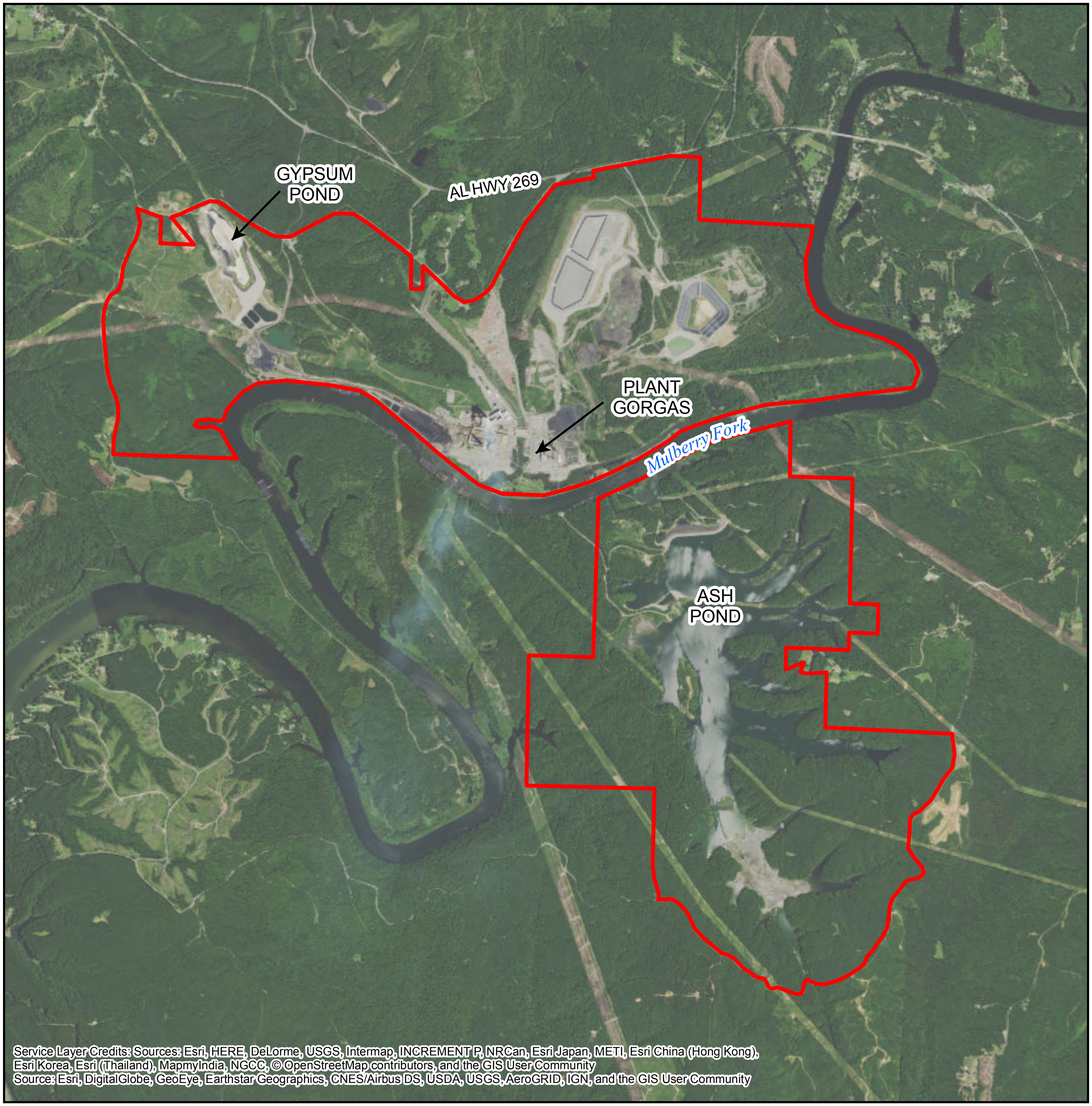
7.0 PROVISIONS FOR ANNUAL COORDINATION MEETING

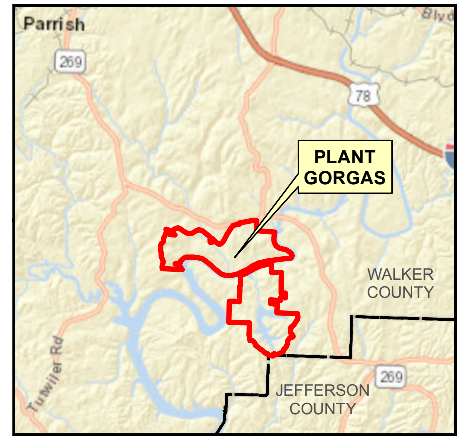
An annual face-to-face meeting will be held with representatives of Plant Gorgas, APC, and local emergency responders. The representatives may include:

- Southern Company Services Fossil Dam Safety
- Plant Gorgas Plant Manager and Team Leaders
- Plant Gorgas Emergency Response Team
- Alabama Power Environmental Affairs
- Alabama Power Corporate Communications
- Local Emergency Responders

APPENDIX A

Plant Gorgas Location Map – Figure 1
Ash Pond Overview – Figure 2
Ash Pond Detail – Figure 3





0 2.5 5
Miles
1 inch = 5 miles

LEGEND

Plant Boundary

N

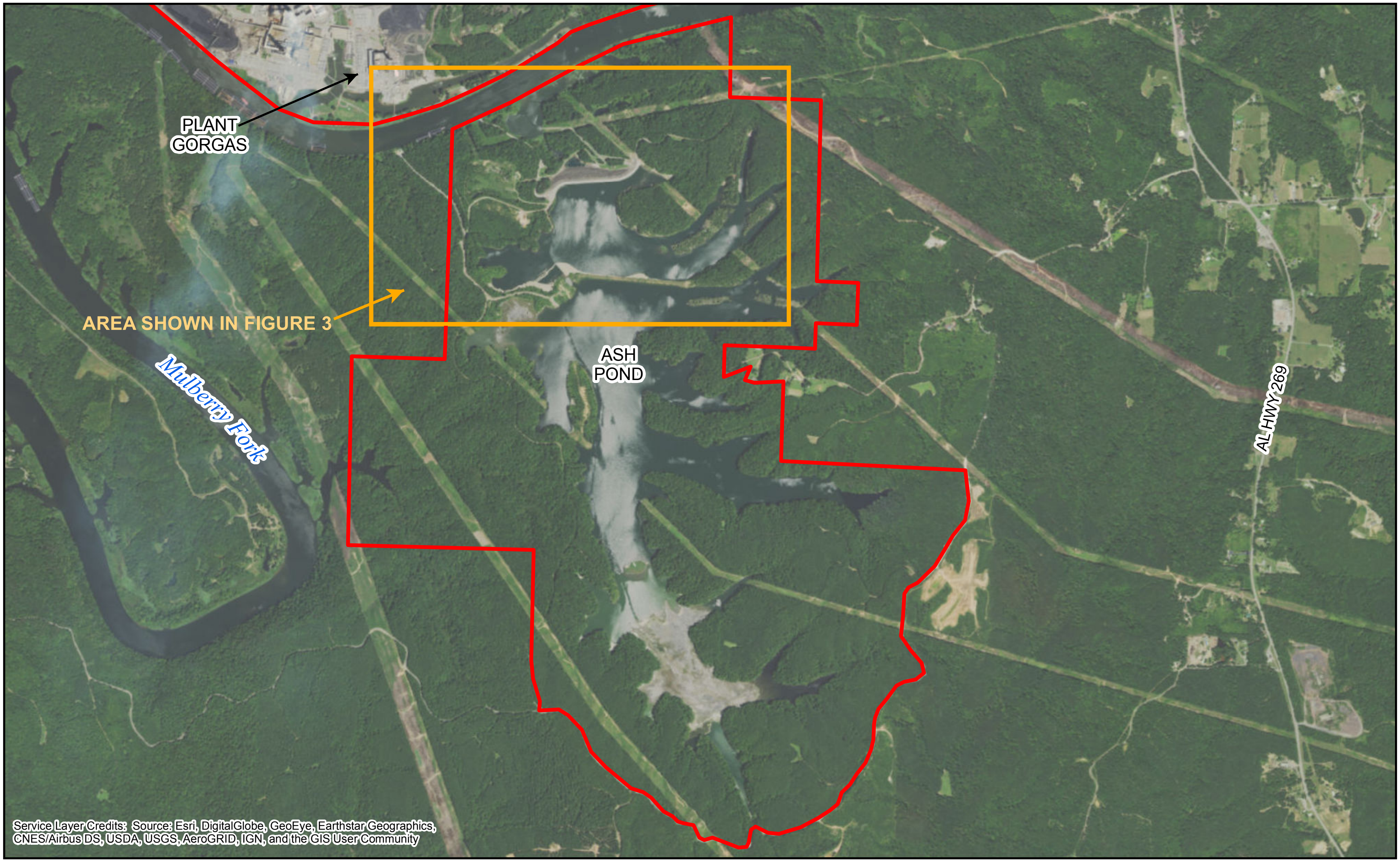
0 0.25 0.5 1
Miles

1 inch = 3,000 feet

FIGURE 1
PLANT GORGAS LOCATION MAP
WALKER COUNTY, ALABAMA

Southern Company Services
FOR

Alabama Power Company



LEGEND

Plant Boundary

N

0 1,000 2,000 4,000

Feet

1 inch = 2,000 feet

FIGURE 2
ASH POND MAP
PLANT GORGAS
WALKER COUNTY, ALABAMA

Southern Company Services
FOR
Alabama Power Company

LEGEND

Approximate Plant Boundary

Approximate Ash Pond Boundary

N

0 300 600 1,200

Feet

1 inch = 600 feet

FIGURE 3
ASH POND DETAIL MAP
PLANT GORGAS
WALKER COUNTY, ALABAMA

Southern Company Services
FOR
Alabama Power Company

APPENDIX B

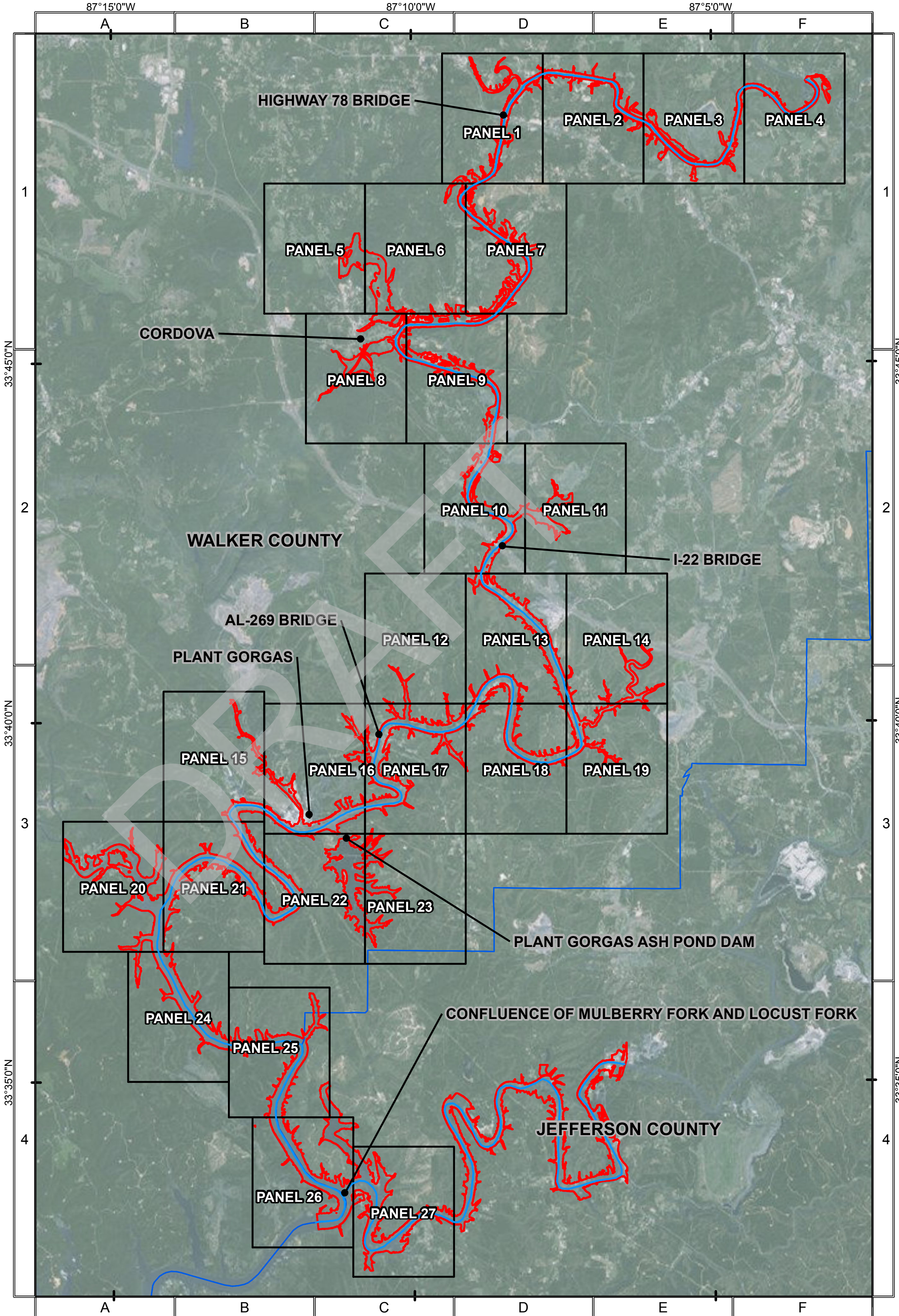
Inundation Maps

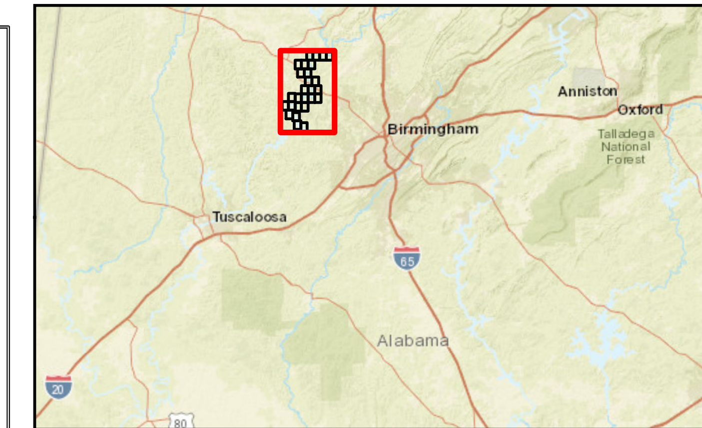
BREACH PROPAGATION INFORMATION

AREA OF INTEREST ID NUMBER	PANEL NUMBER	DISTANCE FROM BREACH*	TIME TO PEAK	BREACH WAVE ARRIVAL TIME**
#		MILES	HOURS	HOURS
1	4	29.9	2.98	2.42
2	4	29.7	2.97	2.42
3	1	22.3	2.38	1.83
4	8	16.7	1.98	1.42
5	8	16.7	1.98	1.42
6	8	16.6	1.98	1.33
7	8	16.5	1.98	1.33
8	8	16.5	1.97	1.33
9	8	16.5	1.97	1.33
10	9	15.6	1.93	1.17
11	10	13.3	1.80	1.08
12	10	13.2	1.79	1.08
13	10	11.4	1.68	0.92
14	13	9.9	1.61	0.83
15	19	8.1	1.53	0.75
16	19	7.9	1.52	0.75
17	19	7.6	1.50	0.67
18	18	6.7	1.46	0.58
19	13	4.6	1.36	0.50
20	18	4.2	1.34	0.42
21	17	3.6	1.31	0.33
22	17	3	1.28	0.33
23	17	2.5	1.26	0.25
24	17	2.4	1.26	0.25
25	17	2.1	1.24	0.25
26	17	2.1	1.24	0.25
27	17	1.3	1.20	0.17
28	16	-0.2	1.17	0.17
29	16	-0.5	1.17	0.08
30	21	-4.7	1.35	0.25
31	20	-6.9	1.46	0.50
32	20	-6.9	1.46	0.50
33	20	-7.2	1.48	0.67
34	20	-7.3	1.49	0.67
35	25	-10.6	1.65	0.67
36	25	-11.6	1.70	0.75
37	26	-13.8	1.79	0.75
38	27	-14.1	1.79	0.75
39	27	-14.3	1.80	0.75
40	27	-14.4	1.81	0.75
41	27	-14.5	1.82	0.92
42	27	-15.8	1.93	0.92
43	27	-15.9	1.94	0.92

* DISTANCE FROM BREACH IS TAKEN AS APPROXIMATE MILES ABOVE THE REACH ALONG THE RIVER CENTERLINE. NEGATIVE VALUES INDICATE THAT THE HAZARD IS DOWNSTREAM OF THE BREACH.

** WAVE ARRIVAL TIME IS CALCULATED AS THE TIME FROM BREACH FOR AN AREA TO EXPERIENCE A BREACH INDUCED 0.5 FOOT RISE IN WATER SURFACE LEVEL.





LEGEND

SUNNY DAY BREACH

MAP PANEL

COUNTY

NOTES

1. THIS MAP DEPICTS THE EXTENT OF THE MAXIMUM WATER SURFACE ELEVATION FROM A SUNNY DAY BREACH OF THE GORGAS ASH POND DAM.
2. MAPPING OF FLOODED AREAS AND FLOOD WAVE TRAVEL TIMES ARE APPROXIMATE AND SHOULD BE USED AS A GUIDANCE FOR ESTABLISHING EVACUATION ZONES.
3. ACTUAL AREAS INUNDATED WILL DEPEND ON FAILURE MODE AND PRE-FAILURE HYDROLOGIC CONDITIONS AND MAY DIFFER SIGNIFICANTLY FROM INFORMATION SHOWN ON THESE MAPS.

REFERENCES

1. BREACH MODEL ADAPTED FROM A USACE HEC-RAS FLOOD MODEL PROVIDED BY SOUTHERN COMPANY SERVICES.
2. TOPOGRAPHY UTILIZED FOR MAPPING TAKEN FROM USGS QL2 LIDAR COLLECTED 12/2015 - 02/2016 BY DIGITAL AERIAL SOLUTIONS, LLC CONTRACT #G10PC00093 TASK ORDER #G15PD00518.
3. RIVER BASEFLOWS TAKEN FROM FEMA FIS 01127CV000B, WALKER COUNTY, AL. SUPPLEMENTARY FLOWS GATHERED FROM USGS STREAMSTATS.
4. AERIAL IMAGERY AND BASEMAP SOURCES: ESRI, HERE, DELORME, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), MAPMYINDIA, NGCC, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

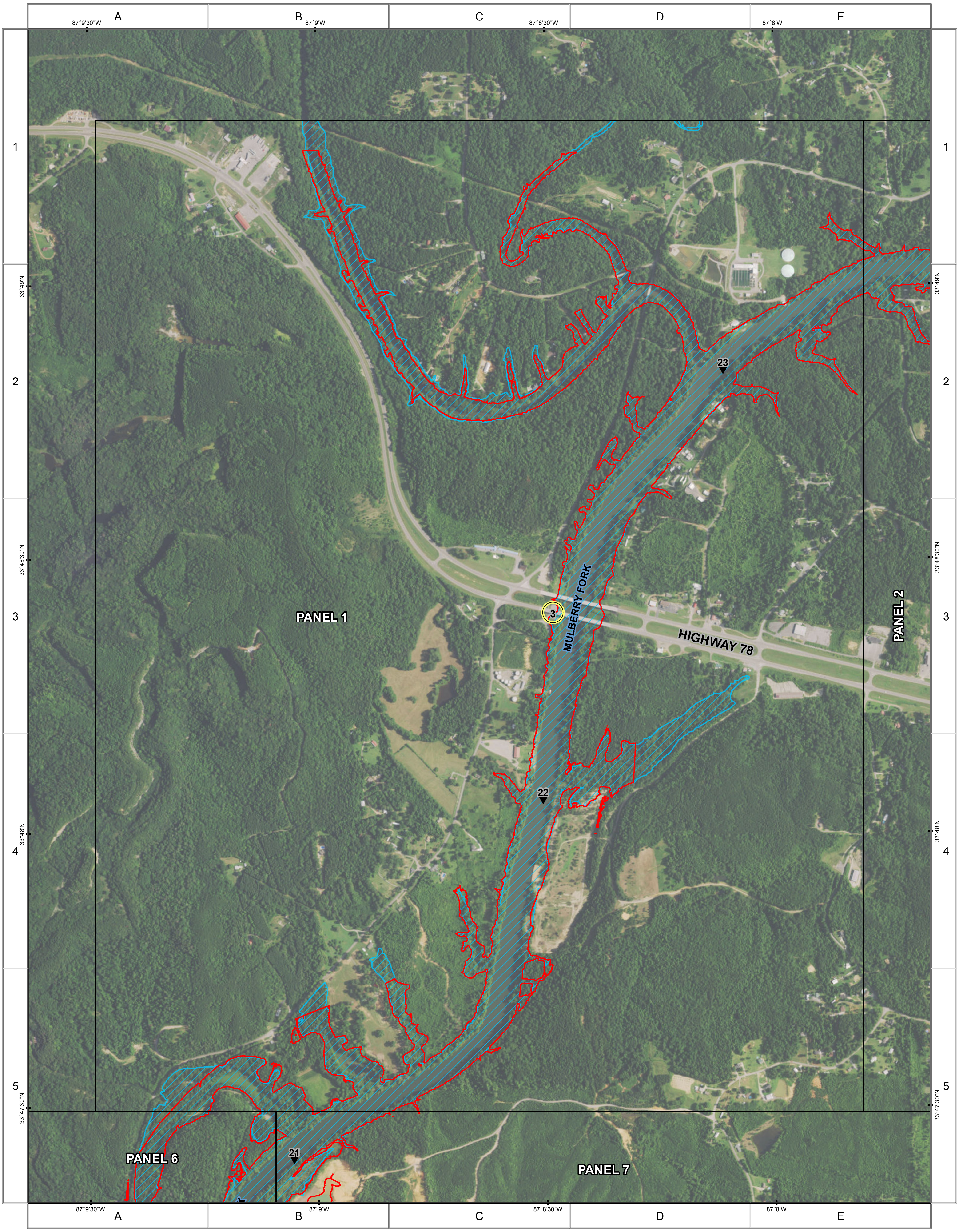
2 1 0 2 4 Miles

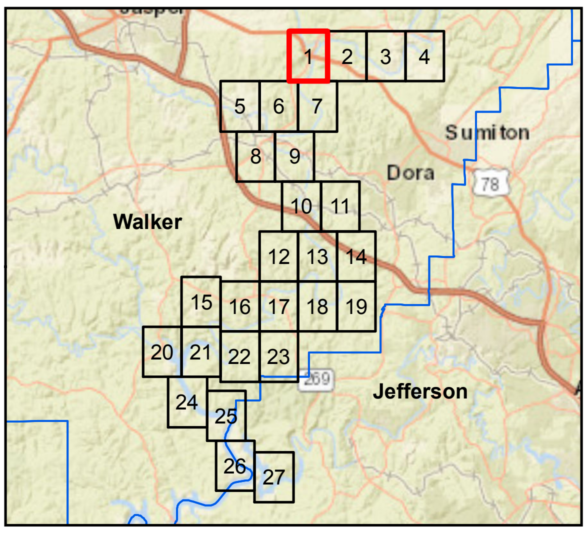
Golder Associates

Projection
Transverse Mercator
NAD 1983 Alabama West
State Plane

N S E W

ISSUE DATE: 3/10/2017 INDEX MAP





PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

ISSUE DATE: 3/28/2017 PANEL 1 of 27

Notes

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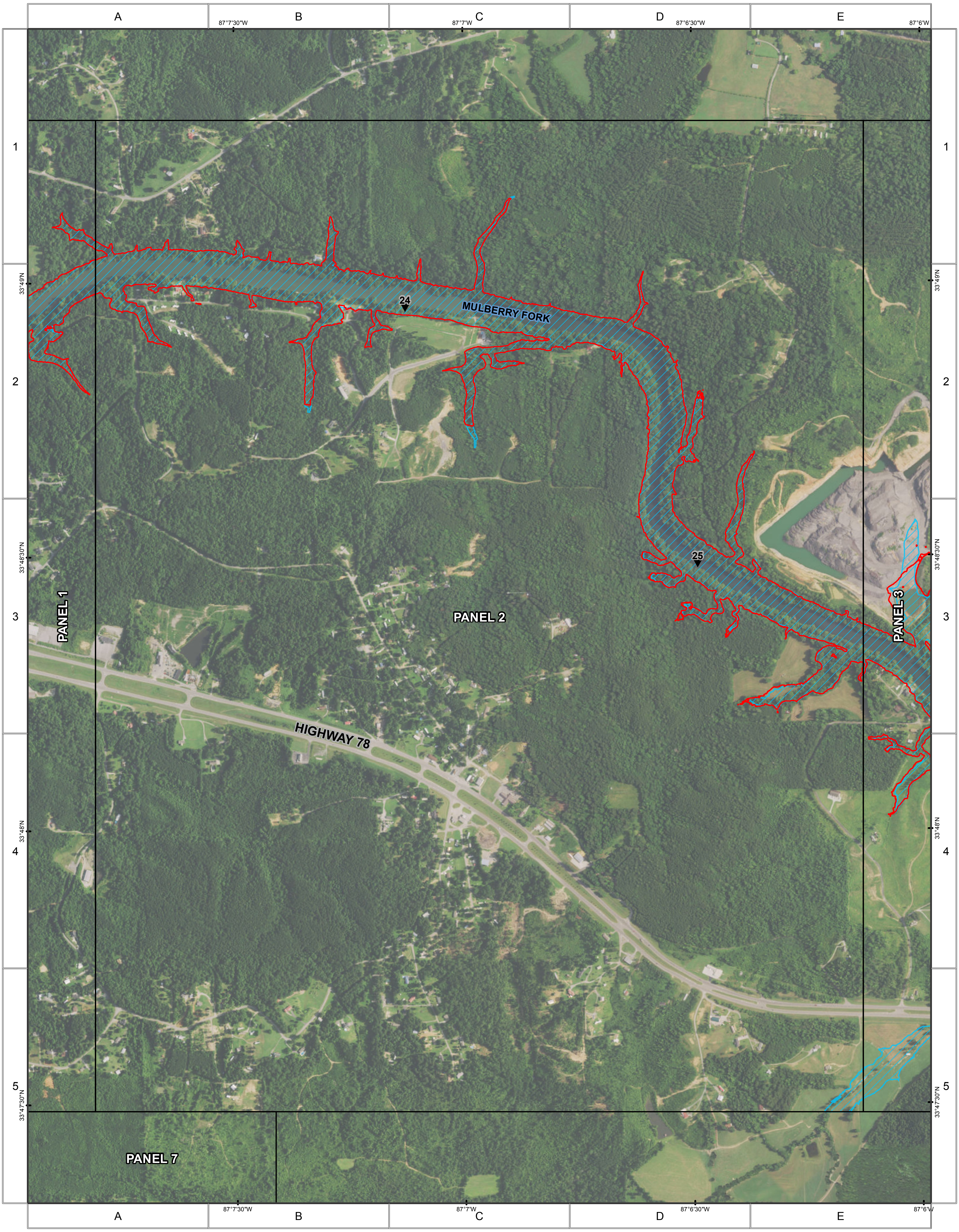
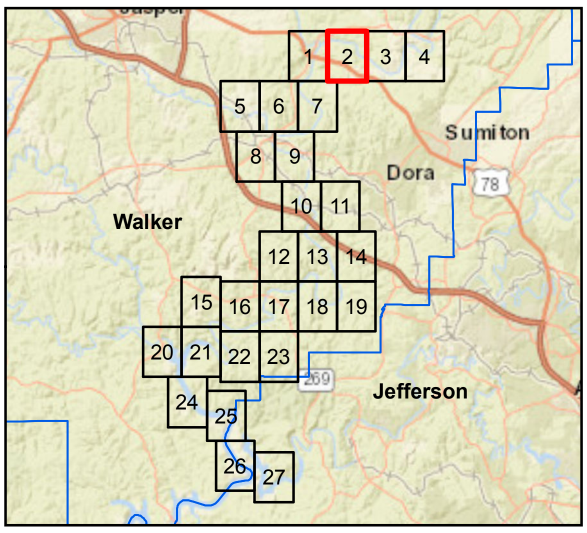
LEGEND

- PANEL
- SUNNY DAY BREACH
- WALKER COUNTY BOUNDARY
- FEMA ZONE A/AE 100 YEAR FLOODPLAIN
- AREA OF INTEREST (ID NUMBER WITHIN)
- MILES FROM BREACH (NEGATIVE DOWNSTREAM)





PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

Golder Associates

ISSUE DATE: 3/28/2017 PANEL 2 of 27

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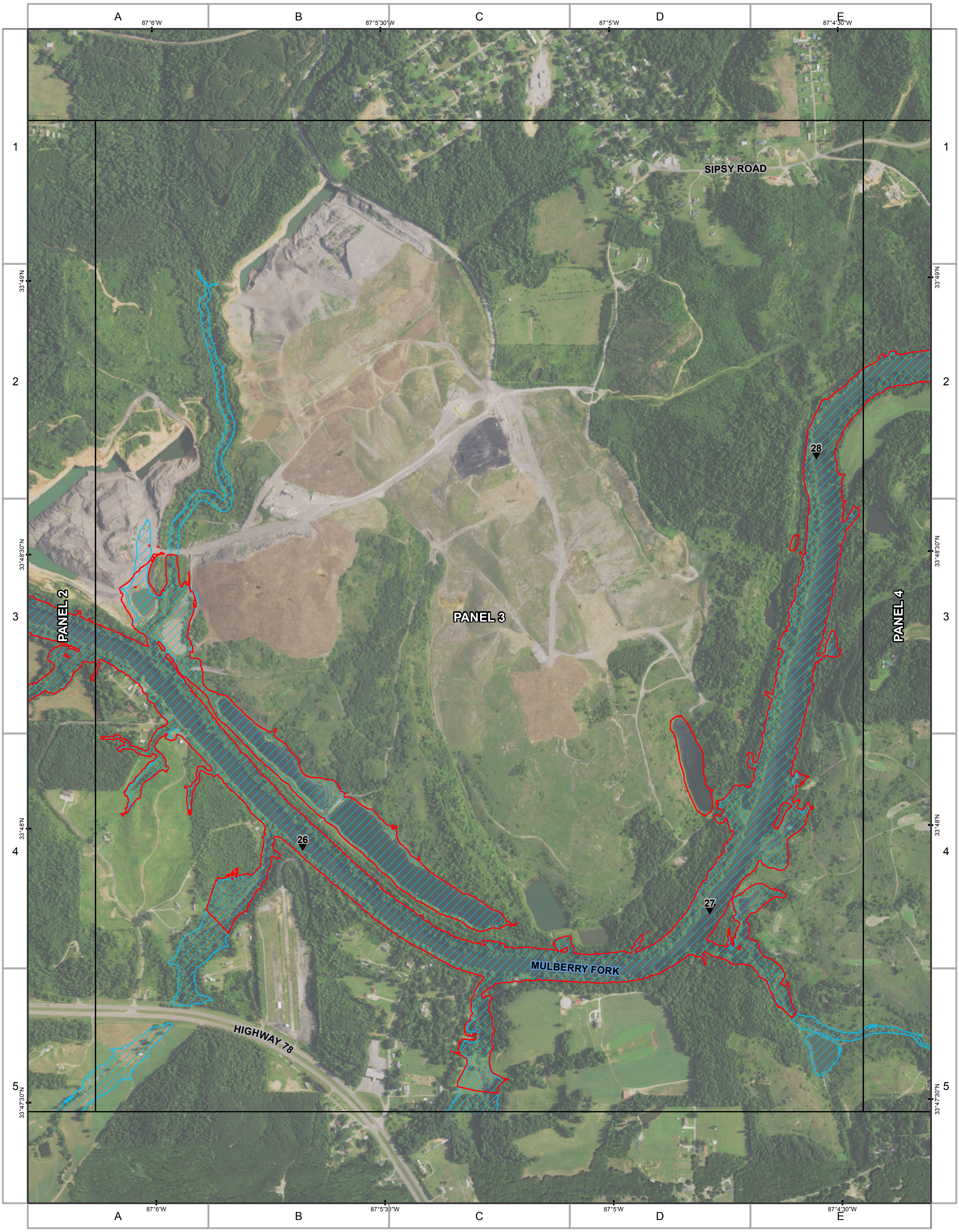

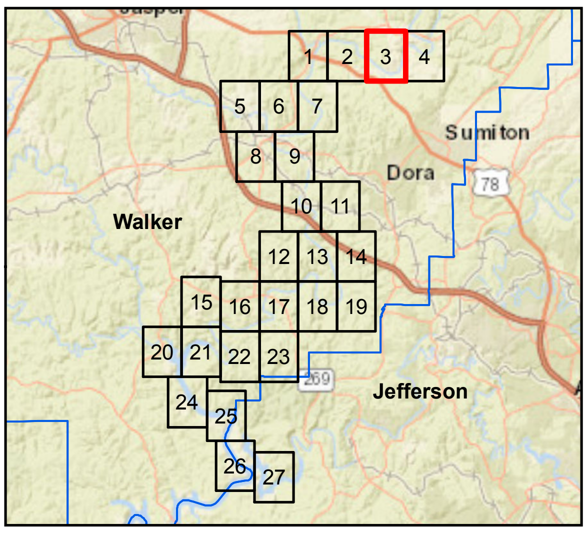

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

ISSUE DATE: 3/28/2017 PANEL 3 of 27

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LEGEND

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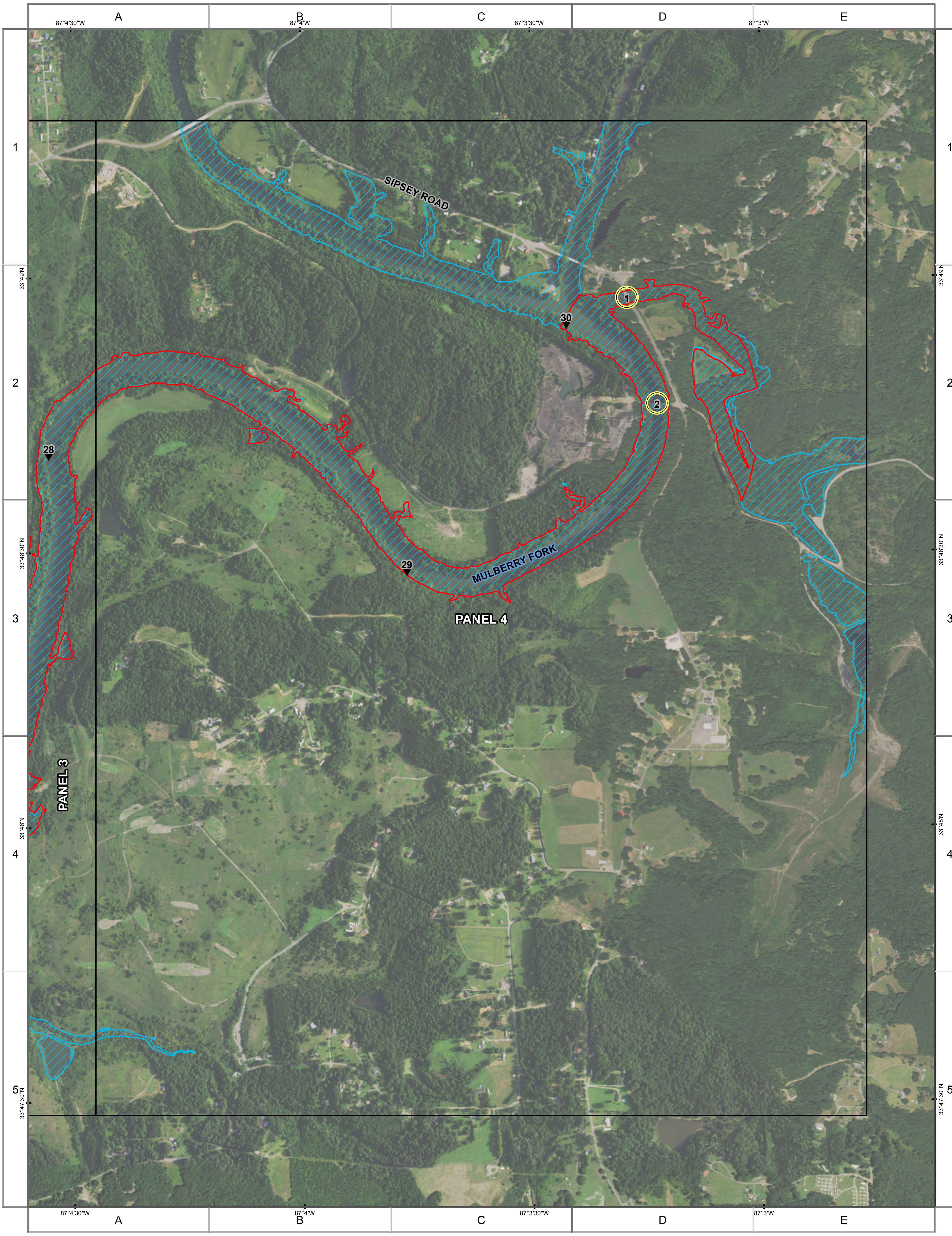

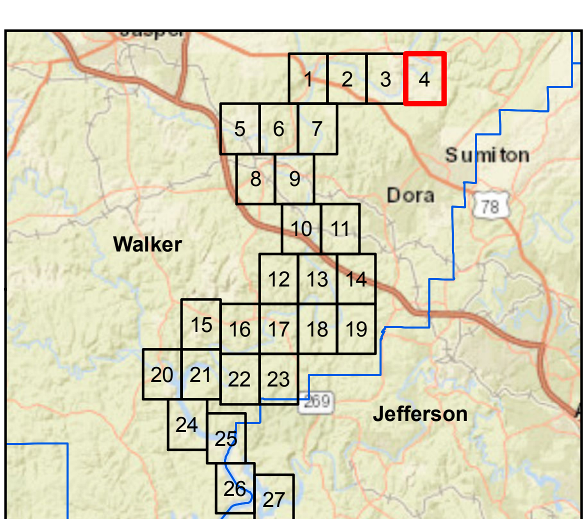

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection
Transverse Mercator
NAD 1983 Alabama West
State Plane

Golder Associates

ISSUE DATE: 3/28/2017 PANEL 4 of 27

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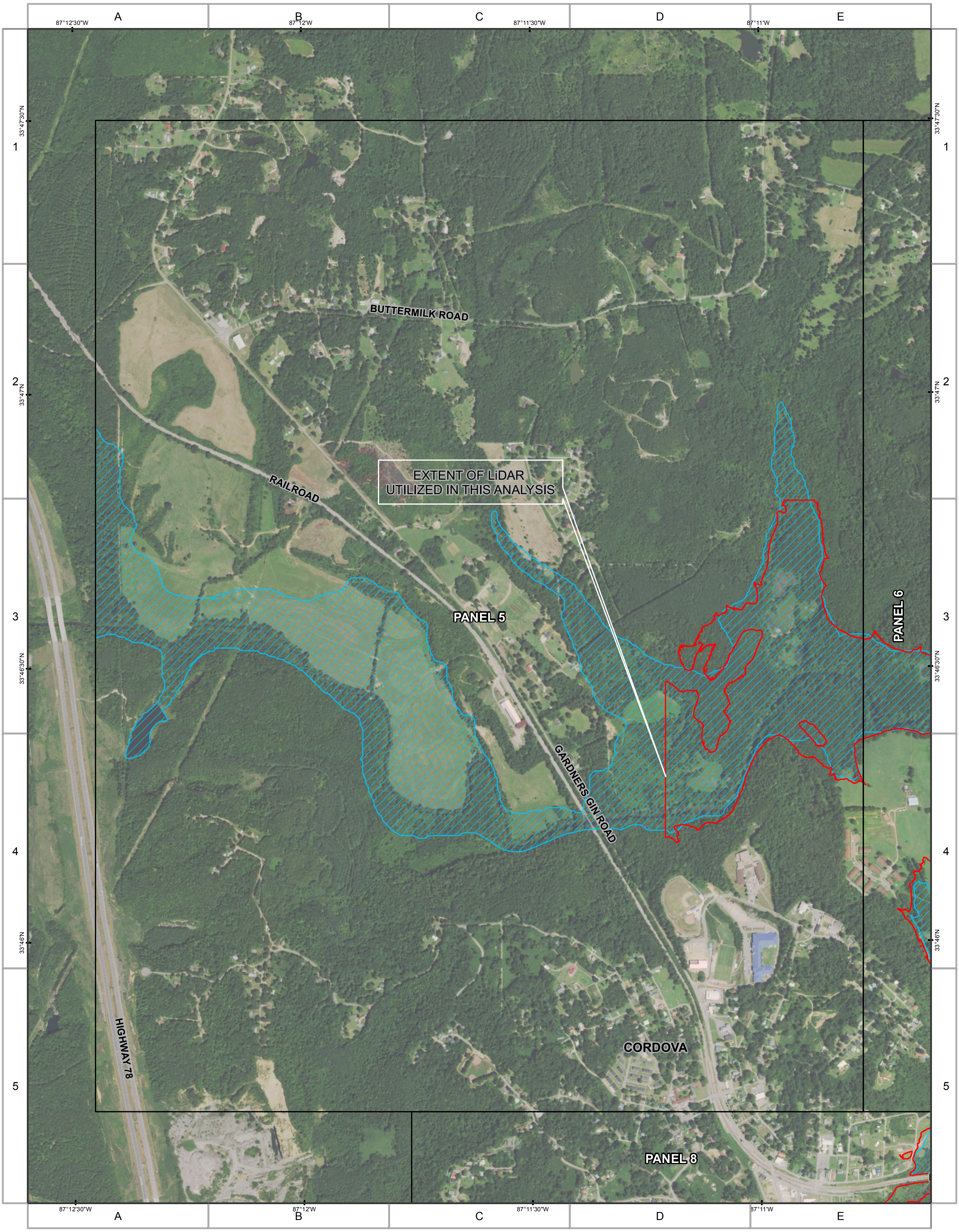

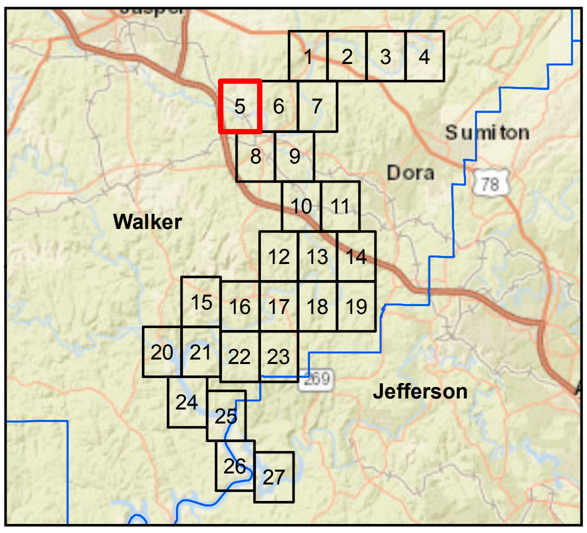

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection

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State Plane

ISSUE DATE: 3/28/2017 PANEL 5 of 27

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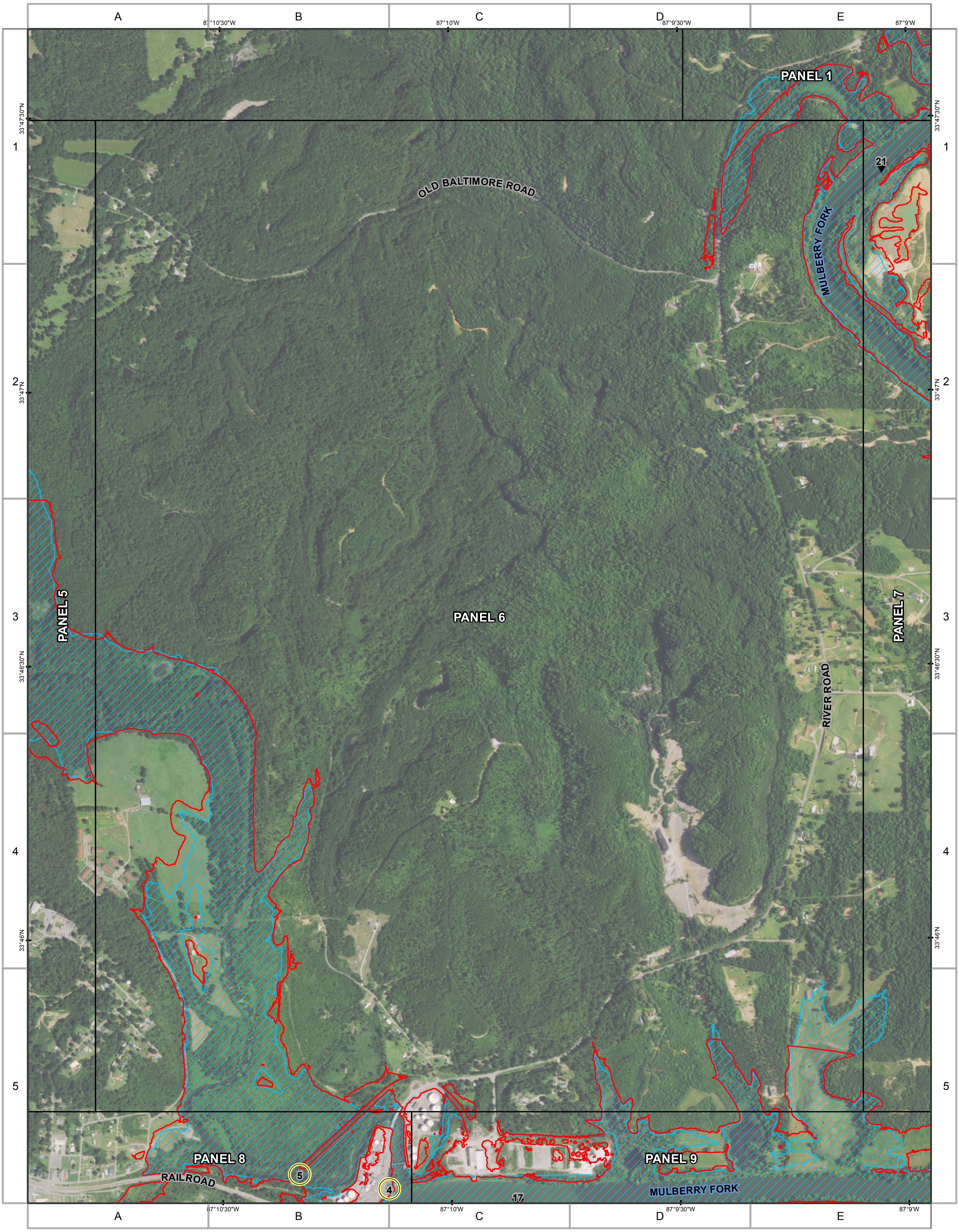
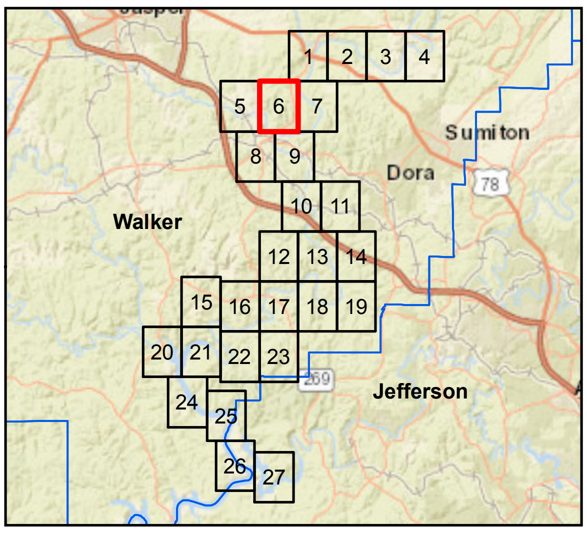
LEGEND

- PANEL
- SUNNY DAY BREACH
- WALKER COUNTY BOUNDARY
- FEMA ZONE A/AE 100 YEAR FLOODPLAIN
- AREA OF INTEREST (ID NUMBER WITHIN)
- MILES FROM BREACH (NEGATIVE DOWNSTREAM)





PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Golder Associates

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

N W E S

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Notes

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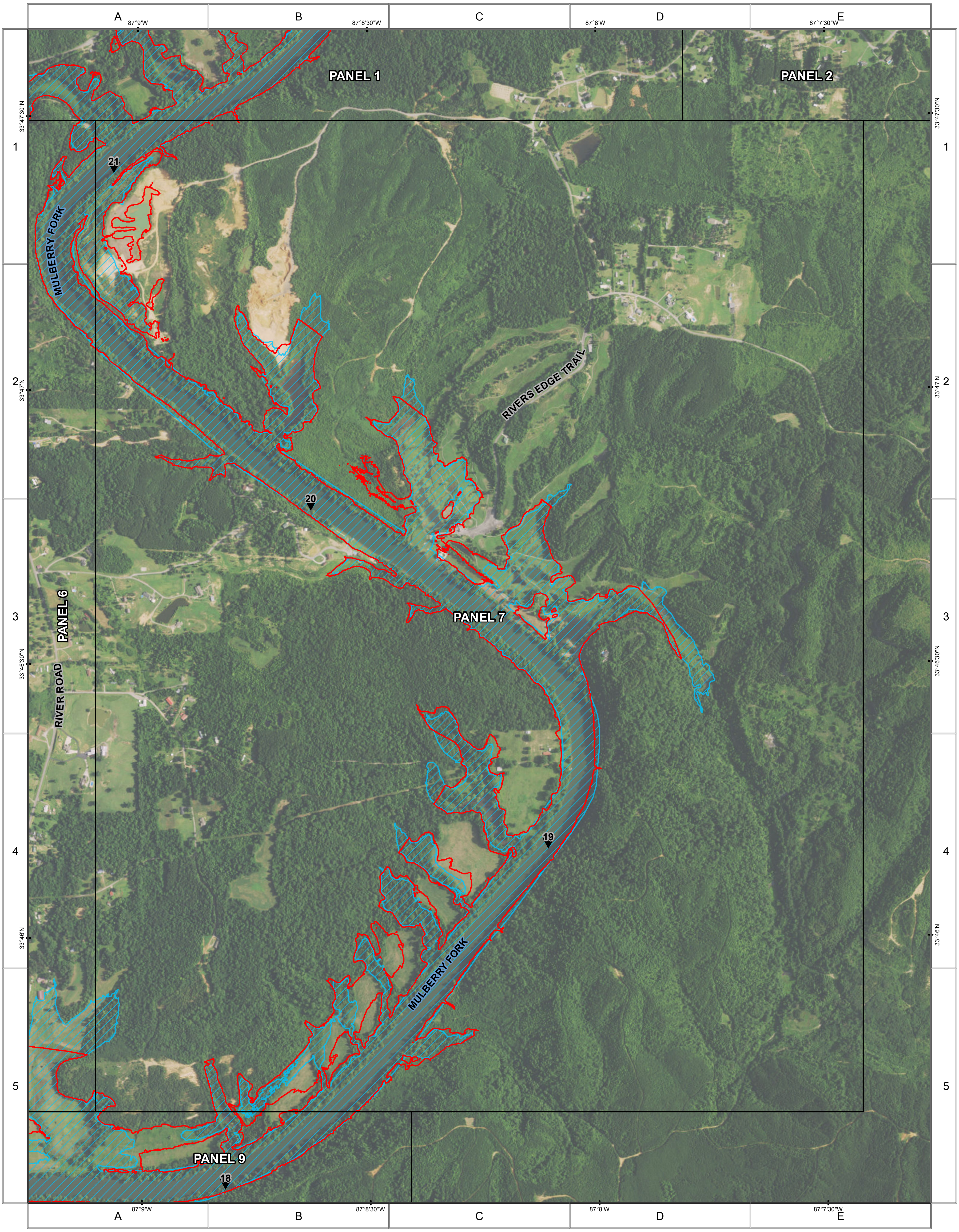

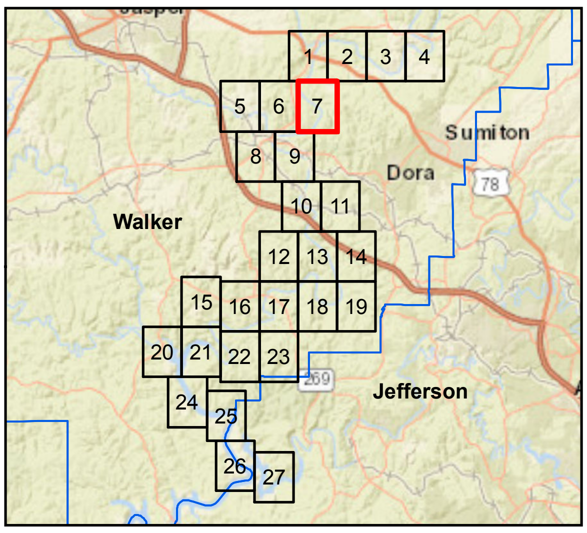

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection
Transverse Mercator
NAD 1983 Alabama West
State Plane

Golder Associates

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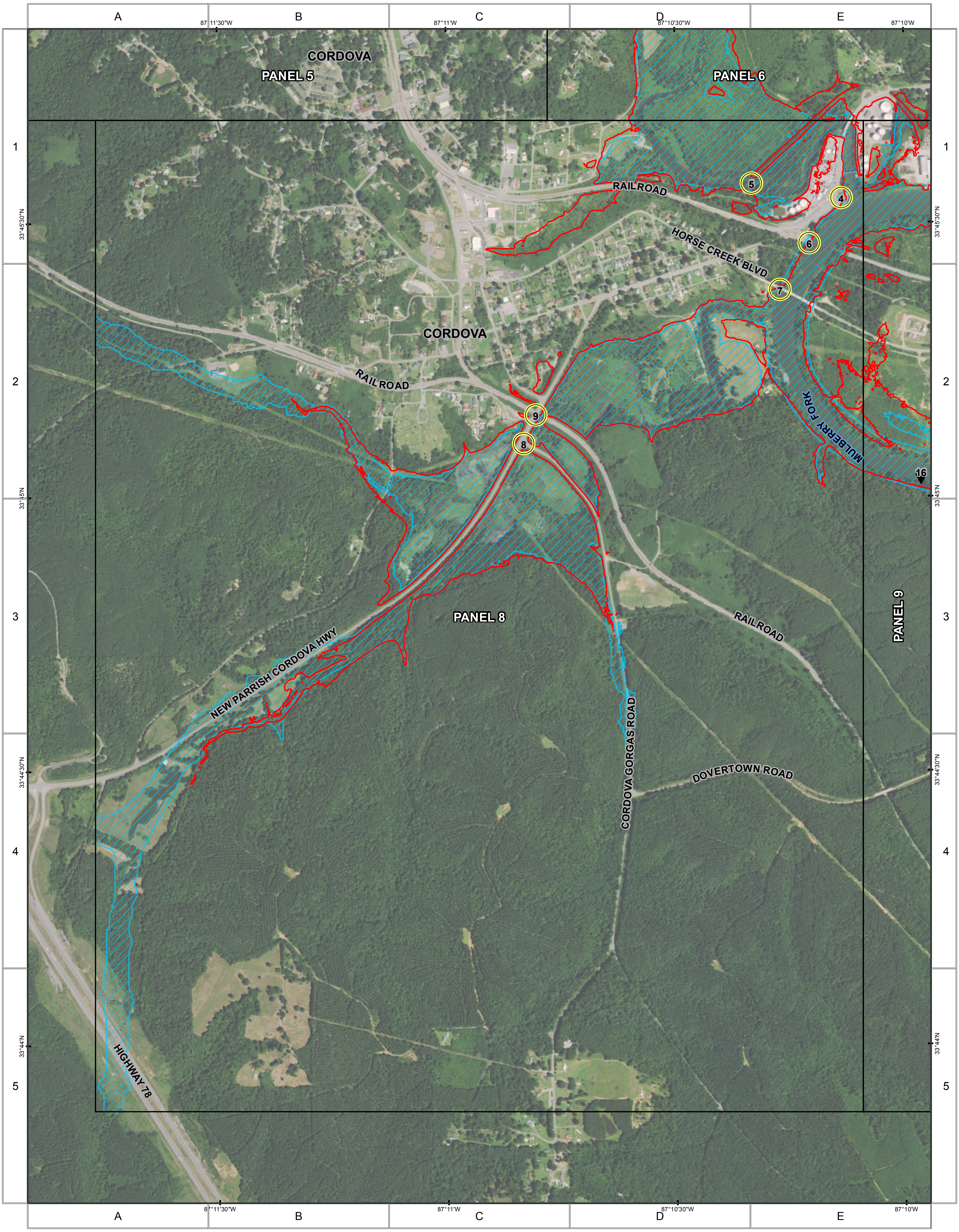

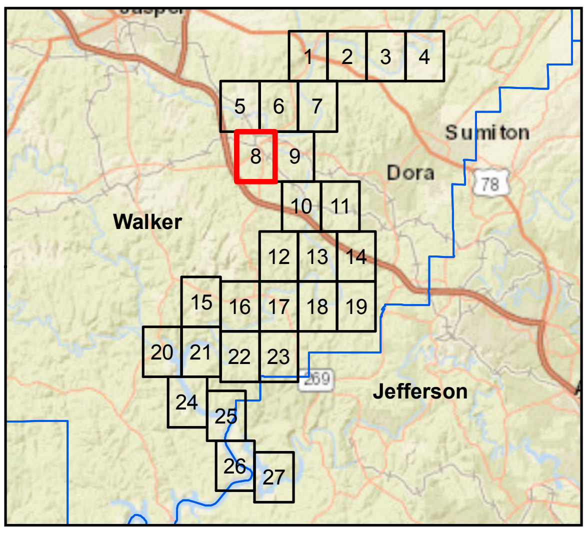

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

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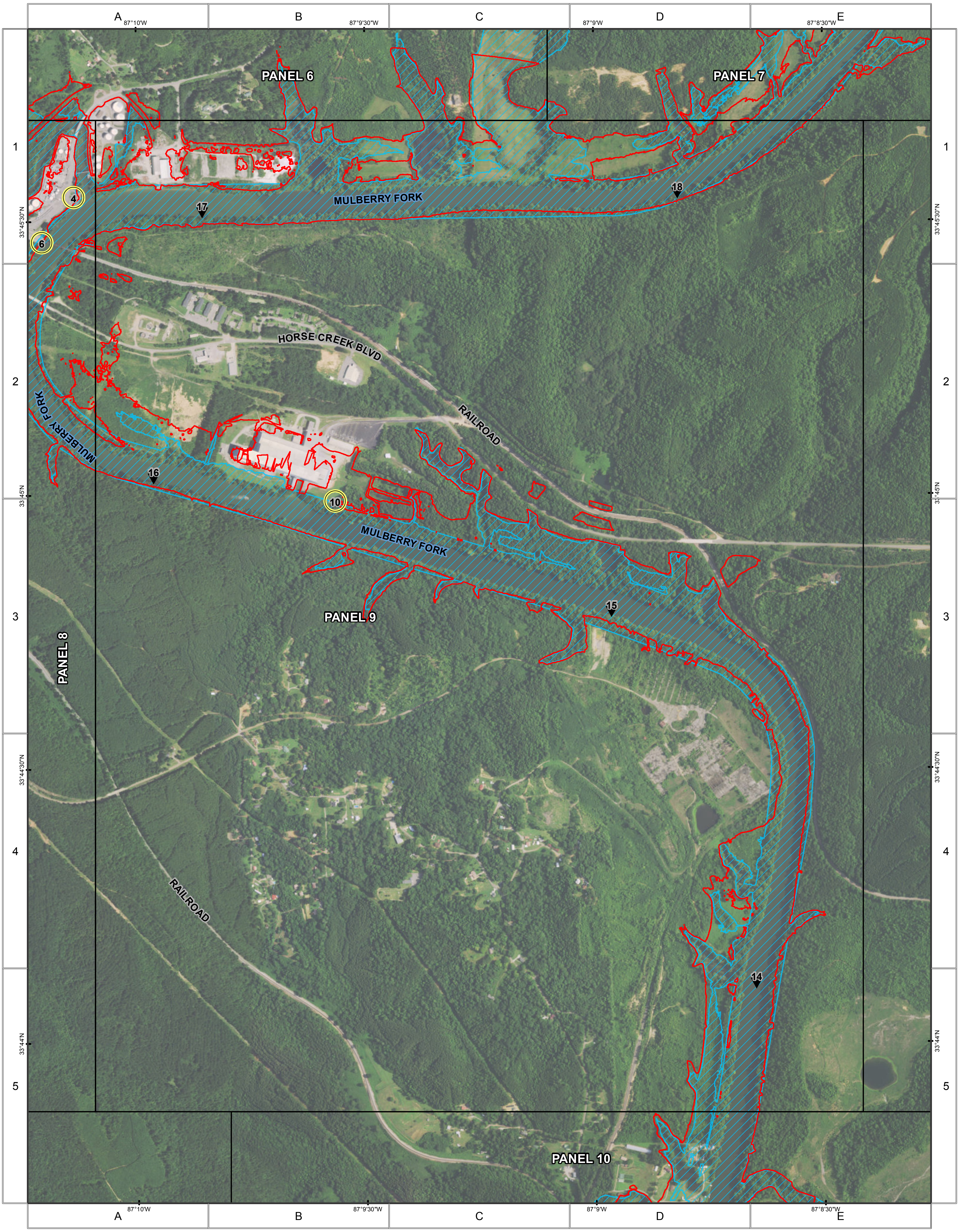

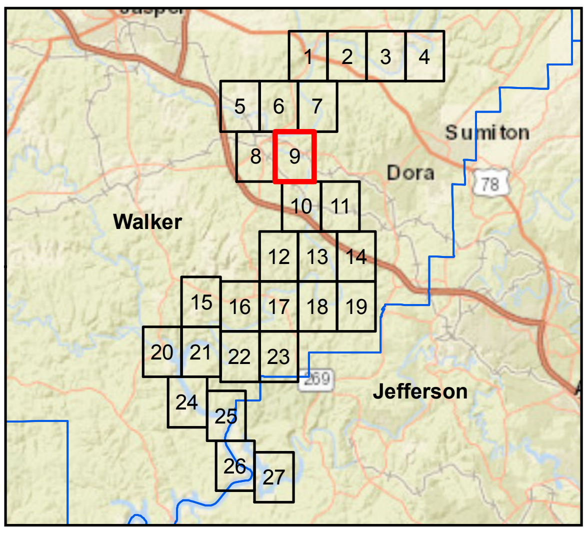

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

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Projection
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Golder Associates

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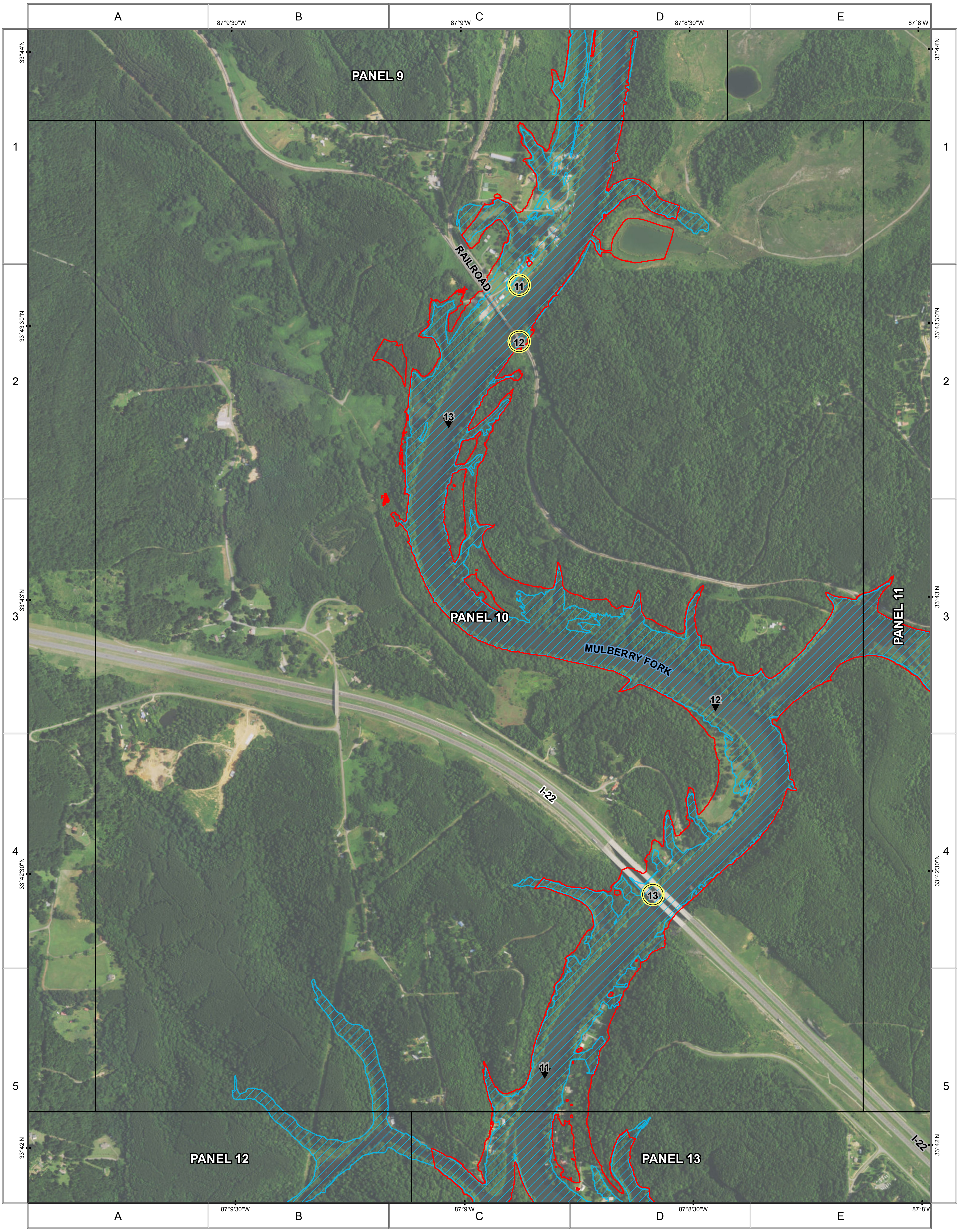

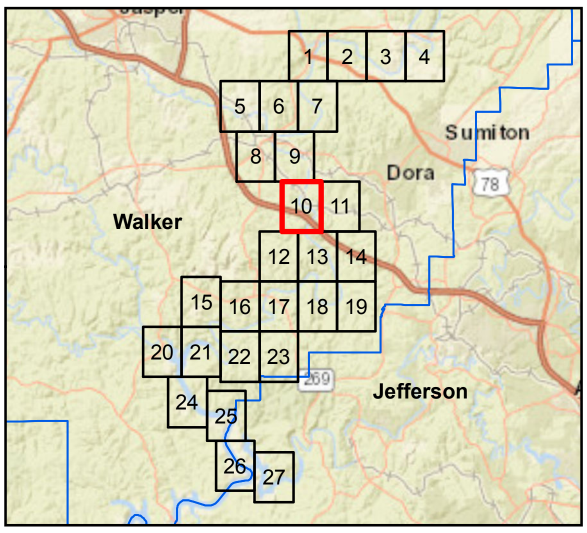

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

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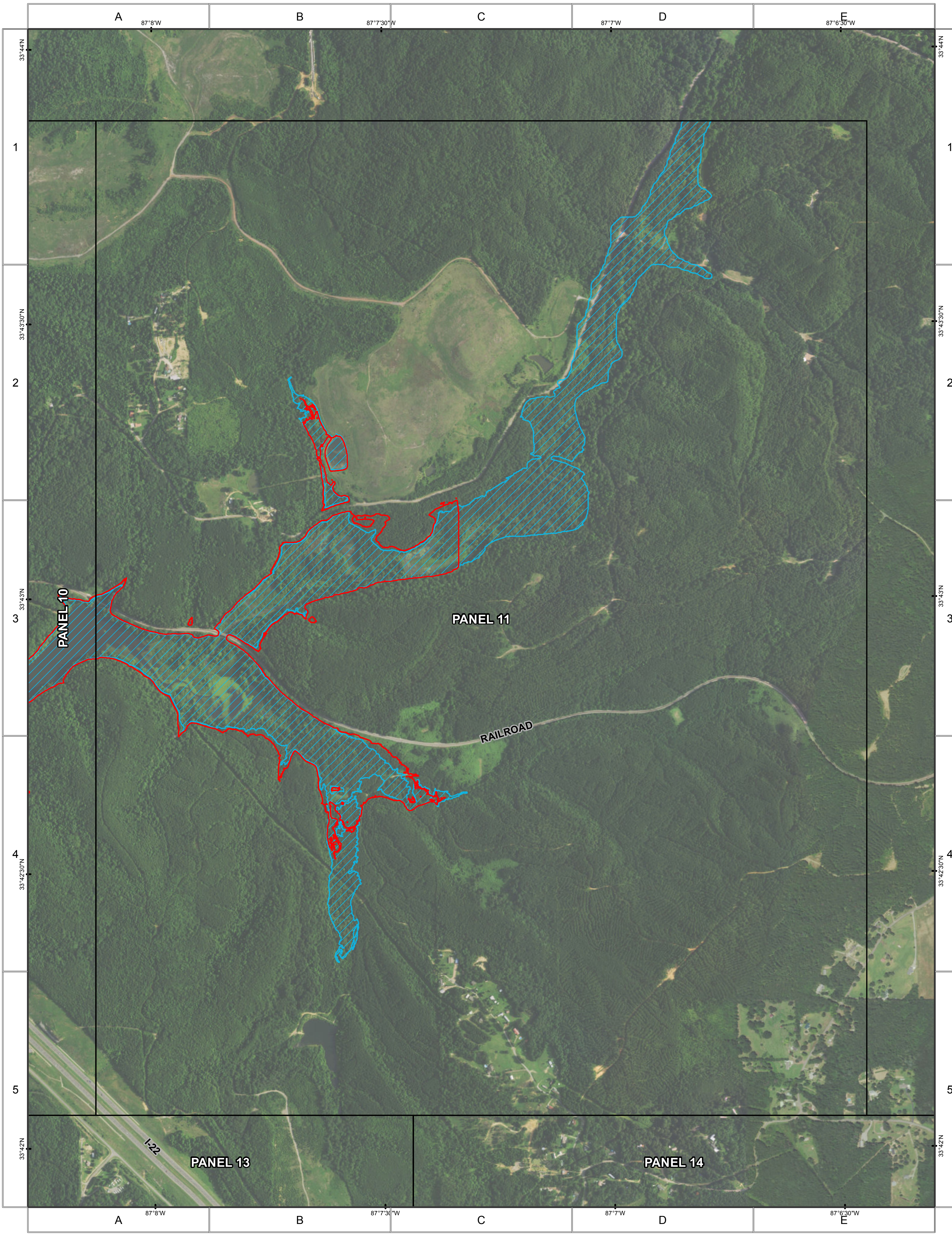

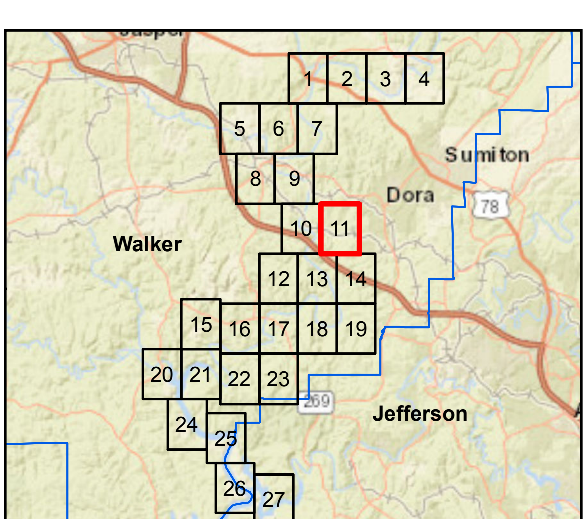

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

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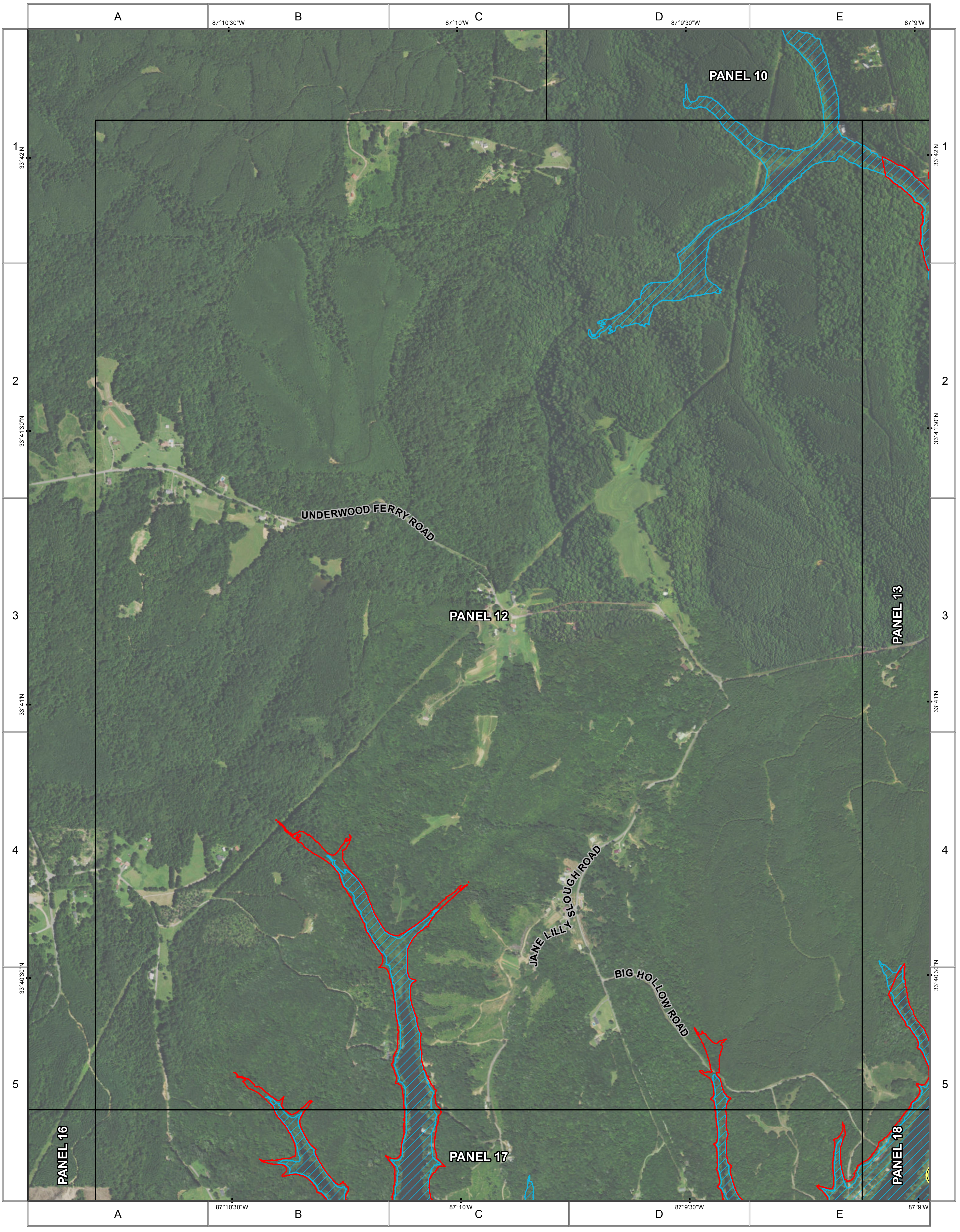

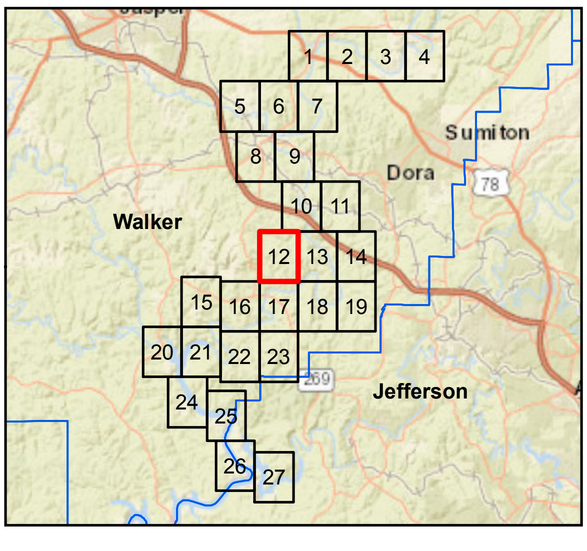

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection
Transverse Mercator
NAD 1983 Alabama West
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Golder Associates

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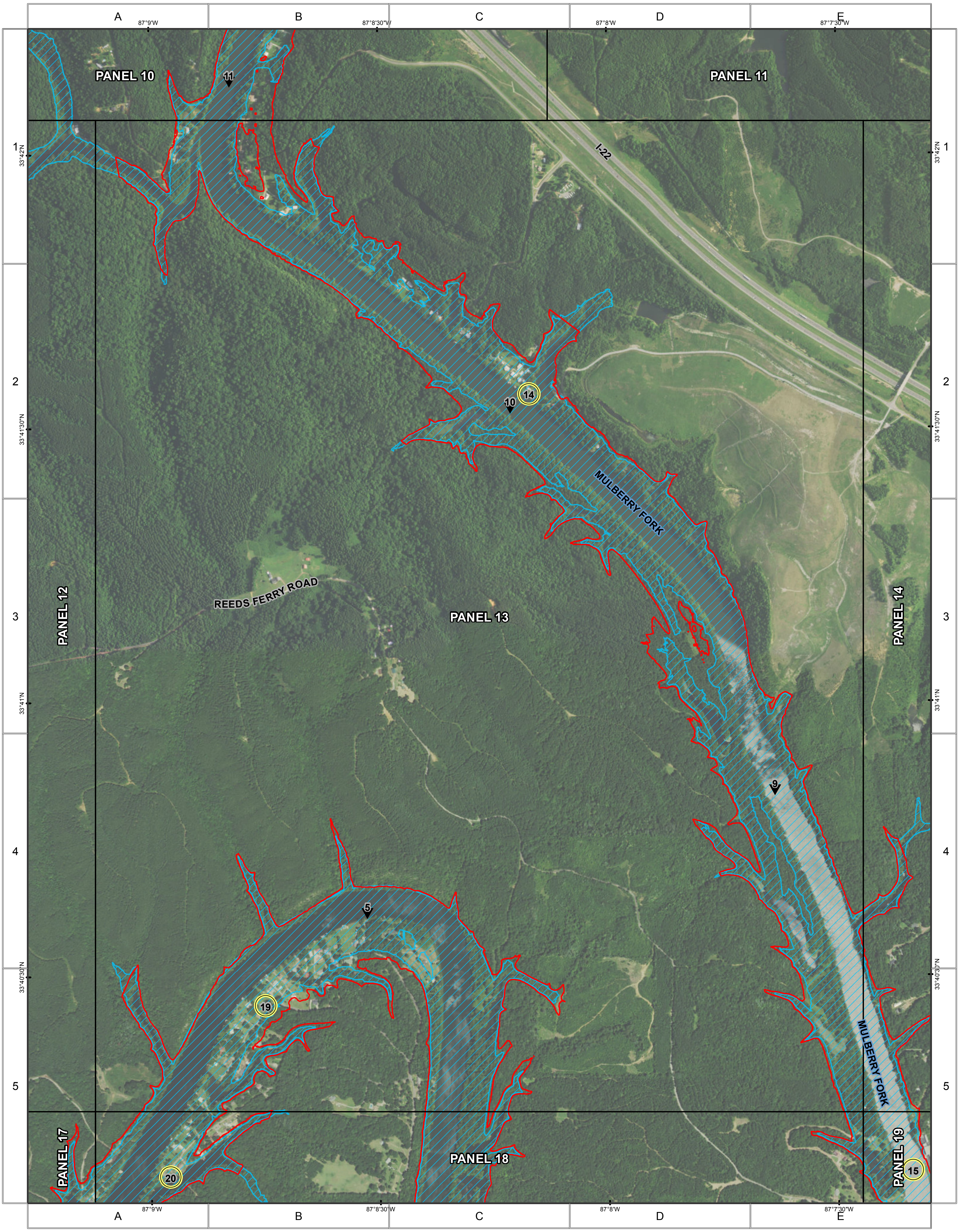

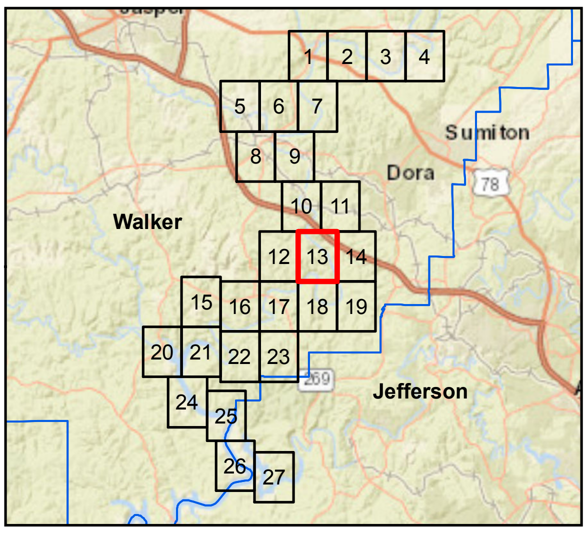

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

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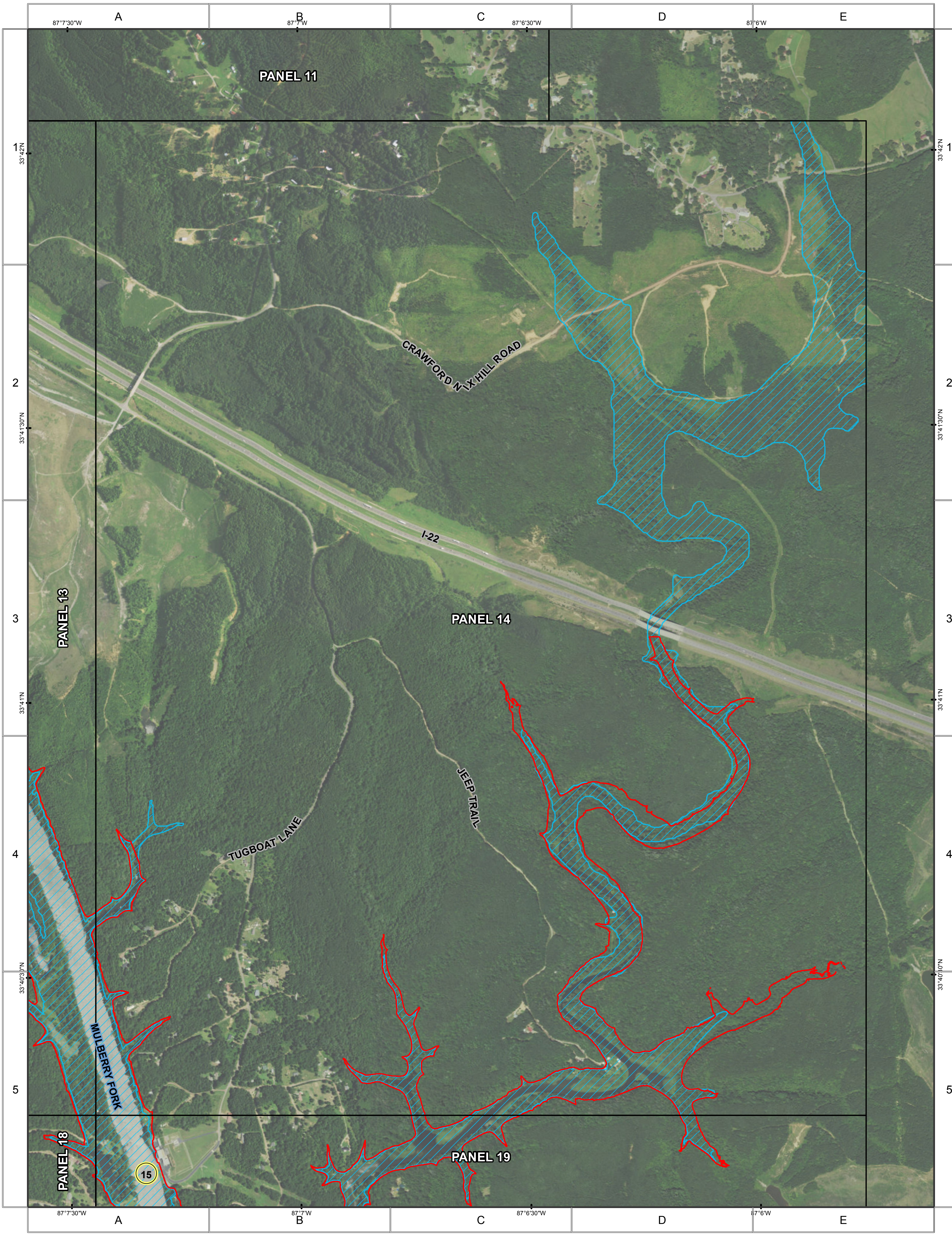

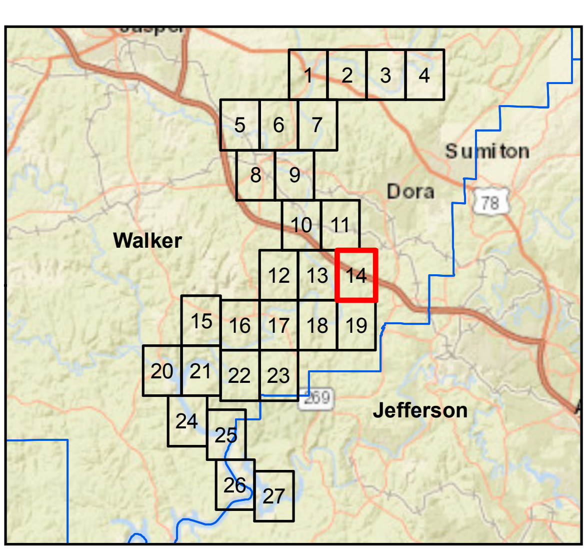

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection
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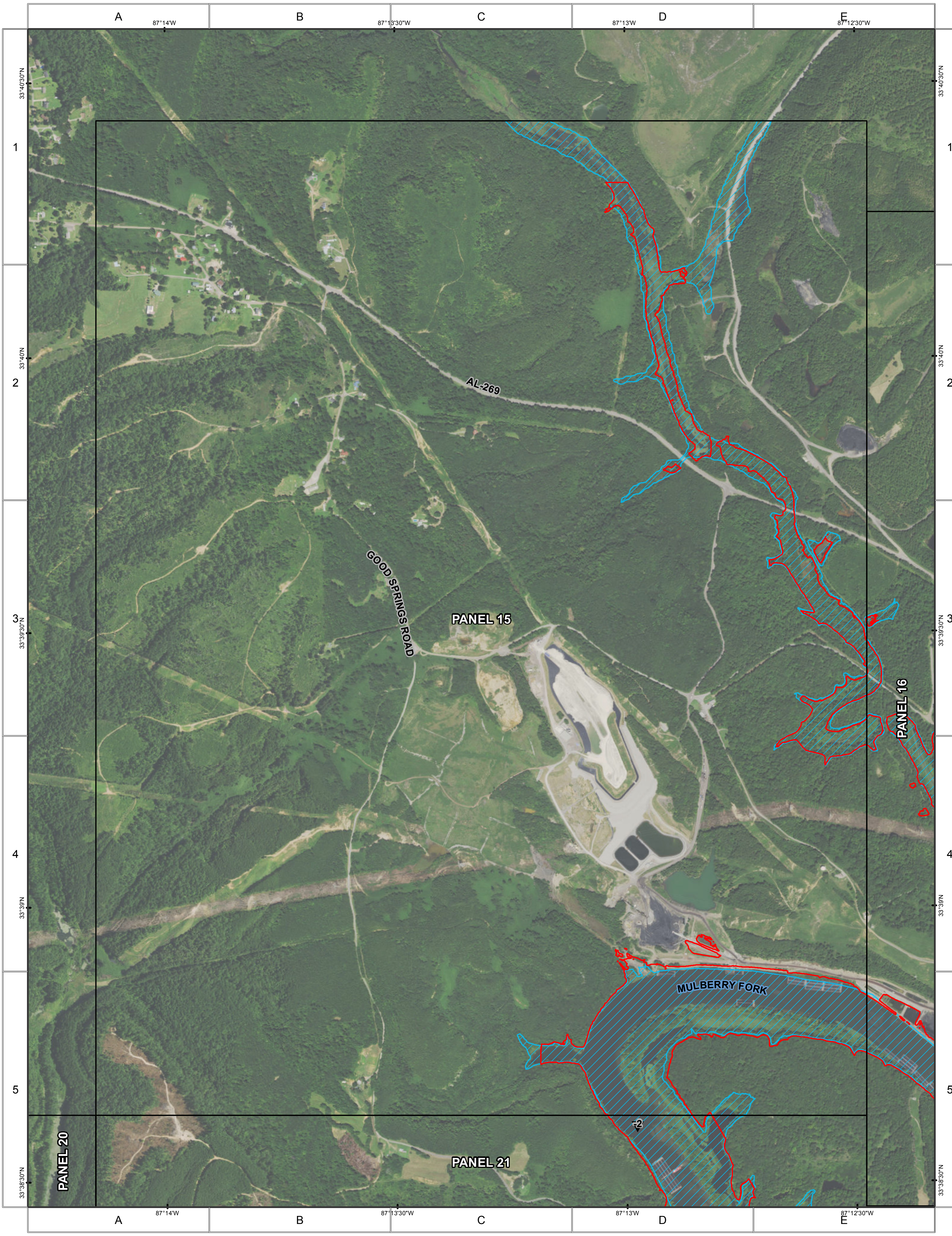

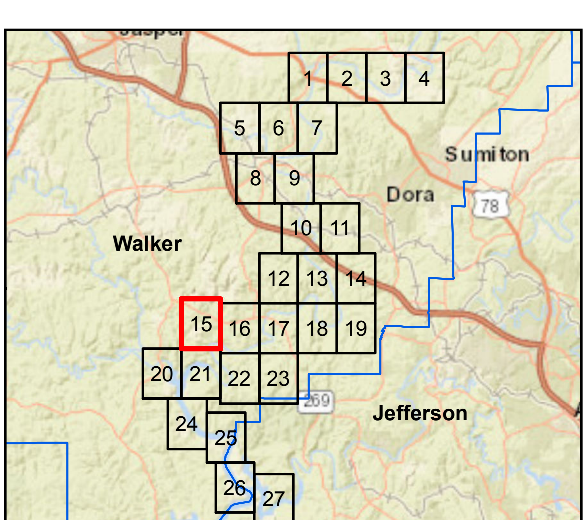

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection
Transverse Mercator
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Golder Associates

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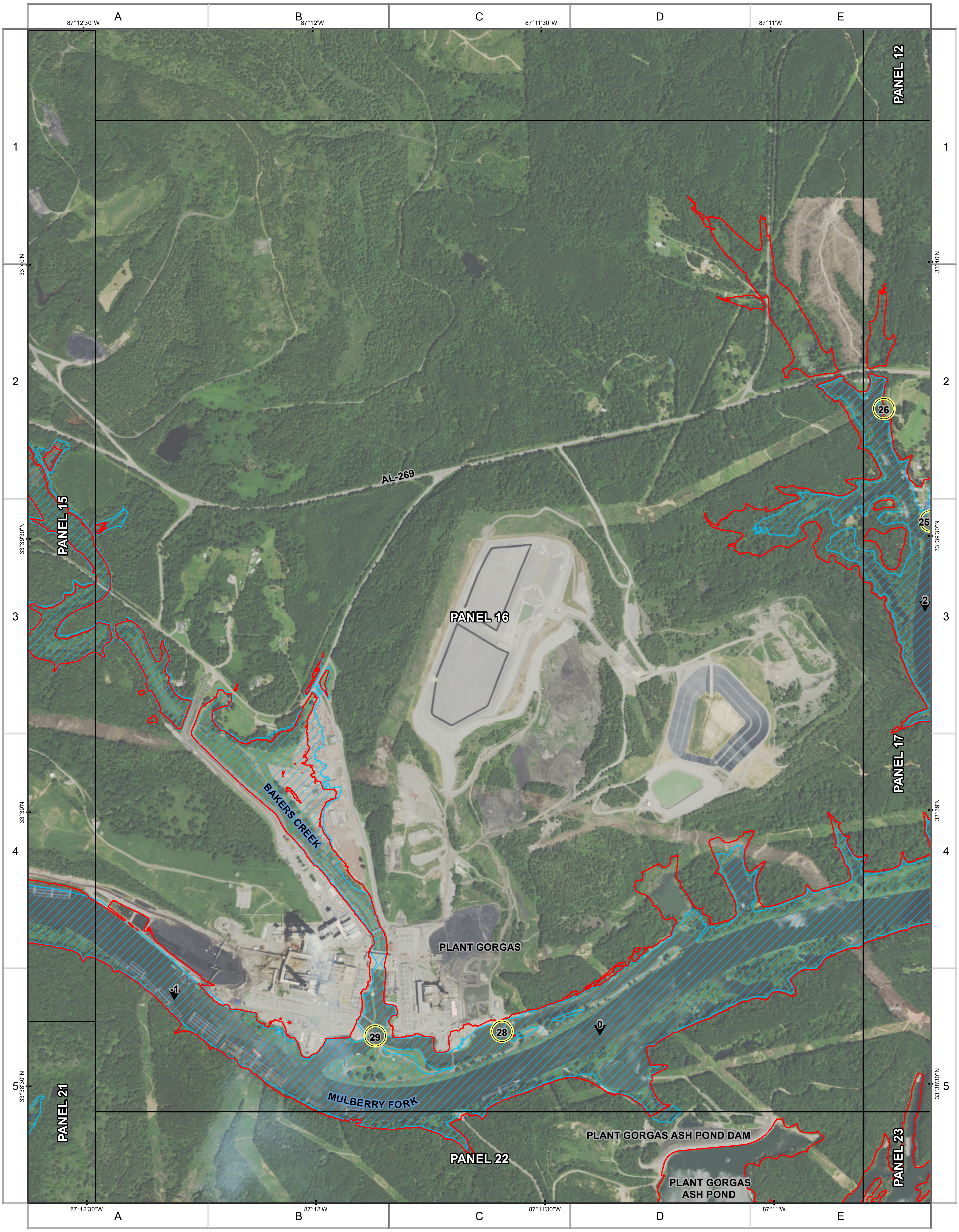

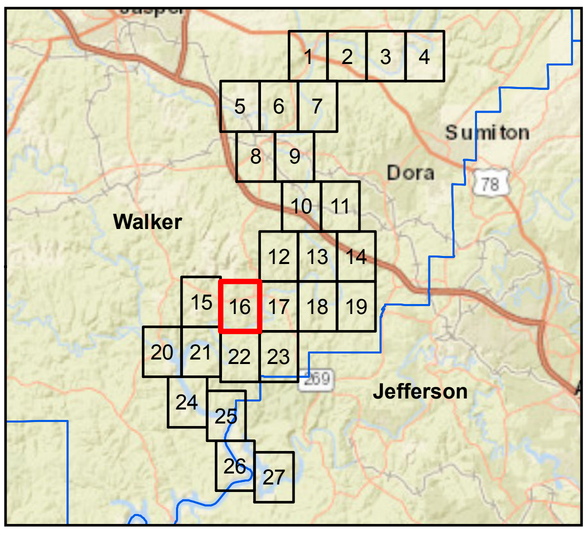

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Golder Associates

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Transverse Mercator
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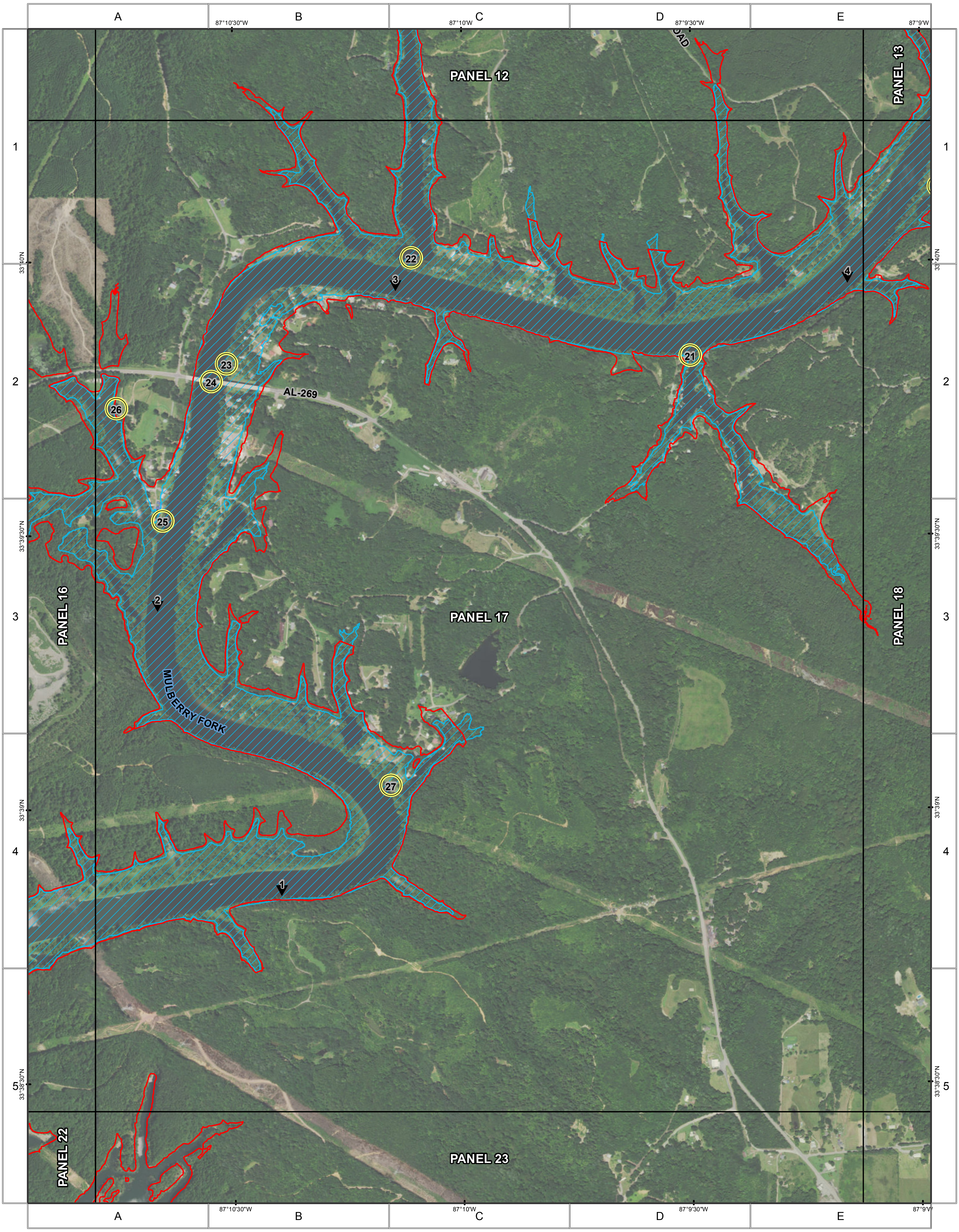

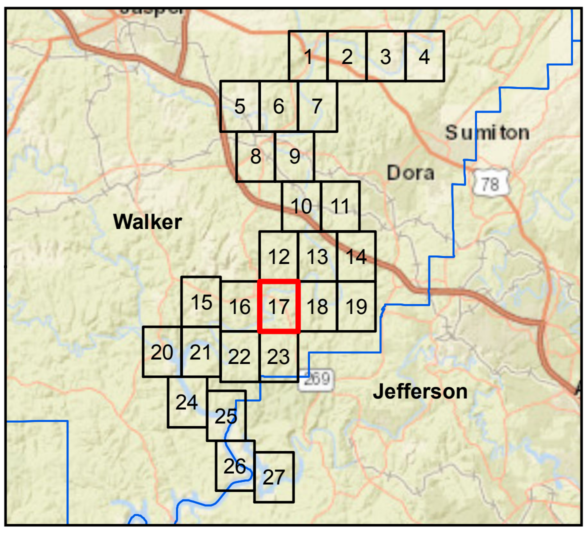

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

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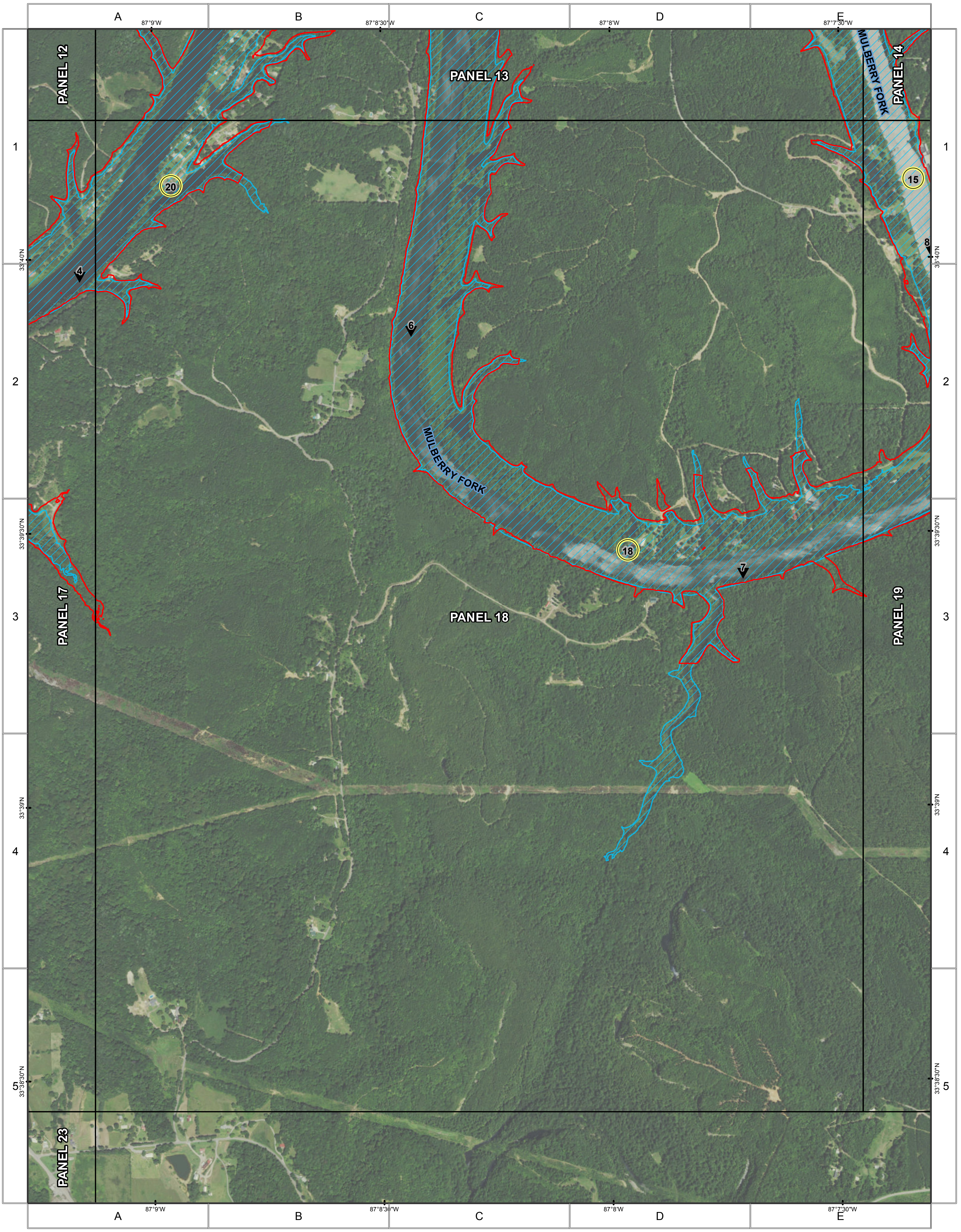

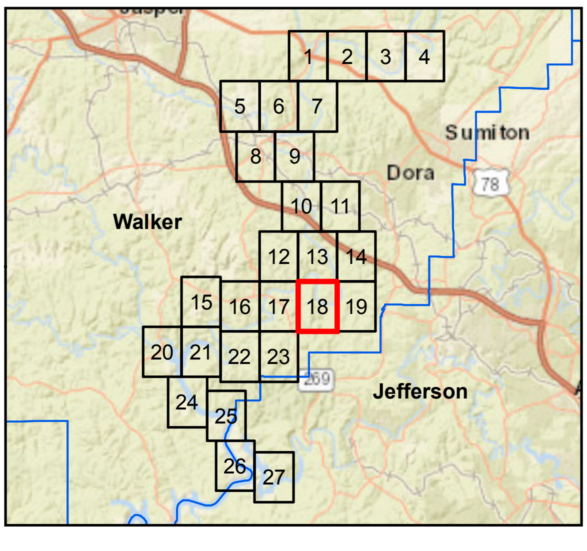

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

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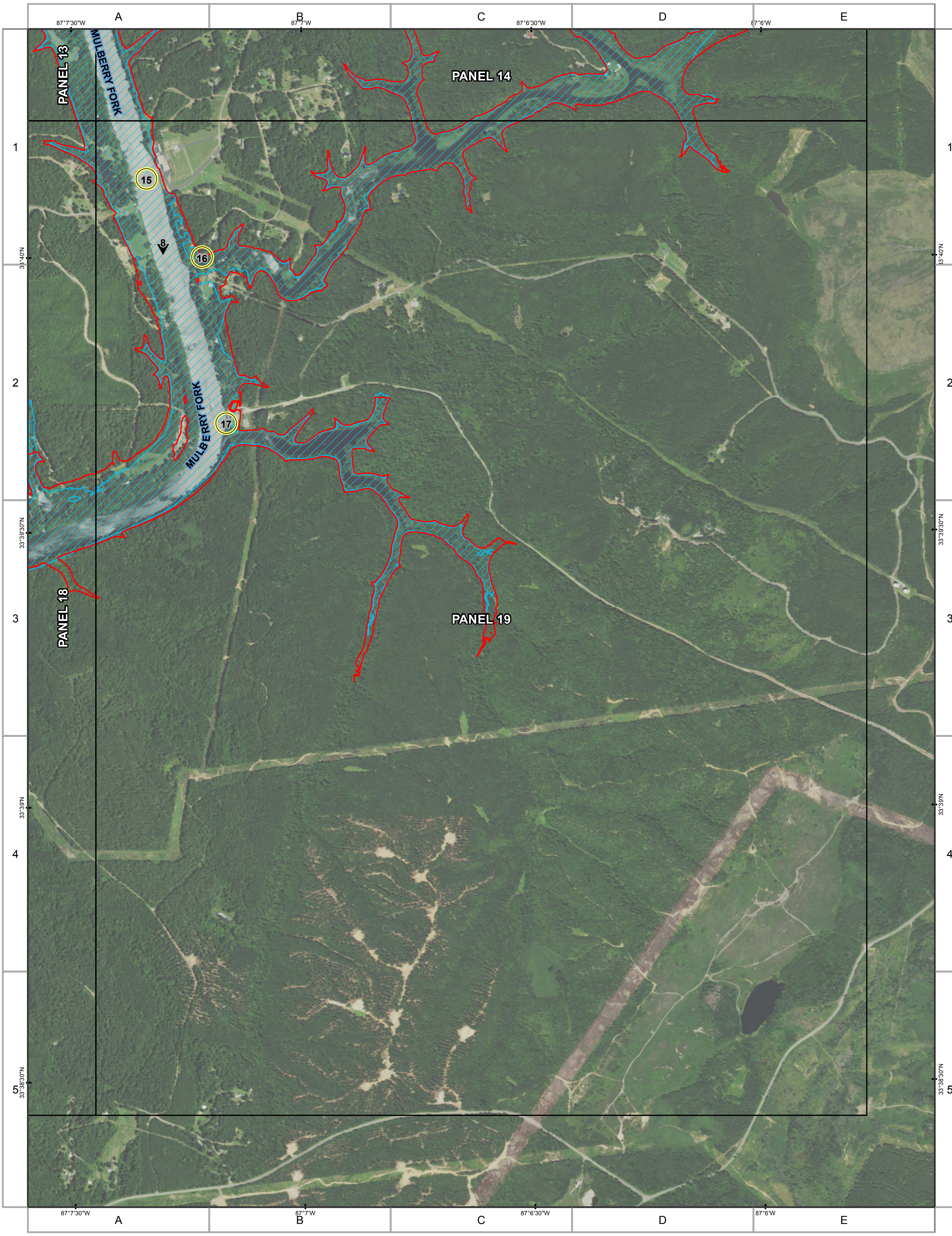

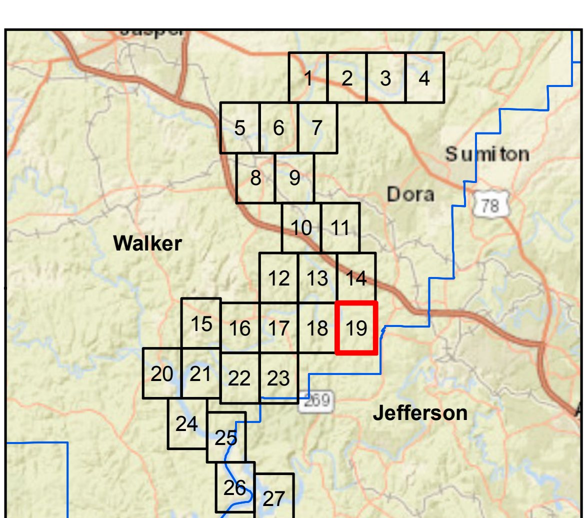

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

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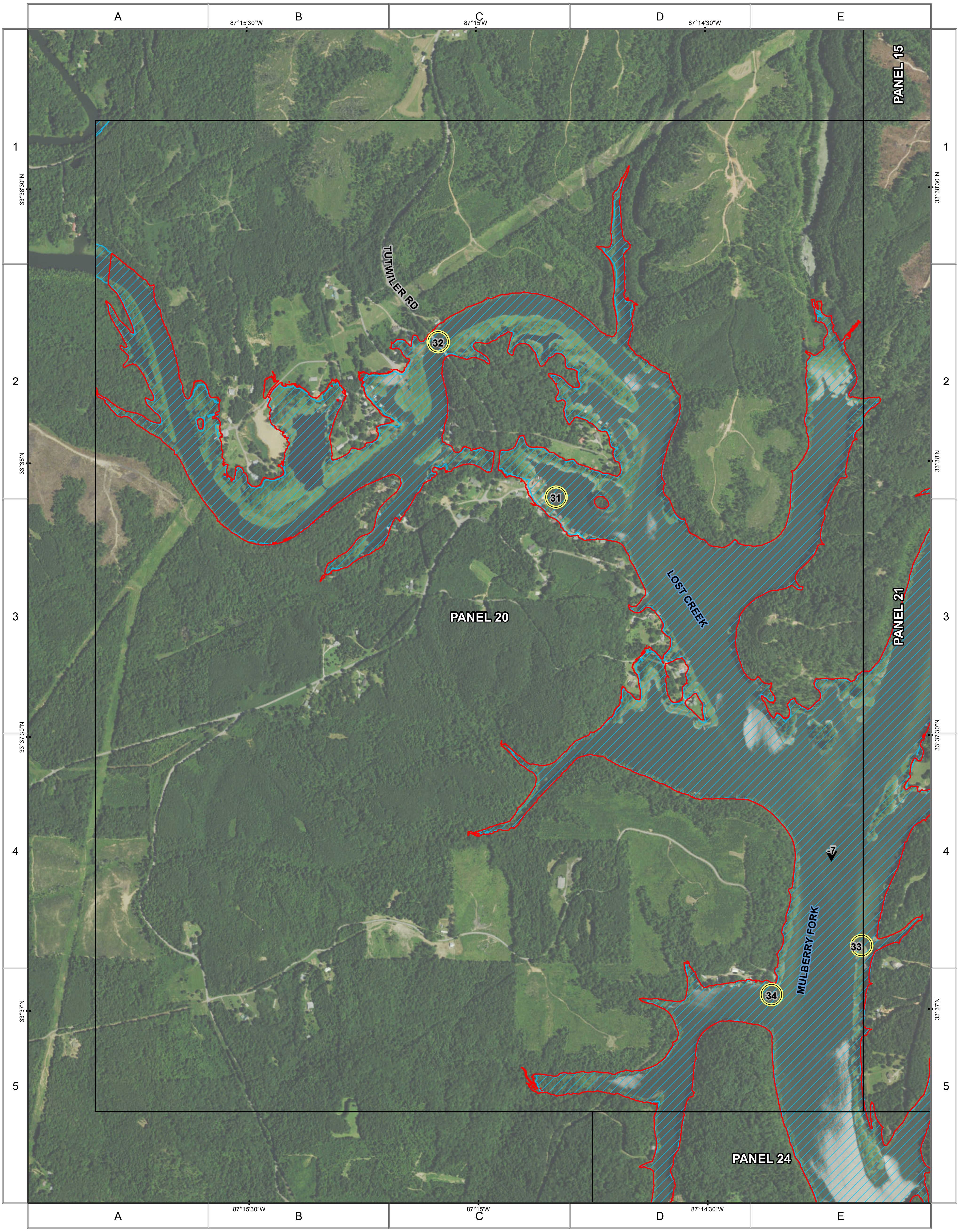

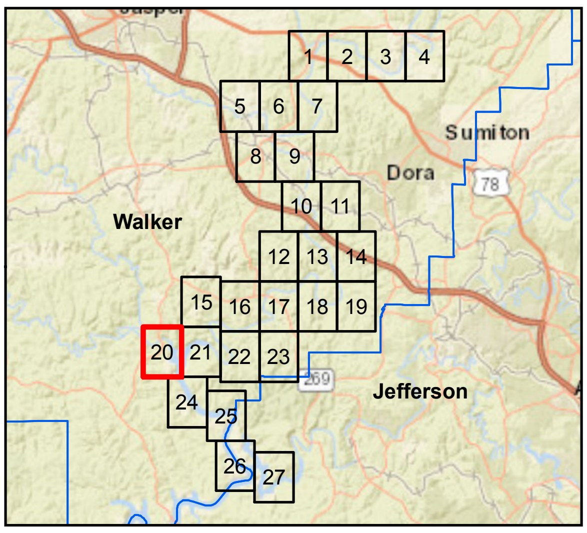

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

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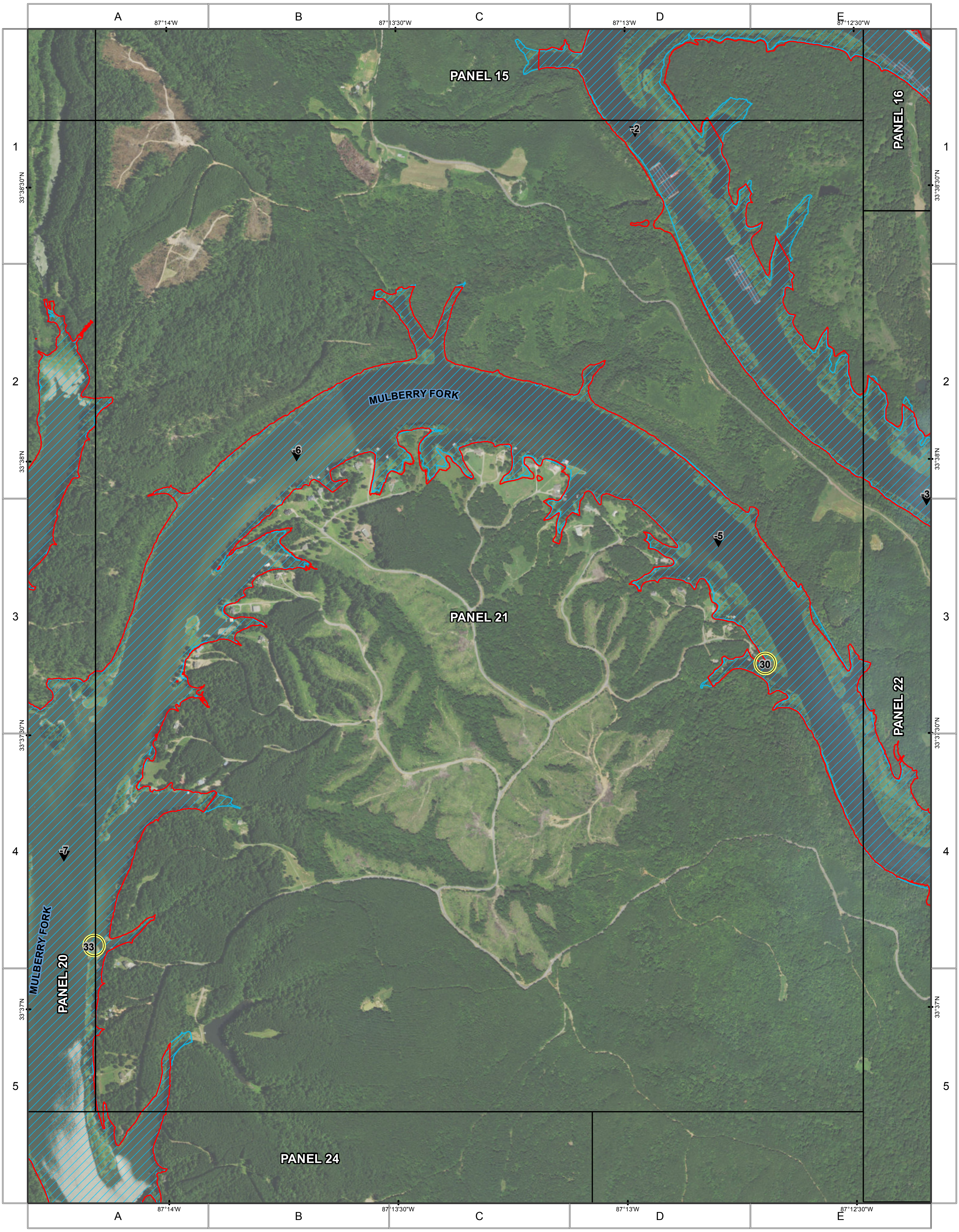

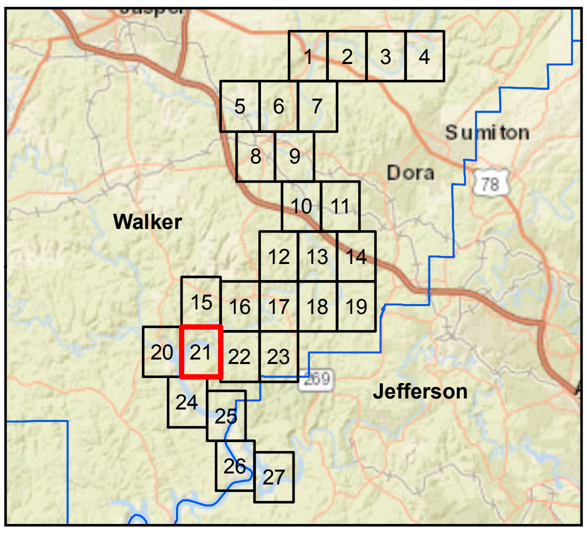

PLANT GORGAS

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1,000 500 0 1,000

Golder Associates

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

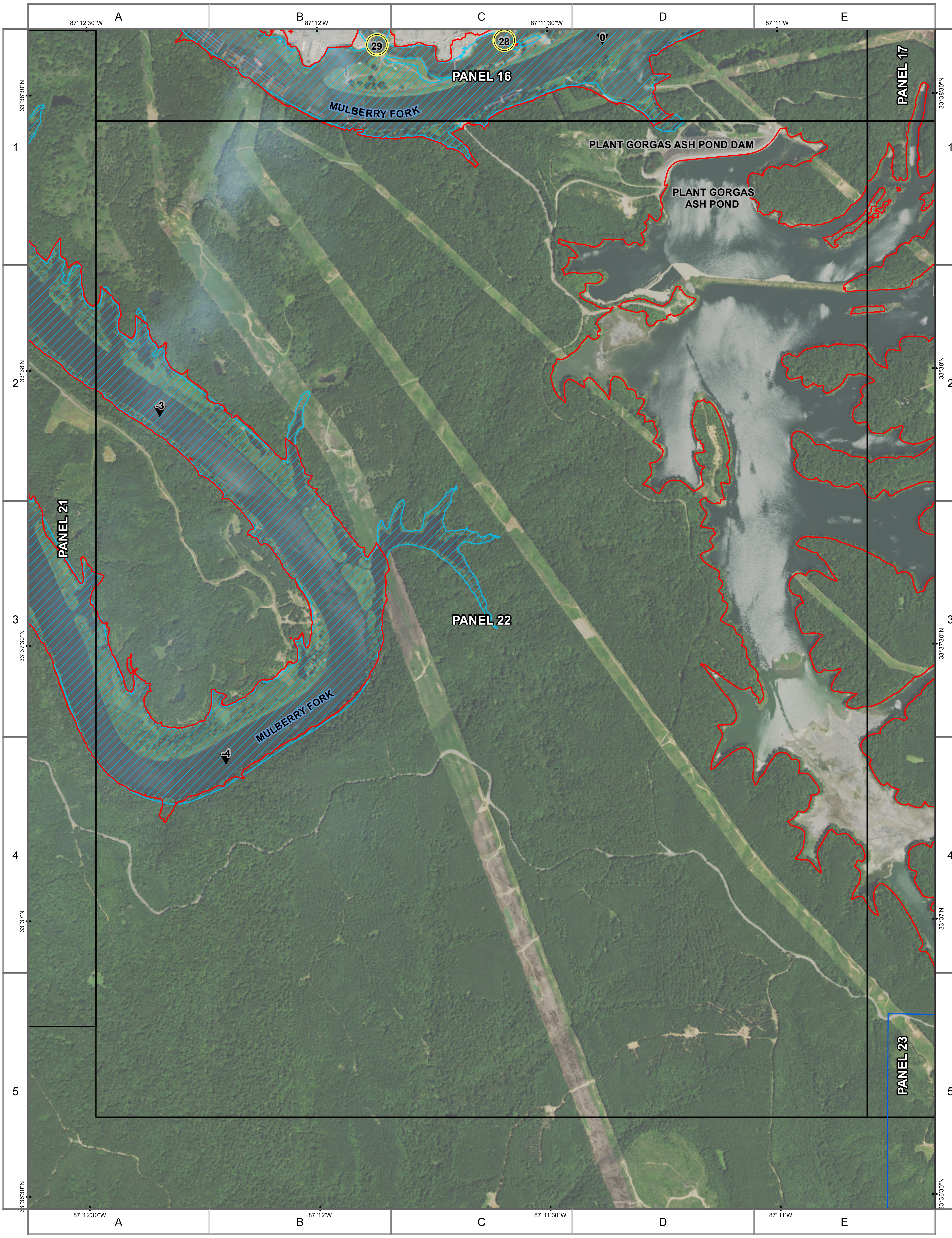
ISSUE DATE: 3/28/2017 PANEL 21 of 27

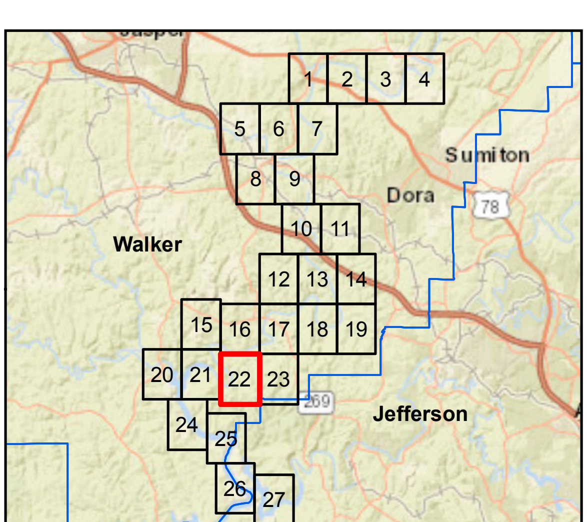
Notes

1. THIS MAP DEPICTS THE MAXIMUM WATER SURFACE ELEVATION FROM SUNNY DAY BREACHING OF THE PLANT GORGAS ASH POND DAM.
2. MAPPING OF FLOODED AREAS AND FLOOD WAVE TRAVEL TIMES ARE APPROXIMATE AND SHOULD BE USED AS GUIDANCE FOR ESTABLISHING EVACUATION ZONES.
3. ACTUAL AREAS INUNDATED WILL DEPEND ON FAILURE MODE AND PRE-FAILURE HYDROLOGIC CONDITIONS AND MAY DIFFER SIGNIFICANTLY FORM INFORMATION SHOWN ON THESE MAPS.

LEGEND

- PANEL
- SUNNY DAY BREACH
- WALKER COUNTY BOUNDARY
- FEMA ZONE A/AE 100 YEAR FLOODPLAIN
- 1 AREA OF INTEREST (ID NUMBER WITHIN)
- 1 MILES FROM BREACH (NEGATIVE DOWNSTREAM)





PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

Golder Associates

ISSUE DATE: 3/28/2017 PANEL 22 of 27

Notes

1. THIS MAP DEPICTS THE MAXIMUM WATER SURFACE ELEVATION FROM SUNNY DAY BREACHING OF THE PLANT GORGAS ASH POND DAM.
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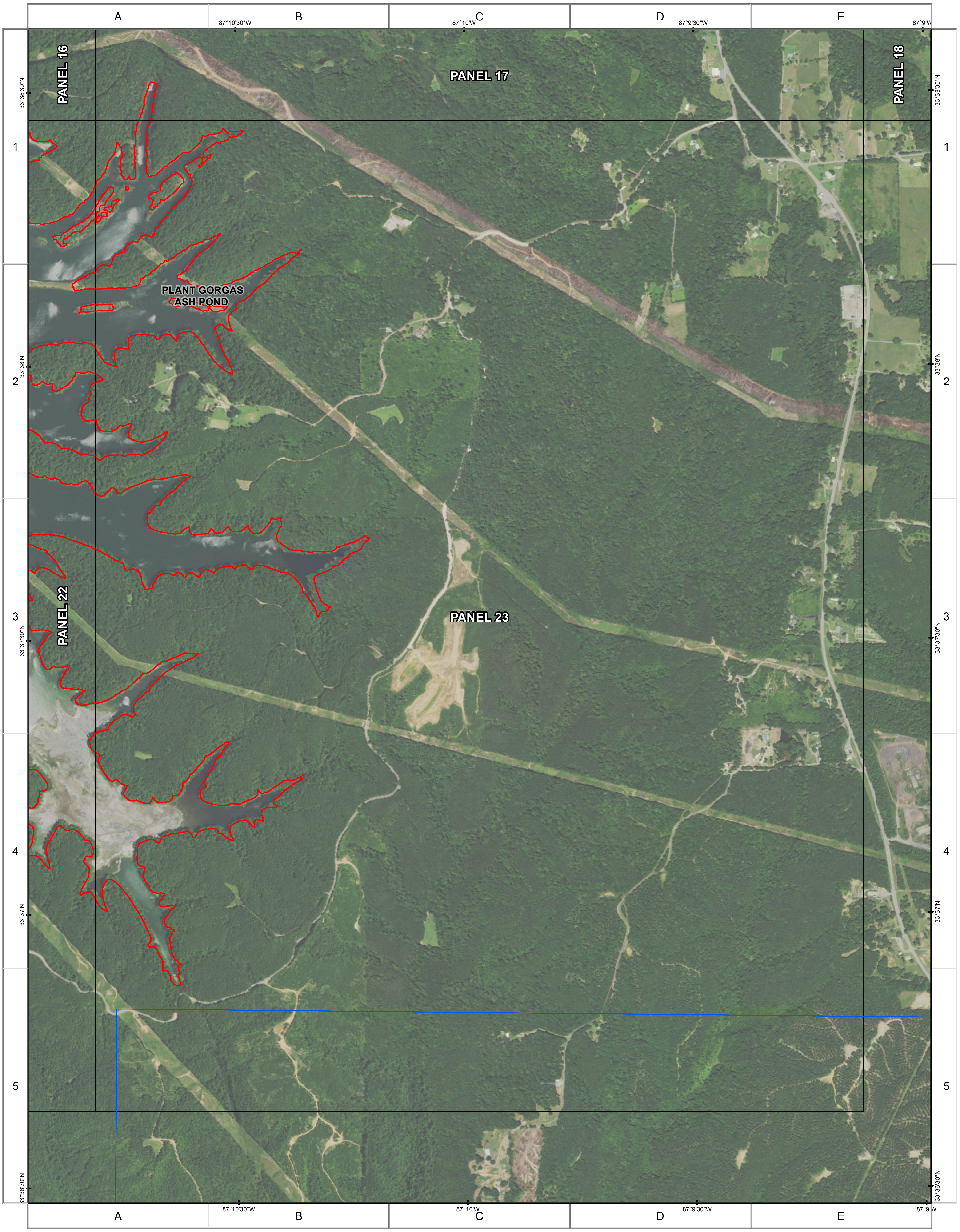
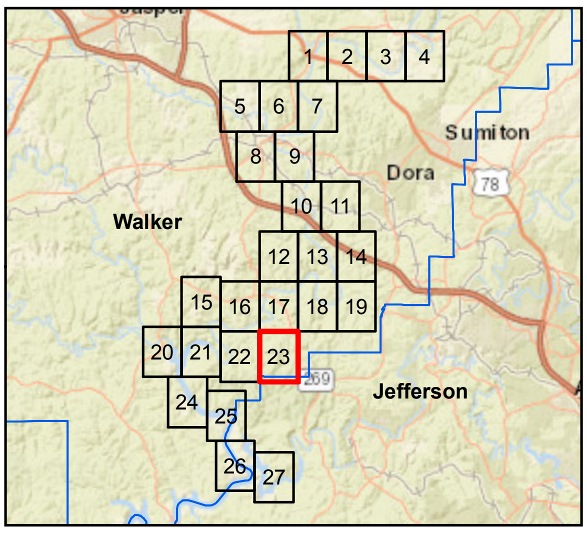
LEGEND

- PANEL
- SUNNY DAY BREACH
- WALKER COUNTY BOUNDARY
- FEMA ZONE A/AE 100 YEAR FLOODPLAIN
- AREA OF INTEREST (ID NUMBER WITHIN)
- MILES FROM BREACH (NEGATIVE DOWNSTREAM)





PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

N S W E

ISSUE DATE: 3/28/2017 PANEL 23 of 27

Notes

1. THIS MAP DEPICTS THE MAXIMUM WATER SURFACE ELEVATION FROM SUNNY DAY BREACHING OF THE PLANT GORGAS ASH POND DAM.
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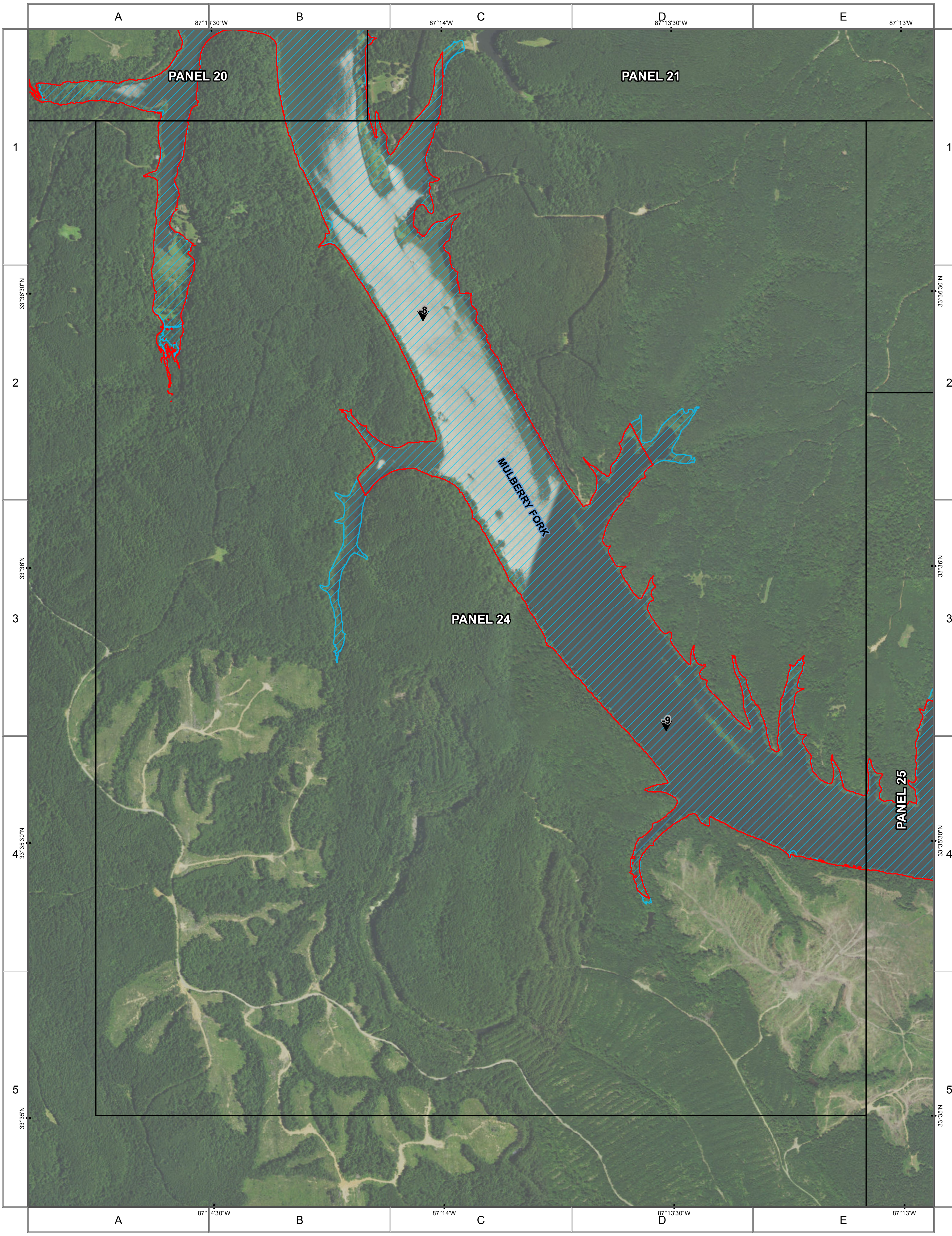
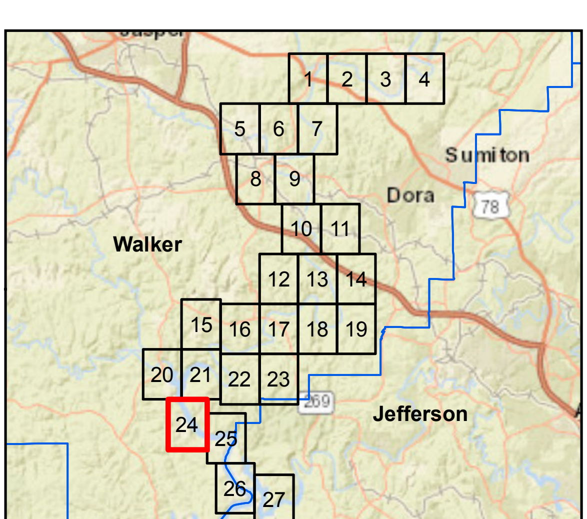
- WALKER COUNTY BOUNDARY
- FEMA ZONE A/AE 100 YEAR FLOODPLAIN
- AREA OF INTEREST (ID NUMBER WITHIN)
- MILES FROM BREACH (NEGATIVE DOWNSTREAM)





PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection

Transverse Mercator
NAD 1983 Alabama West
State Plane

ISSUE DATE: 3/28/2017 PANEL 24 of 27

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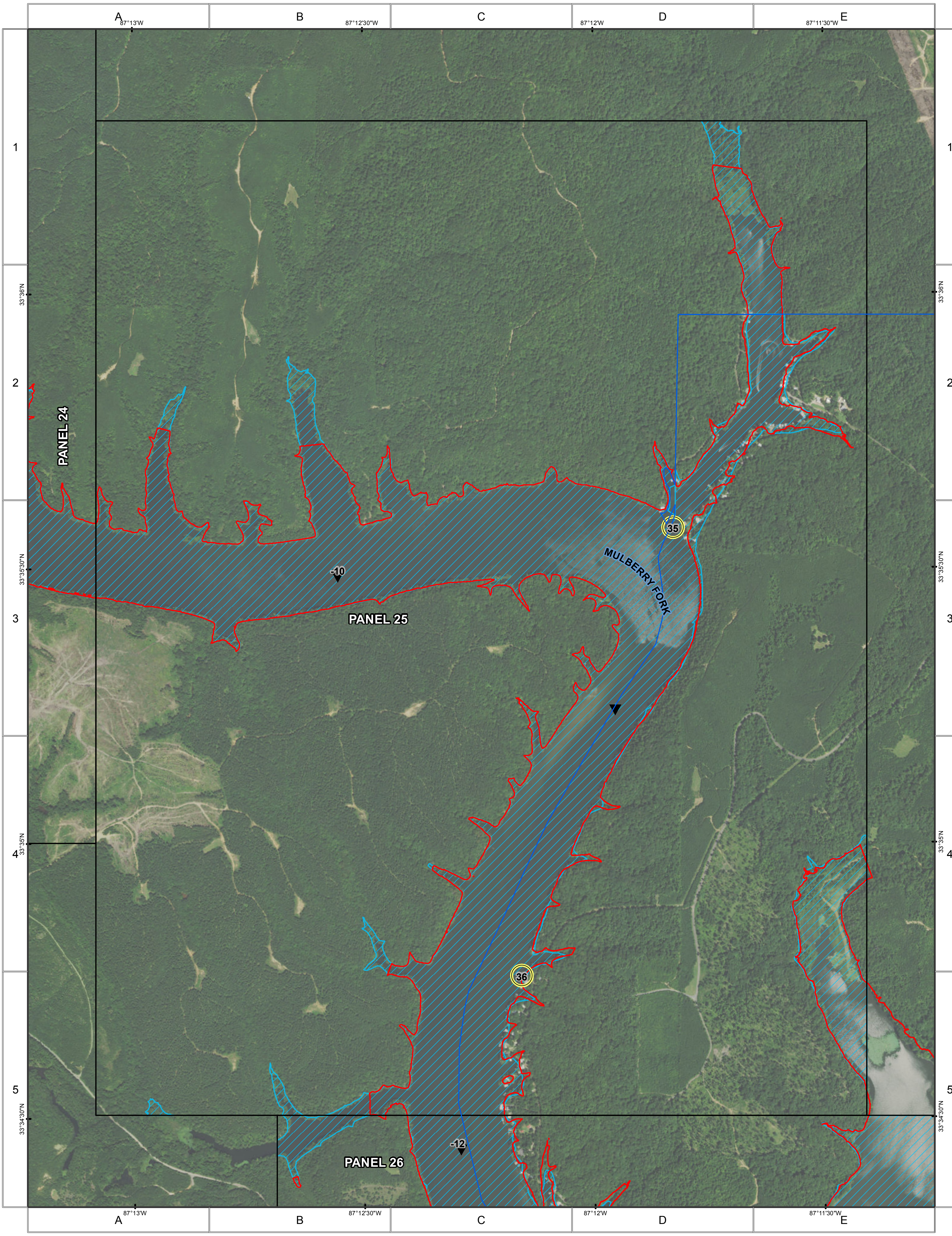
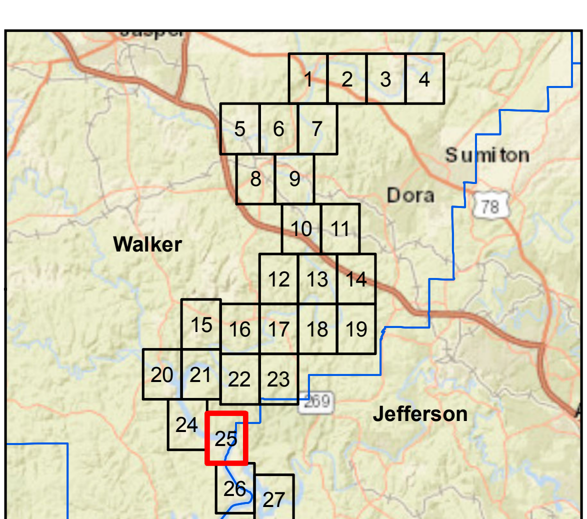
- FEMA ZONE A/AE 100 YEAR FLOODPLAIN
- AREA OF INTEREST (ID NUMBER WITHIN)
- MILES FROM BREACH (NEGATIVE DOWNSTREAM)





PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection
Transverse Mercator
NAD 1983 Alabama West
State Plane

Golder Associates

ISSUE DATE: 3/28/2017

PANEL 25 of 27

Notes

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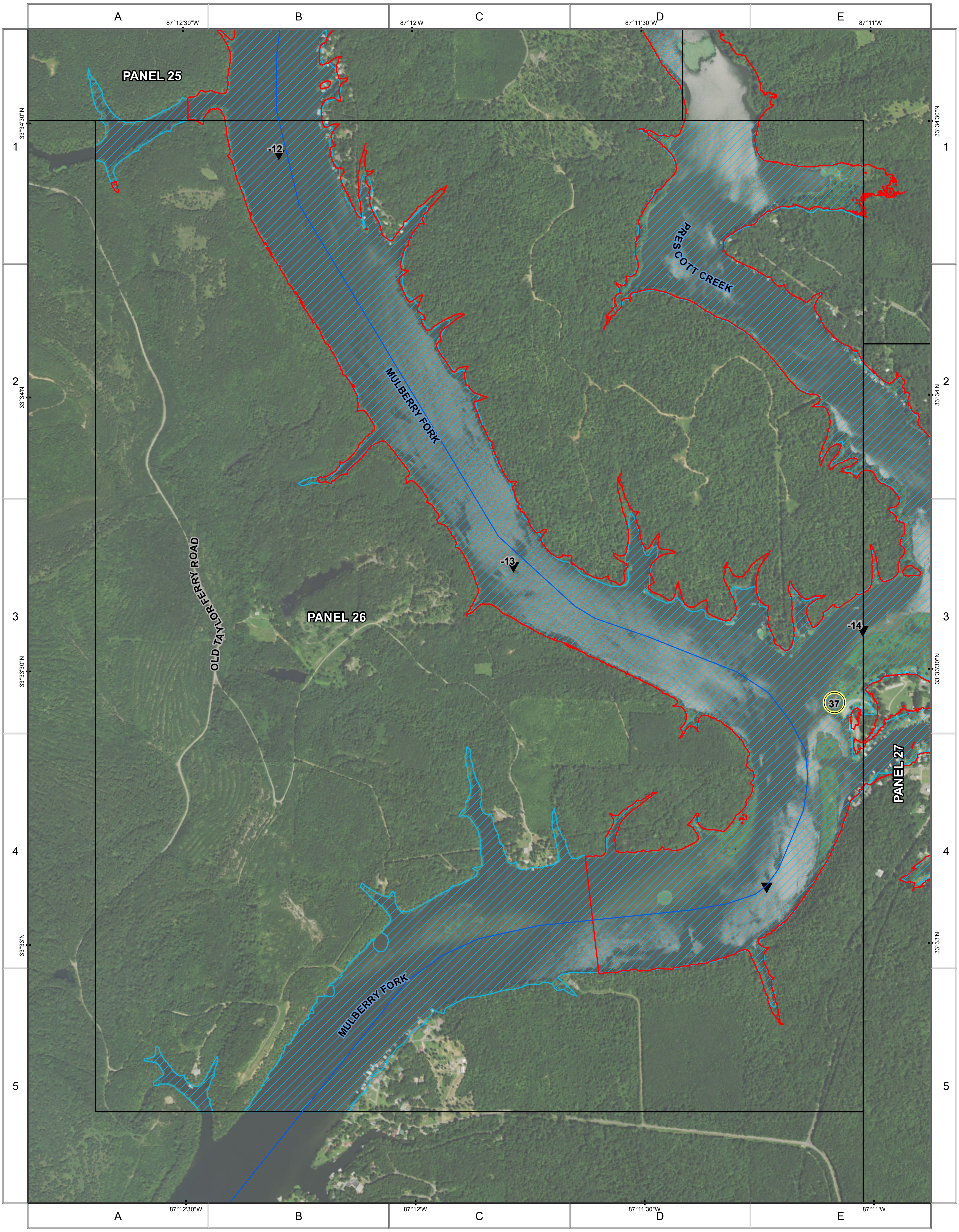
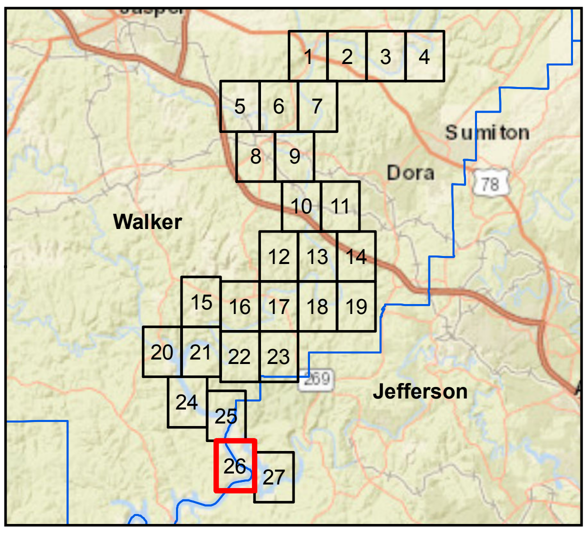
- AREA OF INTEREST (ID NUMBER WITHIN)
- MILES FROM BREACH (NEGATIVE DOWNSTREAM)





PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection
Transverse Mercator
NAD 1983 Alabama West
State Plane

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ISSUE DATE: 3/28/2017

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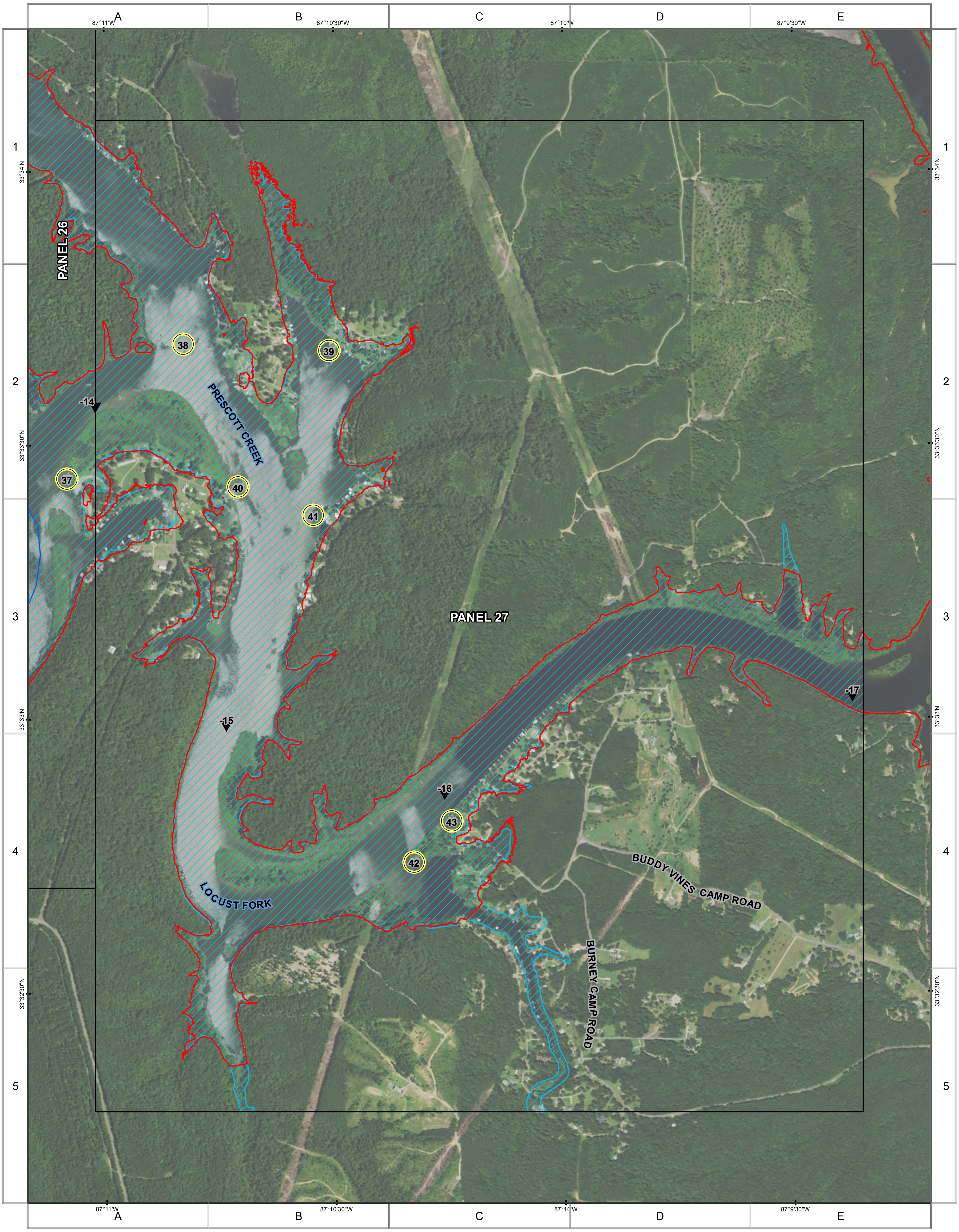

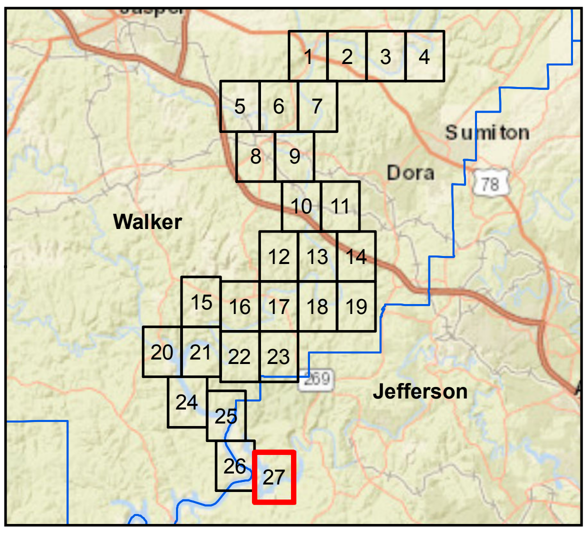

PLANT GORGAS

ASH POND DAM BREACH ANALYSIS

WALKER COUNTY, AL

1,000 500 0 1,000

Projection
Transverse Mercator
NAD 1983 Alabama West
State Plane

Golder Associates

ISSUE DATE: 3/28/2017

PANEL 27 of 27

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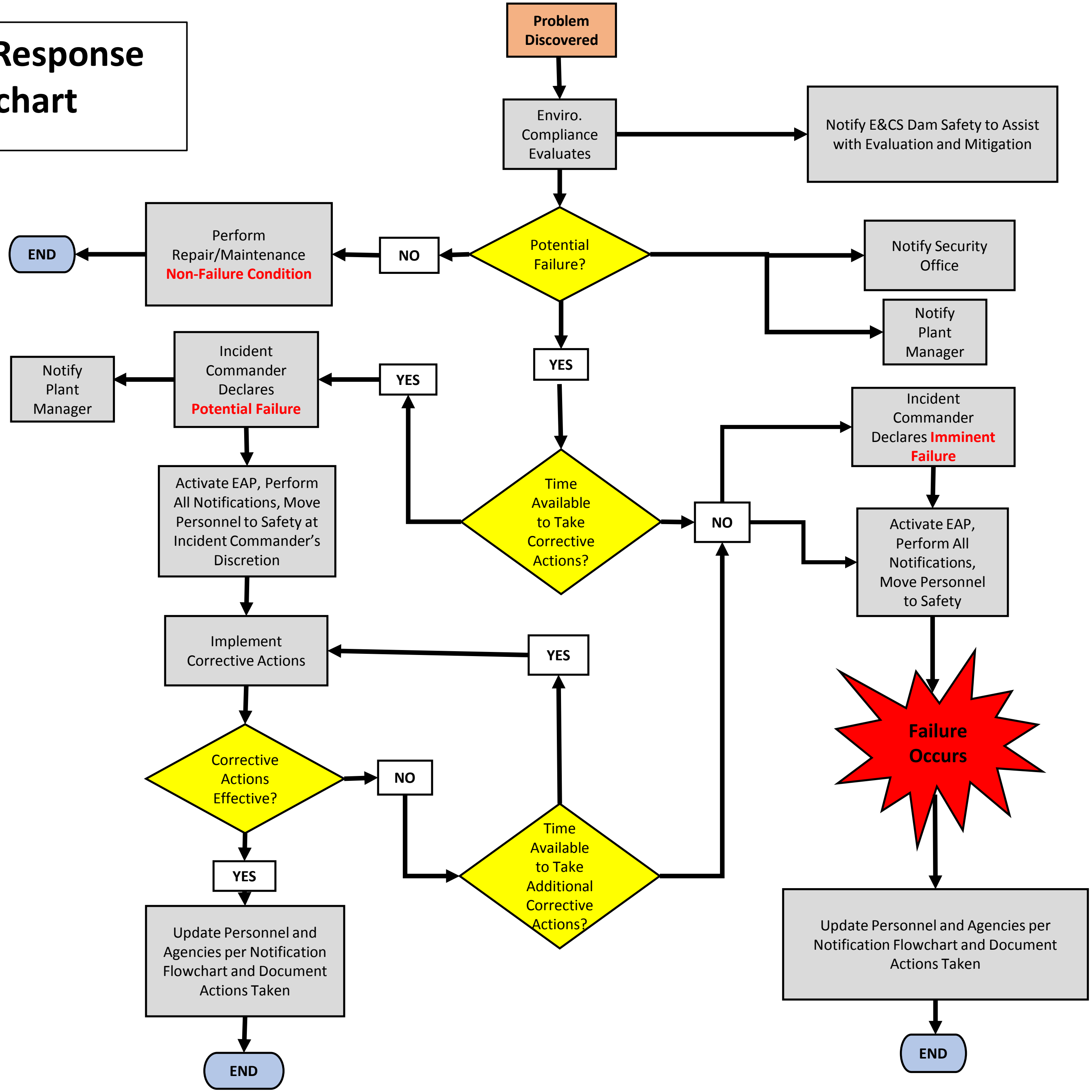
- WALKER COUNTY BOUNDARY
- FEMA ZONE A/AE 100 YEAR FLOODPLAIN
- AREA OF INTEREST (ID NUMBER WITHIN)
- MILES FROM BREACH (NEGATIVE DOWNSTREAM)

APPENDIX C

Incident Response Flowchart

Incident Response Flowchart

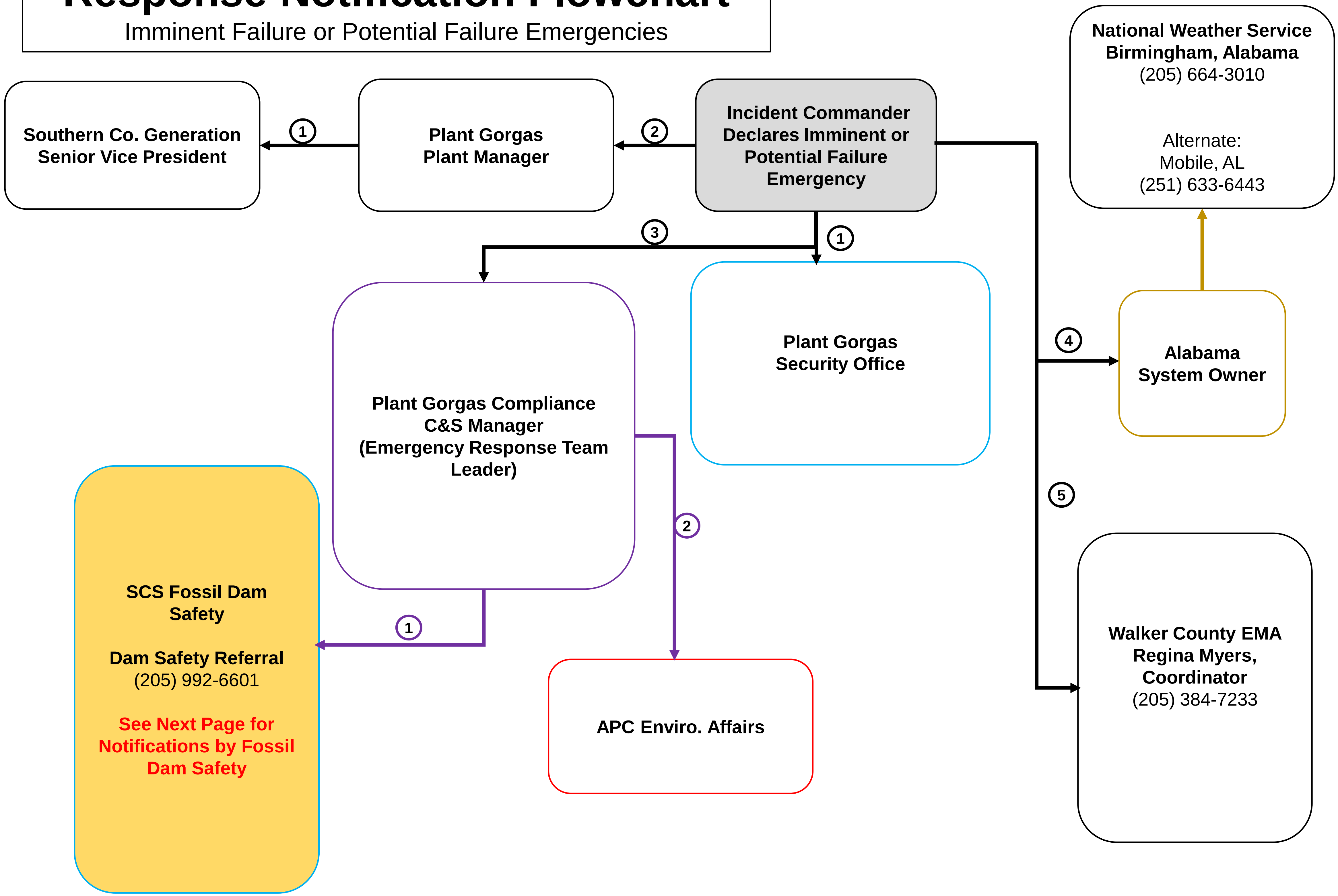


APPENDIX D

Response Notification Flowchart

Response Notification Flowchart

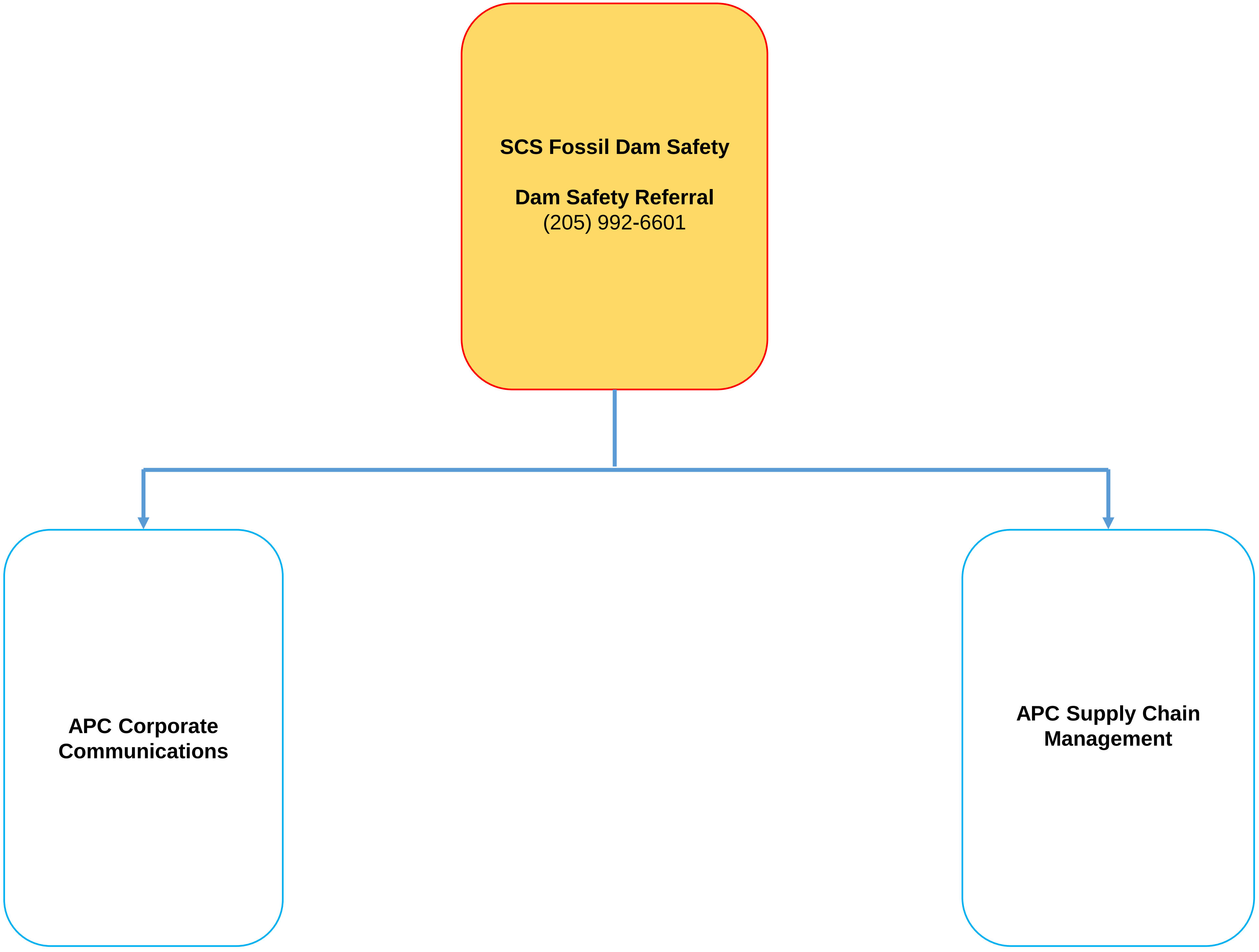
Imminent Failure or Potential Failure Emergencies



Response Notification Flowchart

Imminent Failure or Potential Failure Emergencies

Fossil Dam Safety Notifications



Emergency Responders Contact Information

If a Condition A Emergency has occurred call 911

1) Parrish Police Department – 1-205-686-9991
2) Parrish Fire and Rescue – 1-205-686-5762
3) Walker County Sheriff's Office – 1-205-302-6464
4) Walker County Emergency Management Agency – 1-205-384-7233
5) Alabama Emergency Management Agency – 1-205-280-2200
6) National Weather Service
    a. Birmingham Office – 1-205-664-3010
    b. Mobile Office – 1-251-633-6443

APPENDIX E

Data Recording Sheet

EMERGENCY ACTION PLAN
DATA RECORDING SHEET

The Data Recording Sheet will be used to record important information relating to dam safety emergency.

Team Member(s): ______________________________

Date of Incident: ______________________________

Time of Incident: ______________________________

Type of Emergency: ______________________________

Emergency Coordinator: ______________________________

Description of Events:* ______________________________

____

____

____

____

What is Being Done:* ______________________________

____

____

____

____

*Attach additional pages as necessary.

For incoming questions, refer all calls to:

Media Inquiries:	Alabama Power Company Corporate Communications
EMA Inquiries:	Plant Manager/Incident Commander
Environmental Agency Inquiries:	APC Environmental Affairs

APPENDIX 4

HISTORY OF CONSTRUCTION DOCUMENTS

UPDATED HISTORY OF CONSTRUCTION FOR EXISTING CCR SURFACE IMPOUNDMENT
PLANT GORGAS ASH POND

(i) Site Name and Ownership Information:

Site Name:	William C. Gorgas Electric Generating Plant
Site Location:	Parrish, Alabama
Site Address:	460 Gorgas Rd. Parrish, Alabama 36512
Owner:	Alabama Power Company
Address:	600 North 18th Street Birmingham, AL 35203

CCR Impoundment Name:	Plant Gorgas Ash Pond
NID ID:	AL01662

ADEM's rules governing coal combustion residuals require the owner or operator of an existing CCR surface impoundment to compile a history of construction. *See* ADEM Admin. Code r. 335-15-.04(4)(c)1. To the extent feasible, the following information is provided:

(ii) Location of CCR Unit:

33.655691, -87.217915
See Location Map in the Appendix

(iii) Purpose of CCR Impoundment:

The William C. Gorgas Electric Generating Plant is a 3-unit electric generating facility, all of which are coal-fired units. The Plant Gorgas Ash Pond is designed to receive and store coal combustion residuals produced during the electric generating process at Plant Gorgas, as well as serve as a low-volume waste treatment pond. CCR products are sluiced from the plant to the Ash Pond.

(iv) Watershed Description:

Plant Gorgas is located within the Baker Creek-Mulberry Fork HUC 12 watershed which has a total area of 37,044 acres. The Baker Creek-Mulberry Fork Watershed is located within the Mulberry HUC 8 watershed which has a drainage area of 878,212 acres. Approximately 1,302 acres of the surrounding watershed flow into the Ash Pond.

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

The Plant Gorgas Ash Pond is located within the Warrior Basin physiographic region of the Cumberland Plateau and is a subsection of the Appalachian Plateaus physiographic province. The Warrior Basin consists of a broad upland with moderate relief, and is formed on gently dipping strata of the Pottsville Formation. The upper reaches of the surface geology are dominated by the Pratt Coal Group and the Cobb Coal Group consisting of shale, siltstone, sandstone, and coal seams. Borings taken in the area suggest that only a thin layer of soil (5 to 20 feet) is present above the Pottsville Formation. The Plant Gorgas Ash Pond is founded on the major soil types present above the rock formations, including clays, silty and clayey sands and decomposed rock.

(vi) Summary of Site Preparation and Construction Activities:

The Ash Pond is formed by a cross-valley dam which was originally constructed as a rockfill structure across Rattlesnake Creek in 1953 using local borrow and quarried materials. The crest elevation of the original dam was 320 feet. In the mid-1970’s, the dam was raised to an elevation of 375 feet. During this construction, a relatively impervious blanket was constructed on the upstream face of the original dam. In addition to the blanket, additional rockfill was added on both the upstream and downstream sides of the dam, as well as the inclusion of a relatively impervious core and filter zone near the interior of the dike raise.

In 2007, the dam was raised to an elevation of 395 feet. During this project, a 10-foot wide roller-compacted concrete upstream facing block designed with a slope of 0.75H:1V; a 30-foot thick clay core section; a 10-foot thick fine and coarse filter section; and additional downstream rockfill were used to accommodate the raising of the dam. The original weir flow intake structure was removed and a new overflow structure of comparable design was constructed near the east abutment. Also, an auxiliary spillway was added at an elevation of 385 feet. During the 2007 augmentation, a diversion dike was added within the ash pond for water management purposes. It is near the midpoint of the surface impoundment, and extends from the east side of the pond to a point very close to the west bank.

(vii) Engineering Diagram:

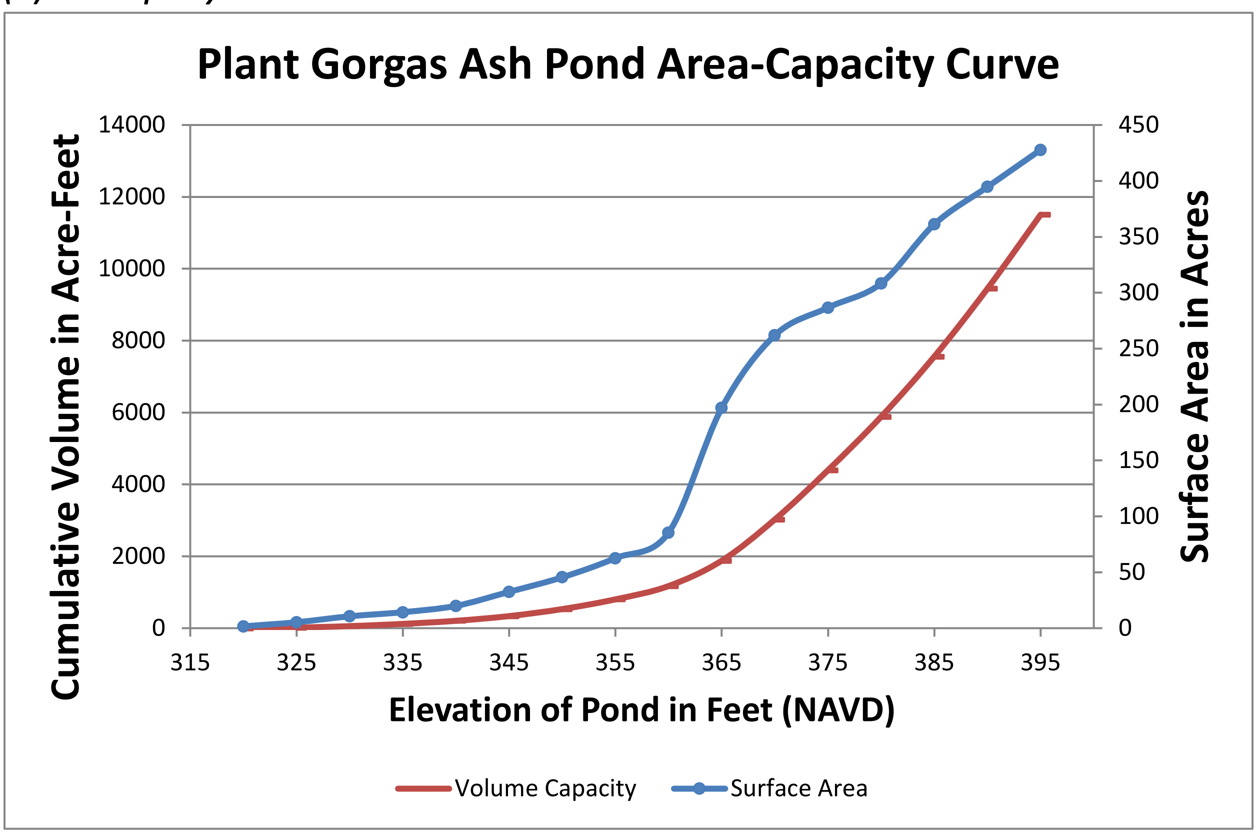
The following drawings reflecting the construction of the Plant Gorgas Ash Pond can be found in the Appendix:

- 1953 - Original Rockfill Dam Design Section
- 2007 - Preconstruction Site Plan
- 2007 - General Arrangement and Site Plan
- 2007 - Sections and Details
- 2007 - New Discharge Structure General Layout, Plan and Sections
- 2007 - New Discharge Structure Plan and Sections
- 2007 - New Discharge Pipe Plans, Sections and Details

(viii) Description of Instrumentation:

There are six vertical deformation monuments, placed at equal spacing, present across the crest of the dam that serve as the only instrumentation at the facility. These monuments are utilized to track vertical and horizontal displacement along the top of the embankment.

(ix) Area-capacity curves:



(x) Spillway/Diversion design features and capacity calculations:

The primary spillway (constructed in 2007) is a concrete overflow weir structure discharging to a 48-inch diameter corrugated metal pipe. A two-bay concrete spillway structure serves as an auxiliary spillway structure. The spillways are designed, constructed operated and maintained to adequately manage flow during and following the peak discharge from the Probable Maximum Flood (PMF) storm event. Normal pool elevation was calculated to be EL 382-ft and the maximum pool elevation utilizing the 6-hour, PMF design storm hydrograph was EL 389.7-ft, or 5.3 feet below top of dam. Normal flow of the Ash Pond is controlled by the primary spillway. This spillway is capable of carrying 384.2 cubic feet per second (cfs) at a maximum pool elevation of 395.0 feet. The auxiliary spillway would carry 1,100 cfs.

(xi) Provisions for surveillance, maintenance and repair:

Inspections of dams and dikes are critical components and are conducted on a regular basis—at least annually by professional dam safety engineers and at a minimum interval of every seven days by qualified persons at the plant. In addition, inspections are performed after unusual events such as storms. The inspections provide assurance that structures are sound and that action is taken, as needed, based on the findings. Specific items addressed during the inspections include observations of 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 the posting of emergency notification information is up to date and evaluate any items noted during plant personnel inspections.

Construction Specifications:

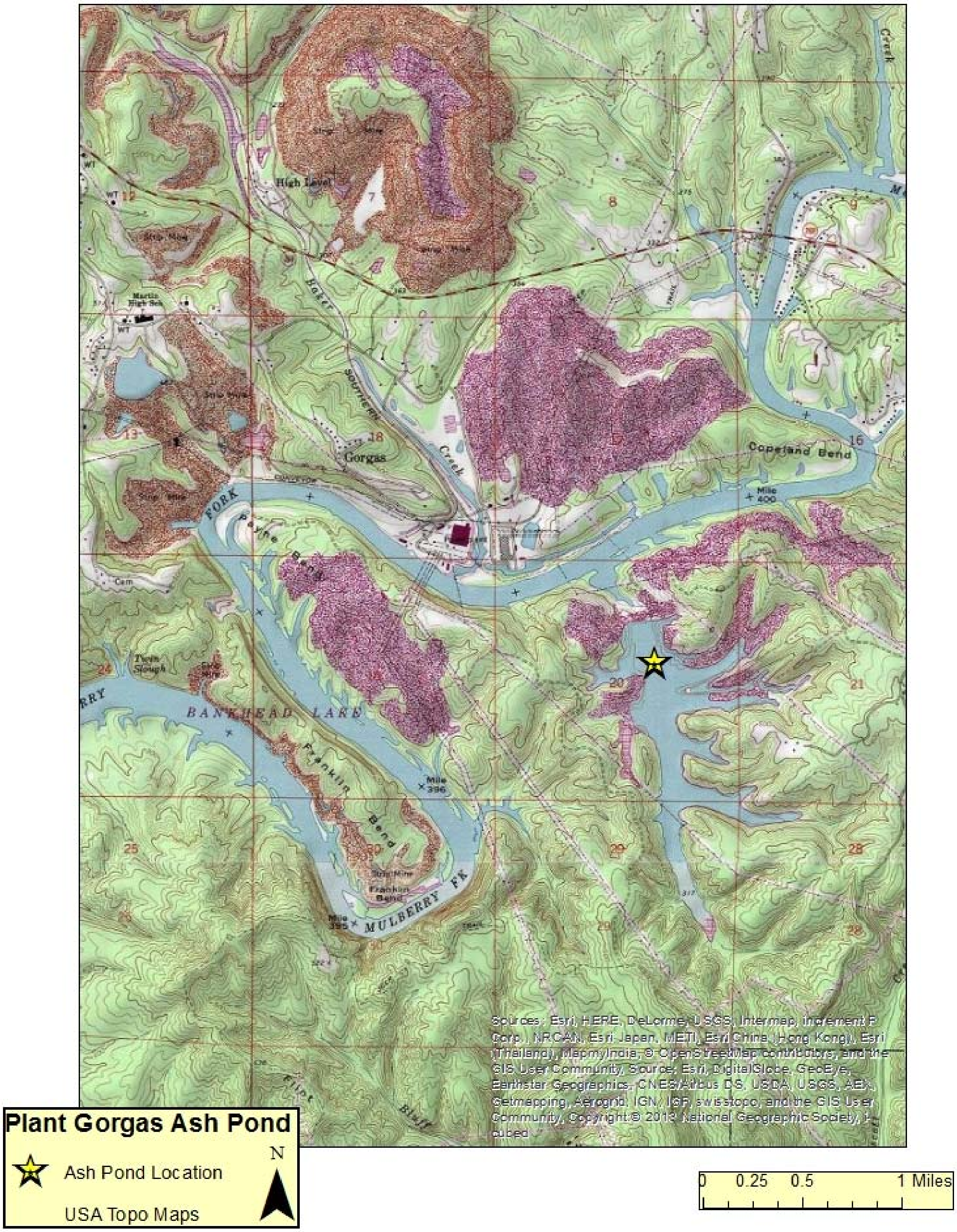
The following specifications relevant to the construction of the Plant Gorgas Ash Pond can be found in the Appendix:

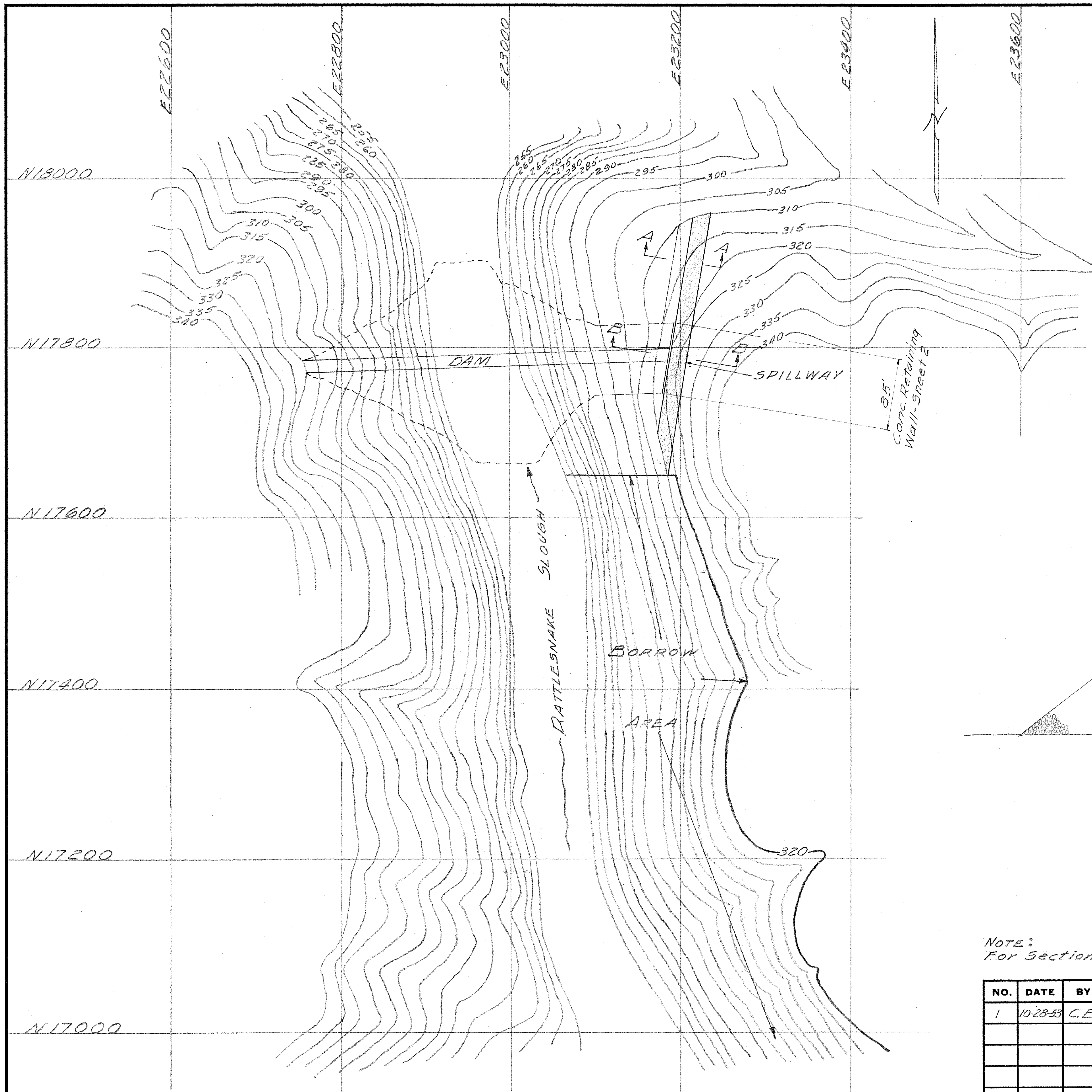
- 2007 Technical Specifications for RCC Crest Raise
- 2007 Crest Raise Notes and Specifications

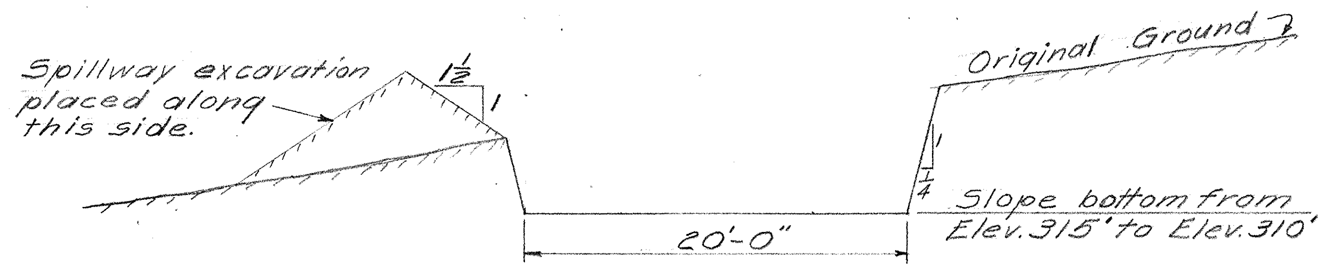
(xii) Known record of structural instability:

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

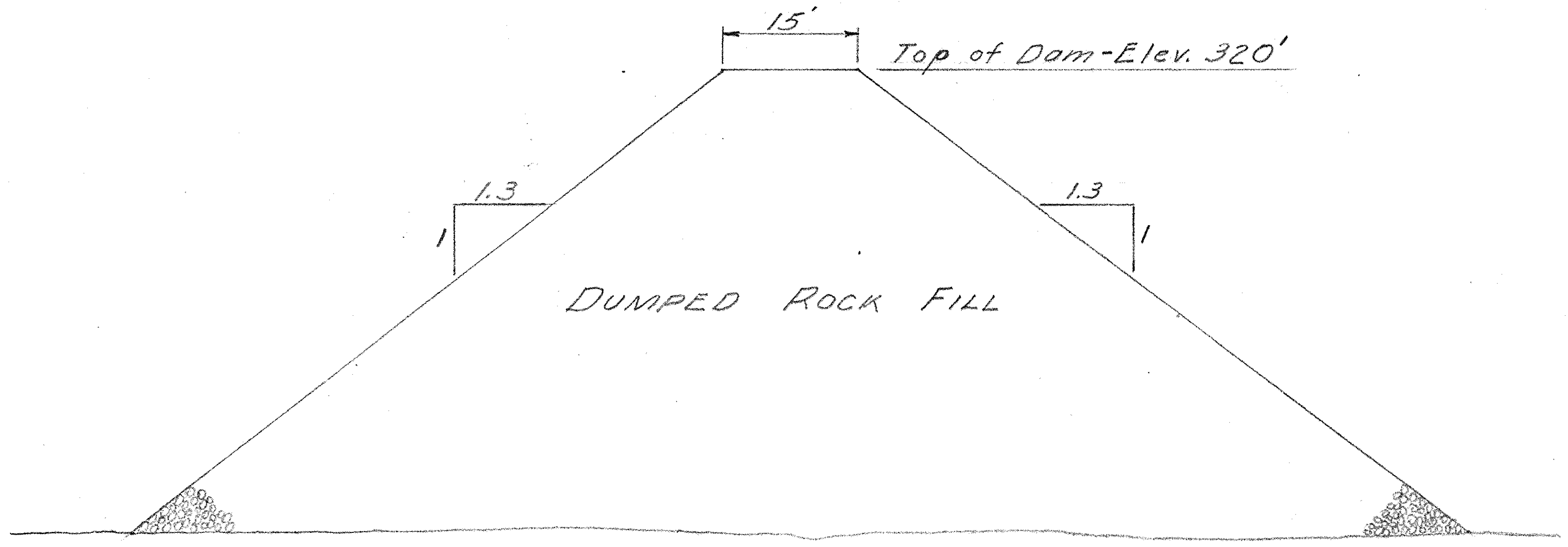
Appendix


Plant Gorgas Ash Pond
Ash Pond Location
USA Topo Maps
N
0 0.25 0.5 1 Miles
High Level
Gorgas
Copeland Bend
Mile 400
FORK
Payne Bend
BANKHEAD LAKE
Franklin
Bend
Mile 396
Mile 395
MULBERRY FK
Twin Slough
Strip Mine
Sources: Esri, HERE, DeLorme, USGS, Intermap, Increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Copyright:© 2013 National Geographic Society, i-cubed





SECTION A-A
SPILLWAY DETAILS
Scale: 1"=10'



TYPICAL FILL SECTION
SCALE: 1"=20'

NOTE:
For Section B-B see sheet 2.

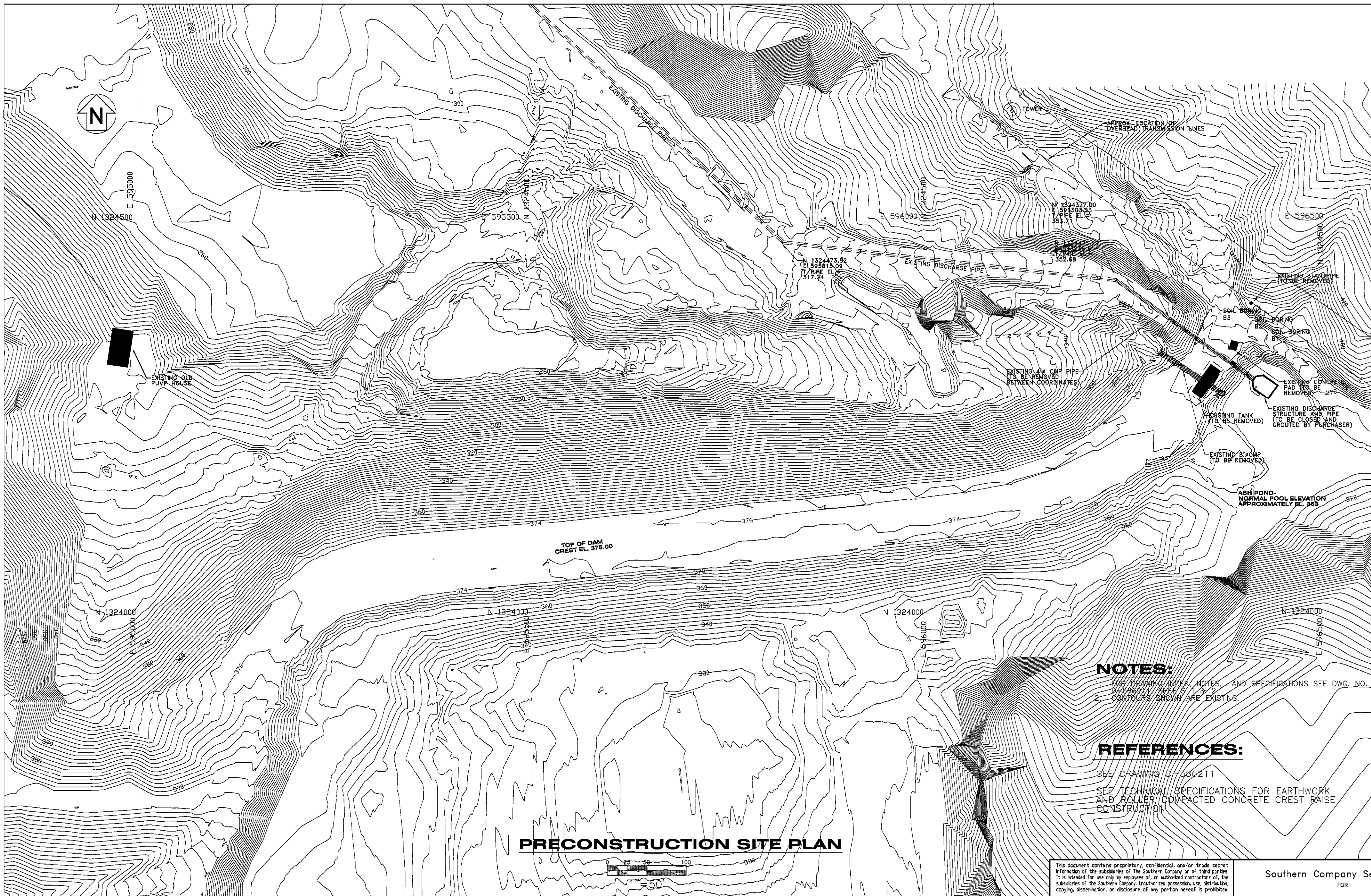
NO.	DATE	BY	REVISION
1	10-28-53	C.B.	Relocate spillway.

ALABAMA POWER COMPANY

SUBJECT GORGAS ASH DISPOSAL POND
DETAIL RATTLESNAKE HOLLOW SITE
ROCK FILL DAM
DRAWN C.B. TRACED
CHECKED DATE AUGUST 19, 1953
APPROVED DATE
APPROVED DATE
SCALE AS SHOWN
SHEET 1 OF 2 SHEETS
SUPERSEDES
B/M

F-97854

K+E ALBANENE 195M TRACING PAPER



NOTES:

1. FOR DRAWING INDEX, NOTES, AND SPECIFICATIONS SEE DWG. NO. D-586211, SHEETS 1 & 2.
2. CONTOURS SHOWN ARE EXISTING.

REFERENCES:

SEE DRAWING D-586211

SEE TECHNICAL SPECIFICATIONS FOR EARTHWORK AND ROLLER COMPACTED CONCRETE CREST RAISE CONSTRUCTION

Southern Company Services, Inc.
FOR
Alabama Power Company

PLANT GORGAS
CREST RAISE OF RATTLESNAKE
HOLLOW ASH POND
PRECONSTRUCTION SITE PLAN

REVISION	DATE	REVISION A	DATE 7-21-06
		ISSUED FOR INQUIRY	JOB NO. 2101FS

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR	SCALE	PROJ I.D.	DRAWING NUMBER	SH	CONT'D	REV
							JWM	PMG JCP	JBS				CKT	1"=50'		**D-586213**	1	FINAL	A

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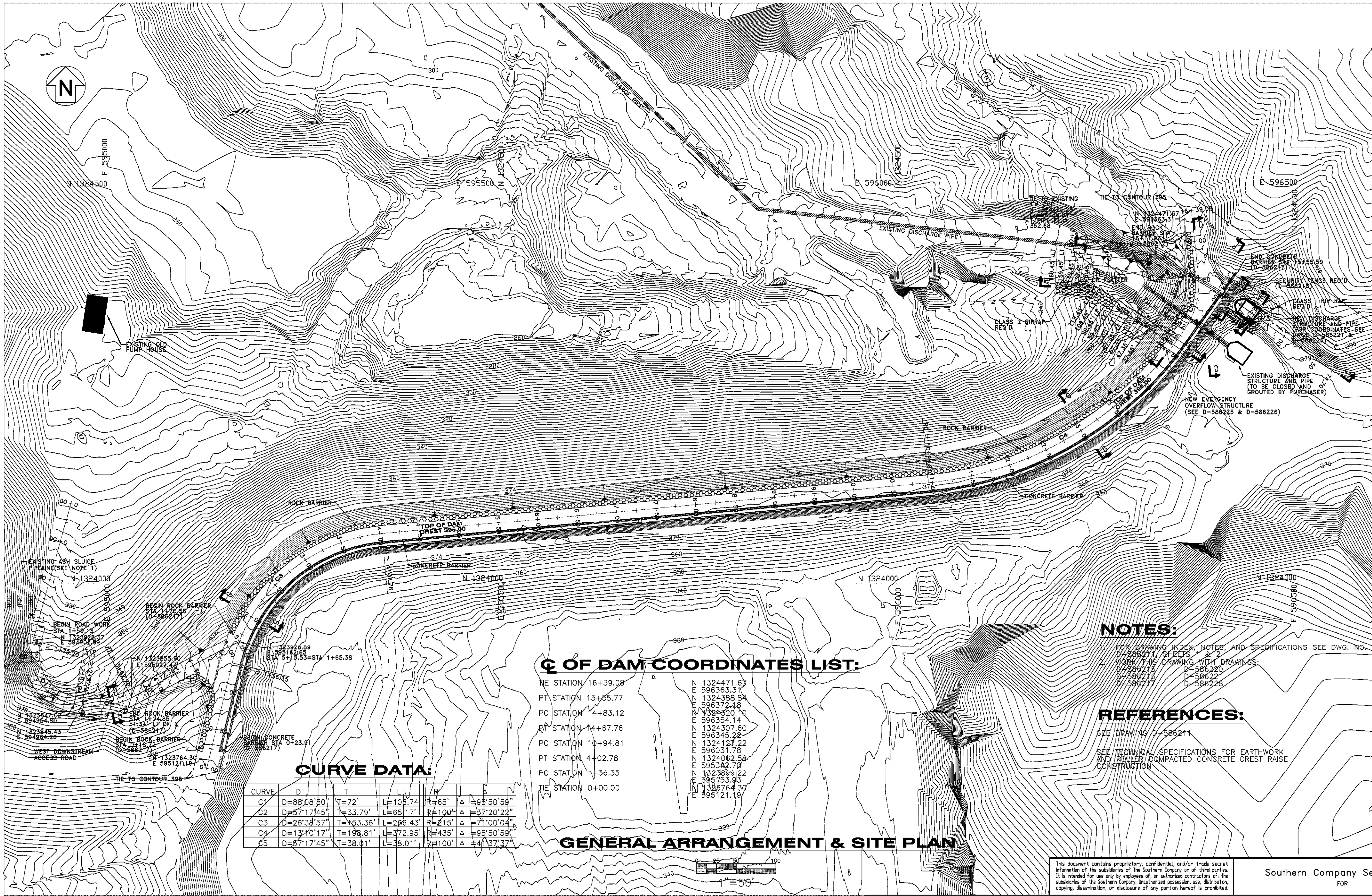


℄ OF DAM COORDINATES LIST:

TIE STATION 16+39.08	N 1324471.67 E 596363.31
PT STATION 15+55.77	N 1324388.84 E 596372.18
PC STATION 14+83.12	N 1324320.10 E 596354.14
PT STATION 14+67.76	N 1324307.60 E 596345.22
PC STATION 10+94.81	N 1324127.22 E 596031.78
PT STATION 4+02.78	N 1324062.58 E 595342.78
PC STATION 1+36.35	N 1323899.22 E 595153.93
TIE STATION 0+00.00	N 1323764.30 E 595121.19

CURVE DATA:

CURVE	D	T	L	R	Δ
C1	D=88°08'50"	T=72'	L=108.74'	R=65'	Δ =95°50'59"
C2	D=57°17'45"	T=33.79'	L=65.17'	R=100'	Δ =37°20'22"
C3	D=26°38'57"	T=153.36'	L=266.43'	R=215'	Δ =71°00'04"
C4	D=13°10'17"	T=198.81'	L=372.95'	R=435'	Δ =95°50'59"
C5	D=57°17'45"	T=38.01'	L=38.01'	R=100'	Δ =41°37'37"

NOTES:

1. FOR DRAWING INDEX, NOTES, AND SPECIFICATIONS SEE DWG. NO. D-586211, SHEETS 1 & 2.
2. WORK THIS DRAWING WITH DRAWINGS:
   D-586215 D-586220
   D-586216 D-586221
   D-586217 D-586228

REFERENCES:

SEE DRAWING D-586211

SEE TECHNICAL SPECIFICATIONS FOR EARTHWORK AND ROLLER COMPACTED CONCRETE CREST RAISE CONSTRUCTION

GENERAL ARRANGEMENT & SITE PLAN

1"=50'

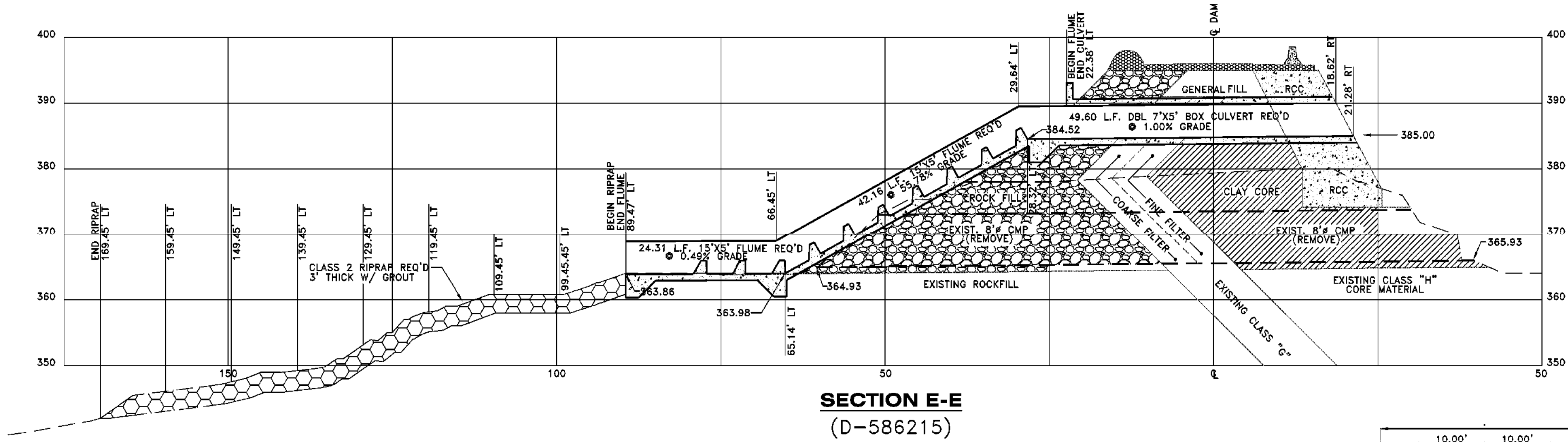
Southern Company Services, Inc.
FOR
Alabama Power Company

PLANT GORGAS
CREST RAISE OF RATTLESNAKE
HOLLOW ASH POND
GENERAL ARRANGEMENT AND SITE PLAN

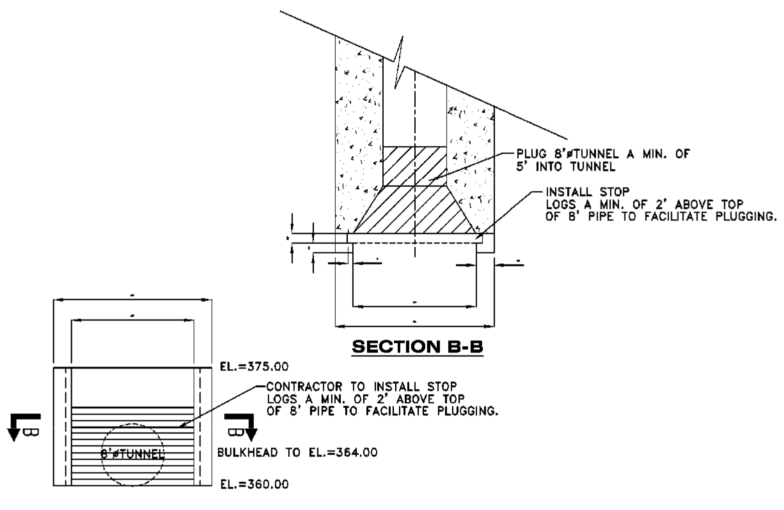
REVISION A — DATE 7-21-06
ISSUED FOR INQUIRY
JOB NO. 2101FS

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR	SCALE	PROJ I.D.	DRAWING NUMBER	SH	CONT'D	REV
JWM	PMG / JCP	JBS				CKT	1"=50'		D-586214	1	FINAL	A

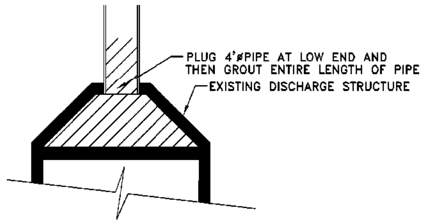
ANSI F: 28x40 Acad2000



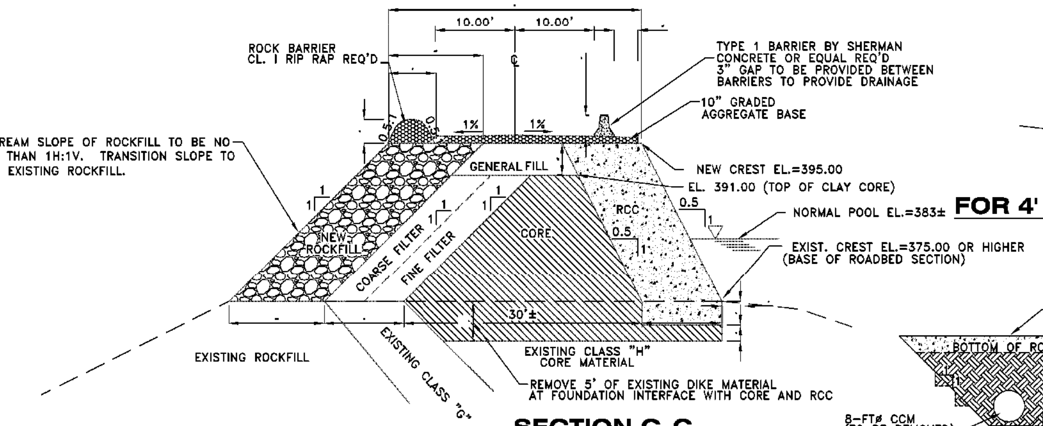
SECTION E-E
(D-586215)



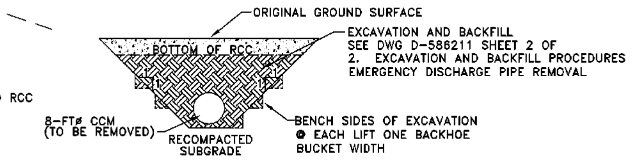
PLUGGING DETAIL FOR 8'Ø PIPE AT PRESCOTT CREEK
(BY CONTRACTOR)



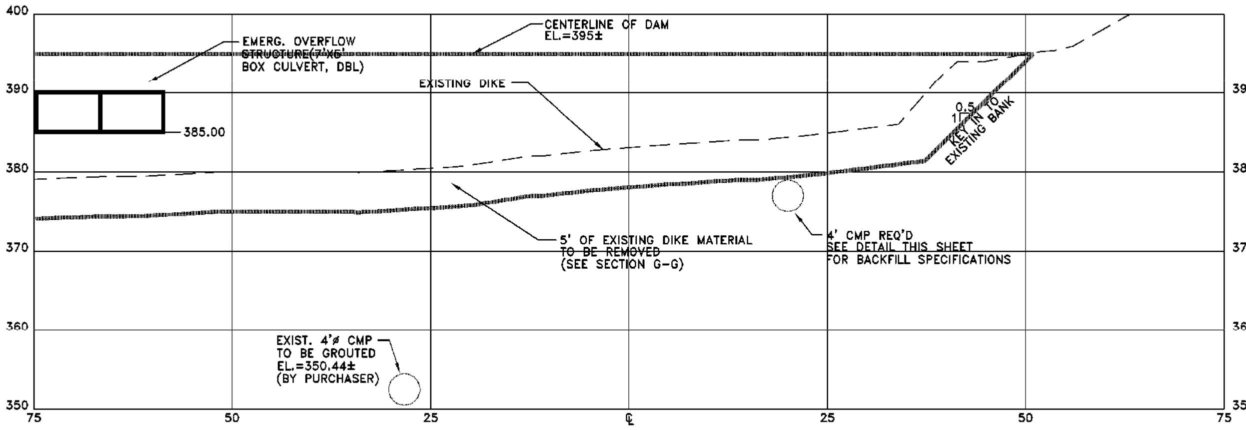
PLUGGING DETAIL FOR 4' Ø CMP AT EXISTING WEIR
(BY PURCHASER)



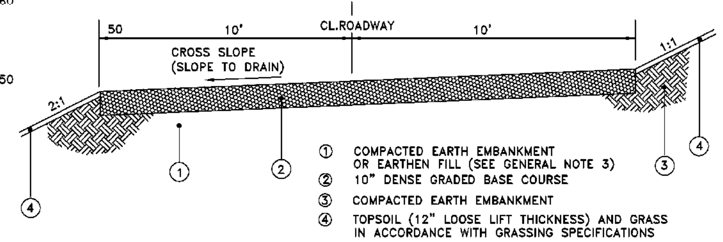
SECTION G-G
DAM TYPICAL SECTION
(N.T.S.)
(D-586216)



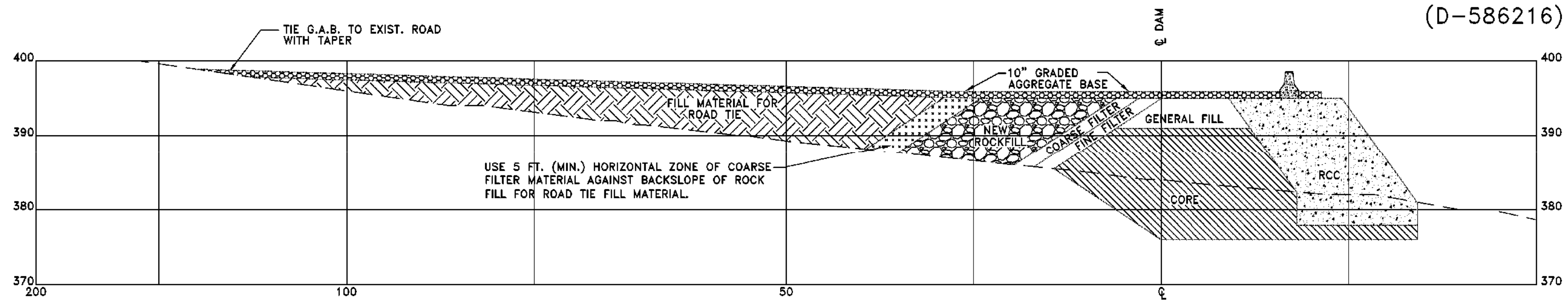
EXISTING EMERGENCY DISCHARGE PIPE EXCAVATION & BACKFILL
(N.T.S.)
(D-586215)



SECTION F-F
(D-586215)



SECTION H-H
WEST DOWNSTREAM ACCESS ROAD
(N.T.S.)
(D-586216)



SECTION D-D
(D-586215)

NOTES:

1. FOR DRAWING INDEX, NOTES, AND SPECIFICATIONS SEE DWG. NO. D-586211, SHEETS 1 & 2.
2. CURVE DATA SHOWN ON D-586214.
2. WORK THIS DRAWING WITH DRAWINGS:
   D-586214
   D-586215
   D-586216
   D-586220

REFERENCES:

SEE DRAWING D-586211

SEE TECHNICAL SPECIFICATIONS FOR EARTHWORK AND ROLLER COMPACTED CONCRETE CREST RAISE CONSTRUCTION

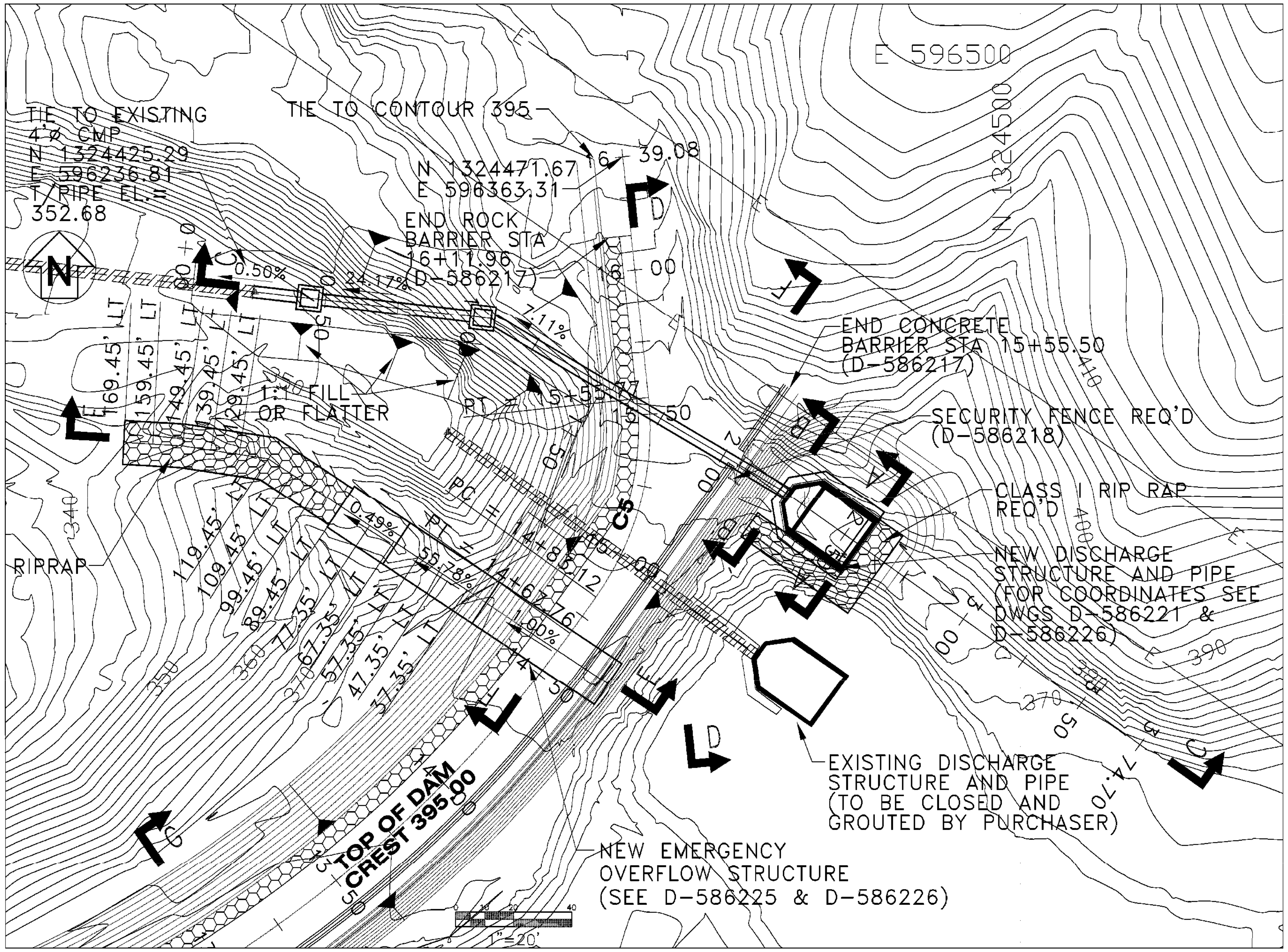
Southern Company Services, Inc.
FOR
Alabama Power Company

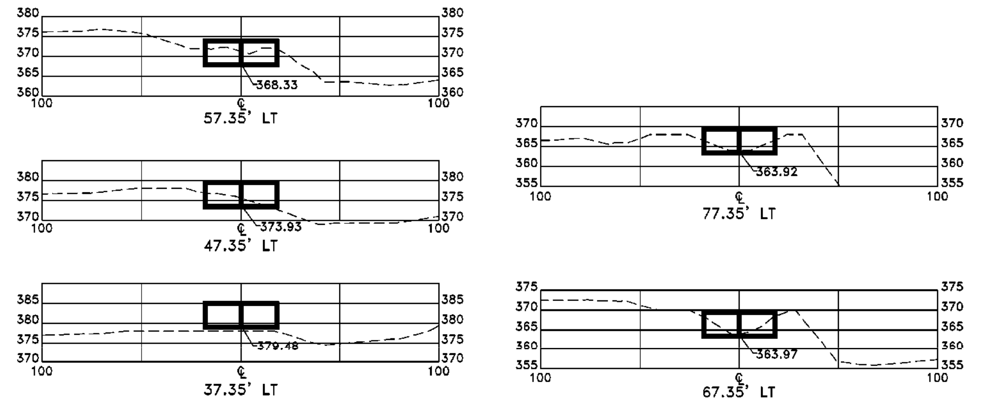
PLANT GORGAS
CREST RAISE OF RATTLESNAKE
HOLLOW ASH POND
SECTIONS AND DETAILS

REVISION	DATE	REVISION A	DATE 7-21-06
		ISSUED FOR INQUIRY	JOB NO. 2101FS

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR	SCALE	PROJ I.D.	DRAWING NUMBER	SH	CONT'D	REV
JWM	PMG / JCP	JBS				CKT	1"=10'		D-586217	1	FINAL	A

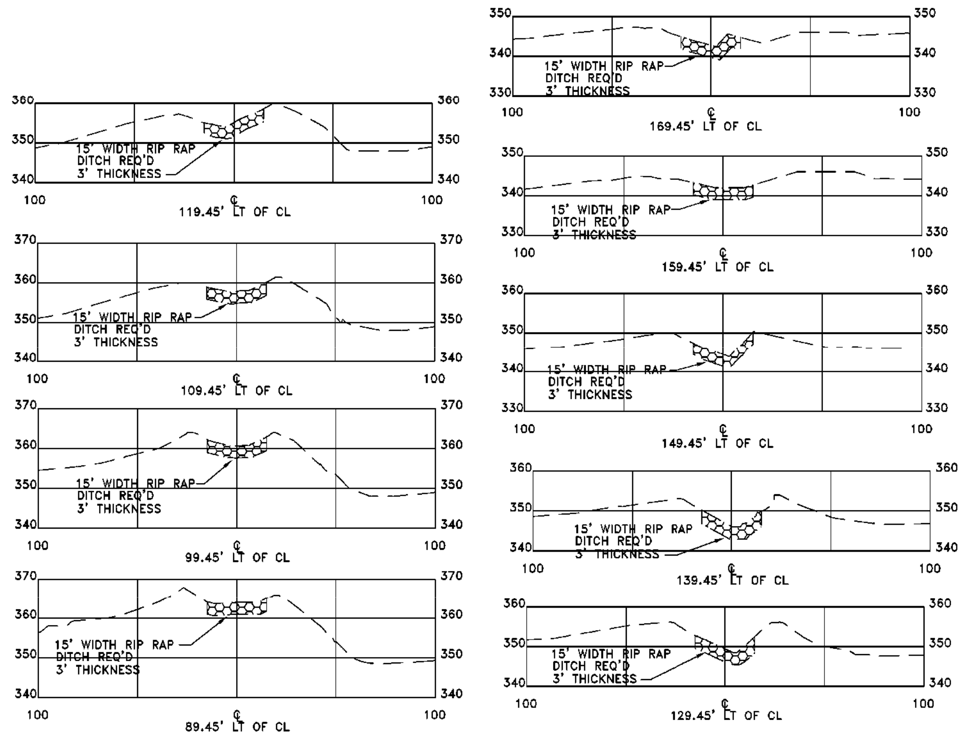
ANSI F: 28x40 Acad2000





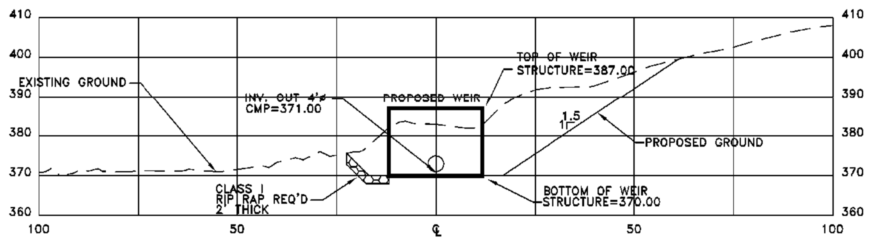
57.35' LT
47.35' LT
37.35' LT
77.35' LT
67.35' LT

FLUME SECTIONS
(D-586215)

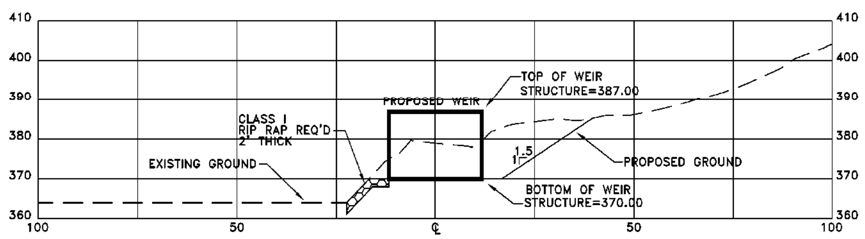


169.45' LT OF CL
119.45' LT OF CL
159.45' LT OF CL
109.45' LT OF CL
149.45' LT OF CL
99.45' LT OF CL
139.45' LT OF CL
89.45' LT OF CL
129.45' LT OF CL

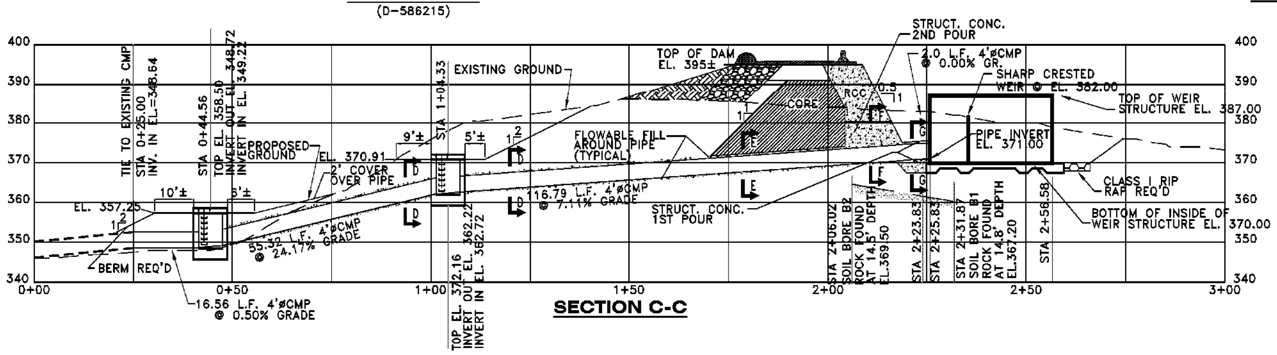
RIP RAP DITCH SECTIONS
(D-586215)



SECTION B-B
(D-586215)



SECTION A-A
(D-586215)



SECTION C-C

REFERENCES:

SEE DRAWING D-586211.

SEE TECHNICAL SPECIFICATIONS FOR EARTHWORK AND ROLLER COMPACTED CONCRETE CREST RAISE CONSTRUCTION.

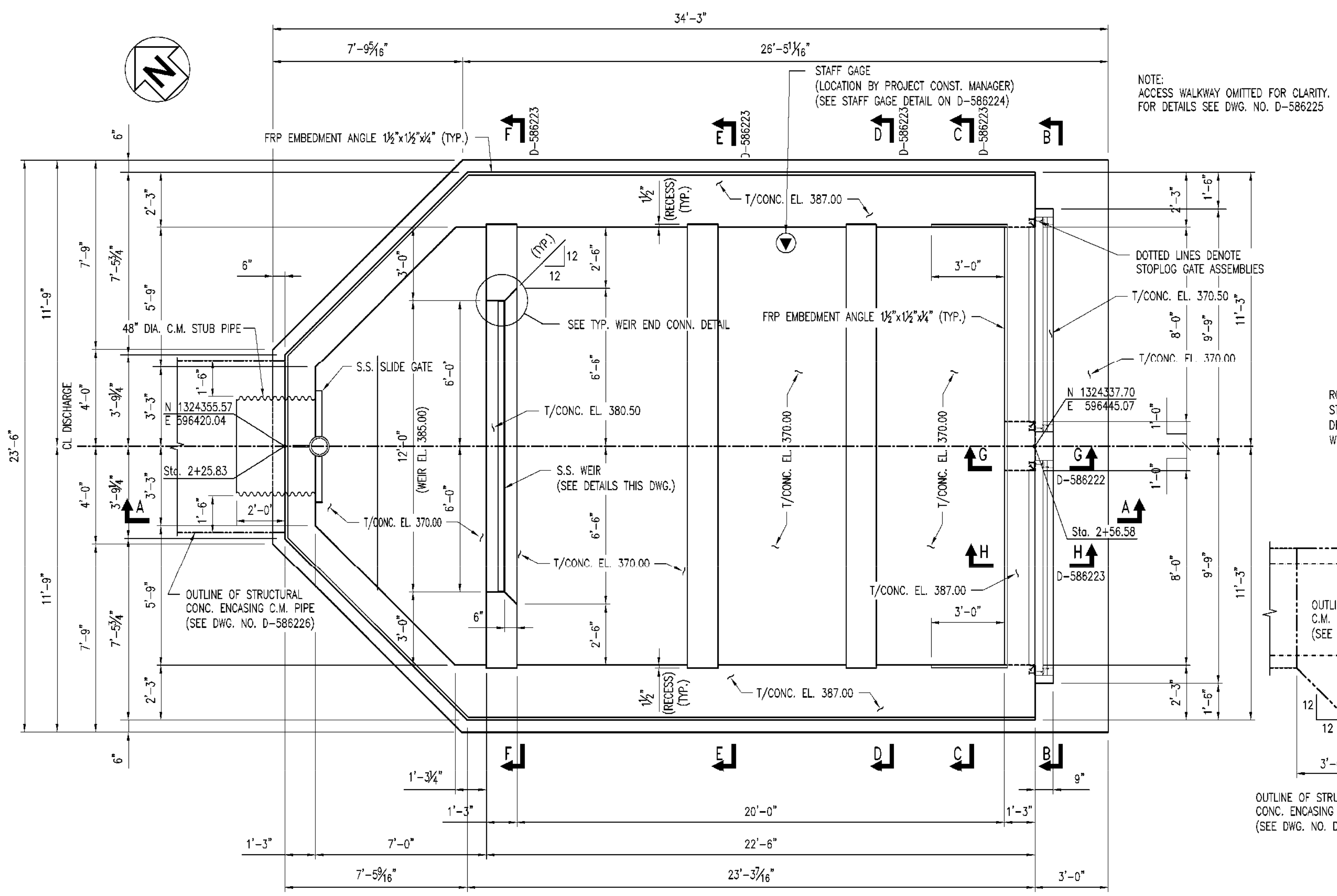
Southern Company Services, Inc.
FOR
Alabama Power Company

PLANT GORGAS
CREST RAISE OF RATTLESNAKE
HOLLOW ASH POND
NEW DISCHARGE STRUCTURE
GENERAL LAYOUT-PLAN & SECTIONS

REVISION	DATE	REVISION A	DATE 7-21-06
		ISSUED FOR INQUIRY	JOB NO. 2101FS

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR	SCALE	PROJ I.D.	DRAWING NUMBER	SH	CONT'D	REV
JWM	PMG / JCP	JBS				CKT	1"=20'		D-586220	1	FINAL	A

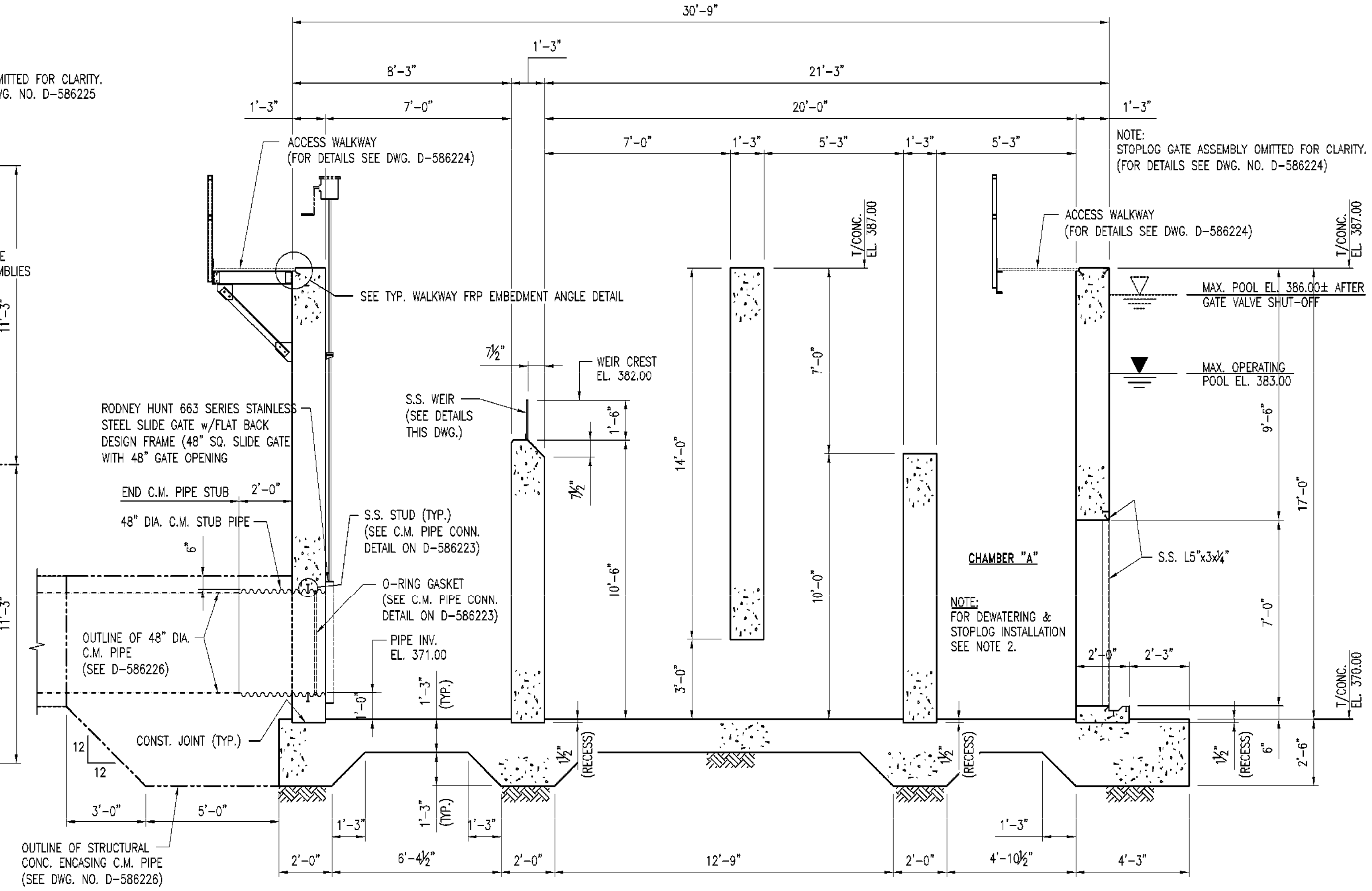
ANSI F: 28x40 Acad2000



PLAN - NEATLINE

SCALE: 3/8" = 1'-0"

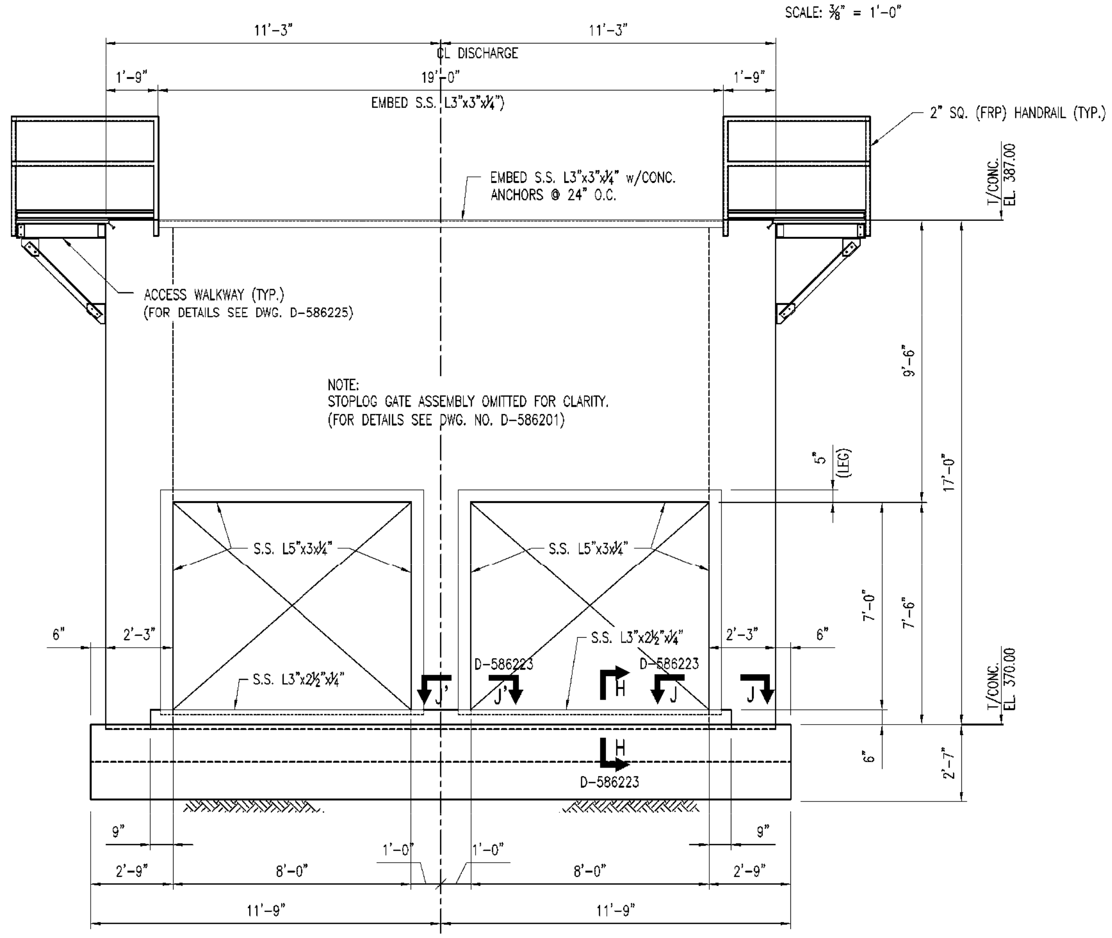
NOTE:
ACCESS WALKWAY OMITTED FOR CLARITY.
FOR DETAILS SEE DWG. NO. D-586225



NOTE:
STOPLOG GATE ASSEMBLY OMITTED FOR CLARITY.
(FOR DETAILS SEE DWG. NO. D-586224)

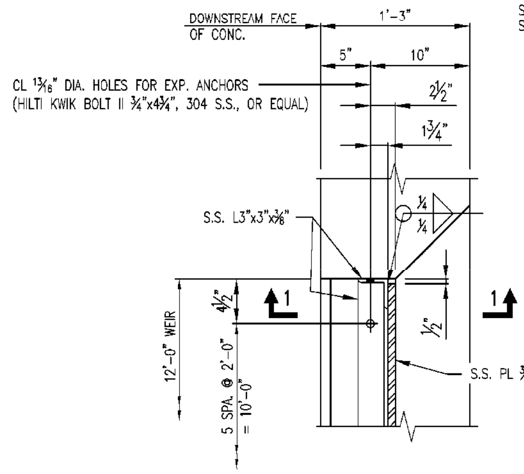
SECTION A-A

SCALE: 3/8" = 1'-0"



SECTION B-B

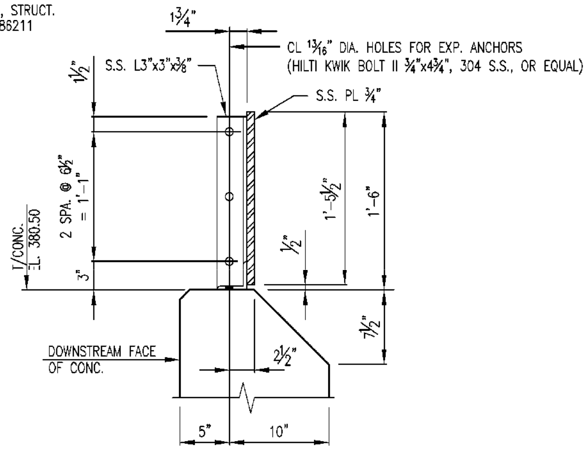
SCALE: 3/8" = 1'-0"



TYP. WEIR END CONN. DETAIL

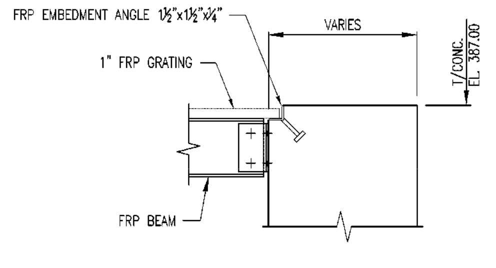
SCALE: 1½" = 1'-0"

NOTE:
FOR STAINLESS STEEL STRUCTURAL SHAPE SPECIFICATIONS SEE NOTE 1, STRUCT. STEEL GEN. NOTES ON D-586211



SECTION 1-1

SCALE: 1½" = 1'-0"



TYP. WALKWAY FRP EMBEDMENT ANGLE DETAIL

SCALE: 1½" = 1'-0"

NOTES:

1. FOR DRAWING INDEX, NOTES, AND SPECIFICATIONS SEE DWG. NO. D-586211 – SHEETS 1 & 2.
2. PROCEDURE FOR DEWATERING AND STOPLOG INSTALLATION:

(THIS PROCEDURE SHALL BE FOLLOWED FOR THE INITIAL DEWATERING OPERATION CHECKOUT AND INSTALLATION OF STOPLOGS BY THE CONTRACTOR, AND IN THE FUTURE WHEN DEWATERING MAY BE REQUIRED.)

A. PRIOR TO INSTALLATION OF STOPLOG GATES, CLEAN STOPLOG GATE PL ¼" AND APPLY A 3" WIDE x ¼" THICK GREASE BEAD AROUND PERIMETER OF PL ¼" ON SEAL SIDE FACE OF STOPLOGS TO FACILITATE WATER TIGHT SEALING.
B. TO PERMIT THE SEALING OF THE STOPLOGS, ONLY DEWATER CHAMBER "A" BY PUMPING DRY. CHAMBER "A" IS THAT AREA LOCATED BETWEEN THE STOPLOGS SLOTS AND THE FLOW DIVERSION CONCRETE WALL. SEE SECTION A-A THIS DWG.
C. THE REMAINING AREA BETWEEN CHAMBER "A" AND THE WEIR SHALL NOT BE DEWATERED.
D. PRIOR TO REMOVING THE STOPLOGS, REFILL CHAMBER "A".

REFERENCES:

SEE DRAWING D-586211 (SHEETS 1 & 2).

CAD D586221
AutoCad 2004 | HLF-A

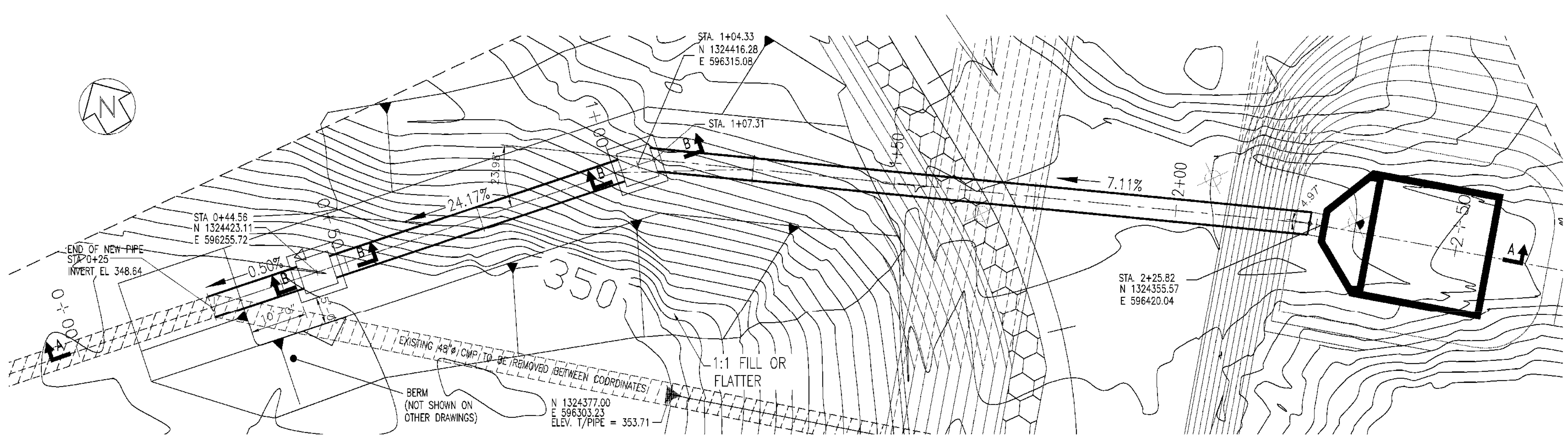
Southern Company Services, Inc.
FOR
Alabama Power Company

GORGAS STEAM PLANT
NEW DISCHARGE STRUCTURE
CONCRETE NEATLINE
PLAN AND SECTIONS

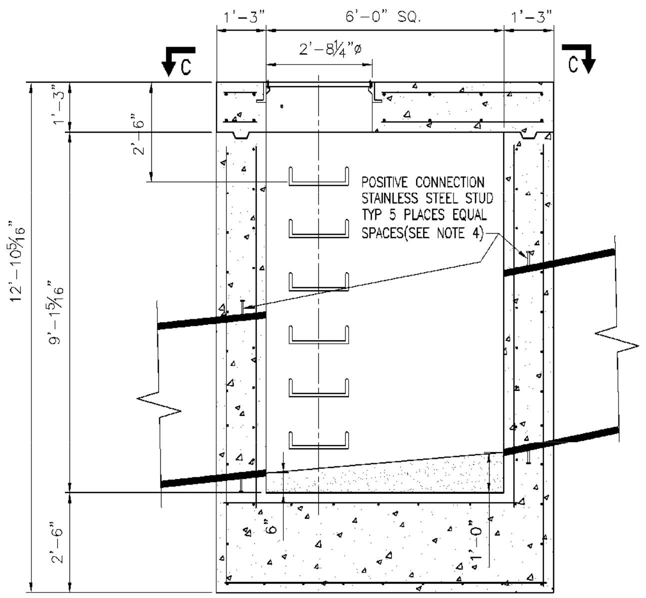
REVISION	DATE						
A	7-21-06						
ISSUED FOR INQUIRY							
JOB NO. 2101FS							
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR	
HLF	PMG	JBS				CKT	

SCALE	PROJ I.D.	DRAWING NUMBER	SH	CONT'D	REV
AS NOTED		D-586221	1	FINAL	A

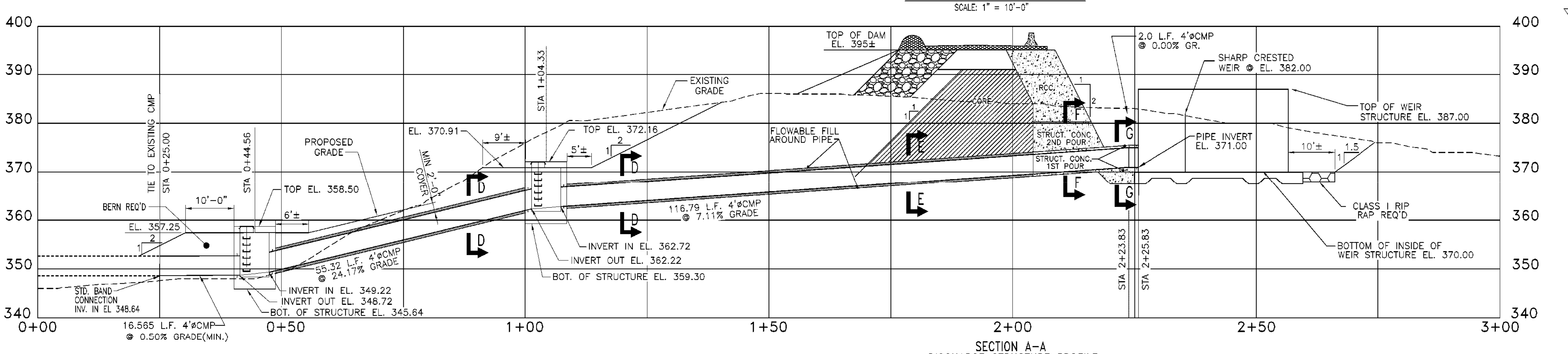
ANSI F: 28x40 Acad2004



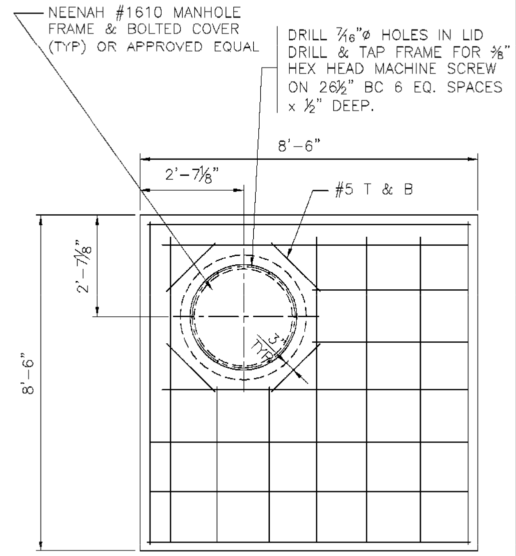
DISCHARGE STRUCTURE PLAN
SCALE: 1" = 10'-0"



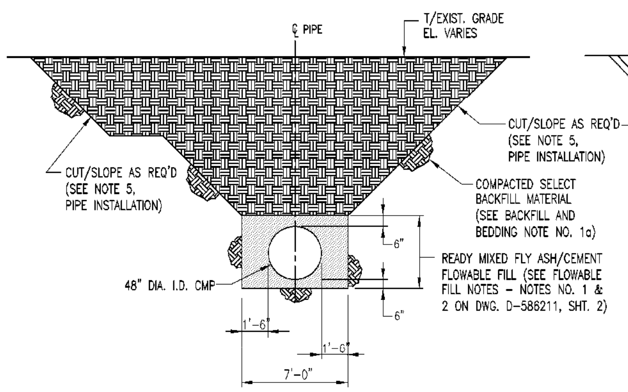
SECTION B-B
SCALE: 1/2" = 1'-0"



SECTION A-A
DISCHARGE STRUCTURE PROFILE
SCALE: 1" = 10'-0"

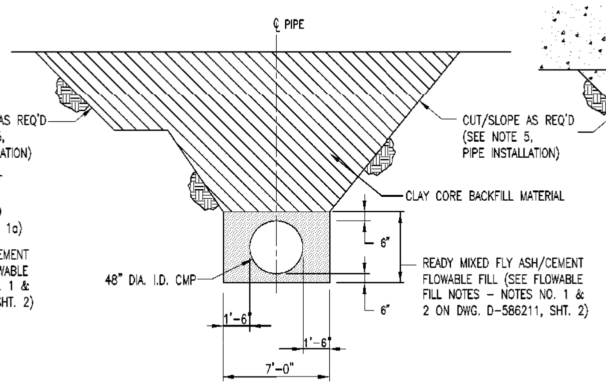


SECTION C-C
SCALE: 1/2" = 1'-0"



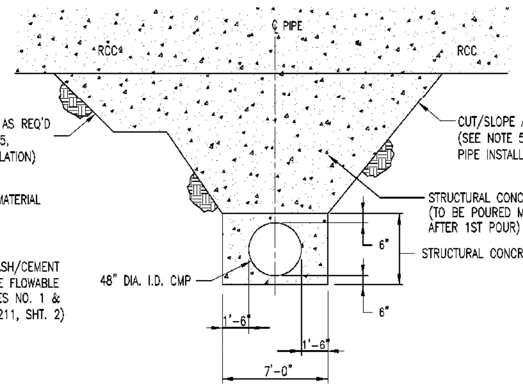
TYP. TRENCH FLOWABLE FILL & BACKFILL DETAIL
FOR NEW 48" CMP PIPE INSTALLATION
FOR NEW DISCHARGE STRUCTURE

SECTION D-D
NTS



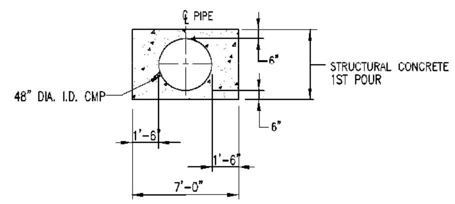
TYP. TRENCH FLOWABLE FILL & BACKFILL DETAIL
FOR NEW 48" CMP PIPE INSTALLATION
FOR NEW DISCHARGE STRUCTURE

SECTION E-E
NTS



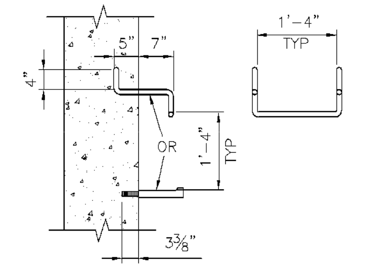
TYP. TRENCH WITH STRUCTURAL CONCRETE DETAIL
FOR NEW 48" CMP PIPE INSTALLATION
FOR NEW DISCHARGE STRUCTURE

SECTION F-F
NTS



TYP. TRENCH WITH STRUCTURAL CONCRETE DETAIL
FOR NEW 48" CMP PIPE INSTALLATION
FOR NEW DISCHARGE STRUCTURE

SECTION G-G
NTS



TYPICAL MANHOLE STEP DETAIL
SCALE: 3/4" = 1'-0"

NOTES:

1. FOR DRAWING INDEX, NOTES AND SPECIFICATIONS SEE DRAWING NO. D-586211, SHEETS 1 & 2.
2. ALL PIPE IS 48"ø CMP.
3. ALL CONCRETE REINFORCING TO BE #5s @ 12" EACH WAY, EACH FACE UNO. MAINTAIN 3" CLR.
4. SEE C.M.PIPE CONNECTION DETAIL AT POURED CONC. WALL ON DWG. D-586223.

REFERENCES:

SEE DRAWING NO. D-586211

REVISION	DATE
A	7-21-06

ISSUE FOR INQUIRY

JOB NO. 2101FS

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR
WJT	PMG	JBS				CKT

Southern Company Services, Inc.
FOR
Alabama Power Company

GORGAS STEAM PLANT
CREST RAISE OF
RATTLESNAKE HOLLOW ASH POND DAM
NEW DISCHARGE PIPE & STRUCTURES
PLAN, SECTIONS & DETAILS

SCALE	PROJ I.D.	DRAWING NUMBER	SH	CONT'D	REV
AS SHOWN	2101FS	D-586226	1	FINAL	A

ANSI F: 28x40 Acad2004

EXHIBIT 4

INQUIRY NO. 000059331

TECHNICAL SPECIFICATIONS
FOR
EARTHWORK AND ROLLER COMPACTED CONCRETE
CREST RAISE CONSTRUCTION

PLANT GORGAS – RATTLESNAKE HOLLOW ASH POND DAM

ALABAMA POWER COMPANY

PREPARED BY: James C. Pegues DATE: 12/16/05

REVIEWED BY: Richard M. Franke DATE: 12/16/05

REVIEWED BY: Patrick M. Gordon DATE: 12/16/05

APPROVALS:

	INITIAL	DATE
J. B. SMITH Civil Engineering Supervisor – Fossil and Hydro Projects Engineering and Construction	JBS	12/16/05

REVISIONS:

NO	DESCRIPTION	BY	REVIEW	APPROVED	DATE
A	Issued for Inquiry	JCP	RMF/PMG	JBS	07/21/06

EXHIBIT 4

INQUIRY NO. 000059331

TECHNICAL SPECIFICATIONS
FOR
EARTHWORK AND ROLLER COMPACTED CONCRETE
CREST RAISE CONSTRUCTION

PLANT GORGAS – RATTLESNAKE HOLLOW ASH POND DAM

ALABAMA POWER COMPANY

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INQUIRY NO. 000059331

TECHNICAL SPECIFICATIONS
FOR
EARTHWORK AND ROLLER COMPACTED CONCRETE
CREST RAISE CONSTRUCTION

PLANT GORGAS – RATTLESNAKE HOLLOW ASH POND DAM

ALABAMA POWER COMPANY

1.0 GENERAL

The purpose of this work is to raise the crest of Rattlesnake Hollow Ash Pond Dam to EL 395 thus increasing the available storage capacity of the ash pond. This is a 20 feet raise above the existing top of dam. Other work associated with the raising of the dam includes, but is not limited to: constructing a new discharge structure and emergency overflow structure; abandoning the existing discharge structure in-place, removing the existing emergency overflow pipe; closing of Prescott Creek tunnel discharge; modification and raising of existing ash sluice lines; modification of existing pontoons and pontoon anchors; construction and installation of new pontoons and anchors; development and operation of borrow areas; realignment and construction of west downstream access road; and improvements and maintenance of other access roads to the site.

Plant Gorgas is a steam electric fossil fueled plant, owned and operated by Alabama Power Company. The plant is located off of Highway 269 along the Black Warrior River near Parrish, Alabama in Walker County. The ash pond is located across the river from the plant.

Exhibit 3 - Scope of Work, this Exhibit 4 - Technical Specifications for Earthwork and Roller Compacted Concrete Crest Raise Construction, hereafter referred to as the Technical Specifications, Exhibit 5 - Drawing List, Drawings and contract documents cover the furnishing of all materials (unless otherwise noted), labor, supervision, equipment and tools required by the Contractor.

The technical and construction requirements, design data, and specifications are available in the Technical Specifications and on the Drawings.

In the case of discrepancies between the Drawings and the Technical Specifications, the Contractor shall notify the Purchaser. In case of discrepancies between the scale dimensions on the Drawings and the dimensions written on them, the written dimensions shall govern.

All work shall meet the construction quality control and quality assurance inspection requirements as set forth in the Specifications in Exhibit 4.

1.1 DEFINITION OF TERMS

The terms used herein in this Contractor's Scope of Work and in the Technical Specifications shall be interpreted and understood as stated:

The term "Contractor" shall be as defined in the General Conditions of the Contract for Construction, SCG-1, Rev. 12 (5-9-2006) (Construction).

The term "Purchaser" shall be as defined in the General Conditions of the Contract for Construction, SCG-1, Rev. 12 (5-9-2006) (Construction).

The term "Project Construction Manager", PCM, denotes the on-site manager of the project or his designated representative. He is the authorized representative at the site for the Purchaser.

The term "QC/QA Inspector" denotes the independent quality control and quality assurance inspector who is provided by the Purchaser.

The term "Purchaser's Engineer" denotes the Purchaser's SCS Engineering representative.

The terms "Accepted, Acceptable, or Approved" denotes that of which must be acceptable, accepted or approved by the Project Construction Manager or his authorized representative.

2.0 APPLICABLE DOCUMENTS

2.1 CODES AND STANDARDS

The following codes are considered to be a part of these Specifications in the areas where they apply to material, fabrication, workmanship, examination, testing, and documentation. The latest revision in effect at the time of issuance of the Inquiry shall be applicable unless otherwise noted. Omission of any codes and standards does not relieve the Contractor of his responsibility to the applicable codes and standards. In the event of a conflict between the following codes and standards and these Specifications and/or accompanying drawings or diagrams, these Specifications and drawings shall govern to the extent of such conflicts. Any deviations contained in these Specifications and/or accompanying drawings from the following regulations have been made to better address the specifics of this particular facility.

A. ASTM Standards

ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138 Standard Test Method for Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete
ASTM C1040 Standard Test Methods for In-Place Density of Unhardened and Hardened Concrete, Including Roller Compacted Concrete, By Nuclear Methods
ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C1116 Standard Specification for Fiber-Reinforced Concrete and Shotcrete
ASTM D422 Standard Test Method for Particle Size Analysis of Soil
ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM D1556 Test Method for Density and Unit Weight of Soil In Place by the Sand Cone Method
ASTM D2216 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488 Description and Identification of Soils (Visual-Manual Procedure)
ASTM D2922 Test Methods for Density of Soil and Soil – Aggregate In Place by Nuclear Methods
ASTM D2937 Test Method for Density of Soil In Place by the Drive Cylinder Method
ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4643 Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
ASTM D4959 Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method

B. American Concrete Institute (ACI)
ACI 207.5R Roller Compacted Mass Concrete
ACI 304 Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
ACI 306 Recommended Practice for Cold Weather Concrete
ACI 309.5R Compaction of Roller-Compacted Concrete

C. Occupational Safety and Health Act (OSHA) of 1970, as amended

D. Codes specific to the local County and City.

E. Alabama Department of Environmental Management (ADEM) Regulations

F. Environmental Protection Agency (EPA) Regulations

2.2 DRAWINGS

The SCS Design Drawings, hereafter referred to as Drawings, pertinent to the design and construction of this project are listed in Exhibit 5.

2.3 FEASIBILITY REPORT

Information about the project background and site conditions were presented in an internal report entitled "Crest Raise Feasibility Study, Rattlesnake Hollow Ash Pond Dam, Gorgas Steam Plant, Alabama Power Company." Portions of this report containing available soils related data are issued as a portion/exhibit to the Inquiry Package and should be read in their entirety in order that the Contractor is aware of the current dam construction, the engineering characteristics of soils and rock likely to be encountered.

If the Contractor judges that the subsurface information is inadequate in any regard, he has the right to perform any additional investigation to supplement the provided information at no expense to the Purchaser. The Purchaser shall not be liable for any oversight made by the Contractor regarding the subsurface conditions.

3.0 CONSTRUCTION REQUIREMENTS

3.1 CLEARING, GRUBBING AND STRIPPING

The surface of the existing embankment and the abutments that lie within the footprint of the area to be raised shall be cleared and grubbed of trees, stumps, and vegetation and stripped of any topsoil. The vegetation, trees, and stumps shall be disposed of in the location designated by the Purchaser. Topsoil shall be stockpiled for later use in restoration of disturbed areas.

3.2 INITIAL EMBANKMENT EXCAVATION AND PREPARATION

The upper surface of the existing embankment consists of a layer of soil and soil/rock mixture, as well as roadway surfacing material (red rock), that covers the various embankment zone materials. This upper surface will need to be removed prior to construction of the roller compacted concrete, core material and filter/transition zone. The upper near surface materials should be excavated to a depth of 5 feet below the existing ground surface, as measured at the location of the upstream toe of the roller compacted concrete section. This excavation should extend on a horizontal line towards the downstream to the downstream edge of the filter/transition zone. The Purchaser's Engineer shall inspect the subgrade after excavation to assess that the expected existing upstream core and transition zone materials are exposed.

Undercut materials will be suitable for reuse as general fill in the crest raise above EL 391, as shown on the Typical Dam Section, as long as they meet the requirements of Section 3.6.4 of these Specifications.

Prior to placement of the roller compacted concrete, core material and filter/transition zone material, the exposed subgrade shall be compacted with a minimum of 5 passes with a sheepsfoot-type compactor.

There are several settlement monitoring monuments on the crest of the dam within the limits of this excavation. These monuments should not be disturbed or damaged in any way, and any excavation around them should be no closer then 5 feet in any direction.

3.3 EMERGENCY OVERFLOW PIPE EXCAVATION AND REMOVAL

The existing emergency overflow pipe is to be removed prior to the raise construction. The pipe should be excavated and removed and the subsequent excavation backfilled in accordance with the notes shown on the Drawings. The excavated pipe should be properly disposed of off-site. The backfilling should proceed upwards in accordance with the applicable notes until the elevation of the bottom of the roller compacted concrete has been reached.

3.4 BORROW AREA DEVELOPMENT

A potential borrow area for the core material has been identified just south and west of the west abutment of the embankment. Materials meeting the requirements of the core material as specified in Section 3.4.1 were identified in several test pits to depths of up to about 5 feet below the existing ground surface. However, the Contractor is responsible for sampling, testing, identifying and selective excavation of materials that meet the referenced requirements.

The Contractor shall clear, grub, and strip the borrow area to uncover and locate the clayey core material soils. Only those sections of the borrow area required to obtain sufficient fill for immediate crest raise construction should be developed. The Contractor shall be responsible for planning the borrow area activities to support the crest raise construction.

The Contractor shall install and maintain erosion control measures in the borrow areas to prevent sediment and erosion activities from affecting wetlands, streams, and surface waters. Section 8.0 addresses erosion control measures.

The Contractor shall construct and maintain access roads to and within borrow areas. These roads must be maintained to allow the hauling and vehicle traffic to travel to the active borrow operations. Erosion control measures shall be installed and maintained along access roads to prevent sediment and erosion activities from affecting wetlands, streams, and surface waters.

The Contractor shall be responsible for providing and planning dust control measures in the borrow area. The PCM shall direct the Contractor to implement these measures when the PCM determines a dust problem exists. Section 8.3 discusses dust control measures for the borrow areas and access roads.

When the Contractor anticipates an upcoming rainfall event, the Contractor shall grade, slope, ditch, and prevent the borrow area from flooding, or affecting nearby wetlands, streams, and surface waters. The Contractor shall construct surface water/sediment runoff ponds, as necessary, to control runoff from rainfall events. The Contractor shall provide a runoff control plan to the PCM within two to five days prior to the start of borrow operations.

Upon completion of borrow operations, the Contractor will be responsible for final grading, establishment of vegetative cover and other restoration of the borrow area as determined by the PCM.

3.5 ROCK BORROW AREA DEVELOPMENT

A rock quarry was previously developed on the Gorgas property to produce large rockfill stone for construction of the downstream shell of the existing Rattlesnake Hollow Dam. The quarry, which was abandoned after construction, is located downstream and above the west abutment of the dam in an undeveloped area. The rock fill required for the current crest raise is to come from this area.

The rock borrow area is overgrown with vegetation and a 20-year growth of scattered pine that will require clearing. Some areas at the toe of the excavated rock are wet and boggy and drainage improvements to facilitate construction traffic may be needed.

The soil cover over the rock is thin and not suitable for use as borrow material in the dam construction. The underlying rock is typical of the coal-bearing Pennsylvanian Pottsville formation found in the area. In the exposed face of the cut, layers of sandstone and weathered shale are visible. The rock ranges from massively-bedded sandstone to shale laminae. The shale will not be suitable for use in the dam and should be separated from the usable rock as much as possible. The Contractor shall be responsible for planning the rock borrow activities to support the crest raise construction.

Traffic management, dust control and erosion and sediment control in accordance with the requirements outlined in Section 3.4.6 for the borrow area shall apply to the rock borrow area as well.

Blasting will be required to excavate the rock from the rock borrow area. The blasting program has very well defined criteria set forth in the Technical Specifications for Blasting that must be followed, including strict vibration limits, so as to not cause damage to existing structures, including the existing embankment.

The Contractor must select one of the specialty contractors listed below to perform the Blasting and shall identify the specialty contractor on his Proposal Form. No substitution will be made without written approval of the Owner. Substitution after the bid opening will not be grounds for changes in bid prices. The specialty contractors who may be used for this portion of the project are the following:

Glenn Barton*
Apache Construction
1940 Pinson Valley Parkway
Birmingham, Alabama 35217
Phone: 205-849-1727
Fax: 205-849-1726

Eddie Johnson*
Blast Pros, Inc.
767 Summerville Road
Jasper, Alabama 35504
Phone: 205-522-8230

George Weimer*
Boren Explosives Co., Inc.
8425 Highway 269
Parrish, Alabama 35580
Phone: 205-686-5095
Fax: 205-686-5902

* Indicates Prime Contact Name
Number in listing in no way represents any order of preference.

3.6 MATERIALS

The earth fill materials to be used in constructing the crest raise shall consist of core material, filter/transition zone material and rock fill. The upstream section of the crest raise shall consist of roller compacted concrete. The cross-sections presented on the Drawings show the zones of each fill. The Contractor shall be responsible for obtaining materials from designated on-site sources or from off-site sources which meet the requirements of the Specifications.

3.6.1 Core Material

Core material should be obtained from the designated on-site borrow source. Test pits in this area indicate that sufficient quantities of core material are expected to be present within the upper 4 to 5 feet of portions of the designated borrow area. However, the Contractor is responsible for identifying, sampling and testing of materials from this area to confirm their presence.

Core material shall consist of soils having a minimum of 50 percent by weight passing the U.S. Standard No. 200 Sieve (per ASTM D-422). The soils shall also have a liquid limit of at least 30 and a plasticity index of at least 10. The maximum particle size allowed for use in this material shall be 4 inches. The soil shall also have a standard Proctor maximum dry density of at least 100 pcf. These soils shall be classified as CL, ML, or CH materials based on ASTM D-4318 and D-2487).

The Contractor shall obtain three soil samples from the on-site borrow source to verify the soil properties described above. Soil testing shall be performed in accordance with ASTM D-422, D–698, D-2487, and D-4318. This testing work shall be performed and completed at least five days prior to the start of core material placement and compaction activities, including those required for the emergency overflow excavation backfill. All test data shall be submitted for approval to the PCM at least five days prior to the start of core material placement activities.

In the event the Contractor is required to locate an off-site clay fill borrow source to complete the placement work, the Contractor shall perform the same soil sampling, testing, and submittal activities as stated above. The PCM shall approve the new off-site borrow source prior to the Contractor utilizing these clay soils in the crest raise construction.

Soil sampling and testing shall be performed on each observed change in soil consistency (determined by the Contractor's field supervisor or the PCM) or for each 5000 cubic yards of clay soil used in the core construction, whichever occurs first. The Contractor shall perform all sampling and testing work at no additional cost to the Purchaser.

3.6.2 Filter/Transition Zone Material

The filter/transition zone will be constructed between the core material and the downstream rock fill, and will be a split, or two zone, system. The full width of the filter transition zone is to be a minimum of 10 feet. The upstream side of the filter that will be adjacent to the core will be a minimum of 5 feet wide, and consist of material having the following gradation, which is comparable to ALDOT No. 100 concrete sand:

Gradation Requirements Upstream Section of Filter/Transition Zone Material	
Sieve Size	**Percent Passing by Weight**
3/8-in	100
No. 4	95-100
No. 8	80-100
No. 16	50-90
No. 50	5-30
No. 100	0-10

The downstream section of the filter that will be placed adjacent to the rock fill will have a minimum width of 5 feet and will consist of material having the following gradation, which is comparable to ALDOT No. 57 coarse aggregate:

Gradation Requirements Downstream Section of Filter/Transition Zone Material	
Sieve Size	**Percent Passing by Weight**
1.5-in	100
1-in	95-100
0.5-in	25-60
No. 4	0-10
No. 8	0-5

The filter/transition zone material can be processed sandstone from the on-site rock borrow area operations or can be processed limestone/dolomite from an off-site source.

The Contractor shall obtain three samples each of both filter/transition zone materials to verify the gradation properties described in this Section above. Testing shall be performed in accordance with ASTM D-422. This testing work shall be performed and completed and all test data shall be submitted for approval to the PCM at least five days prior to the start of filter/transition zone placement activities.

Sampling and testing shall be performed on each filter/transition zone material for each 1000 cubic yards used in the crest raise construction. The Contractor shall perform all sampling and testing work at no additional cost to the Purchaser.

3.6.3 Rock Fill

Rock fill for placement on the downstream section of the crest raise will be obtained from an on-site rock borrow area located northwest of the west abutment. Rock fill from this area should consist predominately of sandstone, with less than 5 percent by weight of intact shale allowed in each load of material.

The particle size of the rock fill shall range from 1-in minimum to 24-in maximum, with at least 50 percent by weight larger than 12 inches, with an allowable oversize tolerance of 5 percent.

3.6.4 General Fill

General fill will be used to construct the portion of the crest raise above EL 391 feet, between the upstream Roller Compacted Concrete and the downstream rock fill.

General fill shall consist of non-organic soils and/or rock, with a maximum particle size of 12 inches. Also, the soils used as general fill shall also have a liquid limit of at less than 50 and a plasticity index less than 30.

3.6.5 Roller Compacted Concrete

Roller compacted concrete (RCC) will be used to construct the upstream section of the crest raise. The RCC shall be proportioned by the Contractor so as to attain a compressive strength at 28 days of 3000 psi.

The RCC shall be composed of cementitious materials, water, fine and coarse aggregate, and admixtures.

3.6.5.1 Cementitious Materials

Cementitious materials shall consist of Portland cement and pozzolan. The Portland cement shall conform to ASTM C 150, Type II.

Pozzolan shall conform to ASTM C 618, Type F Fly Ash. The pozzolan percentage of cementitious material shall not exceed 50 percent.

3.6.5.2 Water

Water shall be free of injurious amounts of oil, acid, salt, alkali, organic material or other deleterious substances. Water from the ash pond shall not be used.

3.6.5.3 Fine Aggregate

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two.

The requirements for deleterious substances and soundness as required by ASTM C 33 shall govern.

Gradation of the fine aggregate shall be as follows:

Gradation Requirements RCC Fine Aggregate	
Sieve Size	**Percent Passing by Weight**
3/8-in	100
No. 4	95 – 100
No. 8	75 – 95
No. 16	55 – 80
No. 30	35 – 60
No. 50	24 – 40
No. 100	12 – 28
No. 200	8 - 18

In addition, the fine aggregate, as delivered to the mixer, shall have a fineness modulus of not less than 2.1 and not more than 2.75.

3.6.5.4 Coarse Aggregate

Coarse aggregate shall consist of crushed stone.

Limits for deleterious substances and physical property requirements shall meet the requirements of Table 3 of ASTM C 33 for Class Designation 4M.

Gradation of the coarse aggregate shall generally conform to the gradation requirements for ASTM C 33 No. 57 stone.

3.6.5.5 Admixtures

Admixtures to serve as a water reducing agent (WRA) shall be used. The WRA shall meet the requirements of ASTM C 494 Type A (water reducing) or Type D (water reducing and retarding.) Any WRA shall be added to and trial mix tested with the RCC mix to be used prior to its use in the field.

Admixtures for air-entrainment shall not be used.

3.6.6 Bedding Concrete

Bedding concrete will be used to increase the bond between RCC lifts. The Bedding Concrete shall be proportioned by the Contractor, and shall be designed with a slump range of 5-in to 7-in. The mix shall contain a minimum of 500 pounds per cubic yard of cementitious materials.

The Bedding Concrete shall be composed of cementitious materials, water, aggregate, and admixtures.

3.6.6.1 Cementitious Materials

Cementitious materials shall consist of Portland cement and pozzolan. The Portland cement shall conform to ASTM C 150, Type II.

Pozzolan shall conform to ASTM C 618, Type F Fly Ash. The pozzolan percentage of cementitious material shall not exceed 30 percent.

3.6.6.2 Water

Water shall be free of injurious amounts of oil, acid, salt, alkali, organic material or other deleterious substances. Water from the ash pond shall not be used.

3.6.6.3 Aggregate

Aggregate shall consist of crushed stone materials.

The requirements for deleterious substances and soundness as required by ASTM C 33 shall govern.

Gradation of the aggregate shall conform to the requirements of ALDOT No. 8910 stone, as follows:

Gradation Requirements Bedding Concrete Aggregate	
Sieve Size	**Percent Passing by Weight**
1/2-in	100
3/8-in	90 – 100
No. 4	60 - 85
No. 8	40 - 70
No. 50	10 – 25
No. 200	1 - 5

3.6.6.4 Admixtures

Admixtures to serve as a water reducing agent (WRA) and retarder shall be used. The WRA shall meet the requirements of ASTM C 494 Type D (water reducing and retarding.)

3.7 PLACEMENT

3.7.1 Earth Fill Materials

The Contractor shall be responsible for the placement of fill materials, which includes the clay core materials, the filter materials and the rockfill. The placement activities will include: the excavation and loading of materials from the borrow source into hauling equipment, transporting the materials to the crest raise placement area, dumping and spreading the materials into lifts, and compacting the material to the designated density level.

The Contractor shall provide an adequate number of laborers to remove roots and other unacceptable debris from each lift of earth material.

When the Contractor anticipates an upcoming rainfall event, the top surface of the compacted lift of core material should be rolled with a smooth-drum roller or bladed with the dozer or scraper to seal the lift surface to facilitate rainfall runoff.

3.7.1.1 Lift Thickness

The lifts of core material, including the initial lift, shall be placed in lifts, each with a loose thickness not to exceed 8 inches.

The lift of filter materials, including the initial lift, shall be placed in lifts, each with a loose thickness not to exceed 12 inches.

The rock fill shall be placed in loose lift thickness not to exceed 30 inches.

3.7.1.2 Compaction

For the clay core and general fill material, the in-place density shall be a minimum of ninety-five percent (95%) of the material’s maximum dry density as per the Standard Proctor designation, ASTM D-698. The in-place density should be obtained by using sheepsfoot type compaction equipment.

For the filter material, compaction shall be achieved with a minimum of 4 passes per lift with a smooth-drum vibratory roller or sled-type vibratory compactor.

For rock fill material, compaction shall be achieved with a minimum of 5 passes of a vibratory steel-drum roller having a static weight of at least 8 tons and a minimum operating dynamic force of 15 tons. Large rubber-tired equipment may also be used in combination with vibratory rollers.

3.7.1.3 Moisture Content

The moisture content of the core material during placement and compaction activities shall be in the range of one percent below to three percent above the optimum moisture content of the soil, based on the ASTM D-698 designation.

The filter material shall be moist enough at the time of placement and compaction activities to "lubricate" the particles to facilitate compaction while at the same time not create unstable support conditions such as pumping and rutting.

Moisture conditioning of the rock fill materials will assist in filling voids by washing of soil fines and smaller particles between the larger rock particles. Wetting of the rock fill should be accomplished following compaction of each lift and prior to the placement of additional lifts. The rock fill lift should not be wetted prior to compaction unless the rock fill is relatively free of fines and rapidly drains prior to compaction.

If the water content is less than the specified level for compaction, the compaction operations shall not proceed until the water content is brought into an acceptable range. Moistening of the core and filter materials shall be performed at the site of compaction. If the water content is greater than the specified level for compaction, the compaction operations shall be delayed until such time as the material has dried to the specified water content. Drying of the material may be accelerated by utilizing a harrow, disc, or similar equipment.

3.7.2 Roller Compacted Concrete

The Contractor shall be responsible for the placement of the RCC, including: the mixing and loading of materials into hauling equipment, transporting the materials to the crest raise placement area, dumping and spreading the materials into lifts, and compacting the material to the designated density level.

The intent is to construct the raise at essentially the same level across the entire horizontal surface. Preferably, the placement and compaction of the RCC should proceed from abutment to abutment. Initially, some modification to this procedure and "partial" lift placement may be needed as the existing dam crest is not on a level plane.

3.7.2.1 Test Section

Prior to the placement of any RCC, the contractor shall construct a test section in an approved location outside the footprint of the crest raise. The purpose of the test section is to demonstrate the suitability of the Contractor's equipment, procedures, methods and training of personnel. The test section shall demonstrate plant batching and mixing capabilities, as well as transporting, spreading and compaction procedures. The test section will also allow for an evaluation of design mix performance for both the RCC and the bedding concrete, and will allow for determination of a target density to use for quality control during construction.

The test section shall be at least 2 lifts thick and shall be at least 10 feet wide and 30 feet long.

The Contractor shall not begin work on the crest raise until all evaluations and testing of the test section are complete and approved by the PCM. If the Contractor does not meet the requirements as specified, an additional test section(s) shall be constructed at no additional costs to the Purchaser.

3.7.2.2 Surface Preparation

The initial lift of RCC shall be placed on the subgrade prepared as specified in Section 3.2.

All additional lift surfaces, including any RCC and bedding concrete, shall be cleaned prior to the placement of additional concrete. All surfaces shall be free of ponded or other visible free water, soil, mud or loose rock. In addition, the surface of any RCC lift shall be moist prior to the placement of bedding concrete. Cleaning methods shall not damage existing RCC lifts such as by undercutting coarse aggregate and/or washing away cement paste.

3.7.2.3 Bedding Concrete

Bedding concrete shall be applied to any existing RCC surface after any needed cleaning is complete and prior to the placement of additional RCC. The thickness of the bedding concrete shall be between 1 and 2 inches. The bedding concrete shall be placed no more than 15 minutes ahead of the RCC.

Bedding concrete shall also be used at the RCC-abutment interface where any sloping or vertical surfaces are present.

3.7.2.4 Lift Thickness

The total thickness of each lift of the RCC after compaction shall not exceed 12 inches.

3.7.2.5 Placement and Spreading

The RCC can be transported to the crest raise area and placed with conveyors, end-dump trucks, scrapers or bottom-dump trucks, or any combination thereof.

Care must be taken to not track or deposit soil, rocks, mud or other deleterious material on the RCC surface during transport and placement.

After placement, the RCC can be spread with a dozer or other similar, approved equipment. The use of specialized spreaders is also acceptable. Means and methods to protect the surface of recently placed and compacted RCC from the treads of dozers or other equipment should be taken.

The RCC should be spread to provide a uniform surface capable of uniform compaction. Care should be taken to not segregate materials during the spreading process.

3.7.2.6 Compaction

After spreading, the RCC shall be compacted with a minimum of four passes of a self-propelled, vibratory steel drum roller. Additional passes may be needed to achieve the required density. Rollers shall not be operated in the vibratory mode unless they are moving.

The RCC should be compacted to a minimum of 98 percent of the theoretical maximum density. The theoretical density will be determined using job mix proportions and Contractor supplied materials, using compaction techniques suitable for RCC and following the appropriate testing procedures used to determine theoretical unit weight of concrete as described in ASTM C 138.

The target number of passes with the roller required to achieve the specified density will be determined at the time of construction of the test strip specified in Section 3.5.2.1. However, the actual density achieved during construction of the crest raise will be determined using a nuclear moisture-density gauge in accordance with ASTM C 1040.

3.7.2.7 Curing

The surface of every RCC lift shall be kept continuously moist, commencing immediately after compaction, until the next lift is placed. The final lift of RCC shall be kept moist for a period of at least 14 days or until covered with other surfacing materials. Water from the ash pond will be acceptable for use in the curing process.

3.7.2.8 Forms

As shown on the drawings, the upstream face of the RCC section of the crest raise is to have a slope of 0.5H:1V. Formwork shall be used as needed to allow for construction of the sloping face and for compaction of the RCC at the outer edge of the face. Formwork must be capable of withstanding the forces and vibrations from placement and compaction of the RCC.

Formwork to be used in the construction of the crest raise shall be included in the construction of the required test strip for evaluation.

3.8 TESTING

The Contractor shall employ and pay for the services of an independent testing laboratory to perform specified earthwork testing. The Contractor shall cooperate with the laboratory to facilitate the execution of its required services. Employment of the laboratory shall in no way relieve the Contractor of his obligations to perform the work and supply the materials in accordance with the Specifications. The Contractor shall have the following responsibilities:

A. Cooperation with laboratory personnel and provision of access to the work area and to the Contractor's operations;

B. Securing for the laboratory personnel adequate quantities of representative samples of materials proposed to be used and which require testing;

C. Furnishing copies of the product test reports as required;

3.8.1 <u>Core Material</u>

A. Field density and moisture content testing shall be performed to verify that compaction requirements have been achieved. In-place field density testing of the compacted core material shall be performed in accordance with the procedure, ASTM D 1556-82, the sand cone method. Test results reported should include both the moisture content and dry density, along with other data such as location, elevation, and Proctor curve used for comparison, etc.

B. Testing of in-place density and moisture content by nuclear methods ASTM D 2922-81 and ASTM D 3017-88, respectively, describe these testing procedures and may be used provided: 1) acceptable correlation with sand cone density test results can be obtained according to the guidelines of Section 7, "Calibration", of ASTM D-2922, and 2) the initial correlation results are reviewed and use of the nuclear device is approved by the Purchaser's Engineer. In addition, it shall be required that the PCM or his testing agency or representative have the necessary licenses to operate a nuclear energy source, and to take all safety precautions per Section 6 of ASTM D-2922.

C. 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 PCM to require one or two-point Proctor checks (on the dry side of optimum) to verify that the proper Proctor curve is being referenced. If not, a new Proctor curve determined by a five-point test shall be required. The Contractor shall sample and perform the five-point testing, all at the Contractor's expense.

D. If the compaction requirements for a lift have not been achieved, the PCM shall direct the Contractor to either rework the lift to obtain the compaction requirements or remove and replace with a new lift for compaction, all at the Contractor's expense.

E. The in-place density testing frequency for the core material shall be one test for each 10,000 square feet of lift area or portion thereof for each lift, with a minimum of three tests per lift.

3.8.2 RCC

A. Field density testing shall be performed to verify that compaction requirements have been achieved. In-place field density testing of the compacted core material shall be performed in accordance with the procedures of ASTM C 1040. Test results reported should include test method used (direct transmission or backscatter), density values, and other requirements of the ASTM standard. The testing equipment shall be calibrated as per the standard.

B. The in-place density testing frequency for the RCC shall be one test for each 2,500 square feet of lift area or portion thereof for each lift, with a minimum of five tests per lift.

4.0 RIGHT OF FIELD INSPECTION

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, the materials in use, and to follow 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 being properly performed or that is not in accordance with these Specifications. The Contractor has the responsibility for his work being performed properly and in accordance with these Specifications and the presence of an inspection shall not relieve the Contractor or his responsible agents of that responsibility.

5.0 QUALITY CONTROL AND QUALITY ASSURANCE

The Contractor shall implement approved quality control plans, programs, or practices, and shall institute any additional controls or procedures in accordance with proven industry practice to assure compliance with the Special Conditions, Scope of Work, Technical Specifications, and Drawings.

6.0 EQUIPMENT

The Earthwork Contractor shall be responsible for providing all equipment necessary to perform the work set forth in these Specifications. The Contractor shall be responsible for maintaining the equipment during the contract period. Any delays in work activities due to equipment maintenance must be reported to the PCM for determination of impacts on the schedule.

The Contractor shall be responsible for the cleaning of haul and other vehicles. The Contractor shall wash down the wheels, outside body, cab, undercarriage, etc., of all haul vehicles to prevent spreading of material during transit of the equipment out of the boundary of the working area or onto the RCC surface.

All the Contractor's equipment shall be operated in a safe, careful manner in accordance with these Specifications.

7.0 VEGETATIVE COVER

A. Establishment of vegetative cover shall be performed on all slopes and disturbed top surfaces of the abutments adjoining the crest raise. Establishment of vegetation shall also be performed in the disturbed areas of the borrow pit, where exposed soils are present in the rock borrow area, and along any haul roads used and/or constructed by the Contractor.

B. The PCM may direct the Contractor to establish vegetation in other areas of the site at an additional cost decided upon by the PCM and Contractor.

C. The Contractor shall produce a satisfactory stand of perennial vegetation. If it is necessary to repeat any or all the work, including plowing, fertilizing, watering, mulching and seeding, the Contractor shall repeat these operations until a satisfactory stand is obtained at no additional cost to the Purchaser.

D. All disturbed areas shall be established with vegetation as indicated by the Purchaser. Hydroseeding methods may be used upon approval of the mix by the PCM.

E. A satisfactory stand of vegetation is defined as a full cover of perennial plants that are alive and growing during the first growing season following seed application that is acceptable to the PCM.

F. Measures shall be taken to prevent erosion of the topsoil layer and vegetation until a full vegetative growth has been obtained.

G. Water required to promote a satisfactory growth shall be furnished and applied by the Contractor.

H. Coordinate seeding with other work.

I. Contractor must comply with regulatory agencies for fertilizer and herbicide composition.

8.0 ENVIRONMENTAL CONTROL MEASURES

8.1 ENVIRONMENTAL OPERATING PARAMETERS

The Contractor shall comply with and abide by all environmental laws, regulations, and permit stipulations which govern the operation of Plant Gorgas and its ash pond. These include but are not limited to the following permits:

- NPDES Permit No. AL-0002909
- Construction Stormwater Permit (to be obtained by Alabama Power Company for this project)

The rules and regulations include but are not limited to the following:

- The Clean Air Act of 1990, as amended
- The Federal Water Pollution Control Act
- Alabama Solid Waste Regulations

The Contractor shall be solely responsible for any penalties and restoration costs associated with the failure to comply with the above stipulations. Failure of the Contractor to conform to the Environmental Operation Parameters, as determined by the PCM shall constitute a breach of contract.

The Contractor shall provide equipment and personnel to perform emergency measures required to contain any spillages and to remove contaminated soils or liquids and shall excavate and dispose of any soil contaminated by the construction operations off-site, and replace such soil with suitable compacted fill and topsoil as directed by the PCM.

The Contractor shall take special measures to prevent harmful substances from entering public waters and shall prevent disposal of wastes, effluents, chemicals, sediments, or other such substances adjacent to streams, or in sanitary or storm sewers.

8.2 CLEANING

The Contractor shall conduct cleaning and disposal operations to comply with all codes, ordinances, regulations, and anti-pollution laws. Disposal of acceptable materials shall be to the ash pond, as determined by the PCM. Only those cleaning materials which will not create hazards to health or property and which will not damage surfaces shall be used. Only those cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned shall be used and cleaning materials shall be used only on those surfaces recommended by the material manufacturer.

The Contractor shall perform periodic cleaning to keep the work, the site, and adjacent properties free from accumulation of waste materials, rubbish, and windblown debris resulting from construction operations. The Contractor shall provide on-site containers for the collection of waste and shall periodically remove waste materials from the site and dispose of such materials in legal disposal areas away from the site.

8.3 DUST CONTROL

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 mud or debris on public road, plant roads, or adjacent properties.

8.4 POLLUTION CONTROL

The Contractor shall provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious and/or toxic substances, fueling stations, and pollutants produced by construction operations.

Toxic liquids, chemicals, fuels, lubricants, etc., shall be deposited into properly labeled containers for subsequent removal offsite in accordance with all applicable Federal, State, and local codes and standards.

8.5 EROSION AND SEDIMENT CONTROL

The Contractor shall provide, implement, and maintain the sediment and erosion control measures described in the plan submitted with the bid. The plan and associated measures will be approved by the PCM prior to the start of construction. The Contractor shall provide the measures for the entire contract period.

9.0 HAUL ROADS

It shall be the responsibility of the Contractor to maintain the existing haul roads, ramps, and associated culverts and ditching, and, with the express approval of the PCM, to design and construct any additional necessary ramps and/or haul roads, as required for his use and mode of operation. The ramps and haul roads shall be maintained in good condition throughout the contract period. The PCM must approve the source of materials required to construct and maintain the haul roads and ramps.

The Contractor shall be responsible for preventing dust problems, equipment tracking mud and soil clods onto County or State roads and highways, and the cleaning of the road surface from equipment usage as per the direction and to the satisfaction of the PCM.

The Contractor shall maintain all access roads used by the Contractor's hauling and vehicular equipment. The Contractor shall grade and repair roads daily to remove potholes, ruts, irregularities and slumps which develop in the road surface.

10.0 FINAL INSPECTION AND CERTIFICATION

The work in this inquiry shall be considered complete after the following:

A. All newly constructed improvements have been turned over to the Purchaser's representative for final inspection and acceptance.

B. A stand of vegetation shall be established such that there is a live, healthy covering of plants acceptable to the PCM 6 months from the time of planting. Furthermore, a stand of vegetation is established by "end of project plus eight weeks" per ALDOT specifications.

C. The survival rate for installed vegetation is at least 80% one year from the time of planting.

D. Contractor's work area is orderly and properly restored.

E. Contractor's equipment and materials have been removed from site.

F. The Contractor shall submit to the Purchaser a Project Completion Report including the following:

- Summary of slope stabilization work by area, along with progress and finish photos.
- QA/QC documentation
- Markups for as-built construction drawings.
- RCC, core soils and filter/transition zone material testing results.
- Applicable permits.
- Other documents as considered applicable and as notified to the Contractor by Purchaser at least 2 weeks prior to the estimated completion date.

DRAWING INDEX

CREST RAISE OF RATTLESNAKE HOLLOW DAM

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GENERAL NOTES - STRUCTURAL STEEL

1. STRUCTURAL STEEL FOR STOPLOG GATE SLOTS SHALL BE AS FOLLOWS:
   a) BAR – ASTM SA 479, GRADE 316L, UNC S31603, STAINLESS STEEL
   b) PLATE – ASTM SA 240, GRADE 316L, UNC S31603, STAINLESS STEEL
   c) SHAPES – ASTM SA 276, GRADE 316L, UNC S31603, STAINLESS STEEL
   d) CONC. ANCHORS (STUDS) – ASTM SA 320, B8FS
2. STRUCTURAL STEEL AND PLATES FOR STOPLOG GATES SHALL BE ASTM A588 (COR–TEN), GR. 50, UNLESS NOTED OTHERWISE.
3. DESIGN, FABRICATION AND ERECTION SHALL CONFORM TO THE AISC SPECIFICATIONS, NINTH EDITION AND THE CODE OF STANDARD PRACTICE.
4. SHOP AND FIELD WELDS SHALL BE PER AWS D1.1/D1.1M: STRUCTURAL WELDING CODE – STEEL. ALL ELECTRODES SHALL BE E70XX.
5. THE STEEL FABRICATOR SHALL OPTAIN APPROVAL OF HIS DETAIL DRAWINGS PRIOR TO BEGINNING OF FABRICATION OF DETAILED ITEMS.

GENERAL NOTES - STRUCTURAL FIBERGLASS

1. STRUCTURAL SHAPES SHALL BE FIBERGLASS REINFORCED PLASTIC VINYL ESTER RESIN (VFR), AS MANUFACTURED BY SEASAFE INC. OR STRONGWELL, INC. OR ANOTHER APPROVED EQUAL. STRUCTURAL SHAPES SHALL BE FABRICATED AND ASSEMBLED AS DETAILED ON THE DESIGN DRAWINGS AND IN ACCORDANCE WITH THE MANUFACTURER'S FABRICATION MANUAL.
2. SQ. HANDRAIL SHALL BE FIBERGLASS REINFORCED PULTRUSION VINYL ESTER RESIN, VFR ASSEMBLIES WITH UV INHIBITOR APPLIED, MEETING OSHA STRUCTURAL AND DIMENSIONAL REQUIREMENTS AND ASTM E–84 CLASS 1 AS MANUFACTURED BY SEASAFE INC. OR APPROVED EQUAL. HANDRAIL COLOR SHALL BE YELLOW. HANDRAIL SHALL INCLUDE VFR KICK PLATE.
3. THE PULTRUDED FIBERGLASS GRATING SHALL BE GATORDECK GD–I6010, (VFR) MANUFACTURED BY SEASAFE INC. OR APPROVED EQUAL. GRATING PANELS SHALL BE 1" THK. WITH BEARING BARS AT 1½" CENTERS WITH INTERLOCKING CROSSBARS SPACED ON 6" CENTERS. THE GRATING COLOR SHALL BE YELLOW WITH A GRITTED SURFACE.
4. ALL STRUCTURAL FASTENERS SHALL BE ½" DIAMETER, 316 STAINLESS STEEL BOLTS, WASHERS, AND NUTS.

CAST-IN-PLACE CONCRETE NOTES:

1. DESIGN MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE FOLLOWING LATEST STANDARDS UNLESS OTHERWISE MODIFIED ON THE DESIGN DRAWINGS OR IN THE SPECIFICATIONS:
   ACI–318–02 BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE
   ACI–315 MANUAL OF STANDARD PRACTICES FOR DETAILING REINFORCED CONCRETE STRUCTURES
   ACI–347R RECOMMENDED PRACTICE FOR PLACING REINFORCED CONCRETE
2. ALL CAST–IN–PLACE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI IN 28 DAYS, UNLESS NOTED.
3. REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO ASTM A615, GRADE 60.
4. CHAMFER ALL EXPOSED EXTERNAL CORNERS OF CONCRETE WITH A 45 DEGREE CHAMFER UNLESS OTHERWISE NOTED.
5. PROVIDE A MINIMUM COVER OF 3" FOR REINFORCING STEEL WHEN THE CONCRETE IS PLACED DIRECTLY AGAINST THE GROUND, UNLESS OTHERWISE NOTED.
6. PROVIDE A MINIMUM COVER OF 2" FOR BARS LARGER THAN #5 AND 1½" FOR #5 BARS OR SMALLER IF AFTER REMOVAL OF FORMS THE CONCRETE IS EXPOSED TO WEATHER OR IN CONTACT WITH THE GROUND, UNLESS OTHERWISE NOTED.
7. EMBEDMENT AND SPLICE LENGTHS FOR REINFORCING STEEL SHALL CONFORM TO ACI–318–02, UNLESS OTHERWISE NOTED.
8. SPLICE TOP BARS AND SIDE BARS AT MID–SPAN, AND BOTTOM BARS AT THE SUPPORT, UNLESS OTHERWISE NOTED.
9. ALL REINFORCING BAR HOOKS SHOWN ON DRAWINGS SHALL BE ACI STANDARD 90 DEGREE HOOKS, UNLESS OTHERWISE NOTED.
10. REBAR FABRICATOR SHALL OBTAIN APPROVAL OF HIS DETAIL DRAWINGS BEFORE BEGINNING FABRICATION.
11. CONCRETE TOP SURFACE SHALL RECEIVE A TROWEL FINIISH PER ACI–301–73, SECTION 11.73, "TROWEL FINISH", UNLESS OTHERWISE NOTED.
12. CONCRETE PLACEMENT SHALL CONFORM TO ACI 304. CONCRETE CONSOLIDATION SHALL CONFORM TO ACI 309. COLD WEATHER CONCRETE SHALL CONFORM TO ACI 306. HOT WEATHER CONCRETE SHALL CONFORM TO ACI 305.
13. IMMEDIATELY AFTER PLACEMENT, CONCRETE SHALL BE PROTECTED FROM HARMFUL EFFECTS SUCH AS SEVERE HEATING OR COOLING, PREMATURE DRYING OUT (INCLUDING BY WIND), LEACHING OUT BY FALLING RAIN OR FLOWING WATER, CHEMICAL ATTACK, OR VIBRATION AND IMPACT WHICH MAY DISRUPT THE CONCRETE OR INTERFERE WITH BOND TO REINFORCEMENT.
14. CONCRETE SHALL BE MAINTAINED WITH MINIMAL MOISTURE LOSS AT A RELATIVELY CONSTANT TEMPERATURE FOR THE PERIOD OF TIME NECESSARY FOR THE HYDRATION OF THE CEMENT AND PROPER HARDENING OF THE CONCRETE. MOIST CURING SHALL CONSIST OF MAINTAINING ALL SURFACES CONTINUOUSLY (NOT PERIODICALLY) WET BY PONDING, SPRINKLING, OR BY KEEPING AN ABSORBANT MAT OR FABRIC CONTINUOUSLY WET. THE WATER FOR CURING SHALL BE CLEAN AND FREE FROM ANY ELEMENTS WHICH WILL CAUSE STAINING OR DISCOLORATION OF THE CONCRETE. THE WATER SHALL BE APPROXIMATELY THE SAME TEMPERATURE AS THE CONCRETE. LENGTH OF MOST CURING SHALL BE AT LEAST 7 DAYS. TEMPERATURE OF CONCRETE SHALL BE PREVENTED FROM FALLING BELOW 50°F DURING THE CURING PERIOD.
15. WEATHER COVERS SHALL BE FURNISHED AND INSTALLED, AS NEEDED, TO PROTECT CONCRETE PLACEMENT.
16. PROPOSED MIX DESIGN SHALL BE SUBMITTED FOR REVIEW PRIOR TO COMMENCEMENT OF WORK.
17. A MINIMUM OF ONE SET OF FOUR CONCRETE TEST CYLINDERS SHALL BE TAKEN FOR EVERY 100 CU. YDS. OR ONE SET PER DAY, IF LESS THAN 100 CU. YDS. OF CONCRETE ARE PLACED. FROM EACH SET OF FOUR CYLINDERS, ONE SHALL BE TESTED AT 7 DAYS, TWO AT 28 DAYS, AND ONE SHALL BE RETAINED FOR FUTURE TESTING AS REQUIRED.
18. ONE SLUMP TEST SHALL BE TAKEN FOR EACH SET OF TEST CYLINDERS TAKEN.
19. SITE QUALITY CONTROL AND SUPPORTING DOCUMENTATION OF DESIGN CRITERIA FOR SOIL, REBAR, CONCRETE INSPECTION AND TESTING SHALL BE PROVIDED. DOCUMENTATION SHALL INCLUDE SUCH ITEMS AS, BUT NOT LIMITED TO: POUR CARDS, BATCH TICKETS, REBAR TICKETS, CONCRETE CYLINDER BREAKS, COMPACTION TESTS AND PROCTOR TESTS.

SPECIFICATIONS - CORRUGATED METAL PIPE

1. THE 48" DIAMETER PIPE SHALL BE A CORRUGATED ALUMINIZED STEEL, TYPE 2, LOCK SEAM OR WELDED, (NO COATING) PIPE WITH A WALL THICKNESS OF 0.064" (14 GAGE) AND 2⅔" x ½" CORRUGATIONS AS MANUFACTURED BY CONTECH OR APPROVED EQUAL. THE PIPES SHALL BE JOINED WITH 2' WIDE BANDS OF THE SAME MATCHING CORRUGATIONS AND WITH AN O–RING. PIPE MATERIAL SHALL MEET AASHTO M274 AND ASTM A929. COILS SHALL MEET AASHTO M36.
2. WATER TIGHTNESS OF JOINTS SHALL BE PER AASHTO BRIDGE SPECIFICATION SECTION 26.4.2.4(f). ADJOINING PIPE ENDS IN ANY JOINT SHALL NOT VARY MORE THAN 0.5 INCH IN DIAMETER OR MORE THAN 1.5 INCHES IN CIRCUMFERENCE. ALL TOLERANCES SHOULD BE OBTAINED EITHER BY PRODUCTION CONTROL OR FIELD MATCHED PIPE ENDS.
3. PIPE DESIGN BASED UPON AASHTO STANDARD BRIDGE DESIGN SPECIFICATIONS, SECTION 12 AND ASTM A796, WITH ALLOWABLE STEEL YIELD POINT OF 33KSI, AND STATE OF ALABAMA HIGHWAY DEPARTMENT STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION.

48" DIA. CMP PIPE INSTALLATION:

1. AFTER DIGGING OR TRENCHING EXISTING BACKFILL, REMOVE ALL ROCK OR UNSUITABLE MATERIAL DOWN TO DESIGNATED PIPE INVERT. EXCAVATE A TRENCH ALONG THE ENTIRE LENGTH OF THE NEW PIPE LOCATION A WIDTH AS SHOWN IN THE DETAILS. LEDGE ROCK OR ROCKS BEYOND THIS DIMENSION MAY BE LEFT IN PLACE. THE NEW BEDDING AND BACKFILL SHALL BE PER THE DETAILS AS SHOWN. ALSO, SEE BACKFILL AND INSTALLATION NOTES.
2. IF POSSIBLE, IT IS RECOMMENDED THAT THE 48"ø CMP IS INSTALLED STARTING AT A LOWER ELEVATION POINT AND PROGRESSING TOWARD A HIGHER ELEVATION POINT. THE OUTSIDE CIRCUMFERENTIAL LAPS SHALL BE PLACED FACING "UPSTREAM". LONGITUDINAL LAPS OR SEAMS SHALL BE AT THE SIDES.
3. THE 48"ø CMP MAY REQUIRE FIELD STRUTS/BRACES PRIOR TO INSTALLATION INTO THE DEFINED DITCH. (SEE NOTE #1, PIPE INSTALLATION.) IF USED, USE 4"x6" TIMBER VERTICAL STRUTS AT 4' SPACING AND WITH A UPPER/LOWER HORIZONTAL SEAL TIMBER. USE SOFT WOOD COMPRESSION CAPS (4"x6") WITH LEAST DIMENSION VERTICAL. IN LIEU OF STRUTS, SHOP ELONGATION MAY BE USED. THE PIPE/STRUTS SHALL BE INSPECTED BY THE PCM PRIOR TO FINAL BACKFILLING.
4. PIPE SHALL NOT BE ROLLED OR DRAGGED OVER GRAVEL AND SHALL BE PREVENTED FROM STRIKING ROCK OR OTHER HARD OBJECTS DURING HANDLING.
5. AT HIS DISCRETION, CONTRACTOR MAY CUT, BENCH, OR SLOPE EXISTING BACKFILL TO FACILITATE WORK AND PIPE INSTALLATION.

SELECT BACKFILL AND BEDDING FOR CMP PIPE:

1. a) SELECT BACKFILL MATERIAL SHALL BE FREE FROM LARGE OR FROZEN LUMPS, CLODS, ROCK OR STONES AND SHALL BE DEPOSITED IN LAYERS NOT TO EXCEED 6". NO ERODIBLE BACKFILL PERMITTED.
   b) GRANULAR, DENSE GRADED OR SANDY MATERIAL WITH MINIMAL PLASTICITY SHALL BE PLACED AROUND THE PIPE AS SHOWN IN THE DETAILS. SANDY MATERIALS SHOULD CONFORM TO AASHTO SPECIFICATION T–99 OR ASTM D698, COMPACTED TO 90% STANDARD DENSITY.
2. ORIGINAL SOIL SHALL BE CLEAR OF ANY SOFT OR LOOSE MATERIALS SO AS TO PROVIDE A SMOOTH AND STABLE SUPPORT FOR THE COMPACTED BEDDING MATERIAL. NO STANDING WATER PERMITTED. IF ROCK IS PRESENT UNDER PIPE LOCATION, CUT OUT ROCK A MINIMUM OF 12" IN DEPTH.
3. PLACE GRANULAR MATERIAL ON OR NEAR STRUCTURE AS SHOWN IN DETAILS, ALTERNATING THE COMPACTED LAYERS ON EACH SIDE OF THE PIPE. MAXIMUM LIFT SHALL BE 8".
4. EACH LAYER ADJACENT TO PIPE SHALL BE MOISTENED TO NEAR OPTIMUM MOISTURE CONTENT AND THEN COMPACTED TO A DENSITY OF NOT LESS THAN 90% STANDARD (ASTM D698).
5. HEAVY EQUIPMENT SHALL NOT BE PERMITTED TO OPERATE DIRECTLY OVER THE PIPE UNTIL A MINIMUM OF 3 FEET OF SELECT BACKFILL HAS BEEN PLACED OR SPECIAL PROVISIONS HAVE BEEN MADE FOR A FILL HEIGHT LESS THAN 4 FEET.

SPECIFICATIONS - FLOWABLE FILL FOR CMP PIPE:

1. FOR PIPE BACKFILL, A FLY ASH/CEMENT FLOWABLE FILL MIX SHALL CONSIST OF THE FOLLOWING:
   - 2,000 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 FOR 72 HOURS PRIOR TO PLACING COMPACTED SOIL BACKFILL ON FLOWABLE FILL ON OR AROUND THE FLOWABLE FILL.

SPECIFICATIONS - EMERGENCY SHUT-OFF GATE:

1. THE STAINLESS STEEL SLIDE GATE SHALL BE A SERIES 600 STAINLESS STEEL SLIDE GATE AS MANUFACTURED BY RODNEY HUNT COMPANY OR APPROVED EQUAL.
2. MATERIALS:

A. DISC SKIN PLATE	A276, TYPE 304 STAINLESS STEEL
B. FRAME AND GUIDES	A276, TYPE 304 STAINLESS STEEL
C. SEALS	1) J SIDE SEAL – RUBBER D2000, GRADE AA625 2) FLAT BOTTOM SEAL – NEOPRENE
D. RETAINER BARS AND FASTENERS FOR SEALS	A276, TYPE 304 STAINLESS STEELFOR SEALS
E. STEMS	A276, TYPE 304 STAINLESS STEEL
F. STEM COUPLINGS	A276, TYPE 304 STAINLESS STEEL
G. STEM GUIDES	A276, TYPE 304 STAINLESS STEEL

3. THE DISC SHALL CONSIST OF A FLAT PLATE REINFORCED WITH STRUCTURAL OR FORMED MEMBERS TO LIMIT ITS DEFLECTION TO THE LESSER OF 1/1000 OF THE GATE WIDTH OR 1/16". A RESILIENT NEOPRENE SEAL SHALL BE ATTACHED TO THE BOTTOM OF THE DISC TO PROVIDE A FLUSH BOTTOM CLOSURE. THE SIDE AND TOP DOUBLE BULB SEALS WILL BE NEOPRENE, AND WILL BE OF A DESIGN TO SEAL IN BOTH THE SEATING AND UNSEATING DIRECTIONS. THE SIDE AND TOP DOUBLE BULB SEALS SHALL BE ATTACHED TO THE GATE DISC USING LOW FRICTION CROMMETS SECURED BY STAINLESS STEEL FASTENERS TO PROVIDE A LOW FRICTION BEARINC SURFACE BETWEEN THE DISC GUIDES AND TO ALLOW EASY REPLACEMENT OF THE SEALS.
4. THE GATE FRAME WILL BE CONSTRUCTED OF STRUCTURAL MEMBERS FORMED FROM STAINLESS STEEL PLATE AND WELDED TO FORM A RIGID ONE–PIECE FRAME. THE GATE FRAME SHALL BE OF A FLAT BACK DESIGN TO ALLOW WALL MOUNTING WITHOUT A BOX–OUT INTO THE CONCRETE OPENING. THE GATE SHALL BE ATTACHED TO THE CONCRETE WALL WITH STAINLESS STEEL ANCHOR BOLTS. ADJUSTABLE ULTRA–HIGH MOLECULAR WEIGHT POLYETHYLENE PRESSURE PADS SHALL BE PROVIDED IN THE GUIDES TO CONTROL THE SEAL COMPRESSION. THE PRESSURE PADS SHALL BE ATTACHED WITH STAINLESS STEEL FASTENERS. ALL SEALING SURFACES SHALL HAVE A FINISH SMOOTHER THAN 125 MICRO–INCH RMS. THE INVERT SHALL BE STAINLESS STEEL ANGLE WELDED TO THE BOTTOM OF THE GUIDES TO FORM THE SEATING SURFACE FOR THE FLUSH–BOTTOM SEATING ATTACHED TO THE DISC. WHERE SELF–CONTAINED GATES ARE REQUIRED, THE YOKE SHALL CONSIST OF TWO STRUCTURAL OR FORMED MEMBERS WELDED TO THE TOP OF THE GUIDES IN A MANNER TO ALLOW REMOVAL OF THE DISC WITHOUT REMOVAL OF THE YOKE. THE YOKE SHALL BE DESIGNED SO THAT ITS DEFLECTION UNDER FULL OPERATING LOAD WILL NOT EXCEED 1/360 OF THE GATE WIDTH.
5. THE GATE LEAKAGE, WHEN SUBJECTED TO THE SPECIFIED HEADS, SHALL NOT EXCEED:
   A. UNDER SEATING HEAD CONDITIONS, THE LEAKAGE SHALL NOT EXCEED 0.1 GPM PER FOOT OF PERIMETER.
   B. FOR UNSEATING HEAD CONDITIONS UP TO A MAXIMUM OF 20 FEET, THE LEAKAGE SHALL NOT EXCEED 0.2 GPM PER FOOT OF SEATING PERIMETER.
6. STEMS SHALL BE TYPE 304 STAINLESS STEEL. STEM THREADS SHALL BE OF THE CUT ACME TYPE. STEMS SHALL BE DESIGNED TO TRANSMIT IN COMPRESSION A MINIMUM OF 2 TIMES THE RATED OUTPUT OF THE HOIST AT 40 POUNDS EFFORT ON THE CRANK. THE L/r RATIO OF THE UNSUPPORTED STEM SHALL NOT EXCEED 200. STEM GUIDES, WHERE REQUIRED TO LIMIT THE UNSUPPORTED STEM LENGTH, SHALL BE BRONZE BUSHED.
7. THE BENCHSTAND HOIST SHALL BE SIZED TO PERMIT OPERATION OF THE GATE UNDER THE FULL OPERATING HEAD WITH A MAXIMUM EFFORT OF 40 POUNDS ON THE CRANK. THE HOIST NUT SHALL BE MANGANESE BRONZE. THE HOIST NUT SHALL BE SUPPORTED ON ROLLER BEARINGS. LUBRICATION FITTINGS SHALL BE PROVIDED TO PREVENT ENTRY OF FOREIGN MATTER. THE DIRECTION OF CRANK ROTATION TO OPEN THE GATE SHALL BE CLEARLY AND PERMANENTLY MARKED ON THE HOIST.
8. RISING STEM GATES SHALL BE PROVIDED WITH CLEAR BUTYRATE STEM COVERS TO PROVIDE INDICATION OF GATE POSITION. PERMIT INSPECTION OF THE STEM THREAD AND TO PROTECT THE STEM FROM CONTAMINATION. THE STEM COVER SHALL BE CONSTRUCTED OF CLEAR RIGID BUTYRATE. VENT HOLES SHALL BE PROVIDED TO PREVENT CONDENSATION.

NOTES:

1. ALSO SEE SHEET 2 OF 2.

REFERENCES:

SEE TECHNICAL SPECIFICATIONS FOR EARTHWORK AND ROLLER COMPACTED CONCRETE CREST RAISE CONSTRUCTION.

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Southern Company Services, Inc.
FOR
Alabama Power Company

GORGAS STEAM PLANT
CREST RAISE OF RATTLESNAKE HOLLOW ASH POND AND NEW DISCHARGE STRUCTURE – DRAWING INDEX, NOTES, AND SPECIFICATIONS

REVISION	DATE
A	7-21-06

ISSUED FOR INQUIRY

JOB NO. 2101FS

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR
HLF	PMG	JBS				CKT

SCALE	PROJ I.D.	DRAWING NUMBER	SH	CONT'D	REV
NONE		D-586211	1/2	FINAL	A

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EXCAVATION AND BACKFILL NOTES:

1. ALL EXCAVATION SHALL COMPLY WITH THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTATION (OSHA) CONSTRUCTION STANDARDS FOR EXCAVATIONS, AND ANY STATE OR LOCAL REGULATIONS.
2. SHORE AND BRACE WHERE SLOPING IS NOT POSSIBLE BECAUSE OF SPACE RESTRICTIONS OR STABILITY OF THE MATERIAL EXCAVATED. MAINTAIN SIDES AND SLOPES OF THE EXCAVATION IN SAFE CONDITION UNTIL COMPLETION OF BACKFILLING.
3. PROVIDE ADEQUATE MEANS OF SUPPORT AND PROTECTION OF EXISTING KNOWN UNDERGROUND PIPING AND UTILITIES DURING EARTH WORK OPERATIONS. DURING EXCAVATION, CARE MUST BE EXERCISED FOR UNKNOWN UNDERGROUND PIPING AND OTHER UTILITIES.
4. PROTECT EXCAVATION BOTTOMS AGAINST FREEZING WHEN ATMOSPHERIC TEMPERATURE IS LESS THAN 35°F (1°C)
5. SURFACE WATER SHALL BE PREVENTED FROM FLOWING INTO EXCAVATIONS AND FROM FLOODING PROJECT WORK AND SURROUNDING AREA. SOME SHALLOW AND/OR PERCHED GROUNDWATER CONDITIONS MAY BE ENCOUNTERED, AND SUBSURFACE WATER FLOWING INTO EXCAVATIONS SHALL BE MINIMIZED TO THE EXTENT POSSIBLE. WATER SHALL NOT BE ALLOWED TO ACCUMULATE IN EXCAVATIONS. ANY INFLOW SHALL BE REMOVED FROM THE EXCAVATION THROUGH THE USE OF SUMPS AND PUMPS. CARE SHALL BE TAKEN TO REDUCE THE POTENTIAL OF PUMPING SOIL FINES FROM THE EXCAVATION.
6. IF SOFT SPOTS ARE IDENTIFIED IN THE SUBGRADE SOIL, THE SUBGRADE SHALL BE SCARIFIED AND PROOFROLLED TO THE REQUIRED DEPTHS. FILL PLACEMENT AND COMPACTION SHALL BE PERFORMED TO THE DENSITY REQUIREMENTS OF NOTE 8. IF THE SOFT AREAS CANNOT BE ADEQUATELY COMPACTED, THE SOFT SOIL SHALL BE REPLACED WITH SUITABLE SOIL MATERIAL AND COMPACTED TO THE DENSITY REQUIREMENTS OF NOTE 8.
7. CONCRETE SHALL BE PLACED AS SOON AS POSSIBLE AFTER FOUNDATIONS ARE EXCAVATED TO FINAL GRADE. IF ANY EXCAVATED HOLE IS LEFT OPEN FOR ANY LENGTH OF TIME SUCH THAT THE BEARING SOIL BECOMES SOFTENED BY SURFACE WATER INTRUSION OR EXPOSURE, THEN THE SOFTENED SOIL SHALL BE REMOVED AND SHALL BE BACKFILLED TO THE GRADE SPECIFIED WITH NATURAL SAND, GRAVEL, OR CRUSHED STONE, AND TAMPED UNTIL A FIRM AND UNYIELDING FOUNDATION IS OBTAINED.
8. COMPACTED FILL AND BACKFILL SHALL BE DEPOSITED IN LAYERS NOT TO EXCEED 8 INCHES IN DEPTH. EXCEPT AS NOTED, EACH LAYER SHALL BE ROLLED AND THOROUGHLY COMPACTED TO A DENSITY OF NOT LESS THAN 96 PERCENT OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY. BACK FILL AND COMPACTED FILL SHALL BE MAINTAINED WITHIN +3 AND −3 PERCENT OF OPTIMUM MOISTURE CONTENT. BACKFILLING AROUND CONCRETE STRUCTURES SHALL NOT BEGIN UNTIL THE CONCRETE WORK HAS BEEN INSPECTED AND APPROVED, AND THE EXCAVATIONS HAVE BEEN CLEARED OF FORM MATERIAL AND TRASH.
9. BACKFILL SHALL BE PLACED ADJACENT TO AND IN CONTACT WITH CONCRETE FOUNDATIONS IN A MANNER WHICH WILL RESULT IN GOOD CONTACT OF THE FILL WITH THE FOUNDATION. CONVENTIONAL COMPACTION EQUIPMENT SHALL BE USED INSOFAR AS POSSIBLE. IN AREAS WHICH CANNOT BE COMPACTED BY CONVENTIONAL COMPACTION EQUIPMENT, THE FILL MATERIAL SHALL BE SPREAD IN 4 INCH LOOSE LIFTS AND COMPACTED WITH MANUALLY-GUIDED PLATE TYPE TAMPERS.

CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL OBTAIN FROM THE PURCHASER DESIGNATED ACCESS DIRECTIONS ACROSS THE PROPERTY TO THE JOB SITE. THE CONTRACTOR WILL NOT BE PERMITTED TO TRAVEL OR RUN MACHINERY ACROSS CERTAIN PLANT ROADS AND TRAILS.
2. EXISTING ACCESS AND PLANT ROADS, INCLUDING ROADS LEADING TO APCO PROPERTY, SHALL BE MAINTAINED AND REPAIRED IF NECESSARY DURING CONSTRUCTION BY THE CONTRACTOR TO THE SATISFACTION OF THE PURCHASER'S REPRESENTATIVE AND OF THE LOCAL PUBLIC ROAD AUTHORITY. THESE ROADS SHALL BE LEFT IN GOOD CONDITION OR BETTER CONDITION AT THE END OF THE PROJECT.
3. THE CONTRACTOR SHALL EXERCISE EXTREME SAFETY PRECAUTIONS AND ABIDE BY SAFE SPEED LIMITS FOR CONSTRUCTION EQUIPMENT WHEN TRAVELING THROUGH RESIDENTIAL AREAS APPROACHING PLANT PROPERTY.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AND MAINTAINING PROPER AND NECESSARY SOIL EROSION AND SEDIMENT CONTROL MEASURES SUCH AS SILT FENCES, TEMPORARY DITCHES, ETC, IN ORDER TO PREVENT THE ENTRY OF SUCH SEDIMENTS INTO WATERS OF THE UNITED STATES AND INTO THE ASH POND.
5. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING AND MAINTAINING DUST CONTROL MEASURES ON THE PROJECT.
6. ALL EXCAVATED MATERIAL UNACCEPTABLE FOR REUSE AND DREDGED MATERIAL FROM THE ASH POND SHALL BE DISPOSED OF IN DESIGNATED SPOIL AREAS APPROVED BY THE PURCHASER.
7. ALL VEGETATION, GRASS, TREES, ROOTS AND OTHER FALLEN DEBRIS REMOVED SHALL BE DISPOSED BY THE CONTRACTOR AS REQUIRED BY THE PURCHASER. NO BURNING OF THESE MATERIALS WILL BE ALLOWED ON THE PURCHASER'S PROPERTY WITHOUT THE PURCHASER'S CONSENT.
8. THE CONSTRUCTION SITE AREA SHALL BE LEFT IN A CLEAN AND AS GOOD OR BETTER CONDITION AT THE END OF THE PROJECT.

SLUICE LINE PIPE MATERIALS SPECIFICATIONS:

1. ALL PIPE AND FITTINGS SHALL BE DRISCOPIPE 1000 SERIES OR APPROVED EQUAL, MANUFACTURED FROM HIGH DENSITY, EXTRA MOLECULAR WEIGHT PE 3408 POLYETHYLENE PIPE GRADE RESIN.
2. ALL HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS SHALL HAVE A STANDARD DIMENSION RATIO (SDR) OF 17 UNLESS DESIGNATED OTHERWISE.
3. ALL BUTT JOINTS SHALL BE MADE WITH APPROPRIATE HEAT FUSION METHODS AND EQUIPMENT. REFER TO DRISCOPIPE INSTALLATION GUIDELINES.
4. STACKING OF HIGH DENSITY POLYETHYLENE PIPING FOR STORAGE ON SITE SHALL BE PER PLASTIC PIPING INSTITUTE'S GUIDELINES.
5. CONTRACTOR SHALL FIELD ROUTE PIPE PER DWG. NO. D-586219 WITH MINIMUM BEND RADIUS OF 50' (27 x O.D.) TO ELIMINATE FITTING REQUIREMENTS.

SLUICE LINE PIPE SUPPORT MATERIALS SPECIFICATIONS:

1. FOR DETAILS AND MATERIAL REQUIREMENTS ON PONTOON SUPPORTS, SEE DWG. NO. D-586228.
2. FOR DETAILS AND MATERIAL REQUIREMENTS ON PIPE RESTRAINTS, SEE DWG. NO. D-586228.

EMBANKMENT CREST RAISE NOTES:

1. THE EMBANKMENT CREST RAISE WILL BE CONSTRUCTED OF ROLLER COMPACTED CONCRETE, EARTHEN CORE MATERIAL, FILTER/TRANSITION ZONE MATERIAL, AND ROCK FILL. THE EARTHEN CORE MATERIAL AND THE ROCK FILL ARE TO BE OBTAINED FROM ON-SITE BORROW/QUARRY SOURCES.
2. REQUIREMENTS FOR MATERIAL PROPERTIES, PLACEMENT AND COMPACTION ARE REFERENCED IN THE TECHNICAL SPECIFICATIONS, EXHIBIT 4.

EXCAVATION AND BACKFILL PROCEDURES EMERGENCY DISCHARGE PIPE REMOVAL

1. THE EXCAVATION WILL EXTEND TO A DEPTH OF ABOUT 1 FOOT BELOW PIPE INVERT (OR TO ABOUT EL. 364 OR DEEPER UNTIL CLAYEY CORE MATERIAL IS ENCOUNTERED. COMMENCE EXCAVATION WITH SUFFICIENT TOP-WIDTH SUCH THAT THE EXCAVATION WILL BE ABOUT 1 BACKHOE BUCKET WIDTH ON EACH SIDE OF THE SPRINGLINE ONCE READHED. THE NET SIDESLOPES OF THE EXCAVATION SHOULD BE SLOPED NO STEEPER THAN 1H:1V. AFTER EXCAVATION, THE PIPE SHOULD BE REMOVED AND PROPERLY DISPOSED OF.
2. AFTER PIPE REMOVAL, THE EXCAVATION SHALL BE INSPECTED BY THE PURCHASER'S ENGINEER TO ASSURE THAT THE EXCAVATION HAS BEEN TAKEN BACK TO FINE-GRAINED CORE MATERIAL WITHIN THE BOUNDARIES OF THE CORE. THE BOTTOM OF THE EXCAVATION SHOULD THEN BE COMPACTED WITH A MINIMUM OF 5 PASSES OF A SHEEPSFOOT TYPE COMPACTOR AND/OR HEAVY RUBBER TIRED EQUIPMENT. BACKFILLING OF THE EXCAVATION CAN THEN BEGIN.
3. FROM THE UPSTREAM FACE OF THE EMBANKMENT, THE EXCAVATION SHOULD BE BACKFILLED WITH CORE MATERIAL IN MAXIMUM 8-INCH (LOOSE MEASURE) LIFTS TO A MINIMUM 95% STANDARD PROCTOR MAXIMUM DRY DENSITY. MOISTURE CONTENT OF THE CORE BACKFILL SHOULD BE WITHIN −1 TO +3 PERCENT OF THE MATERIAL'S OPTIMUM MOISTURE CONTENT. THE BACKFILLING WITH CORE MATERIAL SHOULD EXTEND DOWNSTREAM TO MATCH THE EXISTING CLAY CORE MATERIALS. AT THIS POINT, THE COARSE AND FINE FILTER ZONES AND THE ROCKFILL SHALL BE CONSTRUCTED DOWNSTREAM OF THE CORE TO MATCH THE EXISTING CROSS SECTION OF THE DAM.
4. AS THE BACKFILLING PROCEEDS UPWARDS, THE SIDEWALLS OF THE EXCAVATION SHOULD BE BENCHED WITH EACH LIFT TO "TIE" THE NEW FILL SOILS INTO THE EXISTING SOILS.
5. THE AREA UPSTREAM OF THE CORE BACKFILL SHOULD BE BACKFILLED WITH A MIXTURE OF CORE MATERIAL AND ROCKFILL, SIMILAR TO WHAT IS CURRENT IN PLACE ON THE UPSTREAM FACE OF THE EMBANKMENT.
6. BACKFILLING USING THE METHODS AND MATERIALS DESCRIBED ABOVE SHOULD CONTINUE UPWARDS UNTIL THE DESIGN ELEVATION OF THE BOTTOM OF THE ROLLER COMPACTED CONCRETE IS ACHIEVED.

NOTES:

1. ALSO SEE SHEET 1 OF 2.

REFERENCES:

SEE TECHNICAL SPECIFICATIONS FOR EARTHWORK AND ROLLER COMPACTED CONCRETE CREST RAISE CONSTRUCTION.

CAD D586211-2
AutoCad 2004 | HLF-A

Southern Company Services, Inc.
FOR
Alabama Power Company

GORGAS STEAM PLANT
CREST RAISE OF RATTLESNAKE HOLLOW
ASH POND AND NEW DISCHARGE STRUCTURE
NOTES AND SPECIFICATIONS

REVISION	DATE

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

REVISION A — DATE 7-21-06
ISSUED FOR INQUIRY
JOB NO. 2101FS

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR
HLF	PMG	JBS				CKT

SCALE	PROJ I.D.	DRAWING NUMBER	SH	CONT'D	REV
NONE		D-586211	2/2	FINAL	A

ANSI F: 28x40 Acad2004

APPENDIX 5

STRUCTURAL STABILITY ASSESSMENT

The Updated Structural Stability Assessment for the Plant Gorgas Ash Pond was initially prepared to satisfy federal standards. It also satisfies 33-13-15-.04(4)(d) and 335-13-15-.09(1)(a)7.(ii) and is included for that purpose.

UPDATED STRUCTURAL STABILITY ASSESSMENT
PLANT GORGAS 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(d), requires the owner or operator of an existing CCR surface impoundment to conduct periodic structural stability assessments. The owner or operator must document whether the design, construction, operation and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein.

The CCR surface impoundment located at Alabama Power Company's Plant Gorgas, also referred to as the Plant Gorgas Ash Pond, is located on Plant Gorgas property near Parrish, Walker County, Alabama. The CCR surface impoundment is formed by an engineered cross-valley embankment. The foundations and abutments generally consist of stable stiff to hard silty or sandy clays and partially weathered shale and sandstone.

Slope protection against surface erosion consists of roller compacted concrete on the upstream face and rock fill on the downstream slopes. Wave action could develop under some conditions, but the presence of the roller compacted concrete provides adequate protection against any potential wave action. The pond is not operated in such a manner as to normally be subjected to rapid drawdown conditions. However, historic stability analyses have been conducted for such conditions, and these analyses have indicated that the slopes are stable for rapid drawdown. The roller compacted concrete is not subject to erosion in the event rapid drawdown were to occur.

The cross-valley embankments have been properly constructed using mechanical stabilization, compacted to a density sufficient to withstand the range of loading conditions.

The primary spillway (constructed in 2007) is constructed of a concrete overflow weir structure discharging to a 48-in diameter corrugated metal pipe. A two-bay concrete spillway structure serves as an auxiliary spillway structure. The spillways are designed, constructed operated and maintained to adequately manage flow during and following the peak discharge from the Probable Maximum Flood (PMF).

The CCR unit has a corrugated metal pipe that penetrates the embankment after it leaves the concrete overflow discharge structure. This pipe is encased in flowable fill poured neat against the embankment materials throughout the length of the embankment penetration. Recent inspections of this structure indicate there is no evidence of deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the structure.

The downstream slopes of the embankment are not subject to inundation from adjacent water bodies.

I hereby certify that the structural stability assessment was conducted in accordance with 40 C.F.R. Part 257.73(d).

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

APPENDIX 6

SAFETY FACTOR ASSESSMENT

The Initial Safety Factor Assessment for the Plant Gorgas Ash Pond was initially prepared to satisfy federal standards. It also satisfies 335-13-15-.04(4)(e) and 335-13-15-.09(1)(a)7.(iii) and is included for that purpose.

INITIAL SAFETY FACTOR ASSESSMENT
PLANT GORGAS 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 CCR surface impoundment located at Alabama Power Company's Plant Gorgas also referred to as the Plant Gorgas Ash Pond is located on Plant Gorgas property, southeast of Parrish, Alabama. The CCR surface impoundment is formed by an engineered cross-valley embankment. The critical section of this CCR unit has been determined to be located at the centerline of the embankment, which is the highest section of the embankment.

The analyses used to determine the minimum safety factor for the critical section resulted in the following minimum safety factors:

Loading Condition	Minimum Calculated Safety Factor	Minimum Required Safety Factor
Long-term Maximum Storage Pool (Static)	1.5	1.5
Maximum Surcharge Pool (Static)	1.5	1.4
Seismic	1.5	1.0

The embankments are not constructed of clays and silts that are not susceptible to liquefaction. Therefore, a minimum liquefaction safety factor determination was not required.

I hereby certify that the safety factor assessment was conducted in accordance with 40 C.F.R. Part 257.73 (e)(1).

10/17/16

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-GO-APC389153-001

Project/Plant: Plant Gorgas Ash Pond	**Unit(s):** Units 8-10	**Discipline/Area:** ESFS
Title/Subject: Slope Stability Analysis of Plant Gorgas Ash Pond Dam		
Purpose/Objective: Analyze slope stability of the Plant Gorgas Ash Pond Dam		
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 – Laboratory Analyses	2
Methodology	2	Attachment B – Drawings Used to Develop Critical Section Profile	3
Criteria and Assumptions	2		
Input Data	3		
Summary of Conclusions	4		
Design Inputs/References	4		
Body of Calculation	4		
Total # of pages including cover sheet & attachments:	16		

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Information	SHS 10/06/16	JAJ 10/10/16	JCP 10/10/10

Notes:

Purpose of Calculation

The William C. Gorgas Electric Generating Plant is a 3-unit electric generating facility, all of which are coal-fired units. The Plant Gorgas Ash Pond is designed to receive and store coal combustion residuals produced during the electric generating process at Plant Gorgas, as well as serve as a low-volume waste treatment pond. CCR products are sluiced from the plant to the Ash Pond.

The purpose of this calculation is to provide a slope stability assessment of the Plant Gorgas Ash Pond dam under conditions prescribed by the EPA CCR rule.

Methodology

The calculation was performed using the following methods and software:

GeoStudio 2012 (Version 8.15.5.11777), August 2015 Release, Copyright 1991-2016, GEO-SLOPE International, Ltd.

Strata (Version alpha, Revision 0.2.0), Geotechnical Engineering Center, Department of Civil, Architectural, and Environmental Engineering, University of Texas.

The Morgenstern-Price analytical method with an entry-exit slip surface was used for slope stability calculation.

Criteria and Assumptions

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

- Seismic site response was determined using a one-dimensional equivalent linear site response analysis. The analysis was performed using Strata and utilizing random vibration theory. The input motion consisted of the USGS published 2008 Uniform Hazard Response Spectrum (UHRS) for Site Class B/C at a 2% Probability of Exceedance in 50 years. The UHRS was converted to a Fourier Amplitude Spectrum, and propagated through a representative one dimensional soil column using linear wave propagation with strain-dependent dynamic soil properties. The input soil properties and layer thickness were randomized based on defined statistical distributions to perform Monte Carlo simulations for 100 realizations, which were used to generate a median estimate of the surface ground motions.

- The median surface ground motions were then used to calculate a pseudostatic seismic coefficient for utilization in the stability analysis using the approach suggested by Bray and Tavasarou (2009). The procedure calculates the seismic coefficient for an allowable seismic displacement and a probability exceedance of the displacement. For this analysis, an allowable displacement of 0.5 ft, and a probability of exceedance of 16% were conservatively selected, providing a seismic coefficient of 0.028g for use as a horizontal acceleration in the stability analysis.

- The Corps of Engineers (COE) EM 1110-2-1902 standard, October 2003, allows the use of the phreatic surface established for the maximum storage condition (normal pool) in the analysis for the maximum surcharge loading condition. This is based on the short term duration of the surcharge loading relative to the permeability of the embankment and the foundation materials. This method is used in the analysis for the impoundments at this facility with surcharge loading.

- The current required minimum criteria (factors of safety) were taken from the Structural Integrity Criteria for Existing CCR Surface Impoundments, 40 CFR 257.73, published April 17, 2015.

- The critical section was selected at location having the apparent maximum dam height. The cross-section of the Plant Gorgas Ash Pond dam was modeled using the following sources:
  1) Historical Alabama Power Company (APC) Drawings F-97854, C-189068, and D-586217 depicting typical dam cross sections for original construction, the 1977 dam raise and the 2007 dam raise.
  2) Plant Gorgas CCR Topo and Plan View Mapping Rattlesnake Ash Pond, 2016

Input Data

- Soil Properties: Because the physical properties of the dam construction (materials and configuration) make sampling and testing unfeasible, the selection of soil properties used for the analysis (unit weight, phi angle, and cohesion) relied on historical construction records and historical records of laboratory analyses of borrow material used to construct portions of the dam. The ash properties used for the analysis (unit weight, phi angle, and cohesion) were based on laboratory testing performed on undisturbed and remolded samples of ash from various plants and on engineering judgment.

Soil Description	Unit Weight, pcf	Effective Stress Parameters	
		Cohesion, psf	Phi Angle, degrees
Old Rockfill	140	0	38
New Rockfill	145	0	43
Class H Mine Spoil	129	500	22
Clay Foundation	134	500	31
Ash	98	0	28
Shale	Impenetrable bedrock		

- Phreatic Surface: The phreatic surface used in the analysis was developed from historic geophysical testing and seepage analyses, supplemented by visual observation of dam seepage and engineering judgment.

Summary of Conclusions

The following table summarizes the factors of safety resulting from the slope stability analyses. The results indicate the safety factors of the Plant Gorgas Ash Pond dam meet or exceed the minimum criteria set forth in the structural integrity criteria for existing CCR surface impoundments, 40 CFR 257.73.

Factor of Safety Summary Table

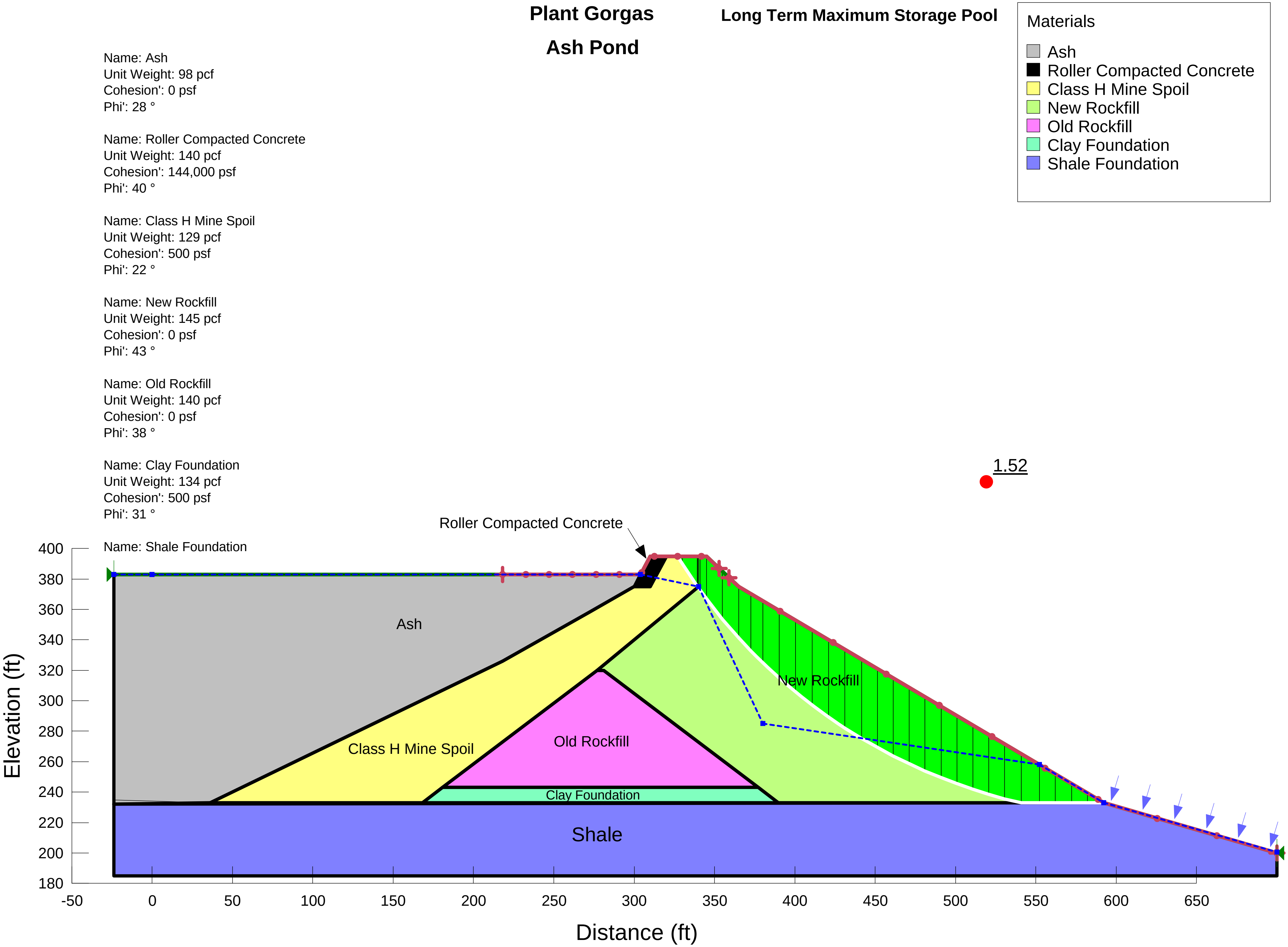
Loading Condition	Minimum Calculated Safety Factor	Minimum Required Safety Factor
Long-term Maximum Storage Pool (Static)	1.5	1.5
Maximum Surcharge Pool (Static)	1.5	1.4
Seismic	1.5	1.0

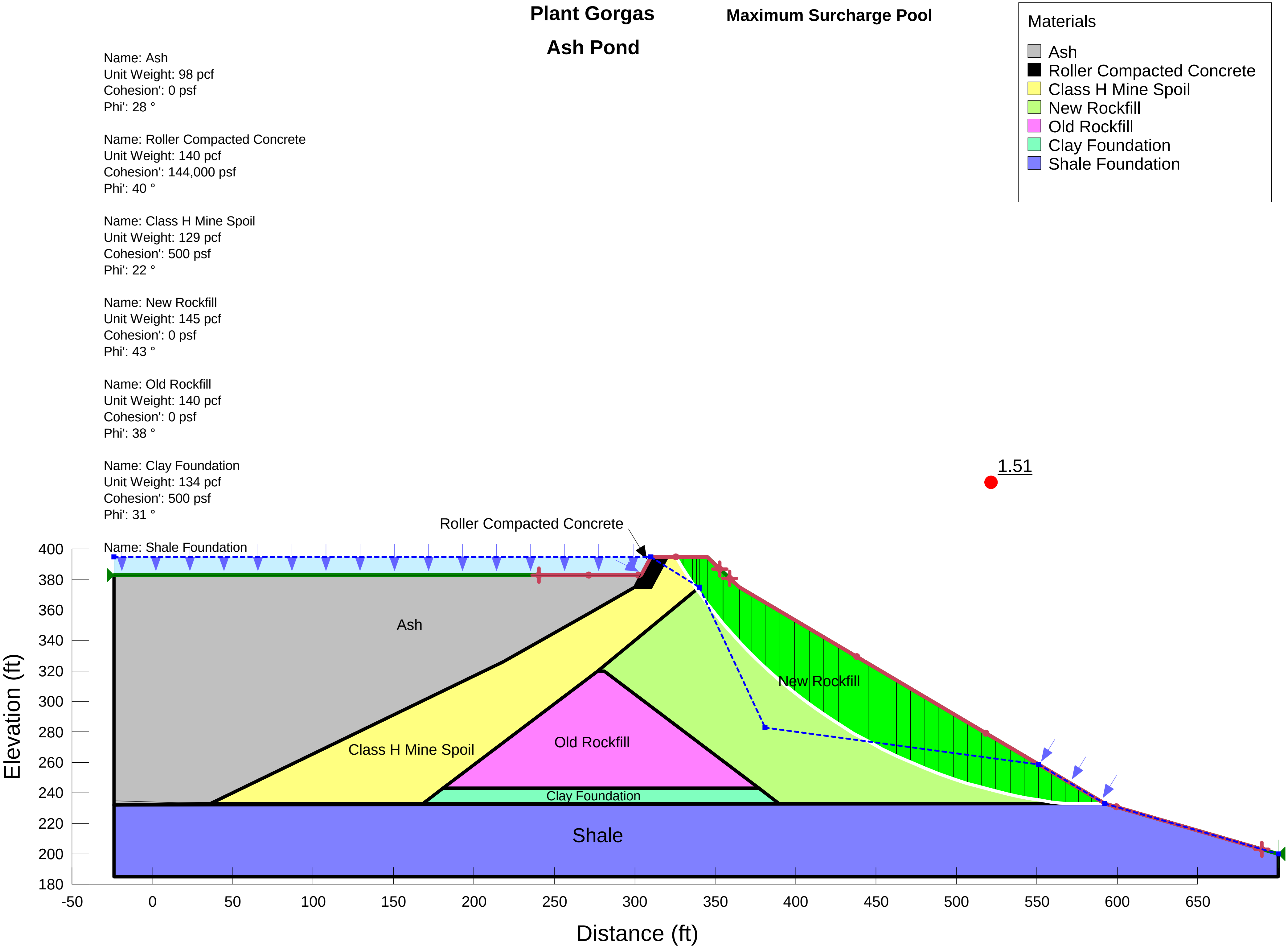
Design Inputs/References

- 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
- APC Drawing F-97854, Gorgas Ash Disposal Pond, Rattlesnake Hollow Site, Rock Fill Dam, 1953
- APC Drawing C-189068, Gorgas Ash Handling, Sloping Core Design (Typical Cross Section), 1973
- APC Drawing D-586217, Crest Raise of Rattlesnake Hollow Ash Pond Sections and Details, 2006
- Crest Raise Feasibility Study, Rattlesnake Hollow Ash Pond Dam, Gorgas Steam Plant, Southern Company Technical Services, 2005

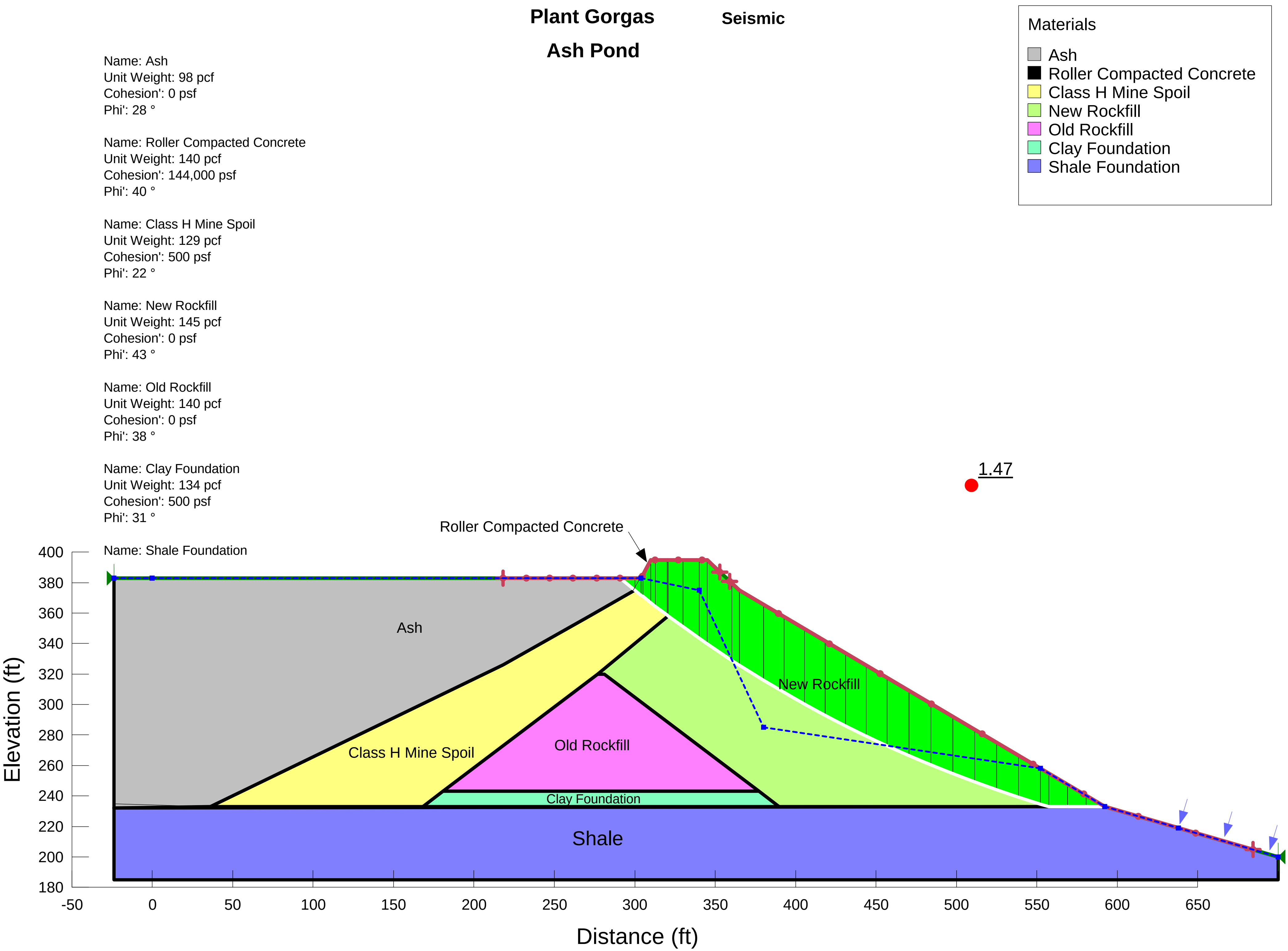
Body of Calculation

Slope/W files attached


Plant Gorgas
Ash Pond
Long Term Maximum Storage Pool
Materials
Ash
Roller Compacted Concrete
Class H Mine Spoil
New Rockfill
Old Rockfill
Clay Foundation
Shale Foundation
Name: Ash
Unit Weight: 98 pcf
Cohesion': 0 psf
Phi': 28 °
Name: Roller Compacted Concrete
Unit Weight: 140 pcf
Cohesion': 144,000 psf
Phi': 40 °
Name: Class H Mine Spoil
Unit Weight: 129 pcf
Cohesion': 500 psf
Phi': 22 °
Name: New Rockfill
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 43 °
Name: Old Rockfill
Unit Weight: 140 pcf
Cohesion': 0 psf
Phi': 38 °
Name: Clay Foundation
Unit Weight: 134 pcf
Cohesion': 500 psf
Phi': 31 °
Name: Shale Foundation
1.52
Roller Compacted Concrete
Ash
New Rockfill
Class H Mine Spoil
Old Rockfill
Clay Foundation
Shale
Elevation (ft)
400
380
360
340
320
300
280
260
240
220
200
180
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Distance (ft)



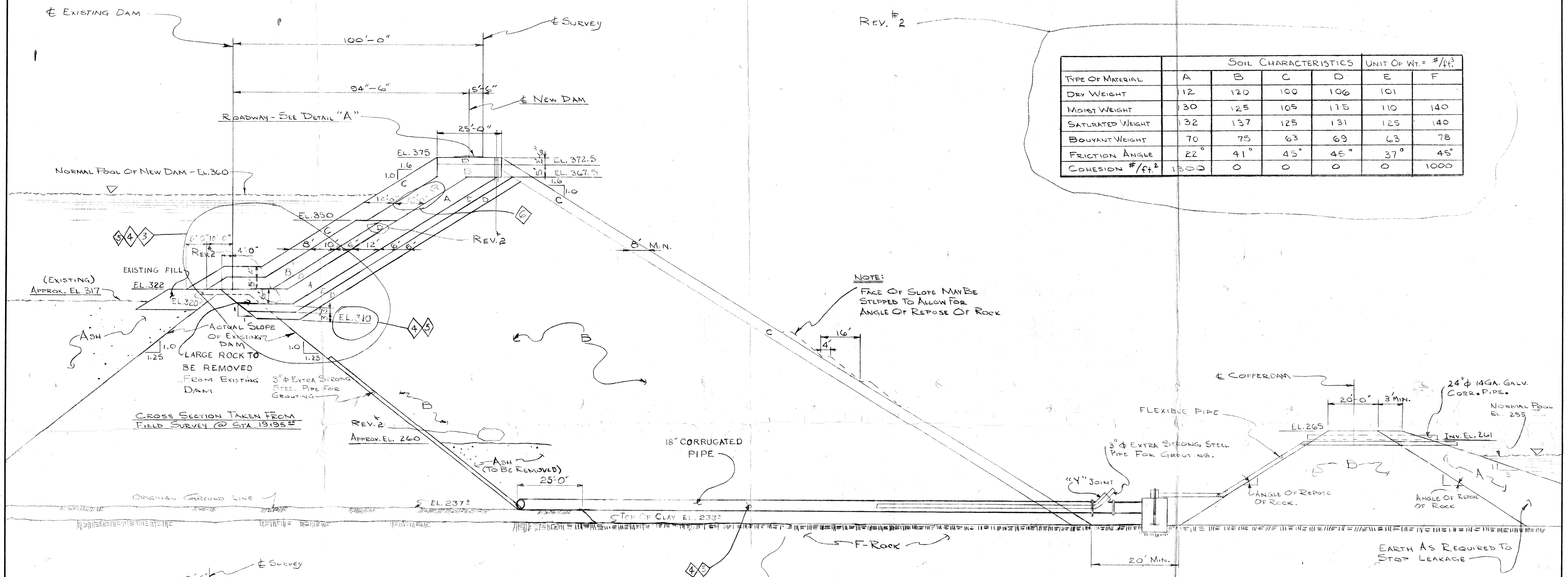
Plant Gorgas
Ash Pond
Maximum Surcharge Pool
Materials
Ash
Roller Compacted Concrete
Class H Mine Spoil
New Rockfill
Old Rockfill
Clay Foundation
Shale Foundation
Name: Ash
Unit Weight: 98 pcf
Cohesion': 0 psf
Phi': 28 °
Name: Roller Compacted Concrete
Unit Weight: 140 pcf
Cohesion': 144,000 psf
Phi': 40 °
Name: Class H Mine Spoil
Unit Weight: 129 pcf
Cohesion': 500 psf
Phi': 22 °
Name: New Rockfill
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 43 °
Name: Old Rockfill
Unit Weight: 140 pcf
Cohesion': 0 psf
Phi': 38 °
Name: Clay Foundation
Unit Weight: 134 pcf
Cohesion': 500 psf
Phi': 31 °
Name: Shale Foundation
1.51
Roller Compacted Concrete
Ash
New Rockfill
Class H Mine Spoil
Old Rockfill
Clay Foundation
Shale
Elevation (ft)
400
380
360
340
320
300
280
260
240
220
200
180
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Distance (ft)



Plant Gorgas
Seismic
Ash Pond
Name: Ash
Unit Weight: 98 pcf
Cohesion': 0 psf
Phi': 28 °
Name: Roller Compacted Concrete
Unit Weight: 140 pcf
Cohesion': 144,000 psf
Phi': 40 °
Name: Class H Mine Spoil
Unit Weight: 129 pcf
Cohesion': 500 psf
Phi': 22 °
Name: New Rockfill
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 43 °
Name: Old Rockfill
Unit Weight: 140 pcf
Cohesion': 0 psf
Phi': 38 °
Name: Clay Foundation
Unit Weight: 134 pcf
Cohesion': 500 psf
Phi': 31 °
Name: Shale Foundation
Materials
Ash
Roller Compacted Concrete
Class H Mine Spoil
New Rockfill
Old Rockfill
Clay Foundation
Shale Foundation
1.47
Roller Compacted Concrete
Ash
New Rockfill
Class H Mine Spoil
Old Rockfill
Clay Foundation
Shale
Elevation (ft)
Distance (ft)
400
380
360
340
320
300
280
260
240
220
200
180
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
650

ATTACHMENTS

Attachment A – Laboratory Analyses

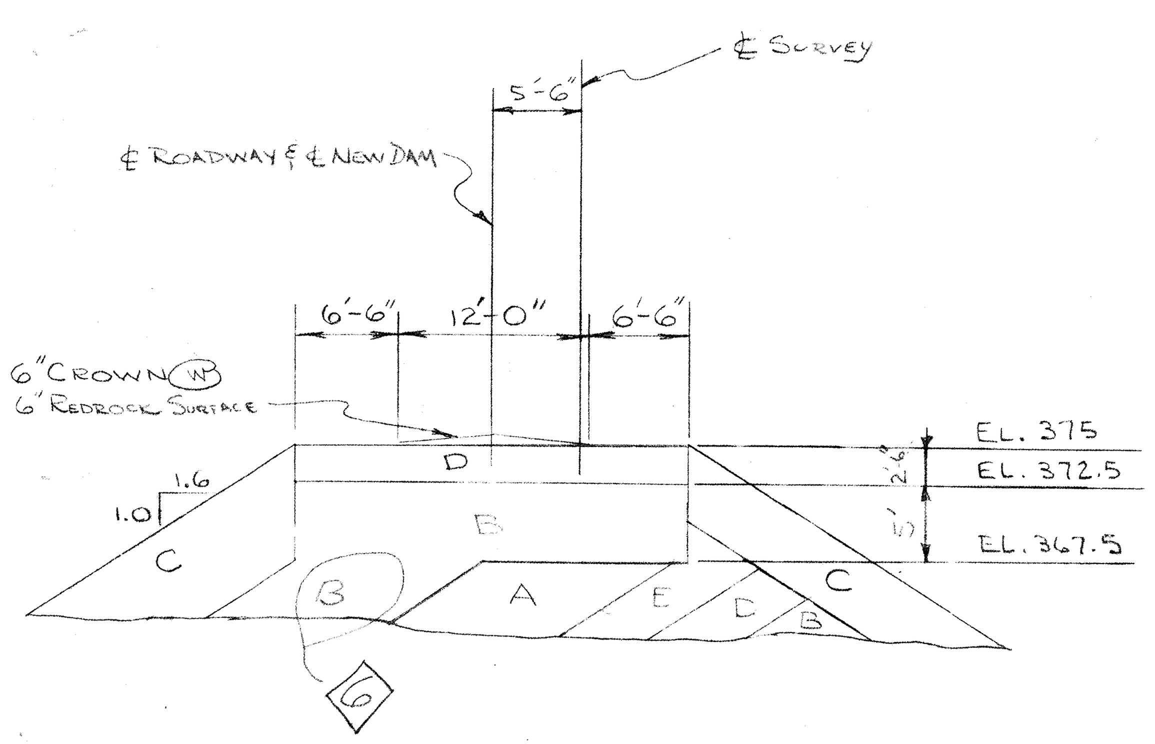


Rev. #2

	Soil Characteristics				Unit Of Wt. = #/ft.³	
Type Of Material	A	B	C	D	E	F
Dry Weight	112	120	100	106	101	
Moist Weight	130	125	105	115	110	140
Saturated Weight	132	137	125	131	125	140
Bouyant Weight	70	75	63	69	63	78
Friction Angle	22°	41°	45°	45°	37°	45°
Cohesion #/ft.²	1300	0	0	0	0	1000

Note:
Location Of Sumps, Pumps And Unwatering Pipe Lines To Be Determined After Overburden Is Removed And Amount Of Leakage Is Determined. Pipe Lines To Be Cement Grouted After They Are No Longer Needed.

Notes:
1. Material Designation (All Material To Be Compacted).
   "A" Impervious Fill.
   "B" Rock, 12" Max. Size.
   "C" Rock, 12" And Larger.
   "D" Coarse Filter.
   "E" Fine Filter.
   "F" Rock.
2. Top Of Dam To Be Furnished With A 12 Foot Wide Redrock Surfaced Roadway - See Detail "A".



Detail - "A"

Reference:
D-189178 - General Layout Of Dam.

Rev.	By	Date	Description
Rev. #6	G.L.H	3-5-75	Chg'd 6' Layer Of "E" & "D" Filter Mtl. To 12' Layer Of "B" Mat'l Above Elev. 350' On U.S. Side Of Core.
Rev. #5	D.C.	10-11-74	Changed EL. 308 To EL. 310 Revised Soil Layers In Core
Rev 4	N.W. Hyde	10-9-74	Changed EL. 310 To EL. 308 Change Rev On Dwg. Had Rev 3 Marked As Rev 4
Rev. #3	D.C.	9-30-74	Revised Soil Layers In Core & Changed Elevation Of Drain Pipe.
Rev. #2	R.D.C.	4-27-73	Added "D" Filter Material To Upstream Face Of "A" Filter Material.
Rev. #2 (Cont'd)	R.D.C.	4-27-73	Changed Assumed Soil Characteristics To Actual Results From Lab Tests.
Rev. #1	R.D.C	3-13-73	General Revision.

Drawn R. Crowson 3-13-73 Checked GDB 3-26-73 Traced

Approved [signature] Date 3-26-73

Approved [signature] Date 3/26/73

ALABAMA POWER COMPANY

Job Gorgas Ash Handling

Detail Sloping Core Design - (Typical Cross Section).

Scale 1"=20' Vertical & Horizontal B/M

Sheet 1 Of 1 Sheets

Supersedes

C-189068

K&E 17 0253 2-72 2300+

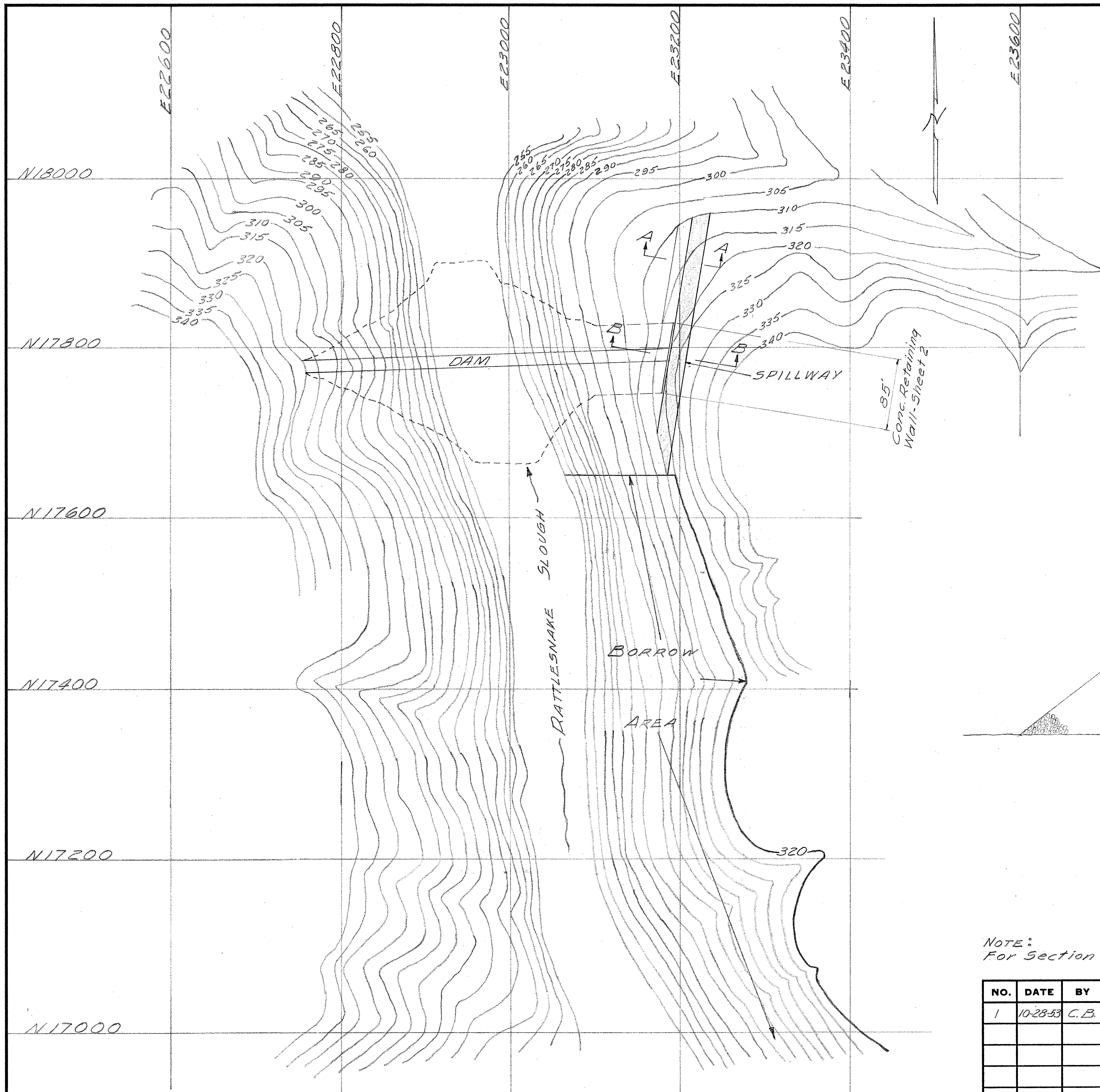
3.1.3 Dike Material Engineering Properties

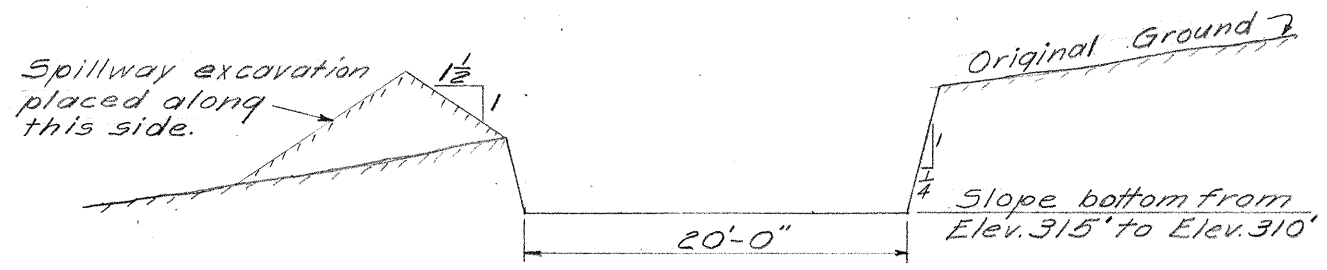
In considering the possible increase in seepage from a proposed raise in hydrostatic head, it was necessary to research previous files for information regarding soil types and properties used in design/construction of the core and filter materials of the last dike raise. During March and April of 1979, samples from potential borrow sources and mine spoil stockpiles in the immediate area were transported to APCo's Central Soils Testing Laboratory in Varnons, Alabama. Most of this material was mine waste with sufficient fines to be considered for use as the upstream "impervious" blanket, or Class H material. These were samples #332 and #333. Two other samples from local sources selected by plant personnel were also tested, taken from areas near the abutments and thought to have greater fines contents. These were designated samples #334 and #335. All samples were tested for shear strength and permeability at both 85% and 92% of their Standard Proctor (SP) maximum dry density for compaction. Table 1 below presents a summary of those test results.

Table 1: Properties of Class H Material

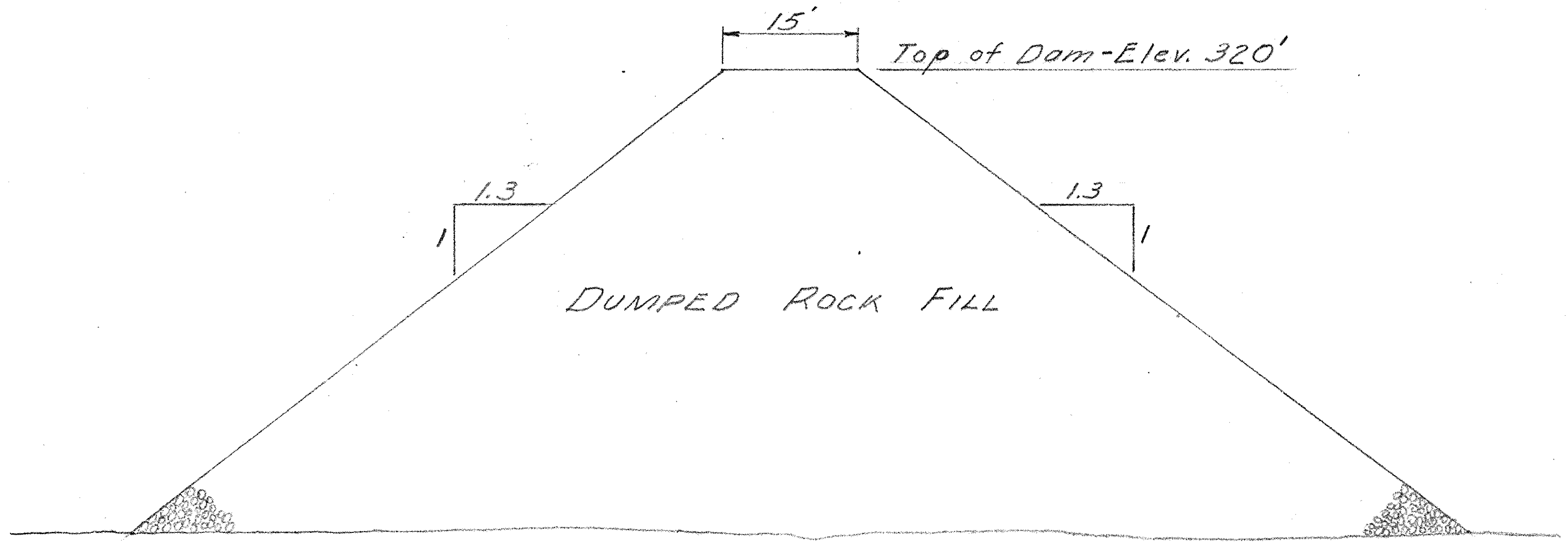
	Lab #332	Lab #333	Lab #334	Lab #335
Description:	Mine Spoil (E)	Mine Spoil (S)	Clayey Silt Borrow 57% passing LL=31, PI=4	NW Abutment 60% passing (25% cl) LL=31, PI=7
Density:	γ_m=122.7 OMC=13.6%	γ_m=118.9 OMC=13.2%	γ_m=107.5 OMC=18.2%	γ_m=111.0 OMC=16.5%
Permeability, κ (cm/sec):				
85% SP	7.4×10^{-4}	5.1×10^{-4}	1.9×10^{-4}	2.0×10^{-4}
92% SP	8.1×10^{-6}	1.0×10^{-5}	2.2×10^{-5}	7.3×10^{-6}
Strength (C=cohesion, ϕ=angle of internal friction. Prime values are effective stress):				
85% SP	C=2.2 ksf ϕ=5° C'=0 ksf ϕ'=32.9°	C=1.4 ksf ϕ=23° C'=0 ksf ϕ'=35°	C=0.4 ksf ϕ=21.5° C'=0 ksf ϕ'=33.7°	
92% SP	C=2.1 ksf ϕ=6.5° C'=0 ksf ϕ'=36.1°	C=1.5 ksf ϕ=28° C'=0 ksf ϕ'=36.1°	C=1.0 ksf ϕ=23° C'=0 ksf ϕ'=36°	C=2.2 ksf ϕ=9°

Attachment B - Drawings Used to Develop Critical Section Profile





SECTION A-A
SPILLWAY DETAILS
Scale: 1"=10'



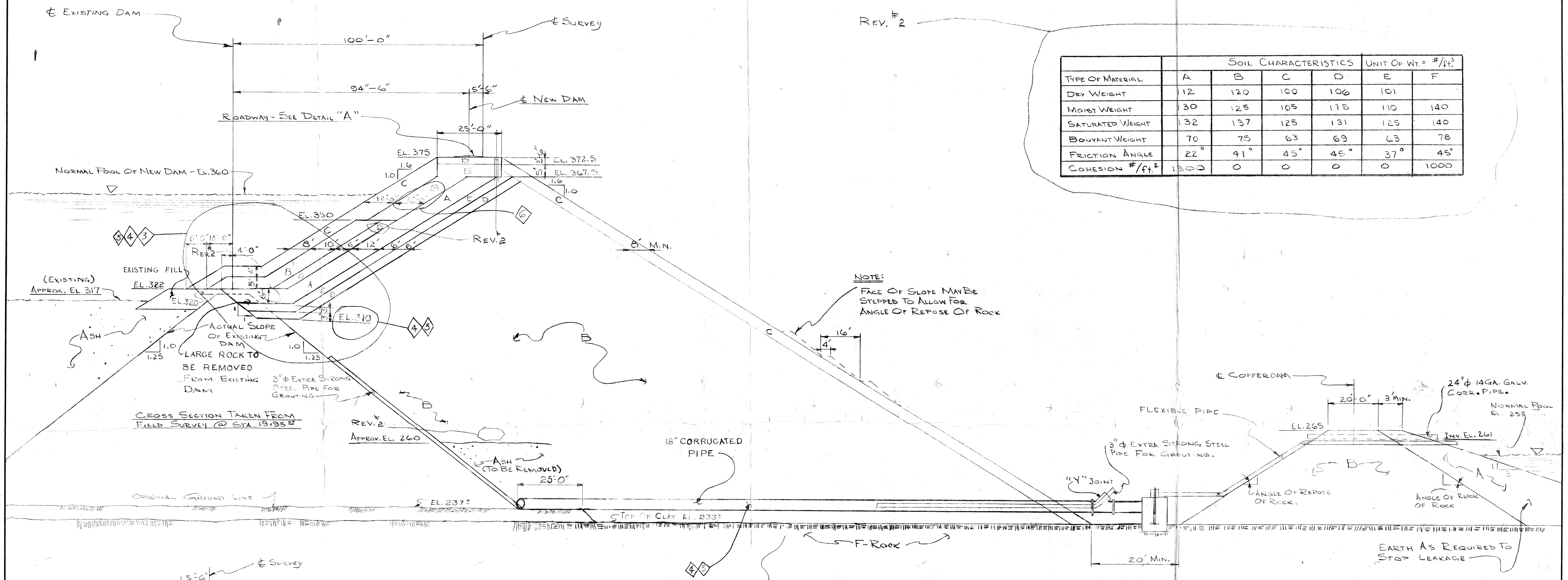
TYPICAL FILL SECTION
SCALE: 1"=20'

NOTE:
For Section B-B see sheet 2.

NO.	DATE	BY	REVISION
1	10-28-53	C.B.	Relocate spillway.

ALABAMA POWER COMPANY	
SUBJECT GORGAS ASH DISPOSAL POND	
DETAIL RATTLESNAKE HOLLOW SITE ROCK FILL DAM	
DRAWN C.B.	TRACED
CHECKED	DATE AUGUST 19, 1953
APPROVED	DATE
APPROVED	DATE
SCALE AS SHOWN	
SHEET 1 OF 2 SHEETS	F-97854
SUPERSEDES	
B/M	

K+E ALBANENE 195M TRACING PAPER

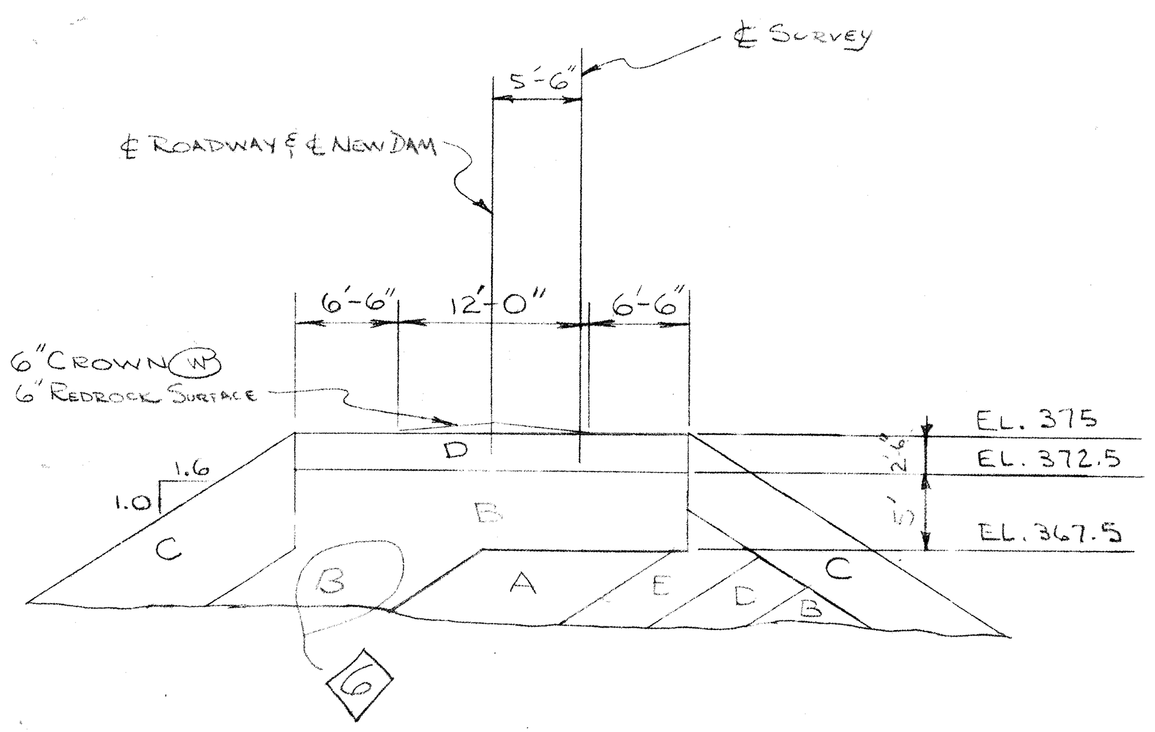


Rev. #2

	Soil Characteristics				Unit Of Wt. = #/ft.³	
Type Of Material	A	B	C	D	E	F
Dry Weight	112	120	100	106	101	
Moist Weight	130	125	105	115	110	140
Saturated Weight	132	137	125	131	125	140
Bouyant Weight	70	75	63	69	63	78
Friction Angle	22°	41°	45°	45°	37°	45°
Cohesion #/ft.²	1300	0	0	0	0	1000

Note:
Location Of Sumps, Pumps And Unwatering Pipe Lines To Be Determined After Overburden Is Removed And Amount Of Leakage Is Determined. Pipe Lines To Be Cement Grouted After They Are No Longer Needed.

Notes:
1. Material Designation (All Material To Be Compacted).
   "A" Impervious Fill.
   "B" Rock, 12" Max. Size.
   "C" Rock, 12" And Larger.
   "D" Coarse Filter.
   "E" Fine Filter.
   "F" Rock.
2. Top Of Dam To Be Furnished With A 12 Foot Wide Redrock Surfaced Roadway - See Detail "A".



Detail - "A"

Reference:
D-189178 - General Layout Of Dam.

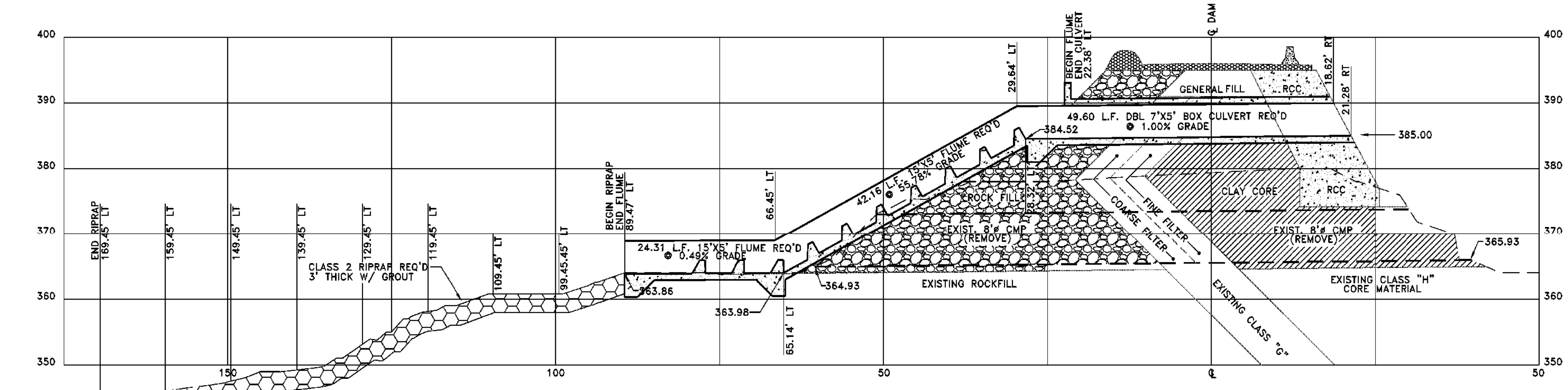
Rev.	By	Date	Description
Rev. #6	G.L.H	3-5-75	Chg'd 6' Layer Of "E" & "D" Filter Mt'l. To 12' Layer Of "B" Mat'l Above Elev. 350' On U.S. Side Of Core.
Rev. #5	D.C.	10-11-74	Changed EL. 308 To EL. 310 Revised Soil Layers In Core
Rev 4	N.W. Hyde	10-9-74	Changed EL. 310 To EL. 308 Change Rev On Dwg. Had Rev 3 Marked As Rev 4
Rev. #3	D.C.	9-30-74	Revised Soil Layers In Core & Changed Elevation Of Drain Pipe.
Rev. #2	R.D.C.	4-27-73	Added "D" Filter Material To Upstream Face Of "A" Filter Material.
Rev. #2 (Cont'd.)	R.D.C.	4-27-73	Changed Assumed Soil Characteristics To Actual Results From Lab Tests.
Rev. #1	R.D.C	3-13-73	General Revision.

ALABAMA POWER COMPANY

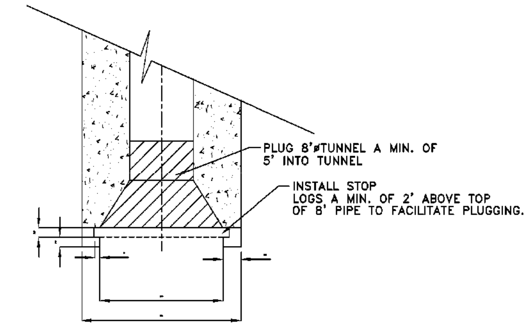
JOB Gorgas Ash Handling
DETAIL Sloping Core Design - (Typical Cross Section).
SCALE 1"=20' Vertical & Horizontal B/M
SHEET 1 OF 1 SHEETS
SUPERSEDES
DRAWN R. Crowson 3-13-73 CHECKED GDB 3-26-73 TRACED
APPROVED G. Bradford DATE 3-26-73
APPROVED [signature] DATE 3/26/73

C-189068

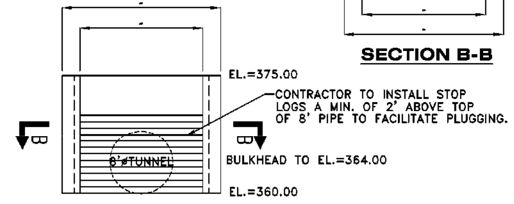
K&E 17 0251 2-72 2300+



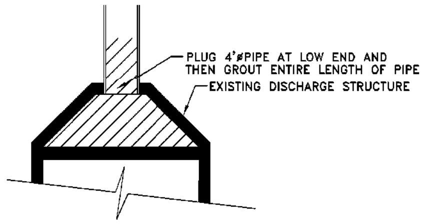
SECTION E-E
(D-586215)



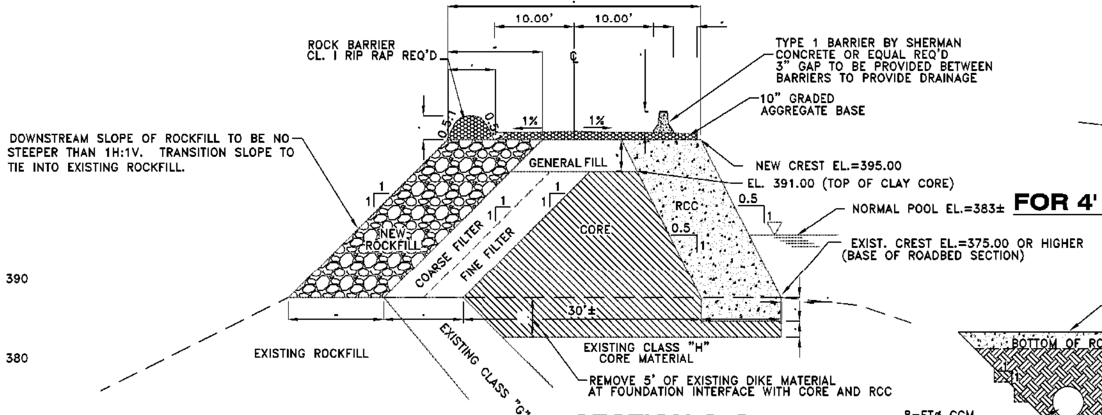
SECTION B-B



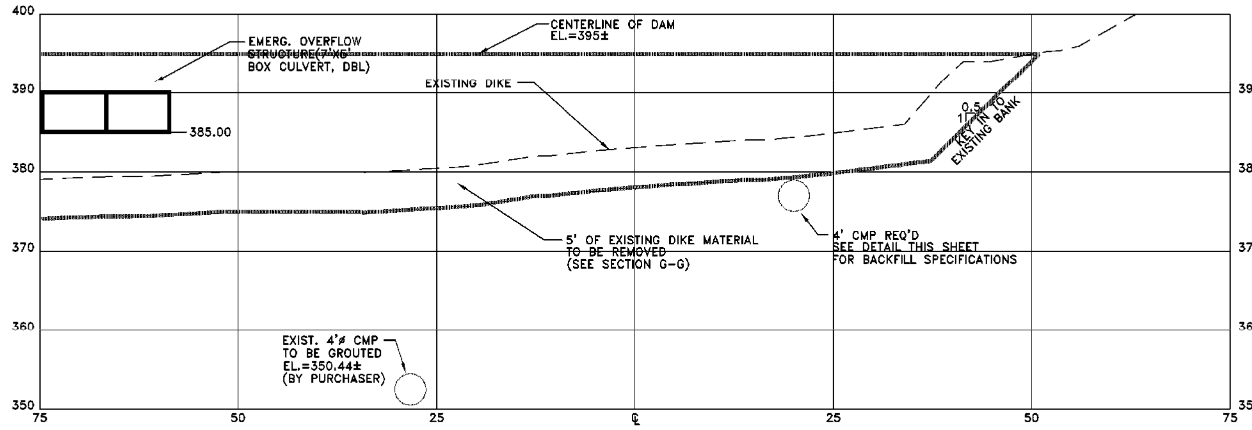
PLUGGING DETAIL
FOR 8'Ø PIPE AT PRESCOTT CREEK
(BY CONTRACTOR)



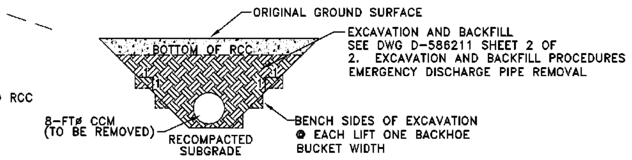
PLUGGING DETAIL
FOR 4' Ø CMP AT EXISTING WEIR
(BY PURCHASER)



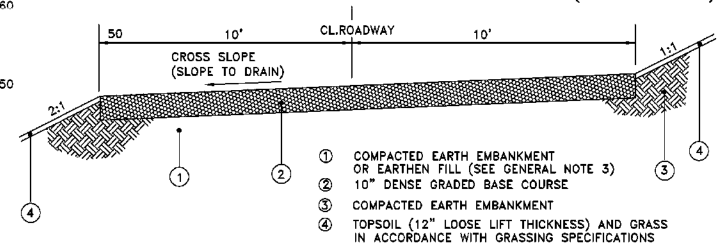
SECTION G-G
DAM TYPICAL SECTION
(N.T.S.)
(D-586216)



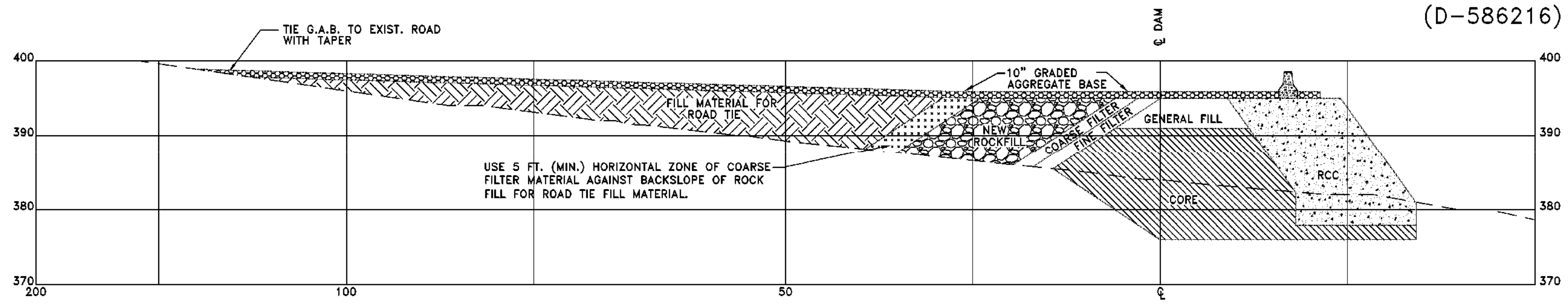
SECTION F-F
(D-586215)



EXISTING
EMERGENCY DISCHARGE PIPE
EXCAVATION & BACKFILL
(N.T.S.)
(D-586215)



SECTION H-H
WEST DOWNSTREAM ACCESS ROAD
(N.T.S.)
(D-586216)



SECTION D-D
(D-586215)

NOTES:

1. FOR DRAWING INDEX, NOTES, AND SPECIFICATIONS SEE DWG. NO. D-586211, SHEETS 1 & 2.
2. CURVE DATA SHOWN ON D-586214.
2. WORK THIS DRAWING WITH DRAWINGS:
   D-586214
   D-586215
   D-586216
   D-586220

REFERENCES:

SEE DRAWING D-586211

SEE TECHNICAL SPECIFICATIONS FOR EARTHWORK AND ROLLER COMPACTED CONCRETE CREST RAISE CONSTRUCTION

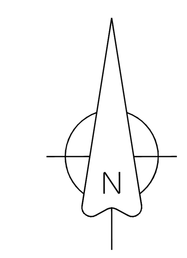
Southern Company Services, Inc.
FOR
Alabama Power Company

PLANT GORGAS
CREST RAISE OF RATTLESNAKE
HOLLOW ASH POND
SECTIONS AND DETAILS

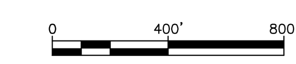
REVISION	DATE	REVISION A	DATE 7-21-06
		ISSUED FOR INQUIRY	
			JOB NO. 2101FS

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	MGR APPR	SCALE	PROJ I.D.	DRAWING NUMBER	SH	CONT'D	REV
JWM	PMG / JCP	JBS				CKT	1"=10'		D-586217	1	FINAL	A

ANSI F: 28x40 Acad2000



GRID COORDINATES
ALABAMA STATE PLANE
NAD 83 WEST ZONE



NOTES:
1) SURVEY FIELD DATA COLLECTED 5/5/16.
2) SOUNDING DATA DATA COLLECTED 5/5/16.
3) LIDAR TOPO DATA FROM 4/12/16 FLIGHT.
4) CONTOUR INTERVAL 1 FOOT.
5) CONTOURS WERE PRODUCED BY DIGITAL TERRAIN MODEL.
5) DRAWING IS ACCURATE ONLY AT ORIGINAL SCALE.

TOPOGRAPHIC/HYDROGRAPHIC SURVEY

Southern Company Generation Engineering and Construction Services
FOR

Alabama Power Company

Plant Gorgas
CCR Topo and Plan View Mapping
Rattlesnake Ash Pond

REVISION 0	DATE 06/7/2016

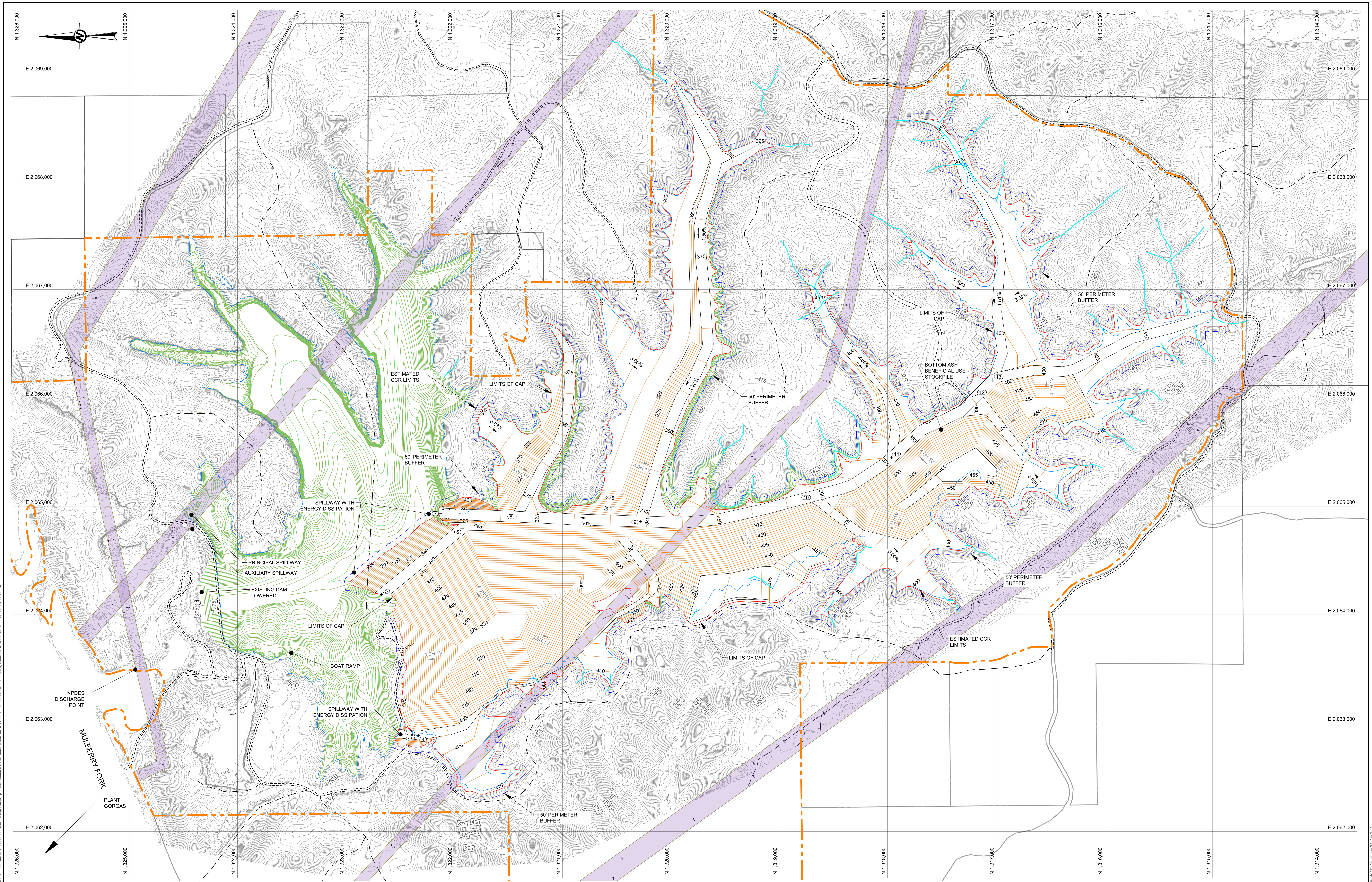
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
ENP						

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
As Noted		1	FINAL	0

ANSI E: 44x34

APPENDIX 7

ON-SITE CONTROL POINTS



LEGEND

- 340 — EXISTING TOPOGRAPHY / BATHYMETRY CONTOURS (REFERENCE NOTE 1 & 2)
- 500 — PROPOSED CLOSURE COVER GRADING CONTOURS
- 340 — CLOSURE BY REMOVAL CONTOURS
- EXISTING ROADS
- EXISTING POWER POLES / TOWERS
- TREE LINE
- APC OWNED PROPERTY BOUNDARIES
- EXISTING TRANSMISSION CORRIDOR
- ELEVATION 395 CONTOUR ESTIMATED CCR LIMITS
- 50' PERIMETER BUFFER ZONE
- LIMITS OF WATER
- STREAMS PROVIDED BY CAHABA CONSULTING, LLC
- 5 — SITE CONTROL POINT, SEE NOTE 3

NOTE(S)

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL, NATIONAL GEODETIC VERTCAL DATUM (NGVD) 1988. COORDINATES CORRESPOND TO ALABAMA WEST COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1983.

2. CONTOUR INTERVAL IS 5 FEET.

3. CONTROL POINTS ARE SHOWN FOR PERMITTING ONLY BASED ON THE CURRENT DESIGN. THESE POINTS MAY BE ALTERED AS NEEDED DURING DETAILED DESIGN ADJUSTMENTS.

REFERENCE(S)

1. EXISTING TOPOGRAPHY PROVIDED BY SOUTHERN COMPANY SERVICES, FEBRUARY 2018.

2. BATHYMETRY DATA PROVIDED BY SOUTHERN COMPANY SERVICES, DATED MAY 5, 2016.

3. BOTTOM OF CCR TOPOGRAPHY TAKEN FROM USGS, PORT BIRMINGHAM, 1938 AND GOODSPINGS, 1971 QUADRANGLES. TOPOGRAPHY WAS INTERPRETED BETWEEN 20 FOOT CONTOURS AND ADJUSTED BASED ON GEOTECHNICAL INVESTIGATION DATA BY GOLDER ASSOCIATES INC.

SITE CONTROL TABLE

POINT	NORTHING	EASTING	ELEVATION
1	1324455.08	2064856.85	395.00
2	1324325.71	2064083.74	290.00
3	1323955.85	2063622.04	395.00
4	1322329.95	2062886.27	390.80
5	1322671.20	2064186.79	340.00
6	1321926.94	2064794.30	340.00
7	1322123.37	2064933.35	311.78
8	1321422.84	2064903.83	322.19
9	1320279.72	2064860.69	339.18
10	1318686.88	2065093.79	363.77
11	1317963.89	2065449.20	375.96
12	1317176.79	2066019.12	390.71
13	1317029.77	2066164.92	394.10

0 300 600
1" = 300' FEET

11/15/2018
PERMIT SUBMITTAL
NOT FOR CONSTRUCTION

CLIENT
SOUTHERN COMPANY SERVICES
Southern Company
Alabama Power

PROJECT
PLANT GORGAS
ASH POND CLOSURE

TITLE
SITE CONTROL PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2018/09/28
DESIGNED	CN
PREPARED	RMS
CHECKED	GLH
REVIEWED / APPROVED	GLH

PROJECT NO.	PHASE/TASK	REV.	FIGURE
1789848		0	9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ARCH D

APPENDIX 8

TOPOGRAPHICAL MAPS, GRADING PLANS AND CROSS SECTIONS

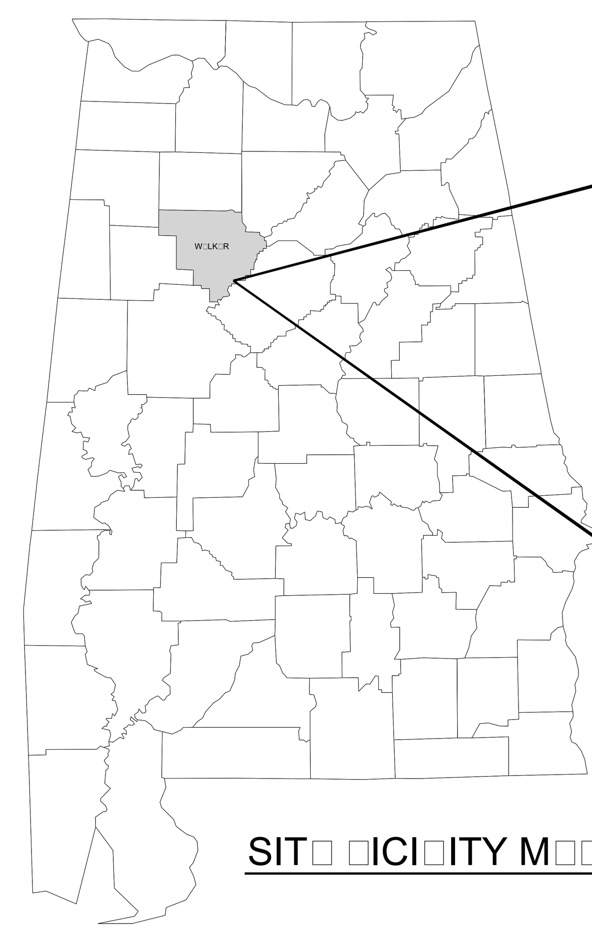
SO□TH□R□ COM□□□Y □□L□B□M□ □OW□R
□L□□T GORG□S
□SH □O□D CLOS□R□ □L□□S

W□LK□R CO□□TY□□L□B□M□

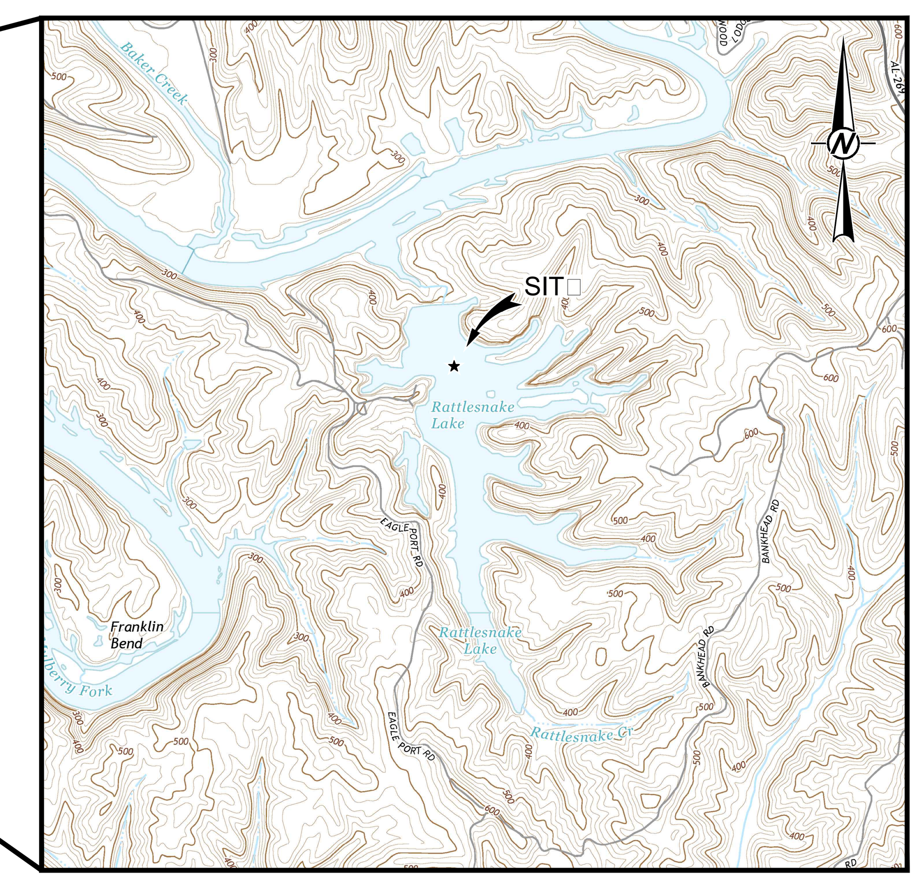
□O□□MB□R 2018

LIST OF SH□□TS

SH□□T	SH□□T TITL□
1	TITL□ SH□□T
2	□□ISTI□G CO□DITIO□S □L□□ - □□RI□L
□	□□ISTI□G CO□DITIO□ □L□□ - TO□OGR□□HY
4	□STIM□T□D BOTTOM OF CCR □L□□
□	□RO□OS□D CLOS□R□
□	CROSS S□CTIO□S □SH□□T 1 0F □□
7	CROSS S□CTIO□S □SH□□T 2 0F □□
8	CROSS S□CTIO□S □SH□□T □0F □□
□	SIT□ CO□TROL □L□□



SIT□ □ICI□ITY M□□



REF□USGS □□MINUTE SERIES TOPOGRAP□IC □UADRANGLES□
GOODSPRINGS AND GILMORE□AL □□□□

SIT□ LOC□TIO□ M□□

0 2000 4000

1" □2000' F□□T

CO□T□CT I□FORM□TIO□

□□GI□□□R

GR□GORY H□B□L□R□□.□.
GOLD□R □SSOCI□T□S I□C.
□170 □□□CHTR□□ RD.
BLDG 100□S□IT□ □00
□TL□□T□□G□ □0□41
T□L□□HO□□□770 □4□□-18□□

OW□□R'S R□□R□S□□T□TI□□

R□B□CC□ M□□LL□R□□.□.
SO□TH□R□ COM□□□Y S□R□IC□S
□□□□ COLO□□□D□ □KWY
BIRMI□GH□M□□L □□24□
T□L□□HO□□□20□ □□□2-□40□

□R□□□R□D BY

GOLDER

□R□□□R□D FOR

Southern Co□ □any

□laba□a □ower

11□1□2018

□□RMIT S□BMITT□L

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CLI□□T
SO□TH□R□ COM□□□Y S□R□IC□S

Southern Co□ □any
□laba□a □ower

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□SH □O□D CLOS□R□
□□RMIT □L□□S

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TITLE S□EET

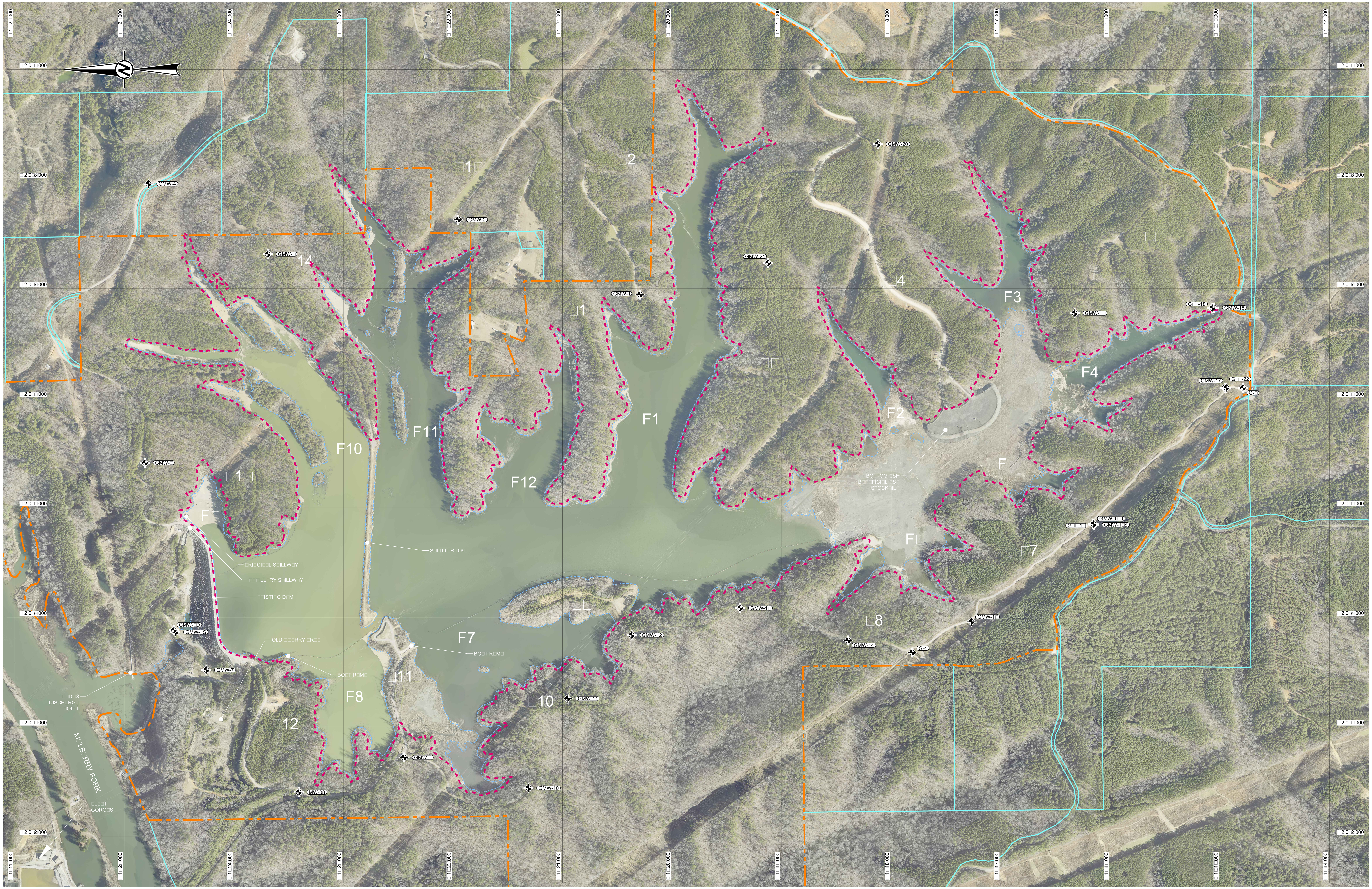
CO□S□LT□□T

GOLDER

YYYY-MM-DD	2018□0□28
D□SIG□□D	C□
□R□□□R□D	RMS
CH□CK□D	GLH
R□□I□W□D □□□□RO□□D	GLH

□RO□□CT □O.	SCS R□F.	R□□.	SH□□T
178□848	GOR17010	0	1

IF THIS M□□S□R□M□□T DO□S □OT M□TCH WH□T IS SHOW□□TH□ SH□□T SI□□ H□S B□□□ MODIFI□D FROM□□RCH D



LEGEND

	□□C OW□□D □RO□□RTY BO□□D□RI□S
	□D□□C□□T □RO□□RTY BO□□D□RI□S
	□STIM□T□D □R□-CLOS□R□ CCR LIMITS
GMW-01	MO□ITORI□G W□LLS
P1	□□□I□S□L□
F1	FI□G□R

NOTES

1. COORDI□□T□S CORR□S□O□D TO □L□B□M□ W□ST COORDI□□T□ SYST□M□□ORTH □M□RIC□□ D□T□M □□D□1□8□.

REFERENCES

1. □□RI□L □HOTOGR□□H □RO□ID□D BY SO□TH□R□ COM□□□Y S□R□IC□S□F□BR□□RY 2018.

11□1□□2018

□□RMIT S□BMITT□L

NOT FOR CONSTRUCTION

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SO□TH□R□ COM□□□Y S□R□IC□S

Southern Co□□any

□laba□a □ower

□RO□□CT
□L□□T GORG□S
□SH □O□D CLOS□R□
□□RMIT □L□□S

TITL□
E□ISTING CONDITIONS PLAN □AERIAL

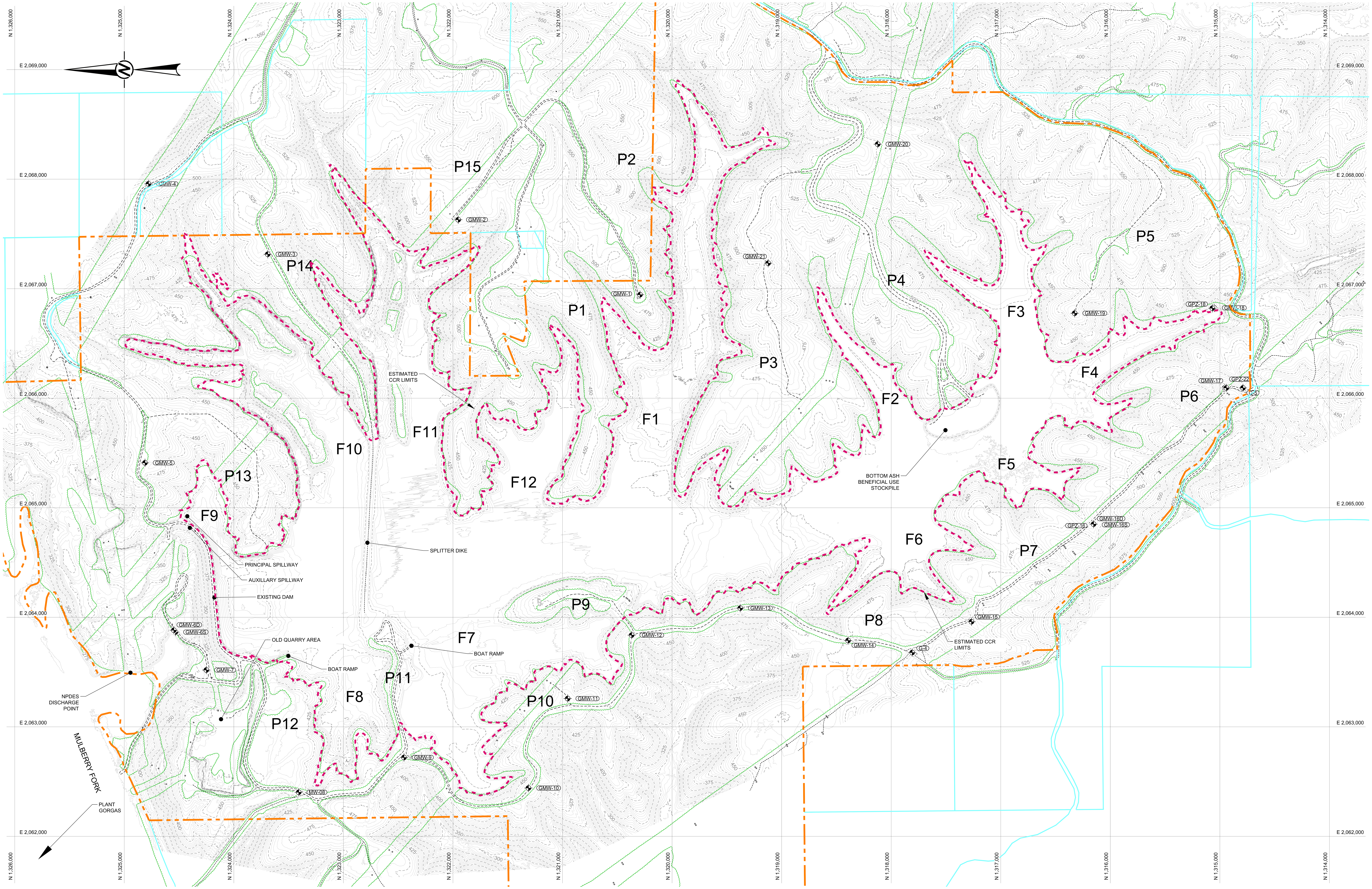
CO□S□LT□□T

GOLDER

YYYY-MM-DD	2018□0□28
D□SIG□□D	C□
□R□□□R□D	RMS
CH□CK□D	GLH
R□□I□W□D □□□□RO□□D	GLH

□RO□□CT □O.	SCS R□F.	R□□.	SH□□T
178□848	GOR17010	0	2

IF THIS M□□S□R□M□□T DO□S □OT M□TCH WH□T IS SHOW□□TH□ SH□□T SI□□ H□S B□□□ MODIFI□D FROM□



LEGEND

□40	□□ISTI□G TO□OGR□□HY □B□THYM□TRY CO□TO□RS □R□F□R□□C□ □OT□ 1 □ 2□
	□□ISTI□G RO□DS
	□□ISTI□G □OW□R □OL□S □TOW□RS
	TR□□ LI□□
	□□C OW□□D □RO□□RTY BO□□D□RI□S
	□D□□C□□T □RO□□RTY BO□□D□RI□S
	□STIM□T□D □R□-CLOS□R□ CCR LIMITS
GMW-01	MO□ITORI□G W□LLS
P1	□□□I□S□L□
F1	FI□G□R

NOTES

1. □L□□□TIO□S □R□ I□ F□□T □BO□□ M□□□ S□□ L□□□L□□□TIO□□L G□OD□TIC □□RTIC□L D□T□M □□G□D□1□88. COORDI□□T□S CORR□S□O□D TO □L□B□M□ W□ST COORDI□□T□ SYST□M□□ORTH □M□RIC□□ D□T□M □□D□1□8□.

2. CO□TO□R I□T□R□□L IS □F□□T.

REFERENCES

1. □□ISTI□G TO□OGR□□HY □RO□ID□D BY SO□TH□R□ COM□□□Y S□R□IC□S□F□BR□□RY 2018.

2. B□THYM□TRY D□T□ □RO□ID□D BY SO□TH□R□ COM□□□Y S□R□IC□S□D□T□D M□Y □□201□.

11□1□□2018

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NOT FOR CONSTRUCTION

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1" □ □00' F□□T

CLI□□T
SO□TH□R□ COM□□□Y S□R□IC□S

Southern Co□ □any

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□RO□□CT
□L□□T GORG□S
□SH □O□D CLOS□R□
□□RMIT □L□□S

TITL□
E□ISTING CONDITIONS PLAN □TOPOGRAP□□

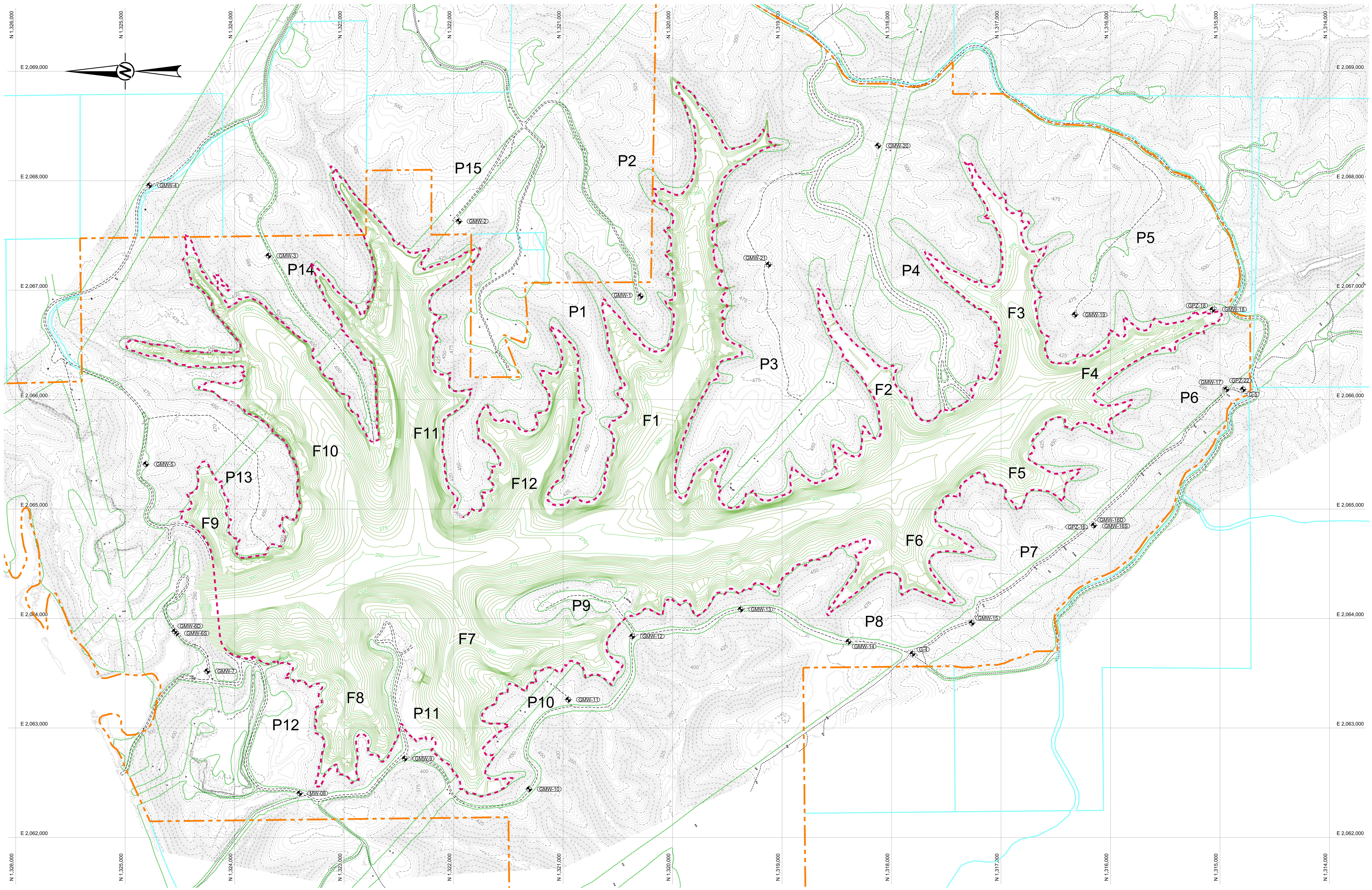
CO□S□LT□□T

GOLDER

YYYY-MM-DD	2018□0□28
D□SIG□□D	C□
□R□□□R□D	RMS
CH□CK□D	GLH
R□□I□W□D □□□□RO□□D	GLH

□RO□□CT □O.	SCS R□F.	R□□.	SH□□T
178□848	GOR17010	0	□

IF THIS M□□S□R□M□□T DO□S □OT M□TCH WH□T IS SHOW□□TH□ SH□□T SI□□ H□S B□□□ MODIFI□D FROM□□RCH □



LEGEND

540 (dashed)	EXISTING TOPOGRAPHY (BATHYMETRY CONTOURS (REFERENCE NOTE 1 & 2)
540 (green)	ESTIMATED BOTTOM OF CCR CONTOURS
(dashed line)	EXISTING ROADS
(symbols)	EXISTING POWER POLES / TOWERS
(green scalloped line)	TREE LINE
(orange dash-dot)	APC OWNED PROPERTY BOUNDARIES
(cyan line)	ADJACENT PROPERTY BOUNDARIES
(magenta dashed)	ESTIMATED PRE-CLOSURE CCR LIMITS
GMW-01	MONITORING WELLS
P1	PENINSULA
F1	FINGER

NOTES

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1988. COORDINATES CORRESPOND TO ALABAMA WEST COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1983.

REFERENCES

1. EXISTING TOPOGRAPHY PROVIDED BY SOUTHERN COMPANY SERVICES, FEBRUARY 2018.

2. BOTTOM OF CCR TOPOGRAPHY TAKEN FROM USGS, PORT BIRMINGHAM, 1958 AND GOODSPRINGS, 1971 QUADRANGLES. TOPOGRAPHY WAS INTERPRETED BETWEEN 20 FOOT CONTOURS AND ADJUSTED BASED ON GEOTECHNICAL INVESTIGATION DATA BY GOLDER ASSOCIATES INC.

CLIENT
SOUTHERN COMPANY SERVICES

Southern Company
Alabama Power

PROJECT
PLANT GORGAS
ASH POND CLOSURE
PERMIT PLANS

TITLE
ESTIMATED BOTTOM OF CCR PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2018-0?-28
DESIGNED	C?
PREPARED	RMS
CHECKED	GLH
REVIEWED / APPROVED	GLH

PROJECT NO.	SCS REF.	REV.	SHEET
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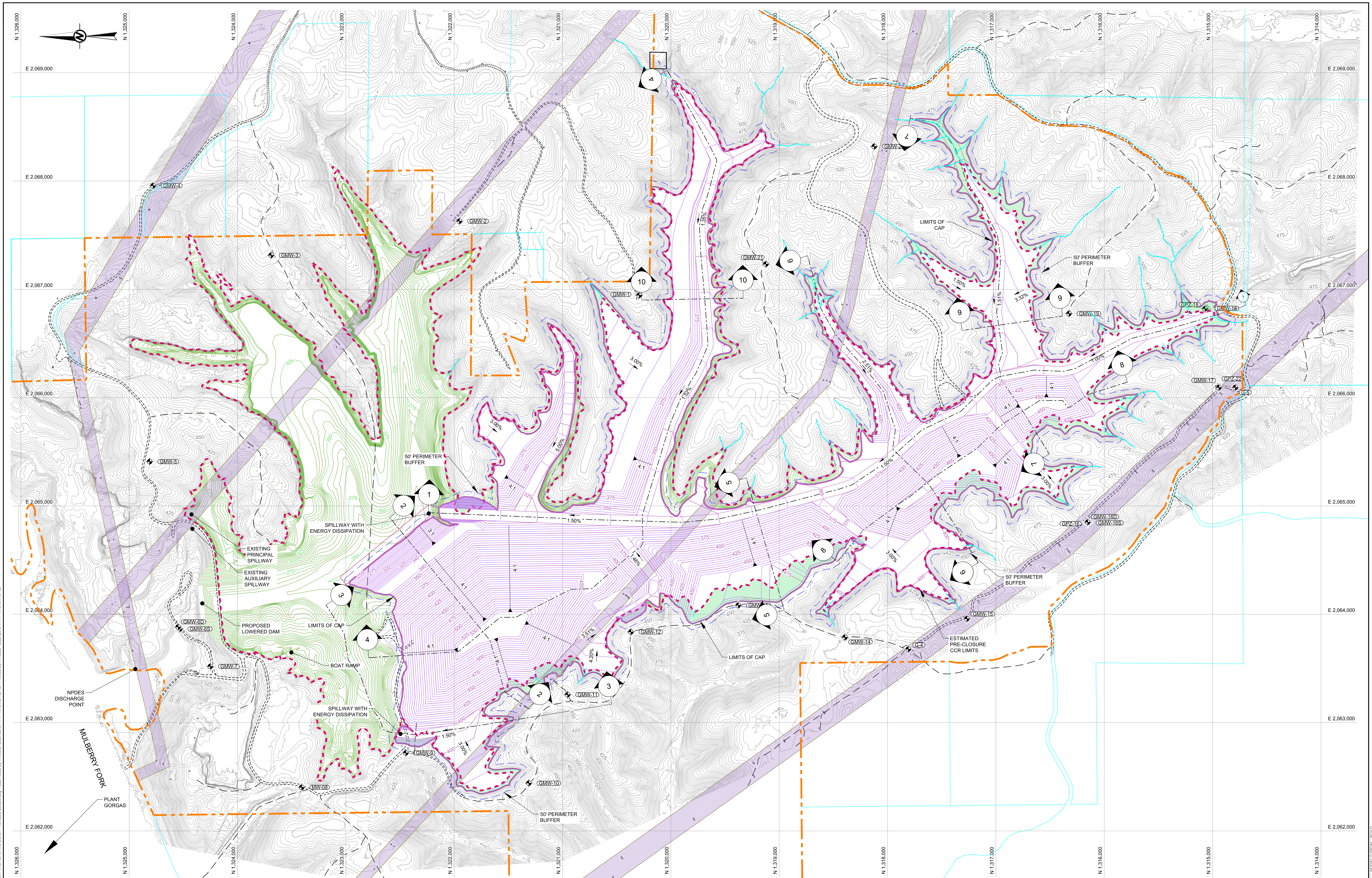

LEGEND

EXISTING TOPOGRAPHY / BATHYMETRY CONTOURS (REFERENCE NOTE 1 & 2)	AREAS OF NON-CCR FILL
PROPOSED CLOSURE COVER GRADING CONTOURS	
CLOSURE BY REMOVAL CONTOURS	
EXISTING ROADS	
EXISTING POWER POLES / TOWERS	
TREE LINE	
APC OWNED PROPERTY BOUNDARIES	
EXISTING TRANSMISSION CORRIDOR	
ESTIMATED PRE-CLOSURE CCR LIMITS	
50' PERIMETER BUFFER ZONE	
LIMITS OF CLOSURE FOOTPRINT	
STREAMS PROVIDED BY CAHABA CONSULTING LLC	
GMW-01 MONITORING WELLS	

NOTES

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1988. COORDINATES CORRESPOND TO ALABAMA WEST COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1983.

2. CONTOUR INTERVAL IS 5 FEET.

REFERENCES

1. EXISTING TOPOGRAPHY PROVIDED BY SOUTHERN COMPANY SERVICES FEBRUARY 2018.

2. BATHYMETRY DATA PROVIDED BY SOUTHERN COMPANY SERVICES DATED MAY 2016.

3. BOTTOM OF CCR TOPOGRAPHY TAKEN FROM USGS "PORT BIRMINGHAM 1958" AND "GOODSPRINGS 1971" QUADRANGLES. TOPOGRAPHY WAS INTERPRETED BETWEEN 20 FOOT CONTOURS AND ADJUSTED BASED ON GEOTECHNICAL INVESTIGATION DATA BY GOLDER ASSOCIATES INC.

4. PROPOSED CLOSURE COVER GRADING CONTOURS DO NOT SHOW INTERMEDIATE BENCHES, TERRACES, AND OTHER LOCALIZED SURFACE WATER CONTROL FEATURES ARE NOT SHOWN FOR CLARITY.

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1" = 500' FEET

11/1/2018

PERMIT SUBMITTAL
NOT FOR CONSTRUCTION

CLIENT
SOUTHERN COMPANY SERVICES

Southern Company — Alabama Power

PROJECT
PLANT GORGES
ASH POND CLOSURE
PERMIT PLANS

TITLE
PROPOSED CLOSURE

CONSULTANT
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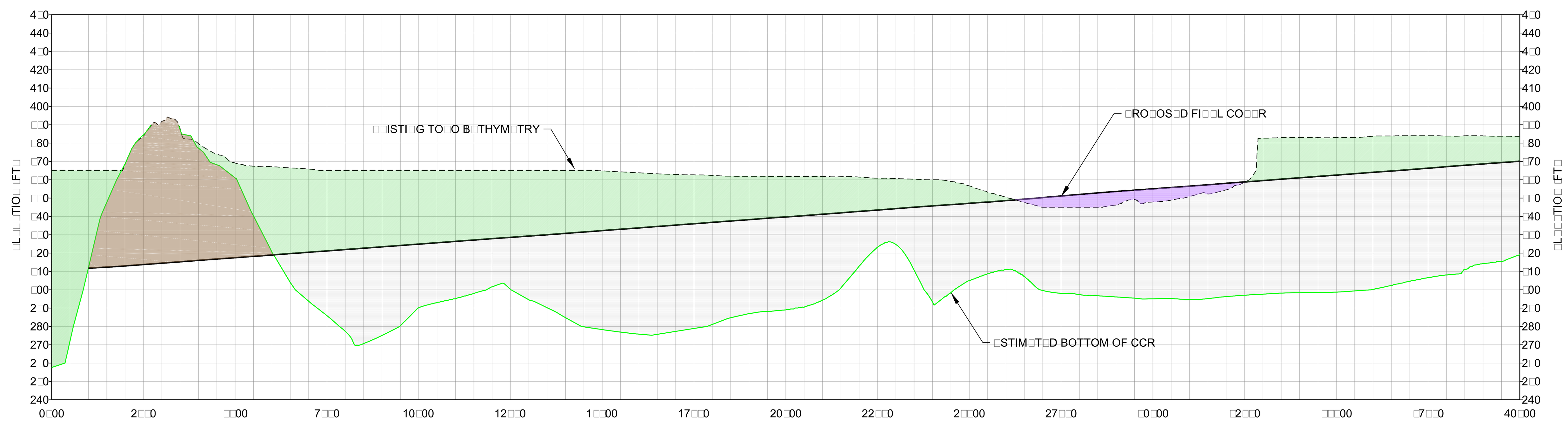

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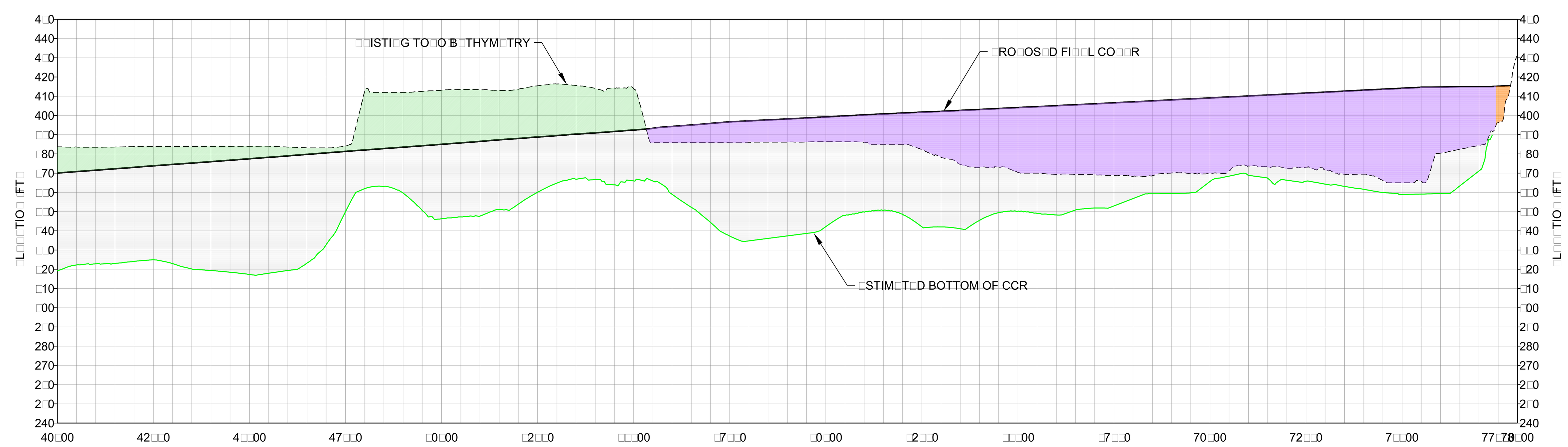

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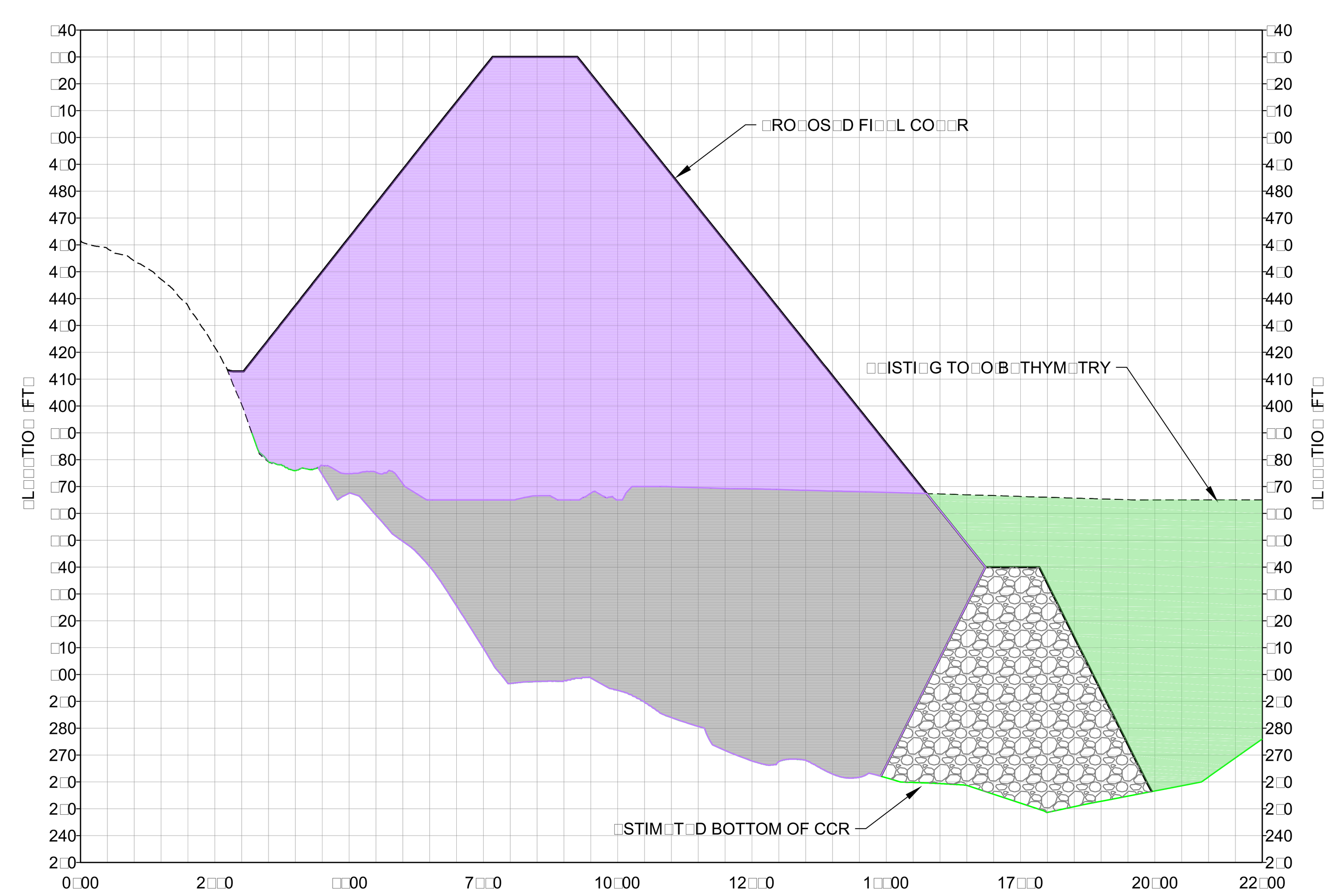

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NOTES

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REFERENCES

1. □□ISTI□G TO□OGR□□HY □RO□ID□D BY SO□TH□R□ COM□□□Y S□R□IC□S□F□BR□□RY 2018.

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□. BOTTOM OF CCR TO□OGR□□HY I□T□R□R□T□D FROM □SGS□□ORT BIRMI□GH□M□1□□8 □□D GOODS□I□GS□1□71 □□□DR□□GL□S. TO□OGR□□HY W□S I□T□R□R□T□D B□TW□□□ 20 FOOT CO□TO□RS □□D □D□□ST□D B□S□D O□ G□OT□CH□IC□L I□□□STIG□TIO□ D□T□ BY GOLD□R □SSOCI□T□S I□C.

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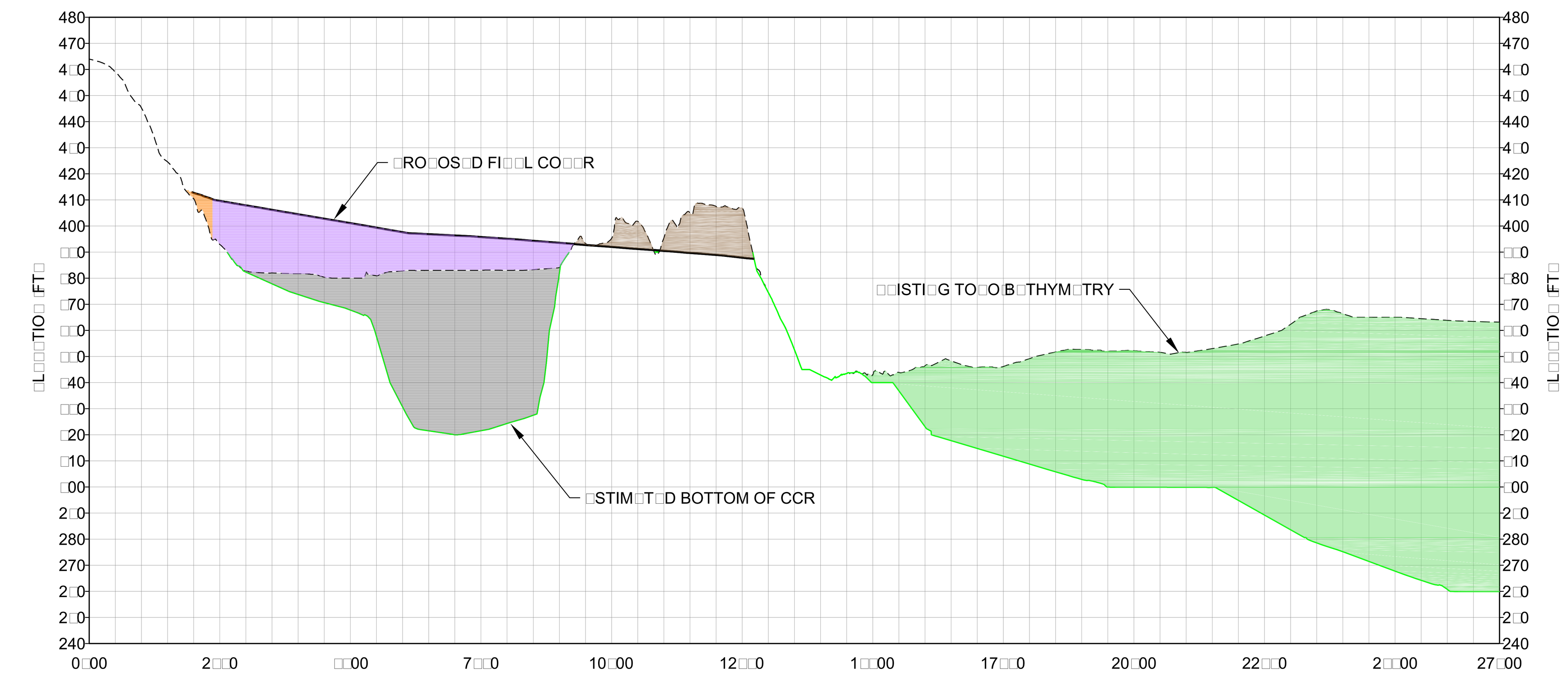

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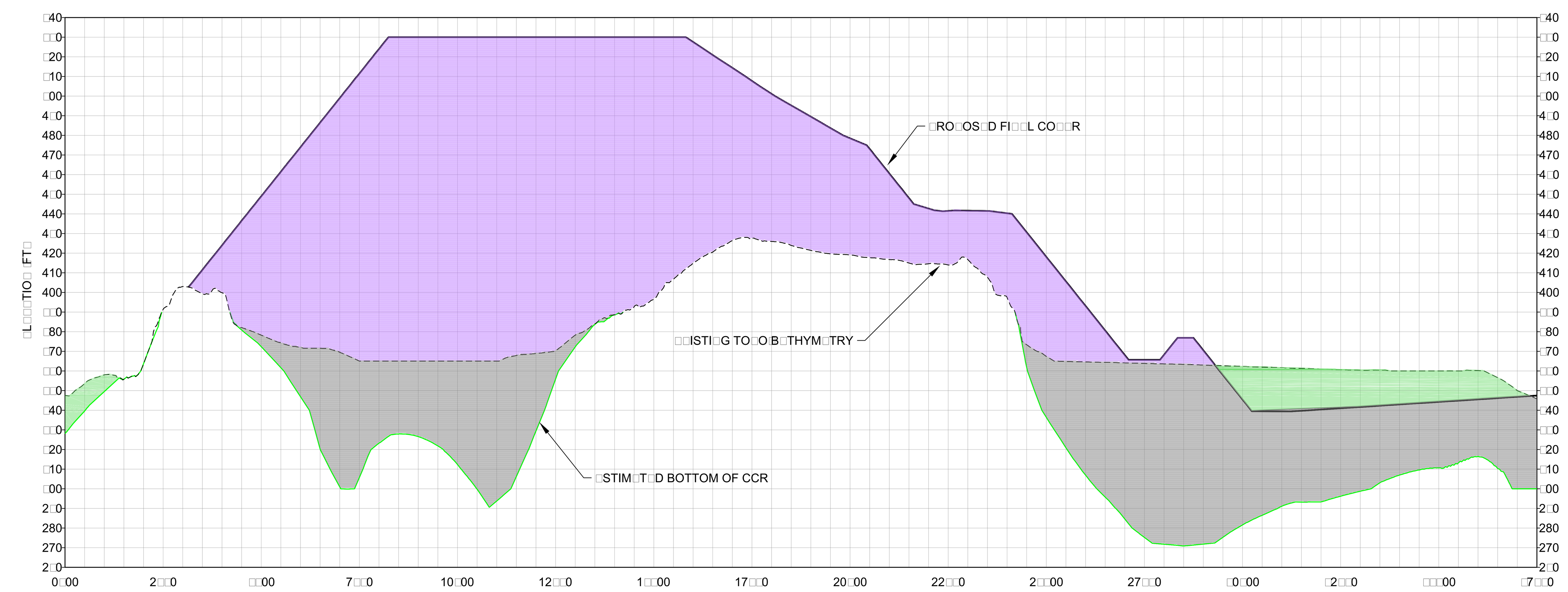

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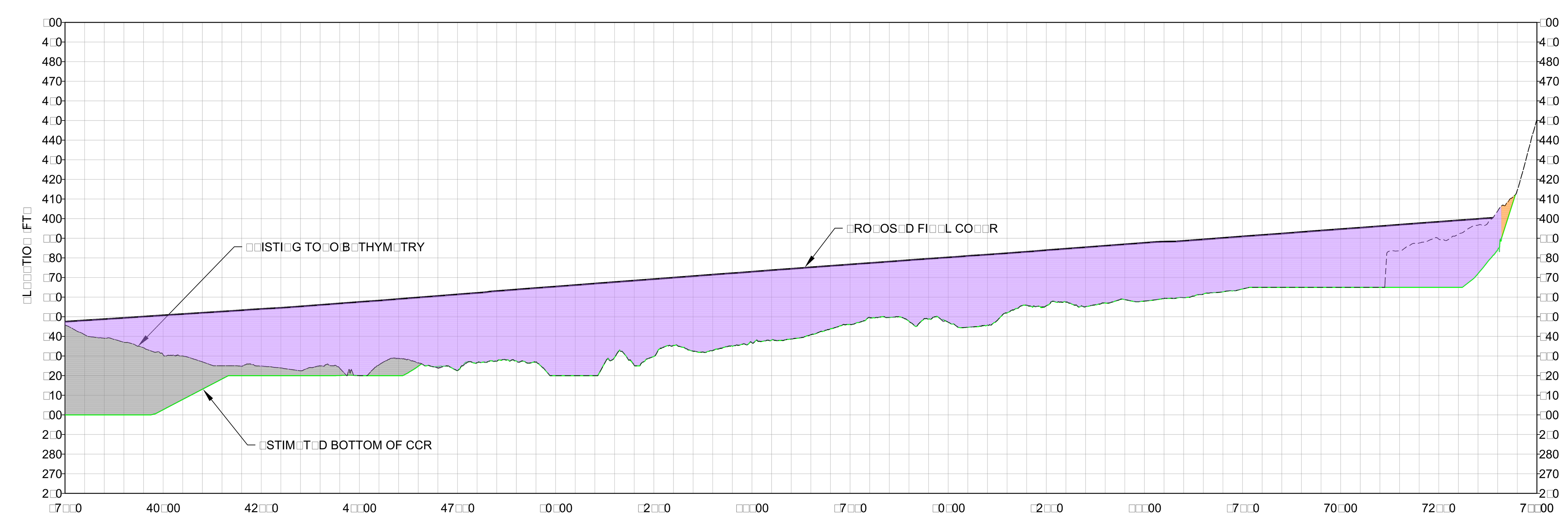

SECTION 04

LEGEND

- PROPOSED FINAL COVER
- EXISTING TOPO BATHYMETRY
- ESTIMATED BOTTOM OF CCR
- EXISTING CCR TO REMAIN
- PROPOSED CCR CUT
- PROPOSED CCR FILL
- PROPOSED NATURAL GROUND CUT
- PROPOSED NON CCR FILL
- PROPOSED ROCK FILL DAM

NOTES

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1988. COORDINATES CORRESPOND TO ALABAMA WEST COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 198[illegible].

2. CHANNELS AND OTHER DETAILED GRADING ARE SHOWN AS CORRIDORS AT THIS STAGE OF DESIGN.

[illegible]. PROPOSED CLOSURE COVER GRADING CONTOURS DO NOT SHOW INTERMEDIATE BENCHES, TERRACES, AND OTHER LOCALIZED SURFACE WATER CONTROL FEATURES ARE NOT SHOWN FOR CLARITY.

REFERENCES

1. EXISTING TOPOGRAPHY PROVIDED BY SOUTHERN COMPANY SERVICES, FEBRUARY 2018.

2. BATHYMETRY DATA PROVIDED BY SOUTHERN COMPANY SERVICES, DATED MAY 201[illegible].

[illegible]. BOTTOM OF CCR TOPOGRAPHY INTERPRETED FROM USGS PORT BIRMINGHAM 1[illegible]8 AND GOODSPRINGS 1[illegible]71 QUADRANGLES. TOPOGRAPHY WAS INTERPRETED BETWEEN 20 FOOT CONTOURS AND ADJUSTED BASED ON GEOTECHNICAL INVESTIGATION DATA BY GOLDER ASSOCIATES INC.

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PERMIT SUBMITTAL
NOT FOR CONSTRUCTION

0 200 400
1" = 200' FEET
HORIZONTAL SCALE

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1" = 40' FEET
VERTICAL SCALE

CLIENT
SOUTHERN COMPANY SERVICES

Southern Company | Alabama Power

PROJECT
PLANT GORGAS
ASH POND CLOSURE
PERMIT PLANS

TITLE
CROSS SECTIONS
SHEET [illegible] OF [illegible]

CONSULTANT
GOLDER

YYYY-MM-DD	2018-0[illegible]-28
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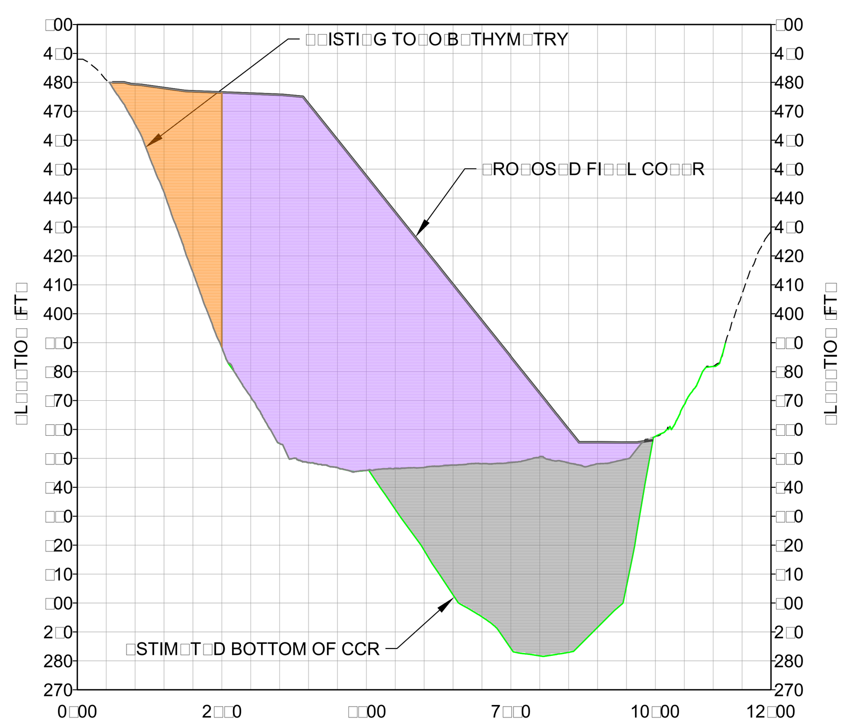

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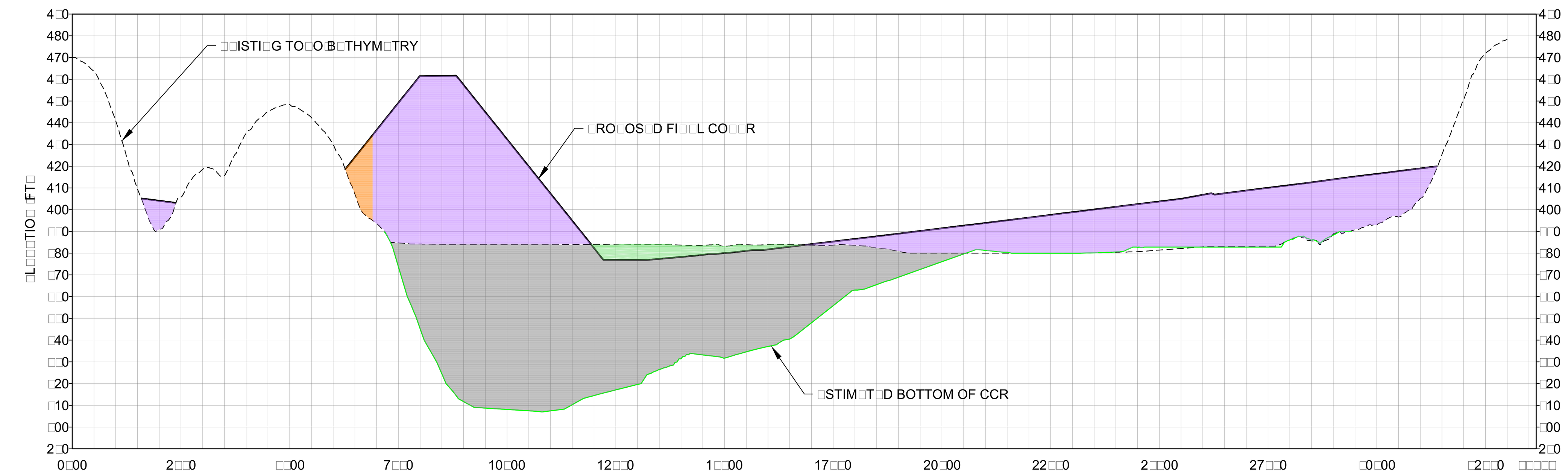

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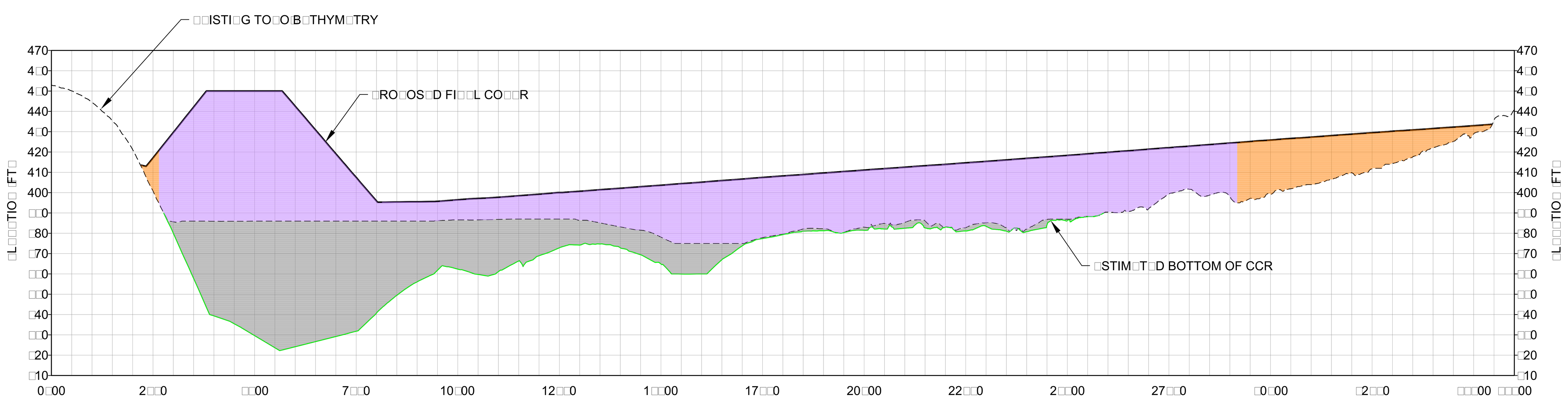

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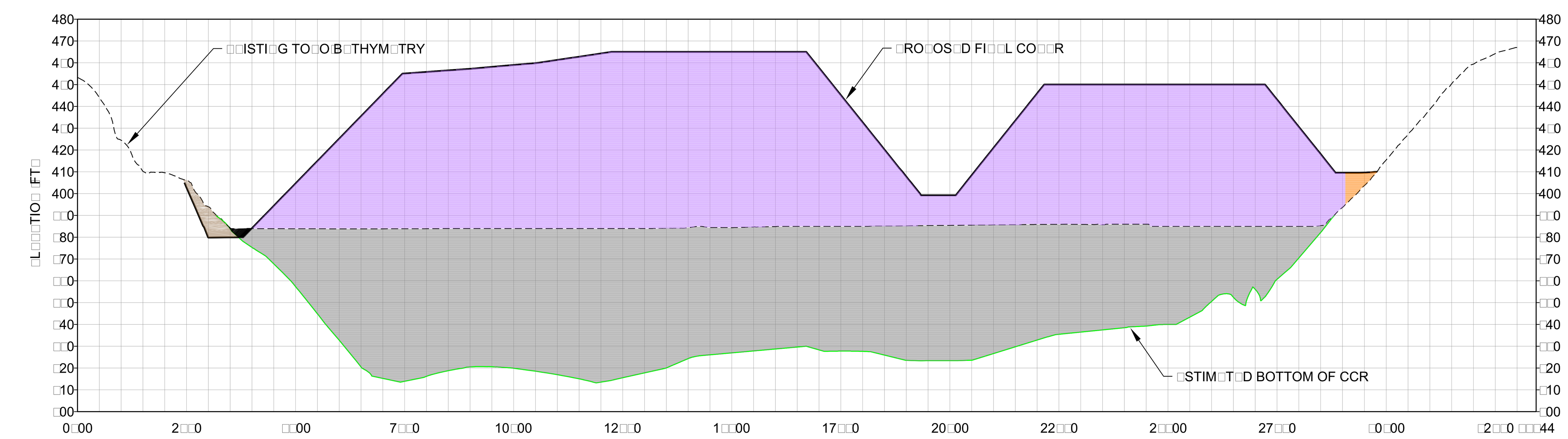

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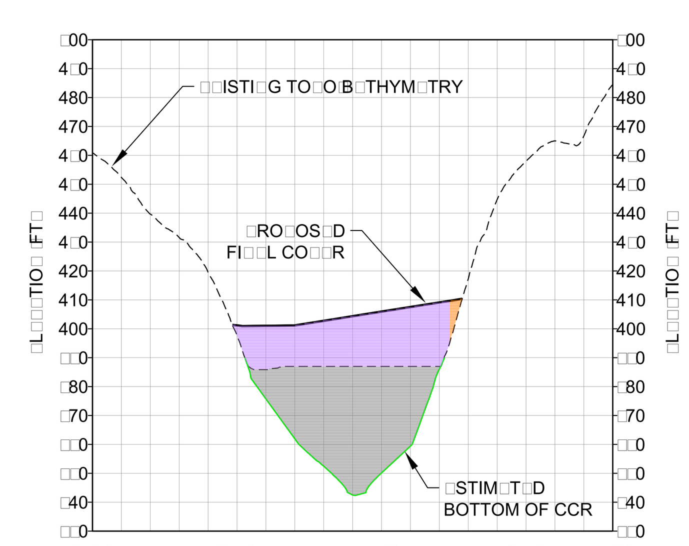

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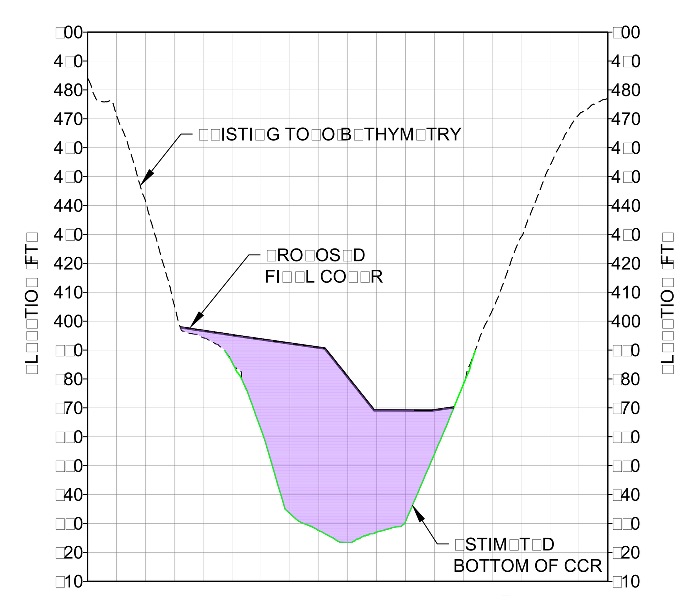

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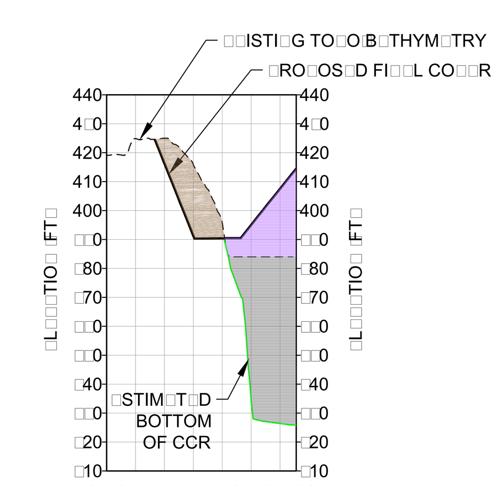

SECTION 11

LEGEND

- PROPOSED FINAL COVER
- EXISTING TOPO BATHYMETRY
- ESTIMATED BOTTOM OF CCR
- EXISTING CCR TO REMAIN
- PROPOSED CCR CUT
- PROPOSED CCR FILL
- PROPOSED NATURAL GROUND CUT
- PROPOSED NON CCR FILL
- PROPOSED ROCK FILL DAM

NOTES

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL NATIONAL GEODETIC VERTICAL DATUM NGVD 1988. COORDINATES CORRESPOND TO ALABAMA WEST COORDINATE SYSTEM NORTH AMERICAN DATUM NAD 1983.

2. CHANNELS AND OTHER DETAILED GRADING ARE SHOWN AS CORRIDORS AT THIS STAGE OF DESIGN.

3. PROPOSED CLOSURE COVER GRADING CONTOURS DO NOT SHOW INTERMEDIATE BENCHES, TERRACES AND OTHER LOCALIZED SURFACE WATER CONTROL FEATURES ARE NOT SHOWN FOR CLARITY.

REFERENCES

1. EXISTING TOPOGRAPHY PROVIDED BY SOUTHERN COMPANY SERVICES FEBRUARY 2018.

2. BATHYMETRY DATA PROVIDED BY SOUTHERN COMPANY SERVICES DATED MAY 201[illegible].

3. BOTTOM OF CCR TOPOGRAPHY INTERPRETED FROM USGS PORT BIRMINGHAM 1[illegible]8 AND GOODSPRINGS 1[illegible]71 QUADRANGLES. TOPOGRAPHY WAS INTERPRETED BETWEEN 20 FOOT CONTOURS AND ADJUSTED BASED ON GEOTECHNICAL INVESTIGATION DATA BY GOLDER ASSOCIATES INC.

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0 200 400
1" = 200' FEET
HORIZONTAL SCALE

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1" = 40' FEET
VERTICAL SCALE

CLIENT
SOUTHERN COMPANY SERVICES

Southern Company | Alabama Power

PROJECT
PLANT GORGAS
ASH POND CLOSURE
PERMIT PLANS

TITLE
CROSS SECTIONS
SHEET [illegible] OF [illegible]

CONSULTANT
GOLDER

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APPENDIX 9

QUALITY ASSURANCE/QUALITY CONTROL

PERMIT-LEVEL CQA PLAN

Draft Construction Quality Assurance (CQA) Plan

Plant Gorgas Ash Pond Closure Project

Submitted to:

Rebecca Mueller
Southern Company Services

Submitted by:

Golder Associates Inc.
5170 Peachtree Road Building 100 Suite 300, Atlanta, Georgia, USA 30341

+1 770 496-1893

1789848_0029

November 2018

Distribution List

David Prater

Jason Wilson

Record of Issue

Company	Client Contact	Version	Date Issued	Method of Delivery
Southern Company	Rebecca Mueller	0	11/13/2018	PIMS

Definitions

The following definitions are using throughout this Construction Quality Assurance (CQA) Plan:

- **Purchaser:** The term Purchaser means Alabama Power Company with whom the Contractor has entered into the Agreement and for whom the Work is to be provided.
- **Contractor:** The term Contractor means the firm that is responsible for the Work of the contract. The Contractor's responsibilities include the Work of any and all subcontractors and suppliers.
- **Project Construction Manager:** The term Project Construction Manager means the representative of the Purchaser for the purpose of administration and inspection of the Work. The Project Construction Manager may be a member or group of the staff or may be an external firm. The Purchaser shall inform the Contractor in writing at the start of the Work who the Project Construction Manager shall be. During the period of Work the Project Construction Manager shall act as an authorized representative of the Purchaser.
- **Engineer:** The term Engineer refers to the firm hired by Purchaser to furnish the design, construction drawings, and technical specifications for construction. The Engineer of Record for the project is a member(s) of the Engineer's firm licensed as a professional engineer in Alabama for the applicable engineering disciplines of the Work.
- **Work:** The term Work means the entire completed construction or various separately identifiable parts, thereof, required to be furnished under the Contract Documents. Work includes any and all labor, services, materials, equipment, tools, supplies, and facilities required by the Contract Documents and necessary for the completion of the project. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.
- **Manufacturing Quality Control (MQC):** A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is performed by either the manufacturer or an independent MQC firm to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in Contract Documents.
- **Construction Quality Control (CQC):** A planned system of inspections that is used to directly monitor and control the quality of a construction project. Construction quality control is performed by the Contractor or by an independent company(ies) hired by the Contractor and is necessary to achieve quality in the constructed or installed system. Construction quality control refers to measures taken by the Contractor to determine compliance with the requirements for materials and workmanship as stated in the Contract Documents. The following parties form part of CQC services to be provided:
  - **Construction Quality Control Engineer (CQC Engineer**): The term CQC Engineer encompasses the soils CQC Engineer, the geosynthetic CQC Engineer, and any other specialized CQC Engineers; though the term CQC Engineer does not relieve the specific experience and qualification requirements for each unique area. The CQC Engineer is a qualified representative of the Contractor or an independent firm hired by the Contractor to observe, test, and document activities related to the quality control of the Work. The term "CQC Engineer" is the title used to describe the official representative of

the CQC firm. The CQC Engineer can have a staff of personnel (CQC Representatives – CQCRs) assigned to the job site during construction activities. Typically, there will be one CQC Field Manager in charge of the CQC team who will be the main point of contact for the CQC Engineer.

- **Soils Testing Laboratory:** The Soils Testing Laboratory is the independent laboratory hired by the Purchaser or CQA Consultant to perform quality assurance soil tests. The term "Soils Testing Laboratory" is used to denote the official representative of that laboratory throughout.
- **Geosynthetic Testing Laboratory:** The Geosynthetic Testing Laboratory is the independent laboratory hired by the Purchaser or CQA Consultant to perform conformance testing and destructive testing on geomembrane seams. The term "Geosynthetic Testing Laboratory" is used to denote the official representative of that laboratory throughout these Technical Specifications.

- **Construction Quality Assurance (CQA):** A planned system of activities conducted by representatives of the Engineer or a third party (hired by the Purchaser) that provides the Purchaser with assurance that the facility was constructed as specified in the Contract Documents. Construction quality assurance includes inspections, verification, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA consultant to assess if the Contractor is in compliance with the plans and specifications for a project. The following parties form part of CQA services to be provided:
  - **Construction Quality Assurance Engineer (CQA Engineer**): The term CQA Engineer encompasses the soils CQA Engineer, the geosynthetic CQA Engineer, and any other specialized CQA Engineers; though the term CQA Engineer does not relieve the specific experience and qualification requirements for each unique area. The CQA Engineer is either the Engineer, a representative of the Engineer, or another independent party hired by the Purchaser to observe, test, and document activities related to the quality assurance of the Work. The term "CQA Engineer" is the title used to describe the official representative of the CQA Consultant. The CQA Engineer can have a staff of personnel (CQA Field Monitors) assigned to the job site during construction activities. Typically, there will be one CQA Field Manager in charge of the CQA monitoring team who will be the main point of contact for the CQA Engineer. The CQA Plan for this project details many responsibilities of the CQA Engineer and its field monitoring staff. In general, these responsibilities include the observation and documentation of activities related to the Work, including the use of geosynthetics and earthen materials for liner and cover systems.
- **Geosynthetic Manufacturers:** The Geosynthetic Manufacturers are those companies hired to furnish the geosynthetic components referenced in the Technical Specifications. The term "Manufacturer" is used throughout the CQA Plan and Technical Specifications to indicate the specific company supplying materials. The CQA Plan for the project includes specific quality assurance requirements for the Geosynthetic Manufacturers, in their relationships to Resin Suppliers (see below), in addition to their role of providing the quality control for the geosynthetic materials.
- **Resin Supplier:** The Resin Supplier(s) is (are) the company(ies) selected by the geomembrane manufacturer, and pipe manufacturer to furnish the polyethylene resin used in fabricating the aforementioned components. The term "Resin Supplier" is used in this manual to denote, individually, each respective supplier.

- **Test Method and Material Definitions:**
  - ArmorFill™ - Armor-Fill™ Liquid Cement is a proprietary Liquid Cement product used to cement the sand infill component of the ClosureTurf® System.
  - Atterberg limits – The liquid limit and plastic limit for soils (ASTM D4318). The water content at which soil behavior changes from the liquid to the plastic state is the liquid limit and from plastic to the semi-solid state is the plastic limit.
  - Classification System – The standard test method for classification of soils for engineering purposes (ASTM D2487, Unified Soil Classification System).
  - ClosureTurf® - A patented 4 component synthetic cover system consisting of a Watershed Geosynthetics specific Gas Management System, an Agru LLDPE (or HDPE) Geomembrane Liner (either Agru Super Gripnet® MicroDrain, or MicroSpike), an Engineered Turf, and a specific grade of sand infill (or alternatively a HydroBinder™ infill material).
  - Compaction – The process of increasing the density or unit weight of soil by rolling, tamping, vibrating, or other mechanical means to reduce void space.
  - Density – Mass density of a soil is its weight per unit volume; usually reported in pounds per cubic foot (lb/ft^3 or pcf).
  - 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.
  - Geomembrane – Polymeric (synthetic) membrane liner or barrier used in civil engineering for geotechnical projects. It can be reinforced with a fabric scrim for added strength.
  - Geotextile – A relatively porous construction or reinforcement fabric used in civil engineering for geotechnical projects. The fabric structure may be knit, woven, or nonwoven mat or net. Geotextiles are also frequently used as a filter or segregation medium.
  - Grain-Size Distribution – Distribution of particle sizes within a soil matrix (ASTM D422).
  - HydroTurf® - A patented 3 component system consisting of a Structured Geomembrane Liner, a specialized Engineered Turf, and HydroBinder™ infill material.
  - HydroBinder™ - A proprietary pozzolanic infill utilized as an infill to the ClosureTurf synthetic grass where higher surface water velocities may occur as well as in anchor trenches where specified.
  - In Situ – Natural, or in-place, condition.
  - Moisture Content – Ratio of weight of water in the soil to the weight of the soil solids (dry soil) expressed in percentage, also referred to as water content.
  - Optimum Moisture Content and Maximum Density – Moisture content corresponding to the maximum dry density achievable using controlled laboratory soil compaction procedures, such as the Standard Proctor Compaction Test (ASTM D698).

- Permeability – Ability of pore fluid to travel through a soil mass via interconnected voids. "High" permeability indicates relatively rapid flow, and vice versa. Rates of permeability are generally reported in centimeters per second (cm/sec).
- Plasticity – Ability of soil mass to flow or be remolded without raveling or breaking apart. Generally, it is the range of soil water content between the liquid and plastic limit.

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APPENDICES

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1.0 INTRODUCTION

1.1 Purpose and Scope

This Construction Quality Assurance (CQA) Plan has been prepared by Golder Associates Inc. (Golder) on behalf of Southern Company Services and Alabama Power Company in support of the anticipated construction project to close the Plant Gorgas Ash Pond (Ash Pond) in accordance with federal and state regulations.

The purpose of this CQA Plan is to provide the CQA requirements for the Ash Pond closure project. At the completion of construction, a CQA Report will be submitted to Southern Company Services, documenting the implementation of the CQA Plan.

This CQA Plan describes the following elements:

- Responsibilities and authorities of the organizations and key personnel involved in design and construction
- Protocols for sampling and testing used to monitor construction
- Reporting requirements for CQA activities including summary reports, inspection data sheets, problem identification and corrective measures reports, design acceptance reports, and final documentation
- Identification of CQA verification testing activities

Reference is made throughout this CQA Plan to the Design Drawings and Technical Specifications, which, along with the contractual specifications and requirements, will comprise the project Contract Documents. Details of materials, construction requirements, and quality control procedures are included in the Technical Specifications, which are included by reference in this CQA Plan.

This CQA Plan addresses CQA, which differs from construction quality control (CQC). In general, CQA refers to measures taken to assess if the Contractor is in compliance with the plans and specifications for a project. CQC refers to measures taken by the Contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project. This CQA Plan is independent of quality control (QC) programs conducted by manufacturers, the Contractor, and subcontractors that are described in the Technical Specifications.

1.2 Construction Quality Assurance Program

A CQA program is a planned system of activities that provides assurance that a project is constructed in accordance with the intent of the Contract Documents. It includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed Work.

The components of the CQA program are:

- Preparation of a CQA Plan
- Verification of conformance testing of geosynthetic, soil, and other materials
- Field monitoring of grades
- Field monitoring and verification testing of soil, CCR, rockfill, and other fill materials during placement and compaction

- Observation that the CCR Removal Verification Procedure was followed for applicable areas
- Field monitoring of the placement of the cover system
- Field monitoring of the installation of drainage infrastructure
- Preparation of CQA Reports and Records
- Review of technical and laboratory data
- Final walk-over of the completed Work
- Compilation and presentation of applicable records, data, as-built documents, photographs, and comments into a Final Construction Certification Report, which certifies that the construction was completed in accordance with the intent of the Design Drawings, Technical Specifications and approved modifications

The CQA Plan guidelines provide for qualified personnel to monitor the progress and quality of construction. This program is intended to provide an objective overview of construction progress and to identify potential deficiencies or problem areas during construction. The CQA program can also assist the Contractor in completing the project more efficiently by requiring compliance with quality control specifications before the project proceeds to the extent where substantial work may have to be redone in order to correct a defect.

The CQA Plan identifies the personnel involved in CQA, and describes roles and responsibilities of the associated parties, CQA reporting, and record storage requirements.

2.0 ORGANIZATION AND RESPONSIBILITIES

2.1 Quality Assurance Organization

2.1.1 Managers

The CQA Plan outlined herein will be administered by the CQA Engineer and designees who will report to the Project Construction Manager for Alabama Power Company. The CQA Engineer will report any concerns or deficiencies with respect to either defective materials or installation practices to the Project Construction Manager who has the authority to stop construction activities until the deficiency is corrected.

2.1.2 Project Construction Manager

The Project Construction Manager is a designated representative of the Purchaser who is responsible for the completion of the Work. The Project Construction Manager is responsible for supervising all the inspection and testing quality assurance (QA) requirements of this section. The Project Construction Manager is also responsible for the preparation of a construction certification report following construction to document the completed observations, measurements and testing. The report will include a certification statement signed by the Project Construction Manager that construction meets or exceeds design requirements and specifications contained in the design documents and achieves regulatory and local requirements.

The specific responsibilities for administering the CQA program are the responsibility of the Project Construction Manager and will include the following at a minimum:

- Reviewing plans and specifications for clarity, completeness, and compliance with the approved closure plan and applicable regulations.
- Educating and training QA personnel on requirements and procedures outlined in the CQA program.
- Scheduling and coordinating QA activities
- Supervising field personnel
- Confirming that QA data are accurately recorded and maintained
- Verifying that raw QA data are properly recorded, reduced, summarized, and interpreted
- Providing associated organizations with reports on CQA activities and results
- Identifying non-conforming construction and verifying corrective measures

2.1.3 Manufacturers

Each manufacturer supplying materials used in the construction of permanent features of the Work will implement a QA/QC program consisting, at a minimum, of a Quality Control (QC) Manager who supplies pertinent information to the Project Construction Manager through the material Manufacturer or Contractor. The responsibility of each Manufacturer's QC Manager will be to test physical, mechanical, and chemical properties of materials and products that will be delivered and used for cover and liner system construction in accordance with the CQA Plan and the Manufacturer's QA/QC document, perform appropriate evaluation of the test data, and report the results to the Project Construction Manager and CQA Engineer. Based on these results and the recommendations of the CQA Engineer, the Project Construction Manager may reject materials or finished products.

2.1.4 Contractors

Each contractor or subcontractor providing construction services for the Closure construction will comply with the Contractor's QA/QC program that has been reviewed and approved by the CQA Engineer in accordance with the CQA Plan. The Contractor will provide QC technicians to test and document all phases of construction, including the testing of supplied materials and of completed construction to ensure adherence to the construction-level specifications and drawings. These QC technicians report to a Senior QC technician or engineer (Senior QC representative) of the same firm, whose responsibilities will include collection and tabulation of all field test data, as well as audits of all QC technicians. The Senior QC representative reports his findings and recommendations to the Contractor, who will forward this information to the Project Construction Manager and CQA Engineer. Based on QC test results, the Project Construction Manager may reject construction materials and/or modify construction operations.

2.2 Qualifications, Authority, and Responsibilities of Personnel

2.2.1 Contractor QC Personnel

All Contractor QC personnel will be properly trained and qualified to test and inspect the soil and geosynthetic components of the Closure. Manufacturers and Contractors will submit qualifications of their proposed QC personnel to the Project Construction Manager and CQA Engineer for review and approval. These qualifications will be kept on permanent file as a record of the construction process.

2.2.2 CQA Engineer, CQA Field Manager and CQA Field Monitors

The CQA Engineer will be a Professional Engineer licensed in the State of Alabama in civil or geotechnical engineering with sufficient practical, technical, and managerial experience to successfully oversee and implement construction quality assurance activities for ash impoundment or waste disposal facilities. He/she will have a demonstrated knowledge of specific construction practices relating to ash impoundment / landfill closure or landfill construction, observation and testing procedures, documentation procedures, permit requirements and regulations applicable to ash impoundment closure. This person will have sufficient educational, technical, and administrative experience to perform his/her responsibilities. The CQA Engineer will ensure that communications of all QA/QC issues are conveyed to and acted upon by the appropriate organizations. The CQA Engineer will maintain regular communications with the CQA Field Monitors. The CQA Engineer will be available for meetings and periodic site inspections.

The CQA Engineer will designate qualified representative(s) to carry out the on-site observation, testing, and documentation under his/her supervision. These representatives will include a CQA Field Manager, as well as additional CQA Field Monitors as required. All CQA field personnel will have adequate experience and training in observation and testing procedures of the appropriate components being installed.

The CQA Field Manager will have at least five years of experience in related construction. This includes demonstrated knowledge of specific field practices relating to construction techniques used for composite-lined facilities, observation and testing procedures, equipment, documentation procedures, and site health and safety.

2.2.2.1 Chain of Authority

The CQA Engineer will report to the Project Construction Manager. The CQA Field Manager will report directly to the CQA Engineer. The CQA Field Monitors will report directly to the CQA Field Manager.

2.2.2.2 Responsibilities of Field CQA Personnel

The CQA Field Manager is responsible for all aspects of executing the CQA program in the field. The CQA Field Manager will direct, oversee, and check the work of the CQA Field Monitors. The CQA Field Monitors will observe all construction activities, including installation of each component of the liner and cover system, and all testing and repairing activities. Key responsibilities of the CQA Field Manager include:

1. Review material submittals required by the construction-level specifications and drawings and evaluate equivalent materials proposed for use by the Contractor, and make recommendations to the Project Construction Manager and the CQA Engineer. Ensure that modifications have been approved prior to their implementation.

2. Review panel-layout shop drawings, which show the proposed installation of synthetic lining and drainage materials. Ensure that every effort is taken to minimize field seams, especially in critical areas (e.g., slopes and sump areas).
3. Complete daily field reports that document the installation of the liner and cover construction efforts. At a minimum, each daily report will record the following, as applicable:

- Date and project name;
- Weather conditions;
- Locations of Work;
- Equipment and personnel used;
- Description of areas of Work observed and/or tested;
- Summary of completed field testing;
- Off-site materials received;
- Decisions made regarding acceptance of specific portions of Work and/or remedial actions implemented in cases of sub-standard quality;
- Record project photographs; and
- Signature of the CQA Field Manager.

1. Confirm that testing equipment, personnel, and procedures do not change during the project or that any such changes do not result in a deterioration of the monitoring process.
2. Provide weekly reports to the Project Construction Manager and the CQA Engineer on the field testing/monitoring results including:

- Reviews and interpretations of observation records and test results;
- Identification of Work that the CQA Field Manager believes should be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval; and
- Reports that reject defective Work including identification of deficiencies.

1. Verify that the Contractor’s proposed and accepted quality control measures are being followed.
2. Verify that the equipment used in testing meets the test requirements and that the tests are conducted by qualified personnel according to the standardized procedures defined by the QA/QC procedures.
3. Monitor all tests conducted by the Contractor’s personnel as may be required by the contract and/or the construction-level specifications and drawings.
4. Perform independent, on-site monitoring of the construction in progress to assess compliance by the Contractor with the design criteria, plans, and specifications. Inspect and observe construction materials for suitability and conformance with plans and specifications prior to installation.
5. Report to the Contractor results of all observations and tests as the Work progresses and interact, as requested by the CQA Engineer, with the Contractor to provide assistance in modifying the materials and work to comply with the specified design.
6. Recommend acceptance or rejection of Work items.

7. Recommend limiting and/or restricting equipment and personnel movement on in-place geosynthetic materials in accordance with required Work activities.
8. Maintain a field file of all field reports, meeting notes, weekly reports, submittals, shop drawings, etc.
9. Assist the CQA Engineer with preparation of a final CQA Report. The purpose of the CQA Report is to provide a permanent record of the construction for submittal to a reviewing regulatory agencies that landfill construction was completed in accordance with the design specifications and drawings, permit, and applicable regulations. The contents of the CQA Report are described in Section 5.0.

2.2.3 Contractor(s)

The Contractor is responsible for the construction of the Work in strict accordance with the material-specific design criteria, plans, specifications and drawings using the necessary and industry-accepted construction procedures and techniques. The Contractor will complete daily reports documenting, at a minimum, Work completed, problems encountered, and solutions.

The Contractor has the authority to direct and manage his employees, subcontractors, and the equipment, means, and methods used to accomplish the construction so as to satisfy the design requirements of the Work.

2.2.4 Independent Testing Laboratories

All laboratory testing of the geosynthetic, soil, CCR, and other materials will be conducted by an independent laboratory or laboratories selected by the CQC Engineer and approved by the CQA Engineer. The geosynthetic laboratory will be accredited by the Geosynthetics Accreditation Institute (GAI) for the specific tests to be performed as required by the CQA Plan. The geotechnical laboratory shall be experienced in conducting the geotechnical tests required by the CQA Plan.

2.2.5 Licensed Land Surveyor

The licensed land surveyor shall provide equipment and personnel needed to perform surveying activities as required by the construction project. The licensed land surveyor shall be licensed in the State of Alabama.

2.3 Document Control

The CQA Engineer will be responsible for the overall administration and control of the CQA program. The CQA Engineer will verify that a project filing system is implemented that will include, at a minimum, survey measurements; field and laboratory tests of soil components; manufacturer, field, and laboratory tests of geosynthetic components; daily field reports; and certifications. This filing system will be maintained by and at the offices of the CQA Engineer with duplicate copies maintained at Project Construction Manager’s office. A file index will be prepared to expedite retrieval of documents.

CQA personnel will be required to continuously update the filing system with new data, test results, certifications, etc.

2.4 Review of Quality Control Information

The CQA Field Manager will be responsible for obtaining all of the QC laboratory test results and QC field test data from the Contractor and for reviewing these data for conformance to the specifications and CQA Plan. All nonconformance items will be resolved between the Project Construction Manager (with a recommendation from the CQA Engineer) and the Contractor. The CQA Field Manager will maintain a field log and record all observations with regard to conformance with the CQA Plan. A daily log will be provided summarizing daily activities and QA/QC inspections, testing, and documentation.

2.5 Project Meetings

In order to successfully complete the Work, it will be necessary for the Contractor, Project Construction Manager, CQA Engineer, and the CQA Field Manager to have formal, structured communications on a regular basis. This will be accomplished through meetings held during the progress of the Work as described below:

2.5.1 Pre-Construction Meeting

A pre-construction meeting will be held at the site prior to the start of major construction efforts. Representatives from Alabama Power, Project Construction Manager, CQA Consultant, and the Contractor will attend the meeting to review construction documents, the CQA Plan, and other issues associated with construction. This meeting should take place at least one (1) week prior to the start of construction. The objectives of the pre-construction meeting are to:

- Review the responsibilities of each organization;
- Review lines of authority and communication for each organization;
- Discuss the established protocol for observations and tests;
- Discuss the established protocol for handling construction deficiencies, repairs, and retesting;
- Review methods for distributing and reporting field monitoring data;
- Review Work area security and safety protocol;
- Discuss any modifications of the CQA Plan to ensure that site-specific considerations are addressed;
- Discuss procedures for the protection of materials and for the prevention of damage from inclement weather or other events; and
- Conduct a site walk to verify that the design criteria, specifications, and drawings are understood and to review material and equipment storage locations.

The meeting will be documented by CQA personnel.

2.5.2 Progress Meetings

Progress meetings will be held weekly, or at the discretion of the CQA Engineer or Project Construction Manager at the Work site, at an agreed-upon date and time. The objectives of each meeting are to:

- Review the activities and accomplishments completed within the previous construction period;
- Review the Work location activities and construction monitoring requirements for the ensuing Work period;
- Identify the Contractor's personnel and equipment assignments for the ensuing Work period; and
- Discuss any potential construction problems.

Each progress meeting will be documented by CQA personnel.

2.5.3 Problem or Work Deficiency Meetings

Special meetings will be held when a problem or deficiency has occurred or may possibly occur. The purpose of the meeting is to define and resolve the problem or recurring Work deficiency in the following manner:

- Define and discuss the problem or deficiency
- Review alternative solutions
- Implement a plan to resolve the problem or deficiency

Each special meeting will be documented by CQA personnel

3.0 EARTHWORK COMPONENTS

The following section summarizes the QA plan for testing and monitoring the earthwork required to close the Plant Gorgas CCR Pond. The Contractor will provide Purchaser's acceptance criteria that documents all imported protective cover soil and topsoil provided for this project is from clean, uncontaminated sources.

3.1 Soil Prequalification

3.1.1 Prequalification Testing

Prior to construction sources of soils for use as structural fill, compacted soil liner, vegetative soil layer and aggregate material will be identified, as applicable to the project. Samples of each applicable material will be tested to determine their conformance with the project requirements. Prequalification testing will be performed in accordance with the methods and frequencies designated in the attached Tables.

3.2 Soils Preconstruction Material Evaluation Testing

The soil preconstruction material evaluation program described here will be applied to all soils procured for use in construction of:

- Structural Fills
- Common Fills
- Vegetative soil layers (topsoil)
- Aggregate Material

Once sources of soils have been qualified as approved sources for the project, preconstruction material evaluation testing of each approved soil component source will be performed at the frequencies defined in Table 2.

3.2.1 Rejection of Soils

Rejection of soils for use in construction may be based on preconstruction material evaluation testing results if the subject soil fails to meet the minimum criteria and/or the requirements of the project. Any rejection of soils based upon the results of preconstruction material evaluation testing will be documented by the CQCR and approved by the CQA Engineer and Project Construction Manager.

3.3 Soils Construction Quality Evaluation

The CQCR will monitor soil component construction continuously. Monitoring of soil component construction Work will include:

- Inspection of construction activities
- Inspection of soil materials (including any deficiencies)
- Inspection of subsurface and excavation conditions;
  - The CQCR will observe the CCR excavation as it advances to determine when removal of ash and concentrations of organic material have met the project criteria.
- Inspection of any onsite soil processing
- Inspection of soil placement and compaction
- Inspection of loose and compacted lift thickness
- Inspection of soil clod and particle size
- Inspection of any reconditioning or replacement of soils required due to deficient soil or weather conditions or deficient construction
- Inspection of physical conditions during soil processing, placement, and compaction (including roller foot penetration, pumping, cracking, slumping, etc.)

In addition to the above and to conducting field testing according to Section 5.3.1, the CQCR will monitor soil component construction continuously for the following:

- Subbase surface shall be substantially free of debris, branches, vegetation, stones greater than 2/3 inch, depressions deeper than 4 inch, snow, ice, frozen material, or water before placement.
- Maximum soil liner lifts not to exceed 6 inches in thickness after compaction.
- Maximum particle size shall not exceed ¼ inch for the top 6 inches underlying the geosynthetic cover system. Maximum particle size shall not exceed ¾ inch for lifts greater than 6 inches below the geosynthetic cover system.

- CCR excavation, backfilling and compaction shall be conducted in accordance with the recommendations from a geotechnical engineer and the project specifications.
- CCR is not placed beyond the stack footprint as designed or agreed upon by the CQA Engineer or Project Construction Manager.

3.3.1 Field Tests

CQCR will perform field tests during construction as indicated in Table 3 to determine whether the minimum criteria and project requirements for the soil components have been met.

Nuclear density method (ASTM Designation D6938) are preferred for field density and moisture determinations because of the ease of testing. However, other field methods, such as the sand cone method (ASTM designated D1556) or a drive ring method (ASTM Designation D2937) may be employed.

The frequency of field testing and the minimum criteria for each soil component are provided in Table 3. All field test results, and their locations will be recorded by the CQCR. Records of both factory and field calibration of all nuclear densimeters used will be maintained onsite using the nuclear density gauge standardization procedure. In addition, all nuclear densimeter operators must be properly trained. Copies of their training certifications will be maintained on site.

A special testing frequency may be used at the discretion of the CQCR when visual observations of construction performance indicated a potential problem.

During construction, the frequency of testing may also be increased in the following situations:

- Adverse weather conditions
- Equipment breakdown
- At the start and finish of grading
- When the material fails to meet the project
- When the Work area is modified substantially

3.3.2 Rejection, Retesting, and Replacement

If field density and moisture test results indicate that the soil layer does not meet the specification requirements, the field test will be repeated within five (5) feet of the failed test to verify the initial field test. Upon failure of the verification field test, the soils tested in the area subject to the failed field test will be removed and replaced by the Contractor. The minimum area to be reworked will be approximately 50 square feet.

All repairs in soil lifts will be retested at the same frequency as the original construction. The CQCR will keep a record of all retesting, repairs, and replacements in the daily field activity log.

3.4 Protection of Completed Work

The soil subgrade shall be protected both during and after construction to prevent the layer from degrading prior to the placement of the geosynthetics. The methods used to protect the subgrade shall include but not be limited to desiccation control and smooth rolling to promote runoff. Additionally, the subgrade shall be protected from freezing and desiccation at all times.

3.5 CCR Grading and Fill

The CQCR(s) will observe CCR filling and grading and confirm it is subsequent to Pond dewatering. Areas that exhibit excessive yielding or rutting shall be reworked or stabilized in accordance with the contract documents. CCR shall be placed in uniform horizontal lifts and compacted with equipment and methods that can achieve a surface that is sufficient to support subsequent lifts and the final cover system. Each lift shall be visually inspected and documented by the CQCR(s) to assure it meets the contract document requirements before subsequent lifts are placed. The CQCR(s) is responsible for observing and documenting the dewatering, grading, compaction, and acceptance associated with each lift until the Geosynthetic subgrade is achieved.

3.6 Geosynthetic Subgrade

Once the Geosynthetic subgrade is obtained, the subgrade will be smooth drum rolled. Ruts or irregular surfaces, stones larger than 0.75 inches, debris, and any existing dense vegetation will be eliminated prior to placement of the geomembrane. The geosynthetic subgrade will be documented by survey and compared to the design elevations. The maximum allowable difference from documented grades to design grades is +0.0/- 0.2 foot. If the documented top of geosynthetic subgrade differs from the design grades by more than +0.0/- 0.2 foot, the subgrade will be regraded and redocumented. Once acceptable, the CQCR will document subgrade acceptance.

3.7 Anchor Trenches

QA associated with monitoring and testing of anchor trenches will include the following:

- Anchor trench excavation will be monitored for proper depth and location
- Geosynthetic panels extending into the anchor trench will be monitored for complete seaming within the anchor trench
- The anchor trench inside edge will be chamfered to avoid pinching and creasing of the geosynthetic materials
- Anchor trench backfill operations will be monitored
- The depth of a typical anchor trench will be measured to conform to contract drawings
- Backfill will be placed in thin lifts not to exceed on foot in loose thickness
- Density tests will be performed at a minimum interval of one per 300 linear feet of anchor trench to be compacted to a minimum of 90 percent of the modified Proctor or 95 percent of the Standard Proctor

maximum dry density in lifts not exceeding 12 inches. The CQCR will increase the testing interval if the Contractor changes backfill material, placement procedures, or compaction methods of backfill.

- The geosynthetic panel runout in the anchor trench will be within +/- 0.3 foot as shown on the contract documents.

3.8 Topsoil

The topsoil will be the final six inches of natural final cover systems (i.e. in areas not using synthetic covers) and applicable other project and restoration areas as identified in the Construction Drawings. This material shall be locally available topsoil with a minimum 2.5 percent organic matter and pH between 6.4 and 7.5 to support the establishment of vegetation and retain moisture. Testing of the topsoil for organic content will be in accordance with ASTM D2974.

The CQCR will observe the following during topsoil placement:

- Placement procedures and equipment sizes
- Weather conditions to prevent placement of frozen material
- Removal of stones or other debris
- Degree of compaction

The CQCR will perform the following testing prior to and during topsoil placement.

- Collect sample for contaminant testing at the request of the Purchaser from potential borrow sites.
- Collect and test a minimum of one sample per 5 acres of material placed and/or when the material source changes for grain size determination in accordance with ASTM D422, for organic content, and pH in accordance with ASTM D4972, “Standard Test Method for pH of Soils”
- Record observations in the daily report and with construction photographs in accordance with Section 4.2

The maximum allowable difference from documented grades to design grades is +0.2/-0.0 feet. If the documented top of topsoil differs from the design grades by more than +0.2/-0.0 feet, the topsoil will be regraded and redocumented.

4.0 CCR REMOVAL VERIFICATION PROCEDURE

4.1 Introduction

This section describes the procedure for CQA Engineers to follow to verify that accumulated CCR have been removed from areas where closure by CCR removal is the intended closure methodology. The qualified person will certify and document that an agreed upon procedure was followed.

Prior to the start of closure all parties involved in the removal and verification of removal of CCR should review the following information and agree upon the anticipated procedures to be used for removal.

- Pre-Closure Conditions (typically presented in the Closure Design Drawings or Report)

- Pre-Closure topography and ground cover conditions
- Estimated CCR Limits for Closure by Removal Areas
- Estimated Bottom of CCR Topography for Closure by Removal Areas
- Available subsurface or geophysical data from Closure by Removal or Adjacent Areas

- Historical Operational Conditions, as documented in:
  - Available Historical Aerial Imagery
  - CCR Facility Operational Records
  - Other Applicable Records

4.2 Overview of Procedure

The procedure for closure by removal of CCR within identified limits will involve the following steps for each area identified as a Closure by CCR removal area:

1) Identification and demarcation of the area (or portion of the area) subject to removal verification. It is noted that the verification and documentation of removal procedures may be completed in phases.
2) Removal of accumulated CCR such that no CCR remains visible.
3) Visual inspection and documentation of the area by qualified person.
4) If required, repeat steps 1 through 3 until CQA Engineer is satisfied that no CCR remains visible.
5) Complete "Pre 6-Inch Over-Dig Survey" and photographic documentation of applicable removal area(s).
   a. The Pre and Post 6-inch Over-Dig surveys will be performed either by:
      i. A grid of discrete survey points with a maximum 100-ft spacing (each way). Horizontal control shall be within 0.1 ft, and vertical control shall be within 0.02 ft, Or
      i. For large areas, a photogrammetric or Lidar survey capable of generating a continuous surface of the surveyed area. For near continuous surveys Horizontal and Vertical controls for Pre and Post Over Dig surveys can be reduced to 0.2 and 0.04 ft, respectively.
6) Over-excavation of a minimum of 6 inches at every applicable point (see Note 1 below) in the designated removal area(s).
7) Complete Post 6-Inch Over-Dig Survey and photographic documentation using the same survey points, procedures, and prescribed minimum tolerances as for the Pre 6-Inch Over-Dig Survey. Complete verification of the prescribed minimum 6" removal across the removal area by survey and visual comparison of the removal area(s).

Notes on Procedure

1) For areas where rock, existing concrete designated to remain, or other similar hard surfaces are present in the excavation area (including the over-excavation zone) the surface will be cleaned to a visually-clean condition through hydraulic or mechanical means such as pressure washing. The soils surrounding the hard areas will be removed to the 6-inch over-excavation criterion.

2) Documentation of the removal verification procedure will include pre and post over-dig photographs documenting the removal verification area, daily field reports from the CQA Engineer, and survey data indicating removal verification areas and confirmation that the over-excavation criterion was achieved. This documentation will be compiled and included in the Construction Certification Report at the completion of the project.

4.3 Additional Considerations

- For areas where the accumulated CCR and natural ground are difficult to distinguish, a hand lens or other visual aid may be used by the qualified person to aid the visual inspection.
- For areas where a clear color contrast between accumulated CCR and natural ground exists, colorimetric methods can be considered to supplement visual identifications.
- The CQA Engineer and land surveyor must be professionally licensed in their respective disciplines in the State of Alabama.

5.0 GEOSYNTHETICS TESTING AND OBSERVATION

5.1 Geocomposite Construction Quality

5.1.1 Requirements

The Manufacturer’s QC tests listed in Tables 4 and 5 will be performed at an interval of at least one test per 100,000 square feet of each type of geocomposite produced for the project.

5.1.2 Preconstruction Construction Quality Activities

The CQCR will review all the Manufacturer’s QC data for conformance with the project prior to deployment of the geocomposite material.

The CQCR will review the following Manufacturer’s QC information:

- Copies of QC certificates issued by the resin supplier for both the geonet and geotextile materials. These certificates will normally contain the resin supplier name, resin production plant, brand name or type of resin, resin chemical composition, resin number, and resin production date.
- Manufacturer’s statement certifying the geonet and geotextile cleanliness and amount of reclaimed polymer,
- Geonet and geotextile composition – percent by weight of all constituents and additives
- Manufacturer’s certificate guaranteeing minimum average roll values required by the design drawings and project. This statement must contain a statement, for non-woven geotextiles, that the manufacturer has inspected the geotextile for needles and found it to be needle free.

- Manufacturer's QC certificates verifying the material properties of the geonet and geotextile. These certificates must be reviewed to ensure that test results are within acceptable ranges, the tests are performed at acceptable frequencies, proper tests are performed, and they are certified by the manufacturer's representative:
  - QC Certificates for geotextile material: roll identification numbers, resin material batch, sampling procedures, and results of geotextile material testing for thickness (ASTM D5199), grab tensile strength and elongation (ASTM D4632), trapezoidal tear strength (ASTM 4533), burst strength 9ASTM D3786), puncture strength (ASTM D4833), mass per unit area (ASTM D5261), apparent opening size (ASTM D4751), and hydraulic permittivity (ASTM D4491).
  - QC certificates for geonet material: roll identification numbers, resin material batch, sampling procedures, and results of geonet material testing for thickness, mass per unit area and specific gravity.
- The CQCR will review the geocomposite manufacturer's QC information and report any discrepancies from the design drawings and project requirements and this CQA Plan to the Contractor.

5.1.3 Material Conformance Testing

The CQCR will ensure that the geocomposite material has been tested by the CQC Laboratory and that the results of material conformance tests are acceptable in accordance with Tables 4 and 5. The CQCR will obtain geocomposite test samples upon delivery of the geocomposite rolls and forward them to the CQC Laboratory for testing.

Acceptance criteria for each property of the geocomposite will be in conformance with the requirements of Section 5.1.4. CQA samples will be taken at a frequency of one sample per lot or one sample per 100,000 square feet, whichever is the greater frequency. A lot is a group of consecutively numbered rolls from the same manufacturing line; or an alternate grouping of geocomposite rolls designated by the CQCR. Samples will be taken across the entire width of the roll, and will not include the first three (3) feet of the roll. Sample size will be three (3) feet by the roll width, unless otherwise specified.

If the results from the CQC Laboratory tests fail and are different from the manufacturer's testing results, the CQC Laboratory will repeat the test. The manufacturer may monitor the verification tests at their discretion. The results from the latter test will determine the suitability of the lot of material tested. The CQCR will review all material conformance tests and report any discrepancies in the daily report prior to installation of the geocomposite. If a test result does not conform to the project requirements and this CQA Plan, all material from the lot represented by the failing test shall be considered as not meeting the project requirements and this CQA Plan, and the CQCR should recommend rejection of the lot to the Project Construction Manager. Additional conformance test samples may be taken by the Contractor to encompass or isolate the portion of the lot that does not meet the required project requirements and this CQA Plan; provided the geocomposite rolls in the lot have been produced and numbered during the same production run.

5.1.4 Geocomposite Installation

The CQCR will monitor and inspect all aspects of geocomposite handling and installation to ensure conformance with the project requirements and this CQA Plan. The CQCR will also monitor placement of all materials located above each geocomposite. The CQCR will keep records of all monitoring activities on a daily log form. Any failure to conform with the project requirements and this CQA Plan, or activities that present a hazard to the material or installation will be noted and recommendations made to Purchaser the Project Construction Manager and Contractor for correction of these defects.

5.2 Geomembrane Construction Quality

5.2.1 Requirements

The geomembrane components of the liner and ClosureTurf final cover shall conform to the latest version of GRI-GM13 for HDPE geomembrane and GRI-GM17 for LLDPE geomembrane as provided in Tables 7,8, and 9. Seam properties shall conform to GRI-GM19 as provided in Table 10.

5.2.2 Preconstruction Construction Quality Activities

The CQCR will review all manufacturer's QC data for conformance with the project prior to deployment of the geomembrane material.

The CQCR will review the following manufacturer's QC information:

- Copies of QC certificates issued by the resin supplier. The resin QC certificate will provide test results at the frequencies described in Section xxx for resin density (ASTM D1505), melt flow index (ASTM D1238, condition E), and carbon black content (ASTM D-1603).
- Manufacturer's statement certifying the geomembrane cleanliness and amount of reclaimed polymer
- Geomembrane composition – percent by weight of polyethylene, carbon black and other additives
- Manufacturer's certificate guaranteeing minimum values required by the drawings and project
- Manufacturer's QC certificates verifying the material properties of the geomembrane.

The CQCR will review the manufacturer's QC information and report any discrepancies from the design drawings and project to the Project Construction Manager and Contractor.

5.2.3 Material Conformance Testing

The CQCR will obtain test samples from the geomembrane upon delivery of the rolls of geomembrane and forward them to the CQC Laboratory and testing. Samples will be taken at a frequency of one sample per lot or one sampler per 100,000 square feet, whichever is the greater frequency. The CQCR may obtain additional samples at suspect locations, at his discretion and with approval of the Project Construction Manager. Samples will be taken across the entire width of the roll and will not include the first three (3) feet of the roll. Sample size will be three (3) feet by the roll width, unless otherwise specified.

The CQCR will ensure that the geomembrane material has been tested by the CQC Laboratory and that the results of material conformance tests are acceptable.

Material conformance tests to be performed by the CQC Laboratory are listed on Table 11. If the results from the CQC Laboratory tests fail and are different from the required manufacturer's testing results, the CQC Laboratory will repeat the test at the direction of the Project Construction Manager. The results from the latter test will determine the suitability of the lot of material tested. The CQCR will review all material conformance tests and report any discrepancies in the daily report prior to installation of the geomembrane.

If a test result does not conform to the project requirements, all material from the lot represented by the failing test shall be considered as not meeting the project requirements, and the CQCR should recommend rejection of the lot to the Project Construction Manager. Additional conformance test samples may be taken by the Contractor to encompass or isolate the portion of the lot that does not meet the required project; provided the geomembrane rolls in the lot have been produced and numbered during the same production run.

5.2.4 Transportation and On Site Storage and Handling

The CQCR will review the proposed and ongoing methods of geomembrane transportation, and on site storage and handling to ensure that geomembrane rolls are not damaged prior to deployment.

5.2.5 Panel Identification

The Contractor and CQCR will develop and agree upon an identification coding system to be employed during the installation of the geomembrane. This coding system will be as simple and logical as possible.

5.2.6 Subgrade Preparation

The CQCR will inspect the subgrade surface upon which the geomembrane is to be deployed, and the anchor trench prior to placing any geomembrane panels.

If the CQCR determine that the subgrade does not conform to the project requirements and this CQA Plan, the non-conformance will be reported immediately to the Contractor and/or Project Construction Manager. At any time during the geomembrane installation, the Project Construction Manager may advise the Contractor of any locations which may not be adequately prepared for placement of the geomembrane.

5.2.7 Material Handling and Acceptance

The CQCR will inspect all rolls or sheets of geomembrane for defects and damage. Rolls, factory panels, sheets, or portions thereof, which have severe flaws or damage, or fail conformance tests will be rejected and returned to the supplier. Any panels or rolls with minor damage or defects that are reparable in the field will be repaired in accordance with the project.

The CQCR will monitor the Contractor's handling of geomembrane materials on site to ensure adequate equipment and care are used to prevent damage to the geomembrane material during handling.

5.2.8 Panel Deployment

The CQCR will monitor geomembrane deployment activities and procedures to ensure conformity with the project requirements and this CQA Plan. The panel identification code and date of installation will be recorded by the CQCR for each panel placed. The CQCR will note any nonconformance with project or inadequate placement practices, and advise the Project Construction Manager and Contractor if the above occurs.

5.2.9 Field Seaming

The CQCR will inspect and monitor field seaming activities and record the results in the daily reports. The CQCR will record the results of all monitoring and testing of field seaming procedures on a panel seaming form. Trial seams will be made by the Contractor. These trial seams will be performed at least two (2) times per shift or every four (4) hours, whichever is less. The CQCR may require additional trial seams if the seaming conditions are suspect. The CQCR will monitor all trial seams.

The CQCR may direct a portion of the trial seam to be tested destructively as indicated. If a trial seam sample fails a destructive laboratory test, a destructive test seam sample will be taken from each seam completed by the seamer during the shift from which the failed trial seam was taken. These destructive test samples will be forwarded to the CQC Laboratory for testing. If a destructive test seam sample has already been taken during normal CQC sampling along a specific seam, the remedial conditions stated above are not required. Failures of these destructive seam tests will be repaired as required by the project.

5.2.10 Testing of Field Seams

5.2.10.1 Non-Destructive Seam Testing

The Contractor will non-destructively test all field seams over their full length. Non-destructive seam testing will include vacuum box testing (extrusion seams), air pressure testing (double fusion seams only), or other approved methods.

The CQCR will perform the following activities for all seams:

- Monitor and inspect all non-destructive testing procedures over the full length of all seams
- Record the location, test data, test unit number, name of tester, and results of all testing
- Where seams cannot be non-destructively tested, the following procedures apply;
  - All such seams will be capped with an additionally geomembrane
  - Non-destructive testing may be performed prior to final installation, if possible.

All capping and “out-of-place” non-destructive testing will be observed by the CQCR and Contractor to ensure uniformity and completeness. Non-destructive seam continuity testing will be performed as the seaming work progresses, not deferred to the end of seaming operations.

5.2.10.2 *Destructive Seam Testing*

Samples for destructive seam tests will be taken to determine seam strength at locations selected by the CQCR. Test locations will be determined at the CQCR's discretion and may be prompted by any indication of imperfect welding. The Contractor will not be informed in advance of destructive sample locations.

One destructive seam sample will be taken for every 500-feet of seam length. Destructive seam sampling will be performed as the seaming progresses, rather than upon seaming completion in order to have laboratory test results before the geomembrane is covered by another material. Duplicate samples for compliance testing may be requested by the Project Construction Manager.

5.2.10.3 *Field Testing*

All holes in the geomembrane resulting from destructive sampling will be immediately repaired in accordance with repair procedures defined in the project. The Contractor will test the two one-inch seam samples for peel and shear respectively, using an approved calibrated electronic field tensiometer. If any test fails, then the procedures outlined in section xxx of this plan will be followed. If both samples pass the field tests, samples taken for CQC Laboratory testing will be submitted.

The date, time, temperatures, seaming unit, name of seamer, welding unit temperatures, and result of test will be recorded.

5.2.10.4 *Laboratory Testing*

The CQCR will be responsible for packaging and shipping destructive test samples to the CQC laboratory in a manner that prevents damage to the samples. The CQCR will be responsible for storage of archive samples.

The CQC Laboratory testing of seam samples will include "seam strength" (ASTM D6392, with a 1-inch wide specimen tested at 2 inches/minute for HDPE and 20 inches/minute for LLDPE) and "peel adhesion" (ASTM D6392). At least five (5) specimens will be tested for each test method. Specimens will be selected alternately by test from the samples (i.e., peel, shear, peel, shear, etc.). At least 4 of the 5 specimens tested will meet or exceed the specification requirements.

The CQC Laboratory will submit all geomembrane seam test results to the CQCR in written form within 48-hours of receipt of test samples unless otherwise specified by the Project Construction Manager. The CQC Laboratory will provide verbal test results for destructive tests within 24-hours of receipt of test samples and maintain that standard throughout the project. The CQCR will review the test results as soon as they are available, and make appropriate recommendations to the Contractor.

5.2.11 Test Failures, Defects and Repairs

Any seam failing non-destructive testing will be repaired according to the procedures given below. The CQCR will inspect such repairs and record his observations.

The following procedures apply whenever a sample fails a destructive test, whether the test was conducted by the Contractor's laboratory, in the field, or by the CQC Laboratory:

- The Contractor may either reconstruct the seam between any two adjacent passing test sample locations; or he may isolate the failed seam length and reconstruct the isolated failure length as described below.
- The Contractor may isolate the failed seam length by tracing the welding path to an intermediate location at least ten (10) feet from the failed test location in each direction, and take a small sample for an additional field test at each location. If these additional samples pass the test, then laboratory samples will be taken as outlined in the Project Specifications. If the laboratory test results pass, then the seam is reconstructed between these locations. If the laboratory test results fail for either sample, then the process is repeated to establish the seam length that should be reconstructed.

All acceptable seams must be bounded by two locations from which samples passing CQC Laboratory destructive tests have been taken. In cases exceeding 150-feet of reconstructed seam, a destructive test sample must be taken from the reconstructed seam and re-evaluated.

The CQCR will document all actions taken in conjunction with destructive test failures.

All seams and non-seam areas of the geomembrane will be visually inspected by the CQCR to identify defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. All seams and non-seam areas exhibiting defects or requiring repair will be repaired by the Contractor according to the project requirements.

Each suspect seam location will be non-destructively tested by the Contractor using approved methods described in the project. Each seam location that fails non-destructive testing will be clearly marked by the CQCR for repair by the Contractor. Work will not proceed with any materials that cover defective areas or repaired areas or seams until corresponding CQC Laboratory test results are available and found to be acceptable by the CQCR.

At any time, panels or portions of panels, which, in the opinion of the CQCR, are damaged beyond repair, will be removed from the Work area. Geomembrane material that is judged repairable will be repaired using methods described in the project documents.

Any portion of the geomembrane exhibiting a flaw or failing a destructive or non-destructive test will be repaired according to the methods described in the project documents. The CQCR may make recommendations concerning repair procedures. Final decisions concerning appropriate repair procedures, materials and techniques will be agreed upon by the CQCR, Project Construction Manager, and Contractor.

Each repair will be non-destructively tested using the approved method as appropriate. Repaired seams or areas which pass non-destructive testing will be accepted as adequately repaired. Large repairs may require destructive testing, at the discretion of the CQCR. Any repair that fails non-destructive testing will be redone and retested until a passing test result is obtained. The CQCR will observe all non-destructive testing of repairs and record the number of each repair, date, technician and test outcome.

The CQCR will identify large wrinkles, that require cutting and re-seaming, when seaming of the geomembrane is completed (or when seaming of a large area of geomembrane is completed), and prior to placing of overlying materials. All wrinkles that overlap on themselves should be marked for cutting and re-seaming. Seams made to repair wrinkles will be tested as any other seam. The placement of overlying materials will be observed by the CQCR to ensure that wrinkle formation is minimized.

5.2.12 Additional Construction Quality for ClosureTurf

As recommended by the manufacturer, the CQCR shall observe general panel deployment techniques as well as the techniques listed below with respect to ClosureTurf installation:

- Observe that the geomembrane component is placed in direct and uniform contact with underlying 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
- Observe that the subgrade beneath the geomembrane component has not deteriorated since previous acceptance.
- Observe that there are no stones, construction debris, soil clods or other deleterious items on the subgrade likely to cause damage to the geomembrane component.
- The geomembrane component will not be deployed during inclement weather conditions as defined in the 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 (the 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 CQCR shall be responsible for approving the integrity of horizontal seams.

5.2.13 Acceptance of Geomembrane

Installed geomembrane may be considered for acceptance upon written recommendation by the CQCR. The CQCR, Project Construction Manager, and Contractor will execute a certificate of completion upon acceptance of any section of the completed geomembrane.

5.3 Engineered Turf Construction Quality

5.3.1 Requirements

The engineered turf material rolls shall conform to the properties provided in the Project Specifications.

5.3.2 Engineered Turf Delivery

Box trucks will generally 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.

The CQCR shall 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
- The engineered turf is protected 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 to be removed from the site or stored at a location separate from accepted rolls, designated by the Purchaser.
- Rolls that do not have proper manufacturer's documentation will be stored at a separate location until documentation has been received and approved by the CQCR.

5.3.3 Engineered Turf Surface Preparation

Prior to installation of Engineered Turf, the CQCR shall observe the following:

- The Geomembrane has been installed in accordance with the specifications.
- The geomembrane installation documentation has been completed and approved by the CQCR for areas where 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.

5.3.4 Engineered Turf Deployment and Field Seaming

During deployment of Engineered Turf, the CQCR shall 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 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 is constructed using a Nulong sewing machine or equivalent.
- Sewing will occur between the 1st or 2nd stitch rows.

5.3.5 Engineered Turf Repairs and Tie-In Procedures

When repairs and tie-ins to Engineered Turf occur, the CQCR shall 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 Turd 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.

5.3.6 Equipment of Engineered Turf

No equipment will be allowed on slopes exceeding 15% until the prescribed 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 pressure on top decks may increase to as much as 120 psi 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.

5.4 Engineered Turf Sand Infill Construction Quality

The CQCR shall observe the following:

- Sand infill will meet the requirements provided in the Project Specifications.
- Areas that are to receive sand infill must be inspected and accepted by the CQCR before placement of sand infill takes place.
- The sand infill layer is 5/8” in thickness with 1/8” tolerance plus or minus.
- The sand infill is worked into Engineered Turf as infill between the synthetic yarn blades.
- No equipment is 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 CQCR approved alternative measuring device. A standard washer will be utilized as a plate for the point of entry into the sand infill for consistent depth control.

5.5 Engineered Turf HydroBinder Infill Construction Quality

5.5.1 Material Requirements

The HydroBinder Infill shall conform to the properties provided in the Project Specifications.

5.5.2 Installation

The CQCR will 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” 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 the minimum performance levels defined in the Project Specifications.

5.5.3 HydroBinder Coverage

The CQCR shall observe that the minimum coverage is met as shown in the Project Specifications.

6.0 DOCUMENTATION AND REPORTING

6.1 General

The CQCR will document all quality assurance observations, testing, and repairs to ensure that the design requirements and other project construction requirements are satisfied. The CQCR will provide signed descriptions, data sheets, and checklists to verify that all testing and monitoring activities have been completed. The CQCR will also maintain a complete file at the site of all documents that govern the construction quality assurance program.

The CQCR will complete a daily log outlining all inspection and testing activities for that day. Precise areas of construction, sample collection and test locations, any repairs and retesting performed, and any other significant construction activities will be noted on the daily log. Any construction deficiencies requiring repair, along with any problems or concerns with on-site construction, drainage, or operations will be noted. This report will be completed at the end of each day (or shift) and a copy provided to Project Construction Manager the following day unless directed otherwise. Any recommended corrective actions, Work stoppages, or repairs will be brought to the Contractor’s and Project Construction Manager’s attention. The daily report will also include a summary of the approximate quantities of all Work completed that day. Lastly, the daily report will state the times of arrival, departure, and note the times of any interruption in the Work.

6.2 Daily Reports

The CQCR(s) collects samples and performs or observes the CQA testing required by the CQA Plan. A daily inspection report is prepared by each CQCR(s) for each day they are onsite observing the construction and kept in a record book which is to be made available to the Purchaser on a daily basis. The report will contain (at a minimum) the following information:

- Date
- Type of Observations

- Summary of weather conditions such as minimum and maximum temperatures, wind speed, and any precipitation.
- Summary of any meetings held and attendees
- Equipment and personnel on the project
- Name and titles of Contractor supervisors and Quality Control personnel
- Summary of construction activities and locations
- Description of offsite materials received
- Calibration and recalibration of test equipment
- Description of procedures used
- Test locations, procedures, results, and test data sheets
- Summary of samples collected
- Record of repairs to cover system
- Personnel involved in daily observations and sampling activities
- Signature of the technician
- Description of delays in construction activities
- Detailed description of any problems or non-conforming construction and resolution/alternatives for each situation
- Approximate quantities completed each day (approximate volume of fill placed, areas of subgrade prepared and/or accepted, areas proof rolled, square footage of geosynthetics placed, etc.)
- Summary of failed testing and corrective actions completed
- Documentation that confirms equipment exerts less than 5 psi on the geosynthetics
- Documentation of field modifications made if hot or cold weather placement procedures for cover system installation are in effect.

6.3 Photographs

The CQCR will coordinate with the Purchaser personnel to ensure sufficient photographs are taken to document construction problems, non-conforming Work, and related repairs taken before and after the problem or non-conforming Work is corrected. The CQCR will take required photographs and record each photograph in a Photo Log showing photo number, date taken, and description.

Photographs approved by the Purchaser security will be provided for inclusion in the Certification Report. At the end of the project, photographs will be retained by the Purchaser.

6.4 Test Data Sheets

At a minimum, the CQCR will record all field test data results on separate forms listed below:

- Daily Field Report
- Certificate of acceptance of prepared subgrade
- Certificate of acceptance of installed geosynthetic cover system
- Initial roll inventory
- Panel placement summary
- Trial Weld Summary
- Panel Seaming Summary
- Repair Summary
- Non-destructive test summary
- Destructive Test Summary – Field
- Destructive Test Summary – Laboratory
- Field compaction summary

Independent consultants or laboratories engaged for the Work will submit their test results on forms acceptable to and approved by the Project Construction Manager.

6.5 Soil Testing Reports

The soil test reports for all soil sources and geosynthetics will be collected and organized by the CQCR. These test reports will include all field and laboratory test results.

6.6 Geosynthetics Testing Reports

The test reports for all geosynthetic material sources will be collected and organized by the CQCR. These test reports will include all field and laboratory test results. A summary list of test sample pass/fail results will be prepared by the CQCR, and provided to the Contractor with the weekly progress reports.

The CQC laboratory will establish a schedule for providing laboratory test results. The CQC laboratory will ensure that the laboratory test results schedule is achieved for the duration of the project.

Upon project completion, the CQCR will assemble and organize all soil and geosynthetic test results and provide them for inclusion in the final certification report.

6.7 Record (As-Built) Drawings

The Contractor will review as-built survey information and prepare record drawings upon completion of the construction activities. The Record Drawings will include, at a minimum, the following information:

- Dimensions, surface elevations and locations of all critical soil layers and related features
- Dimensions, surface elevations and locations of all surface water drainage features, including channels, weirs, pipes and similar structures
- Dimensions, surface elevations and locations of access roads
- Dimensions elevations and locations of all subsurface drainage structures and associated sumps
- Dimensions and locations of the toe drains
- Dimensions, elevations and locations of other site features as directed by the Purchaser of Project Construction Manager.

The as-built drawings will include, at a minimum, the following information for the geosynthetic components construction:

- Panel and seam layout drawings
- Dimensions and locations of all critical geosynthetic structures and related features

The surveying requirements of the project will be followed. The CQC and CQA Engineers will review the Record Drawings for accuracy and may request revisions to more accurately reflect actual field as-built conditions. The Record Drawings will be included in the CQA Report described below.

6.8 CQA Report

The CQA Engineer will prepare a final CQA Report for the Purchaser that certifies that, based on observation of the Contractor’s Work and on evaluation of furnished test results and other information, the various key components of the ash closure construction has been completed in substantial accordance with this CQA Plan and any construction-level specifications and Drawings. At a minimum, the CQA Report will include the following:

- General summary of Work to include Contractors performing construction, construction activities, observations, problems, and corrective actions, deviations from design, etc.;
- Summary of daily field reports;
- Manufacturers’ laboratory test results and certification(s) of all materials used in the construction.
- Independent laboratory testing results and certification(s) for resin, geomembrane, and welds.
- Subgrade (bedding layer surface) acceptance forms from Contractor;
- Material samples;
- Project photographs;
- As-built drawings; and
- Certification that the document is complete and accurate.

The final CQA Report will serve as the permanent record of the completed construction for the ash closure so as to assure regulatory agencies that the components were constructed in substantial accordance with the facility permit and the construction-level specifications and drawings.

6.9 Documentation and Record Storage

The daily records maintained during construction activities include but are not limited to the following:

- Daily observation reports
- Test data sheets
- Test data from independent consultants or laboratories (if any)
- Field records maintained by CQC and CQA personnel

Daily records will be copied and forwarded to the Project Construction Manager on a daily basis.

APPENDIX A

Tables

Table 1 - Pre-qualification Testing Frequency and Minimum Criteria

Soil Test ASTM Designation		Structural Fill	Common Fill	Sand Ballast	Vegetative Soil(3) (Topsoil)	FDOT #57 Stone
USCS Classification D2487	Frequency	3/Source	1/Source	N/A	N/A	N/A
	Min. Criteria	GM, GC, SW, SP, SM, and SC	GM, GC, SW, SP, SM, SC, CL, ML, and MH	N/A	N/A	N/A
Particle Size(1) D6913/D1140/C136	Frequency	3/Source	1/Source	1/Source	1/Source (for amended granular fill)	1/Source
	Min. Criteria	2-in maximum	2-in maximum	<%8 passing 200 sieve	Sand 50-90% Silt <50% Clay <25%	Meet FDOT Gradation
Moisture Content D2216	Frequency	3/Source	1/Source	N/A	N/A	N/A
Atterberg Limits D4318	Frequency	3/Source	1/Source	N/A	N/A	N/A
	Min. Criteria	PI<30, LL<50	PI<50, LL<70	N/A	N/A	N/A
Moisture-Density D698	Frequency	3/Source	1/Source	N/A	N/A	N/A
	Min. Criteria	95 pcf	90 pcf	N/A	N/A	N/A
Organic Content	Frequency	N/A	N/A	N/A	1/Source	N/A
	Min.	N/A	N/A	N/A	>1.5%	N/A
Permeability D2434	Frequency	N/A	N/A	N/A	N/A	1/Source
	Min. Criteria	N/A	N/A	N/A	N/A	0.3 cm/s
Carbonate Content D3042	Frequency	N/A	N/A	1/Source	N/A	1/Source
	Min. Criteria	N/A	N/A	<15%	N/A	<15%

(1) Use ASTM D6913 for structural and common fills and topsoil, ASTM D1140 for sand ballast and ADTM C136 for #57 stone.

(2) The maximum particle size shall not exceed 1/4 inch for the top 6 inches of soil underlying the geocomposite or the geomembrane. The maximum particle size shall not exceed 3/4 inch for compacted lifts greater than 6 inches below the geocomposite or the geomembrane.

(3) The Contractor shall take at least five representative topsoil samples to County Agriculture Extension Service or similar service for soil analysis. Based on the test results and recommendations by the extension service, lime and fertilizer shall be added to amend the topsoil. The Contractor shall submit the soil test results and recommendations from the extension service to the CQA Engineer for review prior to any application.

Table 2 - Pre-construction Testing Frequency

Soil Test ASTM Designation		Structural Fill	Common Fill	Sand Ballast / Drainage Media	Vegetative Soil	Granular Stone
USCS Classification D2487	Frequency	1/5,000 CY	1/5,000 CY	N/A	N/A	N/A
Particle Size[(1)] D6913/D1140/C136	Frequency	1/5,000 CY	1/5,000 CY	1/3,000 CY	1/5,000 CY	1/3,000 CY
Moisture Content D2216	Frequency	1/5,000 CY	1/5,000 CY	N/A	N/A	N/A
Atterberg Limits D4318	Frequency	1/5,000 CY	1/5,000 CY	N/A	N/A	N/A
Moisture-Density D698	Frequency	1/5,000 CY	1/5,000 CY	N/A	N/A	N/A
Organic Content D2974	Frequency	1/5,000 CY	1/5,000 CY	N/A	N/A	N/A
Permeability D2434	Frequency	N/A	N/A	1/3,000 CY	N/A	1/3,000 CY
Carbonate Content D3042	Frequency	N/A	N/A	1/3,000 CY	N/A	1/3,000 CY

(1) Use ASTM D6913 for structural and common fills and topsoil, ASTM D1140 for sand ballast and ASTM C136 for applicable stones.
(2) Minimum criteria requirements are provided in Table 1.

Table 3 - Construction Testing Frequency and Minimum Criteria Requirements

Soil Test ASTM Designation	Structural Fill		Ash and Common Fill	
	Frequency	**Min. Criteria**	**Frequency**	**Min. Criteria**
Field Density D6938/D2937/D1556	1/Lift/1,000 CY for general structural fill 1/Lift/500 CY for dikes or around structures	95% Max. Dry Density (ASTM D698)	1/Lift/1,000 CY for general ash fill 1/Lift/500 CY for dikes or around structures	90% Max. Dry Density (ASTM D698)
Field Moisture Content D6938/D2216/D4643	1/Lift/1,000 CY for general structural fill 1/Lift/500 CY for dikes or around structures	+/- 3% Opt. Moisture (ASTM D698)	1/Lift/1,000 CY for general ash fill 1/Lift/500 CY for dikes or around structures	+/- 5% Opt. Moisture (ASTM D698)
Check Plug[(3)]	1/ Five (5) Density-Moisture Tests or as needed	Min 1/Day with Density-Moisture Tests	1/ Five (5) Density-Moisture Tests or as needed	Min 1/Day with Density-Moisture Tests
Supplementary Proctor D698	As needed	See Table 1	As needed	See Table 1 for Common Fill
Nuclear Density Test Check/Calibration D2937/D1556[(4)]	1/Five (5) Nuclear Density-Moisture D6938 Tests		1/Day with Nuclear Density-Moisture D6938 Tests	

(1) At least one (1) density and moisture test per lift per day will be conducted.
(2) One (1) density and moisture test any time there is suspicion of the effectiveness of compaction.
(3) Supplementary proctor tests shall be conducted if a good match is not possible with previous proctor curves. If testing is consistent, frequency for check plugs may be reduced to one (1) per material per day under the direction of the geotechnical engineer.
(4) If the check/calibration for Nuclear Density testing is consistent, the frequency may be reduced to one (1) per day under the direction of the CQA engineer.

Table 4 - Required Geotextile Properties (For Geocomposites)

Property	ASTM Test Method	Units	Qualifier	Value(2)	
Mass per Unit Area	D5261(4)	oz/yd2	Minimum	6	8
Trapezoidal Tear Strength(1)	D4533	lbs	Minimum	60	90
Grab Strength(1)	D4632	lbs	Minimum	160	225
Grab Elongation	D4632	%	Minimum	50	50
CBR Puncture Strength	D6241	lbs	Minimum	450	600
Apparent Opening Size (AOS)	D4751	Std US Sieve	Maximum	70	80
Permittivity(3)	D4491	1/sec	Minimum	0.02	0.02

(1) Measured in the weakest principal direction of the geotextile.
(2) The values in this table represent minimum roll values. In conformance eating, the roll value shall be determined as the average of the values obtained through testing the number of replicate specimens as specified by the appropriate ASTM method.
(3) The results of testing in accordance with ASTM D4491 are typically reported as permittivity, but shall be expressed as at least one of the three specified terms (permeability, permittivity, water flow rate).
(4) In some instances, some geotextile manufacturers may include the previously used test methods for mass per unit area (D3776) and thickness (D5199) in their printed matter.

Table 5 - Required Geonet Properties (for Geocomposites)

Property	ASTM Test Method	Units	Qualifier	Value
Resin Density[(1)]	D1505/D792	gm/cc	Minimum	0.95
Carbon Black Content	D1603	%	Range	1.5 to 3
Melt Index	D1238 Condition 190/2.16	gm/10 min	Maximum	1.0
Thickness	D5199	inches	Minimum	0.2
Weight	D5261 Option C	psf	Minimum	0.13
Tensile Strength	D7179[(2)]	lb/in.	Minimum	23

(1) Fully compounded, without foam

(2) Test using a 4-in x 8-in specimen

Table 6 - GCL Properties

Property	Unit	ASTM Test Method	Value	Frequency
Clay Swell Index	ml/2g	D5890	24	50 tons
Clay Fluid Loss(1)	ml	D5891	18	50 tons
Non woven Geotextile Cap Fabric Weight(2)	oz/sq. yd.	D5261	5.8	25,000 sq. yd.
Woven Geotextile Cap Fabric Weight	oz/sq. yd.	D5261	3.0	25,000 sq. yd.
Non woven Carrier Fabric Weight(2)	oz/sq. yd.	D5261	5.9	25,000 sq. yd.
Woven Carrier Fabric Weight	oz/sq. yd.	D5261	3.0	25,000 sq. yd.
Geotextile and Reinforcing Yarns Strength Retained(5)	Percent	Note 6	65	Yearly
Mass of GCL	psf	D5993	0.82	5,000 sq. yd.
Mass of Bentonite	psf	D5993	0.75	5,000 sq. yd.
Moisture Content(1)	Percent	D5993	4	5,000 sq. yd.
Tensile Strength Machine Direction	ppi	D6768	23	25,000 sq. yd.
Peel Strength	ppi	D6496	2.1	5,000 sq. yd.
Permeability(1)	cm/sec	D5887	5×10^{-9}	30,000 sq. yd.
Flux(1)	cm^3/sec-cm^2	D5887	1×10^{-6}	30,000 sq. yd.
GCL Permeability(1,4)	cm/sec	D6766 Mod.	5×10^{-8}	Yearly

(1) Include hydrometer testing for cohesive soils.
(2) For both cap and carrier fabrics for non-woven reinforced GCLs; one, or the other, must contain a scrim component of mass greater than 2.9 oz per square yard for dimensional stability.
(3) Mass of GCL and bentonite is measured after oven drying per the stated test method.
(4) Value represents GCL permeability after permeation with a 0.1 M calcium chloride solution (11.1 g of $CaCl_2$ in 1 liter water)
(5) Value represents the minimum percent strength retained from the as-manufactured value after oven aging at 60 degrees Celsius for 50 days.
(6) The geotextiles in their as-received condition are evaluated by incubation in a forced air oven per ASTM D5721 set at 60°C for 50 days. The minimum percent in tensile strength retained at break, as measured by ASTM D6768, is 65%. If individual yarns are used in reinforcing GCLs, they must also meet this same endurance criterion.

Table 7 - Textured 60-mil HDPE Geomembrane Properties

Properties	Test Method	Value	Frequency
Thickness (mils)	D5994 / D5199		per roll
Min. Average		Nom. (-5%)	
Lowest Individual for 8 out 10 values		-10%	
Lowest Individual for any of the 10 values		-15%	
Asperity Height (mils) - Min. Average	D7466	16 mil	every 2nd roll(1)
Formulated Density - Min. Average	D1505/D792	0.940 g/cc	200,000 lbs
Tensile Properties(2)	D6993 Type IV		20,000 lbs
Yield Strength		126 ppi	
Break Strength		90 ppi	
Yield Elongation		12%	
Break Elongation		700%	
Tear Resistance - Min. Average	D1004	42 lbs	45,000 lbs
Puncture Resistance - Min. Average	D4833	90 lbs	45,000 lbs
Stress Crack Resistance(3)	D5397	500 hrs	per GRI GM10
Carbon Black Content - Range	D4218(4)	2.0 to 3.0 %	20,000 lbs
Carbon Black Dispersion	D5996	Note 5	45,000 lbs
Oxidative Induction Time (OIT) - Min. Average(6)			
(a) Standard OIT	D3895	100 min	200,000 lbs
(b) High Pressure OIT	D5885	400 min.	
Oven Aging at 85 ℃(6,7)	D5721		per each formulation
(a) Standard OIT - Min. Average, % retained after 90 days	D3895	55%	
(b) High Pressure OIT - Min. Average, % retained after 90	D5885	80%	
UV Resistance(8)	D7238		per each formulation
(a) Standard OIT - Min. Average	D3895	N.R.(9)	
(b) High Pressure OIT - Min. Average, % retained after 1600 hrs(10)	D5885	50%	

(1) Alternate the measurement side for double sided textured sheet

(2) Machine direction and cross machine direction average values should be on the basis of 5 test specimens each direction

Yield elongation is calculated using a gage length of 1.3 inches

Break elongation is calculated using a gage length of 2.0 inches

(3) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(4) Other methods such as D1603 (tube furnace) or D6370 are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views:

9 in Categories 1 or 2 and 1 in Category 3

(6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(8) The condition of the test should be 20 hr. UV cycle at 75℃ followed by 4 hr. condensation at 60℃.

(9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(10) UV resistance is based on percent retained value regardless of the original HP-OIT value.

(11) Reference: GRI GM13

Table 8A - Textured 40-mil LLDPE Microspike Geomembrane Properties

Properties	Test Method	Value	Frequency
Thickness (mils)	D5994 / D5199		per roll
Min. Average		Nom. (-5%)	
Lowest Individual for 8 out 10 values		-10%	
Lowest Individual for any of the 10 values		-15%	
Asperity Height (mils) - Min. Average	D7466	20 mil	every 2^{nd} roll(1)
Formulated Density - Min. Average	D1505/D792	0.939 g/cc	200,000 lbs
Tensile Properties(2)	D6993 Type IV		20,000 lbs
Break Strength		112 ppi	
Break Elongation		400%	
2% Modulus - Max	D5323	2400	per each formulation
Tear Resistance - Min. Average	D1004	25 lbs	45,000 lbs
Puncture Resistance - Min. Average	D4833	50 lbs	45,000 lbs
Aix-Symmetric Break Resistance Strain - % Min.	D5617	30%	per each formulation
Carbon Black Content - Range	D4218(4)	2.0 to 3.0 %	20,000 lbs
Carbon Black Dispersion	D5996	Note 4	45,000 lbs
Oxidative Induction Time (OIT) - Min. Average(6)			
(a) Standard OIT	D3895	≥140 min.	200,000 lbs
(b) High Pressure OIT	D5885	400 min.	
Oven Aging at 85 ℃(6)	D5721		per each formulation
(a) Standard OIT - Min. Average, % retained after 90 days	D3895	35%	
(b) High Pressure OIT - Min. Average, % retained after 90	D5885	60%	
UV Resistance(7)	D7238		per each formulation
(a) Standard OIT - Min. Average	D3895	N.R.(8)	
(b) High Pressure OIT - Min. Average, % retained after 1600 hrs(10)	D5885	35%	

(1) Alternate the measurement side for double sided textured sheet

(2) Machine direction and cross machine direction average values should be on the basis of 5 test specimens each direction

Break elongation is calculated using a gage length of 2.0 inches at 2 in./min

(3) Other methods such as D1603 (tube furnace) or D6370 are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:

9 in Categories 1 or 2 and 1 in Category 3

(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(7) The condition of the test should be 20 hr. UV cycle at 75℃ followed by 4 hr. condensation at 60℃.

(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

(10) Reference: www.AgruAmerica.com and GRI GM17

Table 8B - Textured 40-mil HDPE Microspike Geomembrane Properties

Properties	Test Method	Value	Frequency
Thickness (mils)	D5994 / D5199		per roll
Min. Average		Nom. (-5%)	
Lowest Individual for 8 out 10 values		-10%	
Lowest Individual for any of the 10 values		-15%	
Asperity Height (mils) - Min. Average	D7466	20 mil	every 2nd roll(1)
Formulated Density - Min. Average	D1505/D792	0.940 g/cc	200,000 lbs
Tensile Properties(2)	D6993 Type IV		20,000 lbs
Yield Strength		84 ppi	
Break Strength		152 ppi	
Yield Elongation		12%	
Break Elongation		700%	
Tear Resistance - Min. Average	D1004	28 lbs	45,000 lbs
Puncture Resistance - Min. Average	D4833	72 lbs	45,000 lbs
Stress Crack Resistance (3)	D5397	500 hrs	per GRI GM10
Carbon Black Content - Range	D4218(4)	2.0 to 3.0 %	20,000 lbs
Carbon Black Dispersion	D5996	Note 5	45,000 lbs
Oxidative Induction Time (OIT) - Min. Average(6)			
(a) Standard OIT	D3895	100 min.	200,000 lbs
(b) High Pressure OIT	D5885	400 min.	
Oven Aging at 85 ℃(6)	D5721		per each formulation
(a) Standard OIT - Min. Average, % retained after 90 days	D3895	55%	
(b) High Pressure OIT - Min. Average, % retained after 90 days	D5885	80%	
UV Resistance(7)	D7238		per each formulation
(a) Standard OIT - Min. Average	D3895	N.R.(9)	
(b) High Pressure OIT - Min. Average, % retained after 1600 hrs(10)	D5885	50%	

(1) Alternate the measurement side for double sided textured sheet

(2) Machine direction and cross machine direction average values should be on the basis of 5 test specimens each direction

Yield elongation is calculated using a gage length of 1.3 inches

Break elongation is calculated using a gage length of 2.0 inches

(3) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(4) Other methods such as D1603 (tube furnace) or D6370 are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views:

9 in Categories 1 or 2 and 1 in Category 3

(6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(8) The condition of the test should be 20 hr. UV cycle at 75℃ followed by 4 hr. condensation at 60℃.

(9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(10) UV resistance is based on percent retained value regardless of the original HP-OIT value.

(11) Reference: GRI GM13

Table 9A - Textured 50-mil LLDPE Super Gripnet or MicroDrain Geomembrane Properties

Properties	Test Method	Value	Frequency
Thickness (mils)	D5994		per roll
Min. Average		Nom. (-5%)	
Lowest Individual for 8 out 10 values		-10%	
Lowest Individual for any of the 10 values		-15%	
Asperity Height (mils) - Min. Average (drainage stud/friction	D7466	130/175 mil	every 2nd roll(1)
Formulated Density - Min. Average	D1505/D792	0.939 g/cc	200,000 lbs
Tensile Properties(2)	D6993 Type IV		20,000 lbs
Break Strength		105 ppi	
Break Elongation		300%	
2% Modulus - Max.	D5323	3000	per each formulation
Tear Resistance - Min. Average	D1004	30 lbs	45,000 lbs
Puncture Resistance - Min. Average	D4833	55 lbs	45,000 lbs
Aix-Symmetric Break Resistance Strain - % Min.	D5617	30%	per each formulation
Carbon Black Content - Range	D4218(4)	2.0 to 3.0 %	20,000 lbs
Carbon Black Dispersion	D5996	Note 4	45,000 lbs
Oxidative Induction Time (OIT) - Min. Average(6)			
(a) Standard OIT	D3895	$\geq$140 min.	200,000 lbs
(b) High Pressure OIT	D5885	400 min.	
Oven Aging at 85 ℃(6)	D5721		per each formulation
(a) Standard OIT - Min. Average, % retained after 90 days	D3895	35%	
(a) High Pressure OIT - Min. Average, % retained after 90 days	D5885	60%	
UV Resistance(7)	D7238		per each formulation
(a) Standard OIT - Min. Average	D3895	N.R.(8)	
(a) High Pressure OIT - Min. Average, % retained after 1600	D5885	35%	

(1) Alternate the measurement side for double sided textured sheet

(2) Machine direction and cross machine direction average values should be on the basis of 5 test specimens each direction

- Break elongation is calculated using a gage length of 2.0 inches at 2 in./min

(3) Other methods such as D1603 (tube furnace) or D6370 are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:

- 9 in Categories 1 or 2 and 1 in Category 3

(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(7) The condition of the test should be 20 hr. UV cycle at 75℃ followed by 4 hr. condensation at 60℃.

(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

(10) Reference: www.AgruAmerica.com and GRI GM17

Table 9B - Textured 50-mil HDPE Super Gripnet or MicroDrain Geomembrane Properties

Properties	Test Method	Value	Frequency
Thickness (mils)	D5994 / D5199		per roll
Min. Average		Nom. (-5%)	
Lowest Individual for 8 out 10 values		-10%	
Lowest Individual for any of the 10 values		-15%	
Asperity Height (mils) - Min. Average	D7466	20 mil	every 2nd roll(1)
Formulated Density - Min. Average	D1505/D792	0.940 g/cc	200,000 lbs
Tensile Properties(2)	D6993 Type IV		20,000 lbs
Break Strength		8105ppi	
Break Elongation		190 ppi	
		12%	
		700%	
Tear Resistance - Min. Average	D1004	35 lbs	45,000 lbs
Puncture Resistance - Min. Average	D4833	90 lbs	45,000 lbs
Stress Crack Resistance (3)	D5397	500 hrs	per GRI GM10
Carbon Black Content - Range	D4218(4)	2.0 to 3.0 %	20,000 lbs
Carbon Black Dispersion	D5996	Note 5	45,000 lbs
Oxidative Induction Time (OIT) - Min. Average(6)			
(a) Standard OIT	D3895	100 min.	200,000 lbs
(b) High Pressure OIT	D5885	400 min.	
Oven Aging at 85 ℃(6)	D5721		per each formulation
(a) Standard OIT - Min. Average, % retained after 90 days	D3895	55%	
(b) High Pressure OIT - Min. Average, % retained after 90 days	D5885	80%	
UV Resistance(7)	D7238		per each formulation
(a) Standard OIT - Min. Average	D3895	N.R.(9)	
(b) High Pressure OIT - Min. Average, % retained after 1600 hrs(10)	D5885	50%	

(1) Alternate the measurement side for double sided textured sheet

(2) Machine direction and cross machine direction average values should be on the basis of 5 test specimens each direction

Yield elongation is calculated using a gage length of 1.3 inches

Break elongation is calculated using a gage length of 2.0 inches

(3) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(4) Other methods such as D1603 (tube furnace) or D6370 are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views:

9 in Categories 1 or 2 and 1 in Category 3

(6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(8) The condition of the test should be 20 hr. UV cycle at 75℃ followed by 4 hr. condensation at 60℃.

(9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(10) UV resistance is based on percent retained value regardless of the original HP-OIT value.

(11) Reference: GRI GM13

Table 10 - Seam Properties

Property	60-mil HDPE	40-mil LLDPE	50-mil LLDPE	Test Method
Hot Wedge Seams(1)				
Shear Strength(2), ppi	120	60	75	ASTM D6392
Shear elongation at break(3), %	50	50	50	
Peel Strength(2), ppi	91	50	63	
Peel Separation, %	25	25	25	
Extrusion Fillet Seams				
Shear Strength(2), ppi	120	60	75	ASTM D6392
Shear elongation at break(3), %	50	50	50	
Peel Strength(2), ppi	78	44	57	
Peel Separation, %	25	25	25	

(1) Also for hot air and ultrasonic seaming methods
(2) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values.
(3) Elongation measurements should be omitted for field testing.

Table 11 - Textured Geomembrane Conformance Testing

Property	Qualifier	Test Method	Units
Thickness	Min. Average	D5994	mils
Density	Per Section 2.3.1	D1505	g/cm
Tensile Yield Strength	Min. Average	D6993 Type IV	ppi
Tensile Break Strength	Min. Average		ppi
Tensile Elongation at Yield	Min. Average		percent
Tensile Elongation at Break	Min. Average		percent
Tear Strength	Min. Average	D1004	lbs
Puncture Resistance	Min. Average	D4833	lbs
Carbon Black Content	Note 1	D1603	percent
Carbon Black Dispersion	Note 2	D5596	N/A

(1) Other methods such as ASTM D4218 or microwavable methods are acceptable if an appropriate correlation to ASTM D1603 can be established.
(2) Carbon Black Dispersion for ten (10) different views:
- Minimum 9 in Categories 1 or 2 and 1 in Category 3

Table 12 – Engineered Turf

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
DuraTurf 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 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/ HydroBinder)		CSU Wave Simulator	4.0 $ft^3/s/ft$
Transmissivity w/ underlying structured geomembrane, Normal Stress @ 50 psf & 0.33m^2/sec gradient	NA	ASTM D4716	2.5 x 10^{-3} m^2/sec, min.
Internal Friction of combined components	N/A	ASTM D5321	35˚, min.

Table 13 – Engineered Turf HydroBinder™ Infill and 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 Mix not as placed.

Table 14 – Engineered Turf Infill and Ballast Sand

Sand Infill Gradation	
Sieve	Percent Passing
3/8 in. (9.5mm)	TBD
No. 4 (4.75 mm)	TBD
No. 8 (2.36 mm)	TBD
No. 16 (1.18 mm)	TBD
No. 30 (600 μm)	TBD
No. 50 (300 μm)	TBD
No. 100 (150 μm)	TBD

Table 15 – Watershed Geosynthetics™ Coverage Area for HyrdroBinder™ Infill

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.

golder.com

APPENDIX 10

OPERATION PLAN

OPERATION PLAN
PLANT GORGAS ASH POND
ALABAMA POWER COMPANY
PARRISH, ALABAMA

This document serves as an operation plan for the Plant Gorgas Ash Pond. The Ash Pond, located in Parrish, Alabama, is owned and operated by Alabama Power Company. This Operation Plan includes a Fugitive Dust Control Plan, an Inflow Design Flood System, a description of the Groundwater Monitoring and Analysis program, a discussion of Recordkeeping and Notification Compliance Procedures, and a discussion of the procedures for updating the plans and assessments required by the Alabama Department of Environmental Management (Department) regulations.

Fugitive Dust Control Plans

The Fugitive Dust Control Plan prepared for the Plant Gorgas Ash Pond can be found in Appendix A of this Operation Plan.

Inflow Design Flood Control Plan

The Inflow Design Flood Control Plan prepared for the Plant Gorgas Ash Pond can be found in Appendix B of this Operation Plan.

Groundwater Monitoring Plan

The Groundwater Monitoring Plan for the Plant Gorgas Ash Pond can be found in Appendix C of this Operation Plan.

Recordkeeping and Notification Compliance Procedures

As outlined in r. 335-13-15-.08(1), 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 r. 335-13-15-.08(2). 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 Director 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 Gorgas 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 r. 335-13-15-.08 and as applicable to the Plant Gorgas Gypsum 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.

APPENDIX A

FUGITIVE DUST CONTROL PLAN

The Fugitive Dust Plan for the Plant Gorgas Ash Pond was initially prepared to satisfy federal standards. It also satisfies 335-13-15-.05(1) and 335-13-15-.09(1)(a)11.(ii) and is included for that purpose.

COAL COMBUSTION RESIDUAL (CCR) FUGITIVE DUST CONTROL PLAN

Plant Gorgas
October 2015

Professional Engineer Certification:

Based upon my knowledge, information, and belief that the content in the attached Fugitive Dust Control Plan is accurate, I hereby certify that this Fugitive Dust Control Plan meets the requirements of 40 CFR § 257.80(b)(1)-(7) (Coal Combustion Residuals Rule).

Wyman Turner, PE No. 30102, 12-31-15 Date: 10-08-15

Name, P.E. License No., Expiration Date

Wyman Turner

Signature

AMENDMENT SUMMARY

Date	Amendment #	Comments / Notes

1.0 PURPOSE

The purpose of this guideline is to demonstrate compliance with the fugitive dust requirements in 40 CFR § 257.80(a) and 257.80 (b)(1) through (7).

2.0 SCOPE

This fugitive dust plan identifies and describes the Coal Combustion Residuals (CCR) fugitive dust control measures that Gorgas Plant will use to minimize CCR from becoming airborne at the facility, including CCR fugitive dust originating from CCR units, roads, and other CCR management and material handling activities. Coal combustion residuals are generated from the burning of coal to produce electricity and are defined as fly ash, bottom ash, boiler slag, and flue gas desulfurization (FGD) materials.

3.0 REFERENCES

40 CFR §§ 257.53, 257.80, 257.105(g)(2)

4.0 GENERAL INFORMATION

EPA defines "fugitive dust" as "solid airborne particulate matter that contains or is derived from CCR, emitted from any source other than through a stack, or chimney." 40 CFR § 257.53.

5.0 PROCESSES

1) Identify the CCR units on plant site that are subject to the requirements in §257.80 to minimize CCR from becoming airborne.

CCR units include:
- Bottom Ash Landfill
- CCB Landfill
- Gypsum Pond
- Gypsum Landfill
- Ash Pond

2) Identify and describe the fugitive dust control measures that are applicable and appropriate to minimize CCR from becoming airborne at the units listed in Section 5.0 (1) of this plan.

Bottom Ash Landfill
Fugitive dust control measures include:
1. Bottom ash is transported wet to the landfill.
2. Active working areas are wetted with a water truck or other methods.
3. Vehicle speed through active working areas is reduced.
4. Water is applied to the landfill when routine inspections indicate that additional dust control is necessary.

CCB Landfill
Fugitive dust control measures include:
1. The baghouse area is washed or vacuumed as necessary to prevent the accumulation and emission of fugitive dust.
2. Water is applied to ash as needed during placement, spreading and compaction .
3. The exposed ash in the cells will be periodically covered with inert material.
4. Access to the landfill is restricted.
5. Speed of vehicles through active work areas is reduced.
6. Water is applied to the landfill when routine inspections indicate that additional dust control is necessary.

Gypsum Pond
Fugitive dust control measures include:
1. Gypsum is handled wet or moist. Water is sprayed on areas as needed .
2. Trucks used to transport gypsum are covered.
3. Vehicle speed of heavy equipment through the gypsum handling area is reduced.

Gypsum Landfill
Fugitive dust control measures include:
1. Gypsum is handled wet or moist.
2. Water is sprayed on areas as needed .
3. Trucks used to transport gypsum are covered.
4. Vehicle speed of heavy equipment through the landfill active work areas is reduced.

Ash Pond
The Ash Pond is maintained in a wet condition and does not require other dust control measures.

3) Explain how the control measures described in Section 5.0 (1) of this plan are applicable and appropriate for site conditions related to each CCR unit.

The fugitive dust control measures described in this plan were adopted and are implemented based upon an evaluation of site-specific conditions, engineering site visits, and subject matter expert input. Handling CCR wet or moist, applying water as needed, reducing speed limits, and routine inspections were determined to be applicable and appropriate for the listed CCR units. The evaluation included assessing the effectiveness of the fugitive dust control measures for each CCR unit over time, while taking into consideration various factors such as site conditions, weather conditions, moisture content

4) Describe the process to emplace CCR as conditioned CCR for any CCR landfill listed in Section 5.0 (1) of this plan.

CCR is conditioned using water as needed for placement, spreading and compaction at the CCR landfills – Bottom Ash Landfill, CCB Landfill, and Gypsum Landfill. Wetting is also employed as needed to control dust in areas of the landfills or work areas as indicated by routine inspections. Plant personnel may use other approved dust suppression agents to prevent dust generation if needed.

5) Describe the fugitive dust control measures to minimize CCR from becoming airborne on roads and at other CCR management and material handling activities.

CCR material is not allowed to accumulate in CCR management areas. Dust accumulation and generation is prevented by washing down or vacuuming work areas, employing closed systems and covered trucks, wetting areas with vehicle traffic, and reducing speed of vehicles in active work areas.

See discussion of CCR units in Section 5.0 item 2) of this plan.

6) Describe the process to periodically assess the effectiveness of the fugitive dust control measures described in this plan.

Plant personnel will perform periodic CCR fugitive dust inspections. Based on these observations, the frequency, location and amount of dust suppression activities and processes discussed in this Plan will be adjusted to prevent dust emissions. Plant personnel understand the importance of minimizing CCR fugitive dust generation and the requirement that any CCR fugitive dust observations should be promptly addressed.

7) Describe the process to log citizen complaints received involving CCR fugitive dust events at the facility.

When a complaint is received regarding a CCR fugitive dust event at the facility, the complaint is documented and investigated. Appropriate steps are taken including any appropriate action, if needed.

APPENDIX B

INFLOW DESIGN FLOOD PLAN

The Inflow Design Flood Control Plan for the Plant Gorgas Ash Pond was initially prepared to satisfy federal standards. It also satisfies 335-13-15-.05(3) and 335-13-15-.09(1)(a)11.(ii) and is included for that purpose.

UPDATED INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
PLANT GORGAS ASH POND
ALABAMA POWER COMPANY

Section 257.82 of EPA's regulations requires the owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment to design, construct, operate and maintain an inflow design flood control system capable of safely managing flow during and following the peak discharge of the specified inflow design flood. The owner or operator also has to prepare a written plan documenting how the inflow flood control system has been designed and constructed to meet the requirements of this section of the rule.

The existing CCR surface impoundment referred to as the Plant Gorgas Ash Pond is located at Alabama Power Company's Plant Gorgas. The facility consists of a 420 acre CCR storage area. The inflow design flood consists of the rainfall that falls within the limits of the surface impoundment, runoff from approximately 882 acres of adjoining watershed, and a nominal amount (relative to the rainfall) of process flows. Stormwater is temporarily stored within the limits of the surface impoundment and discharged through a principal and auxiliary spillway. The primary spillway (constructed in 2007) is constructed of a concrete overflow weir structure discharging to a 48-in diameter corrugated metal pipe. A two-bay concrete spillway structure serves as an auxiliary spillway.

The inflow design flood has been calculated using the Natural Resources Conservation Service method (also known as the Soil Conservation Service (SCS) method) using the Probable Maximum Flood (PMF) storm event required for a High hazard potential facility. Runoff curve number data was determined using Table 2-2A from the Urban Hydrology for Small Watersheds (TR-55). The U.S. Department of Commerce's Hydro Meteorological Report 51 was used to determine the storm depth for a 6-hr PMF storm event, taken as 30.1 inches. A USGS SITES program storm distribution was used to model the 6-hr PMF storm.

The NRCS provided information on the soil characteristics and hydrologic groups present at the site. It was determined that the hydrological groups A, B, and D should be used to best reflect the characteristics of the soils on site. Curve number values for each land use (determined from aerial photography) and soil combination were taken from the National Engineering Handbook

Part 630, Chapter 9. Rating curves were generated from the dynamic wave in PCSWMM and imported into Hydrologic Engineering Center - Hydrologic Modeling System and used to generate appropriate precipitation curves and storm basin routing information to evaluate surface impoundment capacity.

Calculations indicate the unit can safely store and pass the inflow design storm.

The facility is operated subject to and in accordance with § 257.3-3 of EPA's regulations.

I hereby certify that the inflow design flood control system plan meets the requirements of 40 C.F.R. Part 257.82.

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

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

Updated Inflow Design Control System Plan:
Hydrologic and Hydraulic Calculation Summary

for

Plant Gorgas Ash Pond

Prepared by:

Southern Company Services
Technical Services

Originator: Golder Associates

Reviewer: Johnson Leggett for 8/18/17
Jason S. Wilson Date

Approval: 8/18/17
James C. Pegues Date

1.0 Purpose of Calculation

The purpose of this report is to demonstrate the hydraulic capacity of the subject CCR impoundment in order to prepare an inflow design flood control plan as required by the United States Environmental Protection Agency's (EPA) final rule for Disposal of CCR from Electric Utilities (EPA 40 CFR 257).

2.0 Summary of Conclusions

A hydrologic and hydraulic model was developed for the Plant Gorgas Ash Pond to determine the hydraulic capacity of the impoundment. The design storm for the Plant Gorgas Ash Pond is a Probable Maximum Flood (PMF) rainfall event. Southern Company has selected a storm length of 6-hours for the inflow design flood control plan. The results of routing a PMF, 6-hour rainfall event through the impoundment are presented in Table 1 below:

Table 1-Flood Routing Results for Plant Gorgas Ash Pond

Plant Gorgas	Normal Pool El (ft)	Top of embankment El (ft)	Emergency Spillway Crest El (ft)	Peak Water Surface Elevation (ft	Freeboard* (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)
Ash Pond	382.0	395.0	385.0	389.7	5.3	21876	1040

*Freeboard is measured from the top of embankment to the peak water surface elevation

3.0 Methodology

3.1 HYDROLOGIC ANALYSES

The Plant Gorgas Ash Pond is classified as a High hazard structure. The design storm for a High hazard structure is a PMF rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 2.

Table 2. Plant Gorgas Ash Pond Storm Distribution

Hazard Classification	Return Frequency (years)	Storm Duration (hours)	Rainfall Total (Inches)	Rainfall Source	Storm Distribution
High	PMF	6	31.0	U.S. Department of Commerce's Hydro Meteorological Report 51	USGS SITES

The drainage area for the Plant Gorgas Ash Pond was delineated based on LiDAR data acquired for the Plant in 2016. Runoff characteristics were developed based on the Soil

Conservation Service (SCS) methodologies as outlined in TR-55. An overall SCS curve number for the drainage area was developed based on the National Engineering Handbook Part 630, Chapter 9 which provides a breakdown of curve numbers for each soil type and land use combination. Soil types were obtained from the USGS online soils database. Land use areas were delineated based on aerial photography. Time of Concentration and Lag Time calculations were developed based on the overland flow method as described in the National Engineering Handbook Part 630, Chapter 15.Pertinent basin characteristics of the Ash Pond is provided below in Table 3.

Table 3—Ash Pond Hydrologic Information

Drainage Basin Area (acres)	1,302
Hydrologic Curve Number, CN	80
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	46.8
Lag Time (minutes)	28.1
Hydrologic Software	USACE HEC-HMS

Runoff values were determined by importing the characteristics developed above into a hydrologic model with the US Army Corps of Engineers HEC-HMS program.

Process flows from Plant Gorgas were considered in this analysis. Based on normal plant operations, the Ash Pond receives an additional 21.9 MGD (33.9 cfs) of inflow from the Plant.

3.2 HYDRAULIC ANALYSES

Storage values for the Ash Pond were determined by developing a stage-storage relationship utilizing contour data. The spillway system at the Plant Gorgas Ash Pond consists of a primary spillway and an auxiliary spillway. The primary spillway consists of a sharp crested riser weir of 12-foot length which conveys flow to a corrugated metal conduit. The top of the weir box coincides with the normal pool elevation of 382.0 feet. The conduit is 48-inches in diameter and has a length of approximately 190 feet divided into three segments. The auxiliary spillway consists of two 7' x 5' box culverts with a 1% slope. The receiving spillway is a 15' x 5' rectangular flume on a 55% slope. A summary of spillway information is presented below in Table 4.

Table 4—Spillway Attribute Table

Spillway Component	US Invert El (feet)	DS Invert El (feet)	Dimension (ft)	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Primary segment 1	371.0	362.7	4	7.1%	116.8	380
Primary segment 2	362.2	349.2	4	23.5%	55.3	380
Primary segment 3	348.7	348.6	4	0.5%	16.6	380
Auxiliary	385.0	384.5	7-foot span 5-foot rise	0.10	49.6	1,100

Based on the spillway attributes listed above, a rating curve was developed using PCSWMM and inserted into HEC-HMS to determine the pond performance during the design storm. Results are shown in Table 1.

4.0 SUPPORTING INFORMATION

4.1 CURVE NUMBER

	Soil	Area (acres)	Curve Number
Forest	A	76.3	45
	B	285.5	66
	D	530.0	83
Field	A	4.5	30
	B	21.6	58
	D	31.0	78
2 Acre Residential	B	10.3	65
	D	0.9	82
Graded Area	D	3.4	94
Surface Water	N/A	338.6	98
	Total	**1302.0**	**80**

4.2 STAGE-STORAGE TABLE

Elevation	Area (acres)	Volume (acre-ft.)
320	1.6	0
325	5.3	17.4
330	10.6	57.3
335	14.3	119.6
340	20.0	205.3
345	32.5	336.5
350	45.5	531.6
355	62.7	802.0
360	85.5	1172.3
365	197.0	1878.4
370	261.9	3025.7
375	286.7	4397.3
380	308.3	5885.0
385	361.2	7558.9
390	394.6	9448.6
395	427.8	11504.7

TIME OF CONCENTRATION

Sheet Flow

*Manning's coefficient	n	0.4	
Sheet Flow Length	l	55	ft
2-yr, 24-hr Rainfall	P_2	4.13	in
**Slope of Land Surface	S	0.127273	ft/ft
Travel Time	T_{t1}	0.09	hr

Shallow Concentrated Flow

Segment Length	l	1417	ft
Slope of Land Surface	S	0.02	ft/ft
Woodland Landuse			
*Flow Velocity	V	0.7	ft/s
Travel Time	T_{t2}	0.56	hr

Channel Flow 1

Up Invert		148.00	ft-msl
Down Invert		112.00	ft-msl
Length	l	1142.00	ft
Slope	s	0.03	ft/ft
Bottom Width	a	2.00	ft
Side Slope 1		3.00	:1
Side Slope 2		3.00	:1
Channel Height	h	2.00	ft
Wetted Perimeter	P_w	12.65	ft
Channel Area	A	12.00	ft^2
Hydraulic Radius	r	0.95	ft
Manning's Coefficient	n	0.03	
Velocity	V	8.51	ft/s
Travel Time	T_{t3}	0.04	hr

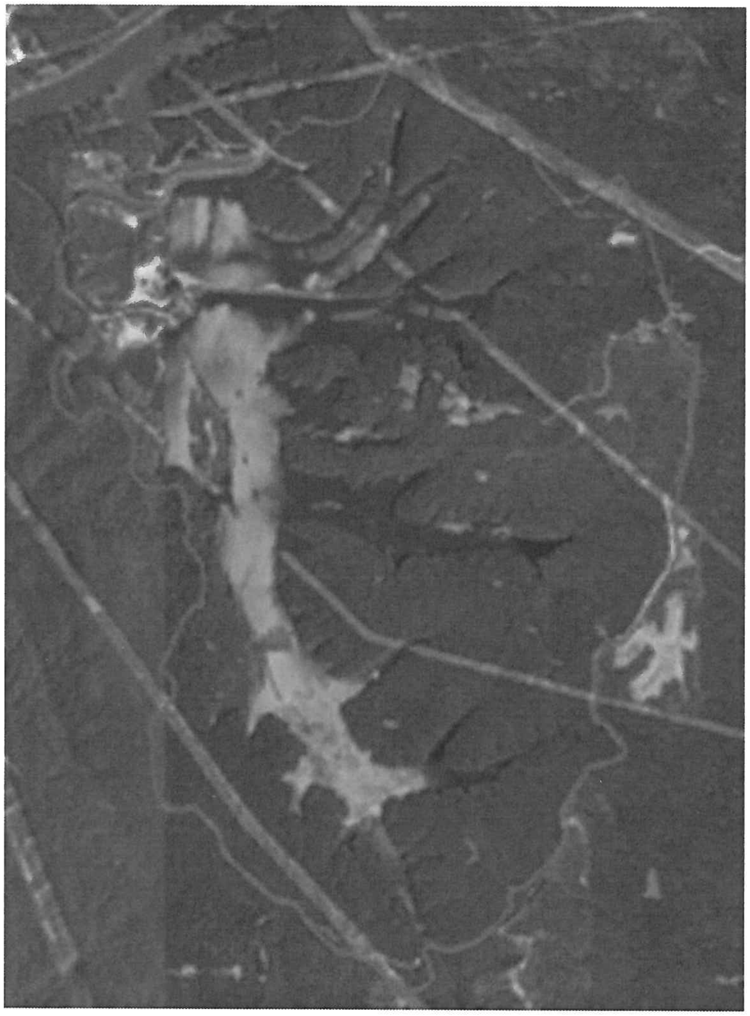
Lake Flow 1

Mean Lake Depth	*Dm*	*20*	*ft*
Flow Length	*L*	*8044*	*ft*
Wave Velocity	*V*	*25.38*	*ft/s*
Travel Time	T_{t3}	*0.09*	*hr*
Total TOC		*0.78*	*hr*
Lag Time		*28.1*	*min*

4.3 RATING CURVE

Elevation (ft-msl)	Head (feet)	Weir	Conduit	Primary Spillway	Auxiliary Spillway	Total
		Flow (cfs)				
382.0	0.0	0.0	293.2	0.0	0.0	0.0
382.5	0.5	13.2	297.9	13.2	0.0	13.2
383.0	1.0	37.2	302.6	37.2	0.0	37.2
383.5	1.5	68.3	307.2	68.3	0.0	68.3
384.0	2.0	105.2	311.8	105.2	0.0	105.2
384.5	2.5	147.0	316.3	147.0	0.0	147.0
385.0	3.0	193.3	320.7	193.3	0.0	193.3
385.5	3.5	243.6	325.1	243.6	33.9	277.5
386.0	4.0	297.6	329.4	297.6	79.4	377.0
386.5	4.5	355.1	333.6	333.6	138.4	472.0
387.0	5.0	415.9	337.8	337.8	206.3	544.1
387.5	5.5	479.8	342.0	342.0	282.2	624.1
388.0	6.0	546.7	346.1	346.1	365.2	711.3
388.5	6.5	616.5	350.1	350.1	454.9	805.0
389.0	7.0	689.0	354.1	354.1	550.7	904.8
389.5	7.5	764.1	358.1	358.1	652.3	1,010.3
390.0	8.0	841.7	362.0	362.0	743.9	1,105.9
390.5	8.5	921.9	365.8	365.8	801.5	1,167.3
391.0	9.0	1,004.4	370.0	370.0	857.4	1,227.4
391.5	9.5	1,089.3	371.4	371.4	911.9	1,283.3
392.0	10.0	1,176.4	371.5	371.5	965.0	1,336.5
392.5	10.5	1,265.7	372.7	372.7	1,016.9	1,389.6
393.0	11.0	1,357.2	375.0	375.0	1,067.7	1,442.7
393.5	11.5	1,450.7	377.3	377.3	1,100.0	1,477.3
394.0	12.0	1,546.4	380.0	380.0	1,100.0	1,480.0
394.5	12.5	1,644.0	381.9	381.9	1,100.0	1,481.9
395.0	13.0	1,743.6	384.2	384.2	1,100.0	1,484.2

4.4 DRAINAGE BASIN



APPENDIX C

GROUNDWATER MONITORING PLAN

Alabama Power

Dustin G. Brooks
Environmental Affairs Supervisor
Environmental Compliance

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12N-0830
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Received: 10/20/21

October 20, 2021

Via email to SSS@adem.alabama.gov

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

Re: ADEM Letter of September 27, 2021
Response to Groundwater Monitoring Plan Comments
Submitted to the Department on August 5, 2021
William C. Gorgas Electric Generating Plant

Dear Mr. Story:

The following provides responses to comments received in a letter from the Alabama Department of Environmental Management (ADEM) Land Division dated September 27, 2021. The letter contained comments on the revised groundwater monitoring plan (GWMP) submitted to the Department in March 2021 for the Ash Pond at the Alabama Power Company (APC) William C. Gorgas Electric Generating Plant. The following presents the full text of the comments provided by ADEM in italics followed by our response indented in plain text.

__Comments and Recommendations:__

1. *Based on the proposed well locations for the American System Monitoring Network in relation to the waste boundary, the monitoring system may not adequately represent the quality of groundwater passing the waste boundary of the CCR unit in compliance with ADEM Admin. Code r. 335-13-15-.06(2)(a)(2). The Department requests proposed or additional well locations closer to the waste boundary and/or further justification of the current proposed locations.*

The initial compliance network, installed prior to 2016, largely targeted Pratt coal seams or higher strata as the uppermost aquifer. Upon determination of SSLs, additional wells were installed to assess vertical and horizontal impacts. Vertical wells were typically installed across the American coal seam as well as some horizontal wells where the Pratt coal was too thin or appeared to yield insufficient volumes of groundwater. Through this process it can be determined that: (1) the initial groundwater monitoring network properly identified potential impacts and (2) the addition of American coal seam wells to the compliance network is proper.

Alabama Power Company proposed augmenting the monitoring well network with (A) existing American coal seam screened delineation wells and (B) recently proposed, in-process wells targeting or recently installed across the American. A map showing spatial locations and overall site coverage of American screened wells was delivered to the Department in a comment response letter dated August 5, 2021. This map has been updated with the latest drilling results and has been included in **Enclosure A**. This update includes the addition of GS-AP-MW-1R to the American coal seam monitoring network and provides additional coverage east of the site. For augmentation into the compliance network, a large subset of these wells located more proximal to the waste boundary is recommended. The recommended American coal seam compliance network is included in **Enclosure B**.

The network provided in **Enclosure B** includes 11 monitoring locations with 4 locations converted from a delineation designation, 2 existing piezometers, 3 locations as recently installed replacement wells, 1 location as recently installed wells originally labeled as vertical delineation, and 1 newly proposed location. GS-AP-PZ-18R is installed just above the Maxine Mine and will provide additional data proximal to the American coal seam. A newly proposed well has been proposed adjacent to GS-AP-MW-14R for purposing of monitoring the American coal seam. This closes a potential data gap in the network.

Locations GS-AP-MW-26H, GS-AP-MW-38H, GS-AP-MW-40H, GS-AP-MW-37H, GS-AP-MW-27H, GS-AP-MW-36V, GS-AP-MW-30HA, GS-AP-MW-31V, and GS-AP-MW-45V will serve delineation wells and piezometers. GS-AP-MW-34HO will continue to serve as an off-site delineation well. These wells reside too far from the waste boundary or are off-site and thus, are not proposed as compliance wells.

Enclosure C contains an updated table of proposed compliance wells (**Table 1A**), piezometers (**Table 1B**), delineation wells (**Table 1C**), and recently relocations (**Table 1D**). Numerous wells have recently been installed and have not been surveyed or developed – details for these wells are labeled "pending" in **Table 1A**.

The following commentary provides justification for the American coal seam monitoring network included in **Enclosure B**.

Hydrogeologic and General Rationale:

1) **Absence of American Coal Seam:** As discussed in a September 7, 2021 transmittal to the Department, the American Coal Seam is absent to the north of the ash pond due to topography

and historical mining activities. To the north, the American coal seam would have: (1) been mined out, (2) daylight above ground surface, or (3) is present in limited extent and at depths to shallow to produce groundwater. This transmittal also highlighted the absence of the American coal seam to the east, southeast, south, and southwest due to deeper underground mining (Maxine Mine). Locations south of an imaginary line from GS-AP-MW-15 to GS-AP-MW-21 will either encounter the Maxine Mine or remnant coal pillars within the mine, with each providing water quality representative of this large mine. For this reason, additional deeper monitoring within the American coal seam has not been proposed between GS-AP-MW-19 and GS-AP-MW-21.

It should also be noted that historical strip mining occurred within the footprint of the ash pond to the north of well location GS-AP-MW-1R – largely concentrated along the western and eastern fringes of the pond and into east-west trending fingers. In these areas, the American and Pratt coal seams are absent and would have been replaced by mine backfill materials.

2) **Non-point source monitoring:** The ash pond at Plant Gorgas has been in operations since the 1950s. Due to the length of operations and the nature of older CCR impoundments, rapid detection from point sources is not as applicable. Calculating linear, straight line travel-times from waste boundary to wells show that wells are located adequately and within sufficient proximity to have detected impacts from the CCR facility (given age of facility).

   The following table shows estimated, straight line travel-times from facility to well. Two distance traveled scenarios were used to estimate travel-times: (1) distance from well to waste boundary (including vertical distance from base of facility to American coal seam) and (2) distance from well to estimated location of the intersection of the American coal seam with the bottom of the ash pond. It should be noted that in scenario 1 (travel-time from waste boundary), travel times are likely greater than listed below because the base of ash pond and American coal seam are separated by sections of low-permeability material and a high degree of permeability contrasts. These factors lead to slower groundwater velocity and increased length of flow path. Travel-times for scenario 1 are likely greater than 5 to 10 years greater than presented below.

Well ID	GW Elevation (ft NAVD)	Pond Elevation (ft NAVD)	Distance Traveled (ft)	Distance from Intersection (ft)	Average Hydraulic Cond. (cm/sec)	Travel-time from Waste Boundary (years)	Travel-time from Unit Intersection (years)
MW-12V	360.26	383.00	186.15	2450.00	0.000452	0.16	28.22
MW-21V	339.54	383.00	559.11	4390.00	0.000452	0.77	47.41
MW-15V	309.53	383.00	404.84	5499.00	0.000452	0.24	44.00

3) **Preferential flow:** In-conjunction with the above, the geology at Plant Gorgas dictates preferential flow through coal seams and vertical to subvertical joints, fractures, and faults.

Targeting such features for monitoring, even if stepped back from the waste boundary, is technically justified. This because preferential flow paths concentrate groundwater migration through enhanced fracture interconnectivity within otherwise impermeable rock strata. Therefore, given the travel-times described above, and the age of the facility – it was appropriate to target these features for determining potential impacts to groundwater.

4) **Ash Pond Geometry –** Rattlesnake lake has many fingers that trend east to west and makes for very different pond geometry than most. This natural geometry allows for wells installed at the waste boundary to be semi-encompassed by fingers of the ash pond to the north and south. Therefore, wells with groundwater elevations lower than pond elevation, may receive fracture flow coming from each finger and from multiple directions. In these cases, wells are suited for detecting impacts along multiple flow paths away from the waste boundaries.

Location Specific Rationale:

GS-AP-MW-1R:
Hydrogeologic: Spatially, located due east of the modeled Pratt Coal Seam – base of Ash Pond Intersection. This marks the first instance where the Pratt Coal Seam resides at or below the base of the ash pond, and thus, provides monitoring of an area where potential preferential flow through the Pratt may have developed. Additionally, this locale is proximal to the fold axis of the previously mapped/speculated Sequatchie Syncline. As previously highlighted, geologic structures are a target for monitoring well locations due to potential for preferential flow to develop along more dense or enhanced fracture networks.

General: These locations were not installed directly at the waste boundary for two reasons: (1) to the north-northwest and south of GS-AP-MW-1R, the waste boundary extends east or past GS-AP-MW-1R, (2) steeply dipping topography from the GS-AP-MW-1R location to the waste boundary exists to the northwest, west, and south making direct placement on the waste boundary unfeasible and unsafe.

Note: GS-AP-MW-46 is the name for the recently installed paired location, adjacent to GS-AP-MW-1R. GS-AP-MW-46 will monitor the Pratt Coal Seam, GS-AP-MW-1R will monitor the American Coal Seam. To date, wells have not been surveyed or developed.

GS-AP-MW-3/GS-AP-MW-3V:
General: These locations were not installed directly at the waste boundary for four reasons: (1) to the north and south of GS-AP-MW-3, the waste boundary extends past or near GS-AP-MW-3, (2) steeply dipping topography from the GS-AP-MW-3 location to the waste boundary exists to the northwest and south making direct placement on the waste boundary unfeasible and unsafe. (3) Additionally, to the west-southwest of GS-AP-MW-3, the land surface and subsurface shifts from native material to mine spoil materials. In this direction, targeted coal seams do not exist for well screens. Lastly, (4) at the time of installation, road access west of GS-AP-MW-3 was largely overgrown with vegetation and in poor condition.

GS-AP-MW-5R:

General: This location was not installed directly at the waste boundary for two reasons: (1) topography dips steeply to the southwest and in the direction of the waste boundary and (2) locations west along the construction access road would not bring this location much closer to the waste boundary. GS-AP-MW-5R was located approximately 131-ft west northwest of GS-AP-MW-5 due to the installation of new powerlines and necessary road improvements to the construction access road.

The area south-southeast of GS-AP-MW-5R was not feasible as this area has been labeled a potential borrow area and area for material stockpile and equipment laydown.

GS-AP-MW-8, GS-AP-MW-9R, GS-AP-MW-9V

Hydrogeologic: Locations GS-AP-MW-9R and GS-AP-MW-9V reside in close proximity to a north-northwest trending normal fault. Faults and faulted strata can develop enhanced permeability through more dense, well connected fractures or can act as barriers to flow if fractures have been mineralized, clogged over time. The areas around faults have been regarded as important well screen targets due to the overall low hydraulic conductivity of site strata.

General: The site access road west of the ash pond is generally as close to the waste facility as feasible. These wells are located on the west side of the access road to facilitate traffic and construction activities. GS-AP-MW-9R was located 53-ft southwest of GS-AP-MW-9 as necessitated to complete improvements to the access road.

Note: GS-AP-MW-8 is an upgradient well. GS-AP-MW-9R monitors the Pratt Coal Seam. GS-AP-MW-9V monitors the American Coal Seam. GS-AP-MW-9R has not been surveyed or developed.

GS-AP-MW-10R

Hydrogeologic: Location GS-AP-MW-10R resides in close proximity to a north-northwest trending normal fault. Faults and faulted strata can develop enhanced permeability through more dense, well connected fractures or can act as barriers to flow if fractures have been mineralized, clogged over time. The areas around faults have been regarded as important well screen targets due to the overall low hydraulic conductivity of site strata.

General: This well location was relocated 217-ft southeast of GS-AP-MW-10 due to the construction of the ash thickening plant. In general, this area contains significant construction activity and traffic with close proximity to the ash thickening plant, construction trailers, and site access road.

GS-AP-MW-11R, GS-AP-MW-12, GS-AP-MW-12V, GS-AP-MW-13R

Hydrogeologic: These locations reside in close proximity to a north-northwest trending normal fault. Faults and faulted strata can develop enhanced permeability through more dense, well connected fractures or can act as barriers to flow if fractures have been mineralized, clogged over time. The areas around faults have been regarded as important well screen targets due to the overall low hydraulic conductivity of site strata.

General: The site access road west of the ash pond is generally as close to the waste facility as feasible. These wells are located on the west side of the access road when necessary to facilitate traffic and construction activities. GS-AP-MW-11R was relocated 173-ft east of GS-AP-MW-11 due to the construction of the ash thickening plant. This location is closer to the ash pond than the original GS-AP-MW-11 location. Well GS-AP-MW-13R was relocated 385-ft northwest on the opposite side of the construction access road due to the construction of the ash thickening plant CCR deposition pipeline network.

Note: GS-AP-MW-12V is screened in the American.

GS-AP-MW-14R, GS-AP-MW-15, GS-AP-MW-15V
General: The site access road west of the ash pond is generally as close to the waste facility as feasible. These wells are located on the west side of the access road when necessary to facilitate traffic and construction activities.
GS-AP-MW-14R was relocated 202-ft north-northwest of GS-AP-MW-14 on the opposite side of the construction access road due to the construction of the ash thickening plant CCR deposition pipeline network. The area east and southeast of GS-AP-MW-14 was not feasible as this area has been labeled a potential borrow area and area for material stockpile and equipment laydown.

Note: GS-AP-MW-15V is screened in the American.

GS-AP-MW-16S, GS-AP-MW-16D, GS-AP-PZ-16, GS-AP-MW-17, GS-AP-MW-17V
General: Historically, the transmission line southwest of the ash pond was as close to the waste facility as feasible. At the time of installation, considerable improvements had to be made to segments of the transmission line in order to facilitate these drilling and subsequent sampling activities. Historically, to the north and northeast of the transmission line, dense vegetation and hilly terrain was present and did not allow for access closer to the pond.

Recently, the area north of the transmission line has been cleared and made more accessible. However, these areas are considered potential areas for borrow, material stockpile, and equipment laydown.

Note: GS-AP-PZ-16 is screened in the Maxine Mine.

GS-AP-MW-21/GS-AP-MW-21V:
General: This location was not installed directly at the waste boundary due to: (1) lack of road access between GS-AP-MW-21 and the waste facility boundary, (2) steep topography south and north of GS-AP-MW-21 down to the waste boundary, and (3) because the ash pond extends east and southeast past GS-AP-MW-21 to the north and south.

2. *It is recommended that piezometers GS-AP-PZ-16, GS-AP-PZ-18, and GS-AP-PZ-22 should continue to be sampled to ensure that all potential contaminant pathways are monitored.*

   GS-AP-PZ-16 and GS-AP-PZ-22 will continue to be sampled as piezometers and to gauge water quality within the mine. Geochemical data will continue to be evaluated with respect to source in the form of piper diagrams, boron to lithium ratios, and additional analyses as needed.

   GS-AP-PZ-18 has been abandoned due to ash pond closure activities. This activity was approved by the Department in June 2021. A replacement well has been installed just above the Maxine Mine to monitor water quality. Well developments and geochemical data evaluation will be conducted to assess the viability of this well.

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, please do not hesitate to contact me.

Sincerely,

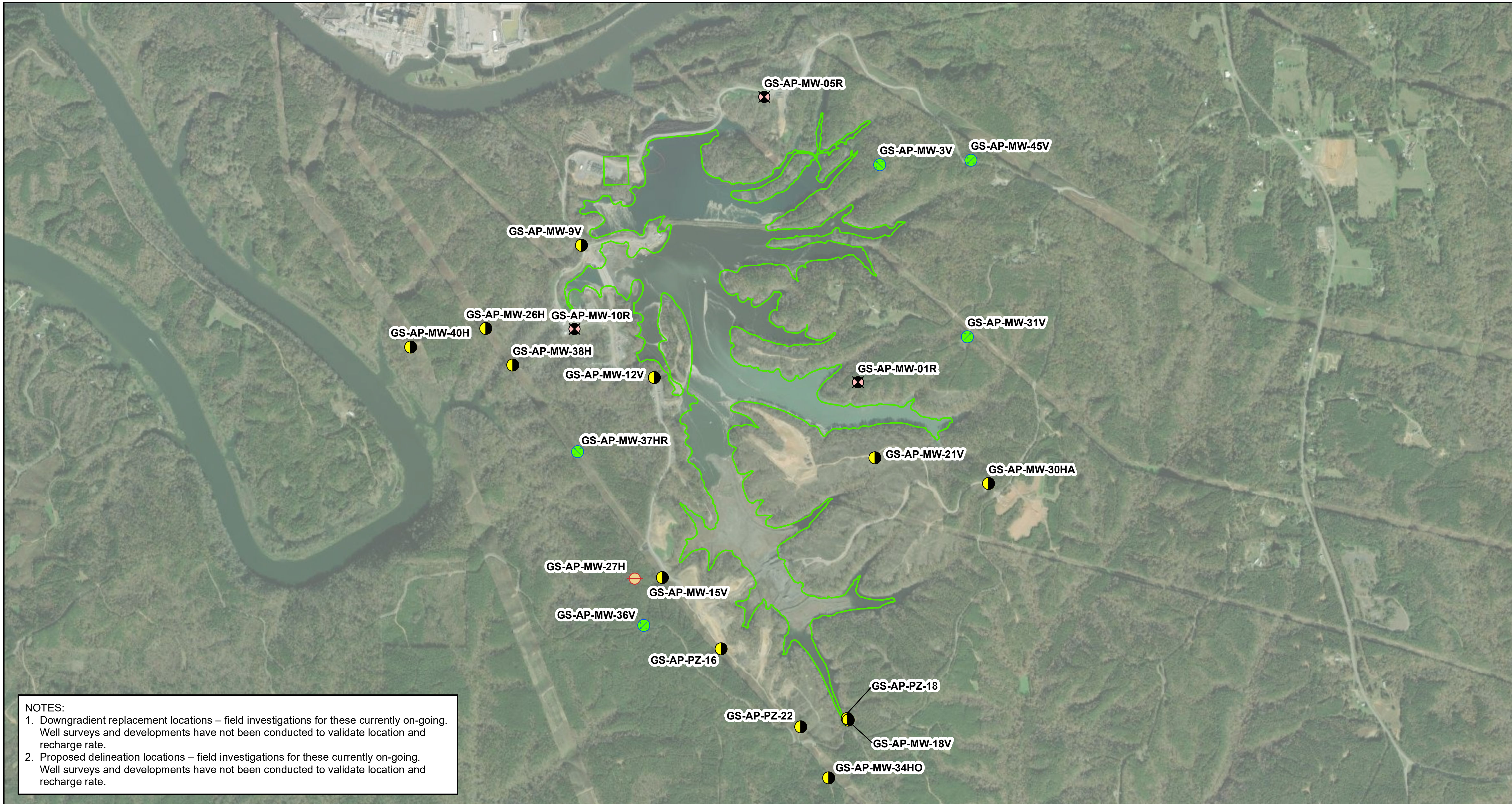
Dustin Brooks

Dustin G. Brooks
Environmental Affairs Supervisor

Cc: Eric Wallis – Southern Company Services

Attachments
Enclosure A – American Flow System Monitoring Network Wells
Enclosure B – Proposed American Flow System Compliance Monitoring Network
Enclosure C – Updated Well Attribute Tables

ENCLOSURE A



NOTES:
1. Downgradient replacement locations – field investigations for these currently on-going. Well surveys and developments have not been conducted to validate location and recharge rate.
2. Proposed delineation locations – field investigations for these currently on-going. Well surveys and developments have not been conducted to validate location and recharge rate.

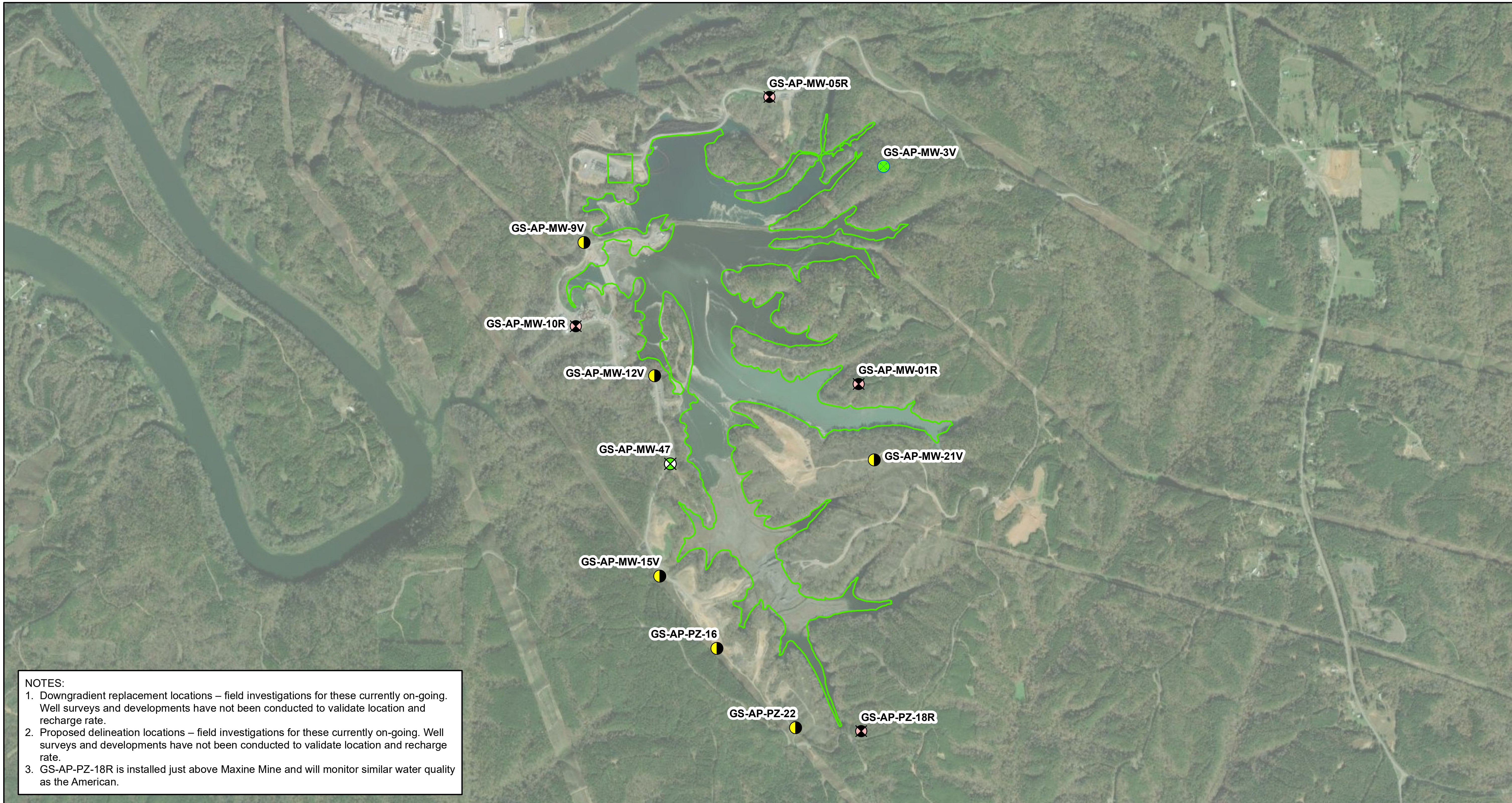
Legend
- Proposed Delineation Well
- Downgradient Replacement Well
- Existing Delineation Well
- Existing Piezometer
- Ash Pond Boundary

N

0 1,000 2,000 4,000 6,000 Feet

SCALE 1:18000	DRAWING TITLE AMERICAN FLOW SYSTEM MONITORING NETWORK PLANT GORGAS ASH POND
DATE 10/19/2021	
DRAWN BY KAR	FIGURE NO
CHECKED BY GBD	Southern Company

ENCLOSURE B



NOTES:
1. Downgradient replacement locations – field investigations for these currently on-going. Well surveys and developments have not been conducted to validate location and recharge rate.
2. Proposed delineation locations – field investigations for these currently on-going. Well surveys and developments have not been conducted to validate location and recharge rate.
3. GS-AP-PZ-18R is installed just above Maxine Mine and will monitor similar water quality as the American.

Legend

- Proposed Delineation Well
- Proposed Downgradient Monitoring Well
- Downgradient Replacement Well
- Existing Delineation Well
- Existing Piezometer
- Ash Pond Boundary

N

0 1,000 2,000 4,000 6,000 Feet

SCALE 1:18000	DRAWING TITLE AMERICAN FLOW SYSTEM PROPOSED COMPLIANCE MONITORING NETWORK PLANT GORGAS ASH POND
DATE 10/20/2021	
DRAWN BY KAR	FIGURE NO
CHECKED BY GBD	Southern Company

ENCLOSURE C

Table 1a.
Compliance Monitoring Well Network Details

Well Name	Proposed Designation	Previous Purpose	Monitored Flow System	Installation Completion Date	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation (ft MSL)	Bottom of Screen Elevation (ft MSL)	Screen Length
GS-AP-MW-8	Upgradient	Upgradient	Upper Pratt Coal Group	2/26/2016	1323405.23	2062398.47	431.63	434.61	64.59	390.02	370.02	20
GS-AP-MW-13	Upgradient, Abandoned	Upgradient	Upper Pratt Coal Group	2/4/2016	1319377.84	2064083.37	461.03	464.20	113.57	370.63	350.63	20
GS-AP-MW-16S	Upgradient	Piezometer, Proposed Upgradient	Upper Pratt Coal Group	4/18/2016	1316149.55	2064844.29	459.04	462.42	133.38	349.04	329.04	20
GS-AP-MW-17V	Upgradient	Proposed Upgradient	Upper Pratt Coal Group	1/20/2019	1314967.05	2066096.42	528.57	531.45	151.40	400.05	380.05	20
GS-AP-MW-2	Downgradient	Downgradient	Pratt Coal	3/10/2016	1321951.86	2067629.25	518.77	522.03	214.22	327.81	307.81	20
GS-AP-MW-3	Downgradient	Piezometer, Proposed Downgradient	Pratt Coal	3/4/2016	1323690.18	2067314.13	508.77	512.29	180.52	341.77	331.77	10
GS-AP-MW-6S	Downgradient	Downgradient	Gillespy Coal Group	1/19/2016	1324533.13	2063864.63	271.57	274.67	46.55	238.12	228.12	10
GS-AP-MW-6D	Downgradient	Downgradient	Gillespy Coal Group	1/18/2016	1324547.48	2063881.96	271.39	274.50	64.48	220.02	210.02	10
GS-AP-MW-7	Downgradient	Downgradient	Gillespy Coal Group	1/26/2016	1324250.98	2063518.48	310.05	313.45	100.49	222.96	212.96	10
GS-AP-MW-12	Downgradient	Downgradient	Pratt Coal	4/20/2016	1320369.19	2063836.90	447.48	450.67	153.98	306.69	296.69	10
GS-AP-MW-15	Downgradient	Downgradient	Pratt Coal	2/8/2016	1317267.07	2063959.21	452.21	454.89	200.08	264.81	254.81	10
GS-AP-MW-16D	Downgradient	Downgradient	Pratt Coal Group	4/20/2016	1316152.70	2064850.23	459.09	462.27	224.23	258.04	238.04	20
GS-AP-MW-17	Downgradient	Downgradient	Pratt Coal	2/11/2016	1314955.86	2066094.14	528.78	531.88	248.85	293.03	283.03	10
GS-AP-MW-19	Downgradient	Downgradient	Pratt Coal Group	4/29/2016	1316325.43	2066775.98	492.60	495.58	179.19	336.39	316.39	20
GS-AP-MW-21	Downgradient	Downgradient	Pratt Coal	2/20/2016	1319122.82	2067233.10	506.51	509.48	236.45	283.03	273.03	10
GS-AP-MW-9V	Downgradient	Vertical Delineation	American Coal	11/6/2019	1322441.98	2062677.69	418.25	420.86	138.05	292.81	282.81	10
GS-AP-MW-12V	Downgradient	Vertical Delineation	American Coal	1/9/2019	1320383.14	2063813.29	446.54	449.74	179.10	312.22	302.22	10
GS-AP-MW-15V	Downgradient	Vertical Delineation	American Coal	10/28/2019	1317266.29	2063940.18	452.91	455.89	235.38	230.51	220.51	10
GS-AP-MW-21V	Downgradient	Vertical Delineation	American Coal	9/26/2019	1319131.76	2067250.33	507.59	509.84	248.95	270.89	260.89	10
GS-AP-MW-05R	Downgradient	Replacement, MW-5	American Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-3V	Downgradient	Proposed, Vertical Delineation	American Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-09R	Downgradient	Replacement, MW-9	Pratt Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-10R	Downgradient	Replacement, MW-10	American Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-11R	Downgradient	Replacement, MW-11	Pratt Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-13R	Downgradient	Replacement, MW-13	Pratt Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-14R	Downgradient	Replacement, MW-14	Pratt Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-18R	Downgradient	Replacement, MW-18	Upper Pratt Group	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-18VR	Downgradient	Replacement, MW-18V	Pratt Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-PZ-18R	Downgradient	Replacement, PZ-18	Nickel Plate	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-01R	Downgradient	Replacement, MW-1	American Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-PZ-16	Piezometer, Downgradient	Piezometer, Vertical Delineation	Maxine Mine, American	3/16/2016	1316157.31	2064852.10	458.83	462.29	252.66	219.63	209.63	10

Table 1a.
Compliance Monitoring Well Network Details

Well Name	Proposed Designation	Previous Purpose	Monitored Flow System	Installation Completion Date	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation (ft MSL)	Bottom of Screen Elevation (ft MSL)	Screen Length
GS-AP-PZ-22	Piezometer, Downgradient	Piezometer, Vertical Delineation	Maxine Mine, American	4/11/2016	1314941.40	2066094.05	529.31	532.38	328.07	214.31	204.31	10
GS-AP-MW-46	Downgradient	New Location; Adjacent to MW-1R	Pratt Coal	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-47	Downgradient	New/Proposed; Adjacent to MW-14R	American Coal	Not Started	Not Started	Not Started	Not Started	Not Started	Not Started	Not Started	Not Started	Not Started

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. Piezometers are utilized for water level readings only; current piezometer MW-16S is being evaluated for potential as a site upgradient well
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'.
5. Previous Purpose - past designation, use of location
6. GS-AP-MW-13 - data from well will continued to be used for statistical analyses even though abandoned
7. GS-AP-MW-13R - replacement for MW-13 did not encounter upgradient well; will be downgradient
8. Pending/Not Started - indicates field investigation on-going

Table 1b.
Water-level Only Piezometer Network Details

Well Name	Purpose	Installation Completion Date	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation (ft MSL)	Bottom of Screen Elevation (ft MSL)	Screen Length
GS-AP-MW-4	Piezometer	3/7/2016	1324779.03	2067957.03	504.61	507.90	163.29	354.61	344.61	10
GS-AP-MW-7V [3,5]	Piezometer	1/18/2019	1324251.90	2063504.32	309.46	312.14	202.68	119.46	109.46	10
GS-AP-MW-20	Piezometer	2/1/2019	1318122.87	2068319.23	525.18	528.15	249.97	288.18	278.18	10
GS-AP-MW-25H [3,5]	Piezometer	1/2/2019	1322710.44	2061621.52	458.66	461.79	168.13	303.66	293.66	10
GS-AP-MW-27H [3,5]	Piezometer	2/12/2019	1317251.09	2063507.76	532.08	535.03	244.95	300.08	290.08	10
GS-AP-MW-30H [3,5]	Piezometer	1/8/2019	1318714.64	2069028.11	579.62	582.49	295.87	296.62	286.62	10
GS-AP-MW-30HS [3,5]	Piezometer	1/10/2019	1318721.10	2069023.99	579.84	582.53	47.19	545.34	535.34	10
GS-AP-MW-37H	Piezometer	10/23/2019	1319199.34	2062581.05	456.12	459.28	293.45	185.83	165.83	20
GS-AP-MW-39H	Piezometer	10/29/2019	1321072.42	2062371.29	448.47	451.13	348.50	122.63	102.63	20
GS-AP-MW-7VR [3,5]	Piezometer	4/18/2020	1324242.41	2063512.64	311.04	313.89	150.30	171.74	161.74	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. Piezometers are utilized for water level readings only
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’ or 0.5'.
5. Delineation wells GS-AP-MW-7V, GS-AP-MW-7VR, GS-AP-MW-25H, GS-AP-MW-27H, GS-AP-MW-30H, and GS-AP-MW-30HS will be utilized for water level data only in future events.

Table 1c.
Delineation Well Network Details

Well Name	Purpose	Installation Completion Date	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation (ft MSL)	Bottom of Screen Elevation (ft MSL)	Screen Length
GS-AP-MW-23H	Horizontal Delineation	1/4/2019	1324901.11	2063751.19	301.9	304.98	42.50	272.48	262.48	10
GS-AP-MW-24H	Horizontal Delineation	1/3/2019	1325034.25	2062579.09	258.38	261.35	62.80	208.55	198.55	10
GS-AP-MW-26H	Horizontal Delineation	1/22/2019	1321144.11	2061189.28	391.68	394.68	193.60	211.08	201.08	10
GS-AP-MW-28H	Horizontal Delineation	2/26/2019	1314721.29	2066153.32	513.84	513.82	229.70	294.12	284.12	10
GS-AP-MW-29H	Horizontal Delineation	2/5/2019	1314844.80	2066948.77	440.71	440.95	130.64	320.31	310.31	10
GS-AP-MW-25HA	Horizontal Delineation	11/7/2019	1322704.82	2061627.52	458.98	462.27	342.90	129.37	119.37	10
GS-AP-MW-30HA	Horizontal Delineation	10/23/2019	1318730.12	2069017.20	579.99	582.40	337.95	254.45	244.45	10
GS-AP-MW-31H	Horizontal Delineation	10/11/2019	1321029.58	2068711.01	584.48	587.39	287.58	309.81	299.81	10
GS-AP-MW-32H	Horizontal Delineation	10/12/2019	1316042.76	2068381.85	547.43	550.03	304.05	265.98	245.98	20
GS-AP-MW-33HO	Horizontal Delineation	11/7/2019	1314683.64	2068050.79	524.08	526.79	282.91	263.88	243.88	20
GS-AP-MW-34HO	Horizontal Delineation	11/9/2019	1314144.24	2066527.09	521.18	523.82	327.60	206.22	196.22	10
GS-AP-MW-35HO	Horizontal Delineation	11/20/2019	1315127.10	2064800.69	550.60	553.35	320.48	242.87	232.87	10
GS-AP-MW-36H	Horizontal Delineation	10/28/2019	1316518.20	2063698.16	533.67	536.61	283.10	263.51	253.51	10
GS-AP-MW-38H	Horizontal Delineation	11/22/2019	1320575.44	2061610.67	343.41	345.74	168.20	187.54	177.54	10
GS-AP-MW-41HS	Horizontal Delineation	10/28/2019	1324686.47	2063278.88	281.75	284.65	37.65	257.00	247.00	10
GS-AP-MW-41HD	Horizontal Delineation	10/27/2019	1324683.42	2063283.86	282.32	284.54	58.30	236.24	226.24	10
GS-AP-MW-42H	Horizontal Delineation	10/29/2019	1325082.88	2064034.21	338.61	340.62	87.51	263.11	253.11	10
GS-AP-MW-43H	Horizontal Delineation	11/11/2019	1321244.07	2067672.16	511.87	514.62	222.75	311.87	291.87	20
GS-AP-MW-6V (VR)	Vertical Delineation	6/23/2020	1324568.11	2063915.62	272.84	275.44	98.5	184.34	174.34	10
GS-AP-MW-40H (HO)	Horizontal Delineation	5/1/2020	1320858.03	2060018.89	355.07	357.91	90.30	274.77	264.77	10
GS-AP-MW-44HO	Horizontal Delineation	8/16/2020	1321163.745	2067488.902	503.33	506.21	208.48	307.23	297.23	10
GS-AP-MW-23V	Vertical Delineation	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-31V	Vertical Delineation	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-36V	Vertical Delineation	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
GS-AP-MW-37HR	Vertical Delineation	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending

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. Piezometers are utilized for water level readings only
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’ or 0.5'.
5. GS-AP-MW-40H when planned was an off-site well, but land was purchased by APC & was installed as an on-site delineation well
6. GS-AP-MW-33HO through GS-AP-MW-35HO and GS-AP-MW-44HO are off-site well locations.

Table 1d.
Well Replacement and Modification Details

Well Name	Purpose	Installation Completion Date	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation (ft MSL)	Bottom of Screen Elevation (ft MSL)	Screen Length
GS-AP-MW-5	ABANDONED	4/2/2016	1324811.04	2065409.73	483.80	487.17	149.37	347.80	337.80	10
GS-AP-MW-9	ABANDONED	4/22/2016	1322446.73	2062720.10	417.06	420.04	111.38	328.66	308.66	20
GS-AP-MW-10	ABANDONED	1/21/2016	1321310.86	2062441.08	464.94	468.41	144.87	343.54	323.54	20
GS-AP-MW-11	ABANDONED	2/4/2016	1320953.14	2063257.73	465.34	468.34	139.90	348.44	328.44	20
GS-AP-MW-13	ABANDONED	2/4/2016	1319377.84	2064083.37	461.03	464.20	113.57	370.63	350.63	20
GS-AP-MW-14	ABANDONED	1/30/2016	1318393.75	2063787.88	469.60	472.40	203.20	279.20	269.20	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. Piezometers are utilized for water level readings only; current piezometer MW-16S is being evaluated for potential as a site upgradient well
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'.

Monitor Well ID	Northing	Easting	Elevation	Approximated Distance to Waste Boundary (ft)	Monitor Well Relocation Details
GS-AP-MW-05R	1324749.59	2065525.5	490.12	439.5	Well relocated 131-ft west-northwest due to new powerline installation and construction access road improvements.
GS-AP-MW-09R	1322411.33	2062680.17	418.28	229.6	Well relocated 53-ft southwest due to construction access road improvements.
GS-AP-MW-10R	1321134.59	2062568.08	449.58	294	Well relocated 217-ft southeast due to the construction of the ash thickening plant.
GS-AP-MW-11R	1320919.69	2063427.42	451.96	152.2	Well relocated 173-ft east due to the construction of the ash thickening plant.
GS-AP-MW-13R	1319694.43	2063864.51	457.67	261.2	Well relocated 385-ft northwest on the opposite side of the construction access road due to the construction of the ash thickening plant CCR deposition pipeline network.
GS-AP-MW-14R	1318593.85	2063759.8	473.85	433.5	Well relocated 202-ft north-northwest on the opposite side of the construction access road due to the construction of the ash thickening plant CCR deposition pipeline network.
GS-AP-MW-18R	1314922.59	2067040.04	459.85	242.8	Well relocated 251.5-ft southeast to higher elevation due to the construction of a water management storage pumping system.
GS-AP-MW-18VR	1314909.29	2067078.64	460.21	283.6	Well relocated 281-ft southeast to higher elevation due to the construction of a water management storage pumping system.
GS-AP-PZ-18R	1314902.69	2067115.57	464.13	320.9	Well relocated 338-ft southeast to higher elevation due to the construction of a water management storage pumping system.
GS-AP-MW-01R	1320305.65	2066985.51	488.86	316.4	Well relocated 42.5-ft to the east-northeast currently a water level only piezometer due to insufficient groundwater yield for sampling and inclusion into the compliance monitoring well network.

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.

Alabama Power

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August 5, 2021

Received: 8/5/21

Via email to SSS@adem.alabama.gov

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

Re: ADEM Letter of July 26, 2021
Response to Groundwater Monitoring Plans Submitted to the Department
William C. Gorgas Electric Generating Plant

Dear Mr. Story:

The following provides responses to comments received in a letter from the Alabama Department of Environmental Management (ADEM) Land Division dated July 26, 2021. The letter pertains to the revised groundwater monitoring plan (GWMPs) submitted to the Department on March 8, 2021, for the (1) Ash Pond, (2) Bottom Ash Landfill, (3) CCR and Gypsum Landfill, and (4) Gypsum Pond at the Alabama Power Company (APC) William C. Gorgas Electric Generating Plant. The following presents the full text of the comments provided by ADEM in italics followed by our response indented in plain text.

Comments and Recommendations:

1. *The Characterization Report indicates that monitoring wells GS-AP-MW-7V, GS-GSA-MW-10H, and GS-AP-MW-39H did not yield sufficient water for sampling. Therefore, it appears appropriate to propose replacement locations for these delineation monitoring wells or provide justification if these wells are not recommended for replacement.*

   GS-AP-MW-7V

   At the Plant Gorgas Ash Pond, well GS-AP-MW-7VR, was installed in April 2020 as a second attempt at vertical delineation adjacent to compliance well GS-AP-MW-7 and as a replacement to well GS-AP-MW-7V but did not yield sufficient groundwater recharge for development or low-flow sampling.

As detailed in the *September 2020 Semi-Annual Progress and Groundwater Delineation Report,* geophysical and hydrophysical logs show no productive groundwater yielding intervals below the screened interval of compliance well GS-AP-MW-7. Well GS-AP-MW-7V was installed at a depth of approximately 199 feet below ground surface (feet BGS) and well GS-AP-MW-7VR was installed at a depth of approximately 147 feet BGS.

No additional, deeper delineation activities are planned due to an absence of deeper groundwater yielding intervals. All data gathered in suggest that groundwater flow zones are limited to more shallow intervals between 55 and 100 feet BGS in the vicinity of GS-AP-MW-7, -7V, and -7VR. A marked up geophysical and hydrophysical log for well GS-AP-MW-7V has been provided in **Enclosure A** to support this discussion.

GS-AP-MW-39H

At the Plant Gorgas Ash Pond, a replacement for delineation well GS-AP-MW-39H has not been proposed due to the proximity of other delineation wells in the direction of groundwater flow away from the facility, and, because GS-AP-MW-39H was installed as a site characterization location (site geology/hydrostratigraphy characterization). The following details support this rationale:

1) Delineation well GS-AP-MW-38H was installed 900 feet west-southwest of GS-AP-MW-39H,
2) Delineation well GS-AP-MW-26H was installed approximately 1200 feet west of GS-AP-MW-39H,
3) Delineation well GS-AP-MW-40H was installed approximately 2350 feet west of GS-AP-MW-39H, and
4) Exceedances of site GWPS were not historically observed at adjacent compliance wells GS-AP-MW-10 and GS-AP-MW-11.

Additionally, replacements are currently being installed for locations GS-AP-MW-10 and GS-AP-MW-11 and will increase the density of well locations and data in this area of GS-AP-MW-39H. Well location and replacement well locations proximal to GS-AP-MW-39H have been provided on map contained in **Enclosure B** and support this discussion.

GS-GSA-MW-10H

At the Plant Gorgas Gypsum Pond, a replacement for well GS-GSA-MW-10H has not been proposed at this time. The primary rationale for this has been: (A) GS-GSA-MW-10H not being located optimally downgradient of groundwater flow away from the facility and (B) absence of SSLs in the upper flow system primarily targeted by GS-GSA-MW-10H.

However, additional studies, including the analyses of boron isotopes are being conducted to further evaluate sources of lithium at the site. At the conclusion of this study, an additional delineation location or replacement location for GS-GSA-MW-10H may be proposed.

2. *In response to Comment #5 additional cross sections were provided in the Characterization Report. After review of the provided Characterization Report, it appears appropriate that the American Coal flow zone and Pratt Coal flow zone should be differentiated and targeted as separate aquifers for groundwater monitoring at the site. The Characterization Report indicates that the flow regime can be grouped into the (1) upper water-table flow system, (2) the Pratt Coal flow system, and (3) the American Coal flow system. Section 3.2.1. of the Characterization Report describes these flow systems as separate aquifers; however, the Permit Application indicates that there are only two general flow systems, (1) an upper water-table flow system and (2) the Pratt Coal Group/deeper bedrock flow group. Please clarify the discrepancy. Based on information included in the Characterization Report, it appears that additional monitoring wells should be proposed to monitor the American Seam flow zone.*

Previously, the Pratt and American flow systems were grouped as a Pratt Coal Group/deeper bedrock flow system and described as part of the regional uppermost aquifer system (Pottsville Formation). The Site Characterization Report is correct in the breakdown of site flow systems and represents the most comprehensive synopsis of site hydrogeology as determined through additional delineation and assessment data. The Water-Table, Pratt, and American represent separate discrete flow systems within the Pottsville Aquifer. Each flow system is separated by low permeability confining strata as is typical of Pottsville flow systems.

The latest interpretation of groundwater flow beneath the Plant Gorgas Ash Pond supports the need for additional monitoring points in the American flow system northeast, east, and west of the Ash Pond. Monitoring points due north are not feasible as the American seam has either been mined out or would exist above ground surface. Similarly, to the south, compliance locations have limited value as the American was underground mined and the remnant mine workings likely are not representative of site groundwater overall.

A map showing all current or planned American screened wells is included within **Enclosure C**. As shown on this map, there will be 19 wells and 1 piezometer that monitor the American seam and additional coverage has been added to areas previously identified as data gaps (west, east, and northeast). The majority of these wells were added via delineation designation, but two replacement compliance wells have been installed in the American – especially when the above Pratt seam does not provide strong indications of groundwater flow (GS-AP-MW-5R and GS-AP-MW-10R). Three locations, GS-AP-PZ-16, GS-AP-PZ-

18, and GS-AP-PZ-22 were piezometers installed to monitor water levels in the Maxine Mine and later, have been sampled as part of delineation and assessment. However, it is unlikely that the mine water is reflective of site groundwater quality and would not be recommended as compliance locations.

The American screened locations shown in **Enclosure C** represent the proposed network and align with requested additional wells by the Department. Delineation wells, sampled semi-annually, will be evaluated with respect to GWPS and corrective action strategies. Mine installed locations will continue to be evaluated for applicability as providing representative samples.

3. *It is recommended that the GWMP be revised to include the monitoring network changes resulting from the April 2, 2021 Monitoring Well Installation and Replacement Request.*

   Monitoring well installations are currently underway in accordance with the April 2, 2021 Monitoring Well Installation and Replacement plan. It is anticipated that well installations, survey and developments will be completed Fall of 2021. Waiting on these activities, especially development, will ensure that future designations of these wells are accurate. The well installation details will be included in the 2021 Annual Groundwater Report submitted to the Department by January 31, 2022.

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

Sincerely,

Dustin Brooks

Dustin G. Brooks
Environmental Affairs Supervisor

Cc: Eric Wallis – Southern Company Services

Attachments
Enclosure A – Geophysical log for well GS-AP-MW-7V
Enclosure B – Location Maps: Monitoring Wells Proximal to GS-AP-MW-39H
Enclosure C – Map Showing Locations of American Coal Seam Wells

ENCLOSURE A

GEOPHYSICAL RECORD OF BOREHOLE: GS-AP-MW-7V

PLANT GORGAS ASH POND DELINEATION WELLS

GOLDER Project Number: 18114896

Client: Southern Company Services

Southern Company

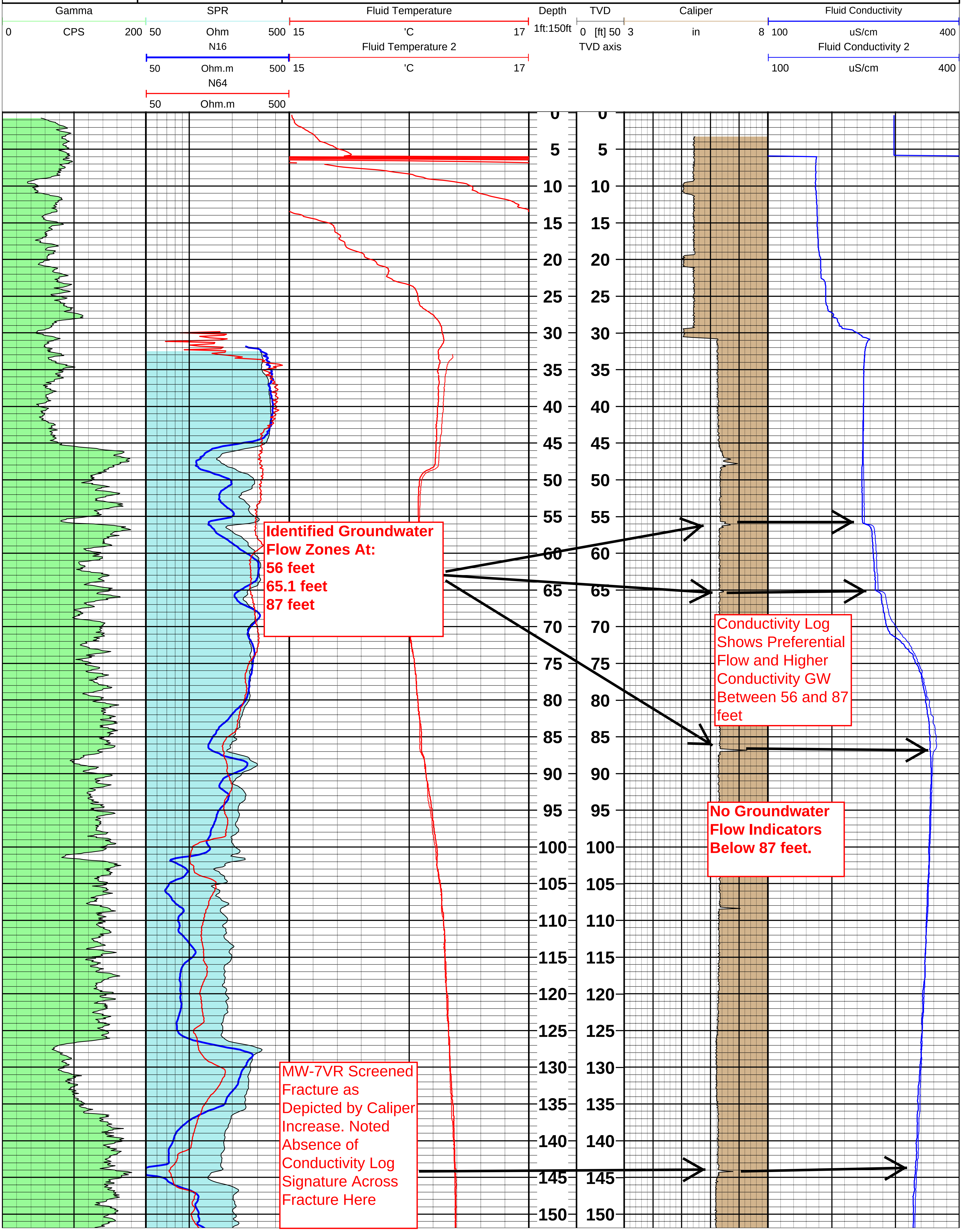
Date: 1-11-2019

Location: Parrish, Al	TOC Elev msl: na
Easting: na	Casing Stick-up: 2.42 ft ags
Northing: na	Casing Diameter: 5.4 in ID
Ground Elev msl: na	Casing Material: Steel
Borehole Dip: vertical	Water Level: 5.98 ft bgs
Borehole Az: na	Logged By: Abernathy
Borehole Size: 6" Sonic	Log Depth Ref: Ground
Drilled Depth: 210 ft	Log Date: 1-11-19
Drill Comp Date: 1-11-19	Image Plot(s) Ref: MN
Casing Depth: 30.9 ft bgs	Dip Referenced to Horizontal

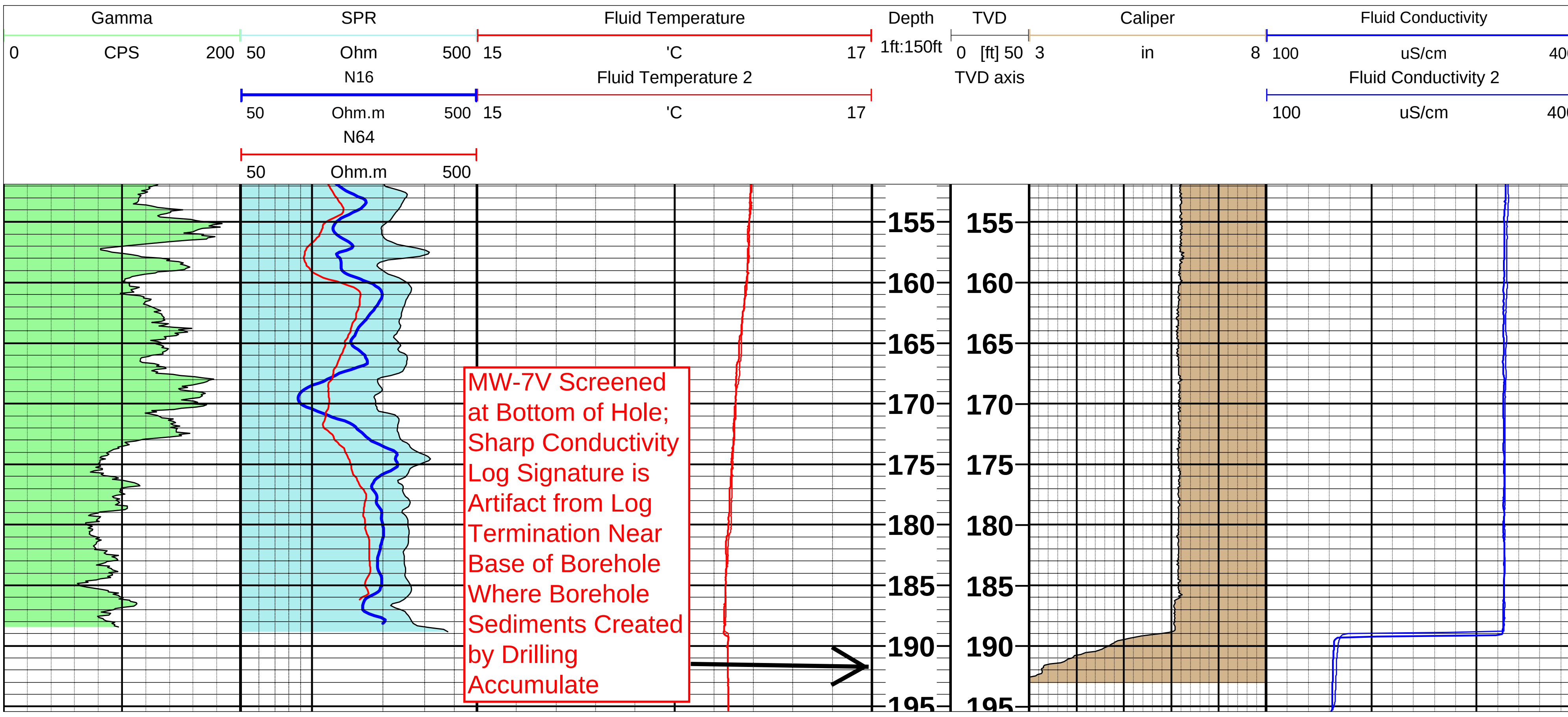
Notes: The FTC run was made under static conditions, the WL was 5.98 ft bgs at setup on the hole, the second FTC run was made under pumping conditions, pump at 30 ft TOC and pumping at 1 gpm, the WL was 8.8 ft at end of the run.

The deviation data was recorded with our OBI sn163404. Closure Distance = 3.1 ft, Closure Angle = 159.5 deg & Tilt at BOH = 1.2 deg

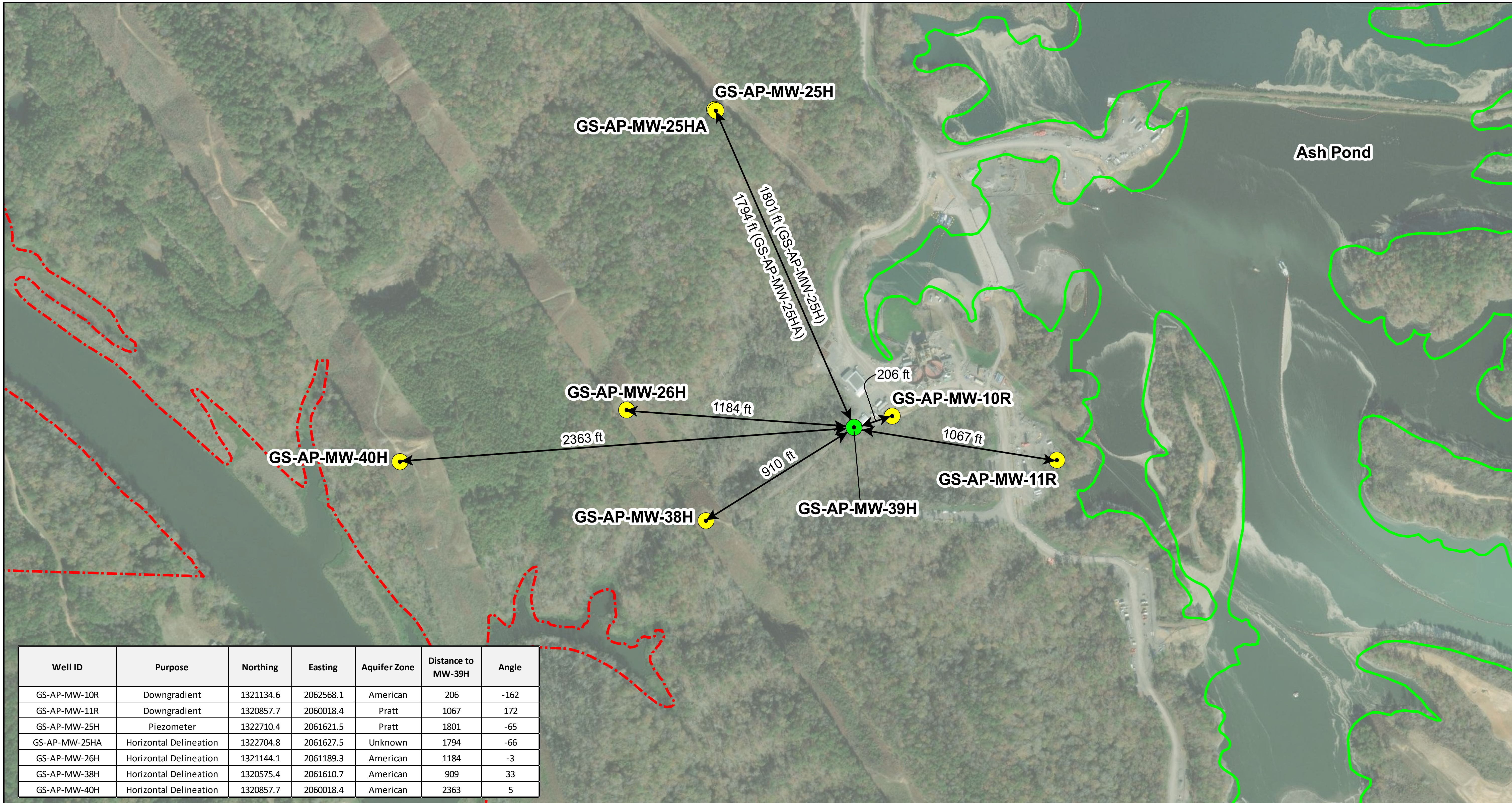
Tools used were Decatur's QL40 set:
FTC sn5518
Caliper sn5521
Gamma sn5499
SPR + Normal Res QL40 sn5512
Deviation OBI sn163404



1/11/2019 2:18:10 PM


Gamma
0 CPS 200
SPR
50 Ohm 500
N16
50 Ohm.m 500
N64
50 Ohm.m 500
Fluid Temperature
15 'C 17
Fluid Temperature 2
15 'C 17
Depth
1ft:150ft
TVD
0 [ft] 50
TVD axis
Caliper
3 in 8
Fluid Conductivity
100 uS/cm 400
Fluid Conductivity 2
100 uS/cm 400
155 160 165 170 175 180 185 190 195
155 160 165 170 175 180 185 190 195
MW-7V Screened at Bottom of Hole; Sharp Conductivity Log Signature is Artifact from Log Termination Near Base of Borehole Where Borehole Sediments Created by Drilling Accumulate

ENCLOSURE B



Well ID	Purpose	Northing	Easting	Aquifer Zone	Distance to MW-39H	Angle
GS-AP-MW-10R	Downgradient	1321134.6	2062568.1	American	206	-162
GS-AP-MW-11R	Downgradient	1320857.7	2060018.4	Pratt	1067	172
GS-AP-MW-25H	Piezometer	1322710.4	2061621.5	Pratt	1801	-65
GS-AP-MW-25HA	Horizontal Delineation	1322704.8	2061627.5	Unknown	1794	-66
GS-AP-MW-26H	Horizontal Delineation	1321144.1	2061189.3	American	1184	-3
GS-AP-MW-38H	Horizontal Delineation	1320575.4	2061610.7	American	909	33
GS-AP-MW-40H	Horizontal Delineation	1320857.7	2060018.4	American	2363	5

Legend
- GS-AP-MW-39H
- Surrounding Wells
- Ash Pond Boundary
- Property Boundary (Approximate)

N

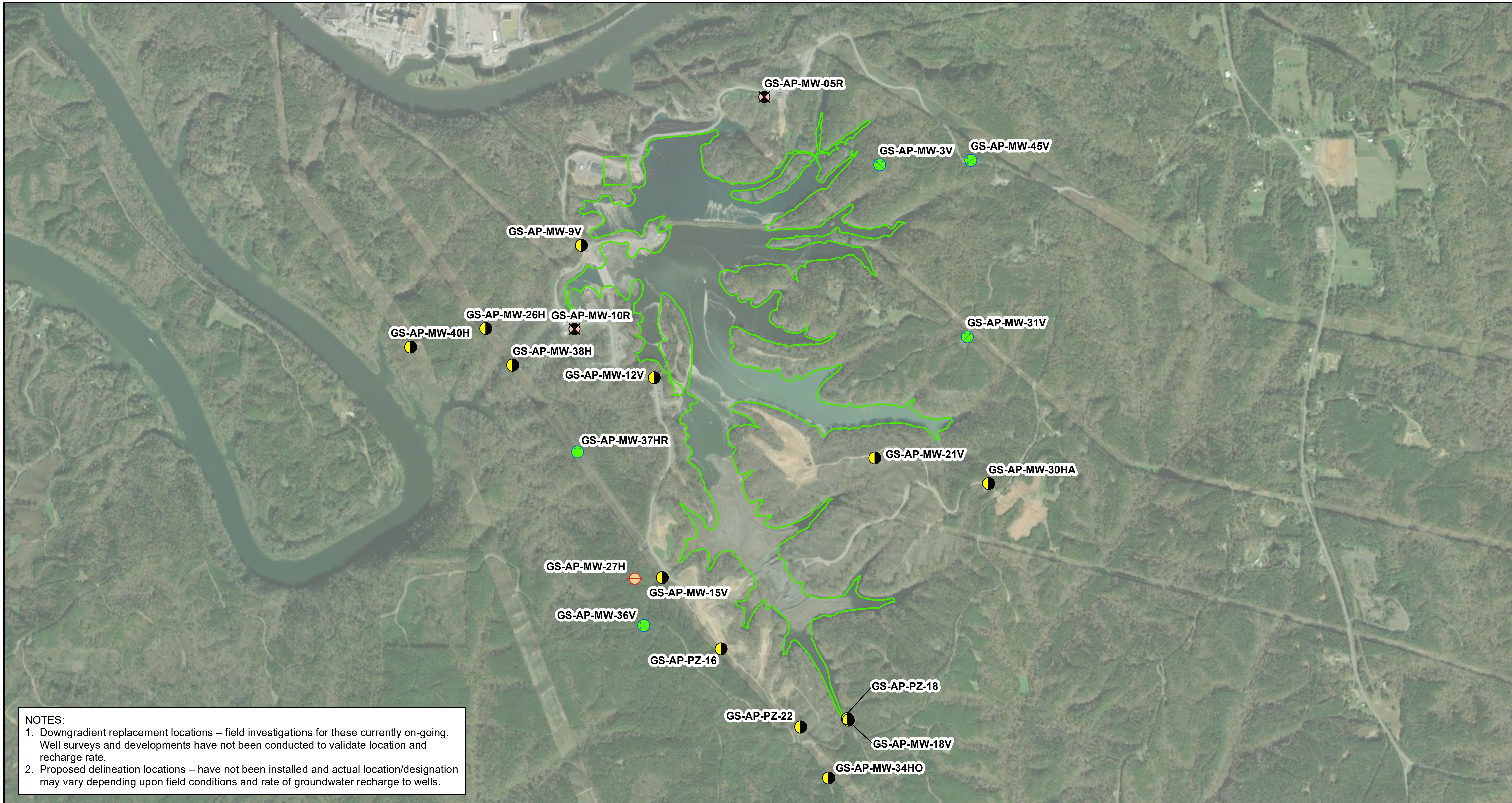
0 250 500 1,000 1,500 Feet

NOTES:
1. Angles are calculated in reference to counterclockwise from due west; i.e., negative angles are clockwise from due west, and positive angles are counterclockwise from due west.

SCALE	1:6000
DATE	8/5/2021
DRAWN BY	KAR
CHECKED BY	GBD
DRAWING TITLE	MONITORING WELL LOCATION MAP DISTANCE TO GS-AP-MW-39H PLANT GORGAS ASH POND
FIGURE NO	

Southern Company

ENCLOSURE C



NOTES:
1. Downgradient replacement locations – field investigations for these currently on-going. Well surveys and developments have not been conducted to validate location and recharge rate.
2. Proposed delineation locations – have not been installed and actual location/designation may vary depending upon field conditions and rate of groundwater recharge to wells.

Legend

- Proposed Delineation Well
- Downgradient Replacement Well
- Existing Delineation Well
- Existing Piezometer
- Ash Pond Boundary

SCALE 1:18000	DRAWING TITLE: AMERICAN FLOW SYSTEM MONITORING NETWORK PLANT GORGAS ASH POND
DATE 8/5/2021	
DRAWN BY KAR	FIGURE NO
CHECKED BY GBD	Southern Company

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

Dear Mr. Story:

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

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

General Comments:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Plant Gorgas Bottom Ash Landfill:

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

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

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

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

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

<u>Plant Gorgas CCR and Gypsum Landfill:</u>

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

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

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

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

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

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

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

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

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

Sincerely,

Dustin Brooks

Dustin G. Brooks
Environmental Affairs Supervisor

Cc: Eric Wallis – Southern Company Services

Attachment

Alabama Power

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August 24, 2020

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. lt is recommended that Section 2.2.2 of the SAP indicate that modifications to background will occur with Department approval.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Individual CCR Unit Comments

Plant Barry Ash Pond

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

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

Plant Barry Gypsum Pond

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

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

Plant Gadsden Ash Pond

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

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

Plant Miller Ash Pond

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

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

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

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

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

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

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

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

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

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

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

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

Sincerely,

Dustin Brooks

Dustin G. Brooks
Environmental Affairs Supervisor

cc: Eric Wallis – Southern Company Services

PLANT GORGAS ASH POND GROUNDWATER MONITORING PLAN

Revision 2: March 10, 2021

Revision 1: August 21, 2020
Submittal: April 20, 2020

PREPARED FOR:

Alabama Power

PREPARED BY:

Southern Company Services
Earth Sciences and Environmental Engineering

REVISED GROUNDWATER MONITORING PLAN

ALABAMA POWER COMPANY - PLANT GORGAS

This *Revised Groundwater Monitoring Plan, Alabama Power Company - Plant Gorgas 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:

_______________________________ 3/10/2021

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

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1. INTRODUCTION

The Gorgas 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 Gorgas 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. The GMP meets the requirements set forth for groundwater monitoring networks as described by ADEM Admin Code r. 335-13-15-.06(2). This 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.

Groundwater monitoring has occurred since 2016 and results reported to ADEM. Upon initiating detection groundwater monitoring at the site in 2017 statistically significant increases (SSIs) of Appendix II monitoring parameters were detected above background levels. Pursuant to State and Federal regulations assessment monitoring was implemented. During assessment monitoring, Appendix IV constituents were detected at statistically significant levels (SSLs) above groundwater protection standards (GWPS). Consequently, an Assessment of Corrective Measures (ACM) was prepared and submitted to ADEM in June 2019. 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 William C. Gorgas Electric Generating Plant (Plant Gorgas) is located in southeastern Walker County. The physical address is 460 Gorgas Road, Parrish, AL 35580. Plant Gorgas lies in portions of Sections 7, 8, 9, 16, 17, 18, 19, 20, 21, 28, and 29, Township 16 South, Range 6 West and Section 12, 13, and 24, Township 16 South, Range 7 West. Section/Township/Range data are based on visual inspection of USGS topographic quadrangle maps and GIS maps (USGS, 1975; USGS, 1983). The Ash Pond is located southeast of the main plant on the opposite side of the Black Warrior River. **Figure 1**, **Site Location Map**, depicts the location of the Plant and Ash Pond with respect to the surrounding area.

The Ash Pond was constructed in 1953 and is approximately 420 acres in size. **Figure 2, Site Plan Map**, depicts the general configuration of the coal combustion residuals (CCR) unit and the site monitoring well network. **Figure 3, Site Topographic Map**, depicts the topography of the site.

3. GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Plant Gorgas lies in the Warrior Basin physiographic region (Sapp and Emplaincourt, 1975), a late Paleozoic basin formed as a result of flexure and sediment loading associated with Appalachian and Ouachita orogenies. The bedrock geology is dominated by clastic sedimentary rocks of the Lower Pottsville Formation as shown on **Figure 4, Site Geologic Map** (GSA, 2010b). The lower Pottsville formation directly underlies Plant Gorgas and extends down to a depth of approximately 2,100 feet below ground surface. This formation is characterized by cyclic sequences (cyclothems) of marginal marine shale/claystone, siltstone, sandstone, conglomerates, and individual coal beds. These depositional cyclothems reflects the sediment balance controlled by 4th or 5th order glacial eustasy, continued basin evolution, and variations in sedimentation rates (Pashin and Raymond, 2004). Deeper stratigraphy is marked by carbonates, shales, chert, and sandstones of Mississippian to Cambrian in age (Raymond et al., 1988).

The Plant Gorgas Ash Pond is directly underlain by rocks belonging to the Pratt and Cobb Coal Groups (Ward II et al., 1989) of the Lower Pottsville Formation. In general, the Pratt Coal Group consists of mudstone, shale, fine-grained sandstone, and interbedded coal in fining-upward sequences. The Pratt Coal Group generally contains 3 named coal seams each separated by 10 to 30 feet of intraburden. In descending order, they are, the Pratt, Nickel Plate, and American coal seams. Locally, Pratt Coal Group strata gently dip (0.5° to 1.0°) to the south and south-southwest. **Figure 5A Geologic Cross-Section A-A’** and **Figure 5B Geologic Cross-Section B-B’**, illustrates the geologic layering beneath the site.

Geologic layering at the site displays high degrees of vertical and horizontal heterogeneity owing to complex fluvio-deltaic and marginal marine depositional environments. At the site, near surface stratigraphy has been divided into 3 stratigraphic units. The paragraphs below describe units from oldest to youngest, with Unit 1 being the lowest stratigraphic unit described.

Unit 1 corresponds to the Pratt Coal Group, a zone consisting of the Pratt, Nickel Plate, and American coal seams separated largely by sandstone intraburden with lesser amounts of claystone and mudstone. Pratt coals were deposited in a paludal, backswamp to interfluvial swamp depositional environment with intraburden sandstone corresponding to channel or flood deposition. The top of the Pratt Coal Group occurs at depths between 70 and 225 feet below ground surface or at elevations between 350 and 306 feet MSL. Beneath the site, the Pratt coal is generally 3 to 4-ft thick and overlies the Nickel Plate Seam, separated by a 10 to 12-ft sequence of claystone grading downward to sandstone. Locally, the Nickel Plate seam is not very prominent and is generally under 1.5 feet in thickness. The American seam generally resides between 15 and 25 feet beneath the Nickel Plate Seam and is separated primarily by a sandstone bed. The American seam generally thickens towards the south where it was underground mined (Maxine Mine).

Overlying Unit 1, is an 80 to 120-foot-thick sequence of shale and mudstone (Unit 2). Unit 2 reflects a 4th or 5th order glacio-eustatic transgressive flooding surface and exemplifies a blocky yet moderately serrate gamma log pattern. This indicates the presence of many discrete depositional events during which clay minerals were deposited in periods of quiescence and larger-grained silts and sands where deposited in slightly higher energy environments. At the site, the presence of Unit 2 represents a shift from the Pratt Coal Group to rocks of the Cobb Coal Group.

Overlying Unit 2, is a 40 to 50-ft sequence of alternating mudstone and sandstone grading horizontally to the north into more of a mudstone unit and vertically upward into a channel sandstone of unknown thickness (Unit 3). Locally, this sandstone unit generally forms the hills and ridges of the site. Coals of the Cobb Group were not encountered as they are stratigraphically higher than what is present at the site. A more detailed description of Site geology was submitted in a Site Hydrogeological Characterization Report submitted March 5th, 2021.

The Pottsville aquifer system is the primary aquifer in Walker County. Although on a regional scale there are other aquifer systems in the vicinity of Plant Gorgas, the Pottsville aquifer system is the most significant. The nearest exposure of the Valley and Ridge aquifer system occurs in central Jefferson County, approximately 25 miles east of Plant Gorgas. The nearest exposure of the Tuscaloosa aquifer system occurs in northwesternmost Walker County, approximately 30 miles northwest of Plant Gorgas. The Tuscaloosa aquifer system is not considered a primary source of groundwater in Walker County (Stricklin, 1989).

The Pottsville aquifer system is comprised primarily of Pennsylvanian-age sandstones, shales, conglomerates, and coal. Groundwater flow primarily occurs via coal seams or rock fabric discontinuities such as bedding planes and fractures. Groundwater in the Pottsville aquifer is commonly regarded as confined due to large permeability contrasts within the aquifer (Stricklin, 1989). Recharge to the Pottsville formation is largely through infiltration of precipitation and to a lesser extent, downward seepage of river water at hydraulically favored locations. Recharge is accommodated largely by fracture enhanced permeability. Major recharge zones to the Pottsville Formation are related to major geologic structures such as large fault zones or along systematic fold axes (Pashin, 2007). Although the Pottsville aquifer system is the primary aquifer in Walker County, groundwater use is relatively limited. According to O'Rear et al., 1972, groundwater use accounted for approximately 15% of total water use in Walker County in 1966. By 2005, groundwater use had declined to less than 1% of total water use in Walker County, or 1.14 million gallons per day (mgd) of groundwater out of a total water use of 969.5 mgd (USGS, 2005).

The Pottsville aquifer is the uppermost aquifer beneath the site. The first occurrence of groundwater yield sufficient for low-flow groundwater sampling generally occurs in the Pratt Coal Group and Pratt to Cobb Coal Group transition of the Lower Pottsville Formation at the site. Lithologic sequences of sandstone, mudstone, and shales in the Pottsville are generally well-cemented, tight units with low permeability and/or low porosity units and are poor transmitters of groundwater. The primary sources of groundwater in the uppermost aquifer are: (1) coal seams, (2) rock fractures or zones of fracture enhanced permeability, and to a lesser extent (3) bedding plains. Fractured intervals are sporadic across the site and tend to occur with greater density in the upper 100 to 150 feet of rock. Generally, groundwater yield at the site is considered low and typical of the Pottsville aquifer system. Wells were generally screened in the Pratt coal seam or across groundwater yielding discontinuities above the Pratt coal seam. Depth to groundwater producing zones were highly variable at the site and generally ranged from 30 to 240 feet BGS.

Caliper, natural gamma, normal resistivity, fluid temperature, fluid resistivity logs, and heat pulse flowmeter logs were utilized to determine groundwater yielding zones. Packer testing was utilized in select borings to further enhance characterization. Aquifer performance testing and heat-pulse flowmeter testing were conducted in borings and wells to assess hydrostratigraphy and groundwater flow characteristics. Heat-pulse flowmeter logging was conducted under “stressed” or injecting conditions in order to stimulate flow at many locations out of necessity, as most borehole intervals were producing less than 0.01 gpm under ambient conditions. The results of heat-pulse flowmeter testing combined with other hydrophysical logs demonstrate that the Pottsville Aquifer underlying the site, contains sparse intervals of groundwater yield and flow rates generally between 0.01 and 0.3 gallons per minute under “stressed” conditions. Well development logs confirm low flow rates, with rates typically stable between 0.07 and 0.4 gallons per minute. Slug testing in monitoring wells reveal that hydraulic conductivity values are generally in the vicinity of 10^{-4} cm/sec to 10^{-5} cm/sec with discrete large fractures capable of 10^{-3} cm/sec.

Based on published data, groundwater quality produced from the Pottsville Formation can be characterized by high concentrations of sulfate, iron, and other trace metals (Jennings and Cook, 2010). Trace metals in Pottsville Formation groundwater are associated with sulfide minerals contained in organic-rich strata (e.g., Mudstones and Coal Seams) and siliceous/carbonate healed fractures and joints. Trace element enrichment is likely the result of migrating hydrothermal fluids generated during the late Paleozoic Allegheny orogeny (Diehl et al., 2005). Arsenic, antimony, molybdenum, selenium, copper, thallium, and mercury are elevated in Warrior Basin coal strata (Goldhaber et al., 2002). **Figures 5A and 5B,** also illustrates key hydrogeologic concepts. Borehole geophysical logs, boring logs, and well construction data for each compliance and delineation well are presented in **Appendix A, Well Installation and Field Logs.**

Groundwater flow is accomplished primarily by means of fracture flow, where groundwater flows along more conductive secondary discontinuities in the rock mass. Fractures at the site are typically high-angle/near vertical (75° to 88°). Bedding planes at the site are near flat lying with dips ranging from 0° to 6° towards the south. Paired well locations and heat pulse flowmeter logging indicate that downward vertical flow is an important component of groundwater flow within the uppermost aquifer at the site. The complex lithostratigraphy, sharp permeability contrasts, and fractured nature of the Pottsville Formation contribute to vertical groundwater flow at the site.

At the site, the groundwater flow regime can be grouped into two general flow systems: (1) a water-table flow system and (2) Pratt Coal Group/deeper bedrock flow system. The water-table flow system shows flow towards the ash pond and other surface water bodies, whereas the Pratt flow system displays a radial flow pattern emanating from the Ash Pond. Recent potentiometric surface contour maps for the Site are presented in **Figure 6A, Potentiometric Surface Contour Map – (Upper) Water Table Aquifer (September 23, 2019) and Figure 6B, Potentiometric Surface Contour Map – (Deep) Pratt Aquifer (September 23, 2019).** The Site Hydrogeological Characterization Report submitted March 5, 2021 shows that the Pratt Coal Group/deeper bedrock flow system can be subdivided into separate, discrete flow systems and contains a separate potentiometric surface map for the American coal seam flow system.

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.

4.1 Compliance Monitoring Network

Groundwater monitoring wells comprising the compliance monitoring network are installed to monitor the uppermost occurrence of groundwater beneath the Site and accurately represent the quality of groundwater passing the waste boundary of the CCR unit. Locations were selected based on facility layout and Site geologic and hydrogeologic considerations. The groundwater monitoring network at Plant Gorgas Ash Pond is subdivided into upgradient background and compliance locations based upon potentiometric contours and interpretation of groundwater flow direction 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 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 the unit. Compliance wells are screened within the uppermost aquifer and are used to assess potential impacts to the first "aquifer" in the event of a release. Groundwater monitoring wells are designed and constructed using "Design and Installation of Groundwater Monitoring Wells in Aquifers", ASTM Subcommittee D18.21 on Groundwater Monitoring, as a guide. **Table 1, Groundwater Monitoring Well Network Details,** and **Figure 7, Groundwater Monitoring Network**, present the designed purpose and locations of monitoring wells with respect to the facility. Monitoring wells are generally installed in Pratt Coal Group strata. Additionally, a table and figure detailing planned and proposed changes to the monitoring well network due to ash pond closure activities and further evaluation of low-yielding wells are presented in **Amendment 1, Monitor Well and Piezometer Abandonments, Replacements, and Modifications Details.**

As shown on **Table 1** and **Figure 7**, there are currently 10 water-level only piezometers on-site. Three other historic piezometers installed across the Maxine Mine were recently converted to vertical delineation wells (GS-AP-PZ-16, GS-AP-PZ-18, GS-AP-PZ-22). Two water-level only piezometers were recently abandoned. These were necessitated for Ash Pond Closure activities (GS-AP-MW-10) and the second due to damage from heavy equipment (GS-AP-MW-5). A plan for replacement well locations and designations is being drafted and is anticipated to be submitted to ADEM for review during the first quarter of 2021. Preliminary proposed details and locations are presented in **Amendment 1**.

Most in-network piezometers were originally intended to be monitoring wells but did not yield sufficient groundwater recharge rates for development or low-flow sampling. Recharge rates at these locations were re-evaluated in the summer and fall of 2020. The study suggested piezometer locations GS-AP-MW-3, GS-AP-MW-16S, and GS-AP-MW-41HS had sufficient recharge rates relative to well depth for low-flow sampling. **Table 1** and **Figure 7** have been updated to include these redesignations.

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.

As presented on **Table 1** and **Figure 7**, wells GS-AP-MW-8, GS-AP-MW-13, and GS-AP-MW-17V, located upgradient of the Ash Pond serve as background monitoring wells. Location, GS-AP-MW-13, was abandoned in 2019 because it was a physical obstruction to Ash Pond closure activities. 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. This plan includes GS-AP-MW-13 as an upgradient well for this reason. A plan for replacement well locations and designations is being drafted and is anticipated to be submitted to ADEM for review during the first quarter of 2021. Preliminary proposed details and locations are presented in **Amendment 1**.

The following provides further detail regarding background well selection.

4.2.1 **Groundwater Elevations and Flow**

The Pottsville at the Site is best described as a series of discrete, confined to semi-confined groundwater yielding zones where groundwater elevations can vary significantly laterally and vertically and are governed by the heterogeneity of the lithology and degree of fracture network interconnectivity. Vertical groundwater flow is often the most dominant flow component in fractured rock settings and especially so where significant lateral permeability contrasts may retard horizontal flow as does occur in the Pottsville Aquifer.

These concepts are manifested at the Site in the form of two prominent flow systems separated vertically by low permeability mudstones, shales, and sandstones. At the Site, the groundwater flow regime can be grouped into two general flow systems: (1) a water-table flow system and (2) Pratt Coal Group/deeper bedrock flow system.

The area water table flow system is higher than the pond along most of the eastern, southern, and southwestern pond boundaries, as well as a portion of the northwestern boundary. This higher water table groundwater likely flows downward and/or along the ash pond axis through ash material to discharge at lower bedrock intervals. Thus, at higher stratigraphic intervals comprising the water-table flow system, groundwater flows towards the Ash Pond or other surface water bodies and cannot be impacted by leakage from the Ash Pond. This flow system is driven by gravity and approximately mimics the topography of the Site. Within deeper rock strata such as coals of the Pratt Group (Pratt Coal Group or deep bedrock flow system), groundwater flows radially away from the Site.

Groundwater in the upper water table aquifer flows towards the Ash Pond, through the base ash material, and then forced radially outward along coal seams of the Pratt Group (which intersect the base of the ash pond) or along fractures and bedding planes (preferential pathways) by the head condition of the ash pond. From there groundwater generally flows towards surface water bodies or the Maxine Mine (American Seam, Pratt Coal Group) to the south and southeast. Recent potentiometric surface contour maps conveying these groundwater flow elements are presented in **Figure 6A** and **Figure 6B**. These potentiometric surface contour maps demonstrate GS-AP-MW-8, GS-AP-MW-13, and GS-AP-MW-17V are hydraulically upgradient of the Ash Pond as groundwater elevations range from 5 ft to nearly 40 feet higher than the Ash Pond elevation which has free surface elevation of approximately 382.5 ft MSL. Newly proposed upgradient well, GS-AP-MW-17V, is screened nearly 20 feet above the top of the ash pond and displays water levels 30 to 40 feet above the pond surface elevation. Monitoring wells displaying consistently higher groundwater elevations than the Ash Pond cannot be downgradient. Geologic cross-section B-B' presented on **Figure 5B** illustrates these concepts and shows the relationship between the water-table flow system, Ash Pond, and deeper Pratt flow system.

The elements described above provide an explanation for why upgradient locations (GS-AP-MW-8, GS-AP-MW-13, and GS-AP-MW-17V) can be located adjacent to downgradient well locations as shown on **Figure 7**. It is because vertical flow is the dominant mechanism for movement through these flow systems and that is a function of the Pottsville operating as a series of discrete, confined to semi-confined groundwater yielding zones. Upgradient well locations monitor younger, recharging waters that will eventually migrate vertically downward into groundwater yielding zones of the Pratt Coal Group. This concept will be further illustrated by a discussion of Appendix III and IV indicator parameters and field data below**.**

As described in the 2020 Annual Groundwater Monitoring and Corrective Action Report, location GS-AP-MW-16S, previously designated as piezometer is now being evaluated as an additional upgradient location for the Plant Gorgas Ash Pond. Historically, groundwater elevations observed from GS-AP-MW-16S range from 403 to 405 ft MSL which is greater than 20 feet above the ash pond surface elevation. For this reason, **Table 1** lists GS-AP-MW-16S as a piezometer/proposed upgradient location. After completion of four to five sampling events (estimated Fall 2021), groundwater geochemistry data will be evaluated, and a recommendation will be made regarding monitoring designation (estimated 2021 Annual Report). If a re-designation to upgradient is recommended, the process described in **Section 4.5** will be followed.

4.2.2 **Groundwater Geochemistry**

A comparison of the concentrations of key Appendix III and Appendix IV indicator parameters is useful in determining if a well is impacted by the CCR unit. Pore-water concentrations, coal source data, and leachate data, when available, can identify these key indicator parameters and these themselves can be a useful point of comparison. For this discussion, monitoring data from upgradient locations and downgradient were evaluated by comparing: (1) field measured indicator parameters recorded during sampling, (2) geochemical signature, and (3) boron isotope data.

Concentrations of key CCR indicator parameters such as boron, sulfate, arsenic, and lithium are lower in these well locations than observed in downgradient wells suspected of being impacted by the CCR Unit and significantly lower than Ash Pond pore water concentrations. The results from these comparisons demonstrate that locations GS-AP-MW-8, GS-AP-MW-13, and GS-AP-MW-17V are not impacted by the CCR unit. The results are presented in **Table 2, Upgradient Comparisons – Key Indicator Parameters**. The low concentrations of indicator parameters coupled with the hydraulic upgradient orientation further demonstrate that these wells have not been affected by the Ash Pond.

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-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 GS-AP-MW-8, GS-AP-MW-13, and GS-AP-MW-17V generally do show lower pH, higher DO, and positive ORP values when compared to Ash Pond pore water samples and downgradient wells suspected of being impacted by the CCR Unit. This comparison provides more assurance that these are upgradient of the Ash Pond.

Boron Isotopic Analyses

Boron isotopic composition has been demonstrated to fingerprint CCR sources in groundwater (e.g., Bassett and Davidson, 1997, Nigro et al., 2016, Ruhl et al., 2014, Williams and Hervig, 2014). For example, Ruhl et al., (2014) and Williams and Hervig (2004) have showed that the fractionation ratio of ^{10}B and ^{11}B, reported as $\delta^{11}B$, can be used to help identify the source of boron in water. Migration of CCR constituents from CCR facilities into groundwater flow affects the $^{11}B/^{10}B$ ratios with a depleted or negative ^{11}B signature between -70‰ and 6‰, indicating a potential CCR source; whereas meteoric waters (precipitation-derived water) typically have a positive $\delta^{11}B$ signature between 10‰ and 40‰. Ruhl et al., (2014) have shown that Appalachian coals typically have $\delta^{11}B$ between -14‰ and -18‰.

CCR impact to groundwater typically results in a $^{11}B/^{10}B$ ratio with a depleted or negative ^{11}B signature between -70‰ and 6‰. Boron isotopic data from wells GS-AP-MW-8 and GS-AP-MW-13 show positive ^{11}B ratio of 13.7‰ and 15.6‰, respectively. Downgradient wells suspected to be impacted by the Ash Pond (GS-AP-MW-6D, GS-AP-MW-7, GSD-AP-MW-18) all displayed a negative ^{11}B ratio between -0.8‰ and -12.8‰ The positive boron isotopic ratios strongly suggest that groundwater in wells GS-AP-MW-8 and GS-AP-MW-13 are not impacted by migration of CCR leachate to groundwater. Rather, the ratios reflect natural groundwater recharge. Boron isotopic results are provided in **Appendix B, Boron Isotope Data**.

Based on review of the above information, the wells identified for use as background groundwater monitoring points satisfy the requisite criteria: the wells are located hydraulically upgradient of the ash pond and do not show evidence of having been impacted by a release from the ash pond. The wells are screened across Pottsville intervals that discharge groundwater to the ash pond as well as deeper intervals in which downgradient compliance wells are screened and thus represent background groundwater quality at the Site.

4.2.3 **Statistical Screening**

Details regarding screening of the background is presented in **Appendix C, 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.

A considerable amount of research, desktop study, and advanced geophysical methods were employed to ensure that wells were located properly and screened across the appropriate intervals to identify impacts to groundwater. To appropriately select downgradient well locations, the following was conducted:

- A thorough review of background literature was conducted to build a proper foundation for understanding the complex geologic setting and hydrogeological conditions in Pottsville Formation flow systems.
- A coal mining consultant was contracted to synthesize and supply additional geologic information not available through web research, including geologic stratigraphy within a 1-mile radius of the plant, identification of coal seams in the area, dip of geologic strata, locations and displacement of geologic faults located by historic mining operations, and hydrogeologic data from mine permitted monitoring wells.
- A desktop study was performed to identify potential regional joint sets and localized lineaments that could lead to preferential groundwater flow concentrated on these fractures.
- A fracture fabric analysis, and geologic field mapping study were conducted to further support understanding of geologic structures at the Site.
- A preliminary geologic cross-section was constructed to identify strata that intersects the pond, including coal seams, which are generally the most permeable strata in the Pottsville Formation due to the structural weakness and resulting cleat systems (joints).
- Borehole geophysics were utilized in open wellbores to determine stratigraphy, fracture density, groundwater yielding intervals, flow characteristics of groundwater yielding zones, and to identify potential geophysical signatures of elevated TDS intervals within the wellbore prior to the selection of well screen intervals.

The results of these studies revealed that coal seams of the Pratt Coal group would intersect the base of the Ash Pond near the geographic center of the ash pond and gently dip (0.5° to 3°) beneath the base of the Ash Pond to the south. Studies also revealed the presence of a concealed normal fault that intersects the southern and south-central portion of the pond trending north-northwest and roughly paralleling the western boundary of the ash pond. Additionally, the fracture fabric analysis revealed two dominant joint sets: a strike joint with a vertical dip of 90° trending northwest-southeast (152°) and dip joint with a vertical dip of 89° and an average trend to the northeast-southwest (238°). Lastly, the studies revealed the presence of an underground coal mine, the Maxine Mine (American Coal Seam), to the south of the pond to the east of the southern tip of the pond. Interpreted fault locations are presented on figures contained in the Site Hydrogeological Characterization Report submitted March 5th, 2021.

In terms of designing the downgradient compliance network, (A) wells on the western side of the Ash Pond targeted the concealed fault and areas adjacent to the fault as fault zones can create a preferential pathway for groundwater migration due to increased fracture density and (B) wells located along the central and southern boundaries of the ash pond targeted coal seams of the Pratt Coal Group (namely Pratt and American Seams) due to the fact that these seams intersect the pond and also, because they represent primary preferential pathways for groundwater flow. In areas to the north of the Ash Pond, where no significant geologic features were noted and, where the Pratt Coal Group exists only above land surface, borehole geophysical methods were utilized to screen groundwater yielding intervals at appropriate elevations beneath the base of the ash pond elevation.

Criteria for setting wells were heavily determined by borehole geophysics and hydrophysical logging. A logging suite consisting of caliper logs, gamma logs, resistivity logs, fluid temperature logs, fluid conductivity logs, and heat-pulse flowmeter logging was utilized in nearly every borehole to determine the well screen interval. Optical or acoustic televiewer logging was also conducted at a few locations. The science and process for employing these methods are described in detail below.

Caliper logging provides a continuous log of borehole diameter. This provides a complete record of fractures or weak zones that intersect the borehole as these zones typically lead to discrete increases in borehole diameter. Coal seams bored typically produce the largest increases in borehole diameter. Gamma and resistivity logs provide a continuous representation of stratigraphy and clues to zones that may be more permeable. Gamma logs, in particular, are invaluable at complex fractured rock Sites as key marker beds can be readily identified and often be correlated Site-wide for a more accurate depiction of stratigraphy and lateral heterogeneity in stratigraphy.

Fluid resistivity and fluid temperatures logs are utilized to determine potential groundwater yielding zones within the borehole. Deviations in fluid temperature and fluid resistivity most often represent groundwater flow into or out of the borehole. Fluid resistivity logs also show which zones within the saturated borehole are most conductive (higher TDS) and thus, can provide indications of preferential flow with the thought that these more conductive zones may be related to an impact from the facility.

All logs described above were reviewed in conjunction to determine a list of potential groundwater yielding intervals for heat-pulse flowmeter logging. Heat-pulse flowmeter logging is specifically designed for low-yielding fractured rock strata such as present beneath the Plant Gorgas Ash Pond. It was conducted at discrete intervals (identified by the other geophysical logs) as well as above and below to determine the flow rate and vertical direction of flow (up/down). Occasionally, if uncertainty remained after a review of all logs and data as to where to screen the well, the aquifer would be stressed via pumping and the suite of fluid resistivity, fluid temperature, and heat-pulse flowmeter logging would be re-run to determine the dominant interval in which groundwater was being pumped from.

Upon receipt of geophysical data, the geologist would determine the most appropriate zone for well screen placement. Most often that was the Pratt or American coal seam. If a second groundwater yielding zone was identified above the Pratt or American coal seam, a second well was often set so that the primary flow zones and potential preferential pathways were captured in the downgradient well network.

Even after utilizing the most sophisticated tools for determining screened intervals, only ~60% of these wells produced sufficient flow rates for well development. This largely because locally, fracture density and permeability of these rock units is considered low. Historically, mining at and beneath the Site may have also served to underdrain the formation leading to less groundwater availability.

Monitoring well locations GS-AP-MW-2, GS-AP-MW-5, GS-AP-MW-6S, GS-AP-MW-6D, GS-AP-MW-7, GS-AP-MW-9, GS-AP-MW-10, GS-AP-MW-11, GS-AP-MW-12, GS-AP-MW-14, GS-AP-MW-15, GS-AP-MW-16D, GS-AP-MW-17, GS-AP-MW-18, GS-AP-MW-19, and GS-AP-MW-21 have been designated as downgradient locations. Downgradient locations GS-AP-MW-9, GS-AP-MW-11, and GS-AP-MW-14 were abandoned in 2019 due to Ash Pond closure activities. A plan for replacement well locations and designations is being drafted and is anticipated to be submitted to ADEM for review during the first quarter of 2021. Preliminary proposed details and locations are presented in **Amendment 1**.

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(s) will be sampled for Appendix III and IV constituents as part of the assessment groundwater monitoring program until the Department approves a change to the monitoring program.

Delineation wells, when installed, will be sampled initially after development, and following this initial sampling event, sampling of delineation wells will be transitioned to the semi-annual compliance sampling event schedule. 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.

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.

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

5. MONITORING WELL DRILLING, CONSTRUCTION, ABANDONMENT & REPORTING

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

5.1 Drilling

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

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

5.2 Design and Construction

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

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

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

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

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

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

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

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

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

5.3 Wells with Inconsistent Water Levels

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

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

The following summarizes the procedure that will be followed:

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

5.4 WELL DEVELOPMENT

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

5.5 ABANDONMENT

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

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

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

5.6 DOCUMENTATION

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

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 D**. 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 to avoid agitation of the water column. Sampling equipment and pump intakes must not extend below the midpoint of any well screen unless the well is known to drawdown and is a threat to go dry even with low flow rates or the water level in the well does not extend above the screened interval.

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

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

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

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

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

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

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

6.2 SAMPLE PRESERVATION AND SHIPMENT

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

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

6.3 ANALYTICAL METHODS

As shown on **Table 3, Analytical Methods 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 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.

DETECTION MONITORING

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

ASSESSMENT MONITORING

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

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

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

6.6 QUALITY ASSURANCE AND QUALITY CONTROL

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

FIELD EQUIPMENT RINSATE BLANKS

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

FIELD DUPLICATES

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

FIELD BLANKS

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

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

7. REPORTING RESULTS

The following subsections outline reportable results and delivery.

7.1 14-Day Notification

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

7.2 Semi-Annual Groundwater Monitoring Reports

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

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

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

11. If applicable, assessment monitoring results.

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

13. Laboratory Reports and COC documentation.

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

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

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

17. Statistical analyses.

18. Certification by a qualified groundwater scientist.

8. STATISTICAL ANALYSIS

Groundwater quality data from each sampling event will be statistically evaluated to determine if there has been a statistically significant change in groundwater chemistry. Historical background data will be used to determine statistical limits. According to ADEM Admin Code r. 335-13-15-.06(4)(f), which incorporates the statistical analysis requirements of 40 CFR 257.93, the Site must specify in the operating record the statistical methods to be used in evaluating groundwater monitoring data for each 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 C,** 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 C**, Interwell prediction limits, combined with a 1-of-2 verification strategy, are used to evaluate Appendix III parameters. 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.

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

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

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

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

8.2.1 Delineation Wells

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

9. REFERENCES

Alabama Department of Environmental Management (ADEM), 2012, Solid Waste Program, Division 13, ADEM Admin. Code r. 335-13-4

ASTM Standard D5092, 2004(2010)e1, Standard Practice for Design and Installation of Groundwater Monitoring Wells, ASTM International, West Conshohocken, PA, DOI 10.1520/D5092-04R10E01, www.astm.org

Davidson, G.R. and Bassett, R.L., 1993, Application of Boron Isotopes for Identifying Contaminants such as Fly Ash Leachate in Groundwater, Eviron. Sci. Technol., v. 27, p. 172-176

Diehl, S.F., Goldhaber, M.B., and Hatch, J.R., 2004, Modes of occurrence of mercury and other trace-elements in coals from the warrior field, Black Warrior Basin, Northwestern Alabama, International Journal of Coal Geology, v. 59, p. 193-208

Geological Survey of Alabama (GSA), 2010b, Digital Geologic Map of Alabama, URL: http://www.gsa.state.al.us/index.html, accessed November, 2010.

Goldhaber, M.B., Lee, R.C., Hatch, J.R., Pashin, J.C., and Treworgy, J., 2000, Distribution of a suite of elements including arsenic and mercury in Alabama coal, U.S. Geological Survey Miscellaneous Field Study Map MF-223

Goldhaber, M.B., Lee, R.C., Hatch, J.R., Pashin, J.C., and Treworgy, J., 2002, The role of large-scale fluid flow in subsurface arsenic enrichment, In: Welch, A., Stollenwerk, K (Eds.), Arsenic in Ground Water: Occurrence and Geochemistry, v. 5, p. 127-176

Nigro, A., Sappa, G., and Barbieri, M, 2016, Application of boron and tritium isotopes for tracing landfill contamination in groundwater, Journal of Geochemical Exploration, v. 172, p. 101-108

Ruhl, L.S., Dwyer, G.S., Heileen, H-K.,, Hower, J.C., and Vengosh, A., 2014, Boron and Strontium Isotopic Characterization of Coal Combusion Residuals: Validation of New Environmental Tracers, Envrion. Sci. Technol., v. 48, p. 14790-14798

Sapp, C.D., and Emplaincourt, J., 1975, Physiographic regions of Alabama, Special Map 168, Geological Survey of Alabama

Southern Company Services (SCS), 2015, Plant Gorgas CCB Landfills Site Hydrogeological Characterization Report

Stricklin, V.E., 1989, Geohydrology and Susceptibility of Major Aquifers to Surface Contamination in Alabama: Area 3, U.S. Geological Survey, Water-Resources Investigations Report 88-4120

U.S. Environmental Protection Agency (EPA), 2004, Evaluation of Sampling and Field-Filtration Methods for the Analysis of Trace Metals In Groundwater Project Summary, EPA/600/SR-94/119

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.

Ward II, W.E., Barnett, R.L., Rheams, L.J., 1989, Coal Resources of Walker County, Alabama, Geological Survey of Alabama, Special Map 205

Geological Survey of Alabama (GSA), 2010b, Digital Geologic Map of Alabama, URL: http://www.gsa.state.al.us/index.html, accessed November, 2010.

Tables

Table 1.
Groundwater Monitoring Well Network Details

Well Name	Purpose	Installation Completion Date	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation (ft MSL)	Bottom of Screen Elevation (ft MSL)	Screen Length	Pottsville Flow System Designation
GS-AP-MW-1	Piezometer	2/24/2016	1320292.58	2066945.10	487.30	490.68	148.38	362.30	342.30	20	Pratt Strata
GS-AP-MW-2	Downgradient	3/10/2016	1321951.86	2067629.25	518.77	522.03	214.22	327.81	307.81	20	Pratt Strata
GS-AP-MW-3	Downgradient	3/4/2016	1323690.18	2067314.13	508.77	512.29	180.52	341.77	331.77	10	Pratt Strata
GS-AP-MW-4	Piezometer	3/7/2016	1324779.03	2067957.03	504.61	507.90	163.29	354.61	344.61	10	Pratt Strata
GS-AP-MW-5	ABANDONED	4/2/2016	1324811.04	2065409.73	483.80	487.17	149.37	347.80	337.80	10	Pratt Strata
GS-AP-MW-6S	Downgradient	1/19/2016	1324533.13	2063864.63	271.57	274.67	46.55	238.12	228.12	10	Upper Water Table
GS-AP-MW-6D	Downgradient	1/18/2016	1324547.48	2063881.96	271.39	274.50	64.48	220.02	210.02	10	Upper Water Table
GS-AP-MW-7	Downgradient	1/26/2016	1324250.98	2063518.48	310.05	313.45	100.49	222.96	212.96	10	Gillespy Transition
GS-AP-MW-8	Upgradient	2/26/2016	1323405.23	2062398.47	431.63	434.61	64.59	390.02	370.02	20	Upper Water Table
GS-AP-MW-9	ABANDONED	4/22/2016	1322446.73	2062720.10	417.06	420.04	111.38	328.66	308.66	20	Pratt Strata
GS-AP-MW-10	ABANDONED	1/21/2016	1321310.86	2062441.08	464.94	468.41	144.87	343.54	323.54	20	Pratt Strata
GS-AP-MW-11	ABANDONED	2/4/2016	1320953.14	2063257.73	465.34	468.34	139.90	348.44	328.44	20	Pratt Strata
GS-AP-MW-12	Downgradient	4/20/2016	1320369.19	2063836.90	447.48	450.67	153.98	306.69	296.69	10	Pratt Strata
GS-AP-MW-13	ABANDONED	2/4/2016	1319377.84	2064083.37	461.03	464.20	113.57	370.63	350.63	20	Upper Water Table
GS-AP-MW-14	ABANDONED	1/30/2016	1318393.75	2063787.88	469.60	472.40	203.20	279.20	269.20	10	Pratt Strata
GS-AP-MW-15	Downgradient	2/8/2016	1317267.07	2063959.21	452.21	454.89	200.08	264.81	254.81	10	Pratt Strata
GS-AP-PZ-16 [7]	Vertical Delineation	3/16/2016	1316157.31	2064852.10	458.83	462.29	252.66	219.63	209.63	10	American Strata
GS-AP-MW-16S [3]	Piezo/Proposed Upgradient	4/18/2016	1316149.55	2064844.29	459.04	462.42	133.38	349.04	329.04	20	Upper Water Table
GS-AP-MW-16D	Downgradient	4/20/2016	1316152.70	2064850.23	459.09	462.27	224.23	258.04	238.04	20	Pratt Strata - Nickel Plate
GS-AP-MW-17	Downgradient	2/11/2016	1314955.86	2066094.14	528.78	531.88	248.85	293.03	283.03	10	Pratt Strata
GS-AP-PZ-18 [7]	Vertical Delineation	2/25/2016	1315069.22	2066821.51	399.77	402.38	183.79	228.59	218.59	10	American Strata
GS-AP-MW-18	Downgradient	3/29/2016	1315052.82	2066824.84	400.17	403.39	98.68	324.71	304.71	20	Pratt Strata
GS-AP-MW-19	Downgradient	4/29/2016	1316325.43	2066775.98	492.60	495.58	179.19	336.39	316.39	20	Pratt Strata
GS-AP-MW-21	Downgradient	2/20/2016	1319122.82	2067233.10	506.51	509.48	236.45	283.03	273.03	10	Pratt Strata
GS-AP-MW-7V [3,5]	Piezometer	1/18/2019	1324251.90	2063504.32	309.46	312.14	202.68	119.46	109.46	10	Gillespy - Curry
GS-AP-MW-12V [6]	Vertical Delineation	1/9/2019	1320383.14	2063813.29	446.54	449.74	179.10	312.22	302.22	10	American Strata
GS-AP-MW-17V	Proposed Upgradient	1/20/2019	1314967.05	2066096.42	528.57	531.45	151.40	400.05	380.05	20	Upper Water Table
GS-AP-MW-18V	Vertical Delineation	1/30/2019	1315045.44	2066833.22	401.81	404.61	137.71	276.90	266.90	10	American Strata
GS-AP-MW-20	Piezometer	2/1/2019	1318122.87	2068319.23	525.18	528.15	249.97	288.18	278.18	10	Pratt Strata
GS-AP-PZ-22 [7]	Vertical Delineation	4/11/2016	1314941.40	2066094.05	529.31	532.38	328.07	214.31	204.31	10	American Strata
GS-AP-MW-23H	Horizontal Delineation	1/4/2019	1324901.11	2063751.19	301.9	304.98	42.50	272.48	262.48	10	Gillespy Transition
GS-AP-MW-24H	Horizontal Delineation	1/3/2019	1325034.25	2062579.09	258.38	261.35	62.80	208.55	198.55	10	Upper Water Table
GS-AP-MW-25H [3,5]	Piezometer	1/2/2019	1322710.44	2061621.52	458.66	461.79	168.13	303.66	293.66	10	Pratt Strata
GS-AP-MW-26H	Horizontal Delineation	1/22/2019	1321144.11	2061189.28	391.68	394.68	193.60	211.08	201.08	10	American Strata

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. Piezometers are utilized for water level readings only; current piezometer MW-16S is being evaluated for potential as a site upgradient well
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'.
5. Delineation wells GS-AP-MW-7V, GS-AP-MW-7VR, GS-AP-MW-25H, GS-AP-MW-27H, GS-AP-MW-30H, and GS-AP-MW-30HS will be utilized for water level data only in future events.
6. Survey for MW-12V is incorrect and will be updated upon re-survey
7. Maxine Mine screened piezometer converted to vertical delineation location

Table 1.
Groundwater Monitoring Well Network Details

Well Name	Purpose	Installation Completion Date	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation (ft MSL)	Bottom of Screen Elevation (ft MSL)	Screen Length	Pottsville Flow System Designation
GS-AP-MW-27H [3,5]	Piezometer	2/12/2019	1317251.09	2063507.76	532.08	535.03	244.95	300.08	290.08	10	American Strata
GS-AP-MW-28H	Horizontal Delineation	2/26/2019	1314721.29	2066153.32	513.84	513.82	229.70	294.12	284.12	10	Pratt Strata
GS-AP-MW-29H	Horizontal Delineation	2/5/2019	1314844.80	2066948.77	440.71	440.95	130.64	320.31	310.31	10	Pratt Strata
GS-AP-MW-30H [3,5]	Piezometer	1/8/2019	1318714.64	2069028.11	579.62	582.49	295.87	296.62	286.62	10	Pratt Strata
GS-AP-MW-30HS [3,5]	Piezometer	1/10/2019	1318721.10	2069023.99	579.84	582.53	47.19	545.34	535.34	10	Upper Water Table
GS-AP-MW-9V	Vertical Delineation	11/6/2019	1322441.98	2062677.69	418.25	420.86	138.05	292.81	282.81	10	American Strata
GS-AP-MW-15V	Vertical Delineation	10/28/2019	1317266.29	2063940.18	452.91	455.89	235.38	230.51	220.51	10	American Strata
GS-AP-MW-21V	Vertical Delineation	9/26/2019	1319131.76	2067250.33	507.59	509.84	248.95	270.89	260.89	10	American Strata
GS-AP-MW-25HA	Horizontal Delineation	11/7/2019	1322704.82	2061627.52	458.98	462.27	342.90	129.37	119.37	10	Gillespy - Curry
GS-AP-MW-30HA	Horizontal Delineation	10/23/2019	1318730.12	2069017.20	579.99	582.40	337.95	254.45	244.45	10	American Strata
GS-AP-MW-31H	Horizontal Delineation	10/11/2019	1321029.58	2068711.01	584.48	587.39	287.58	309.81	299.81	10	Pratt Strata
GS-AP-MW-32H	Horizontal Delineation	10/12/2019	1316042.76	2068381.85	547.43	550.03	304.05	265.98	245.98	20	Pratt Strata
GS-AP-MW-33HO[9]	Horizontal Delineation	11/7/2019	1314683.64	2068050.79	524.08	526.79	282.91	263.88	243.88	20	Pratt Strata
GS-AP-MW-34HO[9]	Horizontal Delineation	11/9/2019	1314144.24	2066527.09	521.18	523.82	327.60	206.22	196.22	10	American Strata
GS-AP-MW-35HO[9]	Horizontal Delineation	11/20/2019	1315127.10	2064800.69	550.60	553.35	320.48	242.87	232.87	10	Pratt Strata
GS-AP-MW-36H	Horizontal Delineation	10/28/2019	1316518.20	2063698.16	533.67	536.61	283.10	263.51	253.51	10	Pratt Strata
GS-AP-MW-37H	Piezometer	10/23/2019	1319199.34	2062581.05	456.12	459.28	293.45	185.83	165.83	20	Pratt Strata
GS-AP-MW-38H	Horizontal Delineation	11/22/2019	1320575.44	2061610.67	343.41	345.74	168.20	187.54	177.54	10	American Strata
GS-AP-MW-39H	Piezometer	10/29/2019	1321072.42	2062371.29	448.47	451.13	348.50	122.63	102.63	20	Gillespy - Curry
GS-AP-MW-41HS	Horizontal Delineation	10/28/2019	1324686.47	2063278.88	281.75	284.65	37.65	257.00	247.00	10	Upper Water Table
GS-AP-MW-41HD	Horizontal Delineation	10/27/2019	1324683.42	2063283.86	282.32	284.54	58.30	236.24	226.24	10	Gillespy Transition
GS-AP-MW-42H	Horizontal Delineation	10/29/2019	1325082.88	2064034.21	338.61	340.62	87.51	263.11	253.11	10	Gillespy Transition
GS-AP-MW-43H	Horizontal Delineation	11/11/2019	1321244.07	2067672.16	511.87	514.62	222.75	311.87	291.87	20	Pratt Strata
GS-AP-MW-7VR [3,5]	Piezometer	4/18/2020	1324242.41	2063512.64	311.04	313.89	150.30	171.74	161.74	10	Gillespy Transition
GS-AP-MW-6V (VR)	Vertical Delineation	6/23/2020	1324568.11	2063915.62	272.84	275.44	98.5	184.34	174.34	10	Gillespy Transition
GS-AP-MW-40H (HO) [8]	Horizontal Delineation	5/1/2020	1320858.03	2060018.89	355.07	357.91	90.30	274.77	264.77	10	American Strata
GS-AP-MW-44HO[9]	Horizontal Delineation	8/16/2020	1321163.745	2067488.902	503.33	506.21	208.48	307.23	297.23	10	Pratt Strata

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. Piezometers are utilized for water level readings only
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’ or 0.5'.
5. Delineation wells GS-AP-MW-7V, GS-AP-MW-7VR, GS-AP-MW-25H, GS-AP-MW-27H, GS-AP-MW-30H, and GS-AP-MW-30HS will be utilized for water level data only in future events.
6. Survey for MW-12V is incorrect and will be updated upon re-survey
7. Maxine Mine screened piezometer converted to vertical delineation location
8. GS-AP-MW-40H when planned was an off-site well, but land was purchased by APC & was installed as an on-site delineation well

9.GS-AP-MW-33HO through GS-AP-MW-35HO and GS-AP-MW-44HO are off-site well locations.

Table 2. Plant Gorgas AP 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)	**Lithium** (mg/L)	**Molybdenum** (mg/L)
Upgradient	GS-AP-MW-8	0.81	5.81	110.8	133.4	Non-Detect [4]	6.33	3.36	3.32	0.0015	Non-Detect [4]	Non-Detect [4]
Upgradient	GS-AP-MW-13	0.19	6.76	50.0	370.3	Non-Detect [4]	44.80	11.23	3.09	Non-Detect [4]	0.009	0.006
Upgradient	GS-AP-MW-17V [1]	4.54	7.71	-84.7	580.2	0.043	30.15	13.50	3.63	0.0013	0.074	0.007
Downgradient Compliance [2]	Average Concentrations from Wells with SSLs	0.22	7.31	-150.08	703.9	1.062	61.23	189.23	13.86	0.075	0.135	0.042
Ash Pore-Water [3]	Average Concentrations from Pore-water	0.20	9.09	-12.43	820.1	4.02	143	282.3	8.2	0.300	1.098	2.0150

Notes:

1. Averages based only upon two monitoring events
2. Compliance wells with SSL's used include GS-AP-MW-6S, GS-AP-MW-6D, GS-AP-MW-7, GS-AP-MW-12, and GS-AP-MW-18 .
3. Ash pore-water wells include: GAP-B-01, GAP-B-02, GAP-B-66
4. Non-Detect indicates the result was not detected above the MDL and is considered a non-detect.

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:

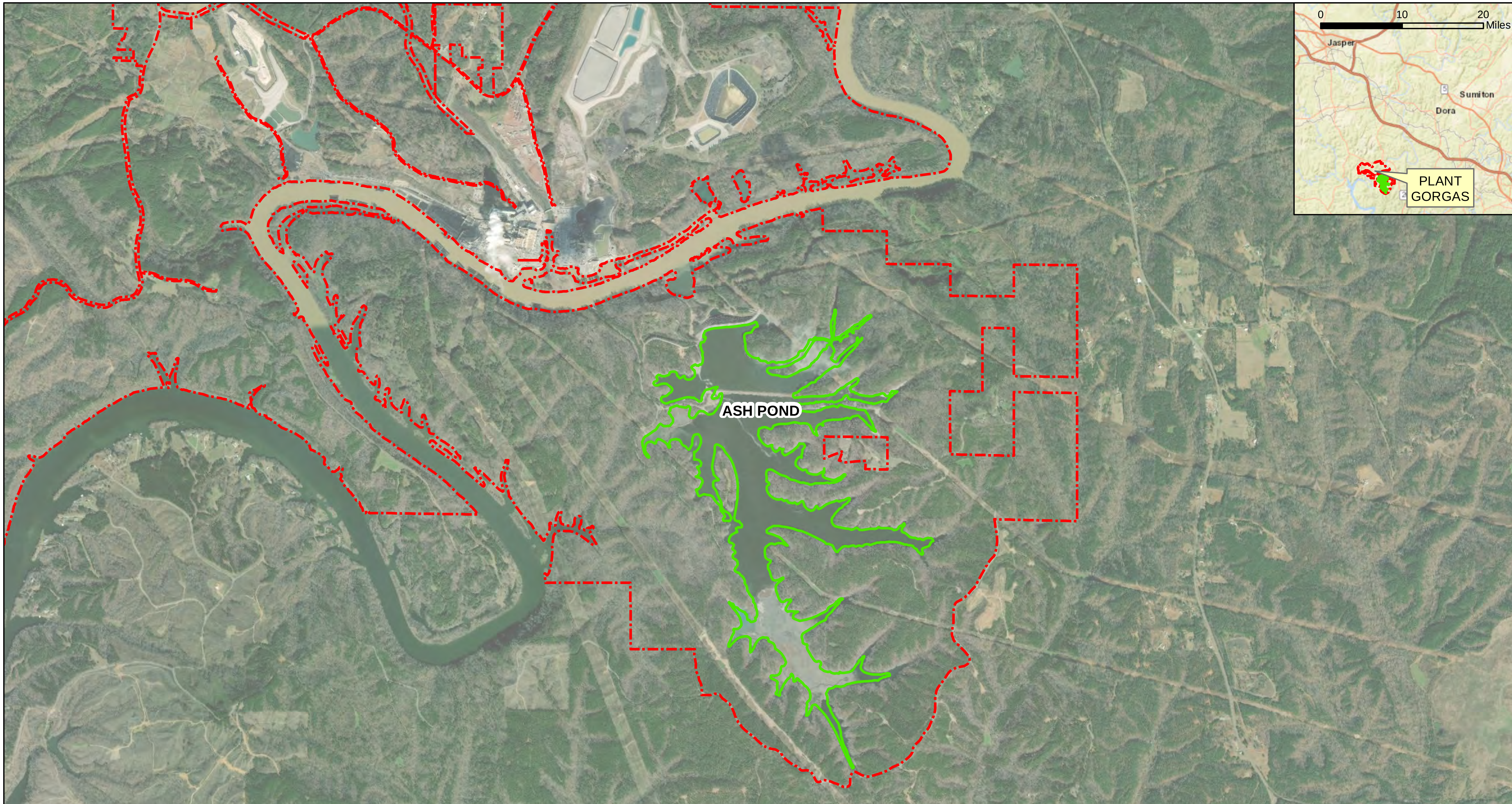
1. mg/L - Milligrams per liter

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 1,000 2,000 4,000 6,000 8,000 Feet

SCALE	1:24,000
DATE	4/14/2020
DRAWN BY	KWR
CHECKED BY	GBD

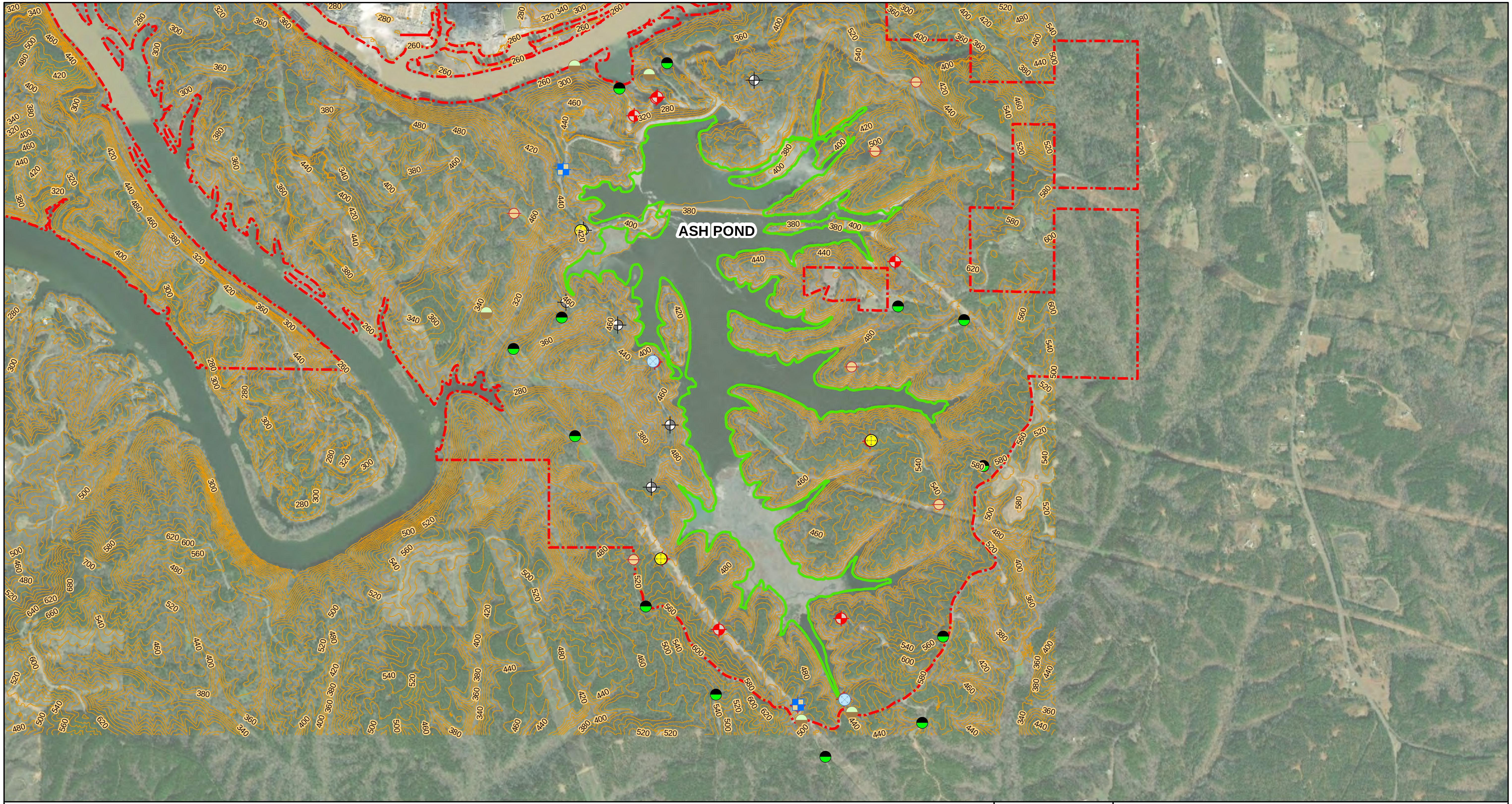
DRAWING TITLE

SITE LOCATION MAP
PLANT GORGAS ASH POND

FIGURE NO

FIGURE 1

Southern Company



Legend

- Ash Pond Boundary
- Property Boundary (Approximate)
- 20-Foot Topographic Contour
- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Phase I Horizontal Delineation Well
- Phase I Vertical Delineation Well
- Phase II Horizontal Delineation Well
- Phase II Vertical Delineation Well
- Piezometer
- Abandoned Well

N

0 1,000 2,000 4,000 Feet

SCALE	1:18,000
DATE	4/14/2020
DRAWN BY	KAR
CHECKED BY	GBD

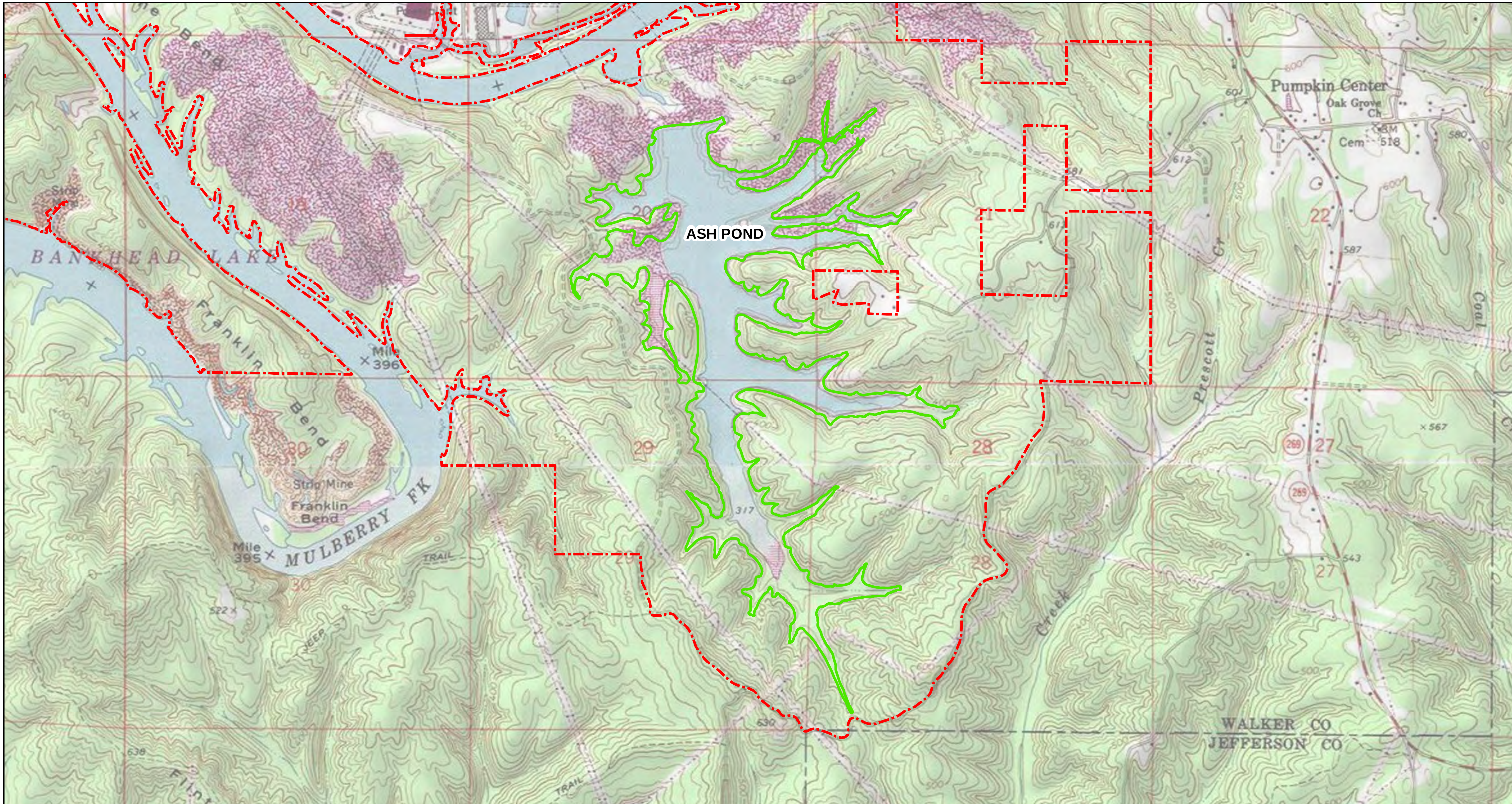
DRAWING TITLE

SITE PLAN MAP
PLANT GORGAS ASH POND

FIGURE NO

FIGURE 2

Southern Company



Legend

- Ash Pond Boundary
- Property Boundary (Approximate)

N

0 1,000 2,000 4,000 6,000 Feet

SCALE	1:18,000
DATE	4/14/2020
DRAWN BY	KWR
CHECKED BY	GBD

DRAWING TITLE

SITE TOPOGRAPHIC MAP
PLANT GORGAS ASH POND

FIGURE NO

FIGURE 3

Southern Company

Legend

Ash Pond Boundary

Property Boundary (Approximate)

Geologic Units

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

SCALE	1:24000
DATE	4/14/2020
DRAWN BY	KWR
CHECKED BY	GBD

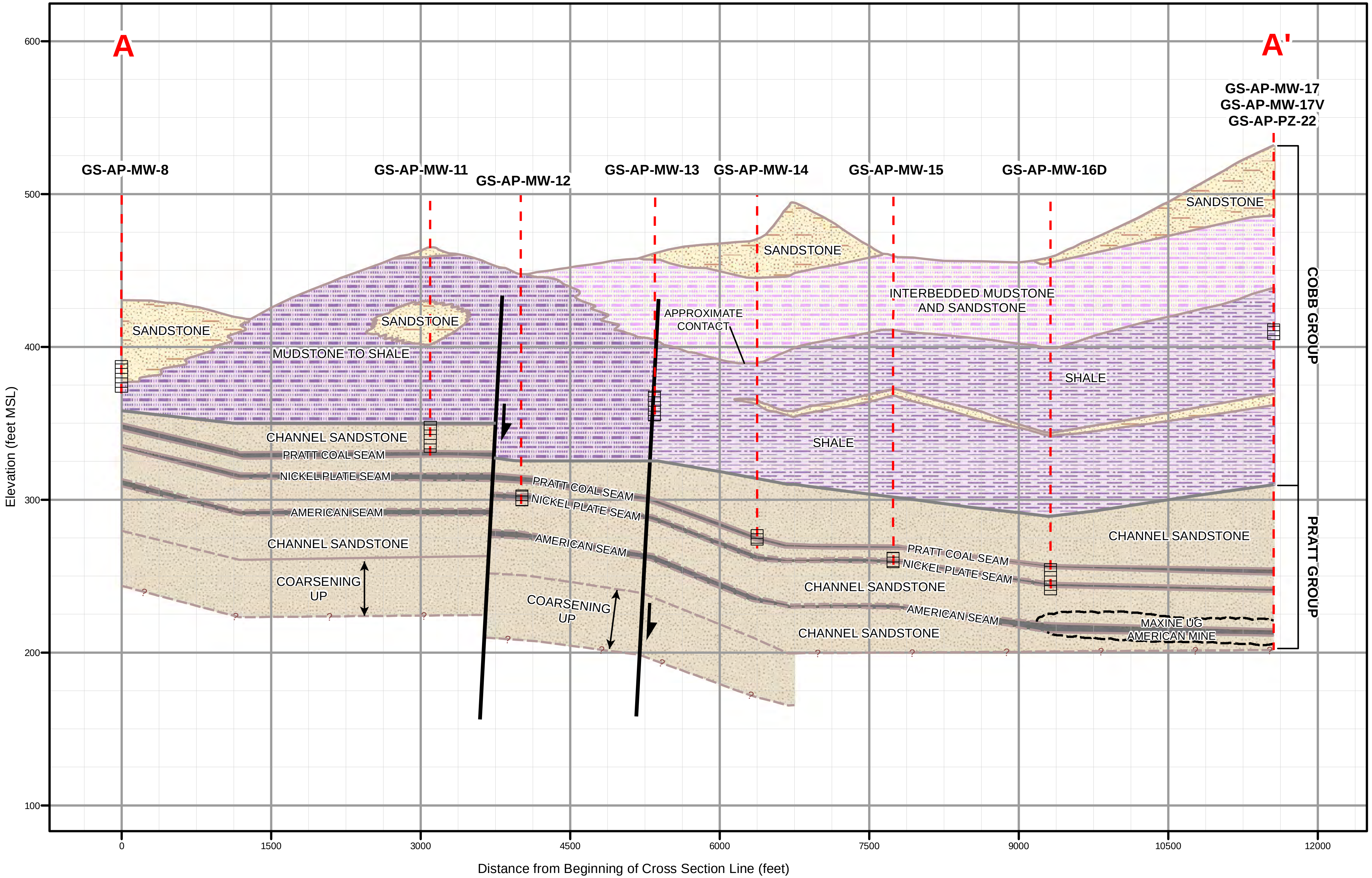
DRAWING TITLE

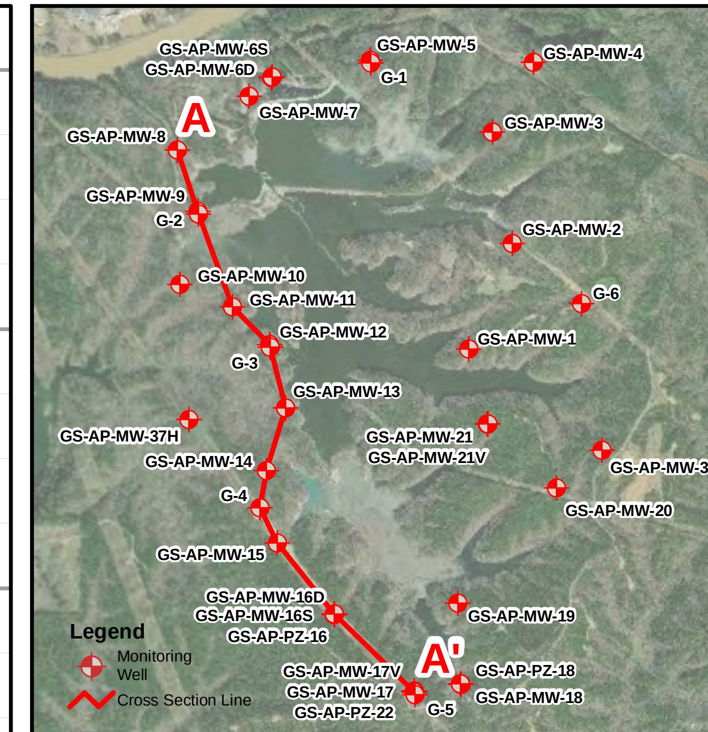
SITE GEOLOGIC MAP
PLANT GORGAS ASH POND

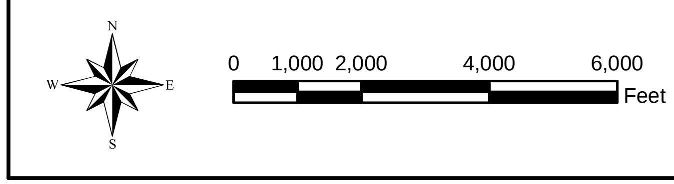
FIGURE NO

FIGURE 4

Southern Company







Legend

- Monitoring Well Location
- Screen Interval
- Group Boundary
- Strata Boundary
- Inferred Strata Boundary
- Fault
- Mine

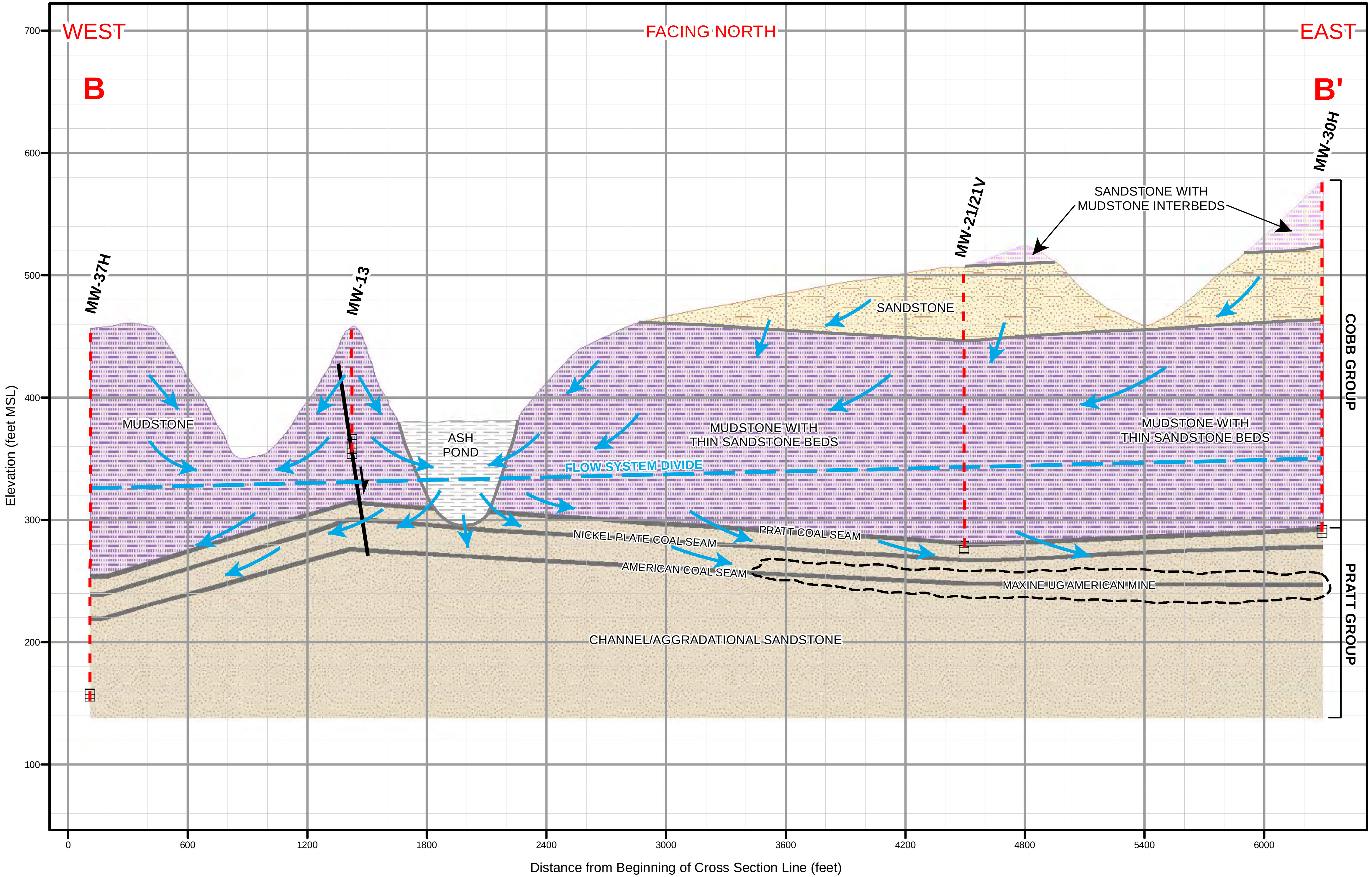
Geologic Units

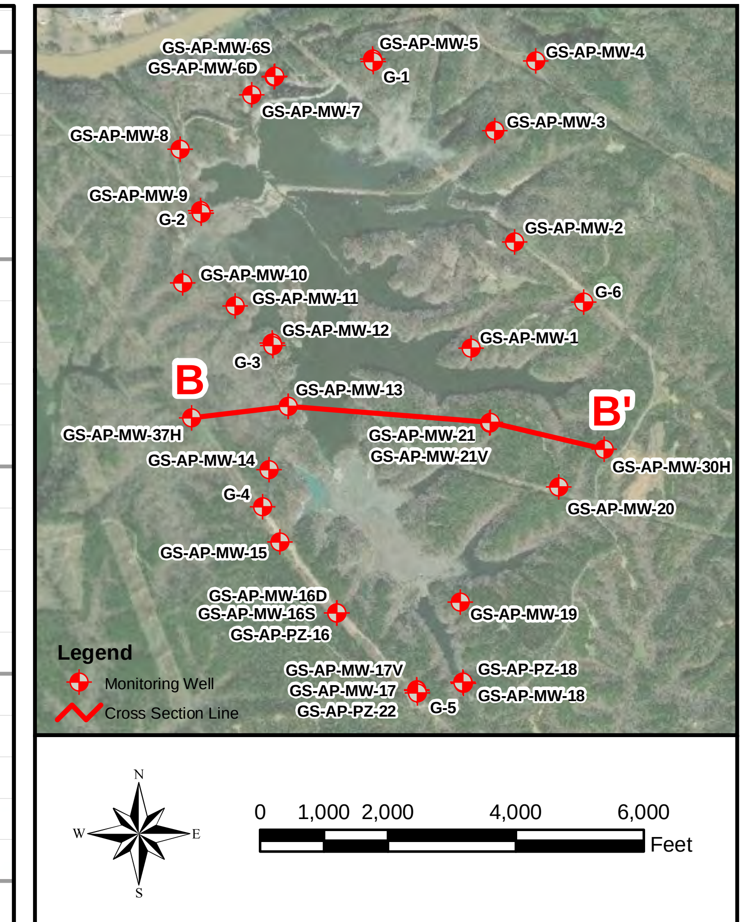
- Shale
- Mudstone to Shale
- Interbedded Mudstone and Sandstone
- Sandstone
- Channel Sandstone
- Coal

Notes:
1. Stratagraphic layers were correlated using a combination of boring data and gamma logs.
2. Elevation data are reported using feet above Mean Sea Level (MSL).
3. Monitoring wells GS-AP-MW-8, GS-AP-MW-13, and GS-AP-MW-17V display groundwater elevations that are higher than the ash pond elevation (382.5 ft MSL).

SCALE	As Shown
DATE	4/14/2020
DRAWN BY	KWR
CHECKED BY	GBD
DRAWING TITLE	GEOLOGIC CROSS SECTION A - A' PLANT GORGAS ASH POND
FIGURE NO	FIGURE 5A

Southern Company





Legend

- Monitoring Well Location
- Screen Interval
- Groundwater Flow Direction
- Flow System Divide
- Group Boundary
- Strata Boundary
- Fault
- Mine

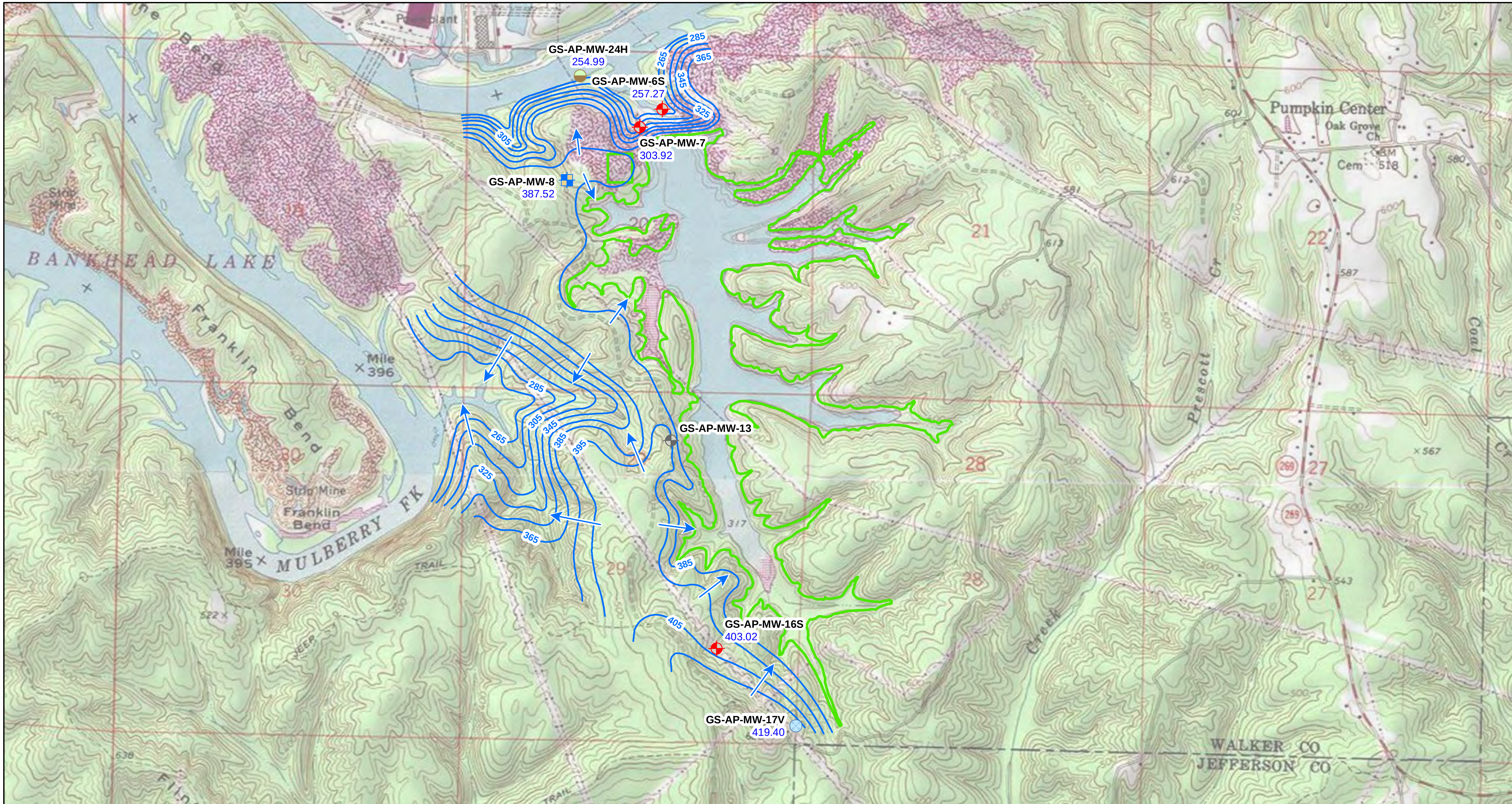
Geologic Units

- Ash Pond (Fill)
- Mudstone with Thin Sandstone Interbeds
- Sandstone with Mudstone Interbeds
- Sandstone
- Channel/Aggradational Sandstone
- Coal

Notes:
1. Stratagraphic layers were correlated using a combination of boring data and gamma logs.
2. Dashed blue line represents approximate boundary between water-table flow system and deeper Pratt flow system.
3. Elevation data are reported using feet above Mean Sea Level (MSL).

SCALE	As Shown
DATE	4/14/2020
DRAWN BY	KAR
CHECKED BY	GBD
DRAWING TITLE	GEOLOGIC CROSS SECTION B - B' PLANT GORGAS ASH POND
FIGURE NO	FIGURE 5B

Southern Company



Legend

- Upgradient Monitoring Well
- Downgradient Monitoring Well
- Horizontal Delineation
- Vertical Delineation Well
- Abandoned Well
- Ash Pond Boundary
- Potentiometric Surface Contour (ft NAVD88)
- Approximate Groundwater Flow Direction

GS-AP-MW-7 Well ID
303.92 Groundwater Elevation

N

0 1,000 2,000 4,000 6,000 Feet

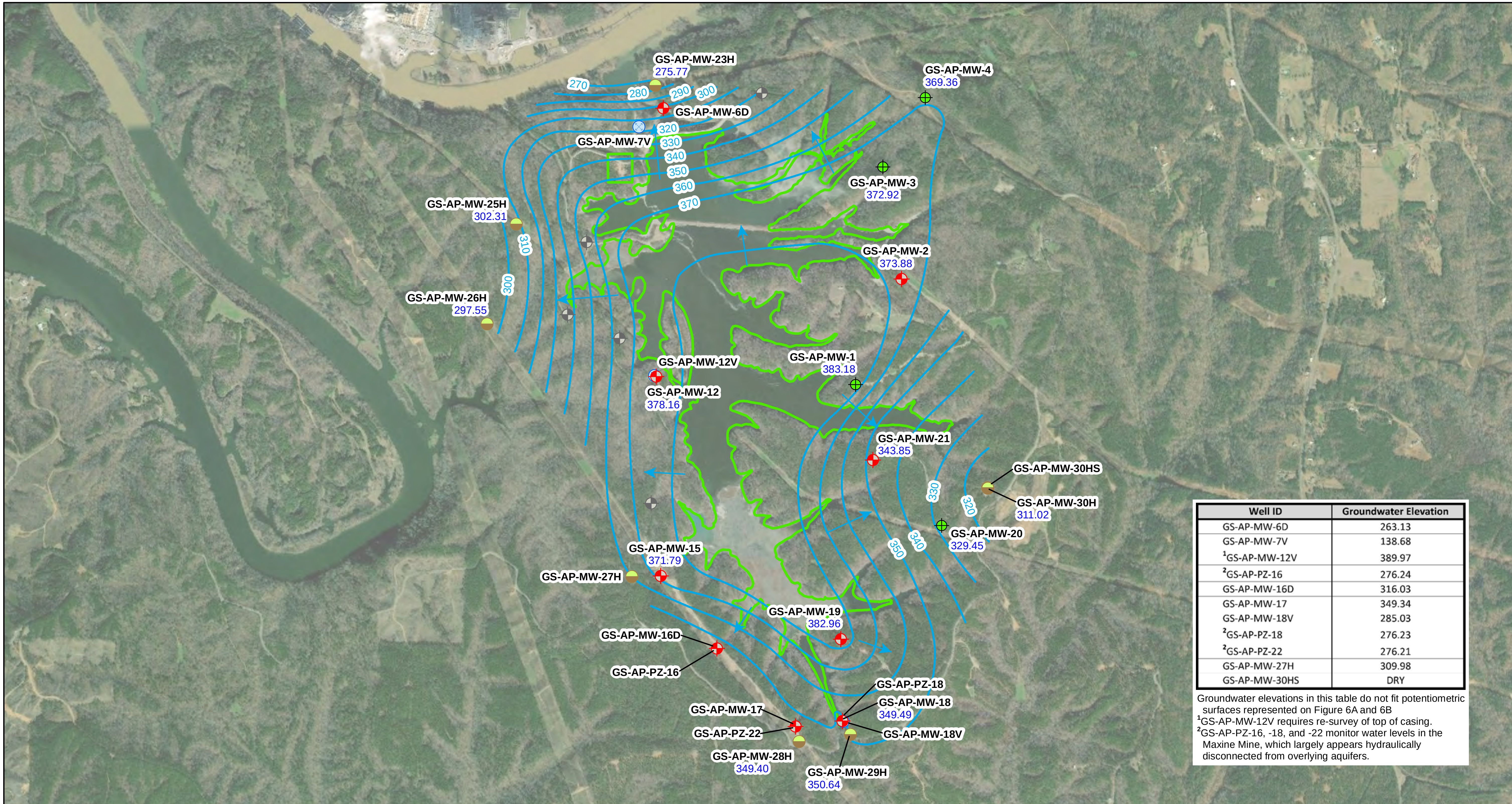
NOTE: 1. NAVD88 indicates North American Vertical Datum of 1988.
2. MW-17V planned to be converted to upgradient location in revised GWMP to be submitted 4/15/20.
3. Generalized water table potentiometric surface map based upon groundwater elevations, surface water elevations, and topography.

SCALE	1:18000
DATE	4/2/2020
DRAWN BY	KAR
CHECKED BY	GBD

DRAWING TITLE
POTENTIOMETRIC SURFACE CONTOUR MAP
(UPPER) WATER TABLE AQUIFER
SEPTEMBER 23, 2019
PLANT GORGAS ASH POND

FIGURE NO
FIGURE 6A

Southern Company



Well ID	Groundwater Elevation
GS-AP-MW-6D	263.13
GS-AP-MW-7V	138.68
[1]GS-AP-MW-12V	389.97
[2]GS-AP-PZ-16	276.24
GS-AP-MW-16D	316.03
GS-AP-MW-17	349.34
GS-AP-MW-18V	285.03
[2]GS-AP-PZ-18	276.23
[2]GS-AP-PZ-22	276.21
GS-AP-MW-27H	309.98
GS-AP-MW-30HS	DRY

Groundwater elevations in this table do not fit potentiometric surfaces represented on Figure 6A and 6B
[1]GS-AP-MW-12V requires re-survey of top of casing.
[2]GS-AP-PZ-16, -18, and -22 monitor water levels in the Maxine Mine, which largely appears hydraulically disconnected from overlying aquifers.

Legend

- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Horizontal Delineation Well
- Vertical Delineation Well
- Piezometer
- Abandoned Well
- Potentiometric Surface Contour (ft NAVD88)
- Approximate Groundwater Flow Direction
- Ash Pond Boundary
- **GS-AP-MW-1** Well ID
- 383.18 Groundwater Elevation

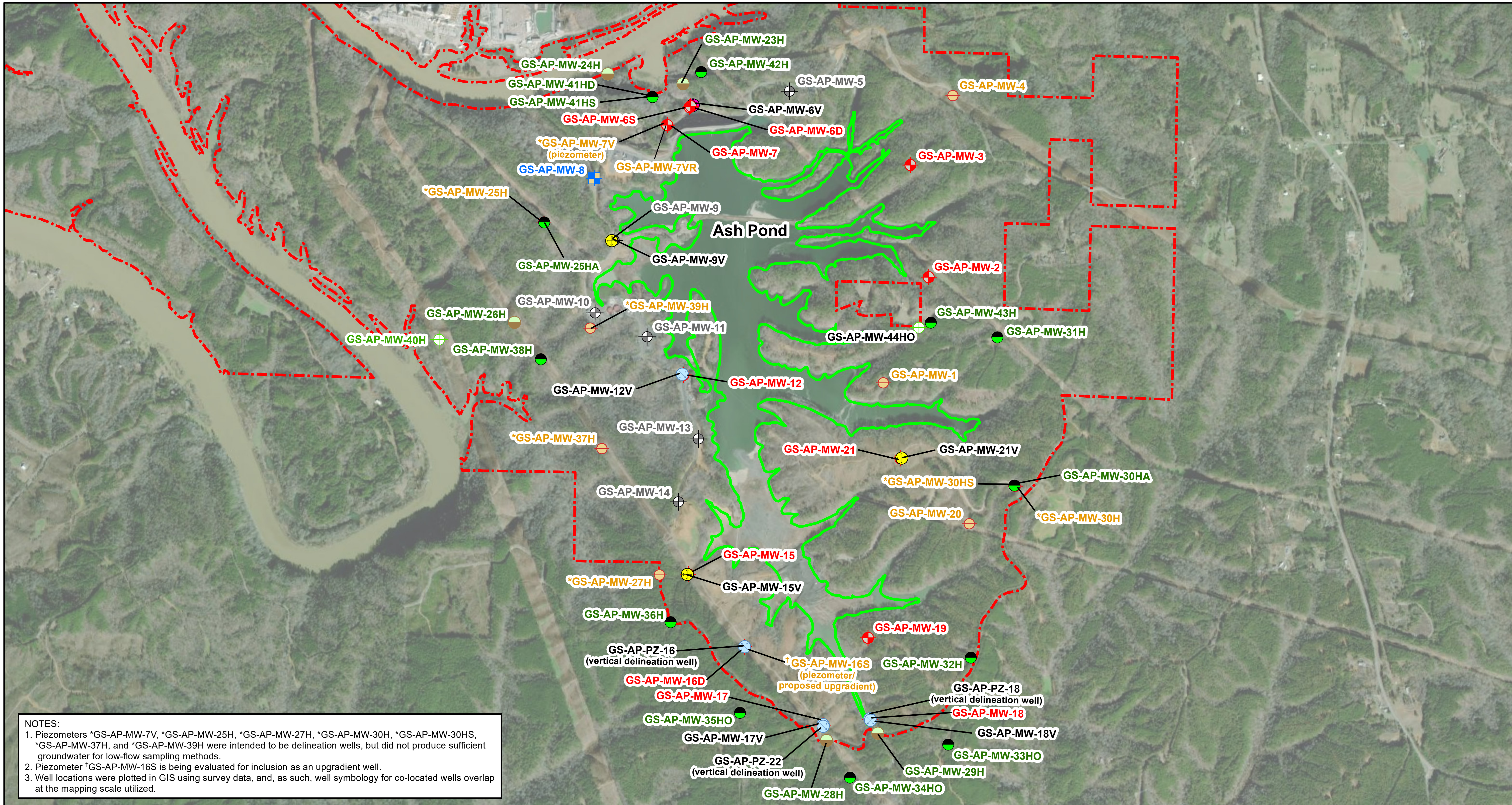
N

0 1,000 2,000 4,000 6,000 Feet

NOTES:
1. NAVD88 indicates North American Vertical Datum of 1988.
2. Monitoring Well GS-AP-MW-5 was inaccessible due to blockage by heavy equipment.
3. GS-AP-MW-5, GS-AP-MW-9, GS-AP-MW-10, GS-AP-MW-11, and GS-AP-MW-14 were abandoned prior to the September 2019 event.
4. Potentiometric contour lines were generalized for depiction and ease of reader.

SCALE	1:18000
DATE	4/14/2020
DRAWN BY	KAR
CHECKED BY	GBD
DRAWING TITLE	POTENTIOMETRIC SURFACE CONTOUR MAP (DEEP) PRATT AQUIFER SEPTEMBER 23, 2019 PLANT GORGAS ASH POND
FIGURE NO	**FIGURE 6B**

Southern Company



NOTES:
1. Piezometers *GS-AP-MW-7V, *GS-AP-MW-25H, *GS-AP-MW-27H, *GS-AP-MW-30H, *GS-AP-MW-30HS, *GS-AP-MW-37H, and *GS-AP-MW-39H were intended to be delineation wells, but did not produce sufficient groundwater for low-flow sampling methods.
2. Piezometer †GS-AP-MW-16S is being evaluated for inclusion as an upgradient well.
3. Well locations were plotted in GIS using survey data, and, as such, well symbology for co-located wells overlap at the mapping scale utilized.

Legend

- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Phase I Horizontal Delineation Well
- Phase I Vertical Delineation Well
- Phase II Horizontal Delineation Well
- Phase II Vertical Delineation Well
- Phase III Horizontal Delineation Well
- Phase III Vertical Delineation Well
- Piezometer
- Abandoned Well
- Ash Pond Boundary
- Property Boundary (Approximate)

GS-AP-MW-2	Downgradient Monitoring Well ID
GS-AP-MW-8	Upgradient Monitoring Well ID
GS-AP-MW-23H	Horizontal Delineation Well ID
GS-AP-MW-9V	Vertical Delineation Well ID
GS-AP-MW-1	Piezometer ID
GS-AP-MW-9	Abandoned Well ID

SCALE 1:18000	DRAWING TITLE: MONITORING WELL LOCATION MAP PLANT GORGAS ASH POND
DATE 3/10/2021	
DRAWN BY KWR	FIGURE NO **FIGURE 7**
CHECKED BY GBD	Southern Company

Amendment 1

Table 2.
Monitor Well and Piezometer Abandonments, Replacements, and Modifications Details

Well Name	Status	Reason For Relocation or Modification	Abandonment Required?	Located in Proposed Borrow Area?	Proposed Relocation Coordinates		Change to Well
					Northing	Easting	
GS-AP-MW-01	Active	Low Yield	Yes	Yes	1320298.40	2066934.48	Abandon and Reinstallation
GS-AP-MW-03	Active	In construction area	No	Yes	Exisiting		Finished well casing elevation lowered with final grade
GS-AP-MW-05	Abandoned	In construction area	Completed	No	1324748.69	2065587.84	Reinstallation
GS-AP-MW-09	Abandoned	In construction area	Completed	No	1322410.29	2062682.63	Reinstallation
GS-AP-MW-10	Abandoned	In construction area	Completed	No	1321135.11	2062567.63	Reinstallation
GS-AP-MW-11	Abandoned	In construction area	Completed	No	1320842.53	2063070.23	Reinstallation
GS-AP-MW-13	Abandoned	In construction area	Completed	No	1319694.25	2063851.95	Reinstallation
GS-AP-MW-14	Abandoned	In construction area	Completed	No	1318724.04	2063811.16	Reinstallation
GS-AP-MW-15	Active	In construction area	No	No	Exisiting		Finished well casing elevation raised with final grade
GS-AP-MW-15V	Active	In construction area	No	No	Exisiting		Finished well casing elevation raised with final grade
GS-AP-MW-16D	Active	In construction area	No	No	Exisiting		Finished well casing elevation raised with final grade
GS-AP-MW-16S	Active	In construction area	No	No	Exisiting		Finished well casing elevation raised with final grade
GS-AP-MW-18	Active	In construction area	Yes	Yes	1314874.90	2067029.94	Abandon and Reinstallation
GS-AP-MW-18V	Active	In construction area	Yes	Yes	1314849.62	2067099.02	Abandon and Reinstallation
GS-AP-MW-19	Active	In construction area	No	Yes	Exisiting		Finished well casing elevation lowered with final grade
GS-AP-MW-20	Active	In construction area	No	Yes	Exisiting		Finished well casing elevation lowered with final grade
GS-AP-MW-21	Active	In construction area	No	Yes	Exisiting		Finished well casing elevation lowered with final grade
GS-AP-MW-21V	Active	In construction area	No	Yes	Exisiting		Finished well casing elevation lowered with final grade
GS-AP-MW-27H	Active	Low Yield	Yes	No	1317240.19	2063510.32	Abandon and Reinstallation
GS-AP-MW-32H	Active	In construction area	No	Yes	Exisiting		Finished well casing elevation lowered with final grade
GS-AP-MW-37H	Active	Low Yield	Yes	No	1319196.55	2062594.25	Abandon and Reinstallation
GS-AP-PZ-16	Active	In construction area	No	No	Exisiting		Finished well casing elevation raised with final grade
GS-AP-PZ-18	Active	In construction area	Yes	Yes	1314928.16	2067077.06	Abandon and Reinstallation

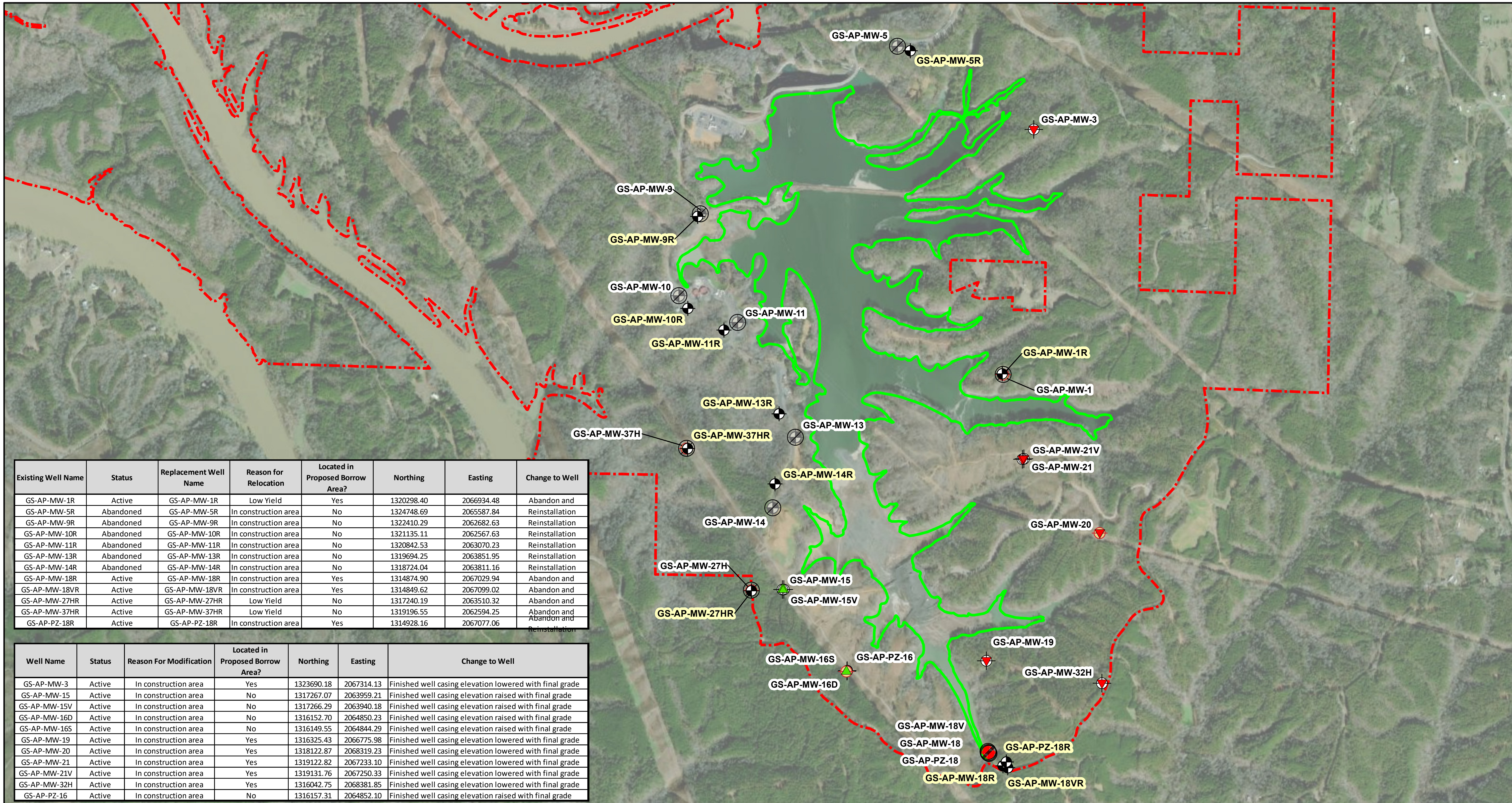
Notes

Wells in borrow areas assume maximum topography change of up to 20 feet. Oversight needed as wells lowered.

Wells in final cover area to be raised. Oversight required when wells raised.

Wells GS-AP-MW-1, GS-AP-MW-18, GS-AP-MW-18V and GS-AP-PZ-18 redrill locations are in proposed borrow areas.

Low Yield = did not produce sufficient volume of groundwater for sampling.



Existing Well Name	Status	Replacement Well Name	Reason for Relocation	Located in Proposed Borrow Area?	Northing	Easting	Change to Well
GS-AP-MW-1R	Active	GS-AP-MW-1R	Low Yield	Yes	1320298.40	2066934.48	Abandon and
GS-AP-MW-5R	Abandoned	GS-AP-MW-5R	In construction area	No	1324748.69	2065587.84	Reinstallation
GS-AP-MW-9R	Abandoned	GS-AP-MW-9R	In construction area	No	1322410.29	2062682.63	Reinstallation
GS-AP-MW-10R	Abandoned	GS-AP-MW-10R	In construction area	No	1321135.11	2062567.63	Reinstallation
GS-AP-MW-11R	Abandoned	GS-AP-MW-11R	In construction area	No	1320842.53	2063070.23	Reinstallation
GS-AP-MW-13R	Abandoned	GS-AP-MW-13R	In construction area	No	1319694.25	2063851.95	Reinstallation
GS-AP-MW-14R	Abandoned	GS-AP-MW-14R	In construction area	No	1318724.04	2063811.16	Reinstallation
GS-AP-MW-18R	Active	GS-AP-MW-18R	In construction area	Yes	1314874.90	2067029.94	Abandon and
GS-AP-MW-18VR	Active	GS-AP-MW-18VR	In construction area	Yes	1314849.62	2067099.02	Abandon and
GS-AP-MW-27HR	Active	GS-AP-MW-27HR	Low Yield	No	1317240.19	2063510.32	Abandon and
GS-AP-MW-37HR	Active	GS-AP-MW-37HR	Low Yield	No	1319196.55	2062594.25	Abandon and
GS-AP-PZ-18R	Active	GS-AP-PZ-18R	In construction area	Yes	1314928.16	2067077.06	Abandon and Reinstallation

Well Name	Status	Reason For Modification	Located in Proposed Borrow Area?	Northing	Easting	Change to Well
GS-AP-MW-3	Active	In construction area	Yes	1323690.18	2067314.13	Finished well casing elevation lowered with final grade
GS-AP-MW-15	Active	In construction area	No	1317267.07	2063959.21	Finished well casing elevation raised with final grade
GS-AP-MW-15V	Active	In construction area	No	1317266.29	2063940.18	Finished well casing elevation raised with final grade
GS-AP-MW-16D	Active	In construction area	No	1316152.70	2064850.23	Finished well casing elevation raised with final grade
GS-AP-MW-16S	Active	In construction area	No	1316149.55	2064844.29	Finished well casing elevation raised with final grade
GS-AP-MW-19	Active	In construction area	Yes	1316325.43	2066775.98	Finished well casing elevation lowered with final grade
GS-AP-MW-20	Active	In construction area	Yes	1318122.87	2068319.23	Finished well casing elevation lowered with final grade
GS-AP-MW-21	Active	In construction area	Yes	1319122.82	2067233.10	Finished well casing elevation lowered with final grade
GS-AP-MW-21V	Active	In construction area	Yes	1319131.76	2067250.33	Finished well casing elevation lowered with final grade
GS-AP-MW-32H	Active	In construction area	Yes	1316042.75	2068381.85	Finished well casing elevation lowered with final grade
GS-AP-PZ-16	Active	In construction area	No	1316157.31	2064852.10	Finished well casing elevation raised with final grade

Legend

- Proposed Well Reinstallation Location
- Monitoring Well to be reinstalled
- Abandoned well to be reinstalled
- Piezometer to be reinstalled
- Piezometer to be raised with final grade
- Monitoring Well to be raised with final grade
- Monitoring Well to be lowered with final grade
- Piezometer to be lowered with final grade
- Ash Pond Boundary
- Property Boundary (Approximate)

N

0 1,000 2,000 3,000 Feet

SCALE 1:16000

DATE 3/3/2021

DRAWN BY KAR

CHECKED BY GFB

DRAWING TITLE

MONITORING WELL MODIFICATION AND REINSTALLATION MAP PLANT GORGAS ASH POND

FIGURE NO

FIGURE 7

Southern Company

Appendix A

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-01

SHEET 1 OF 4
DATUM: Geodetic

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: February 22-24, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET; DRILLING RECORD; DESCRIPTION; SYMBOLIC LOG; ELEV. DEPTH (ft); RUN No.; INDICES: ROCK STRENGTH (R5, R4, R3, R2, R1), WEATHERING (W2, W3, W4) / ALTERATION (2, 3, 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); FRACTURE INDEX PER RUN; Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core; PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Depth (ft)	Drilling Record	Description	Elev. Depth (ft)	Run No.
0		Ground Surface		
0–9	Track Mounted Sonic Drill (12") – Sonic	(GP/SP) GRAVEL and SAND; fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transistion zone. [REGOLITH] [WEATHERED BEDROCK]	0.00	1
9–15	Track Mounted Sonic Drill (12") – Sonic	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	9.00	1
15–36.2	Track Mounted Sonic Drill (6.25") – Sonic (from 20)	Slightly weathered, massive bedded, gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	15.00	2 (15–35)
36.2–40	Track Mounted Sonic Drill (6.25") – Sonic	Fresh, thinly bedded to laminated, dark gray to very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	36.20	

Fracture index per run: 0 (at every 1 ft interval, 0–40 ft)

Lost/Broken core depths: 15.00, 15.80, 18.30, 19.30, 35.00, 37.20, 38.80

Installation: 0.00 – 3.00 Concrete Seal and Pad; 3.00 – 35.00 Bentonite Grout Mix (80 gallons used)

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Geodetic

DRILLING DATE: February 22-24, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Track Mounted Sonic Drill (6.25") Sonic	Fresh, thinly bedded to laminated, dark gray to very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*			3	0 (×15)	
44.20							44.20
55					4	0 (×20)	55.00, 56.40
60							Bentonite Grout Mix (80 gallons used)
70.60							70.60
75					5	0 (×5)	75.00, 75.80
78.60							78.60, 79.10
80							

Column headings: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-01

DATUM: Geodetic

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: February 22-24, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4) | RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION) | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Run No.	Fracture index per run
80–120	Fresh, thinly bedded to laminated, dark gray to very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*	5 (80–95); 6 (95–115); (115–120)	0 (all intervals)

Broken core intervals: 80.10–81.20; 87.00–95.00; 95.50–96.50; 97.30

Lost core: 103.50–115.00

Installation: Bentonite Grout Mix (80 gallons used); PelPlug Bentonite Pellets (5

Depth scale marks: 80, 85, 90, 95, 100, 105, 110, 115, 120

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-01

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Geodetic

DRILLING DATE: February 22-24, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Track Mounted Sonic Drill (6.25"); Sonic

Depth (ft)	Description	Elev. Depth (ft)	Run No.
120 – 127.70	Fresh, thinly bedded to laminated, dark gray to very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		7
127.70 – 140.00	Fresh, laminated, black, very fine grained, weak, COAL [Pottsville Formation]. [BEDROCK]	127.70	7 (to 135), 8
140.00 – 155.00	Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. [BEDROCK]	140.00	8
155.00	End of Borehole.	155.00	

Fracture index per run: 0 for every interval from 120 to 155 ft.

Lost/Broken core intervals: 127.70; 135.00; 136.70; 141.70; 144.40; 146.80; 148.20

Installation:
- gallons used)
- GP#1 Filter Media Sand (13 x 50lb bags used)
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
- GP#1 Filter Media Sand
- Hole Plug Bentonite Chips 3/8" (1 x 50lb bags used)

Depth scale: 120, 125, 130, 135, 140, 145, 150, 155, 160

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

RECORD OF SONIC HOLE: GS-AP-MW-02

SHEET 1 OF 8

DATUM: Ground Surface

DRILLING DATE: February 25 - March 10, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	TOTAL CORE %	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0		Ground Surface				
0	Track Mounted Sonic Drill (12"), Sonic	(ML) CLAYEY SILT; some coarse to very fine angular sand; some medium to coarse angular gravel; red orange; cohesive, w~PL, soft. [NATIVE]	0.00	1		Concrete Seal and Pad
6		(GP/SP) GRAVEL and SAND; fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transition zone. [REGOLITH] [WEATHERED BEDROCK]	6.00			
9		(BOULDER) Sandstone boulder [WEATHERED BEDROCK]	9.00	2		
12		Completely decomposed rock. Reddish yellow to yellowish red to light gray. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	12.00	3	175	Bentonite Grout Mix
25	Track Mounted Sonic Drill (6.25"), Sonic	Moderately weathered, massive bedded, gray, very fine grained, weak, SANDSTONE [Pottsville Formation]. [BEDROCK]	25.00	4		
27		Moderately weathered to slightly weathered, thinly bedded to laminated, very dark gray, very fine grained, weak to very weak, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	27.00	5		Broken Core 27.00 – 30.40
38.4			38.40			
40						

Fracture Index per run: 0 throughout (0–40 ft).

Column headings: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4 / ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); FRACTURE INDEX PER RUN; Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core.

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-02

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 25 - March 10, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4) / ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Depth scale (ft)	Description	Elev. / Depth (ft)	Run No.
40	Slightly weathered, massive bedded, gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*		
	Fresh, thinly bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	40.90	6
	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	57.00	7
~64.5	Dense shale beds, ~0.7' thick.		
~65.5	Turbulent bedding.		
~72	Dense shale beds.		

Fracture index per run: 0 (all intervals, 40–80 ft)

Broken core / lost core intervals (depths): 40.90, 48.10, 53.20, 55.50, 57.80, 63.00, 64.20, 64.90, 68.00, 69.70, 75.70, 77.00, 77.50

Installation: Bentonite Grout Mix

Depth scale ticks: 40, 45, 50, 55, 60, 65, 70, 75, 80

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 25 - March 10, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Track Mounted Sonic Drill (6.25") / Sonic	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*			8	0 (each interval, 80–97)		
96.00 – 97.00							Lost Core	
97–117					9	0 (each interval)		Bentonite Grout Mix
105.90 – 108.10							Broken Core	
114.10 – 117.00							Lost Core	
117–120						0, 0, 0		
117.00 – 119.80							Broken Core	
120								

Column headers also include: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4), RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20), Jn, DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION), J CON, Jr, Ja, Fault/Breccia/Gouge.

CONTINUED NEXT PAGE

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-02

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 25 - March 10, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Track Mounted Sonic Drill (6.25") Sonic	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*	10	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Lost Core 121.60 – 137.00
137			11	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Broken Core 137.00 – 138.10; Lost Core 151.50 – 157.00; Bentonite Grout Mix
157				0 0 0	Broken Core 157.00 – 159.70
160					

Column headers also printed: SYMBOLIC LOG; ELEV. DEPTH (ft); INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4) / ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Elev. Depth (ft)	Run No.	Fracture Index per Run
160	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		12	0 (160–177, each ft)
170	Driller notes oil sheen and coal dust to surface.			
177			13	0 (177–197, each ft)
190	Possible coal seam (Lost Core)			
197	Fresh, laminated, black, very fine grained, very strong, SHALE [Pottsville Formation]. [BEDROCK]	197.00		0 (197–200, each ft)
200		199.60		

Lost/Broken Core intervals: 172.00–177.00 (lost core); 177.00–178.00 (broken core); 179.00–182.50 (broken core); 185.80–197.00 (lost core); 197.00–198.50 (broken core)

Installation:
- Bentonite Grout Mix (to ~180)
- PelPlug Bentonite Pellets (5 gallons used) (~180–183.8)
- GP#1 Filter Media Sand (13 x 50lb bags used)
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen

CONTINUED NEXT PAGE

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-02

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 25 - March 10, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Track Mounted Sonic Drill (6.25") – Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.
200	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*		
	Fresh, laminated, black, very fine grained, very strong, SHALE [Pottsville Formation]. [BEDROCK]	200.80	
	Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK]	203.00	14
205			
210			
215			
220			15
225			
	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	228.00	
230	Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK]	230.00	
	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	231.30	
235			
		237.00	
240			

Fracture index per run: 0 for each 1 ft interval from 200 to 240 ft.

Lost core / broken core marks: 207.10, 217.00, 228.00

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION:
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
- GP#1 Filter Media Sand
- Hole Plug Bentonite Chips 3/8"

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL
DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-02

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 25 - March 10, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Track Mounted Sonic Drill (6.25"), Sonic

Depth (ft)	Description	Elev. Depth (ft)	Run No.
240	Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK] *(continued)*		
	Fresh, laminated, black, very fine grained, weak, COAL [Pottsville Formation]. [BEDROCK]		
246.90	Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK]	246.90	16
	Crushed coal coats core.		
	Small coal seam ~0.1' at 253' bgs.		
~266			17

Fracture index per run: 0 at every 1-ft interval from 240 to 280 ft.

Broken core / lost core intervals: 243.40, 243.90, 246.50, 257.00, 258.20, 258.70, 259.20, 259.60, 260.10, 262.70, 263.30, 276.40, 277.00

Depth scale marks: 240, 245, 250, 255, 260, 265, 270, 275, 280

Piezometer installation: Hole Plug Bentonite Chips 3/8"

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-02

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 25 - March 10, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET; DRILLING RECORD; DESCRIPTION; SYMBOLIC LOG; ELEV. DEPTH (ft); RUN No.; INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); FRACTURE INDEX PER RUN; Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core; PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Elev. Depth (ft)	Run No.	Fracture Index per Run
280–317	Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK] *(continued)*		18 (to 297.0), 19 (297.0–317.0)	0 (each 1 ft interval, 280–317)
317.00	End of Borehole.	317.00		

Lost core: 295.90 – 297.00; 316.40 – 317.00

Broken core: 311.50 – 312.50

Piezometer installation: Hole Plug Bentonite Chips 3/8"

Depth scale marks: 280, 285, 290, 295, 300, 305, 310, 315, 320

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-03

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas
INCLINATION: -90°   AZIMUTH: n/a

DRILLING DATE: March 1-4, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

SHEET 1 OF 5
DATUM: Ground Surface

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET; DRILLING RECORD; DESCRIPTION; SYMBOLIC LOG; ELEV. DEPTH (ft); RUN No.; INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4) / ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); FRACTURE INDEX PER RUN; Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core; PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Track Mounted Sonic Drill (12") — Sonic (0–20 ft); Track Mounted Sonic Drill (6.25") — Sonic (20–40 ft)

Ground Surface

Depth (ft)	Description	Run No.
0.00	(GP/SP) GRAVEL and SAND, fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transition zone. [REGOLITH] [WEATHERED BEDROCK]	1, 2
14.00	Completely decomposed rock. Reddish yellow to yellowish red to light gray. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	2, 3
25.00	Moderately weathered to slightly weathered, massive bedded, gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	4
27.00	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	5
32.20	Slightly weathered to fresh, massive bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	5
33.40 / 33.90	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	5
34.40	Slightly weathered to fresh, massive bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	5

Fracture index per run: 0 at every 0.8 ft interval from 0 to 40 ft.

Discontinuity data: BD,-,- (approx. 25.5 ft); BD,-,- (approx. 31.4 ft)

Broken core / lost core depths: 25.00, 26.40, 27.60, 29.00, 32.20, 33.40, 33.90, 35.30, 36.00, 37.00, 38.40, 39.40

Installation: Concrete Seal and Pad; Bentonite Grout Mix

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL
DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-03

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 1-4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Elev. Depth (ft)	Description
	Fresh, thinly bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation] with some small clean sandstone beds. [BEDROCK] *(continued)*
50.50	Fresh, thinly bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]
	Possible Calamites fossils
60.60	Fresh, massive bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]
62.00	Fresh, thinly bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]

Run No.: 6, 7, 8, 9

Fracture index per run: 0 (every foot interval, 40 to 80 ft)

Lost core / broken core depths: 40.50, 41.40, 42.10, 43.40, 46.40, 47.00, 47.80, 49.50, 50.10, 50.40, 55.10, 57.00, 60.70, 62.00, 64.00, 65.70, 67.00, 75.40, 77.00

Installation: Bentonite Grout Mix

Depth scale: 40, 45, 50, 55, 60, 65, 70, 75, 80

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-03

SHEET 3 OF 5

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 1-4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Track Mounted Sonic Drill (6.25") Sonic	Fresh, thinly bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*		10	0, 0, 0	Bentonite Grout Mix
		Fresh, massive bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	83.00		0, 0	
85		Fresh, thinly bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	84.50		0, 0, 0, 0, 0, 0, 0, 0, 0	
90				11		
		Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	92.00		0, 0, 0, 0, 0	
95–105				12	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	
105–117				13	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	
117–120					0, 0, 0	

Broken core / lost core depths: 83.10, 83.60, 84.40, 85.60, 87.00, 94.00, 97.00, 106.40, 107.00, 112.40, 116.20, 117.00, 118.80

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-03

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 1-4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core / Fault/Breccia/Gouge (ft)	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Track Mounted Sonic Drill (6.25") – Sonic	Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*	14	0 (each interval)	123.20, 127.00	Bentonite Grout Mix
125						
130			15	0 (each interval)	129.90, 137.00	
135						
140			16	0 (each interval)	142.00, 143.80, 147.00	
145						
150			17	0 (each interval)	152.60, 157.00	
155					159.30	
160						

Column headings also printed: SYMBOLIC LOG; ELEV. DEPTH (ft); INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-03

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 1-4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling Record: Track Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160	Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		18	0, 0, 0, 0, 0, 0, 0	PelPlug Bentonite Pellets (5 gallons used) 161.80; 162.30; GP#1 Filter Media Sand (12 x 50lb bags used)
167	Fresh, laminated, black, very fine grained, weak, COAL [Pottsville Formation]. [BEDROCK]	167.00	19	0, 0, 0, 0, 0, 0	169.00; 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
172.4	Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK]	172.40	19 / 20	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	172.40; GP#1 Filter Media Sand; 182.00; Hole Plug Bentonite Chips 3/8" (1 x 50lb bags used); 187.00
187	End of Borehole.	187.00			

Depth scale marks: 160, 165, 170, 175, 180, 185, 190, 195, 200

Column headings: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4), RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20), Jn, DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION), J CON, Jr, Ja, Fault/Breccia/Gouge, Lost Core, Broken Core

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-04

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 6 - March 7,2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET; DRILLING RECORD; DESCRIPTION; SYMBOLIC LOG; ELEV. DEPTH (ft); RUN No.; INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4) / ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); FRACTURE INDEX PER RUN; Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core; PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: 0–19 ft: Track Mounted Sonic Drill (12"), Sonic; 19–40 ft: Track Mounted Sonic Drill (6.25"), Sonic

Ground Surface

Depth (ft)	Description	Run No.
0.00	(OL) organic SILT, ~30% organics; olive gray; cohesive, w~PL, soft. [TOPSOIL]	1
0.70	(ML) CLAYEY SILT; some coarse to very fine angular sand; some medium to coarse angular gravel; red orange; cohesive, w~PL, soft. [NATIVE]	1
3.00	(GP/SP) GRAVEL and SAND; fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transition zone. [REGOLITH/SAPROLITE] [WEATHERED BEDROCK]	1
	(BOULDER) Sandstone boulder [WEATHERED BEDROCK]	1
11.40	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	1
14.00	Highly weathered to slightly weathered, thinly to medium bedded, gray, very fine grained, weak to medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	2, 3
34.00	Slightly weathered, thinly to medium bedded, dark gray to very dark gray, very fine grained, medium strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	3

Fracture index per run (each 1 ft interval, 0–40 ft): 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Discontinuity data:

Depth (approx. ft)	Type and Surface Description
20.0	BD,PL,Ro,CC,Fe/He
20.5	BD,PL,Ro,CC,Fe/He
21.0	BD,PL,Ro,CC,Fe/He
21.5	BD,PL,Ro,CC,Fe/He
24.5	JN,PL,Ro,CC,Fe/He

Core markers: 14.00, 20.00, 23.50, 34.00, 35.00

Installation: Concrete Seal and Pad; Bentonite Grout Mix

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-04

SHEET 2 OF 6

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 6 - March 7,2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Track Mounted Sonic Drill (6.25") / Sonic	Slightly weathered, thinly to medium bedded, dark gray to very dark gray, very fine grained, medium strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		4	0, 0, 0	41.00	
		Slightly weathered, thinly to medium bedded, gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. Calamites (possible) fossil at 47' bgs. [BEDROCK]	43.40		0, 0, 0, 0, 0	43.90, 47.60, 48.20	
45							
		Slightly weathered, thinly to medium bedded, dark gray to very dark gray, very fine grained, medium strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	48.50		0, 0	48.90	
50				5	0, 0, 0, 0, 0	51.10, 52.80	
55					0, 0, 0, 0, 0	55.00	Bentonite Grout Mix
60				6	0, 0, 0, 0, 0	60.30	
65					0, 0, 0, 0, 0	65.00	
70				7	0, 0, 0, 0, 0	70.70	
75					0, 0, 0, 0, 0	75.00, 77.80	
80							

Column headings also printed: SYMBOLIC LOG; INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-04

DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: February 6 - March 7,2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Track Mounted Sonic Drill (6.25") Sonic	Slightly weathered, thinly to medium bedded, dark gray to very dark gray, very fine grained, medium strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		8	0, 0, 0, 0	
		Slightly weathered, thinly to medium bedded, gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	83.70		0, 0, 0	
85						
		Slightly weathered to fresh, thinly to medium bedded, dark gray to very dark gray, very fine grained, medium strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	87.10		0, 0, 0	
90				9	0, 0, 0, 0, 0	
95				10	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	Bentonite Grout Mix
100						
105				11	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	
110		Driller notes oil sheen and coal dust to surface.				
115					0, 0, 0, 0, 0	
120						

Broken Core / Lost Core depths: 92.40, 93.40, 93.70, 95.00, 98.50, 99.00, 101.70, 102.20, 105.00, 108.20, 115.00, 119.00

Column headings: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; SYMBOLIC LOG

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-04

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 6 - March 7,2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Track Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Slightly weathered to fresh, thinly to medium bedded, dark gray to very dark gray, very fine grained, medium strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		12	0, 0, 0, 0, 0	
125	Possible coal seam (Lost Core)			0, 0, 0, 0, 0	125.00, 127.30
130			13	0, 0, 0, 0, 0	Bentonite Grout Mix
135	Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK] High carbon content	135.00	14	0, 0, 0, 0, 0	135.00, 139.80
140	Fresh, deep brown, very fine grained, very strong, MUDSTONE [Pottsville ...] Turbulent mudstone beds Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK]	140.20 144.00		0, 0, 0, 0, 0	144.00, 144.40 PelPlug Bentonite Pellets (5 gallons used)
145	Fresh, laminated, black, very fine grained, weak, COAL [Pottsville Formation]. [BEDROCK]		15	0, 0, 0, 0, 0	GP#1 Filter Media Sand (8 x 50lb bags used)
150				0, 0, 0, 0, 0	
155		157.00		0, 0, 0, 0, 0, 0, 0, 0	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen 157.00, 157.80, 159.00
160					

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 6 - March 7,2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160	Track Mounted Sonic Drill (6.25"), Sonic	Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK] *(continued)*		16	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	160.30, 161.30, 162.30; GP#1 Filter Media Sand
165						
170						
175						177.00
180					0 0 0 0 0 0 0	
185		Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. Mudstone infilled fossils. [BEDROCK]	183.80	17	0 0 0 0 0 0 0 0 0 0 0 0 0	Hole Plug Bentonite Chips 3/8" (14.5 x 50lb bags used); 186.80
190						
195		Shale bed at 198.8' bgs.				195.30
200		Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	197.70		0 0 0	

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-04

SHEET 6 OF 6
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: February 6 - March 7,2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200	Track Mounted Sonic Drill (6.25") Sonic	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*			0	Hole Plug Bentonite Chips 3/8" (14.5 x 50lb bags used)
205		Pyrite/pyrrhotite infilled fossils at 201.9' bgs		18	0	
215					0	214.80
					0	217.00
223		Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. Cross bedded grading into SHALY SANDSTONE. [BEDROCK]	223.00		0	
226		Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK]	226.00	19	0	
231					0	231.30
237		End of Borehole.	237.00			237.00

Column headings: SYMBOLIC LOG; INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core.

Depth scale: 200, 205, 210, 215, 220, 225, 230, 235, 240

File:C:\GOLDER\GORGAS\600 PROCESSED DATA\GINT\GORGAS.GPJ Output Form:BC_DRILLHOLE (MINING STD) Template:BC REGION TEMPLATE BETA 2.GDT Library:BC REGION LIBRARY.GLB CLangford 5/25/16

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-05

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1) / WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20) / RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90) / TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0		Ground Surface		0.00												Concrete Seal and Pad
5																
10																
15																
20																Bentonite Grout Mix
25																
30																
35																
40																

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-05

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°　　AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40																			
45																			
50																			
55																			
60																			Bentonite Grout Mix
65																			
70																			
75																			
80																			

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-05

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH R5 R4 R3 R2 R1 / WEATHERING W2 W3 W4 / ALTERATION 2 3 4	RECOVERY: TOTAL CORE % 80 60 40 20 / RQD % 80 60 40 20	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90 / TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80																
85																
90																
95																Bentonite Grout Mix
100																
105																
110																
115																PelPlug Bentonite Pellets (5 gallons used)
120																

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-05

SHEET 4 OF 8

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	INDICES: WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120																			PelPlug Bentonite Pellets (5 gallons used)
125																			
130																			GP#1 Filter Media Sand (10 x 50lb bags used)
135																			
140																			2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
145																			
150																			GP#1 Filter Media Sand
155																			
160																			Hole Plug Bentonite Chips 3/8"

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-05

SHEET 5 OF 8

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160																			
165																			
170																			
175																			
180																			Hole Plug Bentonite Chips 3/8"
185																			
190																			
195																			
200																			

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-05

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH R5 R4 R3 R2 R1 / WEATHERING W2 W3 W4 / ALTERATION 2 3 4	RECOVERY: TOTAL CORE % 80 60 40 20 / RQD % 80 60 40 20	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90 / TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge / Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200															
205															
210															
215															
220															Hole Plug Bentonite Chips 3/8"
225															
230															
235															
240															

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

RECORD OF SONIC HOLE: GS-AP-MW-05

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH R5 R4 R3 R2 R1	WEATHERING W2 W3 W4 / ALTERATION 2 3 4	RECOVERY: TOTAL CORE % 80 60 40 20	RQD % 80 60 40 20	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
240																			
245																			
250																			
255																			
260																			Hole Plug Bentonite Chips 3/8"
265																			
270																			
275																			
280																			

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-05

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
280																
285																
290																
295																
300																Hole Plug Bentonite Chips 3/8"
305																
310																
315																
320																

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

INCLINATION: -90° AZIMUTH: n/a

RECORD OF SONIC HOLE: GS-AP-MW-06D

DRILLING DATE: January 14-18, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

DATUM: Ground Surface

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (7.625") — Sonic

DEPTH (ft)	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.
0	Ground Surface		
	(OL) organic SILT; ~30% organics; olive gray; cohesive, w~PL, soft. [TOPSOIL]	0.00	1
	(ML) CLAYEY SILT; trace medium to fine angular sand; yellowish red; cohesive, w~PL, firm to stiff. [FILL]	0.80	1, 2
	(GP/ML) GRAVEL and CLAYEY SILT; fine to coarse angular gravel; trace medium to fine angular sand; gray to dark grayish brown; cohesive, w~PL, firm to stiff. [FILL]	14.60	2
	Transition zone [FILL]	16.50	3
	(ML) CLAYEY SILT; trace medium to fine angular sand; yellowish red; cohesive, w~PL, firm to stiff. [FILL]	18.50	3
	(GP/ML) GRAVEL and CLAYEY SILT; fine to coarse angular gravel; trace medium to fine angular sand; gray to dark grayish brown; cohesive, w~PL, firm to stiff. [FILL]	26.50	4
	(SP) SAND; fine, rounded; very dark gray; non-cohesive, moist to wet, compact. [NATIVE]	27.50	4, 5
40			

Fracture index per run: 0 throughout (0–40 ft).

Lost core: 4.00 – 5.00; 30.00 – 35.00

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION:

- Concrete Seal and Pad
- Bentonite Grout Mix (50 gallons used)

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DEPTH SCALE

1 in to 5 ft

LOGGED: CDL

CHECKED: CDL

DRAFT

Golder Associates

RECORD OF SONIC HOLE: GS-AP-MW-06D

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 14-18, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4) / ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Sonic (40–41 ft); Truck Mounted Sonic Drill (6.25"), Sonic (41–80 ft)

Depth (ft)	Description	Run No.
40.00	Moderately weathered, thickly bedded, gray, fine to very fine grained, weak, SANDSTONE [Pottsville Formation]. [WEATHERED BEDROCK]	6
41.00	Slightly weathered, thickly bedded, gray, fine to very fine grained, weak to medium strong, SANDSTONE [Pottsville Formation], slightly shaly. [BEDROCK]	7
45.30	Slightly weathered, thickly bedded, gray, fine to very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	
46.40	Slightly weathered, laminated, black, fine to very fine grained, medium strong, SHALE [Pottsville Formation], fissile. [BEDROCK]	
	Slightly weathered, thickly bedded, gray, fine to very fine grained, weak to medium strong, SANDSTONE [Pottsville Formation], slightly shaly. [BEDROCK]	8
58.00	Slightly weathered, laminated, black, fine to very fine grained, medium strong, SHALE [Pottsville Formation], fissile. [BEDROCK]	9
62.00	Slightly weathered, thickly bedded, gray, fine to very fine grained, weak to medium strong, SANDSTONE [Pottsville Formation], slightly shaly. [BEDROCK]	
65.00	Slightly weathered, laminated, black, fine to very fine grained, medium strong, SHALE [Pottsville Formation], fissile. [BEDROCK]	10
71.00	Fresh, massive bedded, gray, fine to very fine grained, strong, SANDSTONE [Pottsville Formation]. Thin black shale beds between 79 and 81' BGS. [BEDROCK]	

Fracture index per run: 0 (each 1-ft interval, 40 to 80 ft)

Discontinuity data:
- 25 x Mech. FX parallel to bedding, Dip ~0
- 37 x Mech. FX parallel to bedding, Dip ~0
- 54 x Mech. FX parallel to bedding, Dip ~0
- 60 x Mech. FX parallel to bedding, Dip ~0

Lost core / broken core depths: 43.20, 45.50, 54.10, 55.00, 73.50, 75.00

Piezometer installation:
- Bentonite Grout Mix (50 gallons used)
- PelPlug Bentonite Pellets (10 gallons used)
- GP#1 Filter Media Sand (4 x 50lb bags used)
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
- GP#1 Filter Media Sand (4 x 50lb bags used)
- Bentonite Chips 3/8"

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-06D

DATUM: Ground Surface

DRILLING DATE: January 14-18, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Fresh, massive bedded, gray, fine to very fine grained, strong, SANDSTONE [Pottsville Formation]. Thin black shale beds between 79 and 81' BGS. [BEDROCK] *(continued)*		11	0, 0, 0, 0, 0	28 x Mech. FX parallel to bedding, Dip ~0		Bentonite Chips 3/8"
85	Fresh, thickly bedded, gray, fine to very fine grained, strong to very strong, SANDSTONE [Pottsville Formation], thin shale interbeds, some dissolution parallel to bedding, some iron oxidation in higher porosity pathways. [BEDROCK]	85.00	12	0, 0, 0, 0, 0, 0, 0, 0	48 x Mech. FX parallel to bedding, Dip ~0		
93.5	Fresh, thickly bedded, very dark grayish brown, very fine grained, strong to very strong, MUDSTONE [Pottsville Formation], fossiliferous with iron oxide and calcite infilling. [BEDROCK]	93.50		0, 0, 0, 0, 0, 0	8 x Mech. FX parallel to bedding, Dip ~0	Lost Core 93.80 – 95.00	
99.2	Fresh, thickly bedded, gray, fine to very fine grained, strong to very strong, SANDSTONE [Pottsville Formation], thin shale interbeds, some dissolution parallel to bedding, some iron oxidation in higher porosity pathways. [BEDROCK]	99.20	13	0, 0, 0, 0, 0, 0	17 x Mech. FX parallel to bedding, Dip ~0	Broken Core 99.20 – 100.00; 104.40	
	Fresh, laminated, black, very fine grained, weak, COAL [Pottsville Formation]. [BEDROCK]						
105	Fresh, thickly bedded, gray, fine to very fine grained, strong to very strong, SANDSTONE [Pottsville Formation], thin shale interbeds, some dissolution parallel to bedding, some iron oxidation in higher porosity pathways. [BEDROCK]	105.00					
110	End of Borehole.						
115							
120							

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-06S

SHEET 1 OF 1

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 19, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0	Track Mounted Sonic Drill (6.25") / Sonic	Ground Surface				
		(OL) organic SILT; ~30% organics; olive gray; cohesive, w~PL, soft. [TOPSOIL]	0.00	1	0	Bentonite Grout Mix (55 gallons used)
		(ML/GP) CLAYEY SILT and GRAVEL; angular coarse gravel; trace medium to fine angular sand; yellowish red; non-cohesive, dry, loose. [FILL]	0.80	1	0	
5		(ML) CLAYEY SILT; trace medium to fine angular sand; yellowish red; cohesive, w<PL, soft to firm. [FILL]	3.50	1	0	
10		Boulder, highly weathered, thickly bedded, gray, very fine grained, weak, SANDSTONE [Pottsville Formation]. [WEATHERED BEDROCK]	8.00	2	0	
		(GP/ML) GRAVEL and SILTY CLAY; fine to coarse angular gravel; trace coarse to fine angular sand; weak red to dark grey brown; cohesive, w<PL, soft to firm. [possible FILL]	9.60	2	0	
15		Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	12.00	2	0	14.40
		Completely decomposed rock (assumed via driller observation). [WEATHERED BEDROCK]	14.40	2/3	0	
20 / 25		Bedrock (assumed via driller observation). [BEDROCK]	21.00	3	0	27.00
		End of Borehole.	27.00			

INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4); ALTERATION (2 3 4) — RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20) — Jn — DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION — J CON — Jr — Ja — Fault/Breccia/Gouge — Lost Core — Broken Core

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-06S(R1)

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 20, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

DESCRIPTION	ELEV. / DEPTH (ft)	RUN No.
Ground Surface		
(OL) organic SILT; ~30% organics; olive gray; cohesive, w~PL, soft. [TOPSOIL]	0.00	1
Crusher Run GRAVEL [ROAD BASE FILL]	0.80	1
(ML) CLAYEY SILT; some fine to medium angular sand; trace fine angular gravel; red to yellowish red; cohesive, w<PL, soft to firm. [FILL]	2.00	1
Boulder, highly weathered, thickly bedded, gray, very fine grained, weak, SANDSTONE [Pottsville Formation]. [WEATHERED BEDROCK]	3.50	1
(ML) CLAYEY SILT; some fine to medium angular sand; trace fine angular gravel; red to yellowish red; cohesive, w<PL, soft to firm. [FILL]	17.30	3
Boulder, highly weathered, thickly bedded, gray, very fine grained, weak, SANDSTONE [Pottsville Formation]. mixed with (ML) CLAYEY SILT, some fine to medium angular sand; trace fine angular gravel; red to yellowish red; cohesive, w<PL, soft to firm. [FILL] [WEATHERED BEDROCK]		3
Boulder, highly weathered, thickly bedded, gray, very fine grained, weak, SANDSTONE [Pottsville Formation]. [WEATHERED BEDROCK]	34.30	4
Boulder, highly weathered, thickly bedded, gray, very fine grained, weak, SANDSTONE [Pottsville Formation]. mixed with (ML) CLAYEY SILT, some fine to medium angular sand; trace fine angular gravel; red to yellowish red; cohesive, w<PL, soft to firm. [FILL] [WEATHERED BEDROCK]	36.20	4

Runs: 1 (0–7 ft), 2 (7–17 ft), 3 (17–27 ft), 4 (27–37 ft). Fracture index per run: 0 throughout (0–40 ft).

WL at EOD - 26' BGS.

Lost core intervals: 5.50–7.00, 17.00–19.30, 27.00–32.10

Piezometer / Standpipe Installation:

- Concrete Seal and Pad
- Bentonite Grout Mix (50 gallons used)
- PelPlug Bentonite Pellets (10 gallons used)
- GP#1 Filter Media Sand (4 x 50lb bags used)
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-06S(R1)

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Sonic	(SM) SILTY SAND, very fine angular sand; gray to dark brown gray; non-cohesive, wet, compact. [NATIVE] *(continued)*		5	0 0 0 0	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
		Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	43.50 44.00			
45						
		End of Borehole.				
50						
55						
60						
65						
70						
75						
80						

Column headings also printed: SYMBOLIC LOG; INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-07

SHEET 1 OF 4
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: January 18-26, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Depth (ft)	Drilling Record	Description	Elev. Depth (ft)	Run No.	Fracture Index per Run	Jn	Discontinuity Data	Piezometer, Standpipe or Thermistor Installation
0		Ground Surface						
0–3	Track Mounted Sonic Drill (8") / Sonic	(GP/ML) GRAVEL and CLAYEY SILT, fine to coarse angular gravel; trace coarse to fine angular sand; yellowish red to strong brown; cohesive, w~PL, soft to firm. [FILL]	0.00		0, 0, 0			Concrete Seal and Pad
3–6		(GP/ML) GRAVEL and CLAYEY SILT, fine to coarse angular gravel; trace coarse to fine angular sand; yellowish red to strong brown; cohesive, w~PL, soft to firm. [FILL]	3.00	1	0, 0, 0			
6–20		(SP) SILTY SAND, fine to very fine angular sand; reddish yellow; cohesive, w~PL, firm to stiff. [FILL]	6.00	2, 3	0 (each 1 ft interval)			
20–21		Crusher Run GRAVEL and CEMENT [ROAD BASE FILL]	20.00		0			Bentonite Grout Mix (80 gallons used)
21–27		Highly weathered to completely weathered, thinly bedded, light gray, fine to very fine grained, weak to medium strong, SANDSTONE [Pottsville Formation]. [WEATHERED BEDROCK]	21.00	4, 5	0, 0, 0, 0, 0, 0			21.00
27–31		Fresh, thinly bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation], thin shale interbeds. [BEDROCK]	27.00	6	0, 0, 0, 0		31 x Mech. FX parallel to bedding, Dip ~0	27.00, 28.70
31–40	Track Mounted Sonic Drill (6.25") / Sonic	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	31.00	6	0, 0, 0, 0, 0, 0, 0, 0, 0	4	10 x Mech. FX parallel to bedding, Dip ~0; 10 x Mech. FX parallel to bedding, Dip ~0	

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-07

SHEET 2 OF 4
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: January 18-26, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Track Mounted Sonic Drill (6.25") — Sonic

ELEV. DEPTH (ft)	DESCRIPTION
	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*
45.50	Fresh, thinly bedded, gray, very fine grained, strong, MUDSTONE/SILTSTONE [Pottsville Formation], fossiliferous plants with iron oxide infilling. [BEDROCK]
47.50	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]
49.60	Fresh, thinly bedded, gray, very fine grained, strong, MUDSTONE/SILTSTONE [Pottsville Formation], fossiliferous plants with iron oxide infilling. [BEDROCK]
52.70	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]
55.00	Fresh, thinly bedded, gray, very fine grained, strong, MUDSTONE/SILTSTONE [Pottsville Formation], fossiliferous plants with iron oxide infilling. Shaly beds from 59' to 60.5'. [BEDROCK]
64.60	Fresh, thinly bedded to laminated, gray, very fine grained, strong, shaly MUDSTONE/SILTSTONE [Pottsville Formation], fossiliferous plants with iron oxide infilling. [BEDROCK]
67.00	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. Shaly beds from 69.3' to 70.3' bgs. Shaly beds and FeOx staining from 74' to 76.4' bgs. FeOx staining from 83.7' to 85.3'. Coral/shell fossils at 94' bgs. [BEDROCK]

RUN No.	Jn
7	4
8	2
9	
10	

FRACTURE INDEX PER RUN (per ft, 40–80 ft): 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja
BD,PL,Ro,CC,Fe/He	20	1.5	3
BD,PL,Ro,CC,Fe/He	20	1.5	3
BD,PL,Ro,CC,Fe/He	20	1.5	3
26 x Mech. FX parallel to bedding, Dip ~0			
JN,PL,Ro,CC,Shaly	20	3	1
14 x Mech. FX parallel to bedding, Dip ~0			
47 x Mech. FX parallel to bedding, Dip ~0			
29 x Mech. FX parallel to bedding, Dip ~0			
56 x Mech. FX parallel to bedding, Dip ~0			
Dissolution pathway parallel to bedding.			

Lost Core / Broken Core depths: 48.50, 49.20, 52.00, 55.00, 56.00, 57.00, 62.20, 62.70, 66.50, 76.40, 77.00

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION:
Bentonite Grout Mix (80 gallons used)
PelPlug Bentonite Pellets (5

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-07

DRILLING DATE: January 18-26, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Depth scale: 80, 85, 90, 95, 100, 105, 110, 115, 120

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Description: Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. Shaly beds from 69.3' to 70.3' bgs. Shaly beds and FeOx staining from 74' to 76.4' bgs. FeOx staining from 83.7' to 85.3'. Coral/shell fossils at 94' bgs. [BEDROCK] *(continued)*

Run No.: 11, 12, 13, 14

Fracture index per run: 0 (each interval, 80 to 120 ft)

Discontinuity data:
- 51 x Mech. FX parallel to bedding, Dip ~0
- Mech. FX parallel to bedding, Dip ~0

Broken core depths: 88.00, 88.90, 89.90, 93.10, 95.00, 96.70, 97.00, 100.90, 103.30, 104.20, 107.00, 107.20, 112.00, 117.00, 119.50

Installation:
- gallons used)
- PelPlug Bentonite Pellets (5 gallons used)
- GP#1 Filter Media Sand (10 x 50lb bags used)
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
- GP#1 Filter Media Sand
- Hole Plug Bentonite Chips 3/8" (1 x 50lb bags used)

CONTINUED NEXT PAGE

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 18-26, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4) / ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Elev. Depth (ft)	Run No.
120–127.60	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. Shaly beds from 69.3' to 70.3' bgs. Shaly beds and FeOx staining from 74' to 76.4' bgs. FeOx staining from 83.7' to 85.3'. Coral/shell fossils at 94' bgs. [BEDROCK] *(continued)*		15
127.60–132.30	Fresh, thickly bedded, gray, fine to very fine grained, strong to very strong, SANDSTONE [Pottsville Formation], thin shale interbeds, some dissolution parallel to bedding, some iron oxidation in higher porosity pathways. [BEDROCK]	127.60	16
132.30–143.60	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	132.30	17
143.60–144.00	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	143.60	
144.00–147.00	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	144.00	
147.00–150.40	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	147.00	18
150.40–152.80	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, strong, shaly SANDSTONE [Pottsville Formation]. [BEDROCK]	150.40	
152.80–157.00	Fresh, thickly to massive bedded, gray to dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	152.80	
157.00	End of Borehole.	157.00	

Fracture index per run: 0 at every interval from 120 to 157 ft.

Lost core / broken core depths: 127.00, 127.60, 132.30, 136.50, 137.00, 142.60, 144.00, 147.00, 149.40, 150.40, 156.30, 157.00

Piezometer installation: Hole Plug Bentonite Chips 3/8" (1 x 50lb bags used)

Depth scale markers: 120, 125, 130, 135, 140, 145, 150, 155, 160

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-08

SHEET 1 OF 4
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: January 20 - February 26, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4) / ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Track Mounted Sonic Drill (12") – Sonic (0 to 14 ft); Track Mounted Sonic Drill (6.25") – Sonic (14 to 40 ft)

Ground Surface

Depth (ft)	Description
0.00	(OL) organic SILT; ~30% organics; olive gray; cohesive, w~PL, soft. [TOPSOIL]
0.70	(SP) SAND; fine to very fine angular sand; trace silt, trace fine angular gravel; yellowish brown; non-cohesive, dry, loose. [NATIVE]
3.30	(ML) SILT; some fine to very fine angular sand; trace fine angular gravel; light red; cohesive, w<PL, firm. Some coarse gravel from 7.2' to 7.5'. [NATIVE]
10.20	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]
11.70	Decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]
13.00	Completely weathered to fresh, thinly bedded, gray, very fine grained, very weak to strong, SANDSTONE [Pottsville Formation], Iron oxide weathering. [BEDROCK]

Run No.: 1 (0–5 ft); 2 (5–13 ft); 3 (13–15 ft); 4 (15–25 ft); 5 (25–27 ft); 6 (27–37 ft)

Fracture index per run (1-ft intervals, 0 to 40 ft): 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, 3, 1, 5, 3, 2, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Type and Surface Description	J CON	Jr	Ja
BD,PL,Ro,CC,Fe/He	12	3	3
BD,PL,Ro,CC,Fe/He	12	3	3
BD,PL,SM,CC,Fe/He	12	3	3
BD,PL,Ro,CC,Fe/He	12	3	3
JN,PL,Ro,CC,Fe/He	12	4	2
BD,PL,VR,CC,Fe/He	12	3	1.5
BD,PL,Ro,CC,Fe/He	12	3	3
BD,PL,VR,CC,Fe/He	12	3	3
BD,PL,VR,CC,Fe/He	12	3	3
BD,PL,VR,CC,Fe/He	12	3	3
BD,PL,SM,CC,Fe/He	12	3	3
BD,PL,SM,CC,Fe/He	12	3	3
BD,PL,Ro,CC,Fe/He	12	3	3
JN,ST,VR,CC,Fe/He	12	3	2
JN,CU,VR,CC,Fe/He	12	3	2

Broken core / lost core depths: 13.00, 14.10, 14.70, 17.20, 17.50, 20.40, 21.30, 22.10, 23.60, 25.00

Piezometer installation: Concrete Seal and Pad; Bentonite Grout Mix; PelPlug Bentonite Pellets (5 gallons used); GP#1 Filter Media Sand (14 x 50lb

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

File:C:\GOLDER\GORGAS\600 PROCESSED DATA\GINT\GORGAS.GPJ Output Form:BC_DRILLHOLE (MINING STD) Template:BC REGION TEMPLATE BETA 2.GDT Library:BC REGION LIBRARY.GLB CLangford 5/25/16

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-08

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 20 - February 26, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	J_{CON}	Jr	Ja	Lost / Broken Core (depths)	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Completely weathered to fresh, thinly bedded, gray, very fine grained, very weak to strong, SANDSTONE [Pottsville Formation], Iron oxide weathering. [BEDROCK] *(continued)*		7	0, 0, 0, 0					40.00	bags used)
				2	JN,CU,VR,CC,Fe/He	12	4	2	43.00	
45				0, 0					47.00	
			8	0, 0					47.70, 48.40, 48.90	
	Moderately weathered, thinly bedded, gray, very fine grained, strong, altered SANDSTONE [Pottsville Formation]. [BEDROCK]	48.90		0						
50	Fresh, thinly bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	50.10		0					50.30	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
	Slightly weathered to fresh, thinly bedded to laminated, gray, very fine grained, medium strong, shaly SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. [BEDROCK]	51.20		0, 0, 0, 0					53.90	
55				0, 0					57.00	
60			9	0, 0, 0, 0, 0, 0, 0					63.50	
65				0, 0, 0					67.00	
70			10	0, 0, 0, 0, 0, 0, 0, 0, 0, 0					74.40, 75.00, 77.00	GP#1 Filter Media Sand
75										
80			11	0, 0, 0						

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-08

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 20 - February 26, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Track Mounted Sonic Drill (6.25") — Sonic

DEPTH (ft)	DESCRIPTION	RUN No.	DISCONTINUITY DATA
80.00	Fresh, thinly bedded to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. Mudstone replacement of fossils. [BEDROCK]	12	
82.60	Fresh, laminated, black, very fine grained, weak, COAL [Pottsville Formation]. [BEDROCK] Driller noted soft zone ~5' thick at 83' bgs.	12	
88.20	Fresh, thinly bedded to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. Mudstone replacement of fossils and thin shale beds. [BEDROCK]	12	
94.00	Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. [BEDROCK]	12	
96.00	Fresh, thinly bedded to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. Mudstone replacement of fossils and thin shale beds. [BEDROCK]	12 / 13 (from 105)	JN,PL,SM,CC,Ca (~108)
109.00	Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. [BEDROCK]	13	
114.90	Lost Core.	13	

Fracture index per run: 0 for all intervals 80–120 ft, except 1 at 108–109 ft.

Lost core / broken core intervals: 82.60, 82.90, 87.90, 97.30, 105.00, 107.00, 107.70, 112.50, 114.90

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION: GP#1 Filter Media Sand; Hole Plug Bentonite Chips 3/8"

CONTINUED NEXT PAGE

DEPTH SCALE 1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-08

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 20 - February 26, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1) / WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Sonic	Lost Core. *(continued)*							0								Lost Core	Hole Plug Bentonite Chips 3/8"
									0									
									0									
									0									
									0									
125		End of Borehole.		125.00														125.00
130																		
135																		
140																		
145																		
150																		
155																		
160																		

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-09

SHEET 1 OF 8

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
		Ground Surface																	
0				0.00															Concrete Seal and Pad
5																			
10																			
15																			
20																			Bentonite Grout Mix
25																			
30																			
35																			
40																			

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL **DRAFT**

RECORD OF SONIC HOLE: GS-AP-MW-09

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40																			
45																			
50																			
55																			
60																			Bentonite Grout Mix
65																			
70																			
75																			
80																			

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No.

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4); ALTERATION (2 3 4)

RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20)

FRACTURE INDEX PER RUN | Jn

DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja

Fault/Breccia/Gouge | Lost Core | Broken Core

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Depth scale: 80, 85, 90, 95, 100, 105, 110, 115, 120

PelPlug Bentonite Pellets (5 gallons used)

GP#1 Filter Media Sand (10 x 50lb bags used)

2" PVC Sch 40 0.010 Slot PrePack Threaded Screen

GP#1 Filter Media Sand

Hole Plug Bentonite Chips 3/8"

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-09

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120																			
125																			
130																			
135																			
140																			Hole Plug Bentonite Chips 3/8"
145																			
150																			
155																			
160																			

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-09

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°

AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1) / WEATHERING (W2 W3 W4) ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20) / RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90) / TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160																
165																
170																
175																
180																Hole Plug Bentonite Chips 3/8"
185																
190																
195																
200																

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-09

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°

AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200																			
205																			
210																			
215																			
220																			Hole Plug Bentonite Chips 3/8"
225																			
230																			
235																			
240																			

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-09

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1) / WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
240																		
245																		
250																		
255																		
260																		Hole Plug Bentonite Chips 3/8"
265																		
270																		
275																		
280																		

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-09

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
280																			
285																			
290																			
295																			
300																			Hole Plug Bentonite Chips 3/8"
305																			
310																			
315																			
320																			

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-10

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 21, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling Record

Depth (ft)	Drilling Record
0 – 14	Truck Mounted Sonic Drill (12"), Sonic
14 – 40	Truck Mounted Sonic Drill (6.25"), Sonic

Description

Depth (ft)	Description
0.00	Ground Surface
0.00 – 0.40	(OL) organic SILT; ~30% organics; olive gray; cohesive, w~PL, soft. [TOPSOIL]
0.40 – 1.40	(ML) SILT; some coarse to fine angular sand; some fine angular gravel; red orange; cohesive, w~PL, soft. [NATIVE]
1.40 – 2.60	(SP) SAND; fine angular sand; buff; non-cohesive, dry, very loose. [NATIVE]
2.60 – 8.00	(GP/SP) GRAVEL and SAND; fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transition zone. [WEATHERED BEDROCK]
8.00 – 13.00	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]
13.00 – 25.00	Completely weathered to moderately weathered, thinly bedded to laminated, gray, very fine grained, very weak to weak, SANDSTONE/SILTSTONE [Pottsville Formation], Iron oxide weathering parallel to bedding. [BEDROCK]
25.00 –	Moderately weathered to fresh, thinly bedded to laminated, dark gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK]

Runs

Run No.	Depth (ft)	Jn
1	0 – 14	
2	14 – 24	9
3	24 – 27	
4	27 – 37.3	

Fracture Index per Run (per 1 ft interval, 0 – 40 ft)

Depth (ft)	0–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10
0 – 10	0	0	0	0	0	0	0	0	0	0
10 – 20	0	0	0	0	0	3	3	0	1	1
20 – 30	0	0	0	0	0	0	0	0	0	0
30 – 40	0	0	0	0	0	0	0	0	0	0

Discontinuity Data

Type and Surface Description	J CON	Jr	Ja
BD,PL,Ro,CC,Fe/He	12	1.5	2
BD,PL,Ro,CC,Fe/He	12	1.5	2
JN,CU,Ro,CC,Fe/He	12	3	2
BD,PL,Ro,CC,Fe/He	12	1.5	2
BD,PL,Ro,CC,Fe/He	12	1.5	2
JN,CU,Ro,CC,Fe/He	12	3	2
BD,PL,Ro,CC,Fe/He	12	1.5	2
BD,PL,Ro,CC,Fe/He	12	1.5	2

Broken Core / Lost Core Depths (ft)

14.00, 14.50, 15.40, 17.40, 18.00, 18.50, 19.60, 20.50, 21.20, 21.70, 22.20, 22.70, 24.00, 27.00, 37.30, 38.30, 39.30

Piezometer Installation

Concrete Seal and Pad

Bentonite Grout Mix

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-10

SHEET 2 OF 5

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 21, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	TOTAL CORE %	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jcon	Jr	Ja	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Truck Mounted Sonic Drill (6.25") / Sonic	Moderately weathered to fresh, thinly bedded to laminated, dark gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*	5		0, 0, 0, 1, 0, 0, 0	BD,PL,Ro,CC,Fe/He	12	1.5	2	39.80
45–55			6		0, 0, 0, 0, 0, 0, 0, 0, 0, 0					
55–65			7		0, 0, 0, 0, 0, 0, 0, 0, 0, 0					Bentonite Grout Mix; 62.30
65–75			8		0, 0, 0, 0, 0, 0, 0, 0, 0, 0					72.10; 72.70
75–80			9	133	0, 0, 0					

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL
DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-10

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 21, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly bedded to laminated, very dark gray to black with depth, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	80.00	10	0	
85		Driller notes large volume of coal dust in cuttings from ~85 to ~90.			0	85.50
90					0	
95					0	Bentonite Grout Mix
100					0	
105				11	0	105.00
110		Driller notes hard drilling resulting in loss of core due to vibration and rock type.			0	111.60
115					0	PelPlug Bentonite Pellets (5 gallons used)
120					0	GP#1 Filter Media Sand (12 x 50lb bags used)

Column headings: SYMBOLIC LOG; INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-10

SHEET 4 OF 5
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: January 21, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly bedded to laminated, very dark gray to black with depth, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*				0, 0, 0, 0, 0	
125						0, 0, 0, 0, 0	
130		Driller notes extreme loss of core due to loose metal fragments from broken bit at bottom of hole. 125'-177'			12	0, 0, 0, 0, 0	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
135						0, 0, 0, 0, 0	137.00, 137.70, 139.00
140						0, 0, 0, 0, 0	
145					13	0, 0, 0, 0, 0	GP#1 Filter Media Sand
150						0, 0, 0, 0, 0	
155						0, 0, 0, 0, 0	Hole Plug Bentonite Chips 3/8" 157.00
160							160.00

Column headings also include: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4), RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20), Jn, DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION), J CON, Jr, Ja, Fault/Breccia/Gouge, Lost Core, Broken Core.

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-10

SHEET 5 OF 5

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 21, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly bedded to laminated, very dark gray to black with depth, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*			14	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	163.20; Hole Plug Bentonite Chips 3/8"; 177.00
165							
170							
175							
		End of Borehole.		177.00			
180							
185							
190							
195							
200							

Column headings also printed: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4), RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20), Jn, DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION), J CON, Jr, Ja, Fault/Breccia/Gouge, Lost Core, Broken Core

DEPTH SCALE

1 in to 5 ft

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-11

DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: January 21 - February 4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4) / ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION | J_{CON} | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (12") – Sonic (0 to 19.00 ft); Track Mounted Sonic Drill (6.25") – Sonic (19.00 to 40 ft)

ELEV. DEPTH (ft)	DESCRIPTION
0	Ground Surface
0 – 0.40	(OL) organic SILT; ~30% organics; olive gray; cohesive, w~PL, soft. [TOPSOIL]
0.40 – 3.80	(ML) SILT; some coarse to fine angular sand; some fine angular gravel; red orange; cohesive, w~PL, soft. [NATIVE]
3.80 – 8.00	(GP/SP) GRAVEL and SAND; fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transition zone. [WEATHERED BEDROCK]
8.00 – 18.40	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]
18.40 – 19.00	Moderately weathered to slightly weathered, medium bedded to laminated, dark gray to yellow, fine to very fine grained, weak, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]
19.00 – 19.50	Completely weathered, medium bedded to laminated, dark gray to yellow, fine to very fine grained, extremely weak to very weak, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]
19.50 – 24.00	Moderately weathered to slightly weathered, medium bedded to laminated, dark gray to yellow, fine to very fine grained, weak, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]
24.00 – 40	Slightly weathered, thinly to medium bedded, gray, very fine grained, medium strong to strong, SANDSTONE [Pottsville Formation], with shaly beds. [BEDROCK]

RUN No.: 1, 2, 3

FRACTURE INDEX PER RUN (per 1 ft, 0 to 40 ft): 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 4, 2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Jn: 6

TYPE AND SURFACE DESCRIPTION	J_{CON}	Jr	Ja
BD,PL,Ro,CC,Fe/He	12	1.5	2
JN,CU,VR,CC,Fe/He	12	3	2
JN,CU,VR,CC,Fe/He	12	3	2
JN,CU,VR,CC,Fe/He	12	3	2
BD,PL,Ro,CC,Fe/He	12	1.5	2
BD,PL,Ro,CC,Fe/He	12	1.5	2
BD,PL,SM,CC,Fe/He	12	1	2
BD,PL,SM,CC,Fe/He	12	1	2

Lost Core / Broken Core depths: 14.00, 18.40, 19.00, 19.60, 27.00, 35.70, 37.00

Installation: Concrete Seal and Pad; Bentonite Grout Mix

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-11

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 21 - February 4, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4) / ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Elev. Depth (ft)
40	Slightly weathered, thinly to medium bedded, gray, very fine grained, medium strong to strong, SANDSTONE [Pottsville Formation], with shaly beds. [BEDROCK] *(continued)*	
57.00	Slightly weathered, thinly to medium bedded, gray, very fine grained, medium strong to strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	57.00
58.50	Slightly weathered, medium bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	58.50
65.00	Fresh, massive bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	65.00
68.20	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	68.20
~73.5	Clean SANDSTONE bed ~0.2' thick.	
~77	Mixed turbulent bedding from ~76.5' to ~79' bgs.	

Run No.: 4 (to 47.0 ft), 5 (47.0–57.0 ft), 6 (57.0–67.0 ft), 7 (67.0–77.0 ft), next run from 77.0 ft.

Fracture index per run: 0 at each interval from 40 to 80 ft, except 1 at ~68.5 ft.

Discontinuity at ~68.3 ft: JN,PL,SM,CC,Fe/He — J CON 12, Jr 1.5, Ja 2

Fault/Breccia/Gouge: 51.20 – 52.30

Broken core interval depths: 47.00, 51.20, 52.30, 59.20, 60.00, 62.10, 62.70, 65.50, 67.00, 68.20

Installation: Bentonite Grout Mix

Depth scale: 40, 45, 50, 55, 60, 65, 70, 75, 80

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-11

SHEET 3 OF 4
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: January 21 - February 4, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Track Mounted Sonic Drill (6.25") / Sonic	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*	8	0, 0, 0, 0, 0, 0, 0	35 x Mech. FX parallel to bedding, Dip ~0				
85–95			9	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	High-angle FeOx staining, possible joint. 30 x Mech. FX parallel to bedding, Dip ~0				Bentonite Grout Mix
95–105			10	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	28 x Mech. FX parallel to bedding, Dip ~0				PelPlug Bentonite Pellets (5 gallons used)
105–117		Driller notes oil sheen and coal dust to surface.	11	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	18 x Mech. FX parallel to bedding, Dip ~0				GP#1 Filter Media Sand (16 x 50lb bags used); 110.00; 114.70; 117.00
117–120		Possible coal seam (Lost Core)	12	0, 1, 0	JN,PL,VR,CC,Fe/He, 2	6	3	2	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
120									

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-11

SHEET 4 OF 4

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 21 - February 4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Track Mounted Sonic Drill (6.25") / Sonic	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		13	0 0 0 0 0 0 0	8 x Mech. FX parallel to bedding, Dip ~0	125.50 ; 127.00 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
130				14	0 0 0 0 0 0 0 0 0 0	10 x Mech. FX parallel to bedding, Dip ~0	134.00
135		Possible coal seam (Lost Core)					137.00 GP#1 Filter Media Sand ; 140.00 ; 142.40
143.4		Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. Increasingly shaly with depth. [BEDROCK]	143.40	15	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		144.00 Hole Plug Bentonite Chips 3/8" (2 x 50lb bags used) ; Collapsed Rock Fill ; 155.00
155		End of Borehole.	155.00				
160							

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-12

SHEET 1 OF 9

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4	RECOVERY: TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0		Ground Surface		0.00												Concrete Seal and Pad
5																
10																
15																
20																Bentonite Grout Mix
25																
30																
35																
40																

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-12

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	INDICES: WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40																			
45																			
50																			
55																			
60																			Bentonite Grout Mix
65																			
70																			
75																			
80																			

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-12

SHEET 3 OF 9

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4 / ALTERATION 2 3 4	RECOVERY: TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80																
85																
90																
95																
100																Bentonite Grout Mix
105																
110																
115																
120																

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-12

SHEET 4 OF 9

LOCATION: Rattlesnake Lake - Gorgas

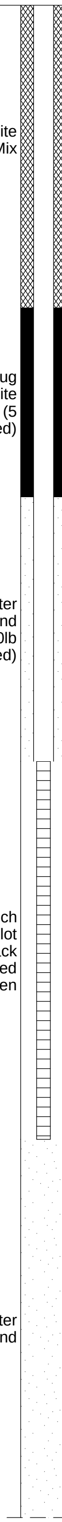
DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	INDICES: WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120																			Bentonite Grout Mix
125																			
130																			PelPlug Bentonite Pellets (5 gallons used)
135																			GP#1 Filter Media Sand (11 x 50lb bags used)
140																			
145																			2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
150																			
155																			GP#1 Filter Media Sand
160		*CONTINUED NEXT PAGE*																	

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.



DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

RECORD OF SONIC HOLE: GS-AP-MW-12

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160																			
165																			
170																			
175																			
180																			Hole Plug Bentonite Chips 3/8"
185																			
190																			
195																			
200																			

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4	RECOVERY: TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200																
205																
210																
215																
220																Hole Plug Bentonite Chips 3/8"
225																
230																
235																
240																

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
240																
245																
250																
255																
260																Hole Plug Bentonite Chips 3/8"
265																
270																
275																
280		*CONTINUED NEXT PAGE*														

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-12

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°

AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
280																			
285																			
290																			
295																			
300																			Hole Plug Bentonite Chips 3/8"
305																			
310																			
315																			
320																			

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-12

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

SHEET 9 OF 9

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
320																			
325																			
330																			Hole Plug Bentonite Chips 3/8"
335																			
340																			
345																			
350																			
355																			
360																			

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-13

SHEET 1 OF 5

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 25 - February 4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	BROKEN CORE / LOST CORE	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0	Track Mounted Sonic Drill (12") Sonic	Ground Surface				
0		(GP/SP) GRAVEL and SAND; fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transition zone. [WEATHERED BEDROCK]	0.00	1		Concrete Seal and Pad
6		Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	6.00		14.00	
10	Track Mounted Sonic Drill (6.25") Sonic			2	19.20	
19.2		Highly weathered, medium bedded to laminated, very dark gray, fine to very fine grained, very weak, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	19.20			Bentonite Grout Mix (50 gallons used)
21.4		Slightly weathered, medium bedded to laminated, very dark gray, fine to very fine grained, weak, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	21.40			
25		Slightly weathered, medium bedded to laminated, very dark gray, fine to very fine grained, medium strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]			25.40, 27.60, 29.60	
30		Bedding plane ~0 weathering, possible flow zone.		3	30.00, 31.20, 33.00, 35.00, 35.50, 37.00, 37.50, 38.60	

FRACTURE INDEX PER RUN: 0 for all intervals from 0 to 40 ft.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-13

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 25 - February 4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	Fracture/Break Depths	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Track Mounted Sonic Drill (6.25") Sonic	Slightly weathered, medium bedded to laminated, very dark gray, fine to very fine grained, medium strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)* Bedding plane ~0 weathering, possible flow zone at 40.5' bgs.		4	40.70, 41.30, 42.00	
45		Slightly weathered, medium bedded to laminated, very dark gray, fine to very fine grained, strong to medium strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	45.00	5	45.00, 48.50, 48.80, 49.40, 53.80, 55.00	
55–65				6	64.20, 65.00	Bentonite Grout Mix (50 gallons used)
65		Slightly weathered, medium bedded to laminated, very dark gray, fine to very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	65.00	7	74.50	
75		Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	75.00		75.00, 75.50	
80						

Fracture Index per run: 0 at every interval from 40 to 80 ft.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-13

SHEET 3 OF 5
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: January 25 - February 4, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	Fault/Breccia/Gouge / Lost Core / Broken Core (depths)	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Track Mounted Sonic Drill (6.25"), Sonic	Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*	8	0, 0, 0, 0, 0	82.40, 84.10	PelPlug Bentonite Pellets (10 gallons used)
85				0, 0, 0, 0, 0	85.00, 85.80, 86.10, 86.80, 88.00, 88.70	GP#1 Filter Media Sand (4 x 50lb bags used)
90			9	0, 0, 0, 0, 0	91.40	
95		Small vertical fracture with FeOx staining.		0, 0, 0, 0, 0	95.00, 99.50	
100			10	0, 0, 0, 0, 0	99.75, 103.35	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
105				0, 0, 0, 0, 0	105.00	
110		Bioturbation - burrow casts	11	0, 0, 0, 0, 0	109.80, 111.00	
115				0, 0, 0, 0, 0	115.00	GP#1 Filter Media Sand (4 x 50lb bags used)
120						

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-13

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 25 - February 4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Run No.
120	Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*	12
125		
130		13
135	Driller notes oil sheen and coal dust to surface.	
140		14
145		
150	Possible coal seam (Lost Core)	15
155		
160	Possible coal seam (Lost Core)	

Fracture index per run: 0 for each interval from 120 to 160 ft.

Core condition depths (ft): 120.10, 121.40, 125.00, 128.55, 131.45, 137.50, 138.20, 142.50, 145.00, 147.10, 153.20, 153.90, 155.00, 157.70, 158.40

Installation: Bentonite Chips 3/8"

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-13

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 25 - February 4, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Lost / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160	Track Mounted Sonic Drill (6.25") / Sonic	Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		16	0, 0, 0, 0, 0	162.90, 163.40	Bentonite Chips 3/8"
165–180				17	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	167.30, 169.00, 169.80, 171.30, 173.80, 180.00	
180		End of Borehole.	180.00				

Column headings: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; SYMBOLIC LOG.

Depth scale: 160, 165, 170, 175, 180, 185, 190, 195, 200

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-14

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

SHEET 1 OF 6
DATUM: Ground Surface

DRILLING DATE: January 27-30, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Columns: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | DISCONTINUITY DATA: Jn, DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION, J CON, Jr, Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (12") – Sonic (0 to 10 ft); Truck Mounted Sonic Drill (6.25") – Sonic (10 to 40 ft)

Depth (ft)	Description
	Ground Surface
0.00	Crusher Run GRAVEL [ROAD BASE FILL]
0.90	(ML) CLAYEY SILT; trace medium to fine angular sand; yellowish red; cohesive, w<PL, soft. [FILL]
3.40	(OL) organic SILT; ~30% organics; olive gray; cohesive, w<PL, soft. [TOPSOIL]
	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]
6.00	Slightly weathered to fresh, massive bedded, gray, fine to very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]
22.80	Fresh, thickly bedded to laminated, very dark gray, very fine grained, strong, shaly SANDSTONE [Pottsville Formation]. Dense shale beds. [BEDROCK]
24.00	Slightly weathered to fresh, massive bedded, gray, fine to very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]
26.00	Fresh, thickly bedded to laminated, fissile, very dark gray, very fine grained, strong, shaly SANDSTONE [Pottsville Formation]. [BEDROCK]
33.20	Fresh, massive bedded, gray, fine to very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]
33.80	Fresh, thickly bedded to laminated, fissile, very dark gray, very fine grained, strong, shaly SANDSTONE [Pottsville Formation]. [BEDROCK]

Run No.: 1 (0–6 ft), 2 (6–14 ft), 3 (14–24 ft), 4 (24–34 ft), 5 (34–40 ft)

Fracture index per run (each 1 ft interval, 0 to 40 ft): 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Discontinuity at ~7 ft: BD,ST,Ro,CC,Fe/He | J CON 12 | Jr 3 | Ja 2

32 x Mech. FX parallel to bedding, Dip ~0

Broken core intervals: 24.00, 25.60, 27.40, 31.70, 32.60, 33.10, 34.00, 34.80, 36.10, 36.90, 39.40

Installation: Concrete Seal and Pad; Bentonite Grout Mix (50 gallons used)

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

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DRILLING DATE: January 27-30, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Broken / Lost Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Truck Mounted Sonic Drill (6.25"), Sonic	Fresh, thickly bedded to laminated, fissile, very dark gray, very fine grained, strong, shaly SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*			0, 0, 0, 0		40.70	
45				6	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	24 x Mech. FX parallel to bedding, Dip ~0	43.50, 44.00, 45.90	
50								
55				7	0, 0, 0, 0, 0, 0, 0, 0, 0, 0		53.40, 54.00, 54.70	
60							59.40, 60.00	Bentonite Grout Mix (50 gallons used)
		Fresh, thickly bedded to laminated, dark gray to very dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with shale beds and mudstone interbeds. [BEDROCK]	62.00				61.50	
65				8	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	24 x Mech. FX parallel to bedding, Dip ~0	64.00	
70							72.90, 74.00	
75				9	0, 0, 0, 0, 0, 0	38 x Mech. FX parallel to bedding, Dip ~0		
80								

CONTINUED NEXT PAGE

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 27-30, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. / DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Truck Mounted Sonic Drill (6.25") / Sonic	Fresh, thickly bedded to laminated, dark gray to very dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with shale beds and mudstone interbeds. [BEDROCK] *(continued)*			0, 0, 0, 0			Bentonite Grout Mix (50 gallons used)
85		Fresh, thickly bedded to laminated, dark gray to very dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with few shale beds and mudstone interbeds. [BEDROCK]	84.00	10	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	8 x Mech. FX parallel to bedding, Dip ~0	93.20 – 94.00 (lost core)	
95				11	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	10 x Mech. FX parallel to bedding, Dip ~0		
105				12	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	30 x Mech. FX parallel to bedding, Dip ~0	104.00 – 104.50; 107.10 – 107.60; 113.10 (broken core)	
115				13	0, 0, 0, 0, 0, 0	24 x Mech. FX parallel to bedding, Dip ~0	114.00 – 115.00 (broken core)	
120								

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PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-14

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 27-30, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Depth scale: 120, 125, 130, 135, 140, 145, 150, 155, 160

Drilling record: Truck Mounted Sonic Drill (6.25"); Sonic

Depth (ft)	Description	Elev. Depth (ft)
120 – 155.60	Fresh, thickly bedded to laminated, dark gray to very dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with few shale beds and mudstone interbeds. [BEDROCK] *(continued)*	
155.60 – 160	Fresh, thickly bedded to laminated, dark gray to very dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with prominent shale beds and mudstone interbeds. [BEDROCK]	155.60

Run No.	Fracture Index per Run	Discontinuity Data
14	0 0 0 0 0 0 0 0 0 0	19 x Mech. FX parallel to bedding, Dip ~0
15	0 0 0 0 0 0 0 0 0 0	28 x Mech. FX parallel to bedding, Dip ~0
16	0 0 0 0 0 0 0 0 0 0	18 x Mech. FX parallel to bedding, Dip ~0
17	0 0 0 0 0 0	13 x Mech. FX parallel to bedding, Dip ~0

Lost core / broken core depths: 129.00, 130.40, 134.40, 135.10, 143.30, 144.00, 144.50, 148.70, 150.70, 151.20, 154.00, 154.70, 155.70, 158.20, 158.80, 160.00

Piezometer installation: Bentonite Grout Mix (50 gallons used)

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-14

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 27-30, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Elev. Depth (ft)	Run No.
160–174	Fresh, thickly bedded to laminated, dark gray to very dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with prominent shale beds and mudstone interbeds. [BEDROCK] *(continued)*		18
174–175.2	Fresh, massive bedded, gray, fine to very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	174.00	19
175.2–179	Fresh, thickly bedded to laminated, dark gray to very dark gray, very fine grained, very strong, SANDSTONE [Pottsville Formation], with prominent shale beds and mudstone interbeds. [BEDROCK]	175.20	19
179–184	Fresh, laminated, black, very fine grained, very strong, SHALE [Pottsville Formation]. [BEDROCK]	179.00	19
184–200	Fresh, thickly bedded to laminated, gray, fine to very fine grained, strong, SANDSTONE [Pottsville Formation]. Some dissolution parallel to bedding. [BEDROCK] Driller notes oil sheen and coal dust to surface.	184.00	20, 21

Fracture index per run: 0 throughout (160–200 ft).

Discontinuity data:
- Run 18: 10 x Mech. FX parallel to bedding, Dip ~0
- Run 21: 21 x Mech. FX parallel to bedding, Dip ~0

Lost/Broken core depth marks: 160.70, 161.20, 161.70, 163.30, 164.00, 164.90, 165.80, 166.30, 166.90, 167.30, 167.80, 169.00, 170.20, 171.80, 172.30, 173.00, 174.00, 175.20, 176.20, 176.60, 177.50, 178.30, 179.00, 179.70, 180.30, 182.60, 184.00, 185.30, 185.90, 187.20, 187.60, 193.00

Piezometer installation:
- Bentonite Grout Mix (50 gallons used)
- PelPlug Bentonite Pellets (10 gallons used)
- GP#1 Filter Media Sand (4 x 50lb bags used)
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen

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DEPTH SCALE 1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-14

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: January 27-30, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200	Sonic	Fresh, thickly bedded to laminated, gray, fine to very fine grained, strong, SANDSTONE [Pottsville Formation]. Some dissolution parallel to bedding. [BEDROCK] *(continued)*		0 0 0 0	200.60 GP#1 Filter Media Sand (4 x 50lb bags used) 204.00
205		End of Borehole.	204.00		
210					
215					
220					
225					
230					
235					
240					

Column headings: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4), RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20), Jn, DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION), J CON, Jr, Ja, Fault/Breccia/Gouge, Lost Core, Broken Core, SYMBOLIC LOG, RUN No.

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-15

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas
INCLINATION: -90° AZIMUTH: n/a

DRILLING DATE: February 5-8, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

SHEET 1 OF 5
DATUM: Ground Surface

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Fault/Breccia/Gouge; Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0	Truck Mounted Sonic Drill (12") Sonic	Ground Surface						
		(OL) organic SILT; ~30% organics; olive gray; cohesive, w~PL, soft. [TOPSOIL]	0.00	1	0			Concrete Seal and Pad
		(BOULDER) Sandstone boulder [WEATHERED BEDROCK]	1.00	1	0			
		(ML) CLAYEY SILT; some medium to very fine angular sand; some fine angular gravel; red orange; cohesive, w~PL, firm to soft. [NATIVE]	1.80	1	0, 0, 0			
5		Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	4.10	2	0, 0			
10		Slightly weathered, thinly to medium bedded, gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	7.00	3	0, 0, 0, 0, 0, 0, 0, 0, 0, 0		13.70; 14.10; 16.80	
				4	0, 0	Sub-vertical fracture results in broken core.		
20	Truck Mounted Sonic Drill (6.25") Sonic	Moderately weathered, medium bedded to laminated, very dark gray, fine to very fine grained, weak, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	19.30	4	0, 0, 0, 0, 0, 0, 0, 0		19.30	Bentonite Grout Mix (50 gallons used)
25–40		Slightly weathered, medium bedded to laminated, very dark gray, fine to very fine grained, strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	27.00	5	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0		27.00; 28.80	

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-15

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 5-8, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Truck Mounted Sonic Drill (6.25") / Sonic	Slightly weathered, medium bedded to laminated, very dark gray, fine to very fine grained, strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*		6	0		40.30 / 41.00
45					0		
		Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	47.00	7	0		
50					0		
55					0		
60				8	0		Bentonite Grout Mix (50 gallons used)
65					0		
70				9	0	12 x Mech. FX parallel to bedding, Dip ~0	
75					0		
80					0		

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-15

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

SHEET 3 OF 5

DATUM: Ground Surface

DRILLING DATE: February 5-8, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4) / ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Depth scale: 80, 85, 90, 95, 100, 105, 110, 115, 120

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Description (80–120 ft): Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*

RUN No.	Fracture index per run	Discontinuity data
10	0, 0, 0, 0, 0, 0, 0	22 x Mech. FX parallel to bedding, Dip ~0
11	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	30 x Mech. FX parallel to bedding, Dip ~0
12	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	18 x Mech. FX parallel to bedding, Dip ~0
13	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	
	0, 0, 0	

Lost/Broken core depths: 88.80, 89.70, 91.30, 101.40, 102.50, 107.00, 107.90, 108.80, 109.60, 110.60, 112.00, 113.50, 114.50, 115.90, 117.00

Installation: Bentonite Grout Mix (50 gallons used)

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

File:C:\GOLDER\GORGAS\600 PROCESSED DATA\GINT\GORGAS.GPJ Output Form:BC_DRILLHOLE (MINING STD) Template:BC REGION TEMPLATE BETA 2.GDT Library:BC REGION LIBRARY.GLB CLangford 5/25/16

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-15

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 5-8, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		14	Freeze Mech. FX parallel to bedding, Dip ~0	
125					
127–129			15		Broken core 127.00–129.00
130					
135					
140			16		Bentonite Grout Mix (50 gallons used)
145	Fresh, thickly bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	145.50			
	Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	147.70			
150			17	30 x Mech. FX parallel to bedding, Dip ~0	
155					
		158.00			158.00
160					

FRACTURE INDEX PER RUN: 0 for all intervals from 120 to 160 ft.

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DEPTH SCALE 1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

RECORD OF SONIC HOLE: GS-AP-MW-15

DATUM: Ground Surface

DRILLING DATE: February 5-8, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.
160	Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. [BEDROCK] *(continued)*		18
			19
	Fresh, thickly bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	178.70	20
	Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. Increasingly shaly with depth. [BEDROCK]	180.90	
	Fresh, laminated, black, very fine grained, weak, COAL [Pottsville Formation]. [BEDROCK]	183.60	
	Fresh, medium bedded to laminated, very dark gray, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Dissolution pathways parallel to bedding. Increasingly shaly with depth. [BEDROCK]	184.40	21
	Fresh, thickly bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	190.50	
	End of Borehole.	197.00	

Depth scale marks: 160, 165, 170, 175, 180, 185, 190, 195, 200

INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4); ALTERATION (2 3 4)

RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20)

FRACTURE INDEX PER RUN: 0 (all intervals)

Jn | DIP w.r.t. CORE AXIS (alpha) 0 30 60 90 | DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Depth (ft)	Installation
to 178.70	Bentonite Grout Mix (50 gallons used)
178.70	PelPlug Bentonite Pellets (10 gallons used)
180.90	
182.60	
183.60	GP#1 Filter Media Sand (4 x 50lb bags used)
184.40	
187.00	
189.50	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
194.60	
197.00	GP#1 Filter Media Sand (4 x 50lb bags used)

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-16D

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: April 19-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core
0	Ground Surface				
	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	0.00		0 0 0 0 0 0 0	
	Slightly weathered, thinly to medium bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	7.00		0	
10	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	8.00	1	0 0	Lost core 8.40–10.00
15			2	0 0 0 0 0 0 0 0 0 0	Lost core 19.30–20.00
20	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	21.10		0 0 0	
	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with black shale interbeds. [BEDROCK]	23.20		0	
25	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	24.00	3	0 0 0 0	
30	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	27.70		0 0 0 0 0	Broken core 31.70–32.30
35	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	32.30	4	0 0 0 0 0 0 0 0	Lost core 38.80–40.00
40					

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION: Concrete Seal and Pad; Bentonite Grout Mix (85 gallons used)

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-16D

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: April 19-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Truck Mounted Sonic Drill (6.25") / Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	5	0 (each 0.5 ft, 40–50)	40.00 – 41.70 Broken Core; 42.40 – 47.00 Broken Core; 49.00 – 50.00 Lost Core	Bentonite Grout Mix (85 gallons used)
50		Turbulent bedding.	6	0 (each 0.5 ft, 50–60)		
60			7	0 (each 0.5 ft, 60–70)	69.20 – 70.00 Lost Core	
70			8	0 (each 0.5 ft, 70–80)	79.70 – 80.00 Lost Core	
80						

Column headings also printed: SYMBOLIC LOG; ELEV. DEPTH (ft); INDICES: ROCK STRENGTH R5 R4 R3 R2 R1, WEATHERING W2 W3 W4, ALTERATION 2 3 4; RECOVERY: TOTAL CORE % 80 60 40 20, RQD % 80 60 40 20; Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90, TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-16D

SHEET 3 OF 6

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: April 19-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Truck Mounted Sonic Drill (6.25"), Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*		0, 0, 0, 0, 0			Bentonite Grout Mix (85 gallons used)
85			9	0, 0, 0, 0, 0		88.50 – 90.00	
90				0, 0, 0, 0, 0			
95			10	0, 0, 0, 0, 0	Sub-vertical fracture no staining.	99.60	
100				0, 0, 0, 0, 0			Hole Plug Bentonite Chips 3/8" (18 x 50lb bags used)
105		Fossiliferous (shells)	11	0, 0, 0, 0, 0		109.70	
110				0, 0, 0, 0, 0			
115			12	0, 0, 0, 0, 0			
120							

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: April 19-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*	13	0 0 0 0 0 0 0 0 0 0	
125					
130			14	0 0 0 0 0 0 0 0 0 0	129.60
135					138.00
140			15	0 0 0 0 0 0 0 0 0 0	140.00 Hole Plug Bentonite Chips 3/8" (18 x 50lb bags used)
145					
150			16	0 0 0 0 0 0 0 0 0 0	
155					158.60
160					160.00

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-16D

SHEET 5 OF 6
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: April 19-20, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Elev. / Depth (ft)
160–175.50	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*	175.50
175.50–176.50	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	176.50
177.00–180.00	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	177.00
180.00	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	180.00
–198.00	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	198.00

Run No.: 17 (160–170), 18 (170–180), 19 (180–190), 20 (190–200)

Fracture index per run: 0 for every 1 ft interval from 160 to 200.

Discontinuity data:
- ~175: Sub-vertical fracture healed with calcite.
- ~177: Sub-vertical discontinuous fracture no staining.

Broken/lost core depths: 166.50, 168.60, 170.00, 172.70, 177.70, 180.00, 182.20, 188.40, 190.00, 196.20, 198.10

Piezometer installation:
- Hole Plug Bentonite Chips 3/8" (18 x 50lb bags used)
- PelPlug Bentonite Pellets (22.5 gallons used)
- GP#1 Filter Media Sand (18 x 50lb bags used)

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-16D

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: April 19-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200–221	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly bedded to laminated, black, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infill of fossiliferous features. Dissolution pathways parallel to bedding. Increasingly shaly with depth. [BEDROCK] *(continued)*		21 (200–210), 22 (210–221)	0 (each 1 ft interval, 200–221)	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen; GP#1 Filter Media Sand
221		End of Borehole.	221.00			

Column headings: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core.

Broken core: 200.20–203.20. Lost core: 205.70–210.00; 217.50–221.00.

Depth scale marks: 200, 205, 210, 215, 220, 225, 230, 235, 240

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-16S

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 30 - April 18, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.
0	Ground Surface		
0	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	0.00	
7	Slightly weathered, thinly to medium bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	7.00	1
10	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	10.00	2
23.4	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	23.40	3
26.8	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	26.80	4

Fracture index per run: 0 for every interval from 0 to 40 ft.

Lost / broken core depths: 19.50, 20.00, 24.50, 26.80, 28.00, 30.00, 30.80, 33.60, 36.80

Piezometer installation: Concrete Seal and Pad; Bentonite Grout Mix (80 gallons used)

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 30 - April 18, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Core break depths (ft)	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]		40.00	5	0 (every interval)	40.00, 45.80, 50.00	Bentonite Grout Mix (80 gallons used)
50					6	0 (every interval)	58.00, 60.00	
60					7	0 (every interval)	61.20, 62.10, 63.70, 65.40, 70.00	
70					8	0 (every interval)	73.80, 74.70, 77.50, 80.00	

Column headings: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-16S

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 30 - April 18, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Truck Mounted Sonic Drill (6.25") / Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*		0	
				0	
				0	
				0	
				0	
85			9	0	
				0	86.00 Bentonite Grout Mix (80 gallons used)
				0	
				0	
				0	
90				0	90.00
				0	
				0	
				0	
				0	
95			10	0	
				0	
				0	97.20
				0	
				0	
100				0	100.00 PelPlug Bentonite Pellets (5 gallons used)
				0	
				0	
				0	
				0	
105			11	0	104.80
				0	GP#1 Filter Media Sand (11 x 50lb bags used)
				0	
				0	
				0	
110				0	110.00
				0	110.60
				0	
				0	113.50
				0	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
115			12	0	115.70
				0	
				0	
				0	
				0	
120					120.00

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-16S

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

SHEET 4 OF 5
DATUM: Ground Surface

DRILLING DATE: March 30 - April 18, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*	13	0 0 0 0 0 0 0 0 0 0	121.00, 122.00, 127.00, 130.00; 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
130			14	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	136.00; GP#1 Filter Media Sand
150			15	0 0 0 0 0 0	150.00, 152.70, 154.70, 156.00; Hole Plug Bentonite Chips 3/8" (10 x 50lb bags used)
156–160				0 0 0 0	

Depth scale marks: 120, 125, 130, 135, 140, 145, 150, 155, 160

Column headings: SYMBOLIC LOG; ELEV. DEPTH (ft); INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); FRACTURE INDEX PER RUN; Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-16S

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 30 - April 18, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*		16	0, 0, 0, 0, 0	164.40 – 165.00	Hole Plug Bentonite Chips 3/8" (10 x 50lb bags used)
165				17	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	172.80 – 175.00	
170							
		Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	173.70				
175		Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	174.60	18	0, 0, 0, 0, 0	175.50 – 177.00	
		Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	177.00				
		Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	178.40				
180		End of Borehole.	180.00				
185							
190							
195							
200							

Column headings: SYMBOLIC LOG; INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge.

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-17

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

SHEET 1 OF 8

DATUM: Ground Surface

DRILLING DATE: February 8-11, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4) | RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION) | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (12") – Sonic, 0 to 10 ft; Truck Mounted Sonic Drill (6.25") – Sonic, 10 to 40 ft.

Ground Surface

Depth (ft)	Description	Elev. Depth (ft)
0.00	(GP/SP) GRAVEL and SAND; fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transistion zone. [WEATHERED BEDROCK]	0.00
4.00	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	4.00
26.20	Completely weathered, thickly bedded to medium bedded, gray, very fine grained, extremely weak, SANDSTONE [Pottsville Formation]. [BEDROCK]	26.20
29.50	Moderately weathered, thinly to medium bedded, very dark gray, very fine grained, weak, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	29.50
	Bedding dips ~5 to ~25 degrees around 37.7' bgs.	
37.00	Slightly weathered, thinly to medium bedded, very dark gray, very fine grained, medium strong to weak, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	37.00

Run No.: 1 (0–5 ft), 2 (5–15 ft), 3 (15–25 ft), 4 (25–35 ft), 35–40 ft.

Fracture index per run: 0 at every interval from 0 to 40 ft, except 1 at about 36 ft.

Discontinuity at about 36 ft: JN,PL,VR,CC,Fe/He, 1; Jr 2; Ja 12.

Broken core: 35.00 to 36.90

Piezometer installation: Concrete Seal and Pad; Bentonite Grout Mix

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 8-11, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.
40	Slightly weathered, thinly to medium bedded, very dark gray, very fine grained, medium strong to weak, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*		5
50			6
55	Slightly weathered, thinly to medium bedded, very dark gray, very fine grained, medium strong to weak, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	55.00	
60			7
70			8
71	Fresh, thinly to medium bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	71.00	
75.8	Slightly weathered, thinly to medium bedded, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	75.80	

FRACTURE INDEX PER RUN: 1 (40–41 ft); 1 (57–58 ft); 0 for all other 1-ft intervals from 40 to 80 ft.

DISCONTINUITY DATA:

Depth (approx.)	TYPE AND SURFACE DESCRIPTION	Jr	Ja
40.5	JN,PL,Ro,CC,Fe/He, 1	2	12
57.5	JN,PL,SM,CC,Fe/He, <1	2	20

Freeze Mech. FX parallel to bedding, Dip ~0

Fault/Breccia/Gouge, Lost Core, Broken Core intervals: 41.40, 42.00, 42.90, 45.00, 52.50, 55.00, 55.70, 59.10, 65.00, 66.30

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION: Bentonite Grout Mix

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 8-11, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Lost / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Slightly weathered, thinly to medium bedded, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*		9	0, 0, 0, 0			Bentonite Grout Mix
	Fresh, thinly to medium bedded, gray, very fine grained, strong to very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	84.00		0			
85				0, 1, 0, 0	JN,IR,VRO,DC		
	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	89.00		0			
90	Overturned beds from 91' to 93' bgs.		10	0, 0, 0, 0, 0			
95	Calcite infilled fossils.			0, 0, 0, 0, 0		Broken core 95.50–96.50	
	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	99.10					
100	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	101.20		0, 0, 0, 0, 0			
105			11	0, 0, 0, 0, 0			
110				0, 0, 0, 0, 0		Lost core 112.50–115.00	
115				0, 0, 0, 0, 0			
120							

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

RECORD OF SONIC HOLE: GS-AP-MW-17

DATUM: Ground Surface

DRILLING DATE: February 8-11, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Description (120–160 ft): Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*

Depth (ft)	Run No.	Fracture Index per Run
120		0
		0
		0
		0
		0
125	12	0
		0
		0
		0
		0
130		0
		0
		0
		0
		0
135		0
		0
		0
		0
		0
140		0
		0
		0
		0
		0
145	13	0
		0
		0
		0
		0
150		0
		0
		0
		0
		0
155		0
		0
		0
		0
		0
160		

Broken core: 159.60

Piezometer installation: Bentonite Grout Mix

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-17

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 8-11, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	BROKEN/LOST CORE	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*			161.00	
				162.70	
165			14	166.00	
	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	166.00			
				168.60	
	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	169.30		169.30	
170					
	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	172.00			
	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	172.50		173.00	
175				175.00	
180					Bentonite Grout Mix
185			15		
190					
195					
200					

Fracture index per run: 0 for every interval from 160 to 200 ft.

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-17

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 8-11, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. / DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*			0	
205			16	0	Bentonite Grout Mix
210				0	
215				0	
220				0	PelPlug Bentonite Pellets (5 gallons used)
225	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	223.70	17	0	
230				0	GP#1 Filter Media Sand (11 x 50lb bags used)
235	Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	236.40 / 236.90		0	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
240					

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

RECORD OF SONIC HOLE: GS-AP-MW-17

DATUM: Ground Surface

DRILLING DATE: February 8-11, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Columns: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Elev. Depth (ft)	Run No.
240	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	240.00	
	Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]		
245	Driller notes oil sheen and coal dust to surface.		18
256	Possible coal seam (Lost Core)		
260	Possible coal seam (Lost Core) - Difficult drilling, collapsed rubbly zone.		
265			19
275	Fresh, thinly bedded to laminated, black, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infill of fossiliferous features. Dissolution pathways parallel to bedding. Increasingly shaly with depth. [BEDROCK]	275.00	

Fracture index per run (1 ft intervals, 240–280 ft): 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Discontinuity data at 245 ft: JN,PL,SM,CC,Ca, <1

Lost/Broken core depths: 243.60, 244.20, 246.40, 255.00, 255.70, 257.00, 257.80, 267.80, 268.60, 279.60

Piezometer installation: 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen; GP#1 Filter Media Sand; Hole Plug Bentonite Chips 3/8"

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-17

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 8-11, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
280	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly bedded to laminated, black, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infill of fossiliferous features. Dissolution pathways parallel to bedding. Increasingly shaly with depth. [BEDROCK] *(continued)*			0	280.40
					0	
					0	
					0	283.50
					0	284.50
285				20	0	
					0	285.70 285.90
					0	Hole Plug Bentonite Chips 3/8"
					0	
					0	
290					0	
					0	
					0	
					0	
					0	294.40
295		End of Borehole.	295.00			
300						
305						
310						
315						
320						

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-18

SHEET 1 OF 3

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 28-29, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

Ground Surface

Depth (ft)	Description	Run No.
0.00	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	1 (0–6), 2 (6–7)
7.00	Slightly weathered, massive bedded, gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	2 (6–7), 3 (7–17)
8.20	Slightly weathered to fresh, medium bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	3 (7–17), 4 (17–37)

Fracture index per run: 0 (every 1-ft interval from 0 to 40 ft)

Broken core / lost core depths: 6.00, 7.50, 8.20, 10.00, 11.00, 12.70, 14.40, 15.20, 15.50, 16.00, 17.00, 18.20, 20.00, 22.40, 23.10, 24.60, 37.00, 38.70

Piezometer installation: Concrete Seal and Pad; Bentonite Grout Mix (55+ gallons used)

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-18

SHEET 2 OF 3
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: March 28-29, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN
40–76	Track Mounted Sonic Drill (6.25") / Sonic	Slightly weathered to fresh, medium bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		5 (40–57), 6 (57–67), 7 (67–77)	0 (each 1 ft interval)
76–80		Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	76.00, 76.80, 78.40	7	0

Column headings: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); FRACTURE INDEX PER RUN; Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core

Depth markers: 40, 45, 50, 55, 60, 65, 70, 75, 80

Core markers: 51.00, 52.30, 57.00, 58.00, 58.70, 59.40, 60.60, 63.10, 64.30, 67.00, 68.00, 72.10, 73.40, 74.80, 76.00, 77.60, 78.40

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION:
- Bentonite Grout Mix (55+ gallons used)
- PelPlug Bentonite Pellets (5 gallons used)
- GP#1 Filter Media Sand (9 x 50lb bags used)
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-18

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: March 28-29, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Track Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	80.00	8	0, 0, 0	81.00, 83.00
	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	83.20		0, 0	
85	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	85.50		0, 0	87.00
	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]		9	0, 0	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
90	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]			0, 0, 0, 0, 0, 0, 0, 0, 0	90.00, 91.00, 92.50, 93.00, 96.00 GP#1 Filter Media Sand, 97.00
97	End of Borehole.	97.00			
100					
105					
110					
115					
120					

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 17-22, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (12") — Sonic

Ground Surface

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.
0	(GP/SP) GRAVEL and SAND, fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transition zone. [WEATHERED BEDROCK]	0.00	1
7	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	7.00	2, 3, 4
36	Highly weathered to moderately weathered, thinly bedded to thickly bedded, gray to white, fine to very fine grained, medium strong to weak, SANDSTONE [Pottsville Formation]. [BEDROCK]	36.00	

FRACTURE INDEX PER RUN: 0 (each foot, 0 to 37 ft); 3; 1; 2

DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja
BD,PL,Ro,CC,Fe/He, 1	12	1.5	2
BD,PL,Ro,CC,Fe/He, 1	12	1.5	2
BD,PL,Ro,CC,Fe/He, 1	12	1.5	2
JN,PL,VR,CC,Fe/He, 1	12	1.5	2

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION: Bentonite Grout Mix (110 gallons used)

Depth scale marks: 0, 5, 10, 15, 20, 25, 30, 35, 40

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

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LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 17-22, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (6.25")

Depth (ft)	Description	Elev. Depth (ft)	Run No.
40 – 65	Highly weathered to moderately weathered, thinly bedded to thickly bedded, gray to white, fine to very fine grained, medium strong to very weak, SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*		5
65 – 80	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	65.00	6

Fracture index per run (per foot, 40 to 80 ft): 2, 1, 2, 0, 0, 5, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Type and Surface Description	J CON	Jr	Ja
JN,PL,VR,CC,Fe/He, 1	12	1.5	2
JN,PL,VR,CC,Fe/He, 1	12	1.5	2
JN,PL,VR,CC,Fe/He, 1	12	1.5	2
BD,PL,Ro,CC,Fe/He, 1	12	1.5	2
BD,PL,Ro,CC,Fe/He, 1	12	3	2
BD,PL,Ro,CC,Fe/He, 1	12	1.5	2
BD,PL,Ro,CC,Fe/He, 1	12	1.5	2

Lost core: 56.20 – 57.00

Piezometer installation: Bentonite Grout Mix (110 gallons used)

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-19

SHEET 3 OF 6

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 17-22, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Truck Mounted Sonic Drill (6.25") Sonic	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*			7	0 (each interval, 80–120)	Bentonite Grout Mix (110 gallons used)
85							
90							
95							
100					8		
105							
110							
115							
120							

Column headings also printed: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4); RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20); Jn; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION); J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core.

Lost/Broken core depths: 96.00, 97.00, 98.00, 99.60, 102.90, 114.40, 117.00, 119.70

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

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RECORD OF SONIC HOLE: GS-AP-MW-19

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas
DRILLING DATE: February 17-22, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.
DATUM: Ground Surface
INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Truck Mounted Sonic Drill (6.25"); Sonic

DEPTH SCALE FEET	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*	9	0					120.50	
			0						
			0					122.70	
			0					123.30	
			0						
125			0						
			1	JN,PL,VR,CC,Ca, 1	12	1.5	2		
			0						
			0						
			0						
130			0						
			0						
			0						Bentonite Grout Mix (110 gallons used)
			0						
			0						
135			0					135.40	
			0						
		10	0					137.00	
			0					138.00	
			0						
140			0						
			0						
			0						
			0						
			0						
145			0						
			0						
			0						
			0						
			0						
150			0						
			0						
			0						Hole Plug Bentonite Chips 3/8"
			0						
			0						
155			0						
			0						
			0						
			0						
			0						
160									

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

INCLINATION: -90° AZIMUTH: n/a

RECORD OF SONIC HOLE: GS-AP-MW-19

DATUM: Ground Surface

DRILLING DATE: February 17-22, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160	Truck Mounted Sonic Drill (6.25") Sonic	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*			11	0	163.20 – 168.20	Hole Plug Bentonite Chips 3/8"
165						0	Lost Core 172.90 – 177.00	
170					12	0	Lost Core 192.30 – 197.00	
175						0	198.60 – 199.80	
180 – 200						0		

Fracture index per run (160–200 ft, each 1 ft interval): 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Column headings: INDICES — ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY — TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA — DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core

Depth markers: 163.20, 168.20, 172.90, 177.00, 192.30, 197.00, 198.60, 199.80

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-19

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 17-22, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (6.25") – Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200				0	
	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	201.30		0, 0	
	Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	203.60		0, 0	
205	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	204.70		0, 0, 0	
	Fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	207.00	13	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	207.00, 207.70
210					
215					217.00, 218.20, 219.30 Hole Plug Bentonite Chips 3/8"
220					
	Fresh, thinly to medium bedded, very dark gray to black, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Increasingly dense shale beds with depth. Fossil replacement with mudstone infill below 243'. [BEDROCK]	221.80	14		221.80
225					226.20
230					
235					237.00
	End of Borehole.	237.00			
240					

Column headings also printed: DRILLING RECORD; SYMBOLIC LOG; INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core.

DEPTH SCALE

1 in to 5 ft

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-19(R1)

SHEET 1 OF 5
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: April 13-19, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0	Truck Mounted Sonic Drill (12") / Sonic	Ground Surface				
		(GP/SP) GRAVEL and SAND; fine to coarse, angular gravel and very fine to coarse, angular sand; some silt; reddish yellow to yellowish red; non-cohesive, dry, very loose. Poorly sorted due to weathering in situ. Soil to Saprolite transition zone. [WEATHERED BEDROCK]	0.00		0 (each 0.5 ft interval)	Concrete Seal and Pad
5						
		Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	7.00	1	0 (each 0.5 ft interval)	
10						
15				2	0 (each 0.5 ft interval)	
20						Bentonite Grout Mix (110 gallons used)
25						
30						
35					0 (each 0.5 ft interval)	
40			39.40			

Column headings also include: SYMBOLIC LOG; INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core.

CONTINUED NEXT PAGE

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: April 13-19, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DRILLING RECORD: Truck Mounted Sonic Drill (6.25")

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Highly weathered to moderately weathered, thinly bedded to thickly bedded, gray to white, fine to very fine grained, medium strong to weak, SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*		3	0, 0, 0, 0, 0	Weathered FX; Weathered FX	
45				0, 0, 0, 0, 0		48.00
50			4	0, 0, 0, 0, 0	Weathered FX; Weathered FX; Weathered FX	52.20; 53.40
55				0, 0, 0, 0, 0		55.00
60				0, 0, 0, 0, 0	Weathered FX; Weathered FX	Bentonite Grout Mix (110 gallons used); 63.00
65	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	63.80	5	0, 0, 0, 0, 0		67.60; 68.40
70				0, 0, 0, 0, 0		74.00
75				0, 0, 0, 0, 0		75.00
80						

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PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-19(R1)

SHEET 3 OF 5
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: April 13-19, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Truck Mounted Sonic Drill (6.25") Sonic	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*				0	
						0	
						0	
						0	
						0	
85					6	0	
						0	
						0	87.40
						0	
						0	89.30
90						0	
						0	
						0	
						0	
						0	
95						0	95.00
						0	
						0	
						0	
						0	Bentonite Grout Mix (110 gallons used)
100						0	
						0	
						0	102.20
						0	
						0	
105					7	0	
						0	
						0	
						0	108.00
						0	
110						0	
						0	
						0	
						0	
						0	
115						0	115.00
						0	116.50
						0	117.50
						0	
						0	119.30
120							

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: April 13-19, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Broken Core / Lost Core depths	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Truck Mounted Sonic Drill (6.25") Sonic	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*				0, 0, 0, 0, 0	120.40, 121.20, 122.00, 122.70, 123.40, 124.10	
125					8	0, 0, 0, 0, 0	124.80	
130						0, 0, 0, 0, 0		Bentonite Grout Mix (110 gallons used)
135						0, 0, 0, 0, 0	135.00, 137.20, 138.80	
140						0, 0, 0, 0, 0	140.80, 142.00	
145					9	0, 0, 0, 0, 0	144.20, 144.90, 148.10	PelPlug Bentonite Pellets (5 gallons used)
150						0, 0, 0, 0, 0		GP#1 Filter Media Sand (18 x 50lb bags used)
155						0, 0, 0, 0, 0	155.00, 156.40	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
160								

Column headers (other): INDICES — ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4); ALTERATION (2 3 4); RECOVERY — TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20); Jn; DISCONTINUITY DATA — DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-19(R1)

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: April 13-19, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160	Truck Mounted Sonic Drill (6.25") Sonic	Slightly weathered to fresh, thinly bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*			0	160.10
					0	
					0	
					0	
					0	
165				10	0	
					0	
					0	2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
					0	
					0	
170					0	170.40
					0	
					0	
					0	
					0	175.00
175					0	GP#1 Filter Media Sand
					0	
		End of Borehole.	177.00			
180						
185						
190						
195						
200						

Column headings also printed: SYMBOLIC LOG; INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge; Lost Core; Broken Core

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-20

SHEET 1 OF 7

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 15-17, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0	Truck Mounted Sonic Drill (12") – Sonic	Ground Surface (ML) CLAYEY SILT; some fine to medium angular sand; trace fine angular gravel; red to yellowish red; cohesive, w<PL, soft to firm. [NATIVE]	0.00	1	Concrete Seal and Pad
		Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	3.70	2, 3, 4	Bentonite Grout Mix
	Truck Mounted Sonic Drill (6.25") – Sonic	Slightly weathered, thinly bedded to laminated, black, very fine grained, medium strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	28.30		
		Slightly weathered, thinly to medium bedded, very dark gray, very fine grained, medium strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	30.20		
40		*CONTINUED NEXT PAGE*			

Depth scale ticks: 0, 5, 10, 15, 20, 25, 30, 35, 40

INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4); ALTERATION (2 3 4)
RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20)
FRACTURE INDEX PER RUN: 0 (all intervals, 0 to 40 ft)
DISCONTINUITY DATA: Jn; DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja
Fault/Breccia/Gouge; Lost Core; Broken Core

Lost Core: 16.00 – 28.30

DEPTH SCALE

1 in to 5 ft

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

RECORD OF SONIC HOLE: GS-AP-MW-20

DATUM: Ground Surface

DRILLING DATE: February 15-17, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly to massive bedded, gray, fine to very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	40.00	5	0 0 0 0 0 0 0		
		Fresh, thinly to medium bedded, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	47.50		0 0 0 0 0 0 0 0	47.50, 48.50, 55.00	
		Fresh, thinly to massive bedded, gray, fine to very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	56.50	6	0 0	57.50	
		Fresh, thinly to medium bedded, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	58.50		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	61.50, 73.50, 75.00, 75.80, 76.70, 77.80	Bentonite Grout Mix
80							

Depth scale ticks: 40, 45, 50, 55, 60, 65, 70, 75, 80

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 15-17, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Depth scale: 80, 85, 90, 95, 100, 105, 110, 115, 120

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

DESCRIPTION: Fresh, thinly to medium bedded, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*

Run No.: 7 (to 95 ft), 8 (95–115 ft)

Fracture index per run: 0 at every interval from 80 to 120 ft

Depths marked in core column: 86.50, 95.00, 96.00, 98.20, 99.30, 100.00, 100.70, 104.00, 115.00, 116.30, 119.30

Installation: Bentonite Grout Mix

CONTINUED NEXT PAGE

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-20

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 15-17, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4) / ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Depth scale: 120, 125, 130, 135, 140, 145, 150, 155, 160

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Description (120 ft): Fresh, thinly to medium bedded, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*

Run No.: 9 (120–135 ft); 10 (135–155 ft)

Fracture index per run: 0 (every interval, 120–160 ft)

Lost core / broken core depths: 127.30, 135.00, 136.60, 137.30, 137.80, 139.50, 155.00

Installation: Bentonite Grout Mix

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-20

DATUM: Ground Surface

DRILLING DATE: February 15-17, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Depth 160–200 ft: Fresh, thinly to medium bedded, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*

Depth (ft)	Run No.	Fracture Index per run
160–175	11	0 (each 1 ft interval)
175–195	12	0 (each 1 ft interval)
195–200		0 (each 1 ft interval)

Broken Core: 171.30 – 172.60
Lost Core: 173.60 – 175.00

Installation: Bentonite Grout Mix

Depth scale marks: 160, 165, 170, 175, 180, 185, 190, 195, 200

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL
DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-20

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 15-17, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Elev. / Depth (ft)	Run No.
200	Fresh, thinly to medium bedded, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		13
213	Fresh, thinly to massive bedded, gray, fine to very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	213.00	
217.4	Fresh, thinly to medium bedded, very dark gray to black, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Increasingly dense shale beds with depth. Fossil replacement with mudstone infill below 243'. [BEDROCK]	217.40	14

Fracture index per run: 0 for every foot from 200 to 240 ft.

Lost Core / Broken Core intervals: 207.20, 211.00, 211.80, 217.40, 221.20, 228.40, 235.00

Piezometer installation:
- Bentonite Grout Mix
- PelPlug Bentonite Pellets (5 gallons used)
- GP#1 Filter Media Sand (10.5 x 50lb bags used)
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen

Depth scale marks: 200, 205, 210, 215, 220, 225, 230, 235, 240

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-20

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas
INCLINATION: -90° AZIMUTH: n/a

DRILLING DATE: February 15-17, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

DATUM: Ground Surface

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
240	Truck Mounted Sonic Drill (6.25") / Sonic	Fresh, thinly to medium bedded, very dark gray to black, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Increasingly dense shale beds with depth. Fossil replacement with mudstone infill below 243'. [BEDROCK] *(continued)*			0, 0, 0, 0, 0		243.00 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
245		Possible coal seam (Lost Core)		15	0, 0, 0, 0, 0		247.10
250					0, 0, 0, 0, 0		GP#1 Filter Media Sand
255					0, 0, 0, 0, 0		
260					0, 0, 0, 0, 1	JN,PL,SM,CC,Ca, <1	
265		Fresh, thinly to massive bedded, gray, fine to very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	265.50	16	0, 0, 0, 0, 0, 1	JN,PL,SM,CC,Ca, <1	Hole Plug Bentonite Chips 3/8" (5 x 50lb bags used)
270					0, 0, 0, 0, 0		273.50
275		End of Borehole.	275.00				275.00
280							

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL
DRAFT

RECORD OF SONIC HOLE: GS-AP-MW-21

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas
SHEET 1 OF 6
DATUM: Ground Surface
DRILLING DATE: February 18-20, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.
INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0	Truck Mounted Sonic Drill (12"), Sonic	Ground Surface					
		Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	0.00	1	0, 0, 0, 0, 0, 0, 0, 0		Concrete Seal and Pad
5							
		Decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE] [WEATHERED BEDROCK]	7.50	2	0, 0, 0, 0, 0, 0, 1	JN,IR,Ro,CC,Fe/He, 1	
10							
		Highly weathered to slightly weathered, thinly to medium bedded, very dark gray, very fine grained, medium strong to weak, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	14.20	3	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0		
15	Truck Mounted Sonic Drill (6.25"), Sonic	Weathering localized to fractures parallel to bedding, ~0.					
20							Bentonite Grout Mix (165+ gallons used)
25		Fossil bed with He/Fe infilling		4	0, 0, 0, 0, 0, 0, 0, 0, 0, 0		25.00, 26.00 (Broken Core)
30							
35							33.00, 35.00 (Lost Core)
		Fresh, thinly to massive bedded, gray, fine to very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	35.40		0, 0, 0, 0, 0		
40							

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-21

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 18-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Truck Mounted Sonic Drill (6.25"); Sonic	Fresh, thinly to massive bedded, gray, fine to very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK] *(continued)*		5	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	Broken Core 40.50–42.00; 45.70–49.50	
50		Fresh, medium bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	49.50		0, 0, 0, 0, 0	Lost Core 50.60–55.00	
55				6	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	Broken Core 56.20–57.50	Bentonite Grout Mix (165+ gallons used)
75–80					0, 0, 0, 0, 0		

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-21

SHEET 3 OF 6

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 18-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Truck Mounted Sonic Drill (6.25") / Sonic	Fresh, medium bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*				0, 0, 0, 0, 0	
85					7	0, 0, 0, 0, 0	86.00
90						0, 0, 0, 0, 0	95.00
95						0, 0, 0, 0, 0	97.60
100						0, 0, 0, 0, 0	99.60 Bentonite Grout Mix (165+ gallons used)
105					8	0, 0, 0, 0, 0	
110						0, 0, 0, 0, 0	113.10
115						0, 0, 0, 0, 0	115.00
120							

Column headings also include: INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4), RECOVERY (TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20), Jn, DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION), J CON, Jr, Ja, Fault/Breccia/Gouge, Lost Core, Broken Core.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-21

DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: February 18-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, medium bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*			9	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Bentonite Grout Mix (165+ gallons used)
125							
130							
133.50–135.00 (Lost Core)							
135					10	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
140							
145							
150							
151.50–155.00 (Lost Core)							
155						0 0 0 0 0	
155.40–156.10 (Broken Core)							
160							

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

File:C:\GOLDER\GORGAS\600 PROCESSED DATA\GINT\GORGAS.GPJ Output Form:BC_DRILLHOLE (MINING STD) Template:BC REGION TEMPLATE BETA 2.GDT Library:BC REGION LIBRARY.GLB CLangford 5/25/16

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 18-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Columns: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Depth (ft)	Description	Run No.	Fracture Index
160–200	Fresh, medium bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*	11 (to 175), 12 (175–195)	0 (each interval)
~187	Driller notes oil sheen and coal dust to surface.		

Lost core / broken core depths: 171.90, 175.00, 175.30, 176.00, 177.20, 180.30, 181.10, 182.10, 184.00, 191.80, 195.00, 196.20, 196.40, 198.40, 198.60

Installation: Bentonite Grout Mix (165+ gallons used)

Depth scale marks: 160, 165, 170, 175, 180, 185, 190, 195, 200

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL
DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-MW-21

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 18-20, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°　AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200	Fresh, medium bedded to laminated, very dark gray, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)* Possible coal seam (Lost Core) centered at 201' bgs.		13	0 (each ft, 200–215)	200.10, 200.40, 202.40, 206.20, 206.50, 208.60 — Bentonite Grout Mix (165+ gallons used)
215					215.00 — PelPlug Bentonite Pellets (5 gallons used)
216.5	Fresh, thinly to medium bedded, very dark gray to black, very fine grained, strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Increasingly dense shale beds with depth. Fossil replacement with mudstone infill below 243'. [BEDROCK]	216.50	14	0 (each ft, 215–235)	218.10 — GP#1 Filter Media Sand (5.5 x 50lb bags used); 222.20; 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen; GP#1 Filter Media Sand
235	End of Borehole.	235.00			235.00
240					

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-PZ-16

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas
SHEET 1 OF 8
DATUM: Ground Surface
DRILLING DATE: February 9 - March 16, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.
INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: 0–5 ft Truck Mounted Sonic Drill (12") – Sonic; 5–40 ft Truck Mounted Sonic Drill (6.25") – Sonic

Depth (ft)	Description	Run No.	Discontinuity data
	Ground Surface		
0.00	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]		
7.00	Slightly weathered, thinly to medium bedded, gray, very fine grained, strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	1	
8.00	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	1, 2	Freeze Mech. FX parallel to bedding, Dip ~0
21.10	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	2	
23.50	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	2	
24.20	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation]. [BEDROCK]	2	
27.30	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	3	
33.10	Fresh, laminated, black, very fine grained, very strong, SHALE [Pottsville Formation]. [BEDROCK]	3	
	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK] Shaly bed at 35.5' bgs.	3	

Fracture index per run: 0 throughout 0–40 ft.

Broken / Lost core intervals: 21.10–23.50 (broken); 24.70–25.40 (broken); 25.40–26.80 (lost); 26.80–27.50 (broken); 36.00–37.00 (lost)

Installation: Concrete Seal and Pad (0–2 ft); Bentonite Grout Mix (110 gallons used)

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL
DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-16

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 9 - March 16, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Fault/Breccia/Gouge, Lost Core, Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Truck Mounted Sonic Drill (6.25") / Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	40.20	4	0	40.20	
					0		
					0		
					0		
					0		
45					0		
					0		
				5	0	47.00	
					0	48.00	
					0		
50					0	49.80	
					0	51.70	
					0		
					0		
					0	54.30	
55					0		
					0		
				6	0	57.40	
					0		
					0	59.40	Bentonite Grout Mix (110 gallons used)
60					0	60.70 / 61.10	
					0		
					0		
					0	62.90 / 63.40	
					0		
65					0		
					0		
					0		
					0		
					0		
70					0	70.70	
					0		
					0		
					0		
					0		
75					0		
					0		
					0	77.00	
					0		
					0		
80					0		

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL **DRAFT**

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-16

SHEET 3 OF 8
DATUM: Ground Surface

LOCATION: Rattlesnake Lake - Gorgas

DRILLING DATE: February 9 - March 16, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*			7	0, 0, 0, 0, 0	Bentonite Grout Mix (110 gallons used)
85						0, 0, 0, 0, 0	85.30
90						0, 0, 0, 0, 0	
95						0, 0, 0, 0, 0	97.00; 99.60
100					8	0, 0, 0, 0, 0	Hole Plug Bentonite Chips 3/8" (27 x 50lb bags used); 103.50
105						0, 0, 0, 0, 0	104.60; 105.30; 107.00
110					9	0, 0, 0, 0, 0	110.60; 112.00
115						0, 0, 0, 0, 0	118.40
120							120.00

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*	10	0 0 0 0 0 0 0	Broken Core 121.00 – 124.30; Lost Core 124.30 – 127.00	
125–135			11	0 0 0 0 0 0 0 0 0 0	Broken Core 127.00 – 137.00	
140			12	0 0 0 0 0 0 0 0 0 0		Hole Plug Bentonite Chips 3/8" (27 x 50lb bags used)
145–160			13	0 0 0 0 0 0 0 0 0 0 0 0 0	Lost Core 155.60 – 157.00	

Column headings (no data recorded): SYMBOLIC LOG; ELEV. DEPTH (ft); INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4); RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20); Jn; DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION; J CON; Jr; Ja; Fault/Breccia/Gouge

CONTINUED NEXT PAGE

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 9 - March 16, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160	Truck Mounted Sonic Drill (6.25"); Sonic	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*		14		
165						165.50 – 167.00
170				15	Freeze break ~80 possible plane of weakness	
		Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	173.70			
175		Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	174.60			174.60 – 176.00 – 177.00
		Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	177.00	16	Freeze break ~80 possible plane of weakness	
180		Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	178.40			Hole Plug Bentonite Chips 3/8" (27 x 50lb bags used)
185		Driller notes oil sheen and coal dust to surface.				
190				17		
195						
200						199.70

Fracture index per run: 0 throughout (160–200 ft).

CONTINUED NEXT PAGE

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 9 - March 16, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK] *(continued)*		18	0, 0, 0, 0	
	Possible coal seam (Lost Core)			0	204.60
205	Fresh, thinly to medium bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	204.60		0, 0	
	Fresh, thinly to medium bedded, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	207.00		0	
210	Fresh, thinly bedded to laminated, black, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infill of fossiliferous features. Dissolution pathways parallel to bedding. Increasingly shaly with depth. [BEDROCK]	208.00	19	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	Hole Plug Bentonite Chips 3/8" (27 x 50lb bags used)
220	Fresh, laminated to medium bedded, dark gray to very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation] with mudstone interbeds. [BEDROCK]	218.90	20	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	PelPlug Bentonite Pellets (5 gallons used)
235	Grading to very dark gray to black shaly sandstone			0, 0	Catcher installed. GP#1 Filter Media Sand in PrePack (0.5 x 50lb bags used); 236.00; 237.00
		237.00		0, 0, 0	
240					

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-PZ-16

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 9 - March 16, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
240	Truck Mounted Sonic Drill (6.25") Sonic	Fresh, thinly bedded to laminated, black, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infill of fossiliferous features. Dissolution pathways parallel to bedding. Increasingly shaly with depth. [BEDROCK] *(continued)*				0	
						0	
						0	
						0	
						0	244.00 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
245						0	
						0	
					21	0	
						0	
						0	249.00
250						0	250.20 GP#1 Filter Media Sand
						0	
						0	
						0	
						0	
255						0	
						0	
						0	
						0	
						0	
260						0	
						0	
						0	262.50
						0	
						0	
265						0	
					22	0	
						0	
						0	
						0	
270						0	
						0	
						0	
						0	
						0	
275						0	
						0	277.00
						0	
						0	
280						0	

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 9 - March 16, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
280	Truck Mounted Sonic Drill (6.25") / Sonic	Fresh, thinly bedded to laminated, black, fine to very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infill of fossiliferous features. Dissolution pathways parallel to bedding. Increasingly shaly with depth. [BEDROCK] *(continued)*			0		
					0		
					0		
					0		
					0		
285					0		
					0		
				23	0		
					0		
					0		
290					0		
					0		
					0		
					0		
					0		
295					0		
					0		
					0		
					0		
					0		
300					0		
					0		
					0		
					0		
					0		
305					0		
					0		
				24	0		
					0		
					0		
310					0		
					0		
					0		
					0		
					0	JN,PL,SM,-	
315					0		
					0		
					0		316.40
		End of Borehole.	317.00				317.00
320							

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-18

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 22-25, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Columns: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES (ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4) | RECOVERY (TOTAL CORE %; RQD %) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION) | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Drilling record: Truck Mounted Sonic Drill (12") – Sonic (0 to 10 ft); Truck Mounted Sonic Drill (6.25") – Sonic (10 to 40 ft)

Depth (ft)	Description	Elev./Depth (ft)	Run No.
0	Ground Surface		
0.00	Completely decomposed rock. Textures and beddings of parent rock are increasingly preserved with depth. FeOx staining and precipitation. [SAPROLITE/REGOLITH] [WEATHERED BEDROCK]	0.00	1
7.00	Slightly weathered, massive bedded, gray, very fine grained, medium strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	7.00	2
8.20	Slightly weathered to fresh, medium bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	8.20	2, 3, 4

Fracture index per run: 0 at every interval from 0 to 40 ft, except 2 at 8 to 9 ft.

Discontinuity data:

Depth (approx. ft)	Type and Surface Description	J CON	Jr	Ja
8	BD,PL,Ro,CC,Fe/He, 1	12	1.5	2
8.5	BD,PL,Ro,CC,Fe/He, 1	12	1.5	2

Lost / broken core depths: 7.30, 13.00, 15.00, 17.00, 17.90, 20.50, 27.00, 28.50, 32.10, 37.00

Installation: Concrete Seal and Pad; Bentonite Grout Mix

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-PZ-18

DRILLING DATE: February 22-25, 2016
DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	Lost Core / Broken Core depths	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	Truck Mounted Sonic Drill (6.25") / Sonic	Slightly weathered to fresh, medium bedded to laminated, very dark gray, very fine grained, very strong to strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		5	0 0 0 0 0 0 0	43.10	Bentonite Grout Mix
45						47.00	
50				6	0 0 0 0 0 0 0 0 0 0		
55						54.60, 57.00	
60				7	0 0 0 0 0 0 0 0 0 0		
65						66.50, 67.00	
70				8	0 0 0 0 0 0 0 0 0 0	73.20	
75		Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	73.20			74.10, 77.00	
80					0 0 0		

CONTINUED NEXT PAGE

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-18

SHEET 3 OF 5

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 22-25, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH SCALE FEET	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.	FRACTURE INDEX PER RUN	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	80.70	9	1	JN,PL,SM,CC,Ca, 1	
	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	83.30		0		
85	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	85.40		0		
	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	86.30		0		
90	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	86.70		0		
95				0		95.70
			10	0		97.00
100				0		Bentonite Grout Mix
105				0		104.50
				0		105.20
110				0		
115				0		117.00
120				0		

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL **DRAFT**

File:C:\GOLDER\GORGAS\600 PROCESSED DATA\GINT\GORGAS.GPJ Output Form:BC_DRILLHOLE (MINING STD) Template:BC REGION TEMPLATE BETA 2.GDT Library:BC REGION LIBRARY.GLB CLangford 5/25/16

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-18

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE: February 22-25, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

DEPTH (ft)	DESCRIPTION	ELEV. DEPTH (ft)	RUN No.
120	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*		11
125	Fresh, laminated, black, very fine grained, very strong, SHALE [Pottsville Formation]. [BEDROCK]	124.90	
	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	126.20	
	One healed curved fracture parallel to core.		12
	One healed curved fracture parallel to core.		
	One healed curved fracture parallel to core.		
151	Fresh, massive bedded, gray, very fine grained, very strong, SANDSTONE [Pottsville Formation]. [BEDROCK]	151.00	
	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK]	152.80	

Fracture index per run (120–160 ft, per 0.2 m interval): 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Discontinuity data:
- JN,CU,SM,CC,Ca, 1 (approx. 139.5 ft)
- JN,CU,SM,CC,Ca, 1 (approx. 143.5 ft)
- JN,CU,SM,CC,Ca, 1 (approx. 150 ft)

Lost core / broken core intervals: 132.00–137.00 (lost core); 138.70–139.70 (broken core); 143.00–144.60 (broken core); 148.00–151.00 (broken core); 152.80–157.00 (lost core)

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION: Bentonite Grout Mix

CONTINUED NEXT PAGE

DEPTH SCALE 1 in to 5 ft

LOGGED: CDL

CHECKED: CDL

DRAFT

Golder Associates

RECORD OF SONIC HOLE: GS-AP-PZ-18

DRILLING DATE: February 22-25, 2016

DRILLING CONTRACTOR: Cascade Drilling, L.P.

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

Column headings: DEPTH SCALE FEET | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (ft) | RUN No. | INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1), WEATHERING (W2 W3 W4), ALTERATION (2 3 4) | RECOVERY: TOTAL CORE % (80 60 40 20), RQD % (80 60 40 20) | FRACTURE INDEX PER RUN | Jn | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90), TYPE AND SURFACE DESCRIPTION | J CON | Jr | Ja | Fault/Breccia/Gouge | Lost Core / Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Depth scale: 160, 165, 170, 175, 180, 185, 190, 195, 200

Drilling record: Truck Mounted Sonic Drill (6.25") — Sonic

Depth / Elev. (ft)	Description
160.00 – 177.00	Fresh, medium bedded to laminated, very dark gray, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. [BEDROCK] *(continued)*
~175 – 177	Possible coal seam (Lost Core) - Driller notes difficult drilling, collapsed rubbly zone.
177.00 – 187.00	Fresh, medium bedded to laminated, very dark gray to black, very fine grained, very strong, SHALY SANDSTONE [Pottsville Formation], with mudstone interbeds. Mudstone infilled fossils. Dissolution pathways parallel to bedding. [BEDROCK]
187.00	End of Borehole.

Run No.: 13 (to 177.00 ft); 14 (177.00 – 187.00 ft)

Fracture index per run (1 ft intervals, 160 – 187 ft): 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

Discontinuity data (approx. 168 ft): JN,PL,SM,CC,Ca, 1

Lost core: 174.10 – 177.00

Broken core: 179.60 – 180.30; 183.90 – 187.00

Piezometer installation:

- Bentonite Grout Mix
- PelPlug Bentonite Pellets (5 gallons used)
- Catcher installed. GP#1 Filter Media Sand in PrePack (0.5 x 50lb bags used)
- 2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
- GP#1 Filter Media Sand

RECORD OF SONIC HOLE: GS-AP-PZ-22

PROJECT No.: 154-4912

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0		Ground Surface		0.00												Concrete Seal and Pad
5																
10																
15																
20																Bentonite Grout Mix
25																
30																
35																
40																

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-22

SHEET 2 OF 9

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°

AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH R5 R4 R3 R2 R1	WEATHERING W2 W3 W4 / ALTERATION 2 3 4	RECOVERY: TOTAL CORE % 80 60 40 20	RQD % 80 60 40 20	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40																			
45																			
50																			
55																			
60																			Bentonite Grout Mix
65																			
70																			
75																			
80																			

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

CONTINUED NEXT PAGE

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-22

SHEET 3 OF 9

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge; Lost Core; Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
80															
85															
90															
95															
100															Bentonite Grout Mix
105															
110															
115															
120															

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-PZ-22

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4	RECOVERY: TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
120																
125																
130																
135																
140																Bentonite Grout Mix
145																
150																
155																
160																

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4); ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
160																
165																
170																
175																
180																Bentonite Grout Mix
185																
190																
195																
200																

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-22

SHEET 6 OF 9

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH R5 R4 R3 R2 R1; WEATHERING W2 W3 W4; ALTERATION 2 3 4	RECOVERY: TOTAL CORE % 80 60 40 20; RQD % 80 60 40 20	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90; TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
200																
205																
210																
215																
220																Bentonite Grout Mix
225																
230																
235																
240																

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

CONTINUED NEXT PAGE

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-22

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1)	WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
240																			
245																			
250																			
255																			
260																			Bentonite Grout Mix
265																			
270																			
275																			
280																			

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

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DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF SONIC HOLE: GS-AP-PZ-22

PROJECT No.: 154-4912
LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90° AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1) / WEATHERING (W2 W3 W4) / ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20)	RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
280																		
285																		
290																		Bentonite Grout Mix
295																		
300																		
305																		PelPlug Bentonite Pellets (5 gallons used)
310																		Catcher installed. GP#1 Filter Media Sand in PrePack (0.5 x 50lb bags used)
315																		2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
320																		

CONTINUED NEXT PAGE

DEPTH SCALE
1 in to 5 ft

Golder Associates

LOGGED: CDL
CHECKED: CDL

DRAFT

PROJECT No.: 154-4912

RECORD OF SONIC HOLE: GS-AP-PZ-22

LOCATION: Rattlesnake Lake - Gorgas

DATUM: Ground Surface

DRILLING DATE:

INCLINATION: -90°   AZIMUTH: n/a

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

DEPTH SCALE FEET	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (ft)	RUN No.	INDICES: ROCK STRENGTH (R5 R4 R3 R2 R1); WEATHERING (W2 W3 W4); ALTERATION (2 3 4)	RECOVERY: TOTAL CORE % (80 60 40 20); RQD % (80 60 40 20)	FRACTURE INDEX PER RUN	Jn	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) (0 30 60 90); TYPE AND SURFACE DESCRIPTION	J CON	Jr	Ja	Fault/Breccia/Gouge	Lost Core / Broken Core	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
320																2" PVC Sch 40 0.010 Slot PrePack Threaded Screen
325																
330																
335																
340																
345																
350																
355																
360																

DEPTH SCALE

1 in to 5 ft

Golder Associates

LOGGED: CDL

CHECKED: CDL

DRAFT

RECORD OF BOREHOLE GS-AP-MW-07V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 210.00 ft
LOCATION: Base of Dam

DRILL RIG: TSI 150CC
DATE STARTED: 1/8/19
DATE COMPLETED: 1/18/19

NORTHING: 1,324,251.90
EASTING: 2,063,504.32
GS ELEVATION: 309.46
TOC ELEVATION: 312.14 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
0		0.00 - 5.00 (ML), SANDY SILT; fine to coarse sand; some fine to coarse gravel; organic plant material; brown; non-cohesive, moist. [RESIDUUM]	ML	304.46 5.00	1		7.00 10.00
5	305	5.00 - 10.00 (GP), GRAVEL; medium angular gravel of highly weathered sandstone and shale, some silt; dark gray; non-cohesive; dry. Silt is mostly rock flour. Original structure likely destroyed by drilling. [SAPROLITE]	GP	299.46 10.00			
10	300	10.00 - 20.00 (GM), sandy silty GRAVEL; fine to coarse sand; fine to coarse gravel of weathered sandstone/siltstone/shale; brown to orange with some red staining; non-cohesive, moist to wet. [SAPROLITE]	GM	289.46 20.00	2		8.00 10.00
15	295						
20	290	20.00 - 25.00 (CL-GP), CLAY and GRAVEL; fine to coarse gravel; trace fine to coarse sand; brown with some orange mottling and brown-red gravel; cohesive, w ~ PL. [SAPROLITE]	CL-GP	284.46 25.00	3		10.00 10.00
25	285	25.00 - 30.00 (GP), GRAVEL; medium angular gravel of highly weathered sandstone and shale, some silt; dark gray; non-cohesive; dry. Silt is rock flour. Original structure likely destroyed by drilling. [WEATHERED BEDROCK / SAPROLITE]	GP	279.46 30.00			
30	280	30.00 - 47.50 Fresh to slightly weathered; medium strong to strong; medium to coarse grained; SANDSTONE.					
35	275				4		10.00 10.00
40	270						

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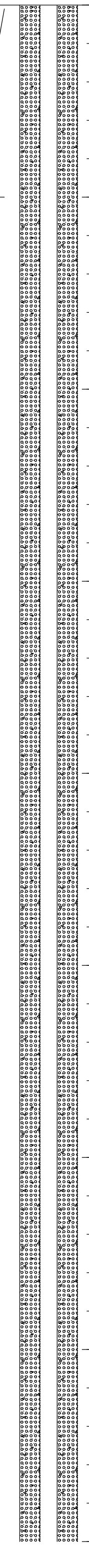
MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 190'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 190' - 200'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 185' - 205'
Type: #2 Silica Sand

FILTER PACK SEAL
Interval: 180' - 185'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0.0' - 180'
Type: Grout: Portland Cement Type I-II, Aquagel, Bentonite High Yield

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Herod

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-07V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 210.00 ft
LOCATION: Base of Dam

DRILL RIG: TSI 150CC
DATE STARTED: 1/8/19
DATE COMPLETED: 1/18/19

NORTHING: 1,324,251.90
EASTING: 2,063,504.32
GS ELEVATION: 309.46
TOC ELEVATION: 312.14 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: SAMPLE NO.	TYPE	REC
40		30.00 - 47.50 Fresh to slightly weathered; medium strong to strong; medium to coarse grained; SANDSTONE. *(Continued)*						
45	265					5		7.50 / 10.00
		47.50 - 68.00 Fresh to slighlty weathered; medium strong; dark gray; thinly laminated interbedded SHALE and SILTSTONE.			261.96 / 47.50			
50	260							
55	255					6		10.00 / 10.00
60	250							
65	245					7		9.50 / 10.00
		68.00 - 69.50 Fresh to slightly weathered; medium strong; gray to dark gray; SANDSTONE interbedded with SHALE.			241.46 / 68.00			
		69.50 - 70.00 Fresh to slightly weathered; weak to medium strong; dark gray; interbedded thinly laminated SHALE and SILTSTONE.			239.96 / 239.46 / 70.00			
70	240	70.00 - 90.00 Fresh; medium strong to strong; light gray to dark gray; thinly interbedded SANDSTONE, SHALE, and SILTSTONE.						
75	235					8		10.00 / 10.00
80	230							

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 190'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 190' - 200'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 185' - 205'
Type: #2 Silica Sand

FILTER PACK SEAL
Interval: 180' - 185'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0.0' - 180'
Type: Grout: Portland Cement Type I-II, Aquagel, Bentonite High Yield

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Herod

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

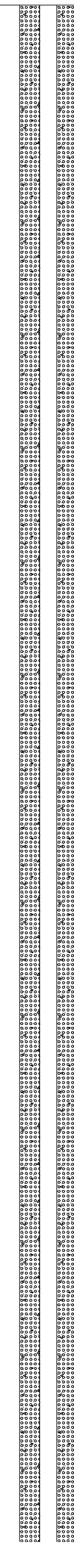
RECORD OF BOREHOLE GS-AP-MW-07V

PROJECT: Gorgas Ash Pond	DRILL RIG: TSI 150CC	NORTHING: 1,324,251.90	DEPTH W.L.:
PROJECT NUMBER: 18114896	DATE STARTED: 1/8/19	EASTING: 2,063,504.32	DATE W.L.:
DRILLED DEPTH: 210.00 ft	DATE COMPLETED: 1/18/19	GS ELEVATION: 309.46	TIME W.L.:
LOCATION: Base of Dam		TOC ELEVATION: 312.14 ft	GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
80		70.00 - 90.00 Fresh; medium strong to strong; light gray to dark gray; thinly interbedded SANDSTONE, SHALE, and SILTSTONE. *(Continued)*						
85	225					9		10.00 / 10.00
		86.00 - 87.00 Bioturbation			222.46			
		88.00 - 90.00 Bioturbation						
90	220	90.00 - 100.00 Fresh; medium strong; gray to dark gray; SHALE interbedded with SILTSTONE and SANDSTONE; thinly laminated and bedded with some larger (1-2") SANDSTONE beds.			219.46 / 90.00			
95	215					10		10.00 / 10.00
100	210	100.00 - 111.00 Fresh; strong; gray; interbedded laminated SHALE and thinly bedded to laminated SILTSTONE.			209.46 / 100.00			
105	205					11		10.00 / 10.00
110	200							
		111.00 - 121.00 Fresh; strong; dark gray; laminated SILTSTONE.			198.46 / 111.00			
115	195					12		10.00 / 10.00
120	190							

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 190'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 190' - 200'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 185' - 205'
Type: #2 Silica Sand

FILTER PACK SEAL
Interval: 180' - 185'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0.0' - 180'
Type: Grout: Portland Cement Type I-II, Aquagel, Bentonite High Yield

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft	GA INSPECTOR: Chris Tidwell
DRILLING COMPANY: Cascade Drilling, L.P.	CHECKED BY: David Hannam
DRILLER: T. Herod	DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-07V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 210.00 ft
LOCATION: Base of Dam

DRILL RIG: TSI 150CC
DATE STARTED: 1/8/19
DATE COMPLETED: 1/18/19

NORTHING: 1,324,251.90
EASTING: 2,063,504.32
GS ELEVATION: 309.46
TOC ELEVATION: 312.14 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
120				188.46 / 121.00			
		121.00 - 135.00 Fresh; strong; gray; fine to medium grained; SANDSTONE with SHALE or SILTSTONE partings.					
125	185				13		10.00 / 10.00
130	180						
135	175			174.46 / 135.00	14		9.50 / 10.00
		135.00 - 146.00 Fresh; strong; dark gray black; laminated SHALE with SANDSTONE partings.					
140	170						
145	165				15		9.00 / 10.00
		146.00 - 150.00 Fresh; strong; gray; fine grained; SANDSTONE with some SILTSTONE partings.		163.46 / 146.00			
150	160	150.00 - 152.50 Fresh; strong; gray and black; interbedded laminated SHALE and fine grained, thinly bedded SANDSTONE.		159.46 / 150.00			
		152.50 - 159.00 Fresh; strong; gray; SANDSTONE with SILTSTONE partings.		156.96 / 152.50			
155	155				16		7.00 / 10.00
		158.50 - 158.80 Bioturbation, shells		150.46 / 159.00			
160	150						

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 190'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 190' - 200'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 185' - 205'
Type: #2 Silica Sand

FILTER PACK SEAL
Interval: 180' - 185'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0.0' - 180'
Type: Grout: Portland Cement Type I-II, Aquagel, Bentonite High Yield

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Herod

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-07V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 210.00 ft
LOCATION: Base of Dam

DRILL RIG: TSI 150CC
DATE STARTED: 1/8/19
DATE COMPLETED: 1/18/19

NORTHING: 1,324,251.90
EASTING: 2,063,504.32
GS ELEVATION: 309.46
TOC ELEVATION: 312.14 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
160		159.00 - 174.00 Fresh; strong; gray; interbedded laminated to thinly bedded SILTSTONE and SANDSTONE. *(Continued)*							
165	145					17		9.00 / 10.00	
170	140								
					135.46 / 174.00				
175	135	174.00 - 196.00 Fresh; very strong; light gray; massive; SANDSTONE with SILTSTONE partings.				18		10.00 / 10.00	
180	130	179.60 - 180.00 Fracture, 90 degrees, stepped, clean.			129.46				Bentonite Pellets
185	125					19		10.00 / 10.00	#2 Silica Sand
190	120								2" PVC 0.010 Slot U-Pack Screen
195	115				113.46 / 196.00	20		10.00 / 10.00	
		196.00 - 202.00 Fresh; strong; gray to gray black; interbedded thinly bedded to laminated SANDSTONE and SHALE.							
		198.00 - 200.00 Bioturbation.							
200	110				109.46				

Log continued on next page

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 190'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 190' - 200'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 185' - 205'
Type: #2 Silica Sand

FILTER PACK SEAL
Interval: 180' - 185'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0.0' - 180'
Type: Grout: Portland Cement Type I-II, Aquagel, Bentonite High Yield

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Herod

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-07V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 210.00 ft
LOCATION: Base of Dam

DRILL RIG: TSI 150CC
DATE STARTED: 1/8/19
DATE COMPLETED: 1/18/19

NORTHING: 1,324,251.90
EASTING: 2,063,504.32
GS ELEVATION: 309.46
TOC ELEVATION: 312.14 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
200		196.00 - 202.00 Fresh; strong; gray to gray black; interbedded thinly bedded to laminated SANDSTONE and SHALE. *(Continued)*			107.46 202.00				
		202.00 - 207.00 Fresh; very strong; gray; medium to fine grained; massive; SANDSTONE with SHALE partings.							Sand Filter Pack
205	105					21		9.50 10.00	Bentonite
					102.46 207.00				
		207.00 - 210.00 Fresh; strong; gray; thinly bedded SANDSTONE interbedded with SHALE partings between sandstone beds.							
210	100				99.46				
		Boring completed at 210.00 ft							
215	95								
220	90								
225	85								
230	80								
235	75								
240	70								

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 190'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 190' - 200'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 185' - 205'
Type: #2 Silica Sand

FILTER PACK SEAL
Interval: 180' - 185'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0.0' - 180'
Type: Grout: Portland Cement Type I-II, Aquagel, Bentonite High Yield

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Herod

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 190.00 ft
LOCATION:

DRILL RIG: TSI
DATE STARTED: 1/4/19
DATE COMPLETED: 1/9/19

NORTHING: 1,320,383.14
EASTING: 2,063,813.29
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
0.00 - 10.00 (SP), SAND, fine to coarse, some fine to coarse gravel, trace silt; light brown to yellow-orange; non-cohesive, dry. [RESIDUUM]	SP	468.64 / 10.00	1		7.50 / 10.00
10.00 - 13.50 (SC), clayey SAND, some gravel; orange, some yellowish mottling; cohesive, w < PL. [RESIDUUM]	SC	465.14 / 13.50			
13.50 - 16.50 (SP), gravelly SAND, fine to coarse, trace silt; orange; non-cohesive, dry. [RESIDUUM]	SP	462.14 / 16.50	2		9.50 / 10.00
16.50 - 20.00 (SP), gravelly SAND, fine to coarse, trace silt; light brown gray; non-cohesive, dry. [RESIDUUM]	SP	458.64 / 20.00			
20.00 - 30.00 (GP-SP), GRAVEL and SAND, fine to coarse, trace silt, gravel is highly weathered shale; gray to dark gray when wet; non-cohesive, dry to moist. [RESIDUUM] Frequency of large sized gravel increases downhole.	GP-SP	448.64 / 30.00	3		9.00 / 10.00
30.00 - 31.10 (SP), gravelly SAND, some silt and clay, fine to coarse sand, fine to coarse gravel; gray-black; cohesive, w <~ PL.	SP	447.54 / 31.10			
31.10 - 38.50 (SP), gravelly SAND, fine to coarse, trace silt, gravel is highly weathered shale/siltstone; gray-black; non-cohesive, dry.	SP	440.14 / 38.50	4		9.00 / 10.00
38.50 - 55.00 Moderately weathered; medium strong; gray black; thinly laminated; SHALE.					

Log continued on next page

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40
Elevation (ft): 475, 470, 465, 460, 455, 450, 445, 440

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Grout (Portland Cement Type I/II and Quick-Gel Bentonite)

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 167'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 167' - 177'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 165' - 181'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 181' - 190'
Type: 3/8" Hole-Plug Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 160'
Type: Grout (Portland Cement Type I/II and Quick-Gel Bentonite)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 190.00 ft
LOCATION:

DRILL RIG: TSI
DATE STARTED: 1/4/19
DATE COMPLETED: 1/9/19

NORTHING: 1,320,383.14
EASTING: 2,063,813.29
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
40		38.50 - 55.00 Moderately weathered; medium strong; gray black; thinly laminated; SHALE. *(Continued)*					
	435						
45		45.00 - 46.50 Increased fracture zone. Fractures at 0 degrees and various angles, wet.		432.14	5		8.50 / 10.00
	430						
50		50.00 - 55.00 Some clay coating.					
	425						
55		55.00 - 57.80 Completely weathered, very weak, ROCK, recovered as, (GC), clayey GRAVEL, some silt, fine to coarse gravel as weathered shale fragments; cohesive, w <~ PL, soft.	GC	423.64 / 55.00	6		8.00 / 10.00
		57.80 - 60.00 Moderately weathered; medium strong; gray black; laminated SHALE with some clay coating.		420.84 / 57.80			
	420						
60		60.00 - 67.50 Weathered; medium strong to strong; dark gray; wet; laminated; SILTSTONE and SHALE.		418.64 / 60.00			
	415						
65		66.00 - 67.50 Crushed zone, contains clay, wet.			7		9.00 / 10.00
		67.50 - 70.00 (GP), GRAVEL, trace silt, fine to coarse gravel of weathered siltstone; light gray; non-cohesive, dry.	GP	411.14 / 67.50			
	410						
70		70.00 - 140.00 Fresh to slightly weathered; medium strong to strong; dark gray to black; wet; thinly laminated SHALE interbedded with SILTSTONE.		408.64 / 70.00			
	405						
75					8		8.30 / 10.00
	400						
80		79.00 - 80.00 Crushed Zone, containes clay, wet.		398.64			

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 167'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 167' - 177'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 165' - 181'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 181' - 190'
Type: 3/8" Hole-Plug Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 160'
Type: Grout (Portland Cement Type I/II and Quick-Gel Bentonite)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 190.00 ft
LOCATION:

DRILL RIG: TSI
DATE STARTED: 1/4/19
DATE COMPLETED: 1/9/19

NORTHING: 1,320,383.14
EASTING: 2,063,813.29
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
80		70.00 - 140.00 Fresh to slightly weathered; medium strong to strong; dark gray to black; wet; thinly laminated SHALE interbedded with SILTSTONE. *(Continued)* 80.00 - 90.00 Trace clay.			80.00				
	395								
85						9		10.00 / 10.00	
	390				388.64				
90									
		91.00 - 92.80 Crushed Zone, wet, contains clay.			385.84 / 92.80				
	385	92.80 - 95.00 Thickly bedded SILTSTONE.			383.64				
95						10		6.50 / 10.00	
	380								
100									
	375								
105						11		6.00 / 10.00	
	370								
110		110.00 - 120.00 Heavily fractured at 0 degrees along laminations; possibly drilling induced.							
	365								
115						12		5.00 / 10.00	
	360				358.64				
120									

Log continued on next page

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 167'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 167' - 177'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 165' - 181'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 181' - 190'
Type: 3/8" Hole-Plug Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 160'
Type: Grout (Portland Cement Type I/II and Quick-Gel Bentonite)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 190.00 ft
LOCATION:

DRILL RIG: TSI
DATE STARTED: 1/4/19
DATE COMPLETED: 1/9/19

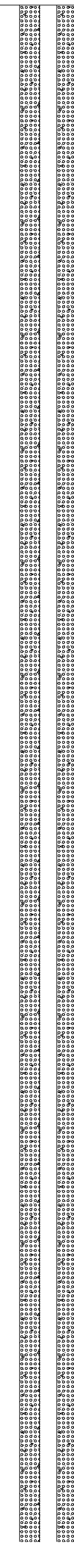
NORTHING: 1,320,383.14
EASTING: 2,063,813.29
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: SAMPLE NO.	TYPE	REC
120		70.00 - 140.00 Fresh to slightly weathered; medium strong to strong; dark gray to black; wet; thinly laminated SHALE interbedded with SILTSTONE. *(Continued)* 120.00 - 130.00 Heavily fractured at 0 degrees along laminations; possibly drilling induced.			120.00			
	355							
125						13		7.50 / 10.00
	350							
130					348.64			
	345							
135						14		5.00 / 10.00
	340				338.64			
140		140.00 - 145.00 Fresh to slightly weathered; medium strong to strong; dark gray; SANDSTONE with very thin interbeds of silt (<0.5").			140.00			
	335	143.75 - 145.00 Some clay content.			333.64			
145		145.00 - 147.00 Completely weathered, very weak, ROCK, RECOVERED AS, (CL), silty CLAY, some gravel; dark gray to black; cohesive, moist, w <~ PL, very stiff to hard.	CL		145.00 331.64	15		8.00 / 10.00
		147.00 - 150.00 Highly weathered; weak; light gray; dry; crushed/fractured SANDSTONE, some interbedded SHALE beds.			147.00			
	330				328.64			
150		150.00 - 155.00 Slightly weathered to fresh; medium strong; moderate gray to dark gray black; SHALE interbedded with thickly laminated SILTSTONE.			150.00			
	325				323.64			
155		155.00 - 157.00 Fresh; medium strong to strong; SANDSTONE with very thin beds of SHALE and SILTSTONE.			155.00 321.64	16		10.00 / 10.00
		157.00 - 160.00 Slightly weathered to fresh; medium strong; moderate gray to dark gray black; SHALE interbedded with thickly laminated SILTSTONE.			157.00			
	320				318.64			
160								

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 167'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 167' - 177'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 165' - 181'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 181' - 190'
Type: 3/8" Hole-Plug Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 160'
Type: Grout (Portland Cement Type I/II and Quick-Gel Bentonite)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 190.00 ft
LOCATION:

DRILL RIG: TSI
DATE STARTED: 1/4/19
DATE COMPLETED: 1/9/19

NORTHING: 1,320,383.14
EASTING: 2,063,813.29
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
160		160.00 - 166.00 Fresh; medium strong; gray; SANDSTONE interbedded with SHALE and SILTSTONE.		160.00				Bentonite Pel-Plug Time Release Pellets
	315							
165				312.64 / 166.00	17		10.00 / 10.00	Filter Media #10 Sand
		166.00 - 174.50 Fresh; weak to medium strong; dark gray to black; thinly laminated SHALE with interbeds of thickly laminated SILTSTONE.						
	310	168.50 - 169.00 Crushed Zone.		309.64				2" PVC Sch 40 0.010 Slot Upack Screw Tight Rubber Seal Screen
170								
	305			304.14 / 174.50				
175		174.50 - 190.00 Fresh; medium strong to strong; gray; SANDSTONE.			18		6.50 / 10.00	
	300							Sand Filter Pack
180								3/8" Hole-Plug Bentonite Chips
	295							
185					19		10.00 / 10.00	
	290			288.64				
190		Boring completed at 190.00 ft						
	285							
195								
	280							
200								

DRAFT

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 167'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 167' - 177'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 165' - 181'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 181' - 190'
Type: 3/8" Hole-Plug Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 160'
Type: Grout (Portland Cement Type I/II and Quick-Gel Bentonite)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-17V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 275.00 ft
LOCATION: South of ash pond, between Bankhead Road and pond, near gate

DRILL RIG: TSI Truck Mounted Sonic
DATE STARTED: 1/10/19
DATE COMPLETED: 1/20/19

NORTHING: 1,314,967.05
EASTING: 2,066,096.42
GS ELEVATION: 528.57
TOC ELEVATION: 531.45 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
0		0.00 - 7.00 (SM), silty SAND; light brown; non-cohesive, dry. [RESIDUUM]	SM	521.57 / 7.00	1		5.00 / 5.00
		7.00 - 11.00 (CL), CLAY, some gravel, trace sand; light brown; stiff, moist, w ~ PL. [RESIDUUM]	CL	517.57 / 11.00	2		10.00 / 10.00
		11.00 - 15.00 (CL), CLAY, some gravel, trace sand; light brown; stiff, dry, w < PL. [RESIDUUM]	ML	513.57 / 15.00			
15		15.00 - 18.50 Moderately weathered; weak; tan; laminated SHALE. [SAPROLITE]	SM	510.07 / 18.50	3		8.50 / 10.00
		18.50 - 24.00 (CL), gravelly CLAY; gray with occasional red brown lagen; cohesive, moist, w < PL. [SAPROLITE]	CL	504.57 / 24.00			
		24.00 - 25.00 COAL, RECOVERED AS, (ML), SILT, trace gravel; black; non-cohesive, dry.		503.57 / 25.00			
25		25.00 - 42.00 Fresh; medium strong to strong; gray; SANDSTONE with SHALE partings. 25.01 - 30.00 Vertical fracture; rough; clean; iron staining		498.57 / 30.00	4		6.00 / 10.00
30		30.00 - 35.00 Iron staining 30.50 - 31.00 SHALE interbeds/laminate.		497.57 / 493.57 / 35.00			
35				490.57	5		6.50 / 10.00
40		Log continued on next page					

Elevation scale: 525, 520, 515, 510, 505, 500, 495, 490

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Grout (Portland Cement and Bentonite halibutan Quik Gel)

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 128'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 128' - 148'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 125' - 150'
Type: #2 Quartz Silica

FILTER PACK SEAL
Interval: 150' - 275'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 119'
Type: Grout (Portland Cement and Bentonite Haliburton Quik Gel)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

DRAFT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Taylor

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-17V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 275.00 ft
LOCATION: South of ash pond, between Bankhead Road and pond, near gate

DRILL RIG: TSI Truck Mounted Sonic
DATE STARTED: 1/10/19
DATE COMPLETED: 1/20/19

NORTHING: 1,314,967.05
EASTING: 2,066,096.42
GS ELEVATION: 528.57
TOC ELEVATION: 531.45 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
40		25.00 - 42.00 Fresh; medium strong to strong; gray; SANDSTONE with SHALE partings. *(Continued)* 35.00 - 42.00 Bioturbation with iron staining. 35.01 - 38.00 Possible fracture ~ 6" Fracture 1, rough stepped, 0 degrees, iron stains Fracture 2, rough straight, ~ 90 degrees, iron stains 35.00 - 42.00 Bioturbation with iron staining. *(Continued)*			486.57 42.00	5		6.50/10.00
	485	42.00 - 45.00 Completely weathered, very weak, ROCK, RECOVERED AS, (CL), gravelly sandy CLAY, medium to coarse gravel of sandstone and shale; gray; cohesive, moist, w ~ PL.	CL		483.57 45.00			
45		45.00 - 58.00 Fresh; strong; dark gray; interbedded SANDSTONE and SILTSTONE. 46.50 - 48.00 Thinly bedded, fossil shells and bioturbation.			480.57	6		6.00/10.00
50	480, 475							
55					470.57 58.00	7		9.00/10.00
60	470, 465	58.00 - 70.00 Fresh; strong; dark gray; SANDSTONE with SHALE partings ~4-6" apart.						
65	460				458.57 70.00	8		10.00/10.00
70	455	70.00 - 75.00 Fresh; strong; interbedded thinly bedded to laminated SANDSTONE and SHALE. 72.00: Fracture ~ 45 degrees, planar, smooth, white mineralization.			453.57 75.00			
75	450	75.00 - 82.50 Fresh; strong; dark gray; laminated SHALE with interbedded SANDSTONE and SILTSTONE.				9		8.00/10.00
80		Log continued on next page						

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 128'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 128' - 148'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 125' - 150'
Type: #2 Quartz Silica

FILTER PACK SEAL
Interval: 150' - 275'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 119'
Type: Grout (Portland Cement and Bentonite Haliburton Quik Gel)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Taylor

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

RECORD OF BOREHOLE GS-AP-MW-17V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 275.00 ft
LOCATION: South of ash pond, between Bankhead Road and pond, near gate

DRILL RIG: TSI Truck Mounted Sonic
DATE STARTED: 1/10/19
DATE COMPLETED: 1/20/19

NORTHING: 1,314,967.05
EASTING: 2,066,096.42
GS ELEVATION: 528.57
TOC ELEVATION: 531.45 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
80		75.00 - 82.50 Fresh; strong; dark gray; laminated SHALE with interbedded SANDSTONE and SILTSTONE. *(Continued)*						
		82.50 - 89.00 Fresh; strong; light gray; thickly bedded to massive SANDSTONE with SHALE partings. 84.00: Fracture ~ 90 degrees, planar, smooth, white mineralization			446.07 82.50	9		8.00 / 10.00
	445							
85		85.00 - 89.00 Bioturbation						
	440							
		89.00 - 115.00 Fresh; strong; dark gray; bioturbation; laminated to very thinly bedded SHALE with SILTSTONE and minor very thin beds of SANDSTONE.			439.57 89.00			
90						10		7.00 / 10.00
	435							
95								
	430							
100						11		9.50 / 10.00
	425							
105								
	420							
110						12		9.00 / 10.00
	415							
115		115.00 - 143.00 Fresh; strong; dark gray; laminated SHALE with interbeds of SANDSTONE and SILTSTONE.			413.57 115.00			
						13		9.50 / 10.00
	410							
120								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Bentonite

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 128'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 128' - 148'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 125' - 150'
Type: #2 Quartz Silica

FILTER PACK SEAL
Interval: 150' - 275'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 119'
Type: Grout (Portland Cement and Bentonite Haliburton Quik Gel)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

Log continued on next page

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Taylor

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-17V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 275.00 ft
LOCATION: South of ash pond, between Bankhead Road and pond, near gate

DRILL RIG: TSI Truck Mounted Sonic
DATE STARTED: 1/10/19
DATE COMPLETED: 1/20/19

NORTHING: 1,314,967.05
EASTING: 2,066,096.42
GS ELEVATION: 528.57
TOC ELEVATION: 531.45 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

SOIL PROFILE

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
120		115.00 - 143.00 Fresh; strong; dark gray; laminated SHALE with interbeds of SANDSTONE and SILTSTONE. *(Continued)*				13		9.50 / 10.00
	405							
125								
	400							
130						14		9.00 / 10.00
	395							
135								
	390							
140						15		7.00 / 10.00
	385	143.00 - 165.00 Fresh; strong; dark gray; interbedded thinly bedded to laminated SANDSTONE and SHALE.			385.57 / 143.00			
145								
	380							
150						16		10.00 / 10.00
	375							
155								
	370					17		9.00 / 10.00
160								

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

#2 Quartz Silica

2" PVC 0.010 Slot Upack Screw Tight Rubber Seal Screen

Sand Filter Pack

Bentonite

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 128'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 128' - 148'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 125' - 150'
Type: #2 Quartz Silica

FILTER PACK SEAL
Interval: 150' - 275'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 119'
Type: Grout (Portland Cement and Bentonite Haliburton Quik Gel)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Taylor

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-17V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 275.00 ft
LOCATION: South of ash pond, between Bankhead Road and pond, near gate

DRILL RIG: TSI Truck Mounted Sonic
DATE STARTED: 1/10/19
DATE COMPLETED: 1/20/19

NORTHING: 1,314,967.05
EASTING: 2,066,096.42
GS ELEVATION: 528.57
TOC ELEVATION: 531.45 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: SAMPLE NO.	TYPE	REC
160		143.00 - 165.00 Fresh; strong; dark gray; interbedded thinly bedded to laminated SANDSTONE and SHALE. *(Continued)*				17		9.00 / 10.00
	365							
165		165.00 - 169.50 Fresh; strong; light gray; possible bioturbation; SANDSTONE.			363.57 / 165.00			
	360							
170		169.50 - 222.50 Fresh; strong; dark gray; interbedded thinly bedded to laminated SANDSTONE, SILTSTONE, and SHALE.			359.07 / 169.50	18		10.00 / 10.00
	355							
175								
	350							
180						19		9.50 / 10.00
	345							
185								
	340							
190						20		10.00 / 10.00
	335							
195								
	330					21		10.00 / 10.00
200								

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 128'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 128' - 148'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 125' - 150'
Type: #2 Quartz Silica

FILTER PACK SEAL
Interval: 150' - 275'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 119'
Type: Grout (Portland Cement and Bentonite Haliburton Quik Gel)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Taylor

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-17V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 275.00 ft
LOCATION: South of ash pond, between Bankhead Road and pond, near gate

DRILL RIG: TSI Truck Mounted Sonic
DATE STARTED: 1/10/19
DATE COMPLETED: 1/20/19

NORTHING: 1,314,967.05
EASTING: 2,066,096.42
GS ELEVATION: 528.57
TOC ELEVATION: 531.45 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
200		169.50 - 222.50 Fresh; strong; dark gray; interbedded thinly bedded to laminated SANDSTONE, SILTSTONE, and SHALE. *(Continued)*				21		10.00 / 10.00
	325							
205						22		8.00 / 10.00
	320							
210								
	315							
215						23		6.50 / 10.00
	310							
220								
		222.50 - 238.00 Fresh; strong; gray; massive; SANDSTONE. Possible 4" vertical fracture, undulating rough, 90 degrees			306.07 / 222.50			
	305							
225						24		6.50 / 10.00
	300							
230		230.00 - 235.00 Possible fracture zone						
	295							
235					293.57	25		6.00 / 10.00
		238.00 - 258.00 Fresh; strong; dark gray; laminated SHALE.			290.57 / 238.00			
	290							
240								

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 128'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 128' - 148'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 125' - 150'
Type: #2 Quartz Silica

FILTER PACK SEAL
Interval: 150' - 275'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 119'
Type: Grout (Portland Cement and Bentonite Haliburton Quik Gel)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Taylor

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-17V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 275.00 ft
LOCATION: South of ash pond, between Bankhead Road and pond, near gate

DRILL RIG: TSI Truck Mounted Sonic
DATE STARTED: 1/10/19
DATE COMPLETED: 1/20/19

NORTHING: 1,314,967.05
EASTING: 2,066,096.42
GS ELEVATION: 528.57
TOC ELEVATION: 531.45 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
240		238.00 - 258.00 Fresh; strong; dark gray; laminated SHALE. *(Continued)*						
	285					25		6.00 / 10.00
245								
	280							
250						26		6.50 / 10.00
	275							
255								
	270	258.00 - 270.00 Collapsed COAL workings			270.57 / 258.00			
260								
	265							
265						27		7.00 / 20.00
	260							
270		270.00 - 275.00 Fresh; strong; light gray; bioturbation; thickly bedded to laminated SANDSTONE with SHALE partings and beds.			258.57 / 270.00			
	255							
275		Boring completed at 275.00 ft			253.57			
	250							
280								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 128'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 128' - 148'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 125' - 150'
Type: #2 Quartz Silica

FILTER PACK SEAL
Interval: 150' - 275'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 119'
Type: Grout (Portland Cement and Bentonite Haliburton Quik Gel)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

DRAFT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: T. Taylor

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-18V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 140.00 ft
LOCATION: South of Ash Pond, near Prescott Creek tunnel entrance

DRILL RIG: TSI Track Rig
DATE STARTED: 1/20/19
DATE COMPLETED: 1/30/19

NORTHING: 1,315,045.44
EASTING: 2,066,833.22
GS ELEVATION: 401.81
TOC ELEVATION: 404.61 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
0		0.00 - 2.50 (CL), gravelly CLAY, some fine sand; red brown; cohesive, w ~ PL. [FILL]	CL	399.31			
	400	2.50 - 5.00 (SP-GP), SAND and GRAVEL; brown; non-cohesive, dry. [FILL]	SP-GP	2.50 396.81			
5		5.00 - 7.50 (SP), SAND; medium grained; yellow black. [FILL]	SP	5.00 394.31	1		10.00 / 10.00
	395	7.50 - 10.00 (GP), GRAVEL, some sand; non-cohesive, dry; some rock flour. [FILL]	Go	7.50 391.81			
10	390	10.00 - 25.00 Fresh; strong; light gray; fine grained; very thinly bedded SANDSTONE with interbeds of SILTSTONE and laminated SHALE.		10.00 376.81			
15	385				2		6.50 / 10.00
20	380						
25		25.00 - 26.00 Fresh; strong; light gray; medium grained SANDSTONE with 60 degree tight very thin white possible calcite vein.		25.00 375.81	3		9.50 / 10.00
	375	26.00 - 77.00 Fresh; strong; light gray; very thinly bedded SANDSTONE with interbeds of SHALE and SILTSTONE. 27.00: Trace pyrite.		26.00			
30	370						
35	365				4		5.00 / 10.00
40							

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Grout (30% Solids Enviroplug Grout)

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 124'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 124' - 134'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 121.8' - 135.5'
Type: GP #2 Silica Sand

FILTER PACK SEAL
Interval: 118' - 122'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 118.8'
Type: Grout (30% Solids Enviroplug Grout)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: GSE
DRILLER: T. Herod

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-18V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 140.00 ft
LOCATION: South of Ash Pond, near Prescott Creek tunnel entrance

DRILL RIG: TSI Track Rig
DATE STARTED: 1/20/19
DATE COMPLETED: 1/30/19

NORTHING: 1,315,045.44
EASTING: 2,066,833.22
GS ELEVATION: 401.81
TOC ELEVATION: 404.61 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
40		26.00 - 77.00 Fresh; strong; light gray; very thinly bedded SANDSTONE with interbeds of SHALE and SILTSTONE. *(Continued)*							
	360								
45						5		8.00 / 10.00	
	355								
50									
	350								
55						6		10.00 / 10.00	
	345								
60									
	340								
65						7		7.00 / 10.00	
	335								
70									
	330								
75						8		7.00 / 10.00	
	325	77.00 - 82.00 Fresh; strong; light gray; trace bioturbation; SANDSTONE with trace SHALE partings.			324.81 / 77.00				
80									

Log continued on next page

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 124'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 124' - 134'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 121.8' - 135.5'
Type: GP #2 Silica Sand

FILTER PACK SEAL
Interval: 118' - 122'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 118.8'
Type: Grout (30% Solids Enviroplug Grout)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: GSE
DRILLER: T. Herod

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-18V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 140.00 ft
LOCATION: South of Ash Pond, near Prescott Creek tunnel entrance

DRILL RIG: TSI Track Rig
DATE STARTED: 1/20/19
DATE COMPLETED: 1/30/19

NORTHING: 1,315,045.44
EASTING: 2,066,833.22
GS ELEVATION: 401.81
TOC ELEVATION: 404.61 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
80		77.00 - 82.00 Fresh; strong; light gray; trace bioturbation; SANDSTONE with trace SHALE partings. *(Continued)*			319.81			
	320	82.00 - 85.50 Fresh; strong; gray; interbedded SANDSTONE, SHALE, and SILTSTONE.			82.00 316.31			
85						9		10.00 / 10.00
	315	85.50 - 87.50 Fresh; strong; light gray; SANDSTONE with trace SHALE partings.			85.50 314.31			
		87.50 - 91.00 Fresh; strong; dark gray; interbedded SANDSTONE, SILTSTONE, and SHALE.			87.50 310.81			
90	310	91.00 - 93.00 Fresh; strong; gray; bioturbation; SANDSTONE.			91.00 308.81			
		93.00 - 120.00 Fresh; strong; dark gray; laminated SHALE interbedded with laminated to thinly bedded SANDSTONE.			93.00			
95						10		9.00 / 10.00
	305							
100	300							
105						11		8.00 / 10.00
	295							
110		110.00 - 120.00 Bioturbation.						
	290							
115						12		9.00 / 10.00
	285	119.00: Pyrite on bedding plane.			281.81			
120		Log continued on next page						

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Bentonite Coated Pellets

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 124'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 124' - 134'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 121.8' - 135.5'
Type: GP #2 Silica Sand

FILTER PACK SEAL
Interval: 118' - 122'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 118.8'
Type: Grout (30% Solids Enviroplug Grout)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: GSE
DRILLER: T. Herod

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-18V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 140.00 ft
LOCATION: South of Ash Pond, near Prescott Creek tunnel entrance

DRILL RIG: TSI Track Rig
DATE STARTED: 1/20/19
DATE COMPLETED: 1/30/19

NORTHING: 1,315,045.44
EASTING: 2,066,833.22
GS ELEVATION: 401.81
TOC ELEVATION: 404.61 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
120		120.00 - 129.00 Fresh; strong; light gray; laminated to very thinly bedded SANDSTONE with occasional interbeds of SILTSTONE.			120.00				2" PVC 0.010 Slot Upack Screw with Rubber Seal Screen
	280								GP #2 Silica Sand
125	275					13		7.00 / 10.00	
		129.00 - 131.00 COAL.			272.81 129.00				
130	270	131.00 - 137.50 Fresh; strong; SHALE with coal partings and trace thinly bedded SANDSTONE.			270.81 131.00				
135	265					14		9.00 / 10.00	Sand Filter Pack
									Bentonite
		137.50 - 140.00 Fresh; strong; dark gray; laminated SHALE with thinly bedded SANDSTONE.			264.31 137.50				
140		Boring completed at 140.00 ft			261.81				
	260								
145	255								
150	250								
155	245								
160									

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 124'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 124' - 134'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 121.8' - 135.5'
Type: GP #2 Silica Sand

FILTER PACK SEAL
Interval: 118' - 122'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 118.8'
Type: Grout (30% Solids Enviroplug Grout)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: GSE
DRILLER: T. Herod

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

RECORD OF BOREHOLE GS-AP-MW-23H

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 50.00 ft
LOCATION:

DRILL RIG: TSI 150CC
DATE STARTED: 1/4/19
DATE COMPLETED: 1/4/19

NORTHING: 1,324,901.11
EASTING: 2,063,751.19
GS ELEVATION: 301.90
TOC ELEVATION: 304.98 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
0		0.00 - 1.00 (GP), sandy GRAVEL, with silt and clay; black gray; highly weathered siltstone/shale fragments; non-cohesive, dry to moist. [RESIDUUM]	GP	300.9 / 1.00			
	300	1.00 - 2.80 (CL), sandy silty CLAY; coarse sand; red-orange; cohesive, w < PL, moist, soft. [RESIDUUM]	CL	299.1 / 2.80			
5	295	2.80 - 8.90 (SP), SAND, fine to coarse, trace silt, trace clay; orange; non-cohesive, dry. [RESIDUUM]	SP	293 / 8.90	1		10.00 / 10.00
10		8.90 - 10.00 (SP), SAND, fine to coarse, some silt, trace fine to coarse gravel; highly weathered siltstone/mudstone; non-cohesive, dry. [RESIDUUM]	SP	291.9 / 10.00			
	290	10.00 - 13.75 (CL), silty CLAY, trace coarse gravel; gray brown; cohesive, w > PL, very soft to soft. [RESIDUUM]	CL	288.15 / 13.75			
		13.75 - 15.00 (SP), SAND, some silt; light gray; non-cohesive, dry. [RESIDUUM]	SP	286.9 / 15.00			
15		15.00 - 16.60 (CL), sandy silty CLAY, trace gravel, fine to coarse sand; brown; cohesive, w ~ PL, very soft. [RESIDUUM]	CL	285.3 / 16.60	2		10.00 / 10.00
	285	16.60 - 17.50 (SP), SAND, fine to coarse, some fine to coarse gravel; weathered siltstone/sandstone; non-cohesive, dry. [RESIDUUM]	SP	284.4 / 17.50			
		17.50 - 18.80 (GP), GRAVEL, some fine to coarse sand; weathered siltstone/sandstone; light gray; non-cohesive, dry. [RESIDUUM]	GP	283.1 / 18.80			
		18.80 - 19.70 (CL), silty CLAY, some sand, some gravel; orange brown; cohesive, w ~ PL, firm to stiff. [RESIDUUM]	CL	282.2			
20		19.70 - 20.00 Completely weathered, very weak, COAL, RECOVERED AS, (ML), SILT; black; non-cohesive, dry.	ML	20.00			
25	280, 275	20.00 - 30.00 SHALE, RECOVERED AS, (GM), silty GRAVEL, fine to coarse; gray; non-cohesive, dry.	GM	271.9 / 30.00	3		6.00 / 10.00
30	270	30.00 - 50.00 Slightly weathered; weak to medium strong; gray; SHALE with interbedded laminated SILTSTONE. 30.01 - 31.00 COAL fragments.		270.9			
35	265	33.50 - 35.00 0 degree, clean, smooth, undulating fractures.		266.9	4		7.00 / 10.00
40		38.00 - 40.00 0 degree, clean, smooth, undulating fractures.		261.9			

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Surface completion: ~3 ft stick up, concrete bollards
Grout (Portland Cement and High-Yield Bentonite)
Bentonite
Quartz Sand
Upack Screen with Sand

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 29'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 29' - 39'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 27' - 45'
Type: Quartz Sand

FILTER PACK SEAL
Interval: 21' - 27'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 21'
Type: Grout (Portland Cement and High-Yield Bentonite)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: GSE
DRILLER: C. Ratley / T. Herod

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-23H

PROJECT: Gorgas Ash Pond	DRILL RIG: TSI 150CC	NORTHING: 1,324,901.11	DEPTH W.L.:
PROJECT NUMBER: 18114896	DATE STARTED: 1/4/19	EASTING: 2,063,751.19	DATE W.L.:
DRILLED DEPTH: 50.00 ft	DATE COMPLETED: 1/4/19	GS ELEVATION: 301.90	TIME W.L.:
LOCATION:		TOC ELEVATION: 304.98 ft	GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
40		30.00 - 50.00 Slightly weathered; weak to medium strong; gray; SHALE with interbedded laminated SILTSTONE. *(Continued)* 40.00 - 50.00 Iron staining and fossils in rock.			40.00				
	260								Sand Filter Pack
45						5		7.50 / 10.00	
	255								Bentonite Chips
		48.00 - 50.00 Crushed rock.							
50					251.9				
		Boring completed at 50.00 ft							
	250								
55									
	245								
60									
	240								
65									
	235								
70									
	230								
75									
	225								
80									

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 29'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 29' - 39'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 27' - 45'
Type: Quartz Sand

FILTER PACK SEAL
Interval: 21' - 27'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 21'
Type: Grout (Portland Cement and High-Yield Bentonite)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: GSE
DRILLER: C. Ratley / T. Herod

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-24H

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 50.00 ft
LOCATION:

DRILL RIG: TSI 150CC
DATE STARTED: 1/3/19
DATE COMPLETED: 1/3/19

NORTHING: 1,325,034.25
EASTING: 2,062,579.09
GS ELEVATION: 258.38
TOC ELEVATION: 261.35 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
0		0.00 - 2.00 (CL-ML), gravelly CLAYEY SILT, trace sand; dark brown; non-cohesive, moist. [FILL]	CL-ML	256.38 / 2.00			
	255	2.00 - 3.00 (SP), SAND, trace gravel, trace silt, trace organics; red brown; non-cohesive, moist. [FILL]	SP	255.38 / 3.00			
		3.00 - 3.50 (ML), clayey SILT, trace organic plant material; dark gray black; cohesive, w < PL, soft. [FILL]	ML	254.88 / 3.50			
5		3.50 - 5.00 (GP), GRAVEL, gravels of organic siltstone; completely weathered; black. [FILL]	GP	253.38 / 5.00	1		8.00 / 10.00
	250	5.00 - 10.00 (CL), CLAY, trace silt; cohesive, w > PL, very soft. [ALLUVIUM]	CL	248.38 / 10.00			
10 – 20	245, 240	10.00 - 20.00 (CL-ML), sandy SILTY CLAY; brown; cohesive, moist, very soft. [ALLUVIUM] 18.00: Progressively more sand and more dry downhole.	CL-ML	238.38 / 20.00	2		10.00 / 10.00
20 – 30	235, 230	20.00 - 30.00 (SM), silty SAND; brown mottled orange; non-cohesive, wet. [ALLUVIUM]	SM	228.38 / 30.00	3		7.00 / 10.00
30 – 37.5	225	30.00 - 37.50 (SM), silty SAND; gray-brown; non-cohesive, wet. [ALLUVIUM]	SM	220.88 / 37.50	4		10.00 / 10.00
37.5 – 40	220	37.50 - 40.00 (GP), GRAVEL, fine to coarse gravels of completely weathered siltstone; gray black; drilling may have destroyed structure. [SAPROLITE]	GP	218.38			

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Grout

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 49.5'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 49.5'-59.5'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 47.7' - 49.5'
Type: Sand

FILTER PACK SEAL
Interval: 29.1' - 37.7'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 29.1'
Type: Grout

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: GSE
DRILLER: T. Herod

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-24H

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 50.00 ft
LOCATION:

DRILL RIG: TSI 150CC
DATE STARTED: 1/3/19
DATE COMPLETED: 1/3/19

NORTHING: 1,325,034.25
EASTING: 2,062,579.09
GS ELEVATION: 258.38
TOC ELEVATION: 261.35 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
40		40.00 - 43.00 (GC-SP), clayey GRAVEL and SAND, gravel of weathered shale; black to gray; non-cohesive. [SAPROLITE]	GC-SP		40.00				Bentonite (Enviroplug)
	215	43.00 - 60.00 Slightly weathered; medium strong; ocassionally fossiliferous; laminated to thinly laminated SHALE. Fractures along laminations, stepped, smooth, 0 degrees; most fractures seem to be drilling induced.			215.38 43.00				
45						5		10.00	
	210								Sand
50									Screen
	205								
55						6		10.00	
	200								
60		Boring completed at 50.00 ft			198.38 60.00				Sand Filter Pack
	195								
65									
	190								
70									
	185								
75									
	180								
80									

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 49.5'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 49.5'-59.5'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 47.7' - 49.5'
Type: Sand

FILTER PACK SEAL
Interval: 29.1' - 37.7'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 29.1'
Type: Grout

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: GSE
DRILLER: T. Herod

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-AP-MW-25H

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 170.00 ft
LOCATION: West of AP under powerline

DRILL RIG: TSI Track Rig
DATE STARTED: 1/23/19
DATE COMPLETED: 1/2/19

NORTHING: 1,322,710.44
EASTING: 2,061,621.52
GS ELEVATION: 458.66
TOC ELEVATION: 461.79 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
0		0.00 - 12.00 (SM), silty SAND; red brown; cohesive, w ~ PL. [RESIDUUM]	SM				
	455						
5					1		10.00 / 10.00
	450						
10							
		12.00 - 14.50 (SP), gravelly SAND, some silt; gray brown; non-cohesive, moist. [RESIDUUM]	SP	446.66 / 12.00			
	445						
15		14.50 - 20.00 Fresh; strong; light gray; SANDSTONE, RECOVERED AS, (GP), GRAVEL and cobbles, mostly destroyed by drilling.	GP	444.16 / 14.50	2		10.00 / 10.00
	440						
20		20.00 - 33.00 Fresh; strong; light gray; medium to coarse grained; SANDSTONE with interbeds of laminated SHALE.		438.66 / 20.00			
	435						
25					3		9.00 / 10.00
	430						
30							
	425	33.00 - 36.00 Fresh; strong; light and dark gray; inter-laminated SANDSTONE and SHALE. 34.00: Pyrite infill in burrow or fossil structure.		425.66 / 33.00			
35					4		8.50 / 10.00
		36.00 - 47.00 Fresh; light gray; medium to coarse grained; SANDSTONE with occasional interbeds of laminated SHALE.		422.66 / 36.00			
	420						
40							

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Aquaguard Bentonite Grout

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 155'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 155' - 165'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 153' - 170'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 148' - 153'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 148'
Type: Aquaguard Bentonite Grout

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: David Hannam
CHECKED BY: Tim Richards
DATE: 4/5/19

Golder Associates