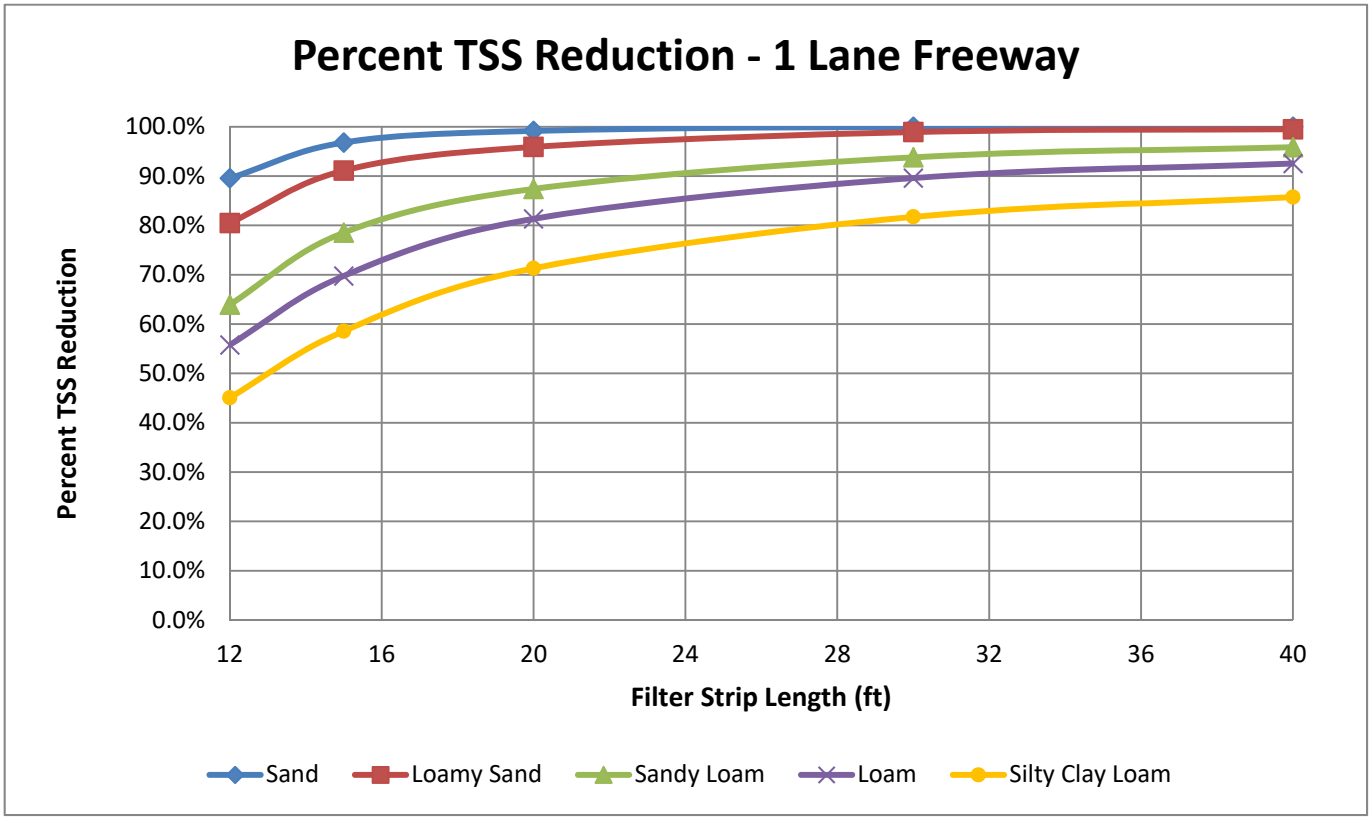
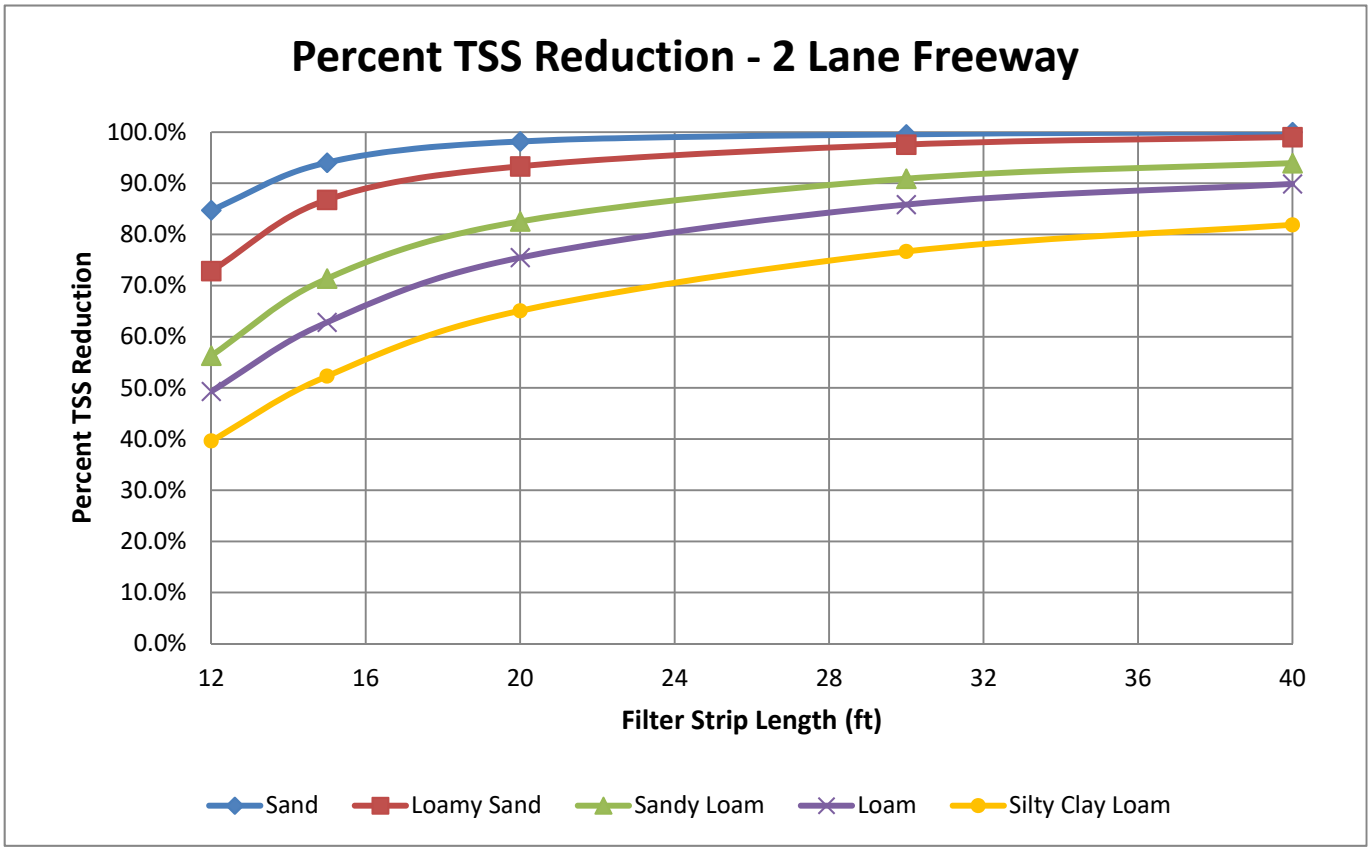
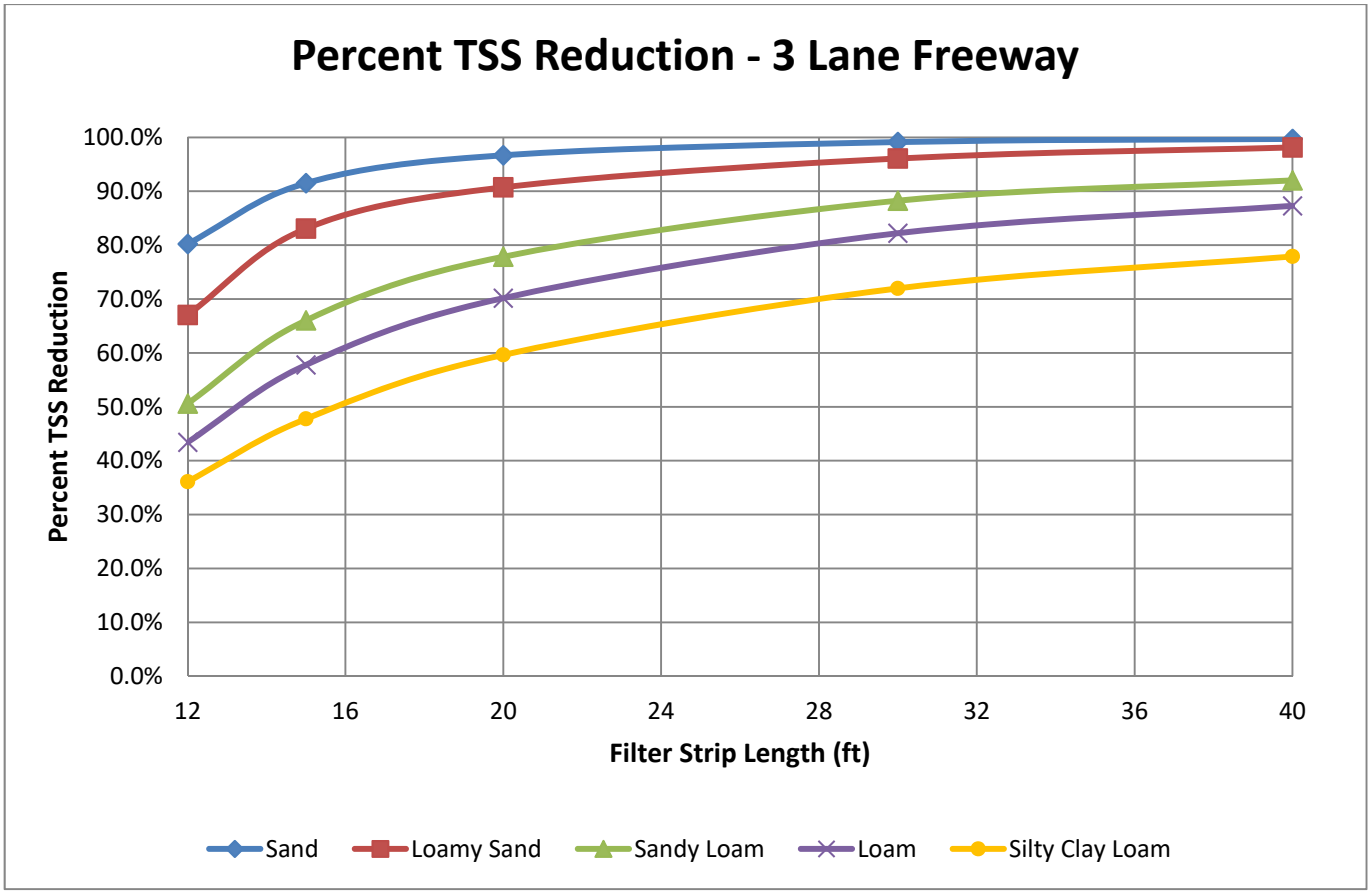
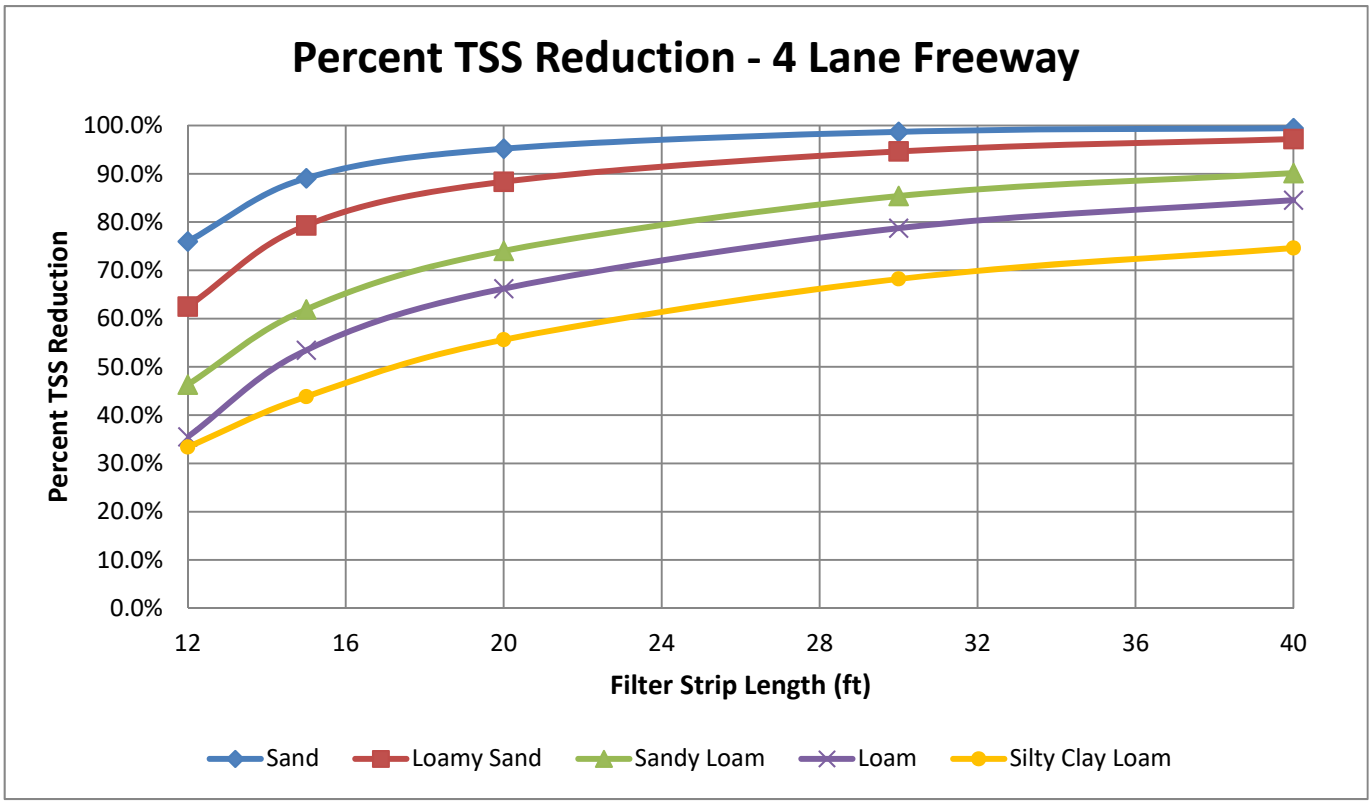
1	**Grass Swale Performance**					
2	Project ID: XXXX-XX-XX					
3	Title: Example Project					
4	Designer/Checker:					
5	DOT Region/Firm Name:					
6	Date:					
7	Drainage Area Basin Number	1	1	1		Total
8	Grass Swale Ending Station Number	13+00	17+00	21+00		
9	Grass Swale Starting Station Number	11+00	13+00	17+00		
10	Left, Center, or Right	R	R	R		
11	***Site Assessment***					
12	Grass Swale Length (ft)	200	400	400		
13	Average Drainage Area Width Outside of ROW (ft)	150	100	300		
14	Average ROW Width (ft)	65	75	90		
15	Average Swale Slope	0.50%	1.5	1		
16	Swale Segment Q2 Flow Rate (cfs)	1.5	4.0	16.5		
17	Average Swale Velocity (ft/s)	0.48	1.28	1.64		
18	Percent Reduction	80%	80%	0%	80%	80%
19	***Results Summary***					
20	Drainage Area (ac)	0.987	1.607	3.581	0.000	6.175
21	ROW Area (ac)	0.298	0.689	0.826	0.000	1.814
22	Percent Reduction per unit ROW Area	80.0%	80.0%	0.0%	80.0%	43.5%

Enter Line Number and Comment. Add more boxes if necessary


Percent TSS Reduction - 1 Lane Freeway
Percent TSS Reduction
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
12
16
20
24
28
32
36
40
Filter Strip Length (ft)
Sand
Loamy Sand
Sandy Loam
Loam
Silty Clay Loam


Percent TSS Reduction - 2 Lane Freeway
Percent TSS Reduction
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
12
16
20
24
28
32
36
40
Filter Strip Length (ft)
Sand
Loamy Sand
Sandy Loam
Loam
Silty Clay Loam


Percent TSS Reduction - 3 Lane Freeway
Percent TSS Reduction
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
12
16
20
24
28
32
36
40
Filter Strip Length (ft)
Sand
Loamy Sand
Sandy Loam
Loam
Silty Clay Loam


Percent TSS Reduction - 4 Lane Freeway
Percent TSS Reduction
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
12
16
20
24
28
32
36
40
Filter Strip Length (ft)
Sand
Loamy Sand
Sandy Loam
Loam
Silty Clay Loam

Filter Strip Performance

Project ID: XXXX-XX-XX
Title: Example Project
Designer/Checker:
DOT Region/Firm Name:
Date:

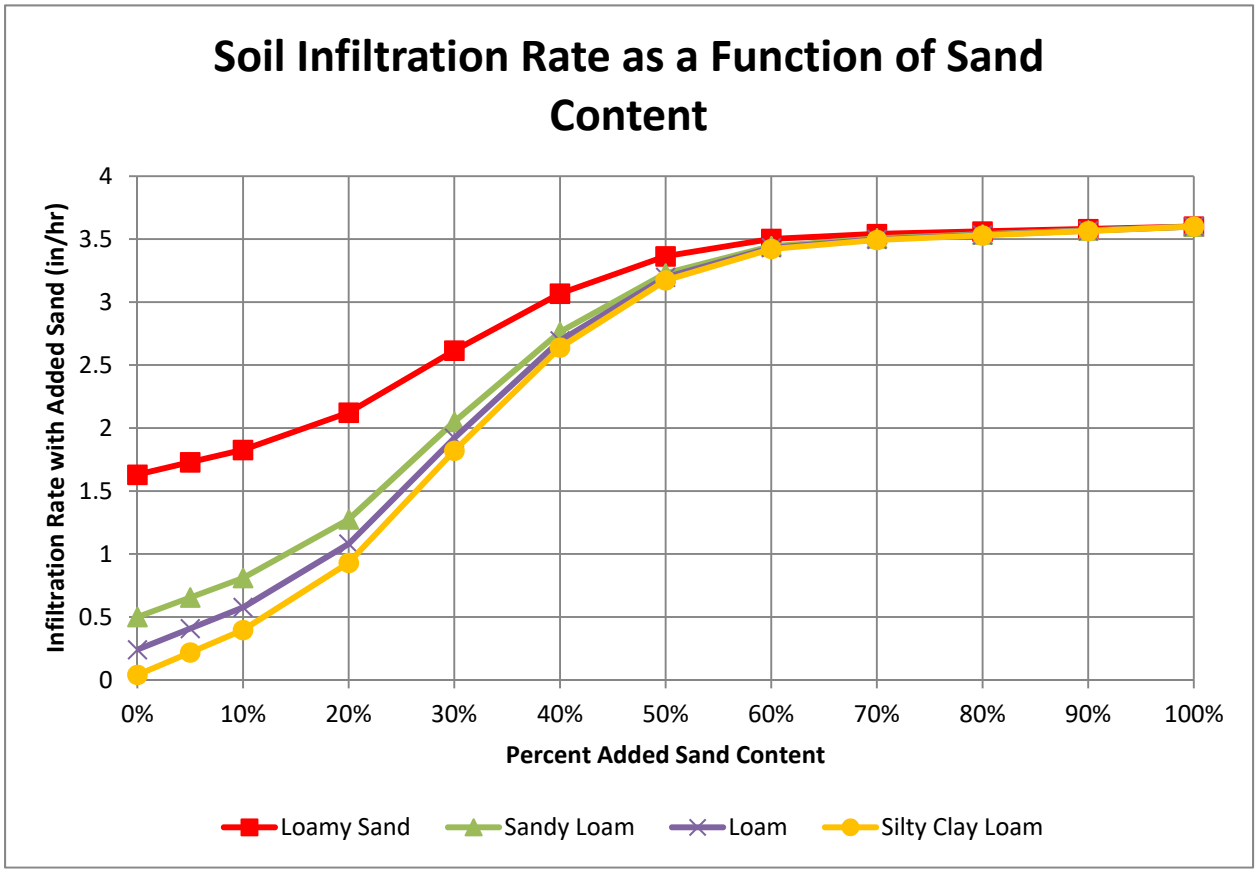
	Drainage Area Basin Number	**1**	**2**	**3**	**Total**
	Filter Strip Ending Station Number	**13+00**	**17+00**	**21+00**	
	Filter Strip Starting Station Number	**11+00**	**13+00**	**17+00**	
	Left, Center, or Right	**R**	**R**	**R**	
	Site Assessment	Cut/Fill Trans.			
	Filter Strip Width parallel to Highway (ft)	200	400	400	1000.000
	Average Drainage Area Width (ft)	50	56	66	172.000
	Average ROW Width (ft)	65	75	85	225.000
	Number of Treated Freeway Lanes	2	2	3	
	Filter Strip Length perpendicular to Highway (ft)	0	22	28	
	Filter Strip Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	
	Design Chart Number	2	2	3	
	Percent Reduction of Treated Area	0%	85%	86%	60.8%
	Results Summary				
	Treated Highway Area (ac)	0.142	0.487	0.652	1.281
	Drainage Area (ac)	0.230	0.514	0.606	1.350
	ROW Area (ac)	0.298	0.689	0.781	1.768
	Percent Reduction per unit ROW Area	0.0%	85.0%	86.0%	60.8%

Enter Line Number and Comment. Add more boxes if necessary

Filter Strip Sand Amendment Analysis

If the designer elects to enhance the embankment soils on slopes 4:1 or flatter to increase the performance of the filter strip, FDM 10-35-10.4.3 suggests that 30% sand, by volume, should be added to the sandy loam, loam or silty clay loam typical soil types to achieve the soil infiltration rate equivalent to loamy sand. This value was developed from the chart illustrated below. The chart describes the soil infiltration rate as sand is added to the soil types described in the filter strip performance charts. These infiltration rates, which are static rates that are assumed to occur when the depth of the water flowing down the filter strip is less than 0.015 feet, which is a reasonable assumption for sheet flow down a highway embankment. For example, a mixture of 30% sand and 70% silty clay will achieve an infiltration rate of about 1.8 inches per hour. This value is close to the 1 63 in/hr static infiltration rate for silty clay with no added sand. This 30% sand amendment volume, as described in Section 10.4.3, was selected from the curve to approximate the infiltration rate for loamy sand, without additional sand, as applied in the design charts.

The chart was developed from a modified soil media table in the WinSLAMM v10.0 program that calculates the infiltration rate of soil mixture combinations. The table was developed from laboratory and field measurements of many soil type combinations.



Calculation of Preliminary Permanent Pool Surface Area for TSS Reduction

Appendix A—Calculation of Preliminary Permanent Pool Surface Area for TSS Reduction [1]			
		80%	60%
Land Use/Description/Management[2]	Total Impervious (%)[3]	Minimum Surface Area of the Permanent Pool (% of Watershed Area)	Minimum Surface Area of the Permanent Pool (% of Watershed Area)
Commercial/Office Park/Institutional/Warehouse/Industrial/Manufacturing/Storage[4] (Non-retail related business, multi-storied buildings, large heavily used outdoor parking areas, material storage, or manufacturing operations	<60 60-80 80-90 >90	1.8 2.1 2.4 2.8	0.6
Parks/Open Space/Woodland/Cemeteries	0-12	0.6	0.2
Highways/Freeways (Includes right-of-way area) Typically grass banks/conveyance Mixture of grass and curb/gutter Typically curb/gutter conveyance	 <60 60-90 >90	 1.4 2.1 2.8	 1.0

[1] Multiply the value listed by the watershed area within the category to determine the minimum pond surface area. Prorate for drainage areas with multiple categories due to different land use, management, percent impervious, soil texture, or erosion rates. For example, to achieve an 80% TSS reduction, a 50 acre (residential, 50% imperviousness) x 0.01 (1% of watershed from table) = 0.5 acre + 50 acres (office park, 85% imperviousness) x 0.024 (2.4% of watershed) = 1.2 acre. Therefore 0.5 acre + 1.2 acre = 1.7 acres for the minimum surface area of the permanent pool.

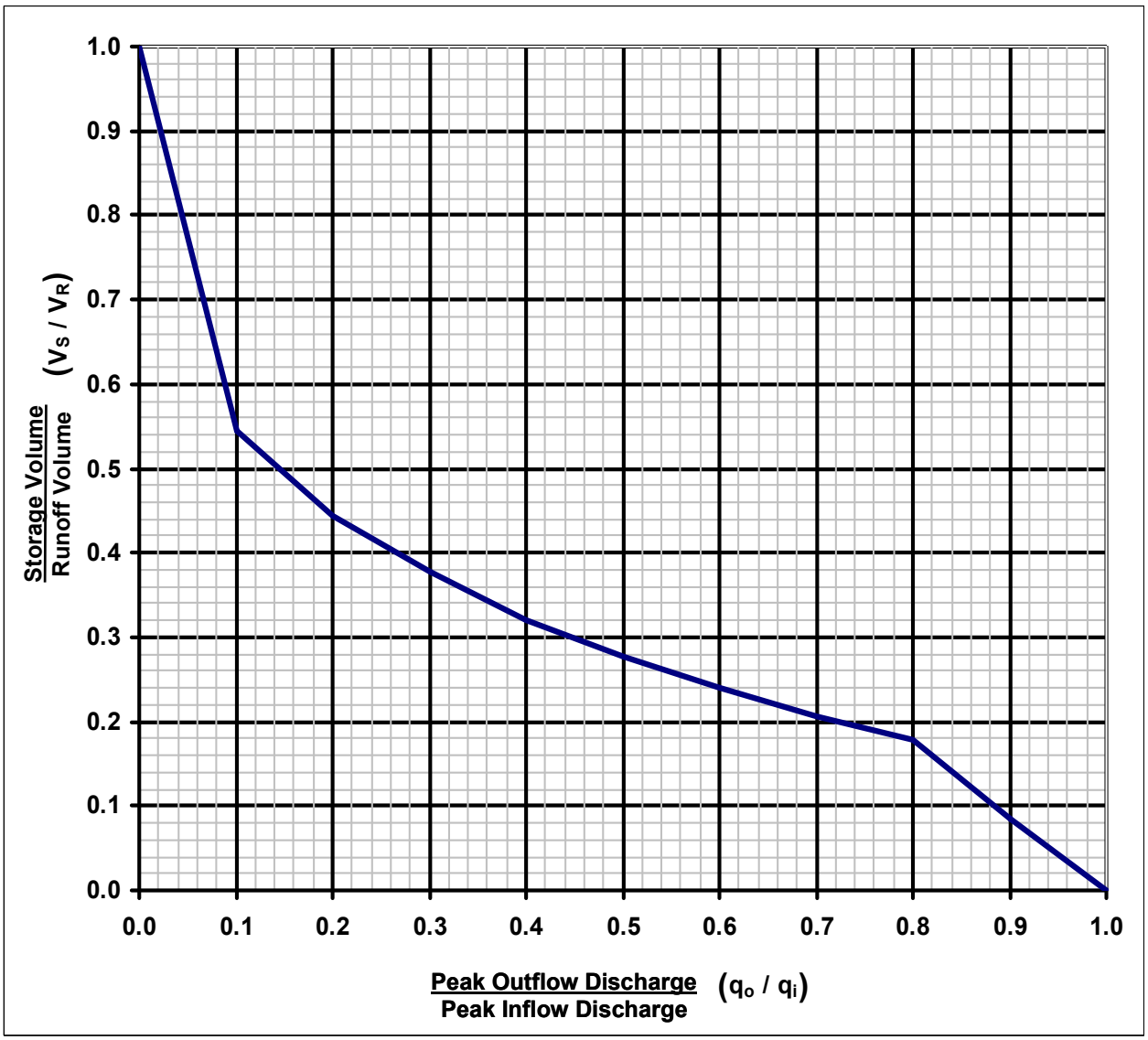
[2] For offsite areas draining to the proposed land use, refer to local municipalities for planned land use and possible institutional arrangements as a regional stormwater plan.

[3] Impervious surfaces include rooftops, parking lots, roads, and similar hard surfaces, including gravel driveways/parking areas.

[4] Category includes insurance offices, government buildings, company headquarters, schools, hospitals, churches, shopping centers, strip malls, power plants, steel mills, cement plants, lumber yards, auto salvage yards, grain elevators, oil tank farms, coal and salt storage areas, slaughter houses, and other outdoor storage or parking areas.

Source: This table was modified from information in "The Design and Use of Detention Facilities for Stormwater Management Using DETPOND" by R. Pitt and J. Voorhees (2000).

Pond Volume/Discharge Design Curve



Source: Technical Release 55, United States Department of Agriculture, Natural Resources Conservation Service, Washington, D.C. 1986. NRCS Bulletin No. WI-210-8-16 (Sept. 12, 1988) amended the TR-55 routing graph for Type II storms to include flows outside the original range.

Rainfall and Runoff Tables

Table 2 – Rainfall for Wisconsin Counties for a 1-year, 24-hour Rainfall[1]	
Inches of Rainfall	County
2.1	Door, Florence, Forest, Kewaunee, Marinette, Oconto, Vilas
2.2	Ashland, Bayfield, Brown, Calumet, Douglas, Iron, Langlade, Lincoln, Manitowoc, Menominee, Oneida, Outagamie, Price, Shawano, Sheboygan
2.3	Barron, Burnett, Dodge, Fond du Lac, Green Lake, Marathon, Milwaukee, Ozaukee, Portage, Racine, Rusk, Sawyer, Taylor, Washburn, Washington, Waukesha, Waupaca, Waushara, Winnebago, Wood
2.4	Adams, Chippewa, Clark, Columbia, Dane, Dunn, Eau Claire, Jackson, Jefferson, Juneau, Kenosha, Marquette, Pepin, Pierce, Polk, Rock, St. Croix, Walworth
2.5	Buffalo, Green, Iowa, La Crosse, Monroe, Richland, Sauk, Trempealeau, Vernon
2.6	Crawford, Grant, Lafayette
[1]TP – 40: Rainfall Frequency Atlas of the United States, U.S. Department of Commerce Weather Bureau.	

Table 3 - Rainfall for Wisconsin Counties for a 1-year, 24-hour Rainfall[2]		
Zone	Inches of Rainfall	County
1	2.22	Douglas, Bayfield, Burnett, Washburn, Sawyer, Polk, Barron, Rusk, Chippewa, Eau Claire
2	2.21	Ashland, Iron, Vilas, Price, Oneida, Taylor, Lincoln, Clark, Marathon
3	1.90	Florence, Forest, Marinette, Langlade, Menominee, Oconto, Door, Shawano
4	2.23	St. Croix, Dunn, Pierce, Pepin, Buffalo, Trempealeau, Jackson, La Crosse, Monroe
5	2.15	Wood, Portage, Waupaca, Juneau, Adams, Waushara, Marquette, Green Lake
6	1.96	Outagamie, Brown, Kewaunee, Winnebago, Calumet, Manitowoc, Fond du Lac, Sheboygan
7	2.25	Vernon, Crawford, Richland, Sauk, Grant, Iowa, Lafayette
8	2.25	Columbia, Dodge, Dane, Jefferson, Green, Rock
9	2.18	Ozaukee, Washington, Waukesha, Milwaukee, Walworth, Racine, Kenosha
[2]Bulletin 71: Rainfall Frequency Atlas of the Midwest, Midwest Climate Center and Illinois State Water Survey, 1992.		

Table 4 – Runoff for Selected Curve Numbers and Rainfall Amounts[1]											
	Runoff Depth in Inches for Curve Number of:										
Rainfall (inches)	50	55	60	65	70	75	80	85	90	95	98
1.9	0.00	0.01	0.04	0.11	0.20	0.33	0.50	0.72	1.01	1.39	1.68
1.96	0.00	0.01	0.05	0.12	0.23	0.36	0.54	0.77	1.06	1.44	1.73
2.1	0.00	0.02	0.08	0.16	0.28	0.43	0.62	0.87	1.18	1.58	1.87
2.15	0.00	0.03	0.09	0.18	0.30	0.46	0.66	0.91	1.22	1.63	1.92
2.18	0.00	0.03	0.10	0.19	0.31	0.47	0.68	0.93	1.25	1.65	1.95
2.2	0.00	0.04	0.10	0.19	0.32	0.48	0.69	0.94	1.27	1.67	1.97
2.21	0.00	0.04	0.10	0.20	0.32	0.49	0.69	0.95	1.28	1.68	1.98
2.22	0.00	0.04	0.10	0.20	0.33	0.49	0.70	0.96	1.28	1.69	1.99
2.23	0.01	0.04	0.11	0.20	0.33	0.50	0.71	0.97	1.29	1.70	2.00
2.25	0.01	0.04	0.11	0.21	0.34	0.51	0.72	0.98	1.31	1.72	2.02
2.3	0.01	0.05	0.12	0.23	0.36	0.54	0.75	1.02	1.35	1.77	2.07
2.4	0.02	0.07	0.15	0.26	0.41	0.59	0.82	1.10	1.44	1.87	2.17
2.5	0.02	0.08	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.96	2.27
2.6	0.03	0.10	0.20	0.34	0.50	0.71	0.96	1.26	1.62	2.06	2.37
[1]NRCS TR-55, Equations 2-1 to 2-4 used to determine runoff depths.											

FIGURE 1
CONCEPTUAL WET DETENTION POND
PLAN VIEW
NOT TO SCALE

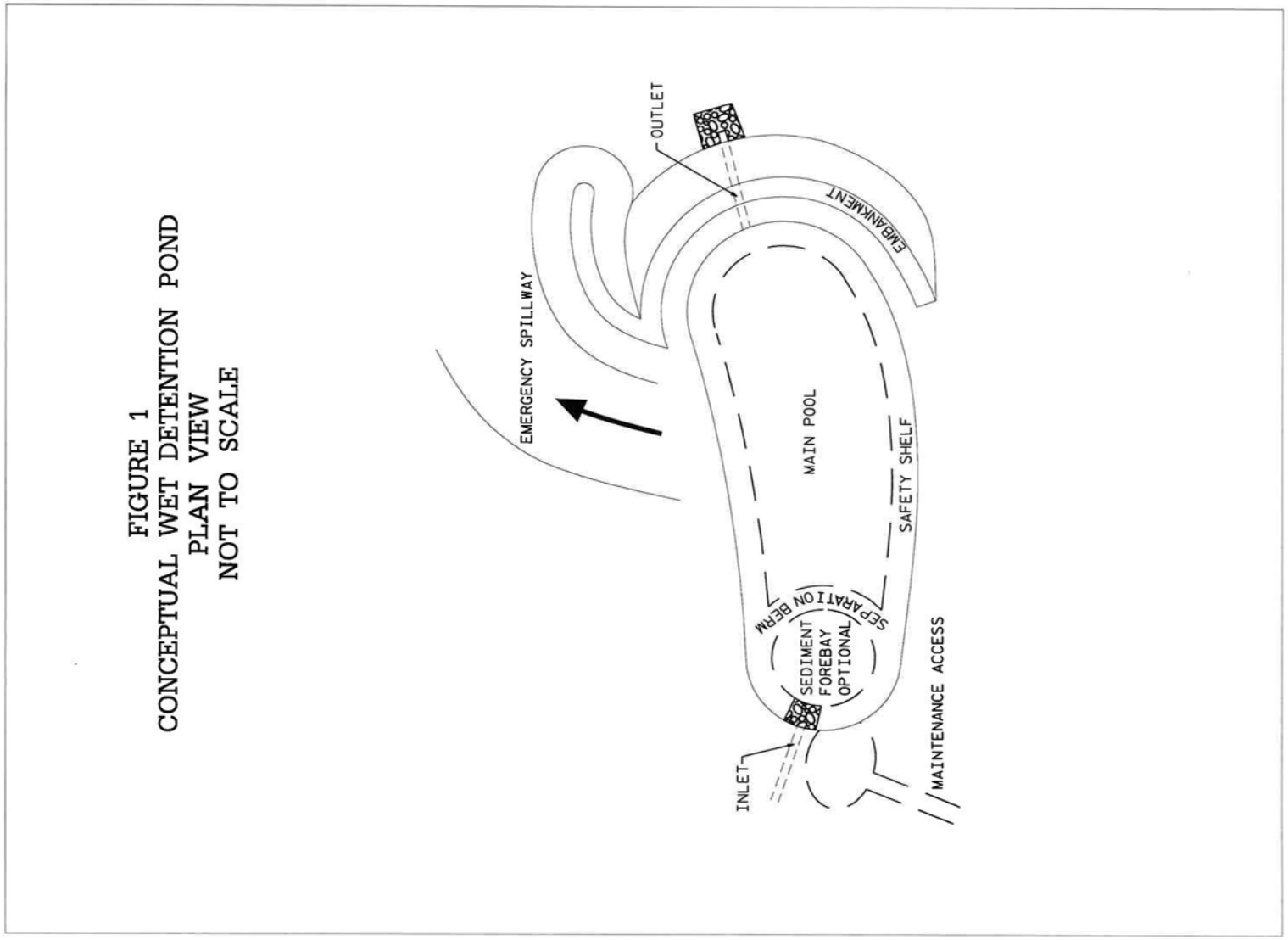
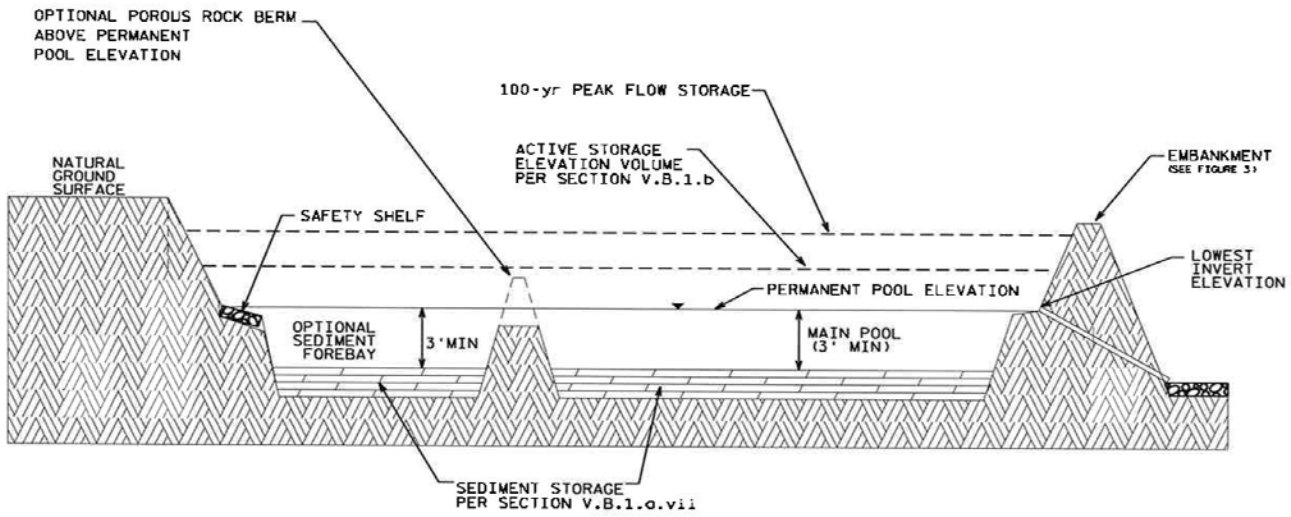
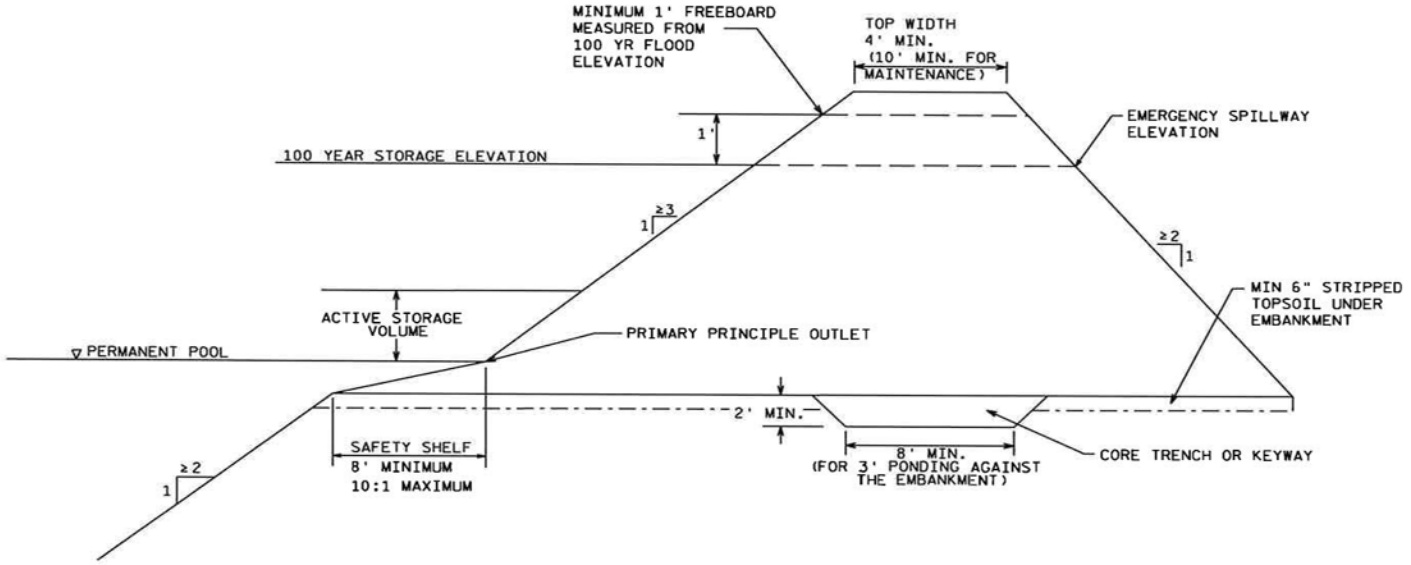


FIGURE 2
CONCEPTUAL WET DETENTION POND
CROSS SECTION
NOT TO SCALE



CROSS SECTION

FIGURE 3
TYPICAL EMBANKMENT CROSS SECTION FOR WET DETENTION POND
NOT TO SCALE



1. THESE ARE CONCEPTUAL OUTLET LOCATIONS TO INDICATE THE NEED TO HAVE DIFFERENT OUTLETS FOR THE DIFFERENT PURPOSES. NUMEROUS OUTLET DESIGNS WILL MEET THE CRITERIA OF THE STANDARD

SAMPLE WET DETENTION PERFORMANCE SPREADSHEET: DRAINAGE-SUMMARY WORKSHEET

A working copy of this form is available at:

http://wisconsindot.gov/rdwy/fdm/files/WisDOT-Stormwater-Drainage-WQ-Channel-Spreadsheets.zip

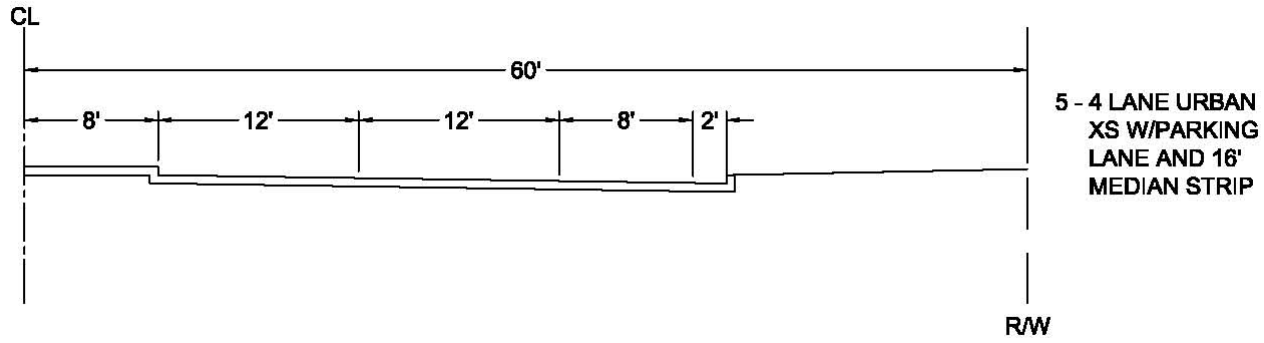
1 **Wet Detention Pond Performance**

2	Project ID: XXXX-XX-XX
3	Title: Example Project
4	Designer/Checker:
5	DOT Region/Firm Name:
6	Date:

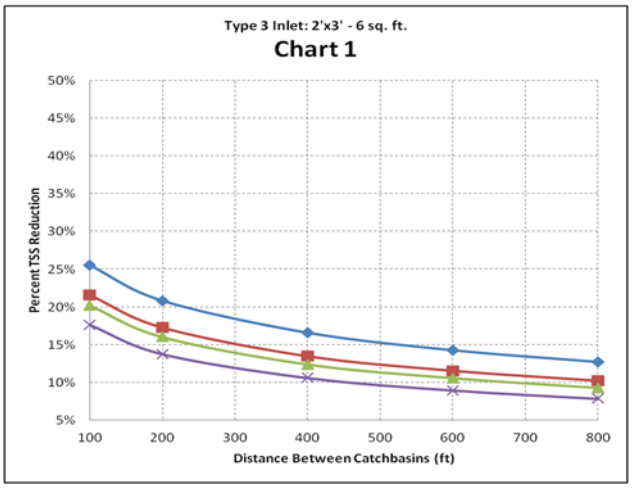
7	Drainage Area Basin Number					Total
8	Pond Number	1	2			
9	Pond Ending Station Number	30+00	48+00			
10	Pond Starting Station Number	20+00	35+00			
11	Left, Center, Right, or All	R	R			
12	***Site Assessment***					
13	Highway Segment Length Treated (ft)	1000	1300			
14	Drainage Area (ac)	12.000	15.000			27.000
15	ROW Area (ac)	1.500	1.900			3.400
16	Percent Reduction	75%	85%			81%
17	***Results Summary***					
18	Percent Reduction per Treated Highway Segment	75.0%	85.0%			80.6%

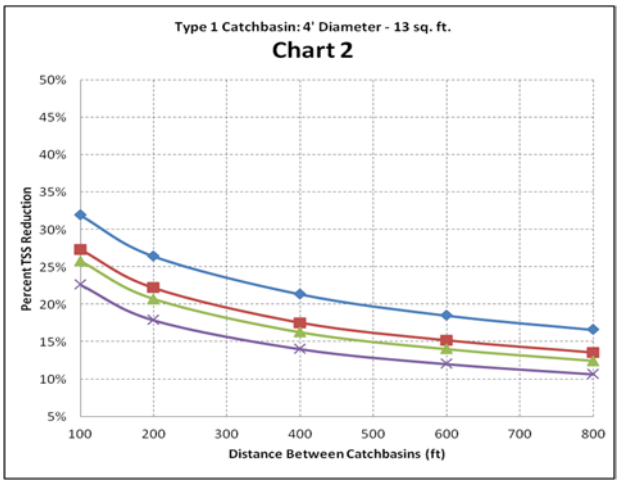
Enter Line Number and Comment. Add more boxes if necessary

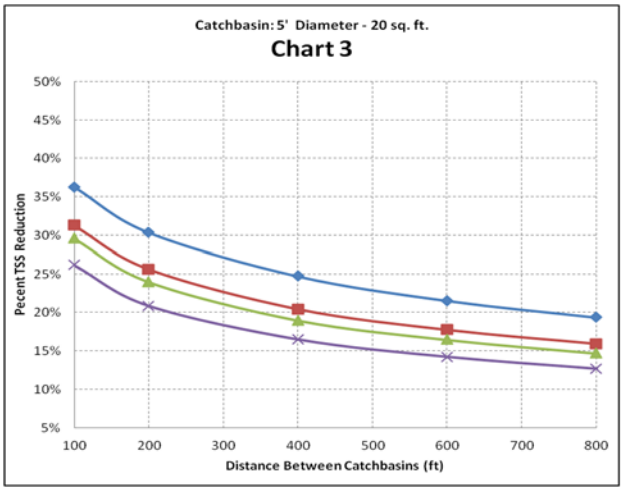
TYPICAL Cross Section TYPE 5

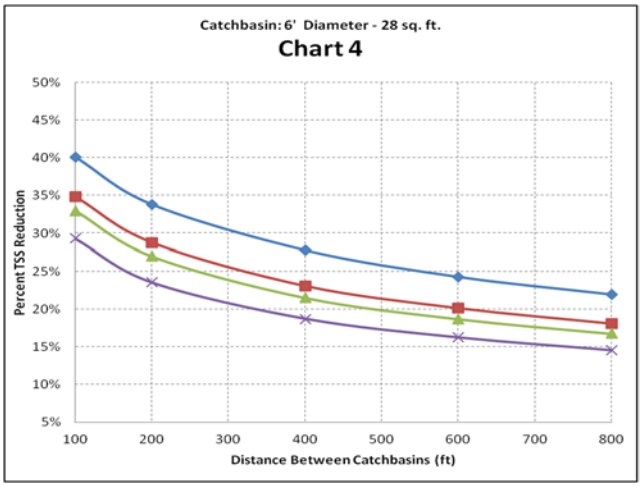


Cross Section Type 5 – Mostly Impervious Surface Beyond Curb Line

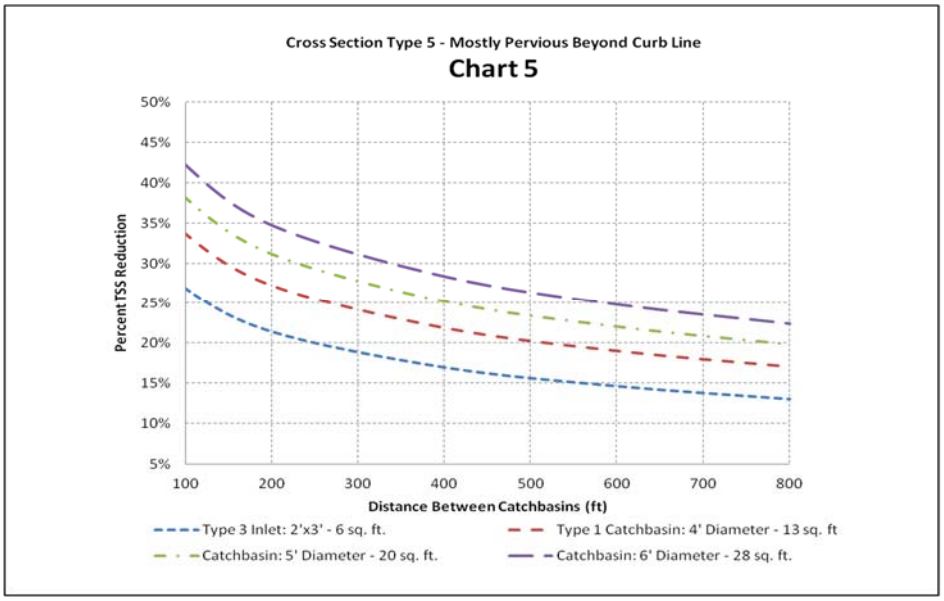




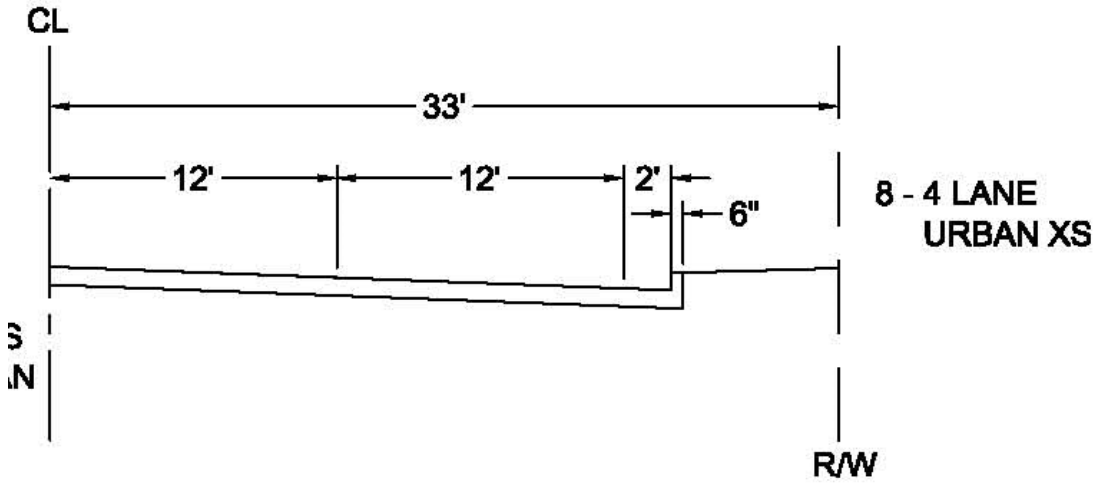




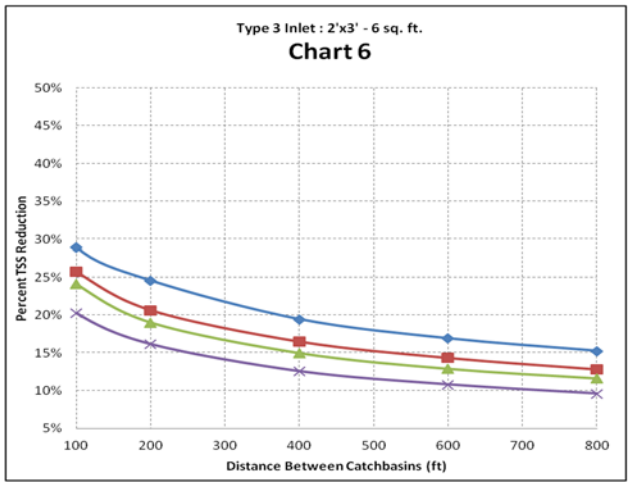
Cross Section Type 5 – Mostly Pervious Surface Beyond Curb Line

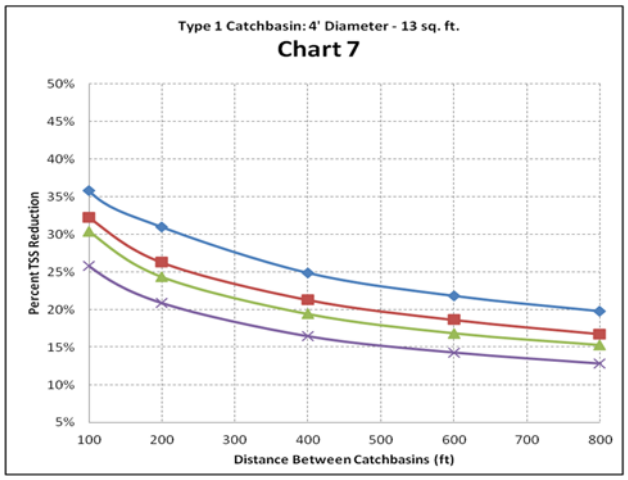


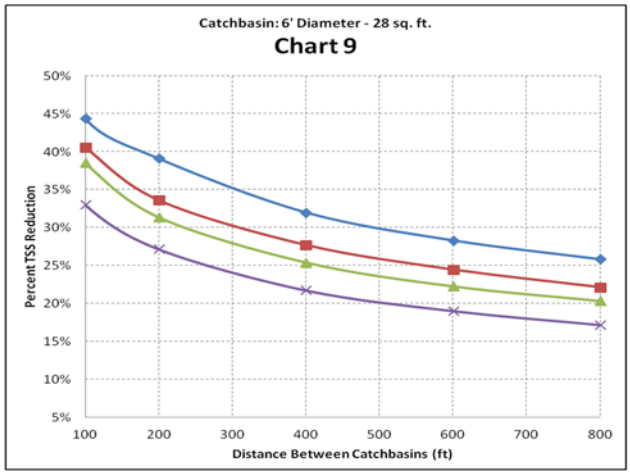
TYPICAL Cross Section Type 8

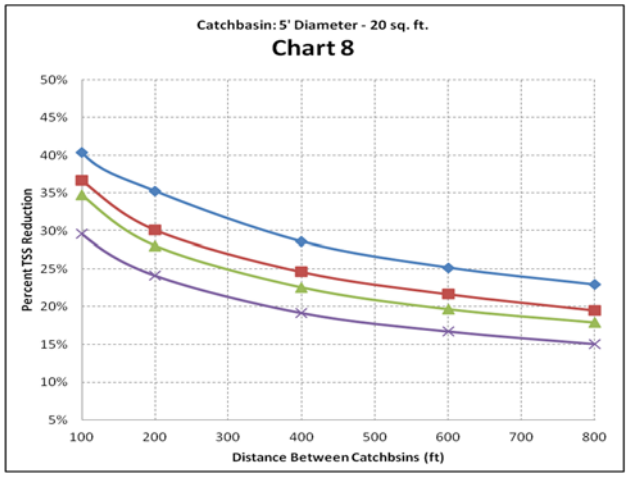


Cross Section Type 8 – Mostly Impervious Surface Beyond Curb Line

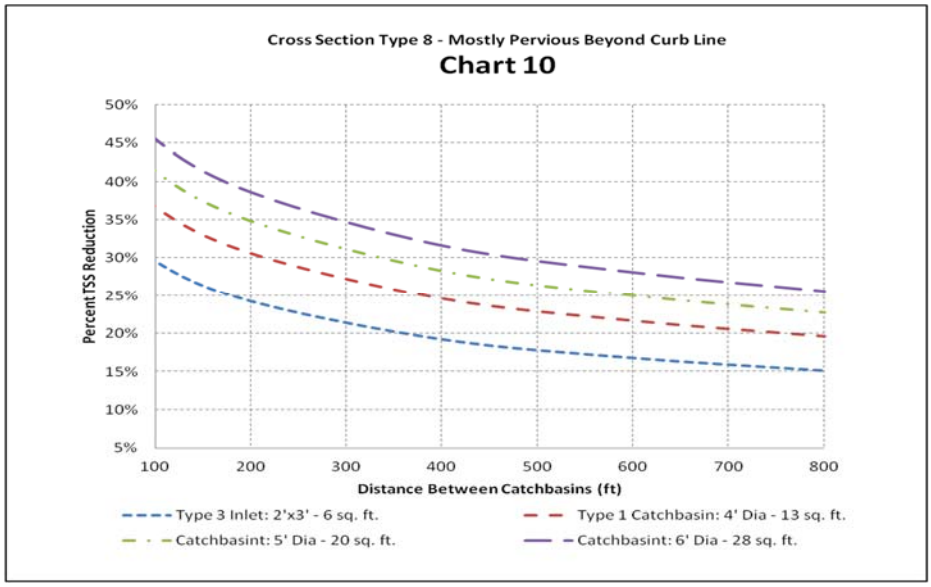








Cross Section Type 8 – Mostly Pervious Surface Beyond Curb Line



SAMPLE CATCHBASIN ANALYSIS SUMMARY SPREADSHEET: DRAINAGE-SUMMARY WORKSHEET

Refer to Attachment 15.5 for a working copy of this form.

Catchbasin Performance

Project ID:	XXXX-XX-XX
Title:	Example Project
Designer/Checker:	
Date:	

Drainage Area Basin Number							Total
Catchbasin Number							
Catchbasin Station	10+00	12+00	12+01	12+02	12+03		
Left, Center, or Right	R	R	R	R	R		
Site Assessment							
Distance to Next Catchbasin or Drainage Area (ft)	200	250	333				
Drainage Area (ac)	0.300	0.450	3.000				3.750
ROW Area (ac)	0.200	0.250	0.300				0.750
Cross Section Type (5 or 8)	5	8					
Catchbasin or Inlet Type/Size	Type 3 Inlet	Type 3 Inlet	Type 1 CB	Type 3 Inlet		DD Menu	
Predominant Cover Type	More Imperv	More Perv				DD Menu	
Design Chart Number	1	10				DD Menu	
Percent Reduction from Design Chart	14%	23%	22%				
Results Summary							
Average Drainage Area Width (ft)	65.34	78.408	392.432432	#DIV/0!	#DIV/0!		
Average ROW Width (ft)	43.56	43.56	39.2432432	#DIV/0!	#DIV/0!		
Percent Reduction per unit ROW Area	2.8%	5.8%	6.6%	0.0%	0.0%		4.0%