U.S. Department of Labor

Mine Safety and Health Administration
1030 London Drive, Suite 400
Birmingham, AL 35211-4542

AUG 31 2015

Lawrence Pasquale, Safety Manager
Concord Mine, ID No. 01-00329
Oak Grove Resources, LLC
8360 Taylors Ferry Road
Hueytown, AL 35023

Dear Mr. Pasquale:

The review of your plans for Slurry Impoundment No. 6, MSHA ID No. AL11-00329-09, to be constructed at the Oak Grove Resources, LLC, Concord Mine, ID No. 01-00329 is complete. The plan meets the requirements of sound engineering design and is hereby **approved**. Please notify this office when construction begins.

If you have any questions concerning this matter, please contact the District Plans Group at (205) 290-7302, ext. 261.

Sincerely,

Richard A. Gates
District Manager

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

July 30, 2015

MINE SAFETY & HEALTH ADMINISTRATION
RECEIVED
AUG 06 2015
DISTRICT II
BIRMINGHAM, ALABAMA

MEMORANDUM FOR RICHARD A. GATES
District Manager, District 11
Coal Mine Safety and Health

THROUGH: WILLIAM J. FRANCART
Chief, Pittsburgh Safety and Health Technology Center

FROM: STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

SUBJECT: Recommendation for Approval of a Design Plan for Slurry Impoundment No. 6, MSHA I.D. No. AL11-00329-09, Oak Grove Resources, LLC, Concord Mine, Mine I.D. No. 01-00329, Hueytown, Jefferson County, Alabama

As requested by your office, a technical review of the subject plan has been completed by a member of my staff. The attached Report No. MW15-055 indicates that the plan for the construction of the new fine coal refuse slurry impoundment appears to be technically acceptable and approval is recommended. The main embankment will be 94 feet high and will have a 1,400-foot-long crest. There will also be three saddle dams between 6 and 40 feet high. All embankments will be constructed from soil obtained at the site. The impoundment will have an open-channel spillway to route the design storm, and its control section will be 6 feet below the crest elevation. The main embankment will include an underdrain to control the phreatic surface. Impoundment and IRPI data sheets are attached. Please contact this office if there are any questions regarding this review.

Attachments

cc: T. Watkins – Acting Director, TS
S. Gigliotti – Chief, Safety Div., CMS&H
D. Braenovich – Safety Div., CMS&H
J. Calhoun – Safety Div., CMS&H

mcgehee engineering corp

July 16, 2015

Richard A. Gates, District Manager
Mine Safety & Health Administration
1030 London Drive, Suite 400
Birmingham, AL 35211
205/290-7300

Jim Kelly, P.E.
DOL, MSHA, PSHTC
Building 38
626 Cochrans Mill Road
Post Office Box 18233
Pittsburgh, PA 15236

RE: Responses to MSHA Comments Dated July 8th, 2015
Oak Grove Resources, LLC.
Concord Mine
MSHA I.D.: 01-00329
Proposed Slurry Impoundment No. 6

Gentlemen:

McGehee Engineering Corp. (MEC) has prepared responses to Mine Safety and Health Administration (MSHA) comments regarding Oak Grove Resources, LLC. (OGR) proposed slurry impoundment near Hueytown, Alabama. Following are MSHA's review comments and MEC's corresponding responses. A copy of MSHA's review letter is also attached.

COMMENTS AND RESPONSES

MSHA Comment No. 1

With respect to previous item 25, the designer should be aware that the 20 acre-foot impoundment storage capacity, as referenced by 30 CFR §77.216(a)(1) to require an MSHA-approved design, is calculated from the upstream toe of the dam to the crest of the embankment and not to the spillway control section elevation. The spillway controls the normal pool, but not the total storage. As currently drawn, the sediment basin volume appears to be above this value, so as stated earlier, when the sediment basin design is finalized, it will need to be smaller or approved by MSHA.

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

Response No. 1

The proposed sediment basin referenced in previous item 25 and comment No. 1 has been removed from the Plan View Drawing (Sheet 2 of 10), Watershed Map (3 of 10) and Abandonment Map (Sheet 10 of 10). Replacement drawings and maps listed above are included in this submittal. Any proposed sediment basin or impoundment final design at this facility will be in accordance with all State and Federal regulations.

MSHA Comment No. 2

The action level for Piezometer No. 2 is shown as 530 feet in the table on Sheet 5 of 10, which is the elevation of the ground surface at its location. This elevation is higher than the phreatic surface at this location that was used in the slope stability analysis. The table should be corrected.

Response No. 2

The Standard Details Sheet, Sheet 5 of 10 has been revised to show the correct action level of 505 MSL for Piezometer No. 2. A replacement Sheet 5 of 10 is enclosed.

MSHA Comment No. 3

In response to previous item 27, the company revised Section 1.1 of the Specifications, Site Preparation, to "ensure any joints or cracks in rock foundations are sealed off using a protective filter." Although a filter constructed over a crack might prevent excessive water or eroded soil from entering the crack from above, surface cracks may indicate cracks that extend far below the surface. Significant flows of water could flow along subsurface cracks, having entered the crack upstream of the area identified at the surface and increasing the hydrostatic head farther downstream at the bottom of the embankment. It is recommended that cracks in the foundation material be filled, as suggested in MSHA's Engineering and Design Manual for Coal Refuse Disposal Facilities (Design Manual), Section 8.5.1.7. Constructing a filter over filled cracks would provide an added degree of protection, so this measure should not be discarded.

Response No. 3

Any cracks or joints discovered in the foundation area shall be treated by grouting or other measures to prevent them from transmitting high hydrostatic pressures and to eliminate potential paths for internal erosion as recommended in Section 8.5.1.7 of MSHA's Design Manual. Installing the protective filter described in Appendix A, Section 1.1 shall remain as part of this plan.

MSHA Comment No. 4

Previous item 32 noted that a list of all drawings showing the latest revision for each should be provided either on a drawing or in the specifications. If this is not done, the inspector or construction supervisor cannot be sure he/she is looking at the current approved drawing. Simply including a revision number on each drawing, as the response indicates was done, does not provide this assurance.

Response No. 4

The enclosed sheet showing the map name, sheet number and date of revision shall be inserted in Appendix D following the cover page for Appendix D.

MSHA Comment No. 5

In response to previous item 29, the company states that compaction will be performed by "tracked mobile equipment, compactor or rubber-tired equipment available at the mine." Optimum compaction of cohesive soils requires specialized equipment, as noted in the MSHA Design Manual, in Sections 11.4.3 and 11.5 and Table 11.5. Although density testing will be performed for quality control, compaction equipment should not be used that is not likely to provide consistently adequate compaction.

Response No. 5

An appropriately sized sheepsfoot roller shall be used for compaction of fill material as recommended by the reviewer in previous item 29 and this comment No. 5.

MSHA Comment No. 6

In response to previous item 7, it is noted that a double hydrometer test (ASTM D4221) on the one sample from Test Pit 15 indicated a dispersivity of 39.5 percent. The response also states that the MSHA Design Manual indicates this level of dispersivity is "only moderately dispersive." Table 6-14 of the MSHA Design Manual does identify the range of 15-40 percent as "moderately dispersive," while dispersivity above 40 percent is "highly dispersive" and should not be used in dams. The Design Manual also notes that the pinhole test (ASTM D4647) is the most reliable method of determining clay dispersivity. This is because it is a direct, rather than indirect method of determining dispersivity. As only one sample was tested and it showed moderate dispersivity, it would be prudent to test a number of samples using the pinhole test. If the material is determined to be less than highly dispersive, MSHA does not categorically prohibit its use, but protective measures may be prudent. Two publications, USDA Soil Conservation Service Soil Mechanics Note 13 (1991), and USBR Report R-91-09 (1991) describe the potential problems with the use of dispersive soils in dams and suggest possible mitigative design and construction measures if dispersive soils are used in dam construction. The designer should perform pinhole tests on soil from TP-15 and consider mitigative measures unless the material is determined to be non-dispersive.

Response No. 6

Pinhole tests on material from samples sites (test pits) TP-10 and TP-15 were recently performed by Geo/Environmental Associates in Knoxville, Tennessee. The sample material was remolded to 95% of the proctor (+2% moisture) for each respective soil. Results of each soil show them to be nondispersive. The pinhole test results are included in this submittal.

Additional material from each test pit was obtained and blended at a 1 to 1 ratio. A proctor was performed on the 1 to 1 blend prior to running a pinhole test on the blend. Results of the blended material pinhole test also show the material to be nondispersive. Results of the blended proctor and pinhole test are included in this submittal.

Please let me know if you have any questions or need any additional information.

Sincerely,

McGehee Engineering Corp.

Jeff Aldridge

Jeff Aldridge, P.E.
Alabama Reg. No. 33959

mcgehee engineering corp

Jeff Aldridge

From:	Donahue, Paul - MSHA <Donahue.Paul@DOL.GOV>
Sent:	Wednesday, July 08, 2015 3:31 PM
To:	jeff@mcgehee.org; ralph.lopez@CliffsNR.com
Cc:	Martin, Eddie - MSHA; Blank, Darren J - MSHA
Subject:	FW: Request for Additional Information - AL11-00329-09

Request for Additional Information Associated with the Revised Plan for Slurry Impoundment No. 6, Concord Mine
Submittal dated April 6, 2015 (Received in PSHTC on April 10, 2015)
Oak Grove Resources, LLC, Mine I.D. No. 01-00329
MSHA I.D. No. AL11-00329-09
Hueytown, Alabama

This email references the following two submittals:

1. "Slurry Impoundment No. 6 Detailed Design Plans," prepared by McGehee Engineering Corp. (MEC), dated June 17, 2014, and received in this office on June 24, 2014.

2. "Responses to MSHA Comments dated January 30, 2015," prepared by MEC, dated April 3, 2015, and received in this office on April 10, 2015.

The review of the original plan (submittal number 1, above) resulted in a request for information from Technical Support dated January 16, 2015, which included 33 items that needed to be addressed. The items in our January 2015 information request included: material- and stability-related issues; seepage- and drainage-related issues; spillway, groin ditch, and sediment basin question; and embankment construction-related issues. The company provided a response to that email via the second subject submittal. Most of the issues were adequately addressed by the company's response; however; there are a few items that still require resolution.

Before the proposed plan can be recommended for approval, the comments below need to be addressed.

1. With respect to previous item 25, the designer should be aware that the 20 acre-foot impoundment storage capacity, as referenced by 30 CFR §77.216(a)(1) to require an MSHA-approved design, is calculated from the upstream toe of the dam to the crest of the embankment and not to the spillway control section elevation. The spillway controls the normal pool, but not the total storage. As currently drawn, the sediment basin volume appears to be above this value, so as stated earlier, when the sediment basin design is finalized, it will need to be smaller or approved by MSHA.

2. The action level for Piezometer No. 2 is shown as 530 feet in the table on Sheet 5 of 10, which is the elevation of the ground surface at its location. This elevation is higher than the phreatic surface at this location that was used in the slope stability analysis. The table should be corrected.

3. In response to previous item 27, the company revised Section 1.1 of the Specifications, Site Preparation, to "ensure any joints or cracks in rock foundations are sealed off using a protective filter." Although a filter constructed over a crack might prevent excessive water or eroded soil from entering the crack from above, surface cracks may indicate cracks that extend far below the surface. Significant flows of water could flow along subsurface cracks, having entered the crack

upstream of the area identified at the surface and increasing the hydrostatic head farther downstream at the bottom of the embankment. It is recommended that cracks in the foundation material be filled, as suggested in MSHA's Engineering and Design Manual for Coal Refuse Disposal Facilities (Design Manual), Section 8.5.1.7. Constructing a filter over filled cracks would provide an added degree of protection, so this measure should not be discarded.

4. Previous item 32 noted that a list of all drawings showing the latest revision for each should be provided either on a drawing or in the specifications. If this is not done, the inspector or construction supervisor cannot be sure he/she is looking at the current approved drawing. Simply including a revision number on each drawing, as the response indicates was done, does not provide this assurance.

5. In response to previous item 29, the company states that compaction will be performed by "tracked mobile equipment, compactor or rubber-tired equipment available at the mine." Optimum compaction of cohesive soils requires specialized equipment, as noted in the MSHA Design Manual, in Sections 11.4.3 and 11.5 and Table 11.5. Although density testing will be performed for quality control, compaction equipment should not be used that is not likely to provide consistently adequate compaction.

6. In response to previous item 7, it is noted that a double hydrometer test (ASTM D4221) on the one sample from Test Pit 15 indicated a dispersivity of 39.5 percent. The response also states that the MSHA Design Manual indicates this level of dispersivity is "only moderately dispersive." Table 6-14 of the MSHA Design Manual does identify the range of 15-40 percent as "moderately dispersive," while dispersivity above 40 percent is "highly dispersive" and should not be used in dams. The Design Manual also notes that the pinhole test (ASTM D4647) is the most reliable method of determining clay dispersivity. This is because it is a direct, rather than indirect method of determining dispersivity. As only one sample was tested and it showed moderate dispersivity, it would be prudent to test a number of samples using the pinhole test. If the material is determined to be less than highly dispersive, MSHA does not categorically prohibit its use, but protective measures may be prudent. Two publications, USDA Soil Conservation Service Soil Mechanics Note 13 (1991), and USBR Report R-91-09 (1991) describe the potential problems with the use of dispersive soils in dams and suggest possible mitigative design and construction measures if dispersive soils are used in dam construction. The designer should perform pinhole tests on soil from TP-15 and consider mitigative measures unless the material is determined to be non-dispersive.

To expedite the approval process, the revised drawing(s) and specifications can be sent directly to me and to District 11, Coal mine Safety and Health. My mailing address is:

Jim Kelly
DOL, MSHA, PSHTC
626 Cochrans Mill Road
Post Office Box18233
Pittsburgh, PA 15236

Respectfully,

James M. Kelly, P.E.
Civil Engineer
Mine Waste and Geotechnical Engineering Division
Pittsburgh Safety and Health Technology Center
412-386-5340

LIST OF REVISED MAPS & DRAWINGS

MAP/DRAWING	SHEET	REVISION	DATE
Plan View	2 of 10	No. 1 No. 2	04-02-15 07-14-15
Watershed	3 of 10	No. 1	07-14-15
Standard Details	5 of 10	No. 1 No. 2	04-01-15 07-14-15
Geotechnical Inv.	6 of 10	No. 1	04-02-15
Abandonment	10 of 10	No. 1	07-14-15

SUMMARY OF LABORATORY TEST RESULTS

					ATTERBERG LIMITS				Project: Concord Slurry Impoundment #6 Project Number: 12-651 Date: July 16, 2015
Sample ID	Sample Type*	Moisture Content (%)	Dry Density (pcf)	Dispersive Classification	Liquid Limit (%)	Plasticity Index (%)	USCS	Other Test **	Soil Description
TP-10	B	20.8	98.2	ND1 Nondispersive	23	np	ML	P,S	Silt, clayey, light reddish brown
TP-15	B	24.7	92.3	ND1 Nondispersive	36	15	CL	P,S	Clay, silty, light brown, tan
TP-10/TP-15	B	25.8	90.2	ND1 Nondispersive	--	--	--	P	Clay, silty, light reddish brown, light brown

*ST-SHELBY TUBE SAMPLE, SS-SPLIT SPOON SAMPLE, B-BAG SAMPLE, J-JAR SAMPLE

**TEST RESULTS REPORTED ON OTHER SHEETS:

T-TRIAXIAL
S-SIEVE OR GRAIN SIZE ANALYSIS
U-UNCONFINED COMPRESSION
P-PROCTOR TEST
K-PERMEABILITY
C-CONSOLIDATION

Geo/Environmental Associates

DATA CHECKED BY

PINHOLE DISPERSION TEST - ASTM D4647 - METHOD A

Project : Concord Slurry Impoundment #6

Date :07/16/15

Project No. : 12-651

Dispersive Classification :Nondispersive ND1

Sample ID : TP-10

Pin Hole size After Test : Not Measurably Larger

Sample Description : Silt, clayey, light reddish brown

Moisture Content : 20.8%

Remolded/Undisturbed : Remolded

Dry Density : 98.2 pcf

Time	Head	Flow		Flow	Turbidity From side						
Span (mn)	(in.)	mL.	sec.	Rate	VD	D	MD	SD	BV	Clear	Comments
1	2	25	28	0.89						X	
3	2	25	27	0.93						X	
5	2	25	28	0.89						X	
10	2	25	28	0.89						X	
1	7	25	24	1.04						X	
3	7	25	23	1.09						X	
5	7	25	23	1.09						X	
1	15	25	18	1.39						X	
3	15	25	18	1.39					X		
5	15	25	18	1.39					X		
1	40	25	15	1.67					X		
3	40	25	14	1.79					X		
5	40	25	14	1.79					X		Nondispersive ND1

Turbidity Guide : VB - Very Dark
D - Dark
MD - Moderately Dark
SD - Slightly Dark
BV - Barely Visible
Clear - Completely Clear

PINHOLE DISPERSION TEST - ASTM D4647 - METHOD A

Project : Concord Slurry Impoundment #6

Date :07/16/15

Project No. : 12-651

Dispersive Classification :Nondispersive ND1

Sample ID : TP-15

Pin Hole size After Test : Not Measurably Larger

Sample Description : Clay, silty, light brown, tan

Moisture Content : 24.7%

Remolded/Undisturbed : Remolded

Dry Density : 92.3 pcf

Time	Head	Flow		Flow	Turbidity From side						
Span (mn)	(in.)	mL.	sec.	Rate	VD	D	MD	SD	BV	Clear	Comments
1	2	25	31	0.81						X	
3	2	25	33	0.76						X	
5	2	25	35	0.71						X	
10	2	25	35	0.71						X	
1	7	25	28	0.89						X	
3	7	25	29	0.86						X	
5	7	25	28	0.89						X	
1	15	25	25	1.00						X	
3	15	25	24	1.04						X	
5	15	25	24	1.04						X	
1	40	25	21	1.19						X	
3	40	25	21	1.19						X	
5	40	25	21	1.19						X	Nondispersive ND1

Turbidity Guide : VB - Very Dark
D - Dark
MD - Moderately Dark
SD - Slightly Dark
BV - Barely Visible
Clear - Completely Clear

PINHOLE DISPERSION TEST - ASTM D4647 - METHOD A

Project : Concord Slurry Impoundment #6

Date :07/16/15

Project No. : 12-651

Dispersive Classification :Nondispersive ND1

Sample ID : TP-10 & TP-15 Mixed

Pin Hole size After Test : Not Measurably Larger

Sample Description : Clay, silty, lt reddish brown, lt brown

Moisture Content : 25.8%

Remolded/Undisturbed : Remolded

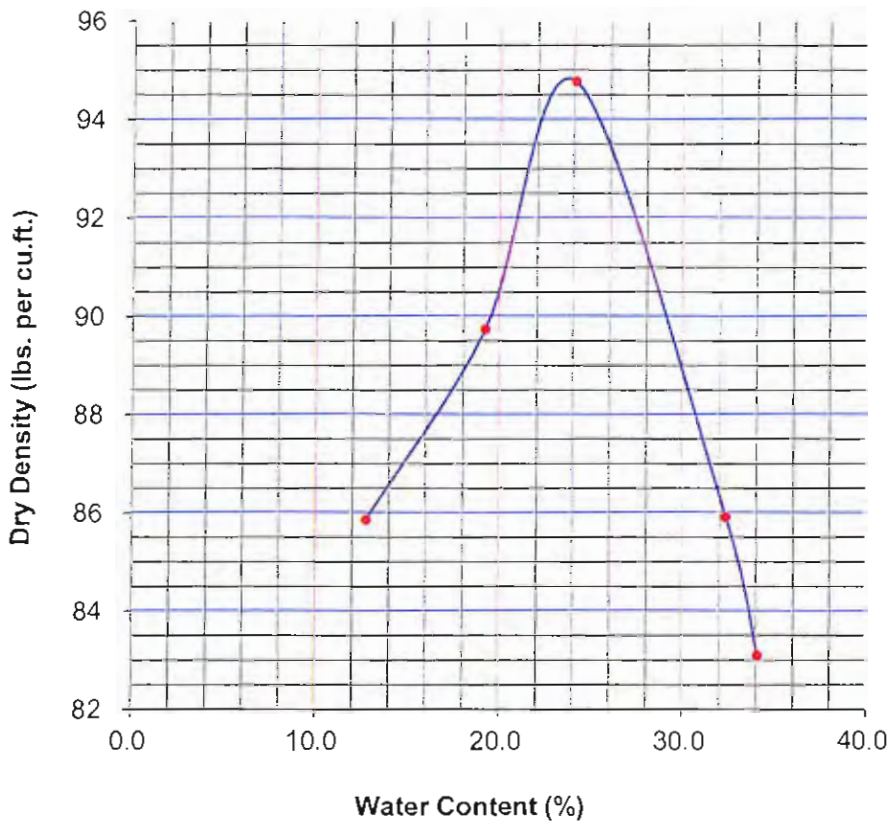
Dry Density : 90.2 pcf

Time	Head	Flow		Flow	Turbidity From side						
Span (mn)	(in.)	mL.	sec.	Rate	VD	D	MD	SD	BV	Clear	Comments
1	2	25	30	0.83						X	
3	2	25	29	0.86						X	
5	2	25	29	0.86						X	
10	2	25	29	0.86						X	
1	7	25	25	1.00						X	
3	7	25	25	1.00						X	
5	7	25	25	1.00						X	
1	15	25	22	1.14						X	
3	15	25	21	1.19						X	
5	15	25	21	1.19						X	
1	40	25	18	1.39						X	
3	40	25	18	1.39					X		
5	40	25	18	1.39					X		Nondispersive ND1

Turbidity Guide : VB - Very Dark
D - Dark
MD - Moderately Dark
SD - Slightly Dark
BV - Barely Visible
Clear - Completely Clear

mcgehee engineering corp

Cliffs
Concord, Slurry Impoundment #6, TP-10 and TP-15 Mixed
Moisture Density Relationship
(Proctor Method)



ASTM D-698 Method A	Water Content %	Specific Gravity	%> No. 4	%< No. 200	LL %	PL %	PI %

Sample Description, Classification and Location	Sample No.:	Slurry Impoundment #6 TP-10 and TP-15 Mixed
	Optimum Moisture Content=	23.8 %
	Maximum Dry Density =	94.9 lbs/cu ft

mcgehee engineering corp

April 3, 2015

Richard A. Gates, District Manager
Mine Safety and Health Administration
1030 London Drive, Suite 400
Birmingham, AL 35211

RE: Submittal Following MSHA Comments Dated January 30th, 2015
Oak Grove Resources, LLC.
Concord Mine
MSHA I.D.: 01-00329
Slurry Impoundment No. 6 Detailed Design Plans

Dear Mr. Gates:

Attached are three (3) binders containing changes, modifications and additional information as required for our response to MSHA's comment letter of January 30th, 2015. Multiple pages of text that reflect response to the comments above are being submitted with this letter. A few of the pages are submitted only because the page number changed. The attached guide gives information concerning the sections, appendices and drawings that are to be replaced or transferred from your existing copy to our April 3rd, 2015 submittal.

If you have any questions or need additional information, please contact our office.

Sincerely,

McGehee Engineering Corp.

Jeff Aldridge

Jeffrey G. Aldridge, P.E.
Alabama Reg. No. 33959

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

Replacement Guide for April 3rd, 2015 Submittal

- Cover page, Table of Contents and Sections 1.0 thru 10.0 – completely replaced by 04-03-15 submittal
- Appendix A should be completely replaced by 04-03-15 submittal
- Appendix B – pages 28 thru 37 replaced by pages 31 thru 40 due to renumbering. Replacements for Figure 1 of Tri-axial Shear Test Reports for sample numbers TP-10, TP-15 and ST-6 are enclosed. All other Laboratory and Field Test Data remains the same and was not duplicated for this submittal.
- Appendix C can be completely replaced by 04-03-15 submittal. Stage storage, HEC-1, emergency spillway freeboard information and subsidence calculations have not changed but were included in our 04-03-15 submittal for ease of transfer for the MSHA reviewer.
- Appendix D drawings 2 of 10, 5 of 10 and 6 of 10 are submitted for replacement. All other maps remain the same.

mcgehee engineering corp

April 3, 2015

Richard A. Gates, District Manager
Mine Safety & Health Administration
1030 London Drive, Suite 400
Birmingham, AL 35211
205/290-7300

RE: Responses to MSHA Comments Dated January 30th, 2015
Oak Grove Resources, LLC.
Concord Mine
MSHA I.D.: 01-00329
Proposed Slurry Impoundment No. 6

Dear Mr. Gates:

McGehee Engineering Corp. (MEC) has prepared responses to Mine Safety and Health Administration (MSHA) comments regarding Oak Grove Resources, LLC. (OGR) proposed slurry impoundment near Hueytown, Alabama. Following are MSHA's review comments and MEC's corresponding responses. A copy of MSHA's review letter is also attached.

Attached are three (3) binders containing changes, modification and additional information as required for our response to MSHA concerns.

COMMENTS AND RESPONSES

MSHA Comment No. 1

All but two of the 31 sieve analysis sheets, from testing performed by McGehee Engineering Corp., show the results of samples taken from the 15 test pits and identify the soil as silty sand (SM), Clayey sand (SC), or SM-SC. The other two sheets identify the soil Coarse Grained Sands, with Fines." None of these sheets identified any of the soil as clay. Conversely: the drilling logs from all seven of the borings identify the soil as sandy clay; five of six gradation tests performed by Geo/Enviromnental Associates, Inc. (GA) on material from two test pits and four Shelby tubes classified the material as silty clay, with the sixth sample classified as clayey, sandy silt; and two of the three samples tested triaxially by GA are identified as silty clay, with the third classified as clayey, sandy silt. The apparent conflict between these tests should be resolved.

Response No. 1

Identification of the soils in the borings was by visual inspection only while the Shelby tubes and test pit materials were based on laboratory analysis.

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

As described in our report, sieve analysis was prepared by both MEC and Geo/Environmental Associates (GEA). Our lab used ASTM method C136 Sieve Analysis of Fine and Coarse Aggregates. ASTM C136 allows for dry sieving or washing over the #200 sieve. ASTM C136 refers to incorporate ASTM C117 Materials Finer than #200 Sieve in Mineral Aggregates by Washing if the minus #200 amount is needed. GEA uses ASTM method D422 Particle-Size Analysis of Soils and ASTM D6913 Particle-Size Distribution of Soils Using Sieve Analysis. ASTM D422 and ASTM D6913 requires/allows for washing the entire sample over a #200 sieve. The method used by GEA resulted in greater than 50% passing the No. 200 sieve as a result of additional "clump" breakdown from washing the entire sample as opposed to MEC's method of washing only the minus #200. Greater than 50% passing places the material on the lower half of the Gradation Curve and Atterberg Limits on Fraction Passing a No. 40 Sieve

Our lab at MEC has since adopted the methods of sieve analysis used by GEA. Previously, most all of our sieve analyses of soils of these types were reported as a SM, SC and SM-SC. Since changing sieve analysis methods we have started reporting soil classification of CL and ML on a regular basis.

MSHA Comment No. 2

The areas from which it is planned to excavate soil for embankment construction should be identified to ensure that the material properties assumed in the stability analyses are representative of the soil that will be used. If only certain areas contain the silty clay that is called for by the specifications, those areas should be shown on a drawing.

Response No. 2

The materials used in the stability analyses were selected to be *representative* of the embankment material. Based on our sampling data, suitable embankment material exist within the entire pool area and adjacent ridge tops. Soil types of similar quality and appearance such as those that exist at this site are typically blended during the process of loading the material into a haulage vehicle for transportation to the embankment. Additional soil samples will be taken as needed for sieve analysis and standard proctors during construction as specified by the on-site Professional Engineer or his representative to ensure the embankment material meets the minimum required criteria.

MSHA Comment No. 3

The effective strength parameters determined for the remolded sample of light reddish clayey, sandy silt are 29.2 degrees and 500 pounds per square foot (psf), and those for the remolded sample of light brown/tan silty clay are 30.7 degrees and 200 psf. The strength parameters used for the embankment material in the submitted slope stability analyses (and cited in the narrative) are 29.2 degrees and 550 psf (vs. the 500 psf from the test report). It may have been more conservative to have used the strength parameters of the other sample (30.7 degrees, 200 psf) in the analyses. The designer should run new stability analyses to determine which set of strength values will result in the lower factor of safety.

Response No. 3

550 psf was incorrectly placed on the original stability analysis presentation. 500 psf was the actual cohesion used in the original stability analysis. MEC and OGR concur that the stability

analysis should be rerun with both sets of reported soil values for comparison. Results are shown in the following Response No. 4 using the Hynes-Griffin and Franklin method as recommended in MSHA Comment No. 4.

MSHA Comment No. 4

The pseudostatic slope stability analysis for deformation screening should have been performed using the Hynes-Griffin and Franklin method, as recommended in MSHA's Engineering and Design Manual for Coal Refuse Disposal Facilities (Design Manual). In this method, for material that is not susceptible to strength loss due to the design seismic event, 80 percent of the undrained peak strength is used for clay-like material and the lower of the drained and undrained peak strength is used for sand-like material. The Design Manual describes the method of determining which classification best fits the material. A horizontal acceleration of one-half the design Peak Ground Acceleration (PGA) is applied to the model. Chapter 7 of the Design Manual, and specifically section 7.7, outlines the method by which design earthquake parameters can be determined. Earthquake parameters for this significant hazard potential facility in a moderate-to-high-seismic-hazard zone would be determined as described in the "Other Cases" block of Figure 7.23.

Response No. 4

MEC and OGR concur with the use of pseudostatic slope stability analysis using the Hynes-Griffin and Franklin method as recommended. The Peak Ground Acceleration (PGA) for the site was determined to be 0.138 (rounded to 0.14) from available USGS data. 0.1 (min. allowed value) is allowable for use as the seismic coefficient because the one half value of the PGA is less than 0.1. However, MEC chose to use the full PGA of 0.14 for the predicted phreatic line case/normal conditions to be more conservative. 80% psf cohesion values were used as recommended. Hynes-Griffin and Franklin method resulted in the following minimum factor of safety for soils taken from Test Pit/sample site TP-10 and T-15:

Sample Site	Embankment No. 1	Embankment No. 3
TP-10		
Static Fs	2.65	1.94
Fs @ phreatic action level	1.85	Not Applicable
Seismic Fs	1.6	1.32
Fs @ phreatic action level	1.32	Not Applicable
TP-15		
Static Fs	2.49	1.90
Fs @ phreatic action level	1.74	Not Applicable
Seismic Fs	1.61	1.29
Fs @ phreatic action level	1.2	Not Applicable

The piezometer action level was determined by raising the phreatic line well above the predicted phreatic line and performing stability analyses for static and dynamic conditions (0.1g) for both

types of soil. Worst case situation is with TP-15 seismic case with the elevated phreatic level. That case was used to determine the piezometer action levels presented later in this report. Revised stability analyses for each factor of safety reported above is included with this submittal for insertion into MSHA's design plan copies.

MSHA Comment No. 5

Embankment cross sections that are analyzed for slope stability should be the most critical sections in the respective embankments. The submitted slope stability analyses for the main embankment were performed on a section with a toe elevation of 471.8 feet. The plan view drawing shows that the downstream toe of this embankment is at elevation 466 feet. If the designer believes that the analyzed cross section is more critical than the section with the longest downstream slope, the reasoning for this opinion should be stated. Otherwise, slope stability analyses for the main embankment should be performed on the cross section that has its downstream toe at elevation 466 feet.

Response No. 5

The stability analysis cross section for Embankment No. 1 was relocated to have a toe elevation of 466 MSL as recommended.

MSHA Comment No. 6

The boreholes from which the Shelby tube samples were obtained should be identified. If they were taken from boreholes other than the seven that are identified, their locations should be shown on a drawing.

Response No. 6

Shelby tubes ST-2, ST-5, ST-6 and ST-7 directly adjacent to the bore hole with the corresponding numerical digit i.e. DH-2 and ST-2. Shelby tube locations have been shown on the Plan View Map, Sheet No. 2 of 10 and noted on the map legend.

MSHA Comment No. 7

The report does not state whether the clay in the area(s) from which the embankment material will be obtained is dispersive or not. Confirmation that the clay is not dispersive should be provided. If the clay is dispersive, appropriate design measures should be proposed.

Response No. 7

To determine the dispersive properties of the proposed embankment materials, MEC performed a double hydrometer test (ASTM D4221) on material from Test Pit 15 (TP-15). TP-15 is also the predominate foundation material. This analysis indicates a dispersivity of approximately 39.5%. MSHA's review manual indicates this level of dispersivity is only moderately dispersive. Therefore MEC does not propose any design measure for dispersion.

MSHA Comment No. 8

The sheet on Page 37, which appears to be a borehole log, is illegible. A legible copy should be submitted.

Response No. 8

The sheet on Page 37 is an excerpt from the actual drill log for Diamond Drill Hole No. M-151 (DDH M-151). The coal section shown on Page 36 of the plans was prepared by others from a cored section of DDH M-151. Page 37 was submitted has background information to show the origin or authenticity of DDH No. 151. Our copy is probably a copy of a copy and each copy decreases the quality of the print. A better quality copy most likely cannot be provided.

MSHA Comment No. 9

The stain rate for the triaxial tests is shown on the test reports as 0.00 inches per minute. The actual strain rate for these tests should be shown, and it should be confirmed that the rate is slow enough to achieve accurate results for the low permeability material that was tested.

Response No. 9

The actual strain rate was 0.003 in./min. Replacement Triaxial Shear Test Reports are enclosed showing three (3) decimal places for the strain rate rather than two (2) as was submitted.

MSHA Comment No. 10

The proposed underdrain does not extend across the width of the main embankment, but rather, it runs along the center of the valley, perpendicular to the embankment crest. While the phreatic surface that is assumed in the slope stability analyses may be reasonable for the cross section that is in line with the underdrain, cross sections that are not close to the drain will very likely have a higher phreatic surface that is not modeled in the analyses, which will result in lower slope stability. The designer should consider either including a chimney drain or a blanket drain that extends across a significant portion of the dam's width, or using a 3-D seepage analysis to model the phreatic surface at distances perpendicular to the proposed drain and performing additional slope stability analyses on less critical cross sections but using the higher phreatic surface that results from the more complex analysis.

Response No. 10

A lateral drain has been added that runs across a significant portion of the dam's width from the beginning of the underdrain. The lateral drain will be placed approximately at natural ground level in compacted fill and will slope to the underdrain from both sides of the dam. The underdrain will remain at three (3') feet by four (4') feet wide as originally proposed. The lateral drain will be three (3') by three (3') feet. Both drains shall have a 6-inch diameter SDR-11 HDPE perforated pipe throughout their lengths. Calculations for the lateral drain and underdrain are enclosed in Appendix C. Construction details are shown on the enclosed Standard Details Sheet, Map 5 of 10.

MSHA Comment No. 11

The proposed locations for the two piezometers (one in the main embankment and one in the largest saddle dam) will not provide useful characterizations of the actual phreatic surfaces that develop within the embankments. They are proposed to be installed near the downstream edge of the embankment crests. With respect to the saddle dam, the stability analyses that were submitted assume a horizontal phreatic surface at the maximum normal pool elevation, which is conservative and the highest it could possibly be, so if all additional slope stability analyses (if any are determined necessary) demonstrate adequate stability with this phreatic surface, no additional piezometers would be required. With respect to the main embankment, however, piezometers at multiple locations on the downstream slope, at some distance from (perpendicular to) the underdrain (if it remains as currently proposed) will be required to adequately establish that the phreatic surface is not higher than assumed in the stability analyses. In addition, levels at which the engineer and MSHA are notified (corresponding to, or slightly below, the maximum phreatic surface that corresponds to an adequate factor of safety) should be established for these piezometers.

Response No. 11

MEC and OGR concur that the relocation of Piezometer No. 1 and an additional piezometer (No. 2) for Embankment No. 1 is needed as recommended. Piezometer No. 1 has been relocated to a position on the downstream slope. Piezometer No. 2 has been placed on the safety bench.

The piezometer at Embankment No. 3 has been renamed Piezometer No. 3.

MSHA Comment No. 12

The sheet showing the result of the seepage analysis should indicate: (1) what program was used to determine the flow rate through the embankment and (2) the soil permeability's that were assumed for the analysis.

Response No. 12

Seepage analysis of the proposed embankments were performed using the computer program Seep/W, which was developed by GEO-SLOPE International Ltd., Calgary, Alberta, Canada. The soil permeability and computer program used was added to the diagrams.

MSHA Comment No. 13

No calculation or procedure was included in the report to confirm the suitability of the geotextile to be used around the underdrain for use with the embankment material. AASHTO M288-2005 provides guidance on geotextile selection for filtration/drainage, including maximum recommended Apparent Opening Sizes (AOS) for different soil gradations. Geotextiles meeting Class 2 survivability criteria (from this standard) are recommended for underdrains. The proposed geotextile should also be tested with the embankment material for clogging resistance, using a standard test method such as ASTM D 5084 (Hydraulic Gradient Ratio Test)

Response No. 13

1.) Retention: To evaluate for retention, the equivalent opening size of each fabric was compared to the grain size of its surrounding soil. Specifically the fabric must meet the following requirement:

$$\frac{EOS(\textit{fabric})}{D_{85}\ (\textit{soil})} < 3$$

Where:

- EOS = the equivalent opening size of the fabric.
- D_{85} = the nominal diameter of spoil particle for which 85% of the soil gradation is finer as determined from a grain size distribution analysis.

Below are tables summarizing the retention properties of proposed fabrics and soils with which they come into contact.

Table 1. Summary of Retention Properties for Mirafi FW700 and Propex 1199

Soil Sample	EOS (*fabric*)	D_{85} (*soil*)	EOS:D_{85}	COMMENT
ST-2	0.212	0.35	0.61	EOS:D_{85}<3
ST-6	0.212	0.20	0.94	EOS:D_{85}<3
ST-7	0.212	0.16	1.33	EOS:D_{85}<3
TP-10	0.212	0.80	0.27	EOS:D_{85}<3
TP-15	0.212	0.075	2.83	EOS:D_{85}<3

2.) Permeability: The estimated flow per square foot through the proposed in-place filter fabric is less than 0.01 gallons per minute per square foot. Mirafi FW700 and Propex 1199 have permeability ratings of 18 and 22 gallons per minute per square foot, respectively.

3.) Clogging: Clogging characteristics of the filter fabric and the proposed back fill material were evaluated using the gradient ratio test. Specifically the gradient ratio filter test was conducted using the proposed fill materials from sample site TP-15 and Mirafi FW 700 filter fabric. As shown in the attached results, the fabric/soil cover system has a gradient ratio less than three (GR$\leq$ 3). Therefore, clogging of the soil and filter fabric system is not expected.

MSHA Comment No. 14

The specifications do not include any requirement for the overlap length or fastening method to be used for the geotextile surrounding the underdrain. This information should be included in the specifications.

Response No. 14

A detail of the internal drain is shown on the Standard Details Sheet, Map 5 of 10 with overlap geotextile overlap requirements. The internal drain will be wrapped in filter cloth with a minimum two (2') foot overlap. A two (2') overlap shall be provided between sections of geotextile. "U" shaped fasteners shall be used as needed to fasten the geotextile overlaps.

MSHA Comment No. 15

It is recommended in the Design Manual that weirs be installed to monitor the outflow from underdrains and confirm that they are operating as designed. The designer should consider the installation of a weir at the underdrain outflow.

Response No. 15

Installation of a weir has been provided for on the Standard Details Drawing, Map Sheet 5 of 10 and Appendix A, Construction Specifications.

MSHA Comment No. 16

The spillway details do not show any penetrations through the transverse footers below the spillway. This would prevent water that may accumulate in the crushed stone below the spillway concrete from traveling downstream. Provision should be made for water to pass through the footers from the crushed stone layer upstream of the footer to the crushed stone layer downstream of the footer.

Response No. 16

MEC typically includes footers for spillways constructed through fill material because of the potential for settlement and cracking. However, this spillway is to be constructed completely in cut. The crushed stone was added to a previously designed impoundment at the request of that particular reviewer and has been carried forward in our subsequent plans. Our experience has been that when a spillway leaks, the footer serves its intended purpose and stops the water flow from continuing underneath the spillway. Instead, the water is forced up and around the footer and usually re-enters the spillway. An intermediate footer with provisions to allow water to pass through it would serve no purpose. The typical spillway cross section has been modified to remove the requirement of intermediate footers. A footer at the entrance and exit of the spillway will be installed. 2" PVC pipe on two (2') foot centers will be installed through the spillway exit footer.

MSHA Comment No. 17

The spillway longitudinal cross-section drawing shows the bottom of the spillway. It is not clear from the drawing that the one-foot-deep footers continue below the side walls. Common practice is for footers to continue below the side walls. If this was the intent it should be clarified. It should also be made clear that footers are constructed below the ends of the side walls.

Response No. 17
Footer proposed for the entrance and exit of the spillway will extend up the side slopes under the side walls.

MSHA Comment No. 18
The specifications do not include provisions for testing of the spillway concrete to ensure the desired quality and strength is achieved. Quality control provisions should be added.

Response No. 18
Given that this spillway will be constructed entirely in cut in natural ground, mostly weathered sandstone (see DH-4) it would be impossible for failure of this impoundment to occur due to failure of the spillway. MEC and OGR propose the following: minimum two (2) four (4") by eight (8") cylindrical concrete tests specimen shall be made per 20 yd^3 of concrete. Samples shall be taken and cured according to ASTM C31/C31M-12 "Standard Practice for Making and Curing Concrete Test Specimens in the Field" and tested according to ASTM C39/C39M-12a "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens".

MSHA Comment No. 19
The dimension shown on the "Typical Spillway Cross-Section" for the distance from the control section to the first footer is "30' MIN." From the note on this same cross-section, it appears that the "MIN" was not intended, or should have read "MAX." If the "MIN" was intended, there should also be a maximum distance stated. On the same cross-section it appears that the open space between the dimension arrows should indicate 30 feet.

Response No. 19
Provisions for the intermediate footers has been removed from the plan

MSHA Comment No. 20
On Map 5, the term "Expansion Joint" is only used on the detail for this joint. It should be made clear on the cross-section drawings of the spillway which joints (e.g., lateral and longitudinal) are to be constructed using this detail.

Response No. 20
Expansion joints are intended only for lateral joints. Side slopes are to be poured in a continuous pour with the bottom slab of the spillway. See note for Typical Longitudinal Joint on Standard Details Sheet, Sheet 5 of 10.

MSHA Comment No. 21
The "Impoundment Profile" on Map 5 incorrectly shows the spillway constructed through the main embankment. This should be corrected.

Response No. 21
The location of the spillway shown on the "Impoundment Profile" was for representation purposes only and has been changed as the reviewer requested the Standard Details Sheet, Sheet 5 of 10.

MSHA Comment No. 22

The MSHA Design Manual recommends that riprap channel linings have a minimum thickness of the greater of either the maximum riprap size or 1.25 times the D50 size. Using this criterion, the thickness of the riprap layer in the groin ditch should be increased.

Response No. 22

D_{max} of the groin ditches as proposed is 1.0'. 1.5 of D_{50} is 11.125'. The minimum riprap thickness shall be 1.2'

MSHA Comment No. 23

The riprap-lined groin ditch should include either geotextile or a layer of smaller stone between the riprap and the soil.

Response No. 23

Its MEC's and OGR's belief that geotextile fabric or a layer of smaller stone between the riprap and the soil as described in MSHA's Engineering and Design Manual is intended for continuous flow applications or in high occasional flow situations. The water flow in the groin ditches at this site is 16.75 cfs for a 100 year 6-hour event, 12.79 cfs for a 25 year 6-hour event and 5.71 cfs for a 10 year 24-hour event. Based on our experience with numerous impoundments in this area, the use of geotextile or smaller stone is unnecessary for this type application....especially when the rip rap is "walked in". The groin ditches rip rap shall be "walked in" with the equipment used to place the stone.

MSHA Comment No. 24

No calculations for the riprap groin ditch design were included. These should be included in the response submittal.

Response No. 24

A SEDCAD analysis of a typical groin ditch for Slurry Impoundment No. 6 is provided. A typical ditch detail is shown on the Standard Details Sheet, Sheet 5 of 10.

MSHA Comment No. 25

The storage volume of the proposed sediment basin that takes the outflow from the spillway is approximately 24 acre-feet. Impoundments of this size require design plans to be submitted to MSHA, accompanied by the same level of documentation as large slurry impoundments. The company may wish to redesign the sediment basin to store less than 20 acre-feet. Otherwise, all documentation required by 30CFR §77.216 should be submitted for the sediment basin.

Response No. 25

The sediment basin that will eventually take outflow from the spillway has not yet been finalized and was included on the Plan View Map for representation purposes. However, the normal pool shown (in blue) and the emergency spillway are located at 540 MSL providing approximately 9.7 ac-ft. of storage. Final design of the basin will be completed at

a later date for submittal to the Alabama Surface Mining Commission. Design storage volume shall be below 20 ac-ft.

MSHA Comment No. 26

Although no details of the sediment basin are shown in the submittal (other than its embankment in plan view), it appears likely that its storage capacity will be exceeded during non-exceptional precipitation events. The designer should consider lining its abutment surfaces and the crest and downstream slope of the embankment with non-erodible material, or including other design features to prevent its destruction.

Response No. 26

The Alabama Surface Mining Commission requires sediment basin designs to be in accordance with the Regulations of the Alabama Surface Mining Commission as adopted by Act 81-435 of December 18, 1981 and as amended to date. Specifically 880-X-C-.20.

MSHA Comment No. 27

The plan and specifications should include a pre-construction inspection of the ground within the embankment footprints for cracking that may be a consequence of the deep mining. While breakthrough is not an issue in this case, cracks in the foundation soil or rock could provide a preferential path for seepage and adversely impact the performance of the impoundment. Actions to minimize the effect of any such cracks that are found should also be included in the plan and specifications.

Response No. 27

The embankment foundation area will be investigated to locate openings and zones of high permeability. Precautions will be taken during foundation preparation to ensure any joints or cracks in rock foundations are sealed off using a protective filter. See Appendix A, Section 1.1, Site Preparation.

MSHA Comment No. 28

The specifications should include a requirement that the embankment foundations be proof rolled following the removal of topsoil and compressible debris.

Response No. 28

The embankment foundations shall be proof rolled following the removal of topsoil. Additional removal of undesirable material and additional proof rolling shall be conducted as needed. See Appendix A, Section 1.2 Topsoil Removal.

MSHA Comment No. 29

Fine-grained, low permeability material is typically compacted in 8-inch layers using compaction equipment suitable for its compaction, such as sheepsfoot rollers or rubber-tired rollers. The specifications should include the use of the particular equipment and compaction method best-suited for the materials that will be used in the embankments. The specifications

should require that if the compaction equipment leaves a smooth surface, the surface shall be scarified before placement of the subsequent lift.

Response No. 29

Maximum lift has been changed in Appendix A to reflect the reviewers recommendation of 8". Comments as follows have been added to Appendix A: "Backfill material will be spread using "caterpillar" type tracked mobile equipment. Compaction will be achieved by tracked mobile equipment, compactor or rubber tired equipment available at the mine. Each lift shall be scarified after compaction for placement of the next lift.

MSHA Comment No. 30

A method of easily determining the pool elevation, such as a staff gauge, should be specified in the plan.

Response No. 30

Appendix A Section 1.9 requires a staff gauge to be installed and maintained as needed to determine the pool elevation.

MSHA Comment No. 31

Throughout the specifications, the word "should" should be replaced with "shall" to make the document enforceable.

Response No. 31

Attached are replacement pages for Section 1.5 in Appendix A that has instances of replacing "should" with "shall"

MSHA Comment No. 32

If any drawings are revised, a list showing the latest revision number of each sheet should be included on a drawing or in the specifications. This will allow contractors and inspectors to have confidence that they are using the latest approved revision of each drawing.

Response No. 32

Revised drawings will be noted as revised along with the revision date

MSHA Comment No. 33

Critical construction activities should be identified in the plan and the mine operator should notify the MSHA District 11 office prior to such activities. Critical construction activities are itemized in Chapter 2, Section IIB of the MSHA Coal Mine Impoundment Inspection and Plan Review Handbook.

Response No. 33

The following information has been added to Appendix A as an introduction to the Construction Narrative.

MSHA recognizes certain construction activities as critical aspects of construction which affect the integrity and overall stability of the impoundment. MSHA must be notified in advance when the Critical Construction Activities listed below are to take place.

CRITICAL CONSTRUCTION ACTIVITIES

- Foundation grubbing in swampy, soft, or unstable conditions where provisions must be made for drainage or stabilization.

- Excavation and backfilling of cutoff trenches.

- Sealing or otherwise treating mine openings, auger holes, foundation cracks or open joints, or existing underground mine workings.
  a. Within the footprint of the dam or close enough to affect the dam.
  b. Within or close to the basin area, as related to mine inundation or breakthrough potential.
- Construction of drains, filters, and placement of geo-fabrics and geo-grids.

- Construction and erosion protection for open channel spillways and diversion ditches, which are relied upon to remove runoff during the design storm.

- Any other critical phases or work affecting the integrity and overall stability of the site.

Please let me know if you have any questions or need any additional information.

Sincerely,

McGehee Engineering Corp.

Jeff Aldridge

Jeff Aldridge, P.E.
Alabama Reg. No. 33959

OAK GROVE RESOURCES, LLC.

CONCORD MINE

PREP PLANT FACILITY

FACILITY IDENTIFICATION NO. 01-00329

SLURRY IMPOUNDMENT NO. 6

FACILITY IDENTIFICATION NO. 1211-AL11-00329-6

ASMC PERMIT NO. P-3233

REVSIED 04-03-15

DESIGN PLANS

FOR

MINE SAFETY AND HEALTH ADMINISTRATION

MCGEHEE ENGINEERING CORP.
P. O. Box 3431
450 19th Street West
Jasper, Alabama 35502-3431
Telephone (205) 221-0686

REPORT
PROPOSED SLURRY IMPOUNDMENT NO. 6 DETAILED DESIGN PLANS
CONCORD MINE PREP PLANT FACILITY
OAK GROVE RESOURCES, LLC.
HUEYTOWN, AL

TABLE OF CONTENTS

SECTION	PAGE	
1	4	Introduction
2	4	Site Conditions
3	6	Coal Refuse Production
4	6	Subsurface Exploration
5	7	Field and Laboratory Testing
6	9	Site Development
7	9	Hydrology
8	13	Effects of Underground Mining
9	17	Stability Analysis
10	20	Conclusions
Appendix A	21	Technical Specification Guidelines
Appendix B	31	Laboratory and Field Test Data
Appendix C	93	Calculation Briefs
Appendix D	188	Maps and Drawings

APPENDIX D
LIST OF DRAWINGS AND MAPS

MAP	TITLE
1	Vicinity Map
2	Plan View Map
3	Watershed Map
4	Underground Mining Map
5	Standard Details Drawing
6	Geologic Cross Section A-A'
7	Geologic Cross Section B-B' Thru D-D'
8	Geologic Cross Section E-E' Thru H-H'
9	Geologic Cross Section E-E' Thru H-H'
10	Abandonment Map

OAK GROVE RESOURCES, LLC.

CONCORD MINE

PREP PLANT FACILITY

1.0 INTRODUCTION

The purpose of this study is to fulfill MSHA's requirements for the design of proposed impoundments as outlined in Title 30 - Mineral Resources, Chapter 1, Part 77, dated July 1, 1991.

Oak Grove Resources, LLC (OGR) currently operates the Concord Mine preparation plant facility near Hueytown, Alabama. The facility has been in operation since approximately 1946. The existing fine coal refuse (slurry) disposal area is currently being expanded to its maximum limit and capacity. At maximum the operation has approximately two (2) years of slurry storage remaining. This impoundment consists of five (5) small earthen embankments and one (1) large earthen embankment and will provide an three (3) to five (5) years of slurry storage.

2.0 SITE CONDITIONS

2.1 PHYSICAL CHARACTERISTICS OF THE SITE

Proposed Slurry Impoundment No. 6 is located in the drainage course of an unnamed tributary to Lick Creek. The main impoundment embankment is located approximately 0.9 miles upstream from the confluence of the unnamed tributary and Lick Creek. The emergency spillway overflow system is to be constructed through a narrow natural ridge and will discharge into another unnamed tributary to Lick Creek. The actual Concord coal preparation plant is located approximately 0.67 miles northwest of the proposed impoundment. The entire impoundment area is located on natural ground, none of which has been disturbed by mining.

2.2 GEOLOGY

This Geology Section was prepared from the Almes & Associates, Inc. Proposed Coal Refuse Disposal Area Expansion Plan prepared for this facility in 1991, on-site visits and foundation investigation bore holes DH-1 thru DH-7.

Slurry Impoundment No. 6 will be located on the southeast limb of the Coalburg syncline approximately 3,500 feet southeast of the synclinal axis and 5,000 feet northwest of the Warrior Basin. The area is characterized by moderate topographic relief composed of gently rolling to steep hillsides and deeply incised stream drainages. Stratigraphically, the bedrock in the area belongs to the Pennsylvanian aged Pottsville Formation.

The strata below the impoundment area consist of sandstones and shales which contain occasional coal seams and fire clays. These strata are nearly flat lying with a regional dip of 50 feet per mile to the southwest. Several thin coal seams, the Thompson Mill, Upper Cobb and Lower Cobb occur in the upper 300 feet of rock strata below the site. These coal seams are thin and unmineable but are easily recognizable in drill hole logs and provide the basis for correlation of strata near the Concord area.

According to the Almes & Associates report, the Thompson Mill seam is generally not more than one foot thick and is rather discontinuous. However, two or three fire clay seams associated with the coal mark the Thompson Mill horizon where the coal is absent. These clays are apparently continuous beneath the site and are probably barriers to the downward movement of groundwater. The Thompson Mill seam and fire clays outcrop at approximately elevation 500 near the Concord plant area.

The Upper and Lower Cobb coal seams occur about 150 to 200 feet below the Thompson Mill seam. The Lower Cobb occurs about 40 feet below the Upper Cobb Seam.

The American coal seam, which occurs between 510 and 580 feet below the site, has been room and pillar mined below proposed Slurry Impoundment No. 6.

3.0 COAL REFUSE PRODUCTION

Current refuse production from the Concord preparation plant is produced from cleaning of coal from OGR's Oak Grove mine. The Concord coal cleaning facility contains a wet process preparation plant with a coal washer and thickener. Coarse coal refuse generated at the preparation plant will continue to be transported by conveyor to a refuse storage bin located adjacent to the plant and then trucked to the disposal area for final placement. The fine coal refuse is currently pumped in slurry form through surface pipelines to an existing slurry impoundment. Fine coal refuse will be disposed of in proposed Slurry Impoundment No. 6 at the end of the useful life of the existing slurry impoundment.

The slurry line discharge pipe into the new slurry impoundment will be periodically relocated to promote a relatively uniform distribution of fine coal refuse along the embankment slope. This technique will create a delta of settled fines against the slope. This procedure for discharging slurry, coupled with the highly compacted soil embankment should minimize seepage losses and increase stability of the large embankment.

The slurry refuse production rates are projected to range between 300 Ac-Ft. per year and 500 Ac.-Ft. per year dependent primarily on raw coal production and market demands.

4.0 SUBSURFACE EXPLORATION

Field studies at the Concord Mine proposed slurry impoundment were conducted in April and May of 2014. The field studies included test pits, drilling, sampling and field testing of the footprint of the embankments and adjacent areas. An important goal of the drilling program was to determine the depth, quantity and engineering characteristics of the soils above the bedrock as it relates to constructing the future embankments.

A total of seven (7) borings and fifteen (15) test pits were completed at the site. Standard Penetration Test (SPT) split-spoon sampling was conducted in the borings at intervals of 1.5', 2.5', 5', 7.5', 10', 15' and 20' foot depths or until refusal by the auger. Undisturbed 3-inch diameter Shelby tube samples of the natural soils were collected in the borings at depths determined during drilling. In-place density, permeability and other characteristics were

performed on each of the Shelby tubes taken from within the footprint of the embankments. Triaxial shear tests were conducted on bore hole DH-6/ST-6.

Initially, samples of visually suitable soils from each of the fifteen (15) test pits were analyzed to determine the suitability of construction soils at this site. Based on the initial test results, bulk samples of the soils proposed for borrow material were collected at two (2) test pits (TP-10 & TP-15) chosen to be representative of the construction soils. Results of the boring and test pit sampling data are presented in Appendix B.

A two-inch diameter open standpipe piezometer was installed in borehole DH-2. Groundwater was measured at 12 feet and 17 feet below the surface on 5-1-14 and 5-27-14, respectively.

The location of the borings and test pits are depicted on the Geotechnical Investigation Map Sheet 6 of 10. Boring logs and all soils analysis are included in Appendix B.

The soils encountered under the footprint of the embankments and borrow areas within the proposed pool area are red to brown sandy clays. The thickness of the soils ranged from 3 to 12 feet based on the bore hole and test pit results. Under the soils is a layer of soft to medium weathered sandstone just above the bedrock of alternating layers of sandstone and shales. The sandstone varies in color from reddish in the weathered zone to gray in the harder zones. The shale is gray with the exception of bore hole DH-5 where a layer of weathered black shale was encountered.

5.0 FIELD AND LABORATORY TESTING

5.1 FIELD TESTING

SPT Split spoon sampling was used on all seven (7) boreholes at depths of 0" – 18", 2.5', 5', 7.5', 10', 15' and 20' or to auger refusal to obtain a measure or index of the in-place firmness of the foundation materials. Blow counts were recorded and are shown on the drill hole logs in Appendix B along with the complete hole log obtained by continuous core drilling in rock sections of each hole.

5.2 LABORATORY TESTING

Laboratory testing was conducted by McGehee Engineering Corp. (MEC) of Jasper, Alabama and Geo-Environmental & Associates, Inc. in Knoxville, TN. MEC used sieve analysis method ASTM

C136-96a and Geo- Environmental & Associates, Inc. used ASTM C117-95 resulting in SC, SM-SC and Cl, ML and CL-ML, respectively.

The material selected to represent the embankment material for stability analysis is coarse grained clayey sand taken from virgin ground within and adjacent to the proposed pool area. This material was selected to be used as embankment construction material due to its physical properties, immediate availability, and abundance at the site. Results of testing show a dry density of 103.4 pounds per cubic foot with optimum moisture of 18.9%. Further testing of the material indicates a liquid limit of 23 and non-plastic limit.

The testing included the following:

- Grain-Size Analyses - Grain-size analyses were performed on coarse and fine refuse samples. Results of the grain-size analysis are presented in Appendix B.

- Permeability - Constant head permeability tests were performed on remolded samples to determine the permeability characteristics of the embankment foundation and borrow materials which will be used for embankment construction. Results of the permeability test are given in Appendix B.

- Shear Strength Tests - Consolidated, undrained triaxial tests with pore pressure measurements were performed on a Shelby tube sample of borehole DH-2. Shear strength tests were also performed on remolded samples of two (2) test pits chosen to be representative of the soils to be used for construction of the embankments. Shear strength results on the in-place soil in boring DH-6 at 1.5 to 3.0'indicate a ϕ angle of approximately 34.6 degrees. Shear strength results for the natural soils in test pits # 10 and #15 indicate a ϕ value of approximately 29.2 degrees and 30.7 degrees respectively.

- Compaction Tests- In-place density test were performed on the Shelby tubes from boreholes DH-1, DH-2, DH-3, DH-4, DH-5, DH-6 and DH-7. A Standard Proctor compaction test (ASTM D 698-07) was performed on the bulk samples from Test Pits #10 and #15. Maximum dry density for the soil chosen for the embankment was determined to be 97.2 pcf at an optimum moisture content of 22.9 percent.

- Atterberg Limits Test- Both liquid and plastic limits testing (ASTM 4318) were performed on each of the bore holes and test pit samples. Bulk samples were pulled for further analysis once the soil within the pool (borrow) area were identified and sites chosen as being representative of the material to be used for the embankments. Results of these

tests are included in Appendix B - Test Data. Test results from the test pits and Shelby tubes indicated the soils to be mostly clay with a low plasticity (USCS type CL or CL-ML).

6.0 SITE DEVELOPMENT

Initial site preparation activities to be conducted include construction of silt fence where necessary and clearing and grubbing in preparation for the sediment basin. The location for the sediment basin is shown on the Plan View Map, 2 of 10 and other drawings.

6.1 SEDIMENT BASINS

One (1) sediment basin is proposed to control runoff and sediment load from the proposed slurry impoundment construction site and emergency spillway. The sediment basin will be designed, constructed and certified in accordance with the Regulations of the Alabama Surface Mining Commission as adopted by Act 81-435 of December 18, 1981 and as amended to date. The proposed basin will not be of the size basin/impoundment that is regulated by MSHA.

7.0 HYDROLOGY

Hydrologic design methods used in the design of this impoundment conform to the Soil Conservation Service's procedures for watershed analyses using the HEC-1 Flood Hydrograph Package. It should be noted that all applicable MSHA requirements are met by the resulting design.

7.1 CLASSIFICATION OF IMPOUNDMENT

Classification of the impoundment was done in two areas thus resulting in a Recommended Minimum Design Storm for Long-Term Conditions. The areas of classification were impoundment size and hazard potential. The impoundment was classified according to the classification system found in the United States Department of Interior publication, Engineering and Design Manual Coal Refuse Disposal Facilities. The impoundment is classified as a large impounding structure with a significant hazard potential due to: 1) more than 1,000 ac.ft. impounded 2) an embankment height greater than 40' 3) the location of Jefferson County 15th Street road approximately 1,200 LF downstream from the largest embankment. According to those criteria a full Probable Maximum Precipitation event (31.0 inches of rainfall of 6 hour duration) should be extended to a 72-hour PMP in the design. There are no other residential structures or other commercial

structures that exist downstream of the impoundment. See the attached Vicinity Map, Sheet 1 of 10.

7.2 DESIGN RUN

Hydrologic design of the impoundment was performed using the HEC-1 Flood Hydrograph Package. The design storm was computed using the above mentioned publication and Hydro meteorological Report 51. Input data required for the hydrological analysis is as follows:

1) WATERSHED DATA

A) Drainage Area = 78.30 Acres

B) Curve Number

Landuse	Acres	Curve Number
Graded and Bare	27.60	81
Impoundment Area	50.70	100

C) Time of Concentration

Tc = Time of Concentration

Graded and Bare
Tc = 0.120

2) RAINFALL FREQUENCY

From HRM 51Rainfall Atlas of the United States Full Probable Maximum Precipitation 31.0" of rainfall of 6 hour duration extended to a 72 hour PMP (50.44").

3) SPILLWAY DISCHARGE

The HEC-1 computer program calculated spillway discharges are as follows:

H (ft)	Q (cfs)
1.0'	48
2.0'	167
4.0'	577
6.0'	1,211

4) STORAGE COMPUTATIONS

See the Elevation Capacity Discharge Table located in Appendix C.

7.3 COMPUTER OUTPUT

From the data input, the HEC-1 computer program was able to generate the accompanying output. The resulting computer printout is shown in Appendix C.

7.4 SPILLWAY DESIGN

The spillway design was performed by trying several spillway widths and choosing the most economical and feasible. The resulting spillway was a trapezoidal channel with a bottom width of twenty (20) feet and side slopes of 2H: 1V. The flow depth at each section was determined using the SEDCAD+ Version 4 computer program. The outputs from the program are attached. Freeboard for the channel was calculated using the formula $Fb = C_f + 0.025(V)(D^{0.33})$ where Fb is the minimum dry freeboard in feet, C_f is a constant V is the velocity in ft/sec, and d is the depth of flow within the channel in feet. From the calculations the following was determined:

Spillway Entrance Depth of Flow = 2.92 ft.
Spillway Entrance Freeboard = 2.12 ft.
Total Channel Depth for Spillway Entrance = 5.04 ft.

Spillway Control Section Depth of Flow = 2.18 ft.
Spillway Control Section Freeboard = 2.23 ft.
Total Channel Depth for Spillway Control Section = 4.41 ft.

Spillway Tail Section Maximum Depth of Flow = 1.36 ft.
Spillway Tail Section Maximum Freeboard = 2.30 ft.
Total Channel Maximum Depth for Spillway Tail Section = 3.66 ft.

The entire spillway, side slopes included will be lined with a minimum of four (4") inches of 3,000 psi concrete. At the entrance to the spillway/control section the concrete will be lined up the side slopes a minimum of 5.04 feet tapering down to a minimum of 4.41 feet up the side slopes at the end of the control section. The tail ditch section of the spillway will be similarly lined 3.66 feet up the side slopes until the end of the spillway. All concrete will be reinforced with 6 gage, 6" x 6" welded wire mesh. Fibermesh may be added to the concrete for additional strength however, the addition of fibermesh shall not be used in place of the required 6 gage 6" x 6" welded wire. The spillway meets all MSHA design guidelines for removal of the 90% of the design storm volume within the ten day limit.

7.5 EMBANKMENT FREEBOARD

Dam Crest Elevation	560.00' M.S.L.
Camber for Consolidation	0.92'
Max. Design Storm Elev. (72-hour PMP)	556.92' M.S.L.
Minimum Actual Freeboard	4.00'
Settlement/Consolidation	0.92'
Freeboard After Settlement	3.08'

7.6 WIND FETCH AND EROSION RESISTANCE

Based upon a fetch distance of approximately 1/2 mile and prevailing wind directions in the area, the 3.00 feet of freeboard would be deemed adequate. Winds in the area prevail in either a northwest to southeast direction or southwest to northeast direction.

7.7 EMBANKMENT SETTLEMENT

Consolidation of the foundation was determined to be 0.92'. The embankments will be constructed to have a camber of 0.92' at the crest.

7.8 DURATION OF HIGH WATER MARK

The duration of the high water mark is insignificant according to the hydrologic analysis done. The high water elevation is of sufficiently short duration that the 3.08 feet of freeboard is adequate for this structure.

8.0 EFFECTS OF UNDERGROUND MINE WORKINGS

Previous reports indicate the Pratt coal seam to have been the only seam mined below this site. Our review of the mine maps and historical drilling data indicates the American coal seam to have been the coal seam mined at the Concord Deep Mine. The effects of subsidence from mining in the Concord Mine were discussed extensively by the Almes, 1991 report for another refuse disposal area at this facility. The discussion and assumptions are relevant for this impoundment and are included in this report. Changes were made as needed to address the conditions at this particular impoundment.

Coal was mined from the Concord Mine by the room and pillar mining method and was extensively mined under the proposed impoundment based on review of the Concord Mine maps. Deep mining was conducted under 100% of the impoundment. The maps indicate secondary recovery of pillars (pulling pillars) was conducted under approximately 71% of the impoundment. Records indicate pulling of pillars occurred under approximately the southern three-fourths of proposed Slurry Impoundment No. 6 from 1952 to 1959 with pulling of pillars under the northern approximately one fourth of the impoundment in 1980.

From the mine maps and an exploration drilling program conducted by U.S. Steel Mining Company it was determined that the deep mined coal seam occurs between 510 and 580 feet below the base of the impoundment. See the attached Oldworks Map, Sheet No. 4 of 10.

Subsidence prediction for any type of mine is extremely complex due to the large number of variables involved. However, reasonably accurate conclusions can be reached for specific geologic and mining conditions provided the limitations on the predictive methodologies are considered.

The strength and characteristics of the overlying and underlying strata will affect the way in which the overburden rocks respond to the stresses created by mine voids. Weak roof and floor rock conditions will tend to accelerate or increase subsidence, while hard rock may have a self-supporting action which could delay or reduce subsidence. The roof and floor rock for the Pratt seam within the study area can be characterized as somewhat fractured, medium to hard rock. This suggests that subsidence fracturing and deformation should develop in accordance with traditional subsidence prediction methodologies for the Appalachian coal fields.

Although many factors affect the extent and magnitude of subsidence, surface manifestations of subsidence are commonly broadly categorized as either sinkholes or troughs. The mode of subsidence that could ultimately occur is closely related to mining method, seam depth, seam thickness, overburden composition and other factors. The maps of the mine workings and geologic structural information support the conclusion that there are no major faults within the study area, and that the geologic dip is relatively small. Accordingly, neither of these factors are expected to have a significant effect on subsidence or subsidence impacts.

Sinkholes (also known as "pits" or "caves") are discrete, occasionally abrupt depressions in the ground surface. Sinkholes are most frequently associated with shallow room-and-pillar mining, and in areas where the soil is very thick and there is little rock strata overlying the mine workings. The sinkhole occurs when the overburden collapses into an open space in the mine, such as an entry or room between pillars, and the collapse travels upward until the shift in the overburden reaches the surface. The name sinkhole comes from the discontinuous surface deformation observed on the surface where the rock and soil settled.

In areas where the overburden is thick, (as is the case at this impoundment) subsidence studies have indicated that similar formations within the Appalachian region will form rubble or gob in the area of caving. This gob, with its increase in volume due to swelling caused by displacement will, in turn, provide some support for the overlying rock structure.

Based upon established theories and research findings associated with subsidence in the northern Appalachian coal fields for conditions similar to those existing within the study area, it can be concluded that the surface effects can be related to the generalized fracture pattern which develops within the overburden above the mined-out area.

Above this level, the rock strata will experience some fracturing, but the premining stratigraphic integrity will be maintained. Accordingly, subsidence that may occur within the study area will be in the form of trough subsidence or subsidence with continuous surface deformation. Associated with the surface deformation, a potential exists for tensile and compressive strain to develop.

In considering the effects of mining subsidence on the overburden, three different zones have been defined. The first is the caved or "gob" zone with associated roof collapse and extensive overburden fracturing. The second is the fractured zone, where the overburden may be fractured and deformed but continues to retain some stratigraphic integrity. The final zone is the zone of deformation, where trough subsidence may occur.

The caved or gob zone has been reported in the literature, to range from 2 to 8 times the height of mineral extraction. In the caved zone, the zone breaks down into blocks or rubble. As rubble, it increases in volume (also referred to as "swelling"), and offers some support to the overlying strata.

Above the rubble or gob area, the rock strata will begin to exhibit "bridging" support that will tend to dampen or mask the subsidence effect. Subsidence in this zone will cause fracturing of the rock strata, but without breaking the rock into blocks or rubble. The fractured zone has been reported to range from 20 to 40 times the height of extraction.

The height of the caved and fractured zones for a particular mine under conditions found in the Appalachian coal fields can be estimated from the formula given by Jones and Kohli, 1985.(2) Based upon the geologic conditions, the overburden in the study area can be classified as medium to hard rock; thus, the maximum height of the caved zone and fractured zone can be determined as follows:

$$\frac{100\,H}{4.7\,H + 19} \pm 2.2 \qquad \text{Caved Zone}$$

$$\frac{100\,H}{1.6H+3.6} \pm 5.6 \qquad \text{Fractured Zone}$$

Where H = mining height in meters.

(2) Jones, T.Z.• and K. K. Kohli, 1985. "Subsidence Engineer," West Virginia Institute of Technology, Montgomery, West Virginia.

At proposed Slurry Impoundment No. 6, this would yield, based upon the above formulas, a caved zone in the range of approximately 56 feet, and a fractured zone in the range of 81 to 118 feet, for a combined caved and fractured zone in the range of 137 to 174 feet. Conservative maximums based upon observations throughout the Appalachian coal field suggests the maximum caved zone could be as high as 112 feet, and the maximum fractured zone could be as high as 290 feet above the coal seam.

In most mined coal areas, potential for surface subsidence is often inevitable. The methods of controlling or mitigating subsidence impacts are as varied as the range of mining situations encountered. The most common and widespread methods of minimizing potential subsidence impacts include leaving sufficiently large mine roof support pillars and conducting mining in a planned manner. Based on review of the available mapping and records, both of these approaches were followed under this proposed impoundment.

Geologic and mining conditions encountered in the Appalachian coal fields have been studied to allow the prediction of surface deformation over mined out areas. While specific occurrences of subsidence cannot be predicted utilizing these formulas due to uncertainties involved in defining the size, location, extent and timing of any area that may subside in the future, it is possible to make a reasonable prediction of the maximum amount of surface deformation that could occur from such a subsidence event.

Based upon the foregoing discussion and related evaluations, the following conclusions and recommendations are made regarding potential subsidence and subsidence impacts within the study area at the Concord facility.

- Sinkhole subsidence or subsidence with discontinuous surface deformation will not occur within the study area. Subsidence that has occurred, and for which there is a future potential, will be in the form of trough subsidence or subsidence with continuous surface deformation.

- Subsidence within the study area will be accompanied by a gob or caved zone, predicted to be in the range of 56 feet, with a maximum of 112 feet. Above the caved zone a fractured zone may develop which is predicted to be in the range of 81 to 118 feet, extending a maximum of 280 feet above the mined seam.

- Based upon the subsidence analysis, the caved zone will not reach the surface within the study area during any future subsidence that might occur.

- Based upon the number of years since mining occurred, it can be concluded that future subsidence affects are unlikely since the majority of subsidence in this area has already occurred.

9.0 STABILITY ANALYSIS

9.1 METHODOLOGY

Stability analyses were performed for Embankment No. 1 and No. 3 using an approximate form of the limiting equilibrium approach as developed by Bishop. The location of the failure surface yielding the minimum safety factor was determined by allowing the computer to use a grid and search routine. The computer program used was the Reame Slope Stability program by Dr. Yang H. Huang, P.E. of the University of Kentucky. (Documentation for this program has been previously submitted accompanying previous designs.)

The proposed embankment was evaluated under static and dynamic (pseudostatic) loading conditions. The pseudostatic slope stability was conducted using the Hynes-Griffin and Franklin method as recommended by MSHA. The Peak Ground Acceleration (PGA) for the site was determined to be 0.138 (rounded to 0.14) from available USGS data. 0.1 (min. allowed value) is allowable for use as the seismic coefficient because the one half value of the PGA is less than 0.1. However, MEC chose to use the full PGA of 0.14 for the predicted phreatic line case/normal conditions to be more conservative. 80% psf cohesion values were used as recommended.

For both static and dynamic cases the phreatic surface (Embankment No. 1) was projected using the computer program Seep/W, which was developed by GEO-SLOPE International, Ltd., Calgary, Alberta, Canada. The results of the seepage analysis along with drain capacity calculations for the underdrain are provided in Appendix C. For the seismic analyses a horizontal acceleration of 0.14g was used.

Piezometers will be installed during the final phase of construction and will be used to monitor the phreatic level to determine the adequacy of the drain system and the need for modifications during operation of the impoundment. The piezometer action level was determined by raising the phreatic line well above the predicted phreatic line and performing stability analyses for static and dynamic conditions (0.1g) for both types of soil. Worst case situation is with TP-15 seismic case with the elevated phreatic level. That case was used to determine the piezometer action levels shown on the Standard Details Drawing, Map Sheet 5 of 10.

9.2 SOIL PARAMETERS

The soil and foundation parameters selected for the design are shown below. These values used are the results of laboratory testing by Geo-Environmental & Associates, Inc. in Knoxville, TN.

MATERIAL	LOCATION	UNIT WEIGHT (WET) PCF	EFFECTIVE ANGLE OF FRICTION	EFFECTIVE COHESION PSF
Clay	Embankment	116.9	29.2 degrees	500
Clay	Foundation	126.6	34.6 degrees	340
Water	Impoundment	62.40	0 degrees	0

9.3 RESULTS OF ANALYSES

Results of these stability analyses show that Slurry Impoundment No. 6 can be built safely with the existing local material. Tabular results of the analyses are found in this section:

STEADY STATE
SEEPAGE

EMBANKMENT NO. 1

NORMAL OPERATING CONDITIONS

SOIL	DOWNSTREAM STATIC LOADING S.F	DOWNSTREAM SEISMIC LOADING S.F
TP-10	2.65	1.6
TP-15	2.49	1.61

ACTION LEVEL (ELEVATED PHREATIC LINE)

SOIL	DOWNSTREAM STATIC LOADING S.F	DOWNSTREAM SEISMIC LOADING S.F
TP-10	1.85	1.32
TP-15	1.74	1.2

EMBANKMENT NO. 3

SOIL	DOWNSTREAM STATIC LOADING S.F	DOWNSTREAM SEISMIC LOADING S.F
TP-10	1.94	1.32
TP-15	1.90	1.29

All calculations performed using simplified Bishop Method of Analysis.

10.0 CONCLUSIONS

The exploratory activities, testing procedures, and evaluative approaches used in this project have been consistent with those employed in geotechnical engineering for earth dams. The hydrologic and stability analysis meets or exceeds all MSHA guidelines. In conclusion, proposed Slurry Impoundment No. 6 was designed, investigated, and analyzed using current prudent engineering practices, resulting in the design of a safe and sound impounding structure.

If any questions arise, please contact the following person.

Jeff Aldridge

Jeffrey G. Aldridge, P.E.
AL. Reg. No. 33959
Design Engineer

Revised 4/3/15

APPENDIX A

TECHNICAL SPECIFICATION GUIDELINES

APPENDIX A
1.0 CONSTRUCTION NARRATIVE

INTRODUCTION

MSHA recognizes certain construction activities as critical aspects of construction which affect the integrity and overall stability of the impoundment. MSHA must be notified in advance when the Critical Construction Activities listed below are to take place.

CRITICAL CONSTRUCTION ACTIVITIES

- Foundation grubbing in swampy, soft, or unstable conditions where provisions must be made for drainage or stabilization.

- Excavation and backfilling of cutoff trenches.

- Sealing or otherwise treating mine openings, auger holes, foundation cracks or open joints, or existing underground mine workings.
  a. Within the footprint of the dam or close enough to affect the dam.
  b. Within or close to the basin area, as related to mine inundation or breakthrough potential.
- Construction of drains, filters, and placement of geo-fabrics and geo-grids.

- Construction and erosion protection for open channel spillways and diversion ditches, which are relied upon to remove runoff during the design storm.

- Any other critical phases or work affecting the integrity and overall stability of the site.

1.1 SITE PREPARATION

In areas beneath the proposed embankments, the natural ground surface will be cleared, grubbed and stripped of all trees, brush and combustible or compressible debris. The embankment foundation area will be investigated to locate openings and zones of high permeability. Precautions will be taken during foundation preparation to ensure any joints or cracks in rock foundations are sealed off using a protective filter.

1.2 TOPSOIL REMOVAL

Topsoil at the site of each embankment shall be removed to a maximum depth possible as specified by the engineer or engineer's on-site representative. Topsoil shall be stored adjacent to the

impoundment for use in covering the impoundment slurry after abandonment of the impoundment. The embankment foundations shall be proof rolled following the removal of topsoil. Additional removal of undesirable material and additional proof rolling shall be conducted as needed.

1.3 COALBED METHANE GAS WELLS, GAS & WATER LINES

Coalbed methane gas wells, gas lines & water removal lines are located adjacent to and within the proposed impoundment pool. The gas and water lines will require relocation prior to significant construction of the impoundment. The well pad elevations for gas wells 6520-C and 16429-C are 550.77 MSL and 553.26 MSL, respectively. Small embankments (No. 5 & No. 6) are to be constructed adjacent to wells 6520-C and 16429-C as shown on the Plan View Map. Surface water runoff from embankments No. 5 & No. 6 to the well pad will be removed by the well operators via underground drains or small, permanent sump pumps.

1.4 KEYWAY TRENCH

The trench(s) will be excavated upon completion of the removal of vegetation and topsoil. The keyway(s) for embankments No. 1 thru No. 4 will consist of a trench constructed to the following minimum width and depths: 20 feet wide and 8 feet deep along the centerline of the dam and extending up both the abutment sides of the embankment to the normal pool elevation. The keyways for embankments No. 5 & No. 6 will consist of a trench constructed to the following minimum width and depths: 10 feet wide and 8 feet deep along the centerline of the dam and extending up both the abutment sides of the embankment to the normal pool elevation. The keyway trench(s) will be excavated using heavy mobile equipment.

1.5 UNDERDRAINS

A lateral drain and main underdrain will be installed as shown on the Plan View Drawing, Sheet 2 of 10 and the Standard Details Sheet, Sheet 5 of 10. The main underdrain shall be three (3') feet by four (4') and approximately 320 linear feet in length. The lateral drain shall be three (3') by three (3') and approximately 980 linear feet in length. Both drains shall have one (1) row of 6" diameter perforated SDR-11 HDPE PIPE (4 rows of ¼" diameter perforations on 2' centers). Both drains shall be wrapped in Mirafi FW 700 geotextile or equivalent with a minimum two (2') overlap. A two (2') overlap shall be provided between sections of geotextile. "U" shaped fasteners shall be used as needed to fasten the overlaps.

1.6 PLACEMENT OF EMBANKMENT FILL

The fill material selected to represent the embankment material is clay, silty, light brown taken from virgin ground. The fill material will have minimum properties as specified in the "SOIL PARAMETERS" in this report. "The material to be placed in the embankment will be free of sod, roots and other objectionable materials. The fill material will consist of earthen material taken from borrow areas within the vicinity of the embankment. The fill material will be placed and spread over the fill area starting at the lowest point in layers not to exceed 8 inches in thickness and compacted in maximum 8 inch lifts to 95% of the standard proctor density. The moisture content will be between optimum and optimum plus 3%. Backfill material will be spread using "caterpillar" type tracked mobile equipment. Compaction will be achieved by the same tracked mobile equipment, compactor or rubber tired equipment available at the mine. Each lift shall be scarified after compaction for placement of the next lift. One field density test shall be performed for every 1000 cubic yards of compacted structural fill, with at least one test per lift. One field density test shall be performed for every 200 cubic yards of compacted backfill in the keyway, with at least one test per lift. One field density test shall be performed any time where there is a suspicion of the effectiveness of compaction. Supplementary laboratory compaction curves shall be run when the material appears to be changing. Field density tests shall be performed at random locations in the fill. Records of the test results, as well as the test locations, shall be kept by OGR personnel or their representative. Also, at a minimum standard proctor density tests of the embankment fill material will be performed every 20 field density tests. As stated earlier, the foundation area will be graded and scarified to provide a uniform graded area prior to the placement of fill material. This is done as to establish a bonding surface between the foundation area and the new embankment material. The embankment and keyway material will be tied into the abutments using "step-type construction methods" as shown on the Embankment Benching into Natural Slope figure on the Standard Details drawing, map 5 of 10. The proposed embankment material will comply with the attached grain size distributions with a maximum particle size of 8 inches.

1.7 SPILLWAY CONSTRUCTION

The spillway system will be constructed entirely in natural ground during placement of embankment fill material or immediately after completion of the embankments. The spillway channel will be lined with a minimum of 4" of 3,000 psi concrete. Concrete filled cutoff trenches will be placed as shown on the Standard Details Map sheet 5 of 10. The spillway will extend to a natural drainage course and form a splash pad, approximately 25 feet wide and 25 feet long, and an energy dissipater. The energy dissipater will be constructed of 6 inch to 24 inch diameter (a minimum of 24 inches thick) non-erodible, limestone or sandstone rip-rap placed at the exit point of the splash pad to prevent scouring at the toe of the splash pad. The riprap energy dissipater will be underlain with Mirafi 500X or equivalent fabric. See attached Standard Details Map sheet 5 of 10.

A minimum two (2) four (4") by eight (8") cylindrical concrete tests specimen shall be made per 20 yd^3 of concrete. Samples shall be taken and cured according to ASTM C31/C31M-12 "Standard Practice for Making and Curing Concrete Test Specimens in the Field" and tested according to ASTM C39/C39M-12a "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens".

1.8 PIEZOMETER INSTALLATION

The piezometers will be installed at the locations on the Plan View Map, Map sheet 2 of 10 and installed as shown on the Standard Details Drawing, sheet 5 of 10. Piezometer readings will be taken during the 7-day inspection to determine the groundwater elevation and reported to the regulatory authority on a yearly basis. Action levels are shown on the Standard Details Drawing, Map Sheet 5 of 10.

1.9 STAFF GAUGE

A staff gauge shall be installed and maintained as needed for determining the pool elevation.

1.10 REVEGETATION

The final step in the construction of Slurry Impoundment No. 6 is revegetation. All completed embankment surfaces and disturbed areas outside of the impoundment drainage area must be revegetated to provide erosion protection. The revegetation shall be performed concurrent

with embankment construction and in accordance with the Alabama Surface Mining Commission permit for this site. Permanent-Mixtures and Rates are shown below. Areas revegetated shall be mulched with hay at a rate of 1 1/2 - 3 tons per acre to control erosion, to promote seed germination, and to increase the moisture retention of the soil.

PERMANENT COVER-MIXTURES AND RATES

Spring Plantings (3-1/6-15)

Species	Seeding Rate pounds/acre
Kentucky 31 Tall Fescue	50
Common Bermuda Grass (hulled)	10
Weeping Love Grass	5
Robe Lespedeza	20
Serala Sericea (hulled)	25

Fall Plantings (9-1/11-15)

Kentucky 31 Tall Fescue	40
Crimson Clover	15
White Clover	10
Rye Grass	15

2.0 OPERATIONAL PROCEDURES

Operational procedures for the Concord Mine Slurry Impoundment No. 6 consist of the actual piping of slurry to the impoundment and the post construction inspection and maintenance of the impoundment. Inspection and maintenance will be discussed in the next section.

2.1 OPERATION DISCRIPTION

Slurry will be piped via Driscoe type "poly" pipe from the Concord Mine Prep Plant to Slurry Impoundment No. 6 and discharged into the impoundment. The slurry will then be allowed to separate into its two components, water and coal/rock fines. The coal/rock fines will settle to the

bottom of the impoundment and the water will leave the impoundment through the spillway system. The impoundment will be operated in such a manner as to discharge clarified water from the impoundment. The water will then pass into a natural drainage channel and pass through the proposed sediment basin for final discharge.

Clarified water retained within Slurry Impoundment No. 6 may be pumped from the impoundment, as necessary, to be used by the support facilities on the surface at this mine site. Pumping of any retained water within Slurry Impoundment No. 6 is not a requirement for the safe operation of Slurry Impoundment No. 6.

3.0 POST CONSTRUCTION INSPECTION

As required under Section 77.216-3 Federal Register Volume 40, and ASMC Regulation 880-X-lOC-.20(1), OGR has a plan for the inspection of this impoundment. The Concord Mine Slurry Impoundment No. 6 shall be inspected according to this plan by an M.S.H.A. certified inspector.

3.1 INSPECTION PLAN

1. Inspections will be made at 7-day intervals, except when more frequent inspections are required by on-site conditions. A formal inspection will be made annually until the removal of the structure or until the release of the performance bond by the Alabama Surface Mining Commission.

2. Inspections will be made by a qualified registered professional engineer or other qualified professional specialist, under the direct supervision of a professional engineer designated by OGR.

3. The inspector will use the M.S.H.A. Coal Refuse Inspection Manual and A.S.M.C. Regulations as guides to make the required inspections.

4. Inspection time, date and results will be recorded in a book at the time of inspection. The inspector will sign the book after each inspection, and it will be counter-signed by a mine official.

5. Promptly after each annual inspection, a certified report that the impoundment has been maintained as designed in accordance with the approved plans will be submitted to the regulatory authority. The report will include discussion of any appearances of instability, structural weakness or other hazardous conditions, depth and elevation of any impounded water, existing storage capacity, any existing or required monitoring procedures and instrumentation and any other aspects of the structure affecting stability.

6. A copy of the annual inspection report will be retained at or near the mine site.

7. General maintenance and repair will be done under the direction of a qualified person and a mine official.

8. If a hazardous condition is found, the inspector will notify a mine official. A mine official will be in charge of following the necessary procedure for eliminating the hazard, notifying M.S.H.A. and implementing an evacuation if necessary.

9. A mine official will then implement whatever action is needed to eliminate the hazard.

10. If evacuation is necessary, miners or other persons that would be affected by the hazard will be notified as quickly as possible and will evacuate the area by route of the access road leading away from the impoundment.

4.0 ABANDONMENT PLAN

A detailed Abandonment Plan will be submitted to MSHA for approval prior to beginning abandonment activities. The abandonment section of these detailed design plans is intended to

provide a general outline of the activities that will occur during the actual abandonment of proposed Slurry Impoundment No. 6.

1. Disconnect the slurry discharge pipe and remove it from the site.

2. Dewatering the impoundment in an environmentally safe manner such as pumping, siphoning, etc. Upon completion of pumping all pump related equipment will be removed from the site.

3. Mine management may elect to use non-toxic, non-flammable rock/soil materials to construct a working surface on the impoundment that will permit equipment travel and provide for positive drainage. All rock fill slopes on the impoundment shall have a maximum and minimum grade of 5 percent and 1 percent, respectively. All cover material will be spread in layers with a minimum compaction of 90 percent of its maximum dry density as determined by the standard proctor compaction test. The thickness of the rock material will be no more than is necessary to support equipment that will be working upon the impoundment surface.

4. Upon the completion of the above mentioned working surface, the graded impoundment surface will be covered with a minimum of four (4) feet of the best available non-toxic, noncombustible and non-acid forming soil on site. All fill slopes on the impoundment shall have a maximum and minimum grade of 5 percent and 1 percent, respectively. Mine management may elect to not construct the above referenced working surface and cover the impoundment with soil only.

5. The FIZZ Test, % Sulfur, Maximum Potential Acidity, Neutralization potential, Acid-Base Account and Past pH of the spoil material will be tested prior to use and only that spoil with an Acid-Base Account greater than -5 will be used in bridging equipment over the sediment for placement of the 4 feet of cover material by OGR.

6. Revegetation shall be performed according to the mixtures and application rates given in the following Permanent Cover-Mixtures and Rates Attachment. Seeding will commence during the first normal planting season to establish a diverse, effective, and permanent vegetative cover. Topsoil, subsoil, and overburden material will be systematically sampled at a rate of 1 sample per 3 acres and sent to Auburn University Testing Laboratory, for analysis to determine type and amount of soil amendments necessary to maintain vegetative growth and applied as recommended. Seedbed preparation shall include disking or scarifying the soil to permit seed application and to aid in the mixing of the soil amendments. All areas shall be mulched with hay at a rate of 1 1/2 - 3 ton per acre to control erosion, to promote seed germination, and to increase the moisture retention of the soil.

APPENDIX B

LABORATORY AND FIELD TEST DATA

DRILLING LOG FOR DH-1

DATE DRILLED:	4/9/2014	DRILL HOLE NO.:	DH-1
DRILLING CONTRACTOR:	Smith Drilling Services, INC.	STATE:	Alabama
DRILLER:	Jeremy Smith	COUNTY:	Jefferson
LOCATION:	Slurry Pond "B"	AREA:	Concord

ROCK QUALITY DESIGNATION (RQD)	TOTAL DEPTH (FT. & 10^{ths})	STRATA DESCRIPTION	THICKNESS (FT. & 10^{ths})
1-2-1*	0.00	Dark Topsoil	0.50
1-2-1*	0.50	Light Brown Sandy Clay	1.00
1-1-3*	1.50	Light Brown Sandy Clay	1.00
3-6-8*	2.50	Light Brown Sandy Clay	2.50
14-16-22*	5.00	Light Brown Sandy Clay	2.50
9-14-20*	7.50	Light Brown Sandy Clay	2.50
25-40-45*	10.00	Light Brown Sandy Clay	5.00
50/1*	15.00	Hard Weathered Sandstone	8.00
		Water at 19.50 ft.	
71.1%	23.00	Conglomerate Sandstone With Coal Lenses	10.00
100.0%	33.00	Conglomerate Sandstone With Coal Lenses	2.40
	35.40	Sandstone	7.60
80.0%	43.00	Shale With Sandstone	0.50
	43.50	Shale	1.95
	45.45	Shale With Sandstone	2.05
	47.50	Shale	5.50
91.0%	53.00	Shale	8.70
	61.70	Shale With Sandstone	1.30
98.0%	63.00	Sandstone	8.90
	71.90	Fireclay	0.20
	72.10	Sandstone	0.90
99.0%	73.00	Sandstone	6.00
	79.00	Sandstone With Shale	4.00
100.0%	83.00	Sandstone With Shale	5.00
	88.00	Sandstone	5.00
100.0%	93.00	Sandstone	3.30
	96.30	Shale	2.70
	99.00	Sandstone With Shale	4.00
96.0%	103.00	Sandstone With Shale	10.00
Total RQD Value	113.00	Total Depth	
92.8%			

**Blow Counts [(%RQD)/(%REC)] - Provided by Smith Drilling Services, INC.*

RQD - ROCK MASS QUALITY CLASSIFICATION TABLE

Very Poor	*Poor*	*Fair*	*Good*	*Excellent*
< 25%	25% - 50%	50% - 75%	75% - 90%	90% - 100%

DRILLING LOG FOR DH-2

DATE DRILLED:	4/9/2014	DRILL HOLE NO.:	DH-2
DRILLING CONTRACTOR:	Smith Drilling Services, INC	STATE:	Alabama
DRILLER:	Jeremy Smith	COUNTY:	Jefferson
LOCATION:	Slurry Pond "B"	AREA:	Concord

ROCK QUALITY DESIGNATION (RQD)	TOTAL DEPTH (FT. & 10^{ths})	STRATA DESCRIPTION	THICKNESS (FT. & 10^{ths})
2-3-2*	0.00	Dark Topsoil	0.50
2-3-2*	0.50	Light Brown Sandy Clay	1.00
4-4-6*	1.50	Light Brown Sandy Clay	1.00
6-7-8*	2.50	Light Brown Sandy Clay	2.50
6-8-10*	5.00	Light Brown Sandy Clay	2.50
5-8-9*	7.50	Light Brown Sandy Clay	2.50
50/1*	10.00	Light Brown Sandy Clay	3.00
96.75%	13.00	Fractured Sandstone	1.50
	14.50	Sandstone	2.00
	16.50	Sandstone With Shale	6.50
100%	23.00	Sandstone With Shale	10.00
100%	33.00	Sandstone With Shale	10.00
Total RQD Value	43.00	Total Depth	
99.0%			

**Blow Counts [(%RQD)/(%REC)] - Provided by Smith Drilling Services, INC.*

RQD - ROCK MASS QUALITY CLASSIFICATION TABLE

Very Poor	*Poor*	*Fair*	*Good*	*Excellent*
< 25%	25% - 50%	50% - 75%	75% - 90%	90% - 100%

DRILLING LOG FOR DH-3

DATE DRILLED:	4/9/2014	DRILL HOLE NO.:	DH-3
DRILLING CONTRACTOR:	Smith Drilling Services, INC.	STATE:	Alabama
DRILLER:	Jeremy Smith	COUNTY:	Jefferson
LOCATION:	Slurry Pond "B"	AREA:	Concord

ROCK QUALITY DESIGNATION (RQD)	TOTAL DEPTH (FT. & 10^{ths})	STRATA DESCRIPTION	THICKNESS (FT. & 10^{ths})
2-1-3*	0.00	Light Brown Sandy Clay	1.50
3-5-10*	1.50	Light Brown Sandy Clay	1.00
11-14-18*	2.50	Light Brown Sandy Clay	2.50
10-12-13*	5.00	Light Brown Sandy Clay	2.50
16-32-50/6*	7.50	Light Brown Sandy Clay	2.50
50/4*	10.00	Weathered Sandstone	5.00
50/6*	15.00	Weathered Sandstone	4.00
	19.00	Weathered Sandstone	16.00
86.0%	35.00	Shale With Sandstone	1.80
	36.80	Shale	8.20
91.6%	45.00	Shale	2.90
	47.90	Weathered Shale	0.80
	48.70	Sandy Shale	1.30
	50.00	Sandstone	4.50
100.0%	54.50	Sandstone	10.00
99.0%	64.50	Sandstone	1.75
	66.25	Shale	8.25
100.0%	74.50	Shale	10.00
100.0%	84.50	Shale	10.00
100.0%	94.50	Shale	3.00
	97.50	Sandstone With Shale	8.00
97.0%	105.50	Sandstone With Shale	2.30
	107.80	Shale	7.70
98.0%	115.50	Shale	10.00
Total RQD Value	125.50	Total Depth	
96.3%			

**Blow Counts [(%RQD)/(%REC)] - Provided by Smith Drilling Services, INC.*

RQD - ROCK MASS QUALITY CLASSIFICATION TABLE

Very Poor	*Poor*	*Fair*	*Good*	*Excellent*
< 25%	25% - 50%	50% - 75%	75% - 90%	90% - 100%

DRILLING LOG FOR DH-4

DATE DRILLED:	4/9/2014	DRILL HOLE NO.:	DH-4
DRILLING CONTRACTOR:	Smith Drilling Services, INC.	STATE:	Alabama
DRILLER:	Jeremy Smith	COUNTY:	Jefferson
LOCATION:	Slurry Pond "B"	AREA:	Concord

ROCK QUALITY DESIGNATION (RQD)	TOTAL DEPTH (FT. & 10^{ths})	STRATA DESCRIPTION	THICKNESS (FT. & 10^{ths})
--	0.00	Dark Topsoil	0.50
--	0.50	Red Sandy Clay	1.00
2-3-5*	1.50	Red Sandy Clay	1.00
8-10-15*	2.50	Red Sandy Clay	2.50
8-14-15*	5.00	Tan & Red Sandy Clay	2.50
12-23-25*	7.50	Tan & Red Sandy Clay	2.50
10-14-19*	10.00	Tan & Red Weathered Sandstone	5.00
23-50/5*	15.00	Tan & Red Weathered Sandstone	5.00
50/1*	20.00	Tan & Red Weathered Sandstone	5.00
Total RQD Value	25.00	Total Depth	
–			

**Blow Counts [(%RQD)/(%REC)] - Provided by Smith Drilling Services, INC.*

RQD - ROCK MASS QUALITY CLASSIFICATION TABLE

Very Poor	*Poor*	*Fair*	*Good*	*Excellent*
< 25%	25% - 50%	50% - 75%	75% - 90%	90% - 100%

DRILLING LOG FOR DH-5

DATE DRILLED:	4/9/2014	DRILL HOLE NO.:	DH-5
DRILLING CONTRACTOR:	Smith Drilling Services, INC	STATE:	Alabama
DRILLER:	Jeremy Smith	COUNTY:	Jefferson
LOCATION:	Slurry Pond "B"	AREA:	Concord

ROCK QUALITY DESIGNATION (RQD)	TOTAL DEPTH (FT. & 10^{ths})	STRATA DESCRIPTION	THICKNESS (FT. & 10^{ths})
2-2-3*	0.00	Light Brown Sandy Clay	1.50
2-2-3*	1.50	Light Brown Sandy Clay	1.00
7-11-20*	2.50	Light Brown Sandy Clay	2.50
9-25-31*	5.00	Light Brown Sandy Clay	2.50
12-16-24*	7.50	Light Brown Sandy Clay	2.50
50/6*	10.00	Light Brown Sandy Clay	5.00
16-25-50/6*	15.00	Weathered Black Shale	5.00
16-50/3*	20.00	Weathered Black Shale	9.00
Total RQD Value	29.00	Total Depth	
--			

**Blow Counts [(%RQD)/(%REC)] - Provided by Smith Drilling Services, INC.*

RQD - ROCK MASS QUALITY CLASSIFICATION TABLE

Very Poor	*Poor*	*Fair*	*Good*	*Excellent*
< 25%	25%- 50%	50%- 75%	75% - 90%	90% - 100%

DRILLING LOG FOR DH-6

DATE DRILLED:	4/9/2014	DRILL HOLE NO.:	DH-6
DRILLING CONTRACTOR:	Smith Drilling Services, INC.	STATE:	Alabama
DRILLER:	Jeremy Smith	COUNTY:	Jefferson
LOCATION:	Slurry Pond "B"	AREA:	Concord

ROCK QUALITY DESIGNATION (RQD)	TOTAL DEPTH (FT. & 10^{ths})	STRATA DESCRIPTION	THICKNESS (FT. & 10^{ths})
3-2-2*	0.00	Light Brown Sandy Clay	1.50
3-5-10*	1.50	Light Brown Sandy Clay	1.00
12-18-25*	2.50	Light Brown Sandy Clay	2.50
25-50/4*	5.00	Light Brown Sandy Clay	5.00
20-50/1*	10.00	Light Brown Sandy Clay	7.00
		Water at 10.50 ft.	
94.5%	17.00	Sandstone	1.65
	18.65	Sandstone With Shale	8.35
100.0%	27.00	Shale	9.40
	36.40	Shale With Sandstone	0.60
99.0%	37.00	Shale With Sandstone	0.80
	37.80	Shale	2.20
	40.00	Shale With Sandstone	7.00
Total RQD Value	47.00	Total Depth	
97.8%			

**Blow Counts [(%RQD)/(%REC)] - Provided by Smith Drilling Services, INC.*

RQD - ROCK MASS QUALITY CLASSIFICATION TABLE

Very Poor	*Poor*	*Fair*	*Good*	*Excellent*
< 25%	25% - 50%	50% - 75%	75% - 90%	90% - 100%

DRILLING LOG FOR DH-7

DATE DRILLED:	4/9/2014	DRILL HOLE NO.:	DH-7
DRILLING CONTRACTOR:	Smith Drilling Services, INC.	STATE:	Alabama
DRILLER:	Jeremy Smith	COUNTY:	Jefferson
LOCATION:	Slurry Pond "B"	AREA:	Concord

ROCK QUALITY DESIGNATION (RQD)	TOTAL DEPTH (FT. & 10^{ths})	STRATA DESCRIPTION	THICKNESS (FT. & 10^{ths})
2-1-3*	0.00	Dark Topsoil	0.33
2-1-3*	0.33	Light Brown Sandy Clay	1.17
3-4-6*	1.50	Light Brown Sandy Clay	1.00
4-7-11*	2.50	Light Brown Sandy Clay	2.50
9-10-15*	5.00	Light Brown Sandy Clay	2.50
50/1*	7.50	Light Brown Sandy Clay	2.50
		Water at 8.50 ft.	
	10.00	Sandstone	0.10
	10.10	Light Brown Sandy Clay	0.05
78.5%	10.15	Sandstone	1.85
	12.00	Sandstone With Shale	5.50
	17.50	Sandy Shale With Sandstone Streaks	2.50
85.3%	20.00	Shale	8.00
	28.00	Sandy Shale With Sandstone Streaks	2.00
93.5%	30.00	Sandy Shale With Sandstone Streaks	10.00
Total RQD Value	40.00	Total Depth	
85.8%			

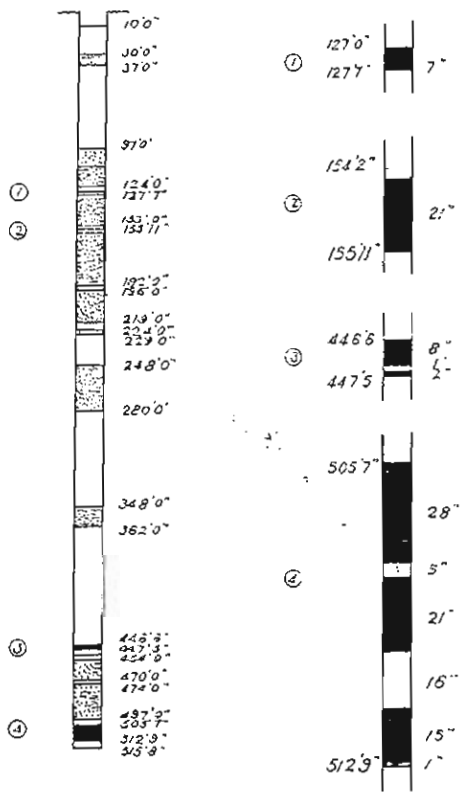
**Blow Counts [(%RQD)/(%REC)] - Provided by Smith Drilling Services, INC.*

RQD - ROCK MASS QUALITY CLASSIFICATION TABLE

Very Poor	*Poor*	*Fair*	*Good*	*Excellent*
< 25%	25%- 50%	50%- 75%	75% - 90%	90% - 100%

Record of Diamond Drill Hole No. M-151.

Scale of Hole: 1in.=100ft. Scale of Coal Sections: 1in = 40in.



UPPER COBB SEAM

LOWER COBB SEAM

PRATT SEAM

AMERICAN SEAM

	V.M.	F.C.	Ash	Sul.	Sp.Gr.	B.T.U.'s
28"	24.31	72.11	3.58	.82	1.29	15182
21"	24.40	72.23	3.37	.70	1.30	15238
15"	24.72	69.32	5.89	1.41	1.30	14703

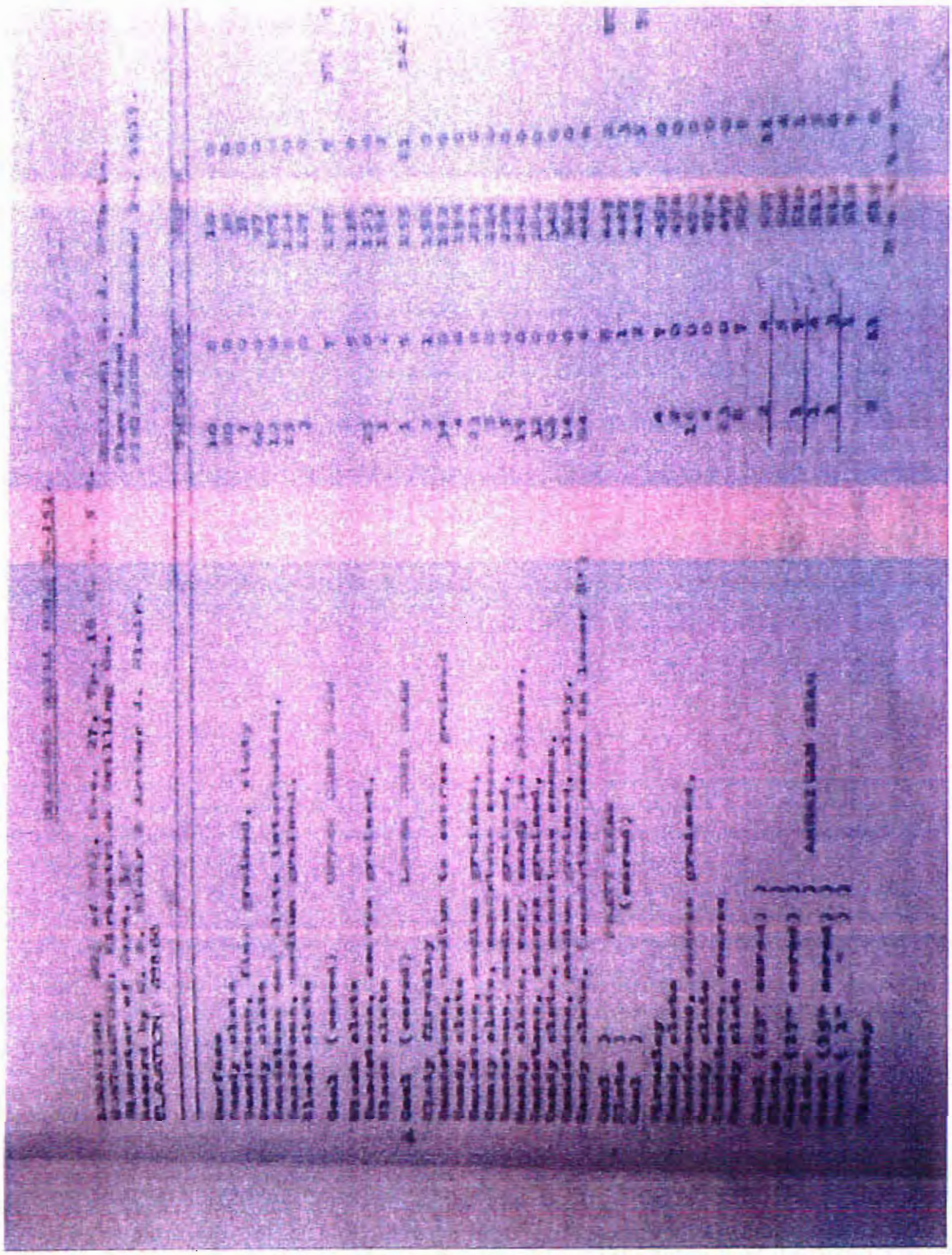
Flotation Test Sample A Coal 28"

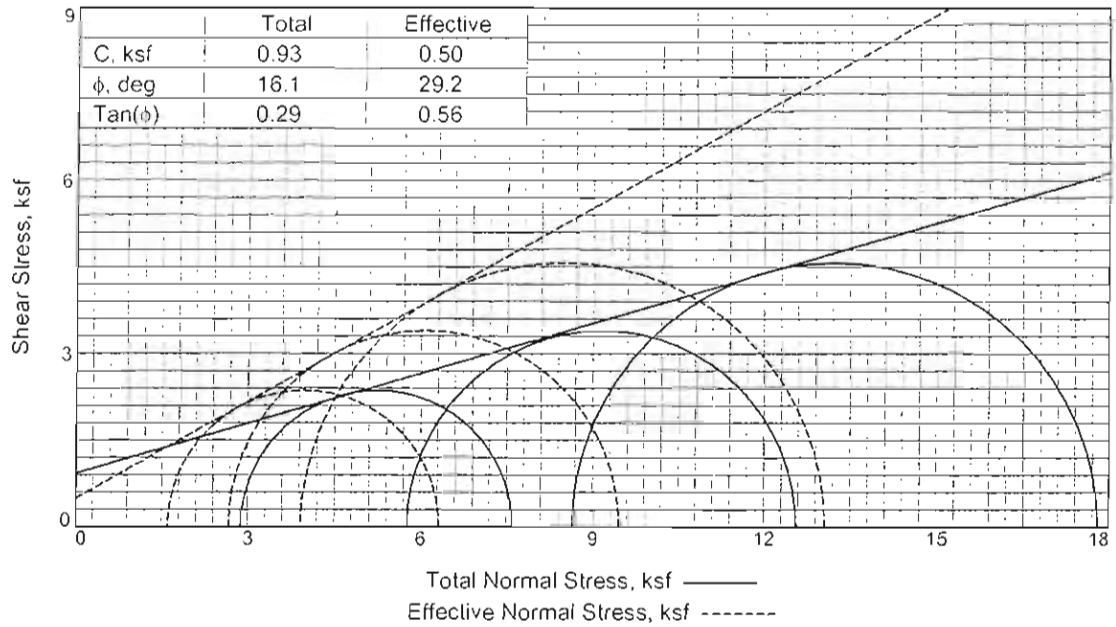
	V.M.	F.C.	Ash	Sul.	%
Float 1.37 Sp.Gr.	25.52	71.82	2.66	.70	97.1
Sink 1.37 Sp.Gr.					2.9
Float 1.56 Sp.Gr.	22.32	53.89	23.80	.85	37.5 of 2.9
Sink 1.56 Sp.Gr.			52.31	4.08	62.5 of 2.9

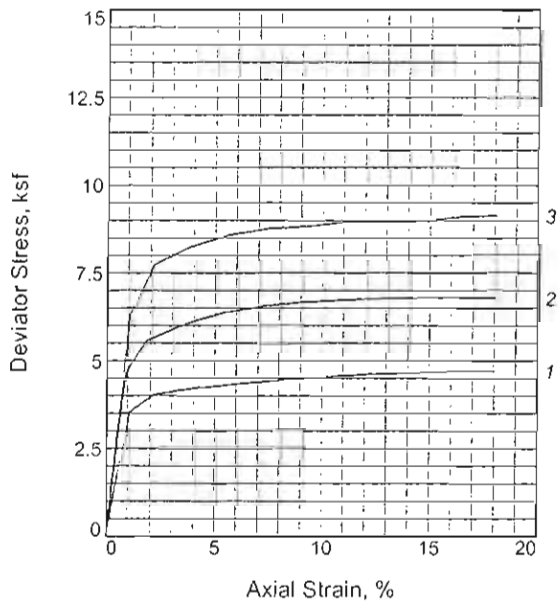
Flotation Test Sample B Coal 21"

	V.M.	F.C.	Ash	Sul.	%
Float 1.37 Sp.Gr.	24.25	72.55	3.20	.68	98.7
Sink 1.37 Sp.Gr.					1.3
Float 1.56 Sp.Gr.	19.01	65.60	15.39	.54	50.0 of 1.3
Sink 1.56 Sp.Gr.			47.84	4.69	50.0 of 1.3

G1-1151







Sample No.		1	2	3
Initial	Water Content, %	18.9	19.0	19.0
	Dry Density, pcf	98.3	98.3	98.4
	Saturation, %	70.6	70.9	71.3
	Void Ratio	0.7281	0.7269	0.7252
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	25.1	24.9	24.4
	Dry Density, pcf	100.8	101.3	102.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.6839	0.6764	0.6647
	Diameter, in.	2.776	2.772	2.767
	Height, in.	5.552	5.545	5.534
Strain rate, in./min.		0.003	0.003	0.003
Back Pressure, psi		30.00	30.00	30.00
Cell Pressure, psi		50.00	70.00	90.00
Fail. Stress, ksf		4.7	6.8	9.1
Total Pore Pr., ksf		5.6	7.4	9.0
Ult. Stress, ksf				
Total Pore Pr., ksf				
$\bar{\sigma}_1$ Failure, ksf		6.3	9.5	13.1
$\bar{\sigma}_3$ Failure, ksf		1.6	2.7	3.9

Type of Test:
CU with Pore Pressures

Sample Type: Bulk Remolded Specimens

Description: Silt, clayey, sandy, light reddish brown

LL= 23 **PI=** np

Specific Gravity= 2.72

Remarks:

Client: McGehee Engineering Corporation

Project: McGehee Lab Testing

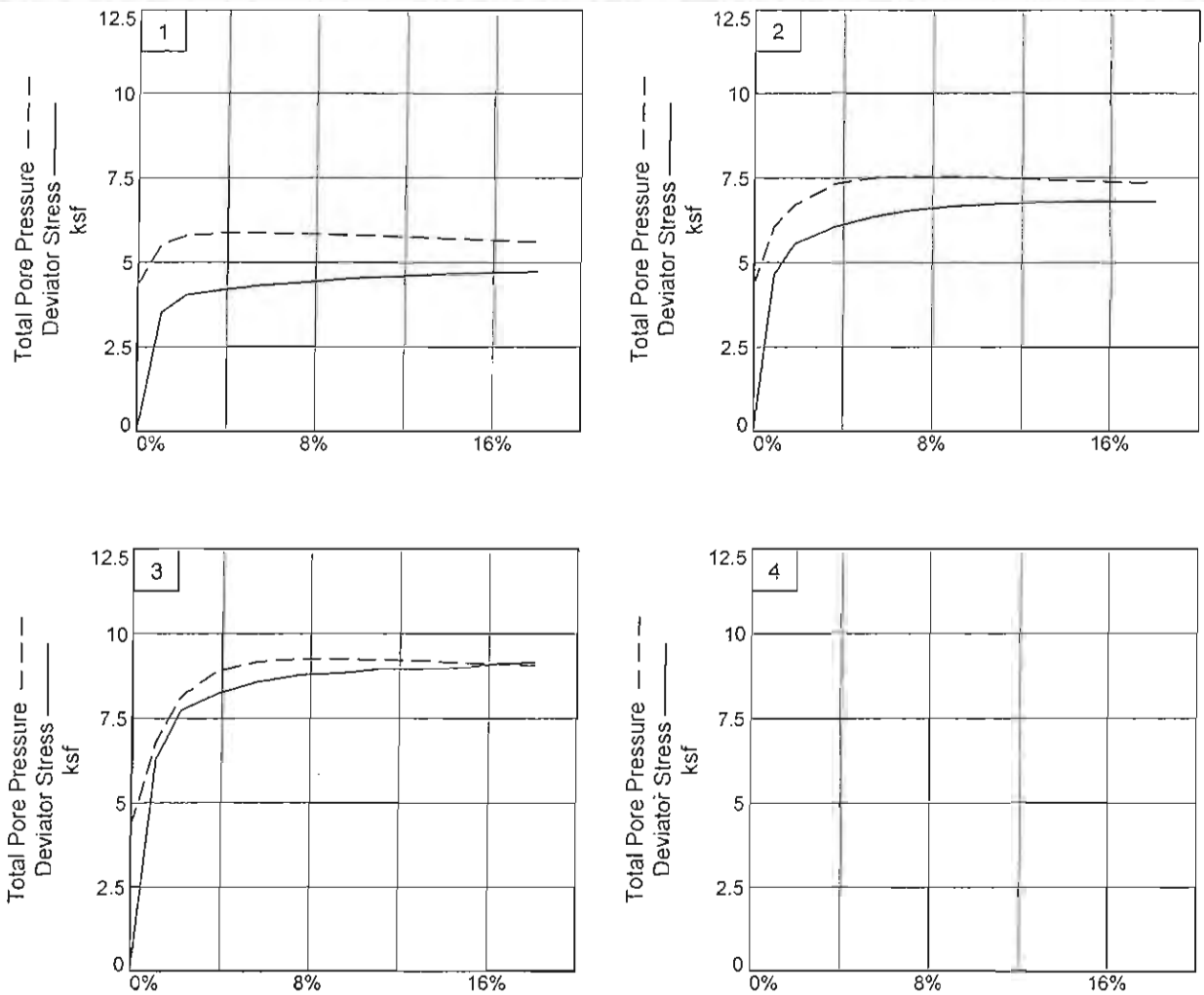
Source of Sample: Oak Grove Resources Concord Prep Plant

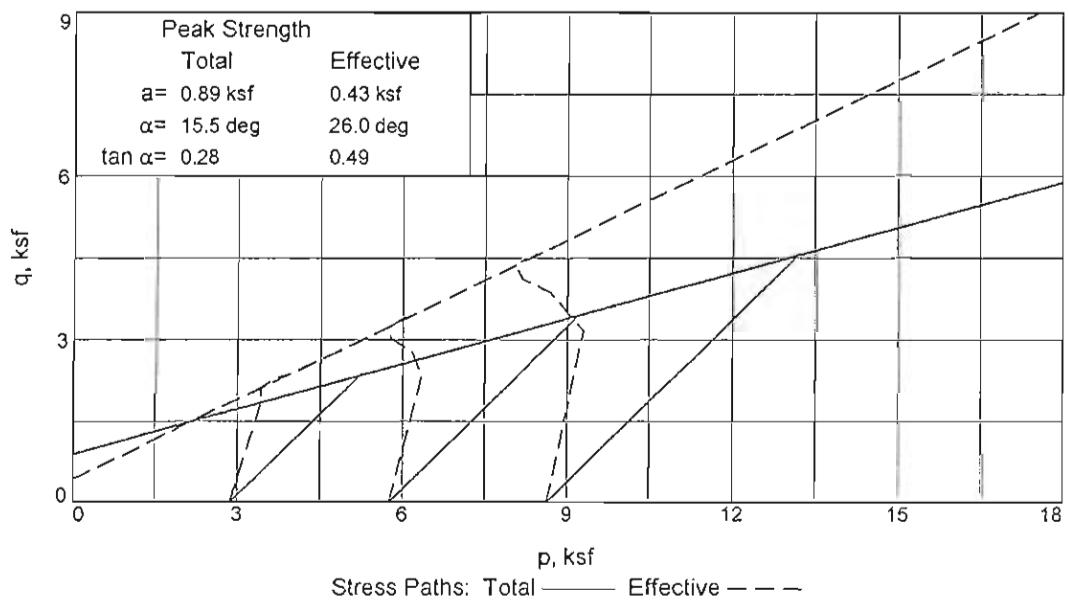
Sample Number: TP-10

Proj. No.: 12-651 **Date Sampled:** 05/29/2014

TRIAXIAL SHEAR TEST REPORT
Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Figure 1





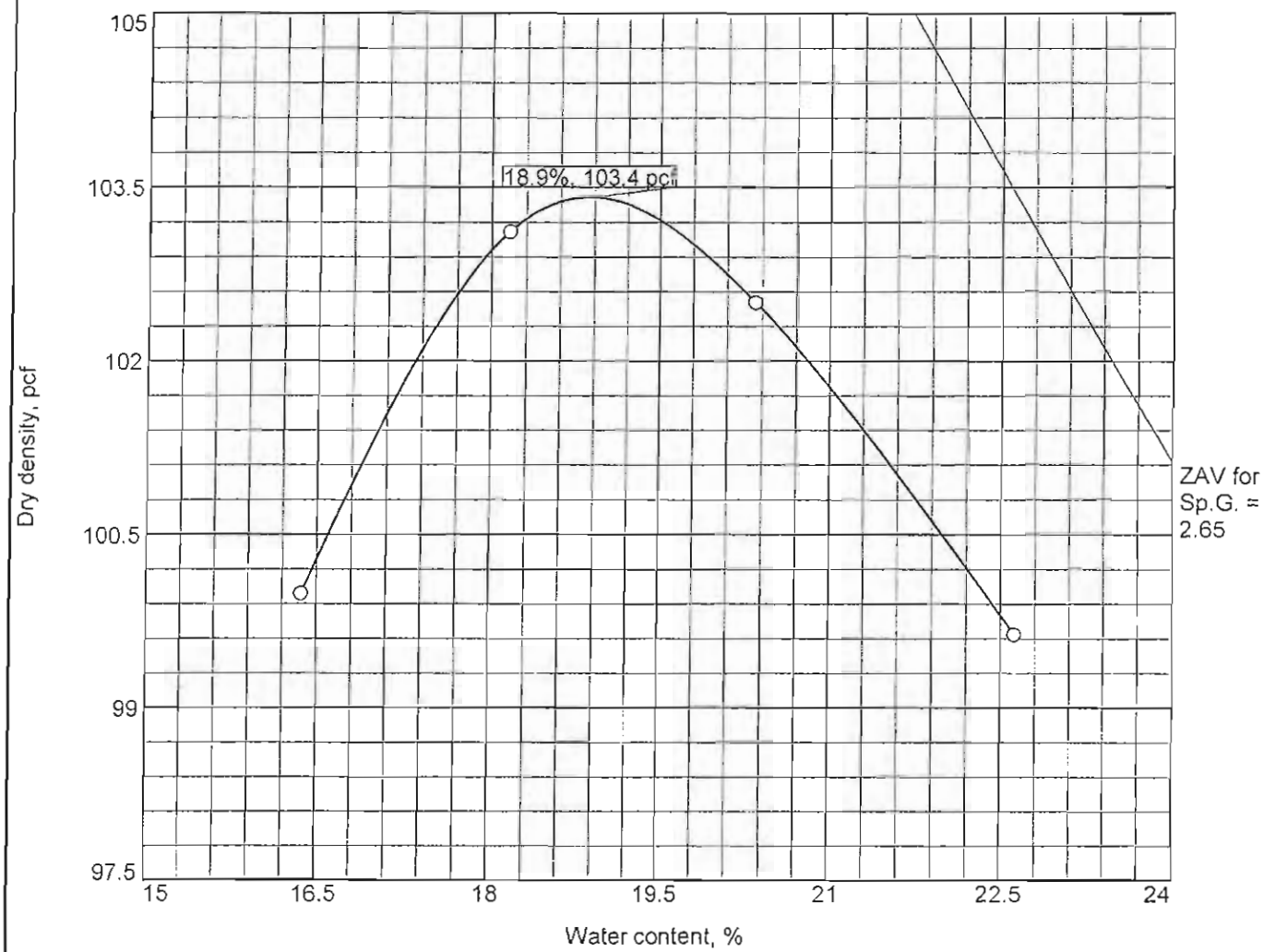
Client: McGehee Engineering Corporation

Project: McGehee Lab Testing

Source of Sample: Oak Grove Resources Concord Prep Plant **Sample Number:** TP-10

Project No.: 12-651 **Figure 2** **Geo/Environmental Associates, Inc.**

COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
	ML	A-4(0)	22.8	2.72	23	np	6.0	64.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 103.4 pcf Optimum moisture = 18.9 %	Silt, clayey, sandy, light reddish brown

Project No. 12-651 **Client:** McGehee Engineering Corporation
Project: McGehee Lab Testing

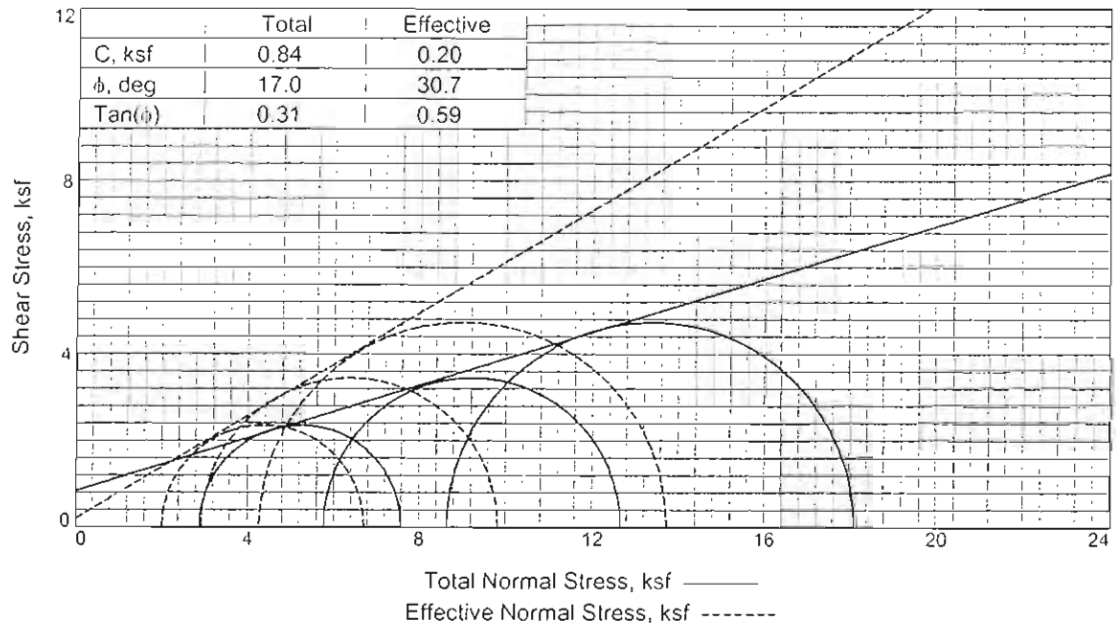
○ **Source:** Oak Grove Resources Concord Prep Plant **Sample No.:** TP-10

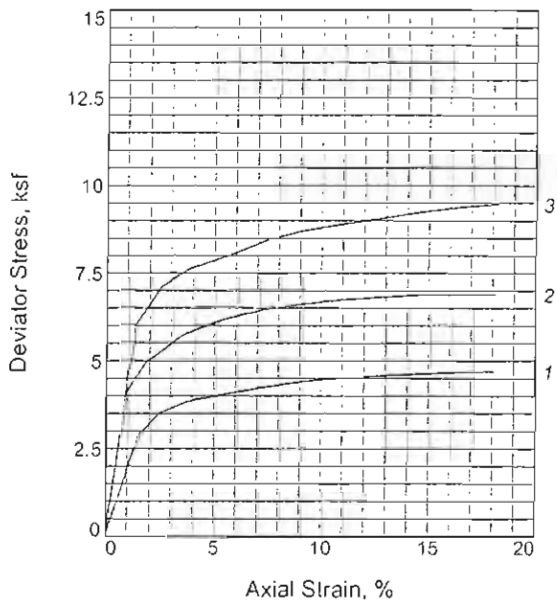
Remarks:

Geo/Environmental Associates, Inc.

Knoxville, Tennessee

Figure





Sample No.		1	2	3
Initial	Water Content, %	22.9	22.9	23.0
	Dry Density, pcf	92.0	92.2	92.3
	Saturation, %	75.0	75.4	75.7
	Void Ratio	0.8177	0.8143	0.8125
	Diameter, in.	2.800	2.800	2.800
	Height, in.	5.600	5.600	5.600
At Test	Water Content, %	28.6	27.5	26.0
	Dry Density, pcf	94.7	96.3	98.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.7674	0.7372	0.6977
	Diameter, in.	2.774	2.760	2.739
	Height, in.	5.548	5.520	5.480
Strain rate, in./min.		0.003	0.003	0.003
Back Pressure, psi		30.00	30.00	30.00
Cell Pressure, psi		50.00	70.00	90.00
Fail. Stress, ksf		4.7	6.9	9.5
Total Pore Pr., ksf		5.2	7.2	8.7
Ult. Stress, ksf				
Total Pore Pr., ksf				
$\bar{\sigma}_1$ Failure, ksf		6.7	9.8	13.7
$\bar{\sigma}_3$ Failure, ksf		2.0	2.9	4.3

Type of Test:
CU with Pore Pressures

Sample Type: Remolded Bulk Specimens

Description: Clay, silty, light brown, tan

LL= 36 **PL=** 21 **PI=** 15

Specific Gravity= 2.68

Remarks:

Client: McGehee Engineering Corporation

Project: McGehee Lab Testing

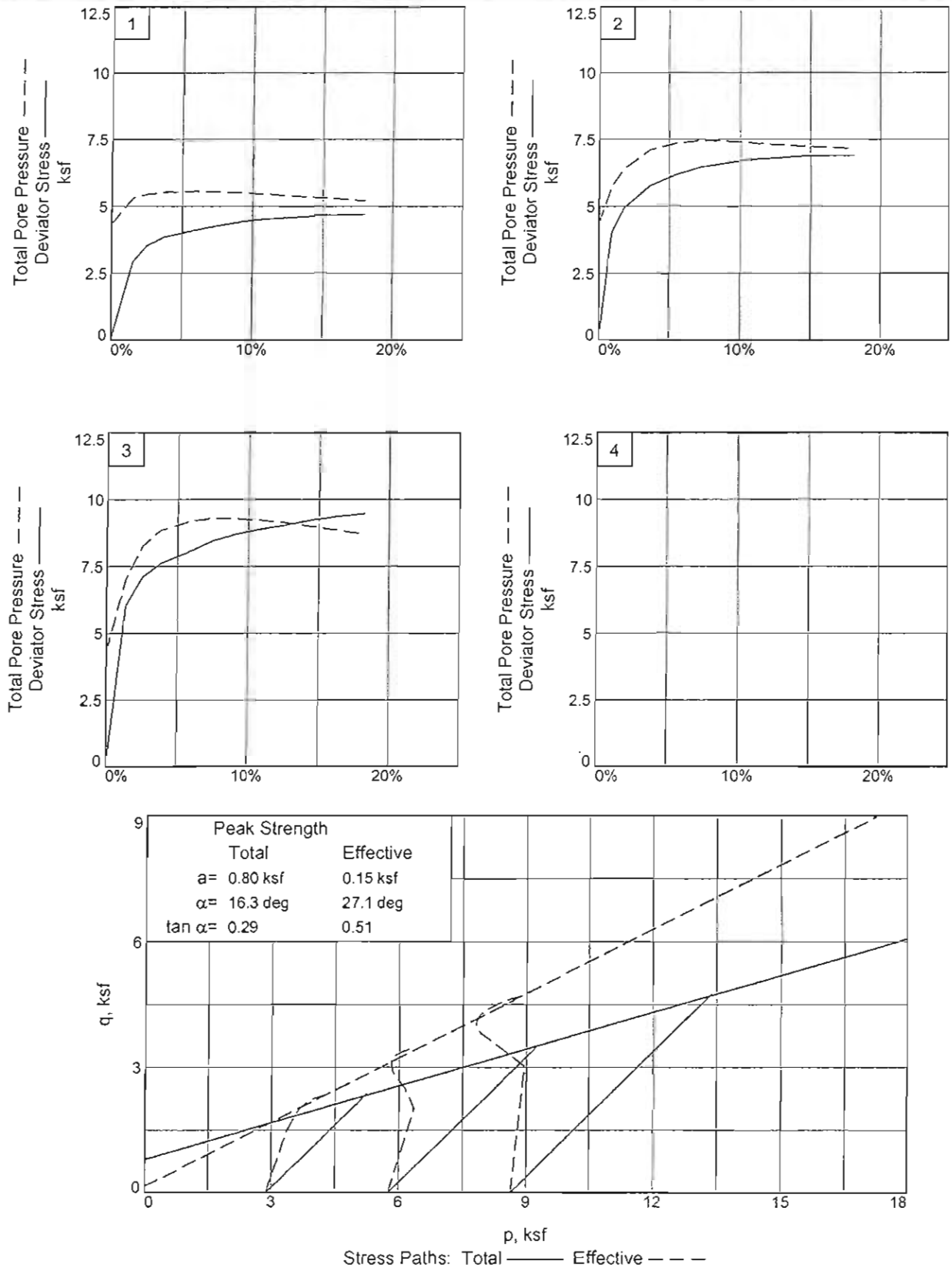
Source of Sample: Oak Grove Resources Concord Prep Plant

Sample Number: TP-15

Proj. No.: 12-651 **Date Sampled:** 05/30/2014

TRIAXIAL SHEAR TEST REPORT
Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Figure 1



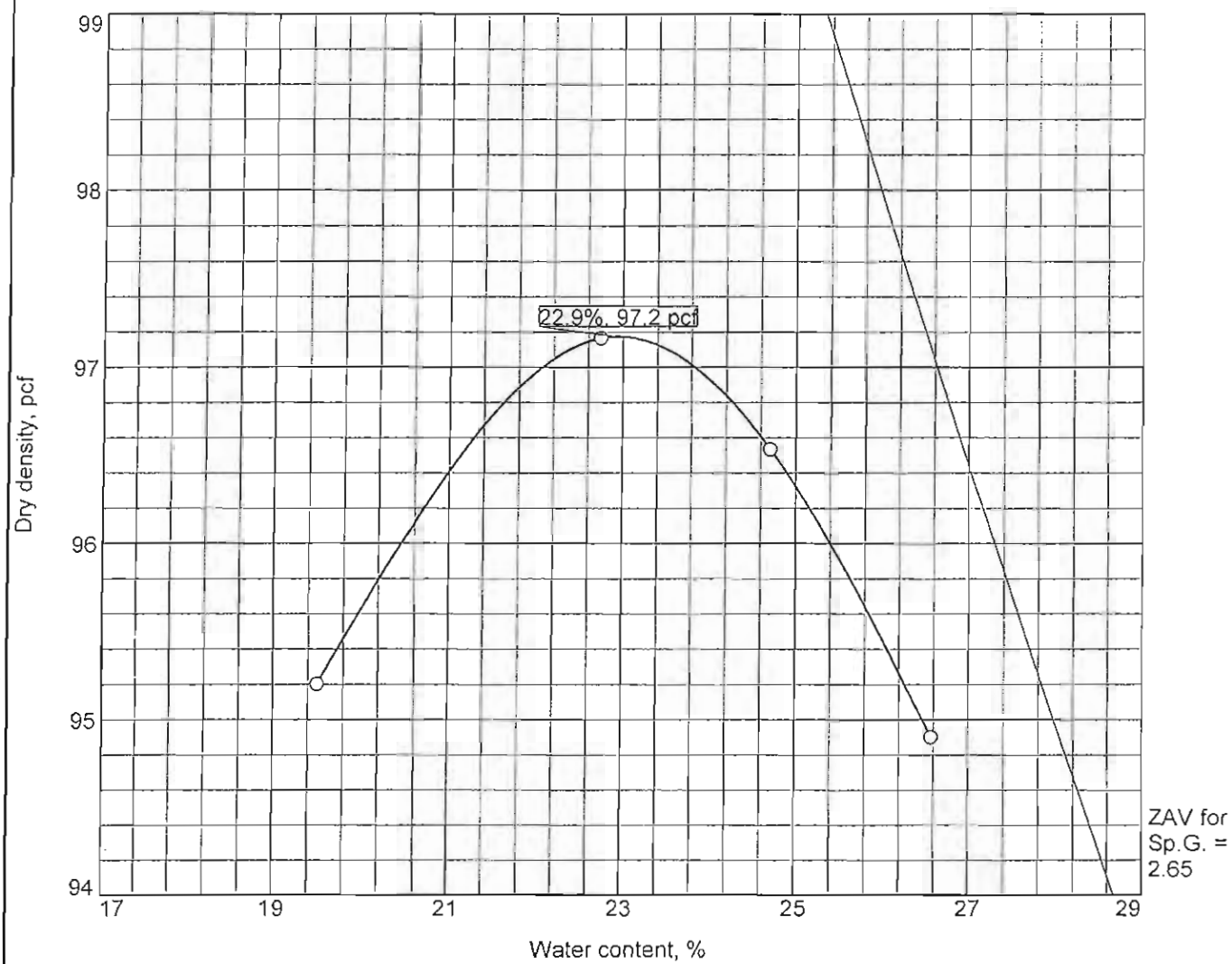
Client: McGehee Engineering Corporation

Project: McGehee Lab Testing

Source of Sample: Oak Grove Resources Concord Prep Plant **Sample Number:** TP-15

Project No.: 12-651 **Figure 2** **Geo/Environmental Associates, Inc.**

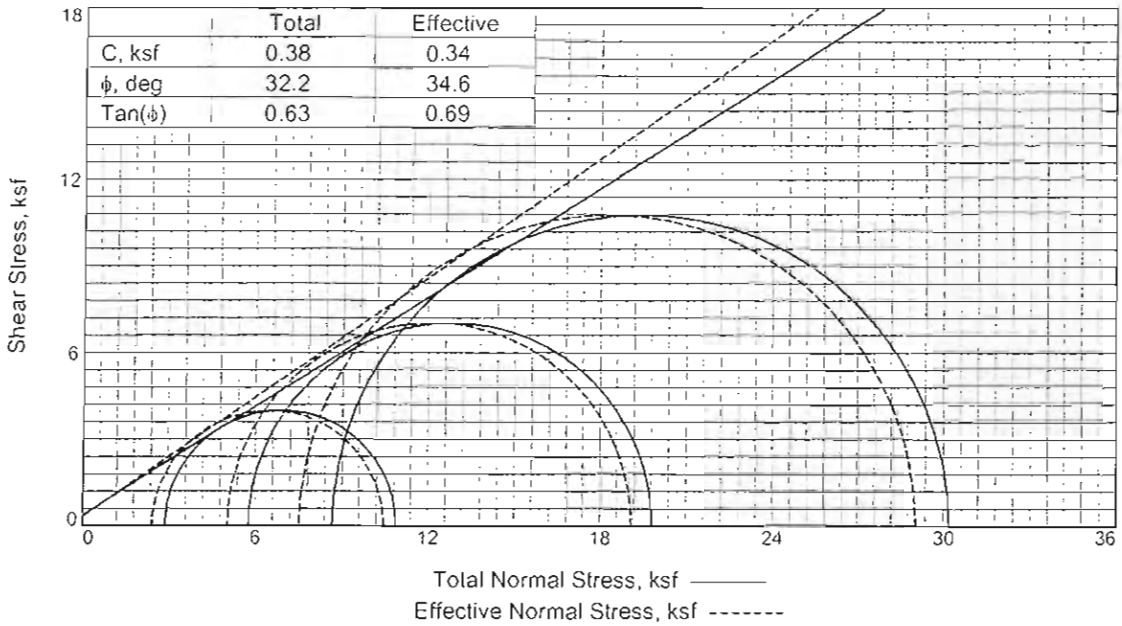
COMPACTION TEST REPORT

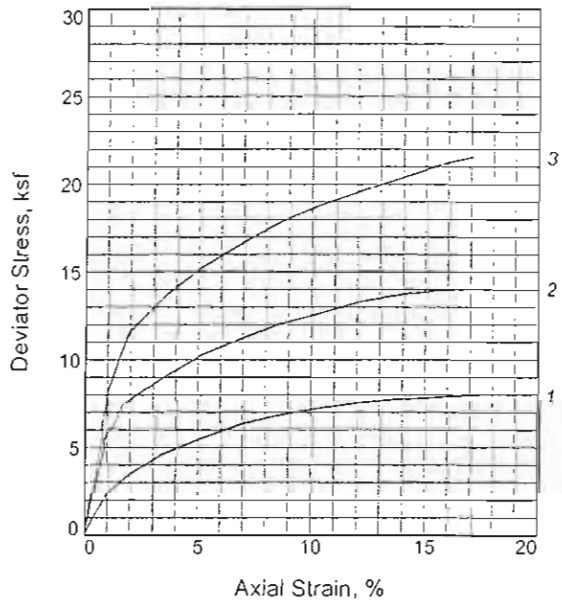


Test specification: ASTM D 698-07 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
	CL	A-6(13)	23.2	2.68	36	15	0.3	85.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 97.2 pcf Optimum moisture = 22.9 %	Clay, silty, light brown, tan
Project No. 12-651 Client: McGehee Engineering Corporation Project: McGehee Lab Testing ○ Source: Oak Grove Resources Concord Prep Plant Sample No.: TP-15	Remarks:
Geo/Environmental Associates, Inc. Knoxville, Tennessee	Figure





Sample No.		1	2	3
Initial	Water Content, %	17.4	16.8	16.8
	Dry Density, pcf	106.4	109.0	110.6
	Saturation, %	86.1	89.5	93.8
	Void Ratio	0.5253	0.4886	0.4670
	Diameter, in.	2.850	2.840	2.850
	Height, in.	5.870	5.860	5.850
At Test	Water Content, %	20.1	17.1	14.8
	Dry Density, pcf	106.6	112.3	117.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5222	0.4454	0.3853
	Diameter, in.	2.848	2.812	2.796
	Height, in.	5.866	5.803	5.740
Strain rate, in./min.		0.003	0.003	0.003
Back Pressure, psi		30.00	30.00	30.00
Cell Pressure, psi		50.00	70.00	90.00
Fail. Stress, ksf		8.0	14.1	21.6
Total Pore Pr., ksf		4.8	5.0	5.5
Ult. Stress, ksf				
Total Pore Pr., ksf				
$\bar{\sigma}_1$ Failure, ksf		10.4	19.1	29.1
$\bar{\sigma}_3$ Failure, ksf		2.4	5.0	7.5

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube Specimens

Description: Clay, silty, light reddish brown

LL= 24 PL= 19 PI= 5

Assumed Specific Gravity= 2.60

Remarks:

Client: McGehee Engineering Corporation

Project: McGehee Lab Testing

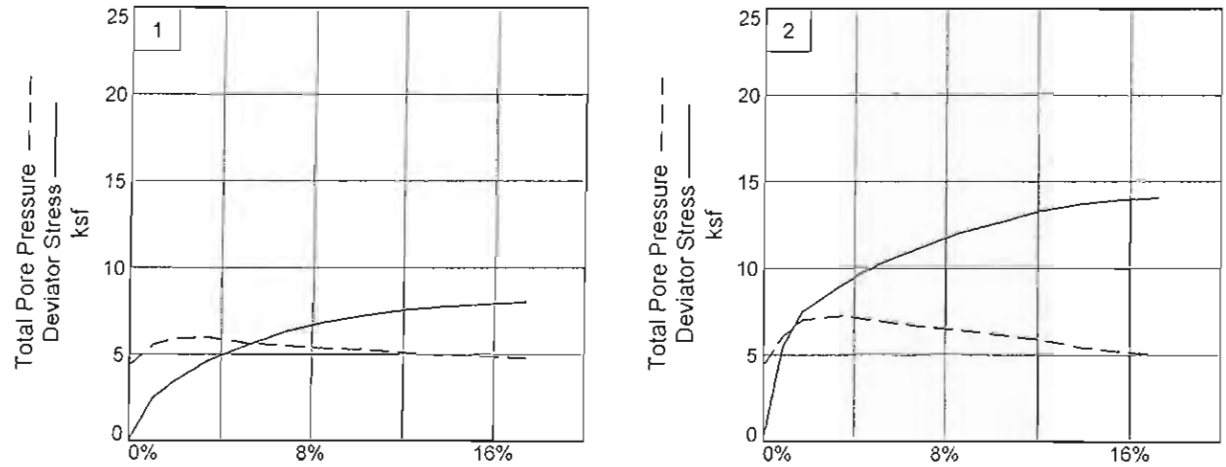
Source of Sample: Oak Grove Resources Concord Prep Plant

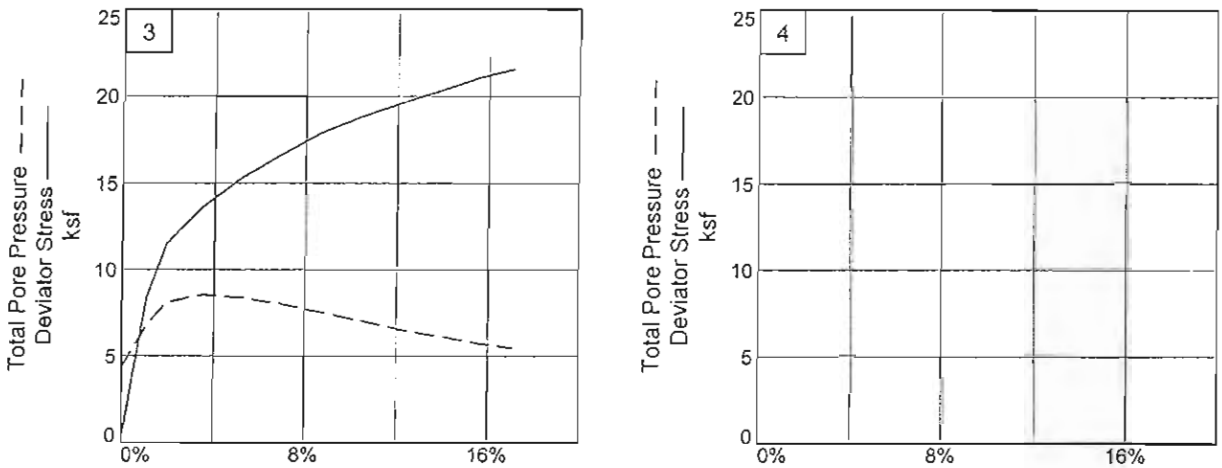
Sample Number: ST-6 **Depth:** 1.5'-3.0'

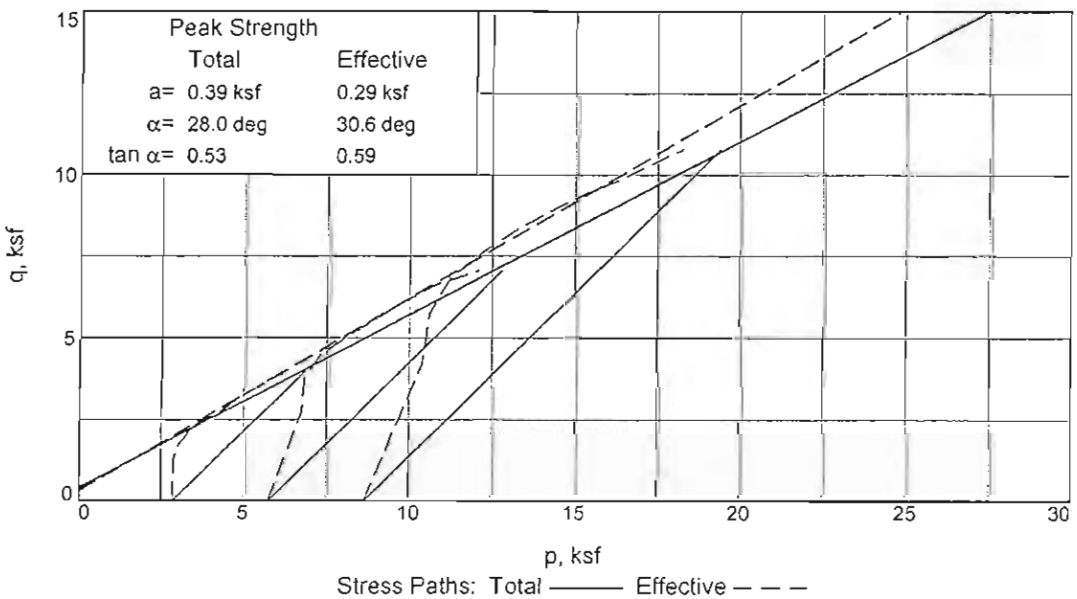
Proj. No.: 12-651 **Date Sampled:** 05/20/14

TRIAXIAL SHEAR TEST REPORT
Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Figure 1







Client: McGehee Engineering Corporation
Project: McGehee Lab Testing
Source of Sample: Oak Grove Resources Concord Prep Plant **Depth:** 1.5'-3.0' **Sample Number:** ST-6
Project No.: 12-651 Figure 2 Geo/Environmental Associates, Inc.

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084

PROJECT NAME	: Oak Grove Resources Concord Prep Plant	PROJECT NUMBER	: 12-651
CLIENT	: McGehee Engineering Corporation	DATE	: May 29, 2014

SAMPLE LOCATION AND CONDITIONS

Sample Id.:	TP-10	Sample Depth :	Na
Sample Remolded:	95% Compaction	Sample Type :	Bulk

Sample Description : Silt, clayey, sandy, light reddish brown

INITIAL SPECIMEN PROPERTIES

Length (in.):	2.75	Volume (ft^3):	0.01015	Wet Density (PCF):	116.7
Diameter (in.):	2.85	Weight (lbs):	1.185	Dry Density (PCF):	98.2
Area (ft^2):	0.04430	Moisture (%):	18.9		

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

$$= \frac{(500.0)(6.99)}{(41.16)(42,180)(211.01)}$$

A = Cross-sectional area of specimen, (cm^2)

$$= \frac{3,495.00}{366,340,538.09}$$

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$= 9.54 \times 10^{-6} \text{ cm/sec}$$

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084

PROJECT NAME	: Oak Grove Resources Concord Prep Plant	PROJECT NUMBER	: 12-651
CLIENT	: McGehee Engineering Corporation	DATE	: May 29, 2014

SAMPLE LOCATION AND CONDITIONS

Sample Id.:	TP-15	Sample Depth :	Na
Sample Remolded:	95% Compaction	Sample Type :	Bulk
Sample Description :	Clay, silty, light brown, tan		

INITIAL SPECIMEN PROPERTIES

Length (in.):	2.75	Volume (ft^3):	0.01015	Wet Density (PCF):	113.5
Diameter (in.):	2.85	Weight (lbs):	1.153	Dry Density (PCF):	92.4
Area (ft^2):	0.04430	Moisture (%):	22.9		

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$= \frac{(500.0)(6.99)}{(41.16)(151{,}800)(211.01)}$$

$$= \frac{1{,}224.65}{1{,}318{,}409{,}048.88}$$

$$= 9.29 \times 10^{-7} \text{ cm/sec}$$

Geo/Environmental Associates, Inc.

3502 Overlook Circle • Knoxville, TN 37909 • 865-584-0344 • Fax 865-584-0778 • www.geoe.com

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084

PROJECT NAME	: Oak Grove Resources Concord Prep Plant	PROJECT NUMBER	: 12-651
CLIENT	: McGehee Engineering Corporation	DATE	: May 29, 2014

SAMPLE LOCATION AND CONDITIONS

Sample Id.:	TP-15	Sample Depth :	Na
Sample Remolded:	95% Compaction	Sample Type :	Bulk
Sample Description :	Clay, silty, light brown, tan		

INITIAL SPECIMEN PROPERTIES

Length (in.):	2.75	Volume (ft^3):	0.01015	Wet Density (PCF):	113.5
Diameter (in.):	2.85	Weight (lbs):	1.153	Dry Density (PCF):	92.4
Area (ft^2):	0.04430	Moisture (%):	22.9		

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$= \frac{(500.0)(6.99)}{(41.16)(151{,}800)(211.01)}$$

$$= \frac{1{,}224.65}{1{,}318{,}409{,}048.88}$$

$$= 9.29 \times 10^{-7} \text{ cm/sec}$$

Geo/Environmental Associates, Inc.

3502 Overlook Circle • Knoxville, TN 37909 • 865-584-0344 • Fax 865-584-0778 • www.geoe.com

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084

PROJECT NAME	: Oak Grove Resources Concord Prep Plant	PROJECT NUMBER	: 12-651
CLIENT	: McGehee Engineering Corporation	DATE	: May 29, 2014

SAMPLE LOCATION AND CONDITIONS

Sample Id.: ST-2 Sample Depth : 2'-4'

Sample Remolded: No Sample Type : Shelby Tube

Sample Description : Clay, silty, light brown, reddish brown

INITIAL SPECIMEN PROPERTIES

Length (in.):	2.39	Volume (ft^3):	0.00889	Wet Density (PCF):	127.4
Diameter (in.):	2.86	Weight (lbs):	1.132	Dry Density (PCF):	109.7
Area (ft^2):	0.04461	Moisture (%):	16.1		

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

. = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$= \frac{(500.0)(6.07)}{(41.45)(49{,}260)(211.01)}$$

$$= \frac{3{,}035.00}{430{,}845{,}915.27}$$

$$= 7.04 \times 10^{-6} \text{ cm/sec}$$

Geo/Environmental Associates, Inc.

3502 Overlook Circle • Knoxville, TN 37909 • 865-584-0344 • Fax 865-584-0778 • www.geoe.com

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084

PROJECT NAME	: Oak Grove Resources Concord Prep Plant	PROJECT NUMBER	: 12-651
CLIENT	: McGehee Engineering Corporation	DATE	: May 29, 2014

SAMPLE LOCATION AND CONDITIONS

Sample Id.:	ST-5	Sample Depth :	3'-5'
Sample Remolded:	No	Sample Type :	Shelby Tube

Sample Description : Clay, silty, reddish brown, brown

INITIAL SPECIMEN PROPERTIES

Length (in.):	2.80	Volume (ft^3):	0.01041	Wet Density (PCF):	126.6
Diameter (in.):	2.86	Weight (lbs):	1.318	Dry Density (PCF):	109.9
Area (ft^2):	0.04461	Moisture (%):	15.2		

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$= \frac{(132.4)(7.11)}{(41.45)(33{,}060)(211.01)}$$

$$= \frac{941.36}{289{,}154{,}810.37}$$

$$= 3.26 \times 10^{-6} \text{ cm/sec}$$

Geo/Environmental Associates, Inc.

3502 Overlook Circle • Knoxville, TN 37909 • 865-584-0344 • Fax 865-584-0778 • www.geoe.com

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084

PROJECT NAME : Oak Grove Resources Concord Prep Plant

PROJECT NUMBER : 12-651

CLIENT : McGehee Engineering Corporation

DATE : May 29, 2014

SAMPLE LOCATION AND CONDITIONS

Sample Id.: ST-6

Sample Depth : 1.5'-3.0'

Sample Remolded: No

Sample Type : Shelby Tube

Sample Description : Clay, silty, light reddish brown

INITIAL SPECIMEN PROPERTIES

Length (in.):	3.14	Volume (ft^3):	0.01176	Wet Density (PCF):	127.8
Diameter (in.):	2.87	Weight (lbs):	1.502	Dry Density (PCF):	109.2
Area (ft^2):	0.04493	Moisture (%):	17.0		

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

$$= \frac{(500.0)(7.98)}{(41.74)(83,040)(211.01)}$$

A = Cross-sectional area of specimen, (cm^2)

$$= \frac{3.990.00}{731,379,566.50}$$

t = Interval of time, over which the flow Q occurs, (sec)

. = Difference in hydraulic head across specimen, (cm)

$$= 5.46 \times 10^{-6} \text{ cm/sec}$$

Geo/Environmental Associates, Inc.

3502 Overlook Circle • Knoxville, TN 37909 • 865-584-0344 • Fax 865-584-0778 • www.geoe.com

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084

PROJECT NAME	: Oak Grove Resources Concord Prep Plant	PROJECT NUMBER	: 12-651
CLIENT	: McGehee Engineering Corporation	DATE	: May 29, 2014

SAMPLE LOCATION AND CONDITIONS

Sample Id.:	ST-7	Sample Depth :	1.5'-3.0'
Sample Remolded:	No	Sample Type :	Shelby Tube
Sample Description :	Clay, silty, light brown, tan		

INITIAL SPECIMEN PROPERTIES

Length (in.):	3.45	Volume (ft^3):	0.01274	Wet Density (PCF):	132.0
Diameter (in.):	2.85	Weight (lbs):	1.681	Dry Density (PCF):	111.1
Area (ft^2):	0.04430	Moisture (%):	18.8		

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

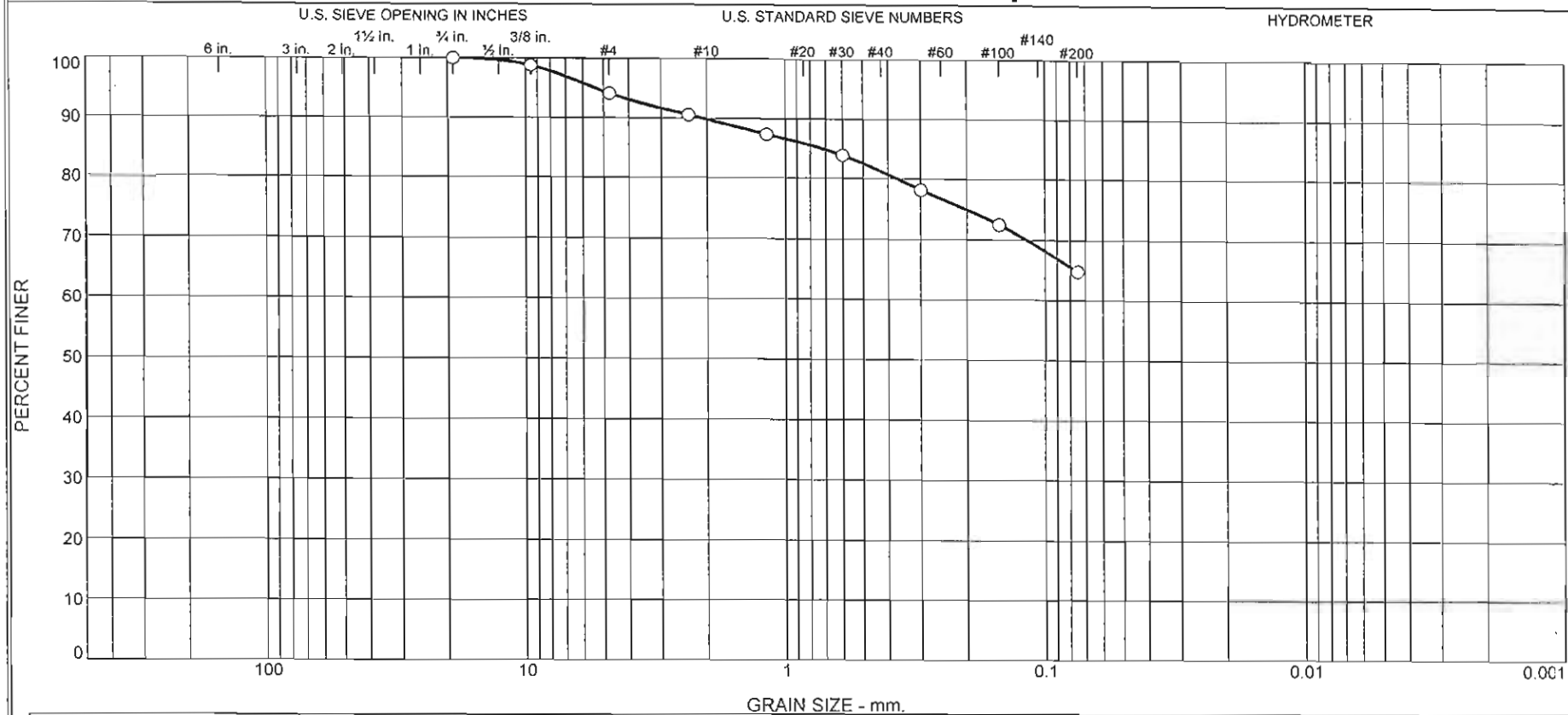
$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$= \frac{(500.0)(8.76)}{(41.16)(92{,}100)(211.01)}$$

$$= \frac{4{,}380.00}{799{,}904{,}304.36}$$

$$= 5.48 \times 10^{-6} \text{ cm/sec}$$

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	6.0	4.1	8.7	16.4	64.8	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	Oak Grove Resources	TP-10			ML	Silt, clayey, sandy, light reddish brown	22.8	23	np
	Concord Prep Plant								

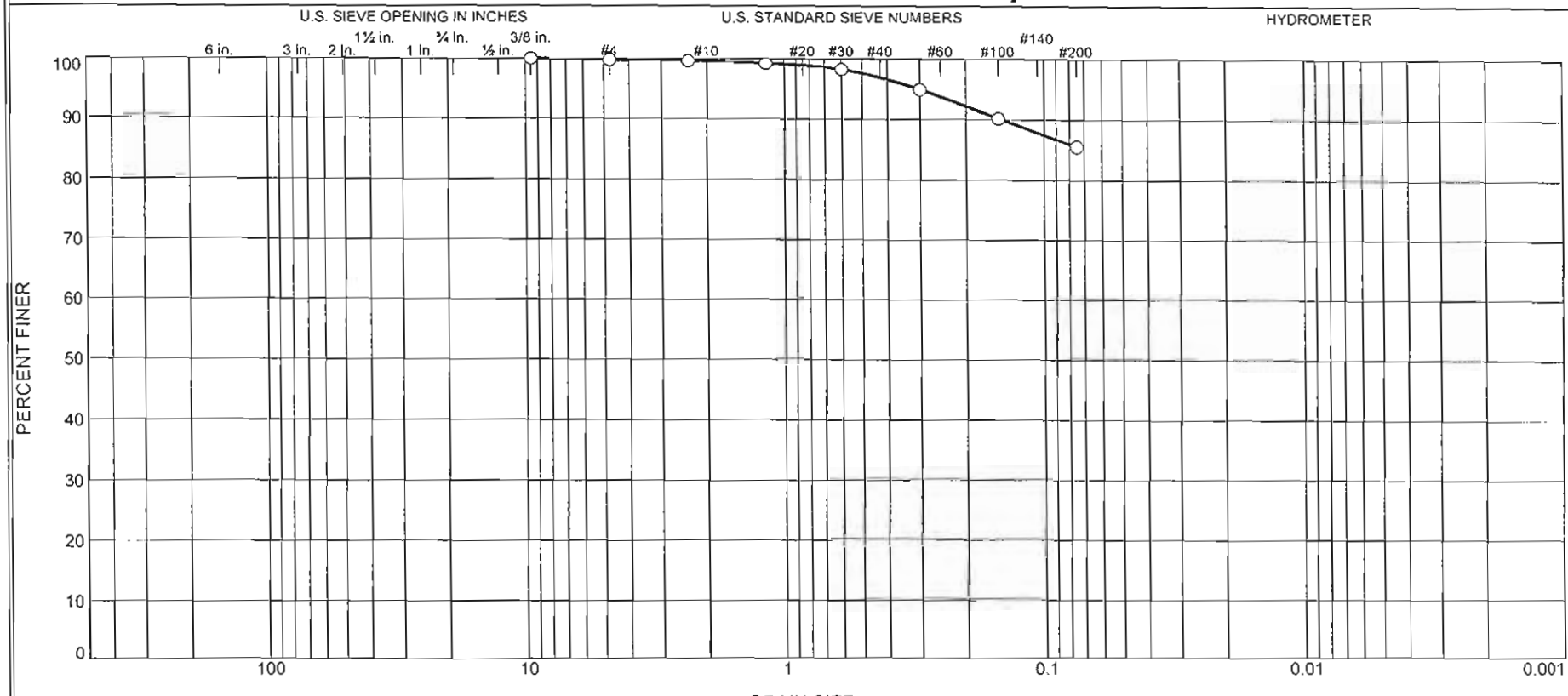
Client McGehee Engineering Corporation

Project McGehee Lab Testing

Project No. 12-651 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	0.3	0.2	2.6	11.3	85.6	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	Oak Grove Resources Concord Prep Plant	TP-15			CL	Clay, silty, light brown, tan	23.2	36	21

Client McGehee Engineering Corporation

Project McGehee Lab Testing

Project No. 12-651 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report

	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	0.8	2.6	9.0	17.0	70.6	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	Oak Grove Resources	ST-2	2'-4'		ML	Clay, silty, light brown, reddish brown	17.2	21	np
	Concord Prep Plant								

Client McGehee Engineering Corporation

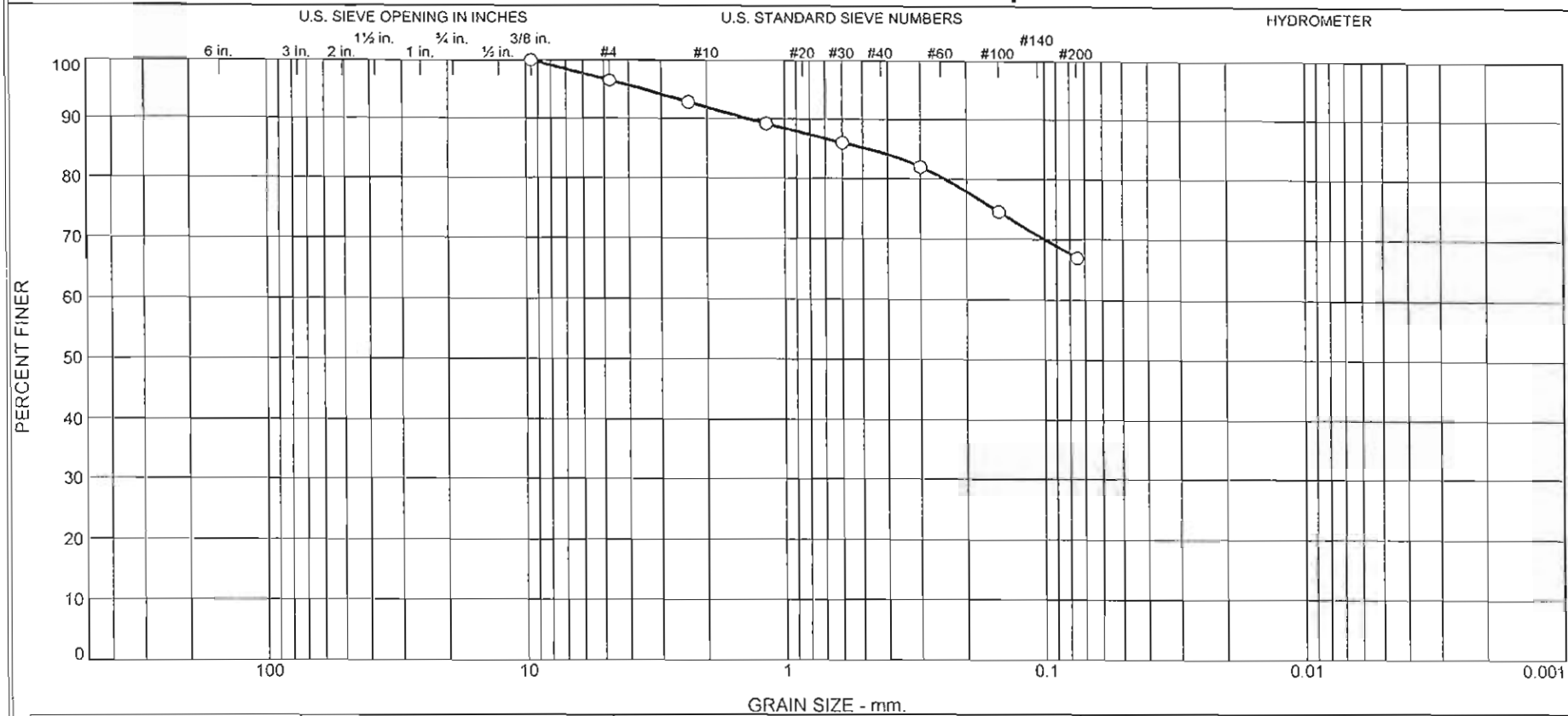
Project McGehee Lab Testing

Project No. 12-651

Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	3.7	4.4	7.5	17.5	66.9	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	Oak Grove Resources	ST-5	3'-5'		CL	Clay, silty, reddish brown, brown	19.4	28	16
	Concord Prep Plant								

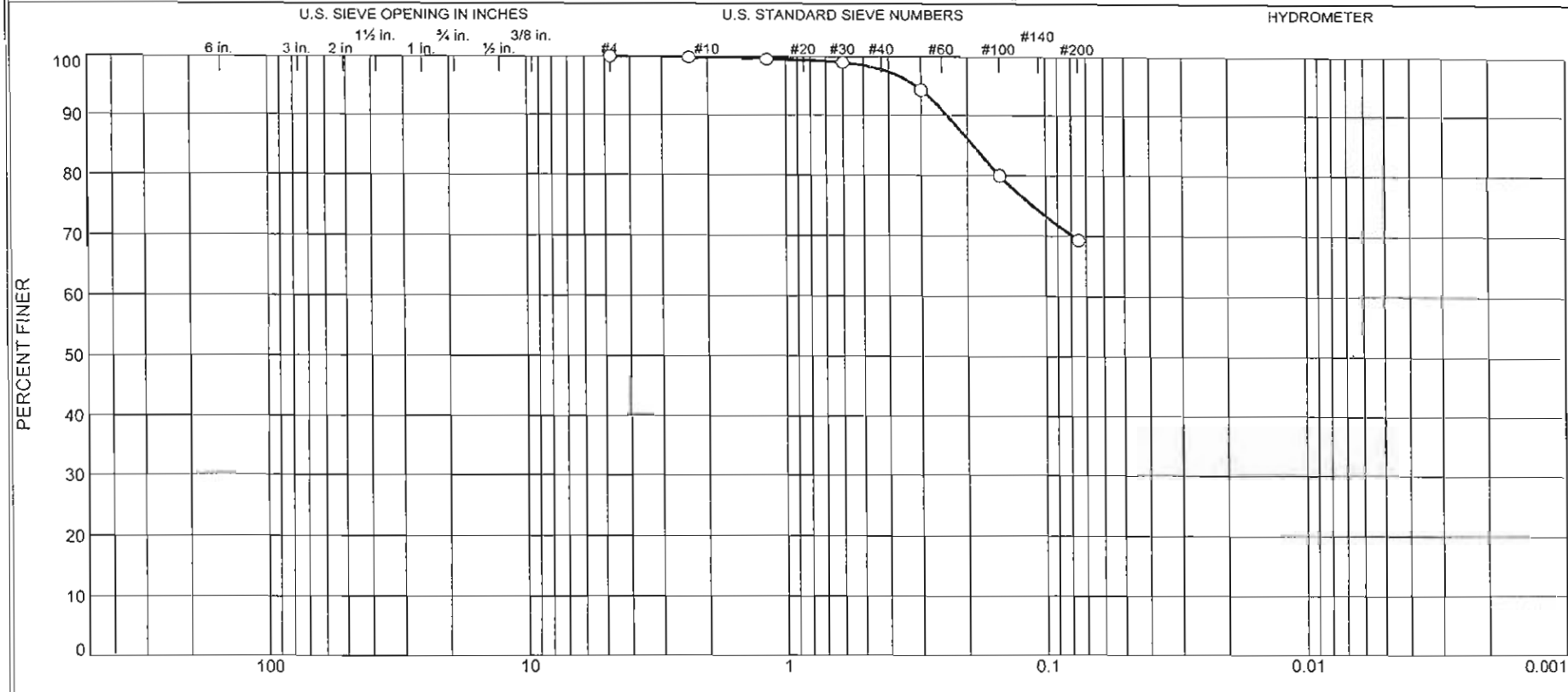
Client McGehee Engineering Corporation

Project McGehee Lab Testing

Project No. 12-651 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	0.0	0.3	2.0	28.4	69.3	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	Oak Grove Resources	ST-6	1.5'-3.0'		CL-ML	Clay, silty, light reddish brown	16.8	24	19
	Concord Prep Plant								

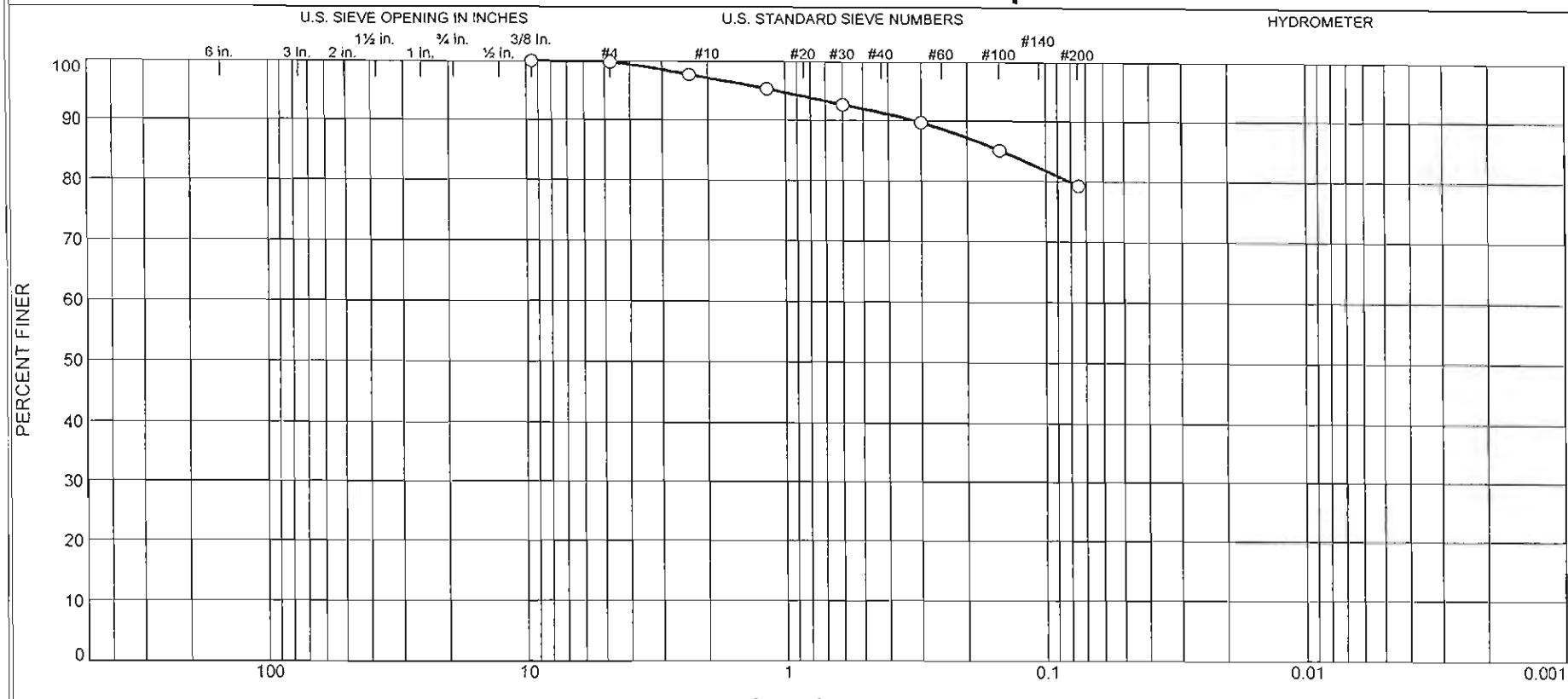
Client McGehee Engineering Corporation

Project McGehee Lab Testing

Project No. 12-651 | Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	0.2	2.7	5.8	12.0	79.3	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	Oak Grove Resources	ST-7	1.5'-3.0'		CL	Clay, silty, light brown, tan	22.0	25	16
	Concord Prep Plant								

Client McGehee Engineering Corporation

Project McGehee Lab Testing

Project No. 12-651 | Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #1
Description: 0' - 3'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/10/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1003.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	566.0	540.0	26.0	2.6	2.6	2.6	97.4
4	676.0	513.0	163.0	16.3	18.8	18.8	81.2
10	591.0	462.0	129.0	12.9	31.7	31.7	68.3
40	692.0	383.0	309.0	30.8	62.5	62.5	37.5
200	587.0	333.0	254.0	25.3	87.8	87.8	12.2
Pan	502.0	380.0	122.0	12.2	100.0	100.0	0.0
		Total Weight (W1):	1003.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 31.0
Plastic Limit: 24.6
Plasticity Index: 6.4

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #1
Description: 3' - 7'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/10/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	544.0	540.0	4.0	0.4	0.4	0.4	99.6
4	576.0	513.0	63.0	6.3	6.7	6.7	93.3
10	575.0	462.0	113.0	11.3	18.0	18.0	82.0
40	680.0	383.0	297.0	29.7	47.7	47.7	52.3
200	680.5	333.0	347.5	34.8	82.5	82.5	17.6
Pan	555.5	380.0	175.5	17.6	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 31.9
Plastic Limit: 23.9
Plasticity Index: 8.0

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #2
Description: 0' - 4'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/10/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	630.0	513.0	117.0	11.7	11.7	11.7	88.3
10	620.0	462.0	158.0	15.8	27.5	27.5	72.5
40	671.0	383.0	288.0	28.8	56.3	56.3	43.7
200	555.2	333.0	222.2	22.2	78.5	78.5	21.5
Pan	594.8	380.0	214.8	21.5	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 23.0
Plastic Limit: 19.2
Plasticity Index: 3.8

Soil Classification: SM

Coarse Grained
Silty Sand

Effective Cohesion: 1.8750 psi
Total Cohesion: 6.528 psi
Permeability: 12.30 ft/yr
Maximum Dry Density: 115.0 pcf
Optimum Moisture: 14.9 %
Effective Cohesion: 270.0 psf
Angle of Internal Friction: 33.02 degrees
Mass Unit Weight: 132.14 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #2
Description: 4' - 7'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/10/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1003.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Pereent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	594.0	513.0	81.0	8.1	8.1	8.1	91.9
10	575.0	462.0	113.0	11.3	19.3	19.3	80.7
40	700.0	383.0	317.0	31.6	50.9	50.9	49.1
200	679.5	333.0	346.5	34.5	85.5	85.5	14.5
Pan	525.5	380.0	145.5	14.5	100.0	100.0	0.0
		Total Weight (W1):	1003.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 28.0
Plastic Limit: 22.7
Plasticity Index: 5.3

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #3
Description: 0' - 3'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/10/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1001.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	551.0	540.0	11.0	1.1	1.1	1.1	98.9
4	659.0	513.0	146.0	14.6	15.7	15.7	84.3
10	625.0	462.0	163.0	16.3	32.0	32.0	68.0
40	698.0	383.0	315.0	31.5	63.4	63.4	36.6
200	578.3	333.0	245.3	24.5	87.9	87.9	12.1
Pan	500.7	380.0	120.7	12.1	100.0	100.0	0.0
		Total Weight (W1):	1001.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 26.5
Plastic Limit: 23.2
Plasticity Index: 3.3

Soil Classification: SM

Coarse Grained
Silty Sand

Effective Cohesion: 1.8750 psi
Total Cohesion: 6.528 psi
Permeability: 12.30 ft/yr
Maximum Dry Density: 115.0 pcf
Optimum Moisture: 14.9 %
Effective Cohesion: 270.0 psf
Angle of Internal Friction: 33.02 degrees
Mass Unit Weight: 132.14 pcf

Post Office Box 3431 • 350 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #4
Description: 0' - 1.5'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/10/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1006.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	569.0	513.0	56.0	5.6	5.6	5.6	94.4
10	598.0	462.0	136.0	13.5	19.1	19.1	80.9
40	702.0	383.0	319.0	31.7	50.8	50.8	49.2
200	582.3	333.0	249.3	24.8	75.6	75.6	24.4
Pan	625.7	380.0	245.7	24.4	100.0	100.0	0.0
		Total Weight (W1):	1006.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 40.9
Plastic Limit: 27.1
Plasticity Index: 13.8

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #4
Description: 1.5' - 4'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/10/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1003.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	563.0	513.0	50.0	5.0	5.0	5.0	95.0
10	529.0	462.0	67.0	6.7	11.7	11.7	88.3
40	690.0	383.0	307.0	30.6	42.3	42.3	57.7
200	740.8	333.0	407.8	40.7	82.9	82.9	17.1
Pan	551.2	380.0	171.2	17.1	100.0	100.0	0.0
		Total Weight (W1):	1003.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 29.3
Plastic Limit: 24.2
Plasticity Index: 5.1

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0681 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #5
Description: 0' - 3.5'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/11/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	629.0	513.0	116.0	11.6	11.6	11.6	88.4
10	665.0	462.0	203.0	20.3	31.9	31.9	68.1
40	700.0	383.0	317.0	31.7	63.6	63.6	36.4
200	488.9	333.0	155.9	15.6	79.2	79.2	20.8
Pan	588.1	380.0	208.1	20.8	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 34.0
Plastic Limit: 21.6
Plasticity Index: 12.4

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #5
Description: 3.5' - 6'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/11/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1003.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	543.0	540.0	3.0	0.3	0.3	0.3	99.7
4	627.0	513.0	114.0	11.4	11.7	11.7	88.3
10	581.0	462.0	119.0	11.9	23.5	23.5	76.5
40	699.0	383.0	316.0	31.5	55.0	55.0	45.0
200	632.8	333.0	299.8	29.9	84.9	84.9	15.1
Pan	531.2	380.0	151.2	15.1	100.0	100.0	0.0
		Total Weight (W1):	1003.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 27.1
Plastic Limit: 23.9
Plasticity Index: 3.2

Soil Classification: SM

Coarse Grained
Silty Sand

Effective Cohesion: 1.8750 psi
Total Cohesion: 6.528 psi
Permeability: 12.30 ft/yr
Maximum Dry Density: 115.0 pcf
Optimum Moisture: 14.9 %
Effective Cohesion: 270.0 psf
Angle of Internal Friction: 33.02 degrees
Mass Unit Weight: 132.14 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #6
Description: 0' - 4'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/11/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 998.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	599.0	513.0	86.0	8.6	8.6	8.6	91.4
10	649.0	462.0	187.0	18.7	27.4	27.4	72.6
40	699.0	383.0	316.0	31.7	59.0	59.0	41.0
200	528.9	333.0	195.9	19.6	78.6	78.6	21.4
Pan	593.1	380.0	213.1	21.4	100.0	100.0	0.0
		Total Weight (W1):	998.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 27.2
Plastic Limit: 18.4
Plasticity Index: 8.8

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #6
Description: 4' - 7'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/11/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	595.0	513.0	82.0	8.2	8.2	8.2	91.8
10	564.0	462.0	102.0	10.2	18.4	18.4	81.6
40	686.0	383.0	303.0	30.3	48.7	48.7	51.3
200	683.0	333.0	350.0	35.0	83.7	83.7	16.3
Pan	543.0	380.0	163.0	16.3	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 26.9
Plastic Limit: 21.7
Plasticity Index: 5.2

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #7
Description: 0' - 4'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/11/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1004.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	655.0	513.0	142.0	14.1	14.1	14.1	85.9
10	696.0	462.0	234.0	23.3	37.5	37.5	62.5
40	683.0	383.0	300.0	29.9	67.3	67.3	32.7
200	403.1	333.0	70.1	7.0	74.3	74.3	25.7
Pan	637.9	380.0	257.9	25.7	100.0	100.0	0.0
		Total Weight (W1):	1004.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 46.7
Plastic Limit: 28.3
Plasticity Index: 18.4

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #7
Description: 4' - 9'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/11/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	547.0	540.0	7.0	0.7	0.7	0.7	99.3
4	695.0	513.0	182.0	18.2	18.9	18.9	81.1
10	669.0	462.0	207.0	20.7	39.6	39.6	60.4
40	605.0	383.0	222.0	22.2	61.8	61.8	38.2
200	440.7	333.0	107.7	10.8	72.6	72.6	27.4
Pan	654.3	380.0	274.3	27.4	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 31.2
Plastic Limit: 26.3
Plasticity Index: 4.9

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • istaff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #8
Description: 0' - 2.5'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/14/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	557.0	540.0	17.0	1.7	1.7	1.7	98.3
4	693.0	513.0	180.0	18.0	19.7	19.7	80.3
10	671.0	462.0	209.0	20.9	40.6	40.6	59.4
40	611.0	383.0	228.0	22.8	63.4	63.4	36.6
200	532.9	333.0	199.9	20.0	83.4	83.4	16.6
Pan	546.1	380.0	166.1	16.6	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 29.6
Plastic Limit: 23.4
Plasticity Index: 6.2

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #8
Description: 2.5' - 4.5'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/14/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1003.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Pereent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	636.0	513.0	123.0	12.3	12.3	12.3	87.7
10	637.0	462.0	175.0	17.4	29.7	29.7	70.3
40	693.0	383.0	310.0	30.9	60.6	60.6	39.4
200	499.9	333.0	166.9	16.6	77.3	77.3	22.7
Pan	608.1	380.0	228.1	22.7	100.0	100.0	0.0
		Total Weight (W1):	1003.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 33.1
Plastic Limit: 25.7
Plasticity Index: 7.4

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #8
Description: 4.5' - 8'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/14/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	555.0	540.0	15.0	1.5	1.5	1.5	98.5
4	654.0	513.0	141.0	14.1	15.6	15.6	84.4
10	578.0	462.0	116.0	11.6	27.2	27.2	72.8
40	541.0	383.0	158.0	15.8	43.0	43.0	57.0
200	755.5	333.0	422.5	42.3	85.3	85.3	14.8
Pan	527.5	380.0	147.5	14.8	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: N/A
Plastic Limit: N/A
Plasticity Index: N/A

Soil Classification: N/A

Coarse Grained
Sands with Fines

Effective Cohesion:	N/A	psi
Total Cohesion:	N/A	psi
Permeability:	N/A	ft/yr
Maximum Dry Density:	N/A	pcf
Optimum Moisture:	N/A	%
Effective Cohesion:	N/A	psf
Angle of Internal Friction:	N/A	degrees
Mass Unit Weight:	N/A	pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #9
Description: 0' - 4'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/16/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	586.0	513.0	73.0	7.3	7.3	7.3	92.7
10	668.0	462.0	206.0	20.6	27.9	27.9	72.1
40	660.0	383.0	277.0	27.7	55.6	55.6	44.4
200	501.6	333.0	168.6	16.9	72.5	72.5	27.5
Pan	655.4	380.0	275.4	27.5	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 41.2
Plastic Limit: 25.1
Plasticity Index: 16.1

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #9
Description: 4' - 7'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/16/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1001.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	553.0	540.0	13.0	1.3	1.3	1.3	98.7
4	683.0	513.0	170.0	17.0	18.3	18.3	81.7
10	615.0	462.0	153.0	15.3	33.6	33.6	66.4
40	537.0	383.0	154.0	15.4	49.0	49.0	51.0
200	665.8	333.0	332.8	33.2	82.2	82.2	17.8
Pan	558.2	380.0	178.2	17.8	100.0	100.0	0.0
		Total Weight (W1):	1001.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 29.5
Plastic Limit: 25.2
Plasticity Index: 4.3

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #10
Description: 0' - 3'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/16/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1020.3 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	547.3	540.0	7.3	0.7	0.7	0.7	99.3
4	660.0	513.0	147.0	14.4	15.1	15.1	84.9
10	675.0	462.0	213.0	20.9	36.0	36.0	64.0
40	663.0	383.0	280.0	27.4	63.4	63.4	36.6
200	539.1	333.0	206.1	20.2	83.6	83.6	16.4
Pan	546.9	380.0	166.9	16.4	100.0	100.0	0.0
		Total Weight (W1):	1020.3				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 30.9
Plastic Limit: 26.5
Plasticity Index: 4.4

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • mail@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #10
Description: 3' - 5'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/16/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1001.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	544.0	540.0	4.0	0.4	0.4	0.4	99.6
4	671.0	513.0	158.0	15.8	16.2	16.2	83.8
10	663.0	462.0	201.0	20.1	36.3	36.3	63.7
40	661.0	383.0	278.0	27.8	64.0	64.0	36.0
200	521.5	333.0	188.5	18.8	82.9	82.9	17.1
Pan	551.5	380.0	171.5	17.1	100.0	100.0	0.0
		Total Weight (W1):	1001.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 34.1
Plastic Limit: 27.2
Plasticity Index: 6.9

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP #10
Description: 5' - 7'

Sample Date: 4/9/14
Analyzed By: CS/JWW
Date Analyzed: 4/16/14
Requested By: Jeff Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	551.0	540.0	11.0	1.1	1.1	1.1	98.9
4	646.0	513.0	133.0	13.3	14.4	14.4	85.6
10	584.0	462.0	122.0	12.2	26.6	26.6	73.4
40	548.0	383.0	165.0	16.5	43.1	43.1	56.9
200	759.4	333.0	426.4	42.6	85.7	85.7	14.3
Pan	522.6	380.0	142.6	14.3	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: N/A
Plastic Limit: N/A
Plasticity Index: N/A

Soil Classification: N/A

Coarse Grained
Sands wth Fines

Effective Cohesion:	N/A	psi
Total Cohesion:	N/A	psi
Permeability:	N/A	ft/yr
Maximum Dry Density:	N/A	pcf
Optimum Moisture:	N/A	%
Effective Cohesion:	N/A	psf
Angle of Internal Friction:	N/A	degrees
Mass Unit Weight:	N/A	pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0681 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-11
Description: 0 - 3'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/16/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 1001.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	677.0	513.0	164.0	16.4	16.4	16.4	83.6
10	690.0	462.0	228.0	22.8	39.2	39.2	60.8
40	665.0	383.0	282.0	28.2	67.3	67.3	32.7
200	486.6	333.0	153.6	15.3	82.7	82.7	17.3
Pan	553.4	380.0	173.4	17.3	100.0	100.0	0.0
		Total Weight (W1):	1001.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 48.9
Plastic Limit: 29.5
Plasticity Index: 19.4

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-11
Description: 3' - 5'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/16/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 998.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	557.0	540.0	17.0	1.7	1.7	1.7	98.3
4	683.0	513.0	170.0	17.0	18.7	18.7	81.3
10	675.0	462.0	213.0	21.3	40.1	40.1	59.9
40	559.0	383.0	176.0	17.6	57.7	57.7	42.3
200	617.6	333.0	284.6	28.5	86.2	86.2	13.8
Pan	517.4	380.0	137.4	13.8	100.0	100.0	0.0
		Total Weight (W1):	998.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 28.2
Plastic Limit: 26.4
Plasticity Index: 1.8

Soil Classification: SM

Coarse Grained
Silty Sand

Effective Cohesion: 1.8750 psi
Total Cohesion: 6.528 psi
Permeability: 12.30 ft/yr
Maximum Dry Density: 115.0 pcf
Optimum Moisture: 14.9 %
Effective Cohesion: 270.0 psf
Angle of Internal Friction: 33.02 degrees
Mass Unit Weight: 132.14 pcf

Post Office Box 3431 • 430 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-11
Description: 5' - 7'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/16/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 977.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Pereent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	628.0	513.0	115.0	11.8	11.8	11.8	88.2
10	670.0	462.0	208.0	21.3	33.1	33.1	66.9
40	656.0	383.0	273.0	27.9	61.0	61.0	39.0
200	555.2	333.0	222.2	22.7	83.7	83.7	16.3
Pan	538.8	380.0	158.8	16.3	100.0	100.0	0.0
		Total Weight (W1):	977.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 30.0
Plastic Limit: 22.9
Plasticity Index: 7.1

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-12
Description: 0' - 3'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/16/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 1000.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	606.0	513.0	93.0	9.3	9.3	9.3	90.7
10	556.0	462.0	94.0	9.4	18.7	18.7	81.3
40	697.0	383.0	314.0	31.4	50.1	50.1	49.9
200	680.4	333.0	347.4	34.7	84.8	84.8	15.2
Pan	531.6	380.0	151.6	15.2	100.0	100.0	0.0
		Total Weight (W1):	1000.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 22.8
Plastic Limit: 21.3
Plasticity Index: 1.5

Soil Classification: SM

Coarse Grained
Silty Sand

Effective Cohesion: 1.8750 psi
Total Cohesion: 6.528 psi
Permeability: 12.30 ft/yr
Maximum Dry Density: 115.0 pcf
Optimum Moisture: 14.9 %
Effective Cohesion: 270.0 psf
Angle of Internal Friction: 33.02 degrees
Mass Unit Weight: 132.14 pcf

Post Office Box 3431 • 4150 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-12
Description: 3' - 8'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/16/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 1011.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	581.0	513.0	68.0	6.7	6.7	6.7	93.3
10	549.0	462.0	87.0	8.6	15.3	15.3	84.7
40	699.0	383.0	316.0	31.3	46.6	46.6	53.4
200	750.4	333.0	417.4	41.3	87.9	87.9	12.1
Pan	502.6	380.0	122.6	12.1	100.0	100.0	0.0
		Total Weight (W1):	1011.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 22.1
Plastic Limit: 21.7
Plasticity Index: 0.4

Soil Classification: SM

Coarse Grained
Silty Sand

Effective Cohesion: 1.8750 psi
Total Cohesion: 6.528 psi
Permeability: 12.30 ft/yr
Maximum Dry Density: 115.0 pcf
Optimum Moisture: 14.9 %
Effective Cohesion: 270.0 psf
Angle of Internal Friction: 33.02 degrees
Mass Unit Weight: 132.14 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-13
Description: 0' - 4'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/21/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 999.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	541.0	540.0	1.0	0.1	0.1	0.1	99.9
4	675.0	513.0	162.0	16.2	16.3	16.3	83.7
10	636.0	462.0	174.0	17.4	33.7	33.7	66.3
40	658.0	383.0	275.0	27.5	61.3	61.3	38.7
200	493.6	333.0	160.6	16.1	77.3	77.3	22.7
Pan	606.4	380.0	226.4	22.7	100.0	100.0	0.0
		Total Weight (W1):	999.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 28.4
Plastic Limit: 18.6
Plasticity Index: 9.8

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-13
Description: 4' - 6'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/21/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 999.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Pereent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	606.0	513.0	93.0	9.3	9.3	9.3	90.7
10	597.0	462.0	135.0	13.5	22.8	22.8	77.2
40	699.0	383.0	316.0	31.6	54.5	54.5	45.5
200	582.5	333.0	249.5	25.0	79.4	79.4	20.6
Pan	585.5	380.0	205.5	20.6	100.0	100.0	0.0
		Total Weight (Wt):	999.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 24.3
Plastic Limit: 18.4
Plasticity Index: 5.9

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-14
Description: 0' - 4'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/21/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 999.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	542.0	540.0	2.0	0.2	0.2	0.2	99.8
4	677.0	513.0	164.0	16.4	16.6	16.6	83.4
10	655.0	462.0	193.0	19.3	35.9	35.9	64.1
40	696.0	383.0	313.0	31.3	67.3	67.3	32.7
200	493.9	333.0	160.9	16.1	83.4	83.4	16.6
Pan	546.1	380.0	166.1	16.6	100.0	100.0	0.0
		Total Weight (W1):	999.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 35.5
Plastic Limit: 23.4
Plasticity Index: 12.1

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-14
Description: 4' - 15'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/22/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 1013.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	559.0	540.0	19.0	1.9	1.9	1.9	98.1
4	693.0	513.0	180.0	17.8	19.6	19.6	80.4
10	691.0	462.0	229.0	22.6	42.3	42.3	57.7
40	697.0	383.0	314.0	31.0	73.2	73.2	26.8
200	423.2	333.0	90.2	8.9	82.2	82.2	17.8
Pan	560.8	380.0	180.8	17.8	100.0	100.0	0.0
		Total Weight (W1):	1013.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 38.3
Plastic Limit: 25.9
Plasticity Index: 12.4

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Oak Grove
Location: Concord
Sample I.D.: TP-15
Description: 0' - 12'

Sample Date: 4/9/14
Analyzed By: CS
Date Analyzed: 4/22/14
Requested By: J. Aldridge

Weight of Oven Dry Sample (W): 988.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	540.0	540.0	0.0	0.0	0.0	0.0	100.0
4	636.0	513.0	123.0	12.4	12.4	12.4	87.6
10	621.0	462.0	159.0	16.1	28.5	28.5	71.5
40	664.0	383.0	281.0	28.4	57.0	57.0	43.0
200	569.0	333.0	236.0	23.9	80.9	80.9	19.1
Pan	569.0	380.0	189.0	19.1	100.0	100.0	0.0
		Total Weight (W1):	988.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 34.9
Plastic Limit: 24.7
Plasticity Index: 10.2

Soil Classification: SC

Coarse Grained
Clayey Sand

Effective Cohesion: 0.6940 psi
Total Cohesion: 8.610 psi
Permeability: 0.50 ft/yr
Maximum Dry Density: 116.0 pcf
Optimum Moisture: 15.1 %
Effective Cohesion: 99.9 psf
Angle of Internal Friction: 27.92 degrees
Mass Unit Weight: 133.52 pcf

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

APPENDIX C

CALCULATION BRIEFS

Oak Grove Resources, LLC, Concord Mine, Slurry Impoundment No. 6

Elevation-Area-Capacity Table

Elevation (ft)	Area (ac)	Capacity (ac-ft)
475.00	0.000	0.000
476.00	0.018	0.006
477.00	0.067	0.046
478.00	0.149	0.151
479.00	0.264	0.354
480.00	0.410	0.688
481.00	0.575	1.178
482.00	0.765	1.846
483.00	0.983	2.718
484.00	1.229	3.821
485.00	1.500	5.183
486.00	1.741	6.802
487.00	1.999	8.671
488.00	2.275	10.806
489.00	2.569	13.227
490.00	2.880	15.950
491.00	3.213	18.995
492.00	3.562	22.381
493.00	3.930	26.126
494.00	4.317	30.248
495.00	4.720	34.764
496.00	5.148	39.697
497.00	5.593	45.066
498.00	6.057	50.889
499.00	6.540	57.186
500.00	7.040	63.975
501.00	7.600	71.293
502.00	8.181	79.182
503.00	8.783	87.661
504.00	9.406	96.754
505.00	10.050	106.480
506.00	10.321	116.913
507.00	11.618	128.130
508.00	12.444	140.159

Elevation (ft)	Area (ac)	Capacity (ac-ft)
509.00	13.299	153.027
510.00	14.160	166.764
511.00	15.132	181.418
512.00	16.112	197.037
513.00	17.124	213.653
514.00	18.168	231.297
515.00	19.240	249.998
516.00	20.118	269.675
517.00	21.014	290.240
518.00	21.930	311.710
519.00	22.866	334.106
520.00	23.820	357.448
521.00	24.721	381.717
522.00	25.638	406.895
523.00	26.572	432.999
524.00	27.523	460.046
525.00	28.490	488.051
526.00	29.370	516.980
527.00	30.262	546.795
528.00	31.168	577.509
529.00	32.088	609.136
530.00	33.020	641.689
531.00	33.863	675.130
532.00	34.716	709.419
533.00	35.580	744.566
534.00	36.455	780.583
535.00	37.340	817.480
536.00	39.014	855.654
537.00	40.723	895.520
538.00	42.469	937.113
539.00	44.252	980.471
540.00	46.070	1025.629
541.00	46.563	1071.945
542.00	47.058	1118.755
543.00	47.556	1166.063
544.00	48.057	1213.869
545.00	48.560	1262.177
546.00	49.069	1310.991
547.00	49.580	1360.315
548.00	50.094	1410.152
549.00	50.611	1460.505

Elevation (ft)	Area (ac)	Capacity (ac-ft)
550.00	51.130	1511.375
551.00	52.323	1563.100
552.00	53.529	1616.025
553.00	54.749	1670.163
554.00	55.983	1725.528
555.00	57.230	1782.134
556.00	58.608	1840.052
557.00	60.001	1899.355
558.00	61.411	1960.060
559.00	62.838	2022.183
560.00	64.280	2085.741

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   06JUN14  TIME  16:21:36   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID  ************************************************************
  2           ID  * Full - 72 HR-PMF FLOOD STORAGE ROUTING                   *
  3           ID  * OAK GROVE RESOURCES, LLC                                 *
  4           ID  * CONCORD PREPARATION PLANT                                *
  5           ID  * SLURRY IMPOUNDMENT NO. 6                                 *
  6           ID  ************************************************************
  7           IT      15       0       0     300
  8           IO       2
  9           JR    FLOW     1.0

 10           KK   BASIN
 11           KM   COMPUTE INFLOW HYDROGRAPH
 12           PB       0
 13           PI   0.025   0.025   0.025   0.025   0.025   0.025   0.025   0.025   0.025   0.025
 14           PI   0.025   0.025   0.025   0.025   0.025   0.025   0.025   0.025   0.025   0.025
 15           PI   0.025   0.025   0.025   0.025   0.031   0.031   0.031   0.031   0.031   0.031
 16           PI   0.031   0.031   0.031   0.031   0.031   0.031   0.031   0.031   0.039   0.039
 17           PI   0.039   0.039   0.039   0.039   0.039   0.039   0.039   0.039   0.039   0.039
 18           PI   0.039   0.039   0.039   0.039   0.039   0.039   0.039   0.039   0.039   0.039
 19           PI   0.039   0.039   0.055   0.055   0.055   0.055   0.055   0.055   0.055   0.055
 20           PI   0.055   0.055   0.055   0.055   0.055   0.055   0.055   0.055   0.055   0.055
 21           PI   0.055   0.055   0.055   0.055   0.055   0.055   0.078   0.079   0.080   0.081
 22           PI   0.081   0.082   0.083   0.084   0.085   0.086   0.088   0.089   0.090   0.091
 23           PI   0.093   0.094   0.096   0.097   0.099   0.101   0.102   0.104   0.106   0.108
 24           PI   0.187   0.195   0.203   0.211   0.219   0.227   0.235   0.243   0.251   0.259
 25           PI   0.267   0.275   0.283   0.290   0.298   0.306   0.313   0.321   0.329   0.336
 26           PI   0.344   0.351   0.358   0.366   0.389   0.462   0.526   0.579   0.622   0.656
 27           PI   0.741   0.923   0.931   1.109   2.532   4.896   5.283   3.609   1.418   0.947
 28           PI   0.963   0.849   0.669   0.641   0.602   0.554   0.495   0.427   0.180   0.175
 29           PI   0.169   0.164   0.160   0.155   0.151   0.147   0.143   0.139   0.136   0.133
 30           PI   0.130   0.127   0.124   0.122   0.119   0.117   0.115   0.114   0.112   0.111
 31           PI   0.110   0.109   0.068   0.068   0.068   0.068   0.068   0.068   0.068   0.068
 32           PI   0.068   0.068   0.068   0.068   0.068   0.068   0.068   0.068   0.068   0.068
 33           PI   0.068   0.068   0.068   0.068   0.068   0.068   0.046   0.046   0.046   0.046
 34           PI   0.046   0.046   0.046   0.046   0.046   0.046   0.046   0.046   0.046   0.046
 35           PI   0.046   0.046   0.046   0.046   0.046   0.046   0.046   0.046   0.046   0.046
 36           PI   0.034   0.034   0.034   0.034   0.034   0.034   0.034   0.034   0.034   0.034
 37           PI   0.034   0.034   0.034   0.034   0.034   0.034   0.034   0.034   0.034   0.034
 38           PI   0.034   0.034   0.034   0.034   0.028   0.028   0.028   0.028   0.028   0.028
 39           PI   0.028   0.028   0.028   0.028   0.028   0.028   0.028   0.028   0.028   0.028
 40           PI   0.028   0.028   0.028   0.028   0.028   0.028   0.028   0.028
 41           BA   0.12
 42           LS       0      93    65.0
 43           UD   0.07

 44           KK  OAK GROVE RESOURCES SLURRY IMPOUNDMENT NO. 6
 45           KM   ROUTE COMPUTED HYDROGRAPH THROUGH THE IMPOUNDMENT
 46           RS       1    ELEV     554
 47           SA    55.9    57.2    58.6    60.0    61.4    62.8
 48           SE     554     555     556     557     558     559
 49           SQ    0.00    48.4   167.4   344.8   577.2  865.25
 50           ZZ
```

1*** ***

```
*                                        *                                                    *                                        *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *                                                    *    U.S. ARMY CORPS OF ENGINEERS        *
*              JUN   1998                *                                                    *    HYDROLOGIC ENGINEERING CENTER       *
*            VERSIGN 4.1                 *                                                    *          609 SECOND STREET             *
*                                        *                                                    *       DAVIS, CALIFORNIA 95616          *
*  RUN DATE   06JUN14  TIME  16:21:36    *                                                    *          (916) 756-1104                *
*                                        *                                                    *                                        *
******************************************                                                    ******************************************


                          ************************************************************
                          * Full - 72 HR-PMF FLOOD STORAGE ROUTING                   *
                          * OAK GROVE RESOURCES, LLC                                 *
                          * CONCORD PREPARATION PLANT                                *
                          * SLURRY IMPOUNDMENT NO. 6                                 *
                          ************************************************************

  8 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           2  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN          15  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      4    0  ENDING DATE
                     NDTIME        0245  ENDING TIME
                      ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL     .25 HOURS
                      TOTAL TIME BASE   74.75 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                      NPLAN           1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF RUNOFF
                   1.00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 10 KK     *     BASIN  *
           *            *
           **************
                         COMPUTE INFLOW HYDROGRAPH

              SUBBASIN RUNOFF DATA

 41 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .12  SUBBASIN AREA

                PRECIPITATION DATA

 12 PB                STORM       50.44  BASIN TOTAL PRECIPITATION

 13 PI            INCREMENTAL PRECIPITATION PATTERN
                     .03       .03       .03       .02       .02       .03       .03       .03       .03       .03
                     .03       .03       .03       .03       .03       .03       .03       .03       .03       .02
                     .02       .02       .02       .02       .03       .03       .03       .03       .03       .03
                     .03       .03       .03       .03       .03       .03       .03       .03       .04       .04
                     .04       .04       .04       .04       .04       .04       .04       .04       .04       .04
                     .04       .04       .04       .04       .04       .04       .04       .04       .04       .04
                     .04       .04       .06       .06       .06       .06       .06       .06       .06       .06
                     .06       .06       .06       .06       .06       .06       .06       .06       .06       .06
                     .06       .06       .06       .06       .06       .06       .08       .08       .08       .08
                     .08       .08       .08       .08       .08       .09       .09       .09       .09       .09
                     .09       .09       .10       .10       .10       .10       .10       .10       .11       .11
                     .19       .20       .20       .21       .22       .23       .24       .24       .25       .26
                     .27       .27       .28       .29       .30       .31       .31       .32       .33       .34
                     .34       .35       .36       .37       .39       .46       .53       .58       .62       .66
                     .74       .92       .93      1.11      2.53      4.90      5.28      3.61      1.42       .95
                     .96       .85       .67       .64       .60       .55       .49       .43       .18       .17
```

.17	.16	.16	.15	.15	.15	.14	.14	.14	.13
.13	.13	.12	.12	.12	.12	.12	.11	.11	.11
.11	.11	.07	.07	.07	.07	.07	.07	.07	.07
.07	.07	.07	.07	.07	.07	.07	.07	.07	.07
.07	.07	.07	.07	.07	.07	.05	.05	.05	.05
.05	.05	.05	.05	.05	.05	.05	.05	.05	.05
.05	.05	.05	.05	.05	.05	.05	.05	.05	.05
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03		

```
42 LS          SCS LOSS RATE
                    STRTL        .15  INITIAL ABSTRACTION
                   CRVNBR      93.00  CURVE NUMBER
                    RTIMP      65.00  PERCENT IMPERVIOUS AREA

43 UD          SCS DIMENSIONLESS UNITGRAPH
                     TLAG        .07  LAG
```

***

UNIT HYDROGRAPH
5 END-OF-PERIOD ORDINATES

230. 64. 13. 3. 0.

****

HYDROGRAPH AT STATION 8ASIN

****

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	.00	.00	.00	0.	*	2		1330	151	.95	.00	.95	368.
1		0015	2	.03	.01	.02	4.	*	2		1345	152	.96	.00	.96	310.
1		0030	3	.03	.01	.02	5.	*	2		1400	153	.85	.00	.85	273.
1		0045	4	.03	.01	.02	5.	*	2		1415	154	.67	.00	.67	223.
1		0100	5	.02	.01	.02	5.	*	2		1430	155	.64	.00	.64	204.
1		0115	6	.02	.01	.02	5.	*	2		1445	156	.60	.00	.60	190.
1		0130	7	.03	.01	.02	5.	*	2		1500	157	.55	.00	.55	176.
1		0145	8	.03	.01	.02	5.	*	2		1515	158	.49	.00	.49	159.
1		0200	9	.03	.01	.02	5.	*	2		1530	159	.43	.00	.43	139.
1		0215	10	.03	.01	.02	5.	*	2		1545	160	.18	.00	.18	77.
1		0230	11	.03	.01	.02	6.	*	2		1600	161	.17	.00	.17	59.
1		0245	12	.03	.01	.02	6.	*	2		1615	162	.17	.00	.17	54.
1		0300	13	.03	.01	.02	6.	*	2		1630	163	.16	.00	.16	51.
1		0315	14	.03	.01	.02	6.	*	2		1645	164	.16	.00	.16	50.
1		0330	15	.03	.01	.02	6.	*	2		1700	165	.15	.00	.15	48.
1		0345	16	.03	.01	.02	6.	*	2		1715	166	.15	.00	.15	47.
1		0400	17	.03	.01	.02	6.	*	2		1730	167	.15	.00	.15	46.
1		0415	18	.03	.00	.02	6.	*	2		1745	168	.14	.00	.14	45.
1		0430	19	.03	.00	.02	6.	*	2		1800	169	.14	.00	.14	43.
1		0445	20	.03	.00	.02	6.	*	2		1815	170	.14	.00	.14	42.
1		0500	21	.02	.00	.02	6.	*	2		1830	171	.13	.00	.13	41.
1		0515	22	.02	.00	.02	6.	*	2		1845	172	.13	.00	.13	41.
1		0530	23	.02	.00	.02	7.	*	2		1900	173	.13	.00	.13	40.
1		0545	24	.02	.00	.02	7.	*	2		1915	174	.12	.00	.12	39.
1		0600	25	.02	.00	.02	7.	*	2		1930	175	.12	.00	.12	38.
1		0615	26	.03	.00	.03	8.	*	2		1945	176	.12	.00	.12	37.
1		0630	27	.03	.00	.03	8.	*	2		2000	177	.12	.00	.12	36.
1		0645	28	.03	.00	.03	8.	*	2		2015	178	.12	.00	.11	36.
1		0700	29	.03	.00	.03	8.	*	2		2030	179	.11	.00	.11	35.
1		0715	30	.03	.00	.03	9.	*	2		2045	180	.11	.00	.11	35.
1		0730	31	.03	.00	.03	9.	*	2		2100	181	.11	.00	.11	34.
1		0745	32	.03	.00	.03	9.	*	2		2115	182	.11	.00	.11	34.
1		0800	33	.03	.00	.03	9.	*	2		2130	183	.11	.00	.11	34.
1		0815	34	.03	.00	.03	9.	*	2		2145	184	.07	.00	.07	24.
1		0830	35	.03	.00	.03	9.	*	2		2200	185	.07	.00	.07	22.
1		0845	36	.03	.00	.03	9.	*	2		2215	186	.07	.00	.07	21.
1		0900	37	.03	.00	.03	9.	*	2		2230	187	.07	.00	.07	21.
1		0915	38	.03	.00	.03	9.	*	2		2245	188	.07	.00	.07	21.
1		0930	39	.03	.00	.03	9.	*	2		2300	189	.07	.00	.07	21.
1		0945	40	.04	.00	.04	11.	*	2		2315	190	.07	.00	.07	21.
1		1000	41	.04	.00	.04	11.	*	2		2330	191	.07	.00	.07	21.
1		1015	42	.04	.00	.04	11.	*	2		2345	192	.07	.00	.07	21.
1		1030	43	.04	.00	.04	11.	*	3		0000	193	.07	.00	.07	21.
1		1045	44	.04	.00	.04	11.	*	3		0015	194	.07	.00	.07	21.
1		1100	45	.04	.00	.04	11.	*	3		0030	195	.07	.00	.07	21.
1		1115	46	.04	.00	.04	11.	*	3		0045	196	.07	.00	.07	21.
1		1130	47	.04	.00	.04	11.	*	3		0100	197	.07	.00	.07	21.
1		1145	48	.04	.00	.04	11.	*	3		0115	198	.07	.00	.07	21.
1		1200	49	.04	.00	.04	11.	*	3		0130	199	.07	.00	.07	21.
1		1215	50	.04	.00	.04	12.	*	3		0145	200	.07	.00	.07	21.
1		1230	51	.04	.00	.04	12.	*	3		0200	201	.07	.00	.07	21.
1		1245	52	.04	.00	.04	12.	*	3		0215	202	.07	.00	.07	21.
1		1300	53	.04	.00	.04	12.	*	3		0230	203	.07	.00	.07	21.
1		1315	54	.04	.00	.04	12.	*	3		0245	204	.07	.00	.07	21.
1		1330	55	.04	.00	.04	12.	*	3		0300	205	.07	.00	.07	21.
1		1345	56	.04	.00	.04	12.	*	3		0315	206	.07	.00	.07	21.

1	1400	57	.04	.00	.04	12.	*	3	0330	207	.07	.00	.07	21.
1	1415	58	.04	.00	.04	12.	*	3	0345	208	.05	.00	.05	16.
1	1430	59	.04	.00	.04	12.	*	3	0400	209	.05	.00	.05	15.
1	1445	60	.04	.00	.04	12.	*	3	0415	210	.05	.00	.05	14.
1	1500	61	.04	.00	.04	12.	*	3	0430	211	.05	.00	.05	14.
1	1515	62	.04	.00	.04	12.	*	3	0445	212	.05	.00	.05	14.
1	1530	63	.04	.00	.04	12.	*	3	0500	213	.05	.00	.05	14.
1	1545	64	.06	.00	.05	15.	*	3	0515	214	.05	.00	.05	14.
1	1600	65	.06	.00	.05	16.	*	3	0530	215	.05	.00	.05	14.
1	1615	66	.06	.00	.05	17.	*	3	0545	216	.05	.00	.05	14.
1	1630	67	.06	.00	.05	17.	*	3	0600	217	.05	.00	.05	14.
1	1645	68	.06	.00	.05	17.	*	3	0615	218	.05	.00	.05	14.
1	1700	69	.06	.00	.05	17.	*	3	0630	219	.05	.00	.05	14.
1	1715	70	.06	.00	.05	17.	*	3	0645	220	.05	.00	.05	14.
1	1730	71	.06	.00	.05	17.	*	3	0700	221	.05	.00	.05	14.
1	1745	72	.06	.00	.05	17.	*	3	0715	222	.05	.00	.05	14.
1	1800	73	.06	.00	.05	17.	*	3	0730	223	.05	.00	.05	14.
1	1815	74	.06	.00	.05	17.	*	3	0745	224	.05	.00	.05	14.
1	1830	75	.06	.00	.05	17.	*	3	0800	225	.05	.00	.05	14.
1	1845	76	.06	.00	.05	17.	*	3	0815	226	.05	.00	.05	14.
1	1900	77	.06	.00	.05	17.	*	3	0830	227	.05	.00	.05	14.
1	1915	78	.06	.00	.05	17.	*	3	0845	228	.05	.00	.05	14.
1	1930	79	.06	.00	.05	17.	*	3	0900	229	.05	.00	.05	14.
1	1945	80	.06	.00	.05	17.	*	3	0915	230	.05	.00	.05	14.
1	2000	81	.06	.00	.05	17.	*	3	0930	231	.05	.00	.05	14.
1	2015	82	.06	.00	.05	17.	*	3	0945	232	.03	.00	.03	11.
1	2030	83	.06	.00	.05	17.	*	3	1000	233	.03	.00	.03	11.
1	2045	84	.06	.00	.05	17.	*	3	1015	234	.03	.00	.03	11.
1	2100	85	.06	.00	.05	17.	*	3	1030	235	.03	.00	.03	11.
1	2115	86	.06	.00	.05	17.	*	3	1045	236	.03	.00	.03	11.
1	2130	87	.06	.00	.05	17.	*	3	1100	237	.03	.00	.03	11.
1	2145	88	.08	.00	.08	22.	*	3	1115	238	.03	.00	.03	11.
1	2200	89	.08	.00	.08	24.	*	3	1130	239	.03	.00	.03	11.
1	2215	90	.08	.00	.08	24.	*	3	1145	240	.03	.00	.03	11.
1	2230	91	.08	.00	.08	25.	*	3	1200	241	.03	.00	.03	11.
1	2245	92	.08	.00	.08	25.	*	3	1215	242	.03	.00	.03	11.
1	2300	93	.08	.00	.08	25.	*	3	1230	243	.03	.00	.03	11.
1	2315	94	.08	.00	.08	25.	*	3	1245	244	.03	.00	.03	11.
1	2330	95	.08	.00	.08	26.	*	3	1300	245	.03	.00	.03	11.
1	2345	96	.08	.00	.08	26.	*	3	1315	246	.03	.00	.03	11.
2	0000	97	.09	.00	.09	26.	*	3	1330	247	.03	.00	.03	11.
2	0015	98	.09	.00	.09	27.	*	3	1345	248	.03	.00	.03	11.
2	0030	99	.09	.00	.09	27.	*	3	1400	249	.03	.00	.03	11.
2	0045	100	.09	.00	.09	28.	*	3	1415	250	.03	.00	.03	11.
2	0100	101	.09	.00	.09	28.	*	3	1430	251	.03	.00	.03	11.
2	0115	102	.09	.00	.09	28.	*	3	1445	252	.03	.00	.03	11.
2	0130	103	.09	.00	.09	29.	*	3	1500	253	.03	.00	.03	11.
2	0145	104	.10	.00	.10	29.	*	3	1515	254	.03	.00	.03	11.
2	0200	105	.10	.00	.10	30.	*	3	1530	255	.03	.00	.03	11.
2	0215	106	.10	.00	.10	30.	*	3	1545	256	.03	.00	.03	9.
2	0230	107	.10	.00	.10	31.	*	3	1600	257	.03	.00	.03	9.
2	0245	108	.10	.00	.10	31.	*	3	1615	258	.03	.00	.03	9.
2	0300	109	.10	.00	.10	32.	*	3	1630	259	.03	.00	.03	9.
2	0315	110	.11	.00	.11	32.	*	3	1645	260	.03	.00	.03	9.
2	0330	111	.11	.00	.11	33.	*	3	1700	261	.03	.00	.03	9.
2	0345	112	.19	.00	.19	51.	*	3	1715	262	.03	.00	.03	9.
2	0400	113	.20	.00	.19	58.	*	3	1730	263	.03	.00	.03	9.
2	0415	114	.20	.00	.20	62.	*	3	1745	264	.03	.00	.03	9.
2	0430	115	.21	.00	.21	64.	*	3	1800	265	.03	.00	.03	9.
2	0445	116	.22	.00	.22	67.	*	3	1815	266	.03	.00	.03	9.
2	0500	117	.23	.00	.23	69.	*	3	1830	267	.03	.00	.03	9.
2	0515	118	.24	.00	.23	72.	*	3	1845	268	.03	.00	.03	9.
2	0530	119	.24	.00	.24	74.	*	3	1900	269	.03	.00	.03	9.
2	0545	120	.25	.00	.25	77.	*	3	1915	270	.03	.00	.03	9.
2	0600	121	.26	.00	.26	79.	*	3	1930	271	.03	.00	.03	9.
2	0615	122	.27	.00	.27	82.	*	3	1945	272	.03	.00	.03	9.
2	0630	123	.27	.00	.27	84.	*	3	2000	273	.03	.00	.03	9.
2	0645	124	.28	.00	.28	87.	*	3	2015	274	.03	.00	.03	9.
2	0700	125	.29	.00	.29	89.	*	3	2030	275	.03	.00	.03	9.
2	0715	126	.30	.00	.30	91.	*	3	2045	276	.03	.00	.03	9.
2	0730	127	.31	.00	.31	94.	*	3	2100	277	.03	.00	.03	9.
2	0745	128	.31	.00	.31	96.	*	3	2115	278	.03	.00	.03	9.
2	0800	129	.32	.00	.32	98.	*	3	2130	279	.03	.00	.03	9.
2	0815	130	.33	.00	.33	101.	*	3	2145	280	.00	.00	.00	2.
2	0830	131	.34	.00	.34	103.	*	3	2200	281	.00	.00	.00	0.
2	0845	132	.34	.00	.34	106.	*	3	2215	282	.00	.00	.00	0.
2	0900	133	.35	.00	.35	108.	*	3	2230	283	.00	.00	.00	0.
2	0915	134	.36	.00	.36	110.	*	3	2245	284	.00	.00	.00	0.
2	0930	135	.37	.00	.37	112.	*	3	2300	285	.00	.00	.00	0.
2	0945	136	.39	.00	.39	118.	*	3	2315	286	.00	.00	.00	0.
2	1000	137	.46	.00	.46	137.	*	3	2330	287	.00	.00	.00	0.
2	1015	138	.53	.00	.53	157.	*	3	2345	288	.00	.00	.00	0.
2	1030	139	.58	.00	.58	174.	*	4	0000	289	.00	.00	.00	0.
2	1045	140	.62	.00	.62	188.	*	4	0015	290	.00	.00	.00	0.
2	1100	141	.66	.00	.66	200.	*	4	0030	291	.00	.00	.00	0.
2	1115	142	.74	.00	.74	222.	*	4	0045	292	.00	.00	.00	0.
2	1130	143	.92	.00	.92	270.	*	4	0100	293	.00	.00	.00	0.
2	1145	144	.93	.00	.93	285.	*	4	0115	294	.00	.00	.00	0.
2	1200	145	1.11	.00	1.11	329.	*	4	0130	295	.00	.00	.00	0.
2	1215	146	2.53	.00	2.53	668.	*	4	0145	296	.00	.00	.00	0.
2	1230	147	4.90	.00	4.89	1306.	*	4	0200	297	.00	.00	.00	0.

2	1245	148	5.28	.00	5.28	1566.	*	4	0215	298	.00	.00	.00	0.
2	1300	149	3.61	.00	3.61	1239.	*	4	0230	299	.00	.00	.00	0.
2	1315	150	1.42	.00	1.42	658.	*	4	0245	300	.00	.00	.00	0.

****

TOTAL RAINFALL = 50.44, TOTAL LOSS = .31, TOTAL EXCESS = 50.13

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	74.75-HR
+		(CFS)				
+ 1566.	36.75		397.	138.	54.	52.
		(INCHES)	30.745	42.869	50.131	50.131
		(AC-FT)	197.	274.	321.	321.

CUMULATIVE AREA = .12 SQ MI

****

HYDROGRAPH AT STATION 8BASIN
PLAN 1, RATIO = 1.00

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		1845	76	17.	2		1330	151	368.	3		0815	226	14.
1		0015	2	4.	1		1900	77	17.	2		1345	152	310.	3		0830	227	14.
1		0030	3	5.	1		1915	78	17.	2		1400	153	273.	3		0845	228	14.
1		0045	4	5.	1		1930	79	17.	2		1415	154	223.	3		0900	229	14.
1		0100	5	5.	1		1945	80	17.	2		1430	155	204.	3		0915	230	14.
1		0115	6	5.	1		2000	81	17.	2		1445	156	190.	3		0930	231	14.
1		0130	7	5.	1		2015	82	17.	2		1500	157	176.	3		0945	232	11.
1		0145	8	5.	1		2030	83	17.	2		1515	158	159.	3		1000	233	11.
1		0200	9	5.	1		2045	84	17.	2		1530	159	139.	3		1015	234	11.
1		0215	10	5.	1		2100	85	17.	2		1545	160	77.	3		1030	235	11.
1		0230	11	6.	1		2115	86	17.	2		1600	161	59.	3		1045	236	11.
1		0245	12	6.	1		2130	87	17.	2		1615	162	54.	3		1100	237	11.
1		0300	13	6.	1		2145	88	22.	2		1630	163	51.	3		1115	238	11.
1		0315	14	6.	1		2200	89	24.	2		1645	164	50.	3		1130	239	11.
1		0330	15	6.	1		2215	90	24.	2		1700	165	48.	3		1145	240	11.
1		0345	16	6.	1		2230	91	25.	2		1715	166	47.	3		1200	241	11.
1		0400	17	6.	1		2245	92	25.	2		1730	167	46.	3		1215	242	11.
1		0415	18	6.	1		2300	93	25.	2		1745	168	45.	3		1230	243	11.
1		0430	19	6.	1		2315	94	25.	2		1800	169	43.	3		1245	244	11.
1		0445	20	6.	1		2330	95	26.	2		1815	170	42.	3		1300	245	11.
1		0500	21	6.	1		2345	96	26.	2		1830	171	41.	3		1315	246	11.
1		0515	22	6.	2		0000	97	26.	2		1845	172	41.	3		1330	247	11.
1		0530	23	7.	2		0015	98	27.	2		1900	173	40.	3		1345	248	11.
1		0545	24	7.	2		0030	99	27.	2		1915	174	39.	3		1400	249	11.
1		0600	25	7.	2		0045	100	28.	2		1930	175	38.	3		1415	250	11.
1		0615	26	8.	2		0100	101	28.	2		1945	176	37.	3		1430	251	11.
1		0630	27	8.	2		0115	102	28.	2		2000	177	36.	3		1445	252	11.
1		0645	28	8.	2		0130	103	29.	2		2015	178	36.	3		1500	253	11.
1		0700	29	8.	2		0145	104	29.	2		2030	179	35.	3		1515	254	11.
1		0715	30	9.	2		0200	105	30.	2		2045	180	35.	3		1530	255	11.
1		0730	31	9.	2		0215	106	30.	2		2100	181	34.	3		1545	256	9.
1		0745	32	9.	2		0230	107	31.	2		2115	182	34.	3		1600	257	9.
1		0800	33	9.	2		0245	108	31.	2		2130	183	34.	3		1615	258	9.
1		0815	34	9.	2		0300	109	32.	2		2145	184	24.	3		1630	259	9.
1		0830	35	9.	2		0315	110	32.	2		2200	185	22.	3		1645	260	9.
1		0845	36	9.	2		0330	111	33.	2		2215	186	21.	3		1700	261	9.
1		0900	37	9.	2		0345	112	51.	2		2230	187	21.	3		1715	262	9.
1		0915	38	9.	2		0400	113	58.	2		2245	188	21.	3		1730	263	9.
1		0930	39	9.	2		0415	114	62.	2		2300	189	21.	3		1745	264	9.
1		0945	40	11.	2		0430	115	64.	2		2315	190	21.	3		1800	265	9.
1		1000	41	11.	2		0445	116	67.	2		2330	191	21.	3		1815	266	9.
1		1015	42	11.	2		0500	117	69.	2		2345	192	21.	3		1830	267	9.
1		1030	43	11.	2		0515	118	72.	3		0000	193	21.	3		1845	268	9.
1		1045	44	11.	2		0530	119	74.	3		0015	194	21.	3		1900	269	9.
1		1100	45	11.	2		0545	120	77.	3		0030	195	21.	3		1915	270	9.
1		1115	46	11.	2		0600	121	79.	3		0045	196	21.	3		1930	271	9.
1		1130	47	11.	2		0615	122	82.	3		0100	197	21.	3		1945	272	9.
1		1145	48	11.	2		0630	123	84.	3		0115	198	21.	3		2000	273	9.
1		1200	49	11.	2		0645	124	87.	3		0130	199	21.	3		2015	274	9.
1		1215	50	12.	2		0700	125	89.	3		0145	200	21.	3		2030	275	9.
1		1230	51	12.	2		0715	126	91.	3		0200	201	21.	3		2045	276	9.
1		1245	52	12.	2		0730	127	94.	3		0215	202	21.	3		2100	277	9.
1		1300	53	12.	2		0745	128	96.	3		0230	203	21.	3		2115	278	9.
1		1315	54	12.	2		0800	129	98.	3		0245	204	21.	3		2130	279	9.
1		1330	55	12.	2		0815	130	101.	3		0300	205	21.	3		2145	280	2.
1		1345	56	12.	2		0830	131	103.	3		0315	206	21.	3		2200	281	0.
1		1400	57	12.	2		0845	132	106.	3		0330	207	21.	3		2215	282	0.
1		1415	58	12.	2		0900	133	108.	3		0345	208	16.	3		2230	283	0.
1		1430	59	12.	2		0915	134	110.	3		0400	209	15.	3		2245	284	0.
1		1445	60	12.	2		0930	135	112.	3		0415	210	14.	3		2300	285	0.
1		1500	61	12.	2		0945	136	118.	3		0430	211	14.	3		2315	286	0.
1		1515	62	12.	2		1000	137	137.	3		0445	212	14.	3		2330	287	0.
1		1530	63	12.	2		1015	138	157.	3		0500	213	14.	3		2345	288	0.

1	1545	64	15.	*	2	1030	139	174.	*	3	0515	214	14.	*	4	0000	289	0.
1	1600	65	16.	*	2	1045	140	138.	*	3	0530	215	14.	*	4	0015	290	0.
1	1615	66	17.	*	2	1100	141	200.	*	3	0545	216	14.	*	4	0030	291	0.
1	1630	67	17.	*	2	1115	142	222.	*	3	0600	217	14.	*	4	0045	292	0.
1	1645	68	17.	*	2	1130	143	270.	*	3	0615	218	14.	*	4	0100	293	0.
1	1700	69	17.	*	2	1145	144	285.	*	3	0630	219	14.	*	4	0115	294	0.
1	1715	70	17.	*	2	1200	145	329.	*	3	0645	220	14.	*	4	0130	295	0.
1	1730	71	17.	*	2	1215	146	668.	*	3	0700	221	14.	*	4	0145	296	0.
1	1745	72	17.	*	2	1230	147	1306.	*	3	0715	222	14.	*	4	0200	297	0.
1	1800	73	17.	*	2	1245	148	1566.	*	3	0730	223	14.	*	4	0215	298	0.
1	1815	74	17.	*	2	1300	149	1239.	*	3	0745	224	14.	*	4	0230	299	0.
1	1830	75	17.	*	2	1315	150	638.	*	3	0800	225	14.	*	4	0245	300	0.
				*					*					*				

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW (CFS)	6-HR	24-HR	72-HR	74.75-HR
+ 1566.	36.75		397.	138.	54.	52.
		(INCHES)	30.745	42.869	50.131	50.131
		(AC-FT)	197.	274.	321.	321.

CUMULATIVE AREA = .12 SQ MI

*** ***

```
              **************
              *            *
 44 KK        *   OAK GR   *     OVE RESOURCES SLURRY IMPOUNDMENT NO. 6
              *            *
              **************
                          ROUTE COMPUTED HYDROGRAPH THROUGH THE IMPOUNDMENT

                HYDROGRAPH ROUTING DATA

 46 RS            STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC     554.00  INITIAL CONDITION
                         X        .00  WORKING R AND D COEFFICIENT

 47 SA                AREA       55.9      57.2      58.6      60.0      61.4      62.8

 48 SE           ELEVATION     554.00    555.00    556.00    557.00    558.00    559.00

 49 SQ           DISCHARGE         0.       48.      167.      345.      577.      865.
                                                              ***

                                          COMPUTED STORAGE-ELEVATION DATA

            STORAGE        .00     56.55    114.45    173.75    234.44    296.54
          ELEVATION     554.00    555.00    556.00    557.00    558.00    559.00
```

****

HYDROGRAPH AT STATION OAK GR
PLAN 1, RATIO = 1.00

****

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	554.0	*	2		0100	101	13.	15.4	554.3	*	3		0200	201	64.	64.3	555.1
1		0015	2	0.	.0	554.0	*	2		0115	102	13.	15.7	554.3	*	3		0215	202	62.	63.4	555.1
1		0030	3	0.	.1	554.0	*	2		0130	103	14.	16.0	554.3	*	3		0230	203	61.	62.5	555.1
1		0045	4	0.	.2	554.0	*	2		0145	104	14.	16.3	554.3	*	3		0245	204	59.	61.7	555.1
1		0100	5	0.	.3	554.0	*	2		0200	105	14.	16.6	554.3	*	3		0300	205	57.	61.0	555.1
1		0115	6	0.	.4	554.0	*	2		0215	106	15.	17.0	554.3	*	3		0315	206	56.	60.2	555.1
1		0130	7	0.	.5	554.0	*	2		0230	107	15.	17.3	554.3	*	3		0330	207	55.	59.5	555.1
1		0145	8	1.	.6	554.0	*	2		0245	108	15.	17.6	554.3	*	3		0345	208	53.	58.8	555.0
1		0200	9	1.	.7	554.0	*	2		0300	109	15.	18.0	554.3	*	3		0400	209	51.	58.0	555.0
1		0215	10	1.	.8	554.0	*	2		0315	110	16.	18.3	554.3	*	3		0415	210	50.	57.3	555.0
1		0230	11	1.	.9	554.0	*	2		0330	111	16.	18.7	554.3	*	3		0430	211	48.	56.6	555.0
1		0245	12	1.	1.0	554.0	*	2		0345	112	16.	19.2	554.3	*	3		0445	212	48.	55.9	555.0
1		0300	13	1.	1.1	554.0	*	2		0400	113	17.	20.0	554.4	*	3		0500	213	47.	55.2	555.0
1		0315	14	1.	1.2	554.0	*	2		0415	114	18.	20.9	554.4	*	3		0515	214	47.	54.5	555.0
1		0330	15	1.	1.3	554.0	*	2		0430	115	19.	21.8	554.4	*	3		0530	215	46.	53.8	555.0
1		0345	16	1.	1.4	554.0	*	2		0445	116	19.	22.7	554.4	*	3		0545	216	46.	53.2	554.9
1		0400	17	1.	1.5	554.0	*	2		0500	117	20.	23.7	554.4	*	3		0600	217	45.	52.5	554.9
1		0415	18	1.	1.6	554.0	*	2		0515	118	21.	24.8	554.4	*	3		0615	218	44.	51.9	554.9
1		0430	19	1.	1.7	554.0	*	2		0530	119	22.	25.8	554.5	*	3		0630	219	44.	51.3	554.9
1		0445	20	2.	1.8	554.0	*	2		0545	120	23.	26.9	554.5	*	3		0645	220	43.	50.7	554.9
1		0500	21	2.	1.9	554.0	*	2		0600	121	24.	28.0	554.5	*	3		0700	221	43.	50.1	554.9
1		0515	22	2.	2.0	554.0	*	2		0615	122	25.	29.2	554.5	*	3		0715	222	42.	49.5	554.9
1		0530	23	2.	2.1	554.0	*	2		0630	123	26.	30.4	554.5	*	3		0730	223	42.	48.9	554.9

1	0545	24	2.	2.2	554.0 *	2	0645	124	27.	31.6	554.6 *	3	0745	224	41.	48.4	554.9
1	0600	25	2.	2.3	554.0 *	2	0700	125	28.	32.8	554.6 *	3	0800	225	41.	47.8	554.8
1	0615	26	2.	2.4	554.0 *	2	0715	126	29.	34.1	554.6 *	3	0815	226	40.	47.3	554.8
1	0630	27	2.	2.5	554.0 *	2	0730	127	30.	35.4	554.6 *	3	0830	227	40.	46.7	554.8
1	0645	28	2.	2.6	554.0 *	2	0745	128	31.	36.7	554.6 *	3	0845	228	40.	46.2	554.8
1	0700	29	2.	2.8	554.0 *	2	0800	129	33.	38.1	554.7 *	3	0900	229	39.	45.7	554.8
1	0715	30	2.	2.9	554.1 *	2	0815	130	34.	39.5	554.7 *	3	0915	230	39.	45.2	554.8
1	0730	31	3.	3.0	554.1 *	2	0830	131	35.	40.9	554.7 *	3	0930	231	38.	44.7	554.8
1	0745	32	3.	3.1	554.1 *	2	0845	132	36.	42.3	554.7 *	3	0945	232	38.	44.2	554.8
1	0800	33	3.	3.3	554.1 *	2	0900	133	37.	43.7	554.8 *	3	1000	233	37.	43.6	554.8
1	0815	34	3.	3.4	554.1 *	2	0915	134	39.	45.2	554.8 *	3	1015	234	37.	43.1	554.8
1	0830	35	3.	3.5	554.1 *	2	0930	135	40.	46.7	554.8 *	3	1030	235	36.	42.5	554.8
1	0845	36	3.	3.6	554.1 *	2	0945	136	41.	48.2	554.9 *	3	1045	236	36.	42.0	554.7
1	0900	37	3.	3.7	554.1 *	2	1000	137	43.	50.0	554.9 *	3	1100	237	35.	41.5	554.7
1	0915	38	3.	3.9	554.1 *	2	1015	138	45.	52.1	554.9 *	3	1115	238	35.	41.0	554.7
1	0930	39	3.	4.0	554.1 *	2	1030	139	47.	54.6	555.0 *	3	1130	239	35.	40.5	554.7
1	0945	40	4.	4.1	554.1 *	2	1045	140	50.	57.3	555.0 *	3	1145	240	34.	40.0	554.7
1	1000	41	4.	4.3	554.1 *	2	1100	141	56.	60.2	555.1 *	3	1200	241	34.	39.5	554.7
1	1015	42	4.	4.4	554.1 *	2	1115	142	62.	63.4	555.1 *	3	1215	242	33.	39.0	554.7
1	1030	43	4.	4.6	554.1 *	2	1130	143	70.	67.1	555.2 *	3	1230	243	33.	38.5	554.7
1	1045	44	4.	4.7	554.1 *	2	1145	144	79.	71.3	555.3 *	3	1245	244	33.	38.1	554.7
1	1100	45	4.	4.9	554.1 *	2	1200	145	88.	75.9	555.3 *	3	1300	245	32.	37.6	554.7
1	1115	46	4.	5.0	554.1 *	2	1215	146	105.	84.2	555.5 *	3	1315	246	32.	37.2	554.7
1	1130	47	4.	5.2	554.1 *	2	1230	147	142.	102.0	555.8 *	3	1330	247	31.	36.7	554.6
1	1145	48	5.	5.3	554.1 *	2	1245	148	208.	128.1	556.2 *	3	1345	248	31.	36.3	554.6
1	1200	49	5.	5.4	554.1 *	2	1300	149	280.	152.0	556.6 *	3	1400	249	31.	35.9	554.6
1	1215	50	5.	5.6	554.1 *	2	1315	150	319.	165.2	556.9 *	3	1415	250	30.	35.5	554.6
1	1230	51	5.	5.7	554.1 *	2	1330	151	330.	168.9	556.9 *	3	1430	251	30.	35.1	554.6
1	1245	52	5.	5.9	554.1 *	2	1345	152	331.	169.1	556.9 *	3	1445	252	30.	34.7	554.6
1	1300	53	5.	6.0	554.1 *	2	1400	153	328.	168.3	556.9 *	3	1500	253	29.	34.3	554.6
1	1315	54	5.	6.1	554.1 *	2	1415	154	324.	166.7	556.9 *	3	1515	254	29.	33.9	554.6
1	1330	55	5.	6.3	554.1 *	2	1430	155	317.	164.5	556.8 *	3	1530	255	29.	33.5	554.6
1	1345	56	5.	6.4	554.1 *	2	1445	156	310.	162.1	556.8 *	3	1545	256	28.	33.1	554.6
1	1400	57	6.	6.5	554.1 *	2	1500	157	302.	159.5	556.8 *	3	1600	257	28.	32.7	554.6
1	1415	58	6.	6.6	554.1 *	2	1515	158	294.	156.8	556.7 *	3	1615	258	28.	32.3	554.6
1	1430	59	6.	6.8	554.1 *	2	1530	159	285.	153.9	556.7 *	3	1630	259	27.	32.0	554.6
1	1445	60	6.	6.9	554.1 *	2	1545	160	275.	150.3	556.6 *	3	1645	260	27.	31.6	554.6
1	1500	61	6.	7.0	554.1 *	2	1600	161	262.	146.2	556.5 *	3	1700	261	27.	31.2	554.6
1	1515	62	6.	7.1	554.1 *	2	1615	162	250.	142.1	556.5 *	3	1715	262	26.	30.8	554.5
1	1530	63	6.	7.2	554.1 *	2	1630	163	238.	138.1	556.4 *	3	1730	263	26.	30.5	554.5
1	1545	64	6.	7.4	554.1 *	2	1645	164	227.	134.3	556.3 *	3	1745	264	26.	30.1	554.5
1	1600	65	6.	7.6	554.1 *	2	1700	165	216.	130.8	556.3 *	3	1800	265	25.	29.8	554.5
1	1615	66	7.	7.8	554.1 *	2	1715	166	206.	127.4	556.2 *	3	1815	266	25.	29.4	554.5
1	1630	67	7.	8.0	554.1 *	2	1730	167	197.	124.2	556.2 *	3	1830	267	25.	29.1	554.5
1	1645	68	7.	8.2	554.1 *	2	1745	168	188.	121.2	556.1 *	3	1845	268	25.	28.7	554.5
1	1700	69	7.	8.4	554.1 *	2	1800	169	179.	118.3	556.1 *	3	1900	269	24.	28.4	554.5
1	1715	70	7.	8.6	554.2 *	2	1815	170	171.	115.6	556.0 *	3	1915	270	24.	28.1	554.5
1	1730	71	7.	8.8	554.2 *	2	1830	171	164.	113.0	556.0 *	3	1930	271	24.	27.8	554.5
1	1745	72	8.	8.9	554.2 *	2	1845	172	159.	110.5	555.9 *	3	1945	272	24.	27.5	554.5
1	1800	73	8.	9.1	554.2 *	2	1900	173	154.	108.1	555.9 *	3	2000	273	23.	27.2	554.5
1	1815	74	8.	9.3	554.2 *	2	1915	174	150.	105.7	555.8 *	3	2015	274	23.	26.9	554.5
1	1830	75	8.	9.5	554.2 *	2	1930	175	145.	103.5	555.8 *	3	2030	275	23.	26.6	554.5
1	1845	76	8.	9.7	554.2 *	2	1945	176	140.	101.3	555.8 *	3	2045	276	22.	26.3	554.5
1	1900	77	8.	9.8	554.2 *	2	2000	177	136.	99.2	555.7 *	3	2100	277	22.	26.0	554.5
1	1915	78	9.	10.0	554.2 *	2	2015	178	132.	97.2	555.7 *	3	2115	278	22.	25.7	554.5
1	1930	79	9.	10.2	554.2 *	2	2030	179	128.	95.3	555.7 *	3	2130	279	22.	25.5	554.5
1	1945	80	9.	10.3	554.2 *	2	2045	180	124.	93.4	555.6 *	3	2145	280	21.	25.1	554.4
1	2000	81	9.	10.5	554.2 *	2	2100	181	120.	91.6	555.6 *	3	2200	281	21.	24.7	554.4
1	2015	82	9.	10.7	554.2 *	2	2115	182	117.	89.8	555.6 *	3	2215	282	21.	24.3	554.4
1	2030	83	9.	10.8	554.2 *	2	2130	183	113.	88.1	555.5 *	3	2230	283	20.	23.9	554.4
1	2045	84	9.	11.0	554.2 *	2	2145	184	110.	86.4	555.5 *	3	2245	284	20.	23.4	554.4
1	2100	85	10.	11.1	554.2 *	2	2200	185	106.	84.7	555.5 *	3	2300	285	20.	23.0	554.4
1	2115	86	10.	11.3	554.2 *	2	2215	186	103.	83.0	555.5 *	3	2315	286	19.	22.6	554.4
1	2130	87	10.	11.4	554.2 *	2	2230	187	99.	81.3	555.4 *	3	2330	287	19.	22.2	554.4
1	2145	88	10.	11.6	554.2 *	2	2245	188	96.	79.7	555.4 *	3	2345	288	19.	21.8	554.4
1	2200	89	10.	11.9	554.2 *	2	2300	189	93.	78.2	555.4 *	4	0000	289	18.	21.5	554.4
1	2215	90	10.	12.2	554.2 *	2	2315	190	90.	76.8	555.3 *	4	0015	290	18.	21.1	554.4
1	2230	91	11.	12.5	554.2 *	2	2330	191	87.	75.4	555.3 *	4	0030	291	18.	20.7	554.4
1	2245	92	11.	12.7	554.2 *	2	2345	192	84.	74.0	555.3 *	4	0045	292	17.	20.3	554.4
1	2300	93	11.	13.0	554.2 *	3	0000	193	82.	72.8	555.3 *	4	0100	293	17.	20.0	554.4
1	2315	94	11.	13.3	554.2 *	3	0015	194	79.	71.5	555.3 *	4	0115	294	17.	19.6	554.3
1	2330	95	12.	13.6	554.2 *	3	0030	195	77.	70.4	555.2 *	4	0130	295	17.	19.3	554.3
1	2345	96	12.	13.9	554.2 *	3	0045	196	74.	69.2	555.2 *	4	0145	296	16.	19.0	554.3
2	0000	97	12.	14.2	554.3 *	3	0100	197	72.	68.1	555.2 *	4	0200	297	16.	18.6	554.3
2	0015	98	12.	14.5	554.3 *	3	0115	198	70.	67.1	555.2 *	4	0215	298	16.	18.3	554.3
2	0030	99	13.	14.8	554.3 *	3	0130	199	68.	66.1	555.2 *	4	0230	299	15.	18.0	554.3
2	0045	100	13.	15.1	554.3 *	3	0145	200	66.	65.2	555.1 *	4	0245	300	15.	17.7	554.3
					*						*						

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	74.75-HR
+ (CFS)	(HR)	(CFS)				
+ 331.	37.75		258.	121.	51.	49.
		(INCHES)	19.985	37.384	47.357	47.372
		(AC-FT)	128.	239.	303.	303.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	74.75-HR
+ (AC-FT)	(HR)				

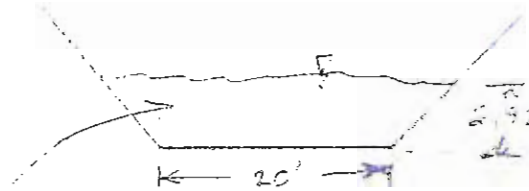
```
      169.      37.75                    145.          87.          42.          40.

  PEAK STAGE     TIME                                MAXIMUM AVERAGE STAGE
                                            6-HR        24-HR        72-HR     74.75-HR
+   (FEET)       (HR)
    556.92      37.75                    556.51       555.53       554.73       554.70

                              CUMULATIVE AREA =      .12 SQ MI

1

                PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                                FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                          TIME TO PEAK IN HOURS

                                                                          RATIOS APPLIED TO FLOWS
 OPERATION        STATION      AREA     PLAN                 RATIO 1
                                                                 1.00

 HYDROGRAPH AT
+                  BASIN        .12      1    FLOW            1566.
                                               TIME           36.75

 ROUTED TO
+                  OAK GR       .12      1    FLOW             331.
                                               TIME           37.75

                                          ** PEAK STAGES IN FEET **
                                          1    STAGE         556.92
                                               TIME           37.75


*** NORMAL END OF HEC-1 ***
```

mcgehee engineering corp

PROJECT NAME: [illegible]

DESCRIPTION [illegible] Freeboard @ Entrance

BY: [illegible] DATE: [illegible] CHECKED BY _____ DATE: _____



2.92' @ peak stage

Area of flow @ peak stage = 75.45 ft²

$V = Q/A = \frac{33 \text{ ft}^3/\text{sec}}{75.45 \text{ ft}^2} = 4.37 \text{ ft/sec}$

Velocity = 4.37 ft/sec

Freeboard (F_B) = $C_f + 0.025(V)(D^{0.33})$

$C_f = 2$

$V = 4.37$ ft/sec

$D = 2.92'$

$F_B = 2 + 0.025(4.37)(2.92^{0.33})$

$F_B = 2.12'$

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

Concord Mine, Slurry Impoundment No. 6, Spillway Control Section Freeboard

Material: Concrete, Rubble

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
20.00	0.5:1	0.5:1	0.5	0.0220	2.23		

	w/o Freeboard	w/ Freeboard
Design Discharge:	331.00 cfs	
Depth:	2.18 ft	4.41 ft
Top Width:	22.18 ft	24.41 ft
Velocity:	7.21 fps	
X-Section Area:	45.92 sq ft	
Hydraulic Radius:	1.847 ft	
Froude Number:	0.88	

$$F_B = C_f + 0.025(V)(D^{0.33})$$

$$F_B = 2 + 0.025(7.21)(2.18^{0.33})$$

$$F_B = 2.23'$$

Concord Mine, Slurry Impoundment No. 6, Spillway Tail Ditch Section Freeboard

Material: Concrete, Rubble

Trapezoidal Channel

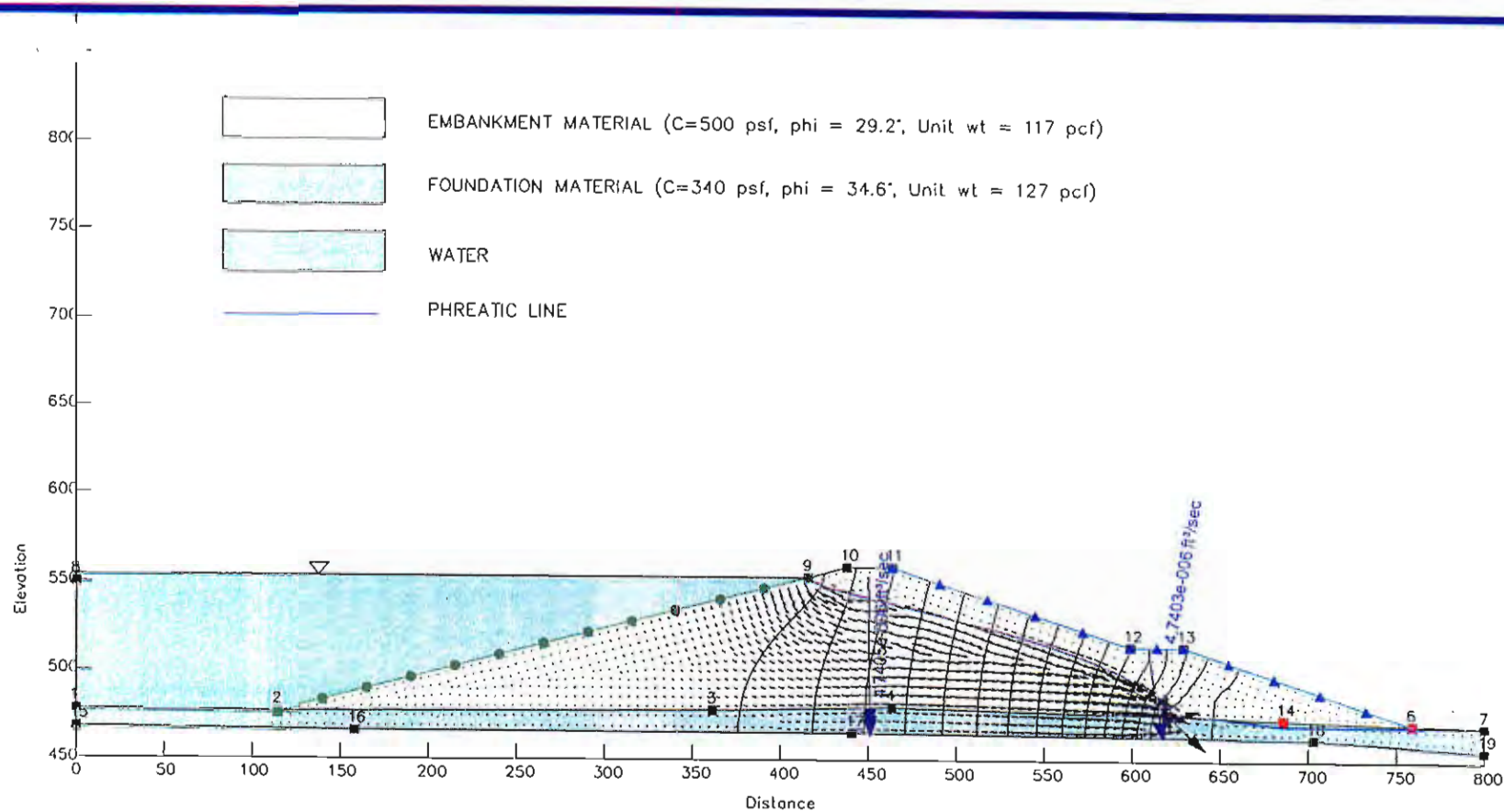
Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
20.00	2.0:1	2.0:1	2.0	0.0220	2.30		

	w/o Freeboard	w/ Freeboard
Design Discharge:	331.00 cfs	
Depth:	1.36 ft	3.66 ft
Top Width:	25.44 ft	34.64 ft
Velocity:	10.72 fps	
X-Section Area:	30.88 sq ft	
Hydraulic Radius:	1.184 ft	
Froude Number:	1.71	

$$F_B = C_f + 0.025 * (V)(D^{0.33})$$

$$F_B = 2 + 0.025 * (10.72)(1.36^{0.33})$$

$$F_B = 2.30'$$



EMBANKMENT MATERIAL SILT (ML)
PERM = 3.13E-007 FT/SEC
FOUNDATION MATERIAL ST-6 CL-ML PERM = 1.79E-007 FT/SEC

SEEPAGE FLOW = 4.74E-006 CF/SEC/FT CALCULATED BY Geostudio Seep/W

OAK GROVE RESOURCES, LLC
CONCORD PREPARATION PLANT
SLURRY IMPOUNDMENT NO. 6
SECTION B–B" OF EMBANKMENT NO. 1
SEEPAGE ANALYSIS

SCALE: 1"=100' H&V

mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

mcgehee engineering corp

PROJECT NAME: Concord Mine, Slurry Impoundment No. 6

DESCRIPTION Lateral Drain Capacity Worksheet

BY: JA DATE: 04-02-15 SHEET 1 OF 2

FLOW IN ROCKFILL

Reference: "Flow Through Rockfills", by Thomas Leps Embankment-Dam Engineering Casagrande Volume (1973).

Flow through rockfill (cfs):

$$Q = \left(Wm^{0.5}\right)\left(i^{0.54}\right)A\left(\frac{e}{1+e}\right)$$

where:

W =empirical constant for a given rockfill
m =mean hydraulic radius
i =hydraulic gradient, ft/ft
A =drain area, square feet
e =void ratio of rockfill

Suggested values of $Wm^{0.5}$ from Leps:

Rock D_{50}	$Wm^{0.5}$
3/4"	10 in/sec
2"	16 in/sec
8"	32 in/sec

PROJECT DATA:

Assumed D_{50} = 0.75 in
Selected $Wm^{0.5}$ = 10 in/sec
Hydraulic Gradient, i = 0.01 ft/ft
Drain Area = 9 ft^2
Assumed void ratio = 0.5

Calculated Flow: Q = 0.23 cfs = 101.2 gpm

Capacity: (Assume a factor of safety of 10) Q = 10.1 gpm

FLOW IN PIPE

Use Chezy-Manning Equation

$$Q = VA = \frac{1.49}{n}A\left(r_H\right)^{2/3}\sqrt{s}$$

where

n =Manning's roughness coefficient
A =inside area of pipe, square feet
r_H =hydraulic radius of pipe, feet
s =pipe slope, ft/ft

PROJECT DATA:

Manning's n = 0.01 (HDPE)
Inside diameter of pipe = 5.349 in (SDR-11, IPS)
Pipe slope = 0.01 ft/ft

CALCULATED VALUES:

A = 0.156 ft^2
r_H = 0.446 ft

CALCULATED FLOW: Q = 0.538 cfs = 242 gpm

TOTAL CAPACITY OF DRAIN:

Q_{tot} = 10.1 + 242 = 252.1 gpm

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • rcw@mcgehee.org

mcgehee engineering corp

PROJECT NAME: Concord Mine, Slurry Impoundment No. 6

DESCRIPTION Lateral Drain Capacity Worksheet

BY: JA DATE: 04-02-15 SHEET 2 OF 2

REQUIRED CAPACITY OF DRAIN:

Average flux value from seepage analysis = 4.7405E-6 cfs/ft
Length of drain subjected to seepage = 590 ft

Required Capacity of Drain = 1.26 gpm

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

mcgehee engineering corp

PROJECT NAME: Concord Mine, Slurry Impoundment No. 6

DESCRIPTION Underdrain Capacity Worksheet

BY: JA DATE: 04-02-15 SHEET 1 OF 2

FLOW IN ROCKFILL

Reference: "Flow Through Rockfills", by Thomas Leps Embankment-Dam Engineering Casagrande Volume (1973).

Flow through rockfill (cfs):

$$Q = \left(Wm^{0.5}\right)\left(i^{0.54}\right)A\left(\frac{e}{1+e}\right)$$

where:

W =empirical constant for a given rockfill
m =mean hydraulic radius
i =hydraulic gradient, ft/ft
A =drain area, square feet
e =void ratio of rockfill

Suggested values of $Wm^{0.5}$ from Leps:

Rock D_{50}	$Wm^{0.5}$
3/4"	10 in/sec
2"	16 in/sec
8"	32 in/sec

PROJECT DATA:

Assumed D_{50} = 0.75 in
Selected $Wm^{0.5}$ = 10 in/sec
Hydraulic Gradient, i = 0.01 ft/ft
Drain Area = 12 ft^2
Assumed void ratio = 0.5

Calculated Flow: Q = 0.30 cfs = 136 gpm

Capacity: (Assume a factor of safety of 10) Q = 13.6 gpm

FLOW IN PIPE

Use Chezy-Manning Equation

$$Q = VA = \frac{1.49}{n}A\left(r_H\right)^{2/3}\sqrt{s}$$

where

n =Manning's roughness coefficient
A =inside area of pipe, square feet
r_H =hydraulic radius of pipe, feet
s =pipe slope, ft/ft

PROJECT DATA:

Manning's n = 0.01 (HDPE)
Inside diameter of pipe = 5.349 in (SDR-11, IPS)
Pipe slope = 0.01 ft/ft

CALCULATED VALUES:

A = 0.156 ft^2
r_H = 0.114 ft

CALCULATED FLOW: Q = 0.538 cfs = 242 gpm

TOTAL CAPACITY OF DRAIN:

Q_{total} = 13.6 + 242 = 255 gpm

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

mcgehee engineering corp

PROJECT NAME: Concord Mine, Slurry Impoundment No. 6

DESCRIPTION Underdrain Capacity Worksheet

BY: JA DATE: 04-02-15 SHEET 2 OF 2

REQUIRED CAPACITY OF UNDERDRAIN:

Average flux value from seepage analysis = 4.7405E-6 cfs/ft
Length of drain subjected to seepage = 155 ft

Required Capacity of Drain = 0.33 gpm

Lateral drain seepage and Underdrain seepage = 1.26 gpm + 0.33 gpm = 1.59 gpm

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

mcgehee engineering corp

PROJECT NAME: Concord Mine. Slurry Impoundment No. 6

DESCRIPTION Subsidence Calculations

BY: JA DATE: 6-10-14 SHEET 1 OF 4

Subsidence Evaluation
Concord Prep Plant, Proposed Slurry Impoundment No. 6
Oak Grove Resources, LLC.
Hueytown, Alabama

OBJECTIVE: Evaluate Potential Subsidence Impacts on Proposed Slurry Impoundment No. 6.

Part 1 – Review Existing Conditions

Part 2 – Evaluate Sinkhole Subsidence

Part 3 – Evaluate Trough Subsidence

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

mcgehee engineering corp

PROJECT NAME: Concord Mine, Slurry Impoundment No. 6

DESCRIPTION Subsidence Calculations

BY: JA DATE: 6-10-14 SHEET 2 OF 4

PART 1 – Review of Existing Conditions

Coal Seam Thickness

Previous reports indicate the Pratt coal seam to have been the only seam mined below this site. Our review of the mine maps and historical drilling data indicates the American coal seam to have been the coal seam mined at the Concord Deep Mine. The Concord Mine ceased operations in 1983.

Average Seam Thickness (obtained from DDH-M151) = 7'
Seam Depth from Surface = 510' to 580'

Overburden Conditions

The depth from surface to coal seam/mine level was obtained by taking the difference from the coal seam elevation shown on the mine map and current surface topography obtained from Jefferson County.

Coal was mined from the Concord Mine by the room and pillar mining method and was extensively mined under the proposed impoundment based on review of the Concord Mine maps. Deep mining was conducted under 100% of the impoundment. The maps indicate secondary recovery of pillars (pulling pillars) was conducted under approximately 71% of the impoundment. Records indicate pulling of pillars occurred under approximately the southern three-fourths of proposed Slurry Impoundment No. 6 from 1952 to 1959 with pulling of pillars under the northern approximately one fourth of the impoundment in 1980.

PART 2 – Evaluate Sinkhole Subsidence

Sinkhole subsidence is commonly associated with gob formation from roof collapse or pillar failure in shallow underground mines. Based on knowledge of historical occurrences, seam and overburden conditions, the potential for sinkhole occurrence can be estimated.

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

mcgehee engineering corp

PROJECT NAME: Concord Mine, Slurry Impoundment No. 6

DESCRIPTION Subsidence Calculations

BY: JA DATE: 6-10-14 SHEET 3 OF 4

Estimation of Gob Zone

a) Empirical Factor - estimate of gob zone based on empirical or rule of thumb factors indicates gob zone formation to be at two to eight times the extracted coal seam thickness. Using eight times the seam height of 7',
Gob Zone = 8 x 7' = 56'

b) Gob Height Formula – estimating the gob zone using the gob height formula of Jones and Kohli, (1985) Subsidence Engineering, WVU Institute of Technology, Montgomery, West Virgina

$$\frac{100\ H}{4.7\ H + 19} \pm 2.2$$

Where H is in meters
America Coal Seam H = 7' = 2.13 meters

$$\text{Gob Height} = \frac{100\ (2.13)}{4.7\ (2.13) + 19} \pm 2.2 = 7.3 + 2.2\ \text{m}$$

Use 9.5 meters = 31.3 feet

Conclusion

Using the worst case condition of the empirical formula method (56') and a factor of safety of 2 yields a value of 112'. Based on exiting sinkhole theories it is highly unlikely that sinkholes can occur at this site due to the large overburden thicknesses.

Based upon the number of years since mining occurred, it can be concluded that future subsidence affects are unlikely since the majority of subsidence in this area has already occurred.

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

mcgehee engineering corp

PROJECT NAME: Concord Mine, Slurry Impoundment No. 6

DESCRIPTION Subsidence Calculations

BY: JA DATE: 6-10-14 SHEET 4 OF 4

PART 3 – Evaluation of Trough Subsidence

Determine the height of the potential fracture zone above the Concord Deep Mine.

a) Empirical Estimate – empirical estimates of fractured zones assume the fractured zone may extend 20 to 40 feet times the extracted coal height (7').

Fractured zone = 20 x 7 feet = 140'
Fractured zone = 40 x 7 feet = 280'

b) Fractured Zone Formula, Jones and Kohli, (1985)

$$\text{Fractured zone formula} = \frac{100\,H}{1.6H+3.6} \pm 5.6$$

Where H is in meters
America Coal Seam H = 7' = 2.13 meters

$$\text{Fractured zone} = \frac{100\,(2.13)}{1.6(2.13)+3.6} \pm 5.6 = 30.4\text{ m} \pm 5.6\text{ m} = 24.8 \text{ to } 36.0\text{ m}$$

= 81.3 feet to 118.1 feet

Conclusion: Subsidence will not cause the fracture zone to reach the surface in the area of proposed Slurry Impoundment No. 6.

Based upon the number of years since mining occurred, it can be concluded that future subsidence affects are unlikely since the majority of subsidence in this area has already occurred.

Post Office Box 3431 • 450 19th Street • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • cw@mcgehee.org

REPORT OF GRADIENT RATIO TESTING
ASTM D 5101

Project : Oak Grove Resources Concord Prep Plant

Project Number : 12-651 **Date :** 04/01/15

Sample Identification: TP15

Sample Description : Clay, silty, sandy, light orangish brown, light brown

Geotextile : Mirafi FW700

Physical Properties of Sample

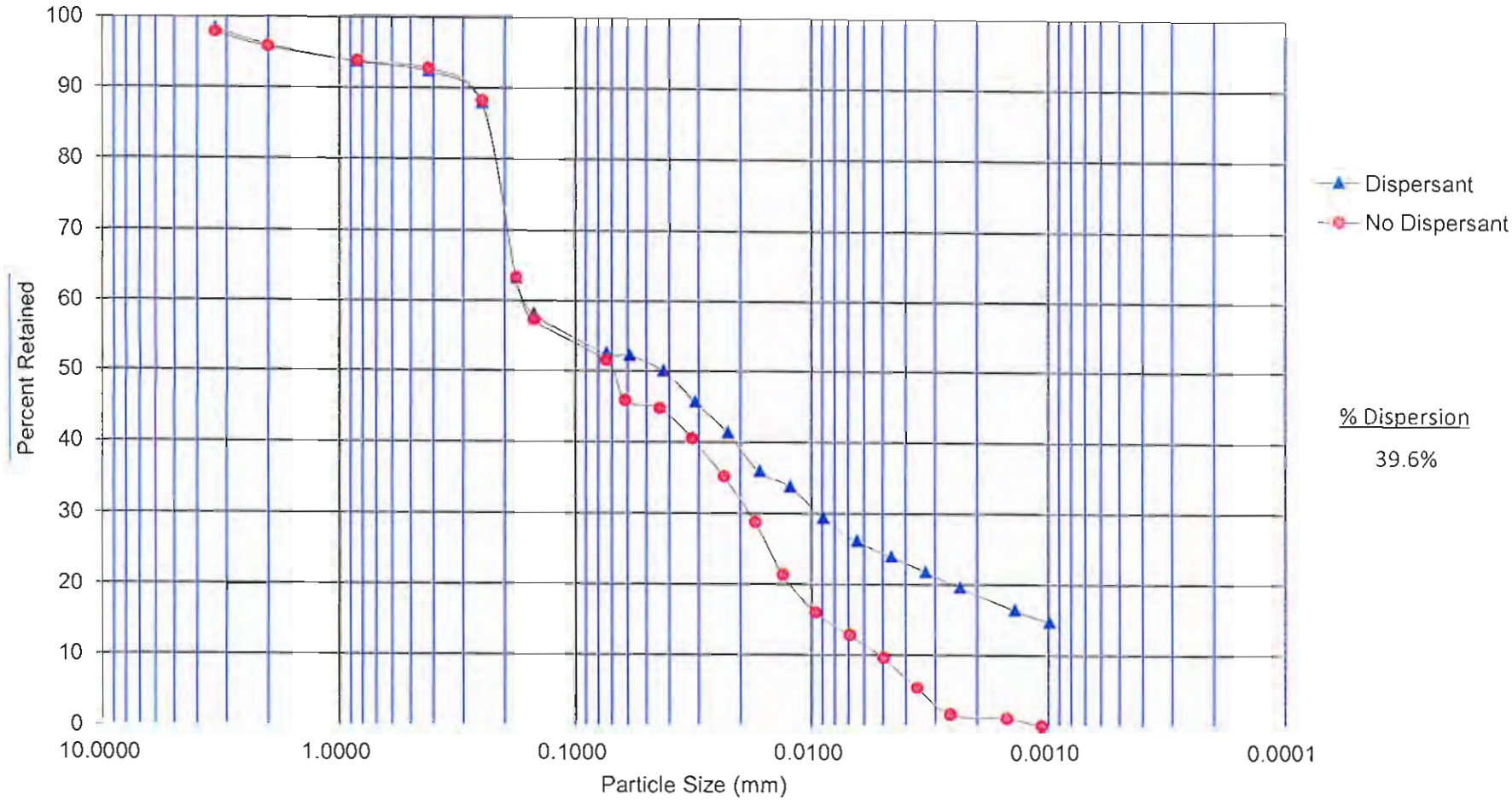
Length	:	4.00 in.	**Moisture**	:	0.9 %
Diameter	:	4.00 in.	**Volume**	:	0.0291 ft^3
Dry Weight	:	2.48 lbs.	**Dry Density (PCF):**		84.6

Gradient Ratio Test Data

Gradient	Elapsed Time (hrs)	Δh_{sf}	Δh_s	Gradient Ratio	System Permeability (cm/sec)
1	1	(2.5)	(1.7)	2.9	0.000964
1	2	(2.7)	(2.4)	2.3	0.000857
1	4	(2.8)	(2.6)	2.2	0.000532
1	8	(2.9)	(2.6)	2.2	0.000400
1	24	(2.9)	(2.6)	2.2	0.000305
2	1	(6.3)	(5.6)	2.3	0.000335
2	2	(7.8)	(9.2)	1.7	0.000308
2	4	(7.9)	(9.5)	1.7	0.000237
2	8	(7.9)	(9.5)	1.7	0.000220
2	24	(7.9)	(9.5)	1.7	0.000198
4	1	(12.4)	(11.9)	2.1	0.000030
4	2	(13.1)	(16.8)	1.6	0.000029
4	4	(13.2)	(17.2)	1.5	0.000029
4	8	(13.2)	(17.3)	1.5	0.000029
4	24	(13.2)	(17.3)	1.5	0.000028

$$Gradient\ Ratio = \frac{\Delta h_{(soil/fabric)} \ / \ Length_{(soil/fabric)}}{\Delta h_{(soil)} \ / \ Length_{(soil)}} = \frac{\Delta h_{sf} \ / \ 2.55\ cm}{\Delta h_s \ / \ 5.10\ cm}$$

Sieve and Hydrometer Size Distribution
Cliffs, Concord Prep
Slurry Imp. 6 -- TP-15



Copyright 1998 -2010 Pamela J. Schwab

Oak Grove Resources, LLC.
Concord Mine
Slurry Impoundment No. 6
Typical Groin Ditch

10 Year 6 Hour Event

Jeff Aldridge, P.E.

General Information

Storm Information:

Storm Type:	scs6hr
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.000 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Typical Groin Ditch

#1
Null

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	4.400	4.400	16.75	1.42

Structure Detail:

Structure #1 (Null)

Typical Groin Ditch

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	4.400	0.120	0.000	0.000	81.000	F	16.75	1.416
	$\sum$	**4.400**						**16.75**	**1.416**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	10.34	180.00	1,740.00	3.210	0.150
#1	**1**	**Time of Concentration:**					**0.120**

Copyright 1998-2010 Pamela J. Schwab

Typical Groin Ditch

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.0:1	2.0:1	26.0	0.50		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.00 cfs	
Depth:	0.96 ft	1.46 ft
Top Width:	3.85 ft	5.85 ft
Velocity:	8.66 fps	
X-Section Area:	1.85 sq ft	
Hydraulic Radius:	0.430 ft	
Froude Number:	2.20	
Manning's n:	0.0500	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

EMBANKMENT MATERIAL

FOUNDATION MATERIAL

WATER

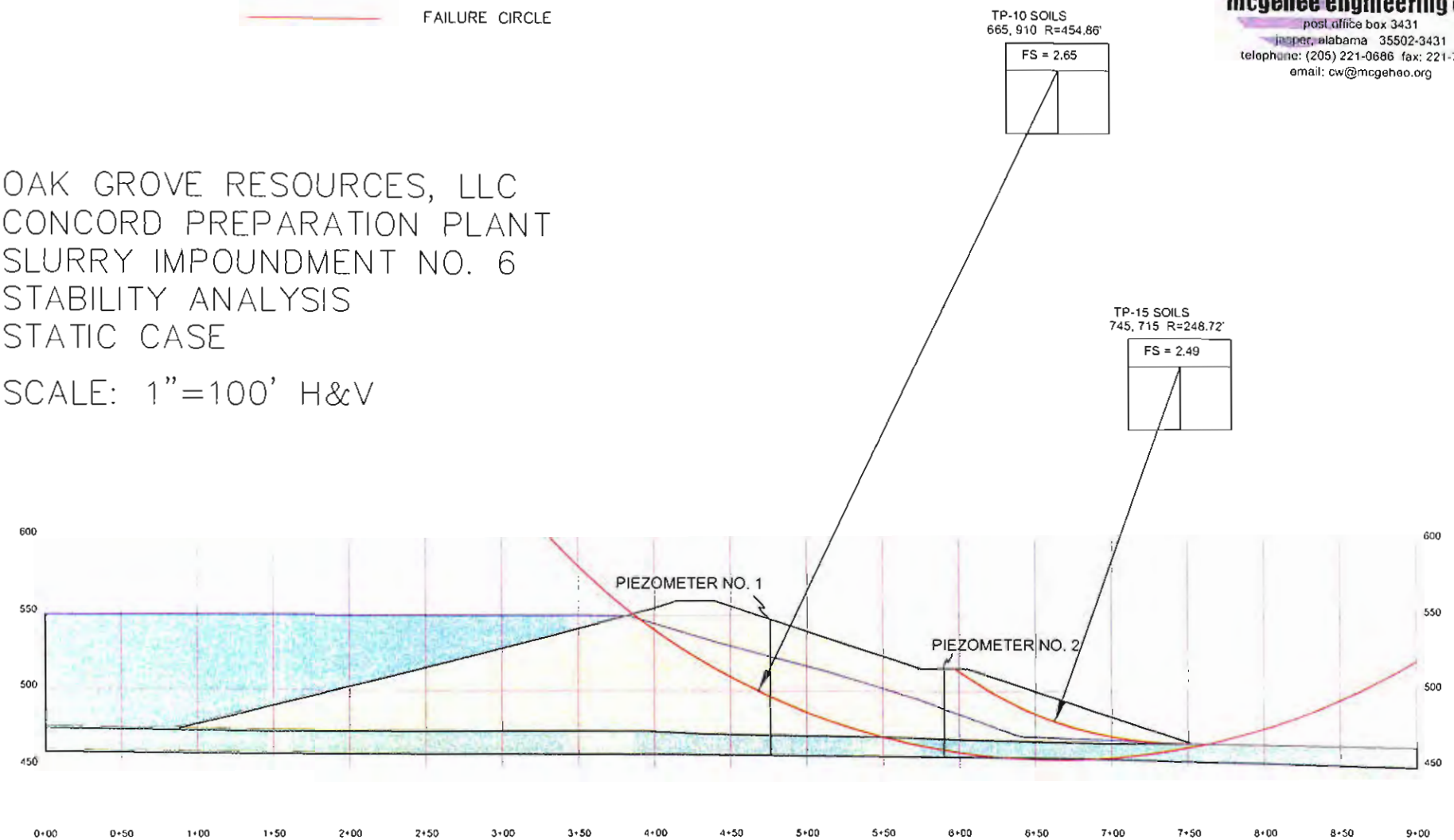
PHREATIC LINE

FAILURE CIRCLE

mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgeheo.org

OAK GROVE RESOURCES, LLC
CONCORD PREPARATION PLANT
SLURRY IMPOUNDMENT NO. 6
STABILITY ANALYSIS
STATIC CASE

SCALE: 1"=100' H&V



Foundation Material c=340 psf, phi = 34.6°, unit wt = 127 pcf)
TP-10 Embankment Material c= 500 psf, phi angle= 29.2°, unit weight = 117 pcf.
TP-15 Embankment Material c= 200 psf, phi angle= 30.7°, unit weight = 113.5 pcf.

EMBANKMENT MATERIAL

FOUNDATION MATERIAL

WATER

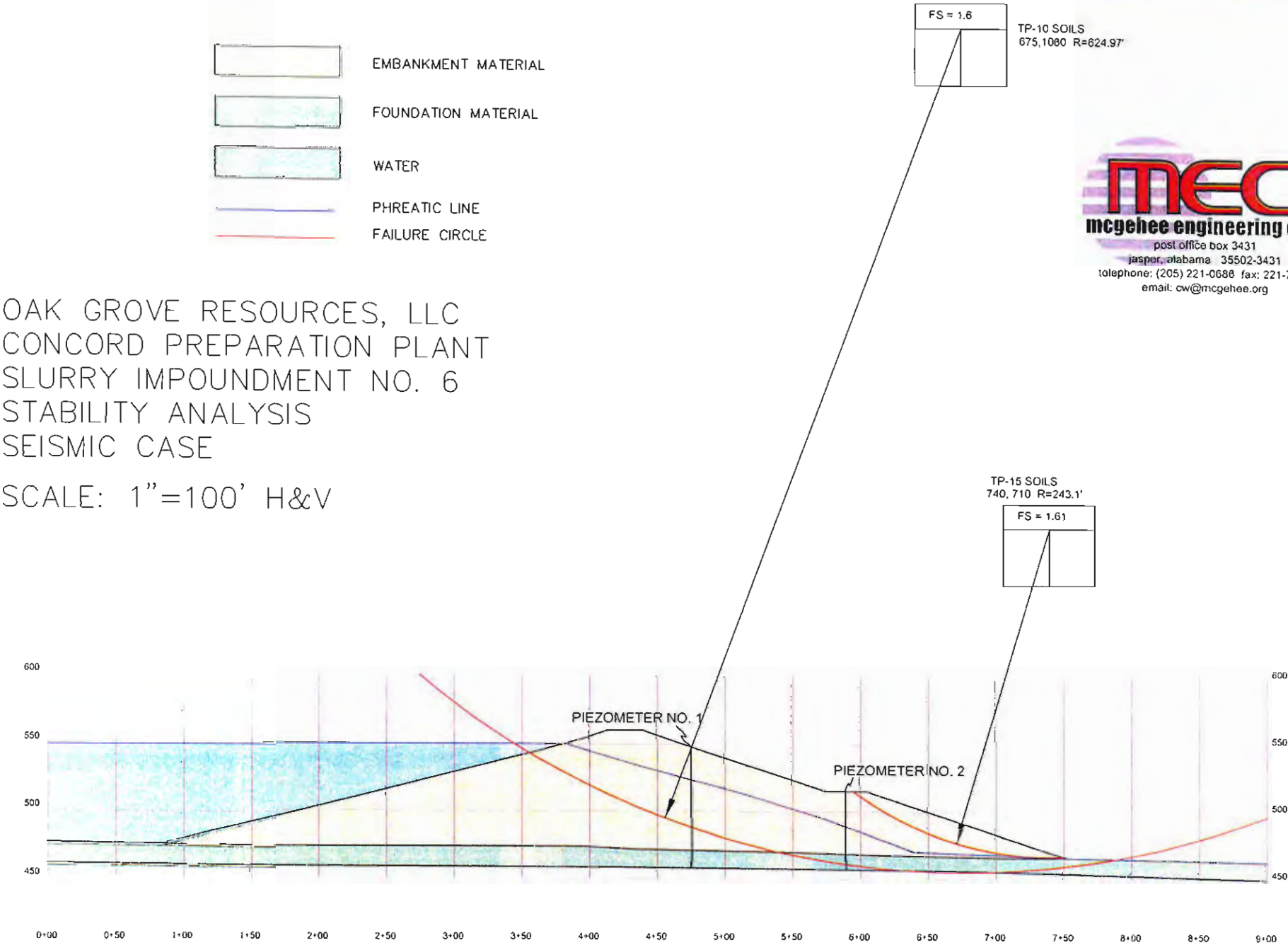
PHREATIC LINE

FAILURE CIRCLE

mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

OAK GROVE RESOURCES, LLC
CONCORD PREPARATION PLANT
SLURRY IMPOUNDMENT NO. 6
STABILITY ANALYSIS
SEISMIC CASE

SCALE: 1"=100' H&V



Peak Ground Acceleration from USGS = 0.14 used in analysis

Foundation Material c= 272 psf (340 psf @ 80%), phi angle = 34.6°, unit weight = 127 pcf

TP-10 Embankment Material c= 400 psf (500 psf @ 80%), phi angle= 29.2°, unit weight = 117 pcf.

TP-15 Embankment Material c= 160 psf (200 psf @ 80%), phi angle= 30.7°, unit weight = 113.5 pcf.

EMBANKMENT MATERIAL

FOUNDATION MATERIAL

WATER

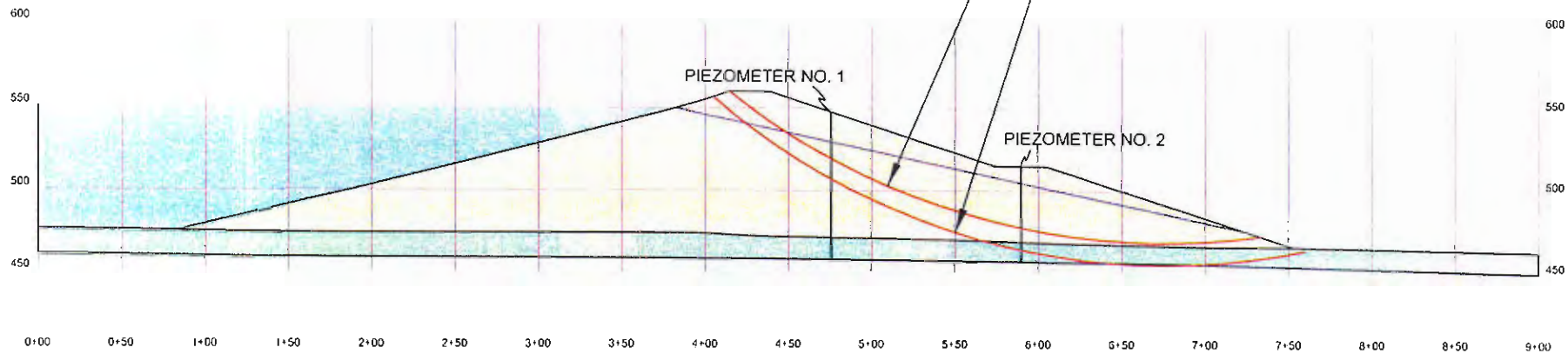
PHREATIC LINE

FAILURE CIRCLE

mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0666 fax: 221-7721
email: cw@mcgehee.org

OAK GROVE RESOURCES, LLC
CONCORD PREPARATION PLANT
SLURRY IMPOUNDMENT NO. 6
STABILITY ANALYSIS
STATIC CASE AT ACTION LEVEL

SCALE: 1"=100' H&V



Peak Ground Acceleration used in analysis = 0.0

Foundation Material c=340 psf, phi angle = 34.6°, unit weight = 127 pcf)

TP-10 Embankment Material c= 500 psf, phi angle= 29.2°, unit weight = 117 pcf.

TP-15 Embankment Material c= 200 psf, phi angle= 30.7°, unit weight = 113.5 pcf.

mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

EMBANKMENT MATERIAL

FOUNDATION MATERIAL

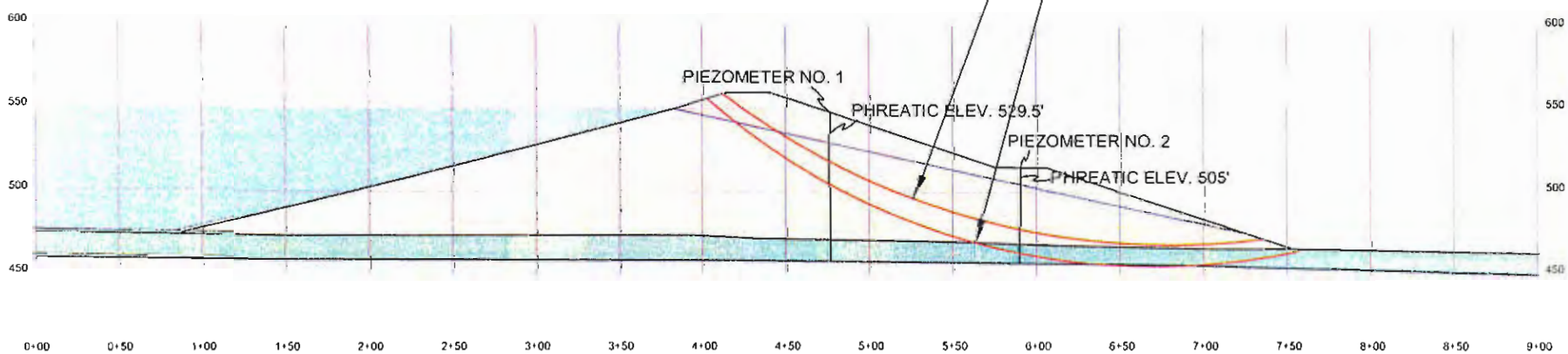
WATER

PHREATIC LINE

FAILURE CIRCLE

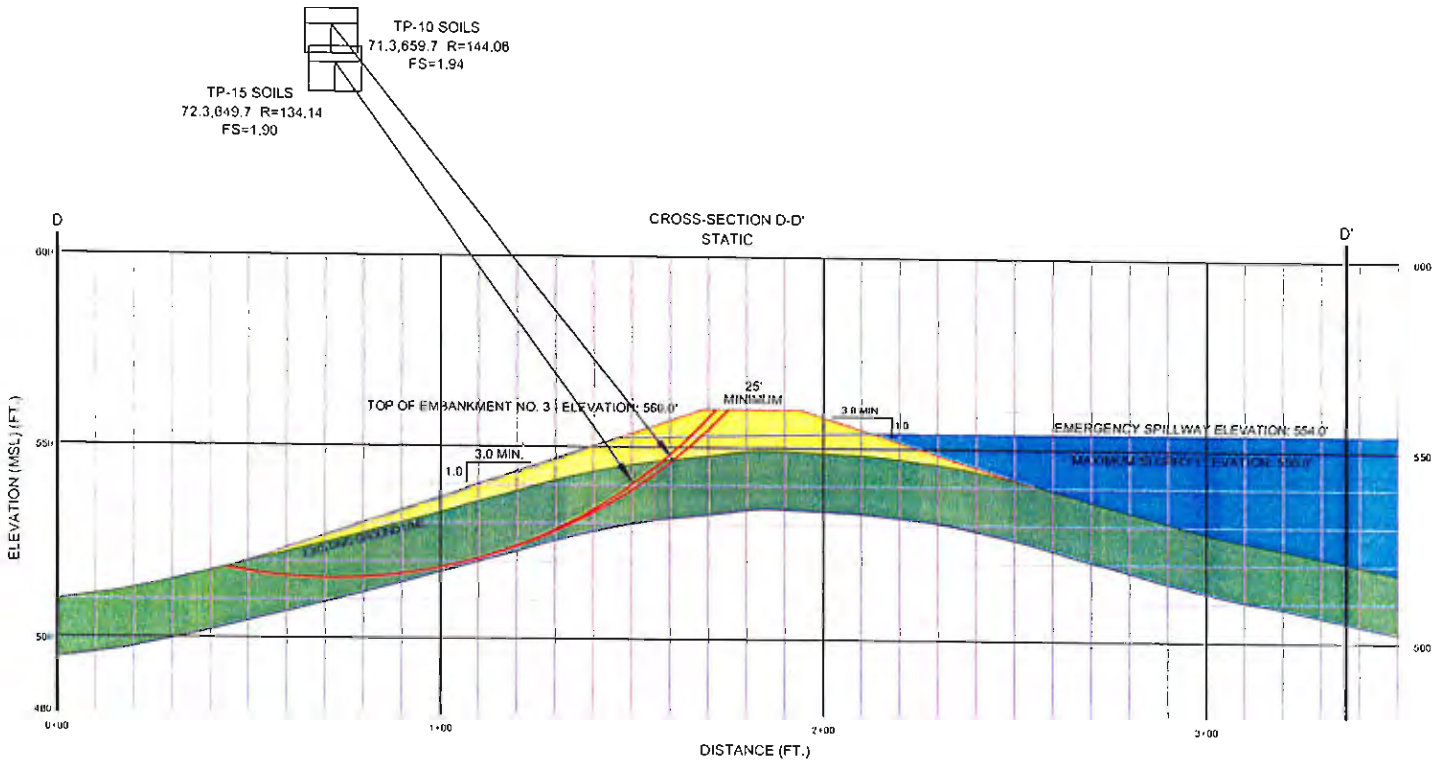
OAK GROVE RESOURCES, LLC
CONCORD PREPARATION PLANT
SLURRY IMPOUNDMENT NO. 6
STABILITY ANALYSIS
SEISMIC CASE ACTION LEVEL

SCALE: 1"=100' H&V



Peak Ground Acceleration from USGS for area = 0.14
Peak Ground Acceleration used in analysis = 0.1

Foundation Material c= 272 psf (340 psf @ 80%), phi angle = 34.6°, unit weight = 127 pcf
TP-10 Embankment Material c= 400 psf (500 psf @ 80%), phi angle= 29.2°, unit weight = 117 pcf.
TP-15 Embankment Material c= 160 psf (200 psf @ 80%), phi angle= 30.7°, unit weight = 113.5 pcf.



Foundation Material c=340 psf, phi angle = 34.6°, unit weight = 127 pcf)

TP-10 Embankment Material c= 500 psf, phi angle= 29.2°, unit weight = 117 pcf.

TP-15 Embankment Material c= 200 psf, phi angle= 30.7°, unit weight = 113.5 pcf.

EMBANKMENT MATERIAL

FOUNDATION MATERIAL

WATER

PHREATIC LINE

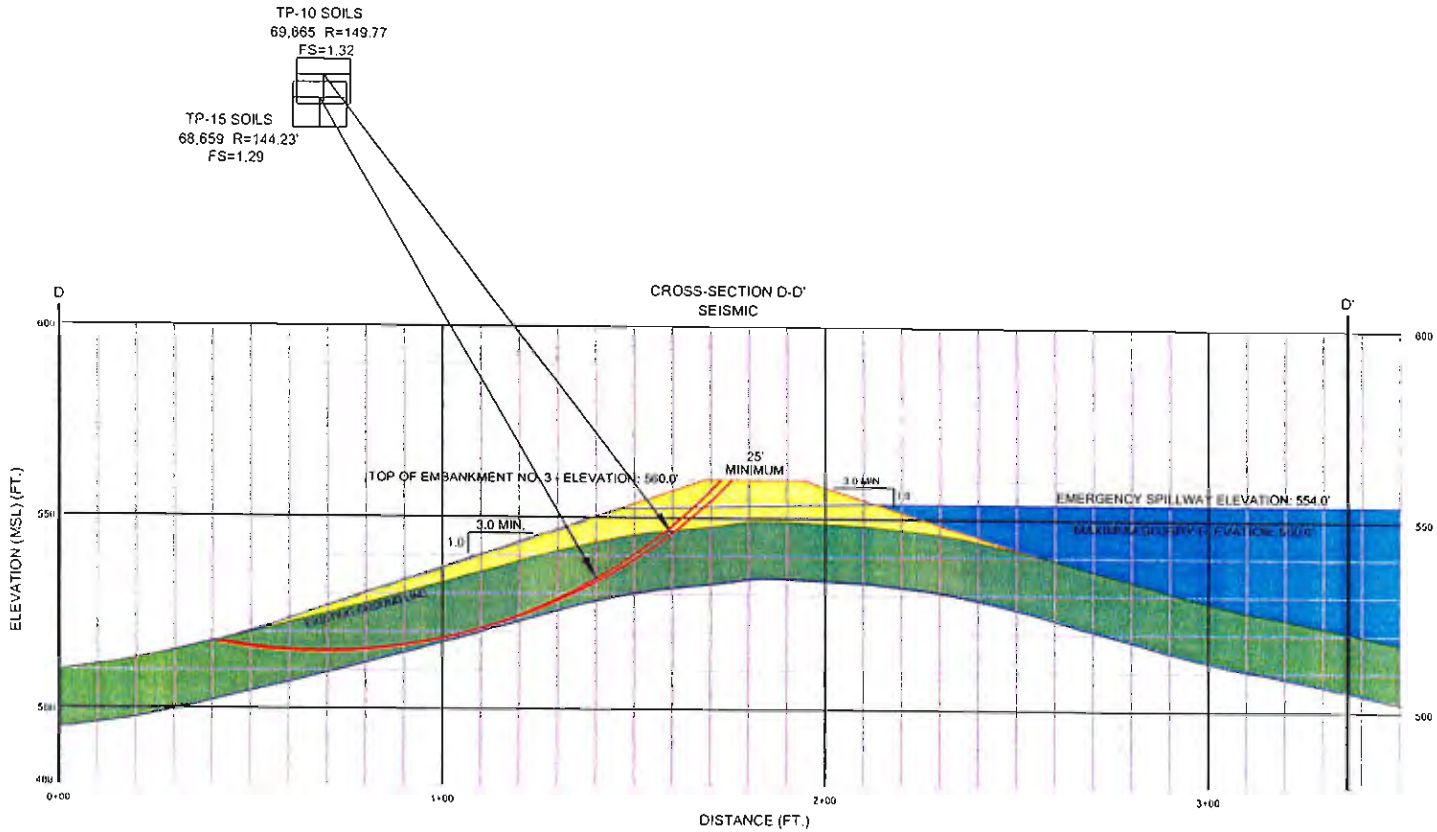
FAILURE CIRCLE

mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

OAK GROVE RESOURCES, LLC
CONCORD PREPARATION PLANT
SLURRY IMPOUNDMENT NO. 6
STABILITY ANALYSIS SECTION D–D'
EMBANKMENT NO. 3

STATIC CASE

SCALE: 1"=50' H&V



Peak Ground Acceleration used in analysis = 0.1

Foundation Material c= 272 psf (340 psf @ 80%), phi angle = 34.6°, unit weight = 127 pcf

TP-10 Embankment Material c= 400 psf (500 psf @ 80%), phi angle= 29.2°, unit weight = 117 pcf.

TP-15 Embankment Material c= 160 psf (200 psf @ 80%), phi angle= 30.7°, unit weight = 113.5 pcf.

EMBANKMENT MATERIAL

FOUNDATION MATERIAL

WATER

PHREATIC LINE

FAILURE CIRCLE

mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

OAK GROVE RESOURCES, LLC
CONCORD PREPARATION PLANT
SLURRY IMPOUNDMENT NO. 6
STABILITY ANALYSIS SECTION D–D'
EMBANKMENT NO. 3

SEISMIC CASE

SCALE: 1"=50' H&V

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 1

Soil TP-10
Static Case
Revised 4-2-15

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -OGRSL6  Revised 4-2-15

TITLE -Oak Grove Resources LLC Concord Preparation Plant  Slurry 6

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1    SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 4
 1  X COORD.= 0              Y COORD.= 41
 2  X COORD.= 400            Y COORD.= 458.55
 3  X COORD.= 750            Y COORD.= 454
 4  X COORD.= 900            Y COORD.= 450

NO. OF POINTS ON BOUNDARY LINE 2 = 4
 1  X COORD.= 83.42          Y COORD.= 474.99
 2  X COORD.= 395.22         Y COORD.= 474
 3  X COORD.= 450            Y COORD.= 471.72
 4  X COORD.= 753            Y COORD.= 466

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 0              Y COORD.= 476.26
 2  X COORD.= 83.42          Y COORD.= 474.99
 3  X COORD.= 382.14         Y COORD.= 554

NO. OF POINTS ON BOUNDARY LINE 4 = 8
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 382.14         Y COORD.= 554
 3  X COORD.= 414.25         Y COORD.= 560
 4  X COORD.= 439.45         Y COORD.= 560
 5  X COORD.= 575.13         Y COORD.= 515
 6  X COORD.= 605.27         Y COORD.= 515
 7  X COORD.= 753            Y COORD.= 466
 8  X COORD.= 900            Y COORD.= 462.82

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +1.044     -0.013     -0.027
 2        -0.003     -0.042     -0.019
 3        -0.015     +0.264
 4        +0.000     +0.187     +0.000     -0.332     +0.000     -0.332
          -0.022

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
```

NO. OF BOTTOM LINES FOR ZONE 1 = 1

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 4
UNIT WEIGHT OF WATER= 62.4

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	340	34.6	127
2	500	29.2	117
3	0	0	62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 6

1	X COORD.= 0	Y COORD.= 554
2	X COORD.= 382.14	Y COORD.= 554
3	X COORD.= 571.51	Y COORD.= 472
4	X COORD.= 639.6	Y COORD.= 470
5	X COORD.= 753	Y COORD.= 466
6	X COORD.= 900	Y COORD.= 462.82

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 580 Y COORD.= 835
POINT 2 X COORD.= 580 Y COORD.= 560
POINT 3 X COORD.= 800 Y COORD.= 560

X INCREMENT= 20 Y INCREMENT= 20
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
580	835	11	2	364.059	2.942	0
580	780	11	2	309.622	2.894	0
580	725	11	2	255.185	2.872	0
580	670	11	2	200.748	2.964	0
580	615	5	1	158.777	3.400	0
580	560	5	1	103.781	4.602	0
635	835	5	1	379.473	2.720	0

635	780	5	1	324.478	2.746	0
635	725	5	1	269.482	2.838	0
635	670	5	1	214.487	3.083	0
635	615	5	1	159.492	3.498	0
635	560	11	6	91.390	4.227	0
690	835	5	1	380.188	2.730	0
690	780	5	1	325.193	2.799	0
690	725	5	1	270.197	2.881	0
690	670	5	1	215.202	2.962	0
690	615	5	1	160.206	3.007	0
690	560	5	1	105.211	3.026	0
745	835	5	1	380.903	3.036	0
745	780	5	1	325.907	3.064	0
745	725	11	7	268.152	2.972	0
745	670	5	1	215.917	2.933	0
745	615	5	1	160.921	3.085	0
745	560	5	1	105.926	3.368	0
800	835	5	1	382.197	3.914	0
800	780	5	1	327.217	4.409	0
800	725	5	1	272.237	5.356	0
800	670	5	1	217.256	7.226	0
800	615	5	1	162.276	12.025	0
800	560	5	1	107.295	29.895	0

AT POINT (635 835) RADIUS 379.473

THE MINIMUM FACTOR OF SAFETY IS 2.720

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
635	835	5	1	379.473	2.720	0
655	835	5	1	379.733	2.683	0
675	835	5	1	379.993	2.688	0
655	855	5	1	399.731	2.679	0
655	875	5	1	419.730	2.671	0
655	895	5	1	439.728	2.669	0
655	915	5	1	459.726	2.676	0
675	895	5	1	439.988	2.659	0
695	895	5	1	440.248	2.705	0
675	915	5	1	459.986	2.660	0
675	875	5	1	419.990	2.662	0
680	895	5	1	440.053	2.665	0
670	895	5	1	439.923	2.659	0
665	895	5	1	439.858	2.658	0
660	895	5	1	439.793	2.660	0
665	900	5	1	444.857	2.657	0
665	905	5	1	449.857	2.656	0
665	910	5	1	454.857	2.655	0
665	915	5	1	459.856	2.655	0
670	910	5	1	454.922	2.656	0

660	910	5	1	454.792	2.661	0

AT POINT (665 910) RADIUS 454.857

THE MINIMUM FACTOR OF SAFETY IS 2.655

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	2	0.263	0.104	0.104	-.622	0.271E+01	0.100E+01	0.765E+05	0.768E+03
2	2	32.110	15.388	5.436	-.587	0.578E+05	0.469E+05	0.187E+08	0.154E+08
3	2	5.722	31.373	10.230	-.545	0.210E+05	0.174E+05	0.525E+07	0.521E+07
4	2	19.478	39.273	12.674	-.517	0.895E+05	0.741E+05	0.213E+08	0.211E+08
5	2	18.617	47.080	15.321	-.475	0.103E+06	0.848E+05	0.238E+08	0.222E+08
6	2	38.095	51.747	17.113	-.413	0.231E+06	0.190E+06	0.535E+08	0.433E+08
7	2	38.095	54.358	15.864	-.329	0.242E+06	0.205E+06	0.583E+08	0.363E+08
8	2	16.111	53.882	12.641	-.270	0.102E+06	0.889E+05	0.256E+08	0.125E+08
9	1	21.984	52.459	9.287	-.228	0.135E+06	0.123E+06	0.410E+08	0.140E+08
10	1	2.779	51.069	7.542	-.201	0.167E+05	0.154E+05	0.518E+07	0.153E+07
11	1	30.140	53.664	10.115	-.164	0.192E+06	0.173E+06	0.581E+08	0.143E+08
12	1	5.176	55.395	12.185	-.126	0.341E+05	0.301E+05	0.102E+08	0.195E+07
13	1	38.095	50.434	13.765	-.078	0.229E+06	0.197E+06	0.674E+08	0.814E+07
14	1	38.095	39.179	13.862	0.006	0.179E+06	0.146E+06	0.518E+08	-.464E+06
15	1	38.095	24.728	10.703	0.089	0.114E+06	0.886E+05	0.336E+08	-.464E+07
16	1	28.270	9.507	5.318	0.162	0.329E+05	0.235E+05	0.117E+08	-.243E+07
17	1	9.825	1.160	1.160	0.204	0.145E+04	0.736E+03	0.178E+07	-.134E+06
							SUM	0.487E+09	0.188E+09

AT CENTER (665.000, 910.000) WITH RADIUS 454.857 AND SEISMIC COEFF. 0.00
FACTOR OF SAFETY BY NORMAL METHOD IS 2.588
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 2.655

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 1

Soil TP-15
Static Case
Revised 4-2-15

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -ogrs16  Revised 04-02-15

TITLE -Oak Grove Resources LLC Concord Preparation Plant  Slurry 6

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1    SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 4
 1  X COORD.= 0              Y COORD.= 41
 2  X COORD.= 400            Y COORD.= 458.55
 3  X COORD.= 750            Y COORD.= 454
 4  X COORD.= 900            Y COORD.= 450

NO. OF POINTS ON BOUNDARY LINE 2 = 4
 1  X COORD.= 83.42          Y COORD.= 474.99
 2  X COORD.= 395.22         Y COORD.= 474
 3  X COORD.= 450            Y COORD.= 471.72
 4  X COORD.= 753            Y COORD.= 466

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 0              Y COORD.= 476.26
 2  X COORD.= 83.42          Y COORD.= 474.99
 3  X COORD.= 382.14         Y COORD.= 554

NO. OF POINTS ON BOUNDARY LINE 4 = 8
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 382.14         Y COORD.= 554
 3  X COORD.= 414.25         Y COORD.= 560
 4  X COORD.= 439.45         Y COORD.= 560
 5  X COORD.= 575.13         Y COORD.= 515
 6  X COORD.= 605.27         Y COORD.= 515
 7  X COORD.= 753            Y COORD.= 466
 8  X COORD.= 900            Y COORD.= 462.82

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +1.044     -0.013     -0.027
 2        -0.003     -0.042     -0.019
 3        -0.015     +0.264
 4        +0.000     +0.187     +0.000     -0.332     +0.000     -0.332
          -0.022

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 4
UNIT WEIGHT OF WATER= 62.4

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	340	34.6	127
2	200	31.7	113.5
3	0	0	62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 6
1 X COORD.= 0 Y COORD.= 554
2 X COORD.= 382.14 Y COORD.= 554
3 X COORD.= 571.5 Y COORD.= 471.8
4 X COORD.= 639.5 Y COORD.= 470
5 X COORD.= 753 Y COORD.= 466
6 X COORD.= 900 Y COORD.= 462.82

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 580 Y COORD.= 835
POINT 2 X COORD.= 580 Y COORD.= 560
POINT 3 X COORD.= 800 Y COORD.= 560

X INCREMENT= 20 Y INCREMENT= 20
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
580	835	14	5	319.962	2.630	0
580	780	14	12	263.665	2.666	0
580	725	17	2	255.185	2.696	0
580	670	11	2	200.748	2.789	0
580	615	11	9	143.195	3.204	0
580	560	5	1	103.781	4.476	0
635	835	11	6	364.949	2.638	0
635	780	11	6	310.024	2.664	0
635	725	11	6	255.135	2.751	0

635	670	11	6	200.322	2.951	0
635	615	11	6	145.700	3.266	0
635	560	8	5	62.556	3.445	0
690	835	5	1	380.188	2.646	0
690	780	5	1	325.193	2.704	0
690	725	11	7	256.937	2.774	0
690	670	11	8	192.427	2.784	0
690	615	11	8	138.967	2.599	0
690	560	11	8	92.673	2.687	0
745	835	11	3	367.629	2.703	0
745	780	11	3	313.750	2.571	0
745	725	11	9	258.492	2.494	0
745	670	11	7	203.513	2.597	0
745	615	11	8	148.812	2.786	0
745	560	5	1	105.926	3.191	0
800	835	11	4	371.899	3.054	0
800	780	8	1	327.217	4.049	0
800	725	8	1	272.237	4.927	0
800	670	5	1	217.256	6.700	0
800	615	5	1	162.276	11.369	0
800	560	5	1	107.295	29.283	0

AT POINT (745 725) RADIUS 258.492

THE MINIMUM FACTOR OF SAFETY IS 2.494

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
745	725	11	9	258.492	2.494	0
765	725	17	4	258.286	2.833	0
725	725	11	3	257.197	2.584	0
745	745	11	9	278.033	2.514	0
745	705	11	10	237.621	2.537	0
750	725	11	7	257.931	2.540	0
740	725	11	9	257.748	2.501	0
745	730	11	9	263.377	2.498	0
745	720	11	9	253.607	2.492	0
745	715	11	9	248.721	2.490	0
745	710	11	9	243.836	2.513	0
750	715	11	7	248.186	2.552	0
740	715	11	9	247.977	2.492	0

AT POINT (745 715) RADIUS 248.721

THE MINIMUM FACTOR OF SAFETY IS 2.490

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL.	SOIL	SLICE	SLICE	WATER	SLICE	TOTAL	EFFEC.	RESIS.	DRIVING

NO.	NO.	WIDTH	HEIGHT	HEIGHT	SINE	WEIGHT	WEIGHT	MOMENT	MOMENT
1	2	8.129	2.942	0.000	-.578	0.271E+04	0.271E+04	0.823E+06	0.390E+06
2	2	7.344	6.990	0.000	-.547	0.583E+04	0.583E+04	0.116E+07	0.793E+06
3	2	15.473	10.230	0.000	-.501	0.180E+05	0.180E+05	0.319E+07	0.224E+07
4	2	15.473	13.345	0.000	-.439	0.234E+05	0.234E+05	0.397E+07	0.256E+07
5	2	15.473	15.129	0.000	-.377	0.266E+05	0.266E+05	0.447E+07	0.249E+07
6	2	15.473	15.699	0.000	-.315	0.276E+05	0.276E+05	0.468E+07	0.216E+07
7	2	15.473	15.143	0.000	-.252	0.266E+05	0.266E+05	0.460E+07	0.167E+07
8	2	15.473	13.522	0.000	-.190	0.237E+05	0.237E+05	0.423E+07	0.112E+07
9	2	15.473	10.883	0.000	-.128	0.191E+05	0.191E+05	0.358E+07	0.608E+06
10	2	15.473	7.256	0.042	-.066	0.127E+05	0.127E+05	0.264E+07	0.208E+06
11	2	15.473	2.660	0.032	-.003	0.467E+04	0.464E+04	0.145E+07	0.404E+04
							SUM	0.348E+08	0.142E+08

AT CENTER (745.000, 715.000) WITH RADIUS 248.721 AND SEISMIC COEFF. 0.00
FACTOR OF SAFETY BY NORMAL METHOD IS 2.442
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 2.490

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 1

Soil TP-10
Seismic Case
Revised 4-2-15

```
      REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -ogrs16  Revised 04-02-15

TITLE -Oak Grove Resources LLC Concord Preparation Plant  Slurry 6

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1    SEISMIC COEFFICIENT= .14

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 4
 1  X COORD.= 0              Y COORD.= 41
 2  X COORD.= 400            Y COORD.= 458.55
 3  X COORD.= 750            Y COORD.= 454
 4  X COORD.= 900            Y COORD.= 450

NO. OF POINTS ON BOUNDARY LINE 2 = 4
 1  X COORD.= 83.42          Y COORD.= 474.99
 2  X COORD.= 395.22         Y COORD.= 474
 3  X COORD.= 450            Y COORD.= 471.72
 4  X COORD.= 753            Y COORD.= 466

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 0              Y COORD.= 476.26
 2  X COORD.= 83.42          Y COORD.= 474.99
 3  X COORD.= 382.14         Y COORD.= 554

NO. OF POINTS ON BOUNDARY LINE 4 = 8
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 382.14         Y COORD.= 554
 3  X COORD.= 414.25         Y COORD.= 560
 4  X COORD.= 439.45         Y COORD.= 560
 5  X COORD.= 575.13         Y COORD.= 515
 6  X COORD.= 605.27         Y COORD.= 515
 7  X COORD.= 753            Y COORD.= 466
 8  X COORD.= 900            Y COORD.= 462.82

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +1.044     -0.013     -0.027
 2        -0.003     -0.042     -0.019
 3        -0.015     +0.264
 4        +0.000     +0.187     +0.000     -0.332     +0.000     -0.332
          -0.022

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 4
UNIT WEIGHT OF WATER= 62.4

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	272	34.6	127
2	400	29.2	117
3	0	0	62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFC)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 6
1 X COORD.= 0 Y COORD.= 554
2 X COORD.= 382.14 Y COORD.= 554
3 X COORD.= 571.51 Y COORD.= 471.8
4 X COORD.= 639.6 Y COORD.= 470
5 X COORD.= 753 Y COORD.= 466
6 X COORD.= 900 Y COORD.= 462.82

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 580 Y COORD.= 835
POINT 2 X COORD.= 580 Y COORD.= 560
POINT 3 X COORD.= 800 Y COORD.= 560

X INCREMENT= 20 Y INCREMENT= 20
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
580	835	11	2	364.059	1.688	0
580	780	11	2	309.622	1.705	0
580	725	11	2	255.185	1.744	0
580	670	11	2	200.748	1.846	0
580	615	11	9	143.195	2.130	0
580	560	5	1	103.781	2.873	0
635	835	5	1	379.473	1.665	0
635	780	5	1	324.478	1.710	0
635	725	5	1	269.482	1.787	0

635	670	5	1	214.487	1.937	0
635	615	5	1	159.492	2.174	0
635	560	11	6	91.390	2.533	0
690	835	5	1	380.188	1.703	0
690	780	5	1	325.193	1.742	0
690	725	5	1	270.197	1.787	0
690	670	5	1	215.202	1.837	0
690	615	11	1	160.206	1.887	0
690	560	5	1	105.211	1.969	0
745	835	5	1	380.903	1.805	0
745	780	5	1	325.907	1.818	0
745	725	5	1	270.912	1.791	0
745	670	5	1	215.917	1.781	0
745	615	5	1	160.921	1.857	0
745	560	5	1	105.926	1.993	0
800	835	5	1	382.197	2.100	0
800	780	5	1	327.217	2.267	0
800	725	5	1	272.237	2.524	0
800	670	5	1	217.256	2.913	0
800	615	5	1	162.276	3.507	0
800	560	5	1	107.295	4.199	0

AT POINT (635 835) RADIUS 379.473

THE MINIMUM FACTOR OF SAFETY IS 1.665

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
635	835	5	1	379.473	1.665	0
655	835	5	1	379.733	1.665	0
615	835	5	1	379.213	1.687	0
635	855	5	1	399.471	1.655	0
635	875	5	1	419.470	1.648	0
635	895	5	1	439.468	1.643	0
635	915	5	1	459.466	1.639	0
635	935	5	1	479.465	1.636	0
635	955	5	1	499.463	1.634	0
635	975	5	1	519.461	1.634	0
635	995	5	1	539.459	1.635	0
655	975	5	1	519.721	1.609	0
675	975	5	1	519.981	1.609	0
695	975	5	1	520.241	1.642	0
675	995	5	1	539.979	1.605	0
675	1015	5	1	559.978	1.602	0
675	1035	5	1	579.976	1.600	0
675	1055	5	1	599.974	1.600	0
675	1075	5	1	619.973	1.599	0
675	1095	5	1	639.971	1.600	0
695	1075	5	1	620.233	1.610	0
655	1075	5	1	619.713	1.611	0

680	1075	5	1	620.038	1.600	0
670	1075	5	1	619.908	1.600	0
675	1080	5	1	624.972	1.599	0
675	1085	5	1	629.972	1.599	0
680	1080	5	1	625.037	1.600	0
670	1080	5	1	624.907	1.600	0

AT POINT (675 1080) RADIUS 624.972

THE MINIMUM FACTOR OF SAFETY IS 1.599

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
2	2	31.361	17.501	17.501	-.494	0.571E+05	0.229E+05	0.146E+08	0.224E+08
3	2	0.358	26.236	26.125	-.468	0.110E+04	0.515E+03	0.235E+06	0.404E+06
4	2	31.752	37.451	27.371	-.443	0.139E+06	0.843E+05	0.324E+08	0.490E+08
5	2	13.257	50.975	28.160	-.407	0.791E+05	0.553E+05	0.199E+08	0.261E+08
6	2	11.943	56.418	28.133	-.386	0.788E+05	0.579E+05	0.204E+08	0.251E+08
7	2	33.067	59.856	27.286	-.350	0.232E+06	0.175E+06	0.622E+08	0.697E+08
8	2	45.009	60.065	23.498	-.288	0.316E+06	0.250E+06	0.910E+08	0.821E+08
9	2	21.302	58.054	18.091	-.235	0.145E+06	0.121E+06	0.448E+08	0.330E+08
10	1	23.707	55.591	13.324	-.199	0.155E+06	0.135E+06	0.593E+08	0.319E+08
11	1	12.594	52.977	8.851	-.170	0.787E+05	0.718E+05	0.319E+08	0.149E+08
12	1	30.140	54.192	10.498	-.136	0.194E+06	0.174E+06	0.778E+08	0.325E+08
13	1	2.275	55.819	12.074	-.110	0.151E+05	0.134E+05	0.602E+07	0.229E+07
14	1	45.009	50.134	13.606	-.072	0.269E+06	0.231E+06	0.106E+09	0.347E+08
15	1	45.009	36.824	13.721	0.000	0.200E+06	0.161E+06	0.771E+08	0.169E+08
16	1	45.009	20.268	10.507	0.072	0.111E+06	0.817E+05	0.433E+08	0.454E+07
17	1	10.427	8.448	6.903	0.116	0.110E+05	0.653E+04	0.466E+07	0.149E+06
18	1	34.583	3.291	3.291	0.152	0.145E+05	0.735E+04	0.921E+07	-.131E+06
							SUM	0.701E+09	0.445E+09

AT CENTER (675.000, 1080.000) WITH RADIUS 624.972 AND SEISMIC COEFF. 0.14
FACTOR OF SAFETY BY NORMAL METHOD IS 1.576
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.599

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 1

Soil TP-15
Seismic Case
Revised 4-2-15

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -ogrs16

TITLE -Oak Grove Resources LLC Concord Preparation Plant  Slurry 6

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1    SEISMIC COEFFICIENT= .14

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 4
 1  X COORD.= 0             Y COORD.= 41
 2  X COORD.= 400           Y COORD.= 458.55
 3  X COORD.= 750           Y COORD.= 454
 4  X COORD.= 900           Y COORD.= 450

NO. OF POINTS ON BOUNDARY LINE 2 = 4
 1  X COORD.= 83.42         Y COORD.= 474.99
 2  X COORD.= 395.22        Y COORD.= 474
 3  X COORD.= 450           Y COORD.= 471.72
 4  X COORD.= 753           Y COORD.= 466

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 0             Y COORD.= 476.26
 2  X COORD.= 83.42         Y COORD.= 474.99
 3  X COORD.= 382.14        Y COORD.= 554

NO. OF POINTS ON BOUNDARY LINE 4 = 8
 1  X COORD.= 0             Y COORD.= 554
 2  X COORD.= 382.14        Y COORD.= 554
 3  X COORD.= 414.25        Y COORD.= 560
 4  X COORD.= 439.45        Y COORD.= 560
 5  X COORD.= 575.13        Y COORD.= 515
 6  X COORD.= 605.27        Y COORD.= 515
 7  X COORD.= 753           Y COORD.= 466
 8  X COORD.= 900           Y COORD.= 462.82

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +1.044     -0.013     -0.027
 2        -0.003     -0.042     -0.019
 3        -0.015     +0.264
 4        +0.000     +0.187     +0.000     -0.332     +0.000     -0.332
          -0.022

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

```
FOR ZONE 1     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 4
UNIT WEIGHT OF WATER= 62.4

SOIL NO.       COHESION       FRIC. ANGLE    UNIT WEIGHT
 1              272            34.6           127
 2              160            30.7           113.5
 3              0              0              62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 6
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 382.14         Y COORD.= 554
 3  X COORD.= 571.5          Y COORD.= 471.8
 4  X COORD.= 639.5          Y COORD.= 470
 5  X COORD.= 753            Y COORD.= 466
 6  X COORD.= 900            Y COORD.= 462.82

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 580      Y COORD.= 835
POINT 2 X COORD.= 580      Y COORD.= 560
POINT 3 X COORD.= 800      Y COORD.= 560

X INCREMENT= 20              Y INCREMENT= 20
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID


IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES
```

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
580	835	14	2	364.059	1.608	0
580	780	14	2	309.622	1.627	0
580	725	17	2	255.185	1.668	0
580	670	17	2	200.748	1.769	0
580	615	17	9	143.195	2.032	0
580	560	11	4	68.060	2.720	0
635	835	11	1	379.473	1.629	0
635	780	11	1	324.478	1.674	0
635	725	11	6	255.135	1.741	0

635	670	11	6	200.322	1.847	0
635	615	11	6	145.700	2.018	0
635	560	8	5	62.556	2.113	0
690	835	11	7	365.440	1.656	0
690	780	11	1	325.193	1.696	0
690	725	11	7	256.937	1.729	0
690	670	11	8	192.427	1.743	0
690	615	11	8	138.967	1.681	0
690	560	11	9	89.090	1.776	0
745	835	11	3	367.629	1.688	0
745	780	11	3	313.750	1.631	0
745	725	11	9	258.492	1.607	0
745	670	11	7	203.513	1.670	0
745	615	11	1	160.921	1.768	0
745	560	5	1	105.926	1.902	0
800	835	11	4	371.899	1.916	0
800	780	8	1	327.217	2.102	0
800	725	5	1	272.237	2.339	0
800	670	5	1	217.256	2.712	0
800	615	5	1	162.276	3.311	0
800	560	5	1	107.295	4.112	0

AT POINT (745 725) RADIUS 258.492

THE MINIMUM FACTOR OF SAFETY IS 1.607

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
745	725	11	9	258.492	1.607	0
765	725	11	1	271.304	1.780	0
725	725	11	3	257.197	1.642	0
745	745	11	9	278.033	1.613	0
745	705	11	10	237.621	1.634	0
750	725	11	7	257.931	1.634	0
740	725	11	9	257.748	1.609	0
745	730	11	9	263.377	1.608	0
745	720	11	9	253.607	1.607	0
745	715	11	9	248.721	1.607	0
745	710	11	9	243.836	1.622	0
750	715	11	7	248.186	1.642	0
740	715	11	9	247.977	1.606	0
735	715	11	9	247.233	1.610	0
740	720	11	9	252.862	1.607	0
740	710	11	9	243.092	1.606	0
740	705	11	9	238.206	1.606	0
745	710	11	9	243.836	1.622	0
735	710	11	9	242.348	1.608	0

AT POINT (740 710) RADIUS 243.092

THE MINIMUM FACTOR OF SAFETY IS 1.606

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	2	10.420	3.772	0.000	-.576	0.446E+04	0.446E+04	0.970E+06	0.747E+06
2	2	5.063	8.163	0.000	-.544	0.469E+04	0.469E+04	0.751E+06	0.751E+06
3	2	15.483	11.057	0.000	-.502	0.194E+05	0.194E+05	0.293E+07	0.293E+07
4	2	15.483	14.166	0.000	-.438	0.249E+05	0.249E+05	0.368E+07	0.339E+07
5	2	15.483	15.915	0.000	-.374	0.280E+05	0.280E+05	0.418E+07	0.340E+07
6	2	15.483	16.424	0.000	-.310	0.289E+05	0.289E+05	0.441E+07	0.308E+07
7	2	15.483	15.783	0.000	-.247	0.277E+05	0.277E+05	0.436E+07	0.255E+07
8	2	15.483	14.057	0.000	-.183	0.247E+05	0.247E+05	0.403E+07	0.190E+07
9	2	15.483	11.292	0.000	-.119	0.198E+05	0.198E+05	0.340E+07	0.123E+07
10	2	15.483	7.519	0.000	-.056	0.132E+05	0.132E+05	0.249E+07	0.621E+06
11	2	15.483	2.753	0.000	0.008	0.484E+04	0.484E+04	0.130E+07	0.154E+06
							SUM	0.325E+08	0.207E+08

AT CENTER (740.000, 710.000) WITH RADIUS 243.092 AND SEISMIC COEFF. 0.14
FACTOR OF SAFETY BY NORMAL METHOD IS 1.567
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.606

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 1

Soil TP-10
Static Case
Action Level for Phreatic Line

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -ogrs16

TITLE -Oak Grove Resources LLC Concord Preparation Plant  Slurry 6

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1    SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 4
 1  X COORD.= 0              Y COORD.= 41
 2  X COORD.= 400            Y COORD.= 458.55
 3  X COORD.= 750            Y COORD.= 454
 4  X COORD.= 900            Y COORD.= 450

NO. OF POINTS ON BOUNDARY LINE 2 = 4
 1  X COORD.= 83.42          Y COORD.= 474.99
 2  X COORD.= 395.22         Y COORD.= 474
 3  X COORD.= 450            Y COORD.= 471.72
 4  X COORD.= 753            Y COORD.= 466

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 0              Y COORD.= 476.26
 2  X COORD.= 83.42          Y COORD.= 474.99
 3  X COORD.= 382.14         Y COORD.= 554

NO. OF POINTS ON BOUNDARY LINE 4 = 8
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 382.14         Y COORD.= 554
 3  X COORD.= 414.25         Y COORD.= 560
 4  X COORD.= 439.45         Y COORD.= 560
 5  X COORD.= 575.13         Y COORD.= 515
 6  X COORD.= 605.27         Y COORD.= 515
 7  X COORD.= 753            Y COORD.= 466
 8  X COORD.= 900            Y COORD.= 462.82

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +1.044     -0.013     -0.027
 2        -0.003     -0.042     -0.019
 3        -0.015     +0.264
 4        +0.000     +0.187     +0.000     -0.332     +0.000     -0.332
          -0.022

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 4
UNIT WEIGHT OF WATER= 62.4

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	272	34.6	127
2	400	29.2	117
3	0	0	62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 6

1	X COORD.= 0	Y COORD.= 554
2	X COORD.= 382.14	Y COORD.= 554
3	X COORD.= 500	Y COORD.= 524.3
4	X COORD.= 725	Y COORD.= 475
5	X COORD.= 753	Y COORD.= 466
6	X COORD.= 900	Y COORD.= 462.82

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 580 Y COORD.= 835
POINT 2 X COORD.= 580 Y COORD.= 560
POINT 3 X COORD.= 800 Y COORD.= 560

X INCREMENT= 20 Y INCREMENT= 20
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
580	835	11	2	364.059	2.180	0
580	780	11	2	309.622	2.119	0
580	725	11	2	255.185	2.071	0
580	670	11	2	200.748	2.107	0
580	615	11	2	146.311	2.375	0
580	560	5	1	103.781	3.195	0
635	835	5	1	379.473	1.946	0
635	780	5	1	324.478	1.932	0
635	725	5	1	269.482	1.962	0

635	670	5	1	214.487	2.099	0
635	615	5	1	159.492	2.359	0
635	560	5	1	104.496	2.859	0
690	835	5	1	380.188	1.876	0
690	780	5	1	325.193	1.922	0
690	725	5	1	270.197	1.976	0
690	670	5	1	215.202	2.036	0
690	615	5	1	160.206	2.072	0
690	560	5	1	105.211	2.101	0
745	835	5	1	380.903	2.194	0
745	780	11	7	322.869	2.219	0
745	725	11	2	265.392	2.165	0
745	670	5	1	215.917	2.183	0
745	615	5	1	160.921	2.304	0
745	560	5	1	105.926	2.540	0
800	835	5	1	382.197	3.106	0
800	780	5	1	327.217	3.546	0
800	725	5	1	272.237	4.355	0
800	670	5	1	217.256	6.011	0
800	615	5	1	162.276	10.321	0
800	560	5	1	107.295	26.775	0

AT POINT (690 835) RADIUS 380.188

THE MINIMUM FACTOR OF SAFETY IS 1.876

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
690	835	5	1	380.188	1.876	0
710	835	5	1	380.448	1.955	0
670	835	5	1	379.928	1.857	0
650	835	5	1	379.668	1.895	0
670	855	5	1	399.926	1.854	0
670	875	5	1	419.925	1.862	0
690	855	5	1	400.186	1.867	0
650	855	5	1	399.666	1.900	0
675	855	5	1	399.991	1.854	0
680	855	5	1	400.056	1.854	0
675	860	5	1	404.991	1.853	0
675	865	5	1	409.990	1.852	0
675	870	5	1	414.990	1.853	0
680	865	5	1	410.055	1.856	0
670	865	5	1	409.925	1.857	0

AT POINT (675 865) RADIUS 409.990

THE MINIMUM FACTOR OF SAFETY IS 1.852

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	2	10.941	5.777	0.000	-.649	0.740E+04	0.740E+04	0.365E+07	0.197E+07
2	2	25.200	21.364	4.098	-.605	0.630E+05	0.565E+05	0.155E+08	0.156E+08
3	2	0.320	30.631	10.202	-.574	0.115E+04	0.943E+03	0.241E+06	0.270E+06
4	2	36.461	36.703	17.739	-.529	0.157E+06	0.116E+06	0.296E+08	0.340E+08
5	2	36.461	44.855	28.796	-.440	0.191E+06	0.126E+06	0.325E+08	0.345E+08
6	2	36.461	48.503	36.365	-.351	0.207E+06	0.124E+06	0.330E+08	0.298E+08
7	2	17.764	48.622	39.536	-.285	0.101E+06	0.572E+05	0.156E+08	0.118E+08
8	1	8.214	47.949	40.325	-.254	0.462E+05	0.255E+05	0.792E+07	0.480E+07
9	1	10.483	48.920	40.610	-.231	0.603E+05	0.338E+05	0.105E+08	0.571E+07
10	1	19.657	52.197	40.585	-.194	0.121E+06	0.715E+05	0.221E+08	0.965E+07
11	1	16.803	52.591	39.771	-.150	0.105E+06	0.632E+05	0.196E+08	0.643E+07
12	1	36.461	46.899	37.078	-.085	0.204E+06	0.120E+06	0.379E+08	0.709E+07
13	1	36.461	36.273	30.556	0.004	0.159E+06	0.897E+05	0.294E+08	-.281E+06
14	1	36.461	22.397	20.785	0.093	0.992E+05	0.519E+05	0.187E+08	-.3[illegible]3E+07
15	1	21.545	9.014	8.904	0.164	0.239E+05	0.120E+05	0.577E+07	-.161E+07
16	1	14.916	1.824	1.824	0.208	0.345E+04	0.176E+04	0.219E+07	-.295E+06
							SUM	0.284E+09	0.156E+09

AT CENTER (675.000, 865.000) WITH RADIUS 409.990 AND SEISMIC COEFF. 0.00
FACTOR OF SAFETY BY NORMAL METHOD IS 1.825
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.852

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 1

Soil TP-15
Static Case
Action Level for Phreatic Line

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -OGRSL6  Revised 04-02-15

TITLE -Oak Grove Resources LLC Concord Preparation Plant  Slurry 6

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1    SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 4
 1  X COORD.= 0              Y COORD.= 41
 2  X COORD.= 400            Y COORD.= 458.55
 3  X COORD.= 750            Y COORD.= 454
 4  X COORD.= 900            Y COORD.= 450

NO. OF POINTS ON BOUNDARY LINE 2 = 4
 1  X COORD.= 83.42          Y COORD.= 474.99
 2  X COORD.= 395.22         Y COORD.= 474
 3  X COORD.= 450            Y COORD.= 471.72
 4  X COORD.= 753            Y COORD.= 466

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 0              Y COORD.= 476.26
 2  X COORD.= 83.42          Y COORD.= 474.99
 3  X COORD.= 382.14         Y COORD.= 554

NO. OF POINTS ON BOUNDARY LINE 4 = 8
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 382.14         Y COORD.= 554
 3  X COORD.= 414.25         Y COORD.= 560
 4  X COORD.= 439.45         Y COORD.= 560
 5  X COORD.= 575.13         Y COORD.= 515
 6  X COORD.= 605.27         Y COORD.= 515
 7  X COORD.= 753            Y COORD.= 466
 8  X COORD.= 900            Y COORD.= 462.82

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +1.044     -0.013     -0.027
 2        -0.003     -0.042     -0.019
 3        -0.015     +0.264
 4        +0.000     +0.187     +0.000     -0.332     +0.000     -0.332
          -0.022

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

```
FOR ZONE 1     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 4
UNIT WEIGHT OF WATER= 62.4

SOIL NO.       COHESION       FRIC. ANGLE    UNIT WEIGHT
 1              340            34.6           127
 2              200            30.7           113.5
 3              0              0              62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 6
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 332.14         Y COORD.= 554
 3  X COORD.= 500            Y COORD.= 524.3
 4  X COORD.= 725            Y COORD.= 475
 5  X COORD.= 753            Y COORD.= 466
 6  X COORD.= 900            Y COORD.= 462.82

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 580      Y COORD.= 835
POINT 2 X COORD.= 580      Y COORD.= 560
POINT 3 X COORD.= 800      Y COORD.= 560

X INCREMENT= 20              Y INCREMENT= 20
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID


IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER  X    CENTER  Y        NO. OF CIRCLE          LOWEST    WARNING
COORDINATE   COORDINATE    TOTAL CRITIC. RADIUS       F.S.
  580          835          11     2     364.059      2.032       0
  580          780          11     2     309.622      1.976       0
  580          725          11     2     255.185      1.932       0
  580          670          11     2     200.748      1.969       0
  580          615          11     9     143.195      2.203       0
  580          560          11     9      88.897      2.971       0
  635          835          11     9     364.949      1.787       0
  635          780          11     9     310.024      1.780       0
  635          725          11     9     255.135      1.834       0
```

635	670	11	9	200.322	1.963	0
635	615	11	9	145.700	2.173	0
635	560	11	9	91.390	2.591	0
690	835	5	1	380.188	1.845	0
690	780	5	1	325.193	1.889	0
690	725	5	1	270.197	1.945	0
690	670	11	7	202.779	1.885	0
690	615	11	8	146.691	1.837	0
690	560	11	8	92.673	1.849	0
745	835	11	3	367.629	2.023	0
745	780	11	3	313.750	1.907	0
745	725	11	9	258.492	1.890	0
745	670	11	10	203.513	1.968	0
745	615	11	8	148.812	2.072	0
745	560	17	15	93.430	2.396	0
800	835	11	4	371.899	2.656	0
800	780	8	1	327.217	3.523	0
800	725	8	1	272.237	4.375	0
800	670	5	1	217.256	6.149	0
800	615	5	1	162.276	10.851	0
800	560	5	1	107.295	29.147	0

AT POINT (635 780) RADIUS 310.024

THE MINIMUM FACTOR OF SAFETY IS 1.780

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
635	780	11	9	310.024	1.780	0
655	780	11	9	310.960	1.779	0
675	780	5	1	324.998	1.856	0
655	800	11	9	330.878	1.764	0
655	820	11	9	350.808	1.756	0
655	840	11	9	370.745	1.752	0
655	860	11	9	390.690	1.758	0
675	840	11	9	371.843	1.752	0
695	840	11	9	373.229	1.830	0
675	860	11	9	391.737	1.744	0
675	880	11	9	411.642	1.740	0
675	900	11	9	431.556	1.741	0
695	880	11	9	412.904	1.774	0
655	880	11	9	410.640	1.762	0
680	880	11	9	411.933	1.741	0
670	880	11	9	411.367	1.742	0
675	885	11	9	416.620	1.740	0
675	890	11	9	421.598	1.740	0
680	885	11	9	416.909	1.740	0
670	885	11	9	416.348	1.743	0

AT POINT (675 885) RADIUS 416.620

THE MINIMUM FACTOR OF SAFETY IS 1.740

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 1

Soil TP-10
Seismic Case
Action Level for Phreatic Line

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -ogrs16

TITLE -Oak Grove Resources LLC Concord Preparation Plant  Slurry 6

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1    SEISMIC COEFFICIENT= .1

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 4
 1  X COORD.= 0              Y COORD.= 41
 2  X COORD.= 400            Y COORD.= 458.55
 3  X COORD.= 750            Y COORD.= 454
 4  X COORD.= 900            Y COORD.= 450

NO. OF POINTS ON BOUNDARY LINE 2 = 4
 1  X COORD.= 83.42          Y COORD.= 474.99
 2  X COORD.= 395.22         Y COORD.= 474
 3  X COORD.= 450            Y COORD.= 471.72
 4  X COORD.= 753            Y COORD.= 466

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 0              Y COORD.= 476.26
 2  X COORD.= 83.42          Y COORD.= 474.99
 3  X COORD.= 382.14         Y COORD.= 554

NO. OF POINTS ON BOUNDARY LINE 4 = 8
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 382.14         Y COORD.= 554
 3  X COORD.= 414.25         Y COORD.= 560
 4  X COORD.= 439.45         Y COORD.= 560
 5  X COORD.= 575.13         Y COORD.= 515
 6  X COORD.= 605.27         Y COORD.= 515
 7  X COORD.= 753            Y COORD.= 466
 8  X COORD.= 900            Y COORD.= 462.82

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +1.044     -0.013     -0.027
 2        -0.003     -0.042     -0.019
 3        -0.015     +0.264
 4        +0.000     +0.187     +0.000     -0.332     +0.000     -0.332
          -0.022

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 4
UNIT WEIGHT OF WATER= 62.4

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	272	34.6	127
2	400	29.2	117
3	0	0	62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 6

1	X COORD.= 0	Y COORD.= 554
2	X COORD.= 382.14	Y COORD.= 554
3	X COORD.= 500	Y COORD.= 524.3
4	X COORD.= 725	Y COORD.= 475
5	X COORD.= 753	Y COORD.= 466
6	X COORD.= 900	Y COORD.= 462.82

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 580 Y COORD.= 835
POINT 2 X COORD.= 580 Y COORD.= 560
POINT 3 X COORD.= 800 Y COORD.= 560

X INCREMENT= 20 Y INCREMENT= 20
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
580	835	11	2	364.059	1.461	0
580	780	11	2	309.622	1.451	0
580	725	11	2	255.185	1.452	0
580	670	11	2	200.748	1.508	0
580	615	11	2	146.311	1.706	0
580	560	11	9	88.897	2.262	0
635	835	5	1	379.473	1.362	0
635	780	5	1	324.478	1.372	0
635	725	5	1	269.482	1.406	0

635	670	5	1	214.487	1.503	0
635	615	5	1	159.492	1.678	0
635	560	5	1	104.496	2.025	0
690	835	5	1	380.188	1.341	0
690	780	5	1	325.193	1.374	0
690	725	5	1	270.197	1.410	0
690	670	5	1	215.202	1.454	0
690	615	5	1	160.206	1.495	0
690	560	5	1	105.211	1.563	0
745	835	5	1	380.903	1.535	0
745	780	5	1	325.907	1.561	0
745	725	5	1	270.912	1.558	0
745	670	5	1	215.917	1.566	0
745	615	5	1	160.921	1.651	0
745	560	5	1	105.926	1.807	0
800	835	5	1	382.197	2.050	0
800	780	5	1	327.217	2.277	0
800	725	5	1	272.237	2.620	0
800	670	5	1	217.256	3.194	0
800	615	5	1	162.276	4.160	0
800	560	5	1	107.295	5.511	0

AT POINT (690 835) RADIUS 380.188

THE MINIMUM FACTOR OF SAFETY IS 1.341

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
690	835	5	1	380.188	1.341	0
710	835	5	1	380.448	1.392	0
670	835	5	1	379.928	1.324	0
650	835	5	1	379.668	1.338	0
670	855	5	1	399.926	1.318	0
670	875	5	1	419.925	1.319	0
690	855	5	1	400.186	1.333	0
650	855	5	1	399.666	1.336	0
675	855	5	1	399.991	1.320	0
665	855	5	1	399.861	1.321	0
670	860	5	1	404.926	1.318	0
670	865	5	1	409.925	1.318	0
675	860	5	1	404.991	1.318	0
665	860	5	1	404.861	1.321	0

AT POINT (670 860) RADIUS 404.926

THE MINIMUM FACTOR OF SAFETY IS 1.318

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	2	13.422	7.095	0.000	-.648	0.111E+05	0.111E+05	0.461E+07	0.326E+07
2	2	22.750	22.871	5.913	-.604	0.609E+05	0.525E+05	0.133E+08	0.168E+08
3	2	2.450	32.032	11.899	-.572	0.918E+04	0.736E+04	0.173E+07	0.242E+07
4	2	33.723	38.358	19.260	-.528	0.151E+06	0.111E+06	0.259E+08	0.373E+08
5	2	36.172	46.158	29.843	-.441	0.195E+06	0.128E+06	0.306E+08	0.416E+08
6	2	36.172	49.817	37.287	-.352	0.211E+06	0.127E+06	0.314E+08	0.375E+08
7	2	17.015	49.962	41.425	-.286	0.995E+05	0.565E+05	0.145E+08	0.151E+08
8	1	12.538	49.173	41.302	-.250	0.727E+05	0.402E+05	0.118E+08	0.100E+08
9	1	6.560	49.431	41.551	-.226	0.382E+05	0.212E+05	0.626E+07	0.491E+07
10	1	23.580	52.630	41.447	-.189	0.147E+06	0.858E+05	0.254E+08	0.167E+08
11	1	12.593	53.599	40.542	-.144	0.801E+05	0.483E+05	0.144E+08	0.768E+07
12	1	36.172	48.316	38.004	-.084	0.209E+06	0.123E+06	0.377E+08	0.150E+08
13	1	36.172	37.747	31.507	0.005	0.164E+06	0.931E+05	0.300E+08	0.600E+07
14	1	36.172	23.939	21.771	0.095	0.105E+06	0.558E+05	0.198E+08	0.886E+05
15	1	26.620	9.298	9.162	0.172	0.303E+05	0.151E+05	0.728E+07	-.918E+06
16	1	9.553	1.194	1.194	0.217	0.145E+04	0.737E+03	0.129E+07	-.700E+05
							SUM	0.276E+09	0.213E+09

AT CENTER (670.000, 860.000) WITH RADIUS 404.926 AND SEISMIC COEFF. 0.10
FACTOR OF SAFETY BY NORMAL METHOD IS 1.293
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.318

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 3

Soil TP-15
Seismic Case
Action Level for Phreatic Line

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -OGRSL6  Revised 04-02-15

TITLE -Oak Grove Resources LLC Concord Preparation Plant  Slurry 6

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1     SEISMIC COEFFICIENT= .1

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 4
 1  X COORD.= 0              Y COORD.= 41
 2  X COORD.= 400            Y COORD.= 458.55
 3  X COORD.= 750            Y COORD.= 454
 4  X COORD.= 900            Y COORD.= 450

NO. OF POINTS ON BOUNDARY LINE 2 = 4
 1  X COORD.= 83.42          Y COORD.= 474.99
 2  X COORD.= 395.22         Y COORD.= 474
 3  X COORD.= 450            Y COORD.= 471.72
 4  X COORD.= 753            Y COORD.= 466

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 0              Y COORD.= 476.26
 2  X COORD.= 83.42          Y COORD.= 474.99
 3  X COORD.= 382.14         Y COORD.= 554

NO. OF POINTS ON BOUNDARY LINE 4 = 8
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 382.14         Y COORD.= 554
 3  X COORD.= 414.25         Y COORD.= 560
 4  X COORD.= 439.45         Y COORD.= 560
 5  X COORD.= 573.13         Y COORD.= 515
 6  X COORD.= 605.27         Y COORD.= 515
 7  X COORD.= 753            Y COORD.= 466
 8  X COORD.= 900            Y COORD.= 462.82

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +1.044     -0.013     -0.027
 2        -0.003     -0.042     -0.019
 3        -0.015     +0.264
 4        +0.000     +0.187     +0.000     -0.332     +0.000     -0.332
          -0.022

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

```
FOR ZONE 1     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 4
UNIT WEIGHT OF WATER= 62.4

SOIL NO.       COHESION       FRIC. ANGLE    UNIT WEIGHT
 1              340            34.6           127
 2              160            30.7           113.5
 3              0              0              62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 6
 1  X COORD.= 0              Y COORD.= 554
 2  X COORD.= 382.14         Y COORD.= 554
 3  X COORD.= 500            Y COORD.= 524.3
 4  X COORD.= 725            Y COORD.= 475
 5  X COORD.= 753            Y COORD.= 466
 6  X COORD.= 900            Y COORD.= 462.82

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 580      Y COORD.= 835
POINT 2 X COORD.= 580      Y COORD.= 560
POINT 3 X COORD.= 800      Y COORD.= 560

X INCREMENT= 20              Y INCREMENT= 20
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID


IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER  X   CENTER  Y        NO. OF CIRCLE          LOWEST   WARNING
COORDINATE  COORDINATE    TOTAL CRITIC.  RADIUS      F.S.
  580          835          11     2     364.059     1.328      0
  580          780          11     2     309.622     1.318      0
  580          725          11     2     255.185     1.320      0
  580          670          11     2     200.748     1.374      0
  580          615          11     9     143.195     1.537      0
  580          560          11     9      88.897     2.037      0
  635          835          11     9     364.949     1.223      0
  635          780          11     9     310.024     1.229      0
  635          725          11     9     255.135     1.267      0
```

635	670	11	9	200.322	1.345	0
635	615	11	9	145.700	1.476	0
635	560	11	6	91.390	1.751	0
690	835	11	9	367.898	1.244	0
690	780	11	10	311.100	1.276	0
690	725	11	10	256.937	1.284	0
690	670	11	7	202.779	1.286	0
690	615	11	8	146.691	1.282	0
690	560	11	8	92.673	1.311	0
745	835	11	3	367.629	1.372	0
745	780	11	3	313.750	1.309	0
745	725	11	9	258.492	1.310	0
745	670	11	10	203.513	1.353	0
745	615	11	8	148.812	1.407	0
745	560	17	15	93.430	1.591	0
800	835	11	4	371.899	1.804	0
800	780	8	1	327.217	2.213	0
800	725	8	1	272.237	2.575	0
800	670	5	1	217.256	3.197	0
800	615	5	1	162.276	4.288	0
800	560	5	1	107.295	5.959	0

AT POINT (635 835) RADIUS 364.949

THE MINIMUM FACTOR OF SAFETY IS 1.223

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
635	835	11	9	364.949	1.223	0
655	835	11	9	365.760	1.207	0
675	835	11	9	366.872	1.208	0
655	855	11	9	385.703	1.207	0
655	815	11	9	345.824	1.212	0
660	835	11	9	366.010	1.206	0
665	835	11	9	366.279	1.206	0
670	835	11	9	366.566	1.206	0
665	840	11	9	371.258	1.204	0
665	845	11	9	376.237	1.203	0
665	850	11	9	381.217	1.202	0
665	855	11	9	386.198	1.202	0
665	860	11	9	391.179	1.201	0
665	865	11	9	396.160	1.200	0
665	870	11	9	401.142	1.200	0
665	875	11	9	406.125	1.200	0
670	870	11	9	401.407	1.199	0
675	870	11	9	401.688	1.199	0
680	870	11	9	401.986	1.200	0
675	875	11	9	406.665	1.198	0
675	880	11	9	411.642	1.197	0
675	885	11	9	416.620	1.197	0

675	890	11	9	421.598	1.197	0
675	895	11	9	426.577	1.196	0
675	900	11	9	431.556	1.196	0
680	895	11	9	426.859	1.196	0
685	895	11	9	427.157	1.197	0
680	900	11	9	431.836	1.196	0
680	905	11	9	436.813	1.195	0
680	910	11	9	441.790	1.195	0
680	915	11	9	446.769	1.195	0
685	910	11	9	442.079	1.195	0
675	910	11	9	441.517	1.197	0

AT POINT (680 910) RADIUS 441.790

THE MINIMUM FACTOR OF SAFETY IS 1.195

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	2	3.089	1.468	0.000	-.605	0.515E+03	0.515E+03	0.374E+06	0.156E+06
2	2	25.200	12.069	0.000	-.573	0.345E+05	0.345E+05	0.908E+07	0.997E+07
3	2	4.166	21.213	0.937	-.540	0.100E+05	0.979E+04	0.237E+07	0.275E+07
4	2	32.455	26.263	7.446	-.498	0.967E+05	0.817E+05	0.200E+08	0.249E+08
5	2	32.455	32.406	16.174	-.425	0.119E+06	0.866E+05	0.218E+08	0.270E+08
6	2	32.455	35.323	22.491	-.351	0.130E+06	0.846E+05	0.220E+08	0.254E+08
7	2	32.455	35.327	26.148	-.278	0.130E+06	0.772E+05	0.209E+08	0.213E+08
8	2	1.696	34.236	26.979	-.239	0.659E+04	0.374E+04	0.103E+07	0.968E+06
9	2	30.140	37.568	27.104	-.203	0.129E+06	0.775E+05	0.214E+08	0.169E+08
10	2	0.619	40.375	26.644	-.168	0.233E+04	0.181E+04	0.499E+06	0.329E+06
11	2	32.455	37.394	25.525	-.131	0.138E+06	0.861E+05	0.242E+08	0.137E+08
12	2	32.455	29.706	21.490	-.058	0.109E+06	0.659E+05	0.194E+08	0.745E+07
13	2	32.455	19.617	15.055	0.016	0.723E+05	0.418E+05	0.133E+08	0.261E+07
14	2	32.455	7.141	6.232	0.089	0.263E+05	0.137E+05	0.594E+07	0.110E+06
							SUM	0.182E+09	0.153E+09

AT CENTER (680.000, 910.000) WITH RADIUS 441.790 AND SEISMIC COEFF. 0.10
FACTOR OF SAFETY BY NORMAL METHOD IS 1.188
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.195

Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 3

Soil TP-10
Static Case
Revised 04-02-15

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -OGRSL6D Revised 04-02-15

TITLE -OAK GROVE RESOURCES LLC SLURRY 6  CROSS SECTION D-D

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1     SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 6
 1  X COORD.= 0              Y COORD.= 495
 2  X COORD.= 47.98          Y COORD.= 504.45
 3  X COORD.= 132.87         Y COORD.= 527
 4  X COORD.= 180            Y COORD.= 540.94
 5  X COORD.= 218.26         Y COORD.= 532.28
 6  X COORD.= 304            Y COORD.= 512.3

NO. OF POINTS ON BOUNDARY LINE 2 = 5
 1  X COORD.= 47.98          Y COORD.= 519.45
 2  X COORD.= 132.87         Y COORD.= 542
 3  X COORD.= 180            Y COORD.= 555.94
 4  X COORD.= 218.26         Y COORD.= 547.28
 5  X COORD.= 252            Y COORD.= 541.55

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 212.86         Y COORD.= 554
 2  X COORD.= 252            Y COORD.= 541.55
 3  X COORD.= 304            Y COORD.= 527.3

NO. OF POINTS ON BOUNDARY LINE 4 = 7
 1  X COORD.= 0              Y COORD.= 510
 2  X COORD.= 47.98          Y COORD.= 519.45
 3  X COORD.= 146.15         Y COORD.= 552.4
 4  X COORD.= 168.78         Y COORD.= 560
 5  X COORD.= 193.97         Y COORD.= 560
 6  X COORD.= 212.86         Y COORD.= 554
 7  X COORD.= 304            Y COORD.= 554

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +0.197     +0.266     +0.296     -0.226     -0.233
 2        +0.266     +0.296     -0.226     -0.170
 3        -0.318     -0.274
 4        +0.197     +0.336     +0.336     +0.000     -0.318     +0.000

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 6
UNIT WEIGHT OF WATER= 62.4

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	340	34.6	127
2	500	29.2	117
3	0	0	62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 5
1 X COORD.= 0 Y COORD.= 510
2 X COORD.= 47.98 Y COORD.= 519.45
3 X COORD.= 146.15 Y COORD.= 552.4
4 X COORD.= 212.86 Y COORD.= 554
5 X COORD.= 304 Y COORD.= 554

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 20 Y COORD.= 685
POINT 2 X COORD.= 67 Y COORD.= 663
POINT 3 X COORD.= 120 Y COORD.= 560

X INCREMENT= 4 Y INCREMENT= 4
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 10
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 10
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
20	685	5	1	176.139	2.716	1
24.7	682.8	5	1	174.556	2.458	1
29.4	680.6	5	1	173.115	2.266	1
34.1	678.4	5	1	171.683	2.134	0
38.8	676.2	5	1	168.350	2.095	0
43.5	673.9999	5	1	165.017	2.061	0
48.2	671.7999	5	1	161.684	2.036	0
52.90001	669.5999	5	1	158.351	2.009	0
57.60001	667.3999	5	1	155.018	1.983	0

62.30001	665.1999	5	1	151.685	1.961	0
67.00001	662.9999	5	1	148.353	1.944	0
25.3	674.7	5	1	166.632	2.482	1
30	672.5	5	1	165.246	2.284	1
34.7	670.3	5	1	163.700	2.152	0
39.4	668.1	5	1	160.368	2.111	0
44.1	665.9	5	1	157.035	2.072	0
48.8	663.7	5	1	153.702	2.041	0
53.5	661.4999	5	1	150.369	2.017	0
58.2	659.2999	5	1	147.036	1.993	0
62.90001	657.0999	5	1	143.703	1.974	0
67.60001	654.8999	5	1	140.370	1.953	0
72.3	652.6999	5	1	137.037	1.943	0
30.6	664.4	5	1	157.403	2.302	1
35.3	662.2	5	1	155.718	2.171	0
40	660	5	1	152.385	2.129	0
44.7	657.8	5	1	149.052	2.088	0
49.4	655.6	5	1	145.719	2.052	0
54.1	653.4	5	1	142.386	2.022	0
58.8	651.2	5	1	139.053	2.000	0
63.5	648.9999	5	1	135.720	1.984	0
68.2	646.7999	5	1	132.387	1.966	0
72.9	644.5999	5	1	129.055	1.952	0
77.6	642.3999	5	1	125.722	1.956	0
35.9	654.1	5	1	147.735	2.196	0
40.6	651.9	5	1	144.402	2.150	0
45.3	649.7	5	1	141.070	2.106	0
50	647.5	5	1	137.737	2.068	0
54.7	645.3	5	1	134.404	2.035	0
59.4	643.1	5	1	131.071	2.006	0
64.1	640.9	5	1	127.738	1.990	0
68.8	638.7	5	1	124.405	1.977	0
73.49999	636.4999	5	1	121.072	1.967	0
78.19999	634.2999	5	1	117.739	1.969	0
82.89999	632.0999	5	1	114.406	1.981	0
41.2	643.8	5	1	136.420	2.176	0
45.9	641.6	5	1	133.087	2.128	0
50.6	639.4	5	1	129.754	2.086	0
55.3	637.2	5	1	126.421	2.052	0
60	635	5	1	123.088	2.019	0
64.7	632.8	5	1	119.755	1.997	0
69.39999	630.6	5	1	116.422	1.983	0
74.09999	628.4	5	1	113.090	1.981	0
78.79999	626.2	5	1	109.757	1.987	0
83.49998	623.9999	5	1	106.424	1.998	0
88.19998	621.7999	5	1	103.091	2.013	0
46.5	633.5001	5	1	125.105	2.154	0
51.2	631.3	5	1	121.772	2.110	0
55.9	629.1	5	1	118.439	2.071	0
60.6	626.9	5	1	115.106	2.038	0
65.3	624.7	5	1	111.773	2.014	0
69.99999	622.5	5	1	108.440	1.993	0
74.69999	620.3	5	1	105.107	1.989	0
79.39999	618.1	5	1	101.774	2.005	0
84.09998	615.9	5	1	98.441	2.020	0
88.79998	613.7	5	1	95.108	2.034	0
93.49998	611.4999	5	1	91.775	2.055	0
51.8	623.2001	5	1	113.789	2.137	0
56.5	621.0001	5	1	110.456	2.098	0

61.2	618.8	5	1	107.123	2.060	0
65.89999	616.6	5	1	103.790	2.035	0
70.59999	614.4	5	1	100.457	2.014	0
75.29999	612.2	5	1	97.124	2.006	0
79.99998	610	5	1	93.792	2.019	0
84.69998	607.8	5	1	90.459	2.041	0
89.39998	605.6	5	1	87.126	2.064	0
94.09998	603.4	5	1	83.793	2.083	0
98.79997	601.2	5	1	80.460	2.110	0
57.09999	612.9001	5	1	102.474	2.127	0
61.8	610.7001	5	1	99.141	2.089	0
66.49999	608.5001	5	1	95.808	2.063	0
71.19999	606.3	5	1	92.475	2.039	0
75.89999	604.1	5	1	89.142	2.037	0
80.59998	601.9	5	1	85.809	2.048	0
85.29998	599.7	5	1	82.476	2.065	0
89.99998	597.5	5	1	79.143	2.091	0
94.69997	595.3	5	1	75.810	2.122	0
99.39997	593.1	5	1	72.477	2.152	0
104.1	590.9	5	1	69.144	2.186	0
62.39999	602.6001	5	1	91.158	2.121	0
67.09999	600.4001	5	1	87.825	2.097	0
71.79999	598.2001	5	1	84.492	2.075	0
76.49998	596.0001	5	1	81.159	2.075	0
81.19998	593.8	5	1	77.827	2.090	0
85.89998	591.6	5	1	74.494	2.109	0
90.59998	589.4	5	1	71.161	2.131	0
95.29997	587.2	5	1	67.828	2.163	0
99.99997	585	5	1	64.495	2.207	0
104.7	582.8	5	1	61.162	2.254	0
109.4	580.6	5	1	57.829	2.301	0
67.7	592.3001	5	1	79.843	2.136	0
72.39999	590.1001	5	1	76.510	2.119	0
77.09999	587.9001	5	1	73.177	2.128	0
81.79999	585.7001	5	1	69.844	2.146	0
86.49998	583.5001	5	1	66.511	2.169	0
91.19998	581.3	5	1	63.178	2.199	0
95.89998	579.1	5	1	59.845	2.233	0
100.6	576.9	5	1	56.512	2.278	0
105.3	574.7	5	1	53.179	2.337	0
110	572.5	5	1	49.846	2.413	0
114.7	570.3	5	1	46.514	2.497	0
73	582.0001	5	1	68.527	2.173	0
77.7	579.8001	5	1	65.194	2.193	0
82.39999	577.6001	5	1	61.861	2.221	0
87.09999	575.4001	5	1	58.529	2.253	0
91.79999	573.2001	5	1	55.196	2.293	0
96.49998	571.0001	5	1	51.863	2.341	0
101.2	568.8	5	1	48.530	2.402	0
105.9	566.6	5	1	45.197	2.474	0
110.6	564.4	5	1	41.864	2.575	0
115.3	562.2	5	1	38.531	2.699	0
120	560	5	1	35.198	2.868	0

AT POINT (72.3 652.6999) RADIUS 137.037

THE MINIMUM FACTOR OF SAFETY IS 1.943

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
72.3	652.6999	5	1	137.037	1.943	0
76.3	652.6999	5	1	136.010	1.949	0
68.3	652.6999	5	1	138.064	1.953	0
72.3	656.6999	5	1	140.903	1.942	0
72.3	660.6999	5	1	144.769	1.942	0
76.3	656.6999	5	1	139.876	1.952	0
68.3	656.6999	5	1	141.930	1.947	0
73.3	656.6999	5	1	140.646	1.943	0
71.3	656.6999	5	1	141.160	1.942	0
70.3	656.6999	5	1	141.416	1.942	0
71.3	657.6999	5	1	142.126	1.942	0
71.3	658.6999	5	1	143.093	1.941	0
71.3	659.6999	5	1	144.059	1.941	0
71.3	660.6999	5	1	145.026	1.941	0
72.3	659.6999	5	1	143.802	1.942	0
70.3	659.6999	5	1	144.316	1.941	0

AT POINT (71.3 659.6999) RADIUS 144.059

THE MINIMUM FACTOR OF SAFETY IS 1.941

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	1	5.034	0.978	0.978	-.179	0.625E+03	0.318E+03	0.282E+06	-.161E+05
2	1	8.200	3.898	3.898	-.133	0.404E+04	0.204E+04	0.606E+06	-.776E+05
3	1	13.234	8.531	8.531	-.059	0.142E+05	0.716E+04	0.136E+07	-.121E+06
4	1	13.234	13.147	13.147	0.033	0.218E+05	0.110E+05	0.174E+07	0.103E+06
5	1	13.234	16.542	16.542	0.125	0.274E+05	0.138E+05	0.201E+07	0.493E+06
6	1	13.234	18.689	18.689	0.217	0.309E+05	0.155E+05	0.217E+07	0.964E+06
7	1	13.234	19.526	19.526	0.308	0.322E+05	0.161E+05	0.220E+07	0.143E+07
8	1	13.234	18.946	18.946	0.400	0.311E+05	0.154E+05	0.211E+07	0.179E+07
9	1	10.566	17.076	17.076	0.483	0.223E+05	0.110E+05	0.155E+07	0.155E+07
10	1	2.668	15.414	14.999	0.529	0.505E+04	0.255E+04	0.369E+06	0.385E+06
11	1	13.234	12.756	9.860	0.584	0.205E+05	0.124E+05	0.180E+07	0.173E+07
12	1	5.071	8.667	2.917	0.648	0.522E+04	0.429E+04	0.651E+06	0.487E+06
13	2	1.657	6.847	0.048	0.671	0.133E+04	0.132E+04	0.240E+06	0.128E+06
14	2	6.505	3.285	0.000	0.699	0.250E+04	0.250E+04	0.799E+06	0.252E+06
							SUM	0.179E+08	0.910E+07

AT CENTER (71.300, 659.700) WITH RADIUS 144.059 AND SEISMIC COEFF. 0.00
FACTOR OF SAFETY BY NORMAL METHOD IS 1.966
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.941

Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 3

Soil TP-15
Static Case
Revised 04-02-15

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -ogrsl6d  Revised 04-02-15

TITLE -OAK GROVE RESOURCES LLC SLURRY 6  CROSS SECTION D-D

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1     SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 6
 1  X COORD.= 0              Y COORD.= 495
 2  X COORD.= 47.98          Y COORD.= 504.45
 3  X COORD.= 132.87         Y COORD.= 527
 4  X COORD.= 180            Y COORD.= 540.94
 5  X COORD.= 218.26         Y COORD.= 532.28
 6  X COORD.= 304            Y COORD.= 512.3

NO. OF POINTS ON BOUNDARY LINE 2 = 5
 1  X COORD.= 47.98          Y COORD.= 519.45
 2  X COORD.= 132.87         Y COORD.= 542
 3  X COORD.= 180            Y COORD.= 555.94
 4  X COORD.= 218.26         Y COORD.= 547.28
 5  X COORD.= 252            Y COORD.= 541.55

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 212.86         Y COORD.= 554
 2  X COORD.= 252            Y COORD.= 541.55
 3  X COORD.= 304            Y COORD.= 527.3

NO. OF POINTS ON BOUNDARY LINE 4 = 7
 1  X COORD.= 0              Y COORD.= 510
 2  X COORD.= 47.98          Y COORD.= 519.45
 3  X COORD.= 146.15         Y COORD.= 552.4
 4  X COORD.= 168.78         Y COORD.= 560
 5  X COORD.= 193.97         Y COORD.= 560
 6  X COORD.= 212.86         Y COORD.= 554
 7  X COORD.= 304            Y COORD.= 554

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +0.197     +0.266     +0.296     -0.226     -0.233
 2        +0.266     +0.296     -0.226     -0.170
 3        -0.318     -0.274
 4        +0.197     +0.336     +0.336     +0.000     -0.318     +0.000

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 6
UNIT WEIGHT OF WATER= 62.4

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	340	34.6	127
2	200	30.7	113.5
3	0	0	62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 5
1 X COORD.= 0 Y COORD.= 510
2 X COORD.= 47.98 Y COORD.= 519.45
3 X COORD.= 146.15 Y COORD.= 552.4
4 X COORD.= 212.86 Y COORD.= 554
5 X COORD.= 304 Y COORD.= 554

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 20 Y COORD.= 685
POINT 2 X COORD.= 67 Y COORD.= 663
POINT 3 X COORD.= 120 Y COORD.= 560

X INCREMENT= 4 Y INCREMENT= 4
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 10
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 10
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
20	685	5	1	176.139	2.591	1
24.7	682.8	5	1	174.556	2.361	1
29.4	680.6	5	1	173.115	2.189	1
34.1	678.4	5	1	171.683	2.074	0
38.8	676.2	5	1	168.350	2.035	0
43.5	673.9999	5	1	165.017	2.002	0
48.2	671.7999	5	1	161.684	1.978	0
52.90001	669.5999	5	1	158.351	1.951	0
57.60001	667.3999	5	1	155.018	1.927	0

62.30001	665.1999	5	1	151.685	1.910	0
67.00001	662.9999	5	1	148.353	1.899	0
25.3	674.7	5	1	166.632	2.383	1
30	672.5	5	1	163.246	2.210	1
34.7	670.3	5	1	163.700	2.092	0
39.4	668.1	5	1	160.368	2.051	0
44.1	665.9	5	1	157.035	2.013	0
48.8	663.7	5	1	153.702	1.983	0
53.5	661.4999	5	1	150.369	1.960	0
58.2	659.2999	5	1	147.036	1.936	0
62.90001	657.0999	5	1	143.703	1.917	0
67.60001	654.8999	5	1	140.370	1.901	0
72.3	652.6999	5	1	137.037	1.897	0
30.6	664.4	5	1	157.403	2.231	1
35.3	662.2	5	1	155.718	2.112	0
40	660	5	1	152.385	2.070	0
44.7	657.8	5	1	149.052	2.029	0
49.4	655.6	5	1	145.719	1.994	0
54.1	653.4	5	1	142.386	1.965	0
58.8	651.2	5	1	139.053	1.944	0
63.5	648.9999	5	1	135.720	1.927	0
68.2	646.7999	5	1	132.387	1.909	0
72.9	644.5999	5	1	129.055	1.900	0
77.6	642.3999	5	1	125.722	1.907	0
35.9	654.1	5	1	147.735	2.138	0
40.6	651.9	5	1	144.402	2.092	0
45.3	649.7	5	1	141.070	2.048	0
50	647.5	5	1	137.737	2.011	0
54.7	645.3	5	1	134.404	1.978	0
59.4	643.1	5	1	131.071	1.949	0
64.1	640.9	5	1	127.738	1.934	0
68.8	638.7	5	1	124.405	1.921	0
73.49999	636.4999	5	1	121.072	1.911	0
78.19999	634.2999	5	1	117.739	1.913	0
82.89999	632.0999	5	1	114.406	1.927	0
41.2	643.8	5	1	136.420	2.118	0
45.9	641.6	5	1	133.087	2.071	0
50.6	639.4	5	1	129.754	2.029	0
55.3	637.2	5	1	126.421	1.995	0
60	635	5	1	123.088	1.963	0
64.7	632.8	5	1	119.755	1.941	0
69.39999	630.6	5	1	116.422	1.927	0
74.09999	628.4	5	1	113.090	1.925	0
78.79999	626.2	5	1	109.757	1.929	0
83.49998	623.9999	5	1	106.424	1.936	0
88.19998	621.7999	5	1	103.091	1.952	0
46.5	633.5001	5	1	125.105	2.098	0
51.2	631.3	5	1	121.772	2.054	0
55.9	629.1	5	1	118.439	2.015	0
60.6	626.9	5	1	115.106	1.982	0
65.3	624.7	5	1	111.773	1.958	0
69.99999	622.5	5	1	108.440	1.938	0
74.69999	620.3	5	1	105.107	1.934	0
79.39999	618.1	5	1	101.774	1.947	0
84.09998	615.9	5	1	98.441	1.958	0
88.79998	613.7	5	1	95.109	1.968	0
93.49998	611.4999	5	1	91.776	1.987	0
51.8	623.2001	5	1	113.789	2.092	0
56.5	621.0001	5	1	110.456	2.042	0

61.2	618.8	5	1	107.123	2.005	0
65.89999	616.6	5	1	103.790	1.980	0
70.59999	614.4	5	1	100.457	1.955	0
75.29999	612.2	5	1	97.124	1.951	0
79.99998	610	5	1	93.792	1.960	0
84.69998	607.8	5	1	90.459	1.979	0
89.39998	605.6	5	1	87.126	1.997	0
94.09998	603.4	5	1	83.793	2.012	0
98.79997	601.2	5	1	80.460	2.035	0
57.09999	612.9001	5	1	102.474	2.073	0
61.8	610.7001	5	1	99.141	2.035	0
66.49999	608.5001	5	1	95.808	2.009	0
71.19999	606.3	5	1	92.475	1.985	0
75.89999	604.1	5	1	89.142	1.982	0
80.59998	601.9	5	1	85.809	1.989	0
85.29998	599.7	5	1	82.476	2.002	0
89.99998	597.5	5	1	79.143	2.024	0
94.69997	595.3	5	1	75.810	2.050	0
99.39997	593.1	5	1	72.477	2.075	0
104.1	590.9	5	1	69.144	2.105	0
62.39999	602.6001	5	1	91.158	2.069	0
67.09999	600.4001	5	1	87.825	2.044	0
71.79999	598.2001	5	1	84.492	2.022	0
76.49998	596.0001	5	1	81.159	2.021	0
81.19998	593.8	5	1	77.827	2.031	0
85.89998	591.6	5	1	74.494	2.045	0
90.59998	589.4	5	1	71.161	2.062	0
95.29997	587.2	5	1	67.828	2.089	0
99.99997	585	5	1	64.495	2.128	0
104.7	582.8	5	1	61.162	2.169	0
109.4	580.6	5	1	57.829	2.211	0
67.7	592.3001	5	1	79.843	2.084	0
72.39999	590.1001	5	1	76.510	2.066	0
77.09999	587.9001	5	1	73.177	2.073	0
81.79999	585.7001	5	1	69.844	2.086	0
86.49998	583.5001	5	1	66.511	2.103	0
91.19998	581.3	5	1	63.178	2.128	0
95.89998	579.1	5	1	59.845	2.156	0
100.6	576.9	5	1	56.512	2.196	0
105.3	574.7	5	1	53.179	2.249	0
110	572.5	5	1	49.846	2.318	0
114.7	570.3	5	1	46.514	2.395	0
73	582.0001	5	1	68.527	2.123	0
77.7	579.8001	5	1	65.194	2.138	0
82.39999	577.6001	5	1	61.861	2.159	0
87.09999	575.4001	5	1	58.529	2.186	0
91.79999	573.2001	5	1	55.196	2.219	0
96.49998	571.0001	5	1	51.863	2.261	0
101.2	568.8	5	1	48.530	2.315	0
105.9	566.6	5	1	45.197	2.380	0
110.6	564.4	5	1	41.864	2.473	0
115.3	562.2	5	1	38.531	2.588	0
120	560	5	1	35.198	2.747	0

AT POINT (72.3 652.6999) RADIUS 137.037

THE MINIMUM FACTOR OF SAFETY IS 1.897

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
72.3	652.6999	5	1	137.037	1.897	0
76.3	652.6999	5	1	136.010	1.908	0
68.3	652.6999	5	1	138.064	1.901	0
72.3	656.6999	5	1	140.903	1.899	0
72.3	648.6999	5	1	133.171	1.896	0
72.3	644.6999	5	1	129.305	1.900	0
76.3	648.6999	5	1	132.144	1.905	0
68.3	648.6999	5	1	134.198	1.906	0
73.3	648.6999	5	1	132.914	1.897	0
71.3	648.6999	5	1	133.428	1.898	0
72.3	649.6999	5	1	134.138	1.896	0
72.3	650.6999	5	1	135.104	1.896	0
73.3	649.6999	5	1	133.881	1.897	0
71.3	649.6999	5	1	134.394	1.897	0

AT POINT (72.3 649.6999) RADIUS 134.138

THE MINIMUM FACTOR OF SAFETY IS 1.896

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	1	4.184	0.850	0.850	-.197	0.452E+03	0.230E+03	0.215E+06	-.119E+05
2	1	8.639	3.838	3.838	-.149	0.418E+04	0.211E+04	0.591E+06	-.835E+05
3	1	12.824	8.619	8.619	-.069	0.139E+05	0.696E+04	0.123E+07	-.128E+06
4	1	12.824	13.197	13.197	0.027	0.212E+05	0.106E+05	0.157E+07	0.752E+05
5	1	12.824	16.544	16.544	0.122	0.265E+05	0.132E+05	0.180E+07	0.433E+06
6	1	12.824	18.635	18.635	0.218	0.297E+05	0.148E+05	0.193E+07	0.867E+06
7	1	12.824	19.403	19.403	0.313	0.308E+05	0.153E+05	0.196E+07	0.129E+07
8	1	12.824	18.734	18.734	0.409	0.296E+05	0.146E+05	0.187E+07	0.162E+07
9	1	12.588	16.471	16.472	0.504	0.253E+05	0.123E+05	0.165E+07	0.171E+07
10	1	0.236	14.640	14.603	0.551	0.418E+03	0.203E+03	0.286E+05	0.310E+05
11	1	12.824	12.231	10.158	0.600	0.188E+05	0.106E+05	0.152E+07	0.151E+07
12	1	3.850	8.238	3.565	0.662	0.366E+04	0.280E+04	0.429E+06	0.325E+06
13	2	5.720	5.403	0.000	0.698	0.351E+04	0.351E+04	0.414E+06	0.328E+06
14	2	3.254	1.777	0.000	0.731	0.656E+03	0.656E+03	0.164E+06	0.644E+05
							SUM	0.154E+08	0.803E+07

AT CENTER (72.300, 649.700) WITH RADIUS 134.138 AND SEISMIC COEFF. 0.00
FACTOR OF SAFETY BY NORMAL METHOD IS 1.913
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.896

Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 3

Soil TP-10
Seismic Case
Revised 04-02-15

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -ogrsl6d  Revised 04-02-15

TITLE -OAK GROVE RESOURCES LLC SLURRY 6  CROSS SECTION D-D

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1    SEISMIC COEFFICIENT= .1

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 6
 1  X COORD.= 0              Y COORD.= 495
 2  X COORD.= 47.98          Y COORD.= 504.45
 3  X COORD.= 132.87         Y COORD.= 527
 4  X COORD.= 180            Y COORD.= 540.94
 5  X COORD.= 218.26         Y COORD.= 532.28
 6  X COORD.= 304            Y COORD.= 512.3

NO. OF POINTS ON BOUNDARY LINE 2 = 5
 1  X COORD.= 47.98          Y COORD.= 519.45
 2  X COORD.= 132.87         Y COORD.= 542
 3  X COORD.= 180            Y COORD.= 555.94
 4  X COORD.= 218.26         Y COORD.= 547.28
 5  X COORD.= 252            Y COORD.= 541.55

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 212.86         Y COORD.= 554
 2  X COORD.= 252            Y COORD.= 541.55
 3  X COORD.= 304            Y COORD.= 527.3

NO. OF POINTS ON BOUNDARY LINE 4 = 7
 1  X COORD.= 0              Y COORD.= 510
 2  X COORD.= 47.98          Y COORD.= 519.45
 3  X COORD.= 146.15         Y COORD.= 552.4
 4  X COORD.= 168.78         Y COORD.= 560
 5  X COORD.= 193.97         Y COORD.= 560
 6  X COORD.= 212.86         Y COORD.= 554
 7  X COORD.= 304            Y COORD.= 554

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +0.197     +0.266     +0.296     -0.226     -0.233
 2        +0.266     +0.296     -0.226     -0.170
 3        -0.318     -0.274
 4        +0.197     +0.336     +0.336     +0.000     -0.318     +0.000

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 6
UNIT WEIGHT OF WATER= 62.4

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	272	34.6	127
2	400	29.2	117
3	0	0	62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 5
1 X COORD.= 0 Y COORD.= 510
2 X COORD.= 47.98 Y COORD.= 519.45
3 X COORD.= 146.15 Y COORD.= 552.4
4 X COORD.= 212.86 Y COORD.= 554
5 X COORD.= 304 Y COORD.= 554

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 20 Y COORD.= 685
POINT 2 X COORD.= 67 Y COORD.= 663
POINT 3 X COORD.= 120 Y COORD.= 560

X INCREMENT= 4 Y INCREMENT= 4
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 10
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 10
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
20	685	5	1	176.139	1.743	1
24.7	682.8	5	1	174.556	1.595	1
29.4	680.6	5	1	173.115	1.486	1
34.1	678.4	5	1	171.683	1.412	0
38.8	676.2	5	1	168.350	1.392	0
43.5	673.9999	5	1	165.017	1.375	0
48.2	671.7999	5	1	161.684	1.363	0
52.90001	669.5999	5	1	158.351	1.349	0
57.60001	667.3999	5	1	155.018	1.336	0

62.30001	665.1999	5	1	151.685	1.325	0
67.00001	662.9999	5	1	148.353	1.317	0
25.3	674.7	5	1	166.632	1.609	1
30	672.5	5	1	165.246	1.497	1
34.7	670.3	5	1	163.700	1.423	0
39.4	668.1	5	1	160.368	1.401	0
44.1	665.9	5	1	157.035	1.382	0
48.8	663.7	5	1	153.702	1.366	0
53.5	661.4999	5	1	150.369	1.355	0
58.2	659.2999	5	1	147.036	1.343	0
62.90001	657.0999	5	1	143.703	1.333	0
67.60001	654.8999	5	1	140.370	1.322	0
72.3	652.6999	5	1	137.037	1.319	0
30.6	664.4	5	1	157.403	1.508	1
35.3	662.2	5	1	155.718	1.435	0
40	660	5	1	152.385	1.413	0
44.7	657.8	5	1	149.052	1.391	0
49.4	655.6	5	1	145.719	1.373	0
54.1	653.4	5	1	142.386	1.358	0
58.8	651.2	5	1	139.053	1.347	0
63.5	648.9999	5	1	135.720	1.340	0
68.2	646.7999	5	1	132.387	1.331	0
72.9	644.5999	5	1	129.055	1.325	0
77.6	642.3999	5	1	125.722	1.329	0
35.9	654.1	5	1	147.735	1.451	0
40.6	651.9	5	1	144.402	1.426	0
45.3	649.7	5	1	141.070	1.403	0
50	647.5	5	1	137.737	1.383	0
54.7	645.3	5	1	134.404	1.366	0
59.4	643.1	5	1	131.071	1.351	0
64.1	640.9	5	1	127.738	1.344	0
68.8	638.7	5	1	124.405	1.338	0
73.49999	636.4999	5	1	121.072	1.334	0
78.19999	634.2999	5	1	117.739	1.338	0
82.89999	632.0999	5	1	114.406	1.348	0
41.2	643.8	5	1	136.420	1.443	0
45.9	641.6	5	1	133.087	1.418	0
50.6	639.4	5	1	129.754	1.395	0
55.3	637.2	5	1	126.421	1.377	0
60	635	5	1	123.088	1.360	0
64.7	632.8	5	1	119.755	1.349	0
69.39999	630.6	5	1	116.422	1.343	0
74.09999	628.4	5	1	113.090	1.344	0
78.79999	626.2	5	1	109.757	1.350	0
83.49998	623.9999	5	1	106.424	1.360	0
88.19998	621.7999	5	1	103.091	1.372	0
46.5	633.5001	5	1	125.105	1.435	0
51.2	631.3	5	1	121.772	1.411	0
55.9	629.1	5	1	118.439	1.391	0
60.6	626.9	5	1	115.106	1.373	0
65.3	624.7	5	1	111.773	1.361	0
69.99999	622.5	5	1	108.440	1.351	0
74.69999	620.3	5	1	105.107	1.350	0
79.39999	618.1	5	1	101.774	1.362	0
84.09998	615.9	5	1	98.441	1.374	0
88.79998	613.7	5	1	95.108	1.386	0
93.49998	611.4999	5	1	91.775	1.403	0
51.8	623.2001	5	1	113.789	1.430	0
56.5	621.0001	5	1	110.456	1.409	0

61.2	618.8	5	1	107.123	1.389	0
65.89999	616.6	5	1	103.790	1.376	0
70.59999	614.4	5	1	100.457	1.365	0
75.29999	612.2	5	1	97.124	1.362	0
79.99998	610	5	1	93.792	1.373	0
84.69998	607.8	5	1	90.459	1.390	0
89.39998	605.6	5	1	87.126	1.407	0
94.09998	603.4	5	1	83.793	1.423	0
98.79997	601.2	5	1	80.460	1.444	0
57.09999	612.9001	5	1	102.474	1.429	0
61.8	610.7001	5	1	99.141	1.409	0
66.49999	608.5001	5	1	95.808	1.396	0
71.19999	606.3	5	1	92.475	1.384	0
75.89999	604.1	5	1	89.142	1.384	0
80.59998	601.9	5	1	85.809	1.394	0
85.29998	599.7	5	1	82.476	1.408	0
89.99998	597.5	5	1	79.143	1.427	0
94.69997	595.3	5	1	75.810	1.450	0
99.39997	593.1	5	1	72.477	1.473	0
104.1	590.9	5	1	69.144	1.500	0
62.39999	602.6001	5	1	91.158	1.433	0
67.09999	600.4001	5	1	87.825	1.421	0
71.79999	598.2001	5	1	84.492	1.410	0
76.49998	596.0001	5	1	81.159	1.412	0
81.19998	593.8	5	1	77.827	1.424	0
85.89998	591.6	5	1	74.494	1.439	0
90.59998	589.4	5	1	71.161	1.457	0
95.29997	587.2	5	1	67.828	1.481	0
99.99997	585	5	1	64.495	1.513	0
104.7	582.8	5	1	61.162	1.548	0
109.4	580.6	5	1	57.829	1.584	0
67.7	592.3001	5	1	79.843	1.449	0
72.39999	590.1001	5	1	76.510	1.441	0
77.09999	587.9001	5	1	73.177	1.450	0
81.79999	585.7001	5	1	69.844	1.465	0
86.49998	583.5001	5	1	66.511	1.483	0
91.19998	581.3	5	1	63.178	1.505	0
95.89998	579.1	5	1	59.845	1.532	0
100.6	576.9	5	1	56.512	1.565	0
105.3	574.7	5	1	53.179	1.609	0
110	572.5	5	1	49.846	1.663	0
114.7	570.3	5	1	46.514	1.726	0
73	582.0001	5	1	68.527	1.481	0
77.7	579.8001	5	1	65.194	1.497	0
82.39999	577.6001	5	1	61.861	1.518	0
87.09999	575.4001	5	1	58.529	1.543	0
91.79999	573.2001	5	1	55.196	1.573	0
96.49998	571.0001	5	1	51.863	1.609	0
101.2	568.8	5	1	48.530	1.655	0
105.9	566.6	5	1	45.197	1.709	0
110.6	564.4	5	1	41.864	1.782	0
115.3	562.2	5	1	38.531	1.873	0
120	560	5	1	35.198	1.995	0

AT POINT (67.00001 662.9999) RADIUS 148.353

THE MINIMUM FACTOR OF SAFETY IS 1.317

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
67.00001	662.9999	5	1	148.353	1.317	0
71.00001	662.9999	5	1	147.326	1.317	0
75.00001	662.9999	5	1	146.299	1.324	0
71.00001	666.9999	5	1	151.192	1.318	0
71.00001	658.9999	5	1	143.460	1.317	0
72.00001	662.9999	5	1	147.069	1.318	0
70.00001	662.9999	5	1	147.582	1.316	0
69.00001	662.9999	5	1	147.839	1.316	0
68.00001	662.9999	5	1	148.096	1.316	0
69.00001	663.9999	5	1	148.806	1.316	0
69.00001	664.9999	5	1	149.772	1.316	0
69.00001	665.9999	5	1	150.738	1.316	0
70.00001	664.9999	5	1	149.515	1.316	0
68.00001	664.9999	5	1	150.029	1.316	0

AT POINT (69.00001 664.9999) RADIUS 149.772

THE MINIMUM FACTOR OF SAFETY IS 1.316

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	1	7.511	1.419	1.419	-.165	0.135E+04	0.689E+03	0.383E+06	-.136E+05
2	1	6.022	4.146	4.146	-.120	0.316E+04	0.160E+04	0.415E+06	-.106E+05
3	1	13.533	8.288	8.288	-.055	0.141E+05	0.712E+04	0.130E+07	0.892E+05
4	1	13.533	12.963	12.963	0.035	0.220E+05	0.111E+05	0.169E+07	0.432E+06
5	1	13.533	16.410	16.410	0.126	0.278E+05	0.140E+05	0.195E+07	0.915E+06
6	1	13.533	18.602	18.602	0.216	0.315E+05	0.158E+05	0.208E+07	0.145E+07
7	1	13.533	19.477	19.477	0.306	0.328E+05	0.164E+05	0.209E+07	0.194E+07
8	1	13.533	18.928	18.928	0.397	0.318E+05	0.158E+05	0.197E+07	0.230E+07
9	1	10.948	17.070	17.070	0.479	0.230E+05	0.114E+05	0.143E+07	0.194E+07
10	1	2.585	15.421	15.018	0.524	0.489E+04	0.247E+04	0.315E+06	0.443E+06
11	1	13.533	12.807	9.891	0.578	0.211E+05	0.127E+05	0.162E+07	0.207E+07
12	1	5.348	8.719	2.858	0.641	0.554E+04	0.458E+04	0.611E+06	0.592E+06
13	2	1.163	7.016	0.140	0.662	0.955E+03	0.945E+03	0.147E+06	0.105E+06
14	2	7.022	3.456	0.000	0.690	0.284E+04	0.284E+04	0.737E+06	0.324E+06
							SUM	0.167E+08	0.126E+08

AT CENTER (69.000, 665.000) WITH RADIUS 149.772 AND SEISMIC COEFF. 0.10
FACTOR OF SAFETY BY NORMAL METHOD IS 1.331
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.316

Analysis of Multilayered Embankments)

Oak Grove Resources, LLC.
Concord Preparation Plant, MSHA 01-00329
Slurry Impoundment No. 6
Embankment No. 3

Soil TP-15
Seismic Case
Revised 04-02-15

```
REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -OGRSL6D  04-02-15

TITLE -OAK GROVE RESOURCES LLC SLURRY 6  CROSS SECTION D-D

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1    SEISMIC COEFFICIENT= .1

NO. OF BOUNDARY LINES= 4

NO. OF POINTS ON BOUNDARY LINE 1 = 6
 1  X COORD.= 0              Y COORD.= 495
 2  X COORD.= 47.98          Y COORD.= 504.45
 3  X COORD.= 132.87         Y COORD.= 527
 4  X COORD.= 180            Y COORD.= 540.94
 5  X COORD.= 218.26         Y COORD.= 532.28
 6  X COORD.= 304            Y COORD.= 512.3

NO. OF POINTS ON BOUNDARY LINE 2 = 5
 1  X COORD.= 47.98          Y COORD.= 519.45
 2  X COORD.= 132.87         Y COORD.= 542
 3  X COORD.= 180            Y COORD.= 555.94
 4  X COORD.= 218.26         Y COORD.= 547.28
 5  X COORD.= 252            Y COORD.= 541.55

NO. OF POINTS ON BOUNDARY LINE 3 = 3
 1  X COORD.= 212.86         Y COORD.= 554
 2  X COORD.= 252            Y COORD.= 541.55
 3  X COORD.= 304            Y COORD.= 527.3

NO. OF POINTS ON BOUNDARY LINE 4 = 7
 1  X COORD.= 0              Y COORD.= 510
 2  X COORD.= 47.98          Y COORD.= 519.45
 3  X COORD.= 146.15         Y COORD.= 552.4
 4  X COORD.= 168.78         Y COORD.= 560
 5  X COORD.= 193.97         Y COORD.= 560
 6  X COORD.= 212.86         Y COORD.= 554
 7  X COORD.= 304            Y COORD.= 554

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
 1        +0.197     +0.266     +0.296     -0.226     -0.233
 2        +0.266     +0.296     -0.226     -0.170
 3        -0.318     -0.274
 4        +0.197     +0.336     +0.336     +0.000     -0.318     +0.000

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 1

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 5
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1
```

FOR ZONE 1 LINE SEQUENCE 1
LINE NO.= 1 BEG. NO.= 1 END NO.= 6
UNIT WEIGHT OF WATER= 62.4

SOIL NO.	COHESION	FRIC. ANGLE	UNIT WEIGHT
1	272	34.6	127
2	160	30.7	113.5
3	0	0	62.4

USE PHREATIC SURFACE
USE GRID
NO. OF SLICES= 10
NO. OF ADD. RADII= 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

NO. OF POINTS ON WATER TABLE= 5
1 X COORD.= 0 Y COORD.= 510
2 X COORD.= 47.98 Y COORD.= 519.45
3 X COORD.= 146.15 Y COORD.= 552.4
4 X COORD.= 212.86 Y COORD.= 554
5 X COORD.= 304 Y COORD.= 554

NO. OF SOILS WITH DIFFERENT WATER TABLE= 0
NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 20 Y COORD.= 685
POINT 2 X COORD.= 67 Y COORD.= 663
POINT 3 X COORD.= 120 Y COORD.= 560

X INCREMENT= 4 Y INCREMENT= 4
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 10
NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 10
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
20	685	5	1	176.139	1.670	1
24.7	682.8	5	1	174.556	1.538	1
29.4	680.6	5	1	173.115	1.441	1
34.1	678.4	5	1	171.683	1.376	0
38.8	676.2	5	1	168.350	1.357	0
43.5	673.9999	5	1	165.017	1.340	0
48.2	671.7999	5	1	161.684	1.329	0
52.90001	669.5999	5	1	158.351	1.315	0
57.60001	667.3999	5	1	155.018	1.302	0

62.30001	665.1999	5	1	151.685	1.294	0
67.00001	662.9999	5	1	148.353	1.288	0
25.3	674.7	5	1	166.632	1.554	1
30	672.5	5	1	165.246	1.453	1
34.7	670.3	5	1	163.710	1.387	0
39.4	668.1	5	1	160.368	1.366	0
44.1	665.9	5	1	157.035	1.347	0
48.8	663.7	5	1	153.702	1.331	0
53.5	661.4999	5	1	150.369	1.320	0
58.2	659.2999	5	1	147.036	1.308	0
62.90001	657.0999	5	1	143.703	1.299	0
67.60001	654.8999	5	1	140.370	1.291	0
72.3	652.6999	5	1	137.037	1.290	0
30.6	664.4	5	1	157.403	1.466	1
35.3	662.2	5	1	155.718	1.400	0
40	660	5	1	152.385	1.378	0
44.7	657.8	5	1	149.052	1.357	0
49.4	655.6	5	1	145.719	1.338	0
54.1	653.4	5	1	142.386	1.324	0
58.8	651.2	5	1	139.053	1.313	0
63.5	648.9999	5	1	135.720	1.306	0
68.2	646.7999	5	1	132.387	1.297	0
72.9	644.5999	5	1	129.055	1.293	0
77.6	642.3999	5	1	125.722	1.299	0
35.9	654.1	5	1	147.735	1.417	0
40.6	651.9	5	1	144.402	1.392	0
45.3	649.7	5	1	141.070	1.369	0
50	647.5	5	1	137.737	1.349	0
54.7	645.3	5	1	134.404	1.332	0
59.4	643.1	5	1	131.071	1.317	0
64.1	640.9	5	1	127.738	1.311	0
68.8	638.7	5	1	124.405	1.305	0
73.49999	636.4999	5	1	121.072	1.301	0
78.19999	634.2999	5	1	117.739	1.304	0
82.89999	632.0999	5	1	114.406	1.314	0
41.2	643.8	5	1	136.420	1.409	0
45.9	641.6	5	1	133.087	1.384	0
50.6	639.4	5	1	129.754	1.362	0
55.3	637.2	5	1	126.421	1.343	0
60	635	5	1	123.088	1.327	0
64.7	632.8	5	1	119.755	1.316	0
69.39999	630.6	5	1	116.422	1.310	0
74.09999	628.4	5	1	113.090	1.311	0
78.79999	626.2	5	1	109.757	1.315	0
83.49998	623.9999	5	1	106.424	1.322	0
88.19998	621.7999	5	1	103.091	1.334	0
46.5	633.5001	5	1	125.105	1.402	0
51.2	631.3	5	1	121.772	1.378	0
55.9	629.1	5	1	118.439	1.358	0
60.6	626.9	5	1	115.106	1.340	0
65.3	624.7	5	1	111.773	1.328	0
69.99999	622.5	5	1	108.440	1.317	0
74.69999	620.3	5	1	105.107	1.317	0
79.39999	618.1	5	1	101.774	1.327	0
84.09998	615.9	5	1	98.441	1.337	0
88.79998	613.7	5	1	95.108	1.346	0
93.49998	611.4999	5	1	91.775	1.361	0
51.8	623.2001	5	1	113.789	1.397	0
56.5	621.0001	5	1	110.456	1.376	0

61.2	618.8	5	1	107.123	1.356	0
65.89999	616.6	5	1	103.790	1.343	0
70.59999	614.4	5	1	100.457	1.332	0
75.29999	612.2	5	1	97.124	1.330	0
79.99998	610	5	1	93.792	1.338	0
84.69998	607.8	5	1	90.459	1.352	0
89.39998	605.6	5	1	87.126	1.366	0
94.09998	603.4	5	1	83.793	1.379	0
98.79997	601.2	5	1	80.460	1.397	0
57.09999	612.9001	5	1	102.474	1.398	0
61.8	610.7001	5	1	99.141	1.377	0
66.49999	608.5001	5	1	95.808	1.364	0
71.19999	606.3	5	1	92.475	1.352	0
75.89999	604.1	5	1	89.142	1.351	0
80.59998	601.9	5	1	85.809	1.358	0
85.29998	599.7	5	1	82.476	1.369	0
89.99998	597.5	5	1	79.143	1.386	0
94.69997	595.3	5	1	75.810	1.406	0
99.39997	593.1	5	1	72.477	1.426	0
104.1	590.9	5	1	69.144	1.449	0
62.39999	602.6001	5	1	91.158	1.402	0
67.09999	600.4001	5	1	87.825	1.389	0
71.79999	598.2001	5	1	84.492	1.378	0
76.49998	596.0001	5	1	81.159	1.380	0
81.19998	593.8	5	1	77.827	1.388	0
85.89998	591.6	5	1	74.494	1.400	0
90.59998	589.4	5	1	71.161	1.415	0
95.29997	587.2	5	1	67.828	1.435	0
99.99997	585	5	1	64.495	1.464	0
104.7	582.8	5	1	61.162	1.495	0
109.4	580.6	5	1	57.829	1.528	0
67.7	592.3001	5	1	79.843	1.419	0
72.39999	590.1001	5	1	76.510	1.411	0
77.09999	587.9001	5	1	73.177	1.417	0
81.79999	585.7001	5	1	69.844	1.429	0
86.49998	583.5001	5	1	66.511	1.443	0
91.19998	581.3	5	1	63.178	1.462	0
95.89998	579.1	5	1	59.845	1.485	0
100.6	576.9	5	1	56.512	1.515	0
105.3	574.7	5	1	53.179	1.554	0
110	572.5	5	1	49.846	1.604	0
114.7	570.3	5	1	46.514	1.662	0
73	582.0001	5	1	68.527	1.451	0
77.7	579.8001	5	1	65.194	1.464	0
82.39999	577.6001	5	1	61.861	1.481	0
87.09999	575.4001	5	1	58.529	1.502	0
91.79999	573.2001	5	1	55.196	1.529	0
96.49998	571.0001	5	1	51.863	1.560	0
101.2	568.8	5	1	48.530	1.601	0
105.9	566.6	5	1	45.197	1.650	0
110.6	564.4	5	1	41.864	1.718	0
115.3	562.2	11	6	37.560	1.799	0
120	560	11	8	32.247	1.906	0

AT POINT (67.00001 662.9999) RADIUS 148.353

THE MINIMUM FACTOR OF SAFETY IS 1.289

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
67.00001	662.9999	5	1	148.353	1.289	0
71.00001	662.9999	5	1	147.326	1.292	0
63.00001	662.9999	5	1	149.379	1.294	0
67.00001	666.9999	5	1	152.218	1.290	0
67.00001	658.9999	5	1	144.487	1.290	0
68.00001	662.9999	5	1	148.096	1.289	0
66.00001	662.9999	5	1	148.609	1.290	0
67.00001	663.9999	5	1	149.319	1.289	0
67.00001	661.9999	5	1	147.386	1.289	0
67.00001	660.9999	5	1	146.420	1.289	0
68.00001	661.9999	5	1	147.129	1.289	0
69.00001	661.9999	5	1	146.873	1.290	0
68.00001	662.9999	5	1	148.096	1.289	0
68.00001	660.9999	5	1	146.163	1.289	0
68.00001	659.9999	5	1	145.196	1.289	0
68.00001	658.9999	5	1	144.230	1.289	0
68.00001	657.9999	5	1	143.263	1.289	0
69.00001	658.9999	5	1	143.973	1.289	0
67.00001	658.9999	5	1	144.487	1.290	0

AT POINT (68.00001 658.9999) RADIUS 144.230

THE MINIMUM FACTOR OF SAFETY IS 1.289

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	SLICE SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	1	8.895	1.714	1.714	-.170	0.194E+04	0.985E+03	0.454E+06	-.200E+05
2	1	4.485	4.333	4.333	-.123	0.246E+04	0.125E+04	0.303E+06	-.905E+04
3	1	13.380	8.160	8.160	-.061	0.137E+05	0.691E+04	0.122E+07	0.706E+05
4	1	13.380	12.851	12.851	0.031	0.215E+05	0.108E+05	0.159E+07	0.394E+06
5	1	13.380	16.296	16.296	0.124	0.272E+05	0.136E+05	0.184E+07	0.855E+06
6	1	13.380	18.467	18.467	0.217	0.307E+05	0.153E+05	0.196E+07	0.137E+07
7	1	13.380	19.301	19.301	0.310	0.320E+05	0.159E+05	0.195E+07	0.184E+07
8	1	13.380	18.685	18.685	0.403	0.308E+05	0.152E+05	0.183E+07	0.216E+07
9	1	13.380	16.443	16.443	0.495	0.268E+05	0.131E+05	0.160E+07	0.223E+07
10	1	13.380	12.294	10.215	0.588	0.197E+05	0.111E+05	0.143E+07	0.189E+07
11	1	4.236	8.309	3.483	0.649	0.406E+04	0.314E+04	0.430E+06	0.423E+06
12	2	5.037	5.733	0.000	0.681	0.328E+04	0.328E+04	0.345E+06	0.356E+06
13	2	4.107	2.131	0.000	0.713	0.994E+03	0.994E+03	0.189E+06	0.112E+06
							SUM	0.152E+08	0.117E+08

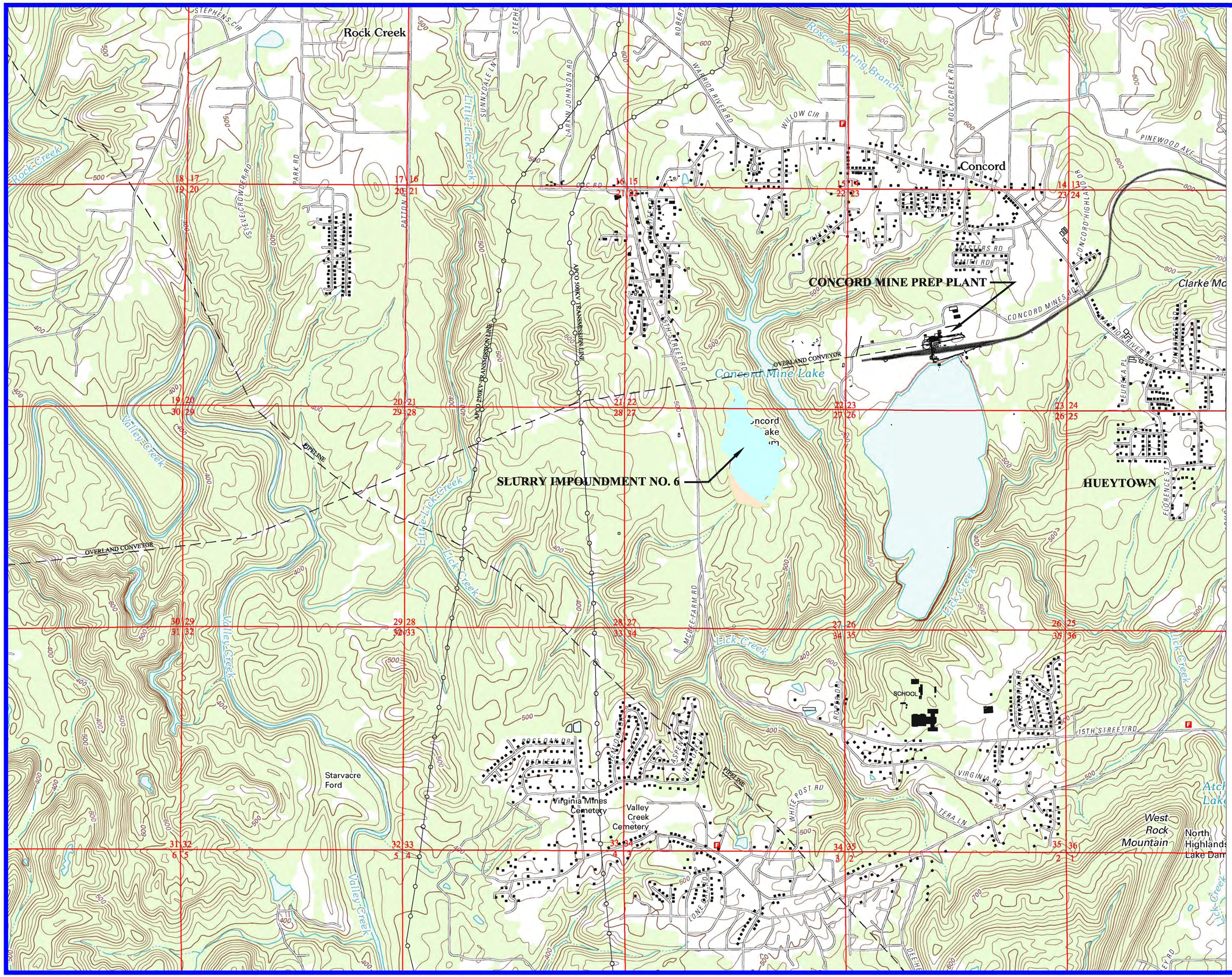
AT CENTER (68.000, 659.000) WITH RADIUS 144.230 AND SEISMIC COEFF. 0.10
FACTOR OF SAFETY BY NORMAL METHOD IS 1.299
FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.289

APPENDIX D

MAPS AND DRAWINGS

LIST OF REVISED MAPS & DRAWINGS

MAP/DRAWING	SHEET	REVISION	DATE
Plan View	2 of 10	No. 1 No. 2	04-02-15 07-14-15
Watershed	3 of 10	No. 1	07-14-15
Standard Details	5 of 10	No. 1 No. 2	04-01-15 07-14-15
Geotechnical Inv.	6 of 10	No. 1	04-02-15
Abandonment	10 of 10	No. 1	07-14-15



mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

SECTIONS 22 & 27,
TOWNSHIP 18 SOUTH, RANGE 5 WEST,
ALL IN JEFFERSON COUNTY, ALABAMA.
BASE MAP: CONCORD U.S.G.S. QUADRANGLE

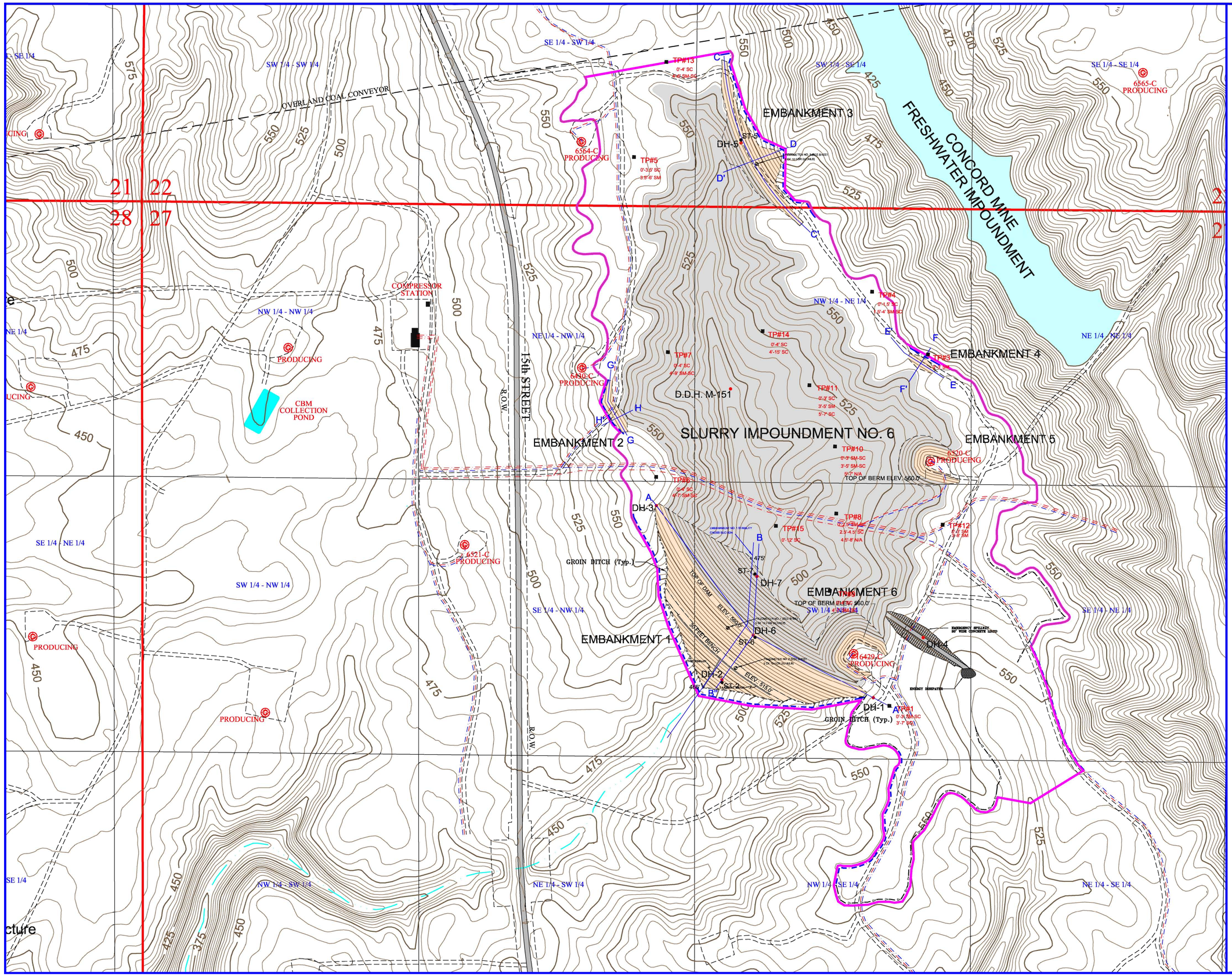
CONTOUR INTERVAL: 20 FT.

OAK GROVE RESOURCES, LLC

CONCORD PREP PLANT
MSHA I.D. NO.: 01-00329

SLURRY IMPOUNDMENT NO. 6
VICINITY MAP

FILE: OGR-SLURRY6	SCALE: 1" = 1,000'	JOB NO.: 14-118
APPROVED BY: C.W.M.	DATE: 04/28/14	SHEET NO.: 1 OF 10



mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

MAP LEGEND

- ASMC Permit Boundary
- Slurry Impoundment Normal Pool
- Impounded Water
- Embankment
- Section Line
- Quarter-Quarter Section Line
- Silt Fence
- Diversion Ditch
- Drainage Divide
- Existing Surface Contour
- 525 Existing Surface Contour
- DH-5 Foundation Investigation Bore Holes
- ST-5 Shelby Tube Location
- Private Access Roads
- Drainage Course
- 16429-C PRODUCING Coal Bed Methane Well
- Coalbed Methane Gas Pipeline
- Coalbed Methane Water Pipeline
- D D' Cross-Section

NOTES:

SURFACE AREAS WITHIN THE ASMC PERMIT BOUNDARY AND ABOVE THE TOP OF DAM ELEVATION OF 560 MSL MAY BE USED FOR EMBANKMENT CONSTRUCTION MATERIAL IF SUITABLE OR FOR FINAL COVER MATERIAL.

N W E S

SECTIONS 22 & 27,
TOWNSHIP 18 SOUTH, RANGE 5 WEST,
ALL IN JEFFERSON COUNTY, ALABAMA.
BASE MAP: CONCORD U.S.G.S. QUADRANGLE

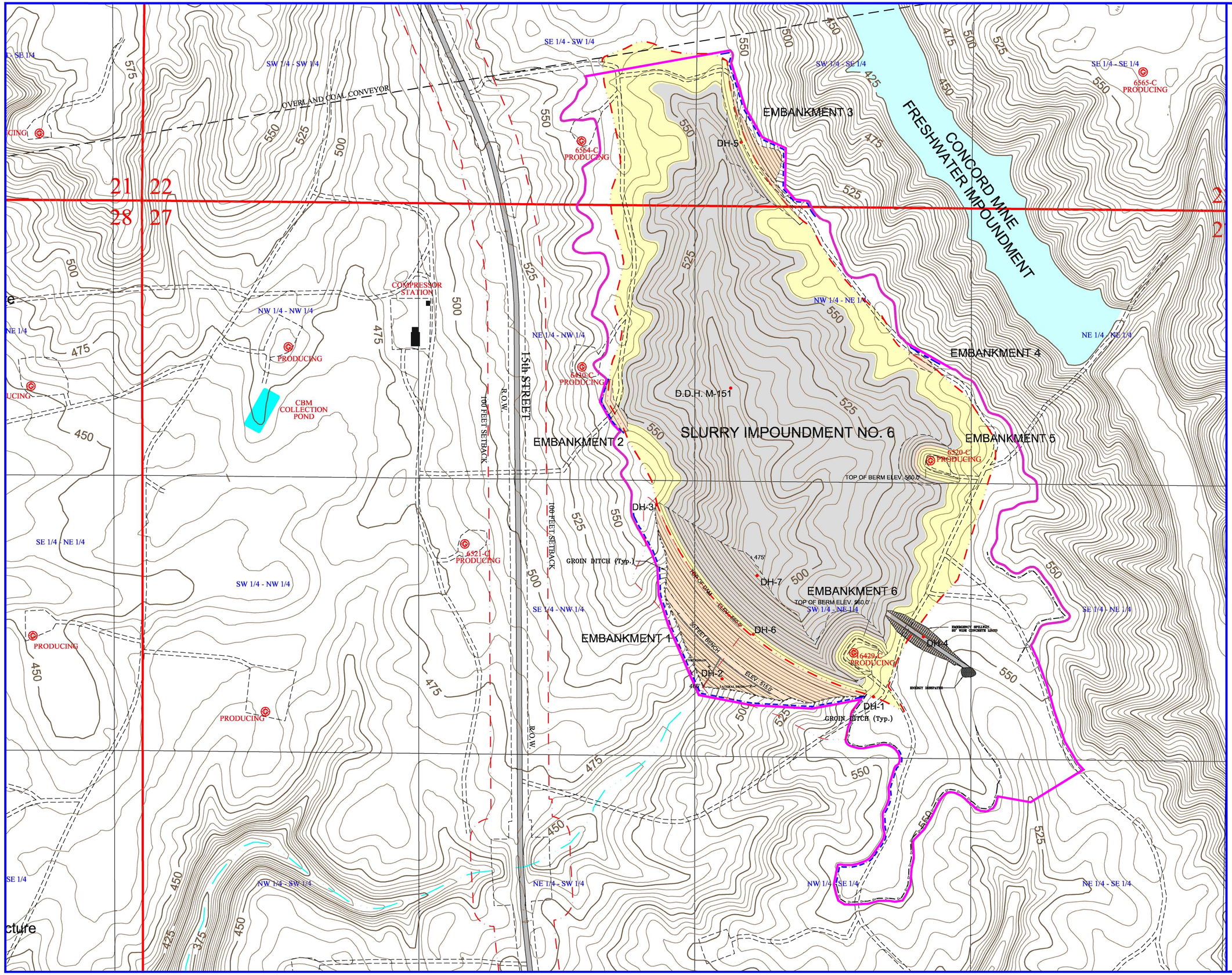
CONTOUR INTERVAL: 5 FT.

OAK GROVE RESOURCES, LLC

CONCORD MINE
MSHA ID. NO. 01-00329

SLURRY IMPOUNDMENT NO. 6
PLAN VIEW DRAWING

FILE: OGR-SLURRY	SCALE: 1" = 200'	JOB NO.:
APPROVED BY: J.G.A.	DATE: 06-13-14 REVISION #2 07-14-15	SHEET NO.: 2 OF 10



mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

MAP LEGEND

- ASMC Permit Boundary
- Slurry Impoundment Normal Pool
- Embankment
- Graded & Bare, C.N. 81
- Section Line
- Quarter-Quarter Section Line
- Silt Fence
- Diversion Ditch
- Drainage Divide
- Existing Surface Contour
- 525 Existing Surface Contour
- DH-5 Foundation Investigation Drill Holes
- Private Access Roads
- Drainage Course
- 16429-C Coal Bed Methane Well

NOTES:

SURFACE AREAS WITHIN THE ASMC PERMIT BOUNDARY AND ABOVE THE TOP OF DAM ELEVATION OF 560 MSL MAY BE USED FOR EMBANKMENT CONSTRUCTION MATERIAL IF SUITABLE OR FOR FINAL COVER MATERIAL.

N
W E
S

SECTIONS 22 & 27,
TOWNSHIP 18 SOUTH, RANGE 5 WEST,
ALL IN JEFFERSON COUNTY, ALABAMA.
BASE MAP: CONCORD U.S.G.S. QUADRANGLE

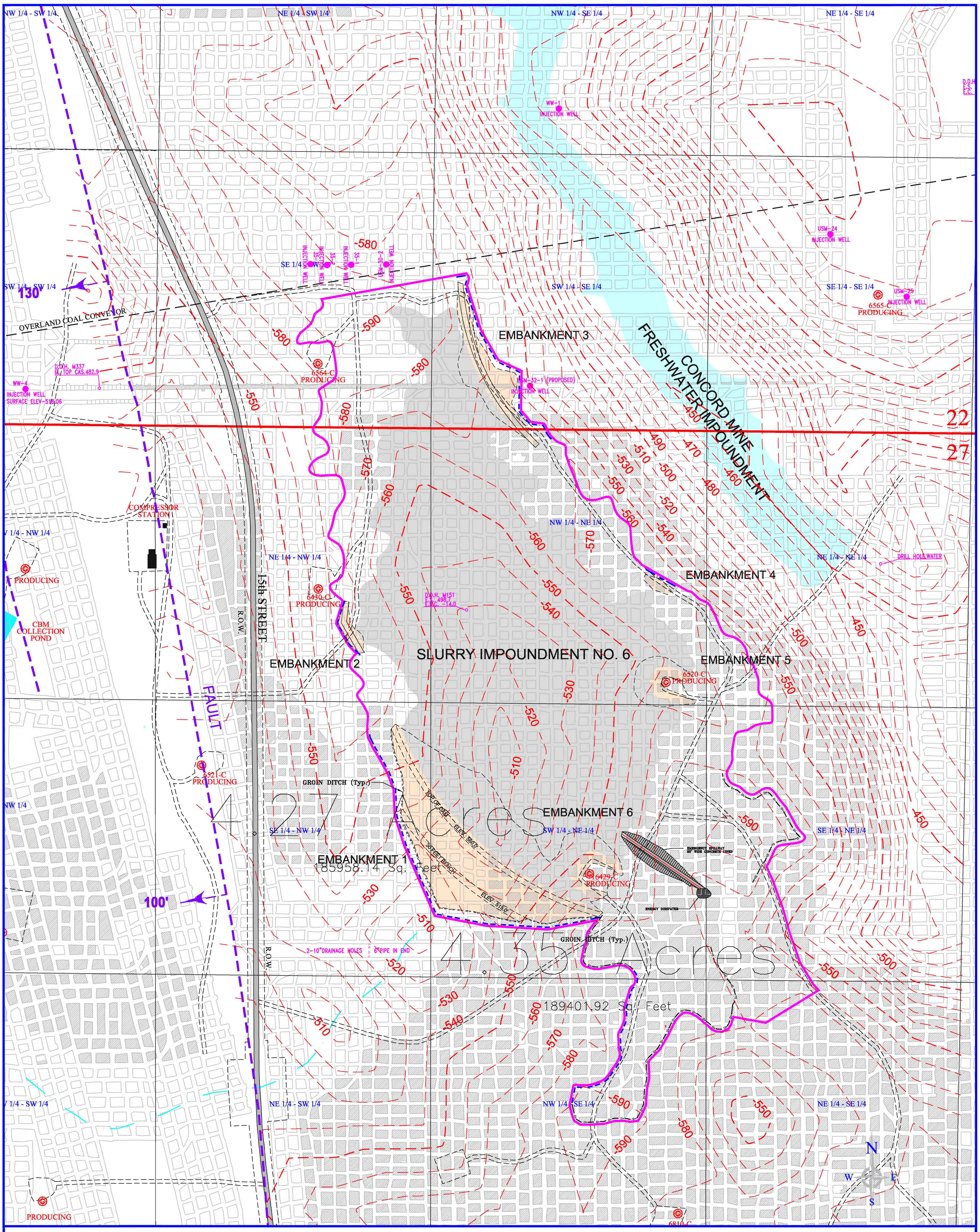
CONTOUR INTERVAL: 5 FT.

OAK GROVE RESOURCES, LLC

CONCORD MINE
MSHA ID. NO. 01-00329

SLURRY IMPOUNDMENT NO. 6
WATERSHED MAP (ACTIVE)

FILE: OGR-SLURRY	SCALE: 1" = 200'	JOB NO.:
APPROVED BY: J.G.A.	DATE: 06-13-14 REVISION #1 07-14-15	SHEET NO.: 3 OF 10



MAP LEGEND

- ASMC Permit Boundary
- Slurry Impoundment Normal Pool
- Embankment
- Section Line
- Quarter-Quarter Section Line
- Silt Fence
- Diversion Ditch
- Fault
- -540 American Coal Seam Depth Contour (Feet)
- D.D.H. M151 Exploration or Other Borehole
- Private Access Roads
- Drainage Course
- 16429-C Coal Bed Methane Well
- Coal Pillar (Abandoned Concord Mine)
- Coal Pillar Extracted (Abandoned Concord Mine)

SECTIONS 22 & 27,
TOWNSHIP 18 SOUTH, RANGE 5 WEST,
ALL IN JEFFERSON COUNTY, ALABAMA.
BASE MAP: CONCORD U.S.G.S. QUADRANGLE

CONTOUR INTERVAL: 5 FT.

mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

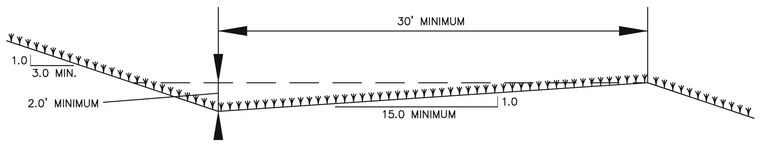
OAK GROVE RESOURCES, LLC

CONCORD MINE
MSHA ID. NO. 01-00329

SLURRY IMPOUNDMENT NO. 6
UNDEGROUND MINING MAP

FILE: OGR-SLURRY	SCALE: 1" = 200'	JOB NO.:
APPROVED BY: C.W.M.	DATE: 06/13/14	SHEET NO.: 4 OF 10

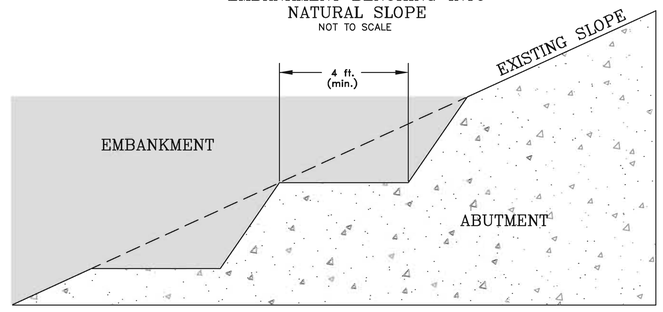
EMBANKMENT SLOPE BENCH TYPICAL CROSS SECTION
NOT TO SCALE

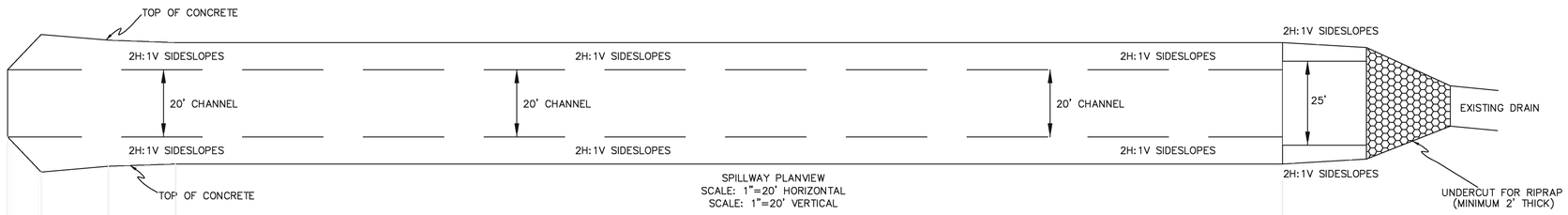


GRASS LINED EMBANKMENT SLOPE BENCH TO BE GRADED FROM CENTER OF EMBANKMENT TO EACH GROIN DITCH AT A GRADE NO STEEPER THAN 2% AND NO FLATTER THAN 1%.

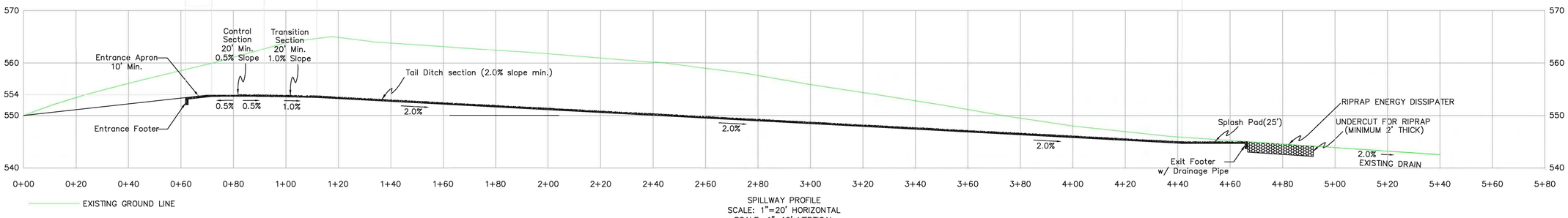
MAXIMUM DRAINAGE AREA = 1.5 ACRES
PEAK FLOW = 5.02 C.F.S. (100 YR. – 6 HR.)
MAXIMUM FLOW DEPTH = 1.31 FT.
DRY FREEBOARD = 0.69 FT.
SEE PLAN VIEW DRAWING FOR EMBANKMENT SLOPE BENCH LOCATION AND ELEVATION.

EMBANKMENT BENCHING INTO NATURAL SLOPE
NOT TO SCALE



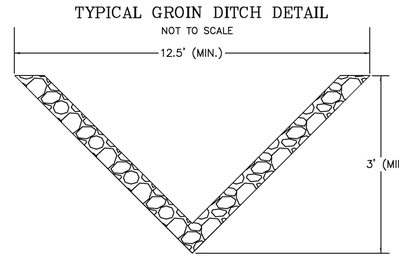


SPILLWAY PLANVIEW
SCALE: 1"=20' HORIZONTAL
SCALE: 1"=20' VERTICAL



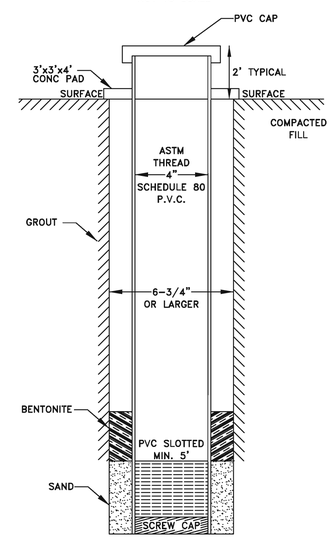
SPILLWAY PROFILE
SCALE: 1"=20' HORIZONTAL
SCALE: 1"=10' VERTICAL

TYPICAL GROIN DITCH DETAIL
NOT TO SCALE



RIPRAP CLASSIFICATION: CLASS 1 SANDSTONE OR LIMESTONE
MINIMUM LINER THICKNESS: 1.2 feet
Dmax: 12.00 In.
D50: 9.0 In.
Dmin: 2.0 In.

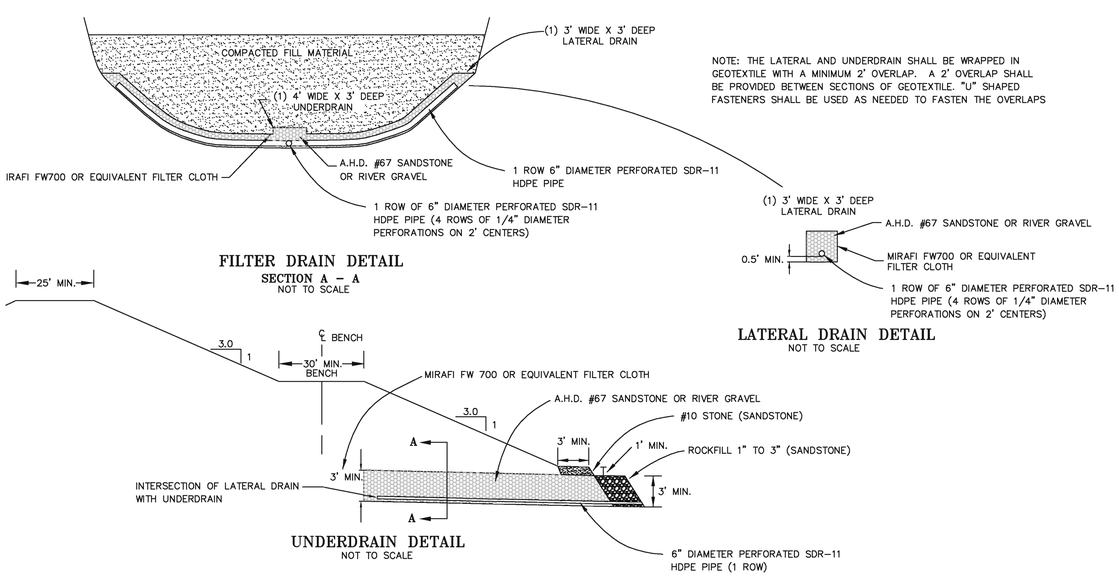
PIEZOMETER DETAIL
NOT TO SCALE



BOTTOM OF HOLE

PIEZOMETER APPROXIMATE SURFACE/BOTTOM ELEVATIONS			
PIEZOMETER/WELL	PIEZOMETER NO. 1	PIEZOMETER NO. 2	PIEZOMETER NO. 3
APP. SURFACE ELEV.	548 MSL	530 MSL	560 MSL
APP. BOTTOM OF HOLE ELEV.	470 MSL	470 MSL	545 MSL

ACTION LEVEL FOR PIEZOMETERS			
PIEZOMETER/WELL	PIEZOMETER NO. 1	PIEZOMETER NO. 2	PIEZOMETER NO. 3
ACTION LEVEL	535 MSL	505 MSL	None proposed

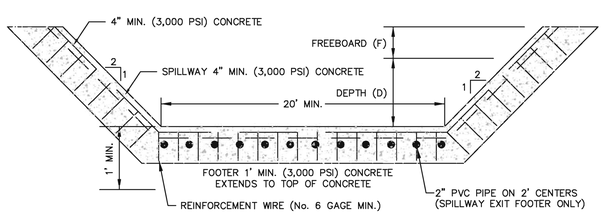


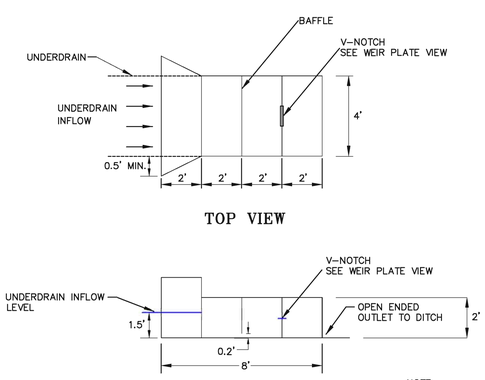
FILTER DRAIN DETAIL
SECTION A – A
NOT TO SCALE

LATERAL DRAIN DETAIL
NOT TO SCALE

UNDERDRAIN DETAIL
NOT TO SCALE

TYPICAL SPILLWAY FOOTER DETAIL
NOT TO SCALE

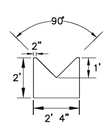




TOP VIEW

SIDE VIEW

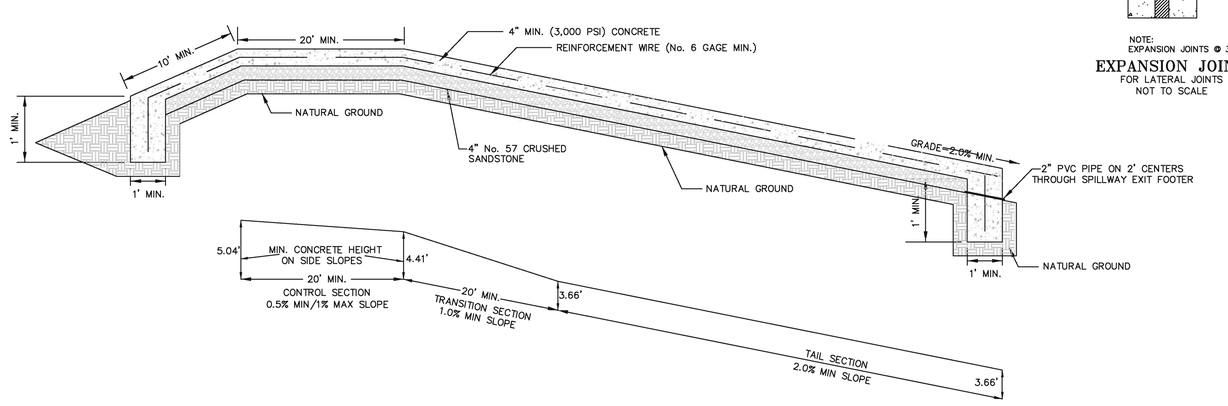
OUTLET WEIR DETAIL
NOT TO SCALE

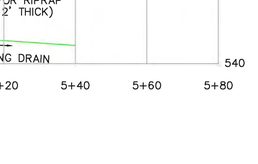


WEIR PLATE VIEW

NOTE:
1. WEIR BOX BOTTOM TO BE CONCRETE. SIDE WALLS TO BE 4"X6"X8" MASONARY BLOCK FILLED WITH CONCRETE. BAFFLE AND WEIR PLATE TO BE 1/4" MILD STEEL.
2. WEIR BOX TO BE SET LEVEL.
3. STAFF GAUGE TO BE INSTALLED IN WEIR BOX STILLING POOL.

TYPICAL SPILLWAY CROSS-SECTION
NOT TO SCALE

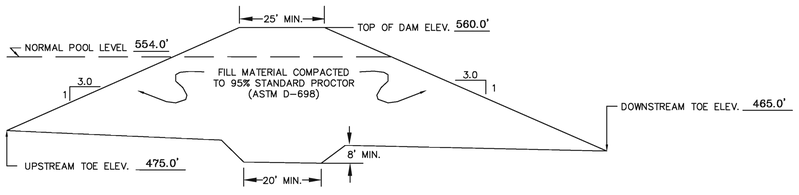




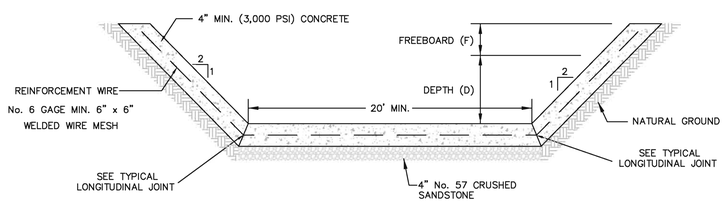
NOTE:
EXPANSION JOINTS @ 30' MAX. SPACING

EXPANSION JOINT
FOR LATERAL JOINTS
NOT TO SCALE

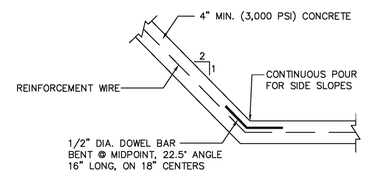
EMBANKMENT CROSS-SECTION
NOT TO SCALE



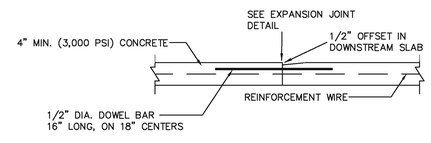
TYPICAL SPILLWAY CROSS-SECTION
NOT TO SCALE



	BEGINNING OF CONTROL SECTION	END OF CONTROL SECTION	END OF TRANSITION SECTION	ENTIRE TAIL SECTION
MAXIMUM FLOW DEPTH "D"	2.92'	2.18'	1.36'	1.36'
FREEBOARD "F"	2.12'	2.23'	2.30'	2.30'
MINIMUM CONCRETE HEIGHT ON SIDE SLOPES	5.04'	4.41'	3.66'	3.66'

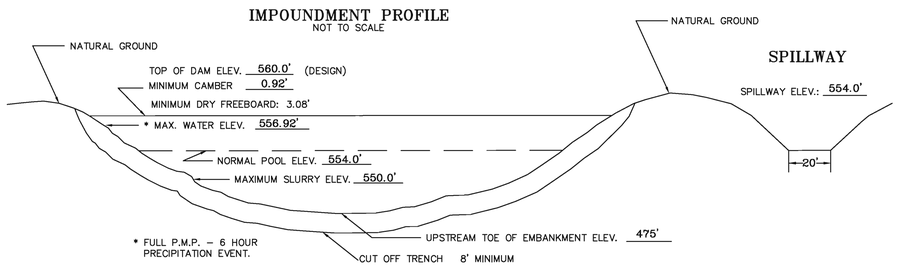


TYPICAL LONGITUDINAL JOINT
NOT TO SCALE



TYPICAL LATERAL JOINT
NOT TO SCALE

IMPOUNDMENT PROFILE
NOT TO SCALE

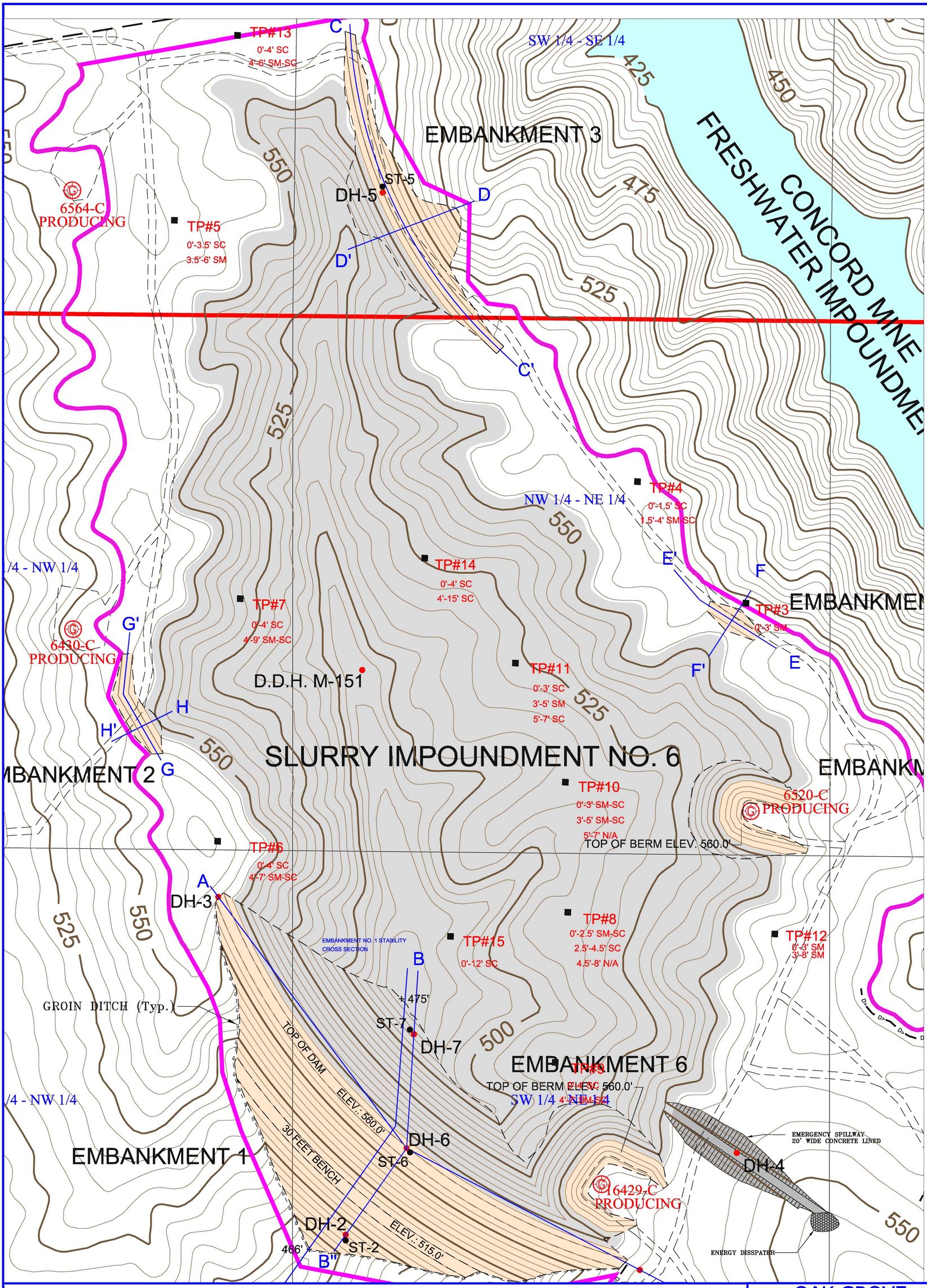


* FULL P.M.P. – 6 HOUR PRECIPITATION EVENT.

McGehee Engineering Corp.
P.O. Box 3431
450 19th Street West
Jasper, AL 35502-3431 PH: (205) 221-0686

FILE NAME: G:\MIN\STANDARDDETAILS.DWG	DATE: 06-12-14 REVISION NO. 2 07-14-15
SOURCE OF TITLE: N/A	DATE OF FIELD WORK: N/A
SURVEY TYPE: N/A	SCALE: AS SHOWN
FIELD BOOK: MLS	DRAWN BY: J.G.A.
CLOSURE: N/A	APPROVED BY: J.G.A.

OAK GROVE RESOURCES, LLC
Concord Mine, MSHA ID 01-00329
Slurry Impoundment No. 6
Standard Details Sheet Sheet 5 of 10



MAP LEGEND

- ASMC Permit Boundary
- Slurry Impoundment Normal Pool
- Embankment
- Section Line
- Quarter-Quarter Section Line
- TP#5 0'-4' SC — Foundation Investigation Test Pit & Soil Classification
- DH-5 — Foundation Investigation Drill Holes
- Private Access Roads
- 16429-C — Coal Bed Methane Well
- D — D' Cross-Section

N W E S

CONTOUR INTERVAL: 5 FT.

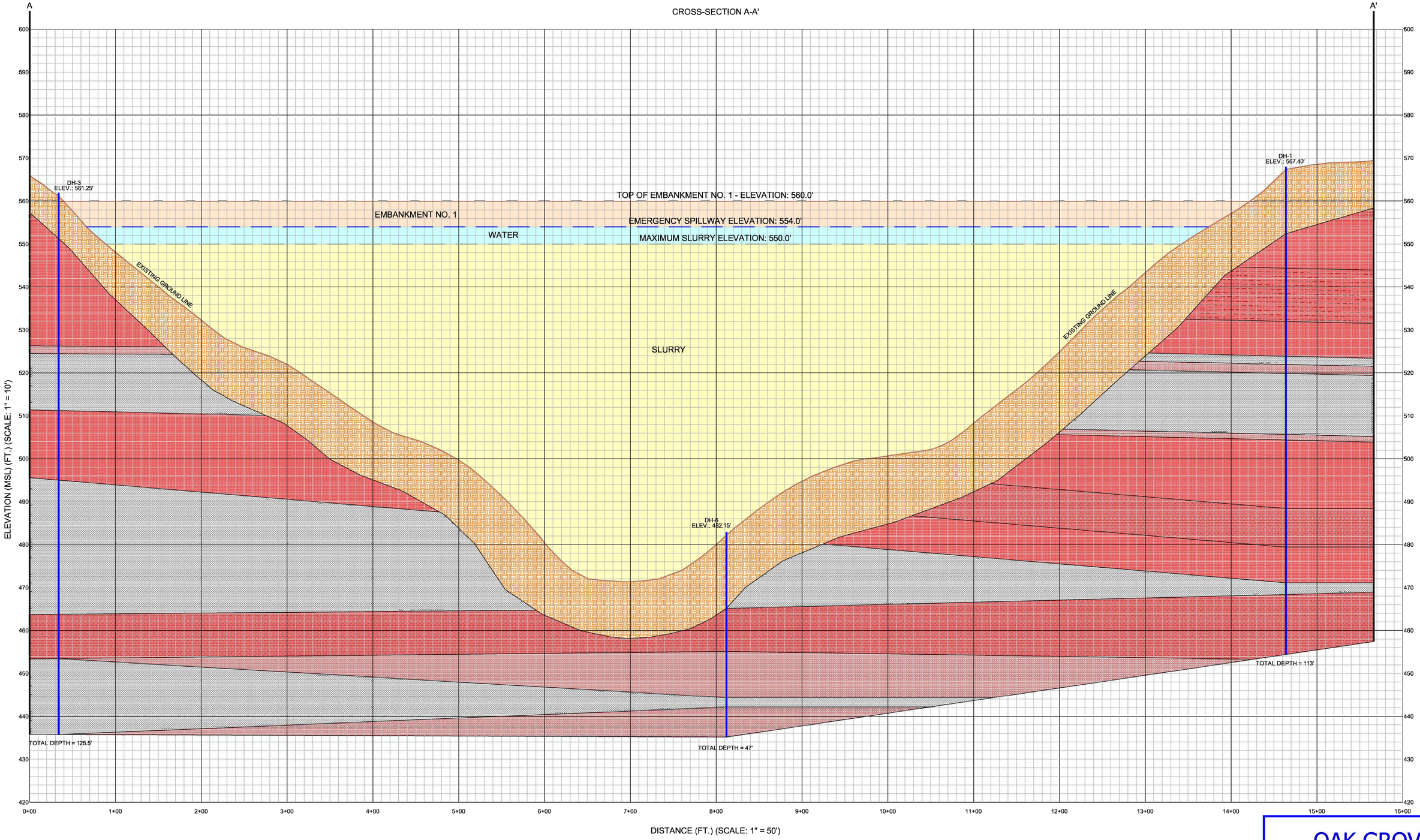
mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

OAK GROVE RESOURCES, LLC

CONCORD MINE
MSHA ID. NO. 01-00329

SLURRY IMPOUNDMENT NO. 6
GEOTECHNICAL INVESTIGATION

FILE: OGR-SLURRY	SCALE: 1" = 200'	JOB NO.: 13-329
APPROVED BY: J.G.A.	DATE: 06/11/14 Revision #1 04/02/15	SHEET NO.: 6 OF 10



LEGEND

EMBANKMENT	WATER	SANDSTONE	SHALE
SLURRY	LIGHT BROWN SANDY CLAY	SANDSTONE WITH SHALE	SHALE WITH SANDSTONE

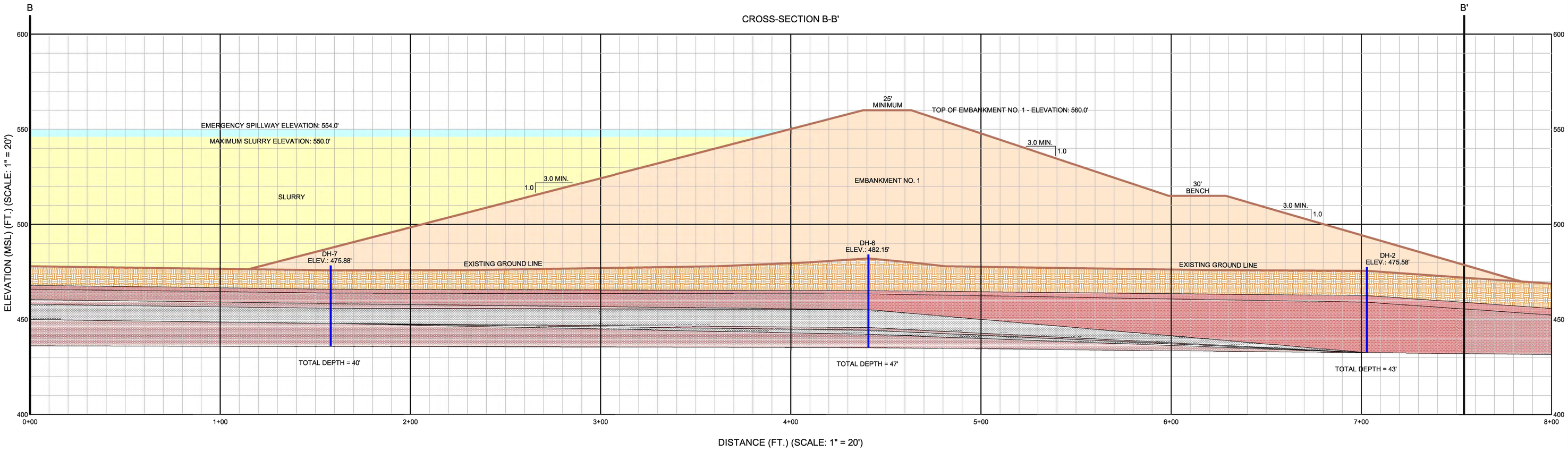
mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

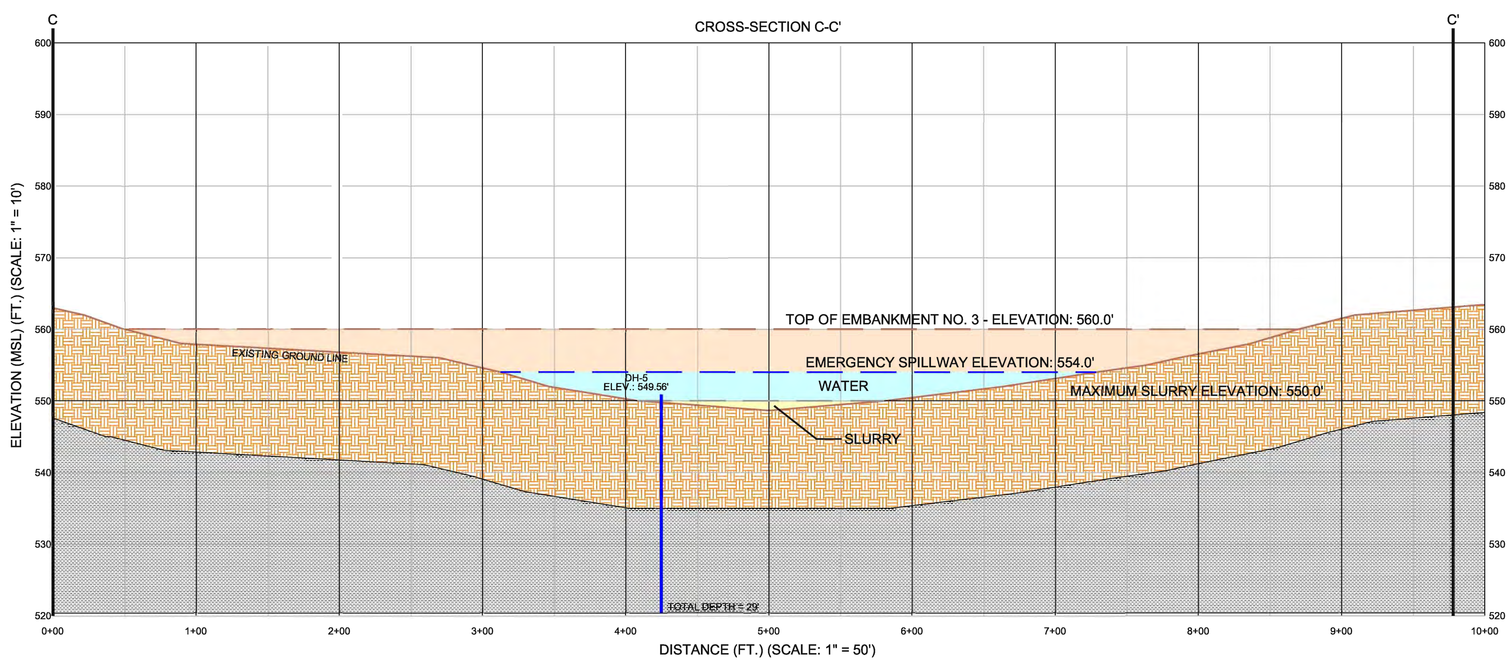
OAK GROVE RESOURCES, LLC

CONCORD MINE
MSHA I.D. NO.: 01-00329

SLURRY IMPOUNDMENT NO. 6
GEOLOGIC CROSS-SECTION A-A'

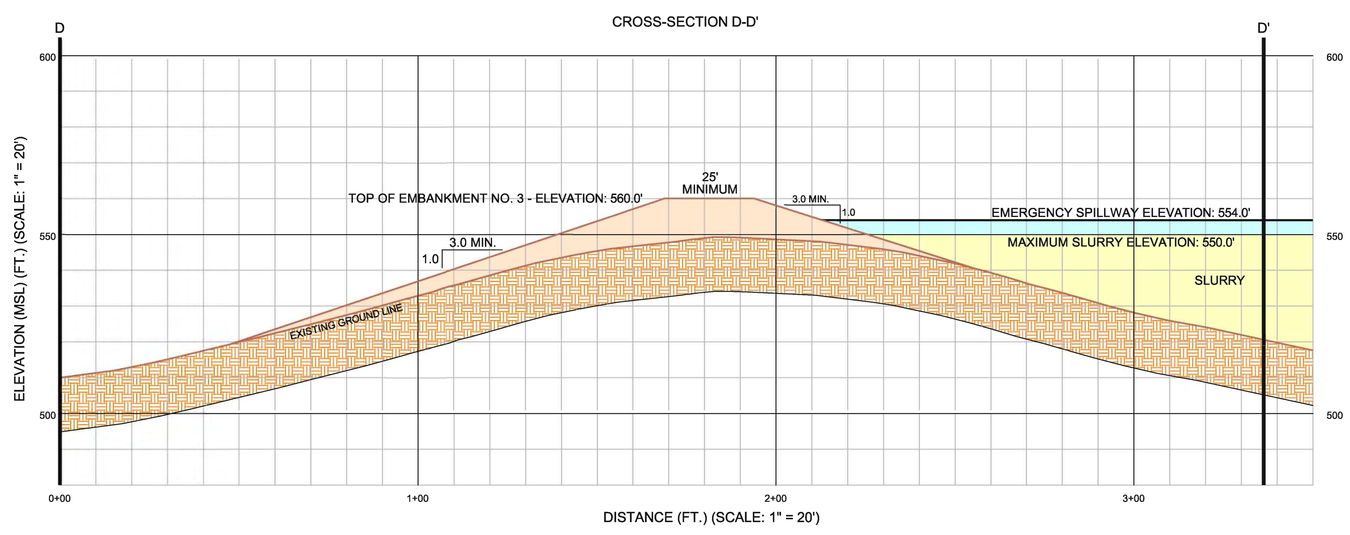
FILE:	SCALE:	JOB NO.:
SLURRY6GEO	AS SHOWN	14-118
APPROVED BY:	DATE:	SHEET NO.:
C.W.M.	06/11/14	7 OF 10





LEGEND

- EMBANKMENT
- SLURRY
- WATER
- LIGHT BROWN SANDY CLAY
- SANDSTONE
- SANDSTONE WITH SHALE
- SHALE
- SHALE WITH SANDSTONE



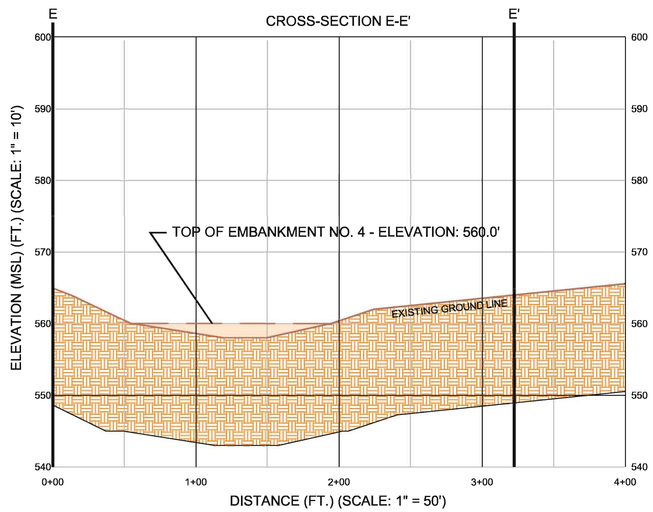
mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

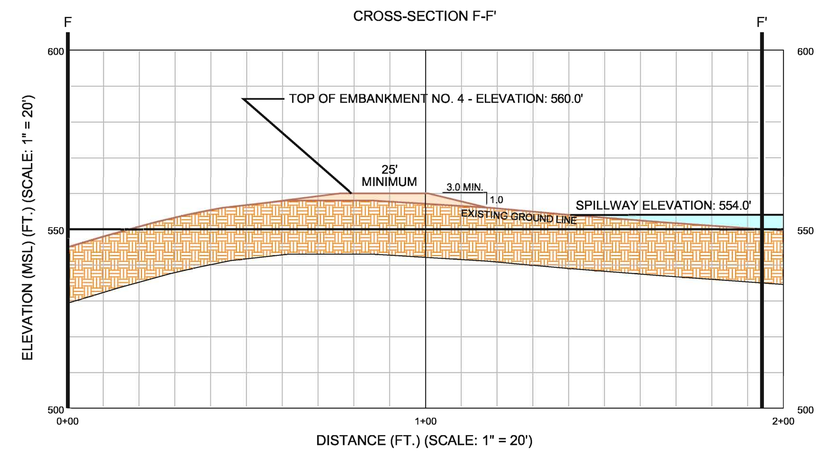
OAK GROVE RESOURCES, LLC

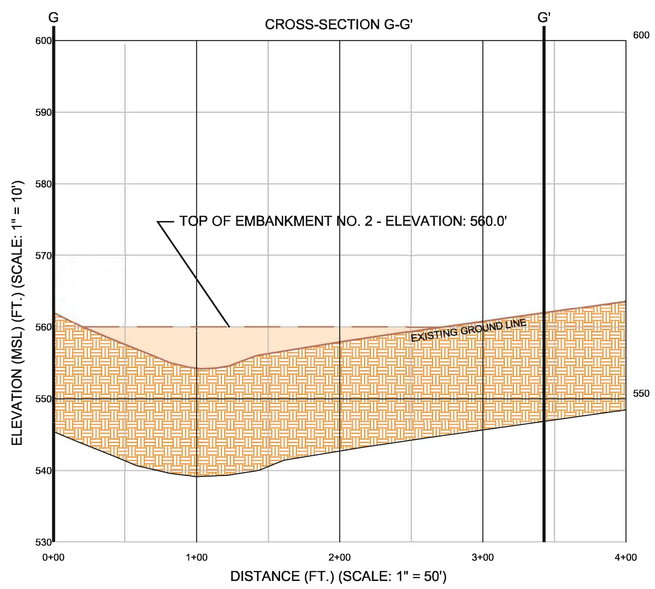
CONCORD PREP PLANT
MSHA I.D. NO.: 01-00329

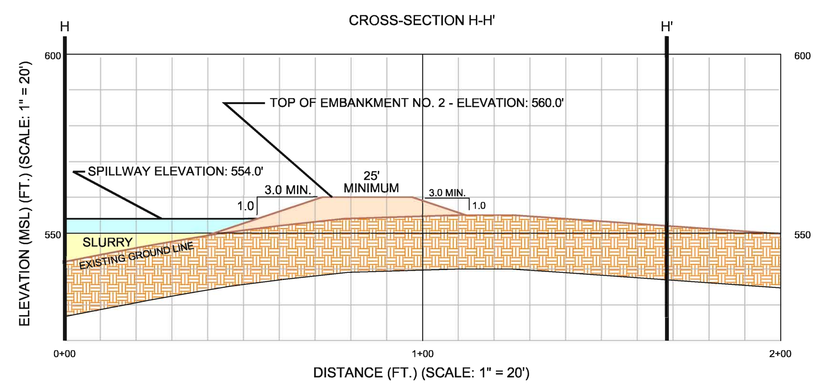
SLURRY IMPOUNDMENT NO. 6
GEOLOGIC CROSS-SECTIONS
B-B' THRU D-D'

FILE: SLURRY6GEO	SCALE: 1" = 20'	JOB NO.: 14-118
APPROVED BY: C.W.M.	DATE: 06/11/14	SHEET NO.: 8 OF 10









LEGEND

EMBANKMENT	WATER	SANDSTONE	SHALE
SLURRY	LIGHT BROWN SANDY CLAY	SANDSTONE WITH SHALE	SHALE WITH SANDSTONE

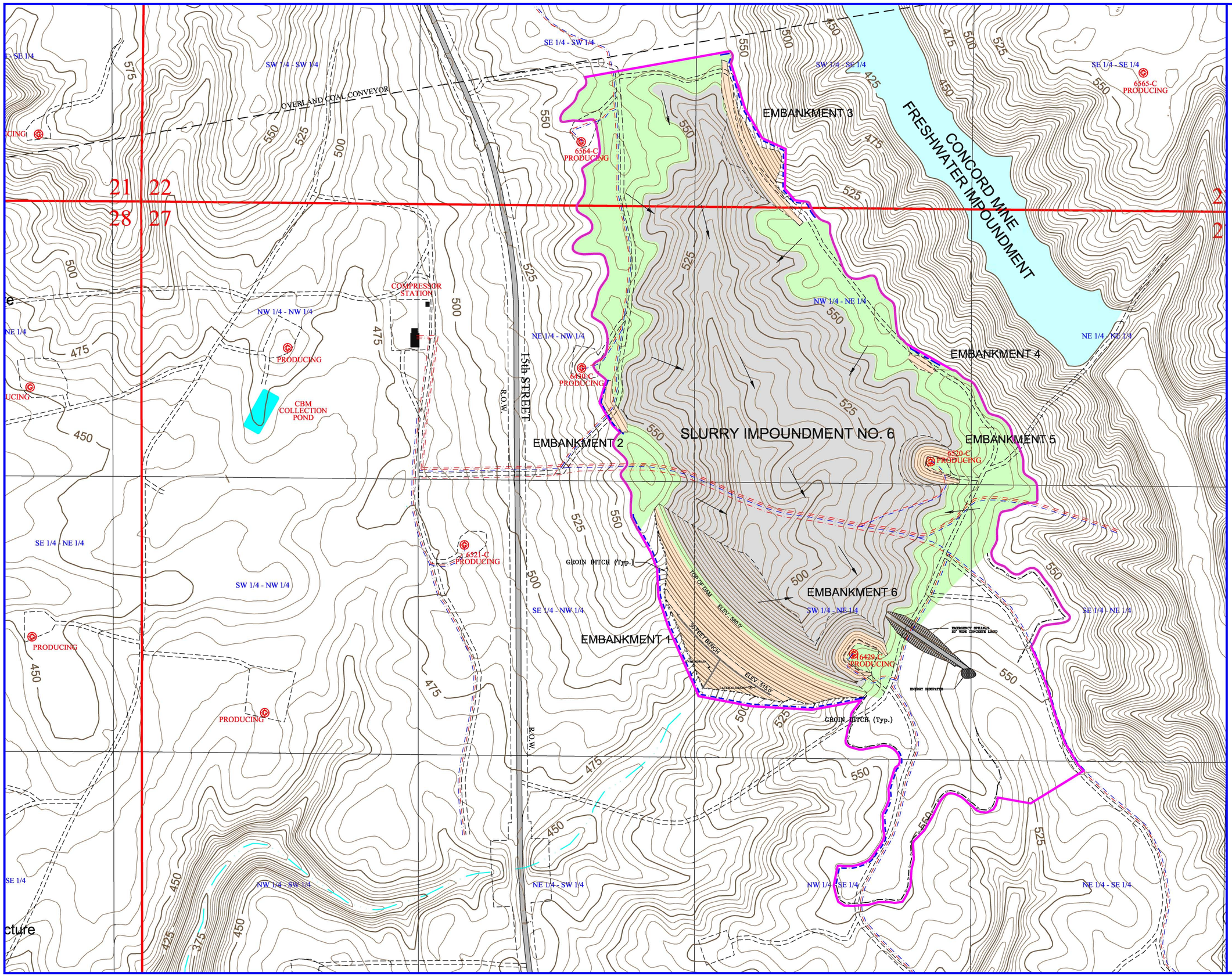
mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

OAK GROVE RESOURCES, LLC

CONCORD PREP PLANT
MSHA I.D. NO.: 01-00329

SLURRY IMPOUNDMENT NO. 6
GEOLOGIC CROSS-SECTIONS
E-E' THRU H-H'

FILE: SLURRY6GEO	SCALE: AS SHOWN	JOB NO.: 14-118
APPROVED BY: C.W.M.	DATE: 06/11/14	SHEET NO.: 9 OF 10



mcgehee engineering corp
post office box 3431
jasper, alabama 35502-3431
telephone: (205) 221-0686 fax: 221-7721
email: cw@mcgehee.org

MAP LEGEND

- ASMC Permit Boundary
- Slurry (Covered, Graded & Bare, C.N. 81)
- Embankment
- Graded & Bare, C.N. 81
- Section Line
- Quarter-Quarter Section Line
- Silt Fence
- Diversion Ditch
- Drainage Divide
- Existing Surface Contour
- 525 Existing Surface Contour
- DH-5 Foundation Investigation Drill Holes
- Private Access Roads
- Drainage Course
- 16429-C Coal Bed Methane Well
- Waterflow Direction

N W E S

SECTIONS 22 & 27,
TOWNSHIP 18 SOUTH, RANGE 5 WEST,
ALL IN JEFFERSON COUNTY, ALABAMA.
BASE MAP: CONCORD U.S.G.S. QUADRANGLE

CONTOUR INTERVAL: 5 FT.

OAK GROVE RESOURCES, LLC

CONCORD PREP PLANT
MSHA ID. NO. 01-00329

SLURRY IMPOUNDMENT NO. 6 ABANDONMENT MAP

FILE: OGR-SLURRY	SCALE: 1" = 200'	JOB NO.:
APPROVED BY: J.G.A.	DATE: 06-13-14 REVISION #1 07-14-15	SHEET NO.: 10 OF 10