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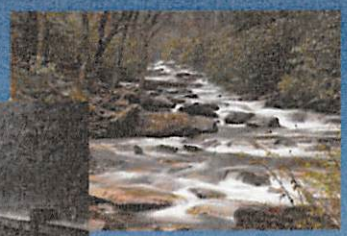
MS4: POLLUTANT REDUCTION PLANNING FOR IMPAIRED WATERWAYS IN CONEWAGO TOWNSHIP

July 26, 2017



How did we get here?

Clean Water Act

↓

Chesapeake Bay TMDL & MS4 Program

↓

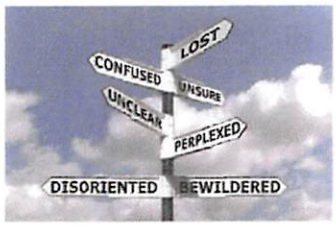
EPA (Environmental Protection Agency)

↓

PA DEP (Dept. of Environmental Protection)

↓

Conewago Township



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Chesapeake Bay TMDL

- Chesapeake Bay Plan is a **TMDL Plan**
  - (pollution diet)
- Adopted in December 29, 2010
  - Largest TMDL ever developed by EPA
- Plan is to be completed by 2025
  - currently at the halfway point where 60% goals are to be met, Phase III Watershed Implementation Plan (WIP's) in progress
- 6 States and D.C. participate by way of WIP's
- PRP's become a tool to help shape and ensure successes for the obligations of a WIP and the Bay TMDL

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What is a PRP?

Pollutant Reduction Plan (PRP)

A plan developed to identify and then reduce a baseline amount of a specific pollutant (or "impairment") by some preset percentage using various facilities, BMP's and programs.

PA overall reduction goals are:

- 10% • Total Suspended Solids
- 5% • Total Nitrogen
- 3% • Total Phosphorus

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What does listed "impairment" mean for PRP?

- These are the listed impairments provided by PA DEP...specific to Conewago Township from their Municipal Requirements Table

	IMPAIRMENT
South Branch Conewago Creek	Appendix E-Siltation (5)
Unnamed Tributaries to South Branch Conewago Creek	
Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)
Plum Creek	Appendix E-Siltation (5)

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Appendices (from Municipal Requirements Table)

- **Appendix A** – Pollutant control measures (i.e., best management practices) must be implemented upon permit coverage to control metals and pH in stormwater discharges to impaired waters (with or without a TMDL).
- **Appendix B** – Pollutant control measures must be implemented upon permit coverage to control pathogens in stormwater discharges to impaired waters (with or without a TMDL).
- **Appendix C** – Pollutant control measures must be implemented upon permit coverage to control priority organic compounds (e.g., PCBs, Chlordane, etc.) in stormwater discharges to impaired waters (with or without a TMDL).
- **Appendix D** – Chesapeake Bay Pollutant Reduction Plan must be submitted with PAG-13 NOI or individual permit application to control nutrients and sediment in stormwater discharges to waters in the Chesapeake Bay watershed.
- **Appendix E** – Pollutant Reduction Plan must be submitted with PAG-13 NOI or individual permit application to control nutrients and/or sediment in stormwater discharges to impaired waters without a TMDL, or impaired waters with a TMDL but there is no WLA.

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What is required to be in a PRP?

Section A – Public Participation

- Complete PRP must be available for someone to review
- Advertise for public review (no less than 45 days prior to submission to PA DEP) – provide copy of ad for PRP
- Accept written comments (30 days from notice)
- Address each noted concern and any changes made

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What is required to be in a PRP?

Section B – Map

- Develop map to show land uses, and/or impervious coverage
- waterways
- stormsewer shed to each outfall to impaired waterway or waterways noted in Appendix D & E
- Parsed areas
- MS4 boundaries
- Outfalls
- Municipal Boundaries

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What is required to be in a PRP?

Section C – Pollutants of Concern

- Note the pollutants being considered as part of the PRP (either by Chesapeake Bay TMDL or by impaired waters (Siltation, Nutrients or both)

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What is required to be in a PRP?

Section D – Determine Existing Loading for Pollutants of Concern

Calculating Pollutant Loads - Several Methods Available:

- **Simplified Approach (used for Conewago Township)**
  - ❑ Obtain county specific loading rates
  - ❑ Determine impervious and non-impervious land coverage (within UA area)
  - ❑ Apply rates to areas and calculate the loading

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Simplified Approach for PRP's

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
Adams	impervious developed	10,373.2	33.43	2.1	1,398.77
	pervious developed	44,028.6	22.99	0.8	207.67
Bedford	impervious developed	3,815.2	19.42	1.9	2,634.34
	pervious developed	19,425	17.97	0.68	301.22
Berks	impervious developed	1,292.4	36.81	2.26	1,925.79
	pervious developed	5,178.8	34.02	0.98	264.29

For land area outside of the urbanized area, undeveloped land loading rates may be used where appropriate. When using the simplified method, DEP recommends the following loading rates (for any county) for undeveloped land:

- TN – 10 lbs/acre/yr
- TP – 0.33 lbs/acre/yr
- TSS (Sediment) – 234.6 lbs/acre/yr

These values were derived by using the existing loads for each pollutant, according to the 2014 Chesapeake Bay Progress Run, and dividing by the number of acres for the unregulated stormwater subsector.

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Utilizing "Parsing" in a PRP

Parsing for PRP – Optional process whereby land area is "removed" from the loading calculations (if shown to not be of concern)

Why would you do this for PRP?

Reduces the pollutant loading by reducing the area...and therefore reduces obligation for reduction

Why wouldn't you do this?

BMP's in parsed areas cannot be included in PRP reduction calculations

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Utilizing "Parsing" in PRP

Examples where Parsing may be appropriate;

- Area of land is covered under an existing NPDES site
  - Industrial Stormwater Discharge for example
- PennDOT rights-of-way
- CAFO (already covered under NPDES)
- Land area where stormwater does not contribute to MS4

Parsing can be "undone"...submit a "modified PRP" (same public hearing applies)

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What is required to be in a PRP?

Section E – Select BMP's to Achieve Minimum Required Reductions in Pollutant Loading

Develop a "top down" calculation of how you will reduce pollutants;

- What new BMP's or programs will community engage in to reduce loading
- Focus on "low hanging fruit" first (e.g., existing street sweeping)
- Other practices should look for most cost effective means (most ROI per dollar spent)
  - Avoid boutique BMP's...low reduction, higher cost
  - Stream restoration best one out there for reductions per cost
  - Look for retrofits (larger facilities handling urban DA)
  - Must be able to complete projects within 5 years (permit cycle)
- Continue reductions until full value is reached

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What about existing BMP's and Programs?

Can I use existing programs or BMP's to offset required reduction for existing pollutant loading?

- [x] YES
- [ ] NO
- [ ] MAYBE

...but not as a direct "deduction"

Existing practices or BMP's can ONLY be accounted for in PRP as reduction in existing baseline.

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What is required to be in a PRP?

Section F – Identify Funding Mechanisms

Feasibility of plan is evaluated by PA DEP

- PRP should look to outside limited term funding programs
  - grants or loans
- Does not have to be guaranteed, but need to have backup plan if funding option fails

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Funding the PRP

Funding sources for the proposed BMP projects outlined in the Conewago PRP include the following:

- Grant Funding
- Stormwater User Fee
- Owner Cooperation (through Credit Program)
- Developer Cooperation (through new projects)

Conewago Township will be working in the following five years (i.e., during the permit term) to determine the best and most appropriate funding source for each proposed BMP project, as each project is undertaken.

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What is required to be in a PRP?

Section G – Identify Responsible Parties for Operation and Maintenance of BMP's

- The party(ies) responsible for ongoing O&M;
- The activities involved with O&M for each BMP; and
- The frequency at which O&M activities will occur.

Annual Report will be mechanism to ensure activities are performed per O&M

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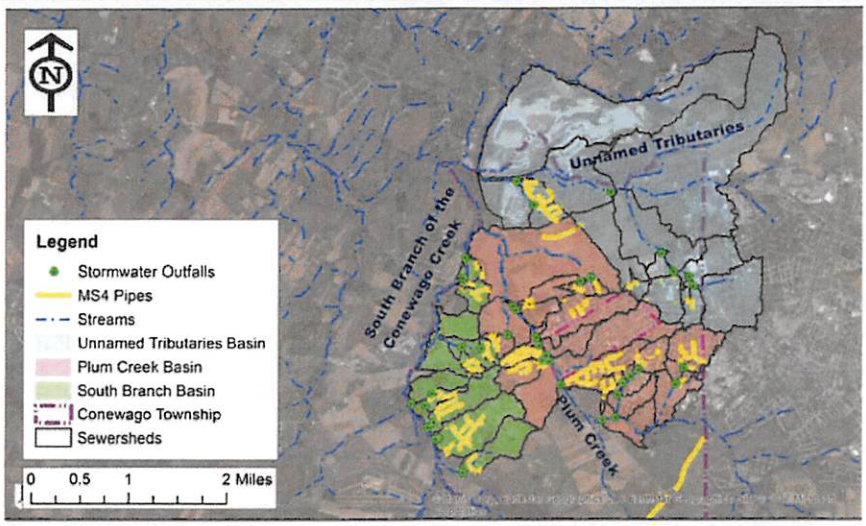
Conewago Township MS4 Map



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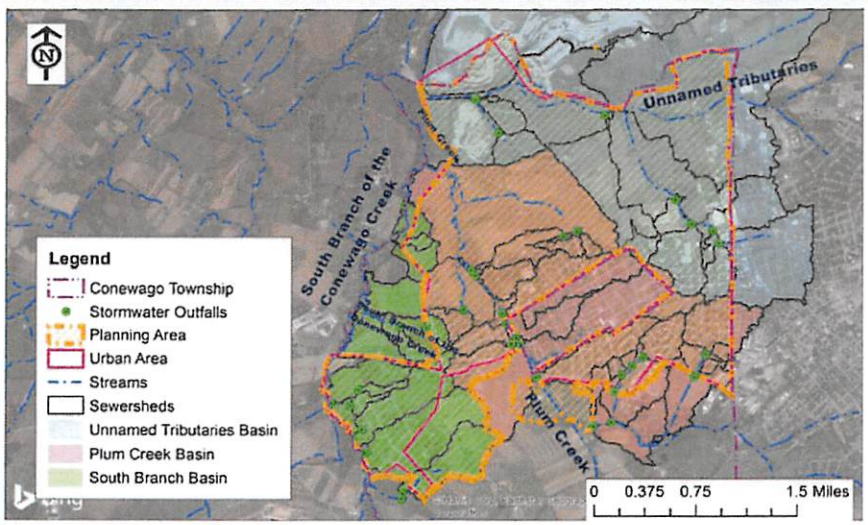
Planning Area



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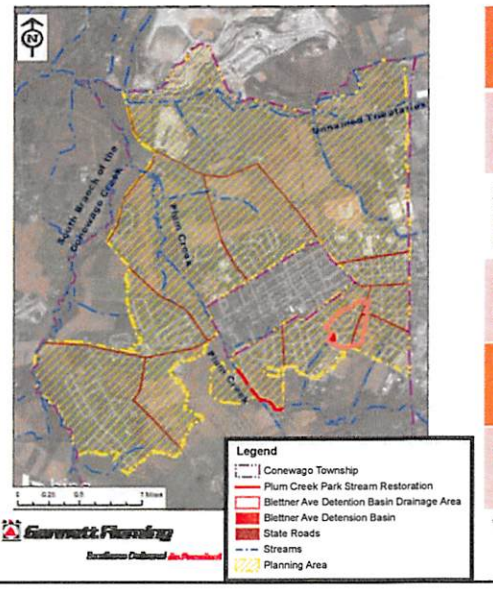
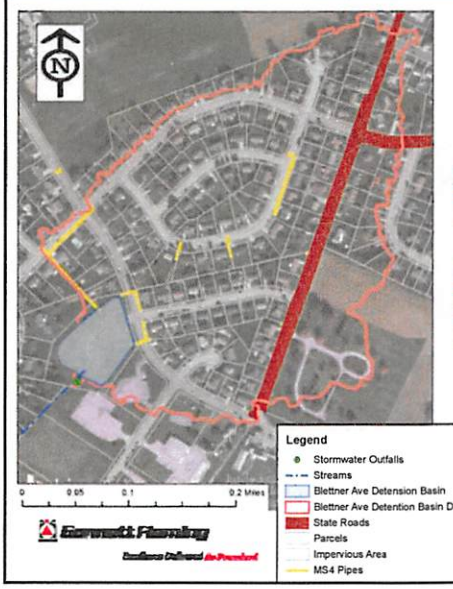
Proposed PRP Reductions



BMP Name	Sediment Loading Reduction*
1. Blettner Ave. Basin Retrofit to include Bioswale(s)	32,340
2. Plum Creek Park Stabilize Existing Stream Channel	121,625
3. Street Sweeping Enhance Ex. Program	1,678
Total BMP Loading Reduction*	155,643
Total Required Loading Reduction*	155,359

*(lbs sediment / year)

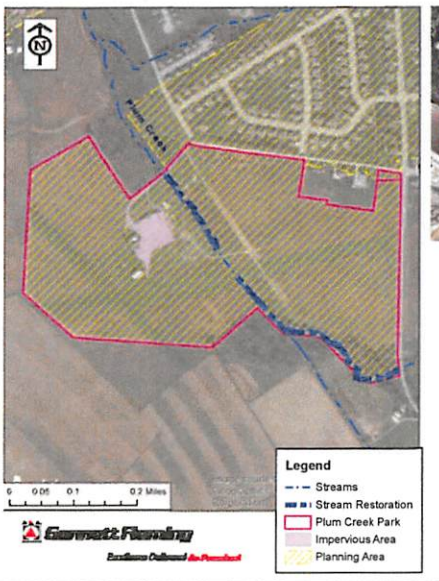
Blettner Avenue Basin – Bioswale(s)



Land Cover	Acres
Impervious Land	24
Pervious Land	33
Sediment Loading*	40,425
Bioswale Loading Reduction*	80%
Total Loading Reduction*	32,340

*lbs sediment / year

Plum Creek Park Stream Restoration

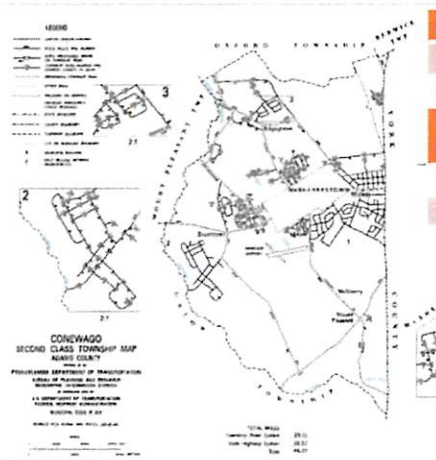


Plum Creek Park	
Stream Length*	2,710
Stream Restoration Loading Reduction**	44.88
Total Loading Reduction***	121,625

*feet **lbs sediment / foot ***lbs sediment / year

An example of a sustainable stream restoration project on Wolf Pit Branch, Carroll County, MD. On-site materials were used, the site was balanced so that no material was hauled off-site, and vegetation bioengineering was the primary stabilization method. (Photo taken 5 years after construction)

Street Sweeping



Street Sweeping	
Lane Miles	60
Sediment Loading*	83,926
Four Passes Annually Loading Reduction**	2%
Total Loading Reduction*	1,678

*lbs sediment / year

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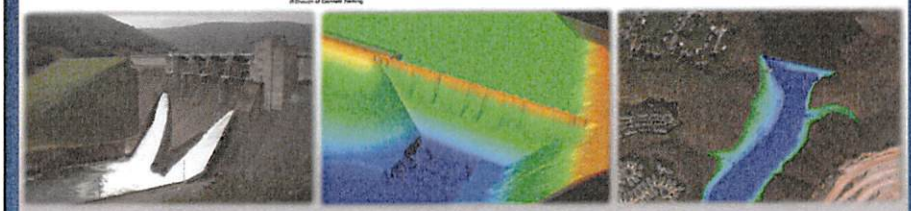


P. Eric Mains, PE
Sr. Water Resource Engineer
pmains@gfnet.com

APPENDIX D

PADEP STATEWIDE MS4 LAND COVER ESTIMATES

Statewide MS4 Land Cover Estimates

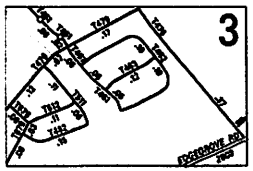
County	Municipality	UA % Impervious	UA % Pervious	Outside of UA % Impervious	Outside of UA % Pervious	UA Acres
Berks	COLEBROOKDALE TWP	22%	78%	14%	86%	2,864.6
Centre	COLLEGE TWP	35%	65%	19%	81%	3,806.7
Montgomery	COLLEGEVILLE BORO	46%	54%	47%	53%	1,027.0
Allegheny	COLLIER TWP	22%	78%	17%	83%	5,593.6
Delaware	COLLINGDALE BORO	51%	49%	50%	50%	558.2
Lancaster	COLUMBIA BORO	44%	56%	44%	56%	1,549.8
Delaware	COLWYN BORO	38%	62%	39%	61%	166.7
Delaware	CONCORD TWP	19%	81%	19%	81%	8,485.3
Cambria	CONEMAUGH TWP	35%	65%	6%	94%	247.0
Somerset	CONEMAUGH TWP	17%	83%	5%	95%	1,840.5
Lancaster	CONESTOGA TWP	11%	89%	3%	97%	1,047.1
Adams	CONEWAGO TWP	21%	79%	13%	87%	3,233.4
Dauphin	CONEWAGO TWP	7%	93%	6%	94%	539.9
York	CONEWAGO TWP	25%	75%	7%	93%	1,861.0
Fayette	CONNELLSVILLE CITY	50%	50%	47%	53%	1,354.6
Fayette	CONNELLSVILLE TWP	25%	75%	5%	95%	846.9
Lancaster	CONOY TWP	7%	93%	4%	96%	1,597.2
Montgomery	CONSHOHOCKEN BORO	67%	33%	67%	33%	660.5
Beaver	CONWAY BORO	45%	55%	45%	55%	958.7
Luzerne	CONYNGHAM BORO	29%	71%	29%	71%	652.9
Montour	COOPER TWP	33%	67%	5%	95%	97.9
Lehigh	COOPERSBURG BORO	36%	64%	36%	64%	598.7
Lehigh	COPLAY BORO	47%	53%	47%	53%	403.4
Allegheny	CORAOPOLIS BORO	52%	48%	52%	48%	949.4
Lebanon	CORNWALL BORO	16%	84%	9%	91%	1,567.7
Luzerne	COURTDALE BORO	14%	86%	14%	86%	646.8
Allegheny	CRAFTON BORO	45%	55%	46%	54%	732.9
Butler	CRANBERRY TWP	23%	77%	22%	78%	13,665.2
Allegheny	CRESCENT TWP	15%	85%	15%	85%	1,523.0
Adams	CUMBERLAND TWP	18%	82%	6%	94%	1,677.2
Berks	CUMRU TWP	26%	74%	13%	87%	4,583.9
Cambria	DAISYTOWN BORO	25%	75%	26%	74%	142.5
Cambria	DALE BORO	73%	27%	71%	29%	112.8
Luzerne	DALLAS BORO	23%	77%	22%	78%	1,442.9
Luzerne	DALLAS TWP	22%	78%	9%	91%	3,243.7
York	DALLASTOWN BORO	50%	50%	50%	50%	501.1
Lackawanna	DALTON BORO	33%	67%	11%	89%	348.0
Montour	DANVILLE BORO	43%	57%	43%	57%	985.3
Delaware	DARBY BORO	47%	53%	46%	54%	535.0
Delaware	DARBY TWP	48%	52%	49%	51%	917.9
Beaver	DARLINGTON BORO	58%	42%	58%	42%	53.2
Beaver	DARLINGTON TWP	31%	69%	4%	96%	220.2
Beaver	DAUGHERTY TWP	13%	87%	7%	93%	1,560.6
Dauphin	DAUPHIN BORO	37%	63%	32%	68%	223.3
Fayette	DAWSON BORO	37%	63%	36%	64%	101.0
Monroe	DELAWARE WATER GAP BORO	30%	70%	13%	87%	440.8
Westmoreland	DELMONT BORO	19%	81%	19%	81%	671.9
Lancaster	DENVER BORO	43%	57%	43%	57%	833.5
Dauphin	DERRY TWP	25%	75%	18%	82%	10,540.4
Westmoreland	DERRY BORO	25%	75%	24%	76%	510.6
Westmoreland	DERRY TWP	14%	86%	3%	97%	3,919.3
Lackawanna	DICKSON CITY BORO	40%	60%	29%	71%	1,899.8
York	DILLSBURG BORO	42%	58%	42%	58%	514.7

APPENDIX E

MAP OF STATE ROADS IN CONEWAGO TOWNSHIP

LEGEND

- LIMITED ACCESS HIGHWAY
- STATE ROUTE AND NUMBER
- STATE MAINTAINED BRIDGE ON TOWNSHIP ROAD
- TOWNSHIP ROAD, NUMBER AND SEGMENT LENGTH IN MILES
- IMPASSABLE TOWNSHIP ROAD
- OTHER ROAD
- RAILROAD (IN SERVICE)
- RAILROAD ABANDONED (TRACK RETAINED)
- STATE BOUNDARY
- COUNTY BOUNDARY
- TOWNSHIP BOUNDARY
- CITY OR BOROUGH BOUNDARY
- MUNICIPAL BUILDING
- SPLIT MILEAGE BETWEEN MUNICIPALITIES



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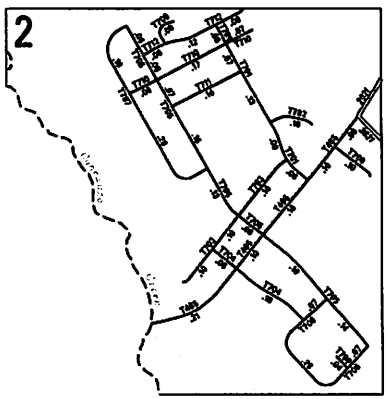

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CONEWAGO
SECOND CLASS TOWNSHIP MAP
ADAMS COUNTY

PREPARED BY THE

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

BUREAU OF PLANNING AND RESEARCH
GEOGRAPHIC INFORMATION DIVISION

IN COOPERATION WITH THE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

MUNICIPAL CODE 01 203

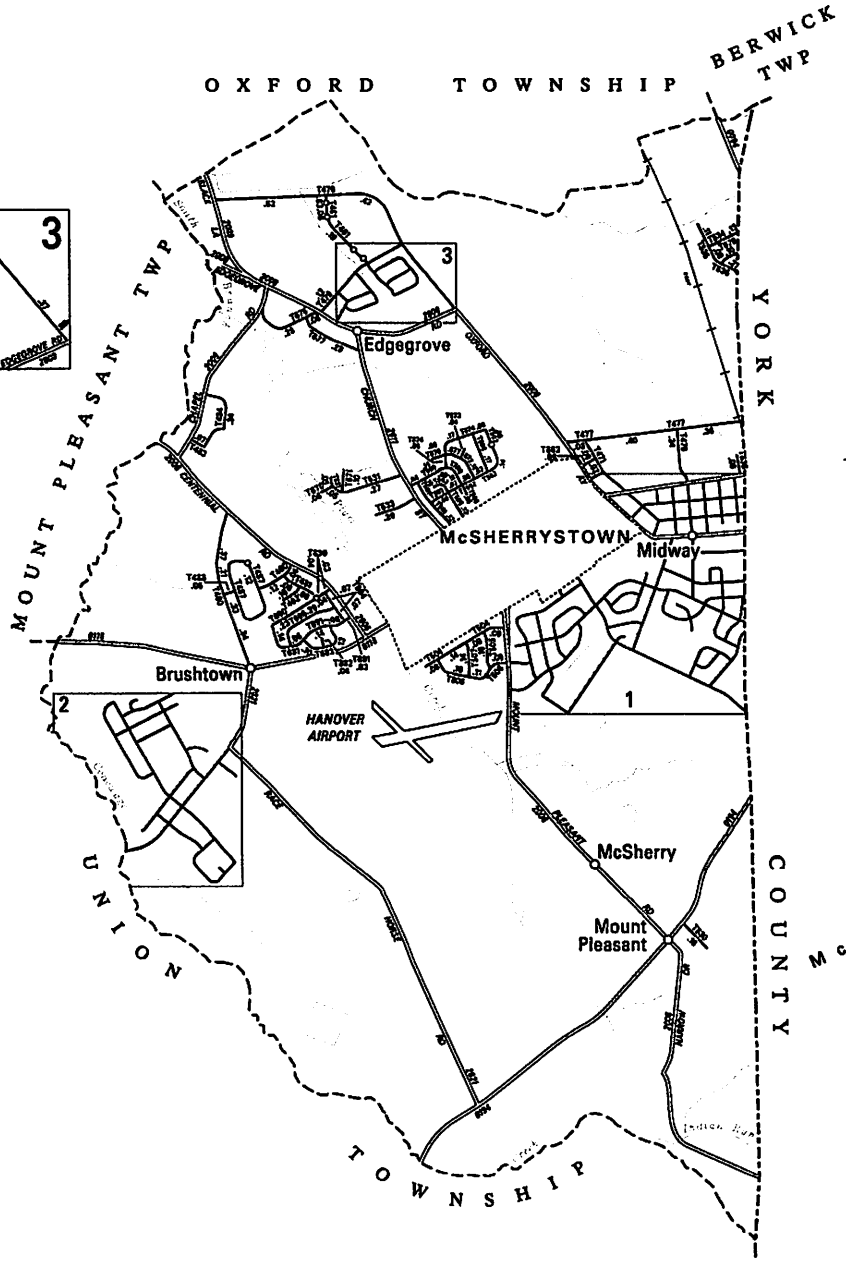
REVISED PER FORM 990 DATED 10-3-12

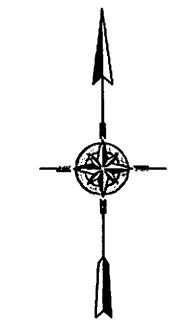
SCALE

0 2000 4000 6000 FEET

0 1000 2000 METERS

(RECREATED BY GSP 4-6-00) (REVISED 9-14-15)

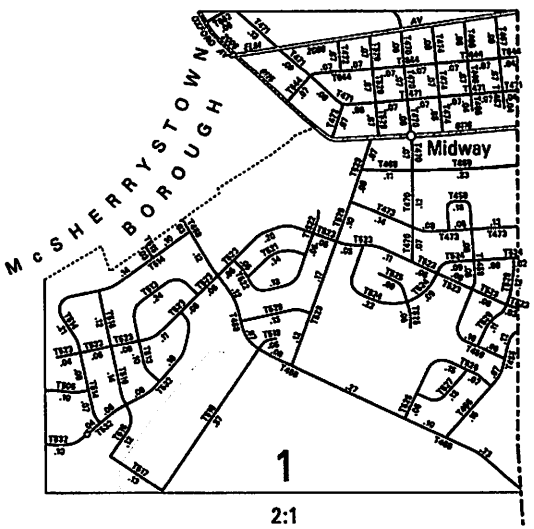




455 FILBERT ST
459 LINCOLN DR
460 SUNDAY DR
461 HEMLOCK DR
462 MAPLE DR
463 BIRCH DR
465 HOSTETTER RD
466 LINCOLN ST
467 GARFIELD ST
468 BLETTNER AV
469 SOUTH ST
470 MADISON ST
471 LINDEN AV
472 WASHINGTON ST
473 DILLER RD
474 JACKSON ST
476 OXFORD AV
477 ARNOLD LA
478 PEANUT DR
480 MICHAEL ST
481 STEVENS ST
482 SANDY CT
483 SUNLIGHT DR
484 FRIENDLY DR
485 BREAT DR
487 BARLEY CIR
500 VINCENT DR
501 SHERRY DR
502 PROVIDENCE DR
503 THIRD ST
504 STAFFORD DR
505 STERLING DR
506 PUMA DR
507 BRISTOL DR
511 EVERGREEN DR
512 LOCUST DR
513 OCELOT DR
514 PANTHER DR
515 FOURTH ST
516 CHEETAH DR
517 COUGAR DR
518 RAM DR
519 BEAR CIR
520 DEER DR
521 CARIBOU ST
522 ELK DR
523 POPLAR ST
524 SYCAMORE LA
525 BUTTERNUT LA
526 KNISLEY DR
527 VALLEY DR
528 DOGWOOD LA
529 JEFFERSON ST
530 PLEASANT VIEW DR
531 CONEWAGO DR
532 LYNX DR
533 OBRIEN LA
534 BETZEL DR
535 HIGH ST
536 ROLLER CIR
644 MAPLE AV
662 NORTH ST
663 RIDGE AV
670 TIFFANY CT
671 SEASE DR
672 FRANKLIN DR
673 BETHEL CT
674 JOHNATHON DR
675 BASILICA DR
676 FRANKLIN CT
677 RAPPLER DR
678 OAK DR
679 EISENHOOSER DR
680 DAKOTA DR
681 SENECA DR
682 PONTIAC PL
683 SHOSHONE DR
684 APACHE PASS
685 COMANCHE TRL
686 THOMAS DR
700 BARN BREEZE CT
701 SANDIE DR
702 SACRAMENTO CT
703 DICKINSON DR
704 PREAKNESS ST
705 ALLWOOD DR
706 DERBY DR
707 LOS ALAMITOS CIR
708 SARATOGA CT
709 OAK CREST CT
710 BLENHEIM ST
711 ROSECROFT RUN
712 STEED LA

TOTAL MILES

Township Road System	29.51
State Highway System	16.57
Total	46.07



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APPENDIX F

PRP INSTRUCTIONS ATTACHMENT B: POLLUTION LOADING RATES

ATTACHMENT B

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

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Blair	impervious developed	3,587.9	20.88	1.73	1,813.55
	pervious developed	9,177.5	18.9	0.62	267.34
Bradford	impervious developed	10,423	14.82	2.37	1,880.87
	pervious developed	23,709.7	13.05	0.85	272.25
Cambria	impervious developed	3,237.9	20.91	2.9	2,155.29
	pervious developed	8,455.4	19.86	1.12	325.3
Cameron	impervious developed	1,743.2	18.46	2.98	2,574.49
	pervious developed	1,334.5	19.41	1.21	379.36
Carbon	impervious developed	25.1	28.61	3.97	2,177.04
	pervious developed	54.2	30.37	2.04	323.36
Centre	impervious developed	7,828.2	19.21	2.32	1,771.63
	pervious developed	15,037.1	18.52	0.61	215.84
Chester	impervious developed	1,838.4	21.15	1.46	1,504.78
	pervious developed	10,439.8	14.09	0.36	185.12
Clearfield	impervious developed	9,638.5	17.54	2.78	1,902.9
	pervious developed	17,444.3	18.89	1.05	266.62
Clinton	impervious developed	7,238.5	18.02	2.80	1,856.91
	pervious developed	11,153.8	16.88	0.92	275.81
Columbia	impervious developed	7,343.1	21.21	3.08	1,929.18
	pervious developed	21,848.2	22.15	1.22	280.39
Cumberland	impervious developed	8,774.8	28.93	1.11	2,065.1
	pervious developed	26,908.6	23.29	0.34	306.95
Dauphin	impervious developed	3,482.4	28.59	1.07	1,999.14
	pervious developed	9,405.8	21.24	0.34	299.62
Elks	impervious developed	1,317.7	18.91	2.91	1,556.93
	pervious developed	1,250.1	19.32	1.19	239.85
Franklin	impervious developed	13,832.3	31.6	2.72	1,944.85
	pervious developed	49,908.6	24.37	0.76	308.31
Fulton	impervious developed	3,712.9	22.28	2.41	1,586.75
	pervious developed	4,462.3	18.75	0.91	236.54
Huntington	impervious developed	7,321.9	18.58	1.63	1,647.53
	pervious developed	11,375.4	17.8	0.61	260.15
Indiana	impervious developed	589	19.29	2.79	1,621.25
	pervious developed	972	20.1	1.16	220.68
Jefferson	impervious developed	21.4	18.07	2.76	1,369.63
	pervious developed	20.4	19.96	1.24	198.60
Juniata	impervious developed	3,770.2	22.58	1.69	1,903.96
	pervious developed	8,928.3	17.84	0.55	260.68
Lackawana	impervious developed	2,969.7	19.89	2.84	1,305.05
	pervious developed	7,783.9	17.51	0.76	132.98
Lancaster	impervious developed	4,918.7	38.53	1.55	1,480.43
	pervious developed	21,649.7	22.24	0.36	190.93
Lebanon	impervious developed	1,192.1	40.58	1.85	1,948.53
	pervious developed	5,150	27.11	0.4	269.81
Luzerne	impervious developed	5,857	20.43	3	1,648.22
	pervious developed	13,482.9	19.46	0.98	221.19
Lycoming	impervious developed	10,031.7	16.48	2.57	1,989.64
	pervious developed	19,995.5	16	0.84	277.38

APPENDIX G

BMP EFFECTIVENESS VALUES

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) STORMWATER DISCHARGES FROM SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEMS BMP EFFECTIVENESS VALUES

This table of BMP effectiveness values (i.e., pollutant removal efficiencies) is intended for use by MS4s that are developing and implementing Pollutant Reduction Plans and TMDL Plans to comply with NPDES permit requirements. The values used in this table generally consider pollutant reductions from both overland flow and reduced downstream erosion, and are based primarily on average values within the Chesapeake Assessment Scenario Tool (CAST) (www.casttool.org). Design considerations, operation and maintenance, and construction sequences should be as outlined in the Pennsylvania Stormwater BMP Manual, Chesapeake Bay Program guidance, or other technical sources. The Department of Environmental Protection (DEP) will update the information contained in this table as new information becomes available. Interested parties may submit information to DEP for consideration in updating this table to DEP's MS4 resource account, RA-EPPAMS4@pa.gov. Where an MS4 proposes a BMP not identified in this document or in Chesapeake Bay Program expert panel reports, other technical resources may be consulted for BMP effectiveness values. Note – TN = Total Nitrogen and TP = Total Phosphorus.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Wet Ponds and Wetlands	20%	45%	60%	A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Nitrogen reduction is minimal.
Dry Detention Basins and Hydrodynamic Structures	5%	10%	10%	Dry Detention Ponds are depressions or basins created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Hydrodynamic Structures are devices designed to improve quality of stormwater using features such as swirl concentrators, grit chambers, oil barriers, baffles, micropools, and absorbent pads that are designed to remove sediments, nutrients, metals, organic chemicals, or oil and grease from urban runoff.
Dry Extended Detention Basins	20%	20%	60%	Dry extended detention (ED) basins are depressions created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Dry ED basins are designed to dry out between storm events, in contrast with wet ponds, which contain standing water permanently. As such, they are similar in construction and function to dry detention basins, except that the duration of detention of stormwater is designed to be longer, theoretically improving treatment effectiveness.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Infiltration Practices w/ Sand, Veg.	85%	85%	95%	A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Design specifications require infiltration basins and trenches to be built in good soil, they are not constructed on poor soils, such as C and D soil types. Engineers are required to test the soil before approval to build is issued. To receive credit over the longer term, jurisdictions must conduct yearly inspections to determine if the basin or trench is still infiltrating runoff.
Filtering Practices	40%	60%	80%	Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. There are various sand filter designs, such as above ground, below ground, perimeter, etc. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require yearly inspection and maintenance to receive pollutant reduction credit.
Filter Strip Runoff Reduction	20%	54%	56%	Urban filter strips are stable areas with vegetated cover on flat or gently sloping land. Runoff entering the filter strip must be in the form of sheet-flow and must enter at a non-erosive rate for the site-specific soil conditions. A 0.4 design ratio of filter strip length to impervious flow length is recommended for runoff reduction urban filter strips.
Filter Strip Stormwater Treatment	0%	0%	22%	Urban filter strips are stable areas with vegetated cover on flat or gently sloping land. Runoff entering the filter strip must be in the form of sheet-flow and must enter at a non-erosive rate for the site-specific soil conditions. A 0.2 design ratio of filter strip length to impervious flow length is recommended for stormwater treatment urban filter strips.
Bioretention – Raingarden (C/D soils w/ underdrain)	25%	45%	55%	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in C or D soil.
Bioretention / Raingarden (A/B soils w/ underdrain)	70%	75%	80%	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in A or B soil.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Bioretention / Raingarden (A/B soils w/o underdrain)	80%	85%	90%	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has no underdrain and is in A or B soil.
Vegetated Open Channels (C/D Soils)	10%	10%	50%	Open channels are practices that convey stormwater runoff and provide treatment as the water is conveyed, includes bioswales. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in C or D soil.
Vegetated Open Channels (A/B Soils)	45%	45%	70%	Open channels are practices that convey stormwater runoff and provide treatment as the water is conveyed, includes bioswales. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in A or B soil.
Bioswale	70%	75%	80%	With a bioswale, the load is reduced because, unlike other open channel designs, there is now treatment through the soil. A bioswale is designed to function as a bioretention area.
Permeable Pavement w/o Sand or Veg. (C/D Soils w/ underdrain)	10%	20%	55%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, no sand or vegetation and is in C or D soil.
Permeable Pavement w/o Sand or Veg. (A/B Soils w/ underdrain)	45%	50%	70%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, no sand or vegetation and is in A or B soil.
Permeable Pavement w/o Sand or Veg. (A/B Soils w/o underdrain)	75%	80%	85%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has no underdrain, no sand or vegetation and is in A or B soil.
Permeable Pavement w/ Sand or Veg. (A/B Soils w/ underdrain)	50%	50%	70%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, has sand and/or vegetation and is in A or B soil.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Permeable Pavement w/ Sand or Veg. (A/B Soils w/o underdrain)	80%	80%	85%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has no underdrain, has sand and/or vegetation and is in A or B soil.
Permeable Pavement w/ Sand or Veg. (C/D Soils w/ underdrain)	20%	20%	55%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, has sand and/or vegetation and is in C or D soil.
Stream Restoration	0.075 lbs/ft/yr	0.068 lbs/ft/yr	44.88 lbs/ft/yr	An annual mass nutrient and sediment reduction credit for qualifying stream restoration practices that prevent channel or bank erosion that otherwise would be delivered downstream from an actively enlarging or incising urban stream. Applies to 0 to 3rd order streams that are not tidally influenced. If one of the protocols is cited and pounds are reported, then the mass reduction is received for the protocol.
Forest Buffers	25%	50%	50%	An area of trees at least 35 feet wide on one side of a stream, usually accompanied by trees, shrubs and other vegetation that is adjacent to a body of water. The riparian area is managed to maintain the integrity of stream channels and shorelines, to reduce the impacts of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals. (Note – the values represent pollutant load reductions from stormwater draining through buffers).
Tree Planting	10%	15%	20%	The BMP effectiveness values for tree planting are estimated by DEP. DEP estimates that 100 fully mature trees of mixed species (both deciduous and non-deciduous) provide pollutant load reductions for the equivalent of one acre (i.e., one mature tree = 0.01 acre). The BMP effectiveness values given are based on immature trees (seedlings or saplings); the effectiveness values are expected to increase as the trees mature. To determine the amount of pollutant load reduction that can credited for tree planting efforts: 1) multiply the number of trees planted by 0.01; 2) multiply the acreage determined in step 1 by the pollutant loading rate for the land prior to planting the trees (in lbs/acre/year); and 3) multiply the result of step 2 by the BMP effectiveness values given.
Street Sweeping	3%	3%	9%	Street sweeping must be conducted 25 times annually. Only count those streets that have been swept at least 25 times in a year. The acres associated with all streets that have been swept at least 25 times in a year would be eligible for pollutant reductions consistent with the given BMP effectiveness values.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Storm Sewer System Solids Removal	0.0027 for sediment, 0.0111 for organic matter	0.0006 for sediment, 0.0012 for organic matter	1 – TN and TP concentrations	This BMP (also referred to as "Storm Drain Cleaning") involves the collection or capture and proper disposal of solid material within the storm system to prevent discharge to surface waters. Examples include catch basins, stormwater inlet filter bags, end of pipe or outlet solids removal systems and related practices. Credit is authorized for this BMP only when proper maintenance practices are observed (i.e., inspection and removal of solids as recommended by the system manufacturer or other available guidelines). The entity using this BMP for pollutant removal credits must demonstrate that they have developed and are implementing a standard operating procedure for tracking the material removed from the sewer system. Locating such BMPs should consider the potential for backups onto roadways or other areas that can produce safety hazards. To determine pollutant reductions for this BMP, these steps must be taken: 1) Measure the weight of solid/organic material collected (lbs). Sum the total weight of material collected for an annual period. Note – do not include refuse, debris and floatables in the determination of total mass collected. 2) Convert the annual wet weight captured into annual dry weight (lbs) by using site-specific measurements (i.e., dry a sample of the wet material to find its weight) or by using default factors of 0.7 (material that is predominantly wet sediment) or 0.2 (material that is predominantly wet organic matter, e.g., leaf litter). 3) Multiply the annual dry weight of material collected by default or site-specific pollutant concentration factors. The default concentrations are shown in the BMP Effectiveness Values columns. Alternatively, the material may be sampled (at least annually) to determine site-specific pollutant concentrations. DEP will allow up to 50% of total pollutant reduction requirements to be met through this BMP. The drainage area treated by this BMP may be no greater than 0.5 acre unless it can be demonstrated that the specific system proposed is capable of treating stormwater from larger drainage areas. For planning purposes, the sediment removal efficiency specified by the manufacturer may be assumed, but no higher than 80%.

APPENDIX H

STREET SWEEPING EFFECTIVENESS VALUES

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	0.7	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

Table 15. Adapting the WINSLAMM Model for the Chesapeake Bay Watershed

Bay rainfall data. The model used the calibration period from 1995 through 2005 using Washington National Airport Station event-based rainfall data. The rainfall data was processed assuming the minimum number of hours between events is 6 hours and the minimum rainfall event depth is 0.01 inch.

East Coast input data files were prepared to represent street conditions across the Chesapeake Bay watershed. The particle size distribution and peak-to-average flow ratio files were set to the program default average pavement and flow ratio files

Four different street types were simulated to represent in different land uses that had curb and gutter drainage systems:

Single-family residential: Approximately 0.25-acre lots, with cul-de-sacs connecting to two-lane residential feeder roads with parallel parking on one side; light traffic; and 25 mile-per-hour (mph) speed limit. Approximately 33 houses in a 10-acre area. The driveways are simulated as draining onto the roads.

Commercial (80 percent impervious): Big box stores and parking lots. Feeder roads (two travel lanes and center turn lane) with no on-street parking, 35 mph speed limit, and heavy traffic.

Ultra-urban downtown (95 percent impervious): Multistory buildings. Two-lane urban roads with parallel parking on both sides of the street, sidewalks, and 25 mph speed limit.

Arterial highway: A four-lane divided road with median with barrier; high-speed traffic with turn lanes; and no on-street parking. Assumed to be commercial land use

Three different sweeping start/stop dates to reflect regional differences in climate across the watershed:

- Sweeping occurs over the entire year
- Sweeping suspended December 1, restarts March 15
- Sweeping suspended December 15, restarts February 15

Six different fixed sweeping schedules

2PW = 2 passes per week	1P4W = 1 pass every 4 weeks
1PW = 1 pass every week	1P8W = 1 pass every 8 weeks
1P2W = 1 pass every 2 weeks	1P12W = 1 pass every 12 weeks

Four seasonal sweeping schedules (more intensive in Spring or Fall)

S1: Spring – One pass every week from March to April. Monthly otherwise
S2: Spring – One pass every other week from March to April. Monthly otherwise
S3: Spring and fall – One pass every week (March to April, October to November). Monthly otherwise
S4: Spring and fall – One pass every other week during the season. Monthly otherwise

Two Levels of Sweeper Technology

MBC = Mechanical broom cleaning	VAC = Vacuum assisted cleaning

Four Options for Street Parking Density and No Parking Enforcement

For more details, consult the technical memo (Tetra Tech, Inc., 2015)