Class III Landfill Run-on and Run-off Control System Plan

Cope Station
Orangeburg County, South Carolina

October 2021

Prepared For:

Dominion Energy of South Carolina
405 State Highway 38 S
Cope, South Carolina 29038

Prepared By:

TRC
50 International Drive, Suite 150
Greenville, South Carolina 29615

Jonathan Hotstream
Senior Scientist

Nakia Addison, P.E.
Project Manager

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APPENDICES

Revision History

Revision Number	Revision Date	Section Revised	Summary of Revisions
0	07/15/2016		Initial Issue, developed by others
1	10/15/2021	1 through 7	Update for periodic revision

1.0 Background

Dominion Energy of South Carolina (DESC) owns and operates the Cope Station (Station). The Cope Station is located in Orangeburg County, South Carolina near the Town of Cope. This Station includes an on-site Class Three Landfill (Landfill), refer to Figure 1. The Landfill is subject to the requirements of the United States Environmental Protection Agency's (USEPA) final coal combustion residual (CCR) rule Title 40 Code of Federal Regulations (40 CFR) Part 257 Subpart D - "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments." The initial run-on and run-off control system plan was developed and placed into the Station's operating record on October 17, 2016. A periodic revision to the run-on and run-off control system plan is required every 5 years pursuant to 40 CFR 257.81(c)(4).

The on-site Class Three Landfill is within the property boundaries of the Station. The permitted Landfill facility is comprised of 26 landfill cells, planned for development in multiple phases. Cells 1 through 4 consist of approximately 26 acres and were placed into operation in accordance with an operation approval issued by the South Carolina Department of Health and Environmental Control (SC DHEC) in 2014.

1.1 Purpose

The purpose of this report is to document that the Cope Station Class Three Landfill run-on and run-off controls meet the requirements of 40 CFR 257.81 – *Run-on and Run-off Controls for CCR Landfills*.

TRC performed the periodic revision of the run-on and run-off control system plan (Plan) by performing a site visit to observe conditions, reviewing the initial run-on and run-off control system plan, reviewing design criteria, and updating calculations.

2.0 Federal Regulations

Pursuant to 40 CFR 257.81, landfills that manage CCR are subject to the following requirements:

(a) The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain:

1. A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and

2. A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

(b) Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under 40 CFR 257.3-3.

(c) Run-on and run-off control system plan

1. *Content of the Plan.* The owner or operator must prepare initial and periodic run-on and run-off control system plans for the CCR unit every five years. These plans must document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations.

3.0 Run-on Control

CCR landfills are required to have a run-on control system designed, constructed and operated to prevent flow onto the active portion of the CCR unit during peak discharge from a 24-hour, 25-year storm.

The Landfill has run-on controls consisting of a perimeter berm and perimeter swales. The perimeter berm constructed around the boundary of the Landfill prevents run-on from entering the active area of the Landfill. As constructed, the perimeter berm for the active Phase 1 of the Landfill is elevated between approximately 8 feet to 18 feet above adjacent ground. Future phases of Landfill development will include a perimeter berm elevated above the adjacent existing ground. The perimeter swales collect and convey stormwater and surface water upgradient of the Landfill to the sediment pond.

Appendix A presents design drawings for the Landfill (Garrett & Moore, 2016). Within Appendix A, Sheet EP-2 from the solid waste permit to construct drawings presents the permitted footprint of the Landfill considering future lateral expansions.

The hydraulic design of the perimeter swale is summarized below and supporting calculations are provided in Appendix B. The stormwater modeling software HydroCAD, was utilized to estimate peak flow rates and associated velocities in swales for the design 24-hour, 25-year storm event. HydroCAD is largely based on the United States Department of Agriculture Soil Conservation Service's, Technical Release 55 (TR-55) and TR-20 hydrology methods.

Based on the HydroCAD analyses, the perimeter swale is sized appropriately for the 24-hour, 25-year storm and manages the peak flow from this storm event with freeboard. TRC performed the analysis considering the following:

- TRC assumed that the drainage area contributing to the perimeter swale is 15 acres for the critical scenario.
- The precipitation volume for the 24-hour, 25-year storm event is 6.71 inches.

The calculations in Appendix B provide the permissible max shear stress of the vegetative lining of the perimeter swale and also estimates the max runoff capacity of the swale. The stormwater calculations in Appendix B presents the estimated peak discharge in the swale from run-on during the design 24-hour, 25-year storm.

Run-on Control Summary:

- Perimeter Swale:
  - Design Peak Flow, 24-hour 25-year Storm: 31 cubic feet per second (cfs)
  - Maximum Design Capacity, perimeter swale based on recent survey data: 935 cfs
  - Peak Velocity: 3.4 feet per second (ft/s), Permissible Velocity: 6.8 ft/s

Based on the existing drainage features and perimeter swales, run-on controls are sufficient to manage the peak discharge from a 24-hour, 25-year storm.

For future lateral expansions, the interphase ditch has the same geometry as the existing condition. Construction of the lateral expansions will reduce the drainage area flowing to the interphase diversion ditch. Therefore, the run-on controls for future phases of development are anticipated to manage the peak discharge from a 24-hour, 25-year storm.

4.0 Run-off Control

CCR landfills are required to have a run-off control system designed, constructed and operated to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

Perimeter ditches located on the CCR side of the Landfill perimeter berm manage run-off from the active portion of the Landfill and future phases of development. Between phases of Landfill construction, an interphase ditch is provided to manage runoff. The interphase ditches have the same geometry as the perimeter ditch and are permanent features for the Landfill. The perimeter ditches and interphase ditches have a fabric formed concrete lining system. Refer to Sheet D-1 in Appendix A for details on the perimeter ditch and interphase ditch. Perimeter ditches discharge to the adjacent downgradient lined Wastewater Pond 1. Additional wastewater ponds will be constructed with future lateral expansions.

Water from Wastewater Pond 1 is pumped back to the Station where it goes through a treatment system prior to being available for recirculation as a process water. After treatment, the Station may discharge this water through a discharge regulated in accordance with a National Pollutant Discharge Elimination System (NPDES) permit issued by the SC DHEC. The permit grants the Station permission to discharge wastewater from the facility in accordance with effluent limitations, monitoring requirements, and other conditions. The NPDES permit is issued in accordance with the provisions of the Federal Clean Water Act. Therefore, by complying with the NPDES permit, the discharge from the wastewater pond is also being handled in accordance with the applicable surface water requirements.

The perimeter ditches and Wastewater Pond 1 are designed to manage the run-off volume resulting from the 24-hour, 25-year storm. The perimeter ditch hydraulic capacity and lining requirements were evaluated using the computer software HydroCAD. Supporting calculations are provided in Appendix C. The drainage area and time of concentration line for the stormwater analysis is presented in Appendix C. The capacity of Wastewater Pond 1 is based on the analysis performed in 2016 (Garrett & Moore). Below is a summary of the stormwater calculations.

Run-Off Control Summary:

- Perimeter Ditches
  - Design Peak Flow, 24-hour 25-year Storm: 145 cfs
  - Maximum Design Capacity, perimeter ditch based on recent survey data: 575 cfs
- Wastewater Pond
  - Berm Crest Elevation: 175 ft
  - Estimated 24-hour, 25-year water surface elevation: 169.2 ft
  - Freeboard: 5.8 ft

The perimeter ditches and the downstream receiving Wastewater Pond 1 exceed the required capacity requirements to collect and control the run-off volume resulting from a 24-hour, 25- year storm.

5.0 Conclusion

The constructed Class Three Landfill adequately manages run-on and run-off in accordance with the requirements of 40 CFR 257.81. Run-off is collected in a lined Wastewater Pond, and treated prior to discharge through an NPDES permitted outfall satisfying the requirements of 40 CFR 257.3-3.

This Plan has been completed in compliance with the requirements set forth in 40 CFR 257.81. This document will be placed in the operating record, posted to the publicly accessible website, and government notifications will be provided.

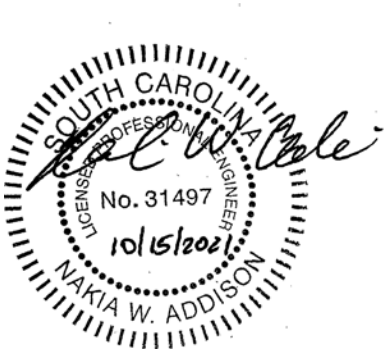
A Run-On and Run-Off Control System Plan must be revised every 5 years. The next periodic revision is required by October 2026.

The Plan must be amended whenever the periodic review period is reached or if changes in site conditions, either intentionally or unintentionally, occur that will sustainably impact the current written plan in effect.

6.0 Certification

I, the undersigned South Carolina Professional Engineer, hereby certify that I am familiar with the technical requirements of 40 CFR 257 Subpart D. I also certify that it is my professional opinion that, to the best of my knowledge, information, and belief, that the information in this demonstration is in accordance with current good and accepted engineering practice(s) and standard(s) and meets the requirements of 40 CFR 257.81.

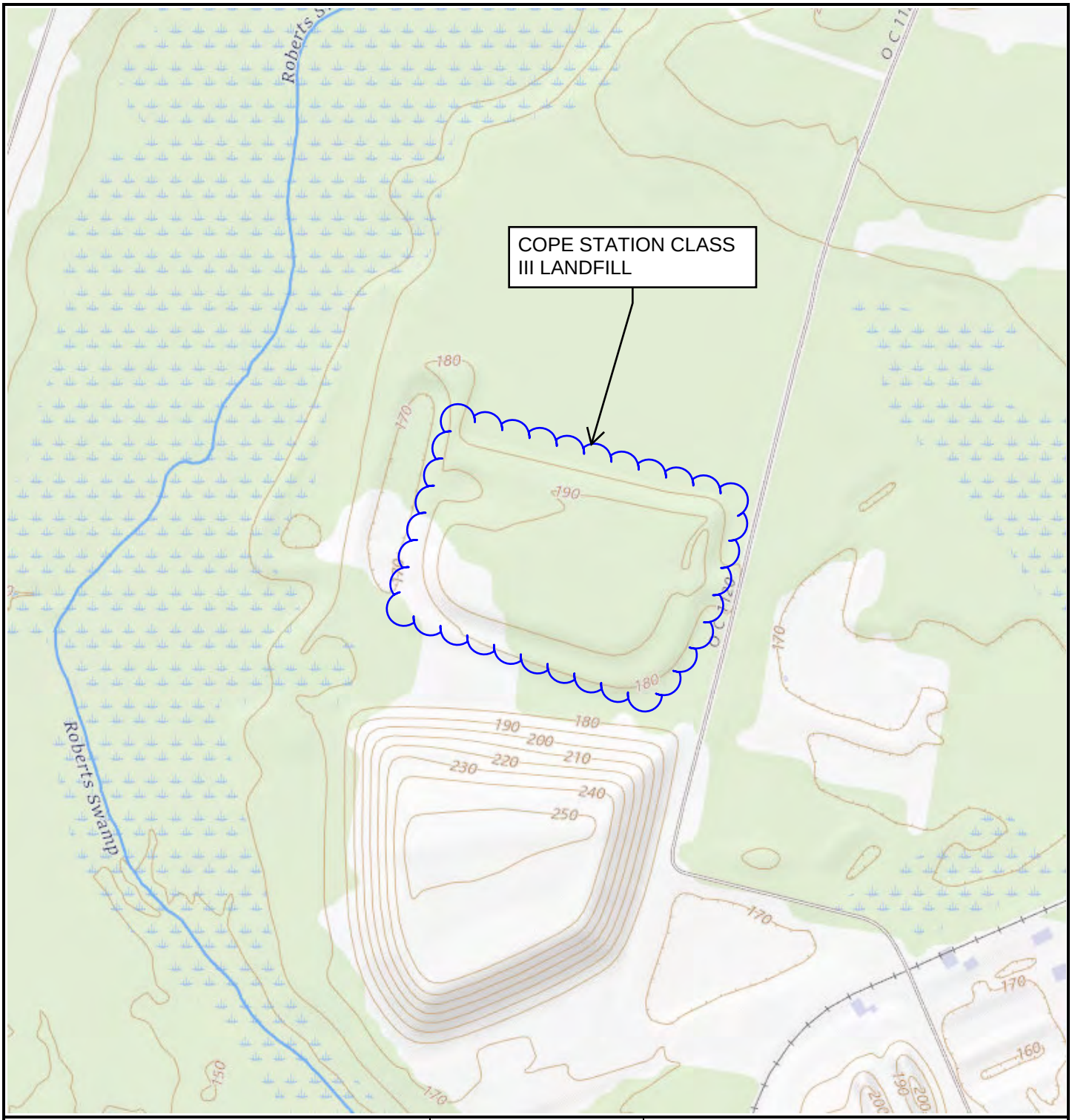
For the purpose of this document, "certify" and "certification" shall be interpreted and construed to be a "statement of professional opinion." The certification is understood and intended to be an expression of my professional opinion as a Licensed Professional Engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.



Nakia Addison, P.E.	31497 Professional Engineer License Number
Signature of Professional Engineer	10/15/2021 Date

7.0 References

Garrett & Moore. 2016. Inflow Design Flood Control System Plan for the Cope Station Class Three Landfill. Orangeburg County, South Carolina. July 2016.

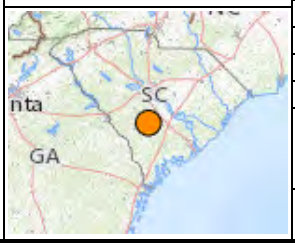


N

0 1,000

feet

33.3736, -81.0401



DOMINION
COPE

SITE LOCATION

DRAWN BY:	S. EDWARDS	PROJ. NO.:	447435.0000
CHECKED BY:	J. HOTSTREAM		
APPROVED BY:	N. ADDISON		
DATE:	OCT. 2021		

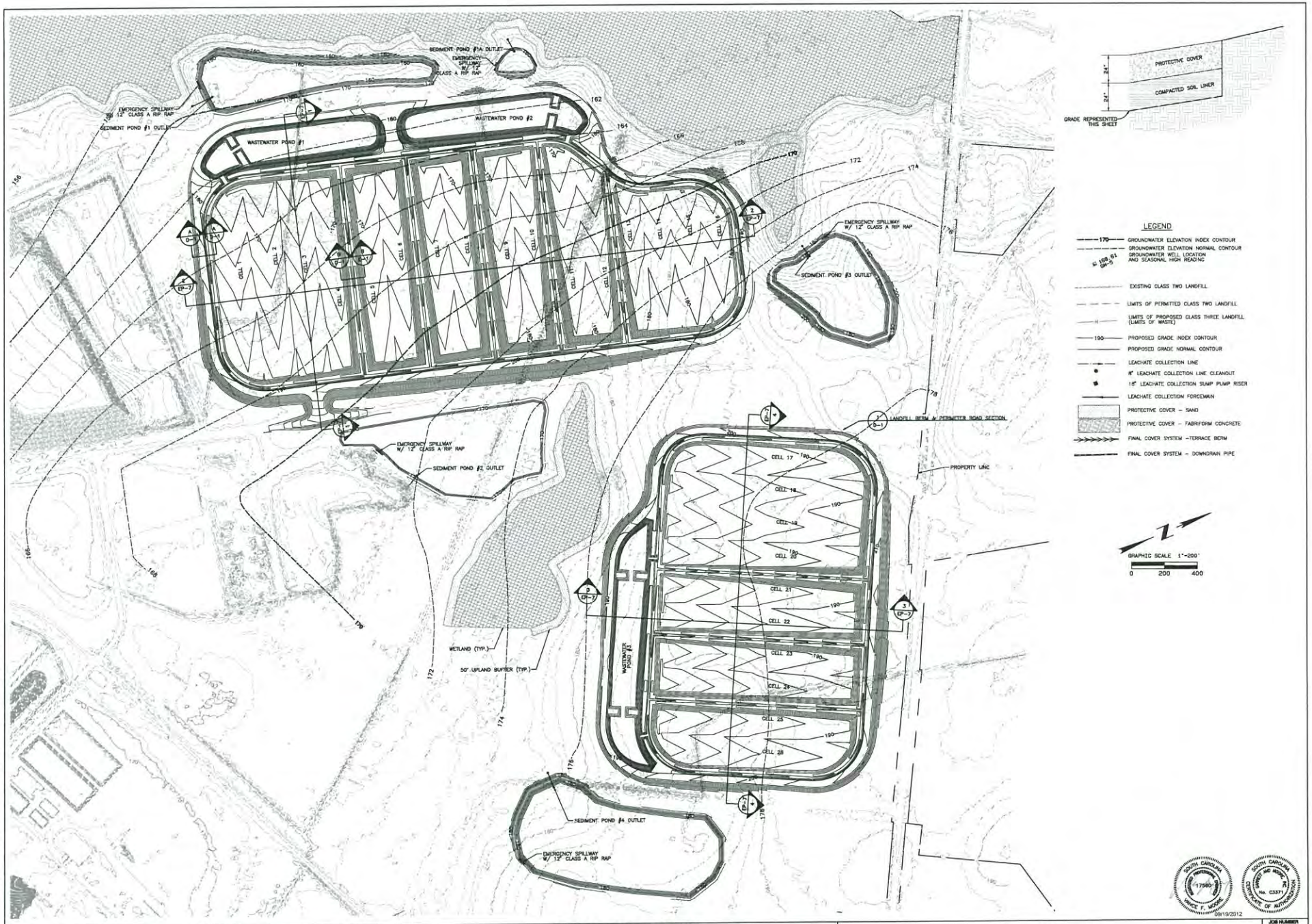
FIGURE 1

TRC
50 INTERNATIONAL DRIVE
SUITE 150
GREENVILLE, SOUTH CAROLINA 29615

FILE: 1FE16F24-F2DB-4588-B872-C76E230A70B9

Base Map: USGS/TNM Topo
Data Sources: TRC, Fulcrum

Appendix A: Select Permit to Construct Drawings



REVISION	DATE
1	
2	
3	
4	
5	

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Engineering for the Power and Waste Industries
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CHARLOTTE, N.C. 28205
TEL: 704 - 355 - 1500
FAX: 866 - 211 - 7506
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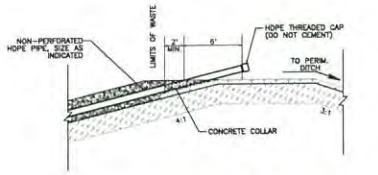
SCE&G - COPE STATION
CLASS THREE LANDFILL

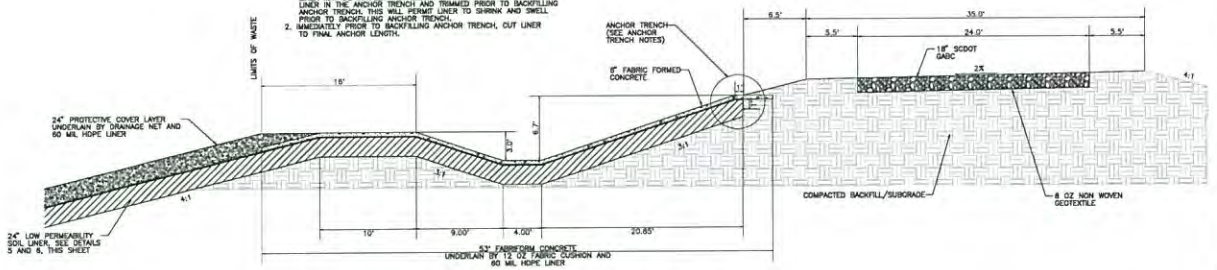
SUBGRADE PLAN

JOB NUMBER
SHEET
SP-2



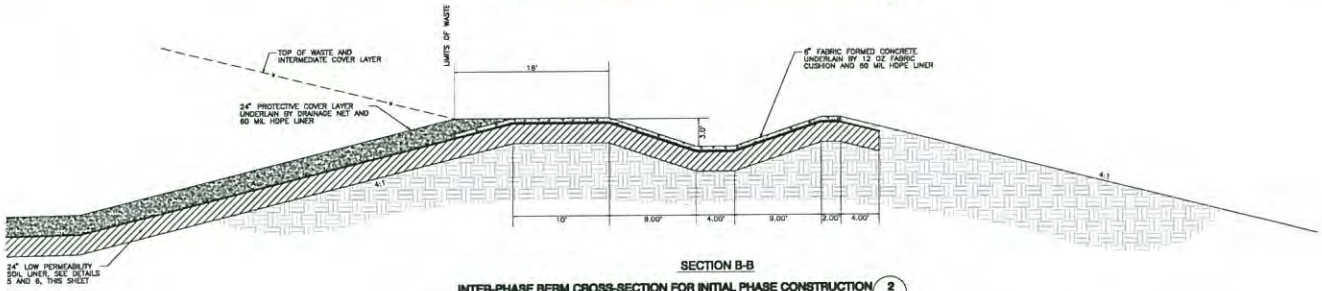
LEACHATE COLLECTION LINE CLEANOUT (4 / D-1)
N.T.S.

ANCHOR TRENCH NOTES:
1. THE DETAIL REPRESENTS FINAL ANCHOR TRENCH CONSTRUCTION. LINER MAY BE INITIALLY INSTALLED WITH MORE THAN ONE FOOT LINER IN THE ANCHOR TRENCH AND TRIMMED PRIOR TO BACKFILLING ANCHOR TRENCH. THIS WILL PERMIT LINER TO SHRINK AND SWELL PRIOR TO BACKFILLING ANCHOR TRENCH.
2. IMMEDIATELY PRIOR TO BACKFILLING ANCHOR TRENCH, CUT LINER TO FINAL ANCHOR LENGTH.



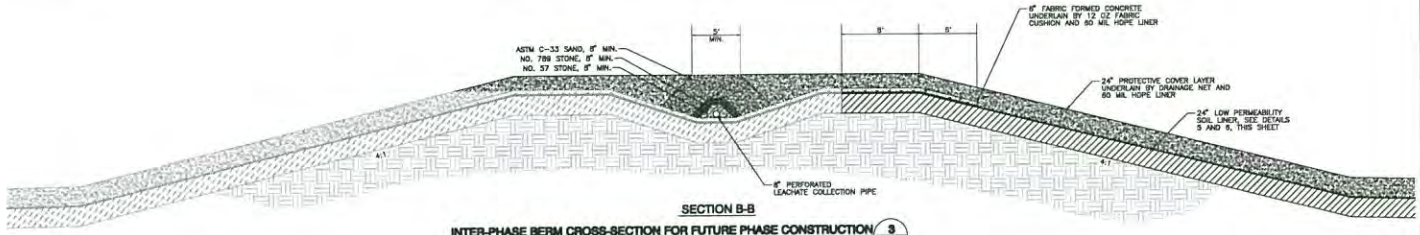
SECTION A-A
LANDFILL BERM/PERIMETER ACCESS ROAD CROSS-SECTION (1 / D-1)
1"=5'

24" LOW PERMEABILITY SOIL LINER - ALT #1 (5 / D-1)
24" SOIL LINER 1x10-7 CM/SEC
N.T.S.

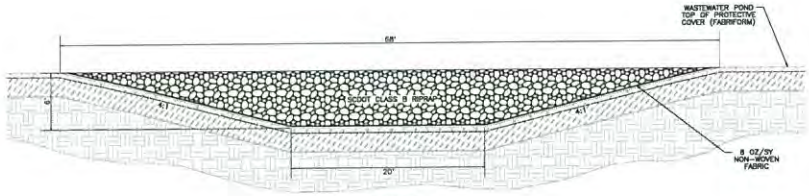


SECTION B-B
INTER-PHASE BERM CROSS-SECTION FOR INITIAL PHASE CONSTRUCTION (2 / D-1)
1"=5'

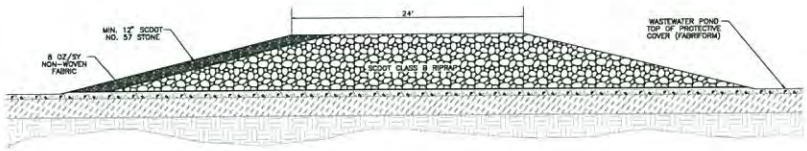
24" LOW PERMEABILITY SOIL LINER - ALT #2 (6 / D-1)
GCL UNDERLAIN BY 24" SOIL LINER 1x10-5 CM/SEC
N.T.S.



SECTION B-B
INTER-PHASE BERM CROSS-SECTION FOR FUTURE PHASE CONSTRUCTION (3 / D-1)
1"=5'



PROFILE



SECTION

FOREBAY ROCK DAM (7 / D-1)

REVISION	DATE
1)	
2)	
3)	
4)	

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TEL: 843 - 795 - 1800
FAX: 866 - 911 - 7200
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COPE STATION
CLASS THREE LANDFILL PROJECT

DETAILS

JOB NUMBER

SHEET
D-1

Appendix B: Run-on Calculations

- Drainage Area Figure
- HydroCAD Calculations
- Trapezoidal Open Channel Calculation

Drainage Area Figure

ANALYSIS POINT

SUBCATCHMENT AREA: 35.92 ACRES

SEDIMENT POND

WASTEWATER POND 1

RUN-ON SUBCATCHMENT: 15 ACRES

PERIMETER SWALE

INTERPHASE DITCH

T_c FLOW LINE: 15.5 MINUTES

PERIMETER DITCH

Tc FLOW LINE: 87.7 MINUTES

PERIMETER BERM

RUN-ON CONTROL PERIMETER SWALE

LEGEND:

RUN-OFF SUBCATCHMENT AREA

T_c FLOW LINE

RUN-ON SUBCATCHMENT AREA

0 200 400

SCALE IN FEET

50 International Drive
Patewood Plaza Three, Suite 150
Greenville, SC 29615
Phone: 864.281.0030

PROJECT:

COPE STATION CLASS III LANDFILL
RUN-ON/RUN-OFF CONTROL PLAN
ORANGEBURG COUNTY, SOUTH CAROLINA

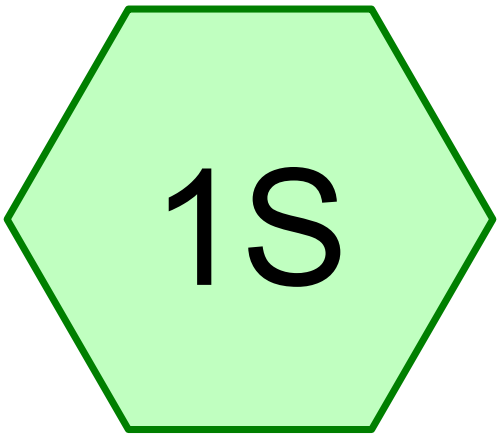
TITLE:

DRAINAGE AREA MAP

DRAWN BY:	C. ALONSO
CHECKED BY:	J. HOTSTREAM
APPROVED BY:	N. ADDISON
DATE:	9/14/2021
PROJ. NO.:	447435
FILE:	Cope Area Map.dwg

FIGURE B

HydroCAD Calculations



Active Perimeter Swale South

Subcat Reach Pond Link

Routing Diagram for Cope - Perimeter Ditch Max Runon
Prepared by TRC, Printed 10/5/2021

Summary for Subcatchment 1S: Active Perimeter Swale South

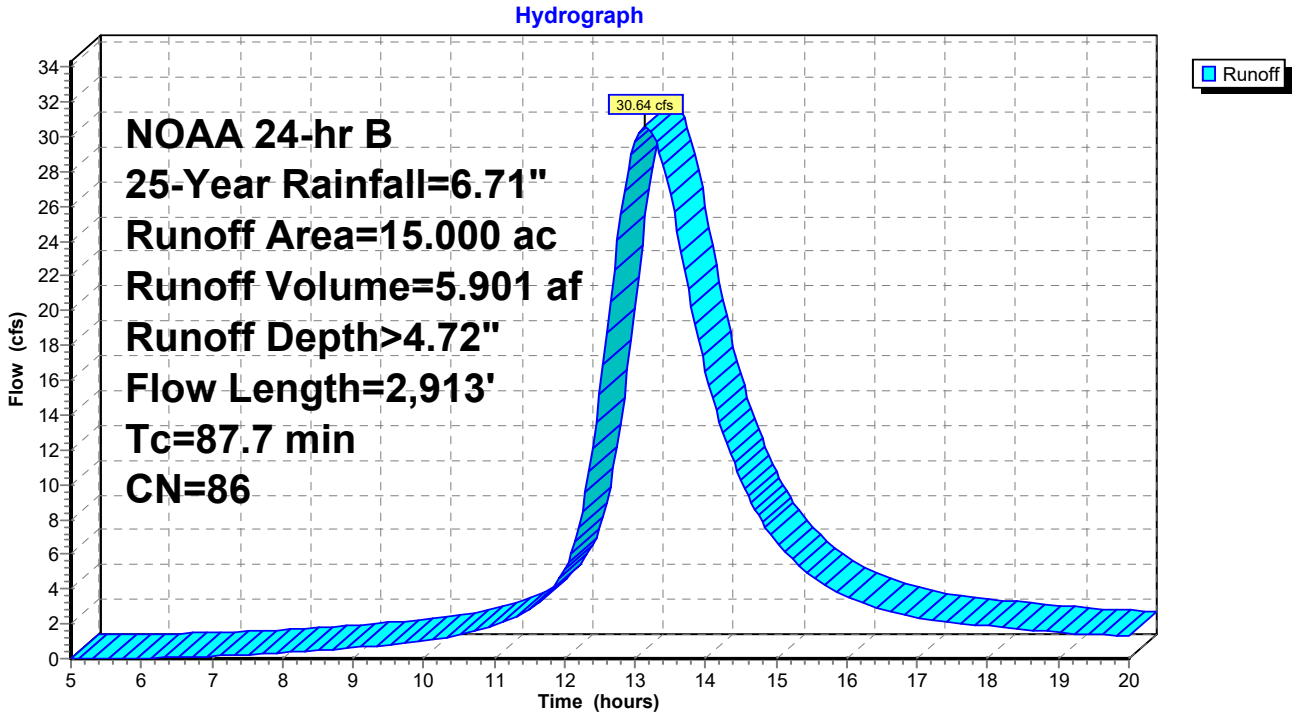
Runoff = 30.64 cfs @ 13.15 hrs, Volume= 5.901 af, Depth> 4.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 25-Year Rainfall=6.71"

Area (ac)	CN	Description
15.000	86	<50% Grass cover, Poor, HSG C
15.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0100	1.10		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.54"
85.1	1,977	0.0015	0.39		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.1	836	0.0080	12.54	1,354.21	**Channel Flow, Grassed channel** Area= 108.0 sf Perim= 18.0' r= 6.00' n= 0.035 Earth, dense weeds
87.7	2,913	Total			

Subcatchment 1S: Active Perimeter Swale South



Trapezoidal Open Channel Calculation

PROJECT:	CCR Five Year Assessment - 447435		
SUBJECT:	Cope Run-on/Run-off Calculations		
COMPUTED BY:	C. Alonso	**CHECKED BY:**	N. Addison
DATE:			

Channel Section Designation: Cope Perimeter Run-on Swale

Channel Section Description: Maximum Runoff and Velocity Check

A. Discharge Q, using Manning's Equation with assigned maximum depth of flow, y.

	Input Data	
max depth of flow (ft), y:	6	
longitudinal slope (ft/ft), S:	0.0085	
bottom width (ft), b:	6	
channel side slope (z:1):	2	
design Q (cfs):	935	
PERMANENT LINING:	Tall Fescue	
roughness coefficient, *n* :	0.035	
max. velocity of lining (ft/s):	5	
retardance class for lining:	D	(From NCDEQ Design Manual Table 8.05c)
VR (max velocity X R):	6.8	(including one retardance class increase)

Permanent lining flow capacity, Q (cfs) = 935

Channel design controlled by permanent lining flow capacity

A, area (sf)	P, wetted perimeter (ft)	R. hydraulic radius (ft)	S, slope (ft/ft)	Q, flow (cfs)	V. velocity (ft/s)
108.0000	32.83	3.29	0.0085	935	8.66

B. Normal Depth and Velocity using Normal-Depth Procedure (known Q)

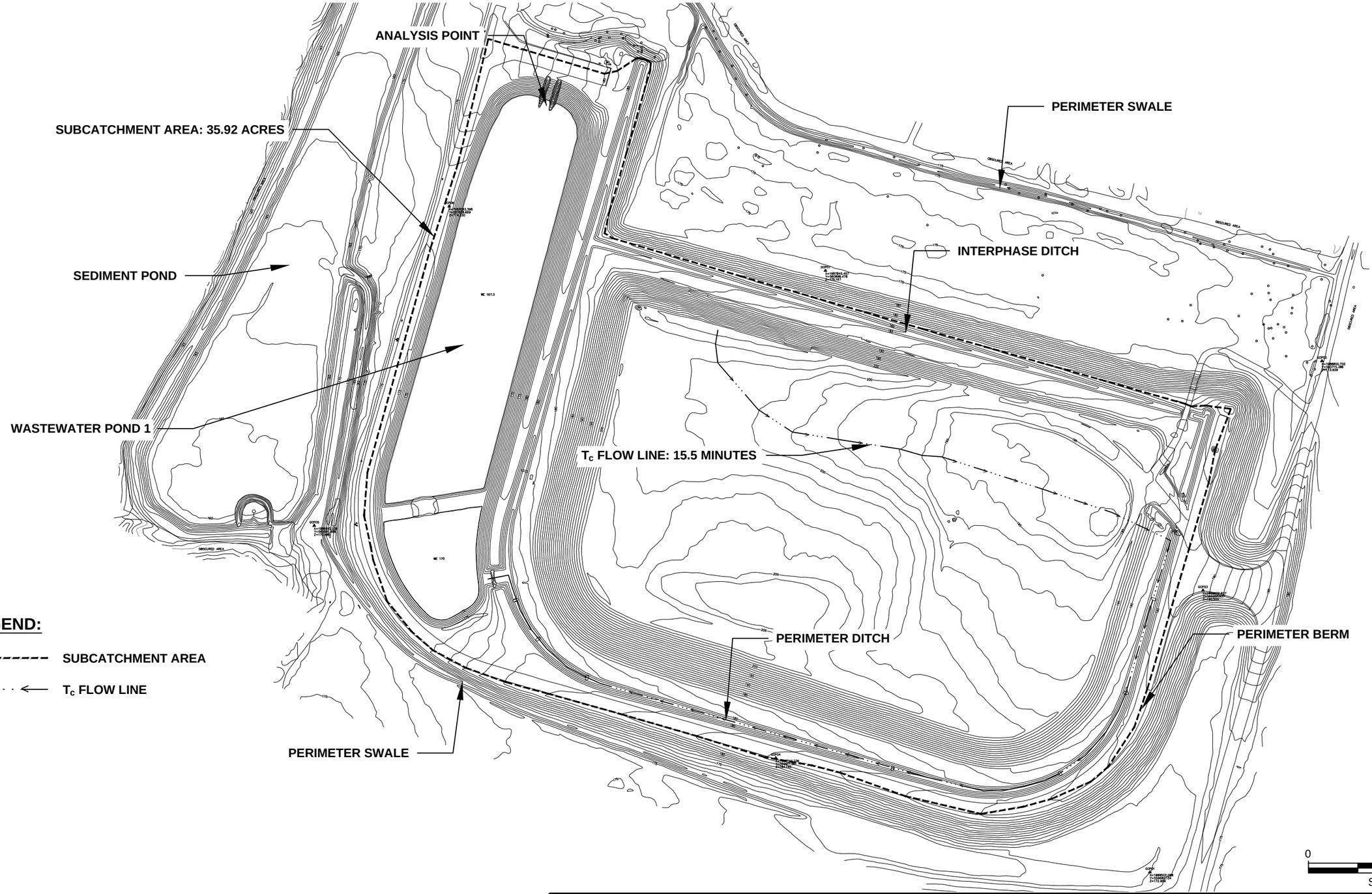
Discharge (cfs), Q:	30.10	From HydroCad, 25-year Peak Flow
longitudinal slope (ft/ft), S:	0.0085	
bottom width (ft), b:	6	
channel side slope (m:1)	2	
	Input	
TEMPORARY LINING:		
roughness coefficient, *n* :	0.035	
max. shear stress (psf), Td:	0	Not Applicable

					Iterate y to make Zav = Zreq		Velocity OK	
Temp. Lined	y-var (ft)	A (ft)	P (ft)	R (ft)	Zav	Zreq	V (ft/s)	Td (psf)
Channel:	1.081	8.8231	10.83	0.81	7.69	7.69	3.411	NA

Appendix C: Run-off Calculations

- Drainage Area Figure
- HydroCAD Calculations
- Trapezoidal Open Channel Calculation

Drainage Area Figure



TRC
50 International Drive
Patewood Plaza Three, Suite 150
Greenville, SC 29615
Phone: 864.281.0030

PROJECT:

COPE STATION CLASS III LANDFILL
RUN-ON/RUN-OFF CONTROL PLAN
ORANGEBURG COUNTY, SOUTH CAROLINA

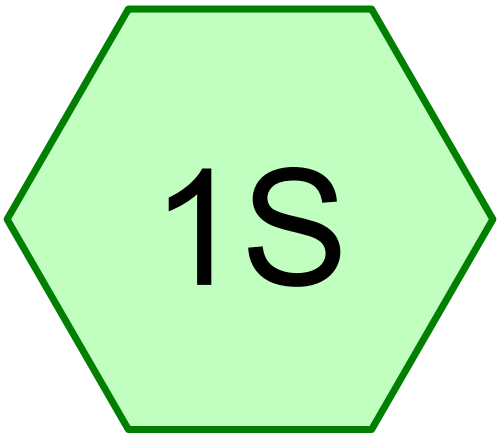
TITLE:

DRAINAGE AREA MAP

DRAWN BY:	C. ALONSO
CHECKED BY:	J. HOTSTREAM
APPROVED BY:	N. ADDISON
DATE:	9/14/2021
PROJ. NO.:	447435
FILE:	Cope Area Map.dwg

FIGURE C

HydroCAD Calculations



Active Perimeter Ditch

Subcat Reach Pond Link

Routing Diagram for Cope - Perimeter Ditch Max Runoff
Prepared by TRC, Printed 9/17/2021

Summary for Subcatchment 1S: Active Perimeter Ditch

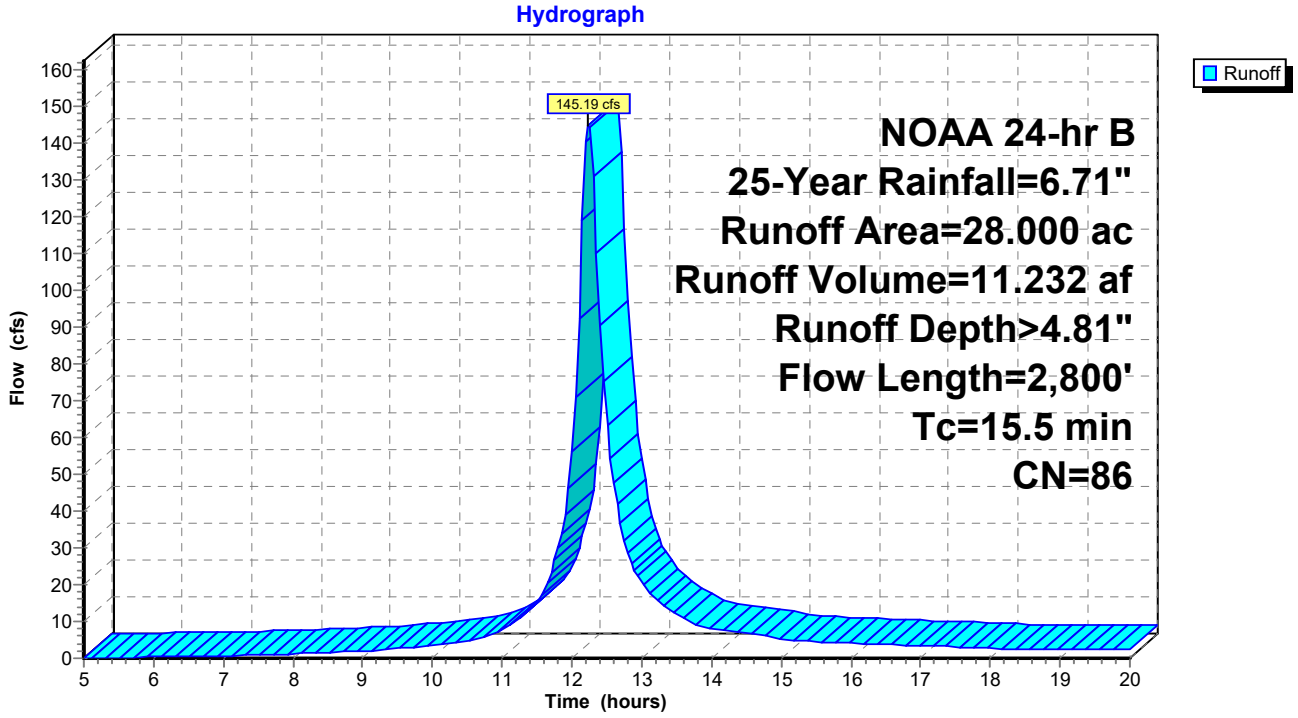
Runoff = 145.19 cfs @ 12.24 hrs, Volume= 11.232 af, Depth> 4.81"

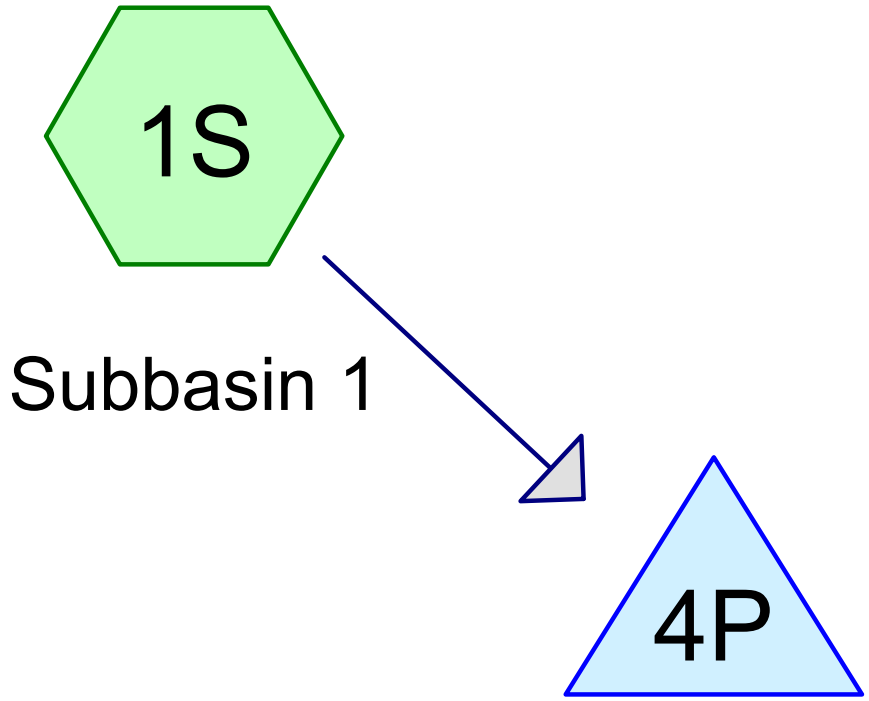
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 25-Year Rainfall=6.71"

Area (ac)	CN	Description
28.000	86	<50% Grass cover, Poor, HSG C
28.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	100	0.0150	1.29		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.54"
12.2	900	0.0150	1.22		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
2.0	1,800	0.0070	14.73	574.57	**Channel Flow, Fabriform Channel** Area= 39.0 sf Perim= 23.0' r= 1.70' n= 0.012
15.5	2,800	Total			

Subcatchment 1S: Active Perimeter Ditch





Subcat Reach Pond Link

Routing Diagram for Cope - Active Cell to Wastewater Pond 1
Prepared by TRC, Printed 9/16/2021

Summary for Subcatchment 1S: Subbasin 1

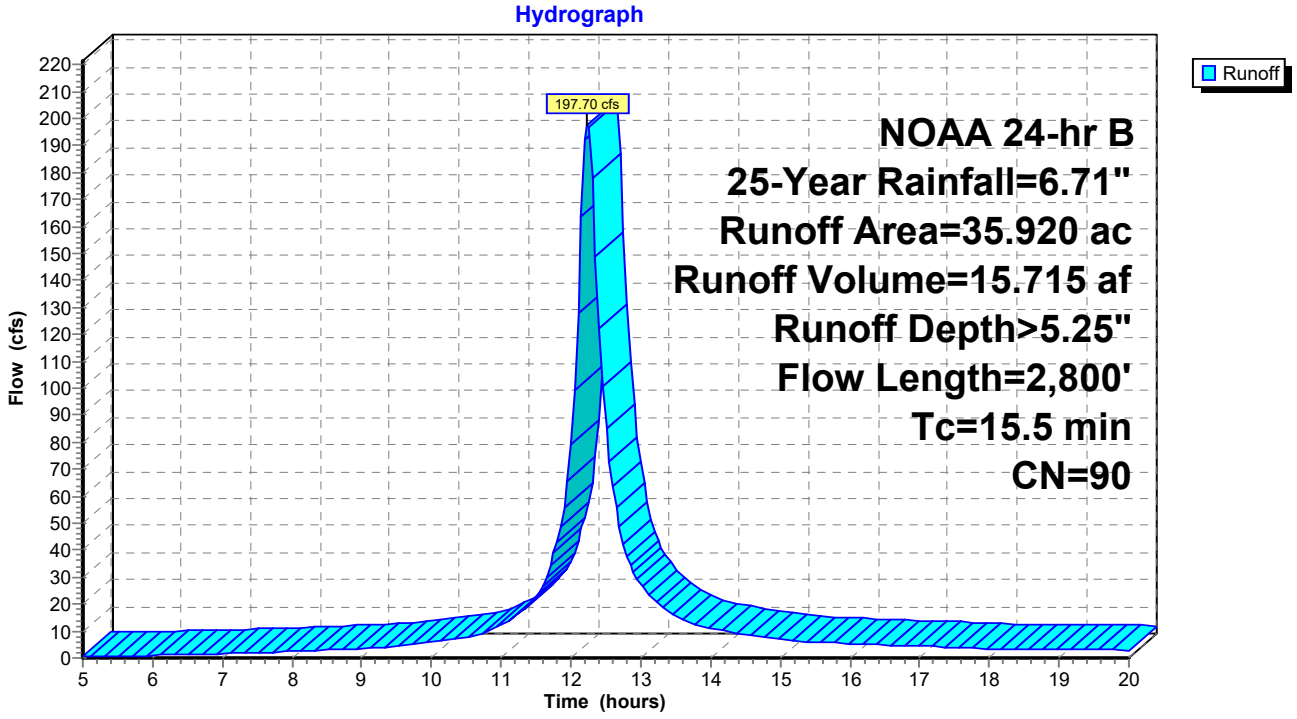
Runoff = 197.70 cfs @ 12.23 hrs, Volume= 15.715 af, Depth> 5.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 25-Year Rainfall=6.71"

Area (ac)	CN	Description
23.900	86	<50% Grass cover, Poor, HSG C
5.720	98	Water Surface, HSG C
6.300	98	Paved roads w/curbs & sewers, HSG C
35.920	90	Weighted Average
23.900		66.54% Pervious Area
12.020		33.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	100	0.0150	1.29		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.54"
12.2	900	0.0150	1.22		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
2.0	1,800	0.0070	14.73	574.57	**Channel Flow, Fabriform Channel** Area= 39.0 sf Perim= 23.0' r= 1.70' n= 0.012
15.5	2,800	Total			

Subcatchment 1S: Subbasin 1



Summary for Pond 4P: Pond 1

Inflow Area = 35.920 ac, 33.46% Impervious, Inflow Depth > 5.25" for 25-Year event
Inflow = 197.70 cfs @ 12.23 hrs, Volume= 15.715 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 4.57' @ 20.00 hrs Surf.Area= 169,088 sf Storage= 684,289 cf

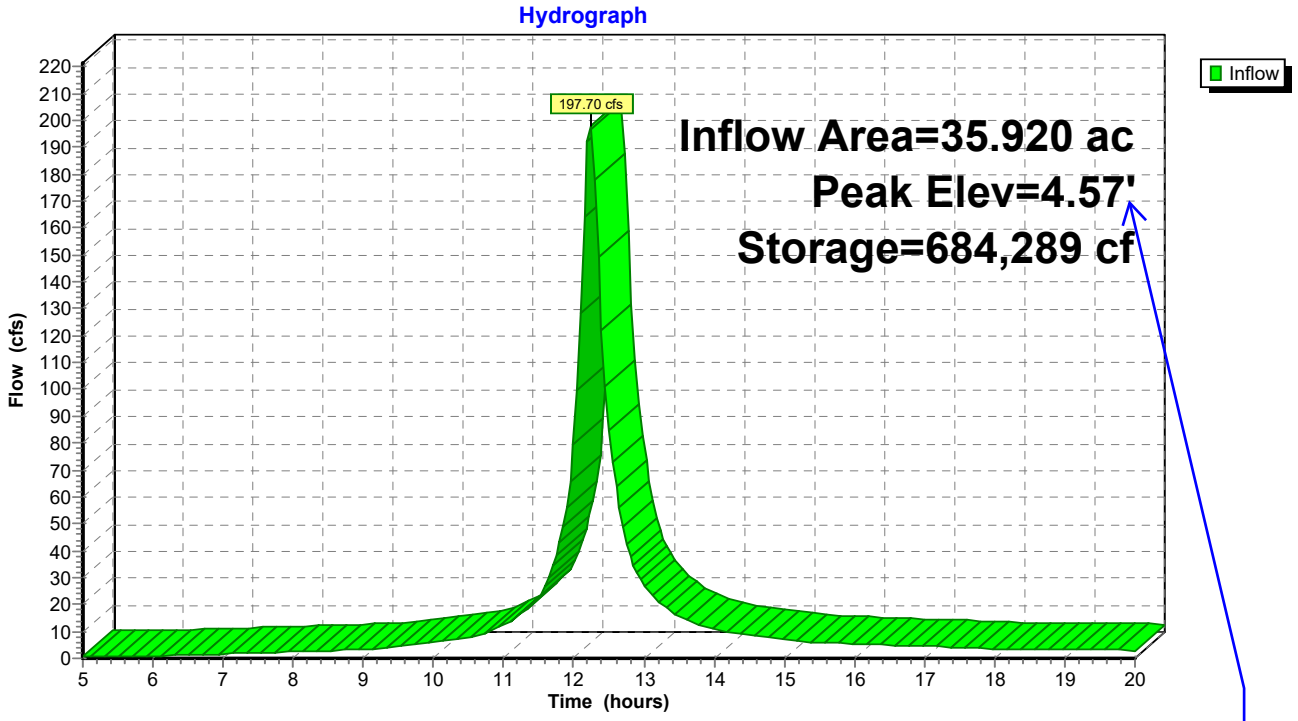
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	1,968,564 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	136,343	0	0
0.40	138,521	54,973	54,973
1.40	144,184	141,352	196,325
2.40	150,282	147,233	343,558
3.40	156,380	153,331	496,889
4.40	162,043	159,212	656,101
5.40	203,425	182,734	838,835
6.40	214,751	209,088	1,047,923
7.40	222,156	218,454	1,266,376
8.40	229,561	225,859	1,492,235
9.40	237,838	233,700	1,725,934
10.40	247,421	242,630	1,968,564

Bottom of pond elevation: 164.6

Pond 4P: Pond 1



Bottom of pond elevation: 164.6
Final Water Elevation: 169.2

Trapezoidal Open Channel Calculation

PROJECT:	CCR Five Year Assessment - 447435
SUBJECT:	Cope Run-on/Run-off Calculations
COMPUTED BY:	C. Alonso **CHECKED BY:** N. Addison
DATE:	

Channel Section Designation: Perimeter Ditch

Channel Section Description: Maximum Runoff and Maximum Shear Stress Check

A. Discharge Q, using Manning's Equation with assigned maximum depth of flow, y.

Input Data

max depth of flow (ft), y:	3
longitudinal slope (ft/ft), S:	0.007
bottom width (ft), b:	4
channel side slope (z:1):	3
design Q (cfs):	575

PERMANENT LINING: Fabriform Concrete

roughness coefficient, *n* :	0.012
max. shear stress (psf), Td:	4

Permanent lining flow capacity, Q (cfs) = 575

Channel design controlled by permanent lining flow capacity

A, area (sf)	P, wetted perimeter (ft)	R. hydraulic radius (ft)	S, slope (ft/ft)	Q, flow (cfs)	V. velocity (ft/s)
39.0000	22.97	1.70	0.007	575	14.74

B. Normal Depth and Shear Stress using Normal-Depth Procedure (known Q)

Discharge (cfs), Q:	145.00	From HydroCad
longitudinal slope (ft/ft), S:	0.007	
bottom width (ft), b:	4	
channel side slope (m:1)	3	

Input

TEMPORARY LINING:	
roughness coefficient, *n* :	0.012
max. shear stress (psf), Td:	4

Iterate y to make Zav = Zreq

OK

Temp. Lined	y-var (ft)	A (ft)	P (ft)	R (ft)	Zav	Zreq	V (ft/s)	Td (psf)
Channel:	1.597	14.0392	14.10	1.00	14.00	14.00	10.33	0.70