Pollution Reduction Plan: A Methodology

The Model Municipality lies in York County, Pennsylvania. The municipality must create a Pollution Reduction Plan (PRP) due to discharges to both the Chesapeake Bay and a local stream impairment for sediment that prompted one Appendix E listing in the MS4 Requirements Table.

Mapping the Sewersheds

The Model Municipality mapped their entire storm sewer system and delineated all of their sewersheds. A clear distinction was made between the sewersheds that discharge to locally impaired waters subject to Appendix E requirements (such as those shown in red in Figure 1 below) and those subject to Appendix D requirements (shown in blue in Figure 1 below):

Figure 1 DEP's Model Map with Appendix E Sewersheds in Red and Remaining Appendix D Sewersheds in Blue

Determine the Existing Loading without BMPs

WikiWatershed was then used to estimate the pervious and impervious area within each sewershed such as in the following example (Figure 2) using Sewershed 14 from the Model Map:

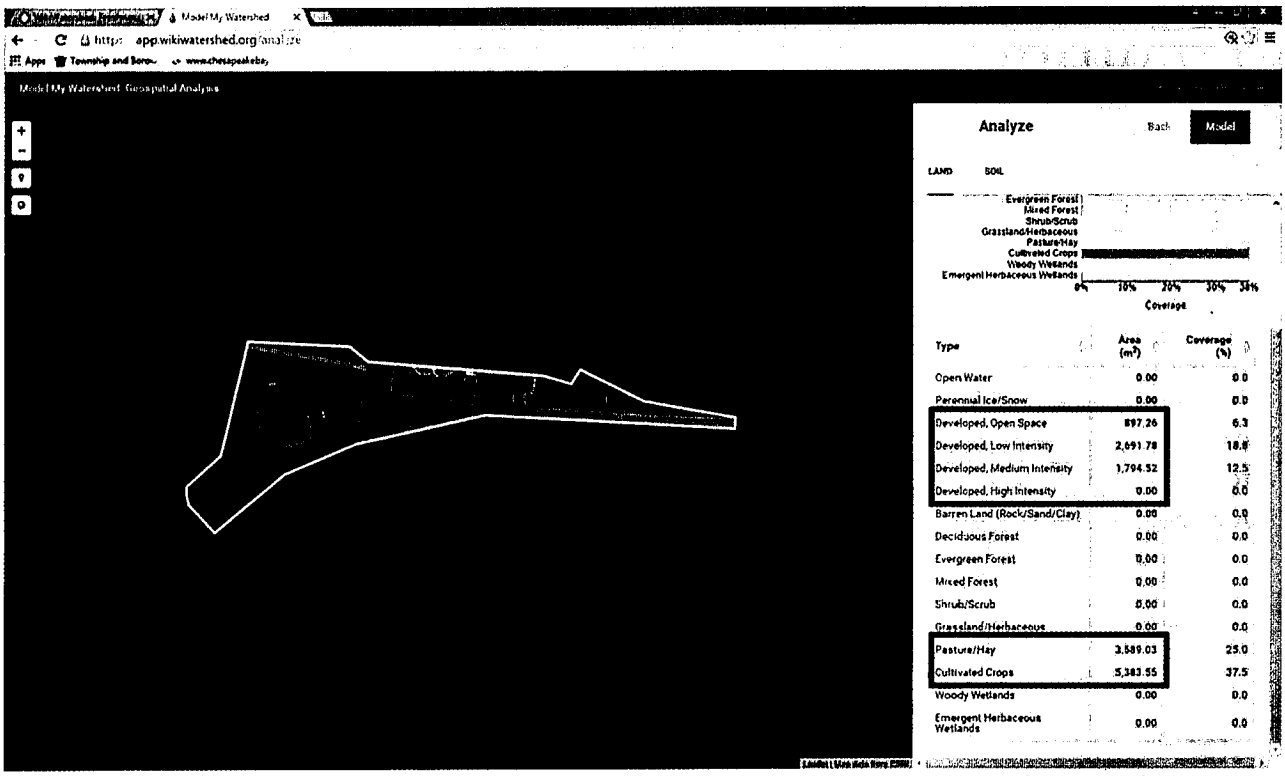


Figure 2 WikiWatershed Delineation of Sewershed 14 with Resulting NLCD 2011 Land Uses and Areas Highlighted in Red Boxes

The land use information from WikiWatershed comes from the 2011 National Land Cover Database (NLCD 2011).

Please note the following NLCD 2011 definitions:

- Developed, Open Space – **Impervious surfaces account for less than 20% of total cover.** These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
- Developed, Low Intensity - **Impervious surfaces account for 20% to 49% percent of total cover.** These areas most commonly include single-family housing units.
- Developed, Medium Intensity - **Impervious surfaces account for 50% to 79% of the total cover.** These areas most commonly include single-family housing units.
- Developed High Intensity - **Impervious surfaces account for 80% to 100% of the total cover.** Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial.

The NLCD 2011 information amalgamates impervious and pervious land uses together to create larger scale land use categories. Therefore the impervious and pervious information needs to be separated out using the percentage information provided in each definition. However PA DEP analysis has determined that the highest percentage of impervious must be used to remain accurate. The appropriate impervious percentages are as follows:

- Developed, Open Space – 19% impervious
- Developed, Low Intensity – 49% impervious
- Developed, Medium Intensity – 79% impervious
- Developed High Intensity – 100% impervious

The "translation" can be performed using a simple spreadsheet that converts the area information from square meters to acres then multiplies by the correct impervious ratio. The resulting impervious acres are summed and subtracted from the total acreage to obtain the pervious acres. The following is an example conversion for the Developed, Open Space land in Sewershed 14:

897.26 square meters of Developed, Open Space land at 19% impervious
897.26 square meters = 0.22 acres total
0.22 acres total * 19% = 0.04 acres impervious
0.22 total acres - 0.04 ac impervious = 0.18 pervious acres

Now applying the same methodology to the rest of the land uses provided by WikiWatershed in Sewershed 14 we get the following Table 1:

Table 1 Conversion from NLCD 2011 Land Use Designation to Impervious and Pervious Acres

Land Use	Area (m^2)	Area (acres)	% Impervious	Impervious Area (acres)	Pervious Area (acres)
Developed, Open Space	897.26	0.22	19	0.04	0.18
Developed, Low Intensity	2,691.78	0.67	49	0.33	0.34
Developed, Medium Intensity	1,794.52	0.44	79	0.35	0.09
Developed High Intensity	0	0	100	0	0
Pasture/Hay	3,589.03	0.89	0	0	0.89
Cultivated Crops	5,383.55	1.33	0	0	1.33
Total		**3.55**		**0.72**	**2.83**

The Pollution Reduction Plan (PRP) Instructions in Section I.B (pg. 1) states:

> For Chesapeake Bay PRPs (Appendix D), the pollutants of concern are sediment, TN and TP and the minimum reductions in loading are 10%, 5% and 3%, respectively.....it expected that, overall within the Bay watershed, the TP (5%) and TN (3%) goals will be achieved when a 10% reduction in sediment is achieved.
>
> For PRPs developed for impaired waters (Appendix E), the pollutant(s) are based on the impairment listing, as provided in the MS4 Requirements Table. If the impairment is based on siltation only, a minimum 10% sediment reduction is required. If the impairment is based on

nutrients.....a minimum 5% TP reduction is required. If the impairment is due to both siltation and nutrients, both sediment (10% reduction) and TP (5% reduction) must be addressed.

The Model Municipality has an Appendix E requirement for siltation only, and will therefore focus only on the 10% sediment reduction for the Appendix E sewersheds, as well as the 10% sediment reduction for the remaining Appendix D sewersheds.

The simplified method land use loading values are located in Attachment B of the Pollution Reduction Plan (PRP) Instructions. As our Model Municipality is in York County we will use those sediment loading rates which are depicted below (Figure 3):

3800-PM-BCW0100k 5/2016
PRP Instructions

ATTACHMENT B

DEVELOPED LAND LOADING RATES FOR PA COUNTIES[1,2,3]

County	Category	Acres	TN lbs/acre/yr	TP lbs/acre/yr	TSS (Sediment) lbs/acre/yr
York	impervious developed	10,330.7	29.69	1.18	1,614.15
	pervious developed	40,374.8	18.73	0.29	220.4

Figure 3 Sediment Loading Rates from Attachment B in the PRP Instructions Highlighted in the Red Box

The numbers state that the impervious land uses in York County discharge sediment at a rate of 1,614.15 lbs/ac/yr and that the pervious land uses discharge sediment at a rate of 220.4 lbs/ac/yr.

Once the impervious and pervious acres have been obtained from our analysis in Table 1, the impervious and pervious acres are simply multiplied by the respective loading rates as seen below in Table 2.

Table 2 Sediment Loading from Sewershed 14

Land Use	Loading Rate (lbs/ac/yr)	Sediment Loading (lb/yr)
0.72 impervious acres	1,614.15	1,162.19
2.83 pervious acres	220.40	623.73
3.55 total acres		**1,786 lb/yr total from Sewershed 14**

The same methodology as used to determine the sediment loading in Sewershed 14, is then used to calculate the sediment loading from all of the sewersheds in the Model Municipality. The results are shown in Appendix 1. Note that the existing loading without accounting for BMPs is **362,118 lb/yr**.

Determine the Final Existing Loading by Accounting for Existing BMPs

The PRP Instructions under Section I.C Existing Loading states, "If structural BMPs were implemented prior to development of the PRP and continue to be operated and maintained, the MS4 may claim pollutant reduction credit in the form of reduced existing loading" (pg. 1). The Model Municipality

contains numerous structural BMPs that were installed prior to the calculation of this PRP that are appropriately operated and maintained and can be seen in the green color in Figure 1.

The PRP Instructions under I.D. BMP Effectiveness states the following:

> All MS4s must use the BMP effectiveness values contained within DEP's BMP Effectiveness Values document (3800-PM-BCW0100m) or Chesapeake Bay Program expert panel reports for BMPs listed in those resources when determining pollutant load reductions in PRPs. For BMPs not listed in 3800-PM-BCW0100m or expert panel reports, MS4s may use effectiveness values from other technical resources; such resources must be documented in the PRP (pg. 2).

Sewershed 1 lies within the western portion of the Model Municipality subject to the Appendix E requirements (Figure 4). The sewershed contains a large infiltration basin that treats runoff from the entire sewershed. The infiltration basin was installed in July of 2012 and designed to the 2-year, 24-hour storm per PA Code Title 25 Chapter 102 requirements for Post Construction Stormwater Management (PCSM).

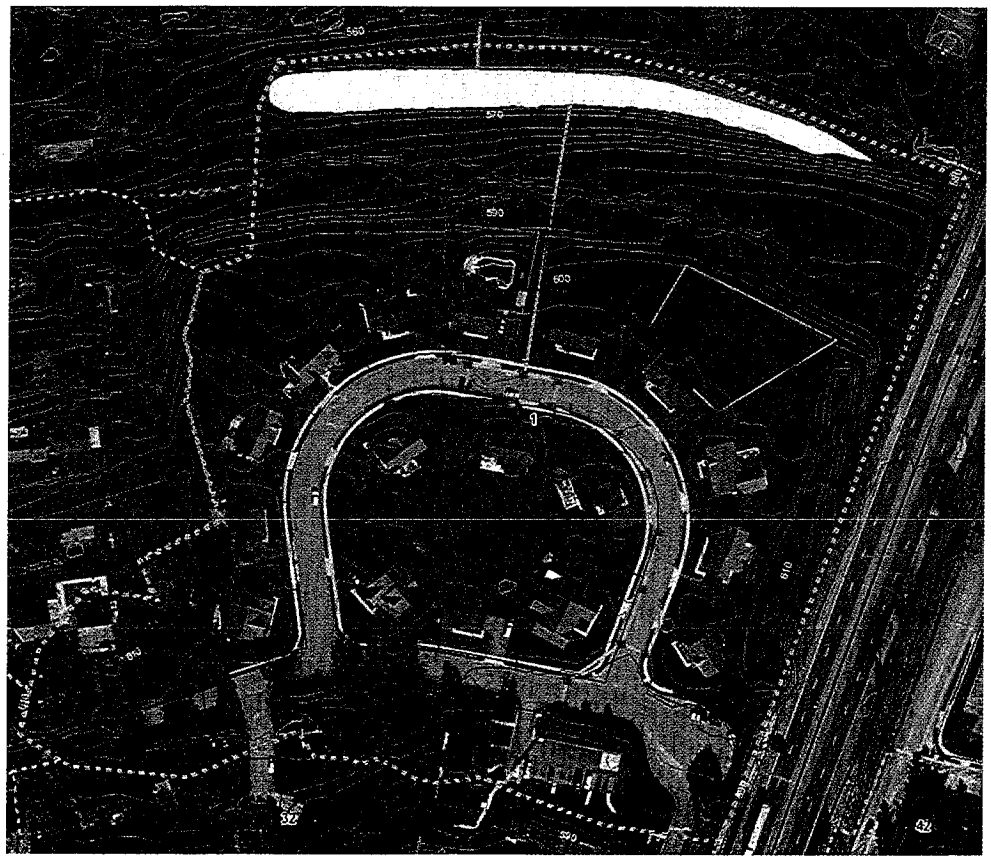


Figure 4 Sewershed 1 within the Model Municipality

The Model Municipality has chosen to calculate the performance of the basin using the "Recommendations of the Expert Panel to Define Removal Rates for New State Stormwater Performance Standards" (Performance Standards Expert Panel Report). However, the file containing the

crucial information to perform the calculations, such as the construction drawing set, local and NPDES permit package, design narrative, and associated documentation is no longer available at the Model Municipality Township Office. Therefore, the parameters necessary to perform the existing BMP performance calculation will have to be estimated.

Figure 5 contains the equation (located on page 11 of the Report) that is used to obtain the BMP removal efficiency percentage within the Performance Standards Expert Panel Report methodology. The required parameters include the runoff volume treated by the practice (in acre-feet), and the impervious area draining to the practice (in acres).

Equation X is a site specific conversion factor equation:

$$= \frac{(12 * EP)}{IA}$$

Where:

EP = State-Specific Engineering Parameter (in acre-feet)
IA = Impervious Area (acres)

Figure 5 Equation X for Determining the Inches of Runoff Treated per Impervious Acre in the Performance Standards Expert Panel Report (pg. 11)

As stated above, the infiltration basin was designed to capture the 2-year, 24-hour storm per the PA Chapter 102 requirements. Therefore, in order to determine the runoff volume treated by the BMP, the 2-year, 24-hour storm will need to be determined. The Model Municipality chose to consult the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates. By providing the location of the BMP, the Model Municipality was able to determine that 2-year, 24-hour storm within Sewershed 1 is 2.98 inches (Figure 6).

The Model Municipality determined that the total area draining to the BMP is 15.065 acres, containing 10.781 acres of pervious and 4.284 acres of impervious. The PA Chapter 102 PCSM calculation methodology requires the net change in volume from the post-development 2-year, 24-hour storm and the pre-development 2-year, 24-hour storm to be treated by the infiltration basin. Therefore, the Model Municipality used a spreadsheet version of Worksheets 4 and 12 from the Pennsylvania BMP Manual similar to the one created by the Chesapeake Stormwater Network entitled, "Pennsylvania DRAFT Compliance Spreadsheet" available at http://chesapeakestormwater.net/training-library/state-specific-resources/pennsylvania/.

In order to use the spreadsheets (which are based off of the curve number method for estimating runoff volumes) the hydrologic soil group must be determined. The National Resource Conservation Service (NRCS) Web Soil Survey was used to accomplish this task (Figure 7).

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular | PF graphical | Supplementary information

PDS-based precipitation frequency estimates with 90% confidence inter

Duration	Average recurrence interval (years)						
	1	2	5	10	25	50	100
5-min	0.323 (0.291-0.360)	0.385 (0.346-0.429)	0.454 (0.408-0.505)	0.505 (0.452-0.561)	0.566 (0.505-0.628)	0.610 (0.542-0.677)	0.653 (0.578-0.724)
10-min	0.516 (0.465-0.575)	0.616 (0.554-0.686)	0.727 (0.654-0.809)	0.807 (0.724-0.897)	0.902 (0.805-1.00)	0.971 (0.863-1.08)	1.04 (0.918-1.15)
15-min	0.645 (0.581-0.718)	0.774 (0.696-0.862)	0.920 (0.827-1.02)	1.02 (0.915-1.13)	1.14 (1.02-1.27)	1.23 (1.09-1.36)	1.31 (1.16-1.45)
30-min	0.884 (0.797-0.985)	1.07 (0.961-1.19)	1.31 (1.18-1.46)	1.48 (1.33-1.64)	1.69 (1.51-1.88)	1.85 (1.65-2.06)	2.01 (1.78-2.23)
60-min	1.10 (0.994-1.23)	1.34 (1.21-1.49)	1.68 (1.51-1.86)	1.93 (1.73-2.14)	2.26 (2.01-2.50)	2.51 (2.23-2.78)	2.77 (2.45-3.07)
2-hr	1.29 (1.17-1.44)	1.57 (1.42-1.75)	2.00 (1.79-2.22)	2.33 (2.08-2.59)	2.80 (2.49-3.10)	3.19 (2.82-3.53)	3.60 (3.17-3.99)
3-hr	1.41 (1.27-1.58)	1.71 (1.54-1.92)	2.17 (1.95-2.43)	2.54 (2.27-2.83)	3.05 (2.71-3.39)	3.47 (3.07-3.85)	3.92 (3.44-4.35)
6-hr	1.74 (1.57-1.96)	2.11 (1.90-2.38)	2.67 (2.39-3.01)	3.14 (2.80-3.52)	3.82 (3.38-4.26)	4.39 (3.86-4.89)	5.02 (4.37-5.59)
12-hr	2.13 (1.89-2.44)	2.57 (2.29-2.95)	3.26 (2.90-3.74)	3.86 (3.41-4.41)	4.76 (4.17-5.42)	5.55 (4.82-6.29)	6.42 (5.52-7.26)
24-hr	2.46 (2.27-2.71)	2.98 (2.75-3.28)	3.82 (3.51-4.20)	4.56 (4.17-4.99)	5.69 (5.15-6.19)	6.68 (6.00-7.25)	7.80 (6.93-8.44)

Figure 6 Screenshot of NOAA Atlas 14 with Red Boxes Indicating the 2-Year, 24-Hour Storm at the Location of the Infiltration Basin in Sewershed 1

Note that the Area of Interest within Sewershed 1 contains hydrologic soil groups B, C, and D. For demonstration purposes this example assumes that the site has only B soils. However, all three soil groups would need to be considered in the pre and post-development volume analysis.

Appendix 2 details the predevelopment runoff estimation. Note that predevelopment runoff was estimated to be 0.2379 acre-feet. Appendix 3 details the post-development analysis with the runoff volume estimated to be 1.3023 acre-feet. Please recall that Sewershed 1 was determined to contain 4.284 acres of impervious area.

The engineering parameter (EP) in Equation X (Figure 5) is the runoff volume treated by the practice (in acre-feet), which in this instance is equal to the difference in the post-development and predevelopment volume of runoff considering the 2-year, 24-hour storm. *Please note that the Performance Standards Expert Panel Report calculation methodology can be used to estimate the pollutant removal efficiency for any new stormwater BMP. The EP is equal to the whatever volume of runoff the practice will treated (in acre-feet), only where the practice was constructed to meet PA Chapter 102 PCSM requirements for NPDES permits is the 2-year, 24-hour storm predevelopment to post-development volume used for EP.*

Tables – Hydrologic Soil Group – Summary By Map Unit

Summary by Map Unit – York County, Pennsylvania (PA133)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CeB	Chester silt loam, 3 to 8 percent slopes	B	6.7	43.3%
Cm	Codorus silt loam	C	0.3	2.1%
GbC	Glenelg channery silt loam, 8 to 15 percent slopes	B	5.0	32.6%
UdB	Urban land-Chester complex, 0 to 8 percent slopes		1.2	8.0%
UfC	Urban land-Mt. Airy complex, 8 to 15 percent slopes		2.2	14.1%
Totals for Area of Interest			15.5	100.0%

Figure 7 Screenshot of NRCS Web Soil Survey with Sewershed 1 as the Area of Interest

For the infiltration basin in Sewershed 1, the EP is calculated as follows:

EP = Post - Predevelopment volume increase
EP = 1.3023 acre-feet - 0.2379 acre-feet
EP = 1.0644 acre-feet

Inserting EP = 1.0644 acre-feet and the 4.284 acres of impervious area into Equation X yields:

X = [12(in/ft) * 1.0644 acre-feet] / 4.284 acres
X = ***2.98 inches***

Please note that the 2-year, 24-hour design storm is also 2.98 inches. It is a matter of coincidence that the design storm and Equation X yield the same value in this instance. As Equation X determines the volume treated per impervious acre, the 2-year, 24-hour design storm value is often greater than the value calculated from Equation X.

Page 12 of the Performance Standards Expert Panel Report contains Table 4, which classifies BMPs into two separate categories: Runoff Reduction (RR) practices and Stormwater Treatment (ST) practices (Figure 8). The Model Municipality determined that the infiltration basin located in Sewershed 1 falls under the category of RR practices.

Referencing the sediment removal curve found on page 10 of the Performance Standards Expert Panel Report, using the 2.98 inches calculated by Equation X, and the determination that the infiltration basin is a RR practice, it is determined that the sediment removal efficiency associated with the BMP in Sewershed 1 is equal to 90% (Figure 9). Note that the Performance Standards Expert Panel Report states on page 10 that in the event that "the runoff captured by the practice exceeds 2.5 inches, simply use the pollutant removal values associated with 2.5 inches". As Equation X yielded 2.98 inches, the Model Municipality was indeed required to use 2.5 inches as the maximum value on the curve.

The 90% sediment removal must now be applied to the post-development sediment load from within Sewershed 1. Recalling that Sewershed 1 is composed of 10.781 acres of pervious area, and 4.284 acres of impervious area, and recalling the York County land use loading rates from Attachment B of the PRP Instructions (Figure 3), the sediment loading rates are calculated in Table 3 (similar to the example in Table 2 above):

Table 3 Sediment Loading from Sewershed 1 without Accounting for the Infiltration Basin

Land Use	Loading Rate (lbs/ac/yr)	Sediment Loading (lb/yr)
4.28 impervious acres	1,614.15	6914.93
10.78 pervious acres	220.40	2376.11
15.07 total acres		**9,291 lb/yr total from Sewershed 1**

To account for the infiltration basin in the existing load from Sewershed 1, the 90% BMP sediment removal efficiency must be applied to the 9,291 lb/yr from Table 3 as follows:

9,291 lb/yr * 0.90 = 8,362 lb/yr removed

9,291 lb/yr - 8,362 lb/yr = **929 lb/yr as the existing load from Sewershed 1 after accounting for the infiltration basin**

Applying the same methodology to the remaining Sewersheds with existing BMPs, we arrive at the final existing loading sediment calculation for the Model Municipality. The results are shown in Appendix 4. Please recall that the existing loading without accounting for BMPs was determined to be 362,118 lb/yr. ***Accounting for existing BMPs in the Model Municipality resulted in a total reduction of 115,419 lb/yr, bringing the existing load down to 246,699 lb/yr***.

Existing Load Summary and Required Reductions

Note that Appendix 1 and Appendix 4 include a category for "impaired". The PRP Instructions in 1.E (pg.2) states that for MS4s within the Chesapeake Bay watershed who must address both Appendices D and E there is a recommended focus on the impaired local waters first to determine if these reductions will meet the overall reduction requirements for the Chesapeake Bay. PRPs that include both Appendix E and Appendix D must address Appendix E and credit cannot be claimed under Appendix E for BMPs implemented outside of the storm sewershed of the local impaired waters.

Table 4 Classification of BMPs based on Runoff reduction capability[1]	
Runoff Reduction (RR) Practices	*Stormwater Treatment (ST) Practices* [2]
Non-Structural Practices	
Landscape Restoration/Reforestation	Constructed Wetlands
Riparian Buffer Restoration	Filtering Practices (aka Constructed Filters, Sand Filters, Stormwater Filtering Systems)
Rooftop Disconnection (aka Simple Disconnection to Amended Soils, to a Conservation Area, to a Pervious Area, Non-Rooftop Disconnection)	Proprietary Practices (aka Manufactured BMPs)
Sheetflow to Filter/Open Space* (aka Sheetflow to Conservation Area, Vegetated Filter Strip)	Wet Ponds (aka Retention Basin)
Non-Structural BMPs, PA 2006 BMP Manual, Chapter 5	Wet Swale
Practices	
All ESD practices in MD 2007	
Bioretention or Rain Garden (Standard or Enhanced)	
Dry Channel Regenerative Stormwater Conveyance (aka Step Pool Storm Conveyance)	
Dry Swale	
Expanded Tree Pits	
Grass Channels (w/ Soil Amendments, aka Bioswale, Vegetated Swale)	
Green Roof (aka Vegetated Roof)	
Green Streets	
Infiltration (aka Infiltration Basin, Infiltration Bed, Infiltration Trench, Dry Well/Seepage Pit, Landscape Infiltration)	
Permeable Pavement (aka Porous Pavement)	
Rainwater Harvesting (aka Capture and Re-use)	
*May include a berm or a level spreader [1]Refer to DC, MD, PA, VA or WV State Stormwater Manuals for more information [2] Dry ED ponds have limited removal capability , their efficiency is calculated using rates in Table B-4, Appendix B	

Figure 8 Performance Standards Expert Panel Report Contains Table 4 Classifying BMPs into Categories of Runoff Reduction (RR) Practices and Stormwater Treatment (ST) Practices (pg.12)

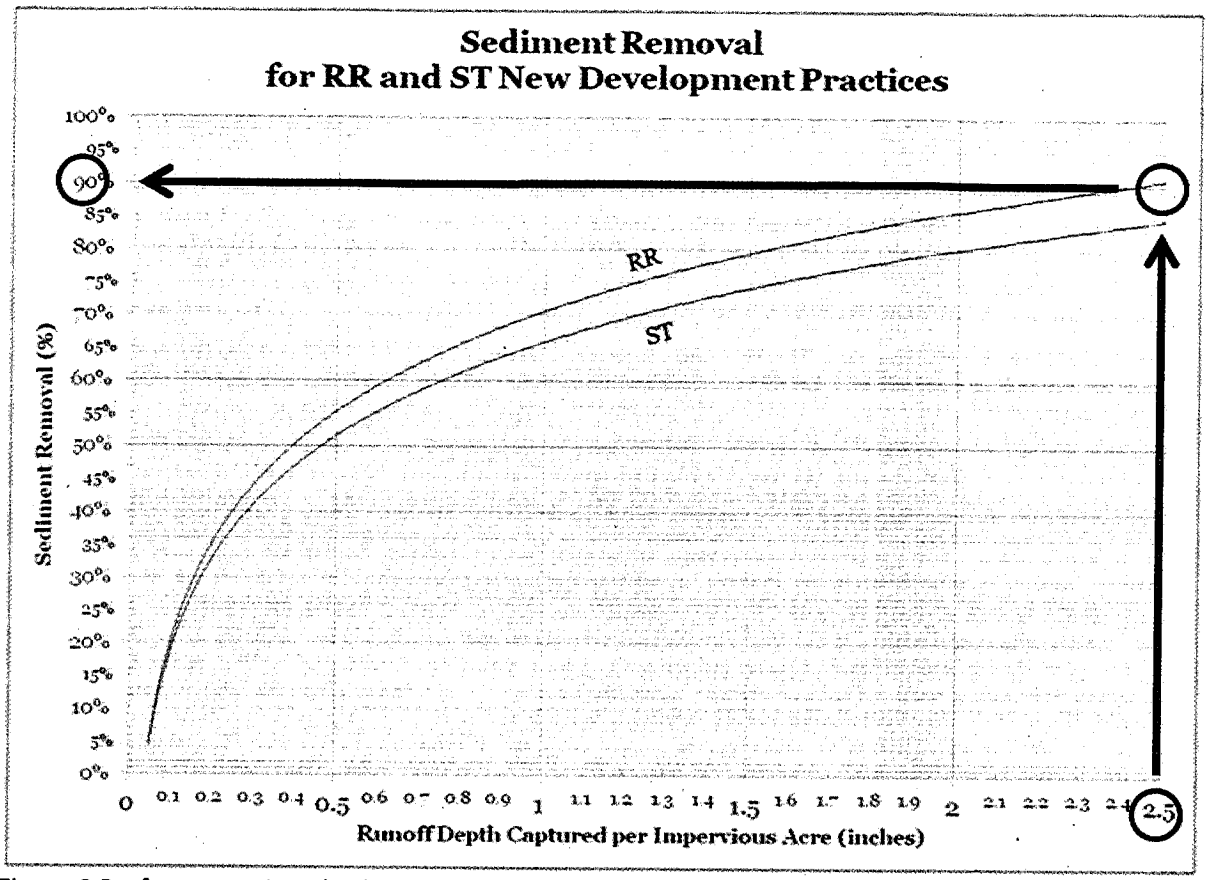


Figure 9 Performance Standards Expert Panel Report Sediment Removal Curve (pg.10) with the Determination of a 90% Sediment Removal Efficiency Outlined in Red

As the Model Municipality discharges to both locally impaired waters, and the Chesapeake Bay, the sewersheds have been divided appropriately. Appendix 5 of this document contains the sewersheds that discharge to locally impaired waters, and Appendix 6 of this document contains those that discharge to the Chesapeake Bay. The existing loading totals subject to each requirement were multiplied by 10% to determine the required sediment reductions subject to Appendices D and E. Table 4 is a summary of the existing loading analysis and Table 5 is summary of the reductions for both Appendix D and Appendix E requirements.

Table 4 Existing Load Summary

Existing Load w/o BMPs (lb/yr)	Existing Load w BMPs (lb/yr)	Appendix D Existing Load (lb/yr)	Appendix E Existing Load (lb/yr)
362,118	246,699	120,001	126,698

Table 5 Required 10% Sediment Reductions to Appendices D and E

Required Reduction to Appendix D	Required Reduction to Appendix E
12,000 (lb/yr)	12,670 (lb/yr)

Meeting the Load Reductions

Street Sweeping

The PRP Instructions state under I.C Existing Pollutant Loading, "MS4s may not claim credit for street sweeping and other non-structural BMPs implemented in the past" (pg. 1). However, the Model Municipality wishes to perform street sweeping throughout the next 5 year permit term, and will calculate the street sweeping reduction using the Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices (Street Sweeping Expert Panel Report).

The Street Sweeping Expert Panel Report Section 6.1 Derivation of the Street Cleaning Credit (pg. 44) states:

> In general, one impervious acre is equivalent to one curb-lane mile swept, assuming they are swept on one-side only. Credit is also provided for cleaning municipal and commercial parking lots (in this case, the acres of parking lot swept are reported, and converted to lane miles using the one acre = one curb lane mile rule of thumb).

Section 6.2 Note on Interaction of Street Cleaning and Other BMPs (pg. 46) of the Street Sweeping Expert Panel Report states:

> A key modeling issue involves how street cleaning interacts with other BMPs located within the same catchment. Roads inevitably intersect drainage areas that may (or may not) be served by upstream and/or downstream BMPs. A potential double counting situation is created when street cleaning interacts with other BMPs in the same catchment. The panel could not find a practical method to isolate the BMP interaction effect over the entire road network of a MS4, and certainly not at the scale of the Chesapeake Bay watershed. The panel concluded that there was a small possibility for double counting, but the effect was too small to quantify.

The response to Comment Number 4 (pg. 77) in the Street Sweeping Expert Panel Report states that "streets and parking lots without curb and gutter are eligible for credit".

The Street Sweeping Expert Panel Report provides an array of options for receiving pollution reduction credit based on the frequency of sweeping and the equipment used (Figure 10 of this document).

This may not last forever. It is for now.

Table 17. Pollutant Reductions Associated with Different Street Cleaning Practices					
Practice #	Description [1]	Approx Passes/Yr [2]	TSS Removal (%)	TN Removal (%)	TP Removal (%)
SCP-1	AST- 2 PW	~100	21	4	10
SCP-2	AST- 1 PW	~50	16	3	8
SCP-3	AST- 1 P2W	~25	11	2	5
SCP-4	AST- 1 P4W	~10	6	1	3
SCP-5	AST- 1 P8W	~6	4	0.7	2
SCP-6	AST- 1 P12W	~4	2	0	1
SCP-7	AST- S1 or S2	~15	7	1	4
SCP-8	AST- S3 or S4	~20	10	2	5
SCP-9	MBT- 2PW	~100	1.0	0	0
SCP-10	MBT- 1 PW	~50	0.5	0	0
SCP-11	MBT- 1 P4W	~10	0.1	0	0
AST: Advanced Sweeping Technology MBT: Mechanical Broom Technology [1] See Table 15 for the codes used to define street cleaning frequency [2] Depending on the length of the winter shutdown, the number of passes/yr may be 10 to 15% lower than shown					

Figure 10 Pollution Reductions Associated with Different Street Cleaning Practices found in Table 17 of the Street Sweeping Expert Panel Report (pg. 44)

The Model Municipality currently operates a Regenerative-Air Sweeper (RAS). Page 12 of the Street Sweeping Expert Panel Report states that RAS qualifies as Advanced Sweeper Technologies (or AST). For all street sweeping routes subject to this PRP, the Model Municipality has committed to sweeping approximately 25 times per year through the permit term. The Model Municipality will therefore receive 11% sediment removal credit using the street cleaning practice (SCP) option 3, referred to as SCP-3 in Table 17 of the Street Sweeping Expert Panel Report.

In the sewersheds that discharge to the waters subject to Appendix E, the Model Municipality sweeps 3.05 miles on both sides of the road, and a 6.12 acre parking lot.

Considering the conditions of the Street Sweeping Expert Panel Report described above, and that the impervious loading rate for York County is 1,614.15 lb/ac/yr (Figure 3), the street sweeping calculation for the Appendix E sewersheds is then as follows:

> 3.05 miles of street swept on both sides = 3.05 miles * 2 acre/mile = 6.10 acres of street
> 6.10 acres of street + 6.12 acre parking lot = 12.22 acres of impervious swept
> Sediment loading to the impervious acres = 12.22 acres * 1,614.15 lb/ac/yr = 19,724.91 lb/yr
> SCP-3 (advanced sweeping technology with 25 passes per year) provides 11% removal credit
> 19,724.91 lb/yr * 0.11 = 2,170 lb/yr removed

As Section 6.2 (pg. 46) of the Street Sweeping Expert Panel Report states that there is no concern with double counting the street sweeping reduction with any other BMPs, the 2,170 lb/yr removed from

street sweeping can then be removed from the entire 10% load reduction from the Appendix E sewersheds.

Please recall that the required load reduction total to the locally impaired waters is 12,670 lb/yr.

With the 2,170 lb/yr sediment reduction from street sweeping, the total required reduction to the locally impaired waters is reduced as follows:

12,670 lb/yr – 2,170 lb/yr = **10,500 lb/yr sediment reduction remaining to Appendix E**

In the sewersheds that discharge to the waters subject to Appendix D, the Model Municipality sweeps 2.11 miles on both sides of the road, and a 6.18 acre parking lot.

Similarly, the street sweeping calculation for the Appendix D sewersheds is then as follows:

2.11 miles swept on both sides = 2.11 miles * 2 acre/mile = 4.22 acres
4.22 acres + 6.18 acre lot = 10.40 acres of impervious swept
Sediment loading to the impervious acres = 10.40 acres * 1,614.15 lb/ac/yr = 16,787.16 lb/yr
SCP-3 (advanced sweeping technology with 25 passes per year) provides 11% removal credit
16,787.16 lb/yr * 0.11 = 1,847 lb/yr removed

Please recall that the required load reduction total to the Bay sewersheds is 12,000 lb/yr

With the 1,847 lb/yr sediment reduction from street sweeping, the total required reduction to the Chesapeake Bay Appendix D sewersheds is reduced as follows:

12,000 lb/yr – 1,847 lb/yr = **10,153 lb/yr sediment reduction remaining to Appendix D**

Wet Pond Restoration to Meet Appendix E Sediment Reduction

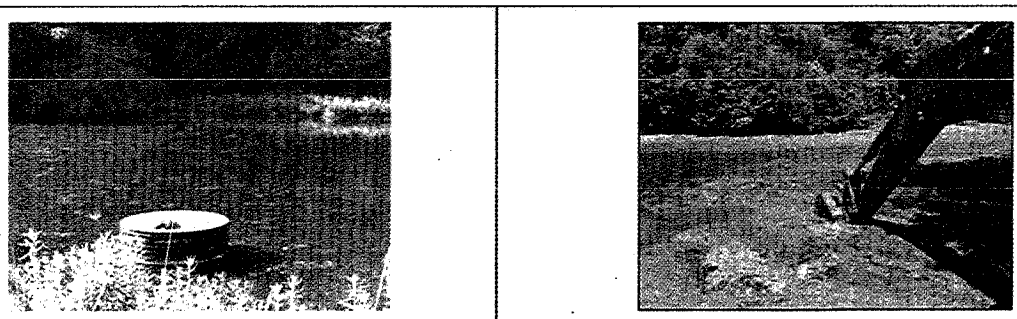
A series of wet ponds was observed during the delineation of Sewershed 3 (Figure 11) which is subject to the Appendix E requirements. During the existing loading analysis, it was noted that the drainage area to the wet ponds appeared to be larger than originally designed, with a significant portion of the drainage consisting of directly connected impervious areas (Appendix 7). The wet ponds appear to be designed for a residential development built in approximately 2003, but over the past several years it seems that additional commercial properties were allowed to connect to the wet pond drainage system.

During a survey of the wet pond's performance it was determined that the wet ponds were designed with an average depth of 6.00 feet, but that sediment accumulation that has caused the average depth to drop to 2.25 feet. Therefore, the municipality has elected to conduct a major repair by dredging the ponds to return them to their original performance at 6.00 feet of depth (Figure 12). The work described is listed as BMP Restoration in the "Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects" (Retrofit Expert Panel) document (pg. 9). The Retrofit Expert Panel document describes a subclass of Restoration projects as:

Major Sediment Cleanouts – Removal of sediment, muck and debris that is equal to or greater than 1/10 the volume of the facility. For wet ponds, the volume of the facility would be where the normal water elevation or invert of the outfall pipe is.

The construction drawing set for the wet ponds are unavailable therefore the geometry of the basins was measured in the field.

Figure 11 Wet Ponds in Sewershed 3



BMP Restoration: increasing performance of a BMP by conducting major repairs or upgrades. In this example, an underperforming pond is dredged for sediment thereby restoring it to its full performance capacity.

Figure12 BMP Restoration from Retrofit Expert Panel Report (pg. 11)

Runoff Treatment Estimation for Full 6.00 foot Capacity

The rectangular East Pond has a length of 235 feet, a width of 121 feet, designed with an average 6 foot water elevation, and 4:1 side slopes. Accounting for these parameters, the East Pond volume is 125,625 cubic feet.

The West Pond has irregular geometry with six sides measuring 401, 105, 250, 170, 114, and 212 feet. The West Pond also was designed with an average 6 foot water elevation and 4:1 side slopes. Factoring these parameters, the West Pond volume would contain 233,232 cubic feet.

Summing the two volumes together creates a total 6 foot depth wet pond stormwater treatment volume of 358,857 cubic feet or 8.238 acre-feet. As the drainage area to the wet ponds contains 48.60 acres of impervious area, the standard retrofit equation from the Retrofit Expert Panel Report (pg. 13) yields:

> Runoff volume treated at the site = (8.238 acre-feet * 12) / 48.60 acres = 2.0 inches

Wet ponds are listed as a stormwater treatment practice in Table 2 on page 16 of the Retrofit Expert Panel Report. Referencing the sediment removal curve on page 15 of that document, it is determined that with an average depth of 6.00 feet the wet ponds would achieve a 2.0 inch runoff treatment volume equal to a 78% reduction.

Runoff Treatment Estimation for Current 2.25 foot Capacity

The analysis for the 2.25 foot capacity was performed during the final existing loading analysis that accounted for existing BMP reductions. The volume of the East Pond was calculated to contain 36,731 cubic feet, and the volume of the West Pond was calculated to hold 67,955 cubic feet. Therefore, the total current storage of the wet ponds is summed to 104,686 cubic feet or 2.403 acre-feet. With 48.60 acres of impervious area loading the wet ponds, the standard retrofit equation from the Retrofit Expert Panel Report (pg. 13) is as follows:

> Runoff volume treated at the site = (2.403 acre-feet * 12) / 48.60 acres = 0.6 inches

Again, referencing the sediment removal curve on page 15 of the Retrofit Expert Panel Report, it is determined that 0.6 inches is equal to a 57% reduction. The 57% reduction was applied to the existing loading from Sewershed 3 (Appendix 4) as such:

> 84,690 lb/yr (draining to ponds) * 57% = 48,273 lb/yr removed from the BMP in the existing condition

The final existing sediment load from Sewershed 3 was therefore determined as follows:

> 84,690 lb/yr – 48,273 lb/yr = **36,417 lb/yr**

Net Pollutant Reduction for the Wet Pond Restoration

Following the methodology outlined on page 18 of the Retrofit Expert Panel Report, the incremental removal rate from the 6.00 foot wet pond depth to the 2.25 foot current depth is 78% - 57% = 21%.

The 21% incremental removal rate is the increased wet pond performance that will credited to the 10% mandatory reduction required by Appendix E.

The sediment loading to the wet ponds has been calculated as 84,690 lb/yr. Therefore the reduction achieved by the increased performance of these wet ponds is:

84,690 lb/yr * 21% incremental removal rate = 17,785 lb/yr reduced

The required reduction for the Appendix E sewersheds was determined to be 10,500 lb/yr after applying the credit for street sweeping of 2,170 lb/yr.

Therefore, the Model Municipality has exceeded its Appendix E requirement by 7,285 lb/yr. The Model Municipality could elect to suspend the street sweeping practice and still meet the requirements; however the Model Municipality will perform this work anyway, and wishes to receive credit for the work.

Basin Retrofit to Meet Remaining Appendix D Requirements

Two basins were observed operating in parallel as the stormwater treatment mechanism for Sewershed 7 (Figure 13) which is located in the Appendix D sewersheds. While performing the existing loading analysis, similar to the wet ponds in Sewershed 3, it was noted that the drainage area to the basins appeared to be larger than originally designed, with a significant portion of the drainage consisting of directly connected impervious areas (Appendix 8). The basins were built in approximately 2001, and although the construction drawing set has been lost, the design strongly suggests that rate control is the primary function as demonstrated by the steep basin contours and lack of level infiltration area (Figure 13).

Current Runoff Treatment Estimation for the Basins

Performing a desktop GIS analysis, it was determined that the 550 foot contour of the West Basin has an area of 6,546 square feet and the 550 foot contour of the East Basin has an area of 8,595 square feet. The mapping of the basins is not complete, but on-the-ground analysis has determined that the basins are indeed operating in parallel. Therefore, the total of the 550 foot contour areas of both basins, at 15,141 square feet, will be considered as the effective BMP area.

The basins are heavily vegetated with many well established trees (Figure 14). It is therefore assumed that although designed primarily for rate control the basins do effectively function to infiltrate 0.5 feet of runoff. Assuming that the 0.5 feet of infiltration occurs over the effective basin area of 15,141 square feet, the basins treat 7,570 cubic feet of runoff or 0.174 acre-feet.

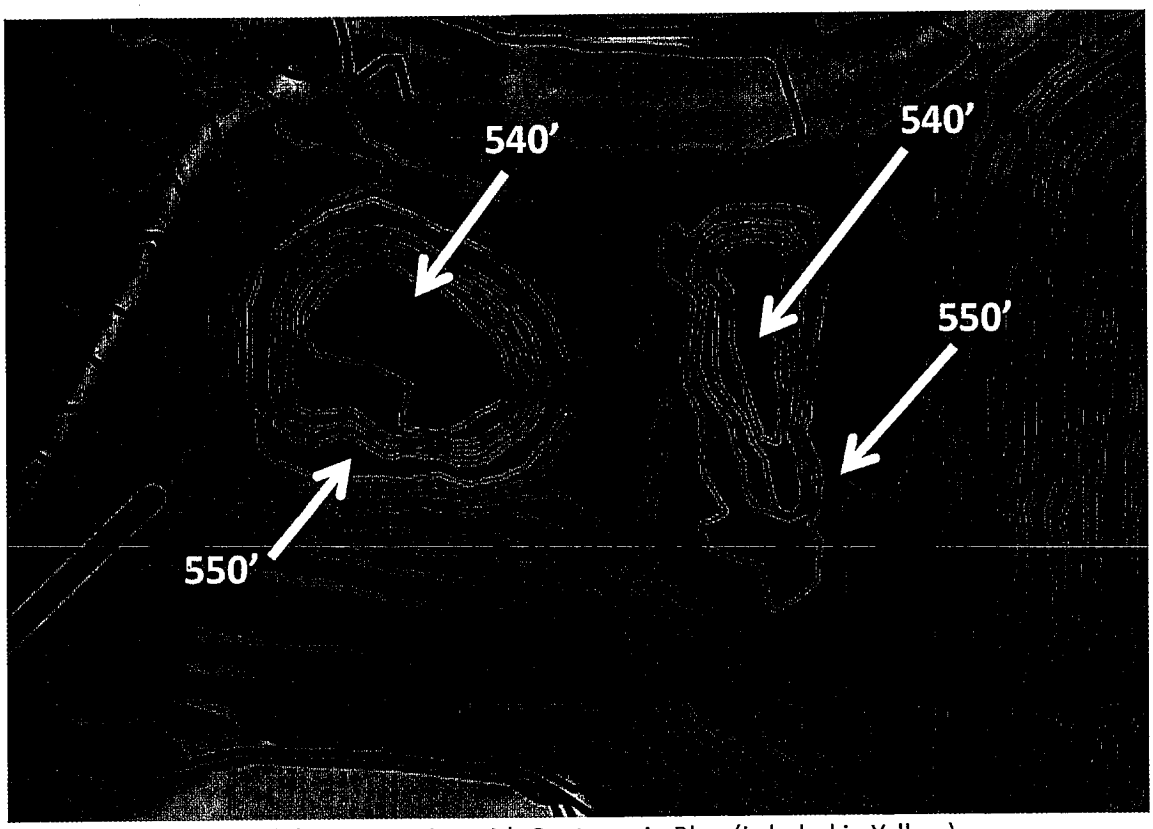


Figure 13 GIS Image of the Two Basins with Contours in Blue (Labeled in Yellow)

As the drainage area to the basins contains 25.59 acres of impervious area, the standard retrofit equation from the Retrofit Expert Panel Report (pg. 13) yields:

Runoff volume treated at the site = (0.174 acre-feet * 12) / 25.59 acres = 0.08 inches

Referencing the sediment removal curve on page 15 of the Retrofit Expert Panel Report, it is determined that 0.08 inches is equal to a 12% reduction. The 12% reduction was applied to the final existing loading from Sewershed 7 (Appendix 4) as such:

44,701 lb/yr (draining to basins) * 12% = 5,364 lb/yr removed from the BMP in the existing condition

The final existing sediment load from Sewershed 7 was therefore determined as follows:

44,701 lb/yr – 5,364 lb/yr = **39,337 lb/yr**

Proposed Retrofit and Volume Reduction Estimation

In order to maximize the treatment area available at the site, a retrofit is proposed that combines the basins into one at the 550 foot contour line as depicted in Figure 15.

Creating one even basin bottom elevation at the 550 foot contour will act to spread the water out across the basin for more effective water quality treatment and will promote infiltration. To create additional storage, and take advantage of the fact that the existing site consists of two basins that are both 10 feet deep, the retrofit will include a proposed gravel storage bed with a depth of 3.75 feet. Assuming a void ratio of 0.4 within the gravel bed, the infiltration basin storage will contain 1.5 feet.

Figure 14 Aerial Image of the Well Established Trees and Vegetation in both Basins (Approximate Basin Areas Outlined in Red)

The area of the proposed basin bottom elevation along the 550 foot contour (Figure 5) is 19,617 square feet. As the gravel bed will contain storage for 1.5 feet of runoff, the retrofitted infiltration basin will capture 29,426 cubic feet of runoff equal to 0.676 acre-feet.

As the drainage area to the basins contains 25.59 acres of impervious area, the standard retrofit equation from the Retrofit Expert Panel Report (pg. 13) yields:

Runoff volume treated at the site = (0.676 acre-feet * 12) / 25.59 acres = 0.32 inches

Referencing the sediment removal curve on page 15 of the Retrofit Expert Panel Report, it is determined that 0.32 inches is equal to a 38% reduction on the Stormwater Treatment (ST) curve.

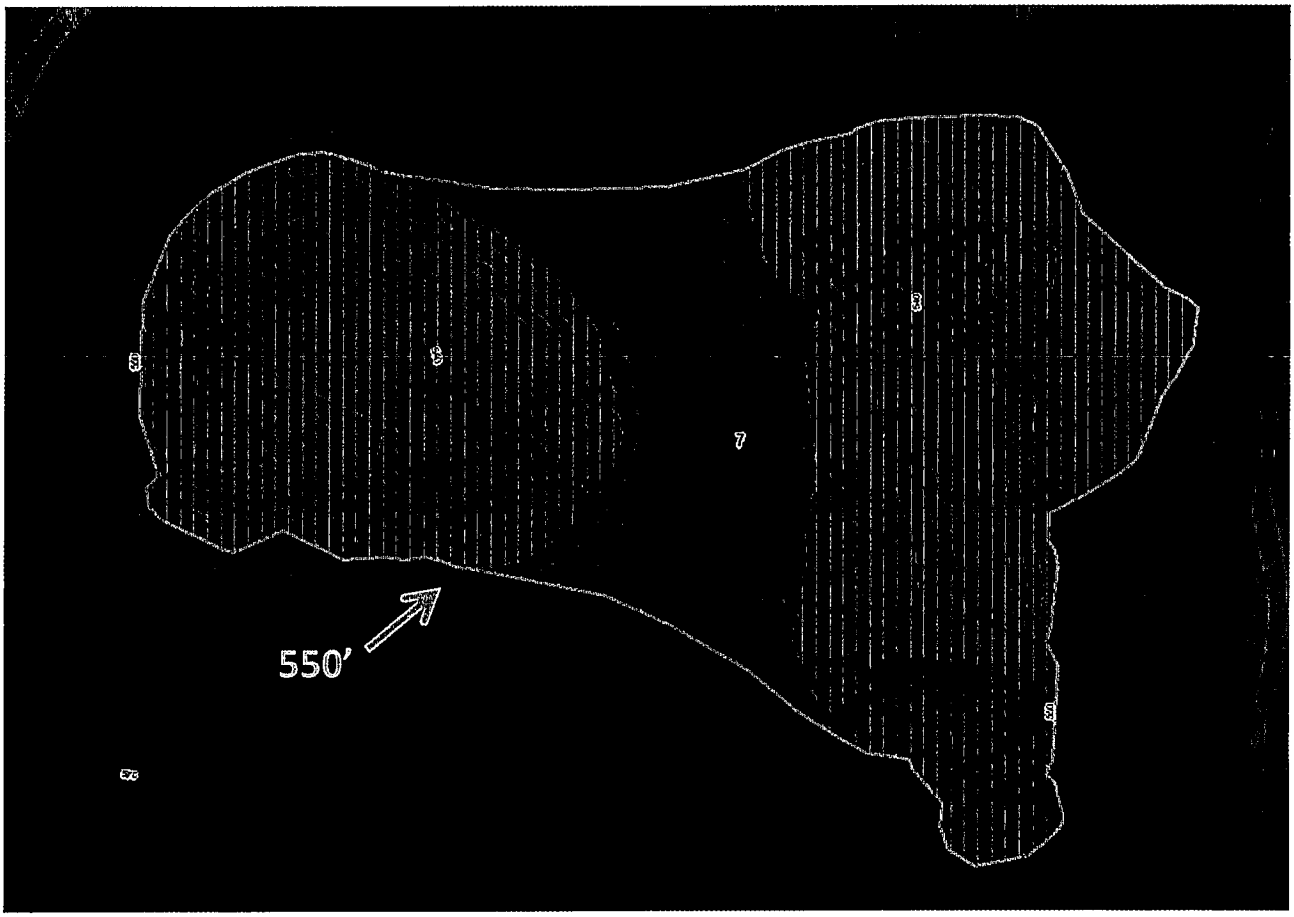


Figure 15 Proposed Retrofit of Extending the Treatment Area by Combining the Basins at the 550 Contour Lines (Shown in Orange)

The ST curve was chosen to be conservative, as the entire proposed retrofit is on C soils (Figure 16). However, during the design phase, the Model Municipality will perform infiltration testing and based upon the results, be able to determine if the runoff will infiltrate in 72 hours, allowing the full use of the Runoff Reduction curve, or if slow release Stormwater Treatment volume will continue to be pursued.

Net Pollution Reduction for the Basin Retrofit

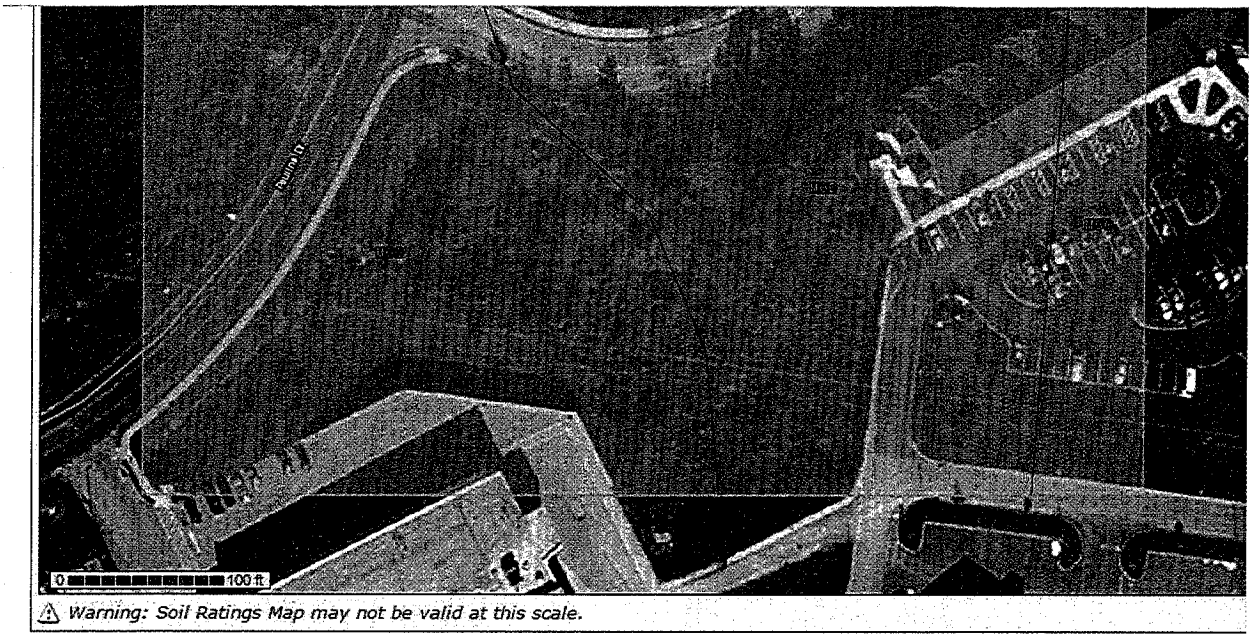
Following the methodology outlined on page 17 of the Retrofit Expert Panel Report, the incremental removal rate (enhanced BMP - existing BMP) is 38% - 12% = 26%.

The 26% incremental removal rate is the increased performance that will be credited to the 10% mandatory reduction required by Appendix D.

The sediment loading to the basins has been calculated as 44,701 lb/yr. Therefore the reduction achieved by retrofit of the basins is:

44,701 lb/yr * 26% incremental removal rate = 11,622 lb/yr reduced

The basins discharge to the portion of the municipality that is subject to the Appendix D requirements. The required reduction for this portion of the municipality was determined to be 10,153 lb/yr after credit for street sweeping of 1,847 lb/yr.



⚠ *Warning: Soil Ratings Map may not be valid at this scale.*

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — York County, Pennsylvania (PA133)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
MOC	Mt. Airy and Manor soils, 8 to 15 percent slopes	C	2.9	56.8%
MOD	Mt. Airy and Manor soils, 15 to 25 percent slopes	C	2.2	43.2%
Totals for Area of Interest			**5.1**	**100.0%**

Figure 16 Web Soil Survey Indicating the Entire Proposed Infiltration Area is Composed of C Soils

Therefore, the Model Municipality has exceeded its Appendix D requirement by 1,469 lb/yr. The Model Municipality could elect to reduce the street sweeping practice and still meet the requirements; however the Model Municipality does this work anyway, and wishes to receive credit for the work.

Summary of BMPs to Meet the Required Reductions

The Model Municipality delineated the sewersheds and determined which sewersheds are subject to the local impairment (Appendix E) requirements and which are subject to the Chesapeake Bay (Appendix D) requirements. The impairment that prompted the Appendix E requirement in the MS4 Requirements Table is for sediment. Therefore the existing sediment load for all of the sewersheds was

calculated without BMPs and determined to be 362,118 lb/yr. Accounting for existing BMPs resulted in a municipal-wide reduction of 115,419 lb/yr of sediment. Dividing the loads among the priority Appendix E, then the Appendix D sewersheds, and then multiplying each load by 10% yielded the required reductions to the Appendix E sewersheds of 12,670 lb/yr, and the required reduction to the Appendix D sewerheds of 12,000 lb/yr (Table 6).

Three stormwater BMPs were proposed to not only meet, but to exceed the reduction requirements (Table 7). First, street sweeping sediment reductions were calculated and applied as such: 2,170 lb/yr were applied to the Appendix E requirements, and 1,847 lb/yr applied to the Appendix D requirements. Second, the restoration of a series of wet ponds was calculated to reduce 17,785 lb/yr of sediment thereby exceeding the Appendix E requirements by 7,285 lb/yr. Third, the retrofit of two parallel stormwater basins was calculated to achieve an 11,622 lb/yr sediment reduction exceeding the Appendix D requirement by 1,469 lb/yr. The Model Municipality will implement the three practices within the 5 year permit term and report the yearly progress.

Please note that the reductions in excess of the Appendix E requirements could have been applied to the remaining Appendix D requirements. If so the Appendix D reduction requirements would be:

> 10,153 lb/yr (after street sweeping) - 7,285 lb/yr (excess Appendix E credits) = **2,868 lb/yr as the remaining Appendix D reduction requirement**

The 2,868 lb/yr remaining Appendix D reduction requirement would still require the implementation of a BMP to meet the obligation. The Model Municipality weighed the option to expand its street sweeping program, but instead chose to implement the basin retrofit project, and to keep the Appendix D and Appendix E credits separate for ease of accounting.

Table 6 Summary of Existing Sediment Loads and the Required Sediment Reductions

Existing Load w/o BMPs (lb/yr)	Final Existing Load w BMPs (lb/yr)	Appendix D Existing Load (lb/yr)	Appendix E Existing Load (lb/yr)	Required Reduction to Appendix D (lb/yr)	Required Reduction to Appendix E (lb/yr)
362,118	246,699	120,001	126,670	**12,000**	**12,670**

Table 7 Sediment Load Reduction by BMP

BMP Type	Load Reduced by BMP to Appendix D (lb/yr)	Load Reduced by BMP to Appendix E (lb/yr)	Load Remaining Appendix D (lb/yr)	Load Remaining Appendix E (lb/yr)
Street Sweeping	1,847	2,170	10,153	10,500
Wet Pond Restoration	N/A	17,785	N/A	**-7,285**
Basin Retrofit	11,622	N/A	**-1,469**	N/A

Appendix 1 Preliminary Existing Loading without Accounting for Existing BMPs

Sewershed	Impaired	Sediment Loading w/o BMP (lb/yr)
1	y	9,291.04
2	y	5,043.10
3	y	84,690.21
4		449.44
5		16,437.13
6		2,916.97
7		44,700.92
8	y	2,525.87
9		9,673.92
11		12,268.05
12	y	5,140.06
13	y	9,617.15
14	y	1,785.92
15	y	3,850.05
16	y	1,969.65
17	y	845.76
18	y	2,126.53
19	y	1,788.48
20	y	1,329.98
21	y	1,094.13
22		1,211.77
23	y	29,670.12
24		14,110.26
25		938.31
26	y	2,492.67
28	y	264.03
29		1,026.20
30	y	2,218.80
31	y	11,170.18
32	y	9,792.19
33		3,064.44
34		7,862.70
35		17,394.06
36	y	1,855.03
37		1,852.22
38		11,966.77
39	y	1,946.89
40	y	6,171.59
41	y	1,216.59
42	y	13,452.32
44	y	4,373.07
45	y	523.03
Totals		**362,117.59**

Appendix 2 Spreadsheet Combining Worksheets 4 and 12 from the PA BMP Manual used to Determine the Predevelopment Runoff Volume in Sewershed 1

TOTAL DISTURBED AREAS:

HSG = b

		POLLUTANT					POLLUTANT LOAD			2 Yr Rainfall	3.0							
	LAND COVER CLASSIFICATION	TSS EMC (mg/l)	TP EMC (mg/l)	Nitrate-Nitrite EMC (mg/l as N)	COVER (Acres)	RUNOFF VOLUME (AF)	TSS** (LBS)	TP** (LBS)	NO_3 (LBS)	CN A	CN B	CN C	CN D	S	Ia (0.2*S)	Q Runoff (in)	Runoff Volume (ac-ft)	Runoff Volume (cu-ft)
Pervious Surfaces	Forest	39	0.15	0.17	15.065	0.238	25.1	0.10	0.11	30	55	70	77	8.18181818	1.636364	0.18953	0.2379	10.365
	Meadow	47	0.19	0.30		0.000	0.0	0.00	0.00	30	58	71	78	7.24137931	1.448276	0.267429	0.0000	0
	Fertilized Planting Area	55	1.34	0.73		0.000	0.0	0.00	0.00	39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
	Native Planting Area	55	0.40	0.33		0.000	0.0	0.00	0.00	39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
	Lawn, Low-Input	180	0.40	0.44		0.000	0.0	0.00	0.00	39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
	Lawn, High-Input	180	2.22	1.46		0.000	0.0	0.00	0.00	39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
	Golf Course Fairway/Green	305	1.07	1.84		0.000	0.0	0.00	0.00	39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
	Grassed Athletic Field	200	1.07	1.01		0.000	0.0	0.00	0.00	39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
Impervious Surfaces	Rooftop	21	0.13	0.32		0.000	0.0	0.00	0.00		98			0.20408163	0.040816	2.748352	0.0000	0
	High Traffic Street / Highway	261	0.40	0.83		0.000	0.0	0.00	0.00		98			0.20408163	0.040816	2.748352	0.0000	0
	Medium Traffic Street	113	0.33	0.58		0.000	0.0	0.00	0.00		98			0.20408163	0.040816	2.748352	0.0000	0
	Low Traffic / Residential Street	86	0.36	0.47		0.000	0.0	0.00	0.00		98			0.20408163	0.040816	2.748352	0.0000	0
	Res. Driveway, Play Courts, etc	60	0.46	0.47		0.000	0.0	0.00	0.00		98			0.20408163	0.040816	2.748352	0.0000	0
	High Traffic Parking Lot	120	0.39	0.60		0.000	0.0	0.00	0.00		98			0.20408163	0.040816	2.748352	0.0000	0
	Low Traffic Parking Lot	58	0.15	0.39		0.000	0.0	0.00	0.00		98			0.20408163	0.040816	2.748352	0.0000	0

Appendix 3 Spreadsheet Combining Worksheets 4 and 12 from the PA BMP Manual used to Determine the Post-development Runoff Volume in Sewershed 1

TOTAL DISTURBED AREAS:

HSG = b

	LAND COVER CLASSIFICATION	POLLUTANT TSS EMC (mg/l)	POLLUTANT TP EMC (mg/l)	POLLUTANT Nitrate-Nitrite EMC (mg/l as N)	COVER (Acres)	RUNOFF VOLUME (AF)	POLLUTANT LOAD TSS** (LBS)	POLLUTANT LOAD TP** (LBS)	POLLUTANT LOAD NO_3 (LBS)
Pervious Surfaces	Forest	39	0.15	0.17		0.000	0.0	0.00	0.00
	Meadow	47	0.19	0.30		0.000	0.0	0.00	0.00
	Fertilized Planting Area	55	1.34	0.73		0.000	0.0	0.00	0.00
	Native Planting Area	55	0.40	0.33		0.000	0.0	0.00	0.00
	Lawn, Low-Input	180	0.40	0.44	10.781	0.321	156.1	0.35	0.38
	Lawn, High-Input	180	2.22	1.46		0.000	0.0	0.00	0.00
	Golf Course Fairway/Green	305	1.07	1.84		0.000	0.0	0.00	0.00
	Grassed Athletic Field	200	1.07	1.01		0.000	0.0	0.00	0.00
Impervious Surfaces	Rooftop	21	0.13	0.32		0.000	0.0	0.00	0.00
	High Traffic Street / Highway	261	0.40	0.83		0.000	0.0	0.00	0.00
	Medium Traffic Street	113	0.33	0.58	4.284	0.981	299.3	0.87	1.54
	Low Traffic / Residential Street	86	0.36	0.47		0.000	0.0	0.00	0.00
	Res. Driveway, Play Courts, etc	60	0.46	0.47		0.000	0.0	0.00	0.00
	High Traffic Parking Lot	120	0.39	0.60		0.000	0.0	0.00	0.00
	Low Traffic Parking Lot	58	0.15	0.39		0.000	0.0	0.00	0.00

2 Yr Rainfall	3.0							
CN A	CN B	CN C	CN D	S	Ia (0.2*S)	Q Runoff (in)	Runoff Volume (ac-ft)	Runoff Volume (cu-ft)
30	55	70	77	8.18181818	1.636364	0.18953	0.0000	0
30	58	71	78	7.24137931	1.448276	0.267429	0.0000	0
39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
39	61	74	80	6.39344262	1.278689	0.357572	0.3212	13.993
39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
39	61	74	80	6.39344262	1.278689	0.357572	0.0000	0
	98			0.20408163	0.040816	2.748352	0.0000	0
	98			0.20408163	0.040816	2.748352	0.0000	0
	98			0.20408163	0.040816	2.748352	0.9811	42.739
	98			0.20408163	0.040816	2.748352	0.0000	0
	98			0.20408163	0.040816	2.748352	0.0000	0
	98			0.20408163	0.040816	2.748352	0.0000	0
	98			0.20408163	0.040816	2.748352	0.0000	0

Appendix 4 Final Existing Loading with Accounting for Existing BMPs

Sewershed	Impaired	TSS Loading w/o BMP (lb/yr)	Existing BMP (y/n)	TSS Removed (lb/yr)	Final TSS Loading (lb/yr)
1	y	9,291.04	y	8,361.93	929.11
2	y	5,043.10	y	4,538.79	504.31
3	y	84,690.21	y	48,273.42	36,416.79
4		449.44			449.44
5		16,437.13			16,437.13
6		2,916.97			2,916.97
7		44,700.92	y	5,364.11	39,336.81
8	y	2,525.87			2,525.87
9		9,673.92			9,673.92
11		12,268.05	y	10,673.20	1,594.85
12	y	5,140.06			5,140.06
13	y	9,617.15			9,617.15
14	y	1,785.92			1,785.92
15	y	3,850.05			3,850.05
16	y	1,969.65			1,969.65
17	y	845.76			845.76
18	y	2,126.53			2,126.53
19	y	1,788.48			1,788.48
20	y	1,329.98			1,329.98
21	y	1,094.13			1,094.13
22		1,211.77			1,211.77
23	y	29,670.12	y	26,703.11	2,967.01
24		14,110.26			14,110.26
25		938.31			938.31
26	y	2,492.67			2,492.67
28	y	264.03			264.03
29		1,026.20			1,026.20
30	y	2,218.80			2,218.80
31	y	11,170.18			11,170.18
32	y	9,792.19			9,792.19
33		3,064.44	y	2,757.99	306.45
34		7,862.70	y	7,076.43	786.27
35		17,394.06			17,394.06
36	y	1,855.03	y	1,669.53	185.50
37		1,852.22			1,852.22
38		11,966.77			11,966.77
39	y	1,946.89			1,946.89
40	y	6,171.59			6,171.59
41	y	1,216.59			1,216.59
42	y	13,452.32			13,452.32
44	y	4,373.07			4,373.07
45	y	523.03			523.03
Totals		**362,117.59**		**115,418.51**	**246,699.08**

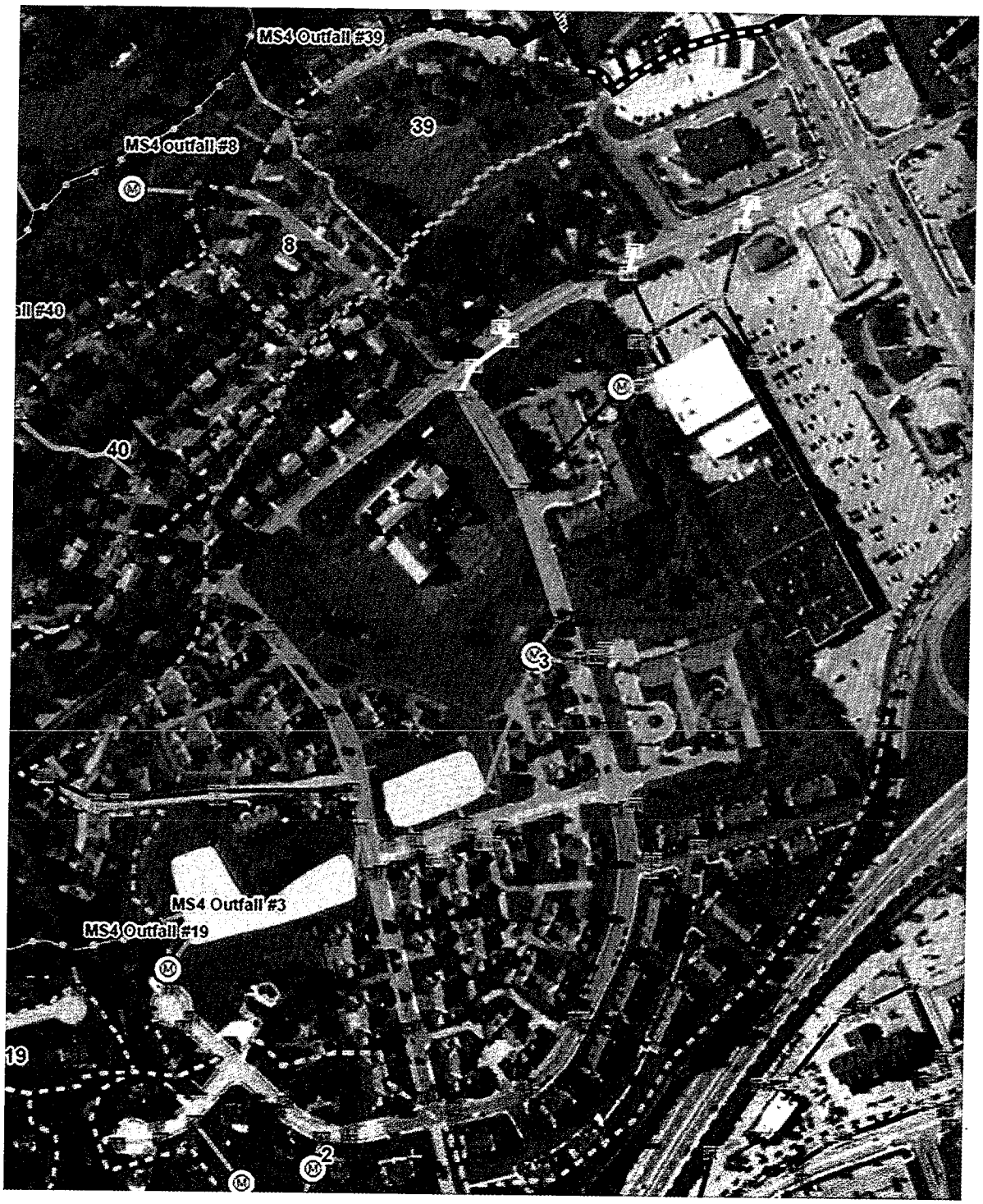
Appendix 5 Sewersheds Discharging to Locally Impaired Waters and the Required Reduction

Sewershed	Impaired	TSS Loading w/o BMP (lb/yr)	Existing BMP (y/n)	TSS Removed (lb/yr)	Final TSS Loading (lb/yr)
1	y	9,291.04	y	8,361.93	929.11
2	y	5,043.10	y	4,538.79	504.31
3	y	84,690.21	y	48,273.42	36,416.79
8	y	2,525.87			2,525.87
12	y	5,140.06			5,140.06
13	y	9,617.15			9,617.15
14	y	1,785.92			1,785.92
15	y	3,850.05			3,850.05
16	y	1,969.65			1,969.65
17	y	845.76			845.76
18	y	2,126.53			2,126.53
19	y	1,788.48			1,788.48
20	y	1,329.98			1,329.98
21	y	1,094.13			1,094.13
23	y	29,670.12	y	26,703.11	2,967.01
26	y	2,492.67			2,492.67
28	y	264.03			264.03
30	y	2,218.80			2,218.80
31	y	11,170.18			11,170.18
32	y	9,792.19			9,792.19
36	y	1,855.03	y	1,669.53	185.50
39	y	1,946.89			1,946.89
40	y	6,171.59			6,171.59
41	y	1,216.59			1,216.59
42	y	13,452.32			13,452.32
44	y	4,373.07			4,373.07
45	y	523.03			523.03
Totals		**216,244.43**		**89,546.78**	**126,697.65**
				Required Reduction	12,670

Appendix 6 Sewersheds Discharging to the Chesapeake Bay and the Required Reduction

Sewershed	Impaired	TSS Loading w/o BMP (lb/yr)	Existing BMP (y/n)	TSS Removed (lb/yr)	Final TSS Loading (lb/yr)
4		449.44			449.44
5		16,437.13			16,437.13
6		2,916.97			2,916.97
7		44,700.92	y	5,364.11	39,336.81
9		9,673.92			9,673.92
11		12,268.05	y	10,673.20	1,594.85
22		1,211.77			1,211.77
24		14,110.26			14,110.26
25		938.31			938.31
29		1,026.20			1,026.20
33		3,064.44	y	2,757.99	306.45
34		7,862.70	y	7,076.43	786.27
35		17,394.06			17,394.06
37		1,852.22			1,852.22
38		11,966.77			11,966.77
Totals		**145,873.16**		**25,871.73**	**120,001.43**
				Required Reduction	12,000

Appendix 7 Sewershed 3 with Large Directly Connected Impervious Areas Draining to the Wet Ponds



Appendix 8 Sewershed 7 with Large Directly Connected Impervious Areas Draining to the Basin

Note – The mapping is incomplete and requires the addition of the East Basin