mcgehee engineering corp

September 26, 2016

Stephen Miles, P.E.
Alabama Surface Mining Commission
P. O. Box 2390
Jasper, AL 35502-2390

RE: **Black Warrior Minerals, Inc.**
Mine No. 2, P-3987, R-2
Sediment Basin 046 Modification & 046A Re-Evaluation

Dear Mr. Miles:

I hereby certify the enclosed detailed design plans for Sediment Basins 046 Modification and 046A Re-Evaluation (Phase 1 and Phase 2) 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 as amended to date and that the information used in the enclosed basin design plans is true and correct to the best of my knowledge and belief.

If you have any questions or need additional information, please do not hesitate to contact our office.

Sincerely,

McGehee Engineering Corp.

ALABAMA LICENSED No. 33277 PROFESSIONAL ENGINEER BRADLEY K. SIMMONS

Bradley K. Simmons, P.E.
Alabama Reg. No. 33277

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

MODIFICATION

Modifications to Sediment Basin 046 include raising the primary spillway 0.95' by adding concrete block to the bottom of the spillway. A 4" PVC siphon tube is also proposed to be added with this modification. The siphon tube will be secured in place in the bottom of the existing concrete spillway. Due to limited spoil room for the mining operation, spoil is proposed to be placed in the upper end of the pool area of Sediment Basin 046. This modification shows that Sediment Basin 046 meets effluent with the reduced volume.

No modifications are proposed for Sediment Basin 046A.

The entire pool area of this Sediment Basin 046A will be in spoil. The pool area up to the emergency spillway elevation will be lined with a minimum 1' of clay. See the attached Typical Clay Liner sheet for details. See the attached Typical Clay Liner sheet for details.

Sediment Basin 046A is designed on assumed coordinates due not knowing the final elevation of the area after the area is mined. Sediment Basin 046A will be constructed at an elevation to ensure that the discharge elevation is above the normal pool elevation of Sediment Basin 046 to allow positive drainage.

Once construction begins basins will be constructed and certified to the Regulatory Authority within 90 days unless an extension is granted by the Director.

SEDIMENT BASIN CONSTRUCTION SPECIFICATIONS

Sediment basins (temporary or permanent) will be designed and constructed using the following as minimum specifications:

1. EMBANKMENT REQUIREMENTS

A) The minimum width of the top of the embankment will under no circumstance be less than twelve (12) feet.

B) The embankment will have a minimum front and back slope no steeper than the slopes listed on the detailed design sheet.

C) The foundation area of the embankment will be cleared and grubbed of all organic matter with no surface slope steeper than 1 horizontal to 1 vertical. The entire wet area, as measured from the upstream toe of the embankment to the normal pool level, will be cleared of trees and large brush.

D) A core will be constructed in a cutoff trench along the centerline of the embankment. The cutoff trench will be of suitable depth and width to attain relatively impervious material.

E) The embankment construction material will be free of sod, roots, stumps, rocks, etc., which exceed six (6") inches in diameter. The embankment material will be placed in layers of twelve (12") inches or less and compacted to ninety five (95%) percent of the standard proctor density, as set forth in ASTM.

F) The embankment, foundation and abutments will be designed and constructed to be stable under normal construction and operating conditions, with a minimum static safety factor of 1.3 at normal pool level with steady seepage saturation conditions.

G) The actual constructed height of the embankment will be a minimum of five (5%) percent higher than the design height to allow for settling over the life of the embankment.

H) The design embankment height for temporary impoundments will be a minimum of one (1) foot above the maximum water level anticipated from a 10 Year - 24 Hour or a 25 Year - 6 Hour precipitation event (whichever is greater). The design embankment height for permanent impoundments will be a minimum of one (1) foot above the maximum water level anticipated from a 10 Year - 24 Hour or a 25 Year - 6 Hour precipitation event (whichever is greater).

I) For embankments constructed as point source discharges, the embankment will be constructed and abutments keyed into undisturbed, virgin, ground if at all possible. In the event that this can not be achieved, additional design and construction specifications will be submitted in the detailed design plans.

J) The embankment and all areas disturbed in the construction of the embankment will be seeded with a mixture of perennial and annual grasses, fertilized and mulched to prevent erosion and ensure restabilization. Hay dams, silt fences, rock check dams, etc. will be installed, where deemed necessary, as additional erosion prevention methods.

2. DISCHARGE STRUCTURE REQUIREMENTS

A) The primary spillway will be designed to adequately carry the anticipated peak runoff from a 10 Year - 24 Hour precipitation event. The combination primary and secondary (emergency) spillway system will be designed to safely carry the anticipated peak runoff from a 25 Year - 6 Hour precipitation event. When sediment basins are proposed in the drainage course of a public water supply, the spillway system will be designed and constructed to adequately carry the runoff from a 50 Year - 24 Hour precipitation event.

B) Channel linings, for secondary (emergency) spillways will be a trapezoidal open channel constructed in natural ground and planted with a mixture of both annual and perennial grasses being predominantly fescue and bermuda. In the event that the spillway can not be constructed in natural ground the spillway will be lined with riprap, concrete, asphalt or durable rock (See Detailed Design Plans for Spillway Lining).

C) When consisting of pipe, the primary spillway will be installed according to Class "C" pipe installation for embankment bedding.

D) Sediment basins with a single spillway system, such as a skimmer board, will be a trapezoidal open channel constructed in consolidated, nonerodible material and lined with rip-rap, concrete, asphalt or durable rock (See Detailed Design Plans for Spillway Lining).

E) The primary spillway will be designed and constructed with device to eliminate floating solids from leaving the impoundment. This device will consist of a turned down elbow when using pipe or a skimmer system when using an open channel spillway.

F) When necessary, to prevent erosion of the embankment or discharge area, a splash pad of rip-rap, durable rock, sacrete, etc. will be installed at the discharge end of the primary spillway.

G) The combined spillway systems, for sediment basins constructed in series, will be designed to adequately accommodate the entire drainage area.

3. INSPECTION, MAINTENANCE AND CERTIFICATION REQUIREMENTS

A) Inspections will be conducted regularly during construction of the sediment basin by a qualified registered professional engineer or other qualified person under the direction of a professional engineer. Upon completion of construction, the sediment basin will be

certified, by a qualified registered professional engineer, to the Regulatory Authority as having been constructed in accordance with the approved detailed design plans.

B) Sediment basins will be inspected semi-monthly for erosion, instability, etc., with maintenance performed as necessary, until the removal of the structure or until a Phase III Bond Release is granted.

C) Sediment basins will be examined quarterly for structural weakness, instability, erosion, slope failure, or other hazardous conditions with maintenance performed as necessary.

D) Formal inspections will be made annually, by a qualified registered professional engineer or other qualified person under the direction of a professional engineer, including any reports or modifications, in accordance with 880-X- 10C- .20[1(j)] of the Alabama Surface Mining Regulations.

E) Retained sediment will be removed from each sediment basin when the accumulated sediment reaches the maximum allowable sediment volume as set forth in the detailed design plans.

4. BASIN REMOVAL REQUIREMENTS

A) Upon completion of mining, reclamation, restabilization and effluent standards being met, each sediment basin not proposed as a permanent water impoundment will be dewatered in a controlled manner by either pumping or siphoning. Upon successful dewatering, a determination will be made as to the retained sediment level in the basin. After determining the retained sediment level, a channel will be cut into the embankment down to the retained sediment level on the side of the embankment deemed most suitable to reach natural ground without encountering prohibiting rock. The embankment material removed from this newly constructed channel will be spread and compacted over the previous impoundment (wet area) area to prevent erosion and ensure restabilization. The newly constructed channel will be of adequate width (minimum 30 feet) and sloped to a grade (approximately 1% to 3%) which will cause all surface drainage to travel across this area in sheet flow, minimizing the possibility of erosion. Also, where necessary, hay dams will be installed in strategic locations across the width of the channel to retain sediment and slow the water velocity to a favorable rate. Upon removal of the embankment section, all disturbed areas will be graded in such a manner to ensure slope stability, successful restabilization and to minimize erosion. All disturbed areas will be seeded with a mixture of annual and perennial grasses, fertilized and mulched. No slope, existing or created in the removal of the sediment basin, will be left on a grade that will slip or slough.

5. PERMANENT WATER IMPOUNDMENT REQUIREMENTS

A) Prior to a request for a Phase II Bond Release, all sediment basins being left as permanent water impoundments will have supplemental data submitted to the Regulatory Authority concerning water quality, water quantity, size, depth, configuration, postmining land use, etc.

B) Final grading slopes of the entire permanent water impoundment area will not exceed a slope of 2 Horizontal to 1 Vertical to provide for safety and access for future water users.

CONSTRUCTION TIMETABLE

PHASE 1 MODIFICATION

Sediment Basin 046 was constructed and certified under P-3950. Phase 1 of the original design plans for P-3987 was certified on April 19, 2016. Phase 1 of these modifications plans consists of raising the spillway to 391.2' and installing the 4" PVC siphon tube.

PHASE 2

Sediment Basin 046A will be constructed and certified to the Regulatory Authority prior to reaching the limits of the graded and bare area as shown on the Phase I Watershed Map.

Note: Once construction begins, the basin will be constructed and certified to the Regulatory Authority within 90 days unless an extension is granted by the Director.

RIPRAP CLASSIFICATION SPECIFICATIONS

CLASS 1 RIPRAP

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 of 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 RIPRAP

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 of 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 RIPRAP

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 of less than sixteen (16) inches; and, no more than 15% 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 RIPRAP

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 of less than twenty two (22) inches; and, no more than 25% 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 RIPRAP

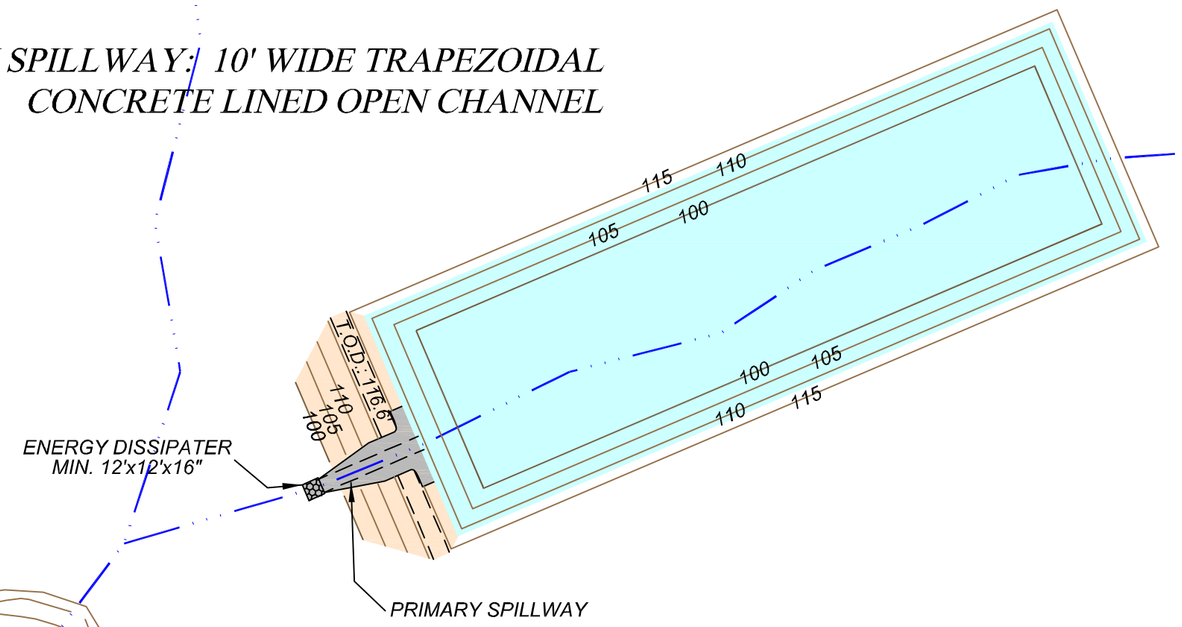
No more than 10% of the stone will have a diameter greater than thirty four (34) inches; no more than 50% of the stone will have a diameter of less than twenty seven (27) inches; and, no more than 25% of the stone will have a diameter of less than sixteen (16) inches. The thickness of the rip-rap liner will be no less than thirty four (34) inches.

9 10
16 15

SEDIMENT BASIN 046A

UPSTREAM TOE ELEV.: 100.0'
SEDIMENT REMOVAL ELEV.: 109.61'
EMERGENCY SPILLWAY ELEV.: 111.75'
**MAXIMUM WATER ELEV.: 114.79'
TOP OF DAM ELEV.: 115.8' DESIGN
TOP OF DAM ELEV.: 116.6' CONSTRUCT.

EMERGENCY SPILLWAY: 10' WIDE TRAPEZOIDAL
CONCRETE LINED OPEN CHANNEL

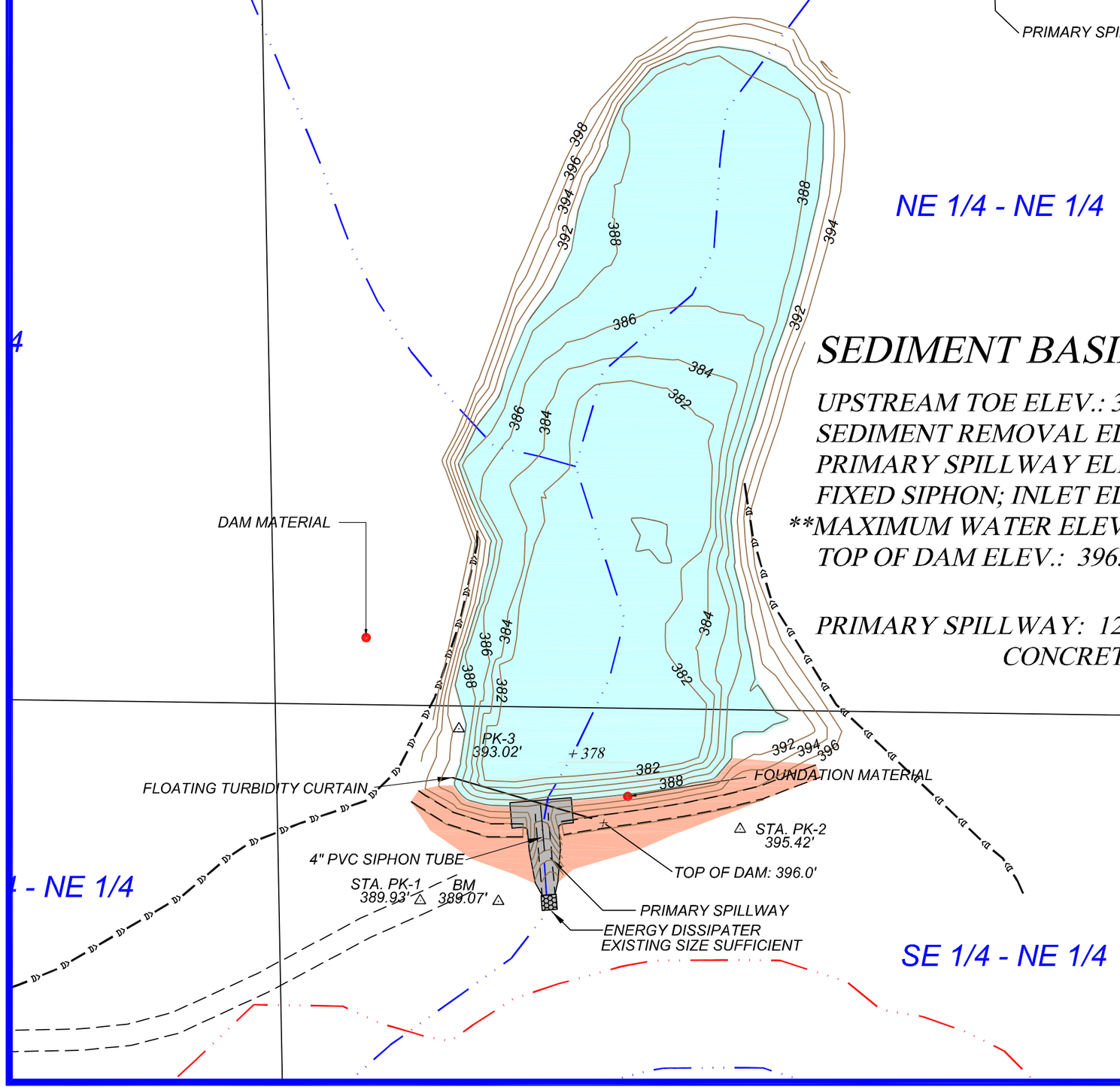


NE 1/4 - NE 1/4

SEDIMENT BASIN 046

UPSTREAM TOE ELEV.: 378.0'
SEDIMENT REMOVAL ELEV.: 388.26'
PRIMARY SPILLWAY ELEV.: 391.2'
FIXED SIPHON; INLET ELEV.389.2', CREST ELEV. 390.2', OULET ELEV. 386.0'
**MAXIMUM WATER ELEV.: 393.97'
TOP OF DAM ELEV.: 396.0' CONSTRUCTED

PRIMARY SPILLWAY: 12' WIDE TRAPEZOIDAL
CONCRETE LINED OPEN CHANNEL



- NE 1/4

SE 1/4 - NE 1/4

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NOTE: ALL ELEVATIONS FOR SEDIMENT BASIN 046A ARE ASSUMED.

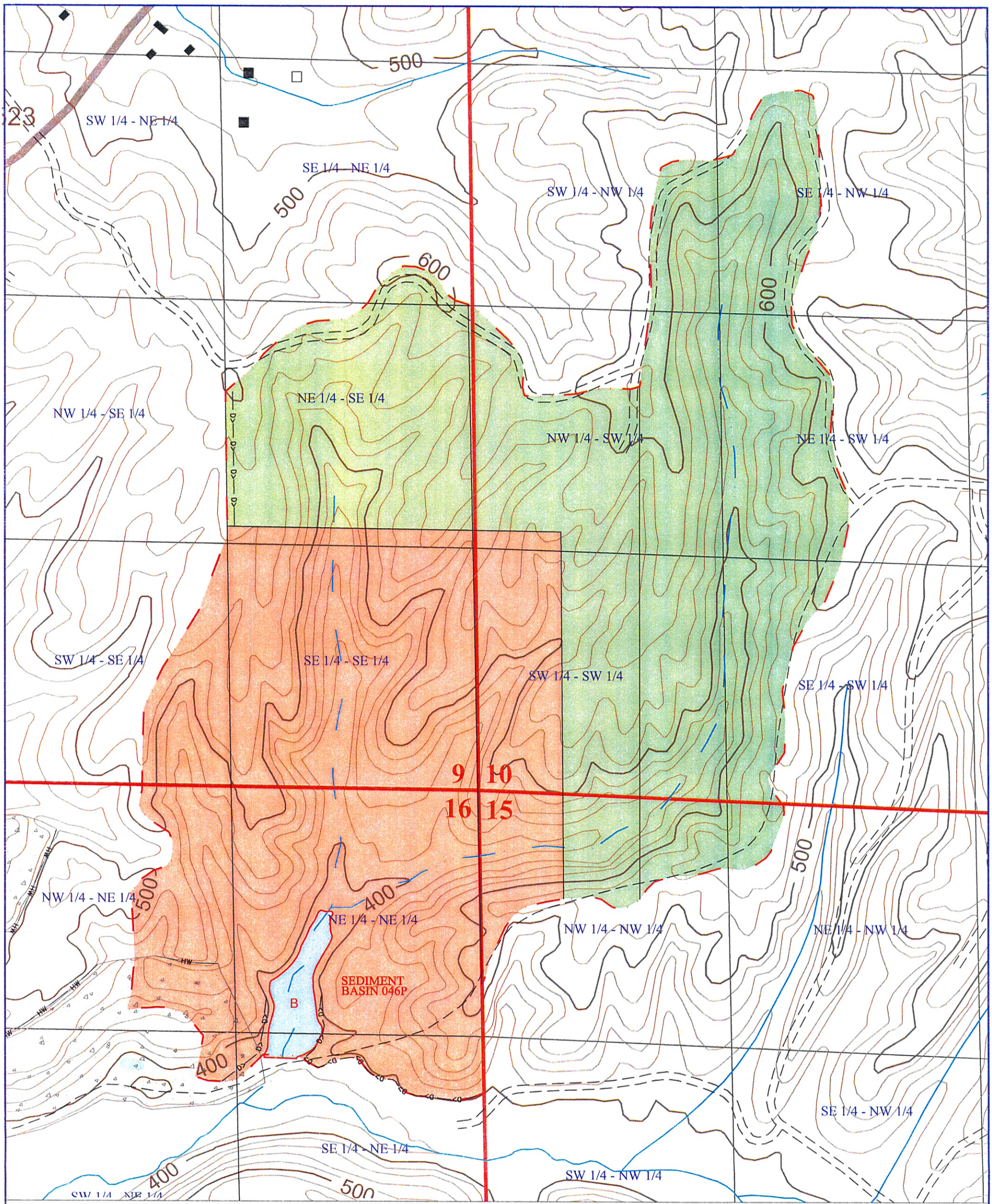
NORMAL POOL AREA
DIVERSION DITCH
ORIGINAL DRAINAGE PATH
100' STREAM BUFFER ZONE
ENERGY DISSIPATER (CLASS II SANDSTONE RIPRAP)

N
W E
S

BLACK WARRIOR MINERALS, INC.

MINE NO. 2, P-3987, R-2

PLAN VIEW DRAWING
SCALE: 1" = 100'
SEDIMENT BASIN 046 & 046A
MODIFICATION



BLACK WARRIOR MINERALS, INC.

MINE NO. 2
ASMC PERMIT NO. P-3987, R-2

WATERSHED MAP
SCALE: 1" = 500'

SEDIMENT BASIN 046 & 046A
PHASE I

WATERSHED MAP LEGEND

- PERMIT BOUNDARY
- FOREST, C.N. 73
- GRADED & BARE, C.N. 81
- SEDIMENT BASIN, C.N. 100
- DRAINAGE DIVIDE
- DIVERSION DITCH

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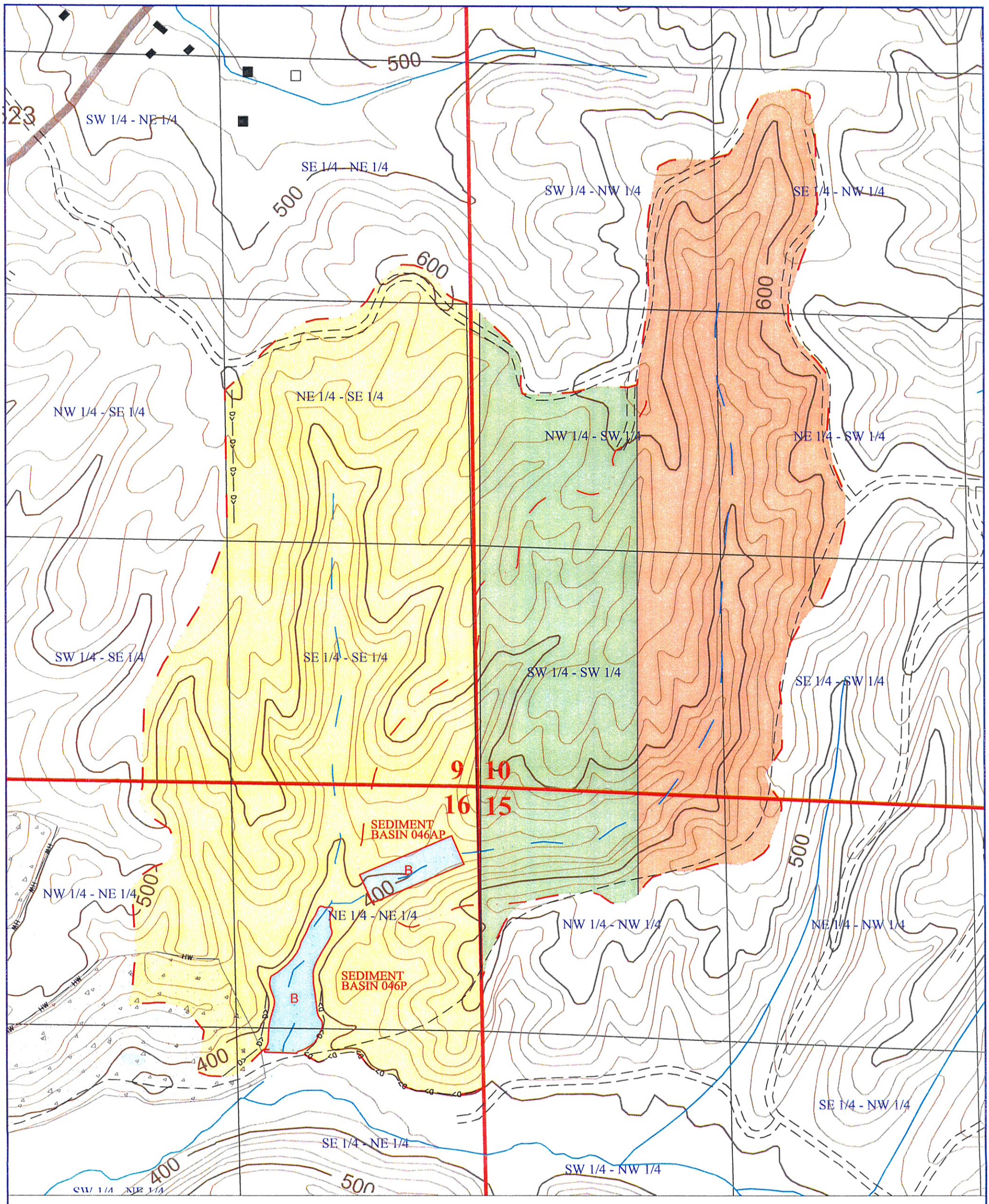

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BLACK WARRIOR MINERALS, INC.

MINE NO. 2
ASMC PERMIT NO. P-3987, R-2

WATERSHED MAP
SCALE: 1" = 500'

SEDIMENT BASIN 046 & 046A
PHASE II

WATERSHED MAP LEGEND

- PERMIT BOUNDARY
- PREVIOUSLY MINED, 0 -2 MONTHS REVEGITATION, C.N. 79
- PREVIOUSLY MINED, 2 -12 MONTHS REVEGITATION, C.N. 74
- GRADED & BARE, C.N. 81
- B — SEDIMENT BASIN, C.N. 100
- DRAINAGE DIVIDE
- D>— D>— DIVERSION DITCH

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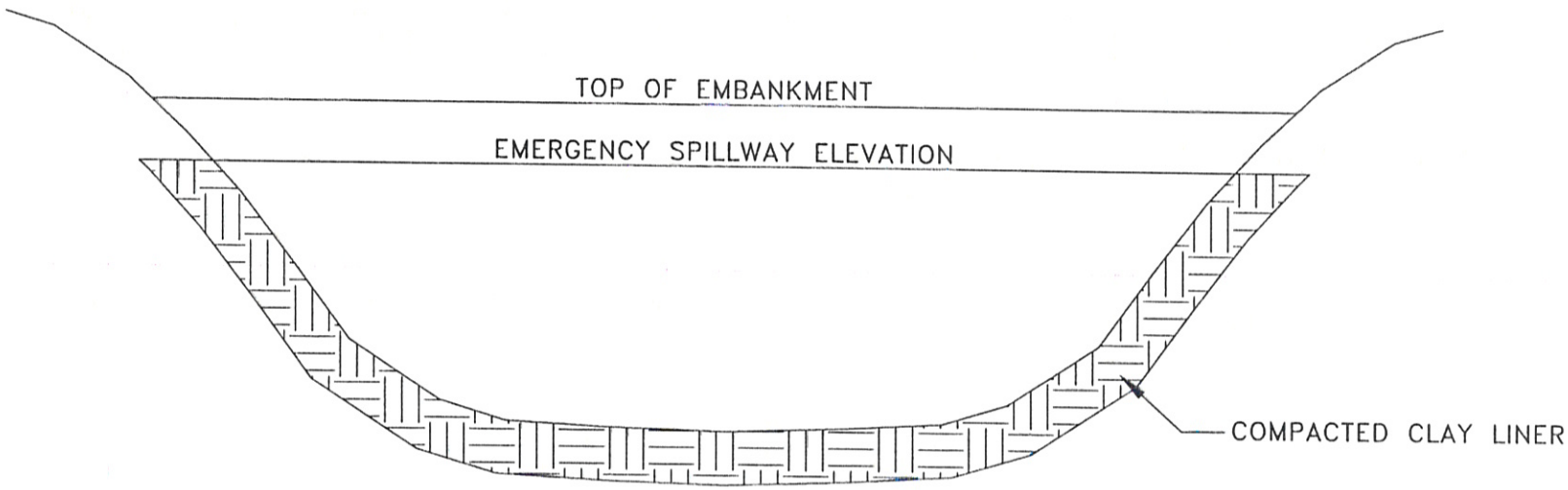
TYPICAL IMPOUNDMENT PROFILE
CLAY LINER CROSS-SECTION



In the event that a sediment basin must be constructed in spoil material, that part of the interior or wet area or wet area located in spoil material will be lined with a minimum of one (1') foot of clay material with a permeability no greater than 0.000001 cm./sec. up to the emergency spillway elevation. The clay liner material will be placed in lifts no greater than six (6") inches and compacted to ninety-five (95) percent of the standard proctor density.

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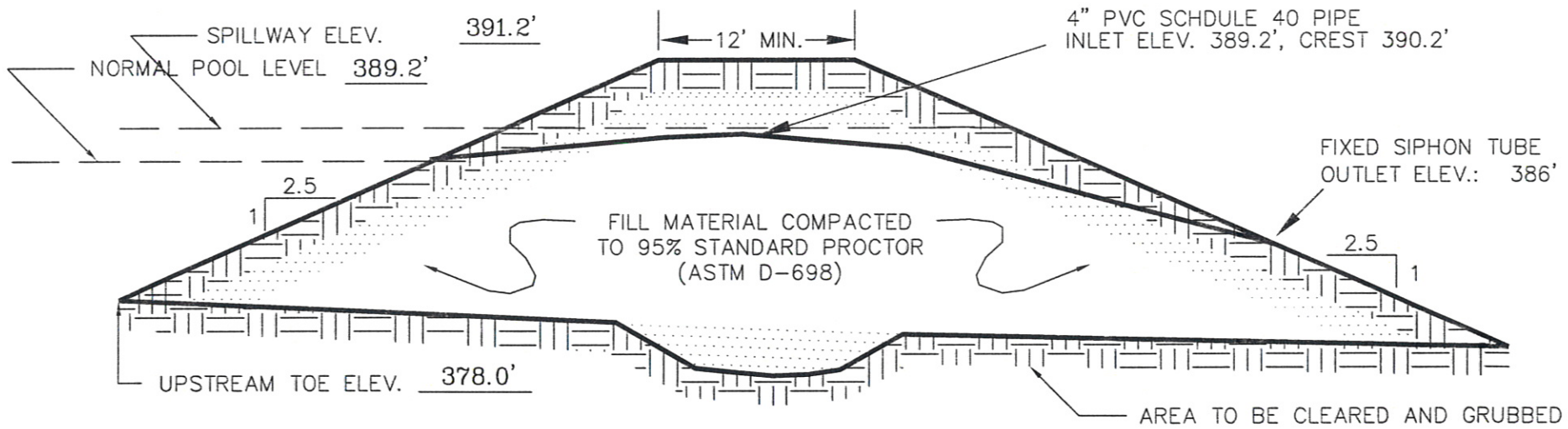
Sediment Basin 046

Elevation-Area-Capacity Table

Elevation (ft)	Area (ac)	Capacity (ac-ft)
378.00	0.000	0.000
378.50	0.006	0.001
379.00	0.023	0.008
379.50	0.051	0.025
380.00	0.090	0.060
380.50	0.258	0.143
381.00	0.512	0.332
381.50	0.853	0.670
382.00	1.280	1.200
382.50	1.361	1.860
383.00	1.445	2.561
383.50	1.531	3.305
384.00	1.620	4.093
384.50	1.732	4.931
385.00	1.848	5.825
385.50	1.967	6.779
386.00	2.090	7.793
386.50	2.226	8.872
387.00	2.366	10.020
387.50	2.511	11.239
388.00	2.660	12.532
388.50	2.904	13.922
389.00	3.159	15.437
389.50	3.424	17.082
390.00	3.700	18.863
390.50	3.784	20.734
391.00	3.868	22.647
391.50	3.954	24.602
392.00	4.040	26.601
392.50	4.119	28.640
393.00	4.198	30.719
393.50	4.279	32.839
394.00	4.360	34.998
394.50	4.437	37.198
395.00	4.514	39.435
395.50	4.592	41.711
396.00	4.670	44.027

EMBANKMENT CROSS-SECTION



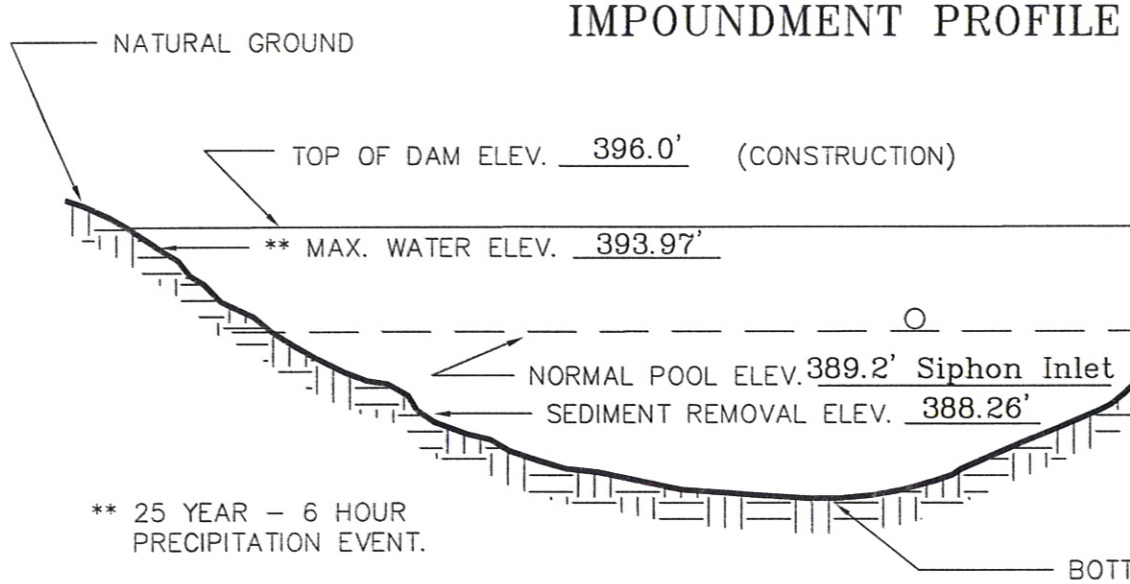
COMPANY: BLACK WARRIOR MINERALS, INC.

MINE NAME: MINE NO. 2

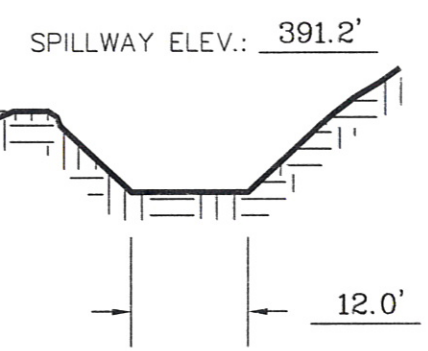
PERMIT #: P-3987

BASIN I.D. #: SEDIMENT BASIN 046 MODIFICATION

IMPOUNDMENT PROFILE



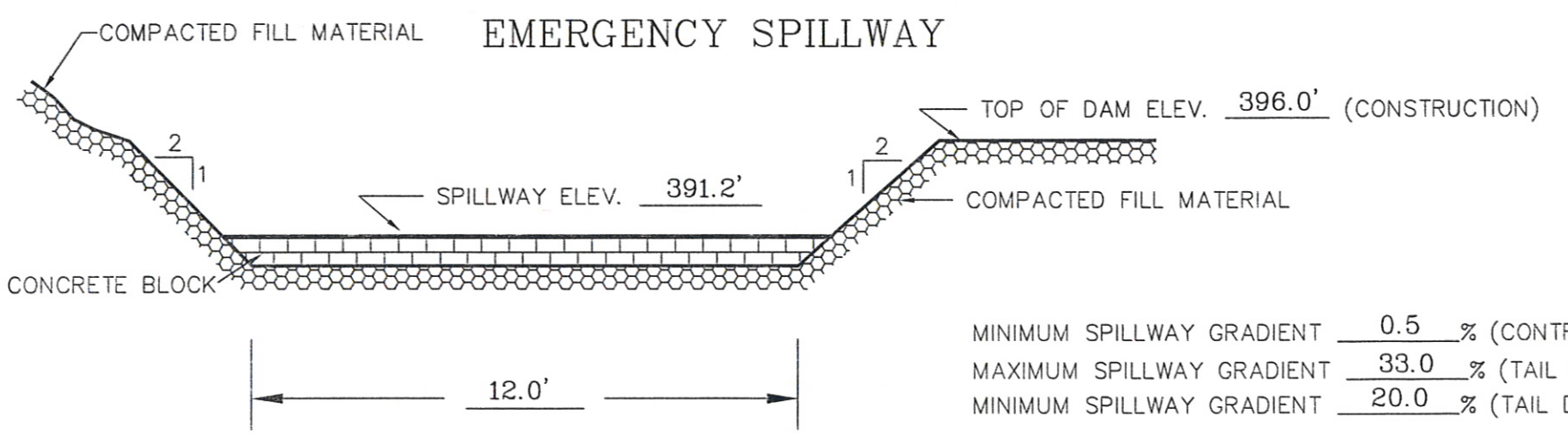
SPILLWAY



KEY BASIN PARAMETERS

DRAINAGE AREA	287	ACRES
DISTURBED AREA	136	ACRES
SEDIMENT STORAGE	13.25	AC.FT.
DETENTION STORAGE (CONCRETE)	10.18	AC.FT.
DETENTION STORAGE (SIPHON INLET)	6.36	AC.FT.
*PERMANENT POOL CAPACITY (CONCRETE)	23.43	AC.FT.
*PERMANENT POOL CAPACITY (SIPHON INLET)	19.61	AC.FT.
* TOTAL BASIN STORAGE CAPACITY	34.72	AC.FT.
** PEAK INFLOW	368.20	C.F.S.
** PEAK OUTFLOW	199.03	C.F.S.

EMERGENCY SPILLWAY



NOTE: ALL ELEVATIONS ASSUMED.

* 10 YEAR - 24 HOUR PRECIPITATION EVENT.

** 25 YEAR - 6 HOUR PRECIPITATION EVENT.

MINIMUM SPILLWAY GRADIENT 0.5 % (CONTROL SECTION)

MAXIMUM SPILLWAY GRADIENT 33.0 % (TAIL DITCH SECTION)

MINIMUM SPILLWAY GRADIENT 20.0 % (TAIL DITCH SECTION)

SEE SPILLWAY CONTROL SECTION AND TAIL DITCH DESIGN FOR CHANNEL LINING REQUIREMENTS.

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DETAILED DESIGN PLANS
SEDIMENT BASIN 046
PHASE I & II

SPILLWAY CHANNEL SPECIFICATIONS
SEDIMENT BASIN 046 – PHASE I & II

The entire control section and tail ditch section of the emergency spillway will be cut into the compacted fill of the embankment and lined with a minimum of 4 inches of reinforced concrete. All concrete will be reinforced with 10 gauge, 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" x 6" welded wire.

The gradient of the control section of the emergency spillway will not exceed one half (0.5%) percent. The gradient of the tail ditch section of the emergency spillway will not be less than twenty (20%) percent and will not exceed thirty-three (33%) percent.

The control section and tail ditch section of the emergency spillway will extend from the inner face of the embankment, past the centerline of the embankment and be carried out beyond the downstream slope of the embankment.

The concrete liner of the control section of the emergency spillway will be a minimum of 3.77 feet as measured vertically, allowing 2.77 feet for the maximum anticipated flow and 1.0 feet of dry freeboard. The concrete liner of the tail ditch section of the emergency spillway will be a minimum of 1.69 feet as measured vertically, allowing 0.69 feet for the maximum anticipated flow and 1.0 foot of dry freeboard. There will be a transition zone of at least 20 feet in length between the control section and the tail section. The minimum depth at the beginning of the transition will be 3.77 feet and 1.69 feet at the end of the transition. The flow line of the spillway will be smoothed at the transition to avoid abrupt changes in the flow line slope.

See enclosed SEDCAD 4.0 spillway tail ditch section design and attached Plan Sheet cross-section for the minimum and maximum emergency spillway construction requirements.

A floating silt fence (lightweight turbidity curtain) will be installed near the entrance to the spillway to accomplish sub-surface withdrawal. The floating silt fence (lightweight turbidity curtain) will be set at normal pool and will be anchored at the 10 Year – 24 Hour Event peak stage with steel fence posts.

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Sediment Basin 046 Spillway Tail Ditch Section

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)
12.00	2.0:1	2.0:1	20.0	0.0220	1.00		

	w/o Freeboard	w/ Freeboard
Design Discharge:	200.00 cfs	
Depth:	0.69 ft	1.69 ft
Top Width:	14.75 ft	18.75 ft
Velocity:	21.77 fps	
X-Section Area:	9.19 sq ft	
Hydraulic Radius:	0.609 ft	
Froude Number:	4.86	

Sediment Basin 046 Spillway Control Section

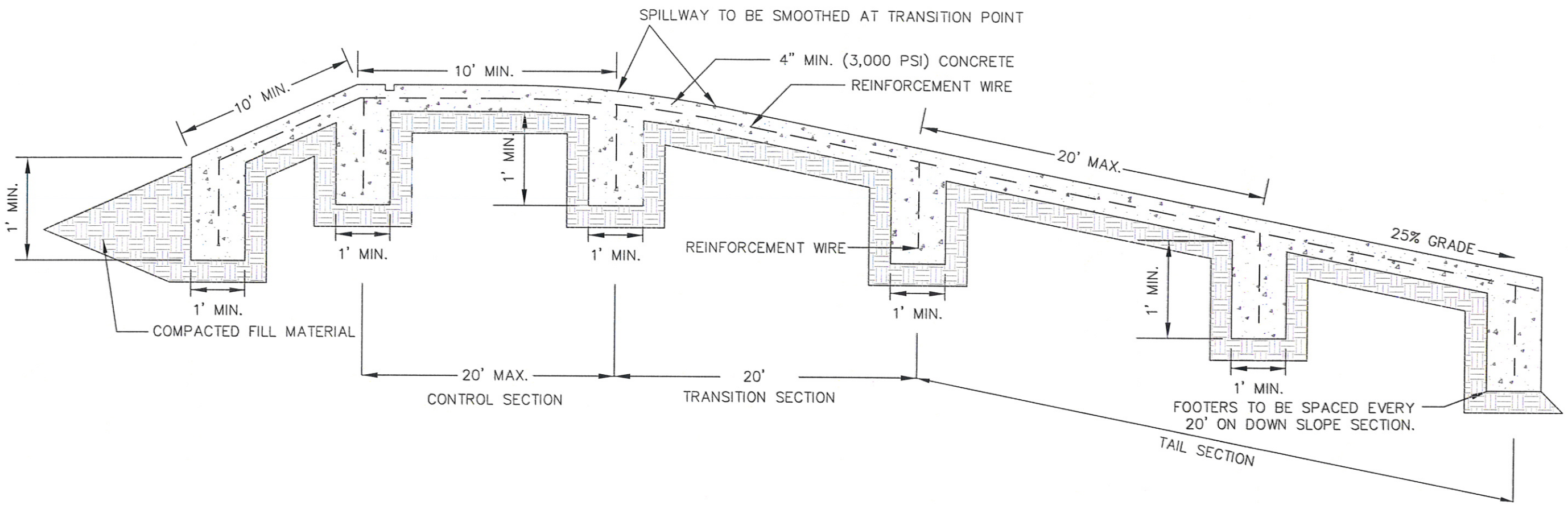
Material: Concrete, Rubble

Trapezoidal Channel

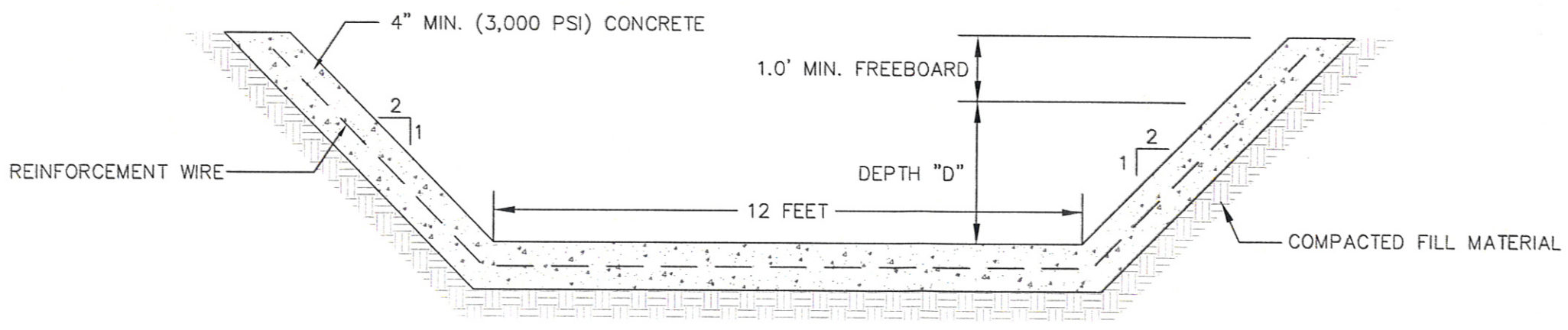
Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
12.00	2.0:1	2.0:1	0.5	0.0220	1.00		

	w/o Freeboard	w/ Freeboard
Design Discharge:	200.00 cfs	
Depth:	1.98 ft	2.98 ft
Top Width:	19.93 ft	23.93 ft
Velocity:	6.32 fps	
X-Section Area:	31.64 sq ft	
Hydraulic Radius:	1.516 ft	
Froude Number:	0.88	

SEDIMENT BASIN 046 SPILLWAY PROFILE



TYPICAL SPILLWAY CROSS-SECTION



SPILLWAY FLOW DEPTH "D" = 2.77 FEET (CONTROL SECTION)

SPILLWAY FLOW DEPTH "D" = 0.69 FEET (TAIL DITCH SECTION)

TOTAL SPILLWAY DEPTH "D+1" = 3.77 FEET (CONTROL SECTION)

TOTAL SPILLWAY DEPTH "D+1" = 1.69 FEET (TAIL DITCH SECTION)

NOTE: TOTAL SPILLWAY DEPTH IN TRANSITION SECTION VARIES FROM 3.77 FEET TO 1.69 FEET

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DETAILED DESIGN PLANS
SEDIMENT BASIN 046A
PHASE II

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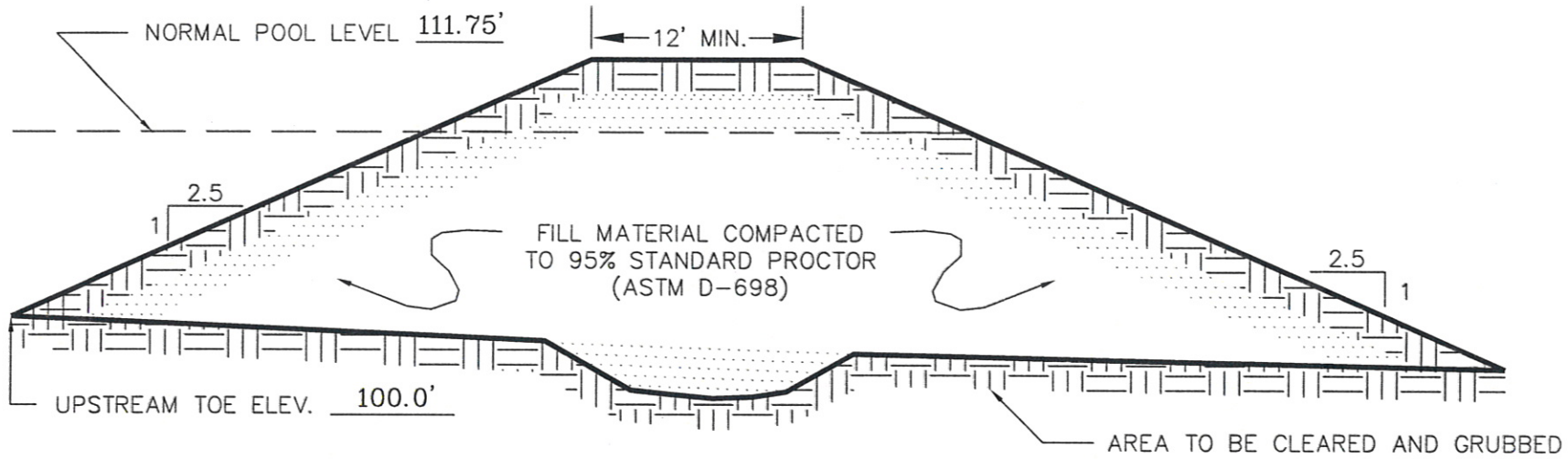
Sediment Basin 046A

Elevation-Area-Capacity Table

Elevation (ft)	Area (ac)	Capacity (ac-ft)
100.00	1.290	0.000
100.50	1.317	0.652
101.00	1.344	1.317
101.50	1.371	1.996
102.00	1.399	2.688
102.50	1.427	3.394
103.00	1.455	4.115
103.50	1.483	4.849
104.00	1.512	5.598
104.50	1.541	6.361
105.00	1.570	7.139
105.50	1.599	7.931
106.00	1.628	8.737
106.50	1.657	9.559
107.00	1.687	10.395
107.50	1.717	11.246
108.00	1.747	12.112
108.50	1.777	12.993
109.00	1.808	13.889
109.50	1.839	14.801
110.00	1.870	15.728
110.50	1.901	16.670
111.00	1.932	17.629
111.50	1.963	18.602
112.00	1.995	19.592
112.50	2.027	20.597
113.00	2.059	21.619
113.50	2.091	22.656
114.00	2.124	23.710
114.50	2.157	24.781
115.00	2.190	25.867
115.50	2.223	26.970
116.00	2.256	28.090
116.50	2.289	29.227
117.00	2.323	30.380
117.50	2.357	31.550
118.00	2.391	32.737

Elevation (ft)	Area (ac)	Capacity (ac-ft)
118.50	2.425	33.941
119.00	2.460	35.162
119.50	2.495	36.401
120.00	2.530	37.657

EMBANKMENT CROSS-SECTION



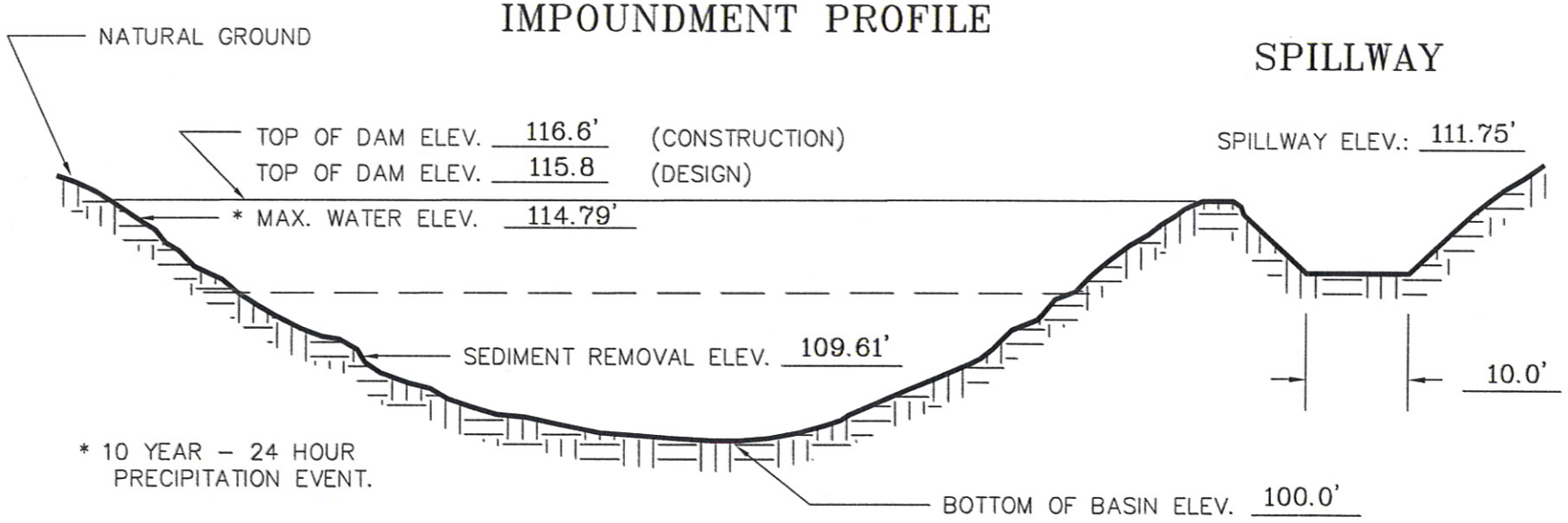
COMPANY: BLACK WARRIOR MINERALS, INC.

MINE NAME: MINE NO. 2

PERMIT #: P-39__

BASIN I.D. #: SEDIMENT BASIN 046A

IMPOUNDMENT PROFILE



* 10 YEAR – 24 HOUR PRECIPITATION EVENT.

SPILLWAY

KEY BASIN PARAMETERS

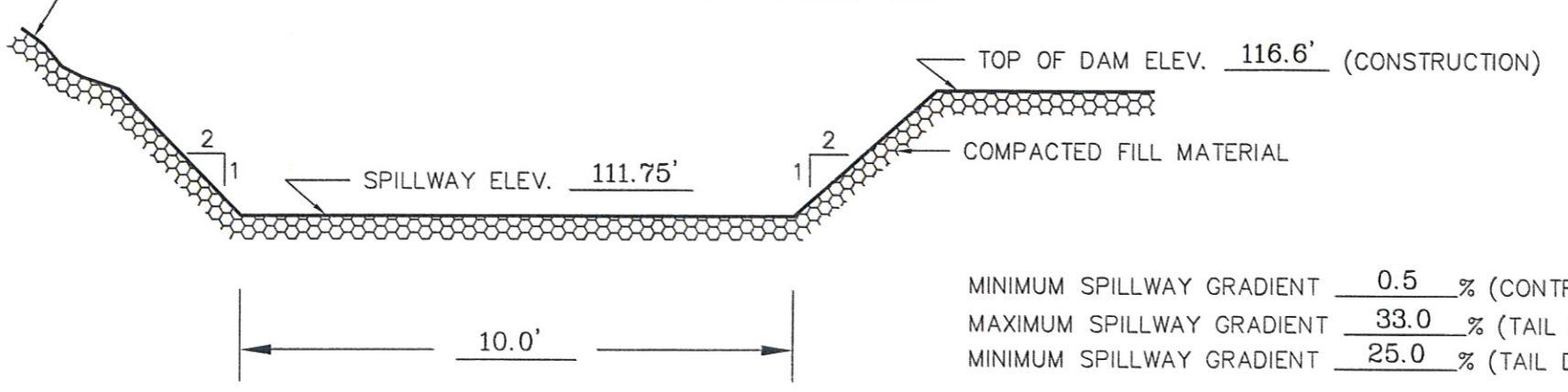
DRAINAGE AREA	138.5	ACRES
DISTURBED AREA	136.0	ACRES
SEDIMENT STORAGE	15.00	AC.FT.
DETENTION STORAGE	4.10	AC.FT.
PERMANENT POOL CAPACITY	19.10	AC.FT.
* TOTAL BASIN STORAGE CAPACITY	24.18	AC.FT.
** PEAK INFLOW	248.73	C.F.S.
** PEAK OUTFLOW	199.81	C.F.S.

NOTE: ALL ELEVATIONS ASSUMED.

* 10 YEAR – 24 HOUR PRECIPITATION EVENT.

** 25 YEAR – 6 HOUR PRECIPITATION EVENT.

EMERGENCY SPILLWAY



MINIMUM SPILLWAY GRADIENT 0.5 % (CONTROL SECTION)

MAXIMUM SPILLWAY GRADIENT 33.0 % (TAIL DITCH SECTION)

MINIMUM SPILLWAY GRADIENT 25.0 % (TAIL DITCH SECTION)

SEE SPILLWAY CONTROL SECTION AND TAIL DITCH DESIGN FOR CHANNEL LINING REQUIREMENTS.

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

SPILLWAY CHANNEL SPECIFICATIONS
SEDIMENT BASIN 046A – PHASE II

The entire control section and tail ditch section of the emergency spillway will be cut into the compacted fill of the embankment and lined with a minimum of 4 inches of reinforced concrete. All concrete will be reinforced with 10 gauge, 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" x 6" welded wire.

The gradient of the control section of the emergency spillway will not exceed one half (0.5%) percent. The gradient of the tail ditch section of the emergency spillway will not be less than twenty (20%) percent and will not exceed thirty-three (33%) percent.

The control section and tail ditch section of the emergency spillway will extend from the inner face of the embankment, past the centerline of the embankment and be carried out beyond the downstream slope of the embankment.

The concrete liner of the control section of the emergency spillway will be a minimum of 4.10 feet as measured vertically, allowing 3.10 feet for the maximum anticipated flow and 1.0 feet of dry freeboard. The concrete liner of the tail ditch section of the emergency spillway will be a minimum of 1.8 feet as measured vertically, allowing 0.8 feet for the maximum anticipated flow and 1.0 foot of dry freeboard. There will be a transition zone of at least 20 feet in length between the control section and the tail section. The minimum depth at the beginning of the transition will be 4.10 feet and 1.8 feet at the end of the transition. The flow line of the spillway will be smoothed at the transition to avoid abrupt changes in the flow line slope.

See enclosed SEDCAD 4.0 spillway tail ditch section design and attached Plan Sheet cross-section for the minimum and maximum emergency spillway construction requirements.

A floating silt fence (lightweight turbidity curtain) will be installed near the entrance to the spillway to accomplish sub-surface withdrawal. The floating silt fence (lightweight turbidity curtain) will be set at normal pool and will be anchored at the 10 Year – 24 Hour Event peak stage with steel fence posts.

Sediment Basin 046A Spillway Control Section

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)
10.00	2.0:1	2.0:1	0.5	0.0220	1.00		

	w/o Freeboard	w/ Freeboard
Design Discharge:	200.00 cfs	
Depth:	2.16 ft	3.16 ft
Top Width:	18.63 ft	22.63 ft
Velocity:	6.47 fps	
X-Section Area:	30.89 sq ft	
Hydraulic Radius:	1.572 ft	
Froude Number:	0.89	

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Sediment Basin 046A Spillway Tail Ditch Section

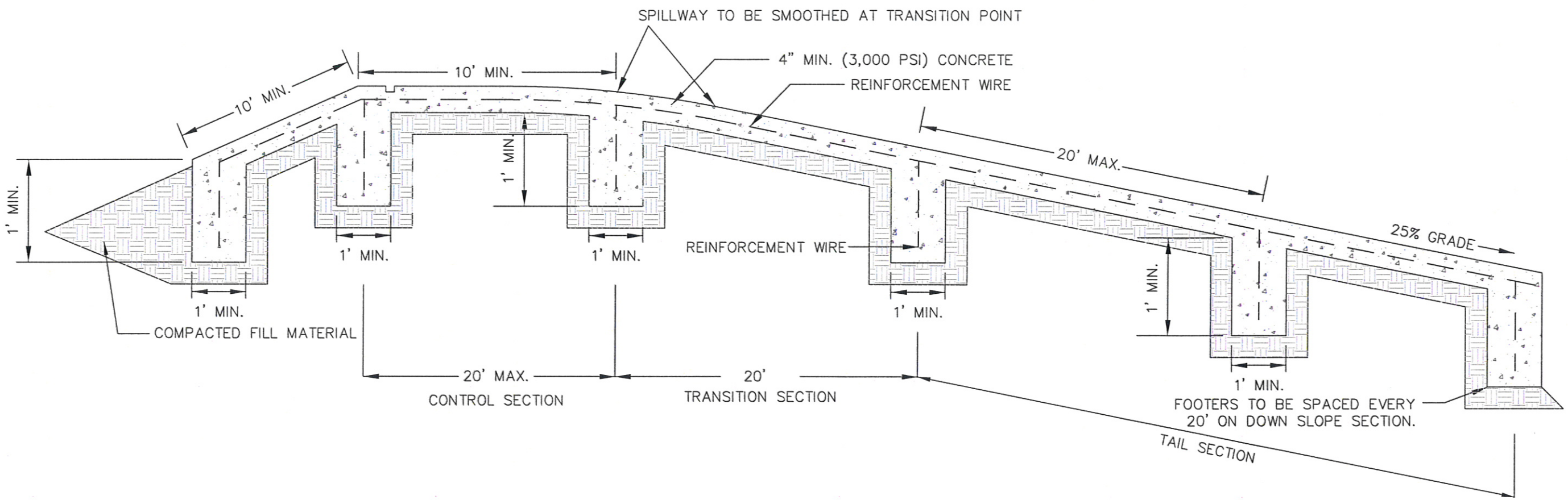
Material: Concrete, Rubble

Trapezoidal Channel

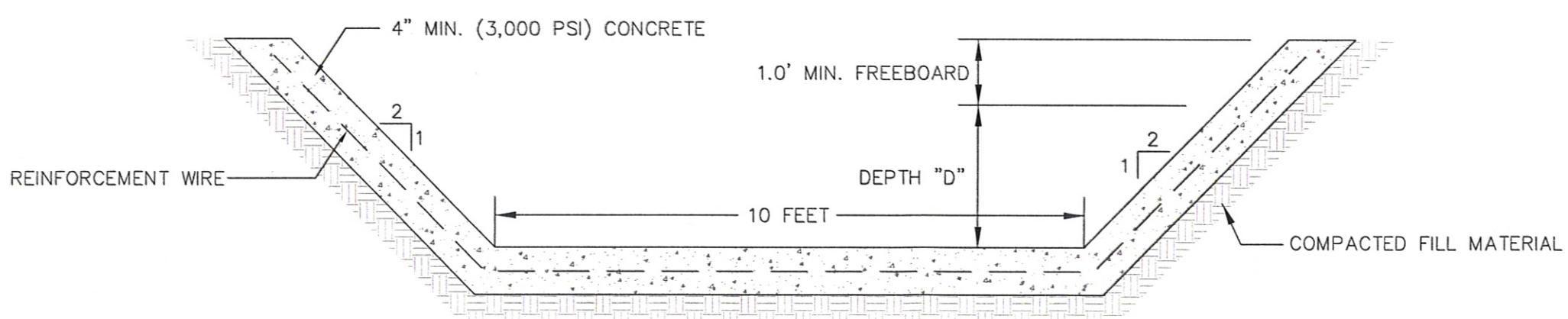
Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
10.00	2.0:1	2.0:1	20.0	0.0220	1.00		

	w/o Freeboard	w/ Freeboard
Design Discharge:	200.00 cfs	
Depth:	0.76 ft	1.76 ft
Top Width:	13.04 ft	17.04 ft
Velocity:	22.82 fps	
X-Section Area:	8.76 sq ft	
Hydraulic Radius:	0.654 ft	
Froude Number:	4.91	

SEDIMENT BASIN 046A SPILLWAY PROFILE



TYPICAL SPILLWAY CROSS-SECTION



SPILLWAY FLOW DEPTH "D" = 3.10 FEET (CONTROL SECTION)

SPILLWAY FLOW DEPTH "D" = 0.80 FEET (TAIL DITCH SECTION)

TOTAL SPILLWAY DEPTH "D+1" = 4.10 FEET (CONTROL SECTION)

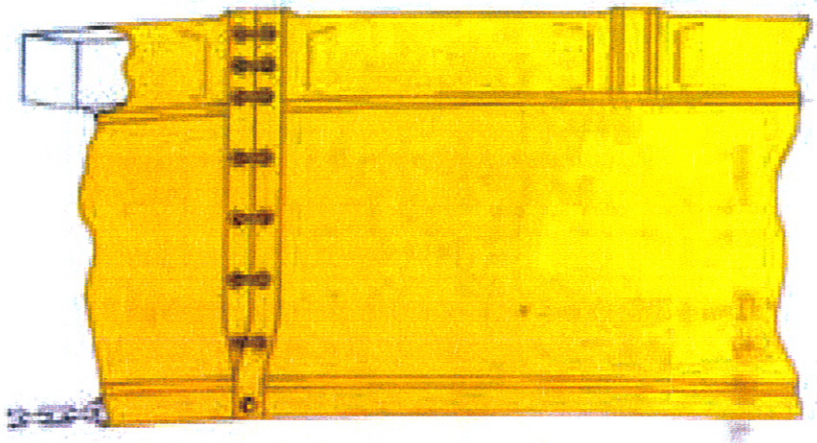
TOTAL SPILLWAY DEPTH "D+1" = 1.80 FEET (TAIL DITCH SECTION)

NOTE: TOTAL SPILLWAY DEPTH IN TRANSITION SECTION VARIES FROM 4.10 FEET TO 1.80 FEET

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

SUBSURFACE WITHDRAWAL DEVICE AND FLOATING SILT BOOM

Lightweight Turbidity Curtain
Application: Calm waters with little current, such as lakes, ponds, canals and shoreline areas.



Specifications

- Curtain to be anchored at the maximum anticipated peak stage elevation (10 Year – 24 Hour Precipitation Event).
- PVC coated floatations - ultraviolet resistant
- Geotextile fabric screens
- Chain ballast with connectors
- Double sewn seams with grommets
- Depths per requirements ' 50' sections = Minimum 24" deep
- Fabric - Polyester reinforced vinyl high visibility yellow
- Connector - Sections are laced together through grommets and load lines are bolted together.
- Flotation - 6" expanded polystyrene over 9 lbs./ft. buoyancy.
- Ballast - 1/4" galvanized chain (.7 lbs/ft).

HYDROLOGY AND SEDIMENTOLOGY PREDICTION
10 YEAR - 24 HOUR PRECIPITATION EVENT
SEDIMENT BASIN 046
PHASE I

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Black Warrior Minerals
Mine No. 2

Sediment Basin 046 & 046A Phase I
Modification R-2

10 Year - 24 Hour Precipitation Event

Bradley K. Simmons, P.E.

General Information

Storm Information:

Storm Type:	DRN 58
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.900 inches

Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	97.000%	98.000%
2.0000	93.000%	97.000%
1.0000	82.000%	85.000%
0.5000	63.000%	70.000%
0.3000	52.000%	46.000%
0.2000	44.000%	37.000%
0.1000	34.000%	26.000%
0.0500	22.000%	15.000%
0.0300	18.000%	12.000%
0.0200	10.000%	9.000%
0.0100	7.000%	6.000%
0.0050	5.000%	4.000%
0.0030	3.000%	2.000%
0.0010	2.000%	1.000%
0.0001	0.000%	0.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Sediment Basin 046 Phase I

#1
Pond

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	286.400	286.400	231.14	66.77	14,622.1	306,464	225.35	109.37
	Out			178.45	60.15	576.7	15,884	0.01	0.00

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	96.479%	100.000%
1.0000	85.090%	100.000%
0.5000	65.417%	100.000%
0.3000	53.980%	100.000%
0.2000	45.670%	100.000%
0.1000	35.282%	100.000%
0.0500	22.824%	100.000%
0.0300	18.674%	100.000%
0.0200	10.381%	100.000%
0.0100	7.266%	100.000%
0.0050	5.189%	100.000%
0.0030	3.112%	78.908%
0.0010	2.074%	52.580%
0.0001	0.000%	0.000%

Structure Detail:

Structure #1 (Pond)

Sediment Basin 046 Phase I

Pond Inputs:

Initial Pool Elev:	389.20 ft
Initial Pool:	2.83 ac-ft
*Sediment Storage:	13.25 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
391.20	20.00	2.00:1	2.00:1	12.00

Fixed Siphon

Crest Elev	Inlet Elev	Outlet Elev	Diameter (in)	Length (ft)	Manning's n
390.20	389.20	386.00	4.00	50.00	0.0190

Pond Results:

Peak Elevation:	393.81 ft
H'graph Detention Time:	2.33 hrs
Pond Model:	CSTRS
Dewater Time:	5.66 days
Trap Efficiency:	96.06 %

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)	
388.26	2.787	0.000	0.000		Top of Sed. Storage
388.40	2.854	0.387	0.000		
388.60	2.954	0.968	0.000		
388.80	3.056	1.569	0.000		
389.00	3.159	2.191	0.000		
389.20	3.264	2.833	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
389.40	3.370	3.496	0.729	11.02*	
389.60	3.478	4.181	0.751	11.04*	
389.80	3.588	4.887	0.772	11.07*	
390.00	3.700	5.616	0.794	11.11*	
390.20	3.733	6.360	0.814	11.05*	Spillway #2
390.25	3.742	6.547	0.819	2.76*	
390.40	3.767	7.110	0.834	8.17*	
390.60	3.800	7.866	0.854	10.72*	
390.80	3.834	8.630	0.874	10.57*	
391.00	3.868	9.400	0.893	10.44*	
391.20	3.902	10.177	0.911	10.32*	Spillway #1
391.40	3.936	10.961	0.930	10.35	
391.60	3.971	11.752	6.824	3.45	
391.80	4.005	12.549	12.718	1.20	
392.00	4.040	13.354	20.828	0.80	
392.20	4.071	14.165	31.064	4.70	
392.40	4.103	14.982	43.064	3.05	
392.60	4.135	15.806	56.676	1.30	
392.80	4.167	16.636	72.205	0.80	
393.00	4.198	17.473	89.736	0.45	
393.20	4.231	18.316	108.966	0.40	
393.40	4.263	19.165	129.895	0.30	
393.60	4.295	20.021	152.532	0.25	
393.80	4.327	20.883	176.888	0.40	
393.81	4.329	20.935	178.452	0.05	Peak Stage
394.00	4.360	21.752	202.977		
394.20	4.391	22.627	230.815		
394.40	4.421	23.508	260.420		
394.60	4.452	24.395	291.810		
394.80	4.483	25.289	325.004		
395.00	4.514	26.188	360.024		
395.20	4.545	27.094	396.889		
395.40	4.576	28.006	435.621		
395.60	4.607	28.925	476.242		
395.80	4.639	29.849	518.773		
396.00	4.670	30.780	563.236		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Fixed Siphon (cfs)	Combined Total Discharge (cfs)
388.26	0.000	0.000	0.000
388.40	0.000	0.000	0.000
388.60	0.000	0.000	0.000
388.80	0.000	0.000	0.000
389.00	0.000	0.000	0.000
389.20	0.000	0.000	0.000
389.40	0.000	0.000	0.729
389.60	0.000	0.000	0.751
389.80	0.000	0.000	0.772
390.00	0.000	0.000	0.794
390.20	0.000	0.000	0.814
390.25	0.000	0.831*	0.819
390.40	0.000	0.836*	0.834
390.60	0.000	0.843*	0.854
390.80	0.000	0.850*	0.874
391.00	0.000	0.857	0.893
391.20	0.000	0.864	0.911
391.40	0.000	0.871	0.930
391.60	5.876	0.878	6.824
391.80	11.753	0.885	12.718
392.00	19.846	0.892	20.828
392.20	30.064	0.899	31.064
392.40	42.047	0.906	43.064
392.60	55.643	0.912	56.676
392.80	71.155	0.919	72.205
393.00	88.671	0.926	89.736
393.20	107.884	0.932	108.966
393.40	128.798	0.939	129.895
393.60	151.420	0.945	152.532
393.80	175.760	0.952	176.888
394.00	201.834	0.958	202.977
394.20	229.657	0.964	230.815
394.40	259.247	0.971	260.420
394.60	290.622	0.977	291.810
394.80	323.802	0.983	325.004
395.00	358.807	0.990	360.024
395.20	395.659	0.996	396.889
395.40	434.377	1.002	435.621
395.60	474.984	1.008	476.242
395.80	517.501	1.014	518.773

Elevation (ft)	Emergency Spillway (cfs)	Fixed Siphon (cfs)	Combined Total Discharge (cfs)
396.00	561.950	1.020	563.236

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	132.000	0.190	0.000	0.000	81.000	F	157.08	39.797
	2	151.000	0.480	0.090	0.351	73.000	S	80.43	25.301
	3	3.400	0.000	0.000	0.000	100.000	F	5.26	1.670
	Σ	**286.400**						**231.14**	**66.767**

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	0.240	200.00	20.00	0.9000	1.0000	1	14,594.8	400,512	294.52	175.35
	2	0.320	200.00	15.00	0.0030	1.0000	2	29.9	1,466	1.06	0.63
	3	0.001	400.00	0.01	0.0001	1.0000	1	0.0	0	0.00	0.00
	Σ							**14,622.1**	**306,464**	**225.35**	**109.37**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	13.33	80.00	600.00	0.920	0.181
		6. Grassed waterway	7.14	50.00	700.00	4.000	0.048
		7. Paved area and small upland gullies	3.13	50.00	1,600.00	3.550	0.125
		8. Large gullies, diversions, and low flowing streams	3.33	70.00	2,100.00	5.470	0.106
#1	**1**	**Time of Concentration:**					**0.190**
#1	2	4. Cultivated, straight row	5.71	40.00	700.00	2.130	0.091
		7. Paved area and small upland gullies	11.43	80.00	700.00	6.800	0.028
		8. Large gullies, diversions, and low flowing streams	3.04	70.00	2,300.00	5.230	0.122
#1	**2**	**Time of Concentration:**					**0.480**
#1	3	4. Cultivated, straight row	5.00	40.00	800.00	1.990	0.111
		7. Paved area and small upland gullies	4.00	60.00	1,500.00	4.020	0.103
#1	**3**	**Time of Concentration:**					**0.000**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	8. Large gullies, diversions, and low flowing streams	1.78	23.00	1,294.00	3.990	0.090
#1	**2**	**Muskingum K:**					**0.090**

BLACK WARRIOR MINERALS, INC.
MINE NO. 2, P-3987, R-2

HYDROLOGY AND SEDIMENTOLOGY PREDICTION
25 YEAR - 6 HOUR PRECIPITATION EVENT
SEDIMENT BASIN 046
PHASE I

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Black Warrior Minerals

Mine No. 2

Sediment Basin 046 & 046A Phase I Modification R-2

25 Year - 6 Hour Precipitation Event

Bradley K. Simmons, P.E.

General Information

Storm Information:

Storm Type:	SCS 6 HOUR
Design Storm:	25 yr - 6 hr
Rainfall Depth:	4.900 inches

Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	97.000%	98.000%
2.0000	93.000%	97.000%
1.0000	82.000%	85.000%
0.5000	63.000%	70.000%
0.3000	52.000%	46.000%
0.2000	44.000%	37.000%
0.1000	34.000%	26.000%
0.0500	22.000%	15.000%
0.0300	18.000%	12.000%
0.0200	10.000%	9.000%
0.0100	7.000%	6.000%
0.0050	5.000%	4.000%
0.0030	3.000%	2.000%
0.0010	2.000%	1.000%
0.0001	0.000%	0.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Sediment Basin 046 Phase I

#1
Pond

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	286.400	286.400	383.55	50.32	19,083.8	503,322	368.56	179.04
	Out			176.05	44.96	1,372.2	46,509	0.93	0.46

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	100.000%	100.000%
1.0000	89.045%	100.000%
0.5000	68.440%	100.000%
0.3000	56.511%	100.000%
0.2000	47.826%	100.000%
0.1000	36.949%	100.000%
0.0500	23.903%	100.000%
0.0300	19.556%	100.000%
0.0200	10.871%	100.000%
0.0100	7.609%	100.000%
0.0050	5.434%	75.577%
0.0030	3.259%	45.330%
0.0010	2.172%	30.206%
0.0001	0.000%	0.000%

Structure Detail:

Structure #1 (Pond)

Sediment Basin 046 Phase I

Pond Inputs:

Initial Pool Elev:	389.20 ft
Initial Pool:	2.83 ac-ft
*Sediment Storage:	13.25 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
391.20	20.00	2.00:1	2.00:1	12.00

Fixed Siphon

Crest Elev	Inlet Elev	Outlet Elev	Diameter (in)	Length (ft)	Manning's n
390.20	389.20	386.00	4.00	50.00	0.0190

Pond Results:

Peak Elevation:	393.79 ft
H'graph Detention Time:	2.70 hrs
Pond Model:	CSTRS
Dewater Time:	5.34 days
Trap Efficiency:	92.81 %

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)	
388.26	2.787	0.000	0.000		Top of Sed. Storage
388.40	2.854	0.387	0.000		
388.60	2.954	0.968	0.000		
388.80	3.056	1.569	0.000		
389.00	3.159	2.191	0.000		
389.20	3.264	2.833	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
389.40	3.370	3.496	0.729	11.02*	
389.60	3.478	4.181	0.751	11.04*	
389.80	3.588	4.887	0.772	11.07*	
390.00	3.700	5.616	0.794	11.11*	
390.20	3.733	6.360	0.814	11.05*	Spillway #2
390.25	3.742	6.547	0.819	2.76*	
390.40	3.767	7.110	0.834	8.17*	
390.60	3.800	7.866	0.854	10.72*	
390.80	3.834	8.630	0.874	10.57*	
391.00	3.868	9.400	0.893	10.55	
391.20	3.902	10.177	0.911	10.45	Spillway #1
391.40	3.936	10.961	0.930	10.30	
391.60	3.971	11.752	6.824	3.35	
391.80	4.005	12.549	12.718	1.25	
392.00	4.040	13.354	20.828	0.80	
392.20	4.071	14.165	31.064	0.50	
392.40	4.103	14.982	43.064	0.35	
392.60	4.135	15.806	56.676	0.30	
392.80	4.167	16.636	72.205	0.30	
393.00	4.198	17.473	89.736	0.40	
393.20	4.231	18.316	108.966	0.70	
393.40	4.263	19.165	129.895	0.50	
393.60	4.295	20.021	152.532	0.40	
393.79	4.326	20.853	176.050	0.50	Peak Stage
393.80	4.327	20.883	176.888		
394.00	4.360	21.752	202.977		
394.20	4.391	22.627	230.815		
394.40	4.421	23.508	260.420		
394.60	4.452	24.395	291.810		
394.80	4.483	25.289	325.004		
395.00	4.514	26.188	360.024		
395.20	4.545	27.094	396.889		
395.40	4.576	28.006	435.621		
395.60	4.607	28.925	476.242		
395.80	4.639	29.849	518.773		
396.00	4.670	30.780	563.236		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Fixed Siphon (cfs)	Combined Total Discharge (cfs)
388.26	0.000	0.000	0.000
388.40	0.000	0.000	0.000
388.60	0.000	0.000	0.000
388.80	0.000	0.000	0.000
389.00	0.000	0.000	0.000
389.20	0.000	0.000	0.000
389.40	0.000	0.000	0.729
389.60	0.000	0.000	0.751
389.80	0.000	0.000	0.772
390.00	0.000	0.000	0.794
390.20	0.000	0.000	0.814
390.25	0.000	0.831*	0.819
390.40	0.000	0.836*	0.834
390.60	0.000	0.843*	0.854
390.80	0.000	0.850*	0.874
391.00	0.000	0.857	0.893
391.20	0.000	0.864	0.911
391.40	0.000	0.871	0.930
391.60	5.876	0.878	6.824
391.80	11.753	0.885	12.718
392.00	19.846	0.892	20.828
392.20	30.064	0.899	31.064
392.40	42.047	0.906	43.064
392.60	55.643	0.912	56.676
392.80	71.155	0.919	72.205
393.00	88.671	0.926	89.736
393.20	107.884	0.932	108.966
393.40	128.798	0.939	129.895
393.60	151.420	0.945	152.532
393.80	175.760	0.952	176.888
394.00	201.834	0.958	202.977
394.20	229.657	0.964	230.815
394.40	259.247	0.971	260.420
394.60	290.622	0.977	291.810
394.80	323.802	0.983	325.004
395.00	358.807	0.990	360.024
395.20	395.659	0.996	396.889
395.40	434.377	1.002	435.621
395.60	474.984	1.008	476.242
395.80	517.501	1.014	518.773

Elevation (ft)	Emergency Spillway (cfs)	Fixed Siphon (cfs)	Combined Total Discharge (cfs)
396.00	561.950	1.020	563.236

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	132.000	0.190	0.000	0.000	81.000	F	331.25	30.399
	2	151.000	0.480	0.090	0.351	73.000	S	102.85	18.537
	3	3.400	0.000	0.000	0.000	100.000	F	12.92	1.383
	Σ	**286.400**						**383.55**	**50.320**

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	0.240	200.00	20.00	0.9000	1.0000	1	19,060.8	562,434	411.90	279.82
	2	0.320	200.00	15.00	0.0030	1.0000	2	28.8	1,564	1.08	0.79
	3	0.001	400.00	0.01	0.0001	1.0000	1	0.0	0	0.00	0.00
	Σ							**19,083.8**	**503,322**	**368.56**	**179.04**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	13.33	80.00	600.00	0.920	0.181
		6. Grassed waterway	7.14	50.00	700.00	4.000	0.048
		7. Paved area and small upland gullies	3.13	50.00	1,600.00	3.550	0.125
		8. Large gullies, diversions, and low flowing streams	3.33	70.00	2,100.00	5.470	0.106
#1	**1**	**Time of Concentration:**					**0.190**
#1	2	4. Cultivated, straight row	5.71	40.00	700.00	2.130	0.091
		7. Paved area and small upland gullies	11.43	80.00	700.00	6.800	0.028
		8. Large gullies, diversions, and low flowing streams	3.04	70.00	2,300.00	5.230	0.122
#1	**2**	**Time of Concentration:**					**0.480**
#1	3	4. Cultivated, straight row	5.00	40.00	800.00	1.990	0.111
		7. Paved area and small upland gullies	4.00	60.00	1,500.00	4.020	0.103
#1	**3**	**Time of Concentration:**					**0.000**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	8. Large gullies, diversions, and low flowing streams	1.78	23.00	1,294.00	3.990	0.090
#1	**2**	**Muskingum K:**					**0.090**

BLACK WARRIOR MINERALS, INC.
MINE NO. 2, P-3987, R-2

HYDROLOGY AND SEDIMENTOLOGY PREDICTION
10 YEAR - 24 HOUR PRECIPITATION EVENT
SEDIMENT BASINS 046 & 046A
PHASE II

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Black Warrior Minerals
Mine No. 2

Sediment Basin 046 & 046A Phase II
Modification R-2

10 Year - 24 Hour Precipitation Event

Bradley K. Simmons, P.E.

General Information

Storm Information:

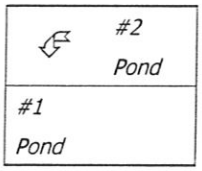
Storm Type:	DRN 58
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.900 inches

Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	97.000%	98.000%
2.0000	93.000%	97.000%
1.0000	82.000%	85.000%
0.5000	63.000%	70.000%
0.3000	52.000%	46.000%
0.2000	44.000%	37.000%
0.1000	34.000%	26.000%
0.0500	22.000%	15.000%
0.0300	18.000%	12.000%
0.0200	10.000%	9.000%
0.0100	7.000%	6.000%
0.0050	5.000%	4.000%
0.0030	3.000%	2.000%
0.0010	2.000%	1.000%
0.0001	0.000%	0.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Sediment Basin 046 Phase II
Pond	#2	==>	#1	0.000	0.000	Sediment Basin 046A Phase II



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)
#2	In	138.500	138.500	148.89	38.98	8,694.1	291,432	216.40	112.91
	Out			133.77	38.98	525.3	18,688	0.48	0.29
#1	In	148.400	286.900	249.81	71.05	1,205.7	21,806	9.29	5.72
	Out			194.57	64.94	433.9	7,266	0.02	0.02

Particle Size Distribution(s) at Each Structure

Structure #2 (Sediment Basin 046A Phase II):

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	100.000%	100.000%
1.0000	89.930%	100.000%
0.5000	74.060%	100.000%
0.3000	48.668%	100.000%
0.2000	39.146%	100.000%
0.1000	27.508%	100.000%
0.0500	15.870%	100.000%
0.0300	12.696%	100.000%
0.0200	9.522%	100.000%
0.0100	6.348%	100.000%
0.0050	4.232%	70.040%
0.0030	2.116%	35.020%
0.0010	1.058%	17.510%
0.0001	0.000%	0.000%

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	100.000%	100.000%
1.0000	99.641%	100.000%
0.5000	90.912%	100.000%
0.3000	74.681%	100.000%
0.2000	68.594%	100.000%
0.1000	61.154%	100.000%
0.0500	53.715%	100.000%
0.0300	51.686%	100.000%
0.0200	49.657%	100.000%
0.0100	47.628%	100.000%
0.0050	33.222%	92.315%
0.0030	16.611%	46.157%

Size (mm)	In	Out
0.0010	8.305%	23.079%
0.0001	0.000%	0.000%

Structure Detail:

Structure #2 (Pond)

Sediment Basin 046A Phase II

Pond Inputs:

Initial Pool Elev:	111.75 ft
Initial Pool:	4.10 ac-ft
*Sediment Storage:	15.00 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
111.75	20.00	2.00:1	2.00:1	10.00

Pond Results:

Peak Elevation:	114.22 ft
H'graph Detention Time:	0.92 hrs
Pond Model:	CSTRS
Dewater Time:	1.00 days
Trap Efficiency:	93.96 %

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)	
109.61	1.846	0.000	0.000		Top of Sed. Storage
109.80	1.857	0.355	0.000		
110.00	1.870	0.728	0.000		
110.20	1.882	1.103	0.000		
110.40	1.895	1.481	0.000		
110.60	1.907	1.861	0.000		
110.80	1.920	2.243	0.000		
111.00	1.932	2.629	0.000		
111.20	1.945	3.016	0.000		
111.40	1.957	3.406	0.000		
111.60	1.970	3.799	0.000		
111.70	1.976	3.996	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
111.75	1.979	4.095	0.000		Spillway #1
111.80	1.982	4.194	0.761	7.90	
112.00	1.995	4.592	3.803	2.55	
112.20	2.008	4.992	6.846	0.95	
112.40	2.020	5.395	9.889	0.60	
112.60	2.033	5.800	16.759	4.75	
112.80	2.046	6.208	25.483	3.60	
113.00	2.059	6.619	35.770	1.70	
113.20	2.072	7.032	47.502	0.60	
113.40	2.085	7.448	60.955	0.35	
113.60	2.098	7.866	76.217	0.25	
113.80	2.111	8.287	93.036	0.15	
114.00	2.124	8.710	111.421	0.20	
114.20	2.137	9.136	131.389	0.20	
114.22	2.139	9.184	133.773	0.10	Peak Stage
114.40	2.150	9.565	152.957		
114.60	2.163	9.997	176.144		
114.80	2.177	10.431	200.972		
115.00	2.190	10.867	227.462		
115.20	2.203	11.307	255.637		
115.40	2.216	11.748	285.521		
115.60	2.230	12.193	317.136		
115.80	2.243	12.640	350.507		
116.00	2.256	13.090	385.658		
116.20	2.269	13.543	422.612		
116.40	2.283	13.998	461.393		
116.60	2.296	14.456	502.024		
116.80	2.310	14.916	544.530		
117.00	2.323	15.380	588.934		
117.20	2.337	15.846	635.260		
117.40	2.350	16.314	683.530		
117.60	2.364	16.786	733.768		
117.80	2.377	17.260	785.996		
118.00	2.391	17.737	840.237		
118.20	2.405	18.216	896.513		
118.40	2.419	18.699	954.847		
118.60	2.432	19.184	1,015.261		
118.80	2.446	19.671	1,077.775		
119.00	2.460	20.162	1,142.413		
119.20	2.474	20.655	1,209.195		
119.40	2.488	21.152	1,278.141		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
119.60	2.502	21.651	1,349.274	
119.80	2.516	22.152	1,422.614	
120.00	2.530	22.657	1,498.180	

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
109.61	0.000	0.000
109.80	0.000	0.000
110.00	0.000	0.000
110.20	0.000	0.000
110.40	0.000	0.000
110.60	0.000	0.000
110.80	0.000	0.000
111.00	0.000	0.000
111.20	0.000	0.000
111.40	0.000	0.000
111.60	0.000	0.000
111.70	0.000	0.000
111.75	0.000	0.000
111.80	0.761	0.761
112.00	3.803	3.803
112.20	6.846	6.846
112.40	9.889	9.889
112.60	16.759	16.759
112.80	25.483	25.483
113.00	35.770	35.770
113.20	47.502	47.502
113.40	60.955	60.955
113.60	76.217	76.217
113.80	93.036	93.036
114.00	111.421	111.421
114.20	131.389	131.389
114.40	152.957	152.957
114.60	176.144	176.144
114.80	200.972	200.972
115.00	227.462	227.462
115.20	255.637	255.637

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
115.40	285.521	285.521
115.60	317.136	317.136
115.80	350.507	350.507
116.00	385.658	385.658
116.20	422.612	422.612
116.40	461.393	461.393
116.60	502.024	502.024
116.80	544.530	544.530
117.00	588.934	588.934
117.20	635.260	635.260
117.40	683.530	683.530
117.60	733.768	733.768
117.80	785.996	785.996
118.00	840.237	840.237
118.20	896.513	896.513
118.40	954.847	954.847
118.60	1,015.261	1,015.261
118.80	1,077.775	1,077.775
119.00	1,142.413	1,142.413
119.20	1,209.195	1,209.195
119.40	1,278.141	1,278.141
119.60	1,349.274	1,349.274
119.80	1,422.614	1,422.614
120.00	1,498.180	1,498.180

Structure #1 (Pond)

Sediment Basin 046 Phase II

Pond Inputs:

Initial Pool Elev:	389.20 ft
Initial Pool:	2.83 ac-ft
*Sediment Storage:	13.25 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
391.20	20.00	2.00:1	2.00:1	12.00

Fixed Siphon

Crest Elev	Inlet Elev	Outlet Elev	Diameter (in)	Length (ft)	Manning's n
390.20	389.20	386.00	4.00	50.00	0.0190

Pond Results:

Peak Elevation:	393.94 ft
H'graph Detention Time:	2.30 hrs
Pond Model:	CSTRS
Dewater Time:	5.36 days
Trap Efficiency:	64.01 %

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)	
388.26	2.787	0.000	0.000		Top of Sed. Storage
388.40	2.854	0.387	0.000		
388.60	2.954	0.968	0.000		
388.80	3.056	1.569	0.000		
389.00	3.159	2.191	0.000		
389.20	3.264	2.833	0.000		
389.40	3.370	3.496	0.729	11.02*	
389.60	3.478	4.181	0.751	11.04*	
389.80	3.588	4.887	0.772	11.07*	
390.00	3.700	5.616	0.794	11.11*	
390.20	3.733	6.360	0.814	11.05*	Spillway #2
390.25	3.742	6.547	0.819	2.76*	
390.40	3.767	7.110	0.834	8.17*	
390.60	3.800	7.866	0.854	10.72*	
390.80	3.834	8.630	0.874	10.57*	
391.00	3.868	9.400	0.893	10.44*	
391.20	3.902	10.177	0.911	10.50	Spillway #1
391.40	3.936	10.961	4.847	4.40	
391.60	3.971	11.752	8.783	1.75	
391.80	4.005	12.549	12.718	1.30	
392.00	4.040	13.354	20.828	1.05	
392.20	4.071	14.165	31.064	4.50	
392.40	4.103	14.982	43.064	3.10	
392.60	4.135	15.806	56.676	1.45	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
392.80	4.167	16.636	72.205	0.80	
393.00	4.198	17.473	89.736	0.45	
393.20	4.231	18.316	108.966	0.40	
393.40	4.263	19.165	129.895	0.30	
393.60	4.295	20.021	152.532	0.25	
393.80	4.327	20.883	176.888	0.25	
393.94	4.350	21.472	194.570	0.30	Peak Stage
394.00	4.360	21.752	202.977		
394.20	4.391	22.627	230.815		
394.40	4.421	23.508	260.420		
394.60	4.452	24.395	291.810		
394.80	4.483	25.289	325.004		
395.00	4.514	26.188	360.024		
395.20	4.545	27.094	396.889		
395.40	4.576	28.006	435.621		
395.60	4.607	28.925	476.242		
395.80	4.639	29.849	518.773		
396.00	4.670	30.780	563.236		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Fixed Siphon (cfs)	Combined Total Discharge (cfs)
388.26	0.000	0.000	0.000
388.40	0.000	0.000	0.000
388.60	0.000	0.000	0.000
388.80	0.000	0.000	0.000
389.00	0.000	0.000	0.000
389.20	0.000	0.000	0.000
389.40	0.000	0.729*	0.729
389.60	0.000	0.751*	0.751
389.80	0.000	0.772*	0.772
390.00	0.000	0.794*	0.794
390.20	0.000	0.814	0.814
390.25	0.000	0.819	0.819
390.40	0.000	0.834	0.834
390.60	0.000	0.854	0.854
390.80	0.000	0.874	0.874

Elevation (ft)	Emergency Spillway (cfs)	Fixed Siphon (cfs)	Combined Total Discharge (cfs)
391.00	0.000	0.893	0.893
391.20	0.000	0.911	0.911
391.40	3.917	0.930	4.847
391.60	7.835	0.947	8.783
391.80	11.753	0.965	12.718
392.00	19.846	0.983	20.828
392.20	30.064	1.000	31.064
392.40	42.047	1.016	43.064
392.60	55.643	1.033	56.676
392.80	71.155	1.049	72.205
393.00	88.671	1.066	89.736
393.20	107.884	1.081	108.966
393.40	128.798	1.097	129.895
393.60	151.420	1.113	152.532
393.80	175.760	1.128	176.888
394.00	201.834	1.143	202.977
394.20	229.657	1.158	230.815
394.40	259.247	1.173	260.420
394.60	290.622	1.187	291.810
394.80	323.802	1.202	325.004
395.00	358.807	1.216	360.024
395.20	395.659	1.230	396.889
395.40	434.377	1.244	435.621
395.60	474.984	1.258	476.242
395.80	517.501	1.272	518.773
396.00	561.950	1.286	563.236

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)
#2	1	81.000	0.340	0.105	0.364	81.000	F	93.68	24.214
	2	41.000	0.180	0.004	0.372	79.000	M	39.35	9.928
	3	14.000	0.100	0.000	0.000	74.000	M	15.30	3.612
	4	2.500	0.010	0.000	0.000	100.000	F	3.87	1.228
	$\sum$	**138.500**						**148.89**	**38.981**
#1	1	14.000	0.130	0.086	0.404	79.000	M	13.51	3.404
	2	131.000	0.370	0.000	0.000	74.000	M	101.25	26.998
	3	3.400	0.000	0.000	0.000	100.000	F	5.26	1.670
	$\sum$	**286.900**						**249.81**	**71.053**

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)
#2	1	0.240	200.00	20.00	0.9000	1.0000	2	8,312.4	378,257	280.95	167.12
	2	0.240	200.00	15.00	0.1300	1.0000	2	346.9	44,739	33.01	18.72
	3	0.240	200.00	15.00	0.0500	1.0000	2	39.7	14,224	10.61	6.00
	4	0.001	400.00	0.01	0.0001	1.0000	1	0.0	0	0.00	0.00
	$\sum$							**8,694.1**	**291,432**	**216.40**	**112.91**
#1	1	0.240	200.00	20.00	0.1300	1.0000	2	147.3	55,128	40.68	23.12
	2	0.320	200.00	15.00	0.0500	1.0000	2	533.1	24,979	18.34	10.58
	3	0.001	400.00	0.01	0.0001	1.0000	1	0.0	0	0.00	0.00
	$\sum$							**1,205.7**	**21,806**	**9.29**	**5.72**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	13.33	80.00	600.00	0.920	0.181
		6. Grassed waterway	7.14	50.00	700.00	4.000	0.048
		7. Paved area and small upland gullies	3.13	50.00	1,600.00	3.550	0.125
		8. Large gullies, diversions, and low flowing streams	3.33	70.00	2,100.00	5.470	0.106
#1	**1**	**Time of Concentration:**					**0.130**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	4. Cultivated, straight row	5.71	40.00	700.00	2.130	0.091
		7. Paved area and small upland gullies	11.43	80.00	700.00	6.800	0.028
		8. Large gullies, diversions, and low flowing streams	3.04	70.00	2,300.00	5.230	0.122
#1	**2**	**Time of Concentration:**					**0.370**
#1	3	4. Cultivated, straight row	5.00	40.00	800.00	1.990	0.111
		7. Paved area and small upland gullies	4.00	60.00	1,500.00	4.020	0.103
#1	**3**	**Time of Concentration:**					**0.000**

BLACK WARRIOR MINERALS, INC.
MINE NO. 2, P-3987, R-2

HYDROLOGY AND SEDIMENTOLOGY PREDICTION
25 YEAR - 6 HOUR PRECIPITATION EVENT
SEDIMENT BASINS 046 & 046A
PHASE II

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Black Warrior Minerals
Mine No. 2

Sediment Basin 046 & 046A Phase II
Modification R-2

25 Year - 6 Hour Precipitation Event

Bradley K. Simmons, P.E.

General Information

Storm Information:

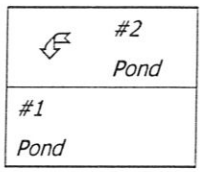
Storm Type:	SCS 6 HOUR
Design Storm:	25 yr - 6 hr
Rainfall Depth:	4.900 inches

Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	97.000%	98.000%
2.0000	93.000%	97.000%
1.0000	82.000%	85.000%
0.5000	63.000%	70.000%
0.3000	52.000%	46.000%
0.2000	44.000%	37.000%
0.1000	34.000%	26.000%
0.0500	22.000%	15.000%
0.0300	18.000%	12.000%
0.0200	10.000%	9.000%
0.0100	7.000%	6.000%
0.0050	5.000%	4.000%
0.0030	3.000%	2.000%
0.0010	2.000%	1.000%
0.0001	0.000%	0.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Sediment Basin 046 Phase II
Pond	#2	==>	#1	0.000	0.000	Sediment Basin 046A Phase II



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)
#2	In	138.500	138.500	248.73	29.67	10,155.0	380,935	279.16	165.54
	Out			199.81	29.67	812.2	29,054	2.21	1.52
#1	In	148.400	286.900	368.20	53.52	1,402.2	25,626	8.93	6.69
	Out			199.03	48.08	645.2	12,046	0.15	0.13

Particle Size Distribution(s) at Each Structure

Structure #2 (Sediment Basin 046A Phase II):

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	100.000%	100.000%
1.0000	100.000%	100.000%
0.5000	86.610%	100.000%
0.3000	56.915%	100.000%
0.2000	45.779%	100.000%
0.1000	32.169%	100.000%
0.0500	18.559%	100.000%
0.0300	14.847%	100.000%
0.0200	11.136%	100.000%
0.0100	7.424%	92.823%
0.0050	4.949%	61.882%
0.0030	2.475%	30.941%
0.0010	1.237%	15.471%
0.0001	0.000%	0.000%

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	100.000%	100.000%
1.0000	100.000%	100.000%
0.5000	100.000%	100.000%
0.3000	85.684%	100.000%
0.2000	80.255%	100.000%
0.1000	73.619%	100.000%
0.0500	66.983%	100.000%
0.0300	65.174%	100.000%
0.0200	63.364%	100.000%
0.0100	57.397%	100.000%
0.0050	38.269%	83.168%
0.0030	19.141%	41.598%

Size (mm)	In	Out
0.0010	9.577%	20.813%
0.0001	0.000%	0.000%

Structure Detail:

Structure #2 (Pond)

Sediment Basin 046A Phase II

Pond Inputs:

Initial Pool Elev:	111.75 ft
Initial Pool:	4.10 ac-ft
*Sediment Storage:	15.00 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
111.75	20.00	2.00:1	2.00:1	10.00

Pond Results:

Peak Elevation:	114.79 ft
H'graph Detention Time:	0.62 hrs
Pond Model:	CSTRS
Dewater Time:	0.66 days
Trap Efficiency:	92.00 %

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)	
109.61	1.846	0.000	0.000		Top of Sed. Storage
109.80	1.857	0.355	0.000		
110.00	1.870	0.728	0.000		
110.20	1.882	1.103	0.000		
110.40	1.895	1.481	0.000		
110.60	1.907	1.861	0.000		
110.80	1.920	2.243	0.000		
111.00	1.932	2.629	0.000		
111.20	1.945	3.016	0.000		
111.40	1.957	3.406	0.000		
111.60	1.970	3.799	0.000		
111.70	1.976	3.996	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
111.75	1.979	4.095	0.000		Spillway #1
111.80	1.982	4.194	0.761	7.90	
112.00	1.995	4.592	3.803	2.55	
112.20	2.008	4.992	6.846	0.95	
112.40	2.020	5.395	9.889	0.55	
112.60	2.033	5.800	16.759	0.40	
112.80	2.046	6.208	25.483	0.25	
113.00	2.059	6.619	35.770	0.25	
113.20	2.072	7.032	47.502	0.50	
113.40	2.085	7.448	60.955	0.80	
113.60	2.098	7.866	76.217	0.50	
113.80	2.111	8.287	93.036	0.30	
114.00	2.124	8.710	111.421	0.25	
114.20	2.137	9.136	131.389	0.20	
114.40	2.150	9.565	152.957	0.15	
114.60	2.163	9.997	176.144	0.15	
114.79	2.176	10.410	199.815	0.15	Peak Stage
114.80	2.177	10.431	200.972		
115.00	2.190	10.867	227.462		
115.20	2.203	11.307	255.637		
115.40	2.216	11.748	285.521		
115.60	2.230	12.193	317.136		
115.80	2.243	12.640	350.507		
116.00	2.256	13.090	385.658		
116.20	2.269	13.543	422.612		
116.40	2.283	13.998	461.393		
116.60	2.296	14.456	502.024		
116.80	2.310	14.916	544.530		
117.00	2.323	15.380	588.934		
117.20	2.337	15.846	635.260		
117.40	2.350	16.314	683.530		
117.60	2.364	16.786	733.768		
117.80	2.377	17.260	785.996		
118.00	2.391	17.737	840.237		
118.20	2.405	18.216	896.513		
118.40	2.419	18.699	954.847		
118.60	2.432	19.184	1,015.261		
118.80	2.446	19.671	1,077.775		
119.00	2.460	20.162	1,142.413		
119.20	2.474	20.655	1,209.195		
119.40	2.488	21.152	1,278.141		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
119.60	2.502	21.651	1,349.274	
119.80	2.516	22.152	1,422.614	
120.00	2.530	22.657	1,498.180	

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
109.61	0.000	0.000
109.80	0.000	0.000
110.00	0.000	0.000
110.20	0.000	0.000
110.40	0.000	0.000
110.60	0.000	0.000
110.80	0.000	0.000
111.00	0.000	0.000
111.20	0.000	0.000
111.40	0.000	0.000
111.60	0.000	0.000
111.70	0.000	0.000
111.75	0.000	0.000
111.80	0.761	0.761
112.00	3.803	3.803
112.20	6.846	6.846
112.40	9.889	9.889
112.60	16.759	16.759
112.80	25.483	25.483
113.00	35.770	35.770
113.20	47.502	47.502
113.40	60.955	60.955
113.60	76.217	76.217
113.80	93.036	93.036
114.00	111.421	111.421
114.20	131.389	131.389
114.40	152.957	152.957
114.60	176.144	176.144
114.80	200.972	200.972
115.00	227.462	227.462
115.20	255.637	255.637

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
115.40	285.521	285.521
115.60	317.136	317.136
115.80	350.507	350.507
116.00	385.658	385.658
116.20	422.612	422.612
116.40	461.393	461.393
116.60	502.024	502.024
116.80	544.530	544.530
117.00	588.934	588.934
117.20	635.260	635.260
117.40	683.530	683.530
117.60	733.768	733.768
117.80	785.996	785.996
118.00	840.237	840.237
118.20	896.513	896.513
118.40	954.847	954.847
118.60	1,015.261	1,015.261
118.80	1,077.775	1,077.775
119.00	1,142.413	1,142.413
119.20	1,209.195	1,209.195
119.40	1,278.141	1,278.141
119.60	1,349.274	1,349.274
119.80	1,422.614	1,422.614
120.00	1,498.180	1,498.180

Structure #1 (Pond)

Sediment Basin 046 Phase II

Pond Inputs:

Initial Pool Elev:	389.20 ft
Initial Pool:	2.83 ac-ft
*Sediment Storage:	13.25 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
391.20	20.00	2.00:1	2.00:1	12.00

Fixed Siphon

Crest Elev	Inlet Elev	Outlet Elev	Diameter (in)	Length (ft)	Manning's n
390.20	389.20	386.00	4.00	50.00	0.0190

Pond Results:

Peak Elevation:	393.97 ft
H'graph Detention Time:	2.54 hrs
Pond Model:	CSTRS
Dewater Time:	5.38 days
Trap Efficiency:	53.99 %

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)	
388.26	2.787	0.000	0.000		Top of Sed. Storage
388.40	2.854	0.387	0.000		
388.60	2.954	0.968	0.000		
388.80	3.056	1.569	0.000		
389.00	3.159	2.191	0.000		
389.20	3.264	2.833	0.000		
389.40	3.370	3.496	0.729	11.02*	
389.60	3.478	4.181	0.751	11.04*	
389.80	3.588	4.887	0.772	11.07*	
390.00	3.700	5.616	0.794	11.11*	
390.20	3.733	6.360	0.814	11.05*	Spillway #2
390.25	3.742	6.547	0.819	2.76*	
390.40	3.767	7.110	0.834	8.17*	
390.60	3.800	7.866	0.854	10.72*	
390.80	3.834	8.630	0.874	10.57*	
391.00	3.868	9.400	0.893	10.60	
391.20	3.902	10.177	0.911	10.40	Spillway #1
391.40	3.936	10.961	0.930	10.55	
391.60	3.971	11.752	6.824	3.90	
391.80	4.005	12.549	12.718	1.35	
392.00	4.040	13.354	20.828	0.85	
392.20	4.071	14.165	31.064	0.50	
392.40	4.103	14.982	43.064	0.40	
392.60	4.135	15.806	56.676	0.30	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
392.80	4.167	16.636	72.205	0.25	
393.00	4.198	17.473	89.736	0.35	
393.20	4.231	18.316	108.966	0.60	
393.40	4.263	19.165	129.895	0.50	
393.60	4.295	20.021	152.532	0.35	
393.80	4.327	20.883	176.888	0.35	
393.97	4.355	21.620	199.027	0.45	Peak Stage
394.00	4.360	21.752	202.977		
394.20	4.391	22.627	230.815		
394.40	4.421	23.508	260.420		
394.60	4.452	24.395	291.810		
394.80	4.483	25.289	325.004		
395.00	4.514	26.188	360.024		
395.20	4.545	27.094	396.889		
395.40	4.576	28.006	435.621		
395.60	4.607	28.925	476.242		
395.80	4.639	29.849	518.773		
396.00	4.670	30.780	563.236		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Fixed Siphon (cfs)	Combined Total Discharge (cfs)
388.26	0.000	0.000	0.000
388.40	0.000	0.000	0.000
388.60	0.000	0.000	0.000
388.80	0.000	0.000	0.000
389.00	0.000	0.000	0.000
389.20	0.000	0.000	0.000
389.40	0.000	0.000	0.729
389.60	0.000	0.000	0.751
389.80	0.000	0.000	0.772
390.00	0.000	0.000	0.794
390.20	0.000	0.000	0.814
390.25	0.000	0.831*	0.819
390.40	0.000	0.836*	0.834
390.60	0.000	0.843*	0.854
390.80	0.000	0.850*	0.874

Elevation (ft)	Emergency Spillway (cfs)	Fixed Siphon (cfs)	Combined Total Discharge (cfs)
391.00	0.000	0.857	0.893
391.20	0.000	0.864	0.911
391.40	0.000	0.871	0.930
391.60	5.876	0.878	6.824
391.80	11.753	0.885	12.718
392.00	19.846	0.892	20.828
392.20	30.064	0.899	31.064
392.40	42.047	0.906	43.064
392.60	55.643	0.912	56.676
392.80	71.155	0.919	72.205
393.00	88.671	0.926	89.736
393.20	107.884	0.932	108.966
393.40	128.798	0.939	129.895
393.60	151.420	0.945	152.532
393.80	175.760	0.952	176.888
394.00	201.834	0.958	202.977
394.20	229.657	0.964	230.815
394.40	259.247	0.971	260.420
394.60	290.622	0.977	291.810
394.80	323.802	0.983	325.004
395.00	358.807	0.990	360.024
395.20	395.659	0.996	396.889
395.40	434.377	1.002	435.621
395.60	474.984	1.008	476.242
395.80	517.501	1.014	518.773
396.00	561.950	1.020	563.236

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)
#2	1	81.000	0.340	0.105	0.364	81.000	F	176.88	18.496
	2	41.000	0.180	0.004	0.372	79.000	M	76.01	7.509
	3	14.000	0.100	0.000	0.000	74.000	M	33.49	2.648
	4	2.500	0.010	0.000	0.000	100.000	F	9.50	1.017
	∑	**138.500**						**248.73**	**29.670**
#1	1	14.000	0.130	0.086	0.404	79.000	M	26.46	2.575
	2	131.000	0.370	0.000	0.000	74.000	M	164.60	19.892
	3	3.400	0.000	0.000	0.000	100.000	F	12.92	1.383
	∑	**286.900**						**368.20**	**53.520**

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)
#2	1	0.240	200.00	20.00	0.9000	1.0000	2	10,204.5	493,074	363.03	253.25
	2	0.240	200.00	15.00	0.1300	1.0000	2	428.9	63,420	46.43	30.18
	3	0.240	200.00	15.00	0.0500	1.0000	2	51.8	23,132	17.25	10.66
	4	0.001	400.00	0.01	0.0001	1.0000	1	0.0	0	0.00	0.00
	∑							**10,155.0**	**380,935**	**279.16**	**165.54**
#1	1	0.240	200.00	20.00	0.1300	1.0000	2	183.6	79,084	57.96	37.53
	2	0.320	200.00	15.00	0.0500	1.0000	2	589.8	31,774	22.95	15.60
	3	0.001	400.00	0.01	0.0001	1.0000	1	0.0	0	0.00	0.00
	∑							**1,402.2**	**25,626**	**8.93**	**6.69**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	13.33	80.00	600.00	0.920	0.181
		6. Grassed waterway	7.14	50.00	700.00	4.000	0.048
		7. Paved area and small upland gullies	3.13	50.00	1,600.00	3.550	0.125
		8. Large gullies, diversions, and low flowing streams	3.33	70.00	2,100.00	5.470	0.106
#1	**1**	**Time of Concentration:**					**0.130**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	4. Cultivated, straight row	5.71	40.00	700.00	2.130	0.091
		7. Paved area and small upland gullies	11.43	80.00	700.00	6.800	0.028
		8. Large gullies, diversions, and low flowing streams	3.04	70.00	2,300.00	5.230	0.122
#1	**2**	**Time of Concentration:**					**0.370**
#1	3	4. Cultivated, straight row	5.00	40.00	800.00	1.990	0.111
		7. Paved area and small upland gullies	4.00	60.00	1,500.00	4.020	0.103
#1	**3**	**Time of Concentration:**					**0.000**

STABILITY ANALYSIS

STABILITY ANALYSIS PROCEDURE

The computer program used to analyze the slope stability was the REAME Slope Stability Program as developed by Dr. Yang H. Huang, P.E. of the University of Kentucky.

SEDIMENT BASIN 046

The soil type of the foundation material beneath the proposed embankment structure of Sediment Basin 046 was sampled, analyzed and classified by personnel of McGehee Engineering Corp. The depth to the stiff base of Sediment Basin 046 (2.15') was measured by personnel of McGehee Engineering Corp.

The soil type to be used in the construction of the proposed embankment structure of Sediment Basin 046 was sampled, analyzed and classified by personnel of McGehee Engineering Corp. This sample of material was taken from the proposed incised/excavation area which will be representative of the material to be used as dam material.

SEDIMENT BASIN 046A

Sediment Basin 046A will be located in a valley created by mining under P-3950. The soil type of the foundation material beneath the proposed embankment structure was identified by personnel of McGehee Engineering Corp. as spoil. All undesirable material will be removed from the entire footprint of the embankment. The entire footprint will be excavated to either the stiff base (pit bottom) OR to a level of the spoil material suitable to be used as the embankment foundation. The entire footprint of the embankment will be backfilled and compacted with embankment material once all undesirable material has been excavated. For the purposes of this evaluation it was assumed spoil material will be the foundation material and that five (5') feet of undesirable material will be required to be excavated.

The foundation and embankment material soil properties for Sediment Basin 046A are both spoil.

SOIL PROPERTIES

USAGE	TYPE	COHESION (psf)	INTERNAL ANGLE OF FRICTION	EFFECTIVE DENSITY (pcf)
046 FOUND.	SM-SC	180.00	30.54	135.96
046 DAM	SC	100.00	27.92	133.52
046A FOUND.	SPOIL	50.00	30.00	135.00
046A DAM	SPOIL	50.00	30.00	135.00

ANALYSIS RESULTS

BASIN	STATIC SAFETY FACTOR
046	1.799
046A	1.454

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SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Black Warrior Minerals
Location: Mine #1
Sample I.D.: Basin 046
Description: Foundation

Sample Date: 3/12/13
Analyzed By: JWW
Date Analyzed: 3/18/13
Requested By: S. Hendon

Weight of Oven Dry Sample (W): **1002.0 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"	571.0	540.0	31.0	3.1	3.1	3.1	96.9
4	641.0	513.0	128.0	12.8	15.9	15.9	84.1
10	678.0	462.0	216.0	21.6	37.4	37.4	62.6
40	721.0	383.0	338.0	33.7	71.2	71.2	28.8
200	396.7	333.0	63.7	6.4	77.5	77.5	22.5
Pan	605.3	380.0	225.3	22.5	100.0	100.0	0.0
		Total Weight (W1):	1002.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 29.7
Plastic Limit: 23.4
Plasticity Index: 6.3

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

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mcgehee engineering corp

SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Black Warrior Minerals
Location: Mine #1
Sample I.D.: Basin 046
Description: Dam Material

Sample Date: 3/12/13
Analyzed By: JWW
Date Analyzed: 3/18/13
Requested By: S. Hendon

Weight of Oven Dry Sample (W): **965.0 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"	589.0	538.0	51.0	5.3	5.3	5.3	94.7
4	726.0	513.0	213.0	22.1	27.4	27.4	72.6
10	650.0	461.0	189.0	19.6	46.9	46.9	53.1
40	680.0	382.0	298.0	30.9	77.8	77.8	22.2
200	362.2	333.0	29.2	3.0	80.8	80.8	19.2
Pan	561.8	377.0	184.8	19.2	100.0	100.0	0.0
		Total Weight (W1):	965.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 42.1
Plastic Limit: 26.4
Plasticity Index: 15.7

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

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STANDARD PROCTOR COMPACTION TEST (ASTM D-698)

Company Name: Black Warrior Minerals
Location: Mine #1
Sample I.D.: Basin 046
Description: Dam Material

Sampled By: B. Justice
Sample Date: 3/12/13
Analyzed By: JWW
Date Analyzed: 3/18/13
Requested By: S. Hendon

Weight of Mold (W1): 4,235 Grams

Test No.	Wt. of Mold & Wet Soil (w2) grams	Wt. of wet Soil (w2-w1) grams	Wet Unit Wt. (w2-w1)/c lb/cu-ft	Moisture Content (w) %	Dry Unit Weight lb/cu-ft
1	5,941	1,706	112.8	13.4	99.5
2	6,073	1,838	121.6	17.6	103.4
3	6,120	1,885	124.7	21.6	102.5
4	6,042	1,807	119.5	27.7	93.6
5	6,004	1,769	117.0	29.0	90.7
6					
7					

Constant C = 15.12 (conversion factor)

MOISTURE CONTENT DETERMINATION

Test No.	1	2	3	4	5	6	7
Can No.	1	2	3	4	5		
Wt. of Can, a, (g)	20.47	20.41	20.57	20.45	20.58		
Wt. of Can + Wet Soil, b, (g)	82.85	84.89	91.23	85.00	87.08		
Wt. of Can + Dry Soil, c, (g)	75.46	75.26	78.67	70.98	72.13		
* Moisture Content, w, (%)	13.44	17.56	21.62	27.75	29.00		

* Moisture Content, w = (b - c)/(c - a) x 100

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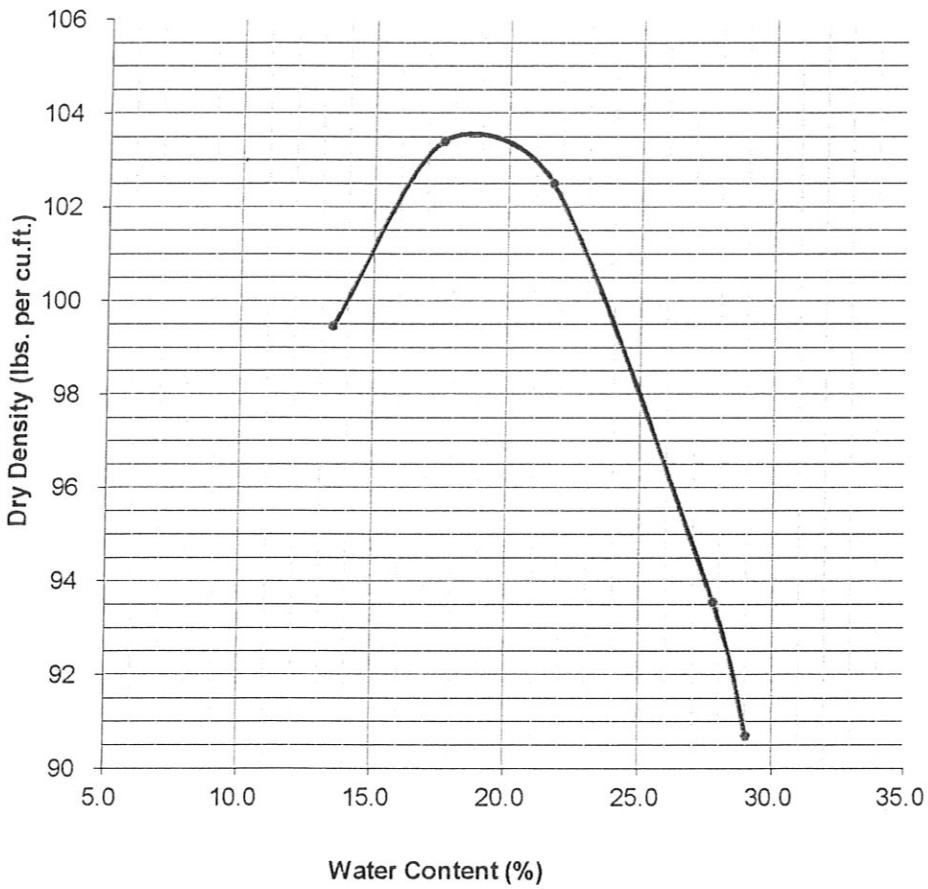
Black Warrior Minerals
Mine #1, Basin 046, Dam Material
Moisture Density Relationship
(Proctor Method)



ASTM D-698 Method A	Water Content %	Specific Gravity	%> No. 4	%< No. 200	LL %	PL %	PI %
			27.4	19.2	42.1	26.4	15.7
Sample Description, Classification and Location				Sample No.:		Basin 046 Dam Material	
Coarse Grained Clayey Sand				Optimum Moisture Content=		18.7	
				Maximum Dry Density =		103.6	

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STABILITY ANALYSIS - COMPUTER OUTPUT
SEDIMENT BASIN 046 - STATIC

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Black Warrior Minerals, Inc.
Mine No. 2, P-39__
Sediment Basin 046
Static Case

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 .000 3.750 2 500.000 .000

On boundary line no. 2 Point no. and coordinates are:
1 200.000 4.400 2 300.892 3.643

On boundary line no. 3 Point no. and coordinates are:
1 .000 5.900 2 200.000 4.400 3 230.625 16.650

On boundary line no. 4 Point no. and coordinates are:
1 .000 16.650 2 230.625 16.650 3 243.500 21.800 4 255.500 21.800 5 293.738 6.505
6 300.892 3.643 7 500.000 2.150

Line no. and slope of each segment are:
1 -.007
2 -.008
3 -.007 .400
4 .000 .400 .000 -.400 -.400 -.007

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	180.000	30.540	135.960
2	100.000	29.720	133.520
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 .000 16.650 2 230.625 16.650 3 257.588 13.008 4 293.738 6.505 5 300.892 3.643
6 500.000 2.150

point1=(256.000, 43.000) point2=(256.000, 23.000) point3=(302.000, 23.000) NJ= 2 NI= 2
Automatic search will follow after grid with XINC= 10.000 and YINC= 10.000

At point (256.000, 43.000) under seepage 1,the radius and the corresponding factor of safety are:
41.169 7.902 37.176 7.338 33.184 7.228 29.191 7.121 25.198 7.431
31.853 7.218 30.522 7.201 27.860 6.966 26.529 6.969
Lowest factor of safety= 6.966 and occurs at radius = 27.860

At point (256.000, 33.000) under seepage 1,the radius and the corresponding factor of safety are:
31.169 7.539 27.178 6.743 23.186 6.473 19.194 6.243 15.203 6.893
21.855 6.427 20.525 6.370 17.864 6.186 16.533 6.352
Lowest factor of safety= 6.186 and occurs at radius = 17.864

At point (256.000, 23.000) under seepage 1,the radius and the corresponding factor of safety are:
21.169 7.549 17.195 6.971 13.222 7.137 9.248 7.570 5.274 7.910
19.845 7.335 18.520 7.031 15.871 6.877 14.546 6.997
Lowest factor of safety= 6.877 and occurs at radius = 15.871

At point (279.000, 43.000) under seepage 1,the radius and the corresponding factor of safety are:
41.341 2.093 38.755 1.993 36.169 2.114 33.583 2.328 30.997 2.786
40.479 2.077 39.617 2.048 37.893 2.022 37.031 2.062
Lowest factor of safety= 1.993 and occurs at radius = 38.755

At point (279.000, 33.000) under seepage 1,the radius and the corresponding factor of safety are:
31.342 2.096 28.899 1.996 26.456 2.132 24.013 2.422 21.570 2.935
30.527 2.079 29.713 2.055 28.084 2.029 27.270 2.074
Lowest factor of safety= 1.996 and occurs at radius = 28.899

At point (279.000, 23.000) under seepage 1,the radius and the corresponding factor of safety are:
21.342 2.372 19.042 2.266 16.742 2.424 14.442 2.715 12.142 3.232
20.575 2.368 19.809 2.349 18.275 2.311 17.509 2.368
Lowest factor of safety= 2.266 and occurs at radius = 19.042

At point (302.000, 43.000) under seepage 1,the radius and the corresponding factor of safety are:
41.514 2.706 40.602 2.798 39.690 2.860 38.777 2.886 37.865 4.692
Lowest factor of safety= 2.706 and occurs at radius = 41.514

At point (302.000, 33.000) under seepage 1,the radius and the corresponding factor of safety are:
31.514 3.091 30.745 3.253 29.976 3.461 29.207 3.069 28.438 5.106
29.719 3.505 29.463 3.409 28.950 3.475 28.694 4.088
Lowest factor of safety= 3.069 and occurs at radius = 29.207

At point (302.000, 23.000) under seepage 1,the radius and the corresponding factor of safety are:

21.514 3.810 20.888 4.071 20.262 4.491 19.636 5.106 19.010 5.747
Lowest factor of safety= 3.810 and occurs at radius = 21.514

For piezometric line No. 1

At point (279.000, 43.000) ,RADIUS 38.755
the minimum factor of safety is 1.993

At point (279.000, 43.000) under seepage 1,the radius and the corresponding factor of safety are:
41.341 2.093 38.755 1.993 36.169 2.114 33.583 2.328 30.997 2.786
40.479 2.077 39.617 2.048 37.893 2.022 37.031 2.062
Lowest factor of safety= 1.993 and occurs at radius = 38.755

At point (289.000, 43.000) under seepage 1,the radius and the corresponding factor of safety are:
41.416 1.866 39.558 1.858 37.700 1.967 35.842 2.377 33.983 3.192
40.797 1.867 40.178 1.869 38.939 1.823 38.319 1.889
Lowest factor of safety= 1.823 and occurs at radius = 38.939

At point (299.000, 43.000) under seepage 1,the radius and the corresponding factor of safety are:
41.491 2.302 40.361 2.322 39.230 2.118 38.100 2.650 36.970 4.172
39.984 2.318 39.607 2.278 38.854 2.252 38.477 2.426
Lowest factor of safety= 2.118 and occurs at radius = 39.230

At point (289.000, 53.000) under seepage 1,the radius and the corresponding factor of safety are:
51.416 1.877 49.415 1.825 47.414 1.940 45.412 2.319 43.411 3.049
50.749 1.867 50.082 1.859 48.748 1.813 48.081 1.869
Lowest factor of safety= 1.813 and occurs at radius = 48.748

At point (289.000, 63.000) under seepage 1,the radius and the corresponding factor of safety are:
61.416 1.946 59.272 1.832 57.127 1.994 54.983 2.297 52.839 2.931
60.701 1.926 59.986 1.913 58.557 1.875 57.842 1.929
Lowest factor of safety= 1.832 and occurs at radius = 59.272

At point (299.000, 53.000) under seepage 1,the radius and the corresponding factor of safety are:
51.491 2.162 50.218 2.175 48.944 2.069 47.671 2.574 46.397 3.879
49.793 2.155 49.369 2.018 48.520 2.197 48.095 2.358
Lowest factor of safety= 2.018 and occurs at radius = 49.369

At point (279.000, 53.000) under seepage 1,the radius and the corresponding factor of safety are:
51.341 2.187 48.612 2.084 45.883 2.214 43.154 2.416 40.425 2.711
50.431 2.165 49.522 2.127 47.702 2.115 46.793 2.159
Lowest factor of safety= 2.084 and occurs at radius = 48.612

At point (291.500, 53.000) under seepage 1,the radius and the corresponding factor of safety are:
51.435 1.880 49.616 1.841 47.796 1.944 45.977 2.361 44.158 3.192
50.828 1.865 50.222 1.852 49.009 1.799 48.403 1.861

Lowest factor of safety= 1.799 and occurs at radius = 49.009

At point (294.000, 53.000) under seepage 1,the radius and the corresponding factor of safety are:

51.454	1.918	49.816	1.887	48.179	1.971	46.542	2.408	44.904	3.368
50.908	1.911	50.362	1.903	49.270	1.808	48.725	1.880		

Lowest factor of safety= 1.808 and occurs at radius = 49.270

At point (291.500, 55.500) under seepage 1,the radius and the corresponding factor of safety are:

53.935	1.888	52.080	1.838	50.225	1.939	48.370	2.349	46.515	3.155
53.316	1.869	52.698	1.853	51.461	1.802	50.843	1.860		

Lowest factor of safety= 1.802 and occurs at radius = 51.461

At point (291.500, 50.500) under seepage 1,the radius and the corresponding factor of safety are:

48.935	1.877	47.151	1.848	45.368	1.952	43.584	2.372	41.801	3.230
48.340	1.865	47.746	1.856	46.557	1.802	45.962	1.868		

Lowest factor of safety= 1.802 and occurs at radius = 46.557

For piezometric line No. 1

At point (291.500, 53.000) ,RADIUS 49.009
the minimum factor of safety is 1.799

Cross section in distorted scale. Numerals indicate boundary line no. If there are 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. The minimum factor of safety is 1.799.

```
 3.200E+01 X+++++++++X+++++++++X+++++++++X+++++++++X+++++++++X
           +    +                                            +
           +    +                                            +
           +    +                                            +
           +    +                                            +
 2.800E+01 X    X    +         +         +         +         X
           +    +                                            +
           +    +                                            +
           +    +                                            +
           +    +                                            +
 2.400E+01 X    X    +         +         +         +         X
           +    +                                            +
           +    +                                            +
           +    +              44                            +
           +    +                                            +
 2.000E+01 X    X    +         +         +         +         X
           +    +                                            +
           +    +                                            +
           +    +                                            +
           +    44444444444444X                              +
 1.600E+01 X    X    +         +         +         +         X
           +    +              P                             +
           +    +                4                           +
           +    +                                            +
           +    +                P*                          +
 1.200E+01 X    X    +         +         +         +         X
           +    +                                            +
           +    +                                            +
           +    +                P                           +
           +    +                                            +
 8.000E+00 X    X    +         +         +         +         X
           +    +                                            +
           +    +                  4                         +
           +    3333333333333      *                         +
           +    +            X22222                          +
 4.000E+00 X    X111111        +   X44444+         +         X
           +    +      111111            444444               +
           +    +            111111            4              +
           +    +                  111111                     +
           +    +                        111111               +
  .000E+00 X+++++++++X+++++++++X+++++++++X+++++1+++X+++++++++X
           +    +                                            +
           +    +                                            +
           +    +                                            +
           +    +                                            +
-4.000E+00 X    X    +         +         +         +         X
           +    +                                            +
           +    +                                            +
           +    +                                            +
           +    +                                            +
-8.000E+00 X+++++++++X+++++++++X+++++++++X+++++++++X+++++++++X
0          -8.00E+01  8.00E+01  2.40E+02  4.00E+02  5.60E+02  7.20E+02
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STABILITY ANALYSIS - COMPUTER OUTPUT
SEDIMENT BASIN 046A - STATIC

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Black Warrior Minerals, Inc.
Mine No. 2, P-39__
Sediment Basin 046A
Static Case

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 .000 10.000 2 500.000 .000

On boundary line no. 2 Point no. and coordinates are:
1 200.000 11.000 2 300.000 9.000

On boundary line no. 3 Point no. and coordinates are:
1 .000 15.000 2 200.000 11.000 3 229.375 22.750

On boundary line no. 4 Point no. and coordinates are:
1 .000 22.750 2 229.375 22.750 3 241.500 27.600 4 253.500 27.600 5 292.781 11.887
6 300.000 9.000 7 500.000 5.000

Line no. and slope of each segment are:
1 -.020
2 -.020
3 -.020 .400
4 .000 .400 .000 -.400 -.400 -.020

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	50.000	30.000	135.000
2	50.000	30.000	135.000
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 .000 22.750 2 229.375 22.750 3 256.672 18.763 4 292.781 11.887 5 300.000 9.000
6 500.000 5.000

point1=(255.000, 49.000) point2=(255.000, 29.000) point3=(301.000, 29.000) NJ= 2 NI= 2
Automatic search will follow after grid with XINC= 10.000 and YINC= 10.000

At point (255.000, 49.000) under seepage 1,the radius and the corresponding factor of safety are:
44.091 6.214 39.563 6.042 35.036 5.866 30.508 5.746 25.980 5.362
24.471 5.947 22.962 8.115
Lowest factor of safety= 5.362 and occurs at radius = 25.980

At point (255.000, 39.000) under seepage 1,the radius and the corresponding factor of safety are:
34.093 6.023 29.574 5.661 25.055 5.333 20.536 5.069 16.017 4.877
14.511 5.172 13.005 6.458
Lowest factor of safety= 4.877 and occurs at radius = 16.017

****WARNING AT NEXT CENTER**** When radius is 6.305
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 (255.000, 29.000) under seepage 1,the radius and the corresponding factor of safety are:
24.095 6.149 19.648 5.819 15.200 5.712 10.752 5.834 6.305**********
18.165 5.735 16.682 5.644 13.717 5.680 12.235 5.756
Lowest factor of safety= 5.644 and occurs at radius = 16.682

At point (278.000, 49.000) under seepage 1,the radius and the corresponding factor of safety are:
44.551 1.762 41.435 1.744 38.318 1.795 35.202 1.919 32.085 2.096
43.512 1.749 42.473 1.743 40.396 1.753 39.357 1.774
Lowest factor of safety= 1.743 and occurs at radius = 42.473

At point (278.000, 39.000) under seepage 1,the radius and the corresponding factor of safety are:
34.553 1.752 31.579 1.735 28.605 1.795 25.632 1.951 22.658 2.187
33.562 1.742 32.571 1.737 30.588 1.746 29.597 1.769
Lowest factor of safety= 1.735 and occurs at radius = 31.579

At point (278.000, 29.000) under seepage 1,the radius and the corresponding factor of safety are:
24.555 1.933 21.724 1.949 18.893 2.016 16.062 2.163 13.230 2.393
Lowest factor of safety= 1.933 and occurs at radius = 24.555

At point (301.000, 49.000) under seepage 1,the radius and the corresponding factor of safety are:
45.011 1.756 43.511 1.723 42.011 1.719 40.511 1.768 39.011 2.251

43.011 1.719 42.511 1.718 41.511 1.721 41.011 1.736
Lowest factor of safety= 1.718 and occurs at radius = 42.511

At point (301.000, 39.000) under seepage 1,the radius and the corresponding factor of safety are:
35.013 1.881 33.656 1.838 32.298 1.822 30.941 1.880 29.584 2.194
33.203 1.827 32.751 1.822 31.846 1.829 31.393 1.847
Lowest factor of safety= 1.822 and occurs at radius = 32.751

At point (301.000, 29.000) under seepage 1,the radius and the corresponding factor of safety are:
25.015 2.122 23.800 2.069 22.586 2.043 21.371 2.089 20.156 2.434
23.395 2.057 22.990 2.048 22.181 2.044 21.776 2.058
Lowest factor of safety= 2.043 and occurs at radius = 22.586

For piezometric line No. 1

At point (301.000, 49.000) ,RADIUS 42.511
the minimum factor of safety is 1.718

At point (301.000, 49.000) under seepage 1,the radius and the corresponding factor of safety are:
45.011 1.756 43.511 1.723 42.011 1.719 40.511 1.768 39.011 2.251
43.011 1.719 42.511 1.718 41.511 1.721 41.011 1.736
Lowest factor of safety= 1.718 and occurs at radius = 42.511

At point (311.000, 49.000) under seepage 1,the radius and the corresponding factor of safety are:
45.211 3.241 44.211 3.558 43.211 4.232 42.212 6.375 41.212 44.034
Lowest factor of safety= 3.241 and occurs at radius = 45.211

At point (291.000, 49.000) under seepage 1,the radius and the corresponding factor of safety are:
44.811 1.490 42.608 1.459 40.405 1.501 38.203 1.707 36.000 2.236
44.077 1.472 43.342 1.461 41.874 1.458 41.140 1.468
Lowest factor of safety= 1.458 and occurs at radius = 41.874

At point (281.000, 49.000) under seepage 1,the radius and the corresponding factor of safety are:
44.611 1.631 41.705 1.636 38.800 1.687 35.894 1.849 32.989 2.116
Lowest factor of safety= 1.631 and occurs at radius = 44.611

At point (291.000, 59.000) under seepage 1,the radius and the corresponding factor of safety are:
54.809 1.514 52.464 1.473 50.118 1.510 47.773 1.723 45.427 2.175
54.027 1.491 53.245 1.477 51.682 1.468 50.900 1.475
Lowest factor of safety= 1.468 and occurs at radius = 51.682

At point (291.000, 39.000) under seepage 1,the radius and the corresponding factor of safety are:
34.813 1.518 32.753 1.479 30.693 1.516 28.633 1.705 26.572 2.280
34.126 1.499 33.440 1.486 32.066 1.477 31.379 1.492

Lowest factor of safety= 1.477 and occurs at radius = 32.066

At point (293.500, 49.000) under seepage 1,the radius and the corresponding factor of safety are:

44.861	1.509	42.834	1.479	40.807	1.484	38.780	1.678	36.753	2.267
44.185	1.497	43.510	1.486	42.158	1.472	41.482	1.473		

Lowest factor of safety= 1.472 and occurs at radius = 42.158

At point (288.500, 49.000) under seepage 1,the radius and the corresponding factor of safety are:

44.761	1.488	42.383	1.466	40.004	1.533	37.625	1.741	35.247	2.196
43.968	1.475	43.175	1.467	41.590	1.471	40.797	1.493		

Lowest factor of safety= 1.466 and occurs at radius = 42.383

At point (291.000, 51.500) under seepage 1,the radius and the corresponding factor of safety are:

47.311	1.492	45.072	1.457	42.834	1.501	40.595	1.710	38.357	2.219
46.564	1.474	45.818	1.462	44.326	1.454	43.580	1.466		

Lowest factor of safety= 1.454 and occurs at radius = 44.326

At point (291.000, 54.000) under seepage 1,the radius and the corresponding factor of safety are:

49.810	1.496	47.536	1.460	45.262	1.502	42.988	1.715	40.713	2.204
49.052	1.478	48.294	1.465	46.778	1.456	46.020	1.465		

Lowest factor of safety= 1.456 and occurs at radius = 46.778

At point (293.500, 51.500) under seepage 1,the radius and the corresponding factor of safety are:

47.361	1.506	45.298	1.475	43.235	1.485	41.172	1.684	39.109	2.263
46.673	1.492	45.985	1.482	44.610	1.468	43.923	1.470		

Lowest factor of safety= 1.468 and occurs at radius = 44.610

At point (288.500, 51.500) under seepage 1,the radius and the corresponding factor of safety are:

47.261	1.492	44.846	1.468	42.432	1.531	40.018	1.743	37.604	2.180
46.456	1.478	45.651	1.470	44.042	1.473	43.237	1.493		

Lowest factor of safety= 1.468 and occurs at radius = 44.846

For piezometric line No. 1

At point (291.000, 51.500) ,RADIUS 44.326
the minimum factor of safety is 1.454

1

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.
The minimum factor of safety is 1.454

```
 3.600E+01 X+++++++++X+++++++++X++++++++++X+++++++++X+++++++++X
           +    +                                             +
           +    +                                             +
           +    +                                             +
           +    +                                             +
 3.200E+01 X    X    +         +         +         +         X
           +    +                                             +
           +    +                                             +
           +    +                                             +
           +    +                                             +
 2.800E+01 X    X    +         44        +         +         X
           +    +                                             +
           +    +                                             +
           +    +                                             +
           +    +                                             +
 2.400E+01 X    X    +         +         +         +         X
           +    +                                             +
           +    44444444444444X                               +
           +    +                                             +
           +    +              P                              +
 2.000E+01 X    X    +         + 4       +         +         X
           +    +                                             +
           +    +               P                             +
           +    +                                             +
           +    +                                             +
 1.600E+01 X    X    +         + *       +         +         X
           +    333              P                            +
           +    +  333                                        +
           +    +     33                                      +
           +    +       333                                   +
 1.200E+01 X    X    +     33  +  4      +         +         X
           +    +            X2                               +
           +    +              22                             +
           +    111              22                           +
           +    +  111            *X44                        +
 8.000E+00 X    X    +11       +      44 +         +         X
           +    +       111             444                   +
           +    +          11              44                 +
           +    +            111             44               +
           +    +               111            4              +
 4.000E+00 X    X    +         +   11    +         +         X
           +    +                    111                      +
           +    +                       11                    +
           +    +                         111                 +
           +    +                            11               +
  .000E+00 X+++++++++X+++++++++X+++++++++X+++++1+++X+++++++++X
           +    +                                             +
           +    +                                             +
           +    +                                             +
           +    +                                             +
-4.000E+00 X+++++++++X+++++++++X+++++++++X+++++++++X+++++++++X
0          -8.00E+01  8.00E+01  2.40E+02  4.00E+02  5.60E+02  7.20E+02
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