

**CARBON OAK, INC.
THUNDER OAKS MINE, P-3976**

**DIVERSION DITCH No. 1
DRAINAGE CONTROL BERM
DIVERSION DITCH No. 2
CULVERT C-1
DIVERSION DITCH No. 3**

DETAILED DESIGN PLANS

Submitted by:
TASK Engineering Management Inc.
P. O. Box 660548
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TASK ENGINEERING MANAGEMENT INC.

PO Box 660548
BIRMINGHAM, ALABAMA 35266
(205) 978-5070

March 23, 2014

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

Re: Carbon Oak, Inc.
Thunder Oaks Mine - P-3976

Dear Mr. Heaton:

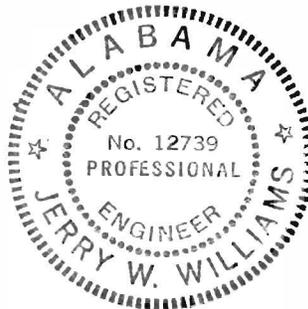
I hereby certify the enclosed detailed design plans for Diversion No. 1, Diversion No. 2 and Drainage Control Berm, Culvert C-1 and Diversion No. 3 for the above referenced mine are in accordance with the Regulations of the Alabama Surface Mining Commission as adopted by Act 81-435 of December 18, 1981 and as amended to date and that the information used in the enclosed diversion berm 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 call us at (205) 978-5070 or email us at jw-task@charter.net.

Sincerely,



Jerry W. Williams, P.E.
Alabama Reg. No. 12739



INTRODUCTION

For Thunder Oaks Mine, P-3976, drainage control during the mining of Increments No. 1 and No. 2 will be accomplished by the construction of a drainage control berm, three (3) drainage diversion ditches and two (2) sedimentation basins. Drainage to the north of Dekalb County Road 683 will be conveyed to Sediment Basin 001 via natural existing drainage channels and drainage to the south of Dekalb 683 will be convey via the following proposed drainage control berm and drainage ditch.

Presently within the reclaimed area of previous mining operations in the NE/SW of Section 3, there are two (2) existing ponds left from these operations labeled Pond #1 and Pond #2 as shown on the map entitled [Drainage Diversions - Plan/Profile](#). Both ponds are incised and are approximately forty (40') feet deep and were left at the request of the landowner during reclamation operations. Diversion No. 1 will be constructed to convey drainage from the northwest area of the NE/SW of Section 3 where a topsoil storage area is proposed into the existing drainage channel and hence into Pond #2. Diversion No. 1 will extend from Station 0+00 to Station 3+15.15 where it will intersect with the existing drainage channel.

Presently drainage flows to the northeast from Pond #1 to Pond #2 and then discharges from Pond #2 to the south into the existing drainage channel of an unnamed tributary of Bengis Creek. At the point of entry to the drainage channel there exists a wetland area present on both sides of the tributary extending due east then south/southeasterly to where the tributary is conveyed under Dekalb County Road 681 via two (2) forty-two (42") inch bituminous coated corrugated drainage culverts. As part of the Compensatory Mitigation Plan with the Army Corp of Engineers (ACOE), these wetland areas will be avoided and left intact per the mining plan of operations at the site. This will be accomplished by the construction of a diversion berm and the construction of a riprap lined diversion ditch that will convey and isolate the drainage from the proposed mining operations to Sediment Basin 009 due south of Dekalb County 681 in the SW/SE of Section 3. To minimize the impact to the existing drainage channel of the unnamed tributary a new drainage culvert will be installed under Dekalb 681 to convey flow from the proposed mining operations to Sediment Basin 009.

The diversion berm and diversion ditch are labeled Diversion No. 2 on the map entitled [Drainage Diversions - Plan/Profile](#) and along with Basins 001 and 009 will be designed, approved, constructed and certified to the Regulatory Authority prior to any active mining within Increments No. 1 and No. 2 of the Thunder Oaks Permit.

The Drainage Control Berm will be constructed by first re-establishing the outflow from Pond #1 to the natural stream channel of the unnamed tributary due east of the embankment of Pond #1 and tying the berm to existing ground between Pond #1 and Pond #2. The berm commences at natural ground level in the NE/SW of Section 3 at Station 0+04.56 and will be constructed on top of the existing embankment of Pond #2, will cut-off the flow of the existing outlet channel to the

south from the pond and will channel the pond discharge into the constructed rip-rap lined diversion ditch at Station 3+64.79. From this point the diversion will flow along the proposed permit boundary in the NW/SE into SW/SE of Section 3, will tie into the existing road embankment of Dekalb Road 681 at Station 17+28.65, under the roadway via the proposed drainage culvert and into Basin 009. (See the attached [Drainage Diversions Plan/Profile](#) for the location/orientation of the drainage berm structure.)

This configuration will remain until completion of mining in Increments No. 1 and No. 2. Upon activation of Increment No. 3 and prior to any mining operations, Basin 008 will be designed, approved, constructed and certified to the Regulatory Authority prior to any active mining within Increment No. 3 of the Thunder Oaks Permit and Basin 009 will be pumped dry and a new drainage channel will be constructed by placing spoil material within the storage area of Basin 009 and lining the channel with 1.0 foot of clay and certified as reconstructed to the Regulatory Authority. Diversion No. 2 and the corresponding drainage culvert will remain as permanent fixtures to isolate the existing wetland area.

CONSTRUCTION AND CERTIFICATION REQUIREMENTS

Due to low inherent surface slopes at the Thunder Oaks mine site, the Drainage Control Berm and Sedimentation Basins 001P and 009P will be constructed prior to any surface coal mining operations are commenced. These facilities will allow for the protection of the existing wetland areas from the proposed surface coal mining operations and will insure that all drainage resulting from natural flows and storm water will be routed through approved sedimentation basins for treatment prior to discharge into Bengis Creek.

The Drainage Control Berm will be built, stabilized and certified in five hundred (500') foot sections and the previously referenced Sedimentation Basins 001P and 009P will be built and certified to the Regulatory Authority prior to any mining disturbance within their corresponding watersheds.

The Drainage Control Berm will be constructed of the best non-toxic, non-acid material resulting from the excavation of the proposed incised sedimentation Basin 009 and compacted to 95%, based on standard proctor as outlined by ASTM. The construction materials will be free of sod, stones, roots, limbs, etc. over six (6") inches in diameter and spread in layers no greater than twelve (12") inches in thickness.

The foundation area of the berm structure will be cleared and grubbed of all organic matter such as tree and large bushes prior to construction and will be constructed at a maximum height of seven (7') feet above existing ground, will be ten (10') in width at the top and the sides will be

sloped at two (2') feet horizontal to one (1') foot vertical. (See the attached [Typical Drainage Control Berm Section](#) for a typical details of the drainage berm structure and see the attached [Drainage Diversions - Plan/Profile, Cross-Sections 0+04.56 to 12+50 and Cross-Sections 13+00 to 17+00](#) for the general plan view, top of berm and ground profiles and cross-sections showing ground elevation and top of berm elevations at the centerline of the proposed Drainage Control Berm.)

All areas disturbed in the construction of the berm structure will be seeded with a mixture of perennial and annual grasses, fertilized and mulched to prevent erosion and ensure restabilization. Silt fence will be installed where toe of the slope of the berm structure intersects natural ground. (See the attached [Silt Fence Detail and Silt Fence Specifications](#)).

The Drainage Control Berm will be constructed, stabilized and certified in intervals of five hundred (500') feet. Inspections will be conducted regularly during construction of the berm structure by a qualified registered engineer or other qualified person under the direction of a professional engineer. Upon completion of construction, the interval will be certified, by a qualified Registered Professional Engineer, to the Regulatory Authority as being constructed in accordance with the approved Detailed Design Plans.

**DIVERSION DITCH AND DIVERSION BERM
DESIGN AND CONSTRUCTION SPECIFICATIONS**

- 1) Temporary diversions will be designed and constructed to adequately carry the runoff from a two (2) year - six (6) hour precipitation event.
- 2) Permanent diversions will be designed and constructed to adequately carry the runoff from a ten (10) year - six (6) hour precipitation event.
- 3) Permanent diversions will be designed and constructed with gently sloping banks stabilized with appropriate vegetation.
- 4) All diversions will be designed, constructed and maintained, using the best technology currently available, whereas additional contribution of suspended solids to stream-flow and to runoff outside the permit area is prevented.
- 5) Maintenance of appropriate gradient, channel lining, revegetation, roughness structures, detention basins, etc. will be used, when necessary, as sediment control measures for these diversions.
- 6) Diversions will not be constructed on existing landslides nor be located so as to increase the potential for landslides.
- 7) Temporary diversions will be removed and the affected area regraded, topsoiled (if required) and revegetated in accordance with Rules 880-X-10C-.10, 880-X-10C-.11, 880-X-10C-.52 thru 880-X-10C-.57 and 880-X-10C-.58, 880-X-10C-.60 and 880-X-10C-.62, when no longer needed.
- 8) Channel linings, for diversions with slopes of three (3%) percent or less, will consist of a mixture of both annual and perennial grasses being predominantly fescue and bermuda. Channel linings, for diversions with slopes greater than three (3%) percent, will consist of rip-rap or other non-erodible material or cut into non-erodible material.
- 9) Adequate freeboard will be provided for protection for transition of flows and critical areas such as swales and curves along the entire diversion length.
- 10) At discharge points where diversions intersect with natural streams or exit velocities of the diversion are greater than that of the receiving streams, energy dissipaters will be installed when deemed necessary.
- 11) Topsoil removed from the diversion area (if required) will be handled in accordance with Rules 880-X-10C-.07 thru 880-X-10C-.11.
- 12) Excess material excavated in the construction of the diversion, not needed for diversion channel geometry or the regrading of the channel, will be disposed of in accordance with Rule 880-X-10C-.36.
- 13) Diversions will not be designed or constructed to divert water into underground mines without written approval from the Regulatory Authority.

- 14) The entire area in which a diversion berm is proposed will be cleared and grubbed of all organic material, scarified and no surface slopes will be left steeper than one (1) Vertical to one (1) Horizontal.
- 15) Diversion berms will be constructed with desirable material, free of sod, stones, roots, limbs, etc. over six (6) inches in diameter. This material will be spread in layers no greater than twelve (12) inches in thickness and compacted to ninety-five (95%) percent of the standard proctor density, as outlined in ASTM, until the design height is reached.
- 16) Upon completion of diversion ditches or diversion berms, all disturbed areas will be seeded with a mixture of both annual and perennial grasses, fertilized and mulched in order to minimize erosion and ensure restabilization.
- 17) All diversions (berms or ditches) will be examined quarterly for erosion, instability, structural weakness or other hazardous conditions and maintenance performed as necessary.
- 18) The diversion will be constructed and stabilized in 500 foot sections.

REMOVAL PLAN FOR DRAINAGE CONTROL BERM

Berms associated with Diversion Ditches No. 1, and No. 3 will be removed after a Phase II bond release for the area draining to the diversions.

Prior to removal, silt fences will be installed along the outside edge of the berm to control runoff from the area disturbed. See Silt Fence Design and Construction Specifications and drawings for silt fence placement.

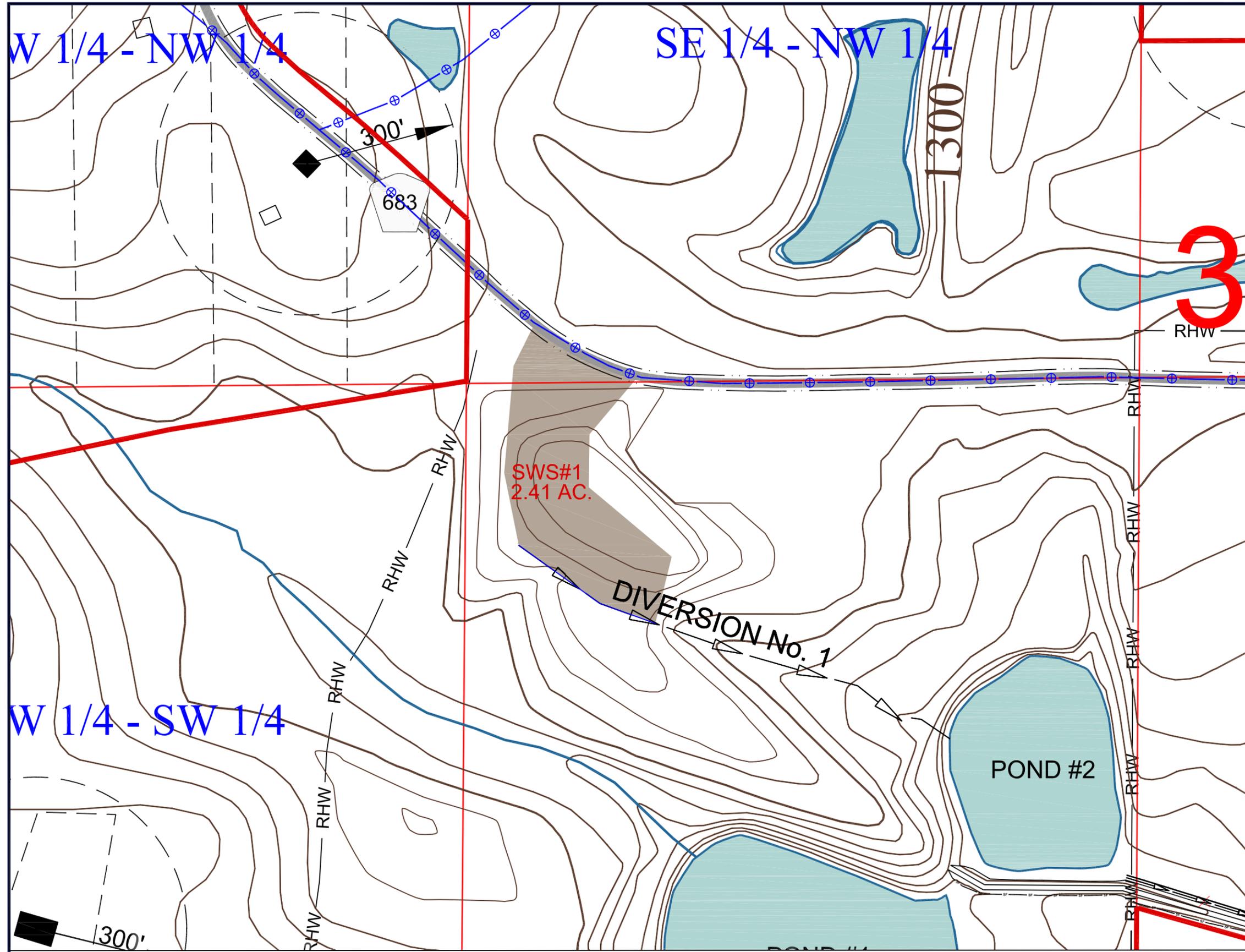
The berm will be removed by grading the material into the adjacent permit area that has been surface mined. The area will be sloped to comply with Part IV of the permit. As soon as grading is complete, the area will be scarified, seeded and mulched in accordance with the approved Part IV of the permit.

Diversion No. 2 is to be permanent to isolate the existing wetland areas to the south of the berm structure and will not be removed.

**DETAILED DESIGN PLANS
DIVERSION DITCH No.1**

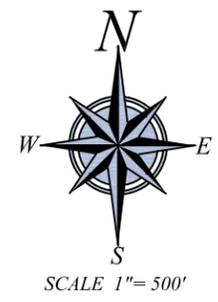
Submitted by:

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WATERSHED DRAINAGE AREA LEGEND

- PERMIT BOUNDARY
- PREVIOUSLY SURFACE MINED
- GRADED & BARE, CN 81
- MINED, REVEG. 0-2 MONTHS, CN 79
- MINED, REVEG. 2-12 MONTHS, CN 94
- MOSTLY FOREST, GOOD COVER, CN 71
- OPEN SPACES, PASTURE LAND, RESIDENTIAL & FARM OUTBUILDINGS, CN 75
- FORESTED WETLAND, CN 91
- TILLED CROPLAND, CN 74
- PONDS/SEDIMENT BASINS, CN 100



LEGEND

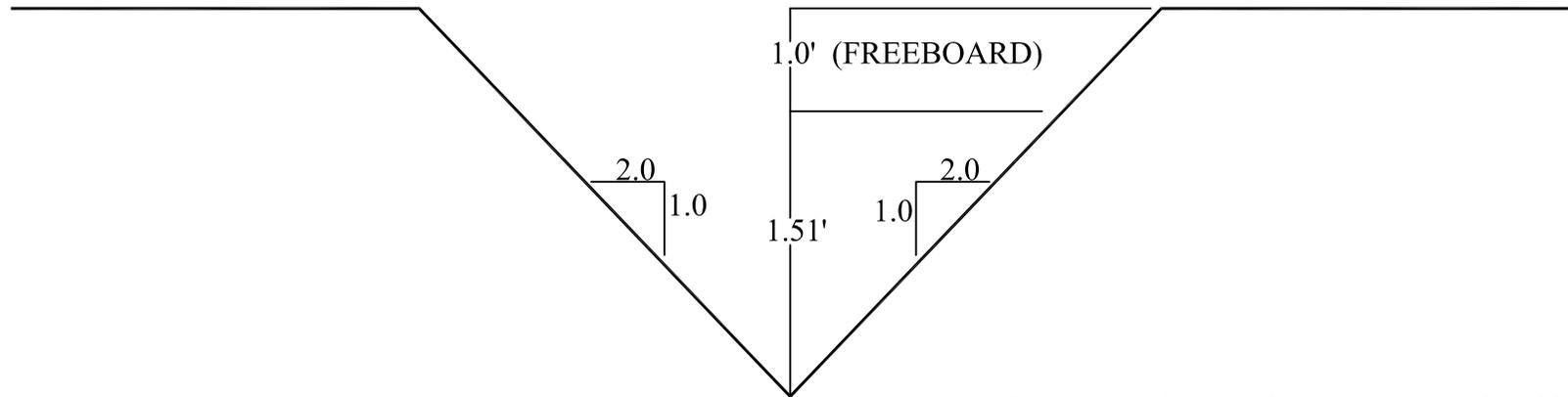
- DRAINAGE DIVIDE
- ROADSIDE DITCH
- DIVERSION DITCH
- BASIN 001 SEDIMENT BASIN/OUTFALL
- WATER IMPOUNDMENT

**CARBON OAK, INC.
THUNDER OAKS MINE**

WATERSHED MAP
SCALE: 1" = 200'
CONTOUR INTERVAL: 5 FT.

DIVERSION No. 1

DIVERSION No. 1
VEGETATED CHANNEL
TRIANGULAR CROSS-SECTION



Design Discharge: 2.54 cfs
Limiting Velocity: 7.0 fps

1.51% Slope

CHANNEL TO BE VEGETATED WITH GRASS
MIXTURE, PREDOMINATELY BERMUDA AND FESCUE.

	STABILITY	CAPACITY
Depth:	0.92 ft.	1.51 ft.
Depth w/ Freeboard:	1.92 ft.	2.51 ft.
Top Width:	3.68 ft.	6.04 ft.
Top Width w/ Freeboard:	7.68 ft.	10.04 ft.
VELOCITY:	1.50 fps	0.56 fps
X-SECTION AREA:	1.70 sq. ft.	4.56 sq. ft.
HYDRAULIC RADIUS:	0.412	0.675
FROUDE NUMBER:	0.39	0.11
ROUGHNESS COEFFICIENT:	0.0676	0.2529

TASK EMI
CONSULTING ENGINEERS

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Carbon Oak, Inc.
Thunder Oaks Mine
Diversion No. 1

SCS - 6 HR
2 Year-6 Hour Event, 2.63 In.

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General Information

Storm Information:

Storm Type:	SCS-6 HOUR
Design Storm:	2 yr - 6 hr
Rainfall Depth:	2.630 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	DIVERSION No. 1 - GRASS LINED CHANNEL

#1 Chan1

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	2.410	2.410	2.54	0.21

Structure Detail:

Structure #1 (Vegetated Channel)

DIVERSION No. 1 - GRASS LINED CHANNEL

Triangular Vegetated Channel Inputs:

Material: Tall fescue

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	1.5	D, B	1.00			7.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	2.54 cfs		2.54 cfs	
Depth:	0.92 ft	1.92 ft	1.51 ft	2.51 ft
Top Width:	3.68 ft	7.68 ft	6.04 ft	10.04 ft
Velocity:	1.50 fps		0.56 fps	
X-Section Area:	1.70 sq ft		4.56 sq ft	
Hydraulic Radius:	0.412 ft		0.675 ft	
Froude Number:	0.39		0.11	
Roughness Coefficient:	0.0676		0.2529	

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	2.410	0.098	0.000	0.000	81.000	F	2.54	0.208
	Σ	2.410						2.54	0.208

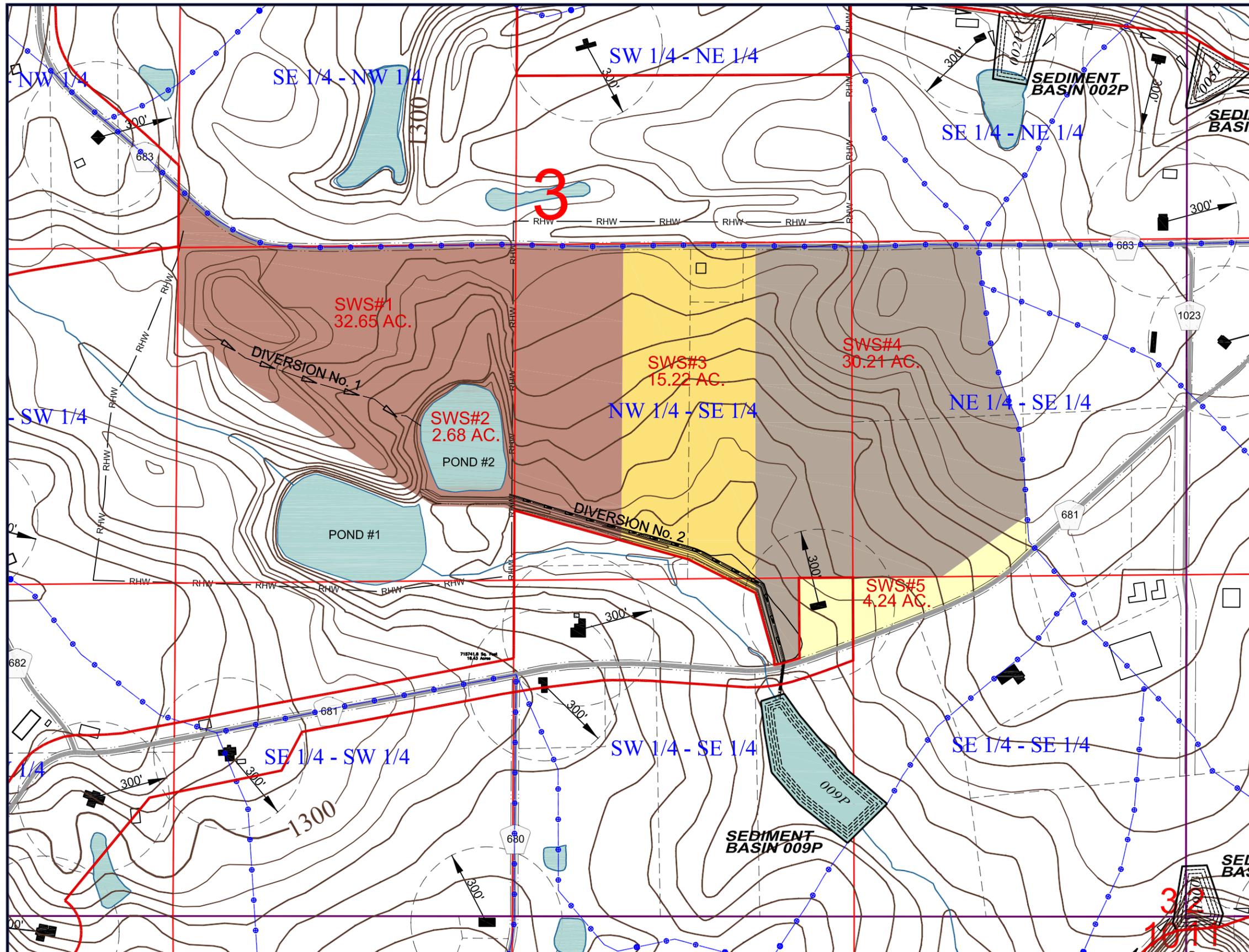
Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	2.17	8.64	397.38	1.470	0.075
		8. Large gullies, diversions, and low flowing streams	1.51	4.77	315.16	3.690	0.023
#1	1	Time of Concentration:					0.098

**DETAILED DESIGN PLANS
DIVERSION DITCH No.2
DRAINAGE CONTROL BERM**

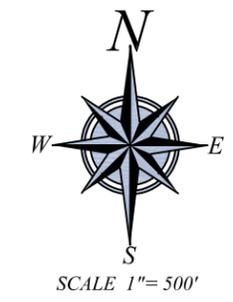
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WATERSHED DRAINAGE AREA LEGEND

- PERMIT BOUNDARY
- PREVIOUSLY SURFACE MINED
- GRADED & BARE, CN 81
- MINED, REVEG. 0-2 MONTHS, CN 79
- MINED, REVEG. 2-12 MONTHS, CN 74
- MOSTLY FOREST, GOOD COVER, CN 71
- OPEN SPACES, PASTURE LAND, RESIDENTIAL & FARM OUTBUILDINGS, CN 75
- FORESTED WETLAND, CN 91
- TILLED CROPLAND, CN 74
- PONDS/SEDIMENT BASINS, CN 100



LEGEND

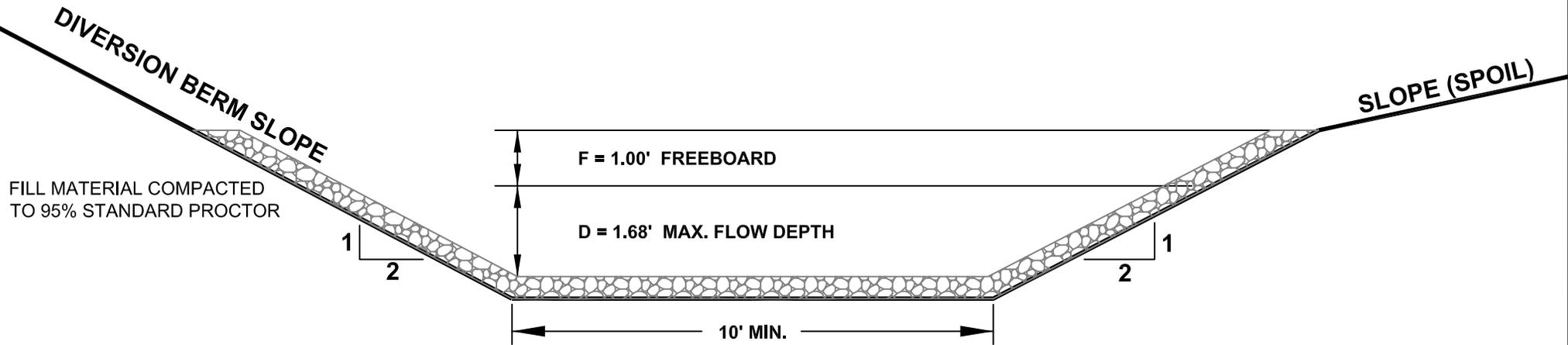
- DRAINAGE DIVIDE
- ROADSIDE DITCH
- DIVERSION DITCH
- SEDIMENT BASIN/OUTFALL
- WATER IMPOUNDMENT

**CARBON OAK, INC.
THUNDER OAKS MINE**

WATERSHED MAP
SCALE: 1" = 400'
CONTOUR INTERVAL: 5 FT.

DIVERSION No. 2

DIVERSION DITCH No. 2
TYPICAL CROSS-SECTION
TRAPEZOIDAL CONFIGURATION
RIP-RAP LINED
NTS



SEDCAD OUTPUT PARAMETERS

DISCHARGE:	105.20 cfs (max)
CHANNEL SLOPE:	0.88%
	w/o FREEBOARD
CHANNEL TOP WIDTH (W):	16.70 ft
FLOW DEPTH (D):	1.68 ft
VELOCITY:	4.70 ft
X-SECTION AREA:	22.36 fps
HYDRAULIC RADIUS:	1.279 ft
FROUDE NUMBER:	0.72
MANNING'S N:	0.0350
Dmin:	2.00 in
D50:	3.00 in
Dmax:	4.50 in
	w/ FREEBOARD
CHANNEL TOP WIDTH (W):	20.70 ft
FLOW DEPTH (D):	2.68 ft

GENERAL SPECIFICATIONS

DIVERSION/BERM PROTECTIVE LINER: RIP-RAP.	
FLOW LIMITED BY MAXIMUM ALLOWABLE VELOCITY (5.0 FPS)	
STORM TYPE:	SCS 6 HOUR
DESIGN STORM:	10 yr - 6 hr
RAINFALL DEPTH:	3.670 inches



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Carbon Oak, Inc.
Thunder Oaks Mine
Diversion No. 2

SCS - 6 HR

10 Year-6 Hour Event, 3.67 In.

Jerry W. Williams, P.E.

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Phone: 205-978-5070
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General Information

Storm Information:

Storm Type:	SCS-6 HOUR
Design Storm:	10 yr - 6 hr
Rainfall Depth:	3.670 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	DIVERSION No. 2 - RIPRAP CHANNEL

#1 Chan1

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	85.000	85.000	105.20	11.19

Structure Detail:

Structure #1 (Riprap Channel)

DIVERSION No. 2 - RIPRAP CHANNEL

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
10.00	2.0:1	2.0:1	0.9	1.00		

Riprap Channel Results:

PADER Method - Mild Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	105.20 cfs	
Depth:	1.68 ft	2.68 ft
Top Width:	16.70 ft	20.70 ft
Velocity:	4.70 fps	
X-Section Area:	22.36 sq ft	
Hydraulic Radius:	1.279 ft	
Froude Number:	0.72	
Manning's n:	0.0350	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

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	32.650	0.066	0.150	0.365	74.000	M	44.31	3.696
	2	2.680	0.010	0.148	0.307	100.000	F	9.42	0.819
	3	15.220	0.145	0.028	0.330	79.000	M	15.82	1.751
	4	30.210	0.244	0.000	0.000	81.000	F	41.24	4.423
	5	4.240	0.103	0.000	0.000	75.000	S	6.11	0.503
	Σ	85.000						105.20	11.192

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	3.42	12.09	353.58	1.470	0.066
#1	1	Time of Concentration:					0.066
#1	3	3. Short grass pasture	2.99	8.92	298.46	1.380	0.060
		8. Large gullies, diversions, and low flowing streams	2.39	34.30	1,433.14	4.640	0.085
#1	3	Time of Concentration:					0.145
#1	4	5. Nearly bare and untilled, and alluvial valley fans	0.89	4.14	467.61	0.940	0.138
		8. Large gullies, diversions, and low flowing streams	3.07	61.90	2,018.01	5.250	0.106
#1	4	Time of Concentration:					0.244
#1	5	3. Short grass pasture	4.24	17.01	400.76	1.640	0.067
		8. Large gullies, diversions, and low flowing streams	3.58	26.40	736.50	5.670	0.036
#1	5	Time of Concentration:					0.103

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	0.82	11.84	1,444.47	2.710	0.148
#1	2	Muskingum K:					0.148
#1	3	8. Large gullies, diversions, and low flowing streams	1.21	4.13	342.27	3.290	0.028
#1	3	Muskingum K:					0.028

**DETAILED DESIGN PLANS
CULVERT C-1**

Submitted by:

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INTRODUCTION

Culvert C-1 is proposed to convey the drainage from Diversion No. 1 and Diversion No. 2 under Dekalb County Road 681. Peak flow was determined to be 105.20 cfs in Diversion No. 2 and Culvert C-1 is designed to handle this flow. C-1 was sized using Carlson Hydrology Module for pipe culvert design. The output showed a 54" circular corrugated metal pipe would handle the peak flow but due to elevation constraints a CONTECH Ultra-Flow Pipe Arch would be equivalent with dimensions of 43" X 64" and would allow for the low cover under Dekalb 681. The following design and specifications support this design.

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Design Parameters

Section

Shape:	Circular
Material:	CONTECH Ultra-Flow
Diameter:	54.00 in Equivalent (43" X 64" PIPE ARCH)*
Manning's n:	0.0120
Number of Barrels:	1

Inlet

Inlet Type:	Mitered to Slope
Ke:	0.70

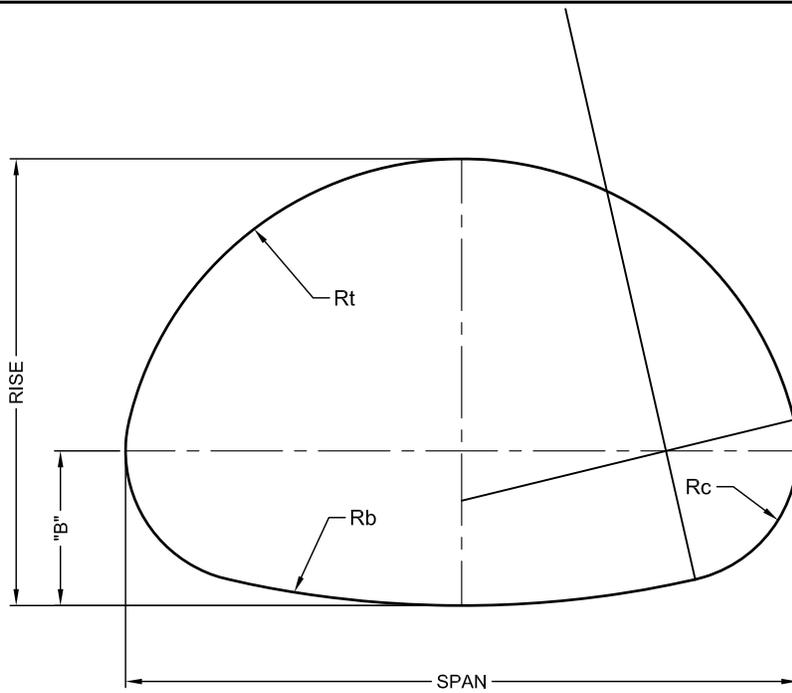
Inverts

Inlet Invert Elevation:	1255.660 ft
Outlet Invert Elevation:	1254.510 ft
Length:	115.000 ft
Slope:	1.00 %

Culvert Calculation

Discharge:	106.34 cfs
Headwater Elevation:	1259.720 ft
Tailwater Elevation:	1256.510 ft
Downstream Velocity:	13.41 ft/s
Downstream Flow Depth:	2.245 ft
Flow Control Type:	Inlet Control, Unsubmerged

*SEE FOLLOWING DETAILS



* NOTE:
 "B" DIMENSION IS MEASURED FROM THE SPRINGLINE
 (THE WIDEST PORTION OF THE PIPE-ARCH) TO
 THE LOWEST PORTION OF THE INVERT.

2 2/3"X1/2" PIPE ARCH DIMENSIONS							
EQUIVALENT DIAMETER (IN)	SPAN (IN)	RISE (IN)	WATERWAY AREA SQ.FT.	LAYOUT DIMENSIONS			
				B	Rc	Rt	Rb
15	17	13	1.1	4 1/8	3 1/2	8 5/8	25 5/8
18	21	15	1.6	4 7/8	4 1/8	10 3/4	33 1/8
21	24	18	2.2	5 5/8	4 7/8	11 7/8	34 5/8
24	28	20	2.9	6 1/2	5 1/2	14	42 1/4
30	35	24	4.5	8 1/8	6 7/8	17 7/8	55 1/8
36	42	29	6.5	9 3/4	8 1/4	21 1/2	66 1/8
42	49	33	8.9	11 3/8	9 5/8	25 1/8	77 1/4
48	57	38	11.6	13	11	28 5/8	88 1/4
54	64	43	14.7	14 5/8	12 3/8	32 1/4	99 1/4
60	71	47	18.1	16 1/4	13 3/4	35 3/4	110 1/4
66	77	52	21.9	17 7/8	15 1/8	39 3/8	121 1/4
72	83	57	26.0	19 1/2	16 1/2	43	132 1/4

DIMENSIONS SHOWN ARE NOT FOR SPECIFICATION PURPOSES AND ARE SUBJECT TO MANUFACTURING TOLERANCES.

CONTECH ID# 0000



9025 CENTRE POINTE DRIVE, SUITE 400
 WEST CHESTER, OHIO 45069
 PH: 1,800,338,1122 FAX: 513,645,7399

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SHEET TITLE
 CORRUGATED METAL PIPE
 PIPE-ARCH LAYOUT DETAIL
 2 2/3"X1/2" CORRUGATION

SCALE: SCALE
 DRAWN BY: JAP
 DATE: 02/26/09
 REV. BY: ---
 DATE: ---
 SHEET: ---
 PAGE

Corrugated Aluminum Pipe

Heights-of-Cover

2-2/3" X 1/2" Height-of-Cover Limits for Corrugated Aluminum Pipe

HL 93 Live Load



Diameter or Span (In.)	Minimum Cover (In.)	Maximum Cover, (Ft.) ⁽²⁾ Equiv. Standard Gage					8 ⁽⁵⁾
		18	16	14	12	10	
6 ⁽⁴⁾	12	197	247				
8 ⁽⁴⁾		147	185				
10 ⁽⁴⁾		119	148				
12			125	157			
15			100	125			
18			83	104			
21			71	89			
24			62	78	109		
27				69	97		
30				62	87		
36				51	73	94	
42					62	80	
48	12				54	70	85
54	15				48	62	76
60	15					52	64
66	18						52
72	18						43

2 2/3" x 1/2" Height-of-Cover Limits for Corrugated Aluminum Pipe-Arch

HL 93 Live Load



Round Pipe Dia. (Inches)	Size, (In.) Span x Rise	Minimum Gage	Minimum ⁽³⁾ Cover (Inches)	Maximum Cover, (Ft.) Aluminum Pipe-Arch ⁽²⁾ 2 Tons/Ft. ² for Corner Bearing Pressures
15	17x13	16	12	13
18	21x15	16	12	12
21	24x18	16	12	12
24	28x20	14	12	12
30	35x24	14	12	12
36	42x29	12	12	12
42	49x33	12	15	12
48	57x38	10	15	12
54	64x43	10	18	12
60	71x47	8 ⁽⁵⁾	18	12

Notes:

1. Height-of-cover is measured to top of rigid pavement or to bottom of flexible pavement.
2. Maximum cover meets AASHTO LRFD design criteria.
3. Minimum cover meets AASHTO and ASTM B 790 design criteria.
4. 1 1/2" x 1/4" corrugation.
5. 8-gage pipe has limited availability.
6. For construction loads, see page 15.

Heights-of-Cover

3" x 1" Height-of-Cover Limits for Corrugated Aluminum Pipe

HL 93 Live Load



Diameter or Span (In.)	Minimum ⁽³⁾ Cover (In.)	Maximum Cover, (Ft.) ⁽²⁾ Equiv. Standard Gage					8 ⁽⁶⁾
		16	14	12	10		
30	12	57	72	101	135	159	
36		47	60	84	112	132	
42		40	51	72	96	113	
48	12	35	44	62	84	99	
54	15	31	39	55	74	88	
60	15	28	35	50	67	79	
66	18	25	32	45	61	72	
72	18	23	29	41	56	66	
78	21		27	38	51	61	
84	21			35	48	56	
90	24			33	44	52	
96	24			31	41	49	
102	24				39	46	
108	24				37	43	
114	24					39	
120	24					36	

3" x 1" Height-of-Cover Limits for Corrugated Aluminum Pipe-Arch

HL 93 Live Load



Round Pipe Dia. (Inches)	Size, (In.) Span x Rise	Minimum Gage	Minimum ⁽³⁾ Cover (Inches)	Maximum Cover, (Ft.) Aluminum Pipe-Arch ⁽²⁾ 2 Tons/Ft. ² for Corner Bearing Pressures
54	60x46	14	15	20
60	66x51	14	18	20
66	73x55	14	21	20
72	81x59	12	21	16
78 ⁽⁴⁾	87x63	12	24	16
84 ⁽⁴⁾	95x67	12	24	16
90 ⁽⁴⁾	103x71	10	24	16
96 ⁽⁴⁾	112x75	8 ⁽⁵⁾	24	16

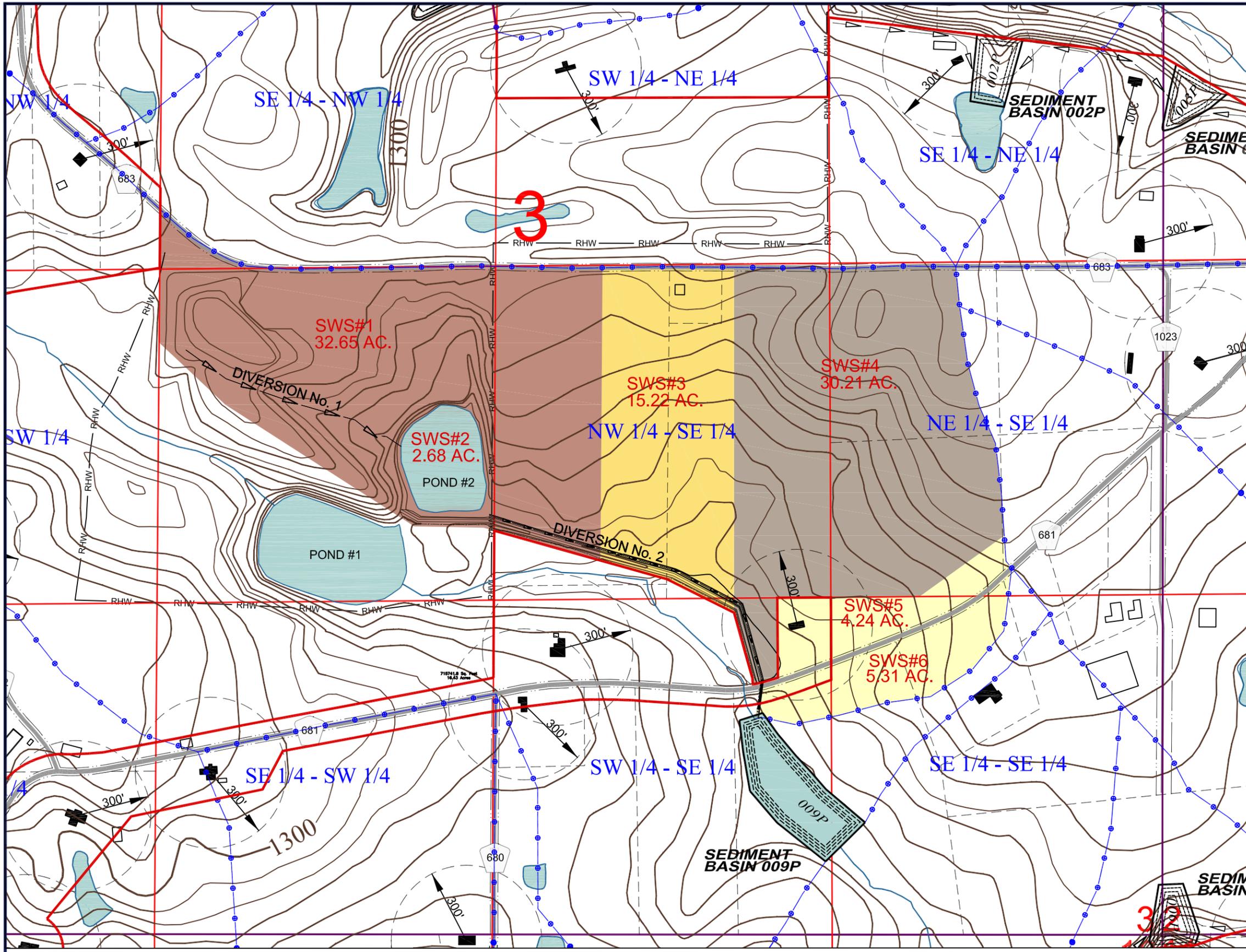
Notes:

1. Height-of-cover is measured to top of rigid pavement or to bottom of flexible pavement.
2. Maximum cover meets AASHTO LRFD design criteria.
3. Minimum cover meets ASTM B 790 design criteria.
4. Limited availability on these sizes.
5. 8-gage pipe has limited availability.
6. For construction loads, see page 15.

**DETAILED DESIGN PLANS
DIVERSION DITCH No.3**

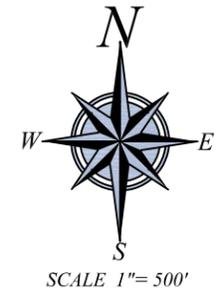
Submitted by:

TASK Engineering Management Inc.
P. O. Box 660548
Birmingham, Alabama 35266
Telephone: (205) 978-5070
Email: jw-task@charter.net



WATERSHED DRAINAGE AREA LEGEND

- PERMIT BOUNDARY
- PREVIOUSLY SURFACE MINED
- GRADED & BARE, CN 81
- MINED, REVEG. 0-2 MONTHS, CN 79
- MINED, REVEG. 2-12 MONTHS, CN 74
- MOSTLY FOREST, GOOD COVER, CN 71
- OPEN SPACES, PASTURE LAND, RESIDENTIAL & FARM OUTBUILDINGS, CN 75
- FORESTED WETLAND, CN 91
- TILLED CROPLAND, CN 74
- PONDS/SEDIMENT BASINS, CN 100



LEGEND

- DRAINAGE DIVIDE
- ROADSIDE DITCH
- DIVERSION DITCH
- SEDIMENT BASIN/OUTFALL
- WATER IMPOUNDMENT

CARBON OAK, INC.
THUNDER OAKS MINE
 WATERSHED MAP
 SCALE: 1" = 400'
 CONTOUR INTERVAL: 5 FT.
DIVERSION No. 3

Carbon Oak, Inc.
Thunder Oaks Mine
Diversion No. 3

SCS - 6 HR

10 Year-6 Hour Event, 3.67 In.

Jerry W. Williams, P.E.

TASK Engineering Management Inc.
P.O. Box 660548
Birmingham, Alabama 35226

Phone: 205-978-5070
Email: jw-task@charter.net

General Information

Storm Information:

Storm Type:	SCS-6 HOUR
Design Storm:	10 yr - 6 hr
Rainfall Depth:	3.670 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	DIVERSION No. 3 - RIPRAP CHANNEL

#1 Chan'

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	90.310	90.310	107.57	11.82

Structure Detail:

Structure #1 (Riprap Channel)

DIVERSION No. 3 - RIPRAP CHANNEL

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
10.00	2.0:1	2.0:1	1.0	1.00		

Riprap Channel Results:

PADER Method - Mild Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	107.57 cfs	
Depth:	1.64 ft	2.64 ft
Top Width:	16.55 ft	20.55 ft
Velocity:	4.95 fps	
X-Section Area:	21.73 sq ft	
Hydraulic Radius:	1.254 ft	
Froude Number:	0.76	
Manning's n:	0.0350	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

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	32.650	0.066	0.150	0.365	74.000	M	44.31	3.696
	2	2.680	0.010	0.148	0.307	100.000	F	9.42	0.819
	3	15.220	0.145	0.028	0.330	79.000	M	15.82	1.751
	4	30.210	0.244	0.000	0.000	81.000	F	41.24	4.423
	5	4.240	0.103	0.000	0.000	75.000	S	6.11	0.503
	6	5.310	0.107	0.000	0.000	75.000	S	7.66	0.629
	Σ	90.310						107.57	11.821

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	3.42	12.09	353.58	1.470	0.066
#1	1	Time of Concentration:					0.066
#1	3	3. Short grass pasture	2.99	8.92	298.46	1.380	0.060
		8. Large gullies, diversions, and low flowing streams	2.39	34.30	1,433.14	4.640	0.085
#1	3	Time of Concentration:					0.145
#1	4	5. Nearly bare and untilled, and alluvial valley fans	0.89	4.14	467.61	0.940	0.138
		8. Large gullies, diversions, and low flowing streams	3.07	61.90	2,018.01	5.250	0.106
#1	4	Time of Concentration:					0.244
#1	5	3. Short grass pasture	4.24	17.01	400.76	1.640	0.067
		8. Large gullies, diversions, and low flowing streams	3.58	26.40	736.50	5.670	0.036
#1	5	Time of Concentration:					0.103
#1	6	3. Short grass pasture	3.12	11.00	352.84	1.410	0.069
		8. Large gullies, diversions, and low flowing streams	3.58	28.32	790.42	5.670	0.038
#1	6	Time of Concentration:					0.107

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	0.82	11.84	1,444.47	2.710	0.148
#1	2	Muskingum K:					0.148
#1	3	8. Large gullies, diversions, and low flowing streams	1.21	4.13	342.27	3.290	0.028

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	3	Muskingum K:					0.028