APPENDIX A

SIMPLIFIED APPROACH-1

HANDOUT FOR APPLICANTS

SIMPLIFIED APPROACH-1
for Stormwater Management

HANDOUT FOR APPLICANTS
JANUARY 2015

UPPER POTTSGROVE TOWNSHIP
MONTGOMERY COUNTY

Prepared by:

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I. GENERAL OVERVIEW

The Pennsylvania Stormwater Management Planning Act (Act 167) of 1978 mandates that counties prepare stormwater management plans and minimum stormwater standards in order to reduce flooding and stormwater impacts of future development and redevelopment. Upper Pottsgrove Township adopted Chapter 301 of the Upper Pottsgrove Township Code of Ordinances (Stormwater Ordinance).

Inadequate management of stormwater runoff resulting from land disturbance and development throughout a watershed can create the following:

- increased flooding
- increased flows and velocities in streams that contribute to erosion and sedimentation
- overtaxed capacity of streams and storm sewers
- increased cost of public facilities to convey and manage stormwater
- reduced infiltration and groundwater recharge
- increased pollution to waterways
- destroyed aquatic habitat
- increased pollutant concentrations such as sediment, nutrients, heavy metals and pathogens

A Simplified Approach-1 has been prepared to aid homeowners with the design and construction of the required stormwater management improvements associated with the proposed improvement to the property.

The Simplified Approach-1 discussed in this Handout applies to activities between 1,000 and 5,000 square feet of impervious surface or between 5,000 square feet and 1 acre of earth disturbance. These limits are as specified in the Stormwater Ordinance to which you should refer if you are interested in more detail.

A stormwater Best Management Practice (BMP) is a facility constructed to manage stormwater impacts by providing water quality treatment, groundwater recharge through infiltration, volume reduction and peak rate control. BMPs include but are not limited to those listed and shown in the Simplified Approach-1, BMP Size Determination Worksheets (Worksheets) provided in Section V of this Handout. See the Stormwater Ordinance definition of BMP included below for more detail.

There are various methods that can be employed to address the increase in stormwater runoff created by an increase in impervious area. While not considered as formal elements, rain barrels can be provided for educational and small re-use applications. Porous paving on driveways and special precast pavers can also be utilized in certain applications, such as a patio, as an alternative to concrete, to reduce the amount of impervious cover being created.

The goal of the Simplified Approach-1 is to allow the Applicant to complete the Worksheets showing compliance with the infiltration goals of the Stormwater Ordinance. As needed or if desired by you, your contractor may complete the Worksheets for you. While the Simplified Approach-1 is offered to Applicants with projects that qualify for it, it is not required to be used,

so you can always voluntarily elect to hire a design professional that can prepare a detailed design that meets the Township Ordinance requirements for your specific application if you so choose.

Additional information related to stormwater and BMPs can be found online at:

PA DEP's website: www.depweb.state.pa.us
Home > Water > Bureau of Point and Non-Point Source Management > Stormwater Management

Montgomery County's website www.montcopa.org
Home > Departments > County Administration > Planning Commission > Programs > Stormwater Management & Flooding

Pennsylvania's e-library: http://www.elibrary.dep.state.pa.us
search 363-0300-002 for the Pennsylvania Stormwater Best Management Practices Manual

II. DEFINITIONS

Following is a list of frequently used definitions related to stormwater management. Additional definitions can be found in the Stormwater Ordinance.

Agricultural Activity – Activities associated with agriculture such as agricultural cultivation, agricultural operation, and animal heavy use areas. This includes the work of producing crops including tillage, plowing, disking, harrowing, planting or harvesting crops; or pasturing and raising of livestock; and installation of conservation measures. Construction of new buildings or impervious area is not considered an Agricultural Activity.

Applicant – A landowner, developer, or other person who has filed an application to the Municipality for approval to engage in any Regulated Activity as defined in the Stormwater Ordinance.

BMP (Best Management Practice) – Methods, measures, or practices used to prevent or reduce surface runoff and/or water pollution including, but not limited to, structural and nonstructural stormwater management practices and operation and maintenance procedures. See also Non-structural Best Management Practice (BMP).

Earth Disturbance (or Earth Disturbance Activity) – A construction or other human activity which disturbs the surface of the land, including, but not limited to, clearing and grubbing; grading; excavations; embankments; road maintenance; land development; building construction; and the moving, depositing, stockpiling, or storing of soil, rock, or earth materials.

Erosion – The process by which the surface of the land, including water/stream channels, is worn away by water, wind, or chemical action.

Erosion and Sediment Control Plan – A plan which shows structures to minimize accelerated erosion and sedimentation, required by the Conservation District or the Municipality, and that must be prepared and approved per the applicable requirements.

Geotextile – A fabric manufactured from synthetic fiber that is used to achieve specific objectives, including infiltration, separation between different types of media (i.e., between soil and stone), or filtration.

Grade/Grading – 1. (Noun) A slope, usually of a road, channel, or natural ground, specified in percent and shown on plans as specified herein. 2. (Verb) To finish the surface of a roadbed, the top of an embankment, or the bottom of an excavation.

Groundwater – Water that occurs in the subsurface and fills or saturates the porous openings, fractures and fissures of under-ground soils and rock units.

Groundwater Recharge – The replenishment of existing natural groundwater supplies from infiltration of rain or overland flow.

Impervious Surface – A surface that prevents the infiltration of water into the ground. Impervious surfaces include, but are not limited to, streets, sidewalks, pavements, driveway areas, or roofs. Any surface areas designed to be gravel or crushed stone shall be regarded as impervious surfaces.

Infiltration – Movement of surface water into the soil, where it is absorbed by plant roots, evaporated into the atmosphere, or percolated downward to recharge groundwater.

Infiltration Facility – A stormwater BMP designed to collect and discharge runoff in a manner that allows infiltration into underlying soils and groundwater (e.g., French drains, seepage pits, or seepage trenches, etc.).

Municipality – the Township.

Nonstructural Best Management Practice (BMPs) – Methods of controlling stormwater runoff quantity and quality, such as innovative site planning, impervious area and grading reduction, protection of natural depression areas, temporary ponding on site, and other techniques.

PADEP – Pennsylvania Department of Environmental Protection.

Predevelopment – Land cover conditions assumed to exist within the proposed disturbed area prior to commencement of the Regulated Activity for the purpose of calculating the Predevelopment water quality, volume, infiltration volume, and peak flow rates as required in the Stormwater Ordinance.

Proposed Impervious Surface - All new, additional and replacement Impervious Surfaces.

Regulated Activity - Any Earth Disturbance Activity(ies) or any activity that involves the alteration or development of land in a manner that may affect stormwater runoff.

Runoff – Any part of precipitation that flows over the land surface.

Sediment – Soil or other materials transported by, suspended in or deposited by surface water as a product of erosion.

Site – Total area of land in the Municipality where any proposed Regulated Activity is planned, conducted, or maintained or that is otherwise impacted by the Regulated Activity.

Stormwater – Drainage runoff from the surface of the land resulting from precipitation or snow or ice melt.

Stormwater Ordinance – Upper Pottsgrove Township Ordinance 2013-04 codified under Chapter 301 of the Upper Pottsgrove Township Code of Ordinances.

Swale – An artificial or natural waterway or low-lying stretch of land that gathers and conveys stormwater or runoff, and is generally vegetated for soil stabilization, stormwater pollutant removal, and infiltration.

Township – Upper Pottsgrove Township, Montgomery County, Pennsylvania.

Watershed – Region or area drained by a river, watercourse, or other body of water, whether natural or artificial.

Wetland – Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, fens, and similar areas.

III. BMP INFORMATION

Stormwater management for small projects must consist of infiltration or on-site reuse of the difference in the rainfall runoff from the pre-development to the post-development conditions for the 2 year storm. Infiltration can be provided by various types of facilities. While not considered as part of the design, certain features can be added 'in line' to the system, for re-use applications. These would include features such as a cistern, rain pillow, and rain barrels. The following are the options that can be selected when utilizing the Simplified Approach-1:

A. BMP TYPES

Underground Options:

- Infiltration Bed
- Infiltration Trench
- Infiltration Trench with Pipe
- Tank with Holes

Aboveground Options:

- Infiltration Basin
- Rain Garden

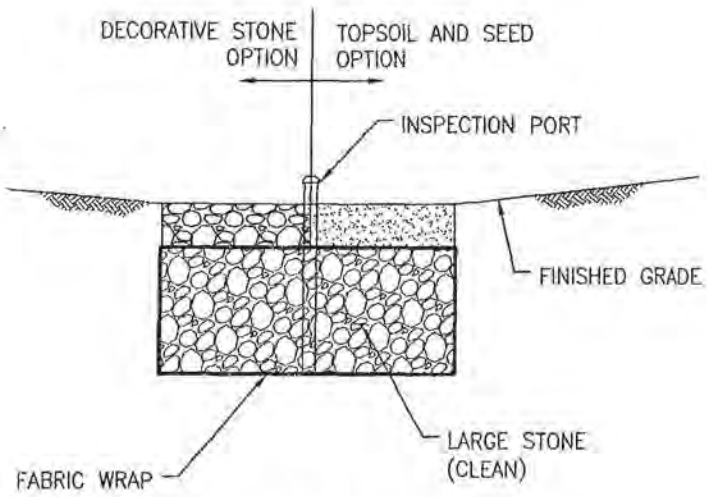
The following pages provide a description of each of the above facilities along with an illustration of each.

For Construction Details for each BMP see Attachment A to this Handout.

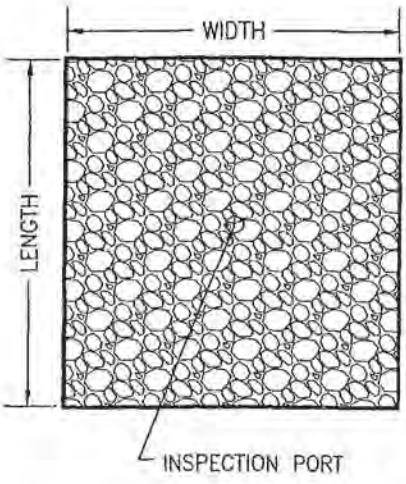
B. BMP DESCRIPTIONS AND ILLUSTRATIONS

Infiltration Bed

An infiltration bed is typically used to capture surface and/or roof water.. Roof drains from the proposed structure are piped into an underground bed of gravel to allow the stormwater to infiltrate into the ground. An overflow pipe is provided to release excess storm volumes. A cleanout is provided to facilitate maintenance and to facilitate inspection.. The soil over the bed should be planted with vegetation that will not interfere with the operation of the bed. In some cases, decorative stone can cover the infiltration bed.



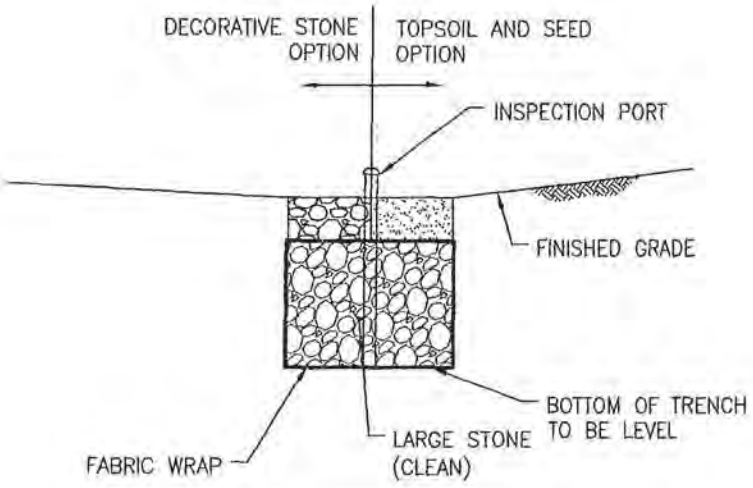
CROSS-SECTION OF BED



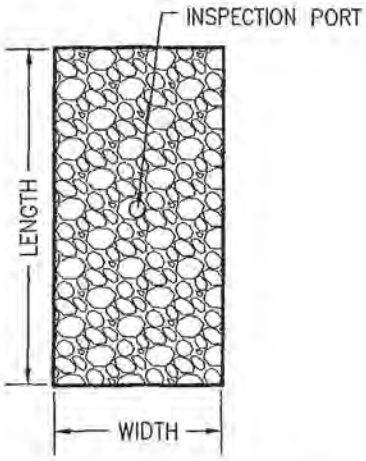
PLAN VIEW OF INFILTRATION BED

Infiltration Trench [with or without a pipe]

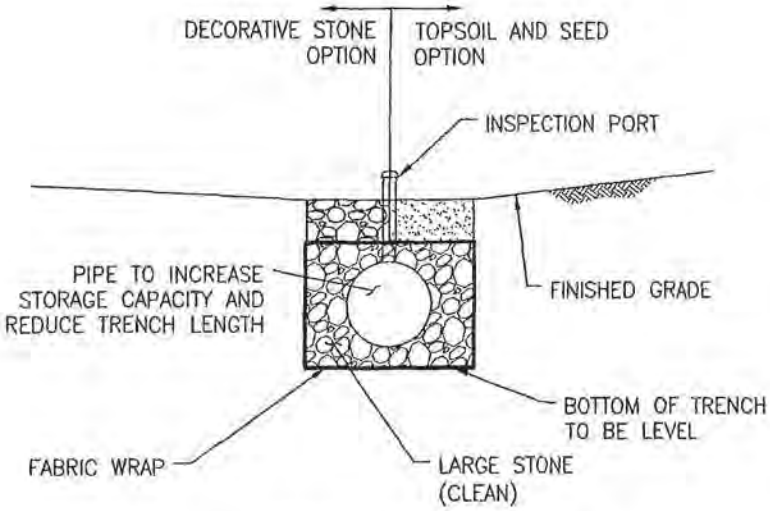
Infiltration trenches are utilized along the perimeter of impervious surfaces to collect, store and infiltrate stormwater runoff from a dwelling, driveway, or other improvement. River rock or equivalent may be placed on the bed to allow the stormwater runoff to enter the trench. Alternatively the bed may utilize a perforated pipe with inlets to facilitate the stormwater entering the trench. When on a slope, the trench is constructed as a terraced system. Pipe can be utilized within the trench to increase the available storage volume. In areas where infiltration is intended, it is important to avoid compaction of the trench and surrounding area (e.g., avoid use of heavy equipment) in order to allow the water to permeate better. To promote infiltration, once the trench has been excavated, the entire bottom area should be scarified to loosen the soils at the bottom of the trench.



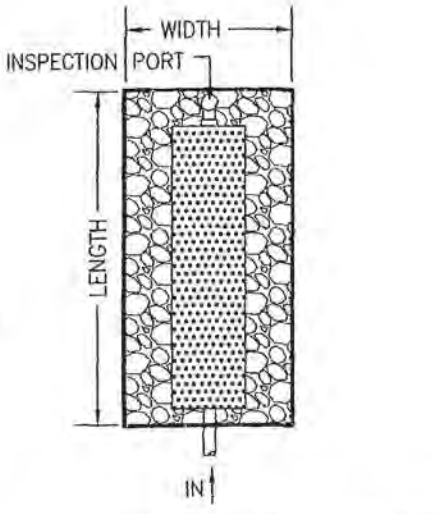
CROSS-SECTION OF TRENCH



PLAN VIEW OF INFILTRATION TRENCH



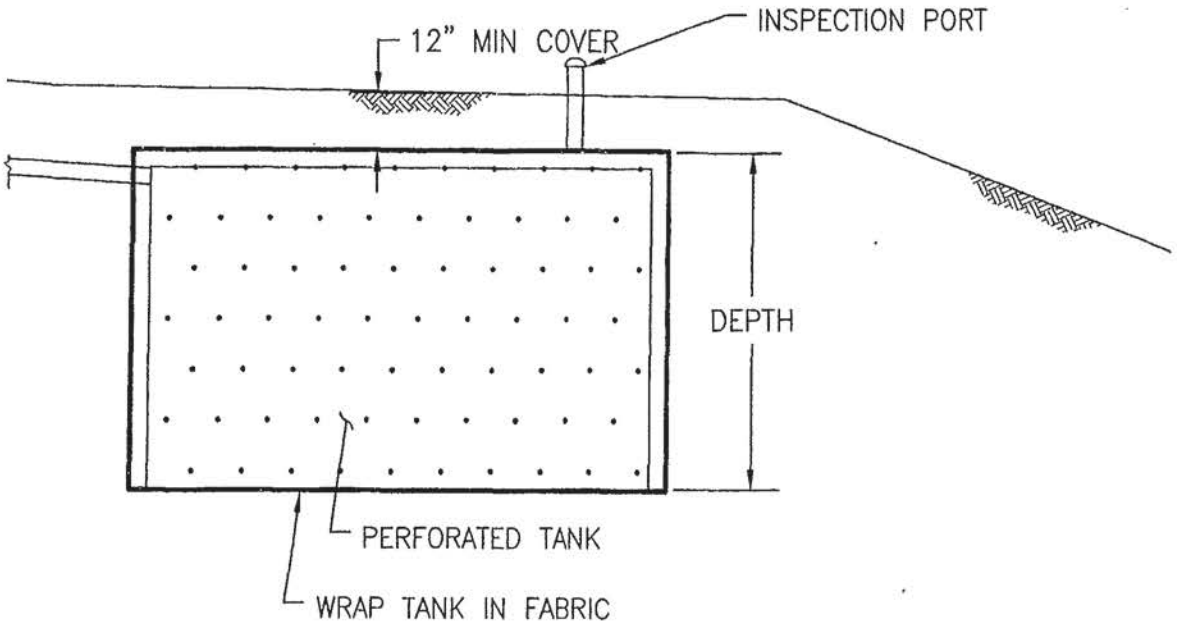
CROSS-SECTION OF TRENCH



PLAN VIEW OF INFILTRATION TRENCH WITH PIPE

Tank [with holes]

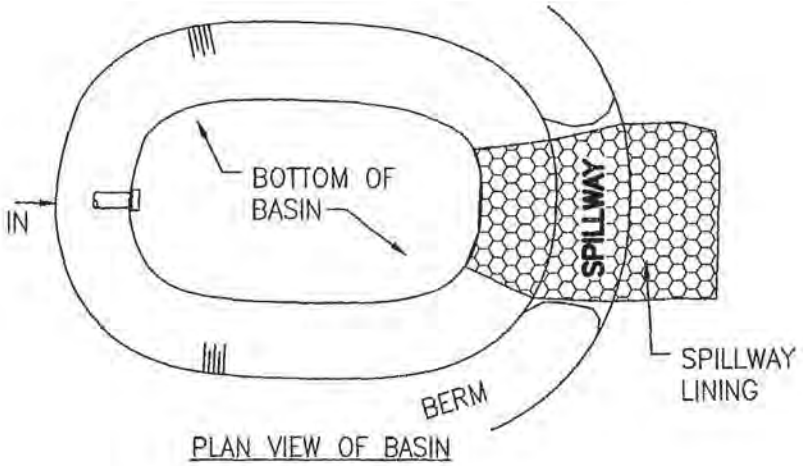
Tanks can be made from a variety of materials, such as steel, concrete, HPDE, etc. Holes are provided in the tank to allow the stored water to slowly drain into the surrounding ground area. Most tanks are pre-manufactured for this type of application, though use of existing materials can be approved on a case-by-case basis.



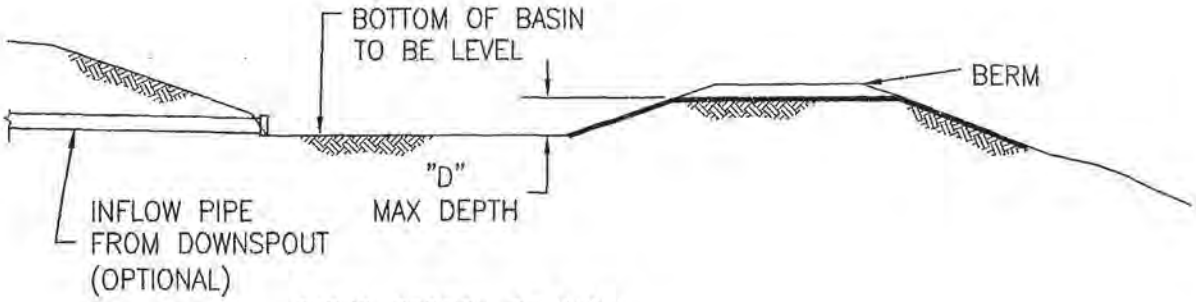
CROSS-SECTION VIEW OF TANK

Infiltration Basin

An infiltration basin provides an aboveground area for water to be stored and infiltrate into the ground. Roof drains and overland stormwater runoff are directed into the aboveground basin area. A spillway is provided to release the larger storm volumes. The spillway should be located such that any down slope problems are avoided when water is flowing over it. The basin needs to be planted with vegetation that is tolerant of the wet conditions that will occur.



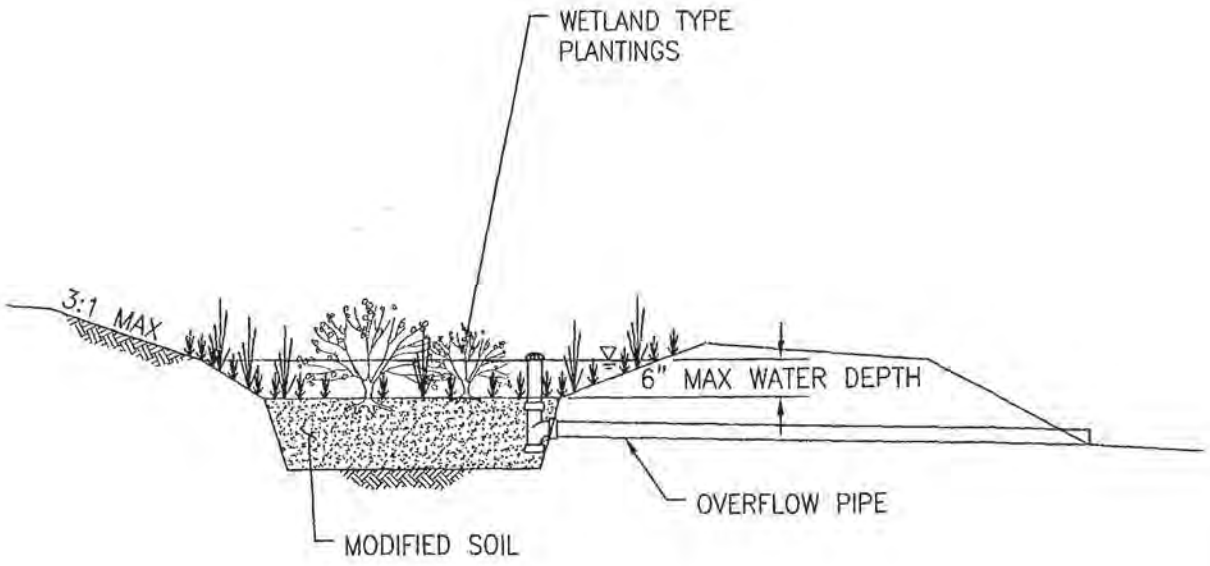
PLAN VIEW OF BASIN



CROSS-SECTION OF BASIN

Rain Garden

Rain gardens are similar to the infiltration basin, but provide less storage volume and rely more on the plantings to provide water quality and to remove the water through evapo-transpiration. Plant material utilized in the rain garden should be selected by a landscaping professional and be suitable for the proposed conditions. The bottom of the garden is a modified soil intended to hold water and allow it to infiltrate. An overflow pipe is provided to take larger volumes of stormwater runoff away. At least twice a year the Landowner is to inspect the rain garden for sediment buildup, ground cover and vegetative conditions and make any repairs as needed. Pruning and weeding may be required especially while vegetation is being established. Plant residue/debris, if any, needs to be removed every year. Perennial plantings may be cut down and removed at the end of the growing season. The mulch needs to be re-spread should erosion be evident and replenished as needed. Once every 2 to 3 years the entire area may require mulch replacement. During extended drought, watering may be necessary. The owner of the facility should be aware of the long-term maintenance needs of the plant materials utilized.



CROSS-SECTION OF GARDEN

C. SELECTION CONSIDERATIONS

Underground Options:

	Pros:	Cons:
Infiltration Bed:	No Visual Impact Direct Connection of Roof Drains Larger Volumes Possible	Requires Roof Gutter Screens Repairs Difficult Area Above Restricted
Infiltration Trench:	No Visual Impact Flexible Location Can Collect Sheet Flow	Requires Roof Gutter Screens Repairs Difficult Area Above Restricted
Infiltration Trench, with Pipe:	No Visual Impact Flexible Location Can Collect Sheet Flow Smaller Footprint-Larger Volume	Requires Roof Gutter Screens Repairs Difficult Area Above Restricted More Expensive
Tank with Holes:	No Visual Impact Direct Connection of Roof Drains Large Volumes Possible Smaller Footprint Easy Access for Inspection	Requires Roof Gutter Screens More Expensive

Aboveground Options:

	Pros:	Cons:
Infiltration Basin:	Easy Maintenance Large Volumes Easily Possible	Standing Water Visually Unattractive
Rain Garden:	Visually Part of Landscape	Some Standing Water More Intense Maintenance

D. LOCATION CONSIDERATIONS

BMP's should be located:

- over the most suitable soil on the site
- avoiding areas of wet or poorly drained soils (high water table)
- avoiding areas underlain by shallow bedrock
- outside wetlands, floodplains and environmentally sensitive areas (requires other permits)

BMP's should be located with the following minimum setbacks:

- ten (10) feet down gradient from a building basement
- one hundred (100) feet up gradient from a building basement
- ten (10) feet from property lines
- one hundred (100) feet from wells
- ten (10) feet from septic system drain fields (or per PADEP)

E. INSTALLATION GUIDELINES

1. BMPs shall be protected during construction to prevent sediment-laden (muddy) water from entering the facility.
2. Excavation for the BMP's shall be conducted in a manner that will not compact the bottom of the facility.
3. For subsurface facilities, the bottom of the facility shall be scarified immediately prior to the placement of geotextile.
4. Geotextile shall be placed in accordance with the manufacturer's specifications. Seams shall be overlapped a minimum of 16 inches.
5. The area of the BMP shall be fenced off during site construction. Construction equipment shall be prohibited from entering the area to avoid soil compaction.

IV. INSTRUCTIONS FOR COMPLETING BMP SIZE DETERMINATION WORKSHEETS

Step One

The first step in sizing any BMP is to determine the volume needed to store the increase in stormwater runoff. This is dependent on total area of impervious surface added by your project. Impervious surface includes all proposed areas of buildings, paving, concrete and compacted gravel. See the definition of impervious surface in Section II above for more information. This value will be placed in the first line of the table under Section V. SIZE DETERMINATION WORKSHEETS, STEP ONE.

The area of impervious surface is then multiplied by the value in the second line of the table under Section V. SIZE DETERMINATION WORKSHEETS, STEP ONE. To determine the volume needed to store the stormwater, multiply the area from line one by the multiplier in line two. This is your VOLUME REQUIRED.

Step Two

The second step in sizing is to choose a BMP to install. Using the information provided for each BMP in Section III and based on the amount of space available and its configuration, choose amongst the BMPs presented. Multiple BMPs may be chosen, and are encouraged, depending on the types of impervious surface proposed and how the surfaces will drain. Alternative BMPs will be considered for approval by the Municipal Engineer on a case-by-case basis. Indicate your choice(s) in the table provided under Section V. SIZE DETERMINATION WORKSHEETS, STEP TWO.

Step Three

The third step in sizing your chosen BMP is to use the formulas contained in the row in Section V. SIZE DETERMINATION WORKSHEETS, STEP THREE corresponding to the BMP chose in Step 2. If more than one BMP is chosen, use the formula for each and combine them for the total VOLUME PROVIDED. The VOLUME PROVIDED must be equal to or larger than the VOLUME REQUIRED as determined in Step One.

Step Four

The fourth step in completing the worksheets is to prepare a site sketch plan of the existing and proposed features in the project area. The blank graph paper provided under Section V. SIZE DETERMINATION WORKSHEETS, STEP FOUR may be used. A smaller size sheet should not be used, larger is allowed.

V. SIZE DETERMINATION WORKSHEETS

STEP ONE: DETERMINE REQUIRED VOLUME	
PROPOSED TOTAL AREA OF IMPERVIOUS SURFACE Includes all proposed areas of buildings, paving, concrete and compacted gravel that are part of the proposed work. See definition of "Impervious Surface".	**sq. ft.**
Multiply by 0.23	**x 0.23**
Infiltration VOLUME REQUIRED – Total	**cu. ft.**

STEP TWO: SELECT BMP(s) TO BE UTILIZED	
BMP TYPE*	(How Many)
1. Infiltration Bed	
2. Infiltration Trench	
3. Infiltration Trench with Pipe	
4. Tank with Holes	
5. Infiltration Basin	
6. Rain Garden	
TOTAL	

* You are not limited to one BMP. Use of multiple BMPs is encouraged and in some cases will be needed to accommodate site topography. Multiple BMPs are also beneficial in the event one would fail or require maintenance, that the secondary BMP is in place and functional.

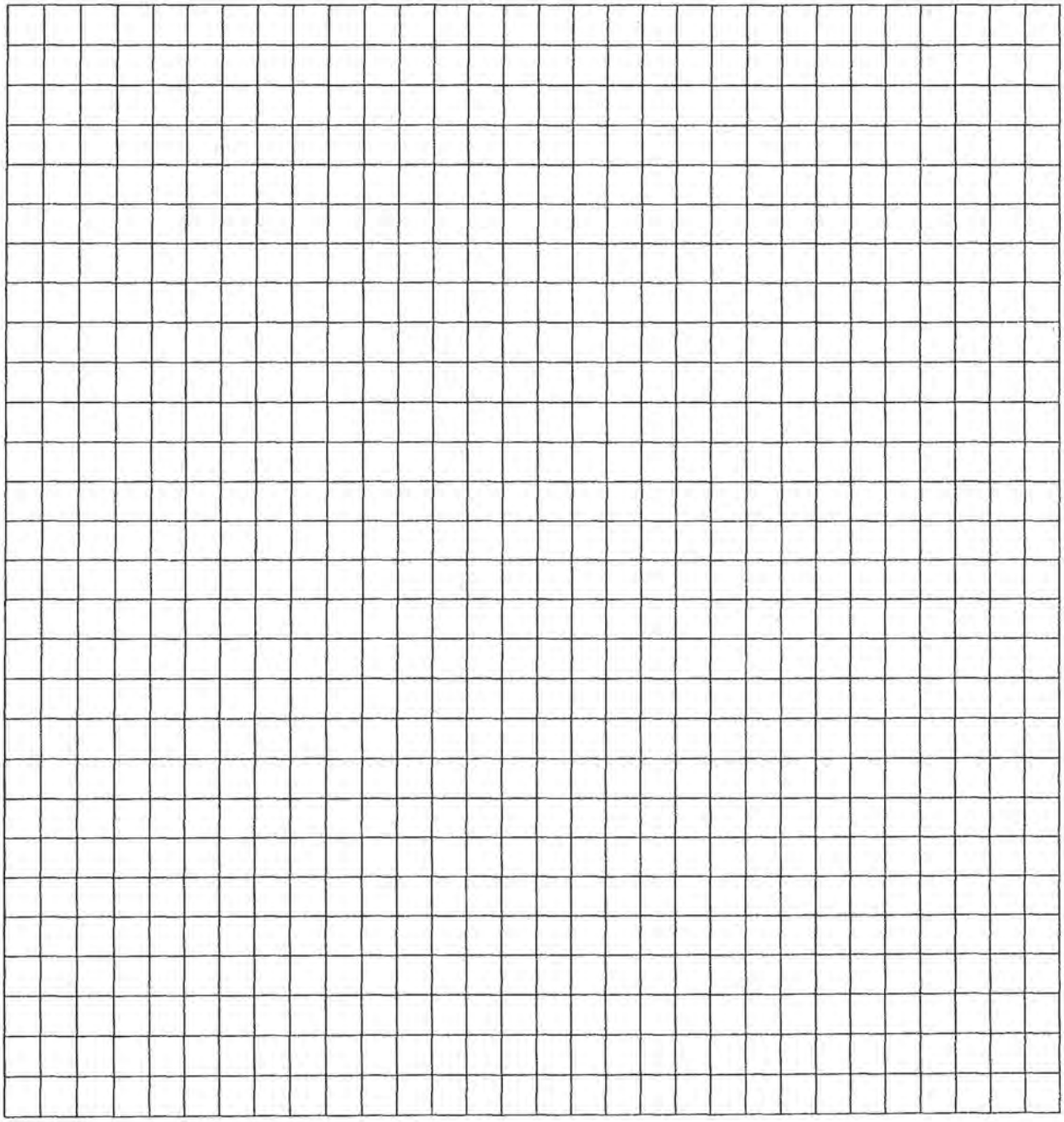
STEP THREE: DETERMINE VOLUME PROVIDED	
BMP (see specific detail drawings for volume calculations)	**Volume (cu. ft.)**
1. Infiltration Bed: volume = length x width x depth x 0.4	
2. Infiltration Trench: volume = length x width x depth x 0.4	
3. Infiltration Trench w/ Pipe: volume = trench volume + pipe volume =	
(length x width x depth x 0.4) + (3.14 x radius x radius x length)	
4. Tank with Holes: volume = per manufacturers specifications	
5. Infiltration Basin: volume = length x width x depth	
6. Rain Garden: volume = (length x width x 0.5) + (length x width x 1.5 x 0.4)	
Infiltration VOLUME PROVIDED - TOTAL*	

*must be greater than the Infiltration VOLUME REQUIRED calculated in Step One

STEP FOUR: PREPARE A SITE SKETCH PLAN

NAME: _____

LOCATION: _____



Is your drawing to scale Y / N? If yes, what is the scale? _____

Any questions please contact:
LTL Consultants, Ltd. at 610-987-9290 or 1-888-987-8886

VI. SUBMISSION/APPLICATION REQUIREMENTS

The items to be submitted to the Township are:

- Grading Permit Application (See Attachment B to this Handout)
- Fee
- Worksheets (all pages from Section V above)
- Site Sketch Plan
- Operation, Maintenance and Inspection Plan and Agreement for Simplified Approach-1 (See Attachment C to this Handout)

Basic information is needed regarding the proposed activity and the BMP(s) chosen to manage the stormwater runoff, including but not limited to the types of materials used, total impervious areas and size chosen. Completion of the Worksheets will provide the needed information. In addition, a simple Site Sketch Plan (see example) showing the location of the following features (existing and proposed) shall be submitted:

- structures, driveways and other paved surfaces (all impervious areas) with approximate dimensions in feet,
- BMPs,
- erosion control measures
- on-site septic system(s) showing rough proximity to infiltration BMPs, and
- well(s) (potable) showing rough proximity to infiltration BMPs.

Completing the Worksheets and submitting them with the Grading Permit Application should provide sufficient information for review for compliance with the requirements.

VII. EXAMPLE

STEP ONE: DETERMINE PROPOSED IMPERVIOUS SURFACE	
PROPOSED TOTAL AREA OF IMPERVIOUS SURFACE Includes all proposed areas of buildings, paving, concrete and compacted gravel that are part of the proposed work. See definition of "Impervious Surface".	new gravel 30 x 30 = 900 new pole barn 24 x 36 = 864 1764 sq. ft.
Multiply by 0.23	x 0.23
Infiltration VOLUME REQUIRED – Total	405.72 use 406 cu. ft.

STEP TWO: SELECT BMP(s) TO BE UTILIZED	
BMP NAME	(How Many)
1. Infiltration Bed	1
2. Infiltration Trench	1
3. Infiltration Trench with Pipe	
4. Tank with Holes	
5. Infiltration Basin	
6. Rain Garden	
TOTAL	2

In the above case, two separate BMP features are being utilized.

STEP THREE: DETERMINE VOLUME PROVIDED	
BMP (see specific detail drawings for volume calculations)	**Volume (cu. ft.)**
1. Infiltration Bed: volume = length x width x depth x 0.4 = 10 x 16 x 3 x 0.4	192 cu. ft.
2. Infiltration Trench: volume = length x width x depth x 0.4 = 90 x 2 x 3 x 0.4	216 cu. ft.
3. Infiltration Trench w/ Pipe: volume = trench volume + pipe volume =	
(length x width x depth x 0.4) + (3.14 x radius x radius x length)	
4. Tank with Holes: volume = per manufacturers specifications	
5. Infiltration Basin: volume = length x width x depth	
6. Rain Garden: volume = (length x width x 0.5) + (length x width x 1.5 x 0.4)	
Infiltration VOLUME PROVIDED - TOTAL*	408 cu. ft.

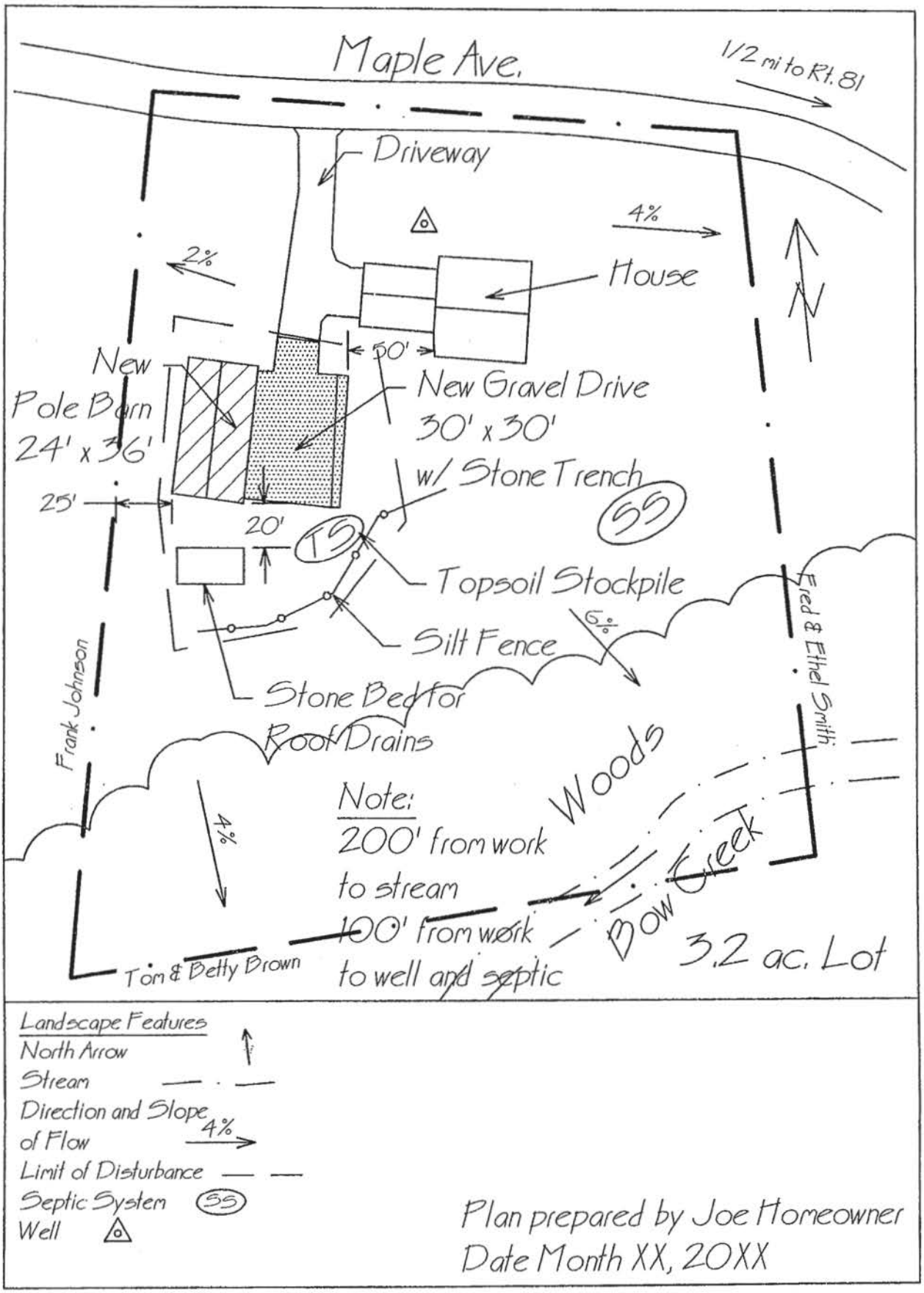
*must be greater than the Infiltration VOLUME REQUIRED calculated in Step One

408 cu. ft. is greater than 406 cu. ft. √

STEP FOUR: SITE SKETCH PLAN

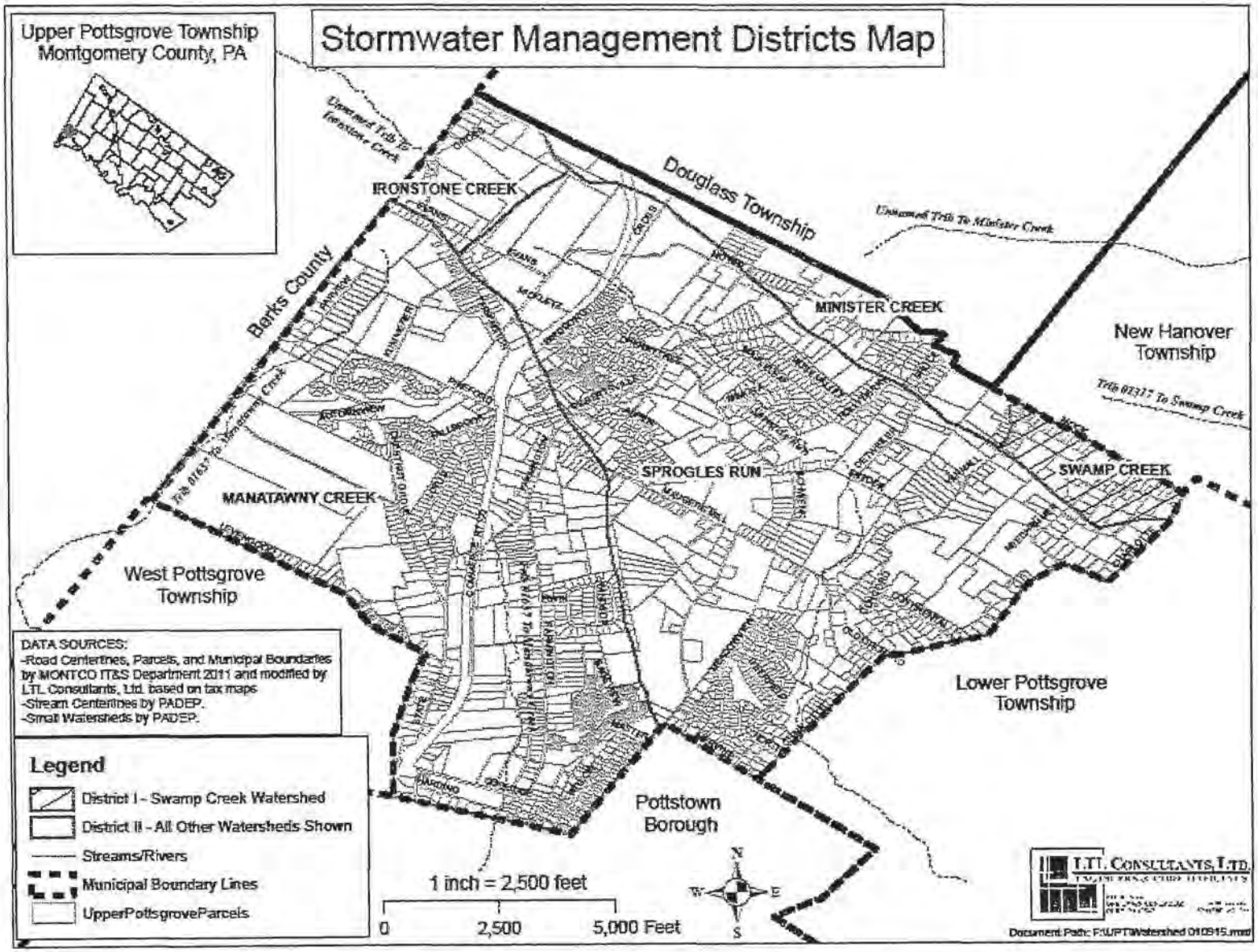
Plan shall contain the following items:

- Lot configuration and total acreage.
- Existing features: buildings, driveways, parking areas, woodland, streams, etc.
- Proposed impervious surfaces: driveways, parking areas including dimensions.
- Names of owners immediately adjacent to the project site location.
- Locations of existing streets or easements, railroads, drainage facilities.
- Proposed erosion and sedimentation control facilities.
- Location of watercourses, wetlands, and riparian stream buffer located within the property or one hundred (100) feet from the project site location.
- Distances between the proposed activity and existing features, property lines, on-lot sewage facilities, wells and watercourses.


Maple Ave.
1/2 mi to Rt. 81
Driveway
4%
2%
House
N
New
Pole Barn
24' x 36'
50'
New Gravel Drive
30' x 30'
w/ Stone Trench
25'
20'
SS
TS
Topsoil Stockpile
Silt Fence
6%
Stone Bed for
Roof Drains
Frank Johnson
Fred & Ethel Smith
Woods
Note:
200' from work
to stream
100' from work
to well and septic
Bow Creek
4%
Tom & Betty Brown
3.2 ac. Lot
Landscape Features
North Arrow
Stream
Direction and Slope of Flow 4%
Limit of Disturbance
Septic System SS
Well
Plan prepared by Joe Homeowner
Date Month XX, 20XX

APPENDIX B

STORMWATER MANAGEMENT DISTRICTS MAP


Upper Pottsgrove Township
Montgomery County, PA
Stormwater Management Districts Map
IRONSTONE CREEK
Douglass Township
Berks County
MINISTER CREEK
New Hanover Township
SPROGLES RUN
SWAMP CREEK
MANATAWNY CREEK
West Pottsgrove Township
Lower Pottsgrove Township
Pottstown Borough
DATA SOURCES:
-Road Centerlines, Parcels, and Municipal Boundaries by MONTCO IT&S Department 2011 and modified by LTL Consultants, Ltd. based on tax maps
-Stream Centerlines by PADEP.
-Small Watersheds by PADEP.
Legend
District I - Swamp Creek Watershed
District II - All Other Watersheds Shown
Streams/Rivers
Municipal Boundary Lines
UpperPottsgroveParcels
1 inch = 2,500 feet
0
2,500
5,000 Feet
N
W
E
S
LTL CONSULTANTS, LTD.

APPENDIX C

STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE C-1
Precipitation-Frequency Atlas of the United States

TABLE C-2
RUNOFF CURVE NUMBERS

TABLE C-3
RATIONAL RUNOFF COEFFICIENTS

TABLE C-4
NONSTRUCTURAL STORMWATER MANAGEMENT MEASURES

TABLE C-1

Precipitation-Frequency Atlas of the United States

Precipitation Frequency Estimates (inches)																		
ARI* (years)	**5 min**	**10 min**	**15 min**	**30 min**	**60 min**	**120 min**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**4 day**	**7 day**	**10 day**	**20 day**	**30 day**	**45 day**	**60 day**
1	0.34	0.54	0.67	0.92	1.15	1.37	1.50	1.88	2.29	2.71	3.13	3.48	4.06	4.61	6.22	7.75	9.84	11.80
2	0.40	0.64	0.81	1.11	1.40	1.67	1.82	2.27	2.77	3.26	3.78	4.19	4.87	5.50	7.38	9.13	11.56	13.81
5	0.47	0.76	0.96	1.36	1.74	2.09	2.29	2.84	3.48	4.10	4.76	5.23	6.01	6.70	8.80	10.64	13.29	15.77
10	0.52	0.84	1.06	1.53	2.00	2.41	2.65	3.31	4.08	4.80	5.55	6.08	6.95	7.67	9.91	11.81	14.58	17.21
25	0.58	0.93	1.18	1.75	2.33	2.85	3.14	3.96	4.96	5.81	6.69	7.28	8.29	9.01	11.41	13.34	16.22	19.01
50	0.63	1.00	1.27	1.91	2.58	3.20	3.52	4.49	5.70	6.67	7.63	8.27	9.39	10.09	12.59	14.49	17.43	20.32
100	0.67	1.06	1.35	2.06	2.84	3.55	3.92	5.06	6.51	7.59	8.63	9.30	10.56	11.20	13.76	15.63	18.56	21.53
200	0.71	1.12	1.42	2.20	3.09	3.90	4.32	5.65	7.38	8.59	9.70	10.41	11.80	12.36	14.95	16.75	19.64	22.66
500	0.75	1.19	1.50	2.38	3.42	4.39	4.87	6.50	8.66	10.06	11.23	11.97	13.56	13.96	16.54	18.19	20.96	24.04
1000	0.79	1.24	1.55	2.52	3.67	4.76	5.30	7.17	9.74	11.27	12.48	13.24	14.99	15.23	17.75	19.26	21.90	25.00

Source: Atlas 14, Volume 2, US Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Hydrometeorological Design Studies Center, Silver Springs, Maryland 20910. NOAA's Atlas 14 can be found on the internet at http://hdsc.nws.noaa.gov/hdsc/pfds/.

TABLE C-2

RUNOFF CURVE NUMBERS

LAND USE DESCRIPTION	Hydrologic Condition	HYDROLOGIC SOIL GROUP A	B	C	D
Open Space					
Grass cover < 50%	Poor	68	79	86	89
Grass cover 50% to 75%	Fair	49	69	79	84
Grass cover > 75%	Good	39	61	74	80
Meadow		30	58	71	78
Agricultural					
Pasture, grassland, or range – Continuous forage for grazing	Poor	68	79	86	89
Pasture, grassland, or range – Continuous forage for grazing	Fair	49	69	79	84
Pasture, grassland, or range – Continuous forage for grazing	Good	39	61	74	80
Brush—brush-weed-grass mixture with brush the major element	Poor	48	67	77	83
Brush—brush-weed-grass mixture with brush the major element	Fair	35	56	70	77
Brush—brush-weed-grass mixture with brush the major element	Good	30	48	65	73
Fallow Bare soil	----	77	86	91	94
Crop residue cover (CR)	Poor	76	85	90	93
Woods – grass combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
Commercial	(85% impervious)	89	92	94	95
Industrial	(72% impervious)	81	88	91	93
Industrial	(50% impervious)	71	82	88	90
Residential districts by average lot size:	% Impervious:				
1/8 acre or less * (townhouses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Farmstead		59	74	82	86
Smooth surfaces (concrete, asphalt, gravel, or bare compacted soil)		98	98	98	98
Water		98	98	98	98
Mining/newly graded areas (pervious areas only)		77	86	91	94

* Includes multi-family housing unless justified lower density can be provided.

Note: Existing site conditions of bare earth or fallow ground shall be considered as meadow when choosing a CN value.

Source: NRCS (SCS) TR-55

TABLE C-3

RATIONAL RUNOFF COEFFICIENTS

HYDROLOGIC SOIL GROUP	A			B			C			D		
SLOPE	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
LAND USE DESCRIPTION												
Cultivated Land												
Winter Conditions	.14	.23	.34	.21	.32	.41	.27	.37	.48	.34	.45	.56
Summer Conditions	.10	.16	.22	.14	.20	.28	.19	.26	.33	.23	.29	.38
Fallow Fields												
Poor Conditions	.12	.19	.29	.17	.25	.34	.23	.33	.40	.27	.35	.45
Good Conditions	.08	.13	.16	.11	.15	.21	.14	.19	.26	.18	.23	.31
Forest/Woodland	.08	.11	.14	.10	.14	.18	.12	.16	.20	.15	.20	.25
Grass Areas												
Good Conditions	.10	.16	.20	.14	.19	.26	.18	.22	.30	.21	.25	.35
Average Conditions	.12	.18	.22	.16	.21	.28	.20	.25	.34	.24	.29	.41
Poor Conditions	.14	.21	.30	.18	.28	.37	.25	.35	.44	.30	.40.	.50
Impervious Areas	.90	.91	.92	.91	.92	.93	.92	.93	.94	.93	.94	.95
Weighted Residential												
Lot Size 1/8 Acre	.29	.33	.36	.31	.35	.40	.34	.38	.44	.36	.41	.48
Lot Size 1/4 Acre	.26	.30	.34	.29	.33	.38	.32	.36	.42	.34	.38	.46
Lot Size 1/3 Acre	.24	.28	.31	.26	.32	.35	.29	.35	.40	.32	.36	.45
Lot Size 1/2 Acre	.21	.25	.28	.24	.27	.32	.27	.32	.37	.30	.34	.43
Lot Size 1 Acre	.18	.23	.26	.21	.24	.30	.24	.29	.36	.28	.32	.41

FIGURE C-3.A
PENNDOT REGION 4 STORM INTENSITY-DURATION-FREQUENCY CURVE

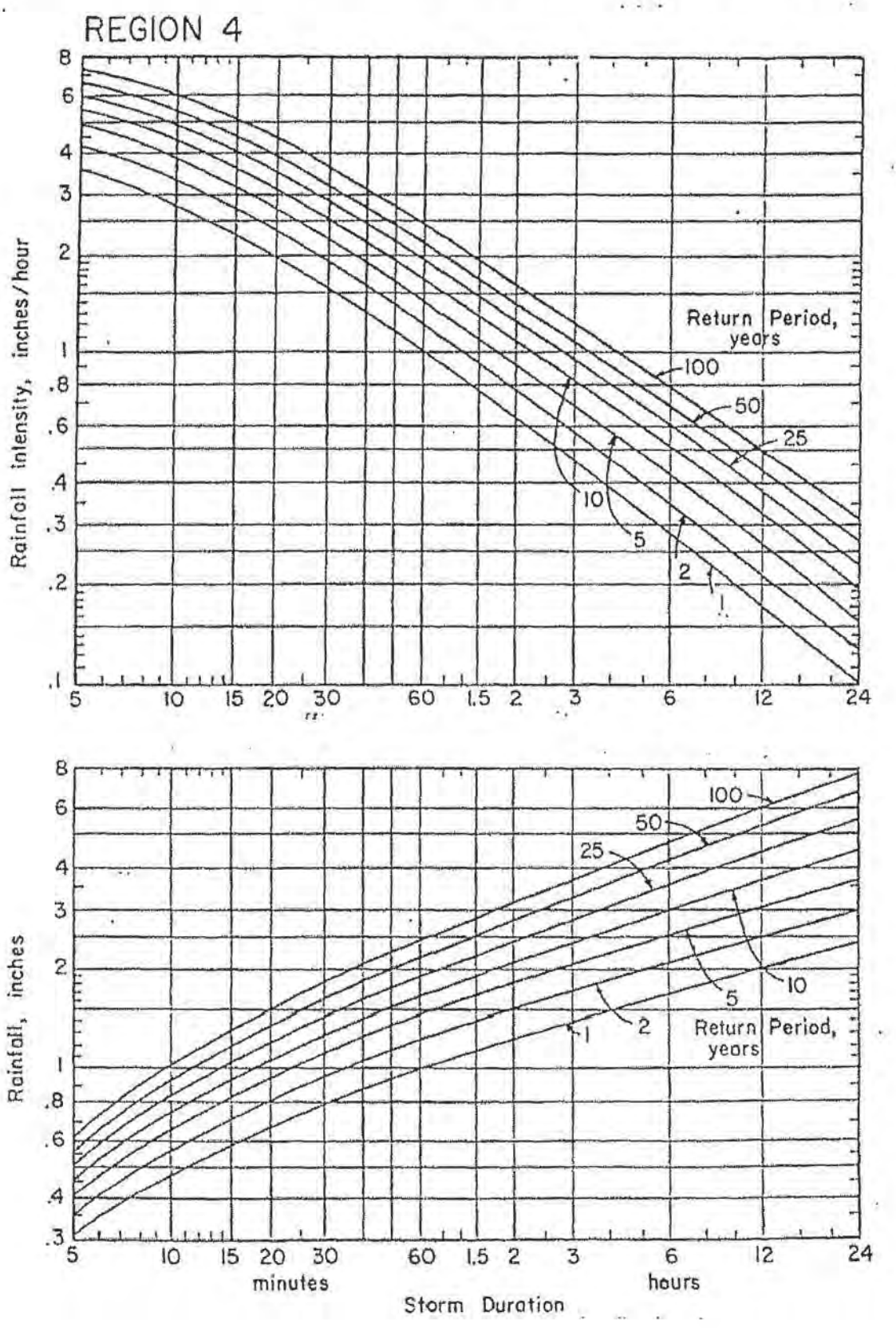


TABLE C-4

NONSTRUCTURAL STORMWATER MANAGEMENT MEASURES

Nonstructural Stormwater Measure	Description
Natural Area Conservation	Conservation of natural areas such as forest, wetlands, or other sensitive areas in a protected easement, thereby retaining their existing hydrologic and water quality characteristics.
Disconnection of Rooftop Runoff	Rooftop runoff is disconnected and then directed over a pervious area where it may either infiltrate into the soil or filter over it. This is typically obtained by grading the site to promote overland flow or by providing bioretention on single-family residential lots.
Disconnection of Nonrooftop Runoff	Disconnect surface impervious cover by directing it to pervious areas where it is either infiltrated or filtered through the soil.
Buffers	Buffers effectively treat stormwater runoff. Effective treatment constitutes capturing runoff from pervious and impervious areas adjacent to the buffer and treating the runoff through overland flow across a grassy or forested area.
Grass Channel (Open Section Roads)	Open grass channels are used to reduce the volume of runoff and pollutants during smaller storms.
Environmentally Sensitive Rural Development	Environmental site design techniques are applied to low-density or rural residential development.

Source: Maryland Department of the Environment, "Maryland Stormwater Design Manual," Baltimore, MD, 2000

TABLE C-5

Roughness Coefficients (Manning's "n") For Overland Flow (U.S. Army Corps of Engineers, HEC-1 Users Manual)

Surface Description				n
Dense Growth		0.4	-	0.5
Pasture	0.3	-	0.4	
Lawns		0.2	-	0.3
Bluegrass Sod		0.2	-	0.5
Short Grass Prairie		0.1	-	0.2
Sparse Vegetation		0.05	-	0.13
Bare Clay-Loam Soil (eroded)		0.01	-	0.03
Concrete/Asphalt – very shallow depths (less than ¼ inch)	0.10	-	0.15	
- small depths(¼ inch to several inches)	0.05	-	0.10	

Roughness Coefficients (Manning's "n") For Channel Flow

Reach Description	n
Natural stream, clean, straight, no rifts or pools	0.03
Natural stream, clean, winding, some pools or shoals	0.04
Natural stream, winding, pools, shoals, stony with some weeds	0.05
Natural stream, sluggish deep pools and weeds	0.07
Natural stream or swale, very weedy or with timber underbrush	0.10
Concrete pipe, culvert or channel	0.012
Corrugated metal pipe	0.012-0.027(1)
High Density Polyethylene (HDPE) Pipe	
Corrugated	0.021-0.029(2)
Smooth Lined	0.012-0.020(2)

(1) Depending upon type, coating and diameter

(2) Values recommended by the American Concrete Pipe Association, check Manufacturer's recommended value.

APPENDIX D

REFERENCES

REFERENCES

BMP Manuals

California
California Stormwater BMP Handbook: New Development and Redevelopment (January 2003) – separate file available at **http://www.cabmphandbooks.org/Development.asp**

Georgia
Georgia Stormwater Management Manual Volume 2: Technical Handbook (August 2001)- separate file **(http://www.georgiastormwater.com/)**

Maryland
2000 Maryland Stormwater Design Manual –
http://www.mde.state.md.us/Programs/Waterprograms/SedimentandStormwater/stormwater design/index.asp

Massachusetts
Stormwater Management, Volume Two: Stormwater Technical Handbook
(Massachusetts, 1997) – separate file available at
http://www.state.ma.us/dep/brp/stormwtr/stormpub.htm

Minnesota
Minnesota Urban Small Sites BMP Manual: Stormwater Best Management Practices for Cold Climates (July 2001) –
http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

New Jersey
Revised Manual for New Jersey: Best Management Practices for Control of Nonpoint Source Pollution from Stormwater (Fifth Draft May 2000) –
http://www.state.nj.us/dep/watershedmgt/bmpmanual.htm

New York
New York State Stormwater Management Design Manual (2001) –
http://www.dec.state.ny.us/website/dow/swmanual/swmanual.html

Pennsylvania
Pennsylvania Stormwater Best Management Practices Manual, January 2005 (draft).
Pennsylvania Association of Conservation Districts, Pennsylvania Handbook of Best Management Practices for Developing Areas, November 14, 1997.

Upper Pottsgrove
Stormwater Management Manual for Western Upper Pottsgrove (August 2001) –
http://www.ecy.wa.gov/programs/wq/stormwater/manual.html

Federal
Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring (FHWA) – **http://www.fhwa.dot.gov/environment/ultraurb/3fs1.htm**

USEPA Infiltration Trench Fact Sheet (September 1999) – **http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post.cfm**

Riparian Buffer References

Alliance for the Chesapeake Bay, Pennsylvania Department of Environmental Protection, September 2000. *Forest Buffer Toolkit*, Stream ReLeaf Program.

Penn State College of Agricultural Sciences, 1996. *Establishing Vegetative Buffer Strips Along Streams to Improve Water Quality.* Publication # AGRS-67.

Fike, Jean, June 1999. *Terrestrial & Palustrine Plant Communities of Pennsylvania,* Pennsylvania Natural Diversity Inventory, The Nature Conservancy, Western Pennsylvania Conservancy, and Pennsylvania Department of Conservation and Natural Resources.

Pennsylvania Association of Conservation Districts, Inc., Keystone Chapter, Soil and Water Conservation Society, Pennsylvania Department of Environmental Protection, Natural Resources Conservation Service, 1998. Pennsylvania Handbook of Best *Management Practices for Developing Areas.* Prepared by CH2MHill.

Palone, R. S. and A. H. Todd (eds), 1997. *Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers.* Chesapeake Bay Program and Northeastern Area State and Private Forestry. Natural Resources Conservation Service Cooperative State Research Education and Extension Services.

The Federal Interagency Stream Restoration Working Group (FISRWG, 10/1998). *Stream Corridor Restoration Principles, Processes, and Practices.* GPO Item No. 0120-A; SuDocs No. A57.6/2:EN3/PT.653. ISBN-0-934213-59-3. Published October 1998. Revised August 2000.

APPENDIX E

WEST NILE VIRUS GUIDANCE

West Nile Virus Guidance

(This source is from the Monroe County, PA Conservation District who researched the potential of West Nile Virus problems from BMPs due to a number of calls they were receiving)

Monroe County Conservation District Guidance:
Stormwater Management and West Nile Virus
Source: Brodhead McMichaels Creeks Watershed Act 167
Stormwater Management Ordinance 2/23/04

The Monroe County Conservation District recognizes the need to address the problem of non-point source pollution impacts caused by runoff from impervious surfaces. The new stormwater policy being integrated into Act 167 Stormwater Management regulations by the PA Department of Environmental Protection (DEP) will make non-point pollution controls an important component of all future plans and updates to existing plans. In addition, to meet post-construction anti-degradation standards under the state National Pollution Discharge Elimination System (NPDES) permitting program, Applicants will be required to employ Best Management Practices (BMPs) to address non-point pollution concerns.

Studies conducted throughout the United States have shown that wet basins and in particular constructed wetlands are effective in traditional stormwater management areas such as channel stability and flood control, and are one of the most effective ways to remove stormwater pollutants (United States Environmental Protection Agency 1991, Center for Watershed Protection 2000). From Maryland to Oregon, studies have shown that as urbanization and impervious surface increase in a watershed, the streams in those watersheds become degraded (CWP 2000). Although there is debate over the threshold of impervious cover when degradation becomes apparent (some studies show as little as 6% while others show closer to 20%), there is agreement that impervious surfaces cause non-point pollution in urban and urbanizing watersheds, and that degradation is ensured if stormwater BMPs are not implemented.

Although constructed wetlands and ponds are desirable from a water quality perspective there may be concerns about the possibility of these stormwater management structures becoming breeding grounds for mosquitoes. The Conservation District feels that although it may be a valid concern, municipalities should not adopt ordinance provisions prohibiting wet basins for stormwater management.

Mosquitoes

The questions surrounding mosquito production in wetlands and ponds have intensified in recent years by the outbreak of the mosquito-borne West Nile Virus. As is the case with all vector-borne maladies, the life cycle of West Nile Virus is complicated, traveling from mosquito to bird, back to mosquito and then to other animals including humans. *Culex pipiens* was identified as the vector species in the first documented cases from New York in 1999. This species is still considered the primary transmitter of the disease across its range.

Today there are some 60 species of mosquitoes that inhabit Pennsylvania. Along with *C. pipiens*, three other species have been identified as vectors of West Nile Virus while four more have been identified as potential vectors.

The four known vectors in NE Pennsylvania are *Culex pipiens*, *C. restuans*, *C. salinarius* and *Ochlerotatus japonicus*. All four of these species prefer, and almost exclusively use, artificial containers (old tires, rain gutters, birdbaths, etc.) as larval habitats. In the case of *C. pipiens*, the most notorious of the vector mosquitoes, the dirtier the water the better they like it. The important factor is that these species do not thrive in functioning wetlands where competition for resources and predation by larger aquatic and terrestrial organisms is high.

The remaining four species, *Aedes vexans*, *Ochlerotatus Canadensis*, *O. triseriatus* and *O. trivittatus* are currently considered potential vectors due to laboratory tests (except the *O. trivittatus*, which did have one confirmed vector pool for West Nile Virus in PA during 2002). All four of these species prefer vernal habitats and ponded woodland areas following heavy summer rains. These species may be the greatest threat of disease transmission around stormwater basins that pond water for more than four days. This can be mitigated however by establishing ecologically functioning wetlands.

Stormwater Facilities

If a stormwater wetland or pond is constructed properly and a diverse ecological community develops, mosquitoes should not become a problem. Wet basins and wetlands constructed as stormwater management facilities, should be designed to attract a diverse wildlife community. If a wetland is planned, proper hydrologic soil conditions and the establishment of hydrophytic vegetation will promote the population of the wetland by amphibians and other mosquito predators. In natural wetlands, predatory insects and amphibians are effective at keeping mosquito populations in check during the larval stage of development while birds and bats prey on adult mosquitoes.

The design of a stormwater wetland must include the selection of hydrophytic plant species for their pollutant uptake capabilities and for not contributing to the potential for vector mosquito breeding. In particular, species of emergent vegetation with little submerged growth are preferable. By limiting the vegetation growing below the water surface, larvae lose protective cover and there is less chance of anaerobic conditions occurring in the water.

Stormwater ponds can be designed for multiple purposes. When incorporated into an open space design a pond can serve as a stormwater management facility and a community amenity. Aeration fountains and stocked fish should be added to keep larval mosquito populations in check.

Publications from the PA Department of Health and the Penn State Cooperative Extension concerning West Nile Virus identify aggressive public education about the risks posed by standing water in artificial containers (tires, trash cans, rain gutters, bird baths) as the most effective method to control vector mosquitoes.

Conclusion

The Conservation District understands the pressure faced by municipalities when dealing with multifaceted issues such as stormwater management and encourages the incorporation of water quality management techniques into stormwater designs. As Monroe County continues to grow, conservation design, groundwater recharge and constructed wetlands and ponds should be among the preferred design options to reduce the impacts of increases in impervious surfaces. When designed and constructed appropriately, the runoff mitigation benefits to the community from these design options will far out weigh their potential to become breeding grounds for mosquitoes.

APPENDIX F

STORMWATER CONTROLS AND BEST MANAGEMENT PRACTICES

OPERATIONS AND MAINTENANCE AGREEMENT

STORMWATER BEST MANAGEMENT PRACTICES (BMPs) AND CONVEYANCES
OPERATION AND MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this _____ day of _____, 20____, by and between _____, (hereinafter the "Landowner"), and Upper Pottsgrove Township , Montgomery County, Pennsylvania, (hereinafter "Municipality");

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property by virtue of a deed of conveyance recorded in the land records of Montgomery County, Pennsylvania, at Deed Book _____ and Page _____, (hereinafter "Property"); and

WHEREAS, the Landowner is proceeding to build and develop the Property; and

WHEREAS, the stormwater Best Management Practices (herein after BMP(s)) and Conveyances, Operations and Maintenance Plan approved by the Municipality (hereinafter referred to as the "O&M Plan") for the Property, which is attached hereto as Appendix A and made part hereof, provides for management of stormwater within the confines of the Property through the use of BMP(s) and conveyances; and

WHEREAS, the Municipality and the Landowner, for itself and its administrators, executors, successors, heirs, and assigns, agree that the health, safety, and welfare of the residents of the Municipality and the protection and maintenance of water quality require that stormwater BMP(s) and conveyances be constructed and maintained on the Property; and

WHEREAS, for the purposes of this agreement, the following definitions shall apply:

BMP – "Best Management Practice" –Those activities, facilities, designs, measures, or procedures as specifically identified in the O&M Plan, used to manage stormwater impacts from land development, to meet state water quality requirements, to promote groundwater recharge, and to otherwise meet the purposes of the Municipality's Stormwater Management Ordinance. BMPs may include, but are not limited to, a wide variety of practices and devices, from large-scale retention ponds and constructed wetlands to small-scale underground treatment systems, infiltration facilities, filter strips, low impact design, bioretention, wet ponds, permeable paving, grassed swales, riparian or forested buffers, sand filters, detention basins, manufactured devices, and operational and/or behavior-related practices that attempt to minimize the contact of pollutants with stormwater runoff. The BMPs indentified in the O&M Plan are permanent appurtenances to the Property; and

Conveyance – As specifically identified in the O&M Plan, a man-made, existing or proposed facility, structure or channel used for the transportation or transmission of stormwater from one place to another, including pipes, drainage ditches, channels and swales (vegetated and other), gutters, stream channels, and like facilities or features. The conveyances identified in the O&M Plan are permanent appurtenances to the Property; and

WHEREAS, the Municipality requires, through the implementation of the O&M Plan, that stormwater management BMPs and conveyances, as required by said O&M Plan and the Municipality's Stormwater Management Ordinance, be constructed and adequately inspected, operated and maintained by the Landowner, its administrators, executors, successors in interest, heirs, and assigns.

NOW, THEREFORE, in consideration of the foregoing promises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto, intending to be legally bound hereby, agree as follows:

1. The foregoing recitals to this Agreement are incorporated as terms of this Agreement as if fully set forth in the body of this Agreement.

2. The Landowner shall construct the BMP(s) and conveyance(s) in accordance with the final design plans and specifications as approved by the Municipality.

_____(title of approved plans)
_____(dated) _____(last revised)

3. The Landowner shall inspect, operate and maintain the BMP(s) and conveyance(s) as shown on the O&M Plan in good working order acceptable to the Municipality and in accordance with the specific inspection and maintenance requirements in the approved O&M Plan.

4. The Landowner hereby grants permission to the Municipality, its authorized agents and employees, to enter upon the Property from a public right-of-way or roadway, at reasonable times and upon presentation of proper identification, to inspect the BMP(s) and conveyance(s) whenever it deems necessary for compliance with this Agreement, the O&M Plan and the Municipality's Stormwater Management Ordinance. Whenever possible, the Municipality shall notify the Landowner prior to entering the Property.

5. The Municipality intends to inspect the BMP(s) and conveyance(s) at a minimum of once every [_____] years to determine if they continue to function as required.

6. The Landowner acknowledges that, per the Municipality's Stormwater Ordinance, it is unlawful, without written approval of the Municipality, to:

a. Modify, remove, fill, landscape, alter or impair the effectiveness of any BMP or conveyance that is constructed as part of the approved O&M Plan;
b. Place any structure, fill, landscaping, additional vegetation, yard waste, brush cuttings, or other waste or debris into a BMP or conveyance that would limit or alter the functioning of the BMP or conveyance;
c. Allow the BMP or conveyance to exist in a condition which does not conform to the approved O&M Plan or this Agreement; and
d. Dispose of, discharge, place or otherwise allow pollutants including, but not limited to, deicers, pool additives, household chemicals, and automotive fluids to directly or indirectly enter any BMP or conveyance.

7. In the event that the Landowner fails to operate and maintain the BMP(s) and conveyance(s) as shown on the O&M Plan in good working order acceptable to the Municipality,

the Landowner shall be in violation of this Agreement, and the Landowner agrees that the Municipality or its representatives may, in addition to and not in derogation or diminution of any remedies available to it under the Stormwater Ordinance or other statutes, codes, rules or regulations, or this Agreement, enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s) and conveyance(s). It is expressly understood and agreed that the Municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.

8. In the event that the Municipality, pursuant to this Agreement, performs work of any nature or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within [_____] days of delivery of an invoice from the Municipality. Failure of the Landowner to make prompt payment to the Municipality may result in enforcement proceedings, which may include the filing of a lien against the Property, which filing is expressly authorized by the Landowner.

9. The intent and purpose of this Agreement is to ensure the proper maintenance of the on-site BMP(s) and conveyance(s) by the Landowner; provided, however, that this Agreement shall not be deemed to create or affect any additional liability on any party for damage alleged to result from or be caused by stormwater runoff.

10. The Landowner, for itself and its executors, administrators, assigns, heirs, and other successors in interest, hereby releases and shall release the Municipality's employees, its agents and designated representatives from all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against said employees, agents or representatives arising out of the construction, presence, existence, or maintenance of the BMP(s) and conveyance(s) either by the Landowner or Municipality. In the event that a claim is asserted or threatened against the Municipality, its employees, agents or designated representatives, the Municipality shall notify the Landowner, and the Landowner shall defend, at his own expense, any claim, suit, action or proceeding, or any threatened claim, suit, action or proceeding against the Municipality, or, at the request of the Municipality, pay the cost, including attorneys' fees, of defense of the same undertaken on behalf of the Municipality. If any judgment or claims against the Municipality's employees, agents or designated representatives shall be allowed, the Landowner shall pay all damages, judgments or claims and any costs and expenses incurred by the Municipality, including attorneys, regarding said damages, judgments or claims.

11. The Municipality may enforce this Agreement in accordance with its Stormwater Ordinance, at law or in equity, against the Landowner for breach of this Agreement. Remedies may include fines, penalties, damages or such equitable relief as the parties may agree upon or as may be determined by a Court of competent jurisdiction. Recovery by the Municipality shall include its reasonable attorney's fees and costs incurred in seeking relief under this Agreement.

12. Failure or delay in enforcing any provision of this Agreement shall not constitute a waiver by the Municipality of its rights of enforcement hereunder.

13. The Landowner shall inform future buyers of the Property about the function of, operation, inspection and maintenance requirements of the BMP(s) prior to the purchase of the Property by said future buyer, and upon purchase of the Property the future buyer assumes all responsibilities as Landowner and must comply with all components of this Agreement.

14. This Agreement shall inure to the benefit of and be binding upon, the Municipality and the Landowner, as well as their heirs, administrators, executors, assigns and successors in interest.

15. Additional items or conditions, as required by the Municipality, as attached herein:

This Agreement shall be recorded at the Office of the Recorder of Deeds of Montgomery County, Pennsylvania, and shall constitute a covenant running with the Property, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL)

For the Municipality:

_____

(SEAL)

For the Landowner:

_____

ATTEST:

_____

APPENDIX G

LOW IMPACT DEVELOPMENT (LID) PRACTICES

LOW IMPACT DEVELOPMENT (LID) PRACTICES

ALTERNATIVE APPROACH FOR MANAGING STORMWATER RUNOFF

Natural hydrologic conditions can be altered radically by poorly planned development practices such as introducing unnecessary impervious surfaces, destroying existing drainage swales, constructing unnecessary storm sewers, and changing local topography. A traditional drainage approach of development has been to remove runoff from a site as quickly as possible and capture it in a detention basin. This approach leads ultimately to the degradation of water quality as well as expenditure of additional resources for detaining and managing concentrated runoff at some downstream location.

The recommended alternative approach is to promote practices that will minimize proposed conditions runoff rates and volumes, which will minimize needs for artificial conveyance and storage facilities. To simulate pre-development hydrologic conditions, infiltration is often necessary to offset the loss of infiltration by creation of impervious surfaces. The ability of the ground to infiltrate depends upon the soil types and its conditions.

Preserving natural hydrologic conditions requires careful alternative site design considerations. Site design practices include preserving natural drainage features, minimizing impervious surface area, reducing the hydraulic connectivity of impervious surfaces, and protecting natural depression storage. A well-designed site will contain a mix of all of those features. The following describes various techniques to achieve the alternative approach:

- **Preserving Natural Drainage Features**. Protecting natural drainage features, particularly vegetated drainage swales and channels, is desirable because of their ability to infiltrate and attenuate flows and to filter pollutants. However, this objective is often not accomplished in land development. In fact, commonly held drainage philosophy encourages just the opposite pattern -- streets and adjacent storm sewers are typically located in the natural headwater valleys and swales, thereby replacing natural drainage functions with a completely impervious system. As a result, runoff and pollutants generated from impervious surfaces flow directly into storm sewers with no opportunity for attenuation, infiltration, or filtration. Developments designed to fit site topography also minimize the amount of grading on site.
- **Protecting Natural Depression Storage Areas.** Depressional storage areas either have no surface outlet or drain very slowly following a storm event. They can be commonly seen as ponded areas in farm fields during the wet season or after large runoff events. Traditional development practices eliminate these depressions by filling or draining, thereby obliterating their ability to reduce surface runoff volumes and trap pollutants. The volume and release rate characteristics of depressions should be protected in the design of the development site. The depressions can be protected by simply avoiding the depression or by incorporating its storage as additional capacity in required detention facilities.

- **Avoiding Introduction of Impervious Areas**. Careful site planning should consider reducing impervious coverage to the maximum extent possible. Building footprints, sidewalks, driveways, and other features producing impervious surfaces should be evaluated to minimize impacts on runoff.
- **Reducing the Hydraulic Connectivity of Impervious Surfaces**. Impervious surfaces are significantly less of a problem if they are not directly connected to an impervious conveyance system (such as a storm sewer). Two basic ways to reduce hydraulic connectivity are routing of roof runoff over lawns and reducing the use of storm sewers. Site grading should promote increasing travel time of stormwater runoff and should help reduce concentration of runoff to a single point in the development.
- **Routing Roof Runoff Over Lawns.** Roof runoff can be easily routed over lawns in most site designs. The practice discourages direct connection of downspouts to storm sewers or parking lots. The practice also discourages sloping driveways and parking lots to the street. By routing roof drains and crowning the driveway to run off to the lawn, the lawn is essentially used as a filter strip.
- **Reducing the Use of Storm Sewers**. By reducing use of storm sewers for draining streets, parking lots, and back yards, the potential for accelerating runoff from the development can be greatly reduced. The practice requires greater use of swales and may not be practical for some development sites, especially if there are concerns for areas that do not drain in a "reasonable" time. The practice requires educating local citizens and public works officials who expect runoff to disappear shortly after a rainfall event.
- **Reducing Street Widths.** Street widths can be reduced by either eliminating on-street parking or by reducing roadway widths. Municipal planners and traffic designers should encourage narrower neighborhood streets that ultimately could lower maintenance.
- **Limiting Sidewalks to One Side of the Street.** A sidewalk on one side of the street may suffice in low-traffic neighborhoods. The lost sidewalk could be replaced with bicycle/recreational trails that follow back-of-lot lines. Where appropriate, backyard trails should be constructed using pervious materials.
- **Using Permeable Paving Materials**. These materials include permeable interlocking concrete paving blocks or porous bituminous concrete. Such materials should be considered as alternatives to conventional pavement surfaces, especially for low use surfaces such as driveways, overflow parking lots, and emergency access roads.
- **Reducing Building Setbacks.** Reducing building setbacks reduces impervious cover associated with driveway and entry walks and is most readily accomplished along low traffic streets where traffic noise is not a problem.
- **Constructing Cluster Developments.** Cluster developments can also reduce the amount of impervious area for a given number of lots. The biggest savings occurs with street length, which also will reduce costs of the development. Cluster development groups the construction activity in less-sensitive areas without substantially affecting the gross density of development.

In summary, a careful consideration of the existing topography and implementation of a combination of the above mentioned techniques may avoid construction of costly stormwater control measures. Benefits include reduced potential for downstream flooding and water quality degradation of receiving streams/water bodies, enhancement of aesthetics, and reduction of development costs. Other benefits include more stable baseflows in receiving streams, improved groundwater recharge, reduced flood flows, reduced pollutant loads, and reduced costs for conveyance and storage.