Fac/Perm/Co ID #	Date	Doc ID#
6230	9/26/08	DIN 26-K

LCID PERMIT RENEWAL
BARNHILL CONTRACTING COMPANY
LANDFILL PERMIT NO. 26-K
CROWELL SITE

CUMBERLAND COUNTY, NORTH CAROLINA

PREPARED FOR:

Barnhill Contracting Company
Mr. Steve Waters
(910) 829-6261
Post Office Box 35376
Fayetteville, North Carolina

FOR SUBMITTAL TO:

NCDENR – Division of Waste Management
Raleigh, North Carolina

PREPARED BY:

ESP Associates, P.A.
Charlotte, North Carolina

ESP

September 22, 2008

NORTH CAROLINA PROFESSIONAL SEAL 25770 ENGINEER DAVID W. WASIELA

9/22/08

September 22, 2008

State of North Carolina
Department of Environment & Natural Resources
Division of Waste Management
1646 Mail Service Center
Raleigh, NC 27699-1646

Reference: **BARNHILL CONTRACTING COMPANY LCID PERMIT RENEWAL PERMIT NO. 26-K**
Cumberland County, North Carolina

Gentlemen:

ESP Associates, P.A. (ESP) has completed the necessary field surveying and engineering certification for the renewal of LCID Landfill Permit No. 26-K issued to Barnhill Contracting Company for a facility located near Doc Bennett Road and NC-87 approximately 10 miles south east of Fayetteville, North Carolina. Our permit renewal application is based on the previous renewal prepared by ESP Associates, P.A. dated December 5, 2001 and approved by the Division of Waste Management.

The 15.6-acre Doc Bennett LCID Landfill is a reclamation of a previous mining operation (Permit No. 26-16) permitted in 1983 and 1993. This permit renewal does not propose any further expansion beyond the previously approved landfill plans. Therefore, the purpose of this renewal is to verify existing field conditions and remaining landfill capacity based on the approved plans. In order to verify existing field conditions, ESP surveyed the LCID Landfill on August 14, 2008 to establish current conditions. A topographic map was developed using the survey data and is included on the plans attached with this renewal. ESP used this information along with the approved landfill grading plans to develop the existing site conditions plan (Plan set under separate cover).

P.O. Box 7030 · Charlotte, NC 28241
1.800.960.7317 · NC: 704.583.4949, fax 704.583.4950 · SC: 803.802.2440, fax 803.802.2515
www.espassociates.com

Updated plans were developed to quantify remaining landfill capacity. Based on the previously mentioned information and utilizing AutoCadd software, approximately 122,000 cubic yards of gross airspace remains in the approved landfill boundaries. Of the 122,000 cubic yards, approximately 30,000 cubic yards is required for soils placed in the buffer area and 30,000 cubic yards for operational and final cover soils. Therefore a net airspace 62,000 cubic yards remains for disposal of LCID waste. The plans also include the cross section locations used to illustrate proposed landfill floor and proposed final contours. The cross sections utilize the previously approved plans for the LCID landfill. The landfill slopes will be maintained at a maximum 3H:1V as filling progresses in accordance with the permit conditions.

The site will no longer operate as an existing mine. Therefore, new erosion and sedimentation control plans have been submitted to the Land Quality Section for approval and are included in this submittal for reference.

Based on the remaining capacity of 62,000 cubic yards and an average waste flow of approximately 5,000 cubic yards per year, the approved landfill footprint and plans has a remaining life of approximately 12.5 years or 12 years and 6 months. The landfill is proposed to operate within the same boundaries as previously approved.

If you should have any questions or require additional information concerning this application for permit renewal or attached drawings, please contact me at (803) 835-0890.

Sincerely,

ESP Associates, P.A.

NORTH CAROLINA PROFESSIONAL SEAL 20770 ENGINEER DAVID W. WASIELA

9-22-08

David W. Wasiela, P.E.
Senior Project Engineer
NC Registration No. 20770

Cc: Mr. Steve Waters – Barnhill Contracting Company

Attch: Plans Under Separate Cover (Sheets 1 – 10)
Erosion & Sedimentation Control Calculations

Erosion Control Design Calculations
For
DOC BENNETT LANDFILL
Cumberland County, North Carolina

Prepared for: BARNHILL CONTRACTING COMPANY
P.O. BOX 35376
Fayetteville, North Carolina
(910) 829-6261

Prepared by: ***ESP Associates, P.A.***
3475 Lakemont Boulevard
Ft. Mill, SC 29708
(803) 802-2440

Project No. WG14.400

Date: September 22, 2008

ESP

NORTH CAROLINA PROFESSIONAL SEAL 22176 ENGINEER DAVID W. WASIELA

9-22-08

TABLE OF CONTENTS

1. SEDIMENT BASIN CALCULATIONS AND SUPPORTING DOCUMENTATION

2. RIP-RAP APRON CALCULATIONS

REFERENCES

NC Erosion and Sediment Control Planning and Design Manual, NCDENR, 2006
Elements of Urban Stormwater Design, HR Malcom, 1989, NCSU, pVI-2.

1. SEDIMENT BASIN CALCULATIONS AND SUPPORTING DOCUMENTATION

Worksheet 1: Runoff curve number and runoff

Project Doc Bennett Landfill	By EJW Date
Location Fayetteville, NC	Checked DJW Date

Check one: ☒ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 8.03e	CN [1] Figure 8.03c	CN [1] Figure 8.03d	Area ☒ acres ☐ mi² ☐ %	Product of CN x area
WAB	Wagram Loamy Sand,	68			15.09	1026.12
VaD	Vaucluse loamy Sand	79			0.23	18.17
BaD	Blaney loamy Sand	86			0.69	59.34
1: Use only one CN source per line		Totals ➡			16.01	1103.63

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{1103.63}{16.01} = 68.9$ **Use CN ➡** 69

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr	2	10	
Rainfall, P (24-hr) ..... in	3.66	5.52	
Runoff, Q ..... in	1.05	2.35	

(Use P and CN with table 8.03d, figure 8.03a, or equations 8.03c and 8.03d)

Table 8.03d Runoff depth for selected CN's and rainfall amounts [1]

Rainfall	Runoff depth for curve number of—												
	40	45	50	55	60	65 69	70	75	80	85	90	95	98
	inches												
1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.08	0.17	0.32	0.56	0.79
1.2	0.00	0.00	0.00	0.00	0.00	0.00	.03	.07	.15	.27	.46	.74	.99
1.4	0.00	0.00	0.00	0.00	0.00	.02	.06	.13	.24	.39	.61	.92	1.18
1.6	0.00	0.00	0.00	0.00	.01	.05	.11	.20	.34	.52	.76	1.11	1.38
1.8	0.00	0.00	0.00	0.00	.03	.09	.17	.29	.44	.65	.93	1.29	1.58
2.0	0.00	0.00	0.00	.02	.06	.14	.24	.38	.56	.80	1.09	1.48	1.77
2.5	0.00	0.00	.02	.08	.17	.30	.46	.65	.89	1.18	1.53	1.96	2.27
3.0	0.00	.02	.09	.19	.33	.51	.71	.96	1.25	1.59	1.98	2.45	2.77
3.5	.02	.08	.20	.35	.53	.75 1.581	1.01	1.30	1.64	2.02	2.45	2.94	3.27
3.66 4.0	.06	.18	.33	.53	.76	1.03 1.05 1.27	1.33	1.67	2.04	2.46	2.92	3.43	3.77
4.5	.14	.30	.50	.74	1.02	1.33	1.67	2.05	2.46	2.91	3.40	3.92	4.26
5.0	.24	.44	.69	.98	1.30	1.65 1.962	2.04	2.45	2.89	3.37	3.88	4.42	4.76
5.52 6.0	.50	.80	1.14	1.52	1.92	2.35 2.35 2.719	2.81	3.28	3.78	4.30	4.85	5.41	5.76
7.0	.84	1.24	1.68	2.12	2.60	3.10	3.62	4.15	4.69	5.25	5.82	6.41	6.76
8.0	1.25	1.74	2.25	2.78	3.33	3.89	4.46	5.04	5.63	6.21	6.81	7.40	7.76
9.0	1.71	2.29	2.88	3.49	4.10	4.72	5.33	5.95	6.57	7.18	7.79	8.40	8.76
10.0	2.23	2.89	3.56	4.23	4.90	5.56	6.22	6.88	7.52	8.16	8.78	9.40	9.76
11.0	2.78	3.52	4.26	5.00	5.72	6.43	7.13	7.81	8.48	9.13	9.77	10.39	10.76
12.0	3.38	4.19	5.00	5.79	6.56	7.32	8.05	8.76	9.45	10.11	10.76	11.39	11.76
13.0	4.00	4.89	5.76	6.61	7.42	8.21	8.98	9.71	10.42	11.10	11.76	12.39	12.76
14.0	4.65	5.62	6.55	7.44	8.30	9.12	9.91	10.67	11.39	12.08	12.75	13.39	13.76
15.0	5.33	6.36	7.35	8.29	9.19	10.04	10.85	11.63	12.37	13.07	13.74	14.39	14.76

1 / Interpolate the values shown to obtain runoff depths for CN's or rainfall amounts not shown.

Worksheet 2: Time of Concentration (T_c) or travel time (T_t)

Project Doc Bennett Landfill	By EJW	Date
Location Fayetteville, NC	Checked DWW	Date

Check one: [X] Present [ ] Developed

Check one: [ ] T_c [ ] T_t through subarea

Note: Space for as many as two segments per flow can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)

Segment ID:					
1. Surface description (table 8.03h)					
2. Manning's roughness coefficient, n (table 8.03h)					
3. Flow length, L (total L + 300ft) ....ft					
4. Two-year 24-hour rainfall, P_2 ....in					
5. Land slope, s ....ft/ft					
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$ Compute T_t ....hr		+		=	

Shallow concentrated flow

Segment ID:					
7. Surface description (paved or unpaved)	unpaved				
8. Flow length, L ....ft	1,000				
9. Watercourse slope, s ....ft/ft	0.027				
10. Average velocity, V (figure 3-1) ....ft/s	2.6				
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ....hr	0.107	+		=	0.107

$\frac{1000}{3600(2.6)} = 0.107$

Channel flow

Segment ID:					
12. Cross sectional flow area, a ....ft^2					
13. Wetted perimeter, P_w ....ft					
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ....ft					
15. Channel slope, s ....ft/ft					
16. Manning's roughness coeficient, n					
17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V ....ft/s					
18. Flow length, L ....ft					
19. $T_t = \frac{L}{3600V}$ Compute T_t ....hr		+		=	
20. Watershed or subarea or (add in step 6,11, and 19) ....Hr					

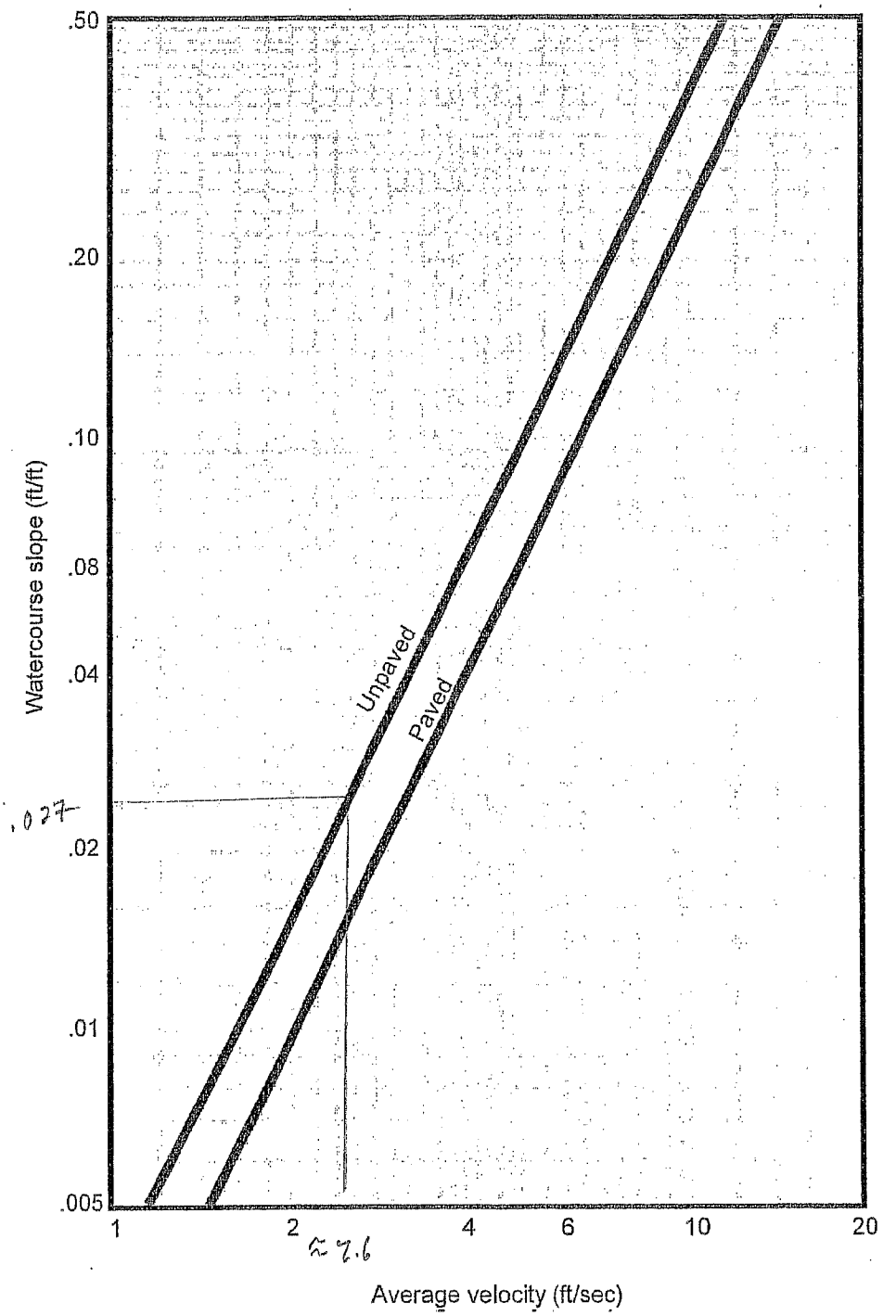


Figure 8.03f Average velocities for estimating travel time for shallow concentrated flow

Worksheet 3: Graphical Peak Discharge Method

Project Doc Bennett Landfill	By ETW	Date
Location Fayetteville, NC	Checked DWW	Date

Check one: ☒ Present ☐ Developed

1. Data

Drainage area ..... A_m = 0.025 mi² (acres/640)

Runoff curve number ..... CN = 69 (From worksheet 1)

Time of concentration ..... T_c = 0.107 hr (from worksheet 2)

Rainfall disturbance ..... = II (I, IA, II, III)

Pond and swamp areas sprea throughout watershed ..... = — percent of Am (_____acres or mi² covered)

	Storm #1	Storm #2	Storm #3
2. Frequency .....yr	2	10	
3. Rainfall, P (24-hour) .....in	3.66	5.52	
4. Initial abstraction, I_a .....in (Use CN with table 8.03h)	0.899	0.899	
5. Compute I_a/P	0.245	0.162	
6. Unit peak discharge, q_u .....csm/in (Use T_c and I_a/P with figure 8.03k)	1000	1000	
7. Runoff, Q .....in (From worksheet 1) Figure 8.03e	1.05	2.35	
8. Pond and swamp adjustment factor, F_p ..... (Use percent pond and swamp area with table 8.03j. Factor is 1.0 for zero percent pond and swamp area.)	1	1	
9. Peak discharge, q_p .....ft³/s (Where $q_p = q_u A_m Q F_p$)	26.25	58.75	

$q_p = (1000)(0.025)(1.05)(1)$
$= 26.25$

$q_p = (1000)(0.025)(2.35)(1)$
$= 58.75$

Figure 8.03i Variation of I_a / P for P and CN

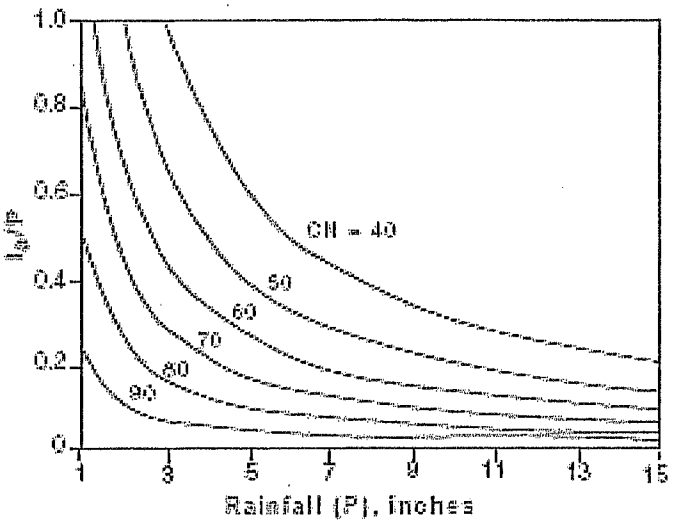


Table 8.03i I_a **values for runoff curve number**

Curve number	I_a (in)	Curve number	I_a (in)
40	3.000	70	0.857
41	2.878	71	0.817
42	2.762	72	0.778
43	2.651	73	0.740
44	2.545	74	0.703
45	2.444	75	0.667
46	2.348	76	0.632
47	2.255	77	0.597
48	2.167	78	0.564
49	2.082	79	0.532
50	2.000	80	0.500
51	1.922	81	0.469
52	1.846	82	0.439
53	1.774	83	0.410
54	1.704	84	0.381
55	1.636	85	0.353
56	1.571	86	0.326
57	1.509	87	0.299
58	1.448	88	0.273
59	1.390	89	0.247
60	1.333	90	0.222
61	1.279	91	0.198
62	1.226	92	0.174
63	1.175	93	0.151
64	1.125	94	0.128
65	1.077	95	0.105
66	1.030	96	0.083
67	0.985	97	0.062
68	0.941	98	0.041
69	0.899		

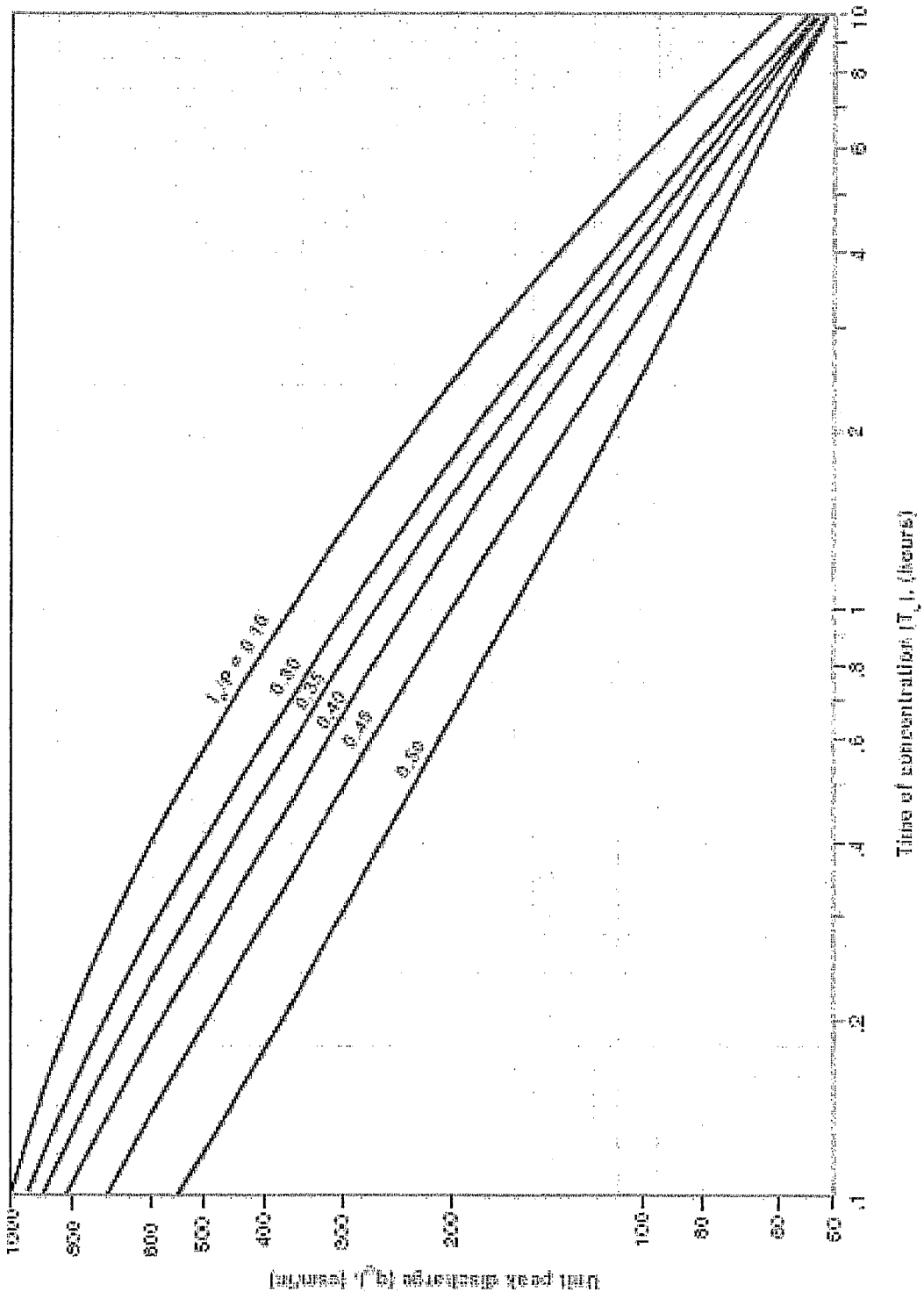


Figure 8.03k Unit peak discharge (q_u) for NRCS (SCS) type II rainfall distribution for NC except lower coastal plain.

		Computed by:	EJW	Date:	9/17/2008
		Checked by:	DWW	Date:	

Project: **Doc Bennett Landfill**
Basin: **SB-1 Pre/Post**
Total Drainage Area to Basin: **16.1** Acres
Disturbed Area Draining to Basin: **12.8** Acres

Runoff:

	2 yr	10 yr
Curve Number:	69	69
Runoff Q:	1.05	2.35

Determine Required Basin Volume:

Min. req. vol. = 1800 cf/ac * **16.1** ac. total drainage area = **28980.0** cf = 1073 cyd
Vol. of Basin at cleanout (Vc):
Vc. = 900 cf/ac * **12.8** ac. disturbed drainage area = **11529.0** cf = 427 cyd
Elevation corresponding to cleanout volume (Cleanout Elevation) = **133.1**

Determine area of basin

Compute minimum basin surface area. (SA)
SA(min) = .01 ac/cfs x Q10
SA(min) = .01 ac/cfs x **58.57** cfs = **0.59** SA min. (acres)
SA(min) = 43560 sf / ac. x **0.59** acres = **25,513** SA min. (sq. ft.)

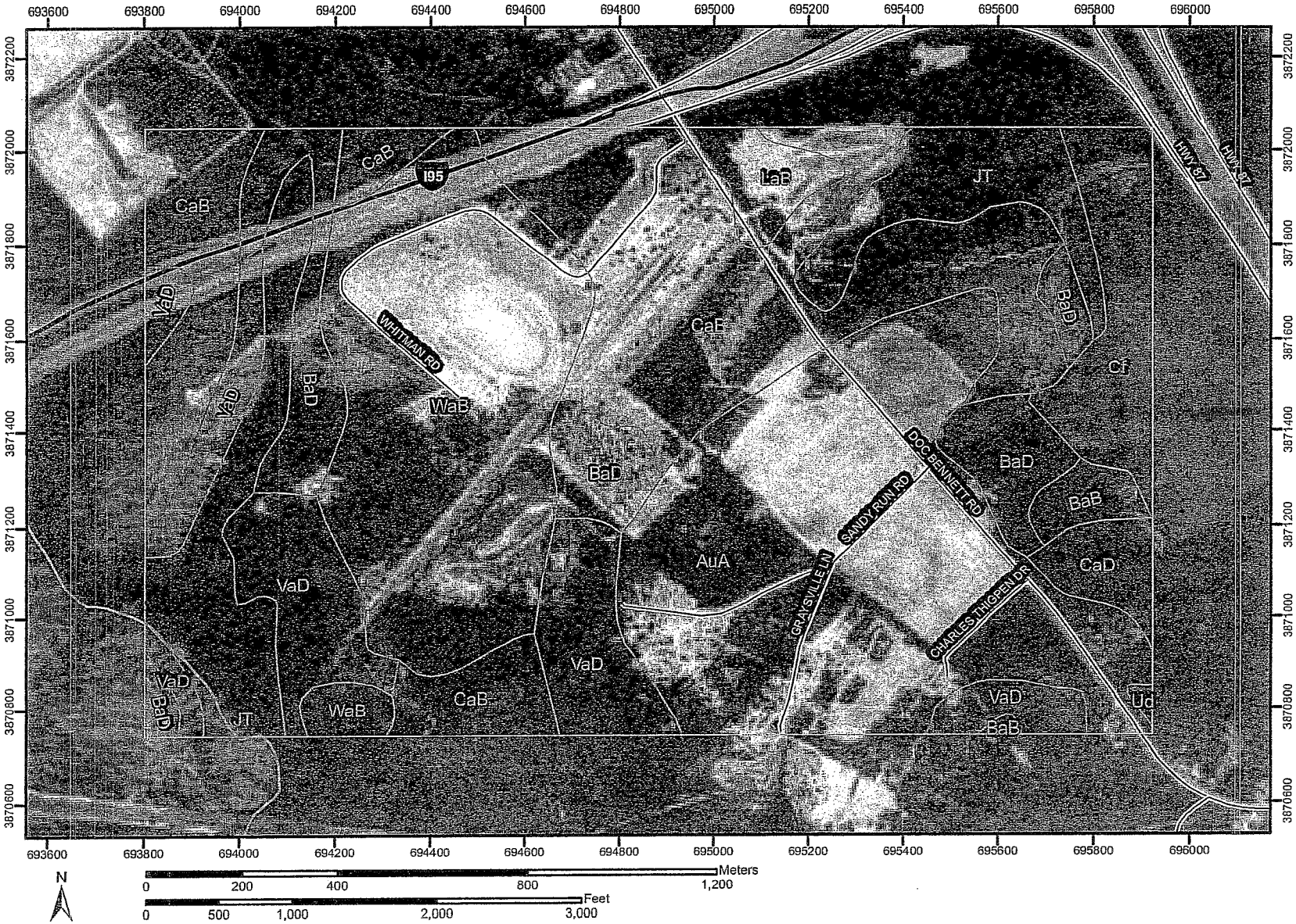
Basin Stage Storage

El	Area	diff El	Inc Vol	Sum Vol
132	5055			0
		1	9105	
133	13155			9105
		1	18770	
134	24384			27875
		1	24953	
135	25521			52827
		1	26102	
136	26683			78929
			0	
				78929
				52827
				52827

= 1957 cyd

Avaliable Area at Riser Crest
Surface area available at Riser Crest **26,683** SA (sq. ft.)
Available area greater than SA (min)? **YES**

Side slopes to be 2.5:1 or flatter
Dam height to be less than 15 ft
Top of Embankment width to be minimum 8 ft


693600
693800
694000
694200
694400
694600
694800
695000
695200
695400
695600
695800
696000
3872200
3872000
3871800
3871600
3871400
3871200
3871000
3870800
3870600
I95
HWY 87
WHITMAN RD
SANDY RUN RD
DOC BENNETT RD
GRANSVILLE LN
CHARLES THIGPEN DR
CaB
LaB
JT
VaD
BaD
WaB
CaE
Cf
BaB
CaD
AuA
Ud
N
Meters
0
200
400
800
1,200
Feet
0
500
1,000
2,000
3,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

Municipalities

- Cities
- Urban Areas

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails

Roads

- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cumberland County, North Carolina
Survey Area Data: Version 9, Jul 21, 2008

Date(s) aerial images were photographed: 3/2/1999; 3/4/1999

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Cumberland County, North Carolina (NC051)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AuA	Autryville loamy sand, 0 to 2 percent slopes	161.1	23.6%
BaB	Blaney loamy sand, 2 to 8 percent slopes	7.1	1.0%
BaD	Blaney loamy sand, 8 to 15 percent slopes	51.2	7.5%
CaB	Candor sand, 1 to 8 percent slopes	156.2	22.8%
CaD	Candor sand, 8 to 15 percent slopes	10.3	1.5%
Cf	Cape Fear loam	28.8	4.2%
JT	Johnston loam	62.7	9.2%
LaB	Lakeland sand, 1 to 8 percent slopes	11.1	1.6%
Ud	Udorthents, loamy	0.7	0.1%
VaD	Vaucluse loamy sand, 8 to 15 percent slopes	70.2	10.3%
WaB	Wagram loamy sand, 0 to 6 percent slopes	124.6	18.2%
Totals for Area of Interest (AOI)		684.2	100.0%

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

FAYETTEVILLE, NORTH CAROLINA (31-3017) 35.0583 N 78.8583 W 49 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 2, Version 3
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2004

Extracted: Thu Sep 4 2008

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | Docs | U.S. Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.43	0.69	0.86	1.18	1.47	1.71	1.82	2.17	2.56	3.02	3.49	3.92	4.55	5.21	7.01	8.74	11.06	13.26
2	0.51	0.81	1.02	1.41	1.77	2.08	2.21	2.63	3.10	3.66	4.23	4.73	5.46	6.24	8.33	10.34	13.03	15.58
5	0.59	0.95	1.21	1.71	2.19	2.63	2.80	3.35	3.97	4.69	5.36	5.93	6.78	7.61	10.00	12.20	15.14	17.93
10	0.66	1.05	1.33	1.94	2.52	3.06	3.28	3.93	4.68	5.52	6.29	6.90	7.82	8.68	11.31	13.62	16.74	19.71
25	0.74	1.18	1.50	2.22	2.95	3.64	3.95	4.75	5.69	6.69	7.58	8.24	9.26	10.14	13.09	15.52	18.84	22.00
50	0.80	1.27	1.61	2.43	3.29	4.10	4.50	5.42	6.54	7.66	8.63	9.33	10.42	11.29	14.49	16.98	20.44	23.73
100	0.86	1.36	1.72	2.64	3.63	4.58	5.08	6.13	7.44	8.67	9.74	10.47	11.62	12.47	15.90	18.43	22.01	25.42
200	0.91	1.45	1.83	2.84	3.99	5.06	5.68	6.89	8.41	9.74	10.92	11.66	12.87	13.69	17.35	19.89	23.57	27.08
500	0.98	1.56	1.96	3.12	4.47	5.72	6.54	7.96	9.82	11.26	12.57	13.32	14.59	15.34	19.32	21.84	25.62	29.23
1000	1.04	1.64	2.06	3.33	4.86	6.24	7.23	8.84	10.98	12.49	13.90	14.65	15.96	16.64	20.86	23.34	27.18	30.85

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

*** Upper bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.48	0.76	0.95	1.31	1.63	1.99	2.12	2.47	2.90	3.26	3.76	4.20	4.88	5.55	7.45	9.27	11.70	13.98
2	0.56	0.90	1.14	1.57	1.97	2.41	2.56	2.99	3.52	3.96	4.54	5.06	5.85	6.64	8.86	10.96	13.78	16.41
5	0.66	1.06	1.34	1.90	2.44	3.04	3.25	3.80	4.49	5.07	5.77	6.34	7.26	8.10	10.63	12.94	15.99	18.89
10	0.73	1.17	1.48	2.14	2.79	3.53	3.80	4.46	5.28	5.96	6.75	7.37	8.37	9.23	12.02	14.46	17.69	20.74
25	0.82	1.30	1.65	2.45	3.26	4.21	4.57	5.37	6.40	7.22	8.13	8.81	9.91	10.79	13.91	16.49	19.92	23.16

50	0.88	1.40	1.78	2.67	3.62	4.74	5.21	6.13	7.33	8.26	9.26	9.97	11.16	12.02	15.41	18.05	21.63	25.00
100	0.94	1.50	1.90	2.90	4.00	5.28	5.86	6.93	8.32	9.35	10.47	11.20	12.45	13.29	16.94	19.61	23.31	26.80
200	1.00	1.59	2.01	3.12	4.38	5.83	6.56	7.76	9.39	10.52	11.74	12.49	13.80	14.60	18.50	21.18	25.00	28.56
500	1.08	1.71	2.15	3.42	4.91	6.59	7.54	8.97	10.94	12.17	13.55	14.32	15.70	16.41	20.63	23.31	27.23	30.91
1000	1.14	1.80	2.26	3.66	5.34	7.20	8.32	9.95	12.20	13.53	15.02	15.79	17.23	17.84	22.32	24.95	28.94	32.70

* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.

Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

*** Lower bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

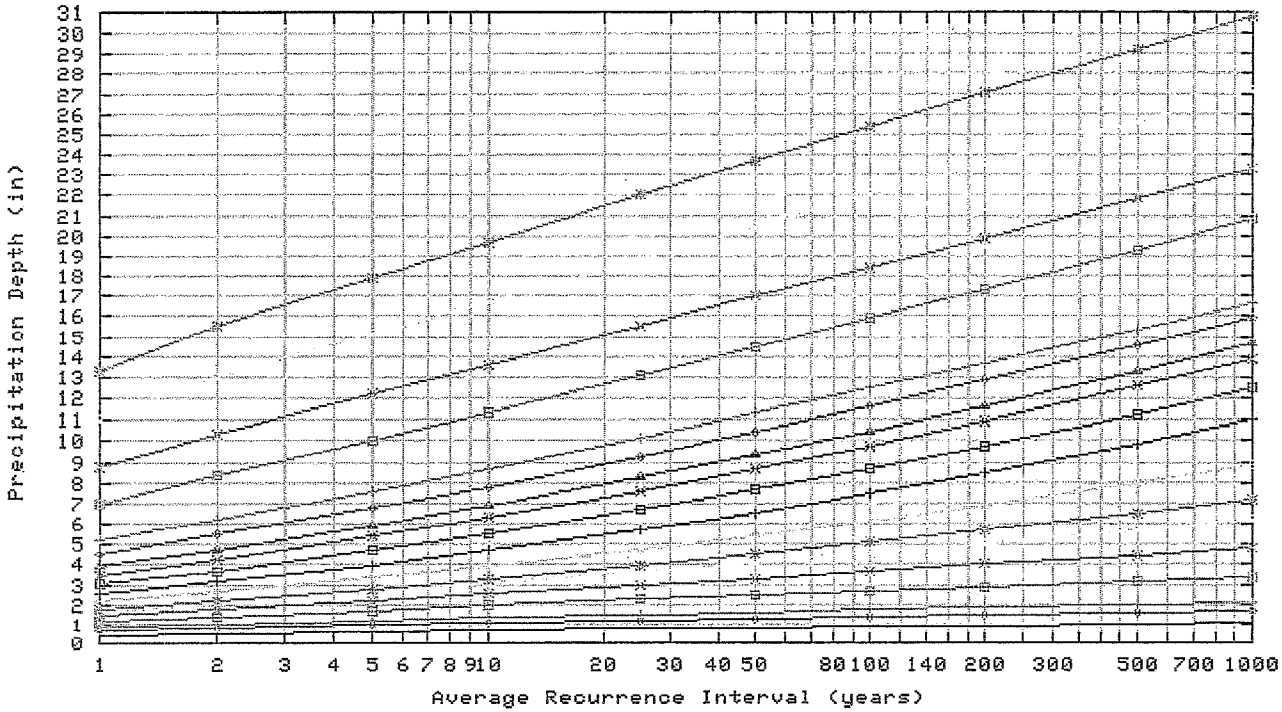
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.39	0.62	0.78	1.07	1.33	1.52	1.62	1.94	2.29	2.81	3.27	3.67	4.26	4.90	6.61	8.26	10.48	12.63
2	0.46	0.73	0.92	1.28	1.60	1.84	1.96	2.35	2.77	3.41	3.95	4.43	5.11	5.86	7.86	9.77	12.34	14.81
5	0.54	0.86	1.09	1.55	1.98	2.33	2.48	2.98	3.53	4.36	5.00	5.54	6.33	7.13	9.42	11.51	14.33	17.03
10	0.59	0.95	1.20	1.75	2.27	2.70	2.90	3.49	4.14	5.12	5.84	6.43	7.29	8.13	10.63	12.84	15.82	18.70
25	0.67	1.06	1.34	1.99	2.65	3.19	3.46	4.18	5.00	6.17	7.00	7.65	8.60	9.45	12.26	14.58	17.77	20.84
50	0.72	1.14	1.44	2.17	2.95	3.58	3.92	4.74	5.71	7.03	7.94	8.62	9.64	10.49	13.53	15.92	19.24	22.42
100	0.76	1.21	1.53	2.35	3.24	3.97	4.39	5.32	6.43	7.92	8.91	9.62	10.70	11.54	14.81	17.24	20.66	23.96
200	0.81	1.28	1.62	2.52	3.54	4.37	4.88	5.92	7.20	8.86	9.93	10.66	11.79	12.61	16.10	18.55	22.07	25.45
500	0.86	1.37	1.72	2.74	3.93	4.89	5.55	6.76	8.28	10.15	11.34	12.09	13.28	14.05	17.83	20.26	23.89	27.37
1000	0.91	1.43	1.79	2.91	4.24	5.29	6.07	7.43	9.15	11.19	12.46	13.22	14.44	15.16	19.14	21.56	25.27	28.80

* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.

Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Text version of tables

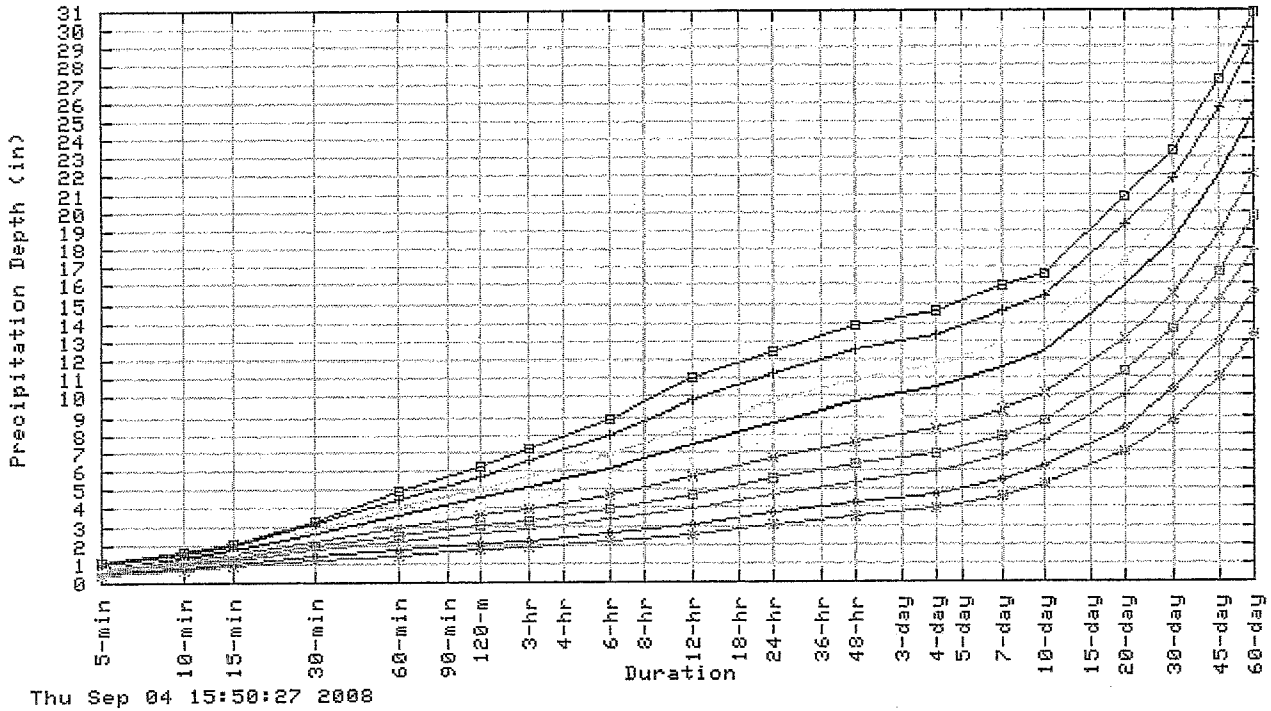
Partial duration based Point Precipitation Frequency Estimates - Version: 3
35.0583 N 78.8583 W 49 ft



Thu Sep 04 15:50:27 2008

Duration			
5-min		48-hr	30-day
10-min	3-hr	4-day	
15-min	6-hr	7-day	60-day
30-min	12-hr	10-day	
60-min	24-hr	20-day	

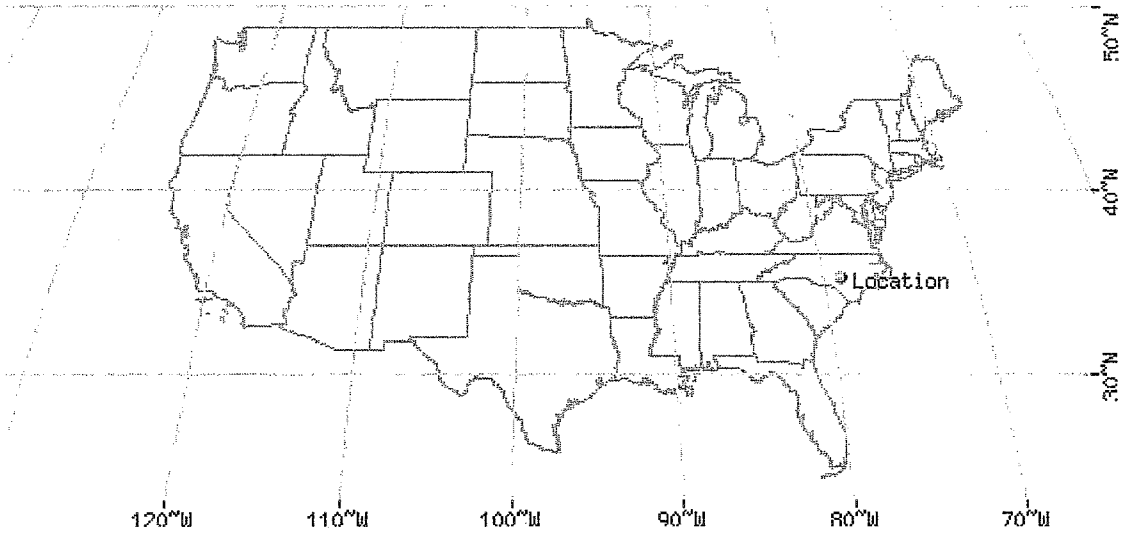
Partial duration based Point Precipitation Frequency Estimates - Version: 3
35.0583 N 78.8583 W 49 ft

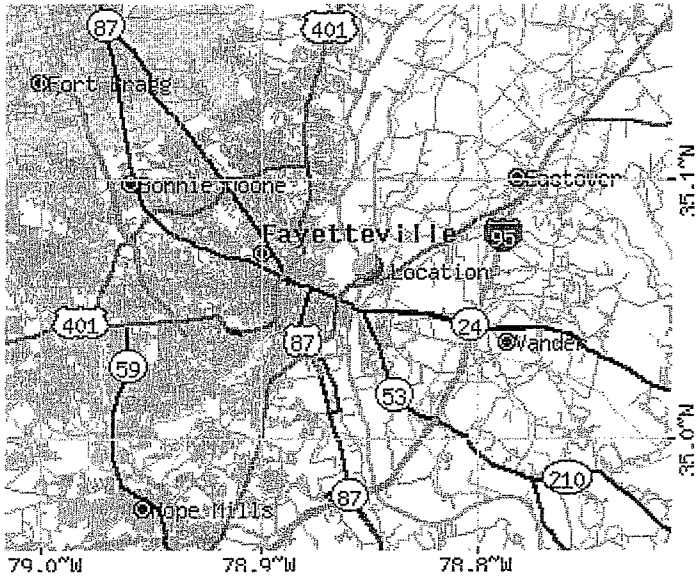


Thu Sep 04 15:50:27 2008

Average Recurrence Interval (years)	
1	100
2	200
5	500
10	1000
25	

Maps -





These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.

LEGEND

- State
- County
- Indian Resv
- Lake/Pond/Ocean
- Street
- Expressway
- Highway
- Connector
- Stream
- Military Area
- National Park
- Other Park
- City
- County

Scale 1:228583 (0 2 4 6 8 mi; 0 2 4 6 8 10 km)

*average--true scale depends on monitor resolution

Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It

combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to our documentation.

Using the **National Climatic Data Center's (NCDC)** station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (35.0583/-78.8583). Digital ASCII data can be obtained directly from **NCDC**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Determining the Skimmer Size and the Required Orifice for the *Faircloth Skimmer®* Surface Drain

November 2007

Important note: *The orifice sizing chart in the Pennsylvania Erosion Control Manual and reproduced in the North Carolina Design Manual* ***DOES NOT APPLY*** *to our skimmers. It will give the wrong size orifice and not specify which size skimmer is required. Please use the information below to choose the size skimmer required for the basin volume provided and determine the orifice size required for the drawdown time, typically 4-7 days in Pennsylvania and 3 days in North Carolina.*

The **size** of a Faircloth Skimmer®, for example a 4" skimmer, refers to the maximum diameter of the skimmer inlet. The inlet on each of the 8 sizes offered can be reduced to adjust the flow rate by cutting a hole or ***orifice*** in a plug using an adjustable cutter (both supplied).

Determining the skimmer size needed and the orifice for that skimmer required to drain the sediment basin's volume in the required time involves two steps: **First**, determining the size skimmer required based on the volume to be drained and the number of days to drain it; and **Second,** calculate the orifice size to adjust the flow rate and "customize" the skimmer for the basin's volume. *The second step is not always necessary* if the flow rate for the skimmer with the inlet wide open equals or is close to the flow rate required for the basin volume and the drawdown time.

Both the skimmer size and the required orifice radius for the skimmer should be shown for each basin on the erosion and sediment control plan. Make it clear that the dimension is either the radius or the diameter. It is also helpful to give the basin volume in case there are questions. During the skimmer installation the required orifice can be cut in the plastic plug using the supplied adjustable cutter and installed in the skimmer using the instructions provided.

The plan review and enforcement authority may require the calculations showing that the skimmer used can drain the basin in the required time.

Determining the Skimmer Size

Step 1. Below are approximate **skimmer maximum flow capacities** based on typical draw down requirements, which can vary between States and jurisdictions and watersheds. If one 6" skimmer does not provide enough capacity, multiple skimmers can be used to drain the basin. For drawdown times not shown, multiply the 24-hour figure by the number of days required.

Example: A basin's volume is 29,600 cubic feet and it must be drained in 3 days. A 3" skimmer with the inlet wide open will work perfectly. (Actually, the chart below gives 29,322 cubic feet but this is well within the accuracy of the calculations and the basin's constructed volume.)
Example: A basin's volume is 39,000 cubic feet and it must be drained in 3 days. The 3" skimmer is too small; a 4" skimmer has enough capacity but it is too large, so the inlet will need

to be reduced using step 2 to adjust the flow rate for the basin's volume. (It needs a 3.2" diameter orifice.)

1½" skimmer:	1,728 cubic feet in 24 hours	6,912 cubic feet in 4 days
with a 1½" head	3,456 cubic feet in 2 days	12,096 cubic feet in 7 days
	5,184 cubic feet in 3 days	
2" skimmer:	3,283 cubic feet in 24 hours	13,132 cubic feet in 4 days
with a 2" head	6,566 cubic feet in 2 days	22,982 cubic feet in 7 days
	9,849 cubic feet in 3 days	
2½" skimmer:	6,234 cubic feet in 24 hours	24,936 cubic feet in 4 days
with a 2.5" head	12,468 cubic feet in 2 days	43,638 cubic feet in 7 days
Revised 11-6-07	18,702 cubic feet in 3 days	
3" skimmer:	9,774 cubic feet in 24 hours	39,096 cubic feet in 4 days
with a 3" head	19,547 cubic feet in 2 days	68,415 cubic feet in 7 days
	29,322 cubic feet in 3 days	
4" skimmer:	20,109 cubic feet in 24 hours	80,436 cubic feet in 4 days
with a 4" head	40,218 cubic feet in 2 days	140,763 cubic feet in 7 days
Revised 11-6-07	60,327 cubic feet in 3 days	
5" skimmer:	32,832 cubic feet in 24 hours	131,328 cubic feet in 4 days
with a 4" head	65,664 cubic feet in 2 days	229,824 cubic feet in 7 days
	98,496 cubic feet in 3 days	
6" skimmer:	51,840 cubic feet in 24 hours	207,360 cubic feet in 4 days
with a 5" head	103,680 cubic feet in 2 days	362,880 cubic feet in 7 days
	155,520 cubic feet in 3 days	
8" skimmer:	97,978 cubic feet in 24 hours	391,912 cubic feet in 4 days
with a 6" head	195,956 cubic feet in 2 days	685,846 cubic feet in 7 days
CUSTOM	293,934 cubic feet in 3 days	
MADE BY ORDER	**CALL!**	

Determining the Orifice

Step 2. To determine the orifice required to reduce the flow rate for the basin's volume and the number of days to drain the basin, simply use the formula volume ÷ **factor** (from the chart below) for the same size skimmer chosen in the first step and the same number of days. This calculation will give the **area** of the required orifice. Then calculate the orifice radius using Area $= \pi r^2$ and solving for r, $r = \sqrt{(Area/3.14)}$ .The supplied cutter can be adjusted to this radius to cut the orifice in the plug. The instructions with the plug and cutter has a ruler divided into tenths of inches. Again, this step is not always necessary as explained above.

An alternative method is to use the orifice equation with the head for a particular skimmer shown on the previous page and determine the orifice needed to give the required flow for the volume and draw down time. C = 0.59 is used in this chart.

Example: A 4" skimmer is the smallest skimmer that will drain 39,000 cubic feet in 3 days but a 4" inlet will drain the basin too fast (in 1.9 days) To determine the orifice required use the factor of 4,803 from the chart below for a 4" skimmer and a drawdown time of 3 days. 39,000 cubic

feet ÷ 4,803 = 8.12 square inches of orifice required. Calculate the orifice radius using Area = πr^2 and solving for r, $r = \sqrt{(8.12/3.14)}$ and r = 1.61". As a practical matter 1.6" is about as close as the cutter can be adjusted and the orifice cut..

Factors (in cubic feet of flow per square inch of opening through a **round** orifice with the head for that skimmer and for the drawdown times shown) for determining the **orifice radius** for a basin's volume to be drained. This quick method works because the orifice is centered and has a constant head (given above in Step 1).

1½" skimmer:	960 to drain in **24 hours**	3,840 to drain in **4 days**
	1,920 to drain in **2 days**	6,720 to drain in **7 days**
	2,880 to drain in **3 days**	
2" skimmer:	1,123 to drain in **24 hours**	4,492 to drain in **4 days**
	2,246 to drain in **2 days**	7,861 to drain in **7 days**
	3,369 to drain in **3 days**	
2½" skimmer:	1,270 to drain in **24 hours**	5,080 to drain in **4 days**
Revised 11-6-07	2,540 to drain in **2 days**	8,890 to drain in **7 days**
	3,810 to drain in **3 days**	
3" skimmer:	1,382 to drain in **24 hours**	5,528 to drain in **4 days**
	2,765 to drain in **2 days**	9,677 to drain in **7 days**
	4,146 to drain in **3 days**	
4" skimmer:	1,601 to drain in **24 hours**	6,404 to drain in **4 days**
Revised 11-6-07	3,202 to drain in **2 days**	11,207 to drain in **7 days**
	4,803 to drain in **3 days**	
5" skimmer:	1,642 to drain in **24 hours**	6,568 to drain in **4 days**
	3,283 to drain in **2 days**	11,491 to drain in **7 days**
	4,926 to drain in **3 days**	
6" skimmer:	1,814 to drain in **24 hours**	7,256 to drain in **4 days**
	3,628 to drain in **2 days**	12,701 to drain in **7 days**
	5,442 to drain in **3 days**	
8" skimmer:	1,987 to drain in **24 hours**	7,948 to drain in **4 days**
	3,974 to drain in **2 days**	13,909 to drain in **7 days**
	5,961 to drain in **3 days**	

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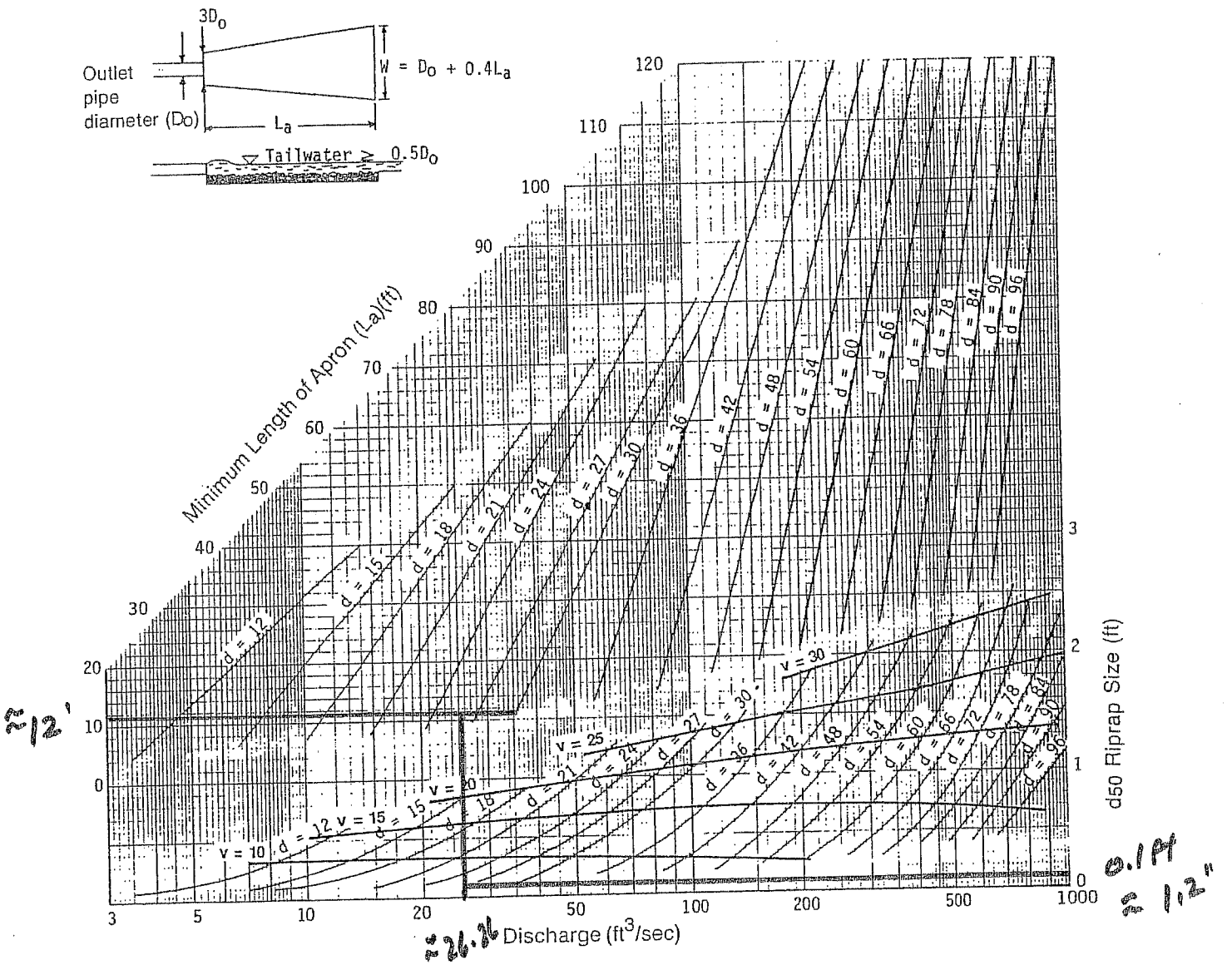
Orifice sizing Revised 2-2-01; 3-3-05; 2-1-07; 11-6-07

2. RIP-RAP APRON CALCULATIONS



Curves may not be extrapolated.

Figure 8.06b Design of outlet protection from a round pipe flowing full, maximum tailwater condition ($T_w \geq 0.5$ diameter).