

APPENDIX D
REFERENCES

STORMWATER MANAGEMENT

168 Attachment 4

Township of West Hanover

Appendix C, Stormwater Management Design Criteria
Table C-2, Runoff Curve Numbers [From NRCS (SCS) TR-55]

Runoff Curve Numbers for Urban Areas					
Cover Description		Curve Numbers for Hydrologic Soil Groups			
Cover Type and Hydrologic Condition	Average Percentage Impervious Area	A	B	C	D
<i>Fully Developed Urban Areas (Vegetation Established)</i>					
Open space (lawns, parks, golf courses, etc):					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc.		98	98	98	98
Streets and roads:					
Paved: curbed and storm sewers		98	98	98	98
Paved: open ditches		83	89	92	93
Gravel		76	85	89	91
Dirt		72	82	87	89
Urban districts:					
Commercial and business	85%	89	92	94	95
Industrial	72%	81	88	91	93
Residential districts by average lot size:					
1/8 acres or less	65%	77	85	90	92
1/4 acre	38%	61	75	83	87
1/3 acre	30%	57	72	81	86
1/2 acre	25%	54	70	80	85
1 acre	20%	51	68	79	84
2 acres	12%	46	65	77	82

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Runoff Curve Numbers for Cultivated Agricultural Lands						
Cover Description			Curve Numbers for Hydrologic Soil Groups			
Cover Type	Treatment	Hydrologic Condition	A	B	C	D
Fallow	Bare Soil	--	77	86	91	94
	Crop Residue Cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight Row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & Terraced (C & T)	Poor	66	74	80	82
		Good	62	71	78	81
	C & T + CR	Poor	65	73	79	81
Good		61	70	77	80	
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C & T	Poor	61	72	79	82
		Good	59	70	78	81
	C & T + CR	Poor	60	71	78	81
Good		58	69	77	80	
Close seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C & T	Poor	63	73	80	83
		Good	51	67	76	80

STORMWATER MANAGEMENT

Runoff Curve Numbers for Other Agricultural Lands					
Cover Description		Curve Numbers for Hydrologic Soil Groups			
Cover Type	Hydrologic Condition	A	B	C	D
Pasture, grassland, or range: continuous forage for grazing	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow: continuous grass, protected from grazing and generally mowed for hay	--	30	58	71	78
Brush: brush, weed, grass mixture with brush the major element	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30	48	65	73
Woods: grass combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
Farmsteads: buildings, lanes, driveways and surrounding lots	--	59	74	82	86

STORMWATER MANAGEMENT

168 Attachment 3

Township of West Hanover

Appendix C, Stormwater Management Design Criteria
Table C-1, Rational Method Runoff Coefficients

Hydrologic Soil Group and Slope Range

Land Use	A			B			C			D		
	0 to 2%	2 to 6%	6+%	0 to 2%	2 to 6%	6+%	0 to 2%	2 to 6%	6+%	0 to 2%	2 to 6%	
Cultivated land	0.08 ^a 0.14 ^b	0.13 0.18	0.16 0.22	0.11 0.16	0.15 0.21	0.21 0.28	0.14 0.20	0.19 0.25	0.26 0.34	0.18 0.24	0.23 0.29	0.31 0.41
Pasture	0.12 0.15	0.20 0.25	0.30 0.37	0.18 0.23	0.28 0.34	0.37 0.45	0.24 0.30	0.34 0.42	0.44 0.52	0.30 0.37	0.40 0.50	0.50 0.62
Meadow	0.10 0.14	0.16 0.22	0.25 0.30	0.14 0.20	0.22 0.28	0.30 0.37	0.20 0.26	0.28 0.35	0.36 0.44	0.24 0.30	0.30 0.40	0.40 0.50
Forest	0.05 0.08	0.08 0.11	0.11 0.14	0.08 0.10	0.11 0.14	0.14 0.18	0.10 0.12	0.13 0.16	0.16 0.20	0.12 0.15	0.16 0.20	0.20 0.25
Residential 1/8 acre	0.25 0.33	0.28 0.37	0.31 0.40	0.27 0.35	0.30 0.39	0.35 0.44	0.30 0.38	0.33 0.42	0.38 0.49	0.33 0.41	0.36 0.45	0.42 0.54
Residential 1/4 acre	0.22 0.30	0.26 0.34	0.29 0.37	0.24 0.33	0.29 0.37	0.33 0.42	0.27 0.36	0.31 0.40	0.36 0.47	0.30 0.38	0.34 0.42	0.40 0.52
Residential 1/3 acre	0.19 0.28	0.23 0.32	0.26 0.35	0.22 0.30	0.26 0.35	0.30 0.39	0.25 0.33	0.29 0.38	0.34 0.45	0.28 0.36	0.32 0.40	0.39 0.50

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Land Use	A		B		C		D		6+%		0 to 2%		2 to 6%		6+%		0 to 2%		2 to 6%		6+%	
	0 to 2%	2 to 6%	0 to 2%	2 to 6%	0 to 2%	2 to 6%	0 to 2%	2 to 6%	0 to 2%	2 to 6%	0 to 2%	2 to 6%	0 to 2%	2 to 6%	0 to 2%	2 to 6%	0 to 2%	2 to 6%	0 to 2%	2 to 6%	0 to 2%	2 to 6%
Residential 1/2 acre	0.16	0.20	0.24	0.23	0.28	0.28	0.22	0.27	0.32	0.32	0.28	0.22	0.27	0.32	0.32	0.26	0.30	0.26	0.30	0.32	0.32	0.37
Residential I acre	0.25	0.29	0.32	0.32	0.36	0.34	0.31	0.35	0.42	0.40	0.36	0.31	0.35	0.42	0.34	0.38	0.38	0.34	0.38	0.42	0.42	0.48
Industrial	0.14	0.19	0.22	0.21	0.26	0.28	0.20	0.25	0.31	0.34	0.26	0.20	0.25	0.31	0.24	0.29	0.29	0.24	0.29	0.31	0.31	0.35
Commercial	0.22	0.26	0.29	0.28	0.34	0.28	0.28	0.32	0.40	0.34	0.34	0.28	0.32	0.40	0.31	0.35	0.35	0.31	0.35	0.40	0.40	0.46
Streets	0.67	0.68	0.68	0.68	0.69	0.68	0.68	0.69	0.69	0.69	0.69	0.68	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.70
Open space	0.85	0.85	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.88
Parking	0.71	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.90
	0.70	0.71	0.72	0.72	0.74	0.72	0.72	0.73	0.76	0.74	0.74	0.72	0.73	0.76	0.73	0.75	0.75	0.73	0.75	0.76	0.76	0.78
	0.76	0.77	0.79	0.82	0.84	0.82	0.84	0.85	0.89	0.84	0.84	0.84	0.85	0.89	0.89	0.91	0.91	0.89	0.91	0.89	0.89	0.95
	0.05	0.10	0.14	0.13	0.19	0.13	0.12	0.17	0.24	0.19	0.19	0.12	0.17	0.24	0.16	0.21	0.21	0.16	0.21	0.24	0.24	0.28
	0.11	0.16	0.20	0.19	0.26	0.19	0.18	0.23	0.32	0.26	0.26	0.18	0.23	0.32	0.22	0.27	0.27	0.22	0.27	0.32	0.32	0.39
	0.85	0.86	0.87	0.86	0.87	0.86	0.85	0.86	0.87	0.87	0.87	0.85	0.86	0.87	0.85	0.86	0.86	0.85	0.86	0.87	0.87	0.87
	0.95	0.96	0.97	0.96	0.97	0.96	0.95	0.96	0.97	0.97	0.97	0.95	0.96	0.97	0.95	0.96	0.96	0.95	0.96	0.97	0.97	0.97

NOTES:

- a Runoff coefficients for storm recurrence intervals less than 25 years.
 - b Runoff coefficients for storm recurrence intervals of 25 years or more.
- Source: Rawls, W.J., S.L. Long, and R.H. McCuen, 1981. Comparison of Urban Flood Frequency Procedures. Preliminary Draft Report prepared for the Soil Conservation Service, Beltsville, Maryland.

NOAA Atlas 14, Volume 2, Version 3
Location name: West Hanover Twp, Pennsylvania,
USA*



Latitude: 40.3575°, Longitude: -76.7422°
Elevation: 587.5 ft**



* source: ESRI Maps
 ** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

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PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	3.95 (3.58-4.38)	4.70 (4.25-5.22)	5.53 (4.98-6.14)	6.12 (5.50-6.78)	6.84 (6.12-7.56)	7.39 (6.60-8.17)	7.92 (7.04-8.76)	8.41 (7.45-9.31)	9.10 (8.00-10.1)	9.61 (8.39-10.7)
10-min	3.14 (2.84-3.48)	3.74 (3.37-4.15)	4.40 (3.96-4.88)	4.85 (4.36-5.38)	5.41 (4.84-5.98)	5.81 (5.19-6.43)	6.22 (5.53-6.87)	6.58 (5.83-7.28)	7.07 (6.22-7.84)	7.43 (6.49-8.25)
15-min	2.61 (2.36-2.89)	3.12 (2.82-3.46)	3.68 (3.32-4.09)	4.07 (3.66-4.51)	4.54 (4.06-5.02)	4.89 (4.36-5.40)	5.22 (4.64-5.76)	5.52 (4.90-6.11)	5.93 (5.22-6.57)	6.22 (5.43-6.90)
30-min	1.77 (1.60-1.96)	2.14 (1.93-2.38)	2.60 (2.34-2.88)	2.92 (2.63-3.24)	3.33 (2.99-3.69)	3.64 (3.25-4.02)	3.95 (3.51-4.37)	4.25 (3.76-4.70)	4.65 (4.09-5.15)	4.95 (4.32-5.50)
60-min	1.10 (0.995-1.22)	1.34 (1.21-1.49)	1.66 (1.49-1.84)	1.90 (1.70-2.10)	2.21 (1.98-2.44)	2.45 (2.19-2.71)	2.71 (2.41-2.99)	2.96 (2.62-3.27)	3.31 (2.91-3.67)	3.59 (3.13-3.99)
2-hr	0.646 (0.583-0.716)	0.782 (0.706-0.868)	0.981 (0.886-1.09)	1.14 (1.02-1.26)	1.37 (1.22-1.51)	1.56 (1.39-1.72)	1.77 (1.56-1.95)	1.99 (1.75-2.20)	2.33 (2.02-2.58)	2.61 (2.24-2.90)
3-hr	0.470 (0.424-0.525)	0.569 (0.514-0.636)	0.715 (0.644-0.798)	0.832 (0.749-0.928)	1.00 (0.894-1.11)	1.14 (1.01-1.27)	1.30 (1.15-1.45)	1.47 (1.29-1.63)	1.73 (1.49-1.92)	1.95 (1.66-2.17)
6-hr	0.292 (0.263-0.327)	0.354 (0.319-0.397)	0.443 (0.398-0.495)	0.517 (0.462-0.577)	0.626 (0.556-0.697)	0.720 (0.636-0.800)	0.825 (0.723-0.916)	0.942 (0.817-1.05)	1.12 (0.956-1.24)	1.27 (1.07-1.42)
12-hr	0.178 (0.159-0.202)	0.215 (0.192-0.244)	0.270 (0.241-0.306)	0.318 (0.282-0.358)	0.389 (0.342-0.438)	0.452 (0.394-0.507)	0.523 (0.452-0.587)	0.604 (0.516-0.676)	0.728 (0.612-0.815)	0.838 (0.695-0.940)
24-hr	0.103 (0.094-0.115)	0.125 (0.114-0.138)	0.157 (0.143-0.174)	0.185 (0.168-0.205)	0.229 (0.206-0.252)	0.268 (0.240-0.295)	0.313 (0.277-0.343)	0.365 (0.320-0.399)	0.447 (0.385-0.486)	0.520 (0.441-0.565)
2-day	0.060 (0.054-0.067)	0.072 (0.066-0.081)	0.091 (0.082-0.102)	0.107 (0.097-0.119)	0.132 (0.118-0.146)	0.153 (0.136-0.170)	0.178 (0.157-0.197)	0.207 (0.180-0.228)	0.251 (0.215-0.277)	0.291 (0.246-0.320)
3-day	0.042 (0.039-0.047)	0.051 (0.047-0.056)	0.064 (0.058-0.071)	0.075 (0.068-0.083)	0.092 (0.084-0.102)	0.108 (0.097-0.118)	0.125 (0.111-0.137)	0.145 (0.128-0.159)	0.176 (0.152-0.193)	0.203 (0.174-0.223)
4-day	0.034 (0.031-0.037)	0.040 (0.037-0.044)	0.051 (0.046-0.056)	0.059 (0.054-0.065)	0.073 (0.066-0.080)	0.085 (0.077-0.093)	0.099 (0.088-0.107)	0.114 (0.101-0.124)	0.138 (0.121-0.150)	0.160 (0.138-0.174)
7-day	0.023 (0.021-0.025)	0.027 (0.025-0.030)	0.034 (0.031-0.037)	0.039 (0.036-0.043)	0.048 (0.044-0.052)	0.055 (0.050-0.060)	0.064 (0.058-0.069)	0.074 (0.066-0.080)	0.089 (0.078-0.096)	0.102 (0.088-0.110)
10-day	0.018 (0.017-0.020)	0.022 (0.020-0.023)	0.027 (0.025-0.029)	0.031 (0.029-0.033)	0.037 (0.034-0.040)	0.042 (0.039-0.046)	0.048 (0.044-0.052)	0.055 (0.050-0.059)	0.065 (0.058-0.070)	0.073 (0.065-0.079)
20-day	0.012 (0.012-0.013)	0.015 (0.014-0.016)	0.017 (0.016-0.019)	0.020 (0.018-0.021)	0.023 (0.022-0.025)	0.026 (0.024-0.027)	0.029 (0.027-0.031)	0.032 (0.029-0.034)	0.037 (0.033-0.039)	0.041 (0.037-0.043)
30-day	0.010 (0.010-0.011)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.015-0.017)	0.018 (0.017-0.019)	0.020 (0.019-0.021)	0.022 (0.021-0.024)	0.024 (0.023-0.026)	0.028 (0.025-0.029)	0.030 (0.028-0.032)
45-day	0.009 (0.008-0.009)	0.010 (0.010-0.011)	0.012 (0.011-0.012)	0.013 (0.012-0.013)	0.014 (0.014-0.015)	0.016 (0.015-0.017)	0.017 (0.016-0.018)	0.019 (0.017-0.020)	0.020 (0.019-0.022)	0.022 (0.020-0.023)
60-day	0.008 (0.007-0.008)	0.009 (0.009-0.009)	0.010 (0.010-0.011)	0.011 (0.011-0.012)	0.013 (0.012-0.013)	0.014 (0.013-0.014)	0.015 (0.014-0.015)	0.016 (0.015-0.017)	0.017 (0.016-0.018)	0.019 (0.017-0.019)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

NOAA Atlas 14, Volume 2, Version 3
Location name: West Hanover Twp, Pennsylvania,
USA*



Latitude: 40.3575°, Longitude: -76.7422°
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* source: ESRI Maps
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PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.329 (0.298-0.365)	0.392 (0.354-0.435)	0.461 (0.415-0.512)	0.510 (0.458-0.565)	0.570 (0.510-0.630)	0.616 (0.550-0.681)	0.660 (0.587-0.730)	0.701 (0.621-0.776)	0.758 (0.667-0.840)	0.801 (0.699-0.889)
10-min	0.523 (0.473-0.580)	0.624 (0.562-0.692)	0.733 (0.660-0.814)	0.809 (0.727-0.896)	0.901 (0.807-0.997)	0.969 (0.865-1.07)	1.04 (0.922-1.15)	1.10 (0.972-1.21)	1.18 (1.04-1.31)	1.24 (1.08-1.38)
15-min	0.652 (0.589-0.722)	0.780 (0.704-0.866)	0.921 (0.829-1.02)	1.02 (0.915-1.13)	1.14 (1.02-1.26)	1.22 (1.09-1.35)	1.30 (1.16-1.44)	1.38 (1.22-1.53)	1.48 (1.30-1.64)	1.55 (1.36-1.73)
30-min	0.887 (0.801-0.982)	1.07 (0.966-1.19)	1.30 (1.17-1.44)	1.46 (1.31-1.62)	1.67 (1.49-1.84)	1.82 (1.63-2.01)	1.98 (1.76-2.18)	2.12 (1.88-2.35)	2.32 (2.04-2.58)	2.48 (2.16-2.75)
60-min	1.10 (0.995-1.22)	1.34 (1.21-1.49)	1.66 (1.49-1.84)	1.90 (1.70-2.10)	2.21 (1.98-2.44)	2.45 (2.19-2.71)	2.71 (2.41-2.99)	2.96 (2.62-3.27)	3.31 (2.91-3.67)	3.59 (3.13-3.99)
2-hr	1.29 (1.17-1.43)	1.56 (1.41-1.74)	1.96 (1.77-2.17)	2.28 (2.05-2.52)	2.74 (2.45-3.02)	3.12 (2.77-3.44)	3.54 (3.12-3.90)	3.99 (3.50-4.40)	4.66 (4.04-5.15)	5.22 (4.49-5.79)
3-hr	1.41 (1.27-1.58)	1.71 (1.55-1.91)	2.15 (1.94-2.40)	2.50 (2.25-2.79)	3.01 (2.69-3.34)	3.44 (3.05-3.82)	3.91 (3.45-4.34)	4.42 (3.87-4.91)	5.19 (4.48-5.78)	5.85 (4.99-6.53)
6-hr	1.75 (1.58-1.96)	2.12 (1.91-2.38)	2.65 (2.38-2.97)	3.09 (2.77-3.46)	3.75 (3.33-4.17)	4.31 (3.81-4.79)	4.94 (4.33-5.49)	5.64 (4.89-6.26)	6.69 (5.73-7.44)	7.61 (6.43-8.48)
12-hr	2.15 (1.92-2.43)	2.59 (2.31-2.94)	3.26 (2.90-3.69)	3.83 (3.39-4.32)	4.69 (4.13-5.27)	5.45 (4.75-6.11)	6.31 (5.45-7.07)	7.27 (6.22-8.15)	8.77 (7.38-9.82)	10.1 (8.37-11.3)
24-hr	2.48 (2.27-2.76)	2.99 (2.73-3.32)	3.77 (3.44-4.18)	4.45 (4.04-4.92)	5.50 (4.95-6.06)	6.44 (5.75-7.07)	7.52 (6.66-8.23)	8.76 (7.67-9.57)	10.7 (9.24-11.7)	12.5 (10.6-13.6)
2-day	2.87 (2.61-3.22)	3.46 (3.15-3.88)	4.36 (3.96-4.88)	5.13 (4.64-5.73)	6.32 (5.66-7.02)	7.37 (6.55-8.17)	8.56 (7.55-9.47)	9.92 (8.66-11.0)	12.1 (10.3-13.3)	13.9 (11.8-15.4)
3-day	3.05 (2.79-3.38)	3.67 (3.36-4.07)	4.61 (4.21-5.10)	5.42 (4.93-5.99)	6.66 (6.01-7.34)	7.76 (6.96-8.53)	9.01 (8.01-9.89)	10.4 (9.19-11.4)	12.7 (11.0-13.9)	14.6 (12.5-16.0)
4-day	3.22 (2.96-3.54)	3.87 (3.56-4.26)	4.85 (4.46-5.33)	5.70 (5.22-6.25)	6.99 (6.37-7.65)	8.15 (7.36-8.89)	9.46 (8.48-10.3)	11.0 (9.72-11.9)	13.3 (11.6-14.4)	15.3 (13.2-16.7)
7-day	3.79 (3.50-4.14)	4.54 (4.20-4.97)	5.64 (5.21-6.16)	6.59 (6.07-7.19)	8.03 (7.34-8.74)	9.30 (8.45-10.1)	10.7 (9.69-11.6)	12.4 (11.0-13.4)	14.9 (13.1-16.1)	17.1 (14.9-18.5)
10-day	4.36 (4.06-4.71)	5.21 (4.86-5.63)	6.39 (5.95-6.90)	7.39 (6.86-7.97)	8.88 (8.19-9.56)	10.2 (9.33-10.9)	11.6 (10.6-12.4)	13.2 (11.9-14.1)	15.5 (13.9-16.7)	17.6 (15.6-18.9)
20-day	5.93 (5.58-6.33)	7.03 (6.61-7.50)	8.37 (7.86-8.93)	9.48 (8.88-10.1)	11.1 (10.3-11.8)	12.4 (11.5-13.2)	13.8 (12.8-14.7)	15.4 (14.2-16.3)	17.6 (16.1-18.7)	19.5 (17.7-20.8)
30-day	7.36 (6.95-7.82)	8.67 (8.19-9.22)	10.2 (9.58-10.8)	11.4 (10.7-12.1)	13.1 (12.3-13.9)	14.5 (13.6-15.4)	16.0 (14.9-17.0)	17.6 (16.3-18.6)	19.8 (18.2-21.1)	21.7 (19.8-23.1)
45-day	9.25 (8.79-9.75)	10.9 (10.3-11.4)	12.5 (11.9-13.2)	13.8 (13.1-14.5)	15.6 (14.8-16.4)	17.0 (16.1-17.9)	18.5 (17.4-19.5)	20.0 (18.8-21.1)	22.1 (20.7-23.3)	23.7 (22.1-25.1)
60-day	11.1 (10.5-11.6)	12.9 (12.3-13.6)	14.8 (14.1-15.5)	16.2 (15.4-17.0)	18.2 (17.2-19.0)	19.7 (18.7-20.6)	21.2 (20.1-22.3)	22.8 (21.5-23.9)	25.0 (23.4-26.2)	26.6 (24.9-28.0)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical



Specification Sheet – VMax® SC250® Turf Reinforcement Mat

DESCRIPTION

The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 70% straw and 30% coconut fiber matrix incorporated into permanent three-dimensional turf reinforcement matting. The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, an ultra heavy UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.5 x 0.5 inch (1.27 x 1.27 cm) openings, and covered by an heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81cm) centers with UV stabilized polypropylene thread to form permanent three-dimensional turf reinforcement matting. All mats shall be manufactured with a colored thread stitched along both outer edges as an overlap guide for adjacent mats.

The SC250 shall meet Type 5A, 5B, and 5C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.18

Material Content		
Matrix	70% Straw Fiber	0.35 lb/sq yd (0.19 kg/sm)
	30% Coconut Fiber	0.15 lbs/sq yd (0.08 kg/sm)
Netting	Top and Bottom, UV-Stabilized Polypropylene	5 lb/1000 sq ft (2.44 kg/100 sm)
	Middle, Corrugated UV-Stabilized Polypropylene	24 lb/1000 sf (11.7 kg/100 sm)
Thread	Polypropylene, UV Stable	

Standard Roll Sizes		
Width	6.5 ft (2.0 m)	8 ft (2.44m)
Length	55.5 ft (16.9 m)	90 ft (27.4 m)
Weight ± 10%	34 lbs (15.42 kg)	70 lbs (31.8 kg)
Area	40 sq yd (33.4 sm)	80 sq. yd. (66.8 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.62 in. (15.75 mm)
Resiliency	ASTM 6524	95.2%
Density	ASTM D792	0.891 g/cm ³
Mass/Unit Area	ASTM 6566	16.13 oz/sy (548 g/sm)
UV Stability	ASTM D4355/1000 HR	100%
Porosity	ECTC Guidelines	99%
Stiffness	ASTM D1388	222.65 oz-in.
Light Penetration	ASTM D6567	4.1%
Tensile Strength – MD	ASTM D6818	709 lbs/ft (10.51 kN/m)
Elongation – MD	ASTM D6818	23.9%
Tensile Strength – TD	ASTM D6818	712 lbs/ft (10.56 kN/m)
Elongation – TD	ASTM D6818	36.9%
Biomass Improvement	ASTM D7322	441%

Design Permissible Shear Stress		
	Short Duration	Long Duration
Phase 1: Unvegetated	3.0 psf (144 Pa)	2.5 psf (120 Pa)
Phase 2: Partially Veg.	8.0 psf (383 Pa)	8.0 psf (383 Pa)
Phase 3: Fully Veg.	10.0 psf (480 Pa)	8.0 psf (383 Pa)
Unvegetated Velocity	9.5 fps (2.9 m/s)	
Vegetated Velocity	15 fps (4.6 m/s)	

Slope Design Data: C Factors

Slope Length (L)	Slope Gradients (S)		
	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.0010	0.0209	0.0507
20-50 ft	0.0081	0.0266	0.0574
≥ 50 ft (15.2 m)	0.0455	0.0555	0.081

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.040
0.50 – 2.0 ft	0.040-0.012
≥ 2.0 ft (0.60 m)	0.011

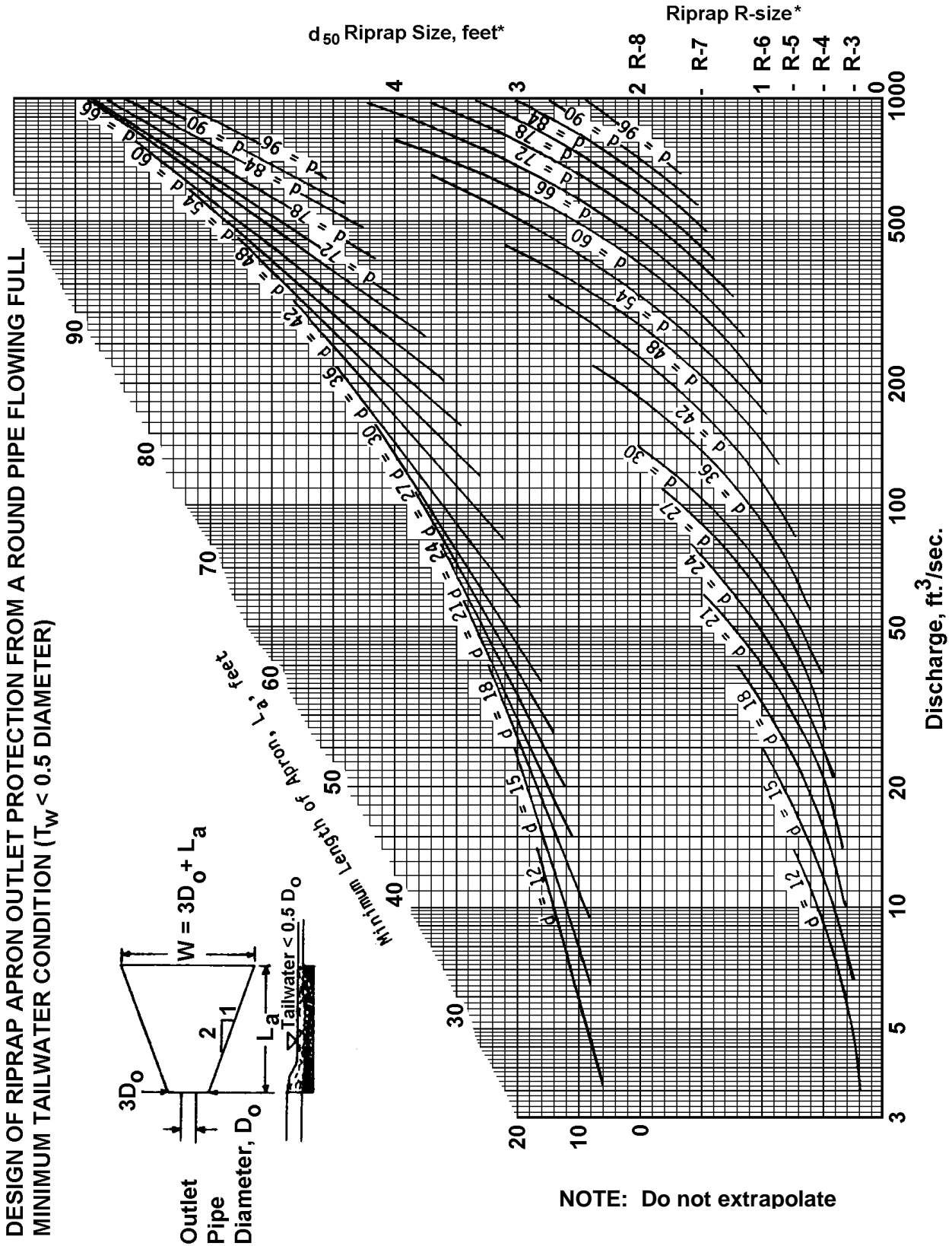


North American Green
5401 St. Wendel-Cynthiana Road
Poseyville, Indiana 47633

nagreen.com
800-772-2040

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FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

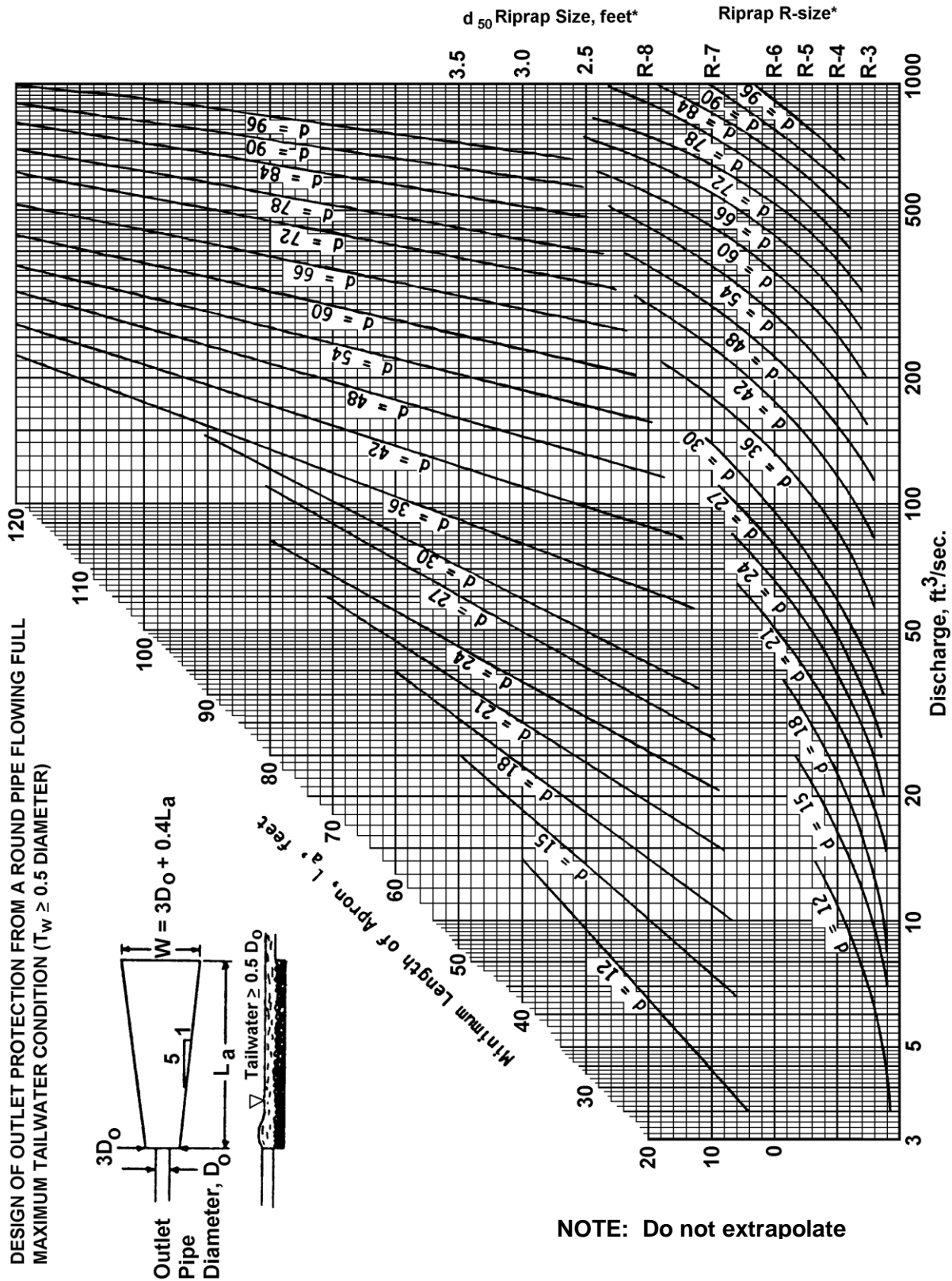


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d₅₀ stone size and/or provide velocity reduction device.

Adapted from USDA - NRCS

Not to be used for Box Culverts

FIGURE 9.4
Riprap Apron Design, Maximum Tailwater Condition



Adapted from USDA - NRCS

Not to be used for Box Culverts