BOWMAN'S CREEK WATERSHED
ACT 167
STORMWATER MANAGEMENT PLAN

WYOMING COUNTY, PENNSYLVANIA

VOLUME II PLAN CONTENTS

JUNE 30, 2000

DEP ME# 96577
FILE NO. SWMP 25:066
BLE PROJECT NO. 98487.00

PREPARED FOR:

WYOMING COUNTY COMMISSIONERS
Wyoming County Courthouse
One Courthouse Square
Tunkhannock, PA 18657

PREPARED BY:

WYOMING COUNTY
PLANNING COMMISSION
One Courthouse Square
Tunkhannock, PA 18657

ENGINEERING CONSULTANT

BORTON-LAWSON ENGINEERING, INC.
613 Baltimore Drive, Suite 300
Wilkes-Barre, PA 18702-7903

WYOMING COUNTY COMMISSIONERS
Anthony Litwin, Chairman
Ronald Williams, Commissioner
Judy Kraft Mead, Commissioner

WYOMING COUNTY PLANNING COMMISSION
Paul Weilage, Executive Director
Charles Mead, Project Planner

LUZERNE COUNTY PLANNING COMMISSION
Adrian Merolli, Executive Director
Nancy Snee, Project Planner

WYOMING COUNTY CONSERVATION DISTRICT
LUZERNE COUNTY CONSERVATION DISTRICT

ENGINEERING CONSULTANT

Borton-Lawson Engineering, Inc.

BOWMAN'S CREEK WATERSHED PLAN ADVISORY COMMITTEE
(WPAC MEMBERSHIP)

Dorne White	**Bowman's Creek Watershed Assoc.**
Member	**Municipality**
Randy Ehrenzeller	**Eaton Township**
Paul Goodwin	**Forkston Township**
Walter Derhammer	**Monroe Township**
John Sichler	**Monroe Township**
Robert Dornblazer	**Northmoreland Township**
Carl Butler	**Noxen Township**
Gregory Montross	**Noxen Township**
Harold Harding	**Noxen Township**

Wyoming County Planning Commission
Luzerne County Planning Commission

Wyoming County Conservation District
Luzerne County Conservation District

RESOLUTION

WHEREAS, the Stormwater Management Act 167 of 1978 provides for the regulation of land and water use for flood control and stormwater management, requires the Pennsylvania Department of Environmental Protection to designate watersheds, and provides for grants to be appropriated and administered by the Department for plan preparation and implementation costs, and provides that each county will prepare and adopt a watershed stormwater management plan for each designated watershed; and

WHEREAS, the Wyoming County Commissioners entered into a grant contract with the Pennsylvania Department of Environmental Protection to develop the watershed stormwater management plan for the Bowman's Creek designated watershed; and

WHEREAS, the purpose of the Bowman's Creek Watershed Stormwater Management Plan is to protect public health and safety and to prevent or mitigate the adverse impacts related to the conveyance of excessive rates and volumes of stormwater runoff by providing for the management of stormwater runoff and control of erosion and sedimentation; and

WHEREAS, design criteria and standards of stormwater management systems and facilities within the Bowman's Creek Watershed shall utilize the criteria and standards as found in the watershed stormwater management plan;

NOW, THEREFORE, BE IT RESOLVED that the Wyoming County Commissioners hereby adopt the Bowman's Creek Watershed Stormwater Management Plan, including all volumes, figures, and appendices, and forward the Plan to the Stormwater Management Section of the Pennsylvania Department of Environmental Protection for approval.

WYOMING COUNTY COMMISSIONERS

, Chairman

TABLE OF CONTENTS

PAGE

Section I. Introduction....I-1
A. Introduction....I-1
B. Stormwater Management....I-1

Section II. Act 167....II-1
A. Stormwater Management Act 167....II-1
B. Purpose of the Study....II-1

Section III. General Description of Watershed....III-1
A. Data Collection....III-2
B. Drainage Area....III-3
C. Topography and Stream Profile....III-3
D. Soils....III-5
E. Geology....III-9
F. Climate....III-10
G. Land Use....III-11
H. Land Development Patterns....III-13
I. Present and Projected Development in the Flood Hazard Areas....III-18
J. Obstructions....III-21
K. Existing Drainage Problems and Proposed Solutions....III-22
L. Existing and Proposed Stormwater Collection Systems....III-26
M. Existing and Proposed Flood Control Projects....III-26
N. Stormwater Collection and Control Facilities....III-26
O. Wetlands....III-27

Section IV. Watershed Technical Analysis....IV-1
A. Watershed Modeling....IV-1
B. Calibration....IV-2
C. Modeling Process....IV-5

Section V. Standards and Criteria for Stormwater Control....V-1
A. Watershed Level Control Philosophy....V-1
B. Description of Management Districts....V-1
C. Standards and Criteria....V-4
D. Sub-Regional (Combined Site) Storage....V-7
E. "No Harm Option"....V-8
F. Alternative Runoff Control Techniques....V-8
G. Regional Detention Facilities....V-13
H. Best Management Practices....V-13
I. Impervious Area Exemptions....V-13

Section VI. Ordinance Provisions VI-1

Section VII. Model Ordinance VII-1

Section VIII. Priorities for Implementation VIII-1
A. DEP Approval of the Plan VIII-1
B. Publishing the Final Plan VIII-1
C. Municipal Adoption of Ordinance to Implement the Plan VIII-1
D. Level of Government Involvement in Stormwater Management VIII-1
E. County-Wide Coordination VIII-2
F. Correction of Existing Drainage Problems VIII-4
G. Culvert Replacement VIII-5
H. PennVEST Funding VIII-5
I. Landowner's / Developer's Responsibilities VIII-5

Section IX. Plan Review Adoption and Updating Procedures IX-1
A. County Adoption IX-1
B. Provisions For Plan Revision IX-1

Section X. Advisory Committee Meetings X-1

Figures

III-1. Site Location III-1
III-2. Digital Elevation Model III-4
III-3. Soil Associations III-6
III-4. Hydrologic Soil Groups III-8
III-5. Geology III-9
III-6. Existing Land Use III-12
III-7. Future Land Use Conditions III-15
III-8. Development & Floodplains III-19
III-9. Obstructions III-23
III-10. Problem Areas, Flooding & Stormwater Control Facilities III-24
III-11. Wetlands III-28
IV-1 2, 10 & 100-year Calibrated Model Comparison at Subarea 110 ..... IV-3
IV-3 Hydrologic Method Comparison IV-6
IV-4 Subareas IV-4
V-1. Relative Timing Of Subwatershed Hydrographs V-2

Tables

III-1. Bowman's Creek Watershed – Municipalities and Subwatersheds III-2

III-2. Land Use Status by Category III-13
III-3. Development Potential by Municipality Based Upon Existing Patterns in the Bowman's Creek Watershed III-14
III-4. Present Versus Future Combined Peak Flows-100-Year 24-Hour Storm ... III-16
III-5. Present Residential and Commercial Areas within 100-Year Floodplain ... III-18
III-6. Bowman's Creek Watershed Problem Areas III-25
III-7. 100-Year Flow Attenuation III-27
IV-2. Comparison of Calibrated PSRM Model to 10-, 50- & 100-year FEMA Flow Values IV-5
V-1. Required Criteria & Standards V-4
V-2. Recommended Criteria & Standards V-5
V-3. Process to Achieve the Standards and Criteria V-7
V-4. Various On-Site Stormwater Control Methods V-9
V-5. Advantages and Disadvantages of Various On-Site Stormwater Control Methods V-10
V-6. Suitability of Control Measures in the Bowman Creek Watershed V-12

305.A.1 Acceptable Computational Methodologies for Stormwater Management Plans 16

Appendices - Following Section X

1 Public Comment
2 Peak Flow Summary Table

PLAN FORMAT

The format of the Bowman's Creek Stormwater Management Plan consists of Volume I, the Executive Summary, Volume II, the Plan Report that includes GIS maps and the Model Ordinance, and Volume III that contains the background technical materials.

Volume I provides an overview of Act 167 and a summary of the standards and criteria developed for the Plan. Volume II, the Plan Report provides an overview of stormwater management, purpose of the study, data collection, present conditions, projected land development patterns, calculation methodology, and ordinance provisions and implementation discussion.

Volume III provides supporting data, watershed modeling parameters and modeling runs, peak flows, release rates, the existing municipal ordinance matrix, and obstructions inventory. Large color copies of the figures are at the Planning Commission's Office.

SECTION I

INTRODUCTION

A. Introduction

This plan has been developed for the Bowmans Creek Watershed in Wyoming County, Pennsylvania under the requirements of the Pennsylvania Stormwater Management Act, Act 167, of 1978. Bowman's Creek Watershed is located in the northcentral portion of Luzerne County and the southcentral portion of Wyoming County. Bowman's Creek is approximately 20 miles long, originating near North Mountain in Fairmount Township and discharging into the North Branch of the Susquehanna River in Eaton Township. With little and inconsistent existing controls for stormwater management within this watershed, this plan has been developed to focus on a watershed wide consistent set of standards and criteria to control stormwater runoff.

This plan is developed with the intent to present all information that may be required in order to implement the plan. The comprehensiveness of the plan covers legal, engineering, and municipal government topics, which combined, form the basis for implementation and enforcement of a final ordinance which will be developed and adopted by each affected municipality. A sample stormwater management ordinance for reference use has been developed as part of the plan and is a separate document.

B. Stormwater Management

Stormwater management entails bringing surface runoff caused by precipitation events under control. In past years, stormwater control was viewed only on a site-specific basis. Recently, local perspectives and policies have changed, with the realization that proper stormwater management can only be accomplished by evaluating the comprehensive picture (i.e., by analyzing what adverse impacts a development located in a watershed's headwaters may have on flooding downstream). Proper stormwater management reduces flooding, soil and streambank erosion and sedimentation and improves the overall quality of the receiving streams.

Stormwater management requires cooperation between the state and county and local officials and involves proper planning, engineering, construction, operation and maintenance. This entails educating the public and local officials and requires program development, financing, revising policy, development of workable criteria and adoption of ordinances. The Bowman's Creek Watershed Stormwater Management Plan, under the Pennsylvania Stormwater Management Act, will enable continued development to occur within the Bowman's Creek Watershed, utilizing both structural and non-structural measures to properly manage stormwater runoff in the watershed.

SECTION II

ACT 167

A. Stormwater Management Act 167

The Pennsylvania General Assembly, recognizing the adverse effects of inadequate management of excessive rates and volumes of stormwater runoff resulting from development, approved the Stormwater Management Act, P.L. 864, No. 167, October 4, 1978. Act 167 provides for the regulation of land and water use for flood control and stormwater management purposes. It imposes duties and confers powers to the Department of Environmental Resources, municipalities and counties, and provides for enforcement and making appropriations. The Act requires the Department to designate watersheds and develop guidelines for stormwater management and model stormwater ordinances (the designated watersheds were approved by the Environmental Quality Board July 15, 1980, and the guidelines and model ordinances were approved by the Legislature May 14, 1985). The Act provides for grants to be appropriated by the General Assembly and administered by the Department for 75% of the allowable costs for preparation of official stormwater management plans and administrative, enforcement and implementation costs incurred by any municipality or county in accordance with Chapter III - Stormwater Management Grants and Reimbursement Regulations (adopted by the Environmental Quality Board August 27, 1985).

Each county must prepare and adopt a watershed stormwater management plan for each of its designated watersheds in consultation with the municipalities, and will periodically review and revise such plans at least every five years when funding is available. Within six months following adoption and approval of a watershed stormwater plan, each municipality is required to adopt or amend, and implement ordinances and regulations as are necessary to regulate development within the municipality in a manner consistent with the applicable watershed stormwater plan and the provisions of the Act.

Developers are required to manage the quantity, velocity, and direction of resulting stormwater runoff in a manner which adequately protects health and property from possible injury, and must implement control measures that are consistent with the provisions of the watershed plan and the Act. The Act also provides for civil remedies for those aggrieved by inadequate management of accelerated stormwater runoff.

B. Purpose of the Study

Development in the Bowman's Creek Watershed causes an increase in stormwater runoff and a reduction in groundwater recharge. Uncontrolled stormwater runoff not only increases the risk of flooding downstream but also causes erosion and sedimentation problems, reduces stream quality, raises the temperature of the streams, impairs the aquatic food chain, and reduces the baseflow of streams which is imperative for aquatic life during the drier summer months. Erosion of the streambanks caused by accelerated stream velocities due to increased runoff is already evident in the middle reaches of Bowman's Creek, along Route 29 in Monroe Township.

There is an increased statewide as well as local recognition that a sound and effective stormwater management plan requires a diversified multiple purpose plan. The plan should address the full range of hydrologic consequences resulting from development instead of simply focusing on controlling site specific peak flow without consideration of including tributary timing of flow volume reduction, base flow augmentation, water quality control and ecological protection.

Managing stormwater runoff on a site-specific basis does not meet the requirements of watershed based planning. The timing of flood peaks for each subbasin within a watershed contributes greatly to the flooding potential of a particular storm. Each stormwater control site within a subbasin should be managed by evaluating the comprehensive picture.

The Bowman's Creek Watershed Stormwater Management Plan provides reasonable regulation of development activities to control accelerated runoff and protect the health, safety and welfare of the public. The Plan includes recognition of the various rules, regulations and laws at the federal, state, county and municipal level. Once implemented, the Plan will aid in reducing costly flood damages by reducing the source and cause of local uncontrolled runoff. The Plan will make municipalities and developers more aware of comprehensive planning in stormwater control and will help maintain the quality of Bowman's Creek and its tributaries.

SECTION III

GENERAL DESCRIPTION OF WATERSHED

Bowman's Creek is located in the northcentral portion of Luzerne County and the southcentral portion of Wyoming County and is contained within six (6) municipalities in Wyoming County and six (6) municipalities in Luzerne County as listed in Table III-1 and illustrated in Figure III-1.

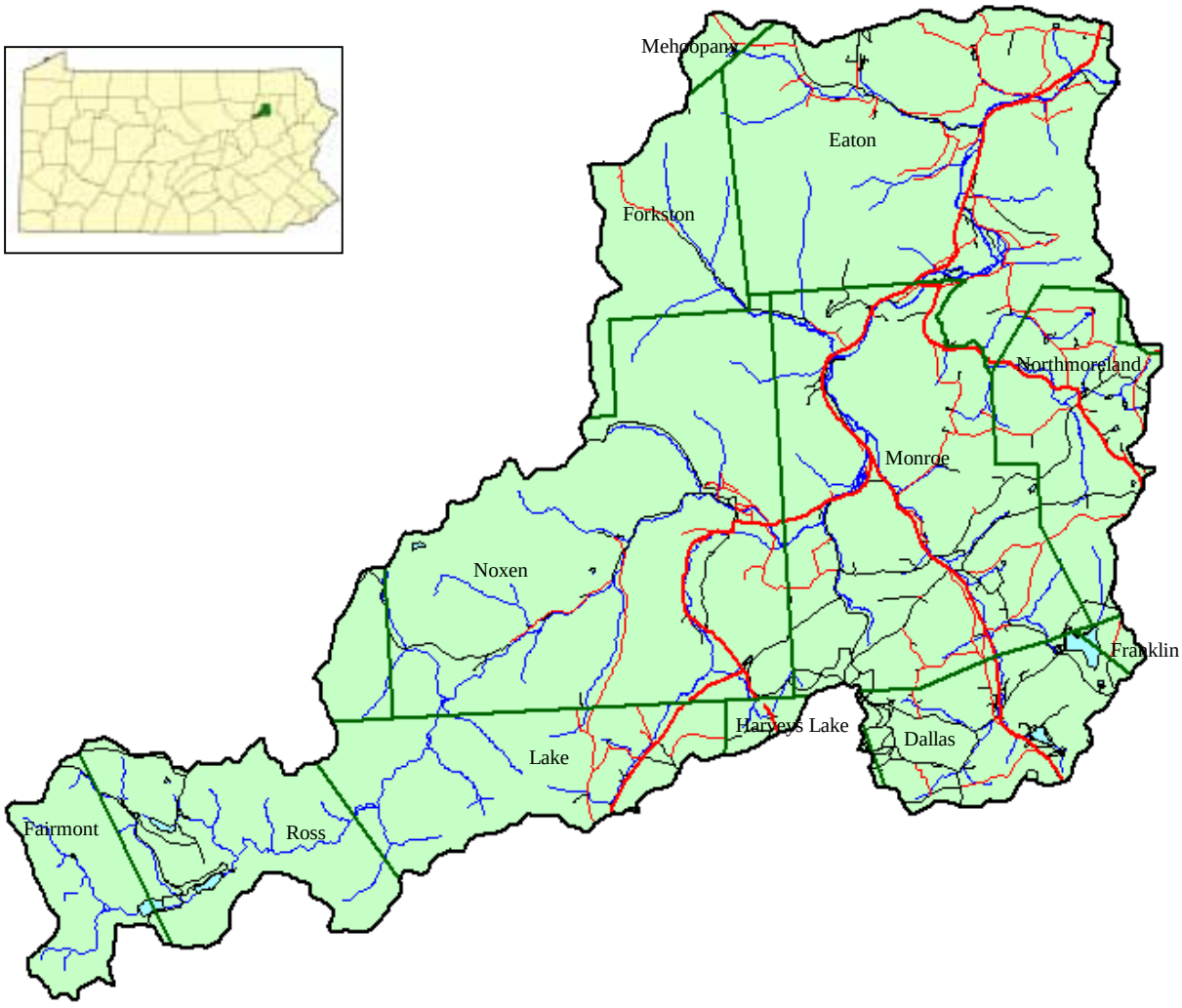


Figure III-1 – Bowman's Creek Watershed Base Map

TABLE III-1
Bowman's Creek Watershed – Municipalities

Wyoming County

1. Eaton Township
2. Forkston Township
3. Mehoopany Township
4. Monroe Township
5. Northmoreland Township
6. Noxen Township

Luzerne County

1. Dallas Township
2. Fairmount Township
3. Franklin Borough
4. Harveys Lake Borough
5. Lake Township
6. Ross Township

A. Data Collection

In order to evaluate the hydrologic response of the watershed, data was collected on the physical features of the watershed as follows:

1. **Base Map:** The base map for Geographic Information System (GIS) generated maps was delineated from the PennDOT 1997 Pennsylvania Cartographic /GIS information CD-ROM. Roads, streams, lakes and municipal boundaries from this CD-ROM were utilized for base mapping purposes. The watershed boundary was digitized from 1:24,000 USGS topographic quadrangles.

2. **Topography:** Subwatersheds or subareas used in the watershed modeling process were developed utilizing U.S.G.S. topographic quadrangles at one inch equals 2,000 feet (1:24,000 scale). Subareas, drainage courses, land slopes and lengths, and drainage element lengths and slopes could all be determined from the base map. The subareas were then digitized into the GIS. A Digital Elevation Model (DEM) for the Bowman's Creek Watershed was also developed.

3. **Soils:** Soil mapping was obtained from the Wyoming and Luzerne County Soil Survey of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) formerly the Soil Conservation Service (SCS). The hydrologic soil groups were digitized using the GIS software and all soil designations for the digitized areas were input into the GIS database. Attributes for Hydrologic Soil Groups (HSG's) were assigned to the attribute table.

4. **Geology:** The digital geology coverage for Wyoming County was obtained from the Pennsylvania Spatial Data Access web site and incorporated into the overall GIS.

5. **Land Use/Zoning:** Existing land use was determined from three primary sources;

U.S.G.S. digital Orthophoto quadrangles (DOQQ's), the U.S.G.S. topographic map and site visits. Soil surveys and personal knowledge were also utilized in this determination. Zoning maps where available for all municipalities within the watershed were digitized into the computer database along with the corresponding zoning district designations to aid in development of the future land use maps. Future land use projections were based upon this zoning and recent development/growth trends.

6. **Wetlands:** Wetlands were obtained from the National Wetlands Inventory Maps in digital format and incorporated into the overall GIS.

B. Drainage Area

Bowman's Creek drains a watershed area of approximately one-hundred twenty (120) square miles. The main sources of Bowman's Creek are Beech and Splash Lakes in Ross Township. Bowman's Creek flows into the Susquehanna River in the Township of Eaton.

The major tributaries to Bowman's Creek are Sugar Hollow Creek, Root Hollow Creek, Leonard Creek, Marsh Creek, Roaring Run, and Beaver Creek. There are also several unnamed tributaries as well.

C. Topography and Streambed Profile

The topography of the watershed ranges from steep hilly terrain in the upper reaches to gently sloping areas in the valley floor. The highest point in the watershed is in Fairmont Township on North Mountain with an elevation of 2470 feet above sea level U.S.G.S. datum. The lowest point occurs at the Susquehanna River confluence with an approximate elevation of 570 feet. The Digital Elevation Model (DEM) for the watershed is displayed in Figure III-2.

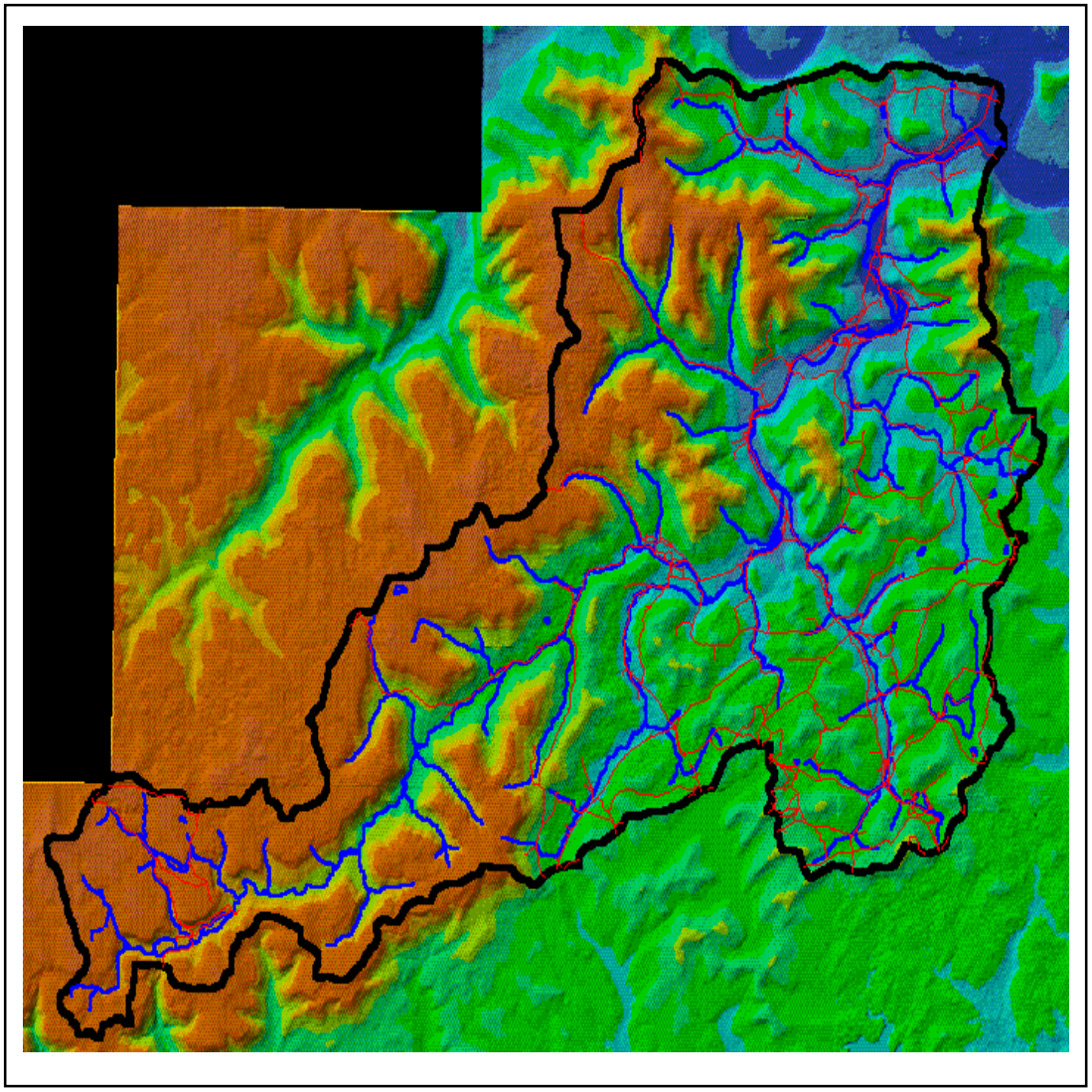


Figure III-2 – Digital Elevation Model

D. Soils

There are four soils associations in the Bowman's Creek Watershed: Wellsboro-Morris-Oquaga, Oquaga-Lackawanna-Arnot, Mardin-Bath-Volusia and Chenango-Wyoming-Pope associations. Soil associations are groups of soils that exhibit a regularly repeating pattern. The four associations are described below and their distribution in Bowman's Creek Watershed is shown in Figure III-3.

1. **Wellsboro-Morris-Oquaga -** The Wellsboro-Morris-Oquaga soil association makes up the eastern half of the watershed. This association consists of nearly level to steep, deep and moderately deep soils that are moderately well drained, somewhat poorly drained, and somewhat excessively drained soils. These soils are on broad rolling uplands and were formed in glacial till derived from sandstone and shale.

2. **Oquaga-Lackawanna-Arnot -** The western portion of the watershed is comprised mostly of the Oquaga-Lackawanna-Arnot soil association. This association is moderately steep and steep, moderately deep, deep, and shallow soils that are somewhat excessively drained. These soils are on mountainsides and were formed in glacial till derived from sandstone and shale.

3. **Mardin-Bath-Volusia -** North of Harveys Lake, the Mardin-Bath-Volusia soil association is found on the rolling uplands. This association formed in glacial till and consists of nearly level to steep, deep soils that are moderately well drained, and somewhat poorly drained.

4. **Wyoming-Pope -** The Wyoming-Pope soil association consists of gravelly sandy loam soils on Bowman's Creek terraces and floodplains. This association is nearly level to steep, deep soils that are somewhat excessively drained and well drained.

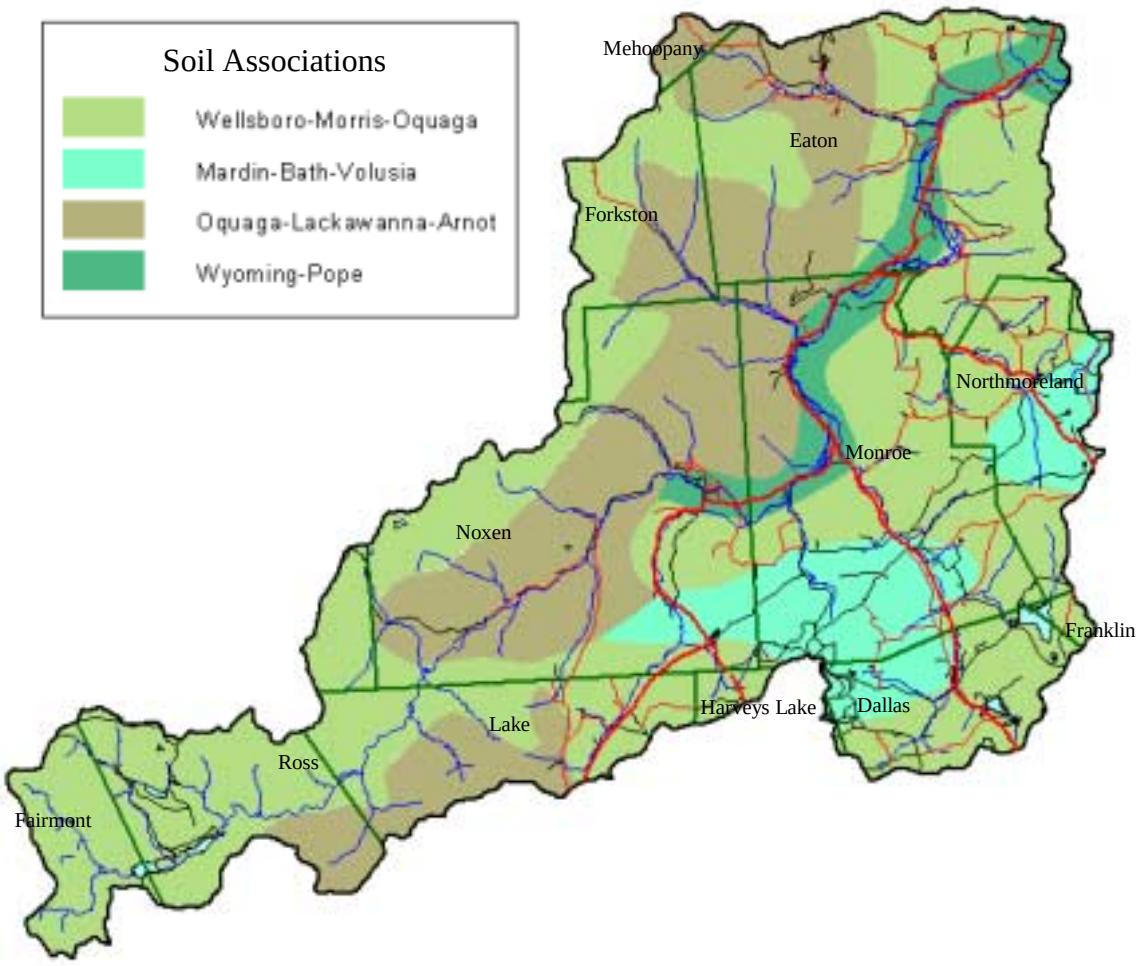


Figure III-3 – Bowman's Creek Watershed Soil Associations

Soil properties influence the runoff generation process. The USDA, Natural Resources Conservation Service (NRCS) has established criteria determining how soils will affect runoff by placing all soils into groups (Hydrologic Soil Groups (HSG's). Hydrologic Soil Groups are broken down into four sub-groups (A through D) based on infiltration rate and depth. The location of the four HSG's in relation to the watershed is shown in Figure III-4. Both A and B soils are found along Bowman's Creek in terraces and floodplains. The A soils are the most pervious and have the lowest runoff potential and are typically sands and gravels. Hydrologic Soils Group B is characterized as having moderate infiltration rates and consist primarily of moderately deep to deep, moderately well to well drained soils that exhibit a moderate rate of water transmission. In the western part of the watershed are the D soils which are tight, low permeable soils with high runoff potential and are typically clay soils. The majority of the soils in the watershed fall in the C hydrologic soil group. Hydrologic Soil Group C has slow infiltration rates when thoroughly wetted and contain fragipans, a layer that impedes downward movement of water and produces a slow rate of water transmission.

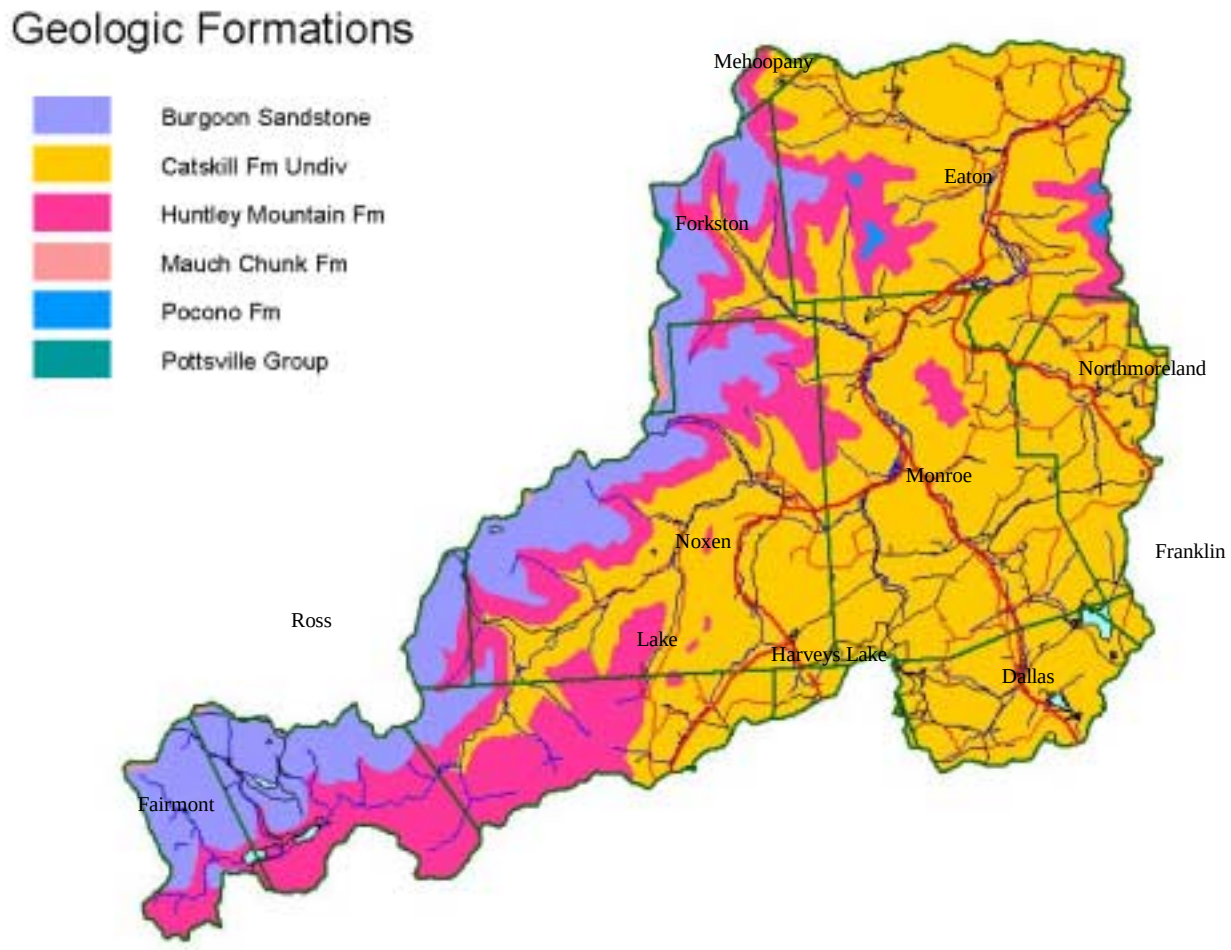
This information was incorporated into the GIS and, from this, the watershed HSG map (Figure III-4) was developed.

Figure III-4 HSG's

E. Geology

Geology plays a direct role in surface runoff in Bowman's Creek because it affects its soil types within the watershed through parent material breakdown. There is no limestone surface geology in the Bowman's Creek Watershed and therefore is no presence of limestone sink holes. The geologic map of the watershed can be found in Figure III-5.

Figure III-5 – Geology in Bowman's Creek Watershed



1. **Burgoon Sandstone** – Buff, medium grained, crossbedded sandstone.

2. **Catskill Formation, Undivided** – Succession of grayish-red sandstone, siltstone, and shale.

3. **Huntley Mountain Formation** – Greenish-gray and light-olive-gray, flaggy, fine-grained sandstone and a few red shale interbeds.

4. **Mauch Chunk Formation** – Grayish-red shale, siltstone, sandstone, and some conglomerate; some local nonred zones.

5. **Pocono Formation** – Light gray to buff or light-olive gray, medium grained, crossbedded sandstone and minor siltstone.

6. **Pottsville Group** – Predominantly gray sandstone and conglomerate; also contains thin beds of shale, claystone, limestone, and coal.

F. Climate

Wyoming and Luzerne Counties are in the path of air masses that originate in western and central Canada. These air masses interact with the warm air from the Gulf of Mexico to produce generous precipitation throughout the year. The higher elevations receive additional precipitation because of upslope motion.

Summers are generally warm, and maximum temperatures average in the low to mid 80's. Occasional higher temperatures occur when warm air moves into the area from the southwest. The annual precipitation is approximately thirty-seven (37) inches with an average of seven thunderstorms during each of the summer months. Heavy rainfall associated with tropical storms and hurricanes moving up the coast occasionally reach Wyoming and Luzerne Counties.

Winter is characterized by cold temperatures and cloudy skies. Daytime temperatures average in the mid to upper 30's at the lower elevations. Higher elevations may have freezing temperatures on 150 days of the year. On 50 of these days, the maximum temperature may be at or below freezing. Winter precipitation is light but frequent. The lower elevations receive most precipitation in the form of rain, whereas the higher elevations receive most in the form of snow. Annual snowfall ranges from about 15 inches at the lower elevation to more than 70 inches at the higher elevations.

Spring and fall are characterized by rapidly changing weather patterns. Alternate periods of freezing and thawing are common during both seasons. The length of the growing season at the lower elevations can range from 120 to 200 days, whereas at the higher elevations it can range from 120 to 180 days.

G. Land Use

The majority of the townships within the watershed is predominantly rural in nature and is largely undeveloped. The predominant land use in the watershed is forest. Farming holds a small percentage of land use within the watershed, and in recent years, there has been a slight decrease in the amount of land being farmed as residential areas grow. Residential and commercial development is mostly concentrated in the vicinities of Routes 29, 309, and 292, and future development is expected to occur primarily along these major transportation arteries.

Figure III-6 displays the existing land use of the watershed while Table III-2 shows the overall land use by category within Bowman's Creek Watershed.

TABLE III-2
Land Use Status by Category

	BOWMAN'S CREEK	
LANDUSE	**SQ MI.**	**PERCENT**
Agricultural	3.10	2.59%
Commercial	0.12	0.10%
Farmstead	0.23	0.19%
Forest	99.30	82.98%
Meadow	12.52	10.46%
Mining	0.07	0.06%
Open Space	0.05	0.04%
Orchard	0.16	0.13%
R-1 (2 to 4 acres)	3.21	2.68%
R-2 (1/2 to 1 acre)	0.12	0.10%
R-3 (1/4 to 1/3 acre)	0.04	0.03%
R-4 (1/8 acre or less)	0.05	0.04%
Water	0.71	0.60%
Total	**119.68**	**100.00%**

Figure III-6

H. Land Development Patterns

Overall, potential development pressures may be minimal. Yet, development pressures in a few select areas will be great. Commercial and industrial development will most likely be confined to areas where public water and sewer may become available. These areas include the Route 415, 29 and 309 corridors. Single lot residential development will continue to occur sporadically throughout the watershed.

Table III-3 provides an overview of the types of development that will occur when existing patterns are considered for each municipality within the watershed.

TABLE III-3
Development Potential by Municipality
Based Upon Existing Patterns in Bowman's Creek Watershed

Municipality	R-4	R-3	R-2	R-1	I	C	OS	F
Dallas Township	-	-	-	O	-	-	-	r
Eaton Township	-	-	O	O	-	-	-	r
Fairmount Township	-	-	-	-	-	-	-	-
Forkston Township	-	-	-	-	-	-	-	-
Franklin Township	-	-	-	-	-	-	-	-
Harveys Lake Borough	-	-	-	O	-	-	-	r
Lake Township	-	-	-	O	-	-	-	r
Mehoopany Township	-	-	-	-	-	-	-	-
Monroe Township	-	-	O	O	-	-	-	r
North Moreland Twp.	-	-	-	O	-	-	-	r
Noxen Township	-	-	O	O	-	-	-	r
Ross Township	-	-	-	-	-	---	-	-

R-4 Residential Lots (1/8 acre or less)
R-3 Residential Lots (1/4 ac. - 1/3 ac)
R-2 Residential Lots (1/2 ac. - 1 ac.)
R-1 Residential Lots (greater than 1 acre)
I Industrial
C Commercial
OS Open Space
F Forest

--- No Impact
O Minor Impact
X Major Impact
r Reduction in Land Use

A future land use scenario was developed with the help of any existing zoning maps, the comprehensive plan and by developing land growth trends. The future land use map for the year 2010 projection is shown in Figure III-7. These increased impervious areas were then included in the Penn State Runoff Model to develop a future condition flows for the 2, 5, 10, 25, 50 and 100-year storms. A comparison of peak flows for the 100-year storm for future and existing conditions can be found in Table III-4.

The future 100- year storm hydrograph peak was found to be approximately ***100.07%*** of the present 100- year storm hydrograph at the Bowman's Creek outlet. Table III-4 summarizes the flows for each subwatershed for existing conditions and for the 2010 future land use projection, assuming proper stormwater management facilities are not installed.

Other storm frequencies can be found in the Technical Appendix. Increased development in a watershed increases runoff peaks, volumes and velocities which decrease the time to peak, increasing the frequency of flooding.

<BLANK PAGE>

TABLE III-4
Present Versus Future Combined Peak Flows –
100-Year 24-Hour Storm

Note: The computed flow values were derived for watershed planning purposes and should not be considered regulatory values for permitting purposes. While they may be used for comparison or checking purposes, additional hydrologic computations may be needed for the design of bridges, culverts and dams.

Subarea No.	Existing Peak Q (cfs)	100-Year Projection Future Peak Q (cfs)	Subarea No.	Existing Peak Q (cfs)	100-Year Projection Future Peak Q (cfs)
1	1,623	1,623	34	2,876	2,879
2	608	607	35	2,935	2,937
3	2,249	2,249	36	2,887	2,889
4	21	21	37	12,314	12,316
5	295	295	38	12,442	12,443
6	944	943	39	1,843	1,846
7	3,205	3,205	40	1,816	1,818
8	6,194	6,194	41	13,883	13,888
9	1,271	1,271	42	14,285	14,289
10	1,116	1,116	43	1,356	1,356
11	2,354	2,354	44	395	395
12	7,235	7,234	45	1,725	1,725
13	7,887	7,887	46	1,746	1,746
14	1,555	1,554	47	1,923	1,925
15	8,702	8,702	48	2,705	2,705
16	8,972	8,972	49	221	221
17	2,370	2,370	50	525	527
18	9,571	9,571	51	3,057	3,057
19	10,301	10,301	52	3,085	3,087
20	10,424	10,423	53	197	197
21	1,743	1,743	54	1,584	1,593
22	1,854	1,857	55	571	571
23	11,398	11,399	56	3,645	3,648
24	11,310	11,310	57	3,750	3,752
25	11,390	11,390	58	3,736	3,738
26	1,885	1,886	59	1,161	1,162
27	1,838	1,839	60	3,879	3,881
28	804	805	61	3,859	3,861
29	1,112	1,113	62	3,796	3,798
30	609	609	63	1,099	1,099
31	1,325	1,331	64	3,858	3,860
32	1,460	1,465	65	3,858	3,861
33	3,007	3,009	66	16,539	16,548

TABLE III-4 (Cont.)
Present Versus Future Combined Peak Flows –
100-Year 24-Hour Storm

Subarea No.	Existing Peak Q (cfs)	100-Year Projection Future Peak Q (cfs)	Subarea No.	Existing Peak Q (cfs)	100-Year Projection Future Peak Q (cfs)
67	16,514	16,526	100	5,057	5,058
68	1,008	1,008	101	24,247	24,262
69	16,682	16,694	102	1,595	1,596
70	16,579	16,591	103	24,332	24,347
71	3,270	3,270	104	24,216	24,232
72	3,375	3,376	105	793	808
73	6,729	6,729	106	24,242	24,259
74	2,814	2,814	107	24,194	24,210
75	7,401	7,401	108	795	796
76	6,226	6,226	109	24,244	24,261
77	20,551	20,561	110	24,023	24,038
78	20,937	20,949			
79	782	783			
80	20,904	20,917			
81	1,947	1,947			
82	1,892	1,894			
83	3,724	3,726			
84	3,038	3,040			
85	1,503	1,503			
86	3,296	3,298			
87	1,821	1,821			
88	3,565	3,567			
89	3,636	3,638			
90	24,464	24,478			
91	24,158	24,172			
92	23,933	23,948			
93	2,009	2,010			
94	23,900	23,915			
95	2,147	2,147			
96	1,870	1,870			
97	4,416	4,417			
98	663	663			
99	4,788	4,789			

I. Present and Projected Development in the Flood Hazard Areas

The U.S. Department of Housing and Urban Development, Federal Insurance Administration, Federal Emergency Management Agency (FEMA) has prepared Flood Insurance Studies (FIS's) and mapping for the following municipalities in Bowman's Creek Watershed: Dallas Township, Eaton Township, Forkston Township, Lake Township, Monroe Township, Northmoreland Township, Noxen Township, and Ross Township. These studies were completed between November of 1979 to July of 1990.

There are two types of studies conducted in the FIS program: detailed and approximate. Detailed methods included hydrologic computations and detailed HEC-2 backwater computations. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction. Those areas studies by the approximate methods were those having low development potential or minimal flood hazards.

Figure III-8 shows the 100-year floodplains, classified as detailed and approximate, as taken from the FEMA mapping for Bowman's Creek Watershed. Infringements of residential, industrial, and commercial areas are clearly shown by overlaying these areas on the floodplain in the GIS. Table III-5 outlines this type of development and land use that infringe upon the floodplain by municipality, general location, and creek or tributary. Municipalities and the Pennsylvania Department of Community and Economic Development (PACED) should be contacted as to the latest FIS studies before use.

TABLE III-5
Bowman's Creek Present Residential And Commercial Areas
Within 100-Year Floodplain

Municipality	Stream/Lake	Land Use Infringing on Flood Boundary	General Location
Dallas Twp	Leonard Creek	R1, Commercial	Along Kunkle Road and SR 0309 at and around Kunkle Corners
Eaton Twp.	Bowman's Creek	R1	On SR 0309 at municipal boundary
		R1	On Township Road near south boundary of municipality
		R1, Mining	Various locations on 3.5 mile stretch of SR 0029
Fairmount Twp.	-	-	-
Forkston Twp.	-	-	-
Franklin Twp.	-	-	-
Harveys Lake Boro.	Tributary to Beaver Run	R1	0.73 mile South of SR 0029 and 0415 intersection on SR 0415
Lake Twp.	Beaver Run	R1	Various locations along 1 mile stretch of SR 0029
Mehoopany Twp.	-	-	-

Figure III-8 Land Development in Floodplains

TABLE III-5 (Cont.)
Bowman's Creek Present Residential And Commercial Areas Within 100-Year Floodplain

Municipality	Stream/Lake	Land Use Infringing on Flood Boundary	General Location
Monroe Township	Leonard Creek	R1	Along SR 0309 from municipal boundary to intersection of SR 0309 and 0029
	Tributary 1 to Leonard Creek	R3	At SR 2018 and crossing of stream
Dallas Twp	Leonard Creek	R1, Commercial	Along Kunkle Road and SR 0309 at and around Kunkle Corners
Eaton Twp.	Bowman's Creek	R1	On SR 0309 at municipal boundary
		R1	On Township Road near south boundary of municipality
		R1, Mining	Various locations on 3.5 mile stretch of SR 0029
Fairmount Twp.	-	-	-
Forkston Twp.	-	-	-
Franklin Twp.	-	-	-
Harveys Lake Boro.	Tributary to Beaver Run	R1	0.73 mile South of SR 0029 and 0415 intersection on SR 0415
Lake Twp.	Beaver Run	R1	Various locations along 1 mile stretch of SR 0029
Mehoopany Twp.	-	-	-
Monroe Township	Leonard Creek	R1	Along SR 0309 from municipal boundary to intersection of SR 0309 and 0029
	Tributary 1 to Leonard Creek	R3	At SR 2018 and crossing of stream
	Tributary 2 to Leonard Creek	R1, Farmstead	Along SR 2020
	Tributary 3 to Leonard Creek	R1	0.95 mile East of SR 0029 and 0309 intersection on Township Road
	South Run	Farmstead	At crossing of SR 2018 and South Run
	South Run	R1	On SR 2001 at the two crossings with South Run
	Bowman's Creek	R1	Along SR 0029 from confluence with South Run to intersection of SR 0029 and 0309
	Bowman's Creek	R1	Along SR 0029 near municipal boundary

TABLE III-5 (Cont.)
Bowman's Creek Present Residential And Commercial Areas
Within 100-Year Floodplain

Municipality	Stream/Lake	Land Use Infringing on Flood Boundary	General Location
Northmoreland Twp.	Marsh Creek	R1	0.26 mile East of municipal boundary on SR 0292
	Marsh Creek	R1	At crossing of SR 2002 and stream
	Tributary to Marsh Creek	R1, R4	On SR 0292 and 2002 at stream crossing
		Farmstead	
	Tributary to Marsh Creek		At crossing of stream with Township Road
Noxen Twp.	Beaver Run	R1	0.5 mile Southwest of SR 3002 and 0029 intersection
	Beaver Run	R1	At confluence of Beaver Run and Bowman's Creek
	Bowman's Creek	R1	At confluence of Beaver Run and Bowman's Creek
	Bowman's Creek	R1, R2	Along SR 3002
	Bowman's Creek	R1	Along Township Road between Broad Hollow Run and Sorber Run
Ross Twp.	-	-	

NOTE: "-" means no flood data or land use infringements in the Bowman's Creek Watershed for this municipality.

The more credits a community can accumulate, the less its residents will have to pay for flood insurance. For further information, the publication "*CRS Credit for Stormwater Management*", July 1996, published by FEMA, available at the County Planning Commission office should be consulted.

J. Obstructions

Locations of significant waterway obstructions (i.e., culverts, bridges, etc.) were obtained by inspection of and digitizing from the U.S.G.S. topographic base map. Data on these obstructions was then obtained from the Pennsylvania Department of Transportation (PaDOT), F.E.M.A. Flood Insurance Studies, and field surveys.

The obstruction capacities were then compared to the peak flow at that point derived through the modeling process for each design storm frequency. The obstructions were then classified into seven categories as follows:

* Those obstructions which are able to pass the 100-year, 24-hour storm without obstructing the flow.

* Those obstructions which are able to pass the 50-year, 24-hour storm without obstructing the flow.

* Those obstructions which are able to pass the 25-year, 24-hour storm without obstructing the flow.

* Those obstructions which are able to pass the 10-year, 24-hour storm without obstructing the flow.

* Those obstructions which are able to pass the 5-year, 24-hour storm without obstructing the flow.

* Those obstructions which are able to pass the 2-year, 24-hour storm without obstructing the flow.

* Those obstructions which are not able to pass the 2-year, 24-hour storm and greater without obstructing the flow.

The locations of all obstructions, including those that fall into the seven categories above, can be found in Figure III-9. The obtained data and the obstruction flow capacities based upon inlet control conditions can be found in the Technical Appendix.

K. Existing Drainage Problems and Proposed Solutions

Information on drainage problems and proposed solutions was solicited from each municipality within the Bowman's Creek Watershed by providing forms to each Watershed Plan Advisory Committee (WPAC) member early in the Watershed Plan study.

Problems were discussed at the WPAC meetings and were primarily minor, usually very local in nature, consisting of mostly clogged or undersized inlets and cross pipes.

Table III-6 summarizes the problems discussed. These are shown graphically in Figure III-10 (Stormwater Problem Areas, Flooding, and Stormwater Control Facilities). Solutions have been proposed both formally and informally as a result of WPAC discussions.

Eight (8) problem areas were identified in this study, including several types of problems. The type, cause, and occurrence of these problems are indicated on Table III-6. The categories selected in Table III-6 typically have similar causes and solutions that are discussed below.

Figure III-9

Figure III-10

TABLE III-6
Bowman's Creek Watershed Problems

MUNICIPALITY	TYPE OF PROBLEMS	CAUSES OF PROBLEMS	OCCURRENCES OF PROBLEMS	TYPES OF DAMAGE
	(A)	(B)	(C)	(D)
Monroe Township	1,2,3,6	1,2,3,4	1,2	2,3
Northmoreland Twp.	2	1,2,3	1	3
Noxen	1,2	1,2,3	3	3

Types of Problems:
(A) 1. Flooding
2. Accelerated Erosion
3. Sedimentation
4. Landslide
5. Groundwater
6. Water Pollution
7. Other

Causes of Problems:
(B) 1. Stormwater Volume
2. Stormwater Velocity
3. Stormwater Direction
4. Water Obstruction
5. Other

Occurrences of Problems:
(C) 1. > 1 time per year
2. < 1 time per year
3. Only major flood events

Types of Damage:
(D) 1. Loss of life
2. Loss of vital services
3. Property damage

Erosion and Sedimentation (E & S)

The Wyoming and Luzerne County Conservation Districts are responsible for administering Title 25, Chapter 102 (Erosion Control Regulations). These regulations address accelerated erosion and the resulting sedimentation from earthmoving activities. Permanent stabilization of exposed areas and proper stabilization of channels of conveyance will reduce erosion problems.

Storm Sewers, Culverts, and Outlets

Some of the problems identified in Table III-6 are the result of inadequately sized storm culverts, and/or unstable outlets that traverse state, township, or private roads. The typical solution involves performing a hydrologic study to determine pipe size and replacing the pipe with a properly sized unit. Costs are typically borne by the owner of the road.

Bridges

Because of the high bedloads of streams within the watershed, gravel deposits threaten bridge capacity in addition to the inadequate waterway opening. The proposed solution typically involves performing a hydrologic study and increasing the hydraulic capacity underneath the roadway. Costs are typically borne by the owner of the bridge.

Flooding

Bowman's Creek and its tributaries have caused flooding conditions in the Bowman's Creek Watershed. The areas within the watershed immediately adjacent to Bowman's Creek and various low lying wetland areas are generally subject to minor flooding after rain or thaw conditions. Flooding in the watershed can be classified into two categories: 1) local flooding caused by inadequately sized storm culverts; and 2) flooding caused by the location of structures within the floodplain of the major tributaries. Of the sites identified in Table III-6, most are caused by inadequate conveyance systems in developed areas.

L. Existing and Proposed Stormwater Collection Systems

There are no existing Stormwater collection systems in Bowman's Creek Watershed and no proposed Stormwater collection systems for the next ten years.

M. Existing and Proposed State, Federal and Local Flood Control Projects

At present, there are no existing flood control projects and no known flood control projects proposed for the next ten years in Bowman's Creek Watershed.

N. Existing and Proposed Stormwater Control Facilities

Due to the rural nature of the watershed and the fact that the largest projects are constructed by the private sector, there are no municipal stormwater control facilities proposed for the next ten years. There are three known private stormwater control facilities as shown in Figure III-10. The cost, design, capacity, construction and operation of these private facilities cannot be projected at this time since they occur on a case by case basis as a developer buys land, submits plans, and develops the tract. Typically, the cost of such facilities is paid through the developer's financing with costs transferred to the buyer.

The lakes/dams in Bowman's Creek Watershed which impact the hydrology of the watershed are Beech Lake Dam, The Meadows Dam, Splash Dam, Dam No. 2, Shady Side Lake (Elstons Ponds) and Lake Catalpa Dam. The attenuation each provides for the 100-year storm is provided in Table III-7.

TABLE III-7
100-Year Flow Attenuation

Lake	Subarea	100-year Flow (cfs) Into Dam	Out-of-Dam	Maximum Storage Volume (AC-FT)*
Dam No. 2 (Mt. Spring Lake)	1	2498.2	1622.9	94.1
The Meadows	2	1158.5	607.5	66.0
Splash Dam	3	2582.7	2248.8	125.9
Beech Lake	4	240.6	20.7	19.8
Elstons Pond	49	1125.1	221.0	75.4
Lake Catalpa	53	1932.9	197.3	729.6

*Storage above normal pool volume

O. Wetlands

Wetlands were obtained from the National Wetlands Inventory Maps in digital format and incorporated into the overall GIS. Figure III-11 shows the wetlands for the watershed.

Wetlands play an important part in flood flow attenuation and pollutant filtering. Wetlands are prevalent along Bowman's Creek's overbanks and their attenuation was accounted for in the computer modeling CTS value. Wetlands should be preserved through the joint permit application process.

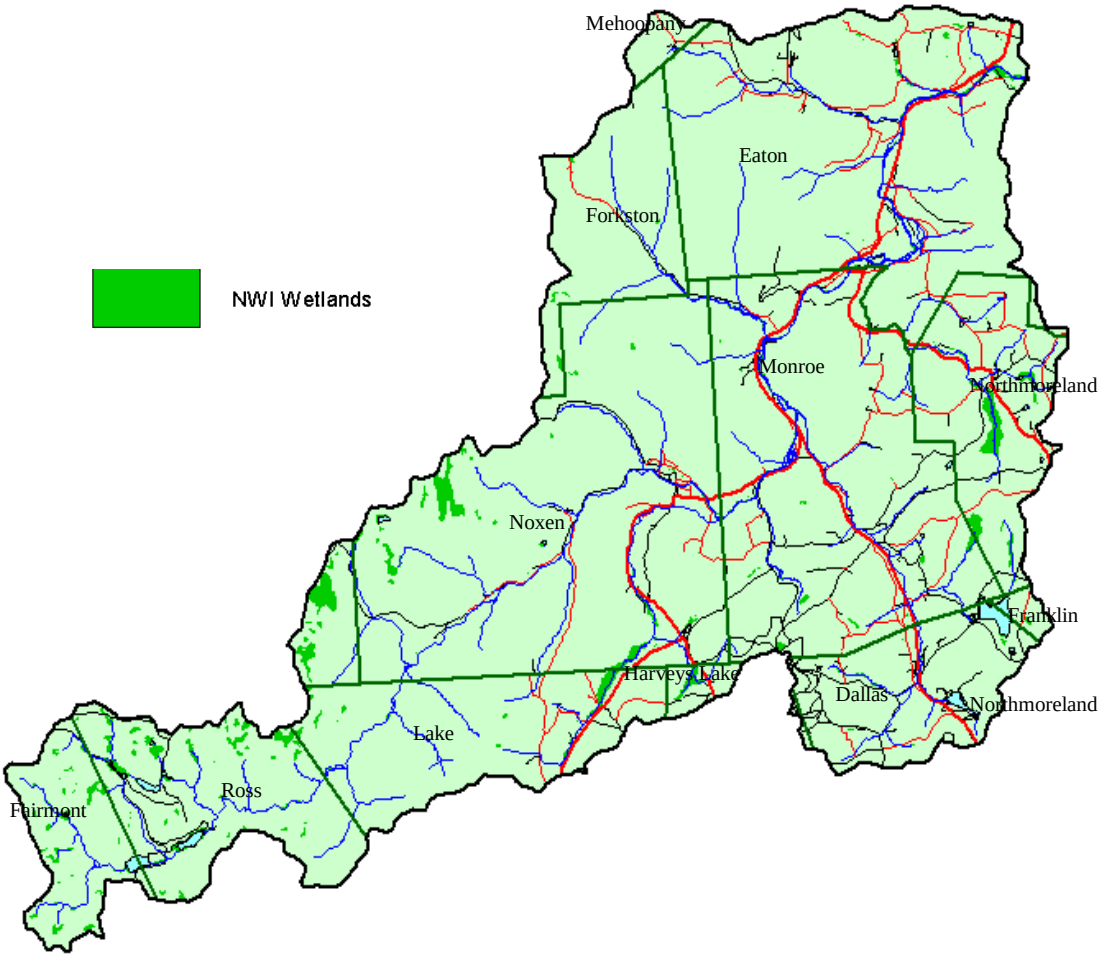


Figure III-11 –Bowman's Creek Wetlands

SECTION IV

WATERSHED TECHNICAL ANALYSIS

A. Watershed Modeling

An initial step in the preparation of this stormwater management plan was the selection of a stormwater simulation model to be utilized. It was necessary to select a model which:

* Modeled design storms of various durations and frequencies to produce routed hydrographs which could be combined.

* Was adaptable to the size of subwatersheds in this study.

* Could evaluate specific physical characteristics of the rainfall-runoff process.

* Did not require an excessive amount of input data yet yielded reliable results.

The model decided upon was the Penn State Runoff Model (PSRM) for the following reasons:

* It had been developed at the Penn State University specifically for the analysis of the timing of surface flow contributions to peak rates at various locations in a watershed.

* Although originally developed as an urban runoff simulation model, data requirements make it easily adaptable to a rural situation.

* Input parameters provide a flexible calibration process.

* It has the ability to analyze reservoir or detention basin routing effects and location in the watershed.

* It is accepted by the Pennsylvania Department of Environmental Protection.

Although other models, such as TR-20, may provide essentially the same results as the Penn State Runoff Model, PSRM's ability to compare subwatershed contributions in a Peak Flow Presentation Table make it specifically attractive for this study. The Penn State Runoff Model generates runoff flow information for selected subareas along the drainage course and compares individual subarea contributions to the total runoff process. The model generates runoff quantities for a specified design storm based upon the physical characteristics of the subarea, and routes the runoff flow through the drainage system in relation to the hydraulic characteristics of the stream. The amount of runoff generated from each subarea is a function of its slope, soil type or permeability, percent of the subwatershed that is developed, and its vegetative cover. Composite runoff curve numbers were generated by overlaying the land use map with the subarea and hydrologic soil groups maps. The generated curve numbers were then

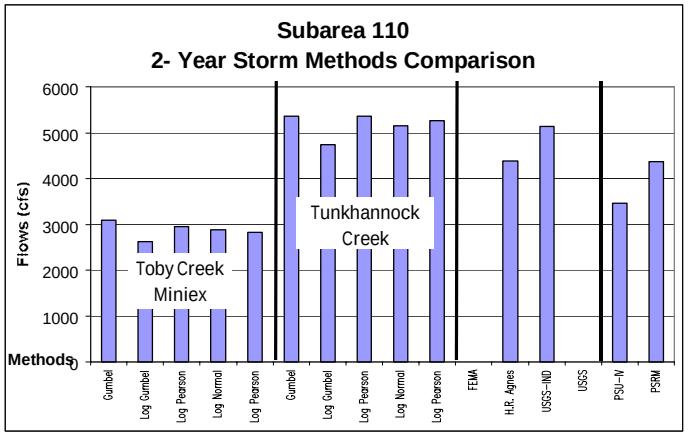
used for input into the computer model. Figure IV-1 displays the subarea delineation for Bowman's Creek Watershed on digital USGS Quadrangles.

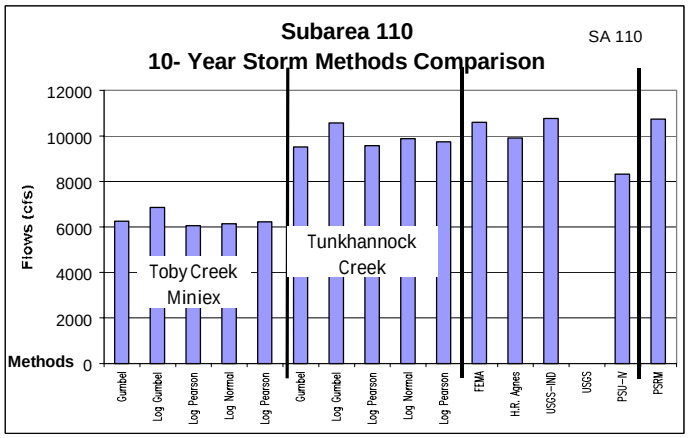
B. Calibration

All simulation models involve a significant degree of subjective input in their development. Values are chosen for various hydrologic parameters describing the runoff characteristics of a watershed which represent average or expected behavior in watersheds of similar soils, slopes, etc. The specific hydrologic characteristics of an individual watershed are not necessarily reflected in such average values. Therefore, the model needs to be fine tuned, or calibrated, to provide a more accurate representation of the real runoff and timing conditions of a watershed. Calibration of a model involves the adjustment of input parameters, within acceptable value ranges, to reproduce the recorded response of an actual storm event. To simulate a specific event, antecedent moisture conditions and rainfall distribution must be duplicated in the model input. Adjustments to other parameters are then made to attempt to duplicate hydrograph shapes and peak flow rates at points in the watershed where flow recordings were made.

In order to maximize the accuracy of the PSRM model, a calibration effort was undertaken. At several key points in the watershed, PSRM generated flows were compared to discharges developed from available regression models historically used in the estimation of peak design storm flows on large watersheds. FEMA Flood Insurance Studies (FIS) were also referenced in areas where detailed floodplain information was available. FIS cross sections were referenced for Mannings 'n' values, channel capacities, channel and overback velocities. Certain areas were field verified.

There are several potential calibration parameters within PSRM. These include initial abstraction, surface roughness, overland flow widths, runoff curve numbers, and hydrograph routing velocities and travel times. After several efforts on sensitivity analyses of each of these parameters, it was determined that the surface roughness factors, specifically the overland flow pervious Manning's "n" value, the in stream to overbank flow velocity ratio, and initial rainfall abstraction, were the most sensitive parameters. These numbers could be revised with confidence, while remaining within an acceptable range of values, for similar soil and sloped subareas, to arrive at flow values developed in the regression analyses. For calibration purposes, the 2-, 10- and 100- year design storms were focussed upon to compare PSRM generated flow to those developed by the regression models and in available FEMA Flood Insurance Studies. Figure IV-2 show results of the peak flow values developed by the calibrated PSRM model compared to predicted flow values determined from several regression methods at the mouth of Bowman's Creek Watershed (Subarea 110). Table IV-1 compares the calibrated PSRM model to flood flow values determined by FEMA at several locations throughout the watershed. It should be noted that regression methods oftentimes do not account for localized variables such as soils and topography. Therefore, the results may vary on a subwatershed basis.





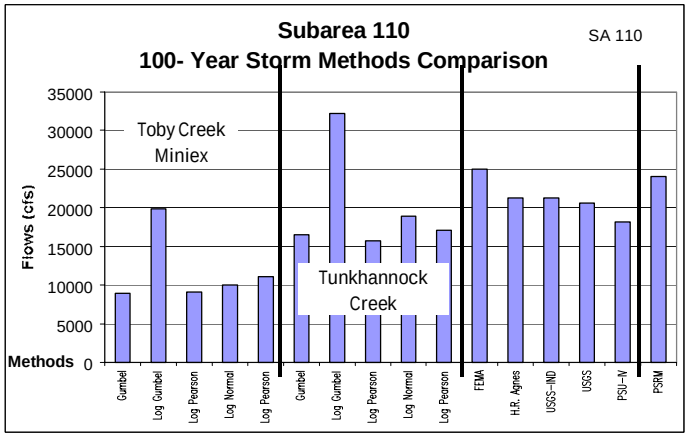


FIGURE IV-1
2, 10 and 100- Year Calibrated Model Comparison at Subarea 110

<BLANK PAGE - SUBWATERSHED ON DRG MAP>

TABLE IV-2
Comparison of Calibrated PSRM Model To
10-, 50- & 100- Year FEMA Flow Values

Subarea No.	Calibrated PSRM Flows (cfs)			FEMA Flows (cfs)		
	10- Year	50- Year	100- Year	10- Year	50- Year	100- Year
70	7,099	12,522	16,579	-	-	16,100
80	9,308	15,891	20,904	8,700	16,100	20,900
110	10,755	18,317	24,023	10,600	19,800	25,000

C. Modeling Process

After delineating the Bowman's Creek watershed on the U.S.G.S. topographic map, the watershed was subdivided into subwatersheds for modeling purposes. The main considerations in the subdivision process were location of obstructions and tributary confluences. This process resulted in a few exceedingly large subareas that were further subdivided. The most downstream point of each of these areas is considered a "point of interest" in which increased runoff must be analyzed for its potential impact.

The ultimate goal for selecting the key points of interest is to provide overall watershed stormwater runoff control through effective control of individual subarea storm runoff. Thus, comprehensive control of stormwater runoff in the entire watershed can be achieved through stormwater management in each subbasin.

The watershed was then modeled to determine the hydrologic response for the 2, 5, 10, 25, 50, and 100-year storm events for the 24-hour storm, the results of which can be found in the Technical Appendix.

The modeling process addressed:

* peak discharge values at various locations along the stream and its tributaries;

* time to peak for the above discharges;

* runoff contributions of individual subareas at selected downstream locations; and

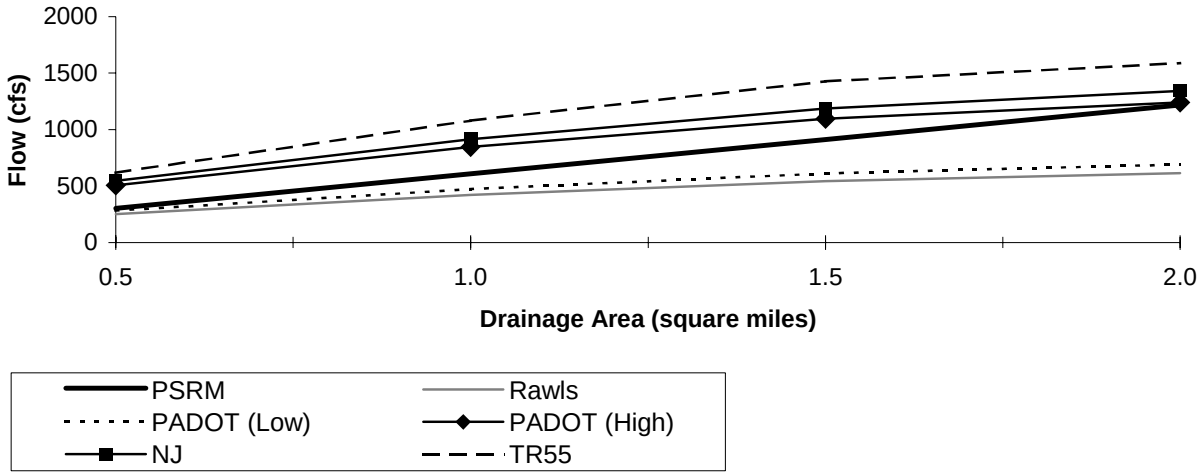
* overall watershed timing.

The calibrated model was also run under different scenarios to compare results obtained by the model with results from various other calculation methodologies. This evaluation was conducted

to determine other engineering methods applicability in generating stormwater flows within the watershed. These other methods, which included the S.C.S. Tabular Method and Rational Method were analyzed for watershed areas from 0.5 to 2.0 square miles. For the Rational Method, various sources of Rational "C" coefficients were referenced. Results for these methods were then compared with results generated from runs on the calibrated PSRM model. Figure IV-3 summarized these comparisons.

Results from this comparison show that utilizing the S.C.S. curve numbers and Rational "C" values specified by Rawls, et al. (1981) and as given in Ordinance Appendix B, either the curve number method or Rational Method could be used in determining pre- and post-development runoff peak rates.

Figure IV-3
Hydrologic Method Comparison



SECTION V

STANDARDS AND CRITERIA FOR THE CONTROL OF STORMWATER

A. Watershed Level Control Philosophy

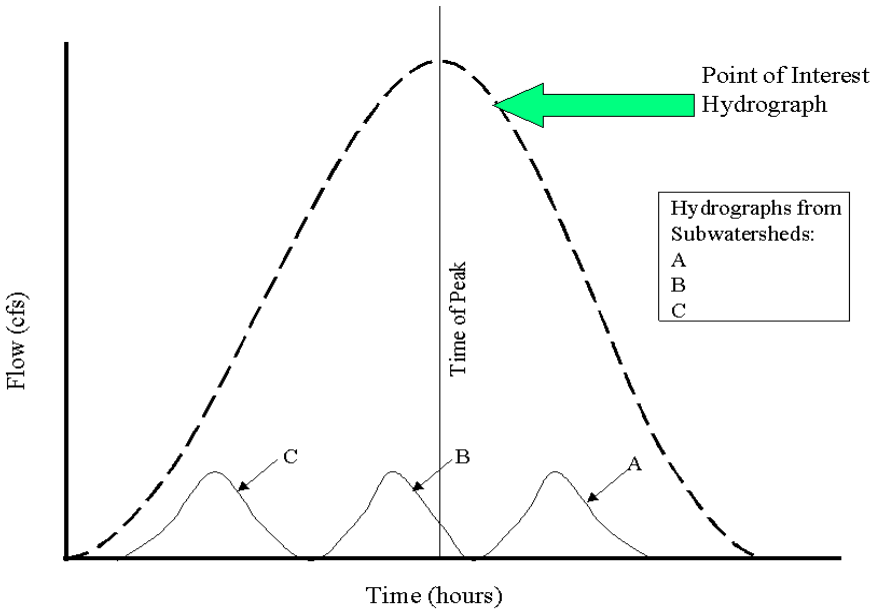
An increase in development, and in turn an increase in impervious surfaces, results not only in an increase in runoff peaks but also increases runoff volume. The primary difference between on-site runoff control philosophy and the watershed level philosophy is the manner in which runoff volume is managed. Conventional on-site control philosophy has as its goal control of the runoff peak from the site. Although there are numerous volume controls which can be implemented on-site such as infiltration basins, porous pavement, etc. these controls are typically implemented to control the runoff peak. Any volume control provided by these measures would be an added benefit. Only under very unusual circumstances (e.g., a very small development) could the total volume of runoff be kept at the level of existing conditions. The proposed watershed level runoff control philosophy seeks to manage the increase in runoff volumes such that the peak rates of runoff throughout the watershed are not increased and it does not necessarily attempt to reduce post development volumes. The basic goal is therefore the same for both on-site and watershed level philosophies; however, the means by which this is achieved are different.

B. Description of Management Districts

The timing of runoff from a development site in a particular subarea in relation to the time and peak site of flows at the points of interest (POI) (subarea outlets) dictate how the runoff in a particular subarea should be managed.

Figure V-1 shows a simplified version of how various subarea hydrographs would contribute to the peak flow at a particular point of interest. As can be seen from Figure V-1, hydrograph "A" peaks after the point of interest hydrograph. In this case, standard detention or reducing post-development flows to pre-development rates would attenuate the flows past A's peak, which would not influence the peak of the POI. A development site in subarea B would contribute flow at a time between the start and end of that subareas hydrograph, and standard detention would attenuate flow to a point where it is increasing flow at the POI; therefore, stormwater management controls would need to reduce the outflow to a higher frequency (smaller) storm. Flows in subarea C enter and exit the stream system before the peak flow occurred at the POI; therefore, it would be advantageous to not detain, if possible. Subareas A, B, and C on the sample would fall into districts A, B, and C as shown on Appendix D of the Model Ordinance. Development of the design storm criteria was based upon downstream obstruction capacities and problem areas identified in the study, as well as the overall goal of maintaining existing conditions flow at all points in the watershed in the future.

Figure V-1
Relative Timing of Subwatershed Hydrographs



In performing the tasks for the Bowman's Creek Watershed Plan under Act 167, a major goal was to determine where in the watershed Stormwater detention was appropriate for new development and, just as importantly, where detention was not appropriate. It was also important to determine to what extent stormwater detention would be required in individual subareas as described above. In the table below, the peak rate of post-development runoff would have to be reduced to the peak rate of predevelopment runoff for the design storms specified. Individual subareas would fall into one of three districts:

District	**Post-Development**	**(reduced to)**	**Pre-Development**
A	2-year		1-year
	5-year		5-year
	10-year		10-year
	25-year		25-year
	100-year		100-year
B	2-year		1-year
	5-year		2-year
	10-year		5-year
	25-year		10-year
	100-year		100-year

C	ND*	ND*

ND* Development sites which can discharge directly to a stream or watercourse main may do so without control of post-development peak rate of runoff. If the post-development runoff is intended to be conveyed to a stream or watercourse, assurance must be provided that such system has adequate capacity to convey the increased peak flows. When adequate capacity of a downstream system does not exist and will not be provided through improvements, the post-development peak rate of runoff must be controlled to the pre-development peak rate as required in District A provisions (post-development flows to pre-development flows for the 2, 5, 10, 25 and 100-year storms).

For these subareas in District C, it was determined that it would be advantageous not to detain the runoff volume for the larger storms, but to allow it to exit the watershed before the peak reaches that particular subarea. It has been found that these areas still require control of the water quality storms to maintain stream water quality. For water quality, the objective is to detain the 1-year flow and release it at the 1-year pre-development rate for residential development and control the first 1/2-inch of runoff for commercial and industrial development. At the same time, the objective is not to attenuate the larger storms. This can be accomplished by configuration of the outlet structure not to control the larger storms, or by a bypass or channel to divert only the 1-year flood into the basin or divert flows in excess of the 1-year storm away from the basin.

Development in those subareas designated in Appendix D of the model Ordinance, as in District C must convey the generated stormwater runoff to a stream or watercourse in a safe manner. The conveyance must manage the quantity, velocity and direction of resulting stormwater runoff in a manner which otherwise adequately protects health and property from possible injury pursuant to Act 167, does not overtax existing drainage facilities and does not cause erosion or sedimentation. Anyone who proposes no detention must comply with Section 303.F, G, and H of the Model Ordinance. Acceptable velocities shall be based upon criteria contained in the DEP "Erosion and Sediment Pollution Control Program Manual". The post-development flow greater than pre-development flow can only be released if it does not aggravate a significant obstruction or existing problem area or would overload existing storm sewer networks. If it would, proper stormwater management, obstruction replacement or standard detention would be required. Additionally, any flow from the 50-year storm not carried by downstream drainage facilities must be addressed and where necessary, additional controls installed to assure collection of this water by control facilities where required by the stormwater design.

Culverts, bridges, stream enclosures or any other facilities proposed within District C must meet the criteria outlined in DEP Chapter 105 Rules & Regulations. Such facilities shall allow an unimpeded flow to be conveyed.

Proper analysis of channel capacity downstream of a development site for the purpose of discharging greater than pre-development peak flow rates is essential to

insure that the goal of not creating any new problem areas or aggravating existing drainage problem areas is achieved. The analysis must include the assumption of complete build-out of the tributary areas to the channel being evaluated based upon the Future Land Use Map (Figure III- 6) or the latest zoning revision after plan adoption assuming no detention in these tributary areas. This is required to evaluate the impacts of all proposed development to increase flows. Also stormwater control measures consistent with the Plan must be assumed in analyzing projected development tributary to the point of evaluation.

Stream channels, water courses or other conveyance facilities may be improved to meet the above requirements and alleviate existing capacity deficiencies as long as local, state, and federal requirements are met and permits obtained. Any facilities that are subject to Chapter 105 criteria must be designed to be consistent with Chapter 105.

In addition to the requirements specified above, the water quality and streambank erosion requirements shall be implemented (Section 308 of the ordinance).

C. Standards and Criteria

The required standards and criteria developed are summarized in Table V-1 while recommended standards and criteria can be found in Table V-2. Table V-3 provides a process to accomplish the required standards and criteria, on a priority basis, looking at means other than detention to reduce postdevelopment peak flows to the required predevelopment rate. The ultimate goal would be to match the predevelopment hydrograph, not just the predevelopment peak. Nonstructural stormwater management measures (or open space planning) should be evaluated to help achieve this goal. Section V of Pennsylvania's BMP Manual should also be consulted to achieve these goals.

TABLE V-1

Required Criteria & Standards

REQUIRED STANDARD	**BENEFIT**
Stormwater Management A, B, and C Detention Districts	No increase in runoff on a watershed wide basis, stormwater detention and attenuation.
Calculations Methodology Parameters must be obtained from the Model Ordinance.	Calculations for consistent stormwater management.
Existing Storm Sewers or Culverts Discharge into existing sewer networks or culverts will be based on system capacity	Preserve sewer/culvert capacity, thereby reducing Operation and

or design storm(s),whichever is more restrictive. Note: The design storm detention shall not necessarily be applied to the sewers and/or culverts.	Maintenance and replacement costs.
Discharge of Accelerated Runoff Accelerated Stormwater runoff shall be safely discharged into existing drainage patterns and storm sewers without adversely affecting properties or causing channel scouring and erosion.	Safe conveyance, continued surface and groundwater quality, flow attenuation.
Inappropriate Outlets If outlet from stormwater conveyance systems from a development site to a stream, tributary, stabilized channel, or storm sewer is not possible, runoff shall be collected in a detention/retention facility and discharged at a nonerosive rate. Outlets discharging onto adjacent property owner(s) properties must have adjacent property owner(s) written permission.	Safe conveyance, continued surface and ground water quality, stormwater detention, flow attenuation.
District C Those areas designated in Appendix D of the Model Ordinance as being in District C shall safely discharge runoff directly into an existing conveyance system with no detention or attenuation except for the 1-year storm.	Allows runoff to exit watershed system prior to peak.
Wetlands Network regulatory agencies involvement within wetland areas.	Infiltration, surface and groundwater recharge, stream baseflow, water quality, flow attenuation, detention.

TABLE V-2
Recommended Criteria & Standards

RECOMMENDED STANDARD	**BENEFIT**
Erosion and Sediment Pollution Control Network with Administrative and Regulatory agencies involvement with earth disturbance sites.	Infiltration, structure integrity, surface water quality, safe conveyance, stream, culvert, and channel capacity.
Floodplains Those floodplains in which the floodplain	Natural stormwater detention/flood

stores water and acts as a detention basin shall not be filled so as to reduce the storage capacity.	control downstream.
Hydrologic Soils Groups A & B All development proposed in hydrologic soils groups A and B should investigate the implementation of infiltration or retention structures for the Stormwater Control measures as opposed to surface detention. This also pertains to the portions of the watershed that have storm sewers. Recharge structures installed prior to tapping into the storm sewers are recommended where soils and physical conditions permit.	Groundwater/stream baseflow recharge, flow attenuation.
Roof Drains, Residential/Commercial Prevent all roof drains from discharging into storm sewers, roadside ditches or channels. Discharge to lawn, recharge basin or storage facilities.	Promotes infiltration, flow attenuation and increases runoff time of concentration, flow attenuation.
Pervious Surfaces The use of pervious materials will be encouraged for parking surfaces and sidewalks.	Infiltration, groundwater recharge.
Structures Concentrate on locating facilities within areas conducive to recharge and design, accommodate recharge to meet release rate requirements.	Infiltration, groundwater recharge, stream baseflow.
Steep Slopes Regulate activities in critical slope areas where management of stormwater by structure is inappropriate.	Stream base flow, flow attenuation, conveyance integrity, surface water quality.

Note: See the Model Ordinance for more detailed standards and criteria.

TABLE V-3
Process to Achieve the Standards and Criteria
in Order of Preference
(Ultimate Goal - Match Predevelopment Hydrograph)

1.	Minimize disturbance of natural features (buffers, trees, vegetation, floodplains, etc.)
2.	Minimize grading.
3.	Minimize impervious surfaces, consider pervious surfaces.
4.	Disconnect large impervious surfaces.
5.	Apply BMP's near the source of the runoff.
6.	Evaluate needs for treating runoff.
7.	Satisfy the groundwater recharge objective.
8.	Satisfy the runoff peak attenuation objective considering all measures other than detention basins.
9.	Size detention basins after considering all other measures.

D. Sub-Regional (Combined Site) Storage

Traditionally, the approach to stormwater management has been to control the runoff on an individual site basis. However, there is a growing commitment to finding cost-effective comprehensive control techniques that both preserve and protect the natural drainage system. In other words, two developers developing sites adjacent to each other could pool their capital resources to provide for a community stormwater storage facility in the most hydrologic advantageous location.

The goal should be the development and use of the most cost-effective and environmentally-sensitive stormwater runoff controls. These controls will significantly improve the capability and flexibility of land developers and communities to control runoff consistent with the Bowman's Creek Stormwater Management Plan.

An advantage to combining efforts is to increase the opportunity to utilize stormwater control facilities to meet other community needs. For example, certain stormwater control facilities could be designed so that recreational facilities such as ball fields, open space, volleyball, etc. could be incorporated. Natural or artificial ponds and lakes could serve both recreational and stormwater management objectives.

To take this concept a step further, there is also the possibility that the stormwater could be managed "off-site"; that is, in a location off the property(s) in question. Stormwater management facilities could be constructed in an off-site location more hydrologically advantageous to the watershed. These facilities could be publicly owned detention, retention,

lake, pond, or other physical facilities to serve multiple developments. The design and release rate would need to be consistent with the Plan.

E. "No Harm Option"

A developer has the option to prove to the municipality that the increase in runoff generated from his site above the allowable release rate will cause "no harm" anywhere in the watershed. The No Harm Option is used when a developer can prove that the post development hydrographs can match pre-development hydrographs, or if it can be proved that the post-development conditions will not cause increases in peaks at all critical points downstream.

Several developers within the same subwatershed identified in Appendix D could independently show that they would cause no harm. However, the cumulative effect of these contributions could significantly increase the flow. Therefore, proof of no harm would have to be shown assuming that the entire subarea(s) within which the proposed development is located would be developed and the cumulative effect would not create a problem anywhere in the watershed. The impact of the increase in flow would have to be followed downstream until the increase diminishes due to additional flow from tributaries and/or stream attenuation.

F. Alternative Runoff Control Techniques

Each developer must not allow the runoff from his site to exceed the applicable release rate applied to the subwatershed in which the site is located. This runoff control can be obtained in a number of different ways. The following tables indicate an overview of general measures that can be applied to reduce or delay stormwater runoff as well as the advantages and disadvantages for several types of runoff control measures. It will be up to the developer or the developer's engineer to select the technique that is the most appropriate to the type of project and physical characteristics of the site.

In determining what measures or combination of measures to install, the following parameters should be considered:

- Soil characteristics (hydrologic soil group, etc.)
- Subsurface conditions (high water table, bedrock, etc.)
- Topography (steepness of slope, etc.)
- Existing drainage patterns
- Economics
- Advantages and disadvantages of each technique

TABLE V-4
Various On-Site Stormwater Control Methods

AREA	REDUCING RUNOFF	DELAYING RUNOFF
Large Flat Roof	1. Cistern storage 2. Rooftop gardens 3. Pool storage or fountain	1. Ponding on roof by constricted downspouts
Parking Lots	1. Porous pavement a. Gravel parking lots. b. Porous or punctured 2. Concrete vaults and cisterns 3. Vegetated ponding areas 4. Gravel trenches.	1. Grassy strips on parking lots. 2. Grassed waterways draining parking lot. 3. Ponding and detention a. Rippled pavement b. Depressions c. Basins
Residential	1. Cisterns for individual homes or groups of homes. 2. Gravel driveways (porous) 3. Contoured landscape. 4. Groundwater recharge: a. Perforated pipe b. Gravel (sand) c. Trench d. Porous pipe e. Dry wells 5. Vegetated depressions	1. Reservoir of detention basin. 2. Planting a high delaying grass (high roughness) 3. Gravel driveways. 4. Grassy gutters or channels. 5. Increased length of travel of runoff by means of gutters, diversions, etc.
General	1. Gravel alleys 2. Porous sidewalks 3. Mulched planters	1. Gravel alleys

Source: Urban Hydrology for Small Watershed. Technical Release No. 55.

TABLE V-5 (PG. 1)
Advantages And Disadvantages Of Various
On-Site Stormwater Control Methods

MEASURE	ADVANTAGES	DISADVANTAGES
A. Cisterns and Covered Ponds.	1. Water may be used for: a. Fire Protection b. Watering lawns c. Industrial processes 2. Reduce runoff while only occupying small area. 3. Land and space above cistern may be used for other purposes.	1. Expensive to install. 2. Cost required may be restrictive if the cistern must accept water from large drainage areas. 3. Requires slight maintenance. 4. Restricted access. 5. Reduces available space in basements for other uses.
B. Rooftop Gardens.	1. Aesthetically pleasing. 2. Runoff reduction. 3. Reduce noise levels. 4. Wildlife enhancement.	1. Higher structural loadings on roof and building. 2. Expensive to install and maintain.
C. Surface Pond Storage (usually residential areas).	1. Controls large drainage areas with low release. 2. Aesthetically pleasing. 3. Possible recreation benefits: a. Boating b. Ice Skating c. Fishing d. Swimming 4. Aquatic life habitat 5. Increases land value of adjoining property.	1. Requires large areas. 2. Possible pollution from stormwater and siltation. 3. Possible mosquito breeding areas. 4. May have adverse alga blooms as a result of 5. Possible drowning. 6. Maintenance problems
D. Ponding on Roof by Constricted Downspouts.	1. Runoff delay. 2. Cooling effect for building: a. Water on roof b. Circulation through 3. Roof ponding provides fire	1. Higher structural loadings. 2. Clogging of constricted 3. Freezing during winter (expansion). 4. Waves and wave loading. 5. Leakage of roof water into
E. Increased Roof Roughness: a. Rippled roof b. Gravel on roof	1. Runoff delay and some reduction (detention in ripples or gravel).	1. Somewhat higher structural

TABLE V-5 (cont.)

MEASURE	ADVANTAGES	DISADVANTAGES
F. Porous pavement (parking lots and alleys): a. Gravel parking lot. b. Holes in impervious pavements (1/4 in. diam.) filled with sand.	1. Runoff reduction (a and b). 2. Potential groundwater 3. Gravel pavements may be cheaper than asphalt or concrete (a).	1. Clogging of holes or gravel (a and b). 2. Compaction of earth below pavement or gravel decreases permeability of soil (a and b). 3. Ground-water pollution from salt in winter (a and b). 4. Frost heaving for impervious pavement with holes (b). 5. Difficult to maintain. 6. Grass or weeds could grow in porous pavement (a and b).
G. Grassed channels and vegetated strips.	1. Runoff delay. 2. Some runoff reduction (infiltration recharge). 3. Aesthetically pleasing: a. Flowers b. Trees	1. Sacrifice some land area for vegetated strips. 2. Grassed areas must be mowed or cut periodically (maintenance costs).
H. Ponding and detention measures on impervious pavement: a. Rippled pavement b. Basins c. Constructed inlets	1. Runoff delay (a, b, and c). 2. Runoff reduction (a and b).	1. Somewhat restricted movement of vehicle (a). 2. Interferes with normal use (a and c). 3. Damage to rippled pavement during snow removal (a). 4. Depressions collect dirt and debris (a, b, and c).
I. Reservoir or detention basin.	1. Runoff delay. 2. Recreation benefits: a. Ice skating. b. Baseball, football, etc. if land is provided. 3. Aesthetically pleasing. 4. Could control large drainage areas with release.	1. Considerable amount of land is necessary. 2. Maintenance costs: a. Mowing grass. b. Herbicides. c. Cleaning periodically (silt removal). 3. Mosquito breeding area. 4. Siltation in basin.
J. Converted septic tank for storage and ground-water recharge.	1. Low installation costs. 2. Runoff reduction 3. Water may be used for: a. Fire protection. b. Watering lawns and gardens.	1. Requires periodic maintenance (silt removal). 2. Possible health hazard. 3. Sometimes requires a pump.

	c. Ground-water recharge.	

TABLE V-6
Suitability Of Runoff Control Measures
In Bowman's Creek Watershed

1. Cisterns and Covered Ponds:
   Recommended in industrial parks where water could be utilized for fire protection; expensive to install with limited benefit; low maintenance costs (usually requires periodic sediment removal).

2. Rooftop Gardens:
   Not recommended in this watershed due to its rural nature. Established urban areas are generally located in "No Detention" areas.

3. Surface Pond Storage:
   Recommended where pond sites exist or on more porous soils (A and B) for groundwater recharge; relatively inexpensive to install and maintain; helps entrap sediment to improve water quality of receiving stream.

4. Ponding on Roof, Constricted Downspouts:
   Possible on large public buildings; required structure modifications usually expensive; low maintenance costs unless leaks occur.

5. Increased Roof Roughness:
   Possible for industrial, commercial and public buildings; relative effectiveness minimal on a watershed wide basis; moderate installation costs; little maintenance costs.

6. Porous Pavement:
   Highly recommended where possible, especially in A and B soils and large parking facilities; promotes groundwater recharge; moderate in expense compared to typical paving; low maintenance costs.

7. Grassed Channels and Vegetated Strips:
   Recommended wherever possible throughout the watershed to slow velocity and reduce erosion; minimal slopes recommended; could entrap sediment to improve water quality; low installation and maintenance costs; promotes infiltration.

8. Ponding and Detention on Pavement:
   Recommended in entire watershed except in "No Detention" areas; very inexpensive with low maintenance costs; freezing should be considered.

9. Reservoir or Detention Basin:
   Recommended in entire watershed except in "No Detention" areas; moderate installation and maintenance costs.

10. Groundwater Recharge:
    Recommended in HSG A and B soils.

11. High Delay Grass and Routing Flow Over Lawns:
    Recommended in the entire watershed; delays runoff, entraps sediment, reduces velocities, reduces erosion potential; relatively inexpensive installation and maintenance costs.

G. Regional Detention Facilities

One option in watershed-wide storm management is to control runoff using regional facilities. Developers could pool their capital to build a regional detention basin at a strategic location in place of installing a basin on each individual site.

The potential for locating regional facilities within the Bowman's Creek Watershed was evaluated. The six parameters used for locating such a facility were:

- Site location's influence on the total watershed hydrology
- Available undeveloped land
- Ownership of the land
- Topography
- Environmental sensitivity of the locations
- Total area and percent of the total contributing area to the basin location.

Due to the existing development and road patterns in the watershed, steep slopes, wetlands, contributing drainage areas, and land ownership considerations, there were only two potentially viable regional basin locations identified in the Bowman's Creek watershed.

These regional facilities, if constructed would have the following effect on the 100-year storm under future conditions.

	100-year Flow (cfs)		Maximum
Subarea	**Into-Dam**	**Out-of-Dam**	**Storage Volume (AC-FT)**
8	3,414	318	953
12	7,248	361	2,687

H. Best Management Practices

The use of traditional and innovative Best Management Practices (BMP's) is encouraged to meet the water quantity and quality criteria established in this Plan. The Pennsylvania Handbook of Best Management Practices for Developing Areas prepared by the Pennsylvania Association of Conservation Districts, Inc., Spring, 1998 should be referenced for design and maintenance of these practices/facilities.

I. Impervious Area Exemptions

For Pennsylvania Act 167 Plans, it has been found that under certain circumstances proposed development may not affect the runoff potential on a given parcel of land. Typical ordinances have exemption criteria of 10,000 square feet of proposed impervious area that serves as the cut off for requiring a stormwater management plan. The reasoning is that this amount of impervious area on a parcel of land would equate to an approximate 1 cfs increase in runoff peaks from pre- to post-development conditions. In practical application to a small parcel of land, say a 1/2 acre lot in which the owner wishes to create an impervious area, he is limited to paving 10,000 square feet, approximately 46 percent of his parcel, without requiring a stormwater management plan. However, if another parcel owner with 30 acres of land wishes to create an impervious area, he is still limited to the 10,000 square feet while the change in impervious area for the parcel is only 0.7 percent. It was, therefore, realized that a sliding scale which took a more comprehensive look at the effect of adding impervious area to parcels would be more preferable than a flat cut off point for exemption from requirement of a Stormwater Management Plan.

A comprehensive analysis was performed to evaluate when exemptions could be applied. It took into account several factors that affect stormwater runoff. These factors included the slope of the land, the overall tract size, the contributing area draining towards the proposed development, soils, and the location of the proposed improvements on the tract with respect to downstream property lines. Several computations where made in which these factors were adjusted. These computations compared the pre-development with the post-development runoff rate for a sample tract. Areas of impervious cover were increased on the sample tract until a change in runoff rate of greater than 1.0 cfs was reached. This area of impervious was then accepted as the maximum impervious area that can be created without requiring a stormwater management plan. This analysis was run for several varying factors as described above. The maximum limit of each computation was then plotted on a scale and a trend analysis was performed to develop a best fit line through the results of the analysis. A table was then created which summarizes the percent proposed impervious area in relation to total site area and can be found in the Model Ordinance Section 402. Two examples utilizing this exemption table can be found below.

Example 1.

50 acre parcel - 30,000 sq. ft. proposed impervious area.

From Section 402 - exemption is 20,000 sq. ft.

(30,000 sq. ft.) >20,000 sq. ft. therefore comply with the ordinance or reduce impervious area to 20,000 sq. ft.

Example 2.

1.5 acre lot - 1 acre proposed to be impervious area.

From Section 402 - exemption is 10,000 sq. ft.

1 acre (43,560 sq. ft.) >10,000 sq. ft. therefore comply with the ordinance or reduce impervious area to 10,000 sq. ft.

SECTION VI

ORDINANCE PROVISIONS

The Stormwater Management Act emphasizes locally administered stormwater programs with the watershed municipalities taking the lead role. Enforcement of the watershed plan standards and criteria will require the municipalities to incorporate them into their applicable ordinances that address land development. Provided as part of the Plan is a model stormwater ordinance. This model ordinance is a single purpose stormwater ordinance that could be adopted by each municipality with minor changes to fulfill the needs of a particular municipality.

In addition to adopting the ordinance itself, the municipalities would also have to revise their existing subdivision, land development, and zoning ordinances to incorporate the necessary linking provisions. These linking provisions would refer to any applicable regulated activities within the watershed to the single purpose ordinance. Key provisions of the model stormwater ordinance include the drainage standards and criteria, performance standards for stormwater management, and maintenance provisions for stormwater facilities.

Finally, the model stormwater ordinances should be understandable, applied fairly and uniformly throughout the watershed, and should not discourage creative solutions to stormwater management problems. It would be desirable for the municipalities to adopt a uniform regulatory approach for the Bowman's Creek Watershed.

The implementation of the runoff control strategy for new development will be through municipal adoption of the appropriate ordinance provisions. As part of the preparation of Bowman's Creek Watershed Stormwater Management Plan, a model municipal ordinance has been prepared which would implement the Plan provisions presented in the ordinance as a single purpose ordinance. This could be adopted essentially "as is" (with some modification) by the municipalities. Provisions would also be required in the Subdivision and Land Development Ordinance to ensure that activities regulated by the ordinance were appropriately referenced. The "Bowman's Creek Watershed Act 167 Stormwater Management Ordinance" will not completely replace the existing storm drainage ordinance provisions currently in effect in the municipalities. The reasons for this are as follows:

* Not all of the municipalities in Bowman's Creek Basin are completely within the watershed. For those portions of the municipality outside Bowman's Creek watershed, the existing ordinance provisions would still apply.

* Permanent and temporary stormwater control facilities are regulated by the Act 167 Ordinance. Stormwater management and erosion and sedimentation control during construction would continue to be regulated under the existing stormwater ordinance and Chapter 102 Erosion and Sediment and Pollution Controls, Title 25 of DEP Regulations.

* The Act 167 Ordinance contains only those minimum stormwater runoff control criteria and standards which are necessary or desirable from a total watershed perspective. Additional stormwater management design criteria (i.e., inlet spacing, inlet type, collection system details, etc.) which should be based on sound engineering practice

should be regulated under the current ordinance provisions or as part of the general responsibilities of the municipal engineer.

The text of the ordinance is organized into eight articles as follows:

I	-	General Provisions
II	-	Definitions
III	-	Stormwater Management
IV	-	Drainage Plan Requirements
V	-	Inspections
VI	-	Fees and Expenses
VII	-	Maintenance Responsibilities
VIII	-	Enforcement and Penalties

Within six months following adoption and approval of the Watershed Stormwater Management Plan, each municipality shall adopt or amend, and shall implement such ordinances and regulations, including zoning, subdivision and land development, building code, and erosion and sedimentation control ordinances, as are necessary to regulate development within the municipality in a manner consistent with the applicable Watershed Stormwater Management Plan and provisions of the Act.

The following amendment is required for municipalities that issue an occupancy permit:

* An Occupancy Permit shall not be secured or issued unless the provisions of the Bowman's Creek Stormwater Management Ordinance have been followed. The Occupancy Permit shall be required for each lot owner and/or developer of all major and minor subdivisions and land development in the municipality

For municipalities without an Occupancy Permit, they may want to adopt the above draft and also include other regulatory items in the occupancy permit requirement for their own purpose and use.

ORDINANCE REQUIREMENTS

The following ordinance provisions must be retained when a municipality either elects to create a single-purpose stormwater ordinance or amends existing subdivision or zoning ordinances to implement the stormwater management plan.

- Article I - General Provisions
- Article II - Definitions
- Article III - Design Criteria for Stormwater Management Facilities Sections 301, 302, 303 (except F), 304, 305, 306
- Article IV - Section 402

- Article VIII - Enforcement and Penalties (only when enacting a single-purpose Ordinance)

The following ordinance provisions are optional, <u>but recommended to be retained</u>:

- Section 303F
- Article V - Inspections
- Article VI - Fees and Expenses

The following ordinance provision is also optional, but municipalities are encouraged to retain:

- Section 307 - Water Quality Requirements

All other provisions are optional and may be modified to be consistent with other municipal ordinances related to land development.

NOTE: If a municipality chooses to use the model ordinance to implement the stormwater management plan, it is recommended that the ordinance be submitted to the municipal solicitor, engineer, and DEP for review prior to enactment.

SECTION VII

MODEL ORDINANCE

BOWMAN'S CREEK WATERSHED

MODEL ACT 167 STORMWATER MANAGEMENT ORDINANCE

WITH OPTIONAL WATER QUALITY STANDARDS

PLEASE HAVE YOUR SOLICITOR REVIEW THE ENCLOSED ORDINANCE AND CHECK THE APPLICABILITY OF ALL SECTIONS TO YOUR MUNICIPALITY

If you have any questions, please call
Durla Lathia or Lynn Manahan of the
DEP Stormwater Planning and Management Section
at (717) 772-4048

BOWMAN'S CREEK WATERSHED STORMWATER MANAGEMENT ORDINANCE

ORDINANCE NO.

_____, _____ COUNTY,

PENNSYLVANIA

Adopted at a Public Meeting Held on
_____, 20__

TABLE OF CONTENTS

PAGE
ARTICLE I- GENERAL PROVISIONS 1
Section 101. Statement of Findings 1
Section 102. Purpose 1
Section 103. Statutory Authority 1
Section 104. Applicability 2
Section 105. Repealer 2
Section 106. Severability 2
Section 107. Compatibility With Other Ordinance Requirements 2
ARTICLE II-DEFINITIONS 3
ARTICLE III-STORMWATER MANAGEMENT 9
Section 301. General Requirements 9
Section 302. Stormwater Management Districts 10
Section 303. Stormwater Management District Implementation Provisions (Performance Standards) 11
Section 304. Design Criteria for Stormwater Management Facilities 13
Section 305. Calculation Methodology 14
Section 306. Erosion and Sedimentation Requirements 16
Section 307. Ground Water Recharge 17
Section 308. Water Quality Requirements 17
ARTICLE IV-DRAINAGE PLAN REQUIREMENTS 18
Section 401. General Requirements 18
Section 402. Exemptions 18
Section 403. Drainage Plan Contents 19
Section 404. Plan Submission 21
Section 405. Drainage Plan Review 22
Section 406. Modification of Plans 23
Section 407. Resubmission of Disapproved Drainage Plans 23
ARTICLE V-INSPECTIONS 24
Section 501. Schedule of Inspections 24
ARTICLE VI-FEES AND EXPENSES 24
Section 601. General 24
Section 602. Municipality Drainage Plan Review Fee 24
Section 603. Expenses Covered by Fees 24
ARTICLE VII-MAINTENANCE RESPONSIBILITIES 25
Section 701. Performance Guarantee 25
Section 702. Maintenance Responsibilities 25
Section 703. Maintenance Agreement for Privately Owned Stormwater Facilities 25
Section 704. Municipal Stormwater Maintenance Fund 26
ARTICLE VIII-ENFORCEMENT AND PENALTIES 26
Section 801. Right-of-Entry 26
Section 802. Notification 26
Section 803. Enforcement 27
Section 804. Public Nuisance 28
Section 805. Penalties 28
Section 806. Appeals 28

PAGE

APPENDIX A - STANDARD STORMWATER FACILITIES MAINTENANCE & MONITORING AGREEMENT 30
APPENDIX B - STORMWATER MANAGEMENT DESIGN CRITERIA 34
APPENDIX C - SAMPLE DRAINAGE PLAN APPLICATION AND FEE SCHEDULE..... 42
APPENDIX D - STORMWATER MANAGEMENT DISTRICT WATERSHED MAP..... 47
APPENDIX E - PENNSYLVANIA LIMESTONE MANUFACTURERS..... 48

ARTICLE I- GENERAL PROVISIONS

Section 101. Statement of Findings

The governing body of the Municipality finds that:

A. Inadequate management of accelerated stormwater runoff resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of existing streams and storm sewers, greatly increases the cost of public facilities to convey and manage stormwater, undermines floodplain management and flood reduction efforts in upstream and downstream communities, reduces groundwater recharge, and threatens public health and safety.

B. A comprehensive program of stormwater management, including reasonable regulation of development and activities causing accelerated erosion, is fundamental to the public health, safety, welfare, and the protection of the people of the Municipality and all the people of the Commonwealth, their resources, and the environment.

Section 102. Purpose

The purpose of this Ordinance is to promote health, safety, and welfare within Bowman's Creek Watershed by minimizing the damages described in Section 101.A of this Ordinance through provisions designed to:

A. Manage accelerated runoff and erosion and sedimentation problems at their source by regulating activities that cause these problems.

B. Utilize and preserve the existing natural drainage systems.

C. Encourage recharge of groundwater where appropriate and prevent degradation of groundwater quality.

D. Maintain existing flows and quality of streams and watercourses in the municipality and the Commonwealth.

E. Preserve and restore the flood-carrying capacity of streams.

F. Provide proper maintenance of all permanent stormwater management facilities that are constructed in the Municipality.

G. Provide performance standards and design criteria for watershed-wide stormwater management and planning.

Section 103. Statutory Authority

The Municipality is empowered to regulate land use activities that affect runoff by the authority of the Act of October 4, 1978 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq., as amended, the

"Stormwater Management Act", [and the applicable Municipal Code].

Section 104. Applicability

This Ordinance shall apply to those areas of the Municipality that are located within Bowman's Creek Watershed, as delineated in Appendix D which is hereby adopted as part of this ordinance.

This Ordinance shall only apply to permanent stormwater management facilities constructed as part of any of the Regulated Activities listed in this Section. Stormwater management and erosion and sedimentation control during construction activities are specifically not regulated by this Ordinance, but shall continue to be regulated under existing laws and ordinances.

This Ordinance contains only the stormwater management performance standards and design criteria that are necessary or desirable from a watershed-wide perspective. Local stormwater management design criteria (e.g., inlet spacing, inlet type, collection system design and details, outlet structure design, etc.) shall continue to be regulated by the applicable Municipal Ordinances or at the municipal engineer's discretion.

The following activities are defined as "Regulated Activities" and shall be regulated by this Ordinance:

A. Land development.
B. Subdivision.
C. Construction of new or additional impervious or semi-pervious surfaces (driveways, parking lots, etc.).
D. Construction of new buildings or additions to existing buildings.
E. Diversion or piping of any natural or man-made stream channel.
F. Installation of stormwater management facilities or appurtenances thereto.

Section 105. Repealer

Any ordinance or ordinance provision of the Municipality inconsistent with any of the provisions of this Ordinance is hereby repealed to the extent of the inconsistency only.

Section 106. Severability

Should any section or provision of this Ordinance be declared invalid by a court of competent jurisdiction, such decision shall not affect the validity of any of the remaining provisions of this Ordinance.

Section 107. Compatibility With Other Ordinance Requirements

Approvals issued pursuant to this Ordinance do not relieve the Applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance.

ARTICLE II-DEFINITIONS

For the purposes of this chapter, certain terms and words used herein shall be interpreted as follows:

A. Words used in the present tense include the future tense; the singular number includes the plural, and the plural number includes the singular; words of masculine gender include feminine gender; and words of feminine gender include masculine gender.

B. The word "includes" or "including" shall not limit the term to the specific example, but is intended to extend its meaning to all other instances of like kind and character.

C. The word "person" includes an individual, firm, association, organization, partnership, trust, company, corporation, or any other similar entity.

D. The words "shall" and "must" are mandatory; the words "may" and "should" are permissive.

E. The words "used or occupied" include the words "intended, designed, maintained, or arranged to be used, occupied or maintained.

Accelerated Erosion - The removal of the surface of the land through the combined action of man's activity and the natural processes of a rate greater than would occur because of the natural process alone.

Agricultural Activities - The work of producing crops and raising livestock including tillage, plowing, disking, harrowing, pasturing and installation of conservation measures. Construction of new buildings or impervious area is not considered an agricultural activity.

Alteration - As applied to land, a change in topography as a result of the moving of soil and rock from one location or position to another; also the changing of surface conditions by causing the surface to be more or less impervious; land disturbance.

Applicant - A landowner or developer who has filed an application for approval to engage in any Regulated Activities as defined in Section 104 of this Ordinance.

BMP (Best Management Practice) - Stormwater structures, facilities and techniques to control, maintain or improve the quantity and quality of surface runoff.

Channel Erosion - The widening, deepening, and headward cutting of small channels and waterways, due to erosion caused by moderate to large floods.

Cistern - An underground reservoir or tank for storing rainwater.

Conservation District - The Wyoming County Conservation District.

Culvert - A structure with appurtenant works which carries a stream under or through an embankment or fill.

Dam - An artificial barrier, together with its appurtenant works, constructed for the purpose of impounding or storing water or another fluid or semifluid, or a refuse bank, fill or structure for highway, railroad or other purposes which does or may impound water or another fluid or semifluid.

Design Storm - The magnitude and temporal distribution of precipitation from a storm event measured in probability of occurrence (e.g., a 5-year storm) and duration (e.g., 24-hours), used in the design and evaluation of stormwater management systems.

Designee - The agent of the _____Planning Commission and/or agent of the governing body involved with the administration, review or enforcement of any provisions of this ordinance by contract or memorandum of understanding.

Detention Basin - An impoundment structure designed to manage stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

Detention District - Those subareas in which some type of detention is required to meet the plan requirements and the goals of Act 167.

Developer - A person, partnership, association, corporation, or other entity, or any responsible person therein or agent thereof, that undertakes any Regulated Activity of this Ordinance.

Development Site - The specific tract of land for which a Regulated Activity is proposed.

Downslope Property Line - That portion of the property line of the lot, tract, or parcels of land being developed located such that all overland or pipe flow from the site would be directed towards it.

Drainage Conveyance Facility - A Stormwater Management Facility designed to transmit stormwater runoff and shall include streams, channels, swales, pipes, conduits, culverts, storm sewers, etc.

Drainage Easement - A right granted by a landowner to a grantee, allowing the use of private land for stormwater management purposes.

Drainage Permit - A permit issued by the Municipal governing body after the drainage plan has been approved. Said permit is issued prior to or with the final Municipal approval.

Drainage Plan - The documentation of the stormwater management system, if any, to be used for a given development site, the contents of which are established in Section 403.

Earth Disturbance - Any activity including, but not limited to, construction, mining, timber harvesting and grubbing which alters, disturbs, and exposes the existing land surface.

Erosion - The movement of soil particles by the action of water, wind, ice, or other natural forces.

Erosion and Sediment Pollution Control Plan - A plan that is designed to minimize accelerated

erosion and sedimentation.

Existing Conditions - The initial condition of a project site prior to the proposed construction. If the initial condition of the site is undeveloped land, the land use shall be considered as "meadow" unless the natural land cover is proven to generate lower curve numbers or Rational "C" value, such as forested lands.

Flood - A general but temporary condition of partial or complete inundation of normally dry land areas from the overflow of streams, rivers, and other waters of this Commonwealth.

Floodplain - Any land area susceptible to inundation by water from any natural source or delineated by applicable Department of Housing and Urban Development, Federal Insurance Administration Flood Hazard Boundary - Mapped as being a special flood hazard area. Also included are areas that comprise Group 13 Soils, as listed in Appendix A of the Pennsylvania Department of Environmental Protection (PaDEP) Technical Manual for Sewage Enforcement Officers (as amended or replaced from time to time by PaDEP).

Floodway - The channel of the watercourse and those portions of the adjoining floodplains, which are reasonably required to carry and discharge the 100-year frequency flood. Unless otherwise specified, the boundary of the floodway is as indicated on maps and flood insurance studies provided by FEMA. In an area where no FEMA maps or studies have defined the boundary of the 100-year frequency floodway, it is assumed - absent evidence to the contrary - that the floodway extends from the stream to 50 feet from the top of the bank of the stream.

Forest Management/Timber Operations - Planning and activities necessary for the management of forest land. These include timber inventory and preparation of forest management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, site preparation and reforestation.

Freeboard - A vertical distance between the elevation of the design high-water and the top of a dam, levee, tank, basin, or diversion ridge. The space is required as a safety margin in a pond or basin.

Grade - A slope, usually of a road, channel or natural ground specified in percent and shown on plans as specified herein. (To) Grade - to finish the surface of a roadbed, top of embankment or bottom of excavation.

Grassed Waterway - A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from cropland.

Groundwater Recharge - Replenishment of existing natural underground water supplies.

Impervious Surface - A surface that prevents the percolation of water into the ground.

Impoundment - A retention or detention basin designed to retain stormwater runoff and release it at a controlled rate.

Infiltration Structures - A structure designed to direct runoff into the ground (e.g., french drains,

seepage pits, seepage trench).

Inlet - A surface connection to a closed drain. A structure at the diversion end of a conduit. The upstream end of any structure through which water may flow.

Land Development - (i) the improvement of one lot or two or more contiguous lots, tracts, or parcels of land for any purpose involving (a) a group of two or more buildings, or (b) the division or allocation of land or space between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups, or other features; (ii) any subdivision of land; (iii) development in accordance with Section 503(1.1)of the PA Municipalities Planning Code.

Land Earth Disturbance - Any activity involving grading, tilling, digging, or filling of ground or stripping of vegetation or any other activity that causes an alteration to the natural condition of the land.

Main Stem (Main Channel) - Any stream segment or other runoff conveyance facility used as a reach in Bowman's Creek hydrologic model.

Manning Equation in (Manning formula) - A method for calculation of velocity of flow (e.g., feet per second) and flow rate (e.g., cubic feet per second) in open channels based upon channel shape, roughness, depth of flow and slope. "Open channels" may include closed conduits so long as the flow is not under pressure.

Municipality - [municipal name], Wyoming County, Pennsylvania.

Nonpoint Source Pollution - Pollution that enters a watery body from diffuse origins in the watershed and does not result from discernible, confined, or discrete conveyances.

NRCS - Natural Resource Conservation Service (previously SCS).

Open Channel - A drainage element in which stormwater flows with an open surface. Open channels include, but shall not be limited to, natural and man-made drainageways, swales, streams, ditches, canals, and pipes flowing partly full.

Outfall - Point where water flows from a conduit, stream, or drain.

Outlet - Points of water disposal from a stream, river, lake, tidewater or artificial drain.

Parking Lot Storage - Involves the use of impervious parking areas as temporary impoundments with controlled release rates during rainstorms.

Peak Discharge - The maximum rate of stormwater runoff from a specific storm event.

Penn State Runoff Model (calibrated) - The computer-based hydrologic modeling technique adapted to Bowman's Creek watershed for the Act 167 Plan. The model has been "calibrated" to reflect actual recorded flow values by adjoining key model input parameters.

Pipe - A culvert, closed conduit, or similar structure (including appurtenances) that conveys stormwater.

Planning Commission - The planning commission of [municipal name].

PMF - Probable Maximum Flood - The flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in any area. The PMF is derived from the probable maximum precipitation (PMP) as determined based on data obtained from the National Oceanographic and Atmospheric Administration (NOAA).

Rational Formula - A rainfall-runoff relation used to estimate peak flow.

Regulated Activities - Actions or proposed actions that have an impact on stormwater runoff and that are specified in Section 104 of this Ordinance.

Release Rate - The percentage of pre-development peak rate of runoff from a site or subarea to which the post development peak rate of runoff must be reduced to protect downstream areas.

Retention Basin - An impoundment in which stormwater is stored and not released during the storm event. Stored water may be released from the basin at some time after the end of the storm.

Return Period - The average interval, in years, within which a storm event of a given magnitude can be expected to recur. For example, the 25-year return period rainfall would be expected to recur on the average of once every twenty-five years.

Riser - A vertical pipe extending from the bottom of a pond that is used to control the discharge rate from the pond for a specified design storm.

Rooftop Detention - Temporary ponding and gradual release of stormwater falling directly onto flat roof surfaces by incorporating controlled-flow roof drains into building designs.

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

Sediment Basin - A barrier, dam, retention or detention basin located and designed to retain rock, sand, gravel, silt, or other material transported by water.

Sediment Pollution - The placement, discharge or any other introduction of sediment into the waters of the Commonwealth occurring from the failure to design, construct, implement or maintain control measures and control facilities in accordance with the requirements of this Ordinance.

Sedimentation - The process by which mineral or organic matter is accumulated or deposited by the movement of water.

Seepage Pit/Seepage Trench - An area of excavated earth filled with loose stone or similar coarse material, into which surface water is directed for infiltration into the ground.

Sheet Flow - Runoff that flows over the ground surface as a thin, even layer, not concentrated in a

channel.

Soil-Cover Complex Method - A method of runoff computation developed by the NRCS that is based on relating soil type and land use/cover to a runoff parameter called Curve Number (CN).

Soil Group, Hydrologic - A classification of soils by the Natural Resources Conservation Service, formerly the Soil Conservation Service, into four runoff potential groups. The groups range from A soils, which are very permeable and produce little runoff, to D soils, which are not very permeable and produce much more runoff.

Spillway - A depression in the embankment of a pond or basin which is used to pass peak discharge greater than the maximum design storm controlled by the pond.

Storage Indication Method - A reservoir routing procedure based on solution of the continuity equation (inflow minus outflow equals the change in storage) with outflow defined as a function of storage volume and depth.

Storm Frequency - The number of times that a given storm "event" occurs or is exceeded on the average in a stated period of years. See "Return Period".

Storm Sewer - A system of pipes and/or open channels that convey intercepted runoff and stormwater from other sources, but excludes domestic sewage and industrial wastes.

Stormwater - The total amount of precipitation reaching the ground surface.

Stormwater Management Facility - Any structure, natural or man-made, that, due to its condition, design, or construction, conveys, stores, or otherwise affects stormwater runoff. Typical stormwater management facilities include, but are not limited to, detention and retention basins, open channels, storm sewers, pipes, and infiltration structures.

Stormwater Management Plan - The plan for managing stormwater runoff in Bowman's Creek Watershed adopted by Wyoming County as required by the Act of October 4, 1978, P.L. 864, (Act 167), and known as the "Bowman's Creek Watershed Action Act 167 Stormwater Management Plan.

Stormwater Management Site Plan - The plan prepared by the Developer or his representative indicating how stormwater runoff will be managed at the particular site of interest according to this Ordinance.

Stream Enclosure - A bridge, culvert or other structure in excess of 100 feet in length upstream to downstream which encloses a regulated water of this Commonwealth.

Subarea - The smallest drainage unit of a watershed for which stormwater management criteria have been established in the Stormwater Management Plan.

Subdivision - The division or re-division of a lot, tract, or parcel of land by any means into two or more lots, tracts, parcels or other divisions of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, transfer of ownership, or building or lot

development: Provided, however, that the subdivision by lease of land for agricultural purposes into parcels of more than ten acres, not involving any new street or easement of access or any residential dwellings, shall be exempt.

Swale - A low lying stretch of land which gathers or carries surface water runoff.

Timber Operations - See Forest Management.

Time-of-Concentration (Tc) - The time for surface runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. This time is the combined total of overland flow time and flow time in pipes or channels, if any.

Watercourse - A stream of water; river; brook; creek; or a channel or ditch for water, whether natural or manmade.

Waters of the Commonwealth - Any and all rivers, streams, creeks, rivulets, ditches, watercourses, storm sewers, lakes, dammed water, wetlands, ponds, springs, and all other bodies or channels of conveyance of surface and underground water, or parts thereof, whether natural or artificial, within or on the boundaries of this Commonwealth.

Wetland - Those areas that are inundated or saturated by surface or ground water 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, including swamps, marshes, bogs, ferns, and similar areas.

ARTICLE III-STORMWATER MANAGEMENT

Section 301. General Requirements

A. All regulated activities in Bowman's Creek Watershed which do not fall under the exemption criteria shown in Section 402 shall submit a drainage plan consistent with Bowman's Creek Watershed Stormwater Management Plan to the municipality for review. This criteria shall apply to the total proposed development even if development is to take place in stages. Impervious cover shall include, but not be limited to, any roof, parking or driveway areas and any new streets and sidewalks. Any areas designed to initially be gravel or crushed stone shall be assumed to be impervious for the purposes of comparison to the exemption criteria.

B. Stormwater drainage systems shall be provided in order to permit unimpeded flow along natural watercourses, except as modified by stormwater management facilities or open channels consistent with this Ordinance.

C. The existing points of concentrated drainage that discharge onto adjacent property shall not be altered without permission of the affected property owner(s) and shall be subject to any applicable discharge criteria specified in this Ordinance.

D. Areas of existing diffused drainage discharge shall be subject to any applicable discharge

criteria in the general direction of existing discharge, whether proposed to be concentrated or maintained as diffused drainage areas, except as otherwise provided by this ordinance. If diffused flow is proposed to be concentrated and discharged onto adjacent property, the Developer must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge, or otherwise prove that no erosion, sedimentation, flooding or other harm will result from the concentrated discharge.

E. Where a development site is traversed by watercourses drainage easements shall be provided conforming to the line of such watercourses. The terms of the easement shall prohibit excavation, the placing of fill or structures, and any alterations that may adversely affect the flow of stormwater within any portion of the easement. Also, maintenance, including mowing of vegetation within the easement shall be required, except as approved by the appropriate governing authority.

F. When it can be shown that, due to topographic conditions, natural drainageways on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the line and grade of such natural drainageways. Work within natural drainageways shall be subject to approval by PaDEP through the Joint Permit Application process, or, where deemed appropriate by PaDEP, through the General Permit process.

G. Any stormwater management facilities regulated by this Ordinance that would be located in or adjacent to waters of the Commonwealth or wetlands shall be subject to approval by PaDEP through the Joint Permit Application process, or, where deemed appropriate by PaDEP, the General Permit process. When there is a question whether wetlands may be involved, it is the responsibility of the Developer or his agent to show that the land in question cannot be classified as wetlands, otherwise approval to work in the area must be obtained from PaDEP.

H. Any stormwater management facilities regulated by this Ordinance that would be located on State highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation (PaDOT).

I. Minimization of impervious surfaces and infiltration of runoff through seepage beds, infiltration trenches, etc. are encouraged, where soil conditions permit, to reduce the size or eliminate the need for detention facilities.

J. Roof drains must not be connected to streets, sanitary or storm sewers or roadside ditches to promote overland flow and infiltration/ percolation of stormwater where advantageous to do so. When it is more advantageous to connect directly to streets or storm sewers, then it shall be permitted on a case by case basis by the municipality.

Section 302. Stormwater Management Districts

A. Bowman's Creek Watershed has been divided into stormwater management districts as shown on the Watershed Map in Appendix D.

Standards for managing runoff from each subarea in Bowman's Creek Watershed for the 2, 10, 25, and 100 year design storms is shown below. Development sites located in each of

the A, B, or C Districts must control post-development runoff rates to pre-development runoff rates for the design storms as follows:

District	Subareas	Design Storm Post-Development	Design Storm Pre-Development
A	1-19, 26-34, 39, 43-51	2- year 5- year 10- year 25- year 100-year	1- year 5- year 10- year 25- year 100-year
B	20-25, 35-38, 40-42, 52-77, 81-88, 95-99	2- year 5- year 10 – year 25- year 100-year	1- year 2- year 5- year 10- year 100-year
C	78-80, 89-94, 100-110	ND*	ND*

- EXPLANATION OF DISTRICT C: Development sites which can discharge directly to Bowman's Creek main channel or major tributaries or indirectly to the main channel through an existing stormwater drainage system (i.e., storm sewer or tributary) may do so without control of post-development peak rate of runoff. If the post-development runoff is intended to be conveyed by an existing stormwater drainage system to the main channel, assurance must be provided that such system has adequate capacity to convey the increased peak flows or will be provided with improvements to furnish the required capacity. When adequate capacity of downstream system does not exist and will not be provided through improvements, the post-development peak rate of runoff must be controlled to the pre-development peak rate as required in District A provisions (i.e.,10-year post-development flows to 10 pre-development flows)for the specified design storms.

In addition to the requirements specified above, the water quality and streambank erosion requirements shall be implemented (Section 308).

Section 303. Stormwater Management District Implementation Provisions (Performance Standards)

A. General - Post-development rates of runoff from any regulated activity shall meet the peak release rates of runoff prior to development for the design storms specified on the Stormwater Management District Watershed Map (Ordinance Appendix D) and Section 302, of the Ordinance.

B. District Boundaries - The boundaries of the Stormwater Management Districts are shown on an official map that is available for inspections at the municipal office. A copy of the

official map at a reduced scale in included in the Ordinance Appendix D. The exact location of the Stormwater Management District boundaries as they apply to a given development site shall be determined by mapping the boundaries using the two-foot topographic contours (or most accurate data required) provided as part of the Drainage Plan.

C. Sites Located in More Than 1 District - For a proposed development site located within two or more stormwater management district category subareas, the peak discharge rate from any subarea shall be the pre-development peak discharge for that subarea as indicated in Section 302. The calculated peak discharges shall apply regardless of whether the grading plan changes the drainage area by subarea. An exception to the above may be granted if discharges from multiple subareas recombine in proximity to the site. In this case, peak discharge in any direction may be a 100% release rate provided that the overall site discharge meets the weighted average release rate.

D. Off-Site Areas - Off-site Areas that drain through a proposed development site are not subject to release rate criteria when determining allowable peak runoff rates. However, on-site drainage facilities shall be designed to safely convey off-site flows through the development site.

E. Site Areas - Where the site area to be impacted by a proposed development activity differs significantly from the total site area, only the proposed impact area utilizing stormwater management measures shall be subject to the Management District Criteria. In other words, unimpacted areas bypassing the stormwater management facilities would not be subject to the Management District Criteria.

F. "No Harm" Option - For any proposed development site not located in a provisional direct discharge district, the developer has the option of using a less restrictive runoff control (including no detention) if the developer can prove that "no harm" would be caused by discharging at a higher runoff rate than that specified by the Plan. The "no harm" Option is used when a developer can prove that the post-development hydrographs can match pre-development hydrographs, or if it can be proved that the post-development conditions will not cause increases in peaks at all points downstream. Proof of "no harm" would have to be shown based upon the following "Downstream Impact Evaluation" which shall include a "downstream hydraulic capacity analysis" consistent with Section 303H to determine if adequate hydraulic capacity exists. The land developer shall submit to the municipality this evaluation of the impacts due to increased downstream stormwater flows in the watershed.

1. The "Downstream Impact Evaluation" shall include hydrologic and hydraulic calculations necessary to determine the impact of hydrograph timing modifications due to the proposed development upon a dam, highway, structure, natural point of restricted streamflow or any stream channel section, established with the concurrence of the municipality.

2. The evaluation shall continue downstream until the increase in flow diminishes due to additional flow from tributaries and/or stream attenuation.

3. The peak flow values to be used for downstream areas for the design return period storms (2, 5, 10, 25, 50, and 100-year) shall be the values from the calibrated model for Bowman's Creek Watershed. These flow values can be obtained from the watershed plan.

4. Developer-proposed runoff controls which would generate increased peak flow rates at storm drainage problem areas would, by definition, be precluded from successful attempts to prove "no-harm", except in conjunction with proposed capacity improvements for the problem areas consistent with Section 303.H.

5. A financial distress shall not constitute grounds for granting a no-harm exemption.

6. Capacity improvements may be provided as necessary to implement the "no harm" option which proposes specific capacity improvements to provide that a less stringent discharge control would not create any harm downstream.

7. Any "no harm" justifications shall be submitted by the developer as part of the Drainage Plan submission per Article IV.

G. "Downstream Hydraulic Capacity Analysis" - Any downstream capacity hydraulic analysis conducted in accordance with this Ordinance shall use the following criteria for determining adequacy for accepting increased peak flow rates:

1. Natural or man-made channels or swales must be able to convey the increased runoff associated with a 2-year return period event within their banks at velocities consistent with protection of the channels from erosion. Acceptable velocities shall be based upon criteria included in the DEP *Erosion and Sediment Pollution Control Program Manual*.

2. Natural or man-made channels or swales must be able to convey increased 25-year return period runoff without creating any hazard to persons or property.

3. Culverts, bridges, storm sewers or any other facilities which must pass or convey flows from the tributary area must be designed in accordance with DEP Chapter 105 regulations (if applicable) and, at minimum, pass the increased 25-year return period runoff.

H. Regional Detention Alternatives - For certain areas within the study area, it may be more cost-effective to provide one control facility for more than one development site than to provide an individual control facility for each development site. The initiative and funding for any regional runoff control alternatives are the responsibility of prospective developers. The design of any regional control basins must incorporate reasonable development of the entire upstream watershed. The peak outflow of a regional basin would be determined on a case-by-case basis using the hydrologic model of the watershed consistent with protection of the downstream watershed areas. "Hydrologic model" refers to the calibrated model as developed for the Stormwater Management Plan.

Section 304. Design Criteria for Stormwater Management Facilities

A. Any stormwater facility located on State highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation (PaDOT).

B. Any stormwater management facility (i.e., detention basin) designed to store runoff and requiring a berm or earthen embankment required or regulated by this ordinance shall be designed to provide an emergency spillway to handle flow up to and including the 100-year post-development conditions. The height of embankment must be set as to provide a minimum 1.0 foot of freeboard above the maximum pool elevation computed when the facility functions for the 100-year post-development inflow. Should any storm-water management facility require a dam safety permit under PaDEP Chapter 105, the facility shall be designed in accordance with Chapter 105 and meet the regulations of Chapter 105 concerning dam safety which may be required to pass storms larger than 100-year event.

C. Any facilities that constitute water obstructions (e.g., culverts, bridges, outfalls, or stream enclosures), and any work involving wetlands as directed in PaDEP Chapter 105 regulations (as amended or replaced from time to time by PaDEP), shall be designed in accordance with Chapter 105 and will require a permit from PaDEP. Any other drainage conveyance facility that does not fall under Chapter 105 regulations must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year design storm with a minimum 1.0 foot of freeboard measured below the lowest point along the top of the roadway. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm with a minimum 1.0 foot of freeboard measured below the lowest point along the top of roadway. Any facility that constitutes a dam as defined in PaDEP chapter 105 regulations may require a permit under dam safety regulations. Any facility located within a PaDOT right of way must meet PaDOT minimum design standards and permit submission requirements.

D. Any drainage conveyance facility and/or channel that does not fall under Chapter 105 Regulations, must be able to convey, without damage to the drainage structure or roadway, runoff from the 10-year design storm. Conveyance facilities to or exiting from stormwater management facilities (i.e., detention basins) shall be designed to convey the design flow to or from that structure. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm. Any facility located within a PaDOT right-of-way must meet PaDOT minimum design standards and permit submission requirements.

E. Storm sewers must be able to convey post-development runoff from a _-year design storm without surcharging inlets, where appropriate.

F. Adequate erosion protection shall be provided along all open channels, and at all points of discharge.

G. The design of all stormwater management facilities shall incorporate sound engineering principles and practices. The Municipality shall reserve the right to disapprove any design that would result in the occupancy or continuation of an adverse hydrologic or hydraulic condition within the watershed.

Section 305. Calculation Methodology

Stormwater runoff from all development sites shall be calculated using either the rational method or a soil-cover-complex methodology.

A. Any stormwater runoff calculations shall use generally accepted calculation technique that is based on the NRCS soil cover complex method. Table 305.A.1 summarizes acceptable computation methods. It is assumed that all methods will be selected by the design professional based on the individual limitations and suitability of each method for a particular site.

   The Municipality may allow the use of the Rational Method to estimate peak discharges from drainage areas that contain less than 200 acres.

B. All calculations consistent with this Ordinance using the soil cover complex method shall use the appropriate design rainfall depths for the various return period storms according to the region for which they are located as presented in Table B-1 in Appendix B of this Ordinance. If a hydrologic computer model such as PSRM or HEC-1 is used for stormwater runoff calculations, then the duration of rainfall shall be 24 hours. The SCS 'S' curve shown in Figure B-1, Appendix B of this Ordinance shall be used for the rainfall distribution.

C. For the purposes of pre-development flow rate determination, undeveloped land shall be considered as "meadow" in good condition, unless the natural ground cover generates a lower curve number or Rational 'C' value (i.e., forest), as listed in Table B-2 or B-3 in Appendix B of this document.

D. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times-of-concentration for overland flow and return periods from the Design Storm Curves from PA Department of Transportation Design Rainfall Curves (1986) (Figures B-2 to B-4). Times-of-concentration for overland flow shall be calculated using the methodology presented in Chapter 3 of Urban Hydrology for Small Watersheds, NRCS, TR-55 (as amended or replaced from time to time by NRCS). Times-of-concentration for channel and pipe flow shall be computed using Manning's equation.

E. Runoff Curve Numbers (CN) for both existing and proposed conditions to be used in the soil cover complex method shall be obtained from Table B-2 in Appendix B of this Ordinance.

F. Runoff coefficients (c) for both existing and proposed conditions for use in the Rational method shall be obtained from Table B-3 in Appendix B of this Ordinance.

G. Where uniform flow is anticipated, the Manning equation shall be used for hydraulic computations, and to determine the capacity of open channels, pipes, and storm sewers. Values for Manning's roughness coefficient (n) shall be consistent with Table B-4 in Appendix B of the Ordinance.

Outlet structures for stormwater management facilities shall be designed to meet the performance standards of this Ordinance using any generally accepted hydraulic analysis technique or method.

H. The design of any stormwater detention facilities intended to meet the performance standards of this Ordinance shall be verified by routing the design storm hydrograph through these facilities using the Storage-Indication Method. For drainage areas greater than 20 acres in size, the design storm hydrograph shall be computed using a calculation method that produces a full hydrograph. The municipality may approve the use of any generally accepted full hydrograph approximation technique that shall use a total runoff volume that is consistent with the volume from a method that produces a full hydrograph.

TABLE 305.A.1
Acceptable Computation Methodologies For
Stormwater Management Plans

METHOD	METHOD DEVELOPED BY	APPLICABILITY
TR-20 (or commercial computer package based on TR-20)	USDA NRCS	Applicable where use of full hydrology computer model is desirable or necessary.
TR-55 (or commercial computer package based on TR-55)	USDA NRCS	Applicable for land development. plans within limitations described in TR-55.
HEC-1	US Army Corps of Engineers	Applicable where use of full hydrologic computer model is desirable or necessary.
PSRM	Penn State University	Applicable where use of a hydrologic computer model is desirable or necessary; simpler than TR-20 or HEC-1.
Rational Method (or commercial computer package based on Rational Method)	Emil Kuichling (1889)	For sites less than 200 acres, or as approved by the Municipality and Municipal Engineer.
Other computation methodologies Other Methods	Varies	approved by the Municipality and Municipal Engineer.

Section 306. Erosion and Sedimentation Requirements

A. Whenever the vegetation and topography are to be disturbed, such activity must be in conformance with Chapter 102, Title 25, Rules and Regulations, Part I, Commonwealth of Pennsylvania, Department of Environmental Protection, Subpart C, protection of natural

Resources, Article II, Water Resources, Chapter 102, "Erosion Control," and in accordance with the Wyoming or Luzerne County Conservation District.

B. Additional erosion and sedimentation control design standards and criteria that must be or are recommended to be applied where infiltration BMPs are proposed shall include the following:

1. Areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase, so as to maintain their maximum infiltration capacity.

2. Infiltration BMPs shall not be constructed nor receive runoff until the entire contributory drainage area to the infiltration BMP has received final stabilization.

Section 307. Ground Water Recharge

A. The ability to retain and maximize the ground water recharge capacity of the area being developed is encouraged. Design of the stormwater management facilities shall give consideration to providing ground water recharge to compensate for the reduction in the percolation that occurs when the ground surface is paved and roofed over. A detailed geologic evaluation of the project site shall be performed to determine the suitability of recharge facilities. The evaluation shall be performed by a qualified person (i.e. geologist, geotechnical engineer and/or soil scientist), and at a minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability. Where pervious pavement is permitted for parking lots, recreational facilities, non-dedicated streets, or other areas, pavement construction specifications shall be noted on the plan.

Section 308. Water Quality and Streambank Erosion Requirements

A. In addition to the performance standards and design criteria requirements of Article III of this Ordinance, the land developer SHALL comply with the following water quality requirements of this Article unless otherwise exempted by provisions of this Ordinance.

B. Detain the post-development 2-year, 24-hour design storm to the pre-development 1-year flow using the SCS Type II distribution. Additionally, provisions shall be made so that the 1-year storm takes a minimum of 24 hours to drain from the facility from a point where the maximum volume of water from the 1-year storm is captured. (i.e., the maximum water surface elevation is achieved in the facility. Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility).

C. To accomplish A. and B. above, the land developer MAY submit original and innovative designs to the Municipal Engineer for review and approval. Such designs may achieve the water quality objectives through a combination of BMPs (Best Management Practices).

D. In selecting the appropriate BMPs or combinations thereof, the land developer SHALL consider the following:

1. Total contributing area.

2. Permeability and infiltration rate of the site soils.
3. Slope and depth to bedrock.
4. Seasonal high water table.
5. Proximity to building foundations and well heads.
6. Erodibility of soils.
7. Land availability and configuration of the topography.

E. The following additional factors SHOULD be considered when evaluating the suitability of BMPs used to control water quality at a given development site:

1. Peak discharge and required volume control.
2. Streambank erosion.
3. Efficiency of the BMPs to mitigate potential water quality problems.
4. The volume of runoff that will be effectively treated.
5. The nature of the pollutant being removed.
6. Maintenance requirements.
7. Creation/protection of aquatic and wildlife habitat.
8. Recreational value.
9. Enhancement of aesthetic and property value.

F. Due to the acidic nature of the water in Bowman's Creek and its tributaries, limestone shall be utilized whenever rock is required where feasible for stormwater management facilities, including rip-rap and gabions. Limestone manufactures management can be found in Ordinance Appendix E.

ARTICLE IV-DRAINAGE PLAN REQUIREMENTS

Section 401. General Requirements

For any of the activities regulated by this Ordinance, the preliminary or final approval of subdivision and/or land development plans, the issuance of any building or occupancy permit, or the commencement of any land disturbance activity may not proceed until the Property Owner or Developer or his/her agent has received written approval of a Drainage Plan from the Municipality.

Section 402. Exemptions

Any Regulated Activity that meets the exception criteria in the following table is exempt from the provisions of this Ordinance. This criteria shall apply to the total development even if development is to take place in phases. The date of the municipal Ordinance adoption shall be the starting point from which to consider tracts as "parent tracts" in which future subdivisions and respective impervious area computations shall be cumulatively considered. An exemption shall not relieve the applicant from providing adequate stormwater management to meet the purpose of this Ordinance; however, drainage plans will not have to be submitted to the municipality.

Stormwater Management Exemption Criteria

Total Parcel Size	Impervious Area Exemption (sq.ft.)
< 1 acre	5,000 sq. ft.
1 - 2 acres	10,000 sq. ft.
2 - 5 acres	15,000 sq. ft
> 5 acres	20,000 sq. ft.

Exemptions shall be at discretion of Municipal Engineer upon review of site conditions, topography, soils and other factors as desired appropriate.

Section 403. Drainage Plan Contents

The Drainage Plan shall consist of all applicable calculations, maps, and plans. A note on the maps shall refer to the associated computations and erosion and sedimentation control plan by title and date. The cover sheet of the computations and erosion and sedimentation control plan shall refer to the associated maps by title and date. All Drainage Plan materials shall be submitted to the municipality in a format that is clear, concise, legible, neat, and well organized; otherwise, the Drainage Plan shall be disapproved and returned to the Applicant.

The following items shall be included in the Drainage Plan:

A. General

1. General description of project.

2. General description of permanent stormwater management techniques, including construction specifications of the materials to be used for stormwater management facilities.

3. Complete hydrologic, hydraulic, and structural computations for all stormwater management facilities.

B. Map(s) of the project area shall be submitted on 24-inch x 36-inch sheets and shall be prepared in a form that meets the requirements for recording at the offices of the Recorder of Deeds of Wyoming County. The contents of the maps(s) shall include, but not be limited to:

1. The location of the project relative to highways, municipalities or other identifiable landmarks.

2. Existing contours at intervals of two feet. In areas of steep slopes (greater than 15 percent), five-feet contour intervals may be used.

3. Existing streams, lakes, ponds, or other bodies of water within the project area.

4. Other physical features including flood hazard boundaries, sinkholes, streams, existing drainage courses, areas of natural vegetation to be preserved, and the total extent of the upstream area draining through the site.

5. The locations of all existing and proposed utilities, sanitary sewers, and water lines within 50 feet of property lines.

6. An overlay showing soil names and boundaries.

7. Proposed changes to the land surface and vegetative cover, including the type and amount of impervious area that would be added.

8. Proposed structures, roads, paved areas, and buildings.

9. Final contours at intervals at two feet. In areas of steep slopes (greater than 15 percent), five-feet contour intervals may be used.

10. The name of the development, the name and address of the owner of the property, and the name of the individual or firm preparing the plan.

11. The date of submission.

12. A graphic and written scale of one (1) inch equals no more than fifty (50) feet; for tracts of twenty (20) acres or more, the scale shall be one (1) inch equals no more than one hundred (100) feet.

13. A North arrow.

14. The total tract boundary and size with distances marked to the nearest foot and bearings to the nearest degree.

15. Existing and proposed land use(s).

16. A key map showing all existing man-made features beyond the property boundary that would be affected by the project.

17. Horizontal and vertical profiles of all open channels, including hydraulic capacity.

18. Overland drainage paths.

19. A fifteen foot wide access easement around all stormwater management facilities that would provide ingress to and egress from a public right-of-way.

20. A note on the plan indicating the location and responsibility for maintenance of stormwater management facilities that would be located off-site. All off-site facilities shall meet the performance standards and design criteria specified in this Ordinance.

21. A construction detail of any improvements made to sinkholes and the location of all notes to be posted, as specified in this Ordinance.

22. A statement, signed by the landowner, acknowledging the stormwater management system to be a permanent fixture that can be altered or removed only after approval of a revised plan by the municipality.

23. The following signature block for the Municipal Engineer:

    (Municipal Engineer), on this date (date of signature), have reviewed and hereby certify that the Drainage Plan meets all design standards and criteria of Bowman's Creek Watershed Act 167 Stormwater Management Ordinance."

24. The location of all erosion and sedimentation control facilities.

C. Supplemental Information

1. A written description of the following information shall be submitted.

    a. The overall stormwater management concept for the project.
    b. Stormwater runoff computations as specified in this Ordinance.
    c. Stormwater management techniques to be applied both during and after development.
    d. Expected project time schedule.

2. A soil erosion and sedimentation control plan, where applicable, including all reviews and approvals, as required by Pa DEP.

3. A geologic assessment of the effects of runoff on sinkholes as specified in this Ordinance.

4. The effect of the project (in terms of runoff volumes and peak flows) on adjacent properties adjacent properties and on any existing municipal stormwater collection system that may receive runoff from the project site.

5. Map of the upgradient contributary drainage areas to the site. USGS topographic maps shall suffice for this requirement.

6. A Declaration of Adequacy and Highway Occupancy Permit from the PaDOT District Office when utilization of a PaDOT storm drainage system is proposed.

D. Stormwater Management Facilities

1. All stormwater management facilities must be located on a plan and described in detail.

2. When groundwater recharge methods such as seepage pits, beds or trenches are used, the locations of existing and proposed septic tank infiltration areas and wells must be

shown.

3. All calculations, assumptions, and criteria used in the design of the stormwater management facilities must be shown.

Section 404. Plan Submission

For all activities regulated by this Ordinance, the steps below shall be followed for submission. For any activities that require a PaDEP Joint Permit Application and regulated under Chapter 105 (Dam Safety and Waterway Management) or Chapter 106 (Floodplain Management) of PaDEP's Rules and Regulations, require a PaDOT Highway Occupancy Permit, or require any other permit under applicable state or federal regulations, the proof of application for that, the permit(s) shall be part of the plan. The plan shall be coordinated with the state and federal permit process.

A. The Drainage Plan shall be submitted by the Developer as part of the Preliminary Plan submission for the Regulated Activity.

B. Four (4) copies of the Drainage Plan shall be submitted.

C. Distribution of the Drainage Plan will be as follows:

1. Two (2) copies to the Municipality accompanied by the requisite Municipal Review Fee, as specified in this Ordinance.

2. One (1) copy to the Municipal Engineers.

3. One (1) copy to the County Planning Commission/Department.

Section 405. Drainage Plan Review

A. The Municipal Engineer shall review the Drainage Plan for consistency with the adopted Bowman's Creek Watershed Act 167 Stormwater Management Plan. The Municipality shall require receipt of a complete plan, as specified in this Ordinance.

B. The Municipal Engineer shall review the Drainage Plan for any submission or land development against the municipal subdivision and land development ordinance provisions not superseded by this Ordinance.

C. For activities regulated by this Ordinance, the Municipal Engineer shall notify the Municipality in writing, within ___ calendar days, whether the Drainage Plan is consistent with the Stormwater Management Plan. Should the Drainage Plan be determined to be consistent with the Stormwater Management Plan, the Municipal Engineer will forward an approval letter to the Developer with a copy to the Municipal Secretary.

D. Should the Drainage Plan be determined to be inconsistent with the Stormwater Management Plan, the Municipal Engineer will forward a disapproval letter to the Developer with a copy to the Municipal Secretary citing the reason(s) for the disapproval. Any disapproved Drainage Plans may be revised by the Developer and resubmitted

consistent with this Ordinance.

E. For Regulated Activities specified in Sections 104.C and 104.D of this Ordinance, the Municipal Engineer shall notify the Municipal Building Permit Officer in writing, within a time frame consistent with the Municipal Building Code and/or Municipal Subdivision Ordinance, whether the Drainage Plan is consistent with the Stormwater Management Plan and forward a copy of the approval/disapproval letter to the Developer. Any disapproved drainage plan may be revised by the Developer and resubmitted consistent with this Ordinance.

F. For Regulated Activities requiring a PaDEP Joint Permit Application, the Municipal Engineer shall notify PaDEP whether the Drainage Plan is consistent with the Stormwater Management Plan and forward a copy of the review letter to the Municipality and the Developer. PaDEP may consider the Municipal Engineer's review comments in determining whether to issue a permit.

G. The Municipality shall not approve any subdivision or land development for Regulated Activities specified in Sections 104 of this Ordinance if the Drainage Plan has been found to be inconsistent with the Stormwater Management Plan, as determined by the Municipal Engineer. All required permits from PaDEP must be obtained prior to approval of any subdivision of land development.

H. The Municipal Building Permit Office shall not issue a building permit for any Regulated Activity specified in Section 104 of this Ordinance if the Drainage Plan has been found to be inconsistent with the Stormwater Management Plan, as determined by the Municipal Engineer, or without considering the comments of the Municipal Engineer. All required permits from PaDEP must be obtained prior to issuance of a building permit.

I. The Developer shall be responsible for completing record drawings of all stormwater management facilities included in the approved Drainage Plan. The record drawings and an explanation of any discrepancies with the design plans shall be submitted to the Municipal Engineer for final approval. In no case shall the Municipality approve the record drawings until the Municipality receives a copy of an approved Declaration of Adequacy, Highway Occupancy Permit from the PaDOT District Office, and any applicable permits from PaDEP.

J. The Municipality's approval of a Drainage Plan shall be valid for a period not to exceed _____ ( ) years. This _____-year time period shall commence on the date that the Municipality signs the approved Drainage Plan. If stormwater management facilities included in the approved Drainage plan have not been constructed, or if constructed, and record drawings of these facilities has not been approved within this _____-year time period, then the Municipality may consider the Drainage plan disapproved and may revoke any and all permits. Drainage Plans that are considered disapproved by the Municipality shall be resubmitted in accordance with Section 407 of this Ordinance.

Section 406. Modification of Plans

A modification to a submitted Drainage Plan for a development site that involves a change in

stormwater management facilities or techniques, or that involves the relocation or re-design of stormwater management facilities, or that is necessary because soil or other conditions are not as stated on the Drainage Plan as determined by the Municipal Engineer, shall require a resubmission of the modified Drainage Plan consistent with Section 404 of this Ordinance and be subject to review as specified in Section 405 of this Ordinance.

A modification to an already approved or disapproved Drainage Plan shall be submitted to the Municipality, accompanied by the applicable review. A modification to a Drainage Plan for which a formal action has not been taken by the Municipality shall be submitted to the Municipality, accompanied by the applicable Municipality Review Fee.

Section 407. Resubmission of Disapproved Drainage Plans

A disapproved Drainage Plan may be resubmitted, with the revisions addressing the Municipal Engineer's concerns documented in writing addressed, to the Municipal Secretary in accordance with Section 404 of this Ordinance and distributed accordingly and be subject to review as specified in Section 405 of this Ordinance. The applicable Municipality Review Fee must accompany a resubmission of a disapproved Drainage Plan.

ARTICLE V-INSPECTIONS

Section 501. Schedule of Inspections

A. The Municipal Engineer or his municipal assignee shall inspect all phases of the installation of the permanent stormwater management facilities as deemed appropriate by the Municipal Engineer.

B. During any stage of the work, if the Municipal Engineer determines that the permanent stormwater management facilities are not being installed in accordance with the approved Stormwater Management Plan, the Municipality shall revoke any existing permits until a revised Drainage Plan is submitted and approved, as specified in this Ordinance.

ARTICLE VI-FEES AND EXPENSES

Section 601. General

The fee required by this Ordinance is the Municipal Review Fee. The Municipal Review fee shall be established by the Municipality to defray review costs incurred by the Municipality and the Municipal Engineer. All fees shall be paid by the Applicant.

Section 602. Municipality Drainage Plan Review Fee

The Municipality shall establish a Review Fee Schedule by resolution of the municipal governing body based on the size of the Regulated Activity and based on the Municipality's costs for reviewing Drainage Plans. The Municipality shall periodically update the Review Fee Schedule to ensure that review costs are adequately reimbursed.

Section 603. Expenses Covered by Fees

The fees required by this Ordinance shall at a minimum cover:

A. Administrative Costs.

B. The review of the Drainage Plan by the Municipality and the Municipal Engineer.

C. The site inspections.

D. The inspection of stormwater management facilities and drainage improvements during construction.

E. The final inspection upon completion of the stormwater management facilities and drainage improvements presented in the Drainage Plan.

F. Any additional work required to enforce any permit provisions regulated by this Ordinance, correct violations, and assure proper completion of stipulated remedial actions.

ARTICLE VII-MAINTENANCE RESPONSIBILITIES

Section 701. Performance Guarantee

The applicant should provide a financial guarantee to the Municipality for the timely installation and proper construction of all stormwater management controls as required by the approved stormwater plan and this ordinance equal to the full construction cost of the required controls.

Section 702. Maintenance Responsibilities

A. The Drainage Plan for the development site shall contain an operation and maintenance plan prepared by the developer and approved by the municipal engineer. The operation and maintenance plan shall outline required routine maintenance actions and schedules necessary to insure proper operation of the facility(ies).

B. The Drainage Plan for the development site shall establish responsibilities for the continuing operating and maintenance of all proposed stormwater control facilities, consistent with the following principals:

1. If a development consists of structures or lots which are to be separately owned and in which streets, sewers and other public improvements are to be dedicated to the municipality, stormwater control facilities may also be dedicated to and maintained by the municipality.

2. If a development site is to be maintained in a single ownership or if sewers and other public improvements are to be privately owned and maintained, then the ownership and maintenance of stormwater control facilities shall be the responsibility of the

owner or private management entity.

C. The governing body, upon recommendation of the municipal engineer, shall make the final determination on the continuing maintenance responsibilities prior to final approval of the stormwater management plan. The governing body reserves the right to accept the ownership and operating responsibility for any or all of the stormwater management controls.

Section 703. Maintenance Agreement for Privately Owned Stormwater Facilities

A. Prior to final approval of the site's stormwater management plan, the property owner shall sign and record the maintenance agreement contained in Appendix A which is attached and made part hereof, covering all stormwater control facilities that are to be privately owned.

B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory maintenance of all facilities. The maintenance agreement shall be subject to the review and approval of the municipal solicitor and governing body.

Section 704. Municipal Stormwater Maintenance Fund

A. Persons installing stormwater storage facilities shall be required to pay a specified amount to the Municipal Stormwater Maintenance Fund to help defray costs of periodic inspections and maintenance expenses. The amount of the deposit shall be determined as follows:

1. If the storage facility is to be privately owned and maintained, the deposit shall cover the cost of periodic inspections performed by the municipality for a period of ten (10) years, as estimated by the municipal engineer. After that period of time, inspections will be performed at the expense of the municipality.

2. If the storage facility is to be owned and maintained by the municipality, the deposit shall cover the estimated costs for maintenance and inspections for ten (10) years. The municipal engineer will establish the estimated costs utilizing information submitted by the applicant.

3. The amount of the deposit to the fund shall be converted to present worth of the annual series values. The municipal engineer shall determine the present worth equivalents, which shall be subject to the approval of the governing body.

B. If a storage facility is proposed that also serves as a recreation facility (e.g., ballfield, lake), the municipality may reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreation purpose.

C. If at some future time a storage facility (whether publicly or privately owned) is eliminated due to the installation of storm sewers or other storage facility, the unused portion of the

maintenance fund deposit will be applied to the cost of abandoning the facility and connecting to the storm sewer system or other facility. Any amount of the deposit remaining after the costs of abandonment are paid will be returned to the depositor.

ARTICLE VIII-ENFORCEMENT AND PENALTIES

Section 801. Right-of-Entry

Upon presentation of proper credentials, duly authorized representatives of the municipality may enter at reasonable times upon any property within the municipality to inspect the condition of the stormwater structures and facilities in regard to any aspect regulated by this Ordinance.

Section 802. Notification

In the event that a person fails to comply with the requirements of this Ordinance, or fails to conform to the requirements of any permit issued hereunder, the municipality shall provide written notification of the violation. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of these violation(s). Failure to comply within the time specified shall subject such person to the penalty provisions of this Ordinance. All such penalties shall be deemed cumulative and does not prevent the municipality from pursuing any and all remedies. It shall be the responsibility of the Owner of the real property on which any Regulated Activity is proposed to occur, is occurring, or has occurred, to comply with the terms and conditions of this Ordinance.

Section 803. Enforcement

The municipal governing body is hereby authorized and directed to enforce all of the provisions of this ordinance. All inspections regarding compliance with the drainage plan shall be the responsibility of the municipal engineer or other qualified persons designated by the municipality.

A. A set of design plans approved by the municipality shall be on file at the site throughout the duration of the construction activity. Periodic inspections may be made by the municipality or designee during construction.

B. Adherence to Approved Plan

It shall be unlawful for any person, firm or corporation to undertake any regulated activity under Section 104 on any property except as provided for in the approved drainage plan and pursuant to the requirements of this ordinance. It shall be unlawful to alter or remove any control structure required by the drainage plan pursuant to this ordinance or to allow the property to remain in a condition which does not conform to the approved drainage plan.

C. At the completion of the project, and as a prerequisite for the release of the performance guarantee, the owner or his representatives shall:

1. Provide a certification of completion from an engineer, architect, surveyor or other

qualified person verifying that all permanent facilities have been constructed according to the plans and specifications and approved revisions thereto.

2. Provide a set of as-built (record) drawings.

D. After receipt of the certification by the municipality, a final inspection shall be conducted by the municipal engineer or designated representative to certify compliance with this ordinance.

E. Prior to revocation or suspension of a permit, the governing body will schedule a hearing to discuss the non-compliance if there is no immediate danger to life, public health or property.

F. Suspension and revocation of Permits

1. Any permit issued under this ordinance may be suspended or revoked by the governing body for:

   a. Non-compliance with or failure to implement any provision of the permit.

   b. A violation of any provision of this ordinance or any other applicable law, ordinance, rule or regulation relating to the project.

   c. The creation of any condition or the commission of any act during construction or development which constitutes or creates a hazard or nuisance, pollution or which endangers the life or property of others, or as outlined in Article IX of this ordinance.

2. A suspended permit shall be reinstated by the governing body when:

   a. The municipal engineer or his designee has inspected and approved the corrections to the stormwater management and erosion and sediment pollution control measure(s), or the elimination of the hazard or nuisance, and/or;

   b. The governing body is satisfied that the violation of the ordinance, law, or rule and regulation has been corrected.

   c. A permit that has been revoked by the governing body cannot be reinstated. The applicant may apply for a new permit under the procedures outlined in this Ordinance.

G. Occupancy Permit

An occupancy permit shall not be issued unless the certification of compliance pursuant to Section 902.D has been secured. The occupancy permit shall be required for each lot owner and/or developer for all subdivisions and land development in the municipality.

Section 804. Public Nuisance

A. The violation of any provision of this ordinance is hereby deemed a Public Nuisance.

B. Each day that a violation continues shall constitute a separate violation.

Section 805. Penalties

A. Anyone violating the provisions of this ordinance shall be guilty of a misdemeanor, and upon conviction shall be subject to a fine of not more than $ _____ for each violation, recoverable with costs, or imprisonment of not more than _____ days, or both. Each day that the violation continues shall be a separate offense.

B. In addition, the municipality, through its solicitor may institute injunctive, mandamus or any other appropriate action or proceeding at law or in equity for the enforcement of this Ordinance. Any court of competent jurisdiction shall have the right to issue restraining orders, temporary or permanent injunctions, mandamus or other appropriate forms of remedy or relief.

Section 806. Appeals

A. Any person aggrieved by any action of the [Municipality] or its designee may appeal to [the municipality's governing body or Zoning Hearing Board] within thirty (30) days of that action.

B. Any person aggrieved by any decision of [the municipality's governing body] may appeal to the County Court of Common Pleas in the County where the activity has taken place within thirty (30) days of the municipal decision.

Ordinance Appendix A

STANDARD STORMWATER FACILITIES MAINTENANCE AND MONITORING

AGREEMENT

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

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property as recorded by deed in the land records of _____ County, Pennsylvania, Deed Book _____ at Page _____, (hereinafter "Property").

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

WHEREAS, the Subdivision/Land Management Plan (hereinafter "Plan") for the _____ Subdivision which is expressly made a part hereof, as approved or to be approved by the Municipality, provides for detention or retention of stormwater within the confines of the Property; and

WHEREAS, the Municipality and the Landowner, his successors and assigns agree that the health, safety, and welfare of the residents of the Municipality require that on-site stormwater management facilities be constructed and maintained on the Property: and

WHEREAS, the Municipality requires, through the implementation of the

_____ Watershed Stormwater Management Plan, that

stormwater management facilities as shown on the Plan be constructed and adequately

maintained by the Landowner, his successors and assigns.

NOW, THEREFORE, in consideration of the foregoing premises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The on-site stormwater management facilities shall be constructed by the Landowner, his successors and assigns, in accordance with the terms, conditions and specifications identified in the Plan.

2. The Landowner, his successors and assigns, shall maintain the stormwater management facilities

in good working condition, acceptable to the Municipality so that they are performing their design functions

3. The Landowner, his successors and assigns, hereby grants permission to the Municipality, his authorized agents and employees, upon presentation of proper identification, to enter upon the Property at reasonable times, and to inspect the stormwater management facilities whenever the Municipality deems necessary. The purpose of the inspection is to assure safe and proper functioning of the facilities. The inspection shall cover the entire facilities, berms, outlet structures, pond areas, access roads, etc. When inspections are conducted, the Municipality shall give the Landowner, his successors and assigns, copies of the inspection report with findings and evaluations. At a minimum, maintenance inspections shall be performed in accordance with the following schedule:

- Annually for the first 5 years after the construction of the stormwater facilities,
- Once every 2 years thereafter, or
- During or immediately upon the cessation of 6 inches of rain or greater.

4. All reasonable costs for said inspections shall be born by the Landowner and payable to the Municipality.

5. The owner shall convey to the municipality easements and/or rights-of-way to assure access for periodic inspections by the municipality and maintenance, if required.

6. In the event the Landowner, his successors and assigns, fails to maintain the stormwater management facilities in good working condition acceptable to the Municipality, the Municipality may enter upon the Property and take such necessary and prudent action to maintain said stormwater management facilities and to charge the costs of the maintenance and/or repairs to the Landowner, his successors and assigns. This provision shall not be construed as to allow the Municipality to erect any structure of a permanent nature on the land of the Landowner, outside of any easement belonging to the Municipality. 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.

7. The Landowner, his successors and assigns, will perform maintenance in accordance with the maintenance schedule for the stormwater management facilities including sediment removal as outlined on the approved schedule and/or Subdivision/Land Management Plan.

8. In the event 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 on account of the Landowner's or his successors' and assigns' failure to perform such work, the Landowner, his successors and assigns, shall reimburse the Municipality upon demand, within 30 days of receipt of invoice thereof, for all costs incurred by the Municipality hereunder. If not paid within said 30-day period, the Municipality may enter a lien against the property in the amount of such costs, or may proceed to recover his costs through proceedings in equity or at law as authorized under the provisions of the _____ Code.

9. The Landowner, his successors and assigns, shall indemnify the Municipality and his agents and employees against any and all damages, accidents, casualties, occurrences or claims which might arise or be asserted against the Municipality for the construction, presence, existence or maintenance of the stormwater management facilities by the Landowner, his successors and assigns.

10. In the event a claim is asserted against the Municipality, his agents or employees, the Municipality shall promptly notify the Landowner, his successors and assigns, and they shall defend, at their

own expense, any suit based on such claim. If any judgment or claims against the Municipality, his agents or employees shall be allowed, the Landowner, his successors and assigns shall pay all costs and expenses in connection therewith.

11. In the advent of an emergency or the occurrence of special or unusual circumstances or situations, the Municipality may enter the Property, if the Landowner is not immediately available, without notification or identification, to inspect and perform necessary maintenance and repairs, if needed, when the health, safety or welfare of the citizens is at jeopardy. However, the Municipality shall notify the landowner of any inspection, maintenance, or repair undertaken within 5 days of the activity. The Landowner shall reimburse the Municipality for his costs.

This Agreement shall be recorded among the land records of

_____ County, Pennsylvania and shall constitute a covenant

running with the Property and/or equitable servitude, and shall be binding on the

Landowner, his administrators, executors, assigns, heirs and any other successors in

interests, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the Municipality:

_____

(SEAL) For the Landowner:

_____

ATTEST:

_____ (City, Borough, Township)

County of _____, Pennsylvania

I, _____, a Notary Public in and for the County and State aforesaid, whose commission expires on the _____ day of _____, 20__, do hereby certify that _____ whose name(s) is/are signed to the foregoing Agreement bearing date of the _____ day of _____, 20__, has acknowledged the same before me in my said County and State.

GIVEN UNDER MY HAND THIS _____ day of _____, 20___.

_____

NOTARY PUBLIC

(SEAL)

ORDINANCE APPENDIX B -
STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE B-1
DESIGN STORM RAINFALL AMOUNT (INCHES)
Source: “Field Manual of Pennsylvania Department of Transportation”
STORM INTENSITY-DURATION-FREQUENCY CHARTS
P D T - I D F" May 1986.

FIGURE B-1
SCS RAINFALL DISTRIBUTION – S CURVE
Source: NRCS (SCS) TR-55

FIGURE B-2
PENNDOT DELINEATED REGIONS
Source: “Field Manual of Pennsylvania Department of Transportation”
STORM INTENSITY-DURATION-FREQUENCY CHARTS
P D T - I D F" May 1986.

FIGURE B-3
PENNDOT STORM INTENSITY-DURATION-FREQUENCY CURVE
REGION 2
Source: “Field Manual of Pennsylvania Department of Transportation”
STORM INTENSITY-DURATION-FREQUENCY CHARTS
P D T - I D F" May 1986.

FIGURE B-4
PENNDOT STORM INTENSITY-DURATION-FREQUENCY CURVE
REGION 3
Source: “Field Manual of Pennsylvania Department of Transportation”
STORM INTENSITY-DURATION-FREQUENCY CHARTS
P D T - I D F" May 1986.

TABLE B-2
RUNOFF CURVE NUMBERS
Source: NRCS (SCS) TR-55

TABLE B-3
RATIONAL RUNOFF COEFFICIENTS

TABLE B-4
MANNING ROUGHNESS COEFFICIENTS

TABLE B-1
Design Storm Rainfall Amount (Inches)

The design storm rainfall amount chosen for design should be obtained from the PennDOT region for which the site is located according to Figure B-2.

Source: "Field Manual of Pennsylvania Department of Transportation"
STORM INTENSITY-DURATION-FREQUENCY CHARTS
P D T - I D F" May 1986.

Design Storm Frequency (yrs)	24 Hours Rainfall Amount (inches)	
	Region 2	Region 3
1	2.04	2.04
2	2.42	2.42
5	3.05	3. 10
10	3.48	3.7
25	4.08	4.4
50	4.56	5.2
100	5.28	6.05

<<FIGURE B-1>>
<<NRCS (SCS) TYPE II RAINFALL DISTRIBUTION>>

<<FIGURE B-2>>
<<PENNDOT STORM INTENSITY-DURATION-FREQUENCY CURVE>>

TABLE B-2
Runoff Curve Numbers
(From NRCS (SCS) TR-55)

		HYDROLOGIC SOIL GROUP			
LAND USE DESCRIPTION		**A**	**B**	**C**	**D**
Open Space		44	65	77	82
Orchard		44	65	77	82
Meadow		30**	58	71	78
Agricultural		59	71	79	83
Forest		36**	60	73	79
Commercial	(85% Impervious)	89	92	94	95
Industrial	(72% Impervious)	81	88	91	93
Institutional	(50% Impervious)	71	82	88	90
Residential					
Average Lot Size	% impervious				
1/8 acre or less	65	77	85	90	92
1/8 - 1/3 acre	34	59	74	82	87
1/3 - 1 acre	23	53	69	80	85
1 - 4 acres	12	46	66	78	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.
** Caution - CN values under 40 may produce erroneous modeling results.

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

<<TABLE B-3>>
<<RATIONAL RUNOFF COEFFICIENTS>>

<<TABLE B-3>>
<<RATIONAL RUNOFF COEFFICIENTS>>

TABLE B-4

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 1/4 inch)	0.10	-	0.15
- small depths (1/4 inch to several inches)	0.05	-	0.10

Roughness Coefficients (Manning's "n") For Sheet Flow (U.S. Soil Conservation Service Technical Release 55)

Surface Description	n
Smooth Surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated Soils:	
Residue Cover Less Than or = 20%	0.06
Residue Cover Greater Than 20%	0.17
Grass:	
Short Grass Prairie	0.15
Dense Grasses	0.24
Bermuda Grass	0.41
Range (natural)	0.13
Woods:	
Light Underbrush	0.40

ORDINANCE APPENDIX C-
SAMPLE DRAINAGE PLAN APPLICATION AND FEE SCHEDULE

(To be attached to the "land subdivision plan or development plan review application or "minor land subdivision plan review application")

Application is hereby made for review of the Stormwater Management and Erosion and Sedimentation Control Plan and related data as submitted herewith in accordance with the _____Township Stormwater Management and Earth Disturbance Ordinance.

_____Final Plan _____Preliminary Plan _____Sketch Plan

Date of Submission _____Submission No.

1. Name of subdivision or development

2. Name of applicant _____ Telephone No._____

   (if corporation, list the corporation's name and the names of two officers of the corporation)
   _____Officer 1
   _____Officer 2

   Address
   _____ Zip

   Applicants interest in subdivision or development
   (if other than property owner give owners name and address)

3. Name of property owner _____Telephone No. ____

   Address
   _____ Zip

4. Name of engineer or surveyor _____Telephone No._____

   Address
   _____ Zip

5. Type of subdivision or development proposed:

____ Single-Family Lots	____ Townhouses	____ Commercial (Multi-Lot)	
____ Two Family Lots	____ Garden Apartments	____ Commercial (One-Lot)	
____ Multi-Family Lots	____ Mobile-Home Park	____ Industrial (Multi-Lot)	
____ Cluster Type Lots	____ Campground	____ Industrial (One-Lot)	
____ Planned Residential Development	____ Other (_____)		

6. Lineal feet of new road proposed?_____ L.F.

7. Area of proposed and existing impervious area on entire tract.

   a. Existing (to remain) _____ S.F. _____% of Property
   b. Proposed _____ S.F. _____% of Property

8. Stormwater

   a. Does the peak rate of runoff from proposed conditions exceed that flow which occurred for pre-development conditions for the designated design storm?

   b. Design storm utilized (on-site conveyance systems) (24 hr.)
      No. of Subarea
      Watershed Name

      Explain:

   c. Does the submission and/or district meet the release rate criteria for the applicable subarea?

   d. Number of subarea(s) from Ordinance Appendix D of Bowman's Creek Watershed Stormwater Management Plan.

   e. Type of proposed runoff control
   f. Does the proposed stormwater control criteria meet the requirement/guidelines of the Stormwater Ordinances?

      If not, what variances/waivers are requested?

      Reasons

   g. Does the plan meet the requirements of Article iii of the Stormwater Ordinances?

      If not, what variances/waivers are requested?

      Reasons Why

   h. Was TR-55, June 1986 utilized in determining the time of concentration?

   i. What hydrologic method was used in the stormwater computations?

   j. Is a hydraulic routing through the stormwater control structure submitted?

k. Is a construction schedule or staging attached?_____

l. Is a recommended maintenance program attached?

9. Erosion and Sediment Pollution Control (E&S):

a. Has the stormwater management and E&S plan, supporting documentation and narrative been submitted to the _____County conservation District?

b. Total area of earth disturbance _____S.F.

10. Wetlands

a. Have the wetlands been delineated by someone trained in wetland delineation?

b. Have the wetland lines been verified by a state or federal permitting authority?

c. Have the wetland lines been surveyed?

d. Total acreage of wetland within the property

e. Total acreage of wetland disturbed_____

f. Supporting documentation

11. Filing

a. Has the required fee been submitted?
Amount

b. Has the proposed schedule of construction inspection to be performed by the applicant's engineer been submitted?_____

c. Name of individual who will be making the inspections_____

d. General comments about stormwater management at development

CERTIFICATE OF OWNERSHIP AND ACKNOWLEDGMENT OF APPLICATION:

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF _____SS

On this the _____ day of _____, 20_____, before me, the undersigned officer, personally appeared _____who being duly sworn, according to law, deposes and says that _____owners of the property described in this application and that the application was made with _____ knowledge and/or direction and does hereby agree with the said application and to the submission of the same.

My Commission Expires_____, 20

THE UNDERSIGNED HEREBY CERTIFIES THAT TO THE BEST OF HIS KNOWLEDGE AND BELIEF THE INFORMATION AND STATEMENTS GIVEN ABOVE ARE TRUE AND CORRECT.

SIGNATURE OF APPLICANT

//

(Information Below This Line To Be Completed By The Municipality)

_____ Township official submission receipt:

Date complete application received _____Plan Number

Fees _____ date fees paid _____ received by

Official submission receipt date

Received by

Township

Drainage Plan
Proposed Schedule Of Fees

Subdivision name _____ Submittal No.

Owner _____ Date

Engineer

1. Filing fee	$
2. Land use	
2a. Subdivision, campgrounds, mobile home parks, and multi-family dwelling where the units are located in the same local watershed.	$
2b. Multi-family dwelling where the designated open space is located in a different local watershed from the proposed units.	$
2c. Commercial/industrial.	$
3. Relative amount of earth disturbance	
3a. Residential	
road <500 l.f.	$
road 500-2,640 l.f.	$
road >2,640 l.f.	$
3b. Commercial/industrial and other	
impervious area <3,500 s.f.	$
impervious area 3,500-43,460 s.f.	$
impervious area >43,560 s.f.	$
4. Relative size of project	
4a. Total tract area <1 ac	$
1-5 ac	$
5-25 ac	$ _____
25-100 ac	$
100-200 ac	$
>200 ac	$
5. Stormwater control measures	
5a. Detention basins & other controls which require a review of hydraulic routings ($ per control).	$
5b. Other control facilities which require storage volume calculations but no hydraulic routings. ($ per control)	$
6. Site inspection ($ per inspection)	$
Total	$

All subsequent reviews shall be 1/4 the amount of the initial review fee unless a new application is required as per Section 406 of the stormwater ordinance. A new fee shall be submitted with each revision in accordance with this schedule.

APPENDIX D -
STORMWATER MANAGEMENT DISTRICT WATERSHED MAP

ORDINANCE APPENDIX E

PENNSYLVANIA LIMESTONE MANUFACTURERS

SOURCE: PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES WEB PAGE

http://www.dcnr.state.pa.us/topogeo

SECTION VIII
PRIORITIES FOR IMPLEMENTATION

The Bowman's Creek Stormwater Management Plan preparation process is complete with Luzerne County's adoption of the draft Plan and submission of the final Plan to DEP for approval, which sets in motion the mandatory schedule of adoption of municipal ordinance provisions needed to implement stormwater management criteria. Bowman's Creek Watershed municipalities had six months from DEP approval to adopt the necessary ordinance provisions.

A. DEP Approval of the Plan

Upon adoption of the Watershed Plan by Luzerne County, the Plan was submitted to DEP for approval. A draft of the Stormwater Management Plan and draft Model Ordinance was be sent to DEP prior to adoption of the Plan. The DEP review process involves determination that all of the activities specified in the Scope of Study have been completed. The DEP also reviewed the Plan for consistency with municipal floodplain management plans, State programs which regulate dams, encroachments and other water obstructions, and State and Federal flood control programs, that the Plan is compatible with other watershed stormwater plans in the basin in which the watershed is located, and that the Plan is consistent with the policies of Act 167.

B. Publishing the Final Plan

Upon DEP approval, the Luzerne County Planning Commission published and provided, at minimum, two copies of the Plan to each municipality. The Plan includes this report, appendices, figures, and Model Ordinance.

C. Municipal Adoption of Ordinance to Implement the Plan

The key ingredient for implementation of the Stormwater Management Plan is the adoption of the necessary ordinance provisions by the Bowman's Creek municipalities. Provided as part of the Plan is the Act 167 Stormwater Management Plan Model Ordinance which is a single purpose stormwater ordinance that could be adopted by each municipality essentially "as is" to implement the Plan. The single purpose ordinance was chosen for ease of incorporation into the existing structure of municipal ordinances. All that is required of any municipality would be to adopt the ordinance itself and adopt the necessary provisions for tying into the existing subdivision and land development ordinance and zoning ordinance as outlined in the Municipal Ordinance Matrix in the Appendix. The tying provisions would simply refer any applicable regulated activities within the Bowman's Creek Watershed from the other ordinances to the single purpose ordinance. It is recommended that the delineation of the watershed subareas and the stormwater management criteria assigned to each subarea be enacted as part of each municipality's zoning or subdivision ordinance so that the requirements for management of stormwater will be applicable to all changes in land use and not limited only to activities which are subject to subdivision and land development regulations.

D. Level of Government Involvement in Stormwater Management

The existing institutional arrangements for the management of stormwater include federal, state, and county governments, as well as every municipality within the watershed.

In the absence of a single entity with responsibility for all aspects of stormwater management within a watershed, it is clear that the "management" which occurs is primarily a function of a multiple permitting process in which a developer attempts to satisfy the requirements of all of the permitting agencies. Each public agency has established its own regulations based on its own objectives and legislative mandates as well as its own technical standards, applicable to its particular stormwater concerns.

The minimum objectives of this Plan and the minimum mandates of Act 167 can be accomplished without significant modification of existing institutional arrangements - by actions taken at the municipal level, participation by the county in the technical review of stormwater management plans, maintenance and operation of the computer model (as necessary), and compilation of date required for periodically updating the Plan. In addition, upon adoption and approval of the Plan, all future public facilities, facilities for the provision of public utility services, and all facilities owned or financed by state funds will have to be consistent with the Plan, even though they might not otherwise be subject to municipal regulation.

The primary municipal level activity will be the adoption or amendment of development regulations to incorporate watershed stormwater management standards. Act 167 requires that this be accomplished within six months of the Plan's adoption and approval. Model ordinance provisions will be distributed to all of the watershed municipalities. The Luzerne County Planning Commission will be available upon request to assist municipalities in the adoption of the model ordinance provisions to fit particular municipal ordinance structures.

The primary county level activity will be the establishment of review procedures. The model ordinance calls for review of stormwater management plans for development sites by the Luzerne County Planning Commission, and Erosion and Sediment Pollution Control Plans by the Luzerne County Conservation District. Evidence that the appropriate state and federal agencies responsible for administering wetland regulatory programs have been contacted for land development sites containing regulated wetlands is also required. The purpose is to ensure that plan standards have been applied appropriately and that downstream impacts have been adequately addressed. Procedures and capabilities for performing the review function exist within the governmental agencies.

The county will also be responsible for the maintenance of data for performance of review and of "no-harm" evaluation. The materials initially prepared by consultants during the plan preparation process which are needed or which may be needed in the development of site specific stormwater management plans, including data needed to perform the "no-harm" evaluation, must be maintained in a place and form which is accessible to users.

E. County-Wide Coordination

There are possible situations of stormwater management functions and concerns, which may not
be adequately addressed within the structure of the existing institutional arrangements or by

the adoption and enforcement of new regulations at the municipal level, as outlined above.

For example, the construction of regional storage facilities may offer a very economic and technically sound alternative to the construction of individual, on-site detention basins. There is, however, no organization at the present time that is capable of implementing such a concept. To do so would require a multi-municipal entity capable of planning, financing, constructing, operating, and maintaining the shared storage facilities in a manner similar to the management required for the collection, treatment, and disposal of sanitary wastes.

The Bowman's Creek watershed is a drainage system. All of its parts are interrelated. What happens upstream affects what happens downstream, and what happens downstream places limitations on what happens upstream. If runoff is not controlled in upstream communities, downstream communities will flood. But, if in a downstream community, the capacity of a drainage channel can be safely increased, more upstream runoff may be released, thus reducing to some degree the cost of required upstream control facilities.

The reduced storm frequency standard proposed in this Plan is the primary standard for managing stormwater on a watershed basis and is a very simple concept that can be implemented on a property-by-property basis. It is equitable and can be used to achieve the law's "no-harm" mandate. But the same technical tool which allowed the modeling of rainfall routing throughout the watershed and the development of a usable standard for property-level control is capable of testing numerous, technically feasible solutions which would work for combinations of properties and for combinations of subareas. Some of these potential solutions may be preferable to those that would result from the application of release rates to individual properties.

There are, of course, ways to work out agreements on a case-by-case basis to permit the accomplishment of almost any objective, whether a public or a private undertaking. But, as the number of stormwater detention and control facilities increases during future years, continuing maintenance to ensure the integrity of structures and their performance will become very important. A proliferation of "special agreements" to handle special situations may make future accountability very difficult.

An ideal structure for the management of stormwater on a watershed basis would be an entity, a regional stormwater management board, capable of dealing with all of the interrelated elements of the system in order to achieve the following:

* the best possible technical solutions in the most effective manner;

* the efficient and competent review of stormwater management components of development plans;

* the continued maintenance and proper functioning of all elements of the system;

* the repair and replacement of system components as necessary;

* continuing monitoring and evaluation of the performance of the drainage system;

* updating and revision of system requirements and standards as necessary;

* responsible financial management including an equitable apportionment of operating and capital costs among the system's users and beneficiaries.

It is clear that not all of these objectives can be achieved on a watershed basis through municipal implementation of the stormwater plan, but that the existence of an intermunicipal entity capable of continuous action at the system or watershed level is required.

An optimum management system would be an entity capable of performing similar functions for multiple watersheds, a county-level stormwater management institution. There are a variety of models for such an entity, ranging from assigning new responsibilities to a coordinated team of existing county departments to the creation of a regional stormwater management board to include stormwater functions. Further, under any management system, some of the elements in the process could be contracted out to a private vendor.

The essential concept is that stormwater can be managed like a public utility and that the costs for planning, construction, operation and maintenance, monitoring and evaluation can be equitably shared by all of the system's users.

A basic assumption underlying the concept of user financing of stormwater management is that damage caused by existing and potential stormwater runoff without controls is intolerable. Therefore, it is in the public interest to undertake stormwater management immediately, and such management should not be delayed until federal and state funding is available.

Based on stormwater management experience elsewhere, users (including beneficiaries) can finance the full cost of stormwater management inexpensively and equitably. The cost to each user is calculated based on user's property characteristics. Because this method is based on a formula, it has the advantage of being objective in its application.

F. Correction of Existing Drainage Problems

The development of the watershed plan has provided a framework for the correction of existing drainage problems, a logical first step in the process of implementation of a stormwater management ordinance. It will prevent the worsening of existing drainage problems and prevent the creation of new drainage problems as well. The step-by-step outline below is by no means a mandatory action to be taken by the municipalities with watershed plan adoption options, it is just one method of solving problems uniformly throughout the watershed in order to solve current runoff situations.

1. Prioritize a list of storm drainage problems within the municipalities based on frequency of occurrence, potential for injury, as well as damage history.

2. Develop a detailed engineering evaluation to determine the exact nature of the top priority drainage problems within the municipalities in order to determine solutions

cost estimates and a recommended course of municipal action.

3. Incorporate implementation of recommended solutions regarding stormwater runoff in the annual municipal capital or maintenance budget.

G. Culvert Replacement

The General Procedures for Municipalities to determine size of replacement culverts using Act 167 data is as follows:

1. Determine the location and Municipality of obstruction on Obstruction Map and obtain the obstruction number.

2. From Section 105.161 of DEP's Chapter 105, determine the design storm frequency.

3. From "Municipal Stream Obstruction Data" tables, locate the Municipality and Obstruction number. Locate the flow value (cfs) for the design storm frequency determined in #2 above.

4. Have the culvert sized for this design flow and obtain any necessary approvals/permits.

Note: Any culverts/stream crossings not identified on the Obstruction Map would need to have storm flows computed for sizing purposes.

H. PennVEST Funding

One way in which the completion and implementation of this plan can be of assistance in addressing storm drainage problems is by opening the avenue of funding assistance through the PennVEST program. The PennVEST Act of 1988, as amended, provides low interest loans to governmental entities for the construction, improvement or rehabilitation of stormwater projects including the transports, storage and infiltration of stormwater and best management practices to address non-point source pollution associated with stormwater.

In order to qualify for a loan under PennVEST, the municipality or county:

1. Must be located in a watershed for which there is an existing county adopted and DEP approved stormwater plan with enacted stormwater ordinances consistent with the plan, or

2. Must have enacted a stormwater control ordinance consistent with the Stormwater Management Act.

I. Landowner's/Developers Responsibilities

Any landowner and any person engaged in the alteration or development of land that may affect stormwater runoff characteristics shall implement such measures consistent with the provisions of the applicable watershed stormwater plan as are reasonably necessary to

prevent injury to health, safety or other property. Such measures shall include such actions as are required:

1. To assure the maximum rate of stormwater runoff is no greater after development than prior to development activities; or

2. To manage the quantity, velocity and direction of resulting stormwater runoff in a manner which otherwise adequately protects health and property from possible injury.

Many developers throughout the state, after realizing the natural resource, public safety and potential economic advantages of proper stormwater management, are constructing new development consistent with natural resources protection.

SECTION IX

PLAN REVIEW ADOPTION AND UPDATING PROCEDURES

A. County Adoption

Prior to plan completion, Wyoming County transmitted a sample of the proposed Stormwater Ordinance for review to affected municipal planning commissions, local governing bodies, the Watershed Plan Advisory Committee and other interested parties. Wyoming County then transmitted a draft plan which included the draft ordinance for review to the municipal planning commission and the governing body of each involved municipality, the County Planning Commission and the Watershed Plan Advisory Committee by official correspondence. This review included an evaluation of the plan's consistency with other plans and programs affecting the watershed. The reviews and comments will be submitted to the county by official correspondence. The county will receive, tabulate, and respond to the comments and will revise the Plan as appropriate.

Wyoming County will hold a public meeting. A notice for the hearing will be published two weeks prior to the hearing date. The meeting notice will contain a summary of the principal provisions of the Plan and will state where copies of the Plan could be examined or obtained within each municipality. The comments received at the public hearing will be reviewed by the county and appropriate modifications to the Plan will be made.

The Plan will be passed as a resolution by the County Commissioners for the purpose of adoption. The resolution will include references to the text of the Plan, maps, plates, and model ordinance. The County resolution will be recorded in the minutes of a regular meeting of the Wyoming County Commissioners.

Wyoming County then submitted to the Department of Environmental Protection a letter of transmittal and three copies of the adopted plan, the review by each affected municipal planning agency and local governing body and the County Planning Commission, public hearing notice and minutes, and the resolution of adoption of the Plan by the County. The letter of transmittal stated that Wyoming County has complied with all procedures outlined in Act 167 and requested that the Department of Environmental Protection approve the adopted plan.

B. Provisions for Plan Revision

Section 5 of the Stormwater Management Act requires that the stormwater management plan be updated at least every five years. This requirement considers the changes in land use, obstructions, flood control projects, floodplain identification, and management objectives or policy that may take place within the watershed.

It will be necessary to collect and manage the required data in a consistent manner and preferably store it in a central location not only to prepare an updated plan, but also, if required, to make interim runs on the runoff simulation model to analyze the impact of a proposed major development or a proposed major stormwater management facility.

The following recommendations deal with the minimum requirements that will have to be undertaken to maintain an effective technical position for periodically reviewing, revising and updating the Plan.

1. It is recommended that the Wyoming County Board of Commissioners authorize the County Planning Commission to undertake the task of collecting and organizing stormwater management plans and supporting documentation and data submitted for review and to assume responsibility for periodically reviewing, revising, and updating the stormwater management plan.

2. It is recommended that the Wyoming County Planning Commission prepare a workable program for the identification, collection and management of the required data. The program should not be limited to the cooperative efforts of the constituent member municipalities within the Bowman's Creek watershed, but should also include both state and county agencies concerned with stormwater management.

3. It is recommended that the Watershed Plan Advisory Committee convene biannually or as needed to review the Stormwater Management Plan and determine if the Plan is adequate for minimizing the runoff impacts of new development. At minimum, the information (to be reviewed by the Committee) will be as follows:

    a. Development activity data as monitored by the Wyoming County Planning Commission.

    b. Information regarding additional storm drainage problem areas as provided by the municipal representatives to the Advisory Committee.

    c. Zoning and Subdivision amendments within the watershed.

    d. Impacts associated with any regional or subregional detention alternatives implemented within the watershed.

    e. Adequacy of the administrative aspects of regulated activity review.

    f. Additional hydrologic data available through preparation of the Stormwater Management Plan for the Bowman's Creek Watershed.

The Committee will review the above data and make recommendations to the County for revisions to the Bowman's Creek Stormwater Management Plan. Wyoming County will review the recommendations of the Watershed Plan Advisory Committee and determine if revisions are to be made. A revised Plan would be subject to the same rules of adoption as the original Plan preparation. Should the County determine that no revisions to the Plan are required for a period of five consecutive years, the County will adopt a resolution stating that the Plan has been reviewed and been found satisfactory to meet the requirements of Act 167 and forward the resolution to the Department of Environmental Protection.

SECTION X

FORMATION OF BOWMAN'S CREEK WATERSHED ADVISORY COMMITTEE

The meeting held by the Committee during the preparation and adoption of the detailed Watershed Stormwater Management Plan.

Advisory Committee meetings and their purposes were as follows:

Meeting	Date	Purpose
1	5/08/97	Introduction to Stormwater Management Review Act 167. Distribute data collection forms - progress report.
2	7/30/98	Retrieve data collection forms - progress report.
3	3/4/99	Problem areas - Municipal Ordinance Matrix - status report, distribute sample ordinance.
4	10/25/99	Summary of data collection, calibration procedure, upcoming steps - status report, summary of modeling results, review ordinance, distribute draft plan.
5	3/14/00	Final WPAC Meeting, Municipal Engineers Committee (MEC), Legal Advisory Committee (LAC) Meeting and Municipal Workshop - Review Ordinance adoption and implementation procedures, standards and criteria, innovative Stormwater Management and Best Management Practices (BMP's).

APPENDIX 1

PUBLIC COMMENT

&

RESPONSES