HYDROLOGY STUDY FOR
BIRMINGHAM COAL & COKE CO., INC.

BEAR CREEK MINE
P-3831 / REVISION R-7
FRANKLIN COUNTY, ALABAMA

BY
PERC ENGINEERING CO., INC.
P.O. BOX 1712
JASPER, ALABAMA 35502

DETAILED DESIGN PLANS
BASIN 010

ATTACHMENT III-B-2(a)

SEPTEMBER 8, 2011

PERC
ENGINEERING CO., INC.

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Facsimile: (205) 295-3114 - Main Building
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Web Address: www.percengineering.com

September 8, 2011

Mr. Gary Heaton, P.E.
Alabama Surface Mining Commission
Post Office Box 2390
Jasper, Alabama 35502-2390

RE: Birmingham Coal & Coke Co., Inc.
Bear Creek Mine
P-3831 / Revision R-7

Dear Gary:

I hereby certify the attached detailed design plans for Basin 010 for the above referenced mine are in accordance with the Regulations of the Alabama Surface Mining Commission as adopted by Act 81-435 of December 18, 1981 and amended to date, and are true and correct to the best of my knowledge and belief.

If you have any questions or required additional information, please feel free to call.

Sincerely,
PERC Engineering Co., Inc.

Leslie G. Stephens, P.E., P.L.S.
Alabama Registration No. 14117-E

ALABAMA PROFESSIONAL ENGINEER AND LAND SURVEYOR REGISTERED No.14117 LESLIE G. STEPHENS

P.O. Box 1712 • Jasper, Alabama 35502 • 1606 Highway 78 West • Jasper, Alabama 35501

Pond Construction Criteria

The embankment for sediment basins (temporary and permanent) shall be designed and built using the following as minimum criteria:

1. The top of the dam shall be no less than 12 feet wide.

2. See design sheet for maximum and minimum embankment slopes.

3. The foundation and abutments for the impounding structure shall be designed to be stable under all conditions of construction and operation of the impoundments, with a minimum static safety factor of 1.3 for the normal pool with steady seepage saturation conditions.

4. The dam shall be constructed with a cutoff trench based upon prudent engineering practices for the site. The cutoff shall be located on the dam centerline and be of sufficient depth to extend into a relatively impervious material from which the core of the dam shall also be constructed.

5. The embankment foundation area shall be cleared of all organic matter, all surfaces sloped to no steeper than lv:lh, and the entire foundation surface scarified.

6. The entire embankment and cutoff trench shall be compacted to 95 percent density, based on standard proctor as outlined in ASTM.

7. The material placed in the embankment shall be free of sod, roots, stones over 6 inches in diameter, and other objectionable materials. The fill material shall be placed and spread over the entire fill area, starting at the lowest point of the foundation, in layers not to exceed 12 inches in thickness. Construction of the fill shall be undertaken only at such times that the moisture content of the fill material will permit satisfactory compaction in accordance with paragraph 5.

8. The pool area of all basins will be cleared of timber and large undergrowth.

9. The primary decant system when consisting of a pipe shall be installed according to Class C pipe installation for embankment bedding.

10. The primary decant system shall be equipped with a device, or constructed, such as to insure that subsurface withdrawal is accomplished to prevent discharge of floating solids. If a channel is used as the primary decant a skimmer shall be installed to prevent floating solids from discharging.

11. A splash pad or riprap may be required under the discharge of the primary decant system where necessary to insure that the discharge does not erode the embankment.

12. The combination primary and secondary decant system shall be designed to safely carry the expected peak flow from a 25 year - 6 hour storm. The entire emergency overflow spillway channel will be a stabilized channel and will be stabilized upon completion of construction as specified within the detailed design plans using prudent engineering measures. These measures may consist of lining the spillway with concrete or a durable rock riprap, or the spillway being constructed in consolidated non-erodible material and planted with a mixture or both annual and perennial grasses, or a combination of any or all of the above.

13. Sediment basins using a single spillway system shall be an open channel of non-erodible construction consisting of concrete, durable rock riprap or its being constructed in consolidated non-erodible material as specified in the detailed design plans.

14. The settled embankment for temporary impoundments shall be a minimum of 1.0 foot above the maximum water elevation for the runoff from a 25 year - 6 hour, or a 10 year - 24 hour precipitation event (whichever has the greatest runoff). The settled embankment for permanent impoundments shall be a minimum of 1.0 foot above the maximum water elevation for the runoff from a 25 year - 6 hour, or a 10 year - 24 hour precipitation event or greater event as specified by the Regulatory Authority.(whichever has the greatest runoff).

15. If basins are built in series, then the combined decant system for each shall be designed to accommodate the entire contributing drainage area.

16. The dam and all disturbed areas shall be seeded with both perennial and annual grasses, fertilized and mulched in order to insure erosion is minimized. Hay bales or riprap may be placed at the toe of the dam immediately upon completion of construction.

17. The constructed height of the dam shall be increased a minimum of 5 percent over the design height to allow for settlement over the life of the embankment.

18. Final graded slopes of the entire permanent water impoundment area shall not exceed 2.5H-1.0V to provide for adequate safety and access for proposed water users.

19. Prior to Phase II bond release, additional data concerning water quality, water quantity, depth, size, configuration, postmining land use, etc., for each proposed permanent water impoundment, shall be submitted to the Regulatory Authority for permanent water impoundment approval.

20. All sediment basins will be inspected for stability, erosion, etc. two (2) times a month until removal of the structure or release of the reclamation bond.

21. The embankment and spillway will be maintained by repairing any damage such as erosion, slope failure or spillway damage until removal of the structure or release of the performance bond.

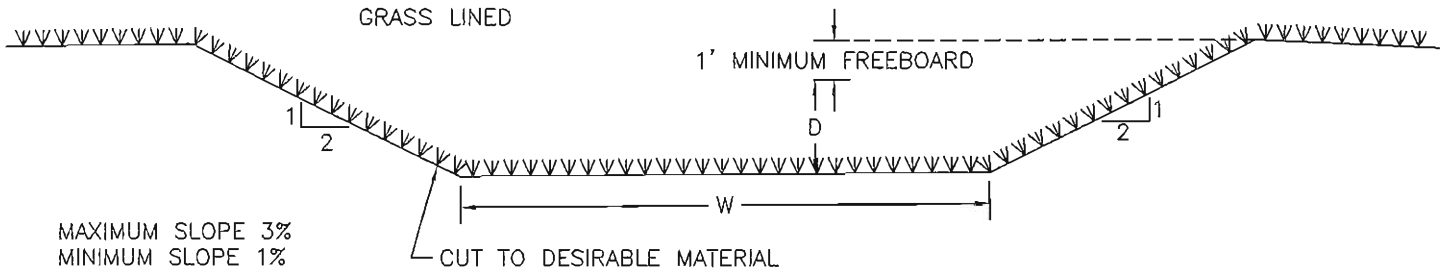
22. All ponds shall be examined quarterly for structural weakness, instability, erosion, or other hazardous conditions and maintenance performed as necessary. Formal inspections shall be made on an annual basis, including any reports or modifications, in accordance with 880-X-10C-.20[l(j)] of the Alabama Surface Mining Commission Regulations.

23. Sediment will be removed from each pond when the accumulated sediment reaches the sediment storage volume as shown on the detailed design sheet.

24. Upon completion of mining, successful reclamation and effluent standards being met, each sediment basin not remaining as a permanent water impoundment will be dewatered in an environmentally safe manner (such as siphoning, pumping, etc.) and reclaimed to approximate original contours by the following procedure: A permanent diversion channel (designed for a 10 year - 24 hour precipitation event) shall be cut along the outer edge of the basin to re-route drainage around the basin and back through the stabilized spillway to allow reclamation of the sediment basin. The diversion channel shall be designed and grassed as per enclosed information. (See permanent diversion for basin disposal).Upon completion of the diversion channel the back slope of the dam shall be graded to a minimum 3H to 1V slope. The dewatered sediment basin area shall be seeded with some combination of the following: Fescue, Bermuda, rye grass, canary grass and willows. After seeding the area shall be mulched. Any additional sediment or embankment material not used to meet original contour, if non-toxic, shall be spread in thin layers within the permit area and vegetated as stated in the approved reclamation plan. All toxic material encountered in the basin disposal shall be buried and covered with 4 feet of non-toxic material and vegetated as stated in the approved reclamation plan.

25. A qualified registered professional engineer or other qualified professional specialist, under the direction of the professional engineer shall conduct regular inspections during construction and upon completion shall inspect each basin for certification purposes.

26. Point source discharge embankments shall be constructed and abutments keyed into desirable material if at all possible. In the event that undesirable material is encountered, addition design and construction criteria shall be submitted prior to certification.



$$Q = \frac{1.49}{N} A R^{2/3} S^{1/2}$$

N(LOOSE STONE OR GRASS LINED) = 0.035

A = AREA

R = AREA/WETTED PERIMETER

S = SLOPE

* GRASS LINING: FESCUE, BERMUDA, RYE GRASS

DIVERSION CHANNEL DEPTH (D) FOR WIDTH (W) 8.0 FT.	
PEAK FLOW Q (CFS)	DEPTH D (FT)
0–15	0.5
15–50	1.0
50–100	1.5
100–180	2.0
180–270	2.5

DIVERSION CHANNEL DEPTH (D) FOR WIDTH (W) 10.0 FT.	
PEAK FLOW Q (CFS)	DEPTH D (FT)
0–15	0.5
15–60	1.0
60–120	1.5
120–210	2.0
210–320	2.5

DIVERSION CHANNEL DEPTH (D) FOR WIDTH (W) 12.0 FT.	
PEAK FLOW Q (CFS)	DEPTH D (FT)
0–20	0.5
20–70	1.0
70–150	1.5
150–250	2.0
250–383	2.5

DIVERSION CHANNEL DEPTH (D) FOR WIDTH (W) 15.0 FT.	
PEAK FLOW Q (CFS)	DEPTH D (FT)
0–25	0.5
25–90	1.0
90–180	1.5
180–300	2.0
300–450	2.5

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TYPICAL PERMANENT DIVERSION FOR BASIN DISPOSAL

DRAWN BY: S.D.M. DWG. NAME: TYPICALS	DATE: 1/4/2011
APPROVED BY: L.G.S.	SCALE: NONE

ATTACHMENT III-B-2-A

\\Perc600\perc_ma\Steve Miles\Steve Docs\Typicals\III-B-2(a)\Attachment III-B-2(a).dwg 01/04/11 12:26

NOTES

1) The primary spillway of Basin 010 consists of a 30-inch diameter corrugated metal pipe and will extend through and down the downstream slope of the embankment back to the original drainage course. The joints of the discharge pipe will be sealed using rubber "boots" type gaskets. To prevent the movement of the discharge pipe, the portions of the discharge pipe that are exposed along the downstream slope of the embankment will be covered with a minimum of 2 feet as measured from the top of the pipe.

2) A 8' x 15' x 16" thick splash pad consisting of durable, non-erodible sandstone or limestone class II riprap, concrete pad, or consolidated non-erodible bedrock will be located at the discharge point of the primary spillway of Basin 010 to prevent erosion.

3) The emergency spillway channel of Basin 010 will be cut along the side of the embankment and carried into natural ground. The channel lining will consist of a grass mixture of but not limited to Fescue, Bermuda, and, Sericea. The channel will be seeded with the mixture, fertilized, and mulched.

RIP-RAP CLASSIFICATION SPECIFICATIONS

CLASS 1 RIP-RAP

No more than 10% of the stone will have a diameter greater than twelve (12) inches; no more than 50% of the stone will have a diameter less than ten (10) inches; and no more than 10% of the stone will have a diameter of less than six (6) inches. The thickness of the rip-rap liner will be no less than twelve (12) inches.

CLASS 2 RIP-RAP

No more than 10% of the stone will have a diameter greater than sixteen (16) inches; no more than 50% of the stone will have a diameter less than twelve (12) inches; and no more than 10% of the stone will have a diameter of less than six (6) inches. The thickness of the rip-rap liner will be no less than sixteen (16) inches.

CLASS 3 RIP-RAP

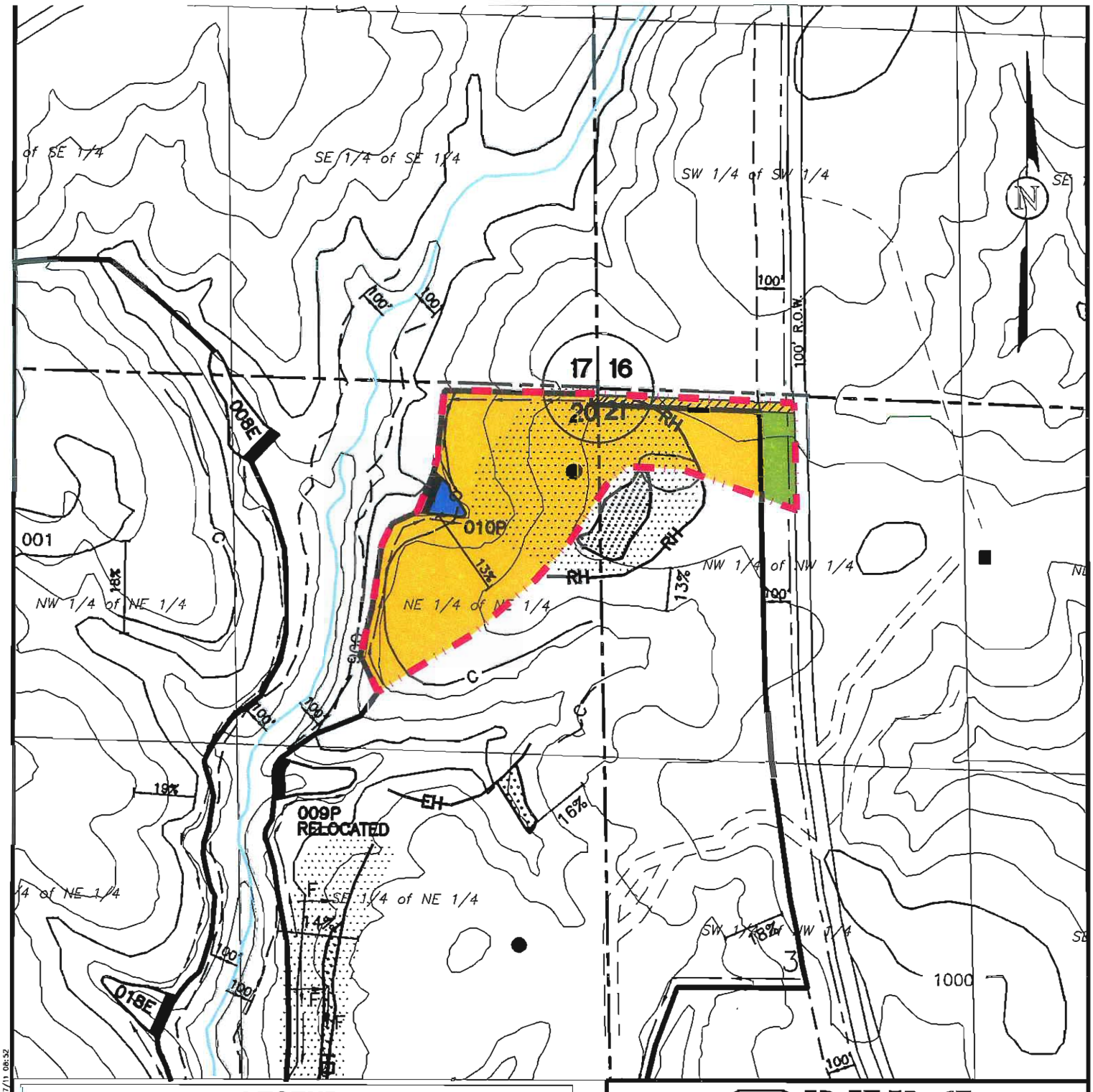
No more than 10% of the stone will have a diameter greater than twenty two (22) inches; no more than 50% of the stone will have a diameter less than sixteen (16) inches; and no more than 10% of the stone will have a diameter of less than eight (8) inches. The thickness of the rip-rap liner will be no less than twenty two (22) inches.

CLASS 4 RIP-RAP

No more than 10% of the stone will have a diameter greater than twenty seven (27) inches; no more than 50% of the stone will have a diameter less than twenty two (22) inches; and no more than 10% of the stone will have a diameter of less than ten (10) inches. The thickness of the rip-rap liner will be no less than twenty seven (27) inches.

CLASS 5 RIP-RAP

No more than 10% of the stone will have a diameter greater than thirty four (34) inches; no more than 50% of the stone will have a diameter less than twenty seven (27) inches; and no more than 10% of the stone will have a diameter of less than sixteen (16) inches. The thickness of the rip-rap liner will be no less than thirty four (34) inches.



LEGEND

- Permit Boundary
- Drainage Divide
- Diversion
- Perennial Stream
- 018E Sediment Basin
- F Flow Direction on Previously Mined Area

LANDUSE & CURVE NUMBER INFORMATION

- Unmanaged Timberland, Curve Number, 70
- Graded & Bare, Curve Number, 81
- Sediment Basin, Curve Number, 100

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ATTACHMENT III-B-2(a)
BIRMINGHAM COAL & COKE CO., INC.
BEAR CREEK MINE
P-3831 / REVISION R-7
BASIN 010 WATERSHED MAP

DRAWN BY: S.D.M. DWG. NAME: BCCBC010WS	DATE: 9/7/2011
APPROVED BY: L.G.S.	SCALE: 1"=500'

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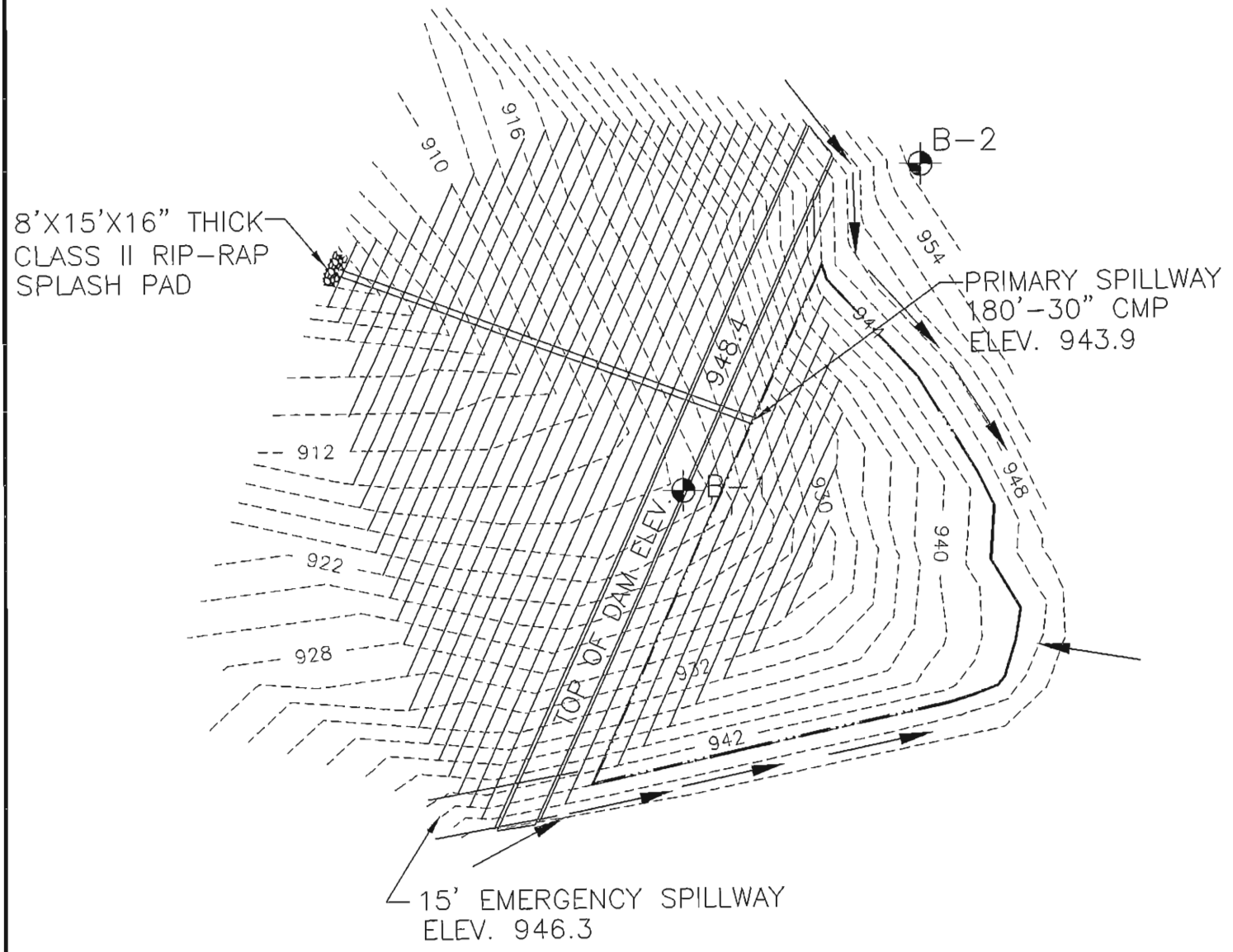

LEGEND

- MAJOR INFLOW
- NORMAL POOL LEVEL ELEV. 943.9
- 940 PROPOSED CONTOURS
- 930 EXISTING CONTOURS
- B-1 FOUNDATION MATERIAL
- B-2 DAM MATERIAL

Scale: 1"=60'

N

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BIRMINGHAM COAL & COKE CO., INC.
BEAR CREEK MINE
P-3831 / REVISION R-7
BASIN 010 PLANVIEW

DRAWN BY: S.D.M. DWG. NAME: BCCBC010PV	DATE: 9/8/2011
APPROVED BY: L.G.S.	SCALE: 1" = 60'

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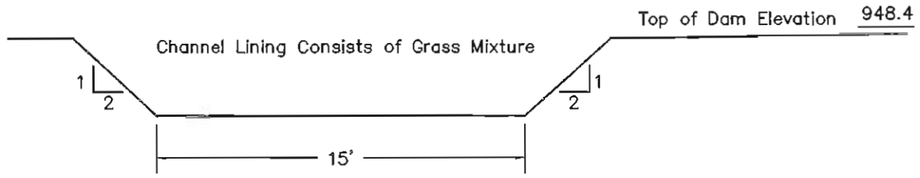


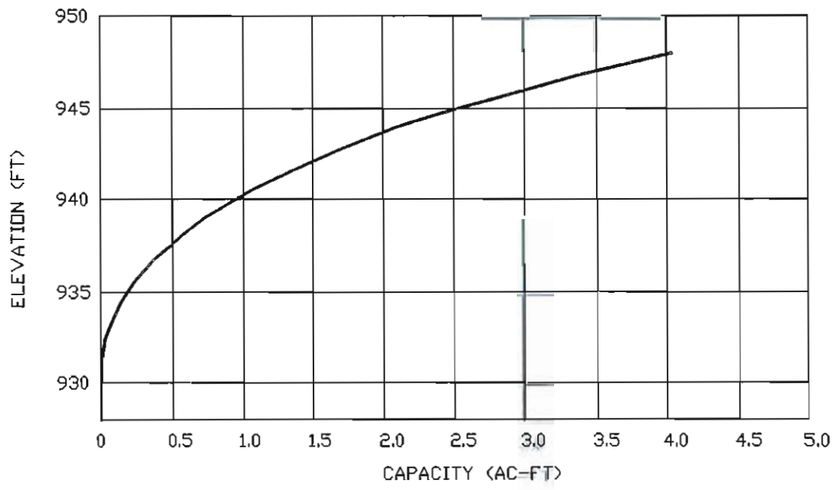
Crest of Emergency Spillway Elevation 946.3
Maximum Spillway Gradient 2.0% (Control Section)
Maximum Spillway Gradient 5.0% (Tail Ditch Section)
Minimum Spillway Gradient 2.0% (Tail Ditch Section)

Emergency Spillway

Notes:

1. The sediment shall be removed from the basin when the accumulated sediment reaches the sediment storage volume.
2. Outer slopes of embankment shall be grassed.
3. Fill material shall be placed in 12" lifts and compacted to 95% of standard proctor.
4. The surface beneath the embankment shall be stripped of undesirable material.
5. Upon completion of mining, reclamation and maintenance of water quality standards the pond will be de-watered and reclaimed.
6. See the attached pond construction criteria.
7. See the attached drawings and specifications for diversions.
8. Elevations are based on assumed datum.

Stage vs. Storage Curve

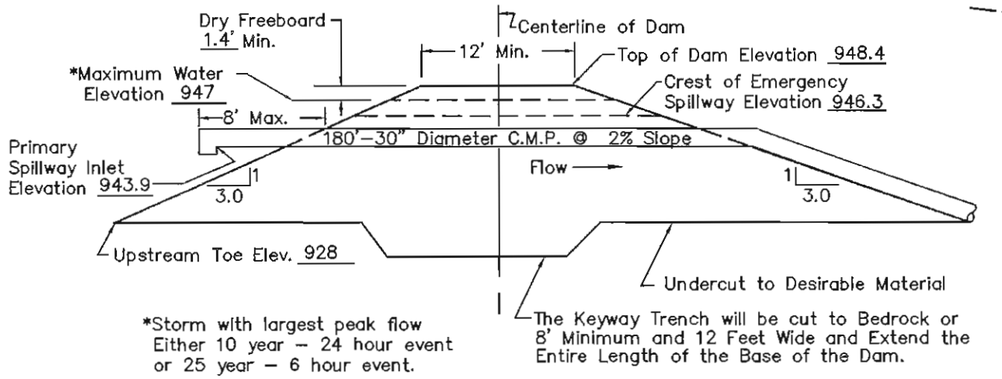


Storage Computation

Elevation (feet)	Area (acres)	Avg. Area (acres)	Interval (feet)	Storage (ac.-ft.)	Acc. Storage (ac.-ft.)
928	0.000				0.000
930	0.004	0.002	2	0.003	0.003
932	0.025	0.015	2	0.026	0.029
934	0.063	0.044	2	0.085	0.114
936	0.109	0.086	2	0.170	0.284
938	0.164	0.137	2	0.271	0.555
940	0.228	0.196	2	0.390	0.945
942	0.300	0.264	2	0.526	1.471
944	0.380	0.340	2	0.679	2.150
946	0.469	0.425	2	0.847	2.997
948	0.574	0.522	2	1.042	4.039

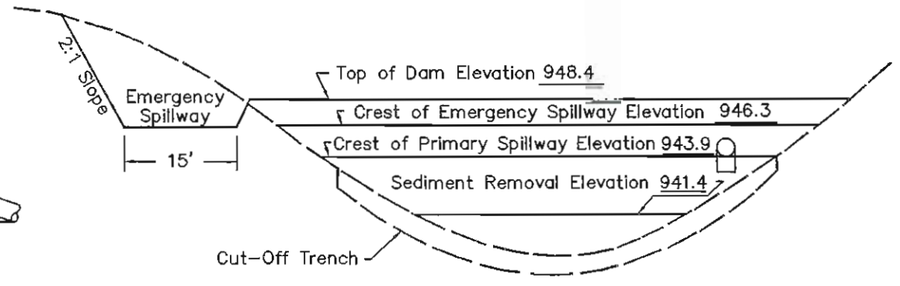
Key Basin Parameters

Drainage Area ____ 18.3 Acres
Disturbed Area ____ 16.4 Acres
Sediment Storage ____ 1.3 Ac. Ft.
Detention Storage ____ 0.8 Ac. Ft.
Permanent Pool Capacity ____ 2.1 Ac. Ft.
Total Basin Capacity ____ 3.5 Ac. Ft.
Peak Inflow ____ 45.5 C.F.S.
Peak Outflow ____ 29.4 C.F.S.



*Storm with largest peak flow
Either 10 year - 24 hour event
or 25 year - 6 hour event.

Typical Cross Section Along Primary Spillway



Typical Profile Looking Downstream

Leslie G. Stephens 9/8/2011
Leslie G. Stephens, P.E., P.L.S. Date
AL Registration. #14117-E

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BIRMINGHAM COAL & COKE CO., INC.
BEAR CREEK MINE
P-3831 / REVISION R-7
BASIN 010

DRAWN BY: S.D.M. DWG. NAME: BCCBC010DT	DATE: 9/8/2011
APPROVED BY: L.G.S.	SCALE: NONE

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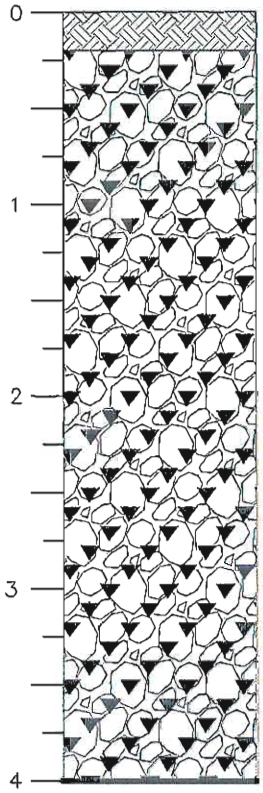
	INTERVAL:	DESCRIPTION:
0	0 – 0.2'	Surface Material
1		
2	0.2' – 4.0'	Sandy Silt
3		
4		Stiff Base



DRILL HOLE: B-1
SAMPLED BY: GREG WADE
SAMPLED DATE: 8/26/2011

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BIRMINGHAM COAL & COKE CO., INC.
BEAR CREEK MINE
P-3831 / REVISION R-7
BASIN 010
FOUNDATION INVESTIGATION

DRAWN BY: S.D.M. DWG. NAME: BCCBC010FI	DATE: 9/7/2011
APPROVED BY: L.G.S.	SCALE: 1" = 1'

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P-3831 / Revision R-7 Basin 010 Spillway Control Section

Material: Grass mixture

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
15.00	2.0:1	2.0:1	2.0	D, B	1.00			5.0

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	7.04 cfs		7.04 cfs	
Depth:	0.34 ft	1.34 ft	0.69 ft	1.69 ft
Top Width:	16.37 ft	20.37 ft	17.77 ft	21.77 ft
Velocity:	1.31 fps		0.62 fps	
X-Section Area:	5.36 sq ft		11.34 sq ft	
Hydraulic Radius:	0.325 ft		0.627 ft	
Froude Number:	0.40		0.14	
Roughness Coefficient:	0.0757		0.2485	

P-3831 / Revision R-7 Basin 010 Spillway Tail Ditch Section

Material: Grass mixture

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
15.00	2.0:1	2.0:1	5.0	D, B	1.00			5.0

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	7.04 cfs		7.04 cfs	
Depth:	0.26 ft	1.26 ft	0.52 ft	1.52 ft
Top Width:	16.04 ft	20.04 ft	17.08 ft	21.08 ft
Velocity:	1.75 fps		0.84 fps	
X-Section Area:	4.02 sq ft		8.36 sq ft	
Hydraulic Radius:	0.249 ft		0.482 ft	
Froude Number:	0.62		0.21	
Roughness Coefficient:	0.0751		0.2429	

Birmingham Coal & Coke Co., Inc.

Bear Creek Mine

P-3831 / Revision R-7

Basin 010

5.8 Inches, 10 Year-24 Hour,

DRN 58

SDM

PERC Engineering Co., Inc.
1606 Highway 78 West
Jasper, AL 35501

Phone: (205) 384-5553
Email: smiles@percengineering.com

General Information

Storm Information:

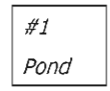
Storm Type:	DRN58
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.800 inches

Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	100.000%	100.000%
2.0000	98.000%	92.000%
1.0000	96.000%	78.000%
0.5000	94.000%	54.000%
0.3000	88.000%	43.000%
0.2000	80.000%	34.000%
0.1000	68.000%	22.000%
0.0500	49.000%	15.000%
0.0300	36.000%	9.000%
0.0200	28.000%	5.000%
0.0100	14.000%	4.000%
0.0050	5.000%	3.000%
0.0030	4.000%	2.500%
0.0010	2.000%	2.000%
0.0001	0.001%	0.001%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Basin 010



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	In	18.300	18.300	22.53	5.69	842.9	181,521	139.02	79.25
	Out			18.75	5.69	29.7	6,637	0.07	0.04

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	92.001%	100.000%
1.0000	78.002%	100.000%
0.5000	54.005%	100.000%
0.3000	43.006%	100.000%
0.2000	34.006%	100.000%
0.1000	22.006%	100.000%
0.0500	15.004%	100.000%
0.0300	9.003%	100.000%
0.0200	5.003%	100.000%
0.0100	4.001%	100.000%
0.0050	3.000%	85.229%
0.0030	2.500%	71.024%
0.0010	2.000%	56.815%
0.0001	0.001%	0.028%

Structure Detail:

Structure #1 (Pond)

Basin 010

Pond Inputs:

Initial Pool Elev:	943.90 ft
Initial Pool:	0.81 ac-ft
*Sediment Storage:	1.30 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
30.00	180.00	2.00	0.0240	943.90	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
946.30	12.00	2.00:1	2.00:1	15.00

Pond Results:

Peak Elevation:	946.24 ft
H'graph Detention Time:	0.90 hrs
Pond Model:	CSTRS
Dewater Time:	0.70 days
Trap Efficiency:	96.48 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
941.40	0.278	0.000	0.000		Top of Sed. Storage
941.50	0.281	0.027	0.000		
942.00	0.300	0.172	0.000		
942.50	0.319	0.327	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
943.00	0.339	0.491	0.000		
943.20	0.347	0.560	0.000		
943.50	0.359	0.666	0.000		
943.90	0.376	0.813	0.000		Spillway #1
944.00	0.380	0.851	0.582	3.75	
944.50	0.401	1.046	2.437	6.25	
945.00	0.423	1.252	6.046	5.10	
945.50	0.446	1.469	10.594	0.95	
946.00	0.469	1.698	15.939	0.50	
946.20	0.479	1.793	18.264	0.15	
946.24	0.481	1.812	18.751	0.05	Peak Stage
946.30	0.484	1.841	19.470		Spillway #2
946.50	0.494	1.939	28.070		
947.00	0.520	2.193	47.231		
947.50	0.547	2.459	88.441		
948.00	0.574	2.740	139.006		

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
941.40	0.000	0.000	0.000
941.50	0.000	0.000	0.000
942.00	0.000	0.000	0.000
942.50	0.000	0.000	0.000
943.00	0.000	0.000	0.000
943.20	0.000	0.000	0.000
943.50	0.000	0.000	0.000
943.90	0.000	0.000	0.000
944.00	(3)>0.582	0.000	0.582
944.50	(3)>2.437	0.000	2.437
945.00	(3)>6.046	0.000	6.046
945.50	(3)>10.594	0.000	10.594
946.00	(3)>15.939	0.000	15.939
946.20	(3)>18.264	0.000	18.264
946.30	(3)>19.470	0.000	19.470
946.50	(3)>21.952	6.119	28.070
947.00	(2)>25.817	21.414	47.231
947.50	(6)>31.980	56.461	88.441

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
948.00	(6)>33.811	105.195	139.006

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	1.000	0.001	0.000	0.000	100.000	F	1.52	0.483
	2	16.400	0.094	0.000	0.000	81.000	F	20.38	5.052
	3	0.900	0.198	0.070	0.397	70.000	M	0.65	0.158
	Σ	**18.300**						**22.53**	**5.693**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.001	200.00	0.01	0.0010	1.0000	1	0.0	0	0.00	0.00
	2	0.240	200.00	13.00	0.9000	1.0000	2	842.8	199,093	152.48	88.57
	3	0.300	200.00	13.00	0.0030	1.0000	1	0.1	683	0.45	0.26
	Σ							**842.9**	**181,521**	**139.02**	**79.25**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	5. Nearly bare and untilled, and alluvial valley fans	2.50	5.00	200.00	1.580	0.035
		8. Large gullies, diversions, and low flowing streams	5.14	75.00	1,460.02	6.790	0.059
#1	**2**	**Time of Concentration:**					**0.094**
#1	3	1. Forest with heavy ground litter	2.00	5.00	250.00	0.350	0.198
#1	**3**	**Time of Concentration:**					**0.198**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	3	8. Large gullies, diversions, and low flowing streams	4.82	80.00	1,660.00	6.580	0.070
#1	**3**	**Muskingum K:**					**0.070**

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Birmingham Coal & Coke Co., Inc.

Bear Creek Mine

P-3831 / Revision R-7

Basin 010

4.6 Inches, 25 Year-6 Hour,

SCS 6 Hour

SDM

PERC Engineering Co., Inc.
1606 Highway 78 West
Jasper, AL 35501

Phone: (205) 384-5553
Email: smiles@percengineering.com

General Information

Storm Information:

Storm Type:	Rainfall Event

Accumulated Time (hrs)	Accumulated Depth (in)
0.00	0.0000
0.50	0.1610
1.00	0.3680
1.50	0.6210
2.00	1.0580
2.50	2.7600
3.00	3.2200
3.50	3.5880
4.00	3.8410
4.50	4.0710
5.00	4.2550
5.50	4.4390
6.00	4.6000

Peak 30-minute Intensity: 3.404 in/hr

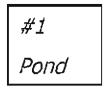
Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	100.000%	100.000%
2.0000	98.000%	92.000%
1.0000	96.000%	78.000%
0.5000	94.000%	54.000%
0.3000	88.000%	43.000%
0.2000	80.000%	34.000%
0.1000	68.000%	22.000%
0.0500	49.000%	15.000%
0.0300	36.000%	9.000%
0.0200	28.000%	5.000%
0.0100	14.000%	4.000%
0.0050	5.000%	3.000%
0.0030	4.000%	2.500%

Size (mm)	Topsoil	Spoil
0.0010	2.000%	2.000%
0.0001	0.001%	0.001%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Basin 010



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	In	18.300	18.300	45.46	4.07	1,035.2	280,284	214.66	132.70
	Out			29.36	4.07	39.4	11,210	0.18	0.12

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	92.001%	100.000%
1.0000	78.002%	100.000%
0.5000	54.004%	100.000%
0.3000	43.004%	100.000%
0.2000	34.005%	100.000%
0.1000	22.005%	100.000%
0.0500	15.004%	100.000%
0.0300	9.003%	100.000%
0.0200	5.003%	100.000%
0.0100	4.001%	100.000%
0.0050	3.000%	78.832%
0.0030	2.500%	65.693%
0.0010	2.000%	52.551%
0.0001	0.001%	0.026%

Structure Detail:

Structure #1 (Pond)

Basin 010

Pond Inputs:

Initial Pool Elev:	943.90 ft
Initial Pool:	0.81 ac-ft
*Sediment Storage:	1.30 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
30.00	180.00	2.00	0.0240	943.90	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
946.30	12.00	2.00:1	2.00:1	15.00

Pond Results:

Peak Elevation:	946.53 ft
H'graph Detention Time:	0.75 hrs
Pond Model:	CSTRS
Dewater Time:	0.40 days
Trap Efficiency:	96.19 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
941.40	0.278	0.000	0.000		Top of Sed. Storage
941.50	0.281	0.027	0.000		
942.00	0.300	0.172	0.000		
942.50	0.319	0.327	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
943.00	0.339	0.491	0.000		
943.20	0.347	0.560	0.000		
943.50	0.359	0.666	0.000		
943.90	0.376	0.813	0.000		Spillway #1
944.00	0.380	0.851	0.582	3.75	
944.50	0.401	1.046	2.437	1.80	
945.00	0.423	1.252	6.046	0.95	
945.50	0.446	1.469	10.594	1.80	
946.00	0.469	1.698	15.939	0.75	
946.20	0.479	1.793	18.264	0.30	
946.30	0.484	1.841	19.470	0.10	Spillway #2
946.50	0.494	1.939	28.070	0.10	
946.53	0.496	1.956	29.365	0.05	Peak Stage
947.00	0.520	2.193	47.231		
947.50	0.547	2.459	88.441		
948.00	0.574	2.740	139.006		

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
941.40	0.000	0.000	0.000
941.50	0.000	0.000	0.000
942.00	0.000	0.000	0.000
942.50	0.000	0.000	0.000
943.00	0.000	0.000	0.000
943.20	0.000	0.000	0.000
943.50	0.000	0.000	0.000
943.90	0.000	0.000	0.000
944.00	(3)>0.582	0.000	0.582
944.50	(3)>2.437	0.000	2.437
945.00	(3)>6.046	0.000	6.046
945.50	(3)>10.594	0.000	10.594
946.00	(3)>15.939	0.000	15.939
946.20	(3)>18.264	0.000	18.264
946.30	(3)>19.470	0.000	19.470
946.50	(3)>21.952	6.119	28.070
947.00	(2)>25.817	21.414	47.231
947.50	(6)>31.980	56.461	88.441

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
948.00	(6)>33.811	105.195	139.006

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	1.000	0.001	0.000	0.000	100.000	F	3.43	0.382
	2	16.400	0.094	0.000	0.000	81.000	F	41.33	3.582
	3	0.900	0.198	0.070	0.397	70.000	M	0.93	0.105
	Σ	**18.300**						**45.46**	**4.068**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.001	200.00	0.01	0.0010	1.0000	1	0.0	0	0.00	0.00
	2	0.240	200.00	13.00	0.9000	1.0000	2	1,035.1	304,854	233.49	148.17
	3	0.300	200.00	13.00	0.0030	1.0000	1	0.1	889	0.58	0.37
	Σ							**1,035.2**	**280,284**	**214.66**	**132.70**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	5. Nearly bare and untilled, and alluvial valley fans	2.50	5.00	200.00	1.580	0.035
		8. Large gullies, diversions, and low flowing streams	5.14	75.00	1,460.02	6.790	0.059
#1	**2**	**Time of Concentration:**					**0.094**
#1	3	1. Forest with heavy ground litter	2.00	5.00	250.00	0.350	0.198
#1	**3**	**Time of Concentration:**					**0.198**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	3	8. Large gullies, diversions, and low flowing streams	4.82	80.00	1,660.00	6.580	0.070
#1	**3**	**Muskingum K:**					**0.070**

Birmingham Coal & Coke Co., Inc.
Bear Creek Mine
P-3831 / Revision R-7
Basin 010
Soil Classification

Birmingham Coal & Coke Co., Inc.
Bear Creek Mine
P-3831 / Revision R-7

STABILITY ANALYSIS DATA

METHODOLOGY

The static and dynamic loading stability analyses were performed using the Simplified Bishop Method. The computer program used was the REAME Slope Stability Program as developed by Dr. Yang H. Haung, P.E. of the University of Kentucky.

SOIL CLASSIFICATION UNITS

The soil type (soil classification) to be used in the construction of the embankment structure of Basin 010 (ML) and the soil type (soil classification) of the material between the proposed embankment and stiff base of Basin 010 was sampled and analyzed by PERC Engineering Co., Inc. The soil properties used in the stability analysis (ML) type soil, was taken from the U.S. Department of the Interior Bureau of Reclamation Design of Small Dams.*

SOIL PROPERTIES

	UNIFIED CLASS	COHESION (PSF)	ANGLE OF INT. FRC.	DESIGN DENSITY (PCF)
Dam Material Basin 010	ML	100.8	29.7	129.5
Foundation Basin 010	ML	100.8	29.7	129.5

*United States Department of Interior Bureau of Reclamation Design of Small Dams Second Edition 1973, Revised Reprint 1974 page 137 and United States Department of Interior Bureau of Reclamation Design of Small Dams Third Edition 1987 page 96 and 97.

STABILITY ANALYSIS DATA

(Continued)

DESIGN DATA

1) Design Density = 95% of the standard proctor maximum density.
2) Embankment top width: 12.0'.
3) Freeboard minimum = 10% of structure (from top of embankment to normal pool level).
4) Safety factors for embankments with 2.5H:1V slopes, front and back.
5) Basin 010 design height = 20.4 ft.
6) DMIN = 0.00
7) All design heights are measured from the top of the embankment to the toe of the upstream slope.

SAFETY FACTORS

BASIN NUMBER	STATIC SAFETY FACTOR
010	1.3

FOUNDATIONS AND ABUTMENTS

The foundation and abutments area will be inspected for visible structural deficiencies after clearing and grubbing, and if found they will be treated using sound engineering practices.

COMPACTION TEST REPORT

Test specification: ASTM D 698-91 Procedure B Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
	ML				25	3		77.94

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 117.1 pcf Optimum moisture = 12.2 %	Silt with sand

Project No. **Client:** Birmingham Coal & Coke

Project: Basin 010

Date: 8-30-11

○ **Location:** Bear Creek R-7

PERC ENGINEERING CO., INC.

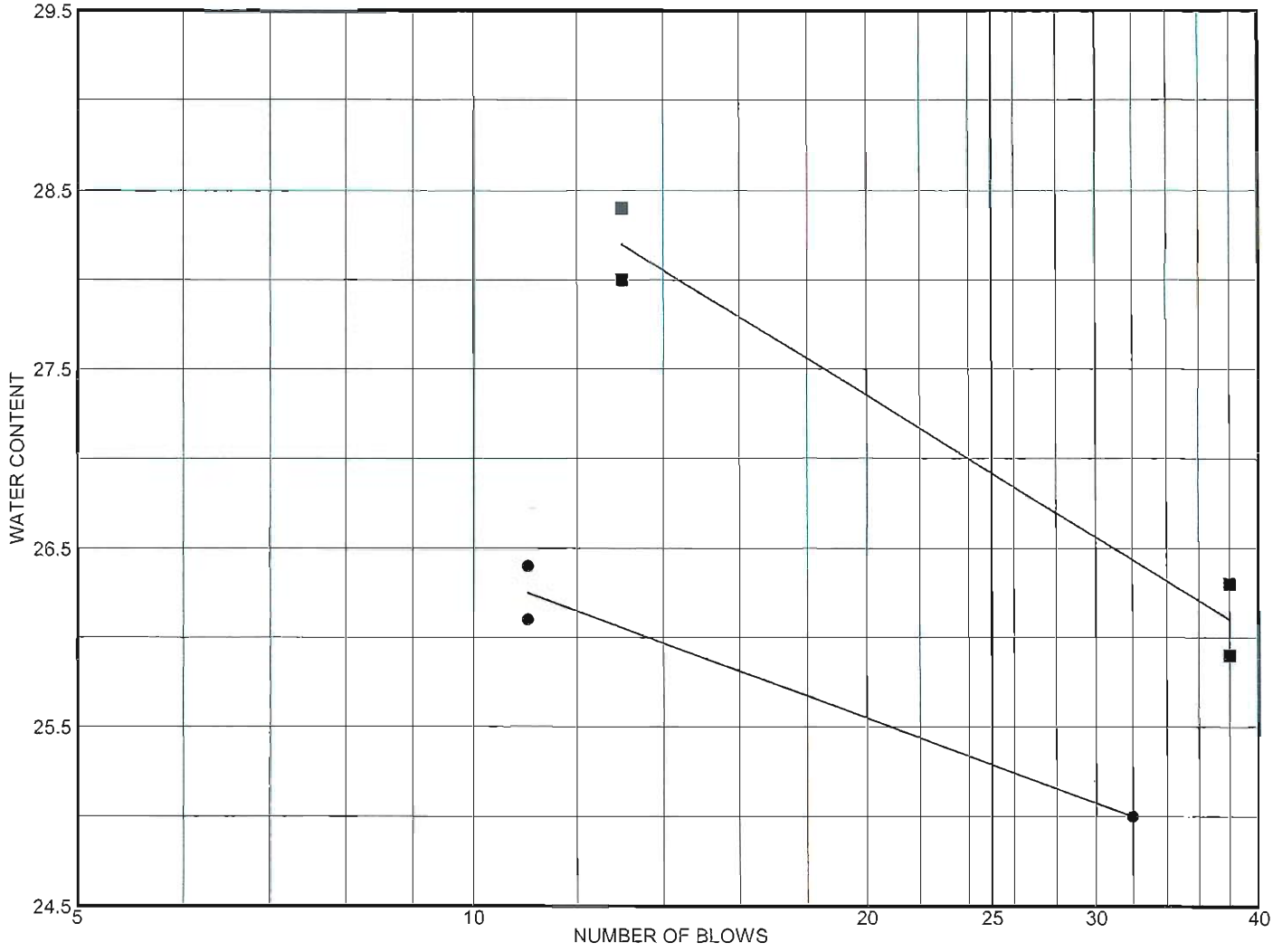
Jasper, Alabama

Remarks:
Dam material

Date 8-30-11

Tested By: MLB **Checked By:** LS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silt with sand	25	22	3	86.98	77.94	ML
■	Sandy silt	27	24	3	80.79	60.11	ML

Project No. **Client:** Birmingham Coal & Coke

Project: Basin 010

Basin 010

● **Location:** Bear Creek R-7

■ **Location:** Bear Creek R-7

Remarks:

● Dam material

■ Foundation

PERC ENGINEERING CO., INC.

Jasper, Alabama

Date 8-29-11

Birmingham Coal & Coke Co., Inc.
Bear Creek Mine
P-3831 / Revision R-7
Basin 010
Stability Analysis

```
 REAME (Rotational Equilibrium Analysis of Multilayered Embankments)
     Implemented on the 16-bit Microcomputers C. F. Hains, Jr. and D. M. Hains
     2301 22nd Ave.
     Northport, AL 35476
     (205)-339-6536


BIRMINGHAM COAL & COKE CO., INC.  BEAR CREEK MINE  P-3831 / REVISION R-7
BASIN 010
STATIC


          Number of cases to be analyzed    1


          Case Number    1


     Number of boundary lines=    4
     Number of points    on boundary lines are:         2         2         3
7

     On boundary line no. 1 Point no. and coordinates  are:
    1    94.000    60.900    2   500.000      .000

     On boundary line no. 2 Point no. and coordinates  are:
    1   200.000    49.000    2   425.818    15.127

     On boundary line no. 3 Point no. and coordinates  are:
    1    94.000    64.900    2   200.000    49.000    3   247.700    64.900

     On boundary line no. 4 Point no. and coordinates  are:
    1    94.000    64.900    2   247.700    64.900    3   251.000    69.400    4
263.000    69.400    5   366.091    35.036
    6   425.818    15.127    7   500.000     4.000

     Line no. and slope of each segment are:
           1     -.150
           2     -.150
           3     -.150       .333
           4      .000     1.364      .000     -.333     -.333     -.150

     No. of radius control zones=  1     Plot or no plot=  1     No. of seepage
cases=  1

     Total no. of lines at bottom of radius control zones   is:    1

     For rad. cont. zone no.  1     Radius decrement=      .000     No. of
Circles=  5     Id no. for first circle=,  1
        Line no.=  1     Begin pt. no.=  1     End pt. no.=  2
```

```
     Soil no.  Cohesion     F. angle     Unit wt.
         1      100.800       29.700      129.500
         2      100.800       29.700      129.500
         3         .000          .000      62.400

     Seismic coefficient=       .000     Min. depth of tallest slice=       .000
Unit weight of water=    62.400

     The factors of safety are determined by the SIMPLIFIED BISHOP method

     NSPG= 1  NSRCH= 0  No. of slices= 10  No. of add. radii= 2

     No. of points on water table for each case=   6

     Under seepage condition 1point no. and            coordinates of water
table are:
    1    94.000    64.900    2   247.700    64.900    3   299.741    51.959    4
366.091    35.036    5   425.818    15.127
    6   500.000     4.000

 point1=(   264.000,    90.000) point2=(   264.000,    70.000) point3=(
427.000,    70.000) NJ=    2 NI=    2
     Automatic search will follow after grid with XINC=    10.000 and YINC=
10.000

 At point (   264.000,    90.000) under seepage    1,the radius and the
corresponding factor of safety are:
         53.996    13.307         47.322    13.889         40.647    14.402
33.973    13.230         27.299     8.198
         25.074     7.627         22.849    10.516
     Lowest factor of safety=     7.627 and occurs at radius  =     25.074


 ****WARNING AT NEXT CENTER**** When radius is    15.108
 center of circle lies below ground line or circle does not intercept ground
line properly, or the circle cuts the slope
 very slightly, so a large factor of safety is assigned.

 At point (   264.000,    80.000) under seepage    1,the radius and the
corresponding factor of safety are:
         44.107    14.242         37.415    14.585         30.723    13.729
24.031    10.601         17.339     6.745
         15.108**********         12.878     9.117
     Lowest factor of safety=     6.745 and occurs at radius  =     17.339


 At point (   264.000,    70.000) under seepage    1,the radius and the
corresponding factor of safety are:
         34.217    16.238         27.551    15.726         20.884    12.700
14.218     8.349          7.552     8.831
         18.662    11.436         16.440     9.173         11.996     8.261
9.774     8.723
     Lowest factor of safety=     8.261 and occurs at radius  =     11.996


 At point (   345.500,    90.000) under seepage    1,the radius and the
corresponding factor of safety are:
```

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        66.086     1.559         61.995     1.585         57.904     1.667
53.813     1.881         49.723     2.577
     Lowest factor of safety=     1.559 and occurs at radius  =     66.086


 At point (   345.500,    80.000) under seepage    1,the radius and the
corresponding factor of safety are:
        56.196     1.625         52.186     1.649         48.176     1.722
44.166     1.919         40.155     2.598
     Lowest factor of safety=     1.625 and occurs at radius  =     56.196


 At point (   345.500,    70.000) under seepage    1,the radius and the
corresponding factor of safety are:
        46.307     1.732         42.377     1.745         38.447     1.815
34.518     1.991         30.588     2.646
     Lowest factor of safety=     1.732 and occurs at radius  =     46.307


 At point (   427.000,    90.000) under seepage    1,the radius and the
corresponding factor of safety are:
        78.175     1.578         76.821     1.667         75.467     1.829
74.113     2.221         72.759     3.563
     Lowest factor of safety=     1.578 and occurs at radius  =     78.175


 At point (   427.000,    80.000) under seepage    1,the radius and the
corresponding factor of safety are:
        68.286     1.648         67.012     1.746         65.739     1.924
64.465     2.315         63.191     3.742
     Lowest factor of safety=     1.648 and occurs at radius  =     68.286


 At point (   427.000,    70.000) under seepage    1,the radius and the
corresponding factor of safety are:
        58.397     1.733         57.204     1.842         56.010     2.039
54.817     2.424         53.624     3.947
     Lowest factor of safety=     1.733 and occurs at radius  =     58.397



 For piezometric line No.    1

 At point (   345.500,    90.000) ,RADIUS    66.086
     the minimum factor of safety is      1.559



 At point (   345.500,    90.000) under seepage    1,the radius and the
corresponding factor of safety are:
        66.086     1.559         61.995     1.585         57.904     1.667
53.813     1.881         49.723     2.577
     Lowest factor of safety=     1.559 and occurs at radius  =     66.086
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 At point (   355.500,     90.000) under seepage    1,the radius and the
corresponding factor of safety are:
         67.569     1.497          63.814     1.525          60.059     1.602
56.304     1.807          52.549     2.514
     Lowest factor of safety=     1.497 and occurs at radius  =     67.569


 At point (   365.500,     90.000) under seepage    1,the radius and the
corresponding factor of safety are:
         69.052     1.444          65.633     1.478          62.214     1.550
58.795     1.743          55.376     2.421
     Lowest factor of safety=     1.444 and occurs at radius  =     69.052


 At point (   375.500,     90.000) under seepage    1,the radius and the
corresponding factor of safety are:
         70.536     1.400          67.452     1.437          64.369     1.514
61.286     1.702          58.202     2.353
     Lowest factor of safety=     1.400 and occurs at radius  =     70.536


 At point (   385.500,     90.000) under seepage    1,the radius and the
corresponding factor of safety are:
         72.019     1.366          69.272     1.407          66.524     1.494
63.776     1.690          61.029     2.342
     Lowest factor of safety=     1.366 and occurs at radius  =     72.019


 At point (   395.500,     90.000) under seepage    1,the radius and the
corresponding factor of safety are:
         73.503     1.342          71.091     1.391          68.679     1.489
66.267     1.709          63.855     2.425
     Lowest factor of safety=     1.342 and occurs at radius  =     73.503


 At point (   405.500,     90.000) under seepage    1,the radius and the
corresponding factor of safety are:
         74.986     1.338          72.910     1.398          70.834     1.518
68.758     1.780          66.682     2.634
     Lowest factor of safety=     1.338 and occurs at radius  =     74.986


 At point (   415.500,     90.000) under seepage    1,the radius and the
corresponding factor of safety are:
         76.470     1.373          74.729     1.447          72.989     1.600
71.249     1.933          69.508     2.969
     Lowest factor of safety=     1.373 and occurs at radius  =     76.470


 At point (   405.500,    100.000) under seepage    1,the radius and the
corresponding factor of safety are:
         84.875     1.321          82.719     1.384          80.562     1.499
78.406     1.751          76.249     2.564
     Lowest factor of safety=     1.321 and occurs at radius  =     84.875
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 At point (   405.500,   110.000) under seepage    1,the radius and the
corresponding factor of safety are:
         94.765     1.311          92.528     1.374          90.291     1.487
88.054     1.735          85.816     2.515
     Lowest factor of safety=     1.311 and occurs at radius  =     94.765


 At point (   405.500,   120.000) under seepage    1,the radius and the
corresponding factor of safety are:
        104.654     1.304         102.337     1.368         100.019     1.481
97.701     1.722          95.384     2.482
     Lowest factor of safety=     1.304 and occurs at radius  =    104.654


 At point (   405.500,   130.000) under seepage    1,the radius and the
corresponding factor of safety are:
        114.544     1.301         112.145     1.362         109.747     1.472
107.349     1.711         104.951     2.455
     Lowest factor of safety=     1.301 and occurs at radius  =    114.544


 At point (   405.500,   140.000) under seepage    1,the radius and the
corresponding factor of safety are:
        124.433     1.295         121.954     1.356         119.476     1.468
116.997     1.705         114.518     2.442
     Lowest factor of safety=     1.295 and occurs at radius  =    124.433


 At point (   405.500,   150.000) under seepage    1,the radius and the
corresponding factor of safety are:
        134.322     1.291         131.763     1.353         129.204     1.465
126.645     1.703         124.086     2.440
     Lowest factor of safety=     1.291 and occurs at radius  =    134.322


 At point (   405.500,   160.000) under seepage    1,the radius and the
corresponding factor of safety are:
        144.212     1.287         141.572     1.350         138.932     1.464
136.293     1.705         133.653     2.444
     Lowest factor of safety=     1.287 and occurs at radius  =    144.212


 At point (   405.500,   170.000) under seepage    1,the radius and the
corresponding factor of safety are:
        154.101     1.285         151.381     1.350         148.661     1.465
145.941     1.708         143.220     2.442
     Lowest factor of safety=     1.285 and occurs at radius  =    154.101


 At point (   405.500,   180.000) under seepage    1,the radius and the
corresponding factor of safety are:
        163.990     1.284         161.190     1.350         158.389     1.467
155.588     1.714         152.788     2.447
     Lowest factor of safety=     1.284 and occurs at radius  =    163.990
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 At point (   405.500,   190.000) under seepage    1,the radius and the
corresponding factor of safety are:
        173.880     1.284        170.999     1.351        168.117     1.470
165.236     1.721        162.355     2.456
     Lowest factor of safety=     1.284 and occurs at radius  =    173.880


 At point (   405.500,   200.000) under seepage    1,the radius and the
corresponding factor of safety are:
        183.769     1.284        180.807     1.352        177.846     1.474
174.884     1.728        171.922     2.468
     Lowest factor of safety=     1.284 and occurs at radius  =    183.769


 At point (   415.500,   190.000) under seepage    1,the radius and the
corresponding factor of safety are:
        175.363     1.286        172.818     1.353        170.272     1.478
167.727     1.733        165.182     2.498
     Lowest factor of safety=     1.286 and occurs at radius  =    175.363


 At point (   395.500,   190.000) under seepage    1,the radius and the
corresponding factor of safety are:
        172.396     1.290        169.179     1.355        165.962     1.474
162.746     1.722        159.529     2.457
     Lowest factor of safety=     1.290 and occurs at radius  =    172.396


 At point (   408.000,   190.000) under seepage    1,the radius and the
corresponding factor of safety are:
        174.251     1.283        171.453     1.351        168.656     1.471
165.859     1.722        163.062     2.461
     Lowest factor of safety=     1.283 and occurs at radius  =    174.251


 At point (   410.500,   190.000) under seepage    1,the radius and the
corresponding factor of safety are:
        174.621     1.283        171.908     1.352        169.195     1.472
166.482     1.724        163.768     2.469
     Lowest factor of safety=     1.283 and occurs at radius  =    174.621


 At point (   413.000,   190.000) under seepage    1,the radius and the
corresponding factor of safety are:
        174.992     1.284        172.363     1.352        169.734     1.474
167.104     1.728        164.475     2.482
     Lowest factor of safety=     1.284 and occurs at radius  =    174.992


 At point (   410.500,   192.500) under seepage    1,the radius and the
corresponding factor of safety are:
        177.094     1.283        174.360     1.352        171.627     1.473
168.894     1.726        166.160     2.470
     Lowest factor of safety=     1.283 and occurs at radius  =    177.094
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 At point (   410.500,   195.000) under seepage    1,the radius and the
corresponding factor of safety are:
        179.566     1.283        176.813     1.352        174.059     1.474
171.306     1.727        168.552     2.472
     Lowest factor of safety=     1.283 and occurs at radius  =    179.566


 At point (   410.500,   197.500) under seepage    1,the radius and the
corresponding factor of safety are:
        182.038     1.283        179.265     1.352        176.491     1.474
173.718     1.729        170.944     2.473
     Lowest factor of safety=     1.283 and occurs at radius  =    182.038


 At point (   413.000,   195.000) under seepage    1,the radius and the
corresponding factor of safety are:
        179.937     1.284        177.267     1.352        174.598     1.475
171.928     1.730        169.259     2.482
     Lowest factor of safety=     1.284 and occurs at radius  =    179.937


 At point (   408.000,   195.000) under seepage    1,the radius and the
corresponding factor of safety are:
        179.195     1.284        176.358     1.351        173.520     1.473
170.683     1.725        167.845     2.465
     Lowest factor of safety=     1.284 and occurs at radius  =    179.195



 For piezometric line No.    1

 At point (   410.500,   195.000) ,RADIUS   179.566
     the minimum factor of safety is      1.283


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     Cross section in distorted scale. Numerals indicate boundary line no.
     If there area more than 10 bound. lines, alphabets will then be used. P
     Indicates Piezometric line. If a portion of Piezometric line coincides with
     the ground or another boundary line, only the ground or boundary
     line will be shown. X indicates intersection of two boundary
     lines. * indicates failure surface.
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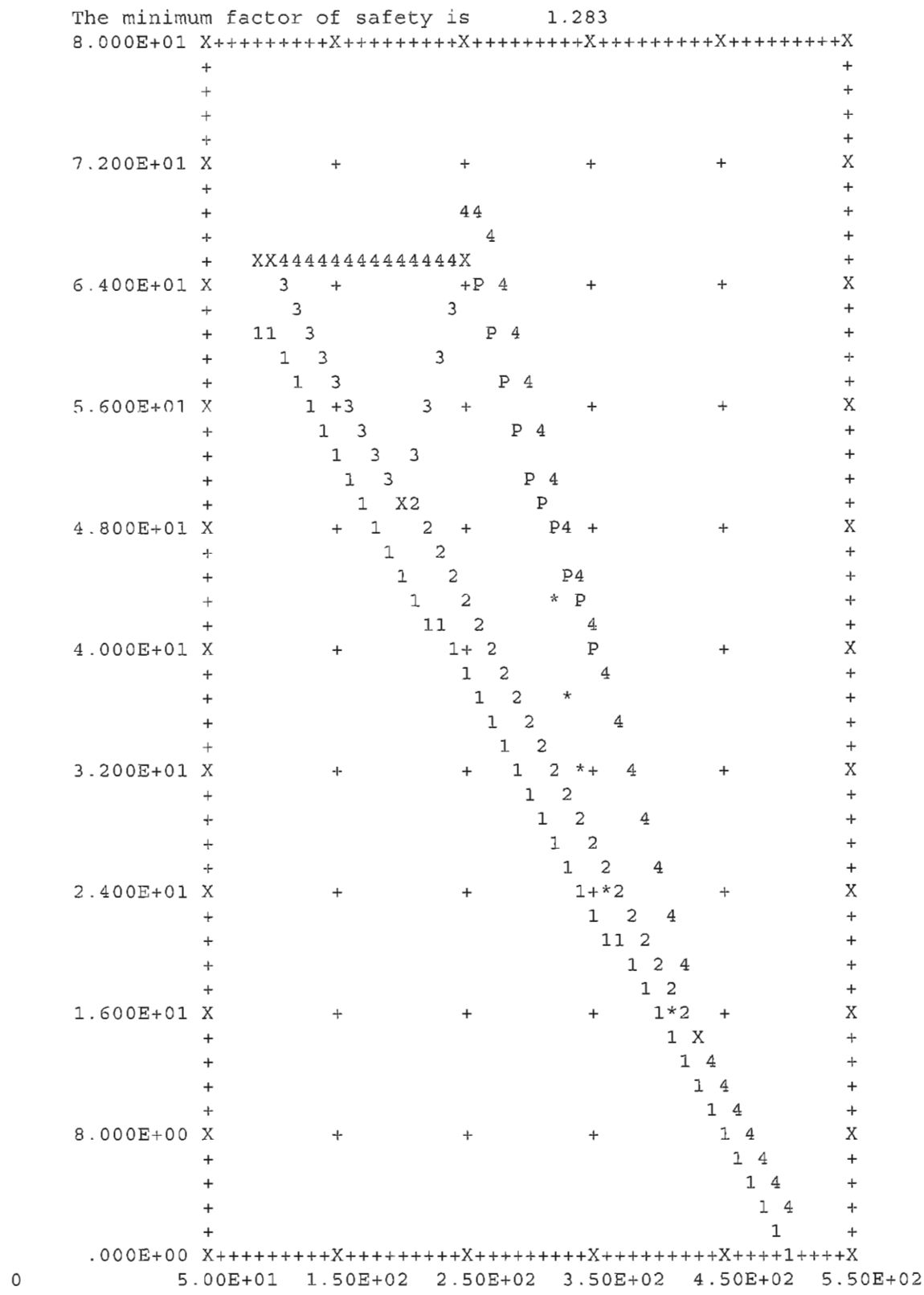
The minimum factor of safety is 1.283
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7.200E+01
6.400E+01
5.600E+01
4.800E+01
4.000E+01
3.200E+01
2.400E+01
1.600E+01
8.000E+00
.000E+00
0
5.00E+01
1.50E+02
2.50E+02
3.50E+02
4.50E+02
5.50E+02