HYDROLOGY STUDY FOR SHANNON, LLC

SHANNON MINE NO. 2
P-3925
JEFFERSON COUNTY, ALABAMA

BY
DRUMMOND COMPANY, INC.
POST OFFICE BOX 1549
JASPER, ALABAMA 35502

JUNE 25, 2012

POND CONSTRUCTION CRITERIA

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

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

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

3. The foundation and abutments for the impounding structure shall be designed to be stable under all conditions of construction and operation of the impoundments, with a minimum static safety factor of 1.5 for the normal pool with steady seepage saturation conditions, and a seismic safety factor of at least 1.20.

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

5. The embankment foundation area shall be cleared of all organic matter, all surfaces sloped to no steeper than 1v:1h, and the entire foundation surface scarified.

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

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

8. The pool area of the basin will be cleared of timber and large undergrowth.

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

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

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

12. The combination primary and secondary decant system shall be designed to safely carry

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

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

14. The settled embankment height for permanent and temporary impoundments shall be a minimum of 1.0 foot above the maximum water elevation for the runoff from either a 25-year/6-hour or a 10-year/24-hour precipitation event (whichever has the greatest runoff).

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

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

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

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

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

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

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

22. All ponds shall be examined quarterly for structural weakness, instability, erosion, or other hazardous conditions and maintenance performed as necessary. Formal inspections shall be made on an annual basis, including any reports or modifications, in accordance with 880-X-10C-.20[1(j)] of the Alabama Surface Mining Commission Regulations.

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

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

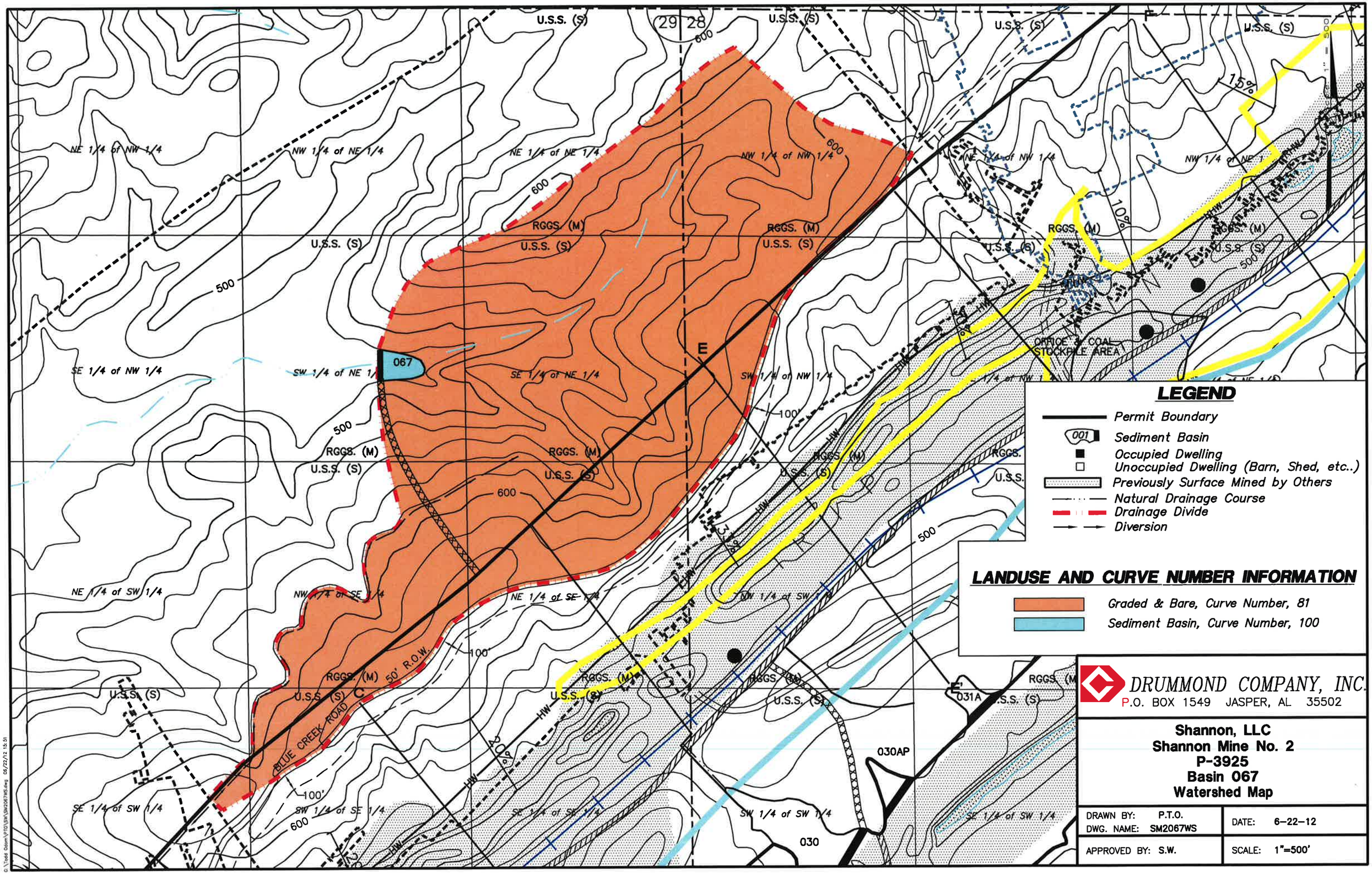
25. A qualified registered professional engineer or other qualified professional specialist, under the direction of the professional engineer shall conduct regular inspections during construction and upon completion shall inspect each basin for certification purposes.

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

NOTES

1) The primary spillway of Basin 067 will consist of a 15' wide open channel lined with inches of concrete reinforced with standard concrete reinforcement wire and a 6 inch diameter PVC fixed siphon tube installed to the lines and grades as specified within these detailed design plans. A 15'x 10' 4" concrete splash pad will be located at the exit point of the tail section of the channel.

2) The gradient of the control section of the primary spillway of Basin 067 will be from 0 % to5 %. A transition section of a minimum of 20 feet will be constructed to transition from the control section to the tail section. The gradient of the transition section will be from 5 % to 40 %. The gradient of the entire tail section of the spillway will be approximately 40 %.



LEGEND

- Permit Boundary
- 001 Sediment Basin
- Occupied Dwelling
- Unoccupied Dwelling (Barn, Shed, etc..)
- Previously Surface Mined by Others
- Natural Drainage Course
- Drainage Divide
- Diversion

LANDUSE AND CURVE NUMBER INFORMATION

- Graded & Bare, Curve Number, 81
- Sediment Basin, Curve Number, 100

DRUMMOND COMPANY, INC.
P.O. BOX 1549 JASPER, AL 35502

Shannon, LLC
Shannon Mine No. 2
P-3925
Basin 067
Watershed Map

DRAWN BY: P.T.O. DWG. NAME: SM2067WS	DATE: 6-22-12
APPROVED BY: S.W.	SCALE: 1"=500'

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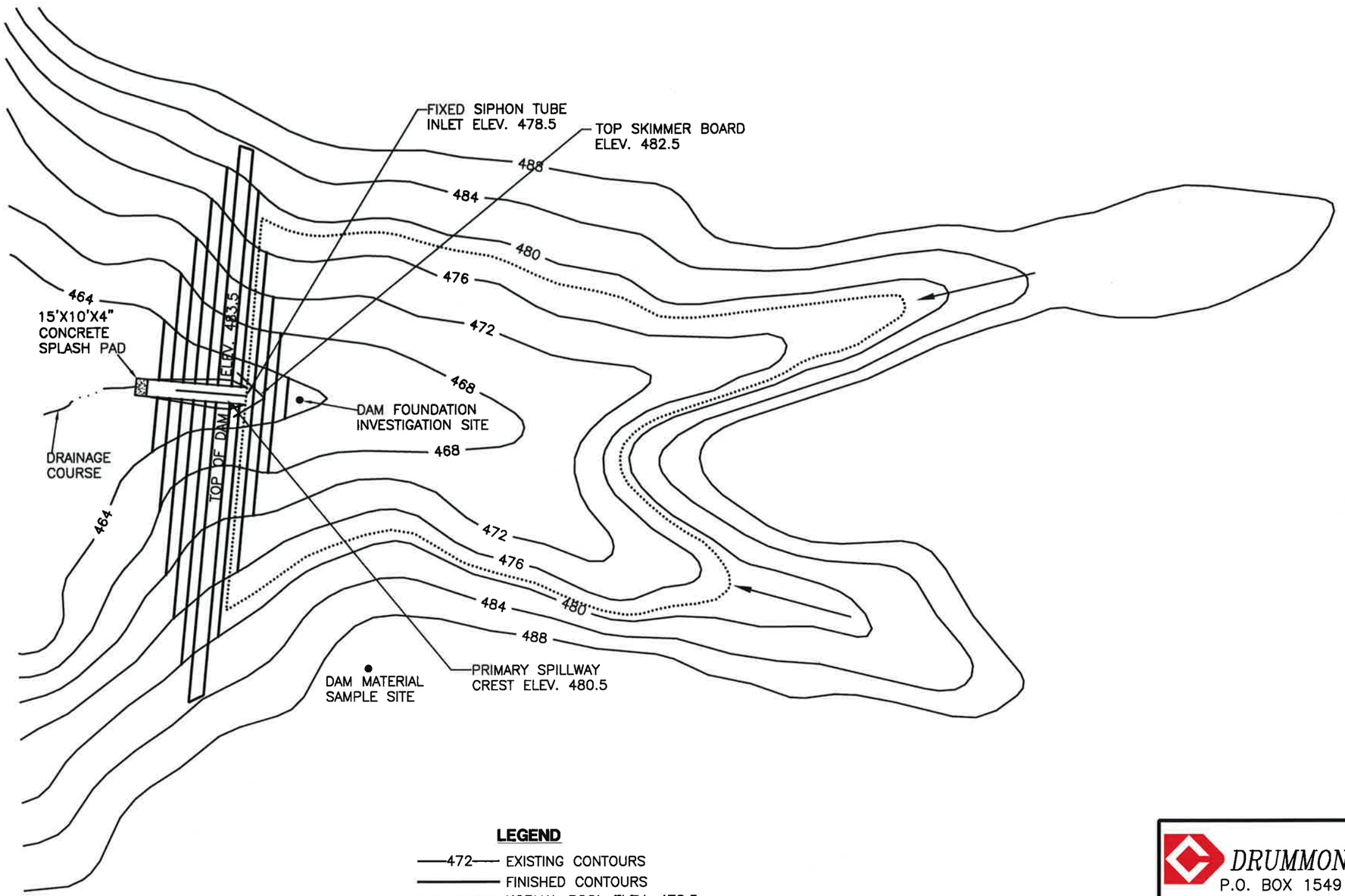

LEGEND

—472— EXISTING CONTOURS
——— FINISHED CONTOURS
····· NORMAL POOL ELEV. 478.5
——► MAJOR INFLOW

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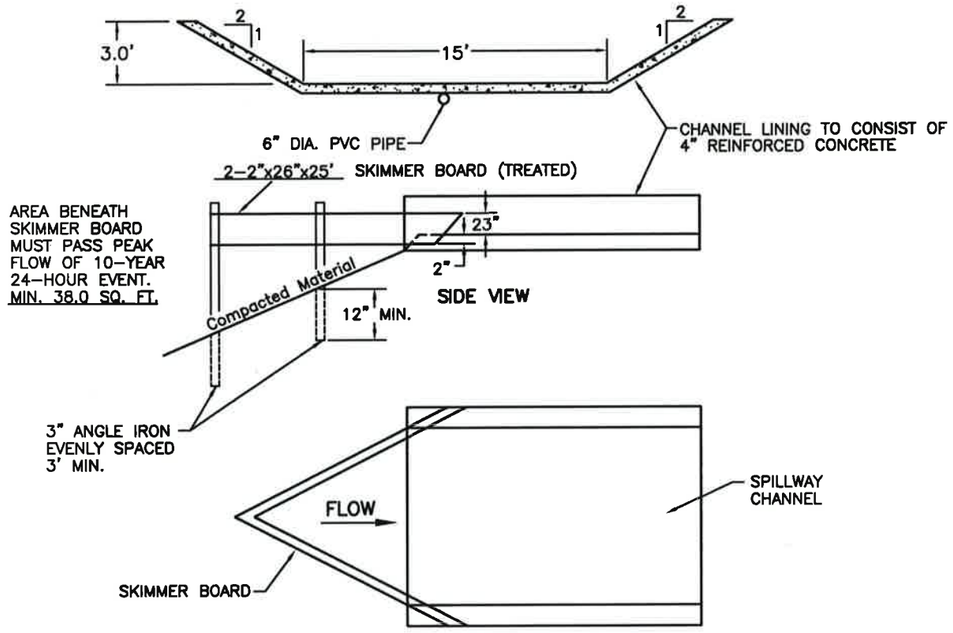
Shannon, LLC
Shannon Mine No. 2
P-3925
Basin 067
Planview

DRAWN BY: P.T.O. DWG. NAME: SM2067PV	DATE: 6-22-12
APPROVED BY: S.W.	SCALE: 1"=100'

Skimmer Board Elev. 482.5
Spillway Elev. 480.5
Q Out 150.5 C.F.S.
V Out 4.0 F.P.S.



SKIMMER BOARD DETAIL

SPILLWAY GRADIENT SHALL BE APPROXIMATELY 40%

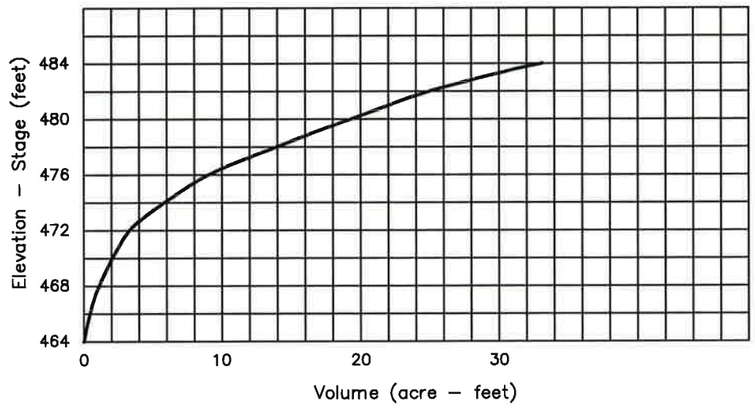
Notes:

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

Storage Computation

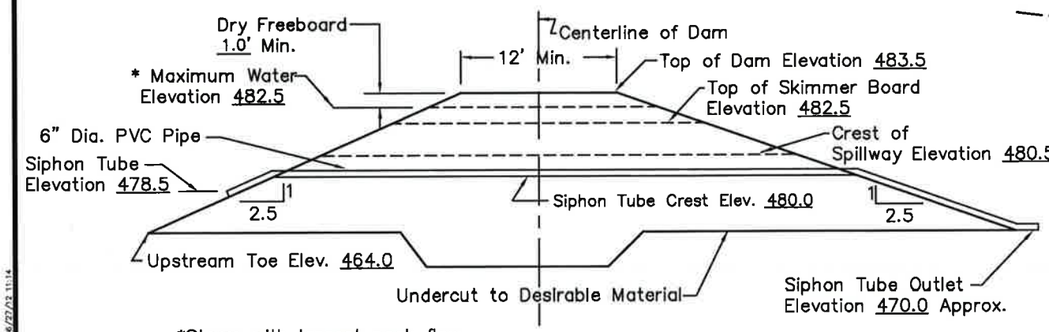
Elevation (feet)	Area (acres)	Avg. Area (acres)	Interval (feet)	Storage (ac.-ft.)	Acc. Storage (ac.-ft.)
464	.000				.000
		0.182	4	0.728	
468	.364				.728
		0.695	4	2.784	
472	1.027				3.512
		1.444	4	5.776	
476	1.860				9.288
		2.432	4	9.728	
480	3.004				19.016
		3.720	4	14.880	
484	4.435				33.896

Stage vs. Storage Curve



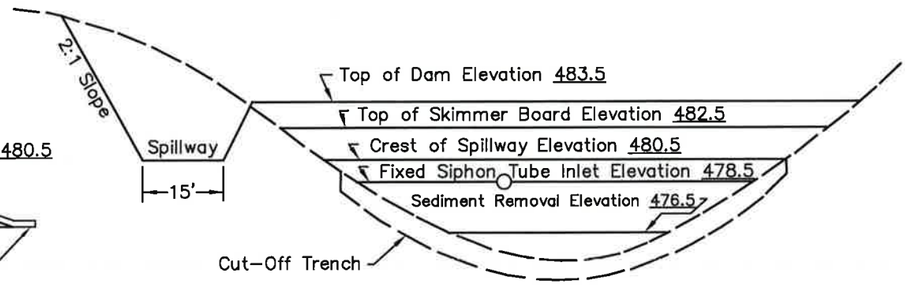
Key Basin Parameters

Drainage Area	134.0 Acres
Disturbed Area	133.0 Acres
Sediment Storage	9.8 Ac. Ft.
Detention Storage	4.5 Ac. Ft.
Full Pool Capacity	19.9 Ac. Ft.
Normal Pool Capacity	14.3 Ac. Ft.
Total Basin Capacity	19.9 Ac. Ft.
Peak Inflow	359.6 C.F.S.
Peak Outflow	150.5 C.F.S.



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

Typical Cross Section Along Spillway



Typical Profile Looking Downstream

Steven R. Ingle, P.E.
AL Registration #18213

ALABAMA REGISTERED No. 18213 PROFESSIONAL ENGINEER STEVEN R. INGLE

DRUMMOND COMPANY, INC.
P.O. BOX 1549 JASPER, AL 35502

Shannon, LLC
Shannon Mine No. 2
P-3925
Basin 067

DRAWN BY: P.T.O. DWG. NAME: SM2067TY	DATE: 6-22-12
APPROVED BY: S.W.	SCALE: NONE

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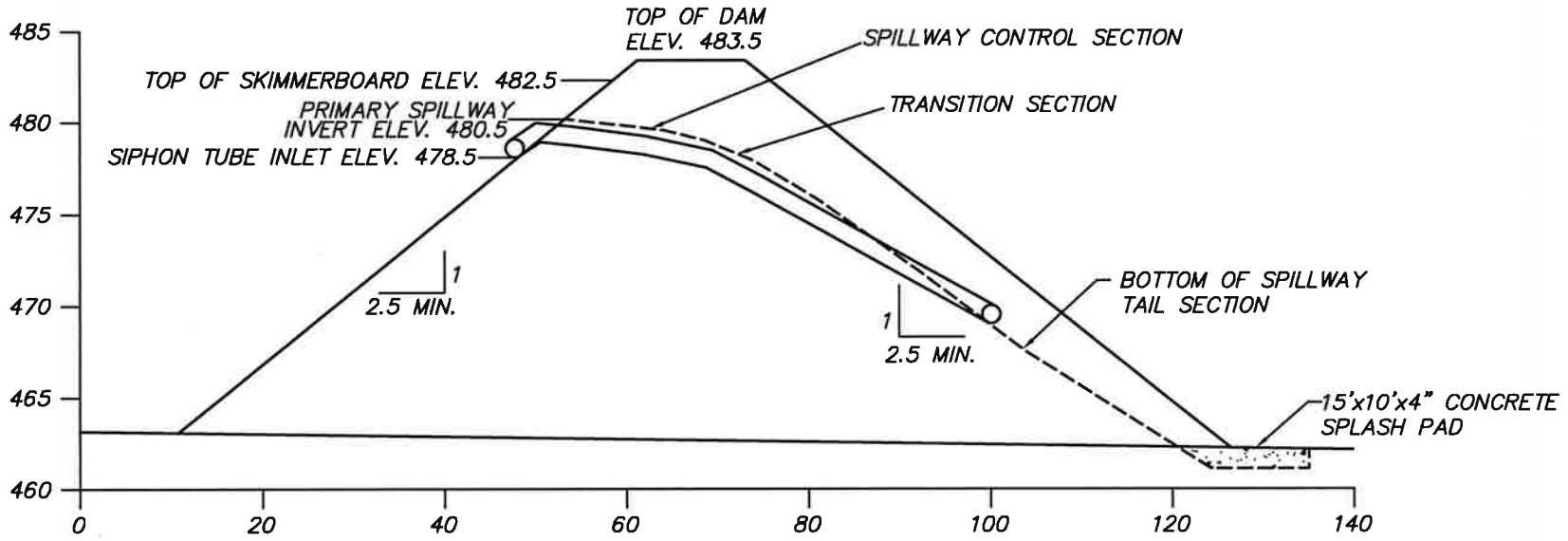
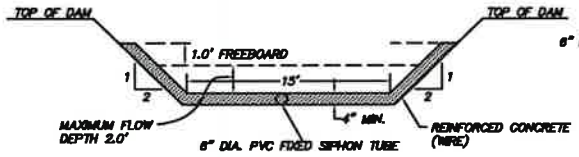
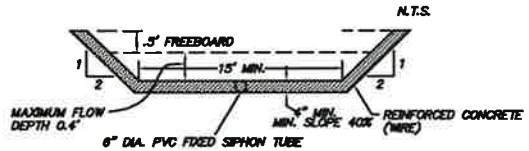
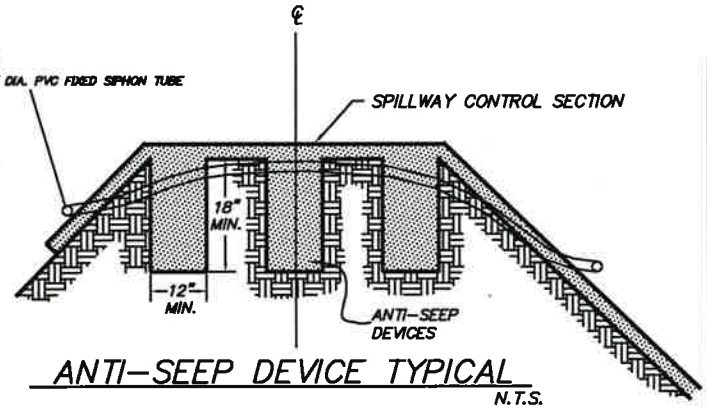




SPILLWAY CONTROL SECTION TYPICAL



SPILLWAY TAIL SECTION TYPICAL
N.T.S.



ANTI-SEEP DEVICE TYPICAL
N.T.S.

DRUMMOND COMPANY, INC.
P.O. BOX 1549 JASPER, AL 35502

Shannon, LLC
Shannon Mine No. 2
P-3925
Basin 067 Dam Detail

DRAWN BY: P.T.O. DWG. NAME: SM2067DD	DATE: 6-26-12
APPROVED BY: S.W.	SCALE: AS NOTED

Shannon LLC
Shannon Mine No. 2
P-3925
Basin 067
6.0 Inches, 10 Year-24 Hour
DRN 58

SEW

General Information

Storm Information:

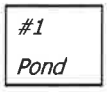
Storm Type:	DRN 58
Design Storm:	10 yr - 24 hr
Rainfall Depth:	6.000 inches

Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	100.000%	100.000%
2.0000	96.000%	94.000%
1.0000	89.500%	74.500%
0.5000	82.500%	49.000%
0.3000	77.500%	39.000%
0.2000	71.500%	32.000%
0.1000	63.000%	24.500%
0.0500	41.000%	16.000%
0.0300	37.000%	13.000%
0.0200	11.000%	8.000%
0.0100	2.500%	3.000%
0.0050	2.500%	3.000%
0.0030	2.500%	3.000%
0.0010	2.500%	3.000%
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	Basin 067



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	134.000	134.000	174.24	43.48	20,089.6	484,002	370.49	223.26
	Out			150.54	46.09	506.6	18,825	0.00	0.00

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	94.000%	100.000%
1.0000	74.500%	100.000%
0.5000	49.000%	100.000%
0.3000	39.000%	100.000%
0.2000	32.000%	100.000%
0.1000	24.500%	100.000%
0.0500	16.000%	100.000%
0.0300	13.000%	100.000%
0.0200	8.000%	100.000%
0.0100	3.000%	100.000%
0.0050	3.000%	100.000%
0.0030	3.000%	100.000%
0.0010	3.000%	100.000%
0.0001	0.000%	0.000%

Structure Detail:

Structure #1 (Pond)

Basin 067

Pond Inputs:

Initial Pool Elev:	478.50 ft
Initial Pool:	4.48 ac-ft
*Sediment Storage:	9.77 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)
480.50	10.00	2.00:1	2.00:1	15.00

Fixed Siphon

Crest Elev	Inlet Elev	Outlet Elev	Diameter (in)	Length (ft)	Manning's n
480.00	478.50	470.00	6.00	10.00	0.0140

Pond Results:

Peak Elevation:	482.52 ft
H'graph Detention Time:	5.89 hrs
Pond Model:	CSTRS
Dewater Time:	1.27 days
Trap Efficiency:	97.48 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
476.50	1.974	0.000	0.000		Top of Sed. Storage
476.50	1.974	0.003	0.000		
477.00	2.091	1.019	0.000		
477.50	2.232	2.100	0.000		
478.00	2.377	3.252	0.000		
478.50	2.527	4.478	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
479.00	2.682	5.780	4.300	3.66*	
479.50	2.841	7.160	4.419	3.78*	
480.00	3.004	8.621	4.536	3.90*	Spillway #2
480.50	3.163	10.163	4.650	4.05	Spillway #1
481.00	3.326	11.785	7.864	3.20	
481.50	3.493	13.489	46.144	10.25	
482.00	3.664	15.278	91.446	1.05	
482.50	3.839	17.154	147.386		
482.52	3.849	17.245	150.537	0.50	Peak Stage
483.00	4.018	19.118	215.212		
483.50	4.224	21.178	294.952		
484.00	4.435	23.342	386.765		
484.50	4.650	25.614	490.872		
485.00	4.872	27.994	607.537		
485.50	5.098	30.486	737.042		
486.00	5.329	33.093	879.682		

**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)
476.50	0.000	0.000	0.000
476.50	0.000	0.000	0.000
477.00	0.000	0.000	0.000
477.50	0.000	0.000	0.000
478.00	0.000	0.000	0.000
478.50	0.000	0.000	0.000
479.00	0.000	0.000	4.300
479.50	0.000	0.000	4.419
480.00	0.000	0.000	4.536
480.50	0.000	0.000	4.650
481.00	3.103	0.000	7.864
481.50	41.275	0.000	46.144
482.00	86.470	0.000	91.446
482.50	142.306	0.000	147.386
483.00	210.030	0.000	215.212
483.50	289.670	0.000	294.952
484.00	381.384	0.000	386.765

Elevation (ft)	Emergency Spillway (cfs)	Fixed Siphon (cfs)	Combined Total Discharge (cfs)
484.50	485.395	0.000	490.872
485.00	601.965	0.000	607.537
485.50	731.377	0.000	737.042
486.00	873.925	0.000	879.682

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	133.000	0.108	0.000	0.000	81.000	F	172.67	42.984
	2	1.000	0.000	0.000	0.000	100.000	S	1.57	0.499
	Σ	**134.000**						**174.24**	**43.484**

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	25.00	0.9000	1.0000	2	20,089.6	487,550	373.21	225.34
	2	0.000	200.00	0.00	0.0010	1.0000	2	0.0	0	0.00	0.00
	Σ							**20,089.6**	**484,002**	**370.49**	**223.26**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	4.17	100.00	2,400.00	6.120	0.108
#1	**1**	**Time of Concentration:**					**0.108**

Shannon LLC
Shannon Mine No. 2
P-3925
Basin 067
4.8 Inches, 25 Year- 6 Hour

SEW

General Information

Storm Information:

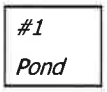
Storm Type:	Rainfall Event

Accumulated Time (hrs)	Accumulated Depth (in)
0.00	0.0000
0.50	0.1680
1.00	0.3840
1.50	0.6480
2.00	1.1040
2.50	2.8800
3.00	3.3600
3.50	3.7440
4.00	4.0080
4.50	4.2480
5.00	4.4400
5.50	4.6320
6.00	4.8000

Peak 30-minute Intensity: 3.552 in/hr

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Basin 067



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	134.000	134.000	359.59	31.37
	Out			135.71	40.34

Structure Detail:

Structure #1 (Pond)

Basin 067

Pond Inputs:

Initial Pool Elev:	478.50 ft
Initial Pool:	4.48 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
480.50	10.00	2.00:1	2.00:1	15.00

Fixed Siphon

Crest Elev	Inlet Elev	Outlet Elev	Diameter (in)	Length (ft)	Manning's n
480.00	478.50	470.00	6.00	10.00	0.0140

Pond Results:

Peak Elevation:	482.40 ft
Dewater Time:	0.96 days

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)	
476.50	1.974	0.000	0.000		
476.50	1.974	0.003	0.000		
477.00	2.091	1.019	0.000		
477.50	2.232	2.100	0.000		
478.00	2.377	3.252	0.000		
478.50	2.527	4.478	0.000		
479.00	2.682	5.780	4.300	3.66*	
479.50	2.841	7.160	4.419	3.78*	
480.00	3.004	8.621	4.536	3.90*	Spillway #2
480.50	3.163	10.163	4.650	4.10	Spillway #1
481.00	3.326	11.785	7.864	3.20	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
481.50	3.493	13.489	46.144	1.30	
482.00	3.664	15.278	91.446	2.05	
482.40	3.803	16.762	135.710	0.95	Peak Stage
482.50	3.839	17.154	147.386		
483.00	4.018	19.118	215.212		
483.50	4.224	21.178	294.952		
484.00	4.435	23.342	386.765		
484.50	4.650	25.614	490.872		
485.00	4.872	27.994	607.537		
485.50	5.098	30.486	737.042		
486.00	5.329	33.093	879.682		

**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)
476.50	0.000	0.000	0.000
476.50	0.000	0.000	0.000
477.00	0.000	0.000	0.000
477.50	0.000	0.000	0.000
478.00	0.000	0.000	0.000
478.50	0.000	0.000	0.000
479.00	0.000	4.300*	4.300
479.50	0.000	4.419*	4.419
480.00	0.000	4.536	4.536
480.50	0.000	4.650	4.650
481.00	3.103	4.761	7.864
481.50	41.275	4.869	46.144
482.00	86.470	4.976	91.446
482.50	142.306	5.080	147.386
483.00	210.030	5.182	215.212
483.50	289.670	5.282	294.952
484.00	381.384	5.380	386.765
484.50	485.395	5.477	490.872
485.00	601.965	5.572	607.537
485.50	731.377	5.666	737.042
486.00	873.925	5.758	879.682

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	133.000	0.108	0.000	0.000	81.000	F	356.01	30.973
	2	1.000	0.000	0.000	0.000	100.000	S	3.58	0.399
	Σ	**134.000**						**359.59**	**31.372**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	4.17	100.00	2,400.00	6.120	0.108
#1	**1**	**Time of Concentration:**					**0.108**

Shannon, LLC
Shannon Mine No. 2
P-3525
Soil Classification

Shannon, LLC
Shannon Mine No. 2
P-3925

STABILITY ANALYSIS DATA

METHODOLOGY

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

SOIL CLASSIFICATION UNITS

The soil type (soil classification) to be used in the construction of the embankment structure of Basins 067 (SM-SC) and the soil type (soil classification) of the material between the proposed embankment and stiff base of Basin 067 (ML) was sampled and analyzed by PERC Engineering Co., Inc. The soil properties used in the stability analysis (SM-SC) and (ML) were taken from the U.S. Department of the Interior Bureau of Reclamation Design of Small Dams.*

SOIL PROPERTIES

	UNIFIED CLASS	COHESION (PSF)	ANGLE OF INT. FRC.	DESIGN DENSITY (PCF)
Basin 067 Dam Material	SM-SC	187.2	30.5	129.4
Basin 067 Foundation Material	ML	100.8	29.7	129.5

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

STABILITY ANALYSIS DATA

(Continued)

DESIGN DATA

1) Design Density = 95% of the standard proctor maximum density.

2) Embankment top width: 12.0'.

3) Freeboard minimum = 10% of structure (from top of embankment to normal pool level).

4) Safety factors for embankments with 2.5H:1V slopes, front and back.

5) Basin 067 design height = 20.5 ft.

8) DMIN = 0.00

9) All design heights are measured from the top of the embankment to the toe of the upstream slope.

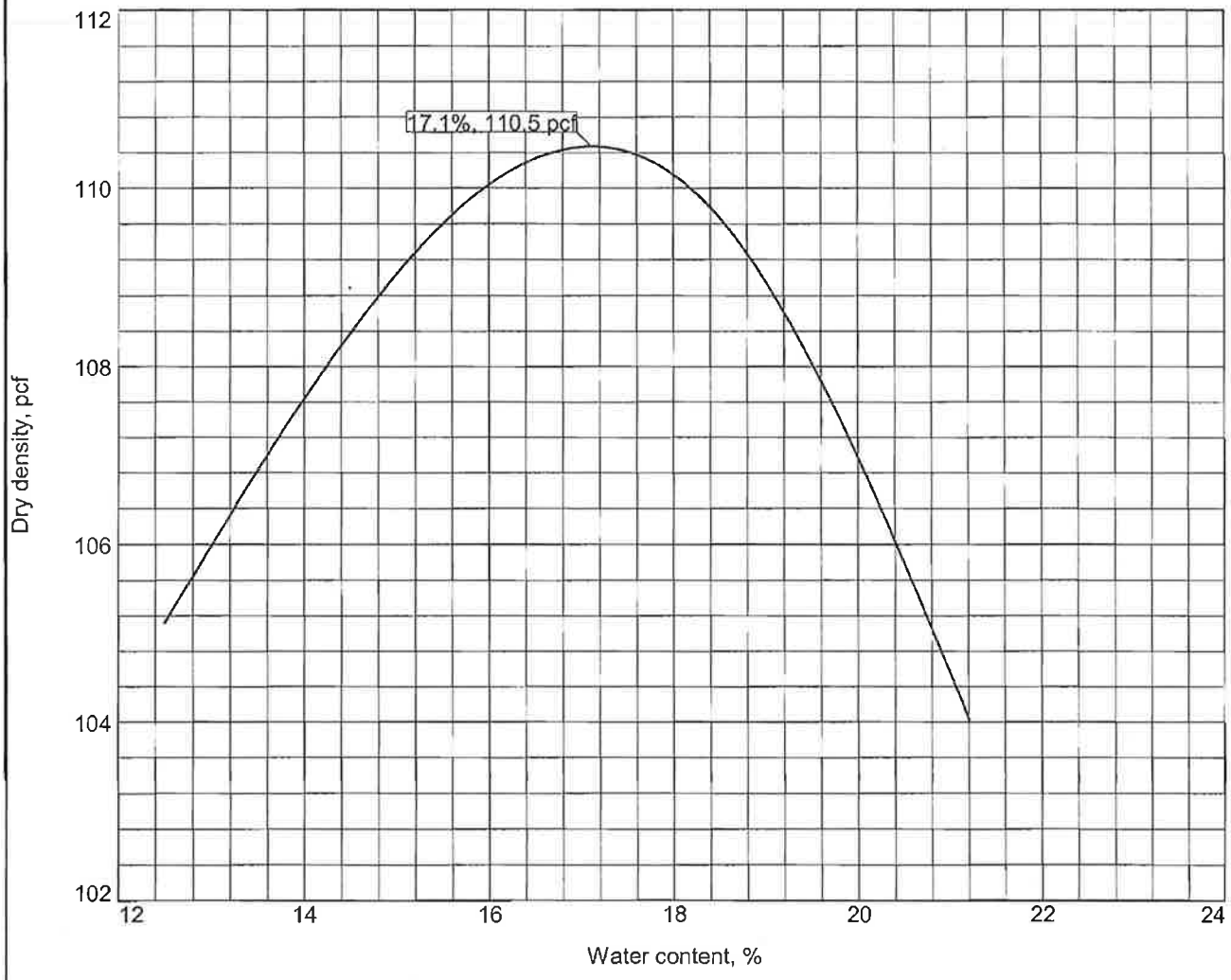
SAFETY FACTORS

BASIN NUMBER	STATIC SAFETY FACTOR
067	1.6

FOUNDATIONS AND ABUTMENTS

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

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure B Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
	SC-SM				26	5		49.4

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 110.5 pcf Optimum moisture = 17.1 %	Silty, clayey sand

Project No. **Client:** Shannon LLC

Project: Basin 067

Date: 5-21-12

Location: Shannon #2 Mine

PERC ENGINEERING CO., INC.

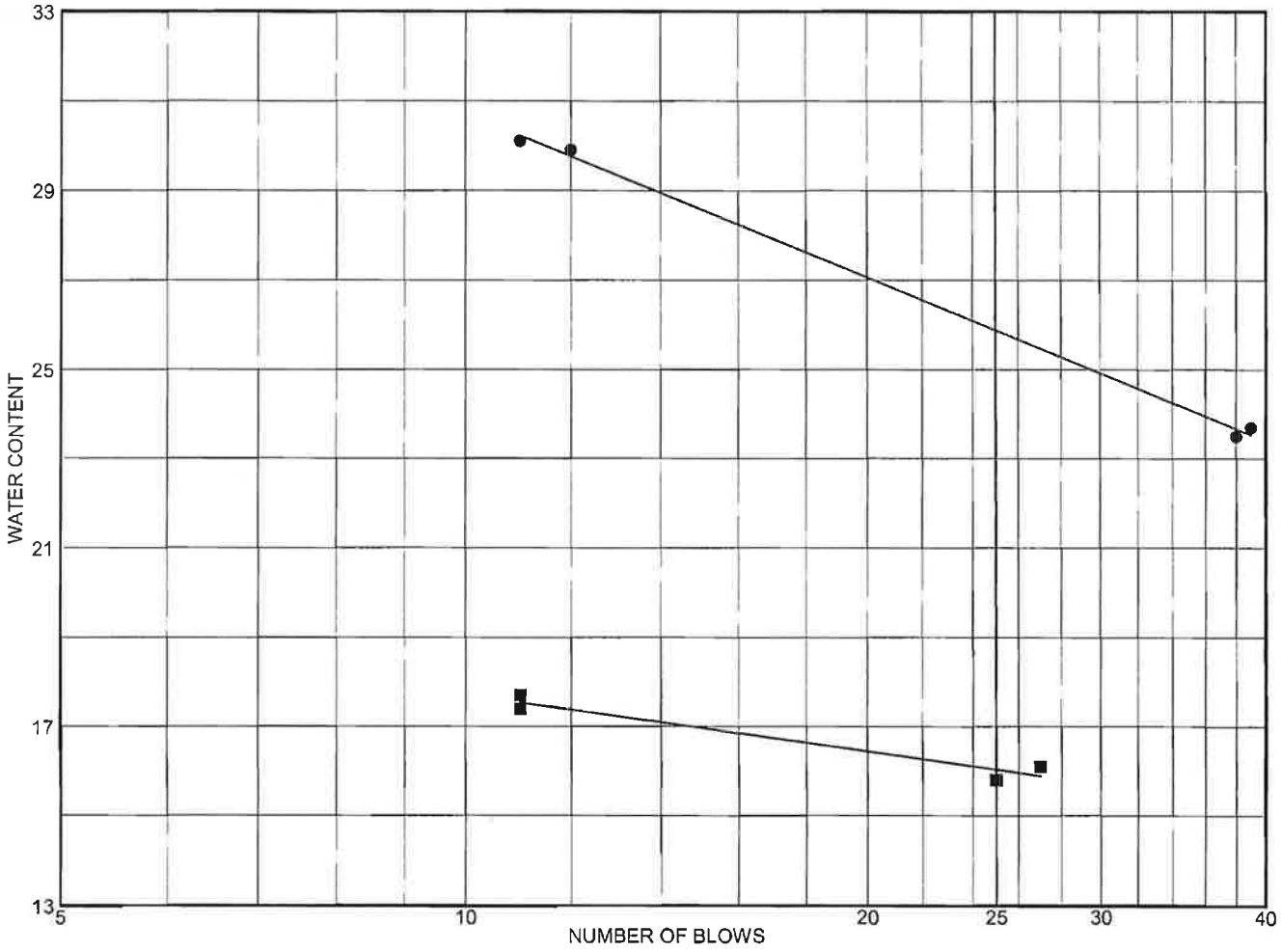
Jasper, Alabama

Remarks:
Dam Material

Date 5-21-12

Tested By: JC **Checked By:** LS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty, clayey sand	26	21	5	94.79	49.4	SC-SM
■	Sandy silt	16	14	2	89.83	63.9	ML

Project No. **Client:** Shannon LLC

Project: Basin 067

Basin 067

● **Location:** Shannon #2 Mine

■ **Location:** Shannon #2 Mine

Remarks:

● Dam Material

■ Foundation Material

PERC ENGINEERING CO., INC.

Jasper, Alabama

Date 5-21-12

Shannon, LLC
Shannon Mine No. 2
P-3925
Basin 067
Stability Analysis

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

Shannon Mine No.2 Basin 067
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 5.000 2 500.000 .000

On boundary line no. 2 Point no. and coordinates are:
1 200.000 5.000 2 317.436 3.826

On boundary line no. 3 Point no. and coordinates are:
1 .000 7.000 2 200.000 5.000 3 243.750 22.500

On boundary line no. 4 Point no. and coordinates are:
1 .000 22.500 2 243.750 22.500 3 251.250 25.500 4 263.250 25.500 5 304.364 9.054
6 317.436 3.826 7 500.000 2.000

Line no. and slope of each segment are:
1 -.010
2 -.010
3 -.010 .400
4 .000 .400 .000 -.400 -.400 -.010

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

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

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

Soil no.	Cohesion	F. angle	Unit wt.
1	100.800	29.700	129.500
2	187.200	30.500	129.400
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	22.500	2	243.750	22.500	3	267.494
17.645	4	304.364	9.054	5	317.436	3.826	
6	500.000	2.000					

point1=(264.000, 47.000) point2=(264.000, 27.000) point3=(318.000, 27.000) NJ= 2 NI= 2

Automatic search will follow after grid with XINC= 10.000 and YINC= 10.000

At point (264.000, 47.000) under seepage 1,the radius and the corresponding factor of safety are:

44.638	6.616	40.013	7.146	35.388	7.407
30.763	7.842	26.138	9.096		

Lowest factor of safety= 6.616 and occurs at radius = 44.638

At point (264.000, 37.000) under seepage 1,the radius and the corresponding factor of safety are:

34.638	6.618	30.015	7.003	25.393	6.884
20.770	7.006	16.147	8.408		
28.475	6.947	26.934	6.958	23.852	6.849
22.311	6.919				

Lowest factor of safety= 6.618 and occurs at radius = 34.638

At point (264.000, 27.000) under seepage 1,the radius and the corresponding factor of safety are:

24.639	7.221	20.045	7.259	15.452	7.221
10.858	8.075	6.265	9.430		
18.514	7.201	16.983	7.154	13.921	7.488
12.389	7.631				

Lowest factor of safety= 7.154 and occurs at radius = 16.983

At point (291.000, 47.000) under seepage 1,the radius and the corresponding factor of safety are:

44.908	1.858	41.980	2.061	39.052	2.229
36.124	2.637	33.196	3.729		

Lowest factor of safety= 1.858 and occurs at radius = 44.908

At point (291.000, 37.000) under seepage 1,the radius and the corresponding factor of safety are:

34.908	1.883	32.123	2.110	29.338	2.316
26.554	2.768	23.769	3.936		

Lowest factor of safety= 1.883 and occurs at radius = 34.908

At point (291.000, 27.000) under seepage 1,the radius and the corresponding factor of safety are:

24.909	2.108	22.267	2.398	19.625	2.606
16.983	3.063	14.341	4.309		

Lowest factor of safety= 2.108 and occurs at radius = 24.909

At point (318.000, 47.000) under seepage 1,the radius and the corresponding factor of safety are:

45.178 2.294 44.201 2.530 43.225 3.036 42.249 4.032 41.273 7.067

Lowest factor of safety= 2.294 and occurs at radius = 45.178

At point (318.000, 37.000) under seepage 1,the radius and the corresponding factor of safety are:

35.178 2.508 34.345 2.769 33.511 3.305 32.678 4.451 31.845 7.922

Lowest factor of safety= 2.508 and occurs at radius = 35.178

At point (318.000, 27.000) under seepage 1,the radius and the corresponding factor of safety are:

25.179 2.858 24.488 3.168 23.798 3.778 23.107 5.131 22.417 9.305

Lowest factor of safety= 2.858 and occurs at radius = 25.179

For piezometric line No. 1

At point (291.000, 47.000) ,RADIUS 44.908
the minimum factor of safety is 1.858

At point (291.000, 47.000) under seepage 1,the radius and the corresponding factor of safety are:

44.908 1.858 41.980 2.061 39.052 2.229 36.124 2.637 33.196 3.729

Lowest factor of safety= 1.858 and occurs at radius = 44.908

At point (301.000, 47.000) under seepage 1,the radius and the corresponding factor of safety are:

45.008 1.659 42.803 1.964 40.598 2.225 38.393 2.772 36.188 4.326

Lowest factor of safety= 1.659 and occurs at radius = 45.008

At point (311.000, 47.000) under seepage 1,the radius and the corresponding factor of safety are:

45.108 1.783 43.625 1.959 42.143 2.482 40.661 3.195 39.179 5.332

Lowest factor of safety= 1.783 and occurs at radius = 45.108

At point (301.000, 57.000) under seepage 1,the radius and the corresponding factor of safety are:
55.007 1.651 52.659 1.920 50.311 2.160 47.963 2.701 45.615 4.124
Lowest factor of safety= 1.651 and occurs at radius = 55.007

At point (301.000, 67.000) under seepage 1,the radius and the corresponding factor of safety are:
65.007 1.687 62.516 1.948 60.025 2.160 57.534 2.640 55.043 3.955
Lowest factor of safety= 1.687 and occurs at radius = 65.007

At point (311.000, 57.000) under seepage 1,the radius and the corresponding factor of safety are:
55.107 1.750 53.482 1.932 51.857 2.392 50.232 3.075 48.606 5.091
Lowest factor of safety= 1.750 and occurs at radius = 55.107

At point (291.000, 57.000) under seepage 1,the radius and the corresponding factor of safety are:
54.907 1.901 51.836 2.107 48.766 2.282 45.695 2.655 42.624 3.555
Lowest factor of safety= 1.901 and occurs at radius = 54.907

At point (303.500, 57.000) under seepage 1,the radius and the corresponding factor of safety are:
55.032 1.625 52.865 1.929 50.698 2.196 48.530 2.759 46.363 4.322
Lowest factor of safety= 1.625 and occurs at radius = 55.032

At point (306.000, 57.000) under seepage 1,the radius and the corresponding factor of safety are:
55.057 1.638 53.071 1.944 51.084 2.244 49.097 2.839 47.111 4.555
Lowest factor of safety= 1.638 and occurs at radius = 55.057

At point (303.500, 59.500) under seepage 1,the radius and the corresponding factor of safety are:
57.532 1.628 55.329 1.922 53.126 2.181 50.923 2.744 48.720 4.271
Lowest factor of safety= 1.628 and occurs at radius = 57.532

At point (303.500, 54.500) under seepage 1,the radius and the corresponding factor of safety are:
52.532 1.626 50.401 1.941 48.269 2.210 46.138 2.776 44.006 4.374

Lowest factor of safety= 1.626 and occurs at radius =
52.532

For piezometric line No. 1

At point (303.500, 57.000) ,RADIUS 55.032
the minimum factor of safety is 1.625
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 boundarylines. * indicates failure surface.
The minimum factor of safety is 1.625