POWERSOUTH®
ENERGY COOPERATIVE

Procedures for Compliance with Recordkeeping and Notification as Required Under 335-13-15-.08

In accordance with 335-13-15-.08, PowerSouth is required to maintain certain files in an electronic operating record for the Charles R. Lowman Power Plant (Lowman Plant). Unless specified otherwise, each file will be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record, or study. PowerSouth will submit, in writing, all notifications required by 335-13-15-.08(2)(e) through (i) to the Director before the close of business on the day the notification is required to be completed. Unless otherwise required in section 335-13-15-.08, the notifications specified in the section will be sent to the Director within 30 days of placing in the operating record the information required by 335-13-15-.08(1). In accordance with 335-13-15-.08(3), PowerSouth is required to maintain a publicly accessible internet site containing the information specified in 335-13-15-.08(3). Unless otherwise required in this section, the information required to be posted to the CCR web site will be made available to the public for at least five years following the date on which the information was first posted to the CCR web site. Unless otherwise specified by section 335-13-15-.08(3), the information will be posted to the CCR web site within 30 days of placing the pertinent information required by 335-13-15-.08(1) in the operating record.

Procedures for Updating All Plans and Assessments Periodically

Certain plans and assessments are required to be updated at specific intervals and/or upon certain modifications at the facility. If and when applicable, updates will be made to the respective plans and assessments and a notification will be placed in the facility operating record. The notification will also be placed on the publicly assessable internet web site and communicated in writing to the department in accordance with 335-13-15.

REV 3

CCR IMPOUNDMENT CLOSURE AND POST CLOSURE PLAN

B&V PROJECT NO. 404320
B&V FILE NO. 50.1000

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PREPARED FOR

PowerSouth Energy Cooperative

19 MARCH 2021

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Morgan, S. Lyle
2021.03.19 21:38:52-04'00'

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Table of Contents

1.0 Overview 1-1
1.1 Design Overview 1-1
2.0 Liner Design 2-1
2.1 Alternative Final Cover 2-1
2.1.1 Demonstration of Compliance 2-1
2.1.2 Veneer Slope Stability 2-2
2.1.3 Settlement 2-2
2.1.4 Construction 2-2
3.0 Grading and Drainage Drawings 3-1
4.0 Construction Quality Assurance Plan 4-1
5.0 Construction Schedule 5-1
6.0 Post Closure Plan 6-1
7.0 Calculations 7-1

Acronym and Definition List

ADEM	Alabama Department of Environmental Management
CCR	Coal Combustion Residual
FGD	Flue Gas Desulphurization
FS	Factor of Safety
One-Hundred year flood	A flood that has a one percent or greater chance of occurring in any given year
Impoundment	CCR surface impoundment that is a natural topographic depression or man-made excavation with earthen material dikes designed to hold an accumulation of wastes with free-liquids. The Unit 2/3 ash and FGD material are surface impoundments.
Run-Off	Any rainwater, leachate, or other liquid that drains over land from any part of the facility.
Run-On	Any rainwater, leachate, or other liquid that drains over land onto any part of the facility.
Twenty-four hour, Twenty-five year storm	The maximum 24 hour precipitation event with a probable return interval of twenty-five years.

1.0 Overview

The purpose of this document is to provide a comprehensive package of deliverables to PowerSouth for their use in applying for an Impoundment Closure permit with the Alabama Department of Environmental Management (ADEM).

1.1 Design Overview

The impoundment covers have been designed to fulfill the requirements of Alabama Administrative Code Chapter 335-13-15 and 40 C.F.R. Part 257, Subpart D, "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments." Section 335-13-15.07(3) (40 C.F.R. § 257.102) provides the requirements for closure or retrofit of CCR units. The Unit 2/3 Impoundment and the FGD Impoundment will be closed by leaving the CCR material in place. The Unit 2/3 Impoundment is approximately 28.19 acres in area with an estimated maximum CCR inventory of 1,206,760 cubic yards. The FGD Impoundment is approximately 34.42 acres in area with an estimated maximum CCR inventory of 1,298,047 cubic yards.

The requirements for the final cover system include:

1. Permeability of the final cover must be less than or equal to the permeability of any bottom liner or natural subsoils present, or a permeability no greater than 1 x 10^{-5} cm/sec, whichever is less.
2. Infiltration layer that includes a minimum of 18-inches of earthen material.
3. Final grades shall not be less than 5 percent.
4. Maximum final grade shall not exceed 25 percent.
5. Horizontal terraces at each 20 foot rise in elevation.
6. Erosion layer that contains a minimum of 6 inches of earthen material that is capable of sustaining native plant growth.

The owner may select an alternative final cover system that meets the design criteria. Any alternative cover must include.

1. An infiltration layer that achieves an equivalent reduction in infiltration.
2. An erosion layer that provides an equivalent protection from wind or water
3. Minimal disruption of the integrity of the liner with a design that accommodates settling and subsidence
4. A written certification from professional engineer that the design meets the regulatory requirements.

Following the last receipt of CCR waste within the Unit 1 portion of the multi-unit CCR treatment system, PowerSouth initiated excavation of the Unit 1 Impoundment on May 31, 2019. Removal of the CCR material from the Unit 1 Impoundment was undertaken in an effort to eliminate it as a potential source for future contaminant migration and to create additional buffer between the remaining portions of the multi-unit CCR treatment system and potential environmental receptors. The Unit 1 Impoundment CCR material was removed and placed within the Unit 2/3 and FGD Impoundments to consolidate CCR waste prior to final cap and closure operations. Prior to clean out, the maximum CCR inventory of the Unit 1 Impoundment was approximately 300,000 cubic yards. This volume is included in the estimated maximum CCR inventory for the Unit 2/3 and FGD Impoundments referenced above. The

Unit 1 Impoundment encompasses an area of approximately 15 acres. There is no CCR remaining in the Unit 1 Impoundment.

Consolidation of the Unit 1 portion of the multiunit CCR treatment system consisted of the follow activities:

- Pumping and conveyance of free and interstitial water from within the Unit 1 Impoundment into the Unit 2/3 impoundment.
- Excavation of CCR material, plus an additional 6 inches of soil below the CCR material and transporting to the existing Unit 2/3 and FGD Impoundments.
- Backfill Unit 1 Impoundment side slopes with clean fill from an onsite Dredge Spoil Pond. HydroSeed side slopes on interior of the Unit 1 Impoundment following placement of clean backfill.

Removal of the free and interstitial water within the Unit 1 Impoundment occurred in two stages. The first stage consisted of removal of “free” liquids within the impoundment using suction lifts pumps. Following removal of “free” liquids, all interstitial water within the Unit 1 footprint was removed via trenching and pumping, allowing the material to be moved to the Unit 2/3 and FGD Impoundments.

Removal of the CCR material was performed through direct excavation of the impoundment to the original design depth of approximately 10 feet MSL. Over-excavation of the impoundment to a depth of at least 6 inches below the observed boundary between the CCR waste and the underlying native soils was performed to remove any impacted soils to the maximum extent practicable.

Given the visually distinct physical characteristics of the CCR waste and the underlying soils, visual observation of the native material was performed by CDG Engineers and Associates, Inc. to confirm all visible CCR material was removed.

2.0 Liner Design

2.1 Alternative Final Cover

The final cover systems of the CCR impoundments were designed to meet the closure performance standards presented in ADEM Admin. Code r. 335-13-15.07(3) (40 C.F.R. § 257.102). The CCR rule requires the final cover system must have a permeability less than or equal to the bottom liner or natural subsoils present or have a permeability no greater than 1 x 10^{-5} cm/sec, whichever is less. Additionally, the final cover must have a minimum thickness of 18-inches of earthen material barrier layer to minimize infiltration and a minimum of 6-inches of earthen material capable of sustaining native vegetation.

A review of the impoundment construction documents show that a constructed bottom liner system was not installed at the base of the impoundments. The design drawings for the Unit 2/3 Impoundment and FGD Impoundment, prepared by Burns and McDonnell in 1976, shows the impoundments were excavated to Elevation 13.0 and then brought up to Elevation 15.0 with "Compacted Type A Embankment" material. Since there is no bottom liner, there are no permeability requirements for the overexcavated and compacted material. The permeability of the natural subsoils has been thoroughly evaluated in several subsurface studies and the permeability is estimated between 1.7 x 10^{-4} to 6.0 x 10^{-5} cm/sec. The regulations require the final cover to be 18-inches of earthen material with a permeability less than or equal to 1 x 10^{-5} cm/sec with a 6-inch thick layer of soil that supports vegetative cover.

Based on the regional soil conditions and previous site work, earthen material with permeability less than or equal to 1 x 10^{-5} cm/sec is not locally available. Therefore, the final cover system includes the installation of a flexible geomembrane liner to achieve a permeability less than or equal to the regulatory requirement. From top to bottom, the final cover system will include the following components:

- 6-inch topsoil capable of supporting native vegetation
- 18-inches of protective soil
- Minimum 250 mil geocomposite drainage layer (geonet sandwiched between two non-woven geotextiles)
- 40-mil textured linear low density (LLDPE) geomembrane

The entire final cover system for both impoundments will be graded to promote drainage to the planned stormwater drainage discharge points. The intent is to prevent impoundment or accumulation of stormwater within the impoundment area footprints.

2.1.1 Demonstration of Compliance

The infiltration barrier components of the final cover consists of a 40-mil LLDPE geomembrane, geocomposite drainage layer, and 18-inches of earthen material. The hydraulic conductivity of this composite system does not exceed 1 x 10^{-5} cm/sec or the permeability of the natural subsoils. A calculation was completed to confirm the liquid flow rate through the composite liner as compared to the regulatory requirement of 18-inches of barrier soil with a permeability less than or equal to 1 x 10^{-5} cm/sec. The calculation is provided in Appendix A.

2.1.2 Veneer Slope Stability

The material properties chosen for the cover soil materials are sufficient to prevent sloughing or movement. The regulations require a minimum surface grade of 5% per ADEM Admin. Code r. 335-13-15-.07(3)(d)3.(i)(III). However, PowerSouth is requesting a variance from ADEM Admin. Code r. 335-13-15-.07(3)(d)3.(i)(III) to use a surface grade of 3%, which is equivalent to a slope angle of 1.7 degrees. The interface slip planes between the geomembrane to CCR, geomembrane to geocomposite, and geocomposite to protective cover soil show the stability to have a factor of safety greater than 1.5. The internal strengths of the geocomposite and the cover soils also show the side slope stability is greater than 1.5. Calculations for side slope stability are provided in Appendix A.

2.1.3 Settlement

Material properties and settlement estimates for the CCR materials were provided in the "Report of Perimeter Berm and Impounded Ash Stability and Final Cover Settlement Report" provided by CDG in July 2020. Settlement parameters were determined for the FGD material as long-term settlement is estimated to occur over 30 years after closure. Based on the settlement estimates the imported fill material and final cover material are estimated to induce settlement approximately 20% of the fill height. Therefore, an additional 15 feet of imported fill and cover soil will induce 3 feet of settlement. Additional imported fill is planned for the site grading to account for long-term settlement.

The Unit 2/3 ash material has properties that will allow for settlement to occur during construction. This was observed as the Unit 1 ash material was placed on the Unit 2/3 Impoundment and graded for a construction laydown area. No additional fill is required for the Unit 2/3 Impoundment to account for long-term settlement. Calculations are provided in Appendix A.

2.1.4 Construction

Low permeable earthen material is not readily available in the vicinity of the plant. The geomembrane composite cap system is shown to provide a better and more consistent moisture barrier. The geocomposite drainage layer is designed to prevent significant water ponding on top of the geomembrane and prevents the protective soil layers from becoming saturated.

Geomembrane – The LLDPE geomembrane will be textured on both sides. The geomembrane will be placed directly on the CCR materials following re-grading. Integrity testing will be completed on 100 percent of the seams using air testing and vacuum testing. The Construction Quality Assurance program will assure the quality control testing is completed and defects are repaired. The LLDPE will provide flexibility to the final cover system to accommodate expected settlement and subsidence.

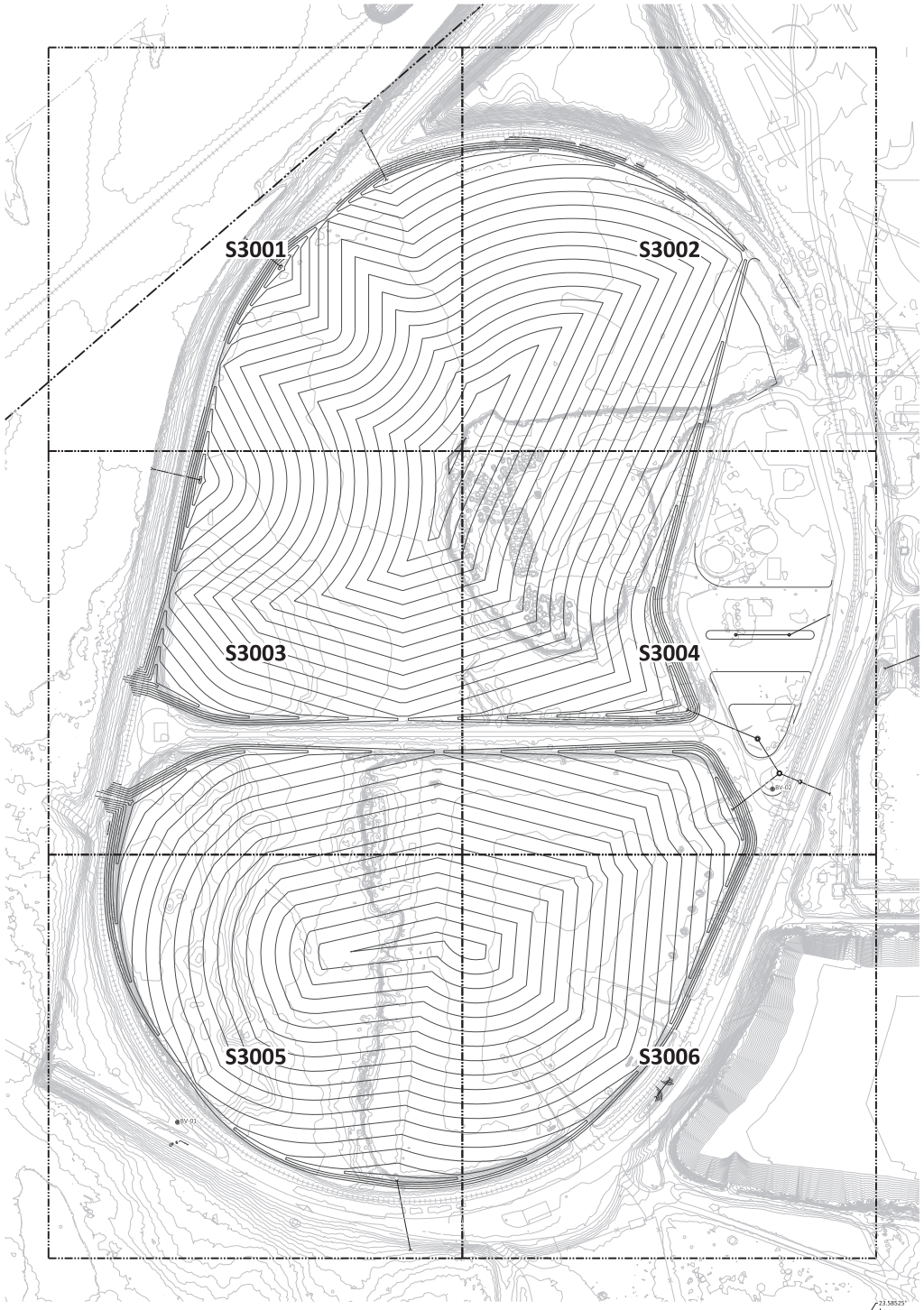
Geocomposite - The geocomposite drainage layer was designed through the use of the EPA's Hydrologic Evaluation of Landfill Performance (HELP) software. The geocomposite is planned to drain water that infiltrates the earthen cover soil layers and prevent a buildup of water on top of the liner. The design condition includes the precipitation event for a 25-year, 24-hour storm. In addition, the geocomposite drainage layer will prevent saturation of the cover soils and loss of shear strength that could lead to sloughing. The transmissivity of the geocomposite is sufficient to allow drainage along the entire slope with outlets planned at elevations above the perimeter drainage ditches. The HELP model calculation is provided in Appendix A.

- Protective Soil – The protective soil layer is designed to have a permeability greater than 1 x 10^{-5} cm/sec. The protective soil will be placed above the geocomposite drainage layer and constructed to a thickness of 18-inches. Suitable borrow sources are available in the vicinity of the power plant.
- Vegetative Cover – A 6-inch layer of vegetative cover soil will be placed above the protective soil. This will be a topsoil material that is capable of supporting vegetative growth. The topsoil layer will be fertilized, seeded, and watered as necessary to promote vegetative growth.

3.0 Grading and Drainage Drawings

The following drawings are included with this submittal:

DRAWING NUMBER	DESCRIPTION
S3000	Grading and Drainage - Key Plan
S3001	Grading and Drainage
S3002	Grading and Drainage
S3003	Grading and Drainage
S3004	Grading and Drainage
S3005	Grading and Drainage
S3006	Grading and Drainage
S3052	FGD cross section
S3053	U2/3 cross section
S3101	Erosion Control
S3102	Erosion Control
S3701	Excavation drawing
S3702	Excavation drawing
S3900	Grading and Drainage - Sections and Details
S3910	Grading and Drainage - Sections and Details
S3920	Typical Erosion Control Drawings



DRAWING INDEX

DWG NO.	DWG SERIES	DESCRIPTION
-	S3000	GRADING AND DRAINAGE PLANS
-	S3100	EROSION CONTROL PLANS
-	S3700	EXCAVATION PLANS
S3052	-	FGD CROSS SECTIONS
S3053	-	U2/3 CROSS SECTIONS
S3900	-	GRADING AND DRAINAGE - SECTIONS & DETAILS
S3910	-	GRADING AND DRAINAGE - SECTIONS & DETAILS
S3920	-	TYPICAL EROSION CONTROL DETAILS

GENERAL NOTES
APPLICABLE TO ALL S3000, S3100, S3700 SERIES DRAWINGS

1. FOR ALL COORDINATES AND ELEVATIONS, SEE THE PROJECT SURVEY CONTROL ON THIS DRAWING.
2. GRADE SHALL SLOPE UNIFORMLY BETWEEN FINISH SPOT ELEVATIONS AND CONTOURS SHOWN ON THE PLANS AND AS INDICATED BY DIRECTION OF FLOW ARROWS.
3. A SMOOTH VERTICAL TRANSITION SHALL BE PROVIDED AT ROAD INTERSECTIONS.
4. CONTRACTOR IS RESPONSIBLE FOR TYING FINISHED CONTOURS INTO EXISTING CONTOURS IN AREAS WHERE THERE IS INSUFFICIENT SURVEY DATA OF THE EXISTING GRADE.
5. SPOT ELEVATIONS AND CONTOURS ARE TOP OF FINISHED GRADE. CONTRACTOR SHALL SUBTRACT FINISH SURFACING MATERIAL THICKNESS TO OBTAIN THE TOP OF SUBGRADE.
6. ALL AREAS DISTURBED SHALL BE RESTORED TO THEIR PRE-CONSTRUCTION CONDITIONS AND STABILIZED, UNLESS NOTED OTHERWISE. DISTURBED AREAS NOT RECEIVING AGGREGATE, RIPRAP, OR CONCRETE SURFACING SHALL BE SEEDED.

LEGEND
APPLICABLE TO ALL S3000, S3100, 3700 SERIES DRAWINGS

PROPERTY LINE
LIMIT OF RIGHT OF WAY (R/W)
EXISTING FENCE
EXISTING RAILROAD
NEW CONTOUR (41)
EXISTING CONTOUR (41)
VEGETATION
PROPOSED EDGE OF WASTE
CATCHBASIN OR MANHOLE
COMPOST FILTER SOCK
EDGE OF WATER
CATCHBASIN OR MANHOLE
NEW CULVERT
DITCH/SWALE FLOW INDICATOR
GRADE SURFACE FLOW INDICATOR
NEW SPOT ELEVATION (41.50)
SURVEY CONTROL MONUMENT
PRECAST CATCHBASIN LABEL (CB-100)
CULVERT LABEL (C-100)
TO BE DEMOLISHED

WETLANDS
AGGREGATE SURFACING
REINFORCED CONCRETE
EARTH
RIPRAP
GRASS
STABILIZED CONSTRUCTION ENTRANCE/EXIT
SECTION OR DETAIL NUMBER
DRAWING DESIGNATION NUMBER
INLET PROTECTION (IP)
CULVERT PROTECTION (CP)
LIMIT OF DISTURBANCE
BERM DRIVE PATH

PROJECT SURVEY CONTROL
EXISTING CONTROL MONUMENT LOCATIONS

MONUMENT NO.	2019 PLANT GRID COORDINATES			STATE PLANE COORDINATES		NAVD 88 ELEVATION	REMARKS
	NORTHING	EASTING	ELEVATION	NORTHING	EASTING		
BV-01	3399.503	2983.603	39.382	540956.820	1838092.145	39.028	EXISTING BENCHMARK
BV-02	4168.938	4357.283	42.460	541112.354	1839658.937	42.106	EXISTING BENCHMARK
BV-03	6248.029	4087.714	41.884	543125.627	1840243.758	41.530	EXISTING BENCHMARK
BV-04	6360.890	5158.007	39.271	542800.822	1841269.802	38.917	EXISTING BENCHMARK

NOTES:

1. COORDINATES ARE BASED ON THE 2019 PLANT GRID SYSTEM, US SURVEY FEET. ALL COORDINATES, BEARINGS AND DISTANCES ARE GRID. FOLLOWING IS THE RELATIONSHIP BETWEEN THE 2019 PLANT GRID SYSTEM AND STATE PLANE (NAD83, ALABAMA WEST, US FOOT): 5000, 5000 = 1840580.484, 541616.834. PLANT GRID NORTH IS ROTATED 23.58525 DEGREES CLOCKWISE FROM STATE PLANE GRID NORTH.
2. ELEVATIONS ARE BASED ON THE PLANT ELEVATION DATUM, WITH UNITS OF FEET. FOLLOWING IS THE RELATIONSHIP BETWEEN THE PLANT ELEVATION DATUM AND NAVD88: 0.354 FEET PLANT DATUM = 0 FEET NAVD88.
3. CONTRACTORS SHALL ONLY USE CONTROL MONUMENTS BV-01, BV-02, BV-03 AND BV-04 FOR SURVEY CONTROL.
4. MONUMENTS BV-03 AND BV-04 ARE LOCATED OUT OF PLAN VIEW.

STANDARD ABBREVIATIONS

AGG	-	AGGREGATE	LP	-	LOW POINT
APPROX	-	APPROXIMATE	LTR	-	LATER
AVG	-	AVERAGE	N	-	NORTH
BLDG	-	BUILDING	NO	-	NUMBER
BM	-	BENCH MARK	NTS	-	NOT TO SCALE
CHDPE	-	CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	OD	-	OUTSIDE DIAMETER
CL	-	CENTERLINE	PI	-	POINT OF INTERSECTION
CLR	-	CLEAR	PL	-	PROPERTY LINE
CMP	-	CORRUGATED METAL PIPE	PLCS	-	PLACES
DIA	-	DIAMETER	R	-	RADIUS
DWG	-	DRAWING	RCP	-	REINFORCED CONCRETE PIPE
E	-	EAST	REQD	-	REQUIRED
EA	-	EACH	REV	-	REVISION
EF	-	EACH FACE	RR	-	RAILROAD
EL	-	ELEVATION	R/W	-	RIGHT-OF-WAY
EOP	-	END OF PIPE	S	-	SOUTH
FC	-	FIELD CHECK	SIM	-	SIMILAR
FG	-	FINISHED GRADE	STA	-	STATION
FT	-	FEET	TOC	-	TOP OF CONCRETE
HDPE	-	HIGH DENSITY POLYETHYLENE PIPE	TOC EL	-	TOP OF CONCRETE ELEVATION
HP	-	HIGH POINT	TYP	-	TYPICAL
ID	-	INSIDE DIAMETER	UNO	-	UNLESS NOTED OTHERWISE
IN	-	INCH	W	-	WEST
INV	-	INVERT	W/	-	WITH
INV EL	-	INVERT ELEVATION	W/O	-	WITHOUT
L	-	LENGTH			

23.58525°
STATE PLANE GRID
PLANT GRID
N

100' 50' 0 100' 200'
1" = 100'

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0	03/NOV/20	ISSUED FOR PERMITTING	MEM	EMR	LM	LM	MEH

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF ALABAMA.
SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 36040-E

BLACK & VEATCH

DESIGNER	DRAWN
EMR	MEM
CHECKED	DATE
LM	03/NOV/20

ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER S. LYLE MORGAN
Morgan, S. Lyle
2021.03.19 21:36:11-04'00'

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POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
GRADING & DRAINAGE - SITE
KEY PLAN, GENERAL NOTES, & LEGEND

PROJECT	DRAWING NUMBER	REV
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CODE		
AREA		

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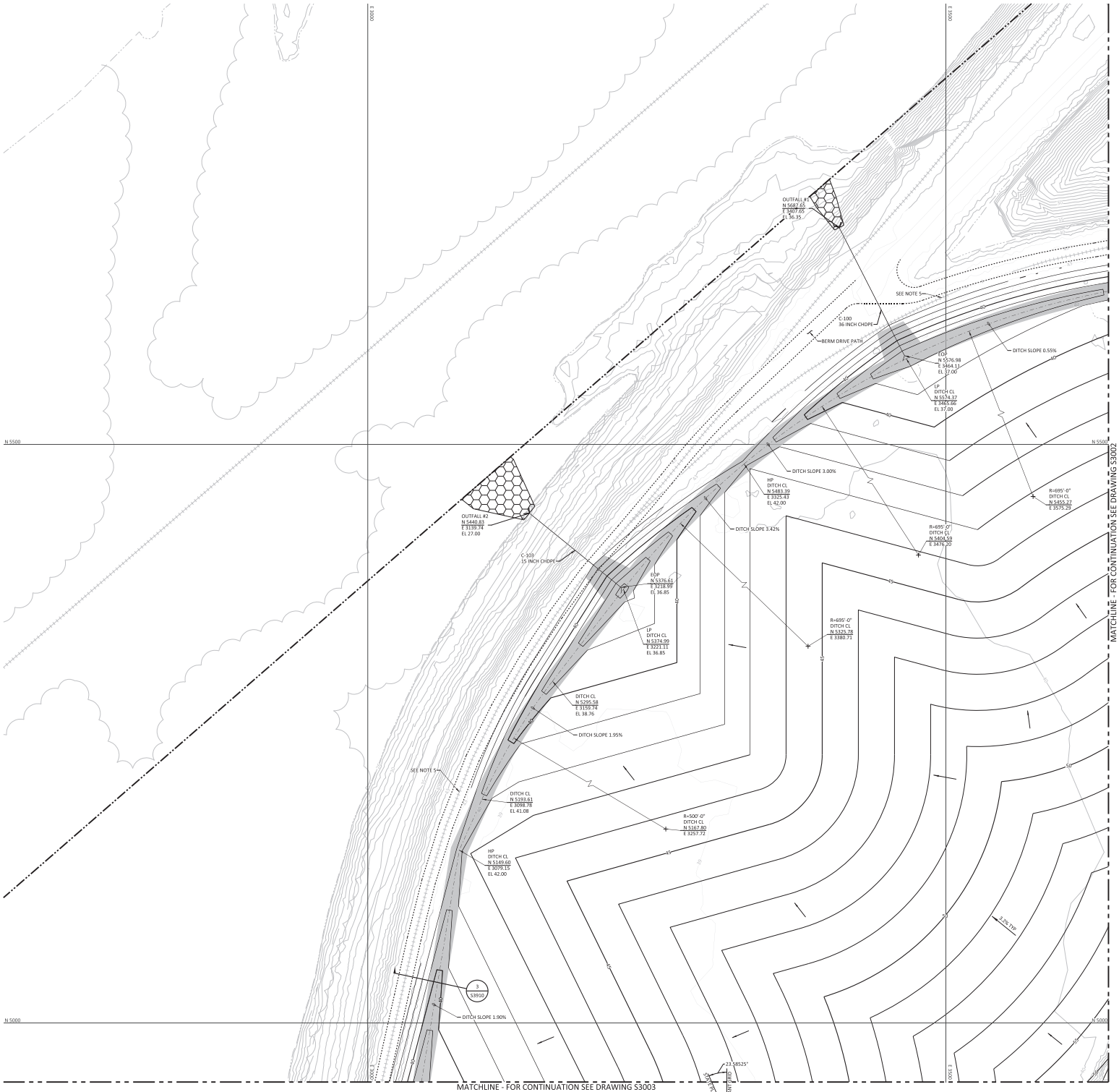
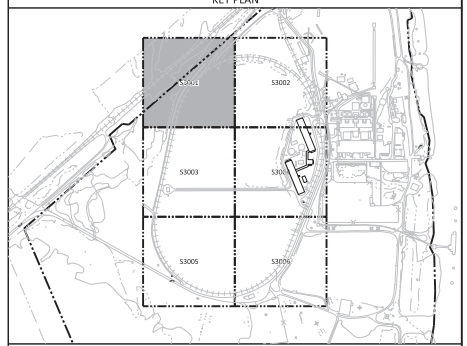


NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. FOR TYPICAL POND CAP SECTION, SEE DETAIL 2, DRAWING S3910.
3. FGD POND PERIMETER DITCH IS TRAPEZOIDAL, 5 FT WIDE BOTTOM AND 1 FT HEIGHT, UNLESS NOTED OTHERWISE, SEE DETAIL 5, DRAWING S3910.
4. FGD POND CAP SLOPE IS 3.2% FROM PEAK TO PERIMETER DITCH.
5. EXISITING RAIL (INCLUDING TIES AND BALLAST ROCK) SHALL BE DEMO, REMOVED AND DISPOSED OFF SITE. RAIL BERM SHALL BE BACKFILLED UP TO EXISITING GRADE (VARIES EL 42 - 43).

KEY PLAN



ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER
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I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF ALABAMA.

SIGNED: S. LYLE MORGAN
DATE: 03/NOV/20 REG NO. 36040-E

BLACK & VEATCH

DESIGNER	EMR	DRAWN	MEM
CHECKED	LM	DATE	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
GRADING & DRAINAGE - SITE PLAN - AREA 1

PROJECT 404320-CSTF-S3001
DRAWING NUMBER
REV 0
CODE
AREA

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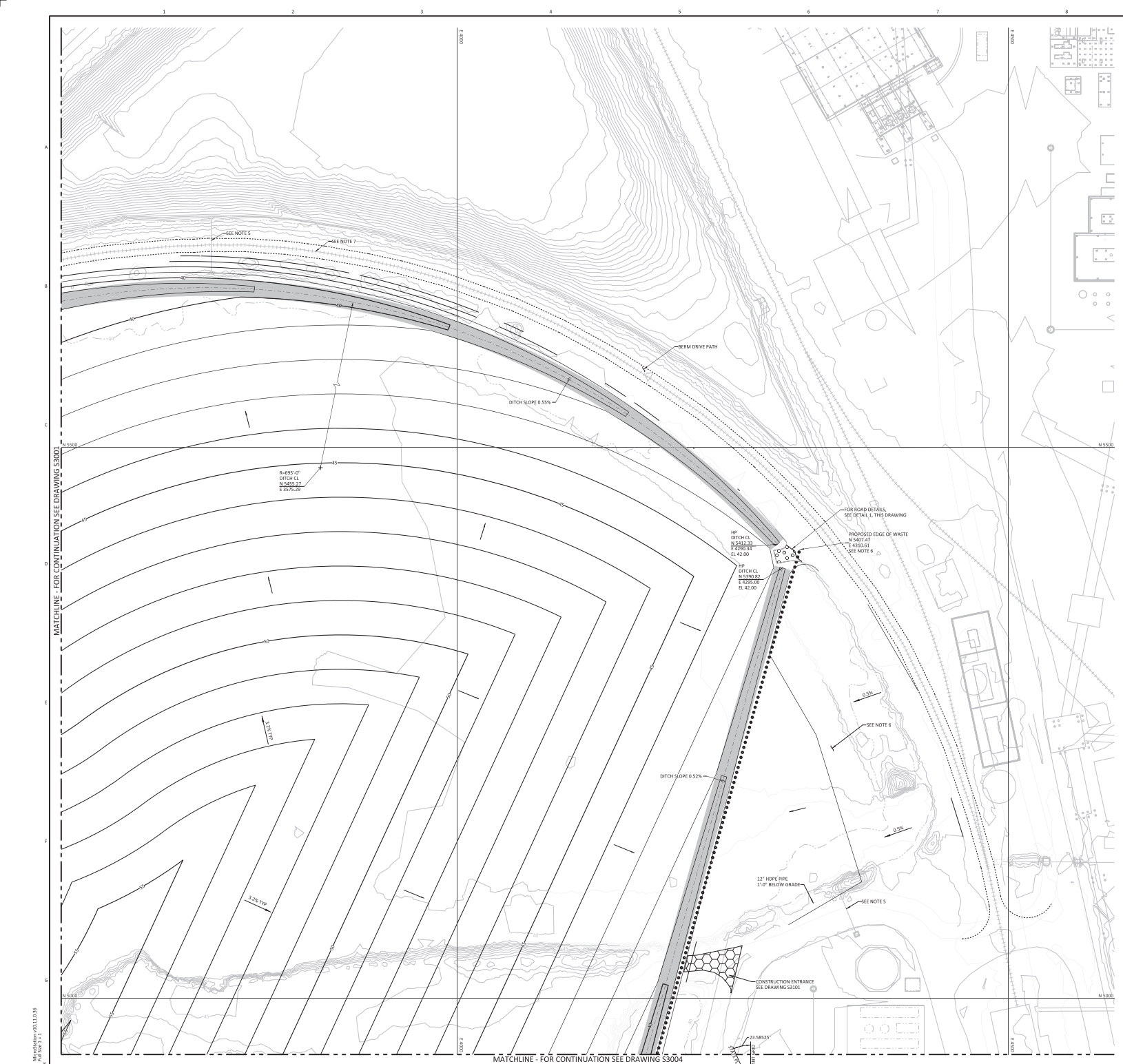

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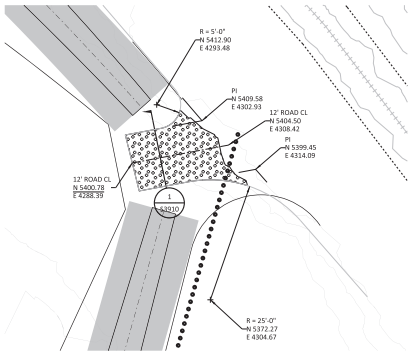
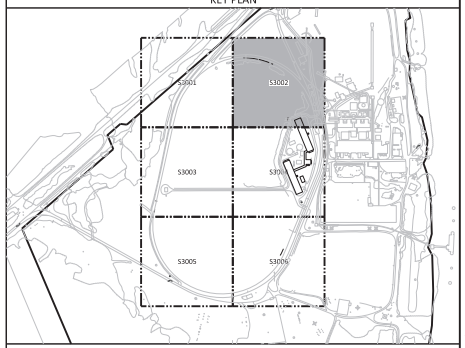
3. FGD POND PERIMETER DITCH IS TRAPEZOIDAL, 5FT WIDE BOTTOM AND 1FT HEIGHT, UNLESS NOTED OTHERWISE. SEE DETAIL 5, DRAWING S3910.
4. FGD POND CP SLOPE IS 3.2% FROM PEAK TO PERIMETER DITCH.
5. WHERE NOTED, THE EXISTING CULVERT SHALL BE DEMO, REMOVE, AND DISPOSE OFF SITE.
6. ALL WASTE (INCLUDING CONTAMINATED RIP RAP) ON THE EAST SIDE OF THE PROPOSED EDGE OF WASTE DEMARCATION LINE SHALL BE ENTIRELY REMOVED AND RELOCATED TO THE WEST SIDE OF PROPOSED EDGE OF WASTE DEMARCATION LINE AND PLACED UNDER THE LINER. THIS ALSO APPLIES TO THE NORTH EAST CORNER OF FGD POND. EXCAVATION AREAS SHALL BE BACKFILLED WITH CLEAN FILL AND GRADED AS INDICATED ON DRAWING.
7. EXISTING RAIL (INCLUDING TIES AND BALLAST ROCK) SHALL BE DEMO, REMOVED AND DISPOSED OFF SITE. RAIL BERM SHALL BE BACKFILLED UP TO EXISTING GRADE (VARIES EL 42 -43.)



DETAIL 1
SCALE: 1"=10'

KEY PLAN



ALABAMA LICENSED No. 38040 PROFESSIONAL ENGINEER S. LYLE MORGAN

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	DWH	LM	LM	MEM

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF ALABAMA.
SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 38040-E

BLACK & VEATCH

DESIGNER	DRAWN
EMR	MEM
CHECKED	DATE
LM	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
GRADING & DRAINAGE - SITE PLAN - AREA 2

PROJECT 404320-CSTF-S3002
DRAWING NUMBER S3002
REV 0
CODE
AREA

mccd7792
MicroStation v10.11.0.36
Full Size 1 = 1
11/11/2020 11:02 AM

MATCHLINE - FOR CONTINUATION SEE DRAWING S3001

MATCHLINE - FOR CONTINUATION SEE DRAWING S3004

MATCHLINE - FOR CONTINUATION SEE DRAWING S3005

OUTFALL #3
N 4907.89
E 2934.72
EL 26.00

C-104
18 INCH CHDPE

EOP
N 4882.83
E 3033.37
EL 36.85

LP
DITCH CL
N 4882.36
E 3035.54
EL 36.85

FGD CAP
HP 56.10

3.2% TYP

BERM DRIVE PATH

DITCH SLOPE 1.90%

SEE NOTE 5

HP
DITCH CL
N 4621.58
E 2992.63
EL 40.00

DITCH SLOPE 2.38%

N 4500

R=300'-0"
DITCH CL
N 4634.23
E 3154.55

OUTFALL #4
DITCH CL
N 4426.46
E 2853.15
EL 36.35

DITCH CL
N 4410.40
E 2926.41
EL 36.90

DITCH CL
N 4350.20
E 3002.45
EL 38.00

DITCH CL
N 4334.72
E 3148.47
EL 39.00

DITCH SLOPE 0.87%

HP
DITCH CL
N 4329.31
E 3491.67
EL 42.00

HP
DITCH CL
N 4329.31
E 3515.69
EL 42.00

SEE ROAD DETAILS
SEE DETAIL 1, THIS DRAWING

SEE ROAD DETAILS
SEE DETAIL 2, THIS DRAWING

HP
DITCH CL
N 4254.87
E 3575.73
EL 42.00

DITCH CL
N 4254.87
E 3148.47
EL 39.07

DITCH SLOPE 0.70%

HP
DITCH CL
N 4254.87
E 3507.71
EL 42.00

OUTFALL #5
DITCH CL
N 4159.42
E 2790.28
EL 36.35

DITCH CL
N 4212.92
E 3000.14
EL 37.98

DITCH CL
N 4138.00
E 2873.85
EL 36.95

DITCH SLOPE 0.72%

BERM DRIVE PATH

DITCH CL
N 4048.26
E 2853.01
EL 37.62

R=300'-0"
DITCH CL
N 4094.74
E 3107.88

23.5825°

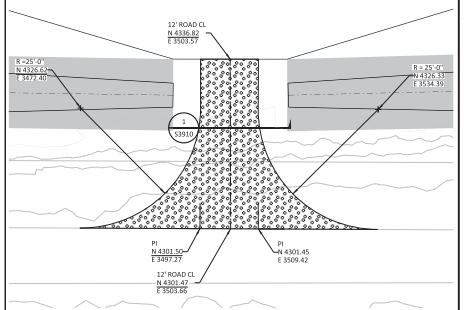
N

30' 20' 10' 0 30' 60'

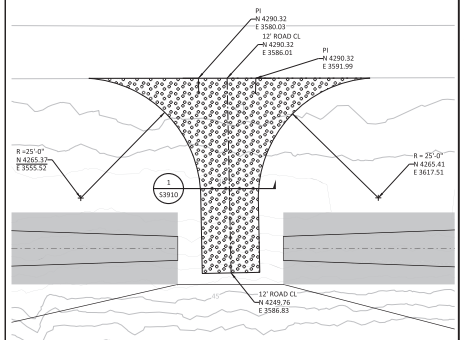
1"=30'

NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. FOR TYPICAL POND CAP SECTION, SEE DETAIL 2, DRAWING S3910.
3. FGD POND AND UNIT 2/3 POND PERIMETER DITCH IS TRAPEZOIDAL, 5FT WIDE BOTTOM AND 1FT HEIGHT, UNLESS NOTED OTHERWISE. SEE DETAIL 5, DRAWING S3910.
4. FGD POND CAP SLOPE IS 3.2% FROM PEAK TO PERIMETER DITCH. UNIT 2/3 POND CAP SLOPE IS 3.0% FROM PEAK TO PERIMETER DITCH.
5. EXISTING RAIL (INCLUDING TIES AND BALLAST ROCK) SHALL BE DEMO, REMOVED AND DISPOSED OFF SITE. RAIL BERM SHALL BE BACKFILLED UP TO EXISTING UP TO EXISTING GRADE (VARIES EL 42 - 43).

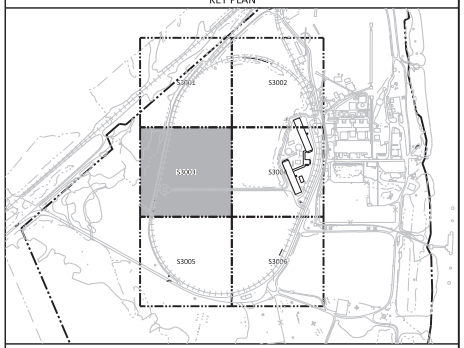


DETAIL 1
SCALE: 1"=10'



DETAIL 2
SCALE: 1"=10'

KEY PLAN



ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER S. LYLE MORGAN

Morgan, S. Lyle
2021.03.19 21:36:03 -04'00'

ISSUED FOR PERMITTING PURPOSES ONLY

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
2	19/MAR/21	ISSUED FOR PERMITTING	JRH	SMH	LM	LM	MEH
1	10/NOV/20	ISSUED FOR PERMITTING	MEM	EMR	LM	LM	MEH
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	EMR	LM	LM	MEH

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SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 36040-E

BLACK & VEATCH

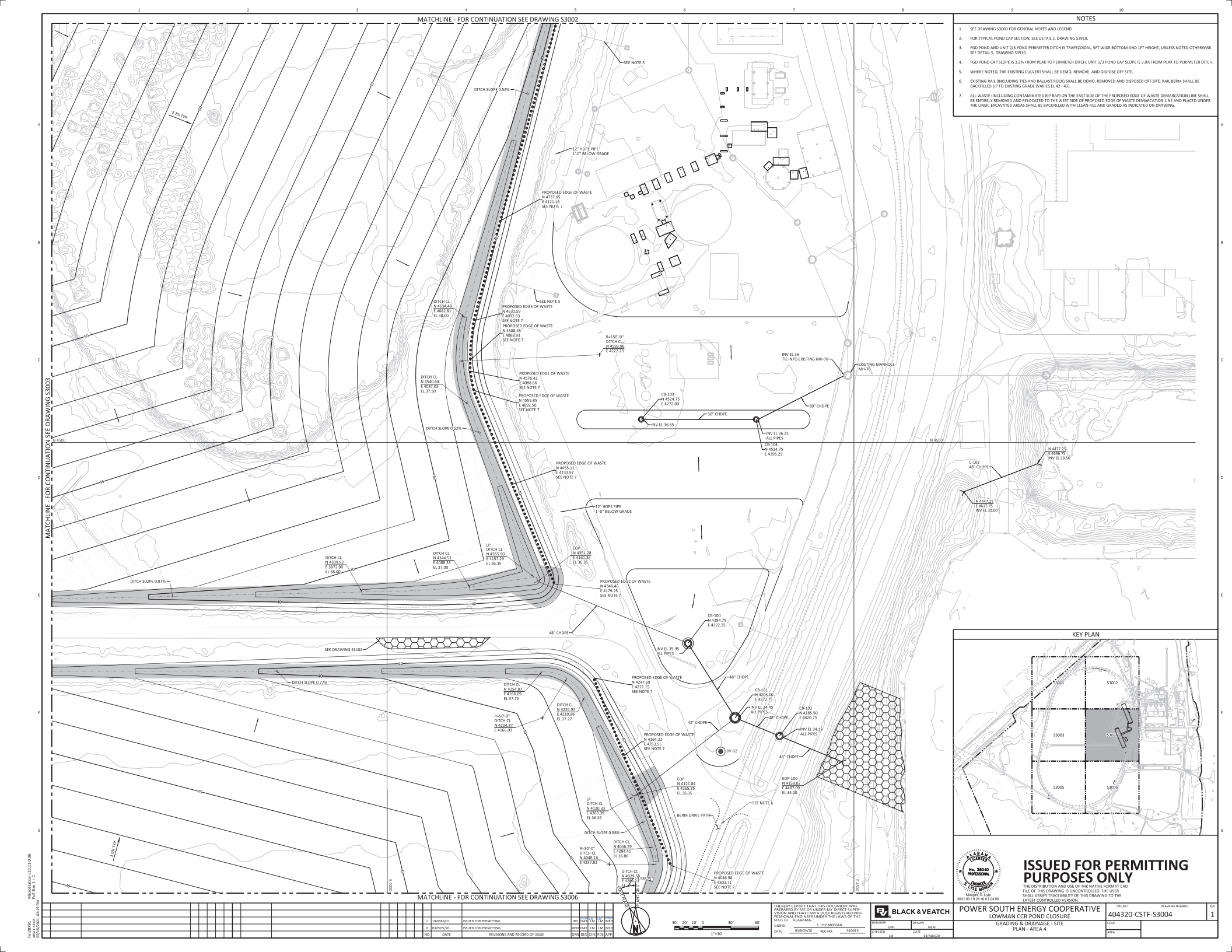
DESIGNER	EMR	DRAWN	MEM
CHECKED	LM	DATE	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE

GRADING & DRAINAGE - SITE PLAN - AREA 3

PROJECT 404320-CSTF-S3003
DRAWING NUMBER
REV 2
CODE
AREA

hm28791
MicroStation v8.11.9.578
Full Size 1:1
03/15/2021 02:18 PM



NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. FOR TYPICAL POND CAP SECTION, SEE DETAIL 2, DRAWING S3910.
3. FGD POND AND UNIT 2/3 POND PERIMETER DITCH IS TRAPEZOIDAL, 5FT WIDE BOTTOM AND 1FT HEIGHT, UNLESS NOTED OTHERWISE. SEE DETAIL 5, DRAWING S3910.
4. FGD POND CAP SLOPE IS 3.2% FROM PEAK TO PERIMETER DITCH. UNIT 2/3 POND CAP SLOPE IS 3.0% FROM PEAK TO PERIMETER DITCH.
5. WHERE NOTED, THE EXISTING CULVERT SHALL BE DEMO, REMOVE, AND DISPOSE OFF SITE.
6. EXISTING RAIL (INCLUDING TIES AND BALLAST ROCK) SHALL BE DEMO, REMOVED AND DISPOSED OFF SITE. RAIL BERM SHALL BE BACKFILLED UP TO EXISTING GRADE (VARIES EL 42 - 43).
7. ALL WASTE (INCLUDING CONTAMINATED RIP RAP) ON THE EAST SIDE OF THE PROPOSED EDGE OF WASTE DEMARCATION LINE SHALL BE ENTIRELY REMOVED AND RELOCATED TO THE WEST SIDE OF PROPOSED EDGE OF WASTE DEMARCATION LINE AND PLACED UNDER THE LINER. EXCAVATED AREAS SHALL BE BACKFILLED WITH CLEAN FILL AND GRADED AS INDICATED ON DRAWING.

KEY PLAN

ALABAMA LICENSED PROFESSIONAL ENGINEER No. 36040 S. LYLE MORGAN
Morgan, S. Lyle
2021.03.19 21:40:07-04'00'

ISSUED FOR PERMITTING PURPOSES ONLY

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
1	19/MAR/21	ISSUED FOR PERMITTING	JRH	SMH	LM	LM	MEH
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	EMR	LM	LM	MEH

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SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 36040-E

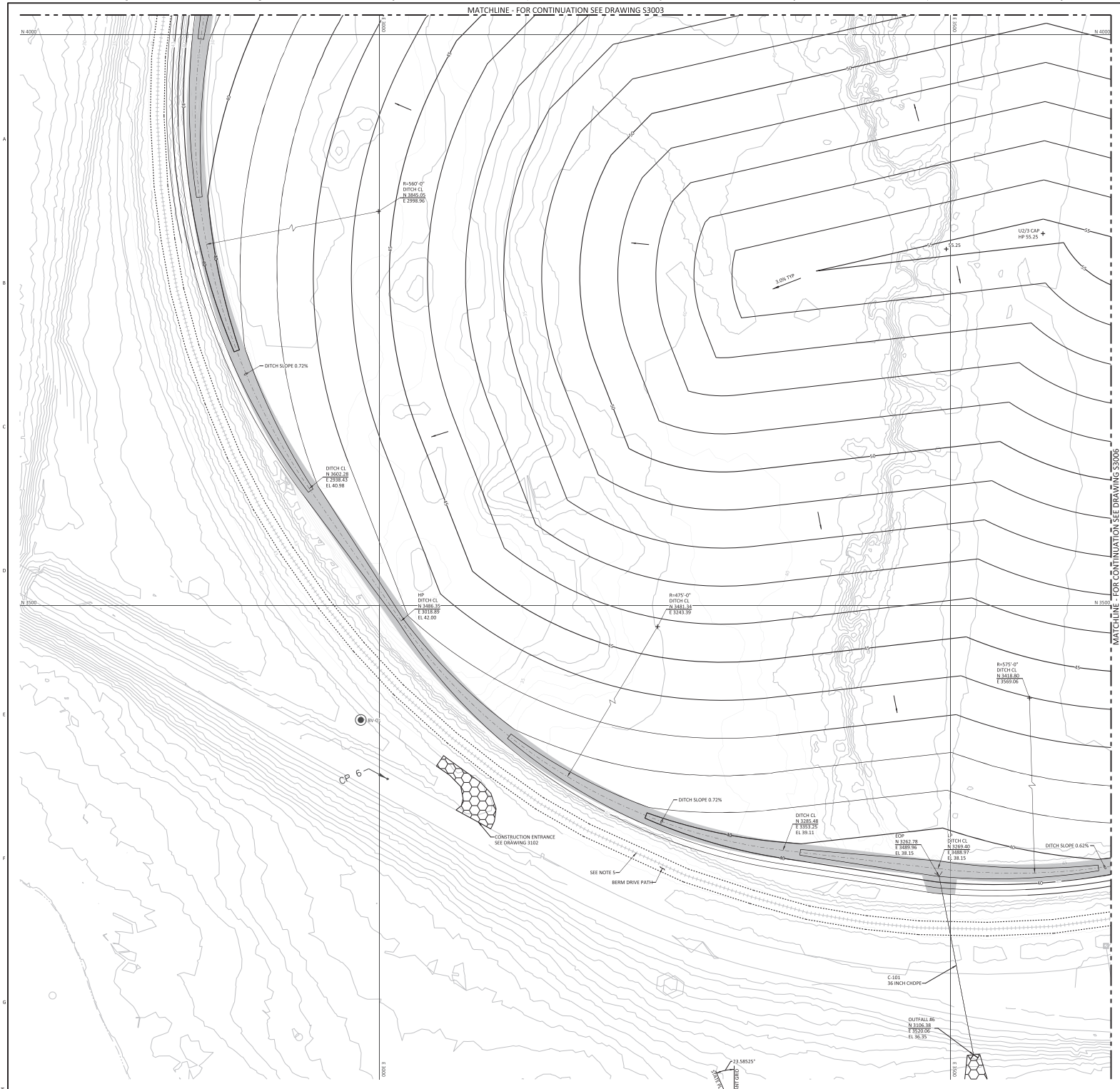
BLACK & VEATCH

DESIGNER	EMR	DRAWN	MEM
CHECKED	LM	DATE	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
GRADING & DRAINAGE - SITE
PLAN - AREA 4

PROJECT 404320-CSTF-S3004
DRAWING NUMBER
REV 1
CODE
AREA

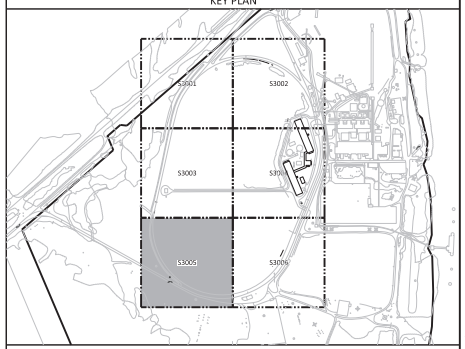
MicroStation v10.11.0.36
Full Size 1 = 1
hm28791
03/15/2021 02:19 PM



NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. FOR TYPICAL POND CAP SECTION, SEE DETAIL 2, DRAWING S3910.
3. UNIT 2/3 POND PERIMETER DITCH IS TRAPEZOIDAL, 5FT WIDE BOTTOM AND 1FT HEIGHT, UNLESS NOTED OTHERWISE. SEE DETAIL 5, DRAWING S3910.
4. UNIT 2/3 POND CAP SLOPE IS 3.0% FROM PEAK TO PERIMETER DITCH.
5. EXISTING RAIL (INCLUDING TIES AND BALLAST ROCK) SHALL BE DEMO, REMOVED AND DISPOSED OFF SITE. RAIL BERM SHALL BE BACKFILLED UP TO EXISTING GRADE (VARIES EL 42-43).

KEY PLAN



ALABAMA LICENSED No. 38040 PROFESSIONAL ENGINEER S. LYLE MORGAN

Morgan, S. Lyle
2021.03.19 21:40:24-04'07'

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	TWH	LM	MEM	

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SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 38040-E

BLACK & VEATCH

DESIGNER	EMR	DRAWN	MEM
CHECKED	LM	DATE	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE

GRADING & DRAINAGE - SITE PLAN - AREA 5

PROJECT 404320-CSTF-S3005
DRAWING NUMBER
REV 0
CODE
AREA

MicroStation v10.11.0.36
Full Size 1 = 1
mcc87792
11/11/2020 10:52 AM

MATCHLINE - FOR CONTINUATION SEE DRAWING S3004

MATCHLINE - FOR CONTINUATION SEE DRAWING S3005

N 4000

N 3500

E 4000

U2/3 CAP
HP 55.25

3.0% TYP

R=475'-0"
DITCH CL
N 3677.43
E 3971.88

DITCH SLOPE 0.88%

SEE NOTE 5

DITCH CL
N 3660.85
E 4156.58
EL 40.67

BERM DRIVE PATH

HP
DITCH CL
N 3532.86
E 4060.12
EL 42.00'

HP
DITCH CL
N 3516.31
E 4045.63
EL 42.00

DITCH CL
N 3500.13
E 4030.07
EL 41.89

SEE NOTE 5

N 3458.12
E 4006.99
DI 39.00

N 3498.23
E 4118.87
EL 39.10

C-105
12" RCP

FOR ROAD DETAILS
SEE DETAIL 1, THIS DRAWING

R=575'-0"
DITCH CL
N 3441.60
E 3693.93

DITCH CL
N 3432.10
E 3961.45
EL 41.27

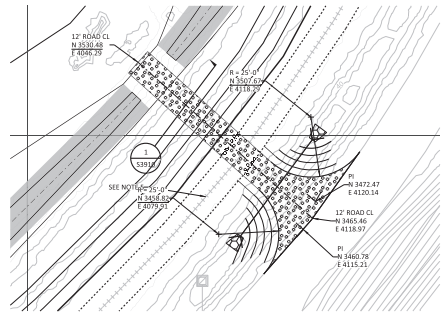
DITCH SLOPE 0.62%

23.58525°
TO TRUE NORTH
FROM PLANT GRID

30' 20' 10' 0 30' 60'
1"=30'

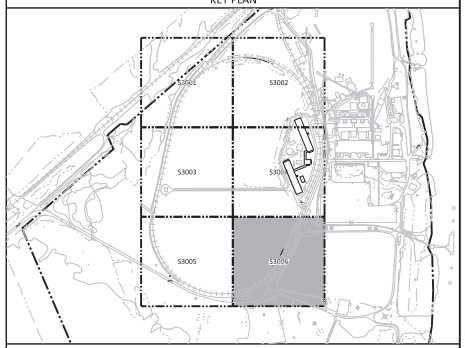
NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. FOR TYPICAL POND CAP SECTION, SEE DETAIL 2, DRAWING S3910.
3. UNIT 2/3 POND PERIMETER DITCH IS TRAPEZOIDAL, 5FT WIDE BOTTOM AND 1FT HEIGHT, UNLESS NOTED OTHERWISE. SEE DETAIL 5, DRAWING S3910.
4. UNIT 2/3 POND CAP SLOPE IS 3.0% FROM PEAK TO PERIMETER DITCH.
5. EXISTING RAIL (INCLUDING TIES AND BALLAST ROCK) SHALL BE DEMO, REMOVED AND DISPOSED OFF SITE. RAIL BERM SHALL BE BACKFILLED UP TO EXISTING GRADE (VARIES EL 42 - 43).



DETAIL 1
SCALE: 1"=10'

KEY PLAN



ALABAMA LICENSED No. 38040 PROFESSIONAL ENGINEER LYLE MORGAN
Margot B. Lyle
2021.03.19 21:40:39-04'07'

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	TWH	LM	LM	MEM

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SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 38040-E

BLACK & VEATCH

DESIGNER	DRAWN
EMR	MEM
CHECKED	DATE
LM	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE

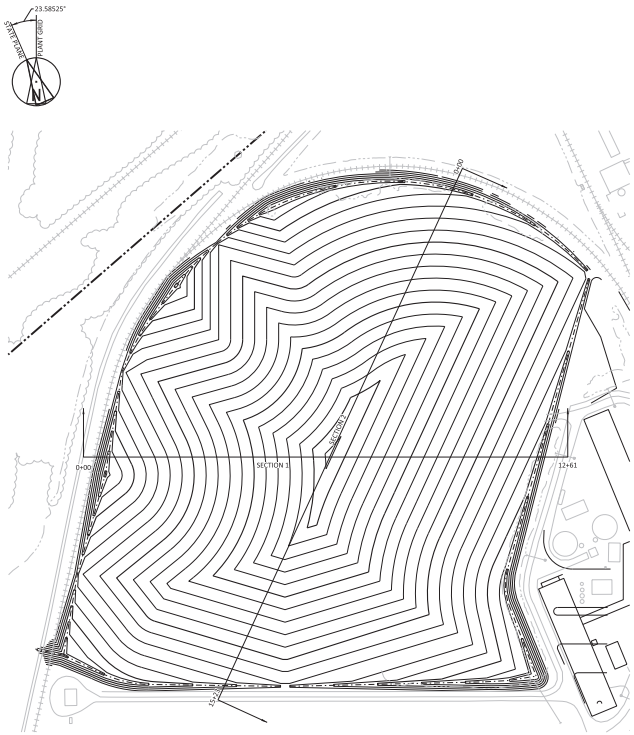
GRADING & DRAINAGE - SITE PLAN - AREA 6

PROJECT 404320-CSTF-S3006
DRAWING NUMBER
REV 0
CODE
AREA

MicroStation v10.11.0.36
Full Size 1 = 1
mcd7792
11/11/2020 10:49 AM

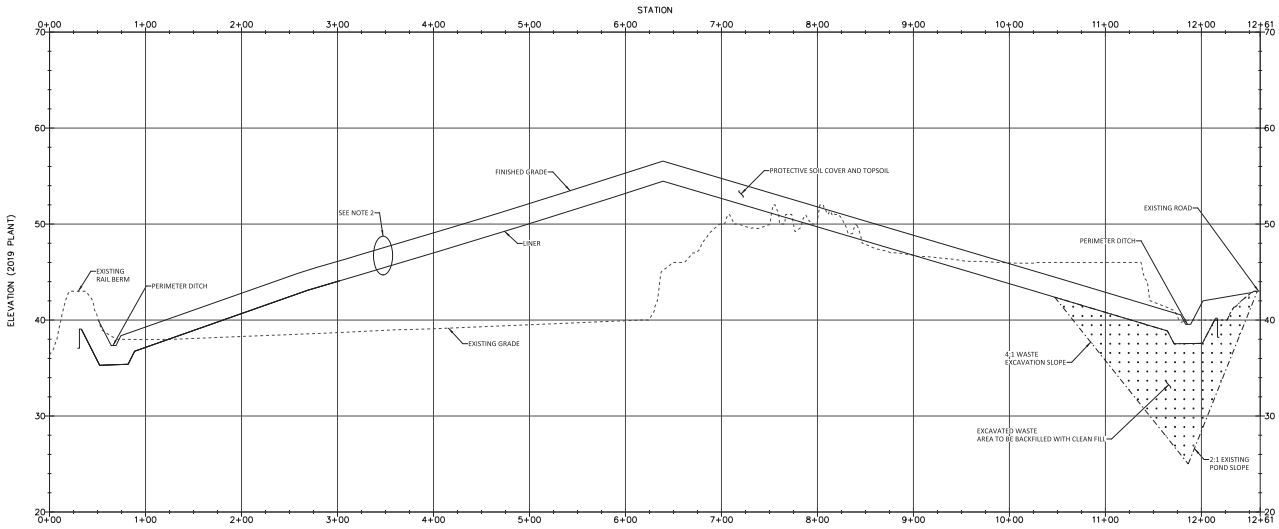
NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. FOR TYPICAL POND CAP SECTION, SEE DETAIL 2, DRAWING S3910.



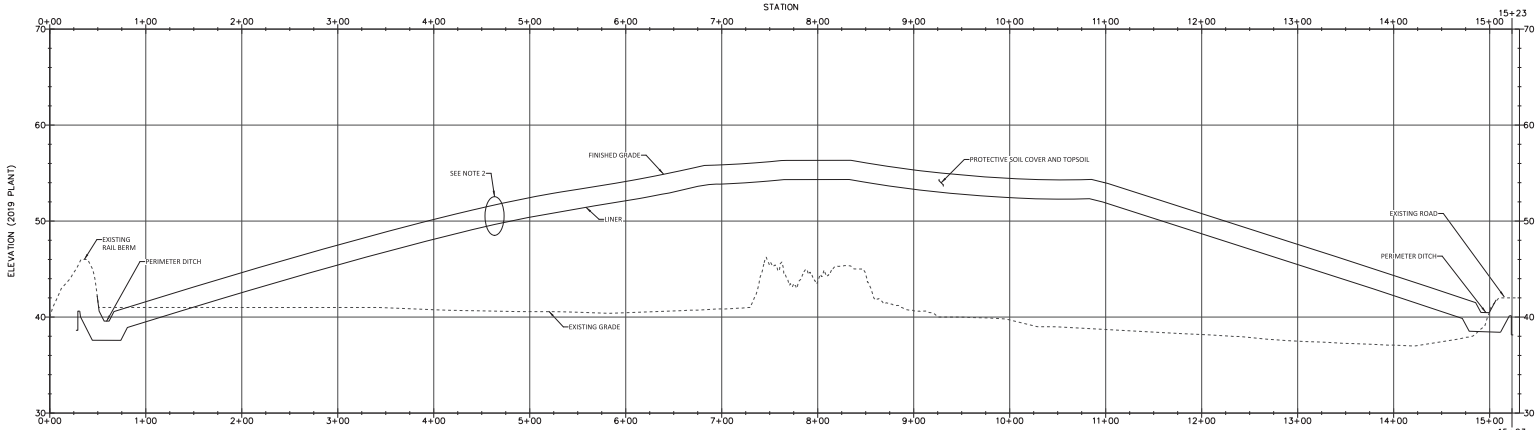
FGD POND - PLAN VIEW

SCALE: 1" = 1500'



SECTION 1
FGD POND - LOOKING NORTH

SCALE
HORIZONTAL 1"=50'
VERTICAL 1"=5'



SECTION 2
FGD POND - LOOKING EAST

SCALE
HORIZONTAL 1"=50'
VERTICAL 1"=5'

ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER S. LYLE MORGAN

Morgan, S. Lyle
2021.03.19 21:40:57-04'00'

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
1	19/MAR/21	ISSUED FOR PERMITTING	JRH	EMR	LM	LM	MEM
0	03/NOV/20	ISSUED FOR PERMITTING	MKM	EMR	LM	LM	MEM

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SIGNED S. LYLE MORGAN

DATE 03/NOV/20 REG NO. 36040-E

BLACK & VEATCH

DESIGNER EMR DRAWN MEM

CHECKED LM DATE 03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE

GRADING & DRAINAGE - SITE
FGD CROSS SECTIONS

PROJECT 404320-CSTF-S3052

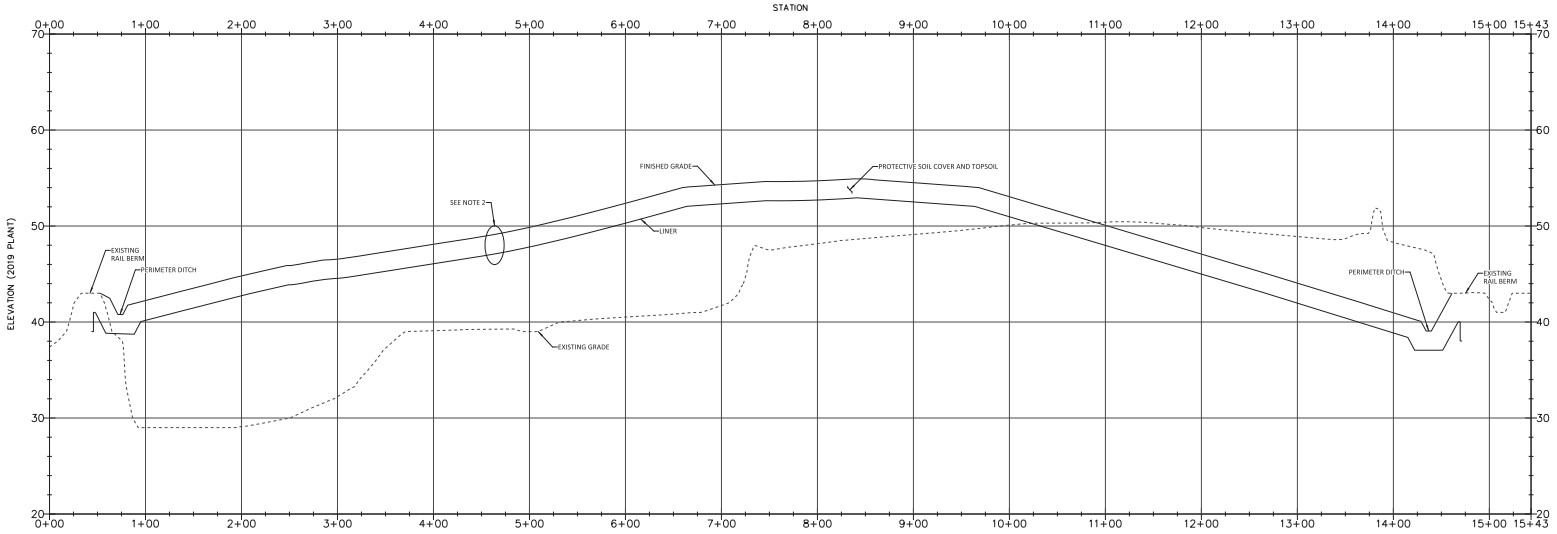
DRAWING NUMBER

REV 1

CODE

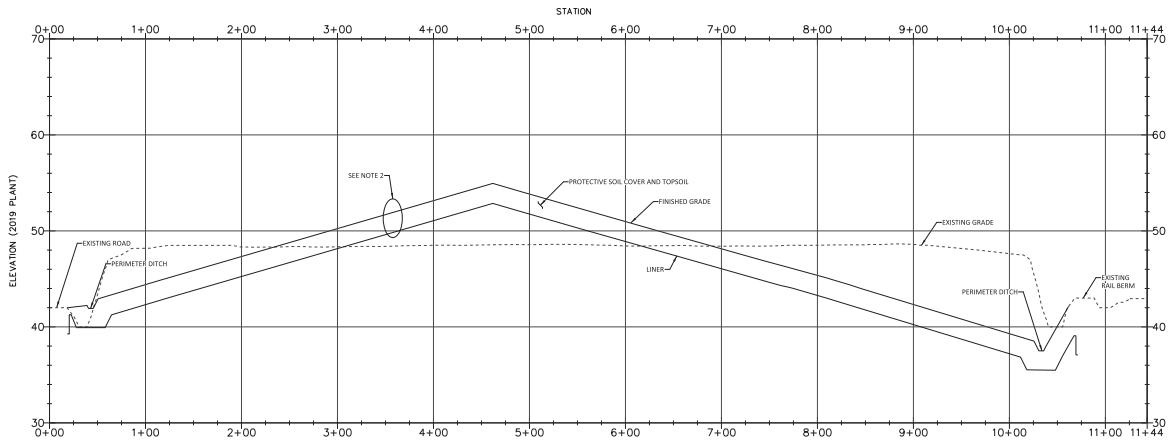
AREA

MicroStation v10.11.0.36
Full Size 1 = 1
mcc67792
11/11/2020
11:02 AM



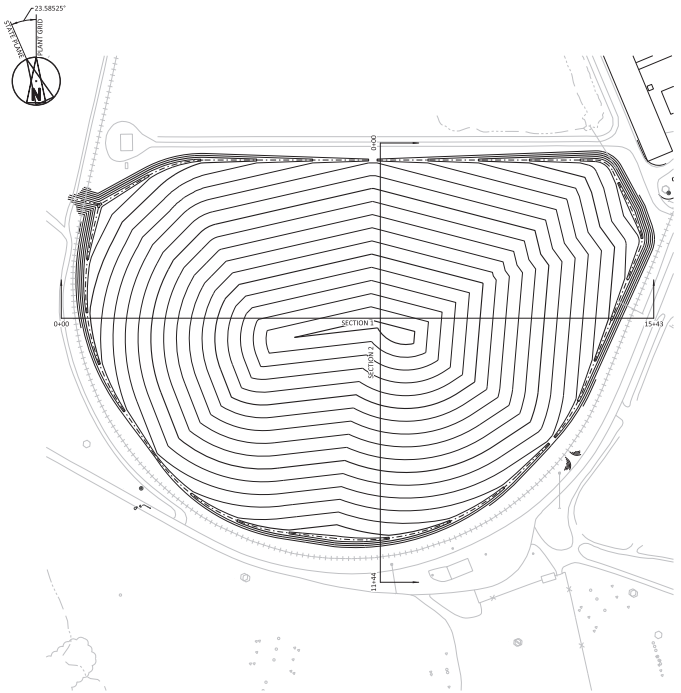
SECTION 1
UNIT 2/3 POND - LOOKING NORTH

SCALE
HORIZONTAL 1"=50'
VERTICAL 1"=5'



SECTION 2
UNIT 2/3 POND - LOOKING EAST

SCALE
HORIZONTAL 1"=50'
VERTICAL 1"=5'



UNIT 2/3 POND - PLAN VIEW

SCALE: 1"=1500'

NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. FOR TYPICAL POND CAP SECTION, SEE DETAIL 2, DRAWING S3910.

ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER S. LYLE MORGAN
Morgan, S. Lyle
2021.03.19 21:41:16-05'00'

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	EMR	LM	MEH	

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF ALABAMA.
SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 36040-E

BLACK & VEATCH

DESIGNER	EMR	DRAWN	MEM
CHECKED	LM	DATE	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
GRADING & DRAINAGE - SITE
UNIT 2/3 CROSS SECTIONS

PROJECT 404320-CSTF-S3053
DRAWING NUMBER
REV 0
CODE
AREA

MicroStation v10.11.0.36
Full Size 1 = 1
mcd7792
11/11/2020 10:39 AM

NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND. SEE DRAWING S3102 FOR NOTES.
2. SEE DRAWING S3920 FOR TYPICAL EROSION CONTROL DETAILS.
3. FILTER SOCKS SHALL BE PLACED AT TOE AND TOP OF SLOPES. CONTRACTOR MAY ADJUST LOCATIONS AS NEEDED.
4. WHERE NOTED, FILTER SOCK SHALL BE PLACED AROUND THE PERIMETER OF EARTH WORK ACTIVITIES. CONTRACTOR MAY ADJUST LOCATIONS AS NEEDED.
5. ON POND CAP, FILTER SOCK SHALL BE PLACED AT MAJOR CONTOURS (5FT INTERVAL).
6. ALL AREAS NOT DESIGNATED WITH SURFACING, BUT DISTURBED DURING CONSTRUCTION SHALL BE STABILIZED AND RESTORED TO THEIR PRE-CONSTRUCTION CONDITION.

23.58525°
STATE PLANE GRID
TRUE NORTH

50' 25' 0 50' 100'
1"=50'

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
2	19/MAR/21	ISSUED FOR PERMITTING	JRH	EMR	LM	LM	MEM
1	10/NOV/20	ISSUED FOR PERMITTING	MEM	EMR	LM	LM	MEM
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	EMR	LM	LM	MEM

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF ALABAMA.
SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 36040-E

BLACK & VEATCH

DESIGNED	EMR	DRAWN	MEM
CHECKED	LM	DATE	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
EROSION CONTROL - SITE PLAN - AREA 1

PROJECT 404320-CSTE-S3101
DRAWING NUMBER
REV 2
CODE
AREA

ALABAMA LICENSED PROFESSIONAL ENGINEER No. 36040 S. LYLE MORGAN
Morgan, S. Lyle 2021.03.19 21:41:36-04'00'

ISSUED FOR PERMITTING PURPOSES ONLY

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MicroStation v10.11.0.36
Full Size 1 = 1
mcc87792
11/01/2020 18:50 PM

EROSION CONTROL NOTES

GENERAL NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND. SEE DRAWING S3920 FOR TYPICAL EROSION CONTROL DETAILS.
2. FILTER SOCKS SHALL BE PLACED AT TOE AND TOP OF SLOPES. CONTRACTOR MAY ADJUST LOCATIONS AS NEEDED.
3. ON POND CAP, FILTER SOCK SHALL BE PLACED AT MAJOR CONTOURS (5FT INTERVAL).
4. ALL AREAS NOT DESIGNATED WITH SURFACING, BUT DISTURBED DURING CONSTRUCTION SHALL BE STABILIZED AND RESTORED TO THEIR PRE-CONSTRUCTION CONDITION.

EROSION & SEDIMENT CONTROL PLAN NOTES:

1. THESE GUIDELINES SHALL APPLY TO ALL WORK CONSISTING OF ANY AND ALL TEMPORARY AND/OR PERMANENT MEASURES TO CONTROL WATER POLLUTION AND SOIL EROSION, AS MAY BE REQUIRED, DURING THE CONSTRUCTION OF THE PROJECT.
2. IN GENERAL, ALL CONSTRUCTION ACTIVITIES SHALL PROCEED IN SUCH A MANNER SO AS NOT TO POLLUTE ANY WETLANDS, WATERCOURSE, WATERBODY, AND CONDUIT CARRYING WATER, ETC. THE CONTRACTOR SHALL LIMIT, IN SO FAR AS POSSIBLE, THE SURFACE AREA OF EARTH MATERIALS EXPOSED BY CONSTRUCTION METHODS AND IMMEDIATELY PROVIDE PERMANENT AND TEMPORARY POLLUTION CONTROL MEASURES TO PREVENT CONTAMINATION OF ADJACENT WETLANDS, WATERCOURSES, AND WATERBODIES, AND TO PREVENT, IN SO FAR AS POSSIBLE, EROSION ON THE SITE.
3. BEST MANAGEMENT PRACTICES FOR EROSION CONTROL SHALL BE IMPLEMENTED AND MAINTAINED AT ALL TIMES DURING CONSTRUCTION IN ACCORDANCE WITH THE ALABAMA CONSTRUCTION GENERAL PERMIT (ALR100000) AND THE PROJECT CONSTRUCTION BEST MANAGEMENT PRACTICES PLAN (CBMPP). METHODS SHALL INCLUDE, BUT ARE NOT LIMITED TO THE USE OF STAKED FILTER CLOTH, FILTER SOCK, SODDING, SEEDING, MULCHING, AND STAGED CONSTRUCTION.

SITE GRADING

GENERAL:

1. THE RESHAPING OF THE GROUND SURFACE BY EXCAVATION AND FILLING OR A COMBINATION OF BOTH, TO OBTAIN PLANNED GRADES, SHALL PROCEED IN ACCORDANCE WITH THE FOLLOWING CRITERIA:

a. THE PERMANENT CUT FACE OF EARTH EXCAVATION SHALL NOT BE STEEPER THAN THREE HORIZONTAL TO ONE VERTICAL (3:1), UNLESS NOTED OTHERWISE (UNO).

b. THE PERMANENT EXPOSED FACES OF FILLS SHALL NOT BE STEEPER THAN THREE HORIZONTAL TO ONE VERTICAL (3:1), UNO.

c. TEMPORARY CONSTRUCTION FACES OF FILLS AND EXCAVATION CUTS SHALL NOT BE STEEPER THAN ONE AND A HALF HORIZONTAL TO ONE VERTICAL (1.5:1).

d. PROVISION SHOULD BE MADE TO CONDUCT SURFACE WATER SAFELY TO DRAINAGE DITCHES TO PREVENT SURFACE RUNOFF FROM DAMAGING CUT FACES AND FILL SLOPES.

e. NO FILL SHOULD BE PLACED WHERE IT WILL SLIDE OR WASH UPON ADJACENT WETLANDS, WATERCOURSES, OR WATERBODIES.

f. PRIOR TO ANY REGRADING, A STABILIZED CONSTRUCTION ENTRANCE SHALL BE PLACED AT THE ENTRANCE TO THE WORK AREA IN ORDER TO REDUCE MUD AND OTHER SEDIMENTS FROM LEAVING THE SITE. AT COMPLETION OF WORK, CONSTRUCTION ENTRANCE SHALL BE REMOVED AND THE AREA STABILIZED AND RETURNED TO THE PRE-CONSTRUCTION CONDITIONS.

TEMPORARY VEGETATIVE COVER

GENERAL:

1. TEMPORARY VEGETATIVE COVER SHALL BE IN ACCORDANCE WITH ALDOT STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION - ITEM 665.
2. DISTURBED AREAS SHALL BE STABILIZED WITHIN 14 DAYS AFTER CONSTRUCTION ACTIVITY HAS TEMPORARILY OR PERMANENTLY CEASED, WITH TWO EXCEPTIONS: WHEN SNOW COVER PRECLUDES CONSTRUCTION OR WHEN CONSTRUCTION WILL RESUME WITHIN 21 DAYS.

SITE PREPARATION:

1. INSTALL REQUIRED SURFACE WATER CONTROL MEASURES.
2. REMOVE LOOSE ROCK, STONE, AND CONSTRUCTION DEBRIS FROM AREA.
3. TILLAGE SHOULD ACHIEVE A REASONABLY UNIFORM LOOSE SEEDBED.

ESTABLISHMENT:

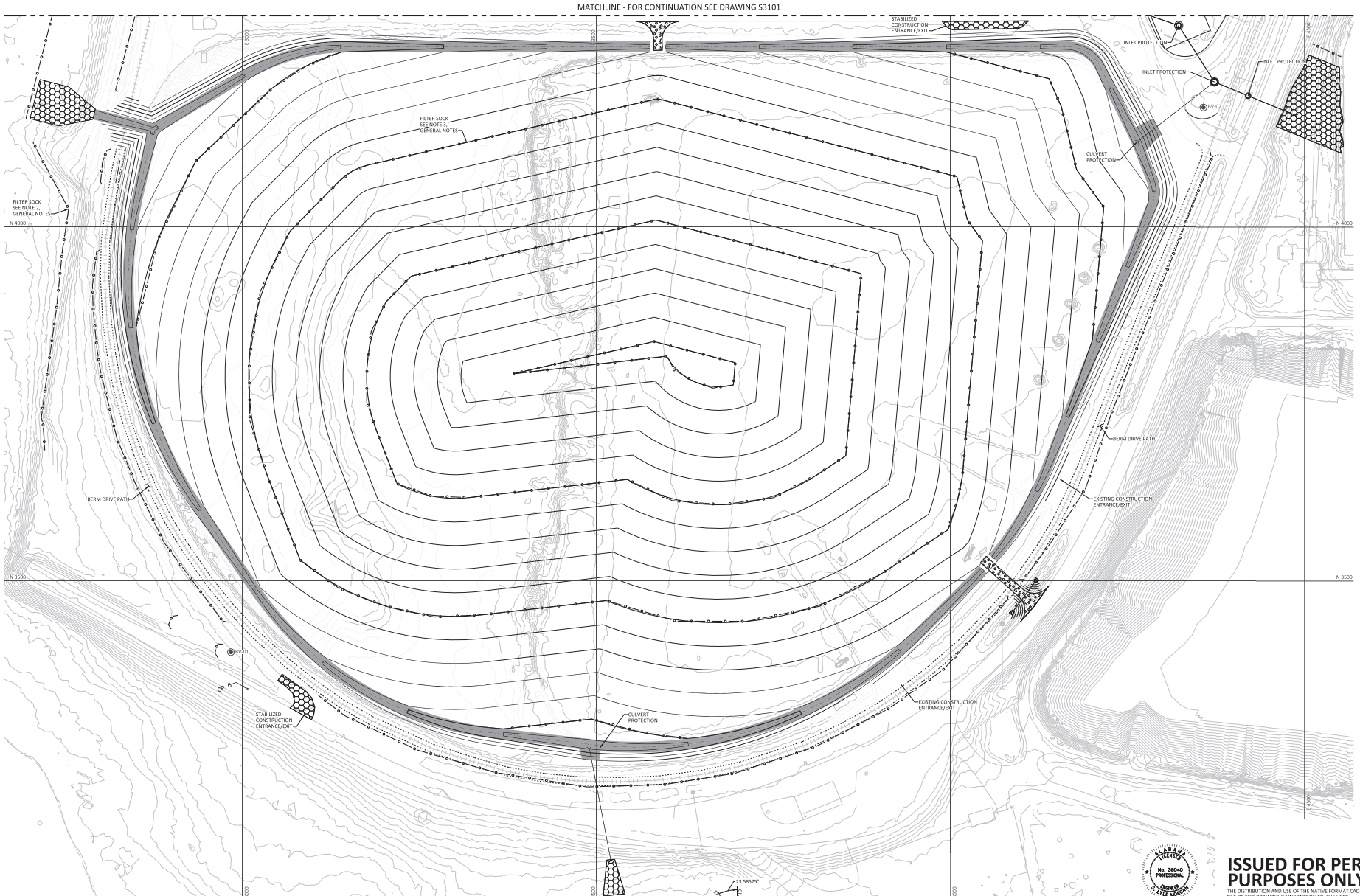
1. SELECT APPROPRIATE SPECIES FOR THE SITUATION. NOTE RATES AND SEEDING DATES AS SPECIFIED BY SEEDING SUPPLIER.
2. APPLY SEED UNIFORMLY ACCORDING TO THE RATE INDICATED BY BROADCASTING, DRILLING, OR HYDRAULIC APPLICATION.
3. UNLESS HYDROSEEDED, COVER SEEDS WITH NOT MORE THAN 1/4 INCH OF SOIL USING SUITABLE EQUIPMENT.
4. MULCH IMMEDIATELY AFTER SEEDING AS REQUIRED. APPLY STRAW OR HAY MULCH AND ANCHOR TO SLOPES GREATER THAN 3% OR WHERE CONCENTRATED FLOW WILL OCCUR.

PERMANENT VEGETATIVE COVER

1. ALL DISTURBED AREAS NOT STABILIZED WITH RIPRAP, AGGREGATE, OR CONCRETE SHALL BE SEEDED WITH PERMANENT VEGETATIVE COVER.

SEDIMENT CONTROL MEASURES

1. TEMPORARY PERVIOUS BARRIERS USING FILTER SOCK OR RIPRAP SHALL BE INSTALLED AND MAINTAINED WHERE INDICATED ON THE DRAWINGS AND AS REQUIRED TO REDUCE SEDIMENTATION IN AREAS DEEMED APPROPRIATE DURING CONSTRUCTION.
2. CULVERT INLET PROTECTION SHALL BE INSTALLED AT ALL CULVERT INLETS WHERE INDICATED ON THE DRAWINGS AND AT ANY OTHER EXISTING CULVERTS DOWNSTREAM OF CONSTRUCTION ACTIVITIES.
3. AN INLET SEDIMENT FILTER SHALL BE INSTALLED AT NEW INLETS AND AT EXISTING INLETS INDICATED ON THE DRAWINGS, AND AT ANY OTHER EXISTING INLETS DOWNSTREAM OF CONSTRUCTION ACTIVITIES. SEE DRAWING S3920 FOR DETAILS.
4. ALL SEDIMENT CONTROL MEASURES SHALL BE MAINTAINED UNTIL THE ENTIRE DRAINAGE AREA IS STABILIZED.
5. COMPOST FILTER SOCK PROTECTION FOR SHEET FLOW RUNOFF SHALL BE INSTALLED WHERE INDICATED ON THE DRAWINGS, GENERALLY AT THE TOP OF THE SLOPE OF THE POND. IF THE LOCATIONS INDICATED ON THE DRAWINGS ARE GRADED AWAY FROM THE SLOPE (AS A DIVERSION BERM), THEN NO COMPOST FILTER SOCK IS REQUIRED AT THOSE LOCATIONS.



I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF ALABAMA.

SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 36040-E

ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER S. LYLE MORGAN
Morgan, S. Lyle
2021.03.19 21:42:00-04'00'

ISSUED FOR PERMITTING PURPOSES ONLY

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	EMR	LM	LM	MEM

BLACK & VEATCH

DESIGNER	DRAWN
EMR	MEM
CHECKED	DATE
LM	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
EROSION CONTROL - SITE PLAN - AREA 1

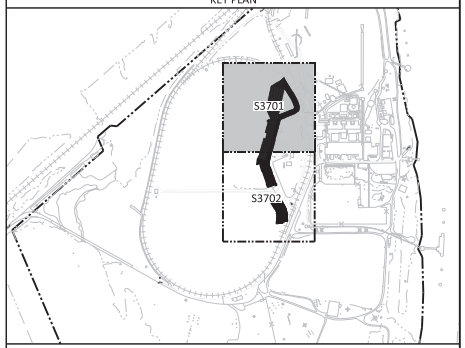
PROJECT	DRAWING NUMBER	REV
404320-CSTE-S3102		0
CODE		
AREA		

MicroStation v10.11.0.36
Full Size 1 = 1
mcc87792
11/11/2020 10:34 AM

NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. THIS DRAWING SHOWS THE AREAS OF EXCAVATED WASTE IN THE NORTHEAST CORNER OF FGD POND AND ALONGSIDE THE ROAD IN THE WATER TREATMENT AREA.
3. EXISTING POND SLOPE IS 2:1 (H:V). TOP OF SLOPE IS APPROXIMATELY EL 42. BOTTOM OF POND IS EL 15.35. FIELD VERIFICATION OF THE LIMITS OF EXISTING WASTE IS REQUIRED. AS SHOWN ON THIS DRAWING, ALL WASTE (INCLUDING CONTAMINATED RIP RAP) ON THE EAST SIDE OF THE PROPOSED EDGE OF WASTE DEMARCATION LINE SHALL BE ENTIRELY REMOVED AND RELOCATED TO THE WEST SIDE OF PROPOSED EDGE OF WASTE DEMARCATION LINE AND PLACED UNDER THE LINER. EXCAVATED AREAS SHALL BE BACKFILLED WITH CLEAN FILL AND GRADED AS INDICATED ON S3000 SERIES DRAWING.
4. EXCAVATED SLOPE FOR THE WASTE WILL VARY PENDING FIELD CONDITIONS. THE 4:1 (H:V) SLOPE SHOWN IS AN ESTIMATE.
5. EXCAVATION SHALL AVOID DISTURBING THE EXISTING 12" HDPE PIPE. CONTRACTOR SHALL COORDINATE WORK WITH OWNER.

KEY PLAN



ALABAMA LICENSED No. 38040 PROFESSIONAL ENGINEER S. LYLE MORGAN

Morgan, S. Lyle
2021.03.19 21:42:30-04'07'

ISSUED FOR PERMITTING PURPOSES ONLY

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	DWR	LM	LM	MEM

30' 20' 10' 0 30' 60'
1"=30'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF ALABAMA.
SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 38040-E

BLACK & VEATCH

DESIGNER	DRAWN
EMR	MEM
CHECKED	DATE
LM	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE

EXCAVATION - SITE PLAN - AREA 1

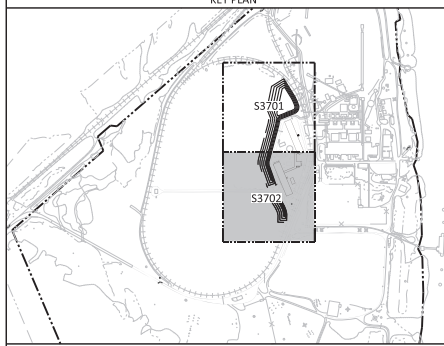
PROJECT	DRAWING NUMBER	REV
404320-CSTF-S3701		0
CODE		
AREA		

mcd7792
MicroStation v10.11.0.36
Full Size 1 = 1
11/11/2020 10:33 AM

NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. THIS DRAWING SHOWS THE AREAS OF EXCAVATED WASTE ALONGSIDE THE ROAD IN THE WATER TREATMENT AREA.
3. EXISTING POND SLOPE IS 2:1 (H:V). TOP OF SLOPE IS APPROXIMATELY EL 42. BOTTOM OF POND IS EL 15.35. FIELD VERIFICATION OF THE LIMITS OF EXISTING WASTE IS REQUIRED. AS SHOWN ON THIS DRAWING, ALL WASTE (INCLUDING CONTAMINATED RIP RAP) ON THE EAST SIDE OF THE PROPOSED EDGE OF WASTE DEMARCATION LINE SHALL BE ENTIRELY REMOVED AND RELOCATED TO THE WEST SIDE OF PROPOSED EDGE OF WASTE DEMARCATION LINE AND PLACED UNDER THE LINER. EXCAVATED AREAS SHALL BE BACKFILLED WITH CLEAN FILL AND GRADED AS INDICATED ON S3000 SERIES DRAWING.
4. EXCAVATED SLOPE FOR THE WASTE WILL VARY PENDING FIELD CONDITIONS. THE 4:1 (H:V) SLOPE SHOWN IS AN ESTIMATE.
5. EXCAVATION SHALL AVOID DISTURBING THE EXISTING 12" HDPE PIPE. CONTRACTOR SHALL COORDINATE WORK WITH OWNER.

KEY PLAN



ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER S. LYLE MORGAN
Morgan, S. Lyle
2021.03.19 21:42:35-04'00'

ISSUED FOR PERMITTING PURPOSES ONLY

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	03/NOV/20	ISSUED FOR PERMITTING	MEM	EMR	LM	LM	MEM

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SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 36040-E

BLACK & VEATCH

DESIGNER	DRAWN
EMR	MEM
CHECKED	DATE
LM	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE

EXCAVATION - SITE PLAN - AREA 2

PROJECT 404320-CSTF-S3702
DRAWING NUMBER
REV 0
CODE
AREA

30' 20' 10' 0 30' 60'
1"=30'

MicroStation v10.11.0.36
Full Size 1 = 1
mcc87792
11/11/2020 10:32 AM

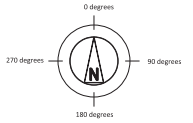
CULVERT TABLE								
CULVERT NO.	DRAWING NO.	PIPE SIZE INCH	NUMBER OF BARRELS	LENGTH FEET	END TYPE FOR INLET	END TYPE FOR OUTLET	PIPE MATERIAL	REMARKS
C-100	S3001	36	1	125	BEVELED	FLARED	CHDPE	
C-101	S3005	36	1	160	BEVELED	FLARED	CHDPE	
C-102	S3004	48	1	85	BEVELED	FLARED	CHDPE	
C-103	S3001	15	1	102	BEVELED	FLARED	CHDPE	
C-104	S3003	18	1	111.5	BEVELED	FLARED	CHDPE	
C-105	S3006	12	1	46	BEVELED	FLARED	RCP	

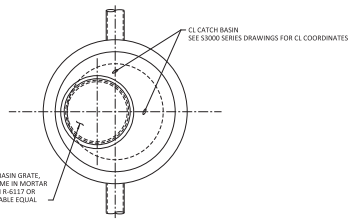
RIPRAP TABLE														
CULVERT/ OUTFALL NO.	DRAWING NO.	INLET D50 INCH	INLET T INCH	INLET L FEET	INLET W1 FEET	INLET W2 FEET	OUTLET D50 INCH	OUTLET T INCH	OUTLET L FEET	OUTLET W1 FEET	OUTLET W2 FEET	TYPE	REMARKS
C-100	S3001	-	-	-	-	-	6	14	17	9	22	1	SEE NOTE 2
C-101	S3005	-	-	-	-	-	8	18	50	9	29	2	SEE NOTE 2
C-102	S3004												SEE NOTE 2
EOP-100	S3004	-	-	-	-	-	15	32	86	-	-	3	SEE NOTE 2
C-103	S3001	-	-	-	-	-	6	14	40	15	55	1	SEE NOTE 2
C-104	S3003	-	-	-	-	-	6	14	40	15	55	1	SEE NOTE 2
OUTFALL #4	S3003	-	-	-	-	-	6	14	40	15	55	1	SEE NOTE 2
OUTFALL #3	S3003	-	-	-	-	-	8	18	42	13	37	1	SEE NOTE 2
C-105	S3006	6	6	4	3	6	6	6	4	3	6	2	SEE NOTE 2

NOTES

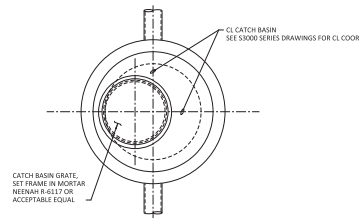
1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. THE RIPRAP D50 SIZES ARE THE MINIMUM ALLOWED. BASED ON THE SELECTED RIPRAP GRADATION, THE THICKNESS OF THE RIPRAP LAYER SHALL BE INCREASED IF NECESSARY TO MEET THE FOLLOWING REQUIREMENTS: THE THICKNESS SHALL BE AT LEAST 1.5 TIMES THE MAXIMUM STONE SIZE. THE THICKNESS SHALL BE AT LEAST 2.2 TIMES THE D50 SIZE. RIPRAP CONFORMING TO ALDOT STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION SECTION 814, CLASS 1 OR 2 IS ALLOWED AS LONG AS IT PROVIDES THE D50 SIZE MINIMUM ALLOWED IN THE TABLE.

DRAINAGE STRUCTURE TABLE																
ID	DRAWING NO.	STRUCTUE INSIDE DIAMETER FEET	TOP OF GRATE EL	BOTTOM OF SLAB TOC EL	ALL PIPE IS CHDPE, UNLESS NOTED OTHERWISE											REMARKS
					PIPE 1			PIPE 2			PIPE 3			PIPE 4		
					DIA	INV EL	DEGREES	DIA	INV EL	DEGREES	DIA	INV EL	DEGREES	DIA	INV EL	DEGREES	
CB-100	S3004	6	41.00	35.45	48	35.95	148	48	35.95	289							
CB-101	S3004	8	41.00	33.95	48	34.45	112	42	34.45	232	48	34.45	328				
CB-102	S3004	6	41.00	33.69	48	34.19	112	48	34.19	292							
CB-103	S3004	4	41.90	36.35	30	36.85	90										
CB-104	S3004	4	41.90	35.75	30	36.25	86	30	36.25	270							





PLAN



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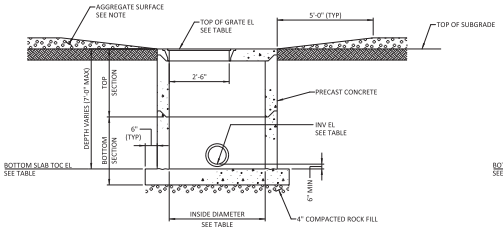
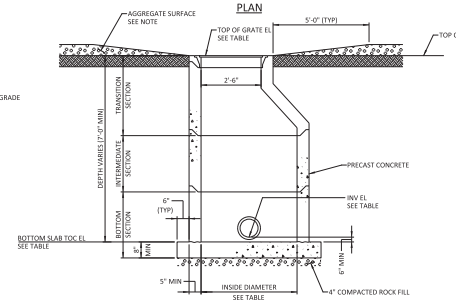


SECTION

NOTE: AGGREGATE SURFACING SHALL TRANSITION FROM 0 AT THE EDGE OF THE CATCH BASIN TO FULL DEPTH WITHIN 5' OF THE CATCH BASIN EDGE

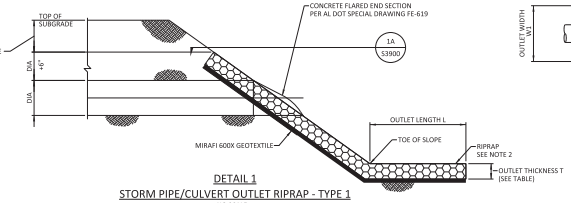
TYPICAL PRECAST CATCH BASIN UNDER 7'-0"
NO SCALE



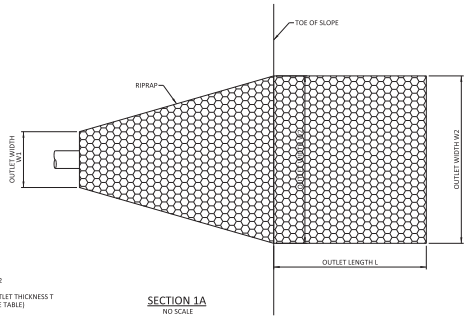
SECTION

NOTE: AGGREGATE SURFACING SHALL TRANSITION FROM 0 AT THE EDGE OF THE CATCH BASIN TO FULL DEPTH WITHIN 5' OF THE CATCH BASIN EDGE

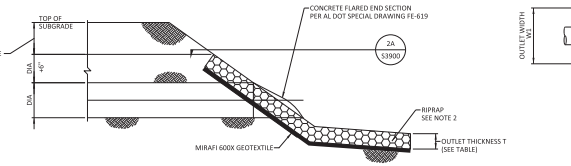
TYPICAL PRECAST CATCH BASIN 7'-0" AND OVER
NO SCALE



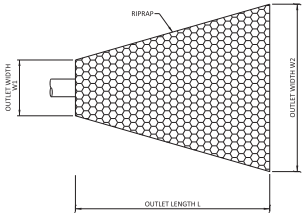
DETAIL 1
STORM PIPE/CULVERT OUTLET RIPRAP - TYPE 1
NO SCALE



SECTION 1A
NO SCALE
THIS DRAWING



DETAIL 2
STORM PIPE/CULVERT OUTLET RIPRAP - TYPE 2
NO SCALE



SECTION 2A
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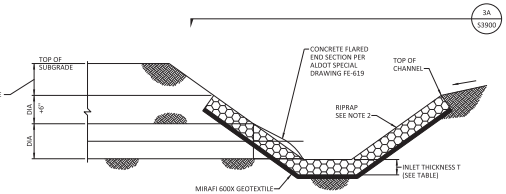
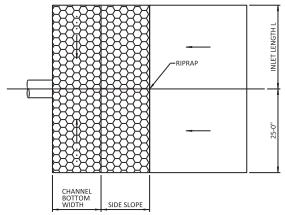
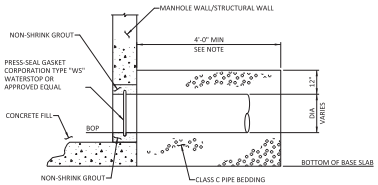


DETAIL 3
STORM PIPE/CULVERT INLET RIPRAP - TYPE 3
NO SCALE



SECTION 3A
NO SCALE
THIS DRAWING



NOTE: CLASS C PIPE BEDDING TO LIMITS SHOWN OR EDGE OF MANHOLE EXCAVATION WHICHEVER IS GREATER.

DETAIL 4
TYPICAL WALL PENETRATION
NO SCALE

ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER S. LYLE MORGAN
Digitally signed by S. Lyle Morgan
2021.03.19 21:42:16-04'07'

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	30/OCT/2020	ISSUED FOR PERMITTING	MEM	EMR	LM	LM	MEM

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF ALABAMA.
SIGNED S. LYLE MORGAN
DATE 30/OCT/2020 REG NO. 36040-E

BLACK & VEATCH

DESIGNER	DRAWN
EMR	MEM
CHECKED	DATE
LM	30/OCT/2020

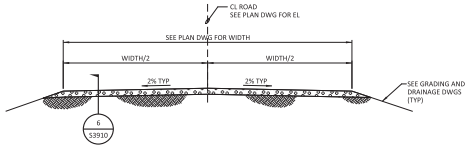
POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
GRADING & DRAINAGE - SITE
SECTIONS & DETAILS

PROJECT	DRAWING NUMBER	REV
404320-CSTF-S3900		0
CODE		
AREA		

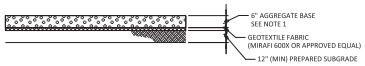
mcd7792
MicroStation v10.11.0.36
Full Size 1 = 1
10/30/2020 04:35 PM

NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.
2. CONTRACTOR SHALL ENSURE NO CCR MATERIAL REMAINS OUTSIDE THE PERIMETER OF THE LINER ANCHOR AS SHOWN IN DETAIL 4.

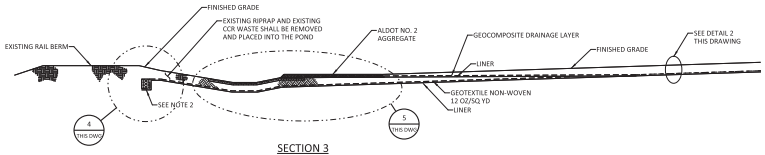


SECTION 1
AGGREGATE SURFACE ROAD
NO SCALE

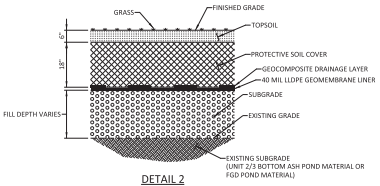


NOTE 1. AGGREGATE BASE SHALL CONFORM TO ALDOT SPECIFICATION 825, TYPE A.

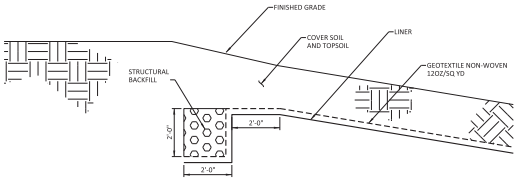
SECTION 6
SEE THIS DWG
NO SCALE



SECTION 3
SEE DWG S3001
NO SCALE



DETAIL 2
TYPICAL POND CAP SECTION
NO SCALE



DETAIL 4
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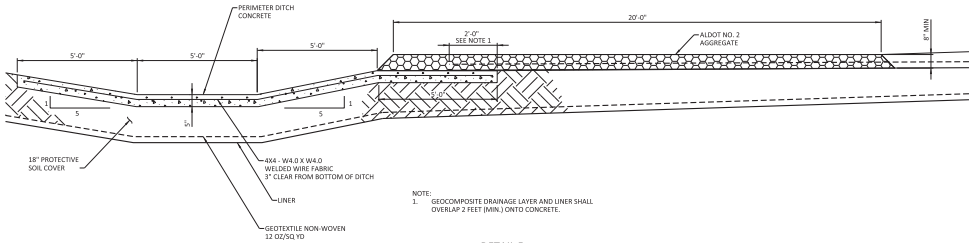

NOTE:
1. GEOCOMPOSITE DRAINAGE LAYER AND LINER SHALL OVERLAP 2 FEET (MIN.) ONTO CONCRETE.

DETAIL 5
SEE THIS DWG
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ALABAMA LICENSED No. 34040 PROFESSIONAL ENGINEER
Morgan T. Lyle
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SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 36040-E

BLACK & VEATCH

DESIGNER EMR | DRAWN MEM | CHECKED LM | DATE 03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
GRADING & DRAINAGE - SITE
SECTIONS & DETAILS

PROJECT 404320-CSTA-S3910
DRAWING NUMBER
REV 1
CODE
AREA

MicroStation v10.11.0.36
Full Size 1 = 1
mcd7792
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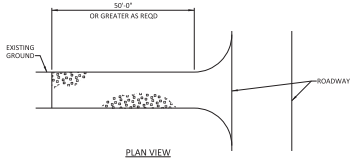
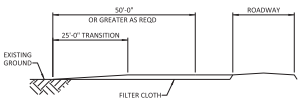
NOTES

1. SEE DRAWING S3000 FOR GENERAL NOTES AND LEGEND.



PLAN VIEW

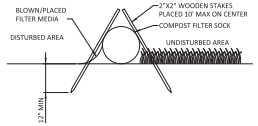


PROFILE

NOTES:
1. PROVIDE APPROPRIATE TRANSITION BETWEEN STABILIZED CONSTRUCTION ENTRANCE AND PUBLIC R.O.W.
2. DESIGN CRITERIA FOR STABILIZED CONSTRUCTION ENTRANCE.

A. STONE SIZE - USE ASTM C-33, SIZE NO. 2 OR 3, USE CRUSHED STONE.
B. THICKNESS - NOT LESS THAN 8 INCHES.
C. WIDTH - NOT LESS THAN FULL WIDTH OF POINTS OF INGRESS OR EGRESS.
D. LENGTH - 50 FEET MINIMUM WHERE THE SOILS ARE SANDS OR GRAVEL OR 100 FEET MINIMUM WHERE SOILS ARE CLAYS OR SILTS, EXCEPT WHERE THE TRAVELED LENGTH IS LESS THAN 50 OR 100 FEET RESPECTIVELY. THESE LENGTHS MAY BE INCREASED WHERE FIELD CONDITIONS DICTATE.
E. FILTER CLOTH - WILL BE PLACED OVER ENTIRE AREA PRIOR TO PLACING OF STONE.
F. MAINTENANCE - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ON TO PUBLIC RIGHT-OF-WAY THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR ADDITIONAL LENGTH AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHT-OF-WAY MUST BE REMOVED IMMEDIATELY.

TYPICAL STABILIZED CONSTRUCTION ENTRANCE
NO SCALE



SECTION VIEW
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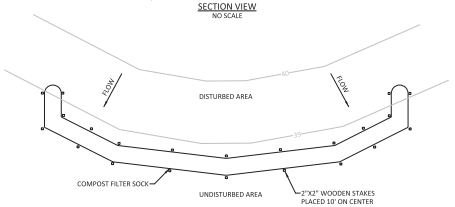


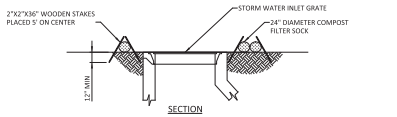
PLAN VIEW

NOTES:
1. COMPOST FILTER SOCK SHALL BE 12 INCH DIAMETER MINIMUM. ALTERNATE DIAMETERS OR STACKED COMPOST FILTER SOCKS SHALL BE USED IF NEEDED TO BLOCK SEDIMENT IN RUNOFF.
2. TRAFFIC SHALL NOT BE PERMITTED TO CROSS FILTER SOCKS.
3. ACCUMULATED SEDIMENT SHALL BE REMOVED WHEN IT REACHES 1/2 THE ABOVE GROUND HEIGHT OF THE SOCK AND DISPOSED IN THE MANNER DESCRIBED ELSEWHERE IN THE PLAN.
4. SOCKS SHALL BE INSPECTED WEEKLY AND AFTER EACH RUNOFF EVENT. DAMAGED SOCKS SHALL BE REPAIRED ACCORDING TO MANUFACTURER'S SPECIFICATIONS OR REPLACED WITHIN 24 HOURS OF INSPECTION.
5. BIODEGRADABLE FILTER SOCK SHALL BE REPLACED AFTER 6 MONTHS, PHOTODEGRADABLE SOCKS AFTER 1 YEAR. POLYPROPYLENE SOCKS SHALL BE REPLACED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
6. UPON STABILIZATION OF THE AREA TRIBUTARY TO THE SOCK, STAKES SHALL BE REMOVED. THE SOCK MAY BE REMOVED OR LEFT IN PLACE AND VEGETATED. IN THE LATTER CASE, THE MESH SHALL BE CUT OPEN AND THE MULCH SPREAD AS A SOIL SUPPLEMENT.

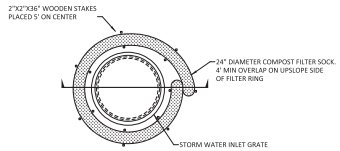
COMPOST STANDARDS

ORGANIC MATTER CONTENT = 80%-100% (DRY WEIGHT BASIS)	ORGANIC PORTION = FIBROUS AND ELONGATED
PARTICLE SIZE = 98% PASS THROUGH 1" SCREEN	pH = 5.5 - 8.0
SOLUBLE SALT CONCENTRATION = 5.0 dS MAXIMUM	MOISTURE CONTENT = 35% - 55%

COMPOST FILTER SOCK - LINEAR INSTALLATION DETAIL
NO SCALE

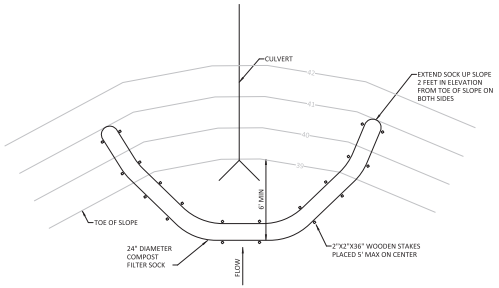


SECTION



PLAN VIEW

INLET PROTECTION
COMPOST FILTER SOCK SEDIMENT FILTER
NO SCALE



CULVERT PROTECTION
COMPOST FILTER SOCK SEDIMENT FILTER
NO SCALE

ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER S. LYLE MORGAN
Morgan, S. Lyle
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SIGNED S. LYLE MORGAN
DATE 03/NOV/20 REG NO. 36040-E

BLACK & VEATCH

DESIGNER	DRAWN
EMR	MEM
CHECKED	DATE
LM	03/NOV/20

POWER SOUTH ENERGY COOPERATIVE
LOWMAN CCR POND CLOSURE
EROSION CONTROL - SITE
TYPICAL EROSION CONTROL DETAILS

PROJECT	DRAWING NUMBER	REV
404320-CSTE-S3920		1
CODE		
AREA		

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4.0 Construction Quality Assurance Plan

The Construction Quality Assurance Plan is attached and included with this submittal.

REV 1

CONSTRUCTION QUALITY ASSURANCE PLAN (CQAP)

B&V PROJECT NO. 404320
B&V FILE NO. 71.0202

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PREPARED FOR

PowerSouth Energy Cooperative

19 MARCH 2021

ALABAMA LICENSED
No. 36040
PROFESSIONAL
ENGINEER
S. LYLE MORGAN

Morgan, S. Lyle
2021.03.19 21:44:12-04'00'

BLACK & VEATCH

Reviewed by: Gary Sommerfeld — 3/19/21

Signature — **Date**

Gary Sommerfeld

Printed Name

Reviewed by: 3/19/21

Signature — **Date**

Monty Hintz

Printed Name

Professional Engineer:

Signature — **Date**

Printed Name

License No.

Approved by: 3/19/21

Signature — **Date**

Alissa Smith

Printed Name

Table of Contents

1.0 Introduction 1-1
2.0 Responsibility, Qualifications, and Authority 2-1
2.1 Responsibility of Parties Involved in Construction Quality Assurance 2-1
2.1.1 Alabama Department of Environmental Management 2-1
2.1.2 Owner 2-1
2.1.3 Professional Engineering Firm 2-1
2.1.4 CQA Officer 2-1
2.1.5 Construction Contractor 2-2
2.1.6 Other Contractors 2-3
2.1.7 CQA Laboratories 2-3
2.1.8 Geosynthetic Manufacturer 2-3
2.1.9 Geosynthetic Installer 2-3
2.1.10 Contractor CQC Laboratory 2-3
3.0 Project Meetings 3-1
3.1 Construction Sequencing Narrative 3-1
3.2 Preconstruction Meeting 3-1
3.2.1 Site Investigations 3-1
3.3 Weekly Progress Meetings 3-2
3.4 Work Deficiency Meetings 3-2
4.0 Earthwork Components 4-1
4.1 Subgrade – General Fill 4-1
4.2 Cover Soil 4-1
4.3 Topsoil 4-2
4.4 Field and Laboratory Testing 4-2
4.4.1 Sampling Basis 4-2
4.4.2 Sampling Size 4-3
4.4.3 Deficiencies 4-3
4.4.4 Testing Requirements 4-3
4.4.5 Qualified Testing Laboratory 4-3
5.0 Geosynthetic Components 5-1
5.1 Manufacturing, Shipping, Testing, and Storage 5-1
5.1.1 Manufacturing 5-1
5.1.2 Shipping and Handling 5-2
5.1.3 Storage 5-2
5.1.4 Conformance Testing 5-2
5.1.5 Sample Collection 5-2
5.2 Geomembrane Installation 5-3

5.2.1 Earthwork 5-3
5.2.2 Geomembrane Placement 5-3
5.2.3 Field Seaming 5-4
5.2.4 Geomembrane Liner Certification/Acceptance 5-12
5.3 Geocomposite Installation 5-13
5.3.1 Handling and Placement 5-13
5.3.2 Stacking and Joining 5-13
5.3.3 Repair 5-14
5.3.4 Placement of Cover Soil 5-14
6.0 Surveying 6-1
6.1 Survey Control 6-1
6.2 Surveying Personnel 6-1
6.3 Precision and Accuracy 6-1
6.4 Lines and Grades 6-1
6.5 Frequency and Spacing 6-1
6.6 Tolerances 6-2
6.7 Documentation 6-2
7.0 Documentation 7-1
7.1 Daily Recordkeeping 7-1
7.1.1 Daily Summary Report 7-1
7.2 Construction Problems and Solution Report 7-2
7.3 Photographic Reporting and Data Sheets 7-2
7.4 Design and/or Specification Changes and Clarifications 7-2
7.5 Reports 7-2
7.5.1 Final Documentation 7-3
Appendix A. CQC/CQA Testing A-1
Appendix B. Forms B-1

1.0 Introduction

Black & Veatch has prepared this construction quality assurance plan (CQAP) for the closure of the interconnected, multiunit CCR treatment system located at Power South's (Owner) Lowman Power Plant (LPP). The multiunit CCR treatment system consist of the Unit 2/3 Ash Pond and the Flue Gas Desulfurization (FGD) Pond.

This CQAP outlines the program to be implemented before, during, and after construction for the following elements.

- Regrading of CCR materials
- Import Fill and Subgrade Preparation
- Placement of Flexible Membrane Liner
- Placement of Geocomposite Drainage Material
- Placement of Protective Soil Cover and Topsoil
- Finished Grading

Construction Quality Assurance (CQA) is defined as a planned system of activities/inspections that are used to directly monitor and control the quality of construction. The CQA will provide assurance that the facility is constructed as specified on the associated drawings and per this CQAP based on testing results and field observations. CQA includes testing, inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. The Owner or their subcontractor will perform CQA activities to ensure compliance with the drawings and this CQAP for the project.

2.0 Responsibility, Qualifications, and Authority

2.1 Responsibility of Parties Involved in Construction Quality Assurance

The responsibilities of the parties involved in CQA for construction of the impoundment closures are described in this section.

2.1.1 Alabama Department of Environmental Management

Alabama Department of Environmental Management (ADEM) has the regulatory authority for approval or denial of state environmental permits required for the facility. The ADEM Land Division – Solid Waste Program has the authority to review all CQA/CQC program documentation prior to, during, and after construction to confirm that the program was followed and the facility was constructed as intended and is in conformance with the CQA plan.

2.1.2 Owner

The Owner is responsible for implementing the requirements of this CQAP. The Owner will assign a CQA Officer and other qualified entities to perform CQA activities/inspections.

The Owner has the authority to select and dismiss parties charged with design and construction activities. The Owner also has the authority to accept or reject drawings and the materials and workmanship of the contractor(s). The Owner will be responsible for specification of corrective measures where deviation from the drawings is detected during CQA activities.

2.1.3 Professional Engineering Firm

The Owner may use a professional engineering firm (PEF) on an as needed basis.

Black & Veatch Corporation (BV) was retained by the Owner to design the closure for each impoundment and associated elements in accordance with the CCR rules. BV may revise component designs to meet unexpected site conditions or as changes in construction methodology occur that could adversely affect facility performance.

BV has been tasked with preparation of this site-specific CQAP for the CCR impoundments closures and associated facilities.

2.1.4 CQA Officer

The Owner will retain a CQA Officer to verify the results of the CQA testing and to compile and complete the final CQA report. The CQAP will be implemented through field observation and testing during construction.

The CQA Officer will have the following responsibilities:

- Review CQA testing/monitoring activities to assess compliance with the specifications, drawings, and this CQAP.
- Monitor and review the work in progress to assess compliance with the drawings and this CQAP.
- Review and approve the Contractor's Quality Control (CQC) Plan.
- Review the results of CQC field tests, measurements, and laboratory analysis for conformance with the drawings and this CQAP.

- Communicate to the Contractor work that is accepted, rejected, needs to be uncovered for observation, or that may require special testing, review, or approval.
- Confirm with the Contractor that any corrective measures are accepted.
- Direct the work of CQA technicians in the process of observations and testing activities. The CQA technicians will report directly to the CQA Officer.
- Prepare a certified CQA report for submittal to ADEM. The report will provide ADEM with a final Certification Report that confirms work has been performed in accordance with the project documents and ADEM regulations.

The CQA Officer will possess sufficient practical, technical, and administrative experience to execute and record monitoring/testing activities. The CQA Officer will have knowledge of field practices relating to soil testing, geosynthetic material installation, practical construction techniques, observation and testing procedures, equipment, and documentation procedures.

The CQA Officer will convey CQA related matters to the Contractor and will assure the matters are addressed by the Contractor.

2.1.5 Construction Contractor

The Construction Contractor is responsible for construction of the impoundment covers in accordance with the project drawings and this plan. Construction of the covers will include:

- Regrading the existing CCR materials.
- Placement, compaction, and grading of imported fill.
- Ongoing dewatering of ponds during construction through dewatering treatment equipment.
- Installation of the flexible membrane liner.
- Installation of the geocomposite drainage layer.
- Placement and grading of cover soil and topsoil.
- Construction and grading of erosion control features.
- Seeding all disturbed areas.
- Installation of concrete perimeter ditch lining and stormwater discharge outfall structures.
- Coordinating with a third-party firm to perform CQC testing, including field tests and measurements, and laboratory analysis.

The Construction Contractor will be responsible for construction management, construction administration, scheduling, and construction quality control (CQC) including field coordination, field testing and surveying. To complete the impoundment closures, the Construction Contractor may utilize subcontractors for portions of the work. The final submittals will be required prior to final acceptance of construction efforts.

The Construction Contractor will be pre-qualified and approved by the Owner. The Construction Contractor will be capable of assigning the personnel and equipment required to perform the work within schedule.

2.1.6 Other Contractors

The Construction Contractor or Owner may solicit other contractors or subcontractors to complete the procurement and construction of the impoundment closures components and other auxiliary facilities as required. These subcontractors will be required to implement a CQC plan.

2.1.7 CQA Laboratories

CQA geosynthetic laboratories will be pre-qualified and approved by the Owner. The geosynthetic laboratories will be experienced in performing laboratory tests to determine characteristic as required in the specifications and the CQAP. The geosynthetic laboratories will demonstrate the firms follow standard test methods listed in the CQAP and maintain the appropriately calibrated equipment to perform tests. The geosynthetic laboratories will adhere to formal in-house quality control programs.

2.1.8 Geosynthetic Manufacturer

The Geosynthetic Manufacturer will be able to provide sufficient production capacity and experience to meet the demands of the project. The Geosynthetic Manufacturer and Manufacturer Quality Control program will be pre-approved by the Owner.

2.1.9 Geosynthetic Installer

The Geosynthetic Installer will be trained and qualified to install the manufacturer's geosynthetics. The Geosynthetic Installer will provide the Owner with the professional record of a proposed field superintendent. The proposed field superintendent will have sufficient experience for the materials used in the impoundment closure.

2.1.10 Contractor CQC Laboratory

The CQC Laboratory provided by the Contractor will be pre-qualified and approved by the Owner. Personnel of the testing firm will possess adequate training for activities/testing they will be performing.

3.0 Project Meetings

3.1 Construction Sequencing Narrative

To achieve a high degree of quality during construction, clear, open channels of communication are essential. The following meetings should be held when appropriate. The Contractor will be required to prepare a construction schedule that provides the details for the sequencing of these construction activities.

3.2 Preconstruction Meeting

The contractor(s) and their respective CQC officers along with the CQA Officer will jointly review the project drawings and specifications and discuss the design concepts to provide an understanding of expected conditions, methods of construction, and the scope of the project drawings and specifications.

This meeting will be held to resolve uncertainties following the issuance of this CQAP and prior to beginning construction of the elements addressed in the plan. The Owner, the CQA Officer, the Contractors and subcontractors, and the Contractor's CQC officer should be present. The topics of these meetings include, but are not limited to:

- Providing each party with all relevant CQA documents and supporting information.
- Familiarizing each party with the CQAP and its role relative to the project drawings and specifications.
- Determining changes to the CQAP that are needed so that the impoundment closures will be constructed to meet or exceed the specified design.
- Reviewing the responsibilities of each party.
- Reviewing lines of authority and communication for each party.
- Reviewing procedures or protocol for observations and tests including sampling strategies.
- Reviewing the procedures or protocol for handling construction deficiencies, repairs, and retesting.
- Reviewing methods for documenting and reporting data.
- Reviewing methods for distributing and storing documents and reports.
- Reviewing procedures for locating and protecting construction materials from inclement weather or other adverse events.

The meeting will be documented via meeting minutes prepared by the CQA Officer and reviewed by the Contractor and the Owner.

3.2.1 Site Investigations

The Contractor will be responsible for verifying existing conditions prior to the preconstruction meeting. The work of dewatering the free water in the impoundments will be completed prior to construction of the closures. Trenches excavated during dewatering will not be backfilled during the dewatering work. Dewatering of interstitial water and stormwater will be ongoing throughout the duration of the construction. The Contractor will be required to observe the site conditions prior to mobilization to verify subgrade conditions and trenches that will require backfill. In addition, the Contractor will perform the following:

- Identify work area security and safety protocol.

- Conduct a site walk to review site conditions for the prevention of damage to materials, inclement weather, or other adverse events.
- Identify material staging and storage locations.
- Identify access roads, haul roads, site security, and project constraints due to construction of adjacent generation facilities.

3.3 Weekly Progress Meetings

A weekly progress meeting will be held between the CQA Officer, the Geosynthetic Installer, the contractor(s), the Owner, and other involved parties. Those attending will discuss, plan, coordinate the work, and identify CQA activities to be completed that week. More frequent meetings may be held if necessary to address construction issues. The meeting will be documented by the CQA Officer and minutes will be transmitted to all involved parties within one (1) week.

3.4 Work Deficiency Meetings

A special meeting will be held when and if a problem or deficiency, which would impact the construction schedule, is present or likely to occur and cannot wait to be addressed during regular weekly meetings. At a minimum, the meeting will be attended by the affected Contractor, any affected subcontractor, the Owner and the CQA Officer. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- Define and discuss the problem or deficiency
- Review alternative solutions
- Implement an action plan to resolve the problem or deficiency

The meeting will be documented by the CQA Officer and minutes will be transmitted within one (1) week to all involved parties.

4.0 Earthwork Components

Materials to be used for the general fill and site grading prior to placement of the geomembrane liner will be CCR materials and borrow fill. Materials used for cover soil and topsoil will be imported materials.

4.1 Subgrade – General Fill

The subgrade will be composed of existing CCR materials in each impoundment and imported general fill. The borrow source for the imported fill will be meet requirements related to material characteristics and construction quality. During construction, additional field and laboratory testing will be performed to confirm the subgrade components have been constructed in accordance with this CQAP, project specifications and drawings.

The subgrade materials will be graded to the planned slopes and elevations shown on the drawings. The final surface of the subgrade materials will be inspected to ensure no soft, structurally weak materials are present, and the surface is free of rocks, sticks, sharp objects, or other deleterious material. The Contractor will monitor depth of ruts that develop with the soil placement and grading equipment and repair as required. A steel-wheeled roller is required to construct a subgrade for contact with the geosynthetic liner. Soil used to construct the subgrade for the geomembrane liner will be observed and tested to confirm it meets the requirements provided in this CQAP, project specifications and drawings.

Initial monitoring of the subgrade will be largely visual as the underlying CCR material are sluiced materials and relatively large lifts of fill may be required for access by construction equipment. The CQA personnel will be familiar with visual-manual soil classification techniques (ASTM D2488).

Prior to placement of the geomembrane liner, the subgrade will be approved by the Contractor, the Geosynthetic Installer, and the CQA Officer.

The Contractor will maintain the subgrade condition until the geomembrane can be installed.

4.2 Cover Soil

Cover soil is the upper soil component of the impoundment lining system. The borrow source for the cover soil fill will meet requirements related to material characteristics and construction quality. Field and laboratory tests will be performed prior to construction to evaluate the borrow source properties. During construction, additional field and laboratory testing will be performed to confirm the cover soil has been constructed in accordance with this CQAP, project specifications and drawings.

Low ground pressure dozers may operate on a minimum thickness of 12 inches of cover soil over the geocomposite drainage layer. Haul trucks or other equipment that is not low ground pressure will only operate on a minimum thickness of 36 inches of soil over the geosynthetics to protect the underlying geosynthetic materials. The Contractor will monitor depth of ruts and ensure that rut depth does not reduce the thickness over the geosynthetics.

Thickness markers will be approved by the CQA Officer. Rigid grade stakes will not be permitted. The CQA Officer may request hand excavated test pits to verify thickness. Field survey control measurements will be recorded at the completion of the geosynthetic material installation and at the completion of the cover soil installation to document the cover soil thickness.

4.3 Topsoil

Topsoil is the final component of the impoundment lining system. The borrow source for the topsoil fill will meet requirements related to material characteristics and construction quality. The Contractor will perform field and laboratory tests prior to construction to evaluate the topsoil properties. During construction, additional field and laboratory testing will be performed to confirm the topsoil has been constructed in accordance with this CQAP, project specifications and drawings.

The Contractor will monitor depth of ruts and ensure that rut depth does not reduce the thickness and allow ponding of surface water runoff.

Thickness markers will be approved by the CQA Officer. The CQA Officer may request hand excavated test pits to verify thickness. Field survey control measurements will be recorded at the completion of the cover soil installation and completion of the topsoil installation to document the topsoil thickness.

4.4 Field and Laboratory Testing

Field and laboratory testing results will contain the following information:

- Date, project name, location.
- Weather conditions for field testing.
- Test location for field testing.
- Origin of sample for laboratory testing.
- Test performed.
- Test result(s).
- Testing equipment, if required for clarification.
- Name of personnel performing test(s).
- Material tested.
- Calibrations or recalibrations of test equipment, including actions taken because of recalibration.
- Indication of pass/fail for testing, as appropriate. Where tests fail, follow-up testing with passing test results are required.
- Signature of the Testing Firm personnel performing testing.

4.4.1 Sampling Basis

Sampling methods and testing frequency will be based on judgmental sampling. Judgmental sampling refers to a sampling strategy where decisions concerning sample size, selection scheme, and/or locations are based on other than probabilistic considerations. The objective is to select typical sample elements that represent a whole process or to identify zones of suspected poor quality. Selection of the sampling location(s) for the construction quality assurance process will be the responsibility of the Owner and the CQA Officer.

The Owner or CQA Officer may request that the CQC personnel take additional samples at locations that represent a worst-case scenario. The Owner or CQA Officer may also conduct additional field testing and submit samples to an independent laboratory for confirmation of the CQC testing.

4.4.2 Sampling Size

The frequency of testing will be in accordance with Appendix A. The frequency of testing will be increased to identify potential problem areas where additional tests should be made. Additional testing will be located where the Owner or CQA Officer have reason to doubt the quality of materials or workmanship.

4.4.3 Deficiencies

When material or work is rejected because observations or tests indicate that it does not meet the tolerances set forth in this CQAP, project specifications or drawings, corrective measures will be implemented. For material or workmanship subject to question because of Owner or CQA Officer observations or test results, additional testing of the component will be performed prior to rejecting the block of work and implementing the corrective measures set forth in this CQAP or the specifications. This additional testing will confirm that there is substandard construction or that the failing test is an unrepresentative test and no action is required. This testing will define the extent of the noncompliance so that appropriate corrective measures can be initiated.

CQA Officer will be made aware of all failed tests, the extent of any rejected material or workmanship, and all proposed corrective measures. CQA Officer will monitor the remediation so the appropriate test results are obtained.

4.4.4 Testing Requirements

Testing requirements are provided in Appendix A.

4.4.5 Qualified Testing Laboratory

Contractor will use a material testing laboratory approved by the Owner and CQA Officer.

5.0 Geosynthetic Components

The geosynthetic components are the linear low-density polyethylene geomembrane (geomembrane) and geocomposite drainage layer (geocomposite).

5.1 Manufacturing, Shipping, Testing, and Storage

The conformance testing for the geosynthetics will be performed and reported by the manufacturers. Shipping, handling, and storage at the project site is provided by the Geosynthetic Installer.

5.1.1 Manufacturing

The Geosynthetic Manufacturer will provide documentation that the materials meet the project requirements and adequate quality control measures have been implemented during the manufacturing.

5.1.1.1 Resin

The Manufacturer will provide the Owner and CQA Officer with the following information:

- The origins, identification, and production date of the resin
- A copy of quality control certificates issued by the resin supplier
- Reports of tests conducted by the resin supplier
- A statement documenting the percentage of reclaimed polymer added to the geosynthetic resin

At the Owner's discretion and cost, additional testing may be carried out by the Geosynthetic CQA Laboratory to for the purpose of verifying conformance.

5.1.1.2 Certification of Property Values

The Geosynthetic Manufacturer will provide the Owner and CQA Officer with a list of guaranteed 'minimum average roll value' properties, as defined in Appendix A for the type of geosynthetic material being provided. The CQA Officer will verify the test methods and values meet the requirements established in Appendix A.

5.1.1.3 Quality Control Certificates

Prior to shipping, the Geosynthetic Manufacturer will provide the Owner and CQA Officer with quality control certificates of the geosynthetic rolls produced for the project. The quality control certificates will be signed by the responsible party for the manufacturer's quality control program. The quality control records will include the roll numbers, batch numbers, sampling procedures, and quality control tests.

The manufacturer will be required to perform, at a minimum, the test included in Appendix A on samples taken at the reported frequencies in the manufacturer's quality control program.

5.1.1.4 Labeling

The Geosynthetic Manufacturer will identify all rolls of geosynthetics delivered to the project site. Each geosynthetic roll will have a weatherproof label containing the following:

- Manufacturers name
- Product identification

- Lot number
- Roll number
- Roll weight
- Roll Dimensions

In addition, any special handling procedures will be marked on the top surface of the geosynthetic roll. Rolls without labels will be rejected by the CQA Officer.

The CQA Officer will examine the rolls upon delivery and report any deviation from the project requirements to the Owner.

5.1.2 Shipping and Handling

Shipping to the project site is the responsibility of the Geosynthetic Manufacturer and Geosynthetic Installer. The CQA Officer will confirm that the handling equipment will not damage the geosynthetic rolls. Upon delivery, the Geosynthetic Installer and the CQA Officer will confirm that the roll identifications correspond to the quality control certificates. The Owner will reject rolls without proper identification.

5.1.3 Storage

The Geosynthetic Installer will be responsible for storage of the geosynthetic materials. Storage space should be protected from theft, vandalism, passing vehicles, supporting subgrade, water and weather. The subgrade will be free of rocks and sharp objects. The maximum storage height of rolls will be four. The CQA Officer will observe the storage and care of geosynthetic rolls.

5.1.4 Conformance Testing

Upon, or prior to, delivery of the rolls of geomembrane, the CQA Officer will verify that samples are removed and forwarded to the geosynthetics CQA laboratory for testing to verify conformance with the test methods, values, and frequencies presented in this CQAP and the specifications.

5.1.5 Sample Collection

Using the packing list provided by the manufacturer or a sequential inventory list made by the CQA Officer, rolls will be selected for sampling at a minimum frequency as specified in Appendix A. If the material is shipped in identifiable lots or manufacturing runs, sample selection should be adjusted to assure that the minimum frequency is met and that each different lot or manufacturing run is represented by at least one sample.

Samples will be taken across the entire width of the roll and will not include the first lineal foot. Unless otherwise specified, samples will be 3 feet long by the roll width. The CQA Officer will mark the machine direction on the samples with an arrow. Conformance testing will be conducted in accordance with this CQAP and the specifications.

5.2 Geomembrane Installation

Three tasks are required for geomembrane installation: earthwork, panel placement, and seaming. The CQA Officer will monitor all phases of geomembrane installation.

5.2.1 Earthwork

Earthwork required for the geomembrane requires coordination between the Contractor and the Geosynthetic Installer. The Contractor is required to:

- Provide a qualified land surveyor to set lines and grades
- Complete all the quality control requirements for earthworks
- Provide a subgrade that has been compacted and graded smooth. The surface will be free of sharp and pointed objects. All stones on the surface will be less than 3/8-inch diameter.
- Roll base and side slopes with smooth drum roller to flatten rough graded subgrade.
- Protect the subgrade until geomembrane can be placed. Standing water will not be permitted.

Immediately prior to placement of geomembrane panels, the Contractor, Geosynthetic Installer and the CQA Officer will observe and approve the subgrade. A subgrade acceptance form will be signed by each entity. The CQA Officer will document and provide the form in the final CQA report.

After acceptance, the responsibility for maintaining the subgrade falls to the Geosynthetic Installer.

5.2.2 Geomembrane Placement

The placement of field panels of geomembrane is the responsibility of the Geosynthetic Installer. The panel placement will be in accordance with the approved panel layout drawings.

The Geosynthetic Installer will provide the Owner and CQA Officer with a panel layout drawing for approval. Panel placement will be in accordance with the approved panel layout drawing. Seams should be parallel to the line of maximum slope. Corners and odd shaped geometry should be minimized to minimize seams.

The CQA Officer will document that each panel is labelled and consistent with the panel layout drawing. The Geosynthetic Installer is responsible to ensure that each panel can be traced back to a geomembrane roll number. The method of labeling panels will be agreed at the preconstruction meeting.

Field panels will be placed one at a time and no more panels placed than can be seamed together in the designated work period. The Geosynthetic Installer is responsible for decisions regarding panel placement procedures. The CQA Officer will record the panels placed each day and weather conditions.

Anchor trenches will be excavated by the Contractor to the line and depths shown on the drawings. Slightly rounded corners will be provided in the trenches. Backfilling will be completed by the Contractor after confirmation with the Geosynthetic Installer.

The Geosynthetic Installer will verify that the following conditions are satisfied.

- Equipment does not damage the geomembrane by handling, traffic, excessive heat or liquids.
- The prepared subgrade has not deteriorated.

- The geomembrane is clean and free of debris.
- Personnel on the geomembrane do not smoke, wear damaging shoes or engage in actives that could damage the geomembrane.
- The method used to deploy the panels does not damage the geomembrane
- The method used to deploy the panels minimize wrinkles.
- There is sufficient temporary loading (sand bags, tires, etc.) to prevent uplift with high winds. Direct contact with the geomembrane is minimized and the panels are protected by geotextile, additional geomembrane, or other materials in high traffic areas.
- The Contractor and Geosynthetic Installer will be responsible for protection of panels from stormwater events.

The CQA Officer will inform the Geosynthetic Installer if these conditions are not fulfilled. Any observed damage will be repaired or replaced by the Geosynthetic Installer.

5.2.3 Field Seaming

Field seaming is the responsibility of the Geosynthetic Installer and performed in accordance with the specifications and the requirements described below.

At the preconstruction meeting the Geosynthetic Installer will provide a list of the personnel, with past records, to the Owner and CQA Officer. The personnel will need to be approved by the Owner and CQA Officer before work can begin. Previous work experience will be required for fusion and extrusion welding. Only seaming by the approved make and model equipment will be used. Field equipment documentation will be submitted to the Owner and CQA Officer for approval.

Field seaming preparation and testing are stated in this CQAP and the specifications. Pre-weld testing is required each day for each machine. Field testing for shear and peel testing is required each day for each machine, including changes in personnel, weather, and any time required by the CQA Officer.

Non-destruct seam testing is required for 100-percent of the field weld seams. Destruct testing is required as stated in this CQAP and the specifications. Air pressure testing is required for double-weld fusion seams and vacuum testing is required for extrusion welds.

The following is the responsibility of the Geosynthetics Installer. The CQA Officer will verify that these conditions are met:

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, oils, greases, debris of any kind, and foreign material. If necessary, the material to be joined must be wiped with a clean cloth just prior to seaming
- A rub sheet must be used to protect the liner while cutting any materials
- If seam overlap grinding is required, the process is completed according to the geomembrane manufacturer's instructions within 1 hour of the seaming operation, and in a way that does not damage the geomembrane
- As a general guidance, the panels of geomembrane will have a finished overlap of a minimum of 3 inches for extrusion seaming and 3 inches for fusion seaming, but in any event sufficient overlap will be provided to allow peel tests to be performed on the seam

- No solvent or adhesive is used unless the product is approved in writing by the Owner (samples will be submitted to the Owner for testing and evaluation)
- The procedure used to temporarily bond adjacent panels together will not damage the geomembrane (in particular, the temperature of hot air at the nozzle of any seaming apparatus is controlled such that the geomembrane is not damaged)
- No abrading is visible when welding is complete
- Seams are aligned with the fewest possible number of wrinkles and "fishmouths"
- No metal objects that could potentially damage the liner are permitted for use on the lined area.

5.2.3.1 Pre-Weld Testing

Test welds will be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate and in accordance with this CQAP and the specifications. Such test welds will be made upon each start of work for each welder, every time seaming equipment is shut down more than 30 minutes, and/or at the discretion of the CQA Officer. A passing test weld will be made for each seaming device and technician. A change in technician or machine on a previously passed test weld warrants the welding of a new passing test weld. A test weld will also be made in the event that the sheet temperature varies more than 18^{o}F since the last passing test weld. Test welds will be made under the same conditions as actual seams. If seaming apparatus is turned off for more than 30 minutes, a new passing test weld must be completed for that specific seaming apparatus.

The geosynthetics installer will provide the tensiometer required for shear and peel testing of test welds in the field. The tensiometer will be automatic and will have a direct digital readout. The tensiometer will be calibrated prior to use. The geosynthetics installer will provide the Owner with the calibration certification.

The test weld sample will be at least 5 feet long by 1 foot wide (after seaming) with the seam centered lengthwise. Seam overlap will be as indicated in this CQAP and the specification.

Six specimens, each 1-inch wide, will be cut from the test weld sample by the Geosynthetics Installer. Three specimens will be tested in shear and three in peel using a field tensiometer. For each fusion specimen, both tracks will be tested. A passing welded seam is achieved in peel and shear when the specimen meets the criteria of this CQAP and the specifications.

If a specimen fails, the entire operation will be repeated. If the additional specimen fails, the seaming apparatus and seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful full test welds areachieved.

The CQA Officer will observe test weld procedures. The remainder of the successful test weld sample will be assigned a number and marked accordingly by the CQA Officer who will also log the data, hour, ambient temperature, number of seaming units, name of seamer, and pass or fail description.

5.2.3.2 Seaming Procedure

Unless otherwise specified, the general seaming procedure used by the installer will be as follows:

- For fusion seaming, a movable protective layer of plastic may be required to be placed directly below each overlap of geomembrane that is to be seamed. This is to help prevent any moisture build-up between the sheets to beseamed

- In general, seams should be oriented parallel to the line of maximum slope, i.e., oriented up and down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams will be minimized
- All production field seaming will be hot wedge fusion welding. Extrusion welding is permitted only in areas where hot wedge fusion welding is not possible. Solvent welding or adhesive tape is not acceptable for either temporary or permanent seams. The CQA Officer and Owner reserve the right to reject any proposed seaming method they believe is unacceptable
- The composition of the extrudate will be identical to the lining material and will be manufactured from the same resin and same additives and proportions thereof as the geomembrane sheet so as to ensure the best possible bonding of extrudate to the geomembrane sheet. Each extrusion welder will be completely purged of heat-degraded extrudate prior to beginning a seam
- All foreign matter (dust, dirt, moisture, oil, etc.) will be removed from the edges of panels to be bonded. If an extrusion weld is required, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternative methods approved by the CQA Officer remove surface debris, cure, and prepare the surfaces for bonding. No solvents will be allowed to clean the geomembrane. Mechanical abrasion will occur within one hour prior to extrusion welding the seam
- No extrusion welding should be attempted above 140°F sheet temperature for extrusion and fusion welding. If seaming is to be performed when the ambient air temperature is below 40°F, preheating of the geomembrane will be required and acceptable test welds, which duplicate as closely as possible actual field conditions, will be achieved. Preheating may be achieved by natural and/or artificial means (shelters and heating devices). Between 40°F and 50°F ambient air temperature, seaming is possible if the geomembrane is preheated by either the sun or a hot air device provided no excessive cooling of the geomembrane results from environmental conditions. No preheating is required above 50°F. In all cases, the geomembrane will be dry and protected from wind damage
- While welding a seam, the geosynthetics installer will monitor temperature gages of the welding device to assure that proper settings are maintained. The welding equipment used will be capable of continuously monitoring and controlling the temperatures and pressures in the zone of contact where the machine is actually welding the lining material so as to ensure that changes in environmental conditions will not affect the integrity of the weld
- All cross-butt seams between two rows of seamed panels will be welded during the coolest time of the day to allow for contraction of the geomembrane
- All "T" joints will have the overlap from the fusion welder seam trimmed back to allow an extrusion fillet weld. The geosynthetics installer will then grind 2 inches minimum on either side of the fusion welded seam and extrusion weld a patch over all of the prepared area
- At the end of each day or installation segment, all unseamed edges will be adequately anchored by sandbags or other approved devices. Sandbags securing the geomembrane on the sideslopes should be connected by a rope fastened at the top of the slope by a temporary anchor. If high winds are expected, boards along the edge of unseamed panels, with weighted sandbags on top, should be used to anchor the geomembrane on the bottom of the cell. Staples, U-shaped rods, or other penetrating anchors may not be used to secure the geomembrane on the sideslopes
- If required, a firm substrate will be provided by using a flat board or similar hard surface directly under the seam overlap to achieve proper support

- Wrinkles at the seam overlaps will be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut wrinkles will be seamed and any portion where the overlap is inadequate will then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 inches beyond the cut in all directions
- Seaming will extend to the outside edge of panels to be placed in the anchor trench
- The CQA Officer should observe all test weld procedures. The remainder of the successful test weld sample will be assigned a number and marked accordingly by the CQA Officer, who will also log the date, hour, ambient temperature, number of seaming units, name of seamer, and pass or fail description. The sample itself should be retained in the Owner's archives. In addition, at least one tested specimen from each test as selected by the CQA Officer will be retained by the CQA Officer. The CQA Officer will transmit these specimens to the Owner following substantial completion of the geomembrane installation. No field seaming will take place without the Master Seamer being present.

The CQA Officer shall verify that the above seaming procedures are followed and will inform the Owner if they are not.

5.2.3.3 Non-Destruct Testing

The geosynthetics installer will non-destructively test 100 percent of the field seams over their full length using a vacuum test unit (for extrusion seams only), air pressure test (fusion seams), or other approved method. The testing will be carried out to the accepted standards of the industry. The purpose of non-destructive tests is to check the continuity of seams. It does not provide any information on seam strength. Continuity testing will be carried out as the seaming work progresses and not at the completion of all field seaming, unless otherwise approved by the Owner. The geosynthetics installer will complete any required repairs in accordance with the specifications and the CQA Plan. Non-destructive testing will not be permitted before sunrise or after sunset unless the geosynthetics installer demonstrates capabilities to do so.

5.2.3.3.1 Air Pressure Testing:

Unless otherwise specified, the general air pressure testing procedure used by the geosynthetics installer will be as follows:

- Seal both ends of the seam to be tested.
- Insert needle of other approved pressure feed device into the airspace created by the double fusion welds.
- Inflate the test channel to 30 to 35 psi, close valve, and observe initial pressure after approximately 2 minutes.
- Initial pressure settings are read after a 2 minute "relaxation period". Initial pressure setting will be between 30 to 35 psi. The purpose of the "relaxing period" is to permit the air temperature and pressure to stabilize.
- Observe and record the air pressure 5 minutes after "relaxing period" ends and initial pressure setting is used. If loss of pressure exceeds 10 percent, or if the pressure does not stabilize, the Geosynthetics Installer will locate the faulty area and repair it in accordance with this CQAP and the specifications.

- At the conclusion of the pressure test, the end of the seam opposite the pressure gauge is cut. A decrease in a gauge pressure must be observed or the air channel will be considered "blocked" and the test will have to be repeated after the blockage is corrected.
- Remove needle or other approve pressure feed device and seal the resulting hole by extrusion welding.
- Test results will be recorded by the CQA Officer.

5.2.3.3.2 Non-complying Air Pressure Test

In the event of a non-complying air pressure test, the following procedure will be followed:

- Check the seam and seals and retest the seam.
- If deviation with specified maximum pressure differential reoccurs, cut 1 inch samples from each end suspect area.
- Perform destructive peel tests on the samples using the field tensiometer.
- If all samples pass destructive testing, the installer may:
    - Cap-strip the suspect area, or
    - Further isolate the air pressure failure as agreed upon by the CQA Officer and Owner
- If one or more samples fail the peel tests, additional samples will be taken. When two passing samples are located, the suspect areas will be considered non-complying. In this section, the seam will be cap stripped, or the overlap left by the wedge welder will be heat tacked in place along the entire length of the seam will be extrusion welded. Test the entire length of the repaired seam by vacuum testing.
- If the seam is in non-compliance due to air channel blockage, the blockage will be isolated, as agreed upon by the CQA Officer.
- All sections will be retested and repaired in accordance with this section.

5.2.3.3.3 Vacuum Testing

Unless otherwise specified, the general vacuum testing procedure used by the geosynthetics installer will be as follows:

- Turn on the vacuum pump to reduce the vacuum box to approximately 5 psi.
- Apply a generous amount of a solution of liquid soap and water to the area to be tested.
- Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the liner.
- Close the bleed valve and open the vacuum valve.
- Ensure that a leak tight seal is created between the vacuum box and the geomembrane.
- For a period of not less than 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
- If no bubbles appear after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3-inch overlap, and repeat the process.

5.2.3.3.4 Non-Complying Vacuum Test

In the event of a non-complying vacuum test, the following procedure will be followed:

- Mark all areas where soap bubbles appear and repair the marked areas, as specified in this section.

5.2.3.4 CQA Responsibilities

The CQA Officer will:

- Document all continuity testing.
- Record location, date, unit number, name of tester, and outcome of all testing.
- Inform the Geosynthetics Installer and Owner of any required repairs.

When defects are located, the CQA Officer will:

- Observe the repair and retesting of the repair.
- Mark on the geomembrane that the repair has been made.
- Document the results.

5.2.3.4.1 Non-Testable Areas

The Geosynthetics Installer will use the following procedures at locations where seams cannot be non-destructively tested:

- All such seams will be cap-stripped with the same geomembrane material.
- If the seam is accessible to testing equipment prior to final installation, the seam will be non-destructively tested.
- If the seam cannot be tested prior to final installation, the seaming and cap-stripping operations will be observed by the CQA Officer and Geosynthetics Installer for uniformity and completeness.
- The seam number, date of observation, name of tester, and outcome of the test or observation will be recorded by the CQA Officer.

5.2.3.4.2 Destructive Testing

The Geosynthetics Installer will not be informed in advance of the locations where the seam samples will be taken. The purpose of these tests is to evaluate seam strength.

Samples will be cut by the geosynthetics installer as the seaming progresses in order to have passing laboratory test results before the geomembrane is covered by another material. The CQA Officer will:

- Observe sample cutting
- Assign a number to each sample, and mark it accordingly
- Record the sample location on the layout drawing
- Record the reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane)

All holes in the geomembrane resulting from destructive seam sampling will be immediately repaired in accordance with repair procedures described in this section of the CQA Plan. The continuity of the new seams in the repaired area will be tested.

The destructive sample will be 12 inches wide by 36 inches with the seam centered lengthwise. The sample for Laboratory testing will be located between the two specimens for field testing. The sample will be cut into three parts and distributed as follows:

- One portion to the Geosynthetics Installer for field testing, 12 inches x 12 inches
- One portion to the Owner for archive storage, 12 inches x 12 inches
- One portion for Geosynthetics CQA Laboratory testing, 12 inches x 12 inches

Final determination of the sample sizes will be made at the Preconstruction meeting.

5.2.3.5 Geosynthetics CQA Laboratory Testing:

Destructive test samples will be packaged and shipped, if necessary, by the CQA Officer in a manner that will not damage the test sample. The Owner will be responsible for storing the archive samples. Test samples will be tested by the Geosynthetics CQA Laboratory. Testing will include shear and peel and will meet the requirements in Appendix A. At least five specimens will be tested for each test method. The Geosynthetics CQA Laboratory will provide test results, in writing, on more than 24 hours after they receive the samples. The Geosynthetic Laboratory will document the results of seam testing. The CQA Officer will review laboratory test results as soon as they become available and make appropriate recommendations to the Owner. Results from the Geosynthetics Installer's laboratory testing, if conducted, will be presented to the Owner and the CQA Officer for review.

Destructive Test Failure:

The following procedures will apply whenever a sample fails a destructive test, whether that test is conducted by the Geosynthetics CQA Laboratory, the Installers Laboratory, or by the field tensiometer.

- The Geosynthetics Installer can reconstruct the seam between any two passed destructive seam test locations
- The Geosynthetics Installer can trace the seaming path to an intermediate location (at least 10 ft from the point of the failed test in each direction) and obtain full size destructive laboratory samples. If these destructive laboratory samples pass the tests, then the seam is reconstructed between these locations by capping or by extrusion welding the flap for fusion welds (see Section 3.2.4.1 for definitions). If the new samples fail the laboratory testing, then the process is repeated to establish the zone in which the seam should be reconstructed

If a fusion type seam fails destructive testing and the Geosynthetic Installer chooses to cap the seam, only acceptable capping methods will be allowed

All acceptable seams must be bounded by two locations from which destructive samples passing laboratory tests have been taken. In cases exceeding 150 feet of reconstructed seam, a sample will be taken from the zone in which the seam has been reconstructed. This sample must pass destructive testing or the procedure outlined here must be repeated.

The CQA Officer will document all actions taken in conjunction with destructive test failures.

5.2.3.6 Defects and Repairs

Seams and non-seam areas of the geomembrane will be examined by the CQA Officer for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defeats, the surface of the geomembrane will be clean at the time of examination. The surface will be swept or washed by the geosynthetics installer if the amount of dust or mud inhibits examination.

5.2.3.6.1 Repair Procedures

Any portion of the geomembrane exhibiting a flaw, failing a destructive test, or failing a non- destructive test, will be repaired. Several procedures exist for the repair of these areas. The Owner and the CQA Officer will approve the final decision as to the appropriate repair procedure. The procedures available include:

- Patching - Apply a new piece of geomembrane sheet over, and at least 6 inches beyond the limits of a defect. The patch will be extrusion seamed to the underlying geomembrane. This method should be used to repair large holes, tears, destructive test locations, undispersed raw materials, and contamination by foreign matter.
- Spot Seaming - Apply a "bead" of extrudate, maximum length of 6 inches, over a defect. Spot seaming should be used only to repair dents, pinholes, pressure test air holes, or other minor, localized flaws.
- Capping - Apply a new strip of geomembrane along the length of a delineated faulty seam. The cap strip will extend at least 6 inches beyond the limit of the seam and the edges will be extrusion seamed to the underlying geomembrane. This method should be used to repair lengths of extrusion or fusions seamed to the underlying geomembrane.
- Welding Flap - Where an adequate flap exists (at least 1-1/2 inches), it is permissible to extrusion weld the flap of a fusion seam. At the ends of this repair, the flap will be cut to allow the extrusion weld to enclose the failed area.
- Replacement - The faulty seam is removed and replaced.

In addition, the following provisions will be satisfied:

- Surfaces of the geomembrane which are to be repaired will be abraded no more than one hour prior to extrusion welding of the repair.
- All surfaces must be clean and dry at the time of the repair.
- All seaming equipment used in repairing procedures must be approved.
- The repair procedures, materials, and techniques will be approved in advance of the specific repair by the CQA Officer and geosynthetics installer.
- Patches or caps will extend at least 6 inches beyond the edge of the defect, and all corners of patches will be rounded.
- Seam repairs over 150 feet long will require a destructive test to be taken from the repair.

5.2.3.6.2 Verification of Repairs

Each repair will be numbered and logged by the CQA Officer and the Geosynthetics Installer. Each repair will be non-destructively tested using the methods described in this section as appropriate. Repairs, which pass the non-destructive test, will be taken as an indication of an adequate repair. However, if

the CQA Officer suspects a repair to be questionable, although it passes non-destructive testing, a destructive test can be requested. Failed tests will require the repair to be redone and retested until a passing test result is achieved. The CQA Officer will observe non-destructive testing of repairs and will record the date of the repair and test outcome.

5.2.3.6.3 Large Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the CQA Officer will observe the geomembrane wrinkles. The CQA Officer will indicate to the Owner which wrinkle should be cut and resealed by the geosynthetics installer. The seam thus produced will be tested like any other repair.

5.2.3.7 Backfilling of Anchor Trench

Anchor trenches will be adequately drained to prevent ponding or otherwise softening of the adjacent soils while the trench is open. Anchor trenches will be backfilled and compacted as geotextile and liner position is finalized. General fill used when backfilling the trench will be material with 100 percent of the particles finer than 1/2 inches. Care will be taken when backfilling the trenches to prevent any damage to the geosynthetics.

Unless otherwise approved by the PEF, each lift of backfill material spread for compaction will not exceed a loose lift thickness of 8 to 12 inches, depending upon material type. Each lift of backfill will cover the length and width of the area to be backfilled, will be uniform in thickness, and will be spread and compacted as specified before the next lift is started unless otherwise permitted.

The CQA Officer will approve each lift before successive lifts are placed. The CQA Officer will observe the backfilling operation and advise the Owner of any problems.

5.2.4 Geomembrane Liner Certification/Acceptance

The Geosynthetics Installer and the manufacturer will retain ownership and responsibility for the geosynthetics in the facility until acceptance by the Owner.

The liner system will be accepted by the Owner when:

- The installation is finished.
- Verification of the adequacy of seams and repairs, including associated testing, is complete.
- Geosynthetics Installer’s representative furnishes the Owner with documentation that the geomembrane was installed in general accordance with the Manufacturer's recommendations as well as this CQAP and the design plans and specifications.
- All documentation of installation is completed including the CQA Officer final report.
- Record Documentation, including record drawings, sealed by the PEF has been received by the Owner.

The CQA Officer will provide documentation that installation has proceeded in general accordance with this CQA Plan for the project except as noted to the Owner.

5.3 Geocomposite Installation

The CQA Officer will verify that the geocomposite is installed in accordance with the procedures described below. Extreme care will be exercised so as not to damage the geomembrane during placement of the geocomposite and the materials overlying the geocomposite.

5.3.1 Handling and Placement

The geosynthetics installer will handle geocomposite in such a manner as to minimize damage and comply with the following:

- On slopes, the geocomposite will be secured in the anchor trench and then rolled down the slope in such manner as to continually keep the geocomposite sheet in tension. If necessary, the geocomposite will be positioned by hand after being unrolled to minimize wrinkles. Geocomposite can be placed in the horizontal direction (i.e., across the slope). The Geosynthetics Installer will handle geocomposite in such a manner as to minimize damage and comply with the following:
    - In the presence of wind, geocomposite will be weighted with sandbags or the equivalent. Such sandbags will be installed during placement and remain until replaced with overlying material.
    - Sandbags will be filled with fine-grained material and must be handled with care to prevent rupture.
    - Unless otherwise specified, geocomposite will not be welded to geomembranes.
    - The geosynthetics installer will take necessary precautions to prevent damage to underlying layers during placement of the geocomposite. Care should be taken not to leave tools on or under the geocomposite.
    - During placement of geocomposite, care will be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane.

The CQA Officer will note any deviation and report it to the Owner.

5.3.2 Stacking and Joining

Stacked geocomposite will be placed in the same direction to prevent the stands of one layer from penetrating the channels of the lower layer, thereby significantly reducing the transmissivity. Geocomposite will not be laid in direction perpendicular to the underlying geonet unless otherwise specified by the PEF.

Adjacent geocomposite will be joined according to this CQAP and the design specifications. As a minimum, the following requirements will be met:

- The geonet portion of adjacent rolls will be overlapped by at least 4 inches. Ends of adjacent rolls will be overlapped by at least 8 inches.
- When more than one layer of geocomposite is installed, joints will be staggered so that the joints do not lie above one another.
- The upper non-woven geotextile will be overlapped using the procedures outlined in this CQAP and the specifications unless otherwise directed by the Owner.

The CQA Officer will document the roll numbers placed and approximate installed square footage and will note any deviation and report it to the Owner.

5.3.3 Repair

Any holes or tears in the geocomposite will be repaired by placing a patch extending 2 feet beyond the edges of the hole or tear. If the hole or tear width across the roll is more than one-half the width of the roll, the damaged area will be cut out and the two portions of the geonet will be joined as indicated in the this CQAP and the specifications.

The CQA Officer will observe any repair, note any deviation with the above requirements, and report them to the Owner.

5.3.4 Placement of Cover Soil

The placement of materials on geocomposite will be as soon as possible, such that:

- The geocomposite and underlying geomembrane are not damaged
- Minimal slippage of the geocomposite on the underlying geomembrane occurs
- No excess tensile stresses occur in the geocomposite
- In sloped areas, placement of soil/aggregate is started at the toe and extended up the slope. Placement of soil/aggregate will never start at the top of the slope.

If portions of the geocomposite are exposed, the CQA Officer will periodically place marks on the geocomposite and the underlying geomembrane and measure the elongation of the geocomposite during the subsequent construction activities. Before a subsequent layer of material is placed on the geocomposite, the CQA Officer should observe the geocomposite and underlying liner to determine if any dirt, excessive dust, or any stones are entrapped in or below the material. If so, the geocomposite must be cleaned or the geocomposite removed so that the liner can be cleaned.

Any deviation will be noted by the CQA Officer and reported to the Owner.

6.0 Surveying

The Contractor will conduct surveying of lines and grades on an ongoing basis during construction of the soil layers and geosynthetics placement. Surveying will be performed to provide documentation for record plans, verify quantities of soils and geosynthetics. Surveying conducted at the site will be part of the construction quality assurance program.

6.1 Survey Control

One or more permanent benchmark(s) will be established for the site at location(s) indicated on the drawings. The vertical and horizontal controls for this benchmark will be established within normal land surveying standards. The benchmark(s) horizontal and vertical position(s) will be tied to the North American Datum NAD83, Alabama State Plane Coordinate System and the North American Vertical Datum NAVD88.

6.2 Surveying Personnel

Surveying will be performed under the direct supervision of a qualified, licensed Land Surveyor, who may also be the Senior Surveyor on-site. The survey crew will consist of the Senior Surveyor and as many Surveying Assistants as are required to satisfactorily undertake the work. Surveying personnel will be experienced in the provision of these services, including detailed, accurate documentation.

6.3 Precision and Accuracy

The survey instruments used for this work will be precise and accurate to meet the needs of the project. Survey instruments will be capable of reading to a precision of 0.01 of a foot and with a setting accuracy of 10 seconds. Calibration certificates for survey instruments will be submitted to the CQA Officer prior to initiation of surveying activities.

6.4 Lines and Grades

When required, the following surfaces will be surveyed to determine the lines and grades achieved during construction:

- Surface of prepared subgrade (prior to liner installation)
- Surface and limits of geosynthetics
- Anchor trench
- Alignment and inverts of outlet structures
- Surface of protective cover soils

6.5 Frequency and Spacing

Surveying will be performed as soon as possible after completion of a given installation to facilitate progress and avoid delaying the next installation. In addition, spot checks during construction will be required to assist the Contractor in complying with the required grades.

The following spacing and locations will be provided, as minimum, for survey points:

- Surfaces, with slopes less than 10 percent, will be surveyed on a square grid not wider than 100 feet linear.

- On slopes greater than 10 percent, a square grid not wider than 100 feet will be used, but in any case, a line at the crest, midpoint, and toe of the slope will be taken.
- A line of survey points no farther than 100 feet apart will be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope).
- Along linear features, survey sections or points should be at 50-foot centers.

6.6 Tolerances

Acceptable tolerances on survey coordinates, within the closure area, will be 0 to -0.2 feet on subgrade elevations, and 0 to +0.2 feet on soil liner and protective cover layers, provided minimum permit conditions and state regulations are adhered to (i.e., thickness, grades, etc.).

6.7 Documentation

The Senior Surveyor will retain original field survey notes. The surveyor will produce record plans for the CQA Officer as the job progresses. The results from the field surveys will be documented on a set of record plans. At a minimum, these plans will show the final elevations of the surfaces shown on the Drawings at a scale of 1 inch equal 100 feet with contour intervals no greater than 2 feet.

Survey results will be certified by a land surveyor licensed by the state of Alabama.

7.0 Documentation

An effective CQA Plan depends largely on recognition of all construction activities that should be monitored, and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance activities. The CQA Officer will document that quality assurance requirements have been addressed and satisfied.

The CQA Officer will provide the Owner with signed descriptive remarks, data sheets, and logs to verify that all monitoring activities have been carried out. The CQA Officer will also maintain at the job site a complete file of design plans, design specifications, the CQA Plan, checklists, test procedures, daily logs, and other pertinent documents

7.1 Daily Recordkeeping

Standard reporting procedures will include preparation of a daily report which, at a minimum, will consist of a daily summary report including memoranda of meetings and/or discussions with the Owner and/or site contractors, observation logs, and test data sheets. Other forms of daily recordkeeping to be used as appropriate include construction problem and solution data sheets and photographic reporting data sheets.

7.1.1 Daily Summary Report

The CQA Officer will prepare a daily summary report, which may include the following information as appropriate:

- Date, project name, location, and other identification
- Data on weather condition
- Information on meetings held or discussions which took place
- Names of parties to discussion
- Relevant subject matter or issues
- Decisions reached
- Activities planned and their schedule
- A reduced-scale site plan showing all proposed work areas and test locations
- Descriptions and locations of ongoing construction
- Descriptions and locations of work being tested and/or observed and documented, as well as test results
- Calibrations or recalibration of test equipment and actions taken as a result of recalibration, or reference to specific observation logs and/or test data sheets
- Off-site materials received, including quality verification documentation
- Decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality

7.2 Construction Problems and Solution Report

The CQA Officer, as required by the Owner, will prepare reports describing special construction situations or clarifications to technical specifications or construction deficiencies.

These reports may include the following information as appropriate:

- A detailed description of the clarification or construction deficiency
- The location and probable cause of the situation or construction deficiency
- Documentation of the corrective action taken to address the situation or deficiency
- Final results of any responses
- The signature of the CQA Officer, PEF, the Owner indicating concurrence.

The Owner will be made aware of any significant recurring non-conformance with the design specifications. The CQA Officer will then determine the cause of the non-conformance and recommend appropriate changes in procedures or specifications to the Owner. If these changes are significant in nature, they will be submitted to the PEF for approval. When this type of evaluation is made, the results will be documented, and any revision to procedures design specification, or permit specifications will be approved by the PEF, and if necessary, ADEM.

7.3 Photographic Reporting and Data Sheets

Photographic reporting data sheets, where used, will be cross-referenced with observation logs and test data sheets and/or construction problem and solution reports.

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. The basic file will contain color prints. These records will be presented to the Owner upon completion of the project.

7.4 Design and/or Specification Changes and Clarifications

Design and/or permit specification changes or clarification may be required during construction. In such cases, the CQA Officer will notify the PEF and Owner. The PEF will then notify ADEM, if necessary.

Significant design and/or permit specification changes will be made only with the written agreement of the PEF and will take the form of an addendum to the specifications. The CQA Officer will document clarifications to specifications as they are made.

7.5 Reports

At the end of each week of construction until construction is complete, a summary report must be either prepared by the CQA Officer or under the supervision of the CQA Officer. The report must include descriptions of the weather, locations where construction occurred during the previous week, materials used, results of testing, inspection reports, and procedures used to perform the inspections. The CQA Officer must certify the report.

At the completion of the work, final documentation will be prepared and will include a professional engineer's seal and supporting field and laboratory test results.

7.5.1 Final Documentation

At the completion of the work, the CQA Officer will submit to the PEF the signed Final Record Documentation. Record Documentation will describe activities associated with the construction of the item including construction procedures and observations and tests performed by CQA Officer. The report will be organized into sections discussing the major components of liner construction, including subgrade, synthetic liner, protective cover, and piping and anchor trenches. At a minimum, the Final Report will include:

- Summaries of all construction activities
- Observation logs and test data sheets including sample location plans and supporting field and laboratory test results
- Construction problems and solutions reports
- Changes from design and material specifications
- Record plans
- A summary statement sealed and signed by a professional engineer registered in the state of where the permit was issued.

The record plans will include scale plans depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). A qualified land surveyor will prepare surveying and base maps required for development of the record plans.

Appendix A. CQC/CQA Testing

TABLE 1

LABORATORY TEST METHODS
FOR THE EVALUATION OF SOIL AND AGGREGATE

Common Test Name	Parameter Defined	Standard Method
Sieve Analysis	Particle Size Distribution of Coarse Grained Soils	ASTM D6913
Hydrometer Analysis	Particle Size Distribution of Fine Grained Soils	ASTM D7928
Atterberg Limits	Liquid and Plastic Limits, Plasticity Index	ASTM D4318
Standard Proctor Density	Moisture/Density Relationship Using 5.5 lb (2.46 kg) Rammer and 12 inch (305 mm) Drop	ASTM D698
Modified Proctor Density	Moisture/Density Relationship Using 10 lb (4.54 kg) Rammer and 18 inch (457 mm) Drop	ASTM D1557
Moisture Content	Water Content of Soil by Mass	ASTM D2216
Permeability: Flexible Wall Permeameter	Permeability (Hydraulic Conductivity) on Undisturbed or Remolded Samples of Soil	ASTM D5084
Permeability: Constant Head	Permeability (Hydraulic Conductivity) of Granular Soils	ASTM D2434
Carbonate Content	Carbonate Content	ASTM D3042 or ASTM D4373

Note:

Not all tests are required for this site, refer to the permit, technical specifications, and EARTHWORK COMPONENTS in the CQA Plan.

TABLE 2
FIELD TEST METHODS
FOR THE EVALUATION OF SOIL AND AGGREGATE

Common Test Name	Parameter Defined	Standard Method
Visual Classification	Maximum Particle Size, General Material Characteristics	ASTM D2488
USDA Classification	Classification of Ability to Support Vegetation	USDA Method
Nuclear Density Gauge	In-Place Density and Moisture Content	ASTM D2922 and ASTM D3017
Moisture Content	In-Place Moisture as Check on Nuclear Densometer Measurements	ASTM D2216
Sand Cone Density	In-Place Density as Check on Nuclear Densometer Measurements	ASTM D1556
Drive Tube Sample	In-Place Density as Check on Nuclear Densometer Measurements	ASTM D2937
Lift Depth Check	Thickness of Placed Soils or Aggregates	Visual Confirmation

Note:

Not all tests are required for this site, refer to the permit, technical specifications, and EARTHWORK COMPONENTS in the CQA Plan.

TABLE 3

MINIMUM TEST FREQUENCIES

FOR SOIL AND AGGREGATE MATERIALS

Liner Component	Required Test	Minimum Frequency[1]	Sample Size[2]	Acceptance Criteria[3]
Excavation to Subgrade	Visual Observation	As required	N/A	Subgrade does not pump or rut excessively once
Fill Placed for Subgrade	Visual Observation	Borrow Areas: As required Stockpiles: As required Placed Material: As required	N/A	Proof rolled material shall be substantially free of debris, rocks greater than 3/8 inch at the subgrade surface, sharp aggregates at the subgrade surface, plant materials, or other deleterious material. Final surface: firm, smooth, and uniform. Rutting depth less than 1-inch.
Engineered Fill Placed outside of perimeter of Liner	Nuclear Density Gauge In-Place Density and Moisture Content	Placed Material: 1 per 2,000 cy	N/A	≥95% Standard Proctor maximum dry density
	Sieve Analysis	Placed Material: As required	5-10 lb	Rocks greater than 3/8-inch shall not be at the subgrade surface.
	Standard Proctor Density	Placed Material: As required	50 lb	Borrow Source in native soil areas – >95% of maximum Proctor Density.
	Moisture Content	Placed Material: 1 per day that nuclear densometer is used	Varies	Check of nuclear densometer measurements to determine if recalibration is necessary.
	Sand Cone Density or Drive Tube Sample	Placed Material; As required	Varies	Check of nuclear densometer measurements to determine if recalibration is necessary.

Liner Component	Required Test	Minimum Frequency[1]	Sample Size[2]	Acceptance Criteria[3]
Protective Cover	Visual Observation	Placed Material: As required	N/A	Substantially free of debris, large rocks, plant materials, or other deleterious materials.
	Sieve Analysis	Placed Material: As required	5-10 lbs.	Max. 1/2 in. size. ASTM D2487 CL,SM,SC
	Compaction	Placed Material: 1 per 10,000 sf	N/A	> 92% of maximum Proctor density
	Depth Check	Placed Material: As required	N/A	Per Drawings.
	Survey	As-Built Conformation	N/A	Per Section 3.8 and Drawings.

Notes:

(1) In general, where the symbol "N/A" (not applicable) is used, the test is performed on in-place materials.
(2) See technical specifications for further definition of acceptance criteria.

TABLE 4
REQUIRED 40 MIL TEXTURED LLDPE GEOMEMBRANE PROPERTIES

Material Property	Value	Units	Test Method	Test Frequency
Thickness	≥38/34[(1)]	mil	ASTM D5994	1 per roll
Asperity Height[(2)]	≥9	mil	GRI GM12 / ASTM D7466	1 every roll
Density	≥0.939	N/A	ASTM D792	1 per roll
Tensile Properties (each direction)[(3)]			ASTM D6693; Type IV	1 per roll
1. Tensile Strength at Break	≥80	lb/in.		
2. Elongation at Break	≥350	percent		
Tear Resistance	≥23	Lb	ASTM D1004	Manufacture QC
Puncture Resistance	≥40	Lb	ASTM D4833	Manufacture QC
Carbon Black Content	2 – 3	percent	ASTM D1603	Manufacture QC
Carbon Black Dispersion	9 of 10 Category 1 or 2 1 of 10 Category 3	N/A	ASTM D5596	Manufacture QC
Oxidative Induction Time (OIT)	≥100	min	ASTM D3895	Manufacture QC
Oven Aging at 85°C/ High Pressure OIT – percent retained after 90 days	≥60	percent	ASTM D5721/ ASTM D5885	Manufacture QC
UV Resistance/ High Pressure OIT - percent retained after 1600 hrs[(5)(6)]	≥35	percent	GM 11/ ASTM D5885	Manufacture QC

Notes:

(1) The first value represents the minimum average thickness measurements of 10 measurements the second value represents the lowest allowable individual thickness measurement.
(2) Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils.
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Yield elongation is calculated using a gage length of 1.3 inches.
- Break elongation is calculated using a gage length of 2.0 inches.

(4) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(5) The condition of the test should be 20 hr. UV cycles at 75°C followed by 4 hr. condensation at 60°C.
(6) UV resistance is based on percent retained value regardless of the original HP-OIT value.

TABLE 5

REQUIRED MATERIAL CONFORMANCE TESTING
40 MIL TEXTURED LLDPE GEOMEMBRANE

Material Property	Value	Units	Test Method	Test Frequency
Thickness(1)	≥40	mil	ASTM D5994	1 per 50,000 ft^2
Density	≥0.939	g/cc	ASTM D1505	1 per 50,000 ft^2
Tensile Properties (each direction)(3)				
1. Tensile Strength at Break	≥80	lb/in. percent	ASTM D638;Type IV	1 per 50,000 ft^2
2. Elongation at Break	≥350	lb/in. percent	ASTM D638;Type IV	1 per 50,000 ft^2
Tear Resistance	≥23	lb	ASTM D1004	Manufacture QC
Puncture Resistance	≥40	lb	ASTM D4833	Manufacture QC

Notes:

(1) Minimum of five readings must average nominal thickness or greater, no single reading falling more than 10% below the specified value.
(2) Whichever results in the greater number of samples tested.
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Yield elongation is calculated using a gage length of 1.3 inches.
- Break elongation is calculated using a gage length of 2.0 inches.

TABLE 6

REQUIRED MATERIAL PROPERTIES GEOCOMPOSITE DRAINAGE LAYER

Material Property	Value	Units	Test Method	Test Frequencies
Geonet Density	≥0.940(1)	gm/cm³	ASTM D1505	Per Manufacturer
Geonet Thickness	≥0.30	inches	ASTM D5199	Per Manufacturer
Geonet Carbon Black Content	1 – 3	percent	ASTM D1603	Per Manufacturer
Geonet Tensile Strength at Break	≥80	lbs/in	ASTM D5035	Per Manufacturer
Drainage Composite Transmissivity @ 1000 psf(2)	$\geq 7 \times 10^{-3}$	m²/sec	ASTM D4716	Per Manufacturer
Drainage Composite Ply Adhesion	≥0.5	lb/in	ASTM F904	Per Manufacturer

Notes:

(1) Must be less than or equal to the specific density of the geomembrane.

(2) Transmissivity will be measured in the laboratory using water at 20°C with a gradient of 0.25, between the materials specified in the permit (i.e., 60-mil HDPE geomembrane and Protective Cover material) and will be tested after a seating period of 24 hours (minimum).

(3) Geotextile to meet properties of Table 3.6-1, 10 oz/sy for the base liner drainage composite and 6 oz/sy for the enhanced liner system and cap drainage composite.

TABLE 7

REQUIRED MATERIAL CONFORMANCE TESTING GEOSYNTHETIC DRAINAGE COMPOSITES

Material Property	Value	Units	Test Method	Test Frequencies
Transmissivity @ 1,000sf(1)	$\geq 5x10^{-4}$	m^2/s	ASTM D4716	CQA Request
Ply Adhesion	≥1	lb/in	ASTM F904	CQA Request

Note:

(1) Transmissivity will be measured in the laboratory using water at 20°C with a gradient of 1.0, between rigid end platens

Appendix B. Forms

PowerSouth® ENERGY COOPERATIVE

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

FIELD ACTIVITY DAILY LOG

PROJECT NAME:	PROJECT NO.:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:	VISITORS ON-SITE:
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
PREPARED BY:	DATE:

PowerSouth Energy Cooperative

SHEET_____OF _____

FIELD INVENTORY RECORD

GEOSYNTHETICS

PROJECT NAME:	INVENTORY DATE:
PROJECT NO.:	TECHNICIAN:
OWNER:	WEATHER CONDITIONS:
POND:	

GEOSYNTHETIC PRODUCT DESIGNATION:	
GEOSYNTHETIC MATERIAL TYPE:	
SHIPMENT NUMBER:	DELIVERY DATE:
GENERAL COMMENTS ON ROLL CONDITION:	GENERAL COMMENTS ON STORAGE CONDITIONS:

MATERIAL		ROLL DIMENSIONS		CONFORMANCE	
ROLL NUMBER	BATCH/LOT NUMBER	WIDTH (FEET)	LENGTH (FEET)	SAMPLE NO.	REMARKS

PowerSouth® ENERGY COOPERATIVE

SHEET NO. _____OF____

DATE _____

PROJECT NAME: _____

PROJECT NO.: _____

TECHNICIAN: _____

MATERIAL DESCRIPTION:_____

GEOMEMBRANE DEPLOYMENT LOG

PANEL NO.	PANEL DATE	ROLL NO.	LENGTH	WIDTH	SQUARE FOOTAGE
				TOTAL SQUARE FOOTAGE	

PowerSouth Energy Cooperative

TRIAL SEAM REPORT

SHEET_____OF_____

PROJECT NAME:	TECHNICIAN:	Passing Peel = Fusion: _____ppi Extrusion: _____ppi Passing Shear = Fusion: _____ppi Extrusion: ppi
PROJECT NO.:	GEOMEMBRANE TYPE:	
INSTALLER:		

SAMPLE NO.	DATE/ TIME	AMBIENT TEMP (˚F)	SEAMER NAME	MACHINE NUMBER	MACHINE SETTINGS		PEEL TEST RESULTS			SHEER TEST RESULTS			PASS/ FAIL	COMMENTS
					TEMP (˚F)	SPEED	1 (LB/IN)	2 (LB/IN)	3 (LB/IN)	1 (LB/IN)	2 (LB/IN)	3 (LB/IN)		

POWERSOUTH® ENERGY COOPERATIVE

GEOMEMBRANE SEAMING SUMMARY

PROJECT NAME______________________ TECHNICIAN______________

PROJECT NUMBER______________________ SHEET________OF ______

SEAM NUMBER	DATE SEAMED	SEAM TYPE	SEAM LENGTH (FEET)	SEAMER INITIALS	MACHINE NUMBER	TIME		AMBIENT TEMP (˚F)	COMMENTS
						START	FINISH		

PowerSouth Energy Cooperative

GEOMEMBRANE NON-DESTRUCTIVE TESTING SUMMARY

PROJECT NAME______________________________ TECHNICIAN____________

PROJECT NUMBER______________________________ SHEET_______OF _______

SEAM NUMBER	DATE TESTED	LENGTH (FEET)	AIR TEST				RESULTS (P/F)	DATE SEAM REPAIRED	DATE VACUUM TESTED	SEAM STATUS (P/F)	COMMENTS
			STARTING		ENDING						
			TIME	PRESS.	TIME	PRESS.					

PowerSouth
ENERGY COOPERATIVE

GEOMEMBRANE DESTRUCTIVE TESTING SUMMARY

PROJECT NAME________________________ TECHNICIAN ____________

PROJECT NUMBER______________________ SHEET________ OF ______

DESTRUCTIVE SAMPLE NUMBER	SEAM NO.	SEAM TYPE	DATE SAMPLED	WELDER	MACHINE NUMBER	FIELD TEST RESULTS			LAB TEST RESULTS			COMMENTS
						PEEL (P/F)	SHEAR (P/F)	CQA INITIALS	PEEL (P/F)	SHEAR (P/F)	DATE TESTED	

PowerSouth® ENERGY COOPERATIVE

GEOMEMBRANE DEFECT LOG

PROJECT NAME_____ TECHNICIAN_____

PROJECT NUMBER_____ SHEET_____OF _____

REPAIR NO.	LOCATION OF DEFECT	DEFECT TYPE	DATE	REMARKS	REPAIR TYPE	REPAIR DATE	REPAIR (P/F)	CQA INITIALS

Repair Type: P – Patch, T – Weld, CAP – Cap Strip, DS – Destructive Sample, B – Bead

PowerSouth® ENERGY COOPERATIVE

DRAINAGE COMPOSITE DEPLOYMENT LOG

SHEET NO. _____OF_____

DATE:_____

PROJECT NAME: _____

PROJECT NO.: _____

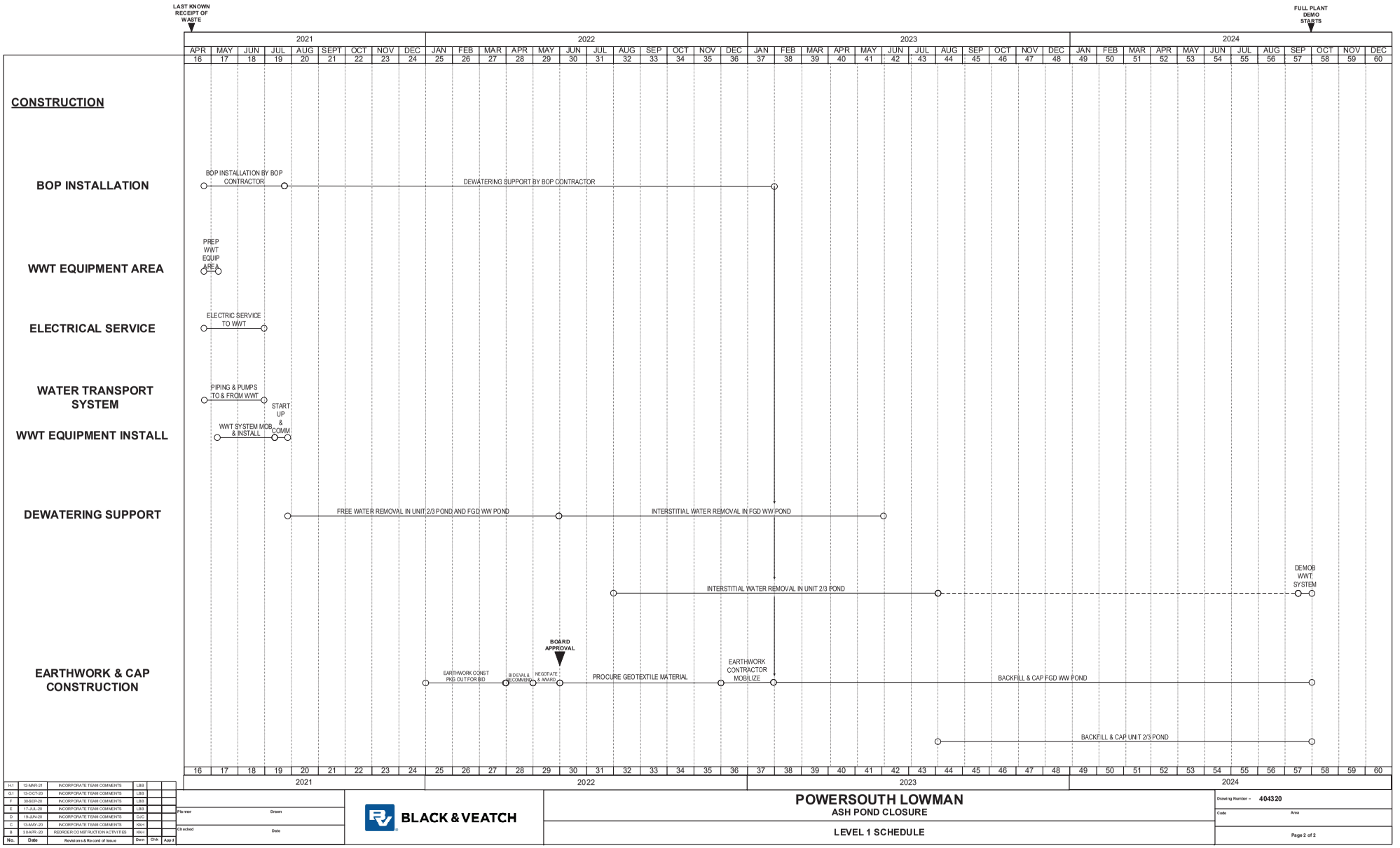
COMPUTED BY: _____

CHECKED BY: _____

MATERIAL DESCRIPTION:_____

PANEL DATE	ROLL NO.	LENGTH	WIDTH	SQUARE FOOTAGE
			TOTAL SQUARE FOOTAGE	

5.0 Construction Schedule



No.	Date	Revisions & Record of Issue	Dsn	Chk	Appd
H1	12-MAR-21	INCORPORATE TEAM COMMENTS	LBB		
G1	13-OCT-20	INCORPORATE TEAM COMMENTS	LBB		
F	30-SEP-20	INCORPORATE TEAM COMMENTS	LBB		
E	17-JUL-20	INCORPORATE TEAM COMMENTS	LBB		
D	19-JUN-20	INCORPORATE TEAM COMMENTS	DJC		
C	13-MAY-20	INCORPORATE TEAM COMMENTS	KKH		
B	3-0APR-20	REORDER CONSTRUCTION ACTIVITIES	KKH		

Planner | Drawn
Checked | Date

BLACK & VEATCH

POWERSOUTH LOWMAN
ASH POND CLOSURE
LEVEL 1 SCHEDULE

Drawing Number – 404320
Code | Area

S:\Projects\Powersouth\1ICES Projects\404320 Lowman Pond Closure\404320 Lowman Pond Closure Level 1 Schedule - 210312 REV H1.mpd
3/12/2021

6.0 Post Closure Plan

The following maintenance and monitoring activities will be implemented.

6.1.1 Final Cover Maintenance

Lowman Plant personnel will maintain the integrity and effectiveness of the final cover system, including making repairs to the final cover as necessary to correct the effects of settlement, subsidence, and erosion.

The final cover system will be inspected monthly and after major storm events in accordance with Lowman Plant's CCR Impoundment Inspection Plan to identify problems with erosion, cracks, ponding, settlement, and other deficiencies such as tears or punctures to the flexible membrane liner.

Eroded areas will be filled with suitable soil cover, compacted, graded, and revegetated. Areas that experience settlement will be repaired, filled, and graded. Following grading activities, a supplemental geosynthetic cap will be placed over the additional fill. Extensive surface cracks will be identified and corrected to prevent the infiltration of surface water.

To allow for inspections at the frequency identified in the Lowman Plant's CCR Impoundment Inspection Plan, the vegetative layer will be mowed at least semi-annually to minimize the growth of deep rooted vegetation. The voluntary growth of any trees will be prevented on the final cover. An inspection immediately following mowing will be conducted to identify the shallow erosion or the settlement of the cover. Erosion problems that are identified will be repaired to prevent damage to the final cover system.

6.1.2 Facility Maintenance

Lowman Plant personnel will inspect all groundwater monitoring wells, access control structures and storm water control structures including concrete inlets, storm sewers, culverts, berms, ditches, and terraces to insure the integrity of the surface water control system remains intact. Any damage due to settlement, erosion, or caused by maintenance equipment will be promptly repaired.

The area of the Unit 1 Impoundment will be included in these inspections. The CCR material from the Unit 1 Impoundment was removed and placed within the Unit 2/3 Impoundment and FGD Impoundment.

6.1.3 Maintenance of the Groundwater Monitoring System

During the post-closure care period, Lowman Plant personnel will maintain the groundwater monitoring system and perform monitoring activities in accordance with the Groundwater Monitoring and Corrective Action requirements as outlined in 335-13-15-.06 (40 C.F.R. §§ 257.90-257.98).

6.1.4 Contact Information

Name:	Scott Chastain
Address:	PO Box 10, Leroy, AL 36458
Phone Number:	251-246-8126
Email:	Scott.Chastain@powersouth.com

6.1.5 Property Use During Post-Closure

Unit 2/3 and FGD Impoundment post-closure land uses will be limited to purposes that rely on the use of short rooted grasses and those that will not disturb the integrity of the final cover system.

The Unit 1 Impoundment area is currently being used as a stormwater detention basin and has been designated for future plant purposes. Currently, PowerSouth plans to hydraulically dredge sandy silt water bottom material, up to 14,222 cubic yards annually, from in front of the Lowman river water intake structure in the Tombigbee River. This clean sandy silt material will be pumped, via hydraulic dredging, into the Unit 1 Impoundment area to begin backfilling the impoundment.

7.0 Calculations

The following calculations are included with this submittal:

- HELP Model Demonstration
- Soil Cover Equivalency Demonstration
- Side Slope Stability
- Settlement – FGD Material

58.0206.1101
CalcNo: 58.XXXXX

PS Lowman - HELP Demonstration.xlsm

VERSION: NA

Client Name: Power South — Page 1
Project Name: Lowman Power Plant - CCR Impoundment Closure
Project Number: 404320
Calculation Title HELP Model Demonstration
Prepared By (Date): GDS (28 August 2020)
Verified By (Date): Almaleh, Lawrence J. (Larry) Digitally signed by Almaleh, Lawrence J. (Larry) DN: CN="Almaleh, Lawrence J. (Larry)", OU=Professionals, OU=Corp - NA, OU=Corp, O=BPProtected, DC=na, DC=bvcorp, DC=net Date: 2021.03.19 17:42:26 05'00'
Project Eng. Approval (Date): MEHintz 03Nov20
Calcualtion is: *Final*
Quality Record: *No*
Objective: *See Purpose Below*

UNVERIFIED ASSUMPTIONS REQUIRING SUBSEQUENT VERIFICATION			
Number	**Assumption**	**Verified By**	**Date**
	See Page 1 and/or 2 of this calculation for assumptions.		

Verification Method:

Quality Control Review

This Section Used for Computer Generated Calculations

REVIEW AND APPROVAL							
Rev	**Revised Pages**	**Prepared By**	**Date**	**Verified By**	**Date**	**Project Engineer Approval**	**Date**
0	*See Rev*	#N/A		#N/A		*See above for Project Engineer approval/date for applicable submittal.*	
1	*1*	GDS 10/30/2020		#N/A			
2	*See Rev*	#N/A		#N/A			

ALABAMA LICENSED
No. 36040
PROFESSIONAL
ENGINEER
S. LYLE MORGAN

Morgan, S. Lyle
2021.03.19 21:44:45-04'00'

PURPOSE / SCOPE

Demonstrate the planned cover material for the CCR impoundment provides sufficient drainage and reduction of infiltration.

DESIGN CRITERIA

ADEM AAC 335-13-15.07(3)(d)3.(I to vii).

DESIGN REFERENCES

The Hydrologic Evaluation of Landfill Performance (HELP) Model - Engineering Documentation fo Version 3; EPA

DESIGN INPUT REFERENCES

Geotechnology of Waste Management; Oweis and Khera; 2nd Ed	

ASSUMPTIONS

BASIC PARAMETERS OF THE HELP MODEL

WEATHER DATA

PRECIPITATION: Synthetic generation for 25-years.
Data developed for Mobile, Alabama.
Year 19, Month 5, Day 14 was the highest precipitation. Precipitation on this date was edited to be 8.85"
8.85 inches is the 25-year, 24-hour storm event.

TEMPERATURE: Synthetic generation for 25-years.
Data developed for Mobile, Alabama.

SOLAR RADIATION: Synthetic generation for 25-years.
Data developed for Mobile, Alabama.

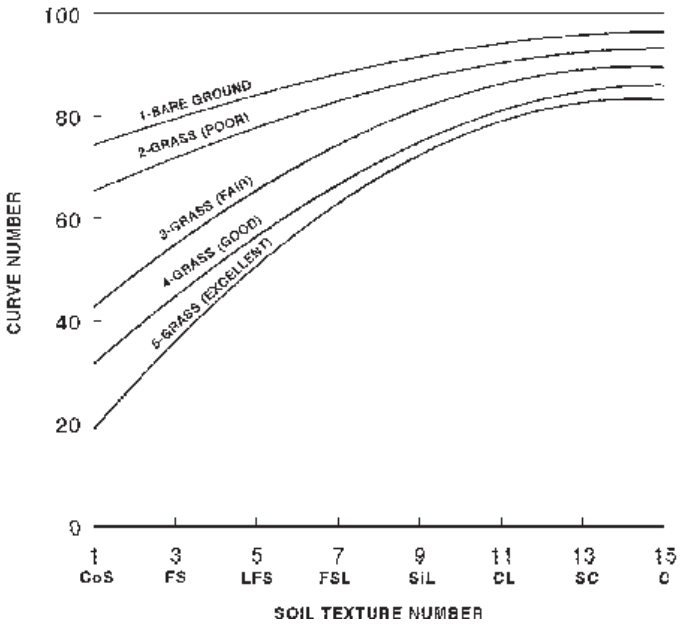
EVAPO TRANSPIRATION: Synthetic generation for 25-years.
Data developed for Mobile, Alabama.

SOIL DESIGN DATA

LANDFILL AREA: Use 1 acre to compare to Soil Liner Equivalent calculation
Runoff is possible on 100%
Computer Model will initialize the moisture content

RUNOFF CURVE NUMBER TO BE CALCULATED BY HELP MODEL
SLOPE: 3%
SLOPE LENGTH: 500 FEET
SOIL TEXTURE: 8 - From topsoil identified in layer profile
VEGETATION: 3 - Fair Stand of Grass

PROGRAM RUNOFF CURVE NUMBER = 78.8



TOPSOIL

LAYER 1 LAYER TYPE: 1 - VERTICAL PERCOLATION
LAYER THICKNESS: 6 INCHES
POROSITY: 0.463
FIELD CAPACITY: 0.232
WILTING POINT: 0.116
INITIAL MOISTURE: 0.1922
SAT. HYDR. CONDUCTIVITY : 3.7 X 10(-4) cm/s
DRAINAGE LENGTH: 500
DRAINAGE SLOPE: 3%

This represents the properties of a silty loam (ML)

COVER SOIL

LAYER 2 LAYER TYPE: 1 - VERTICAL PERCOLATION
LAYER THICKNESS: 18 INCHES
POROSITY: 0.437
FIELD CAPACITY: 0.105
WILTING POINT: 0.047
INITIAL MOISTURE: 0.26
SAT. HYDR. CONDUCTIVITY : 6.4 X 10(-5) cm/s
DRAINAGE LENGTH: 500
DRAINAGE SLOPE: 3%

This represents the properties of a silty sand (SM)

Sat. Hydr. Conductivity = 1.7 x 10(-3) cm/s

This is is the soil cover with the highest anticipated permeability.

GEOCOMPOSITE (SEE CALCULATION BELOW FOR DESIGN HYDRAULIC CONDUCTIVITY)

LAYER 3 LAYER TYPE: 2 - LATERAL DRAINAGE LAYER
LAYER THICKNESS: 0.35 INCHES
POROSITY: 0.85
FIELD CAPACITY: 0.01
WILTING POINT: 0.005
SAT. HYDR. CONDUCTIVITY : 23.34 cm/sec
DRAINAGE LENGTH: 500
DRAINAGE SLOPE: 3%

Thickness of geonet

Transmissivity = 9.0×10^{-3} cm/sec

The calculation below includes the manufacturer's design transmissivity, geonet thickness safety factors, and reduction factors to determine the allowable hydraulic conductivity.

LLDPE LINER

LAYER 4 LAYER TYPE: 4 - GEOMEMBRANE
LAYER THICKNESS: .04 INCHES
DRAINAGE LENGTH: 500
DRAINAGE SLOPE: 3%

40 MIL

CCR WASTE MATERIAL

LAYER 5	LAYER TYPE:	1 - VERTICAL PERCOLATION
	LAYER THICKNESS:	12 INCHES
	POROSITY:	0.437
	FIELD CAPACITY:	0.19
	WILTING POINT:	0.0085
	INITIAL MOISTURE:	0.15
	SAT. HYDR. CONDUCTIVITY :	7.2 x 10(-4) cm/s
	DRAINAGE LENGTH:	500
	DRAINAGE SLOPE:	3%

This represents the properties of a silty sand (SM)

GEOCOMPOSITE TRANSMISSIVITY

$$\theta_{DESIGN} = \frac{\theta_{LAB}}{RF_{CR} * RFIN * RFCD * RFPC * RFCC * RFBC * FS}$$

θ_{DESIGN} = Transmissivity to be used for design

θ_{LAB} = Laboratory measured transmissivitly from Manufacturer

RF_{CR}=	Reduction Factor for Creep =	1.2
RF_{IN}=	Reduction Factor for Delayed Intrusion =	1.1
RF_{CD}=	Reduction Factor for Chemical Degradation =	1.1
RF_{PC}=	Reduction Factor for Particulate Clogging =	1.2
RF_{CC}=	Reduction Factor for Chemical Clogging =	1.1
RF_{BC}=	Reduction Factor for Biological Clogging =	1.2
FS =	Overall Safety Factor =	2

→ 4.6

Triplanar Geonet Agru America - 330 mil Geocomposite

θ_{LAB} = 0.009 m2/sec =

330 mil Geocomposite

Geonet Component (1)

Property	Test Method	Frequency	Minimum Average Roll Value
Thickness, mil (mm)	ASTM D5199	50,000 sf	330 (8.3)
Peak Tensile Strength MD, lbs./in. (N/mm)	ASTM D5035/7179	50,000 sf	95 (16.5)
Density, g/cm³	ASTM D792, Method B	50,000 sf	0.94
Carbon Black Content (%)	ASTM D4218	50,000 sf	2 - 3
Transmissivity(2), m²/sec. (gal/min/ft)	ASTM D4716	500,000 sf	9 x 10^{-3} (43.4)

$\theta_{DESIGN} = \frac{0.009}{4.6}$ = 0.0019565 m2/sec = 19.57 cm2/s

k = Hydraulic Conductivity

t = Geocomposite Thickness = 330 mil = 0.8382 cm

k = $\frac{\theta_{DESIGN}}{t}$ = 23.34 cm/sec

HELP MODEL RESULTS

The results of the HELP model are attached.

1. The average head on the liner is 0.007 inches.

2. 65.74 inches of annual rainfall (average)
   - 3.44 inches of runoff
   - 40.55 inches of evaportranspiration
   - 21.7 inches of lateral drainage from the geocomposite
   - .005 inches of percolation through the liner

3. Peak Daily Rainfall Value = 8.85 inches (the 25-year, 24-hour storm)
   - Average head on the liner = 0.209 inches …. OK.. Less than thickness of geocomposite
   - Maximum peak head on the liner = 0.413 inches This is a short term event
     This is satisfactory considering the safety factor of 2.0 was provided was included in the degradation factors.

```
*******************************************************************************
*******************************************************************************
**                                                                           **
**                                                                           **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                    USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                           **
**                                                                           **
*******************************************************************************
*******************************************************************************


PRECIPITATION DATA FILE:    C:\PSPRECIP.D4
TEMPERATURE DATA FILE:      C:\PSTEMP.D7
SOLAR RADIATION DATA FILE:  C:\PSSOLR.D13
EVAPOTRANSPIRATION DATA:    C:\PSEVAP.D11
SOIL AND DESIGN DATA FILE:  C:\PSPROF3.D10
OUTPUT DATA FILE:           C:\PSOUT3.OUT


TIME:  10:52     DATE:   9/21/2020


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

     TITLE:  POWERSOUTH - LOWMAN

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


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   8
          THICKNESS                    =      6.00   INCHES
          POROSITY                     =      0.4630 VOL/VOL
          FIELD CAPACITY               =      0.2320 VOL/VOL
          WILTING POINT                =      0.1160 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1898 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.369999994000E-03 CM/SEC
       NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
```

PSOUT3
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.1050	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2686	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.639999998000E-04	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.33	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0304	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	23.3400002000	CM/SEC
SLOPE	=	3.00	PERCENT
DRAINAGE LENGTH	=	500.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.000000000000E+00	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4530	VOL/VOL
FIELD CAPACITY	=	0.1900	VOL/VOL
WILTING POINT	=	0.0850	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1620	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.720000011000E-03	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 8 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 500. FEET.

SCS RUNOFF CURVE NUMBER	=	78.80	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.381	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.770	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.448	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	7.927	INCHES
TOTAL INITIAL WATER	=	7.927	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM MOBILE ALABAMA

STATION LATITUDE	=	30.41	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	39	
END OF GROWING SEASON (JULIAN DATE)	=	351	
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.00	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00	%

PSOUT3

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MOBILE ALABAMA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.59	4.91	6.48	5.35	5.46	5.07
7.74	6.75	6.56	2.62	3.67	5.44

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MOBILE ALABAMA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
50.80	53.60	60.10	68.00	74.90	80.50
82.20	81.80	78.20	68.50	58.60	53.10

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MOBILE ALABAMA
AND STATION LATITUDE = 30.41 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.91	4.86	6.11	5.21	5.30	6.33
	7.54	6.96	7.52	2.43	3.07	6.49
STD. DEVIATIONS	1.98	2.43	3.27	3.21	3.68	2.68
	3.21	2.78	2.24	1.38	1.69	3.45
RUNOFF						
TOTALS	0.123	0.250	0.449	0.473	0.479	0.131
	0.272	0.234	0.488	0.031	0.070	0.439
STD. DEVIATIONS	0.282	0.465	0.639	0.616	1.290	0.210
	0.523	0.292	0.455	0.129	0.123	0.498

EVAPOTRANSPIRATION

TOTALS	1.543	2.137	3.421	4.825	4.091	4.900
	5.485	5.048	4.477	2.544	1.075	1.005
STD. DEVIATIONS	0.279	0.394	0.661	0.827	1.882	1.494
	1.354	1.661	1.018	0.576	0.249	0.153

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	2.5958	2.5262	2.4186	2.3663	1.3060	0.8940
	1.3356	1.3897	1.6718	1.0438	0.7974	3.3496
STD. DEVIATIONS	1.6386	1.7152	1.8330	1.5779	1.4172	0.4689
	0.9832	0.9795	1.2516	0.9233	0.8277	1.8439

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0007	0.0006	0.0006	0.0006	0.0004	0.0003
	0.0004	0.0004	0.0005	0.0003	0.0002	0.0008
STD. DEVIATIONS	0.0003	0.0003	0.0003	0.0003	0.0003	0.0001
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0018	0.0016	0.0018	0.0017	0.0019	0.0018
	0.0017	0.0017	0.0015	0.0017	0.0016	0.0013
STD. DEVIATIONS	0.0027	0.0023	0.0023	0.0022	0.0020	0.0019
	0.0018	0.0018	0.0016	0.0016	0.0015	0.0014

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0106	0.0113	0.0098	0.0099	0.0053	0.0038
	0.0054	0.0057	0.0070	0.0042	0.0034	0.0136
STD. DEVIATIONS	0.0067	0.0076	0.0075	0.0066	0.0058	0.0020
	0.0040	0.0040	0.0053	0.0038	0.0035	0.0075

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 25

	INCHES	CU. FEET	PERCENT

	PSOUT3		
PRECIPITATION	65.74 (8.664)	238623.1	100.00
RUNOFF	3.438 (1.7400)	12478.50	5.229
EVAPOTRANSPIRATION	40.552 (4.2465)	147205.16	61.689
LATERAL DRAINAGE COLLECTED FROM LAYER 3	21.69493 (4.91203)	78752.594	33.00292
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00570 (0.00098)	20.697	0.00867
AVERAGE HEAD ON TOP OF LAYER 4	0.007 (0.002)		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.02006 (0.02311)	72.819	0.03052
CHANGE IN WATER STORAGE	0.031 (1.7654)	114.07	0.048

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 25

	(INCHES)	(CU. FT.)
PRECIPITATION	8.85	32125.502
RUNOFF	4.636	16826.9961
DRAINAGE COLLECTED FROM LAYER 3	1.65536	6008.94971
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000228	0.82911
AVERAGE HEAD ON TOP OF LAYER 4	0.209	
MAXIMUM HEAD ON TOP OF LAYER 4	0.413	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	5.2 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000444	1.61200
SNOW WATER	2.24	8127.3745
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4007	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0658	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 25

LAYER	(INCHES)	(VOL/VOL)
1	1.5186	0.2531
2	5.6011	0.3112
3	0.0082	0.0249
4	0.0000	0.0000
5	1.5848	0.1321
SNOW WATER	0.000	

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58.0206.1102
CalcNo: 51.2001

PS Lowman - Soil Cover Equivalency Demonstration.xlsm

VERSION: NA

Client Name: Power South — Page 1
Project Name: Lowman Power Plant - CCR Impoundment Closure
Project Number: 404320
Calculation Title Soil Cover Equivalency Demonstration
Prepared By (Date): GDS (11 May 2020)
Verified By (Date): Almaleh, Lawrence J. (Larry) Digitally signed by Almaleh, Lawrence J. (Larry) DN: CN="Almaleh, Lawrence J. (Larry)", OU=Professionals, OU=Corp - NA, OU=Corp, OU=Protected, DC=na, DC=bvcorp, DC=net Date: 2021.03.19 17:43:04 -05'00'
Project Eng. Approval (Date): MEHintz 03Nov20
Calcualtion is: *Final*
Quality Record: *No*
Objective: *See Purpose Below*

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Number	**Assumption**	**Verified By**	**Date**
	See Page 1 and/or 2 of this calculation for assumptions.		

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1	*1*	GDS 10/30/2020		#N/A			
2	*See Rev*	#N/A		#N/A			

ALABAMA LICENSED
No. 36040
PROFESSIONAL
ENGINEER
S. LYLE MORGAN

Morgan, S. Lyle
2021.03.19 21:45:19-04'00'

PURPOSE / SCOPE

Demonstrate the planned cover material for the CCR impoundment meets the equivalency of the CCR regulations.

DESIGN CRITERIA

ADEM AAC 335-13-15.07(3)(d)3.(I to vii).	

DESIGN REFERENCES

Leakage Control using Geomembrane Liners, Giroud, J.P., 2016	
Hydraulic Equivalency Comparison CFR Prescriptive Liner vs Coash Ash Barrier, GSE Environmental, GSE World	

DESIGN INPUT REFERENCES

ASSUMPTIONS

Leakage through geomembrane is only through defects.	
Use 1 acre for comparison.	

LEAKAGE THROUGH GEOMEMBRANE. Geomembrane beneath protective soil cover

$$Q = C\,[1 + 0.1(h_w / t)^{0.95}] \times a^{0.1} \times h_w^{0.9} \times k_s^{0.74}$$ per defect

Q = Rate of leakage through a defect (m3/s)
C - Dimensionless constant related to intimate contact between liner and subgrade
hw = head on liner (m)
t = thickness of underlying clay or subgrade (m)
a = area of defect in geotmembrane (m2)
ks = hydraulic conductivity of underlying clay or subgrade (m/s)

C =	0.21	(good contact with a subgrade)
hw =	0.3048	meters. (12 inches)
t =	0.457	meters. Say top 18-inches of CCR
a =	0.0001	m2. this is an average hole for defect created by aggregate
ks =	0.00001	this is 1 x 10(-3) cm/s
Q =	6.1155E-06	m3/s per defect
Assume	4	defects per acre Installation quality good to fair = 4 defects/acre
Q =	9.8997E-06	m3/s per acre

LEAKAGE THROUGH REGULATORY SOIL COVER 18" of soil with hydraulic conductivity of 1 x 10^{-5} cm/s

$$Q = A \times k \times (h/t + 1)$$

Q = Rate of leakage (m3/s)
A = Area of interest (m2)
k = Hydraulic Concuctivity (m/s)
h = Hydraulic head (m)
t = Thickness (m)

A =	4047	m2 = 1 acre
k =	0.0000001	m/s = 1 x 10(-5) cm/s
h =	0.3048	m = 12 inches
t =	0.4572	m = 18 inches
Q =	0.0006745	m3/sec per acre

The results show the CCR cover material with a geomembrane layer is less permeable than the prescriptive soil cover

58.0206.1104
CalcNo: 58.XXXXX

Side Slope Stability.xlsx

VERSION: NA

Client Name: Power South
Page 1
Project Name: Lowman Power Plant - CCR Impoundment Closure
Project Number: 404320
Calculation Title Side Slope Stability
Prepared By (Date): GDS (21 September 2020)
Verified By (Date): Almaleh, Lawrence J. (Larry)
Project Eng. Approval (Date): MEHintz 03Nov20
Calcualtion is: *Final*
Quality Record: *No*
Objective: *See Purpose Below*

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ALABAMA LICENSED
No. 36040
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ENGINEER
S. LYLE MORGAN

Morgan, S. Lyle
2021.03.19 21:45:46-04'00'

PURPOSE / SCOPE

Demonstrate the planned cover material for the CCR impoundments meets the equivalency of the CCR regulations.

DESIGN CRITERIA

ADEM AAC 335-13-15.07(3)(d)3.(iii).

DESIGN REFERENCES

"Analysis and Design of Veneer Cover Soils", Koerner, 1998 Conference on Geosynthetics

DESIGN INPUT REFERENCES

Geotechnology of Waste Management; Oweis and Khera; 2nd Ed	

ASSUMPTIONS

The impoundment cover includes the following materials

CS	Cover Soil
GDL	Geocomposite Drainage Layer - Nonwoven Geotextile Both sides
HDPE	Textured HDPE Liner
FILL	FILL OR CCR MATERIAL

The interfaces between materials and the internal strengths of the soils are the likely failure planes.

INTERFACE FRICTION ANGLES

MATERIAL OR INTERFACE	FRICTION ANGLE	COHESION
Cover Soil	28	
Cover Soil to Geotextile Geocomposite	25	
Geotextile to Textured LLDPE	21	
Textured LLDPE to CCR Material	23	

The maximum slope angle will be 3%

Therefore the slope will be 33.3 feet horizontal per 1 foot vertical rise

The HELP model shows that the drainage layer will keep the cover soils from saturating.

Assume the water height in the cover soil is 1 inch

This is conservative.

COVER SOIL

The cover soil is planned to be a sand or loam soil material. This will be a locally available borrow source

From NAVFAC 7-2 pg 39, a compacted Silty Sand would have an internal angle of friction of 34 degrees.

The bottom layer will be compacted with a LGP so **assume internal angle of friction is 28°.**

COVER SOIL ABOVE TOP NON-WOVEN GEOTEXTILE OF GEOCOMPOSITE = **25°**

Table 2. Interface friction angles and efficiency comparison of the fixed shear and geotextile-soil interface cylindrical tests.

Sand Type	Geotextile Type	Average Peak Friction Angle (Internal friction angle, ϕ or interface friction angle, δ)		Fixed Shear Efficiency	GICT Efficiency
		Shear Box	GICT		
Dense Brown Sand (e=0.58; D_r=0.75)	Sand only	37.5		1.00	
	Type A	32.9	30.9	0.88	0.82
	Type B	36.7	37.2	0.98	0.99
	Type C	37.1	32.9	0.99	0.88
	Type D	32.3	34.5	0.86	0.92
Loose Brown Sand (e=0.79; D_r=0.03)	Sand only	32.8		1.00	
	Type A	29.7	25.1	0.91	0.77
	Type B	32.3	28.4	0.98	0.87
	Type C	32.6	28.1	0.99	0.86
	Type D	31.3	27.1	0.95	0.83
Dense Ottawa Sand (e=0.58; D_r=0.73)	Sand only	41.9		1.00	
	Type A	36.9	35.7	0.88	0.85
	Type C	41.0	34.8	0.98	0.83
	Type D	35.0	35.6	0.84	0.85
Loose Ottawa Sand (e=0.79; D_r=0.03)	Sand only	34.6		1.00	
	Type A	33.2	28.5	0.96	0.82
	Type C	35.0	27.9	1.01	0.81
	Type D	32.3	28.7	0.93	0.83

Efficiency = 91%

Interface Shear Strength =

91% x 28° = 25°

NON-WOVEN GEOTEXTILE ABOVE TEXTTURED GEOMEMBRANE = **21°**

Table 3. Shear strength parameters of GM interfaces.

Interface	Peak Shear Strength			Residual Shear Strength		
	Friction Angle δ (°)	Adhesion c (kPa)	Correlation Coefficient R^2	Friction Angle δ (°)	Adhesion c (kPa)	Correlation Coefficient R^2
GM(S)–FS	28.96	0.50	0.9891	22.75	4.66	0.9857
GM(T)–FS	32.72	20.65	0.9875	31.14	17.25	0.9926
GM(S)–SG	30.62	1.86	0.9875	24.64	5.59	0.9769
GM(T)–SG	36.81	12.79	0.9983	33.81	3.35	0.9991
GM(S)–GT	11.61	0	0.9841	10.75	0	0.9684
GM(T)–GT	20.88	5.62	0.9981	16.37	0	0.9937
GM(S)–OC	17.57	1.83	0.9990	14.32	0	0.9919
GM(T)–OC	18.81	2.1	0.9985	16.29	0	0.9920
GM(S)–NFC	12.68	2.52	0.9965	12.54	1.26	0.9986
GM(T)–NFC	16.77	4.76	0.9985	14.94	4.39	0.9971

From Laboratory Investigation of Shear Behavior of High Density Geomembrane Interfaces, Chen,Wang,Sen, 2018

TEXTURED GEOMEMBRANE OVER FILL/CCR WASTE = **23°**

Table 4. Summary of GM(S/T)–soil interface shear strength parameters from previous studies.

Source	Normal Stress (kPa)	Interface	Peak shear Strength		Residual Shear Strength	
			Friction Angle δ (°)	Adhesion c (kPa)	Friction Angle δ (°)	Adhesion c (kPa)
Mitchell et al. [11]	158, 316, 479	GM(S)–concrete sand	18	-	-	-
		GM(S)–Ottawa sand	18	-	-	-
		GM(S)–Misa Schist sand	17	-	-	-
Izgin and Wasti [4]	5–50	GM(S)–Ottawa sand	22	2.76	-	-
		GM(T)–Ottawa sand	32	5.00	-	-
		GM(S)–Ottawa stone	31	4.25	-	-
		GM(T)–Ottawa stone	37	2.89	-	-
Bergado et al. [16]	150–400	GM(S)–compacted clay	10.5	-	-	-
Fleming et al. [17]	-	GM(S)–Silty sand	21.4–23.7	1.77–3.10	23.6–25.1	−12.6–−2.38
		GM(S)–6% Sand-bentonite	19.8–21.1	2.43–2.80	16.6–19.2	2.30–3.57
Mariappan et al. [33]	100, 200, 300	GM(S)–Native soil	15.6	0.00	-	-
		GM(T)–Native soil	23	0.00	-	-

Based on the references, the low shear strength value for material interface is between non-woven geotextile and textured geomembrane.

The value of 21° will be used for the failure plane analysis.

GEOCOMPOSITE PLY ADHESION

Geocomposite

Property	Test Method	Frequency	Minimum	Average Roll Value	
Ply Adhesion, lbs./in. (g/cm)	ASTM D7005	50,000 sf	1 (178)	1 (178)	1 (178)

The Ply adhesion between geotextile and geonet is 1 pound per inch
We will assume the value is 0.5 pounds per inch = 89 gm/cm.

$$\text{Shear-adhesion (kPa)} = 0.11 \times \text{Ply-adhesion (gm/cm)}$$

Shear Adhesion = 0.11 x 89 gm/cm 9.79 kPa = **204.5 psf**

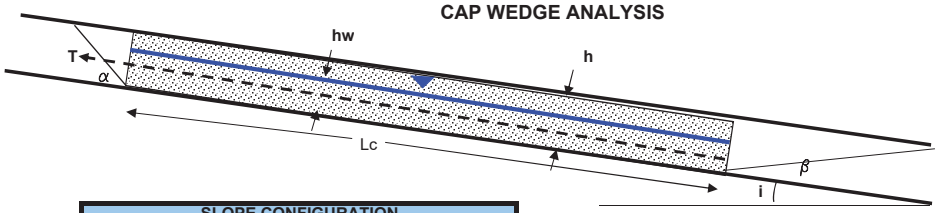
This is conservative

The reference for the calcuation between ply adhesion and shear is

Lamination Strength Requirements for Geonet Drainage Geocomposites

Richard Thiel[1] and Dhani Narejo[2]

CAP WEDGE ANALYSIS



SLOPE CONFIGURATION			
Slope Angle	i=	**33.3**	H : 1 V
		1.720	degrees
		0.030	radians
Length of Slope	Lc =	**500**	feet

LOWEST STRENGTH INTERFACE MATERIALS			
Friction Angle	Øim=	**21**	degrees
		0.366519	radians
Interface cohesion	cim =	**0**	PSF

COVER SOIL PROPERTIES			
Thickness of cover soil	h =	**18**	inches
Wetted Thickness	hw =	**1**	inches
Unit Weight of Soil	γ =	**120**	pounds per cubic foot
Internal Angle of Friction	Φm=	**28**	degrees
		0.489	radians
Cohesion	cm =	**0**	pounds per square ft
Unit Weight of Water	γw =	**62.4**	pounds per cubic foot

REINFORCING TENSILE FORCE			
	T =	0	pounds

INFINITE SLOPE FACTOR OF SAFETY
F = 12.41
r = 0.00

RESULT: NO TENSILE FORCES ARE REQUIRED FOR SLOPE STABILITY
SAFETY FACTOR GREATER THAN 2.0 FOR NORMAL CONDITION

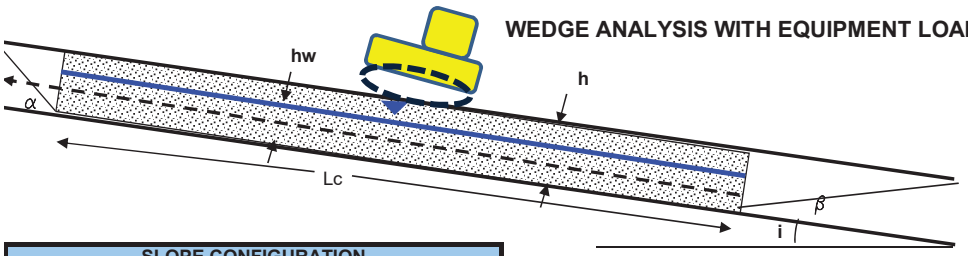
α	58.2 degrees	The is the alpha that provides the maximum Pa
	1.01606244 radians	
tan a =	1.61384664 radians	
La =	1.76462152 feet	

β	29.6 degrees	This is the beta that provides the minimum Pp
	0.5168699 radians	
tan b	0.56841301 radians	
Lp =	3.03544585 feet	

CALCULATED LOADS		
Wa =	85.2371412 pounds	0.042619
Wc =	89959.4463 pounds	44.97972
Wp =	225.585377 pounds	0.112793
Pwa =	3.1138634 pounds	
Pwc=	2597.65743 pounds	
Pwp=	0.41607637 pounds	

Pa =	292.926974 pounds
Pc =	-32298.249 pounds
Pp =	55.9273512 pounds

WEDGE ANALYSIS WITH EQUIPMENT LOAD



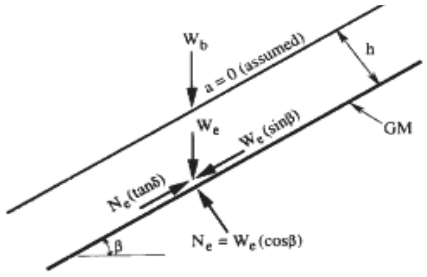
SLOPE CONFIGURATION			
Slope Angle	i=	**33.3**	H : 1 V
		1.720	degrees
		0.030	radians
Length of Slope	Lc =	**500**	feet

LOWEST STRENGTH INTERFACE MATERIALS			
Friction Angle	φ=	**21**	degrees
		0.366519	radians
Interface cohesion	ci =		PSF

COVER SOIL PROPERTIES			
Thickness of cover soil	h =	**18**	inches
Wetted Thickness	hw =	**1**	inches
Unit Weight of Soil	γ =	**120**	pounds per cubic foot
Internal Angle of Friction	φ =	**28**	degrees
		0.489	radians
Cohesion	cm =	**0**	pounds per square ft
Unit Weight of Water	γω =	**62.4**	pounds per cubic foot

REINFORCING TENSILE FORCE			
	T =	0	pounds

INFINITE SLOPE FACTOR OF SAFETY	
F = 12.78	
r = 0.00	



(a) Equipment moving up slope
(load with no assumed acceleration)

This assumes the cover soil has no free water during placement

α	59.0	degrees
	1.029744	radians
La =	1.74995	feet

This alpha is determined from 45 + phi/2

β	31.0	degrees
	0.541052	radians
Lp =	2.912406	feet

This beta is determined from 45 - phi/2

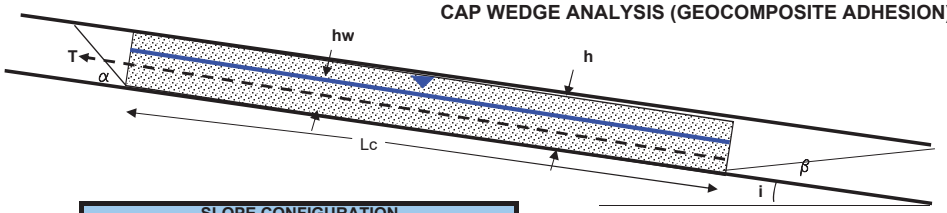
CALCULATED LOADS			
Wa =	82.60673	pounds	0.041303
Wc =	90000	pounds	45
Wp =	213.9832	pounds	0.106992
Pwa =	3.086201	pounds	
Pwc=	2597.657	pounds	
Pwp=	0.400296	pounds	

Pa =	299.164	pounds
Pc =	-32312.4	pounds
Pp =	58.57865	pounds

TRACKED EQUIPMENT			
Wb=	48500	pounds	Weight of D6 Dozer
Tp	8	psi	Ground Pressure
We =	96	psf	Gravity Load of Dozer on Liner
Ne =	95.95674	psf	
Ne tan(φ) =	36.83434	psf	
We sin i =	2.881584	psf	

Gravity Load on Interface =	276	psf
Normal Load due to Gravity Load	275.8756	
Resistance from Normal Load	105.8987	
Driving Force	8.284554	

CAP WEDGE ANALYSIS (GEOCOMPOSITE ADHESION)



SLOPE CONFIGURATION			
Slope Angle	i=	**33.3**	H : 1 V
		1.720	degrees
		0.030	radians
Length of Slope	Lc =	**500**	feet

LOWEST STRENGTH INTERFACE MATERIALS			
Friction Angle	Øim=	**0**	degrees
		0	radians
Interface cohesion	cim =	**204**	psf

COVER SOIL PROPERTIES			
Thickness of cover soil	h =	**18**	inches
Wetted Thickness	hw =	**1**	inches
Unit Weight of Soil	γ =	**120**	pounds per cubic foot
Internal Angle of Friction	Φm=	**28**	degrees
		0.489	radians
Cohesion	cm =	**0**	pounds per square ft
Unit Weight of Water	γw =	**62.4**	pounds per cubic foot

REINFORCING TENSILE FORCE			
	T =	0	pounds

INFINITE SLOPE FACTOR OF SAFETY
F = 37.77
r = 0.00

RESULT: NO TENSILE FORCES ARE REQUIRED FOR SLOPE STABILITY
SAFETY FACTOR GREATER THAN 2.0 FOR NORMAL CONDITION

α	58.2 degrees	The is the alpha that provides the maximum Pa
	1.01606244 radians	
tan a =	1.61384664 radians	
La =	1.76462152 feet	

β	29.6 degrees	This is the beta that provides the minimum Pp
	0.5168699 radians	
tan b	0.56841301 radians	
Lp =	3.03544585 feet	

CALCULATED LOADS		
Wa =	85.2371412 pounds	0.042619
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Wp =	225.585377 pounds	0.112793
Pwa =	3.1138634 pounds	
Pwc=	2597.65743 pounds	
Pwp=	0.41607637 pounds	

Pa =	292.926974 pounds
Pc =	-99188.552 pounds
Pp =	55.9273512 pounds

58.0206.1103

CalcNo: 58.XXXXX *Consolidation Settlements.xlsx* VERSION: NA

Client Name: Power South Page 1
Project Name: Lowman Power Plant - CCR Impoundment Closure
Project Number: 404320
Calculation Title Settlement - FGD Material
Prepared By (Date): GDS (07 October 2020)
Verified By (Date): Almaleh, Lawrence J. (Larry) Digitally signed by Almaleh, Lawrence J. (Larry) DN: CN="Almaleh, Lawrence J. (Larry)", OU=Professionals, OU=Corp - NA, OU=Corp, OU=Protected, DC=na, DC=bvcorp, DC=net Date: 2021.03.19 17:43:39-05'00'
Project Eng. Approval (Date): MEHintz 03Nov20
Calcualtion is: *Final*
Quality Record: *No*
Objective: *See Purpose Below*

UNVERIFIED ASSUMPTIONS REQUIRING SUBSEQUENT VERIFICATION			
Number	**Assumption**	**Verified By**	**Date**
See Page 1 and/or 2 of this calculation for assumptions.			

Verification Method:

Quality Control Review

This Section Used for Computer Generated Calculations

REVIEW AND APPROVAL							
Rev	**Revised Pages**	**Prepared By**	**Date**	**Verified By**	**Date**	**Project Engineer Approval**	**Date**
0							
1	*1*	GDS 10/30/2020					
2							

ALABAMA LICENSED No. 36040 PROFESSIONAL ENGINEER S. LYLE MORGAN

Morgan, S. Lyle
2021.03.19 21:46:01-04'00'

PURPOSE / SCOPE

Determine the long-term settlement of the FGD material due to overburden stress of the imported fill material

DESIGN CRITERIA

ADEM AAC 335-13-15.07(3)(d)3.(iii).	

DESIGN REFERENCES

Report of the Perimeter Berm and Impounded Ash Stability and Final Cover Settlement Analysis - CCR Impoundments - Consolidaiton Option Lowman Power Plant" CDG - July 20, 2020

DESIGN INPUT REFERENCES

Geotechnology of Waste Management; Oweis a	

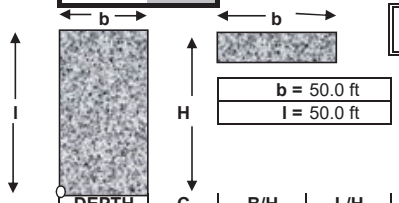
ASSUMPTIONS

ESTIMATE OF CONSOLIDATION SETTLEMENT

SIZE OF FOUNDATION	
B =	100 ft
L =	100 ft

DEPTH TO GROUNDWATER	7	FT
CONTACT PRESSURE	1.1	KSF

11 feet of fill with Unit Weight of 100 pcf

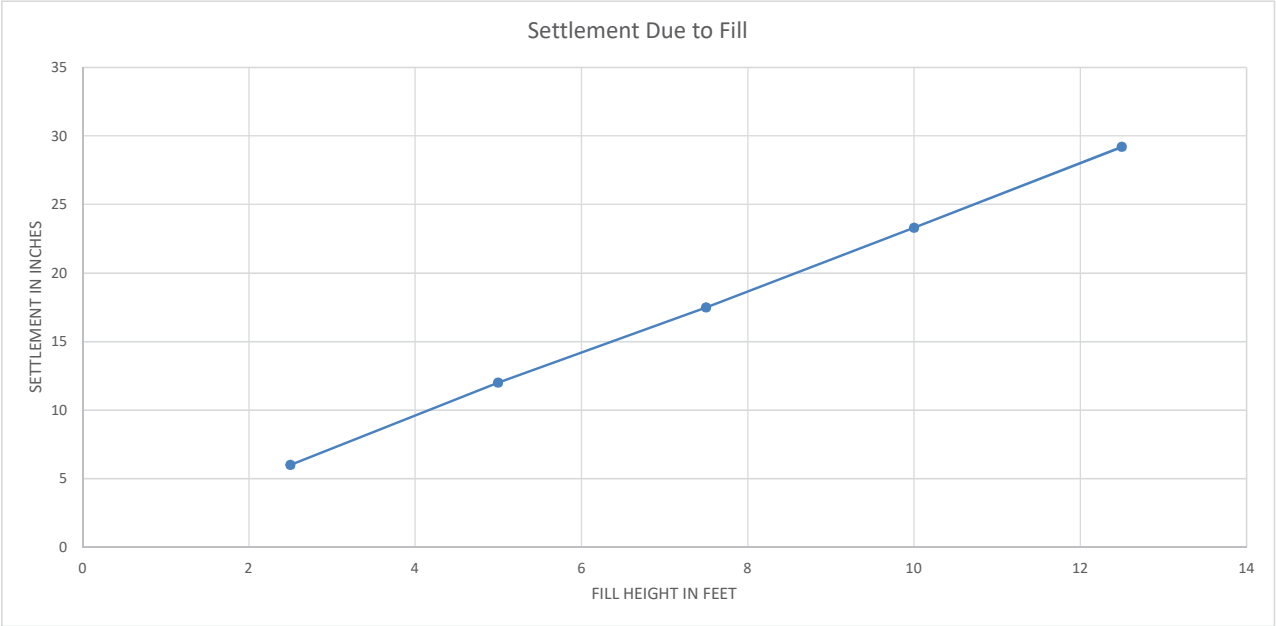


b = 50.0 ft
I = 50.0 ft

TOTAL CONSOLIDATION SETTLEMENT 25.66 in

DEPTH	C	B/H	L/H	I	4 x I	γt (kcf)	γ' (kcf)	σo (ksf)	Δσ'	M (ksf)	Stotal (ft)	Stotal (in)	
1	70.7	50.00	50.00	0.250	1.0000	0.084	0.084	0.0840	1.10	550	0.002	0.024	
2	70.7	25.00	25.00	0.250	1.0000	0.084	0.084	0.1680	1.10	550	0.002	0.023999	
3	70.8	16.67	16.67	0.250	0.9998	0.084	0.084	0.2520	1.10	550	0.002	0.023996	FGD
4	70.8	12.50	12.50	0.250	0.9996	0.084	0.084	0.3360	1.10	550	0.001999	0.023991	ABOVE
5	70.9	10.00	10.00	0.250	0.9993	0.084	0.084	0.4200	1.10	550	0.001999	0.023982	WATER TABLE
6	71.0	8.33	8.33	0.250	0.9987	0.084	0.084	0.5040	1.10	550	0.001997	0.023969	
7	71.1	7.14	7.14	0.249	0.9980	0.084	0.022	0.5256	1.10	550	0.001996	0.023952	
8	71.2	6.25	6.25	0.249	0.9970	0.084	0.022	0.5472	1.10	16	0.068546	0.822546	
9	71.3	5.56	5.56	0.249	0.9958	0.084	0.022	0.5688	1.10	16	0.068461	0.821536	FGD
10	71.4	5.00	5.00	0.249	0.9943	0.084	0.022	0.5904	1.09	16	0.068358	0.820293	BELOW
11	71.6	4.55	4.55	0.248	0.9925	0.084	0.022	0.6120	1.09	16	0.068233	0.8188	WATER TABLE
12	71.7	4.17	4.17	0.248	0.9904	0.084	0.022	0.6336	1.09	16	0.068087	0.817041	
13	71.9	3.85	3.85	0.247	0.9879	0.084	0.022	0.6552	1.09	10	0.108667	1.304006	
14	72.1	3.57	3.57	0.246	0.9851	0.084	0.022	0.6768	1.08	10	0.108357	1.300283	
15	72.3	3.33	3.33	0.245	0.9819	0.084	0.022	0.6984	1.08	10	0.108007	1.296084	
16	72.5	3.13	3.13	0.245	0.9783	0.084	0.022	0.7200	1.08	10	0.107617	1.291398	
17	72.7	2.94	2.94	0.244	0.9744	0.084	0.022	0.7416	1.07	10	0.107185	1.28622	FGD
18	73.0	2.78	2.78	0.243	0.9701	0.084	0.022	0.7632	1.07	10	0.106712	1.280548	BELOW
19	73.2	2.63	2.63	0.241	0.9654	0.084	0.022	0.7848	1.06	10	0.106198	1.274381	WATER TABLE
20	73.5	2.50	2.50	0.240	0.9604	0.084	0.022	0.8064	1.06	10	0.105644	1.267725	
21	73.8	2.38	2.38	0.239	0.9550	0.084	0.022	0.8280	1.05	10	0.105049	1.260585	
22	74.1	2.27	2.27	0.237	0.9492	0.084	0.022	0.8496	1.04	10	0.104414	1.252972	
23	74.4	2.17	2.17	0.236	0.9431	0.084	0.022	0.8712	1.04	10	0.103741	1.244897	
24	74.7	2.08	2.08	0.234	0.9366	0.084	0.022	0.8928	1.03	10	0.103031	1.236375	
25	75.0	2.00	2.00	0.232	0.9299	0.084	0.022	0.9144	1.02	10	0.102285	1.227422	
26	75.3	1.92	1.92	0.231	0.9228	0.084	0.022	0.9360	1.02	10	0.101505	1.218056	
27	75.7	1.85	1.85	0.229	0.9154	0.084	0.022	0.9576	1.01	10	0.100691	1.208296	
28	76.1	1.79	1.79	0.227	0.9077	0.11	0.048	1.0052	1.00	15	0.066565	0.798775	FGD
29	76.4	1.72	1.72	0.225	0.8998	0.11	0.048	1.0528	0.99	15	0.065982	0.791785	BELOW
30	76.8	1.67	1.67	0.223	0.8916	0.11	0.048	1.1004	0.98	15	0.065381	0.784575	WATER TABLE
31	77.2	1.61	1.61	0.221	0.8831	0.125	0.063	1.1630	0.97	1800	0.00054	0.006476	
32	77.614	1.56	1.56	0.219	0.8745	0.125	0.063	1.2260	0.96	1800	0.000534	0.006413	
33	78.032	1.52	1.52	0.216	0.8657	0.125	0.063	1.2890	0.95	1800	0.000529	0.006348	NATIVE
34	78.46	1.47	1.47	0.214	0.8566	0.125	0.063	1.3520	0.94	1800	0.000524	0.006282	SUBGRADE
35	78.899	1.43	1.43	0.212	0.8475	0.125	0.063	1.4150	0.93	1800	0.000518	0.006215	
36	79.347	1.39	1.39	0.210	0.8381	0.125	0.063	1.4780	0.92	1800	0.000512	0.006146	
37	79.806	1.35	1.35	0.207	0.8287	0.125	0.063	1.5410	0.91	1800	0.000506	0.006077	
38	80.275	1.32	1.32	0.205	0.8191	0.125	0.063	1.6040	0.90	1800	0.000501	0.006007	
39	80.753	1.28	1.28	0.202	0.8095	0.115	0.053	1.6566	0.89	3600	0.000247	0.002968	
40	81.24	1.25	1.25	0.200	0.7997	0.115	0.053	1.7092	0.88	3600	0.000244	0.002932	
41	81.737	1.22	1.22	0.197	0.7899	0.115	0.053	1.7618	0.87	3600	0.000241	0.002896	NATIVE
42	82.244	1.19	1.19	0.195	0.7801	0.115	0.053	1.8144	0.86	3600	0.000238	0.00286	SUBGRADE
43	82.759	1.16	1.16	0.193	0.7702	0.115	0.053	1.8670	0.85	3600	0.000235	0.002824	

FILL HEIGHT (feet)	SETTLEMENT (in)
2.5	6
5	12
7.5	17.5
10	23.3
12.5	29.2

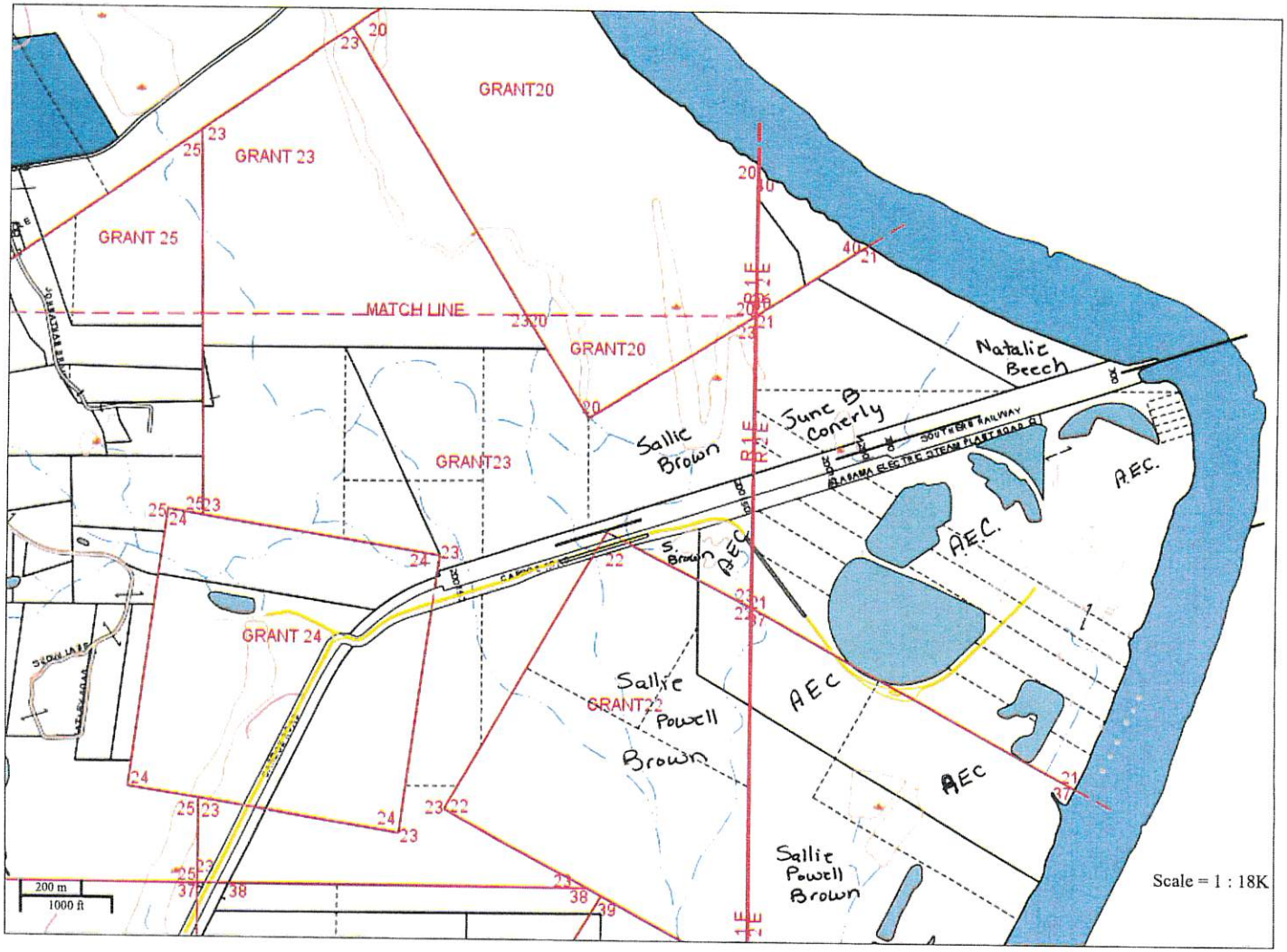


Name and mailing address of all property owners, per county tax records, whose property is adjacent to the CCR surface impoundment at PowerSouth's Charles R. Lowman Power Plant.

Sallie Powell Brown
2075 Powell Cut Off Rd
Leroy, AL 36548

June B. Conerly
373 Shades Crest RD
Birmingham, AL 35226

Natalie Beech
82 Plantation Pointe 290
Fairhope, AL 36532


GRANT20
GRANT 23
GRANT 25
MATCH LINE
GRANT20
GRANT23
GRANT 24
GRANT22
Natalie Beech
June B Conerly
Sallie Brown
S. Brown
Sallie Powell Brown
A.E.C.
A.E.C.
A.E.C.
A.E.C.
A.E.C.
SOUTHERN RAILWAY
ALABAMA ELECTRIC STEAM PLANT ROAD
200 m
1000 ft
Scale = 1 : 18K

CERTIFICATION PAGE

I hereby certify that the information given in this document, based on information and belief formed after reasonable inquiry is true, accurate and complete.

Brian Matheson
Vice President of Power Production

12/1/20

Date