DARBY AND COBBS CREEKS
WATERSHED ACT 167
STORMWATER MANAGEMENT PLAN

VOLUMES I AND II

DELAWARE, CHESTER, MONTGOMERY, AND
PHILADELPHIA COUNTIES, PENNSYLVANIA

May 2005

DARBY AND COBBS CREEKS WATERSHED ACT 167 STORMWATER MANAGEMENT PLAN

VOLUME I - EXECUTIVE SUMMARY

DELAWARE, CHESTER, MONTGOMERY, AND PHILADELPHIA COUNTIES, PENNSYLVANIA

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May 2005

ENGINEERING CONSULTANT

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

PLAN FORMAT

The format of the Darby and Cobbs Creek Watershed Act 167 Stormwater Management Plan consists of Volume I, the Executive Summary; Volume II, the Plan Report, which includes GIS maps and the model ordinance; and Volume III, which 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, all GIS maps, present conditions, projected land development patterns, calculation methodology, the model ordinance, and implementation discussion.

Volume III provides supporting data, watershed modeling parameters and modeling runs, peak flows, release rates, and the obstructions inventory. Due to large volumes of data, one copy of Volume III will be on file at each of the Delaware County Planning Department, the Chester and Montgomery County Planning Commissions, and the Philadelphia Water Department offices.

The draft plan's figures were in black and white. The final plan contains color figures. Large-scale copies of the figures are at each County Planning office and at the Philadelphia Water Department.

Definitions for stormwater related terms or phrases can be found in Article II of the model ordinance, Appendix 1.

I. INTRODUCTION

This plan has been developed for the Darby and Cobbs Creeks watershed in Delaware, Chester, Montgomery, and Philadelphia Counties, Pennsylvania, to comply with the requirements of the Pennsylvania Storm Water Management Act, Act 167 of 1978. The Darby and Cobbs Creek watersheds are two separate Department of Environmental Protection (DEP) Act 167-designated watersheds. However, Cobbs Creek is actually a tributary of Darby Creek. In order to properly address stormwater management in the Darby Creek watershed below the confluence of Cobbs and Darby Creeks, it was determined that both watersheds needed to be hydrologically evaluated. One Act 167 plan was, therefore, developed encompassing the two watersheds, thus satisfying the Act 167 planning requirements for both watersheds. For the purposes of this report, when the combined watersheds are being formally referenced such as in section headings, the text used to refer to them will read the Darby and Cobbs Creeks watershed. When the combined watersheds are being informally referenced such as in the text of the report, for ease of reading the acronym used to refer to them will be the Darby-Cobbs watershed. Otherwise, they will be referenced individually when appropriate to do so.

The main objective of a stormwater management plan is to control stormwater runoff from new development on a watershed-wide basis rather than on a site-by-site basis, taking into account how development in any part of the watershed will affect stormwater runoff in all other parts of the watershed.

II. WATERSHED DESCRIPTION

The Darby and Cobbs Creeks watersheds are two separate DEP Act 167-designated watersheds. Cobbs Creek is actually a tributary of Darby Creek. The two watersheds are located primarily in eastern Delaware County. The upper portion of the Darby Creek watershed is located in southeastern Chester County. The upper portion of the Cobbs Creek watershed is located in southwestern Montgomery County, and it flows through southwestern Philadelphia County. The Darby-Cobbs watershed lies within 26 municipalities in Delaware County, two municipalities in Chester County, two municipalities in Montgomery County, and one municipality in Philadelphia County as follows:

Delaware County

- Aldan Borough
- Clifton Heights Borough
- Collingdale Borough
- Colwyn Borough*
- Darby Borough*
- Darby Township
- East Lansdowne Borough (Cobbs only)
- Folcroft Borough
- Glenolden Borough
- Morton Borough
- Newtown Township
- Norwood Borough
- Prospect Park Borough
- Radnor Township*
- Ridley Township
- Ridley Park Borough
- Rutledge Borough
- Sharon Hill Borough

Haverford Township*
Lansdowne Borough*
Marple Township
Millbourne Borough (Cobbs only)
Springfield Township
Tinicum Township
Upper Darby Township*
Yeadon Borough*

Chester County

Easttown Township
Tredyffrin Township

Montgomery County

Lower Merion Township*
Narberth Borough (Cobbs only)

Philadelphia County

City of Philadelphia*

* In both the Darby Creek and Cobbs Creek watersheds

Darby Creek drains a total watershed area of approximately 77.2 square miles and includes the following major tributaries: Little Darby Creek, Julip Run, Ithan Run, Meadowbrook Run, Wigwam Run, Foxes Run, and Muckinipates Creek. Approximately 39.6 square miles of the Darby Creek watershed are upstream of its confluence with Cobbs Creek. Cobbs Creek, a major tributary of Darby Creek, has a drainage area of 22.2 square miles. Approximately 15.4 square miles of the Darby Creek watershed are located below its confluence with Cobbs Creek. Darby Creek flows into the Delaware River just south of Little Tinicum Island.

III. METHODOLOGY

The engineer for the project is Borton-Lawson Engineering, Inc. The plan was developed from data collected on the physical features of the watershed, such as soils, wetlands, topography, floodplains, dams and reservoirs, stream dimensions, and obstructions. Information on existing problem areas was solicited from the Watershed Plan Advisory Committee (WPAC), which consisted of representatives from the 31 municipalities as well as other interested parties including the County Conservation Districts, the Darby Creek Valley Association (DCVA), and others. Although the plan is not geared toward solving existing problems, knowing where and why they exist aided the engineer in developing the subwatersheds, identifying points of interest, and understanding the hydrologic flow of the watershed as a whole. Information on existing land use and zoning was also collected. This helped the engineer to determine where and to what extent future development would take place. All of this data was compiled into a geographic information system (GIS) database.

The computer model used for the project was the U.S. Army Corps of Engineers Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS). This model was chosen for the project because it can be easily adapted to an urban and/or rural area, it has the ability to analyze reservoir or detention basin routing effects, and it is accepted by DEP. To gain a realistic picture of what occurs in the Darby-Cobbs watershed, the model was calibrated against actual stream flow data, regression models, as well as data from the Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers.

The process of determining how runoff flows throughout the watershed is a complex one. It involves running numerous scenarios through the model, taking into account the location of obstructions and tributary confluences. This process produced a few large subbasins, which were then 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.

Another aspect of the analysis involves modeling design storms. This term refers to assigning a frequency to a storm based on the amount of rain that falls over a 24-hour period. As the amount of rain falling over a 24-hour period increases, the frequency or chance of that storm occurring decreases. For example, 2.64 inches of rain falling over a 24-hour period is associated with the 1-year design storm, while the occurrence of 6.24 inches falling over a 24-hour period happens theoretically only every 25 years. For this study, the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year storms were modeled.

To make implementation of the plan viable by the municipalities, a simple but accurate method was developed for municipal officials, engineers, and developers to abide by the plan. The watershed was divided into four stormwater management districts and assigned the following proposed condition/existing condition runoff rates for each as indicated in the following plan table.

TABLE V-3
Stormwater Management Districts in the Darby-Cobbs Creek Watershed

District	Proposed Condition Design Storm	(reduce to)	Existing Condition Design Storm
A	2 - year		1 - year
	5 - year		5 - year
	10 - year		10 - year
	25 - year		25 - year
	100-year		100-year
B-1	2 - year		1- year
	10 - year		5 - year
	25 - year		10 - year
	50- year		25- year
	100-year		100-year

B-2	2 - year 5 - year 25 - year 50- year 100 - year	1- year 2 - year 5 - year 10- year 100 - year
C *	Provisional Direct Discharge District	

** In District C, development sites which can discharge directly to the Darby-Cobbs 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 greater than the 5-year storm. Sites in District C will still have to comply with the groundwater recharge criteria, the water quality criteria, and stream bank erosion criteria. 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 flows greater than the 2-year pre-development peak flow or will be provided with improvements to furnish the required capacity. When adequate capacity in the 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-year pre-development flows) for the specified design storms.*

All regulated activities not otherwise exempt from the ordinance are required to implement water quality controls as defined by the ordinance. Generally, they are as follows:

1. Provide infiltration capacity for the net increase in the 2-year volume of runoff from the development site in exceptional value (EV) and high quality (HQ) watersheds. In other areas (or if this cannot be physically accomplished in EV and HQ watersheds), a lesser volume of infiltration can be provided based upon capturing and infiltrating 1 inch of runoff from all new impervious surfaces, but under no conditions should the infiltration capacity provided on the site be less than the minimum of 0.50 inch of runoff from impervious surfaces. The infiltration volume does not have to be provided in one location. However, if site conditions preclude capture of runoff from portions of the impervious area, the infiltration volume for the remaining area should be increased an equivalent amount to offset the loss.

2. If site conditions preclude use of infiltration facilities for such reasons as high groundwater tables or extensive rock conditions, a waiver from Section 405, Groundwater Recharge, would be required by the municipality.

3. Provide buffer areas on perennial or intermittent streams passing through the site. The buffer areas are recommended to be at least 50 feet wide; municipalities may set a lower figure, but never less than 10 feet wide. The buffer shall be maintained with and encouraged to use appropriate native vegetation.

4. If none of the above options are feasible due to site constraints, the applicant must provide stormwater detention that meets the release rate criteria for the site location or else obtain approval from the municipal Engineer to implement other best management practices (BMPs) that will provide water quality benefits of an equivalent level.

5. Exempted activities as defined by the ordinance are still encouraged to implement voluntary stormwater management practices as indicated in Appendix B of the model ordinance.

IV. EXEMPTIONS

Exemptions for land use activities include:

1. Use of land for gardening for home consumption.

2. Agriculture when operated in accordance with a conservation plan, nutrient management plan, or erosion and sedimentation control plan approved by the County Conservation District, including activities such as growing crops, rotating crops, tilling of soil, and grazing animals. Installation of new or expansion of existing farmsteads, animal housing, waste storage, and production areas having impervious surfaces that result in a net increase in earth disturbance of greater than 5,000 square feet shall be subject to the provisions of the ordinance.

3. Forest management operations which are following DEP's management practices contained in its publication *Soil Erosion and Sedimentation Control Guidelines for Forestry* and are operating under an approved erosion and sedimentation plan must comply with the stream buffer requirements in Section 406.G.

4. Road replacement, development, or redevelopment that has less than 2,000 square feet of new, additional, or replaced impervious surface/cover, or in the case of earth disturbance only, less than 5,000 square feet of disturbance, is exempt from the ordinance.

The following land development and earthmoving activities are exempt from the drainage plan submission requirements of the ordinance.

1. A maximum of 2,000 square feet of new, additional, or replacement proposed impervious surface.

   Or in the case of earth disturbance resulting in less than 2,000 square feet of impervious cover (as noted above)

2. Up to a maximum of 5,000 square feet of disturbed earth.

These criteria shall apply to the total development even if the 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” upon which future subdivisions and respective earth disturbance computations shall be cumulatively considered.

V. NPDES REGULATIONS

New federal regulations approved in October 1999 require operators of small municipal separate storm sewer systems (MS4s) to obtain NPDES Phase II (National Pollutant Discharge Elimination System Phase II Stormwater Permitting Regulations) permits from DEP by March 2003. This program affects all municipalities in “urbanized areas” of the state. This definition applies to all Darby-Cobbs watershed municipalities. Therefore, all municipalities within the Darby-Cobbs watershed will be subject to the NPDES Phase II requirements mandated by the federal Clean Water Act as administered by DEP. For more information on NPDES II requirements, contact the DEP Regional Office.

VI. IMPLEMENTATION

All municipalities within the watershed are required to adopt the provisions of the Darby and Cobbs Creeks Stormwater Management Plan’s model ordinance following County adoption and DEP approval. The standards and criteria contained in this ordinance apply only to those portions of the municipality that are located within the boundaries of the Darby-Cobbs watershed. The areas outside of the watershed are still regulated by the municipality’s subdivision/land development ordinance unless otherwise written so as to apply to other areas of the municipality.

County adoption of the plan occurred in May 2005. The plan was then sent to DEP for approval, which was granted on October 25, 2005. All of the municipalities are required to adopt the model ordinance provisions within six months of DEP approval.

DARBY AND COBBS CREEKS WATERSHED ACT 167 STORMWATER MANAGEMENT PLAN

VOLUME II – PLAN CONTENTS

DELAWARE, CHESTER, MONTGOMERY, AND PHILADELPHIA COUNTIES, PENNSYLVANIA

May 2005

DARBY AND COBBS CREEKS WATERSHED
ACT 167
STORMWATER MANAGEMENT PLAN

DELAWARE, CHESTER, MONTGOMERY, AND PHILADELPHIA COUNTIES, PENNSYLVANIA

VOLUME II - PLAN CONTENTS

May 2005

ENGINEERING CONSULTANT

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

RESOLUTION

WHEREAS, the Stormwater Management Act, 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, 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, Delaware County Council entered into contract with the Pennsylvania Department of Environmental Protection to develop the watershed stormwater management plan for the Darby and Cobbs Creeks designated watershed; and

WHEREAS, the purposes of the Darby and Cobbs Creeks Watershed Stormwater Management Plan are 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 for stormwater management systems and facilities within the Darby and Cobbs Creeks watershed shall utilize the criteria and standards as found in the watershed stormwater management plan;

NOW, THEREFORE, BE IT RESOLVED that Delaware County Council hereby adopts the Darby and Cobbs Creeks Watershed Stormwater Management Plan, including all volumes, figures, appendices, and model ordinance, and forwards the plan to the Stormwater Management Section of the Pennsylvania Department of Environmental Protection for approval.

This Resolution is hereby adopted this 26th day of April, 2005 by:

DELAWARE COUNTY COUNCIL

Tim Murtaugh, Chairman

Andrew J. Reilly, Vice Chairman

Linda A. Cartisano

Mary Alice Brennan

Attest:

Joyce Lamont
Delaware County Clerk

Michael V. Puppio, Jr.

RESOLUTION # 26-05

WHEREAS, the Stormwater Management Act 167 of 1978 provides for the regulation of land and water use for flood control and stormater 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 Chester County Commissioners entered into a grant agreement with Delaware County and the Department to develop the watershed stormwater management plan for the Darby and Cobbs Creeks designated watershed; and

WHEREAS, policies of the Chester County Comprehensive Plan Landscapes, calls for the reduction of public costs from flood damage and the protection of water quality in streams; and

WHEREAS, the purpose of the Darby and Cobbs Creeks 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 Darby and Cobbs Creeks Watershed shall utilize the criteria and standards as found in the watershed stormwater management plan;

NOW, THEREFORE, BE IT RESOLVED that the Chester County Commissioners hereby adopt the Darby and Cobbs Creeks Watershed Stormwater Management Plan, including all volumes, figures, appendices, model ordinance and forward the Plan to the Stormwater Management Section of the Pennsylvania Department of Environmental Protection for approval.

This Resolution is hereby adopted this 26th day of May, 2005 by:

CHESTER COUNTY COMMISSIONERS

Donald Mancini, Chairman

Carol Aichele

Andrew Dinniman

COUNTY COMMISSIONERS

May 5, 2005

05-C. 159

On motion of Mr. Ellis, seconded by Ms. Damsker, it was unanimously adopted, that

WHEREAS, Act 167, the Stormwater Management Act requires Pennsylvania counties to develop stormwater management plans for watersheds within their borders, and

WHEREAS, the Act encourages cooperation between counties where watersheds cross county borders, permitting both counties to adopt one plan for that watershed, and

WHEREAS, Delaware County has completed the Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan with assistance from Montgomery County, and

WHEREAS, the plan dated January 2005 meets all of the requirements of Act 167 and has been reviewed by the PA Department of Environmental Protection, and

WHEREAS, The Plan includes a model ordinance requiring comprehensive stormwater management, volume control, water quality protection, streambank protection, and infiltration, and

WHEREAS, The municipalities and the public have participated in the development of the Plan through the Watershed Plan Advisory Committee and a public hearing held on March 29, 2005.

NOW, THEREFORE, BE IT RESOLVED, that the Montgomery County Commissioners do hereby adopt the January, 2005 Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan.

cc: File
Controller
Purchasing
Finance
Department

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 purpose of the Darby and Cobbs Creeks 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 Darby and Cobbs Creeks Watershed shall utilize the criteria and standards as found in the watershed stormwater management plan;

WHEREAS; the City of Philadelphia Water Department has been authorized under the ordinances of the City of Philadelphia to develop regulations for the management of stormwater and to review stormwater management plans for development within the City of Philadelphia;

NOW, THEREFORE, BE IT RESOLVED that the City of Philadelphia, acting through its Water Department, hereby adopts the Darby and Cobbs Creeks Watershed Stormwater Management Plan, including all volumes, figures, appendices, model ordinance and forward the Plan to the Stormwater Management Section of the Pennsylvania Department of Environmental Protection for approval.

This Resolution is hereby adopted this 5th day of May, 2005 by:

CITY OF PHILADELPHIA
WATER COMMISSIONER

Bernard Brunwasser

Bernard Brunwasser

DELAWARE COUNTY COUNCIL

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Andrew J. Reilly, Vice Chairman
Linda A. Cartisano
Mary Alice Brennan
Michael V. Puppio, Jr.

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Stephanie W. Naidoff (City Representative and Director of Commerce)

ENGINEERING CONSULTANT

Borton-Lawson Engineering, Inc.

DARBY CREEK WATERSHED DESIGNATED WPAC MEMBERS
As of March 9, 2004

Delaware County

Delaware County Planning Department	Ms. Karen Holm Manager, Environmental Section
Delaware County Conservation District	Mr. Edward Magargee District Manager
Aldan Borough	Mr. Charlie Duffy Designated Representative
Clifton Heights Borough	Mr. Michael Galentino, Esq. Borough Council President
Collingdale Borough	Ms. Eileen Nelson Engineer
Colwyn Borough *	Mr. Daniel McEnhill Manager
Darby Borough *	Ms. Eileen Mulvena Engineer
Darby Township	Mr. John O'Neill Designated Representative
East Lansdowne Borough (C)	Ms. Eileen Mulvena Engineer
Folcroft Borough	Ms. Judith Serratore Secretary
Glenolden Borough	Mr. Earl W. Bell Manager
Haverford Township *	Mr. Michael English Manager
Lansdowne Borough *	Mr. William T. Smith Borough Council
Marple Township	Mr. William Brainerd EAC Member

Millbourne Borough (C)	Ms. Elizabeth Catania-Smith Engineer
Morton Borough	Ms. Dolores Giardina Borough Council
Newtown Township	Mr. James Sheldrake Manager
Norwood Borough	Ms. Eileen Mulvena Engineer
Prospect Park Borough	Ms. Eileen Nelson Engineer
Radnor Township *	Mr. Dan Malloy Engineer
Ridley Township	Mr. Charles J. Catania Engineer
Ridley Park Borough	Mr. Robert J. Poole Manager
Rutledge Borough	Mr. Edward O. McGaughey Borough Council President
Sharon Hill Borough	Mr. William H. Scott Manager
Springfield Township	Mr. Kevin Kane Engineer
Tinicum Township	Mr. Robert Bernauer Engineer
Upper Darby Township *	Mr. Fernando Baldivieso Engineer
Yeadon Borough *	Ms. Eileen Mulvena Engineer

Chester County

Chester County Planning Commission	Mr. Wayne Clapp Assistant Director
Chester County Conservation District	Mr. Dan Greig District Manager

Chester County Water Resources Authority	Ms. Janet Bowers Executive Director
Easttown Township	Mr. Surender S. Kohli Engineer
Tredyffrin Township	Mr. Steve Norcini Munic. Authority Operation Mgr.

Montgomery County

Montgomery County Planning Commission	Mr. Michael M. Stokes, AICP Associate Planning Director
Montgomery County Conservation District	Mr. Richard Kadwill District Manager
Lower Merion Township *	Ms. Andrea Campisi Senior Planner
Narberth Borough (C)	Mr. William Martin Manager

City of Philadelphia *

Philadelphia Water Department	Mr. Howard Neukrug, P.E. Director, PWD Office of Watersheds
Philadelphia Planning Commission	Ms. Maxine Griffith, AICP Executive Director

Others

Darby Creek Valley Association	Mr. Fritz Thornton President
Natural Resources Conservation Service (NRCS)	Mr. Sam High District Conservationist

* In both Darby and Cobbs watersheds (C) In Cobbs watershed only

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SECTION I

INTRODUCTION

A. Introduction

This plan has been developed for the Darby-Cobbs watershed in Delaware, Chester, Montgomery, and Philadelphia Counties, Pennsylvania to comply with the requirements of the Pennsylvania Storm Water Management Act, Act 167, of 1978. The Darby and Cobbs Creeks watersheds are two separate Department of Environmental Protection (DEP) Act 167 designated watersheds. However, Cobbs Creek is actually a tributary of Darby Creek. In order to properly address stormwater management in the Darby Creek watershed below the confluence of Cobbs and Darby Creeks, it was determined that both watersheds needed to be hydrologically evaluated. One Act 167 plan was, therefore, developed encompassing the two watersheds, thus satisfying the Act 167 planning requirements for both watersheds. For the purposes of this report, when the combined watersheds are being formally referenced such as in section headings, the text used to refer to them will read the Darby and Cobbs Creeks watershed. When the combined watersheds are being informally referenced such as in the text of the report, for ease of reading the acronym used to refer to them will be the Darby-Cobbs watershed. Otherwise, they will be referenced individually when appropriate to do so.

The Darby-Cobbs watershed is located predominantly in the eastern portion of Delaware County. Portions of the watershed also extend into eastern Chester, southern Montgomery, and western Philadelphia Counties.

This report 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 that 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 included in Appendix 1.

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. We have realized 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 stream bank erosion and sedimentation, and improves the overall quality of the receiving streams.

Stormwater management requires cooperation among state, county, and local officials. It involves proper planning, engineering, construction, operation, and maintenance. This entails educating the public and local officials, and it also requires program development, financing, policy revision, the development of workable criteria, and the adoption of ordinances. The Darby and Cobbs Creeks Watershed Stormwater Management Plan, under the Pennsylvania Storm Water Management Act, Act 167, will enable continued development to occur within the Darby-Cobbs watershed, utilizing both structural and nonstructural measures to properly manage stormwater runoff in the watershed.

SECTION II

ACT 167

A. Storm Water Management Act, Act 167

Recognizing the adverse effects of excessive stormwater runoff resulting from development, the Pennsylvania General Assembly approved the Storm Water Management Act, P.L. 864, No. 167, on October 4, 1978. Act 167 provides for the regulation of land and water use for flood control and stormwater management purposes. It imposes duties, confers powers to DEP, counties, and municipalities, and provides for enforcement and appropriations. The Act requires DEP to designate watersheds, develop guidelines for stormwater management, and develop model stormwater ordinances. The designated watersheds were approved by the Environmental Quality Board on July 15, 1980, and the guidelines and model ordinances were approved by the Legislature on May 14, 1985. The Act provides for grants to be appropriated by the General Assembly and administered by DEP for 75% reimbursement of the allowable costs for the preparation of a stormwater management plan. It also provides for 75% reimbursement of 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 on August 27, 1985).

All counties must, in consultation with their municipalities, prepare and adopt a stormwater management plan for each of their designated watersheds. The county must 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 stormwater ordinances as laid out in the plan. These ordinances must regulate development within the municipality in a manner consistent with the 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 that adequately protects health and property from possible injury. They 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 Darby-Cobbs watershed causes an increase in stormwater runoff and a reduction in groundwater recharge. A number of negative effects result from uncontrolled stormwater runoff in addition to the risk of flooding downstream. It also causes erosion and sedimentation problems, reduces stream quality, raises the temperature of the streams, and impairs the aquatic food chain. It can also reduce the baseflow of streams, which is imperative for aquatic life during the drier summer months.

Erosion of the stream banks caused by accelerated stream velocities due to increased runoff is already evident in the following municipalities: Chester County - Easttown Township; Delaware County - Aldan Borough, Haverford Township, Lansdowne Borough, Marple Township, Newtown Township, Radnor Township, and Sharon Hill Borough.

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 by considering tributary timing of flow volume reduction, baseflow augmentation, water quality control, and ecological protection rather than simply focusing on controlling site-specific peak flow.

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 Darby and Cobbs Creeks Watershed Stormwater Management Plan provides reasonable regulations for 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 levels. 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 the Darby and Cobbs Creeks and their tributaries.

SECTION III

GENERAL DESCRIPTION OF THE WATERSHED

The Darby-Cobbs watershed is located predominantly in the eastern portion of Delaware County. Portions of the watershed extend into eastern Chester, southern Montgomery, and western Philadelphia Counties. There are 26 municipalities in Delaware County, two municipalities in Chester County, two municipalities in Montgomery County, and one municipality in Philadelphia County as listed in Table III-1 and illustrated in Figure III-1A, the Base Map.

TABLE III-1
Darby and Cobbs Creeks Watershed Municipalities

Delaware County

Aldan Borough
Clifton Heights Borough
Collingdale Borough
Colwyn Borough*
Darby Borough*
Darby Township
East Lansdowne Borough (Cobbs only)
Folcroft Borough
Glenolden Borough
Haverford Township*
Lansdowne Borough*
Marple Township
Millbourne Borough (Cobbs only)
Morton Borough
Newtown Township
Norwood Borough
Prospect Park Borough
Radnor Township*
Ridley Township
Ridley Park Borough
Rutledge Borough
Sharon Hill Borough
Springfield Township
Tinicum Township
Upper Darby Township*
Yeadon Borough*

Chester County

Easttown Township
Tredyffrin Township

Montgomery County

Lower Merion Township*
Narberth Borough (Cobbs only)

Philadelphia County

City of Philadelphia*

* In both the Darby and Cobbs Creek watersheds

A. Drainage Area

The Darby-Cobbs watershed has a total area of 77.2 square miles; of that, 6.5 square miles lie in Chester County, 4.2 square miles lie in Montgomery County, 6.5 square miles lie in Philadelphia County, and 60 square miles lie within Delaware County. Darby Creek originates in Easttown Township in Chester County and flows in a south/southeast direction through most of the watershed. It changes direction in the southern portion of the watershed where it flows in a west/southwest direction until it discharges into the Delaware River between the Townships of Ridley and Tinicum. The major tributaries to Darby Creek include: Cobbs Creek, Little Darby Creek, Julip Run, Ithan Run, Meadowbrook Run, Wigwam Run, Foxes Run, and Muckinipates Creek.

Cobbs Creek, a separately identified watershed for the purposes of Act 167 planning, is a major tributary of Darby Creek, constituting almost 1/3 of the watershed. Therefore, it was included as part of this study. The total drainage area of Cobbs Creek above its confluence with Darby Creek is 22.2 square miles. The drainage area of the Darby Creek watershed below the confluence is 15.4 square miles. After the confluence with Cobbs Creek, Darby Creek flows for approximately five miles until it reaches the Delaware River (see Figure III-1A).

The major routes in the Darby-Cobbs watershed include I-476 and I-95, U.S. Routes 30, 13, and 1, and PA Routes 291, 320, and 3. I-476 runs through the watershed for approximately eight miles following Darby Creek from Radnor Township to Springfield Township. I-95 runs through the southern section of the watershed for approximately four miles. I-95 crosses Darby Creek at the Township line between Ridley and Tinicum Townships. U.S. Route 30 runs through the watershed for approximately twelve miles across the northern section of the watershed. U.S. Route 13 enters the watershed in Ridley Park Borough and exits into the City of Philadelphia. U.S. Route 13 crosses Darby Creek in Darby Borough and crosses Cobbs Creek at the Delaware County/ Philadelphia border. U.S. Route 1 runs through the watershed from Springfield to Philadelphia and crosses Darby Creek at the Township line between Springfield and Upper Darby. Route 291 runs parallel with I-95 in the southern portion of the watershed. Route 320 enters the watershed near Villanova, then crosses Darby Creek near the Old Foxcroft Quarry, Marple Township, and exits near Cardinal O'Hara High School. Route 3 runs approximately ten miles through the Darby-Cobbs watershed. Route 3 crosses Darby Creek at the Marple/Haverford border and crosses Cobbs Creek at the Delaware County/Philadelphia border.

B. 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 the geographic information system (GIS) generated maps was developed from data received from DEP and the Pennsylvania Department of Transportation (PennDOT). Streams, lakes, and the watershed

Location Map

Base Map

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-1A

Map Legend

	Watershed Boundary		Interstate Roads
	County Boundaries		U.S. Traffic Routes
	Municipal Boundaries		PA. Traffic Routes
	Cities		State Routes
	Townships		Township & Local Roads
	Boroughs		Railroads
	Streams		
	Water		

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Note:

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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE

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Date: 12/13/2004

file: p:\99613\00\data\gis\avprojects\wshed.apr\Base Map boundary were obtained from DEP. County and municipal boundaries, roads, and railroads were obtained from PennDOT.

2. The overall Darby-Cobbs watershed boundary includes the separate DEP Act 167 boundaries for Darby Creek and Cobbs Creek. These two separate watershed boundaries were merged and overlaid on United States Geological Survey (USGS) topographic maps to ascertain accuracy. Minor adjustments to the DEP boundaries were made based on the USGS topographic maps.

3. **Elevation Data:** A digital elevation model (DEM) for the Darby-Cobbs watershed was developed from DEM data obtained from the USGS. Subwatersheds or subareas used in the watershed modeling process were derived from the DEM. Subareas, drainage courses, land slopes and lengths, and drainage element lengths and slopes could all be determined from the DEM.

4. **Soils:** Soil mapping data were obtained from the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). Two sets of data were used, the State Soil Geographic Database (STATSGO) and the Soil Survey Geographic Database (SSURGO).

5. STATSGO maps are statewide soil maps made by generalizing the detailed county soil survey data. The STATSGO data were used to create the generalized soils map. SSURGO is the most detailed level of soil mapping done by NRCS. SSURGO are digital duplications of the original county soil survey maps. The SSURGO data were used for all other soil maps.

6. **Geology:** The digital geology coverages for Chester, Delaware, Montgomery, and Philadelphia Counties were obtained from the Pennsylvania Geological Survey.

7. **Land Use:** The existing land use map was generated by overlaying Delaware Valley Regional Planning Commission (DVRPC) land use data on year 2000 DVRPC aerial photographs and then using parcel data and heads up digitizing to update the DVRPC data and improve the spatial accuracy.

8. **Wetlands:** Wetlands were obtained from the United States Fish and Wildlife Service (USFWS) in the form of digital National Wetlands Inventory (NWI) maps.

9. **Stream Bank Erosion/Stability Assessment:** Achieving natural stream stability plays an important role in minimizing stream bank erosion and resultant sediment pollution, and in turn, water quality and aquatic habitat preservation. Natural stream stability is achieved by allowing the stream to develop stable dimensions (stream bankfull width, width/depth ratio, and capacity), profile, and pattern so that the stream system neither degrades (erodes) nor aggrades (accumulates

sediment). Assessing stream stability requires a fluvial geomorphological (FGM) assessment and baseline determination. These dimensions for stability can be mathematically determined using the “Rosgen” classification method of FGM assessment (D. L. Rosgen, *Applied River Morphology*, 1996). Once the stream is categorized and instability problems identified, effective and sustainable stream restoration measures to bring the stream back into a stable condition can be recommended through proper targeted stormwater management and recommended restoration measures.

A stormwater management plan, in addition to items required under Section 5(b) of the Storm Water Management Act, should include an assessment of stream stability and its relation to flooding events and existing erosion problems. Such an assessment is critical to:

- Identifying changes in channel configuration in response to changes in stormwater runoff that might contribute to flooding problems in the future as the stream reaches a new equilibrium.
- Ensuring adequate protection of sewage infrastructure.
- Relating stream bank erosion, sedimentation, and downstream water quality problems to changes in stormwater flows (both volume and peak).
- Living resource protection through aquatic habitat preservation.
- Recommending effective and sustainable stream restoration measures.

Darby Creek FGM Assessment

To properly characterize the Darby Creek watershed, measurement of geomorphological parameters and physical and hydraulic relationships was performed at both the Rosgen Level I and Level II. This addressed some of the root causes of stream bank erosion and sedimentation, habitat loss, and water quality impairments. It provides critical information for use in identifying and understanding existing and future problems and in devising an effective framework for stormwater management that will protect any future stream restoration efforts.

Level I: Desktop Survey – A Level I FGM assessment of the watershed was performed based on the Rosgen classification methodology. This is desktop delineation of the stream using generalized major stream types A through G based on available topographic information, geological maps, soils maps, and aerial photographs, all of which are part of the overall Act 167 planning effort. The purpose of this inventory was to provide an initial framework for organizing and targeting subsequent field assessments of targeted or important reaches where problems are known to occur or are anticipated to occur.

Available topographical information, geological maps, soils maps, and aerial photographs were reviewed, and specific drainage areas for selected stream reaches within the watershed were calculated where needed. Using regional curve data developed for the Northeast, ranges of hydraulic geometry relationships based on the bankfull discharge were estimated. Stream reaches were initially classified by stream type based on objective comparisons of land forms, soils, slope, and channel patterns obtained from aerial photographs, topographical, geological, and soil survey maps, and the field data collected from the reference reaches and extrapolated reaches. Field verification was required where stream types change or where distinct variations in conditions are observed.

Level II: Stream Reach Survey – A field team was sent out to traverse up to 18 miles of the highest order streams and tributaries within the Darby Creek watershed. Field teams of two stream surveyors walked along the designated lengths of each stream and tributary and estimated the following parameters by observation:

Channel Morphology

Bankfull Elevation	Sinuosity Range
Bankfull Width	Channel Slope Range
Entrenchment Ratio Range	Channel Materials (pebble count)
Width/Depth Ratio Range	Meander Pattern

Photographs were taken at strategic points throughout the inventoried portions of the streams and coded for future reference. In addition, any obvious erosion or stream blockages were noted for mapping. A Level II Reach Field Form was developed for the Darby Creek, and a Watershed Data Summary Sheet for the parameters observed was completed for each reach. The result is a measured stream reach classification Level II morphological description of the stream reaches for which Level II data have been collected.

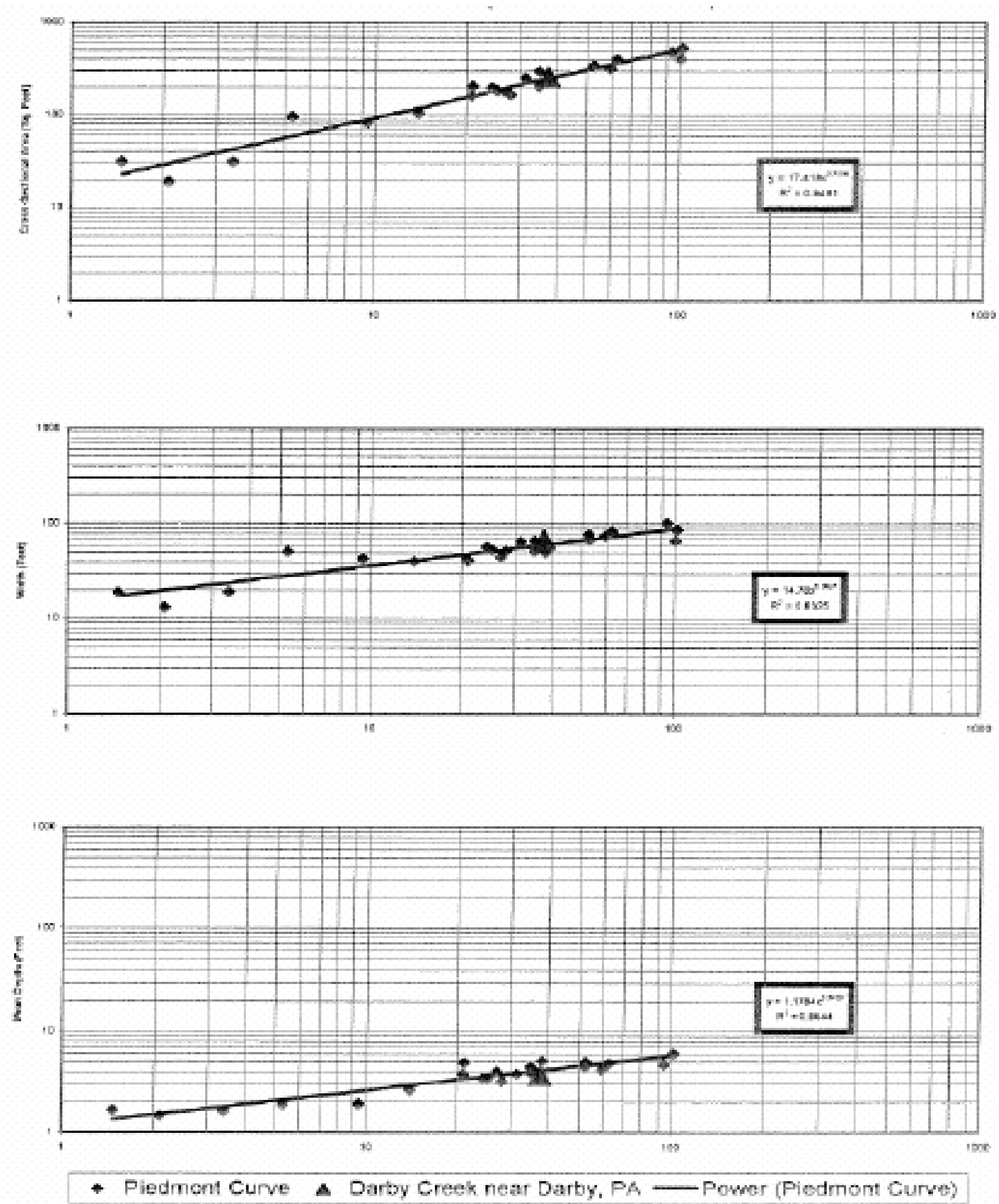
The distribution of reaches measured was determined from the inventoried reach evaluation, the assessment of where problems are occurring, and the importance attached to the stream segment. A single assessment reach typically is not more than about 1,000 feet in length. An average of five reaches per stream mile were measured. Part of the classification includes estimation of the bankfull discharge. This was accomplished using the existing USGS discharge gauge information on Darby Creek. The difference between the water surface elevation and the bankfull elevation was compared with the gauge information. Then, the elevation difference was added to the water surface elevation at the gauge to determine the bankfull stage elevation relative to the gauge staff. The bankfull discharge was then calculated using the gauge station data. Once the stage-discharge relationship was established, the recurrence interval for the bankfull stage was calculated, and the hydraulic geometry data for width, depth, velocity, and cross-sectional area vs. stream discharge was calculated as shown in Figure III-1B.

For each measured reach, the following protocols were adhered to:

Channel Morphology (Rosgen)

One cross-sectional survey (by rod, measuring tape, and level) was performed at a representative crossover location that includes stream invert, maximum depth, bankfull depth, and flood-prone level (enough stations to determine if the entrenchment is greater

Figure III-1B
Bankfull Channel Dimensions as a Function of Drainage Area,
Piedmont Curve (USFWS, March 2002)



than 2.2 (Rosgen, 1996)). The stations within the cross-section included significant slope changes and in no case were greater than two feet apart. An Excel spreadsheet program was used for entering and plotting the data and cross-section to scale. Each cross-section was marked in the field with labeled flagging, located approximately with global positioning system, and indicted on an area map.

Bankfull depth was determined through field visits, and bankfull stage was calibrated to known stream flows from appropriate stream gauging stations. The bankfull stages field-calibrated at streams were plotted in order to build a database to refine the bankfull channel dimensions for ungauged areas within the stream.

In order to assure that the field teams produced consistent results, a modified Wolman Pebble Count for each channel material category (silt/clay, sand, gravel, cobble, boulders) found in the watershed was performed for two reaches. The FGM report is available for viewing at DCPD.

C. Topography and Stream Bed Profile

The topography of the watershed ranges from hilly terrain in the northwestern portion of the watershed to gently sloping areas throughout most of the central to southern end. The highest point in the watershed is in Tredyffrin Township with an elevation of 557 feet above sea level USGS datum. The lowest elevation, sea level, is found where Darby Creek enters the Delaware River between Ridley and Tinicum Townships and in the large wetland area (John Heinz National Wildlife Refuge at Tinicum) in the southeastern portion of the watershed, near the Philadelphia Airport. The DEM for the watershed is displayed in Figure III-2.

D. Soils

There are three generalized soil groups in the Darby-Cobbs watershed as listed below. Generalized soils are groups of soils that exhibit a regularly repeating pattern. The distribution of the three associations in the Darby-Cobbs watershed is shown in Figure III-3. The descriptions were derived from the USDA STATSGO statewide NRCS soils database.

1. **Neshaminy-Lehigh-Glenelg -** The Neshaminy-Lehigh-Glenelg soil association is found in the northwestern portion of the watershed. This association consists of moderately deep and deep, well-drained, silty, channery, and gravelly soils on grabbro and granodiorite.

2. **Chester-Glenelg-Manor -** The Chester-Glenelg-Manor soil association is found throughout the watershed except for the southern portion. This association consists of shallow to deep, silty and channery soils on grayish-brown schist and gneiss.

3. **Urban Land-Westbrook-Pits** - The Urban Land-Westbrook-Pits soil association is found in the southern portion of the watershed. This association consists of deep, silty or sandy soils on coastal plain sediments. Urban Land and Pits are areas that have been highly disturbed.

Soil permeability of the Darby-Cobbs watershed is shown in Figure III-4. The soil permeability is derived from the digital county soils files developed by NRCS and represent vertical water movement when the soil is saturated and does not consider lateral seepage. Permeability estimates are based upon soil characteristics such as soil structure, porosity, and gradient or texture, which influences the downward movement of water in soil. Soil permeability is measured at rates in inches per hour and classified as follows: *very slow* (less than 0.06 inch/hr); *slow* (0.06 to 0.20 inch/hr); *moderately slow* (0.20 to 0.60 inch/hr); *moderate* (0.60 to 2.0 inches/hr); *moderately rapid* (2.0 to 6.0 inches/hr); *rapid* (6.0 to 20.0 inches/hr); and *very rapid* (more than 20.0 inches/hr). These rates vary based upon soil layer or depth below the surface. The soil permeability rates mapped in Figure III-4 were derived from the difference between the highest permeability rate (PERMH) and the lowest permeability rate (PERML) for the third soil layer, which can range from 15 to 64 inches below the surface, where most infiltration structures would be constructed. Compaction of soils by construction equipment reduces permeability (Ocean County Soil Conservation District, 2001).

Figure III-5 shows erodible soils in the watershed. The erodibility hazard indicates the level of erosion controls necessary when disturbing soils for development, wood harvesting, or agriculture. Slight, moderate, and severe indicate the degree of major soil limitations to be considered in management. A slight rating indicates that the risk of soil erosion is low, a rating of moderate indicates that erosion control is necessary during earth disturbance activities, and a rating of severe indicates that erosion potential is a severe hazard when disturbing these soils. Approximately 53% of the area within the Darby-Cobbs watershed is classified as slightly erodible soils. Several erodible soils are found in the middle portion of the watershed along Darby and Cobbs Creeks and their tributaries. Moderately erodible soils are usually found connected to severely erodible soils. Around 40% of the area in the watershed is classified as Urban Land/Made Land, and their erodibilty cannot be determined.

Soil properties influence the runoff generation process. The USDA NRCS has established a criterion determining how soils will affect runoff by placing all soils into four hydrologic soil groups (HSGs) – A through D, based on infiltration rate and depth. HSG A characteristics are found sporadically throughout the Darby-Cobbs watershed. Group B soils are found along Darby Creek in terraces and floodplains. Group B is characterized as having moderate infiltration rates, and it consists primarily of moderately deep to deep, moderately well to well drained soils that exhibit a moderate rate of water transmission. Group C soils have 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. Found throughout the watershed, D soils are tight, low permeabililty soils with high runoff potential and are typically clay soils. This information was incorporated into the GIS and, from this, the watershed HSG map was developed as shown in Figure III-6.

Digital Elevation Model

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

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Phase II

Figure III-2

Map Legend

- Watershed Boundary
- Municipal Boundary
- Stream
- Water

Elevation (feet)

- 0 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- 300 - 350
- 350 - 400
- 400 - 450
- 450 - 500

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Note:

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Data Sources:
DRGs & DEMs - USGS
Water - PennDOT & BLE
Boundaries - PennDOT & BLE

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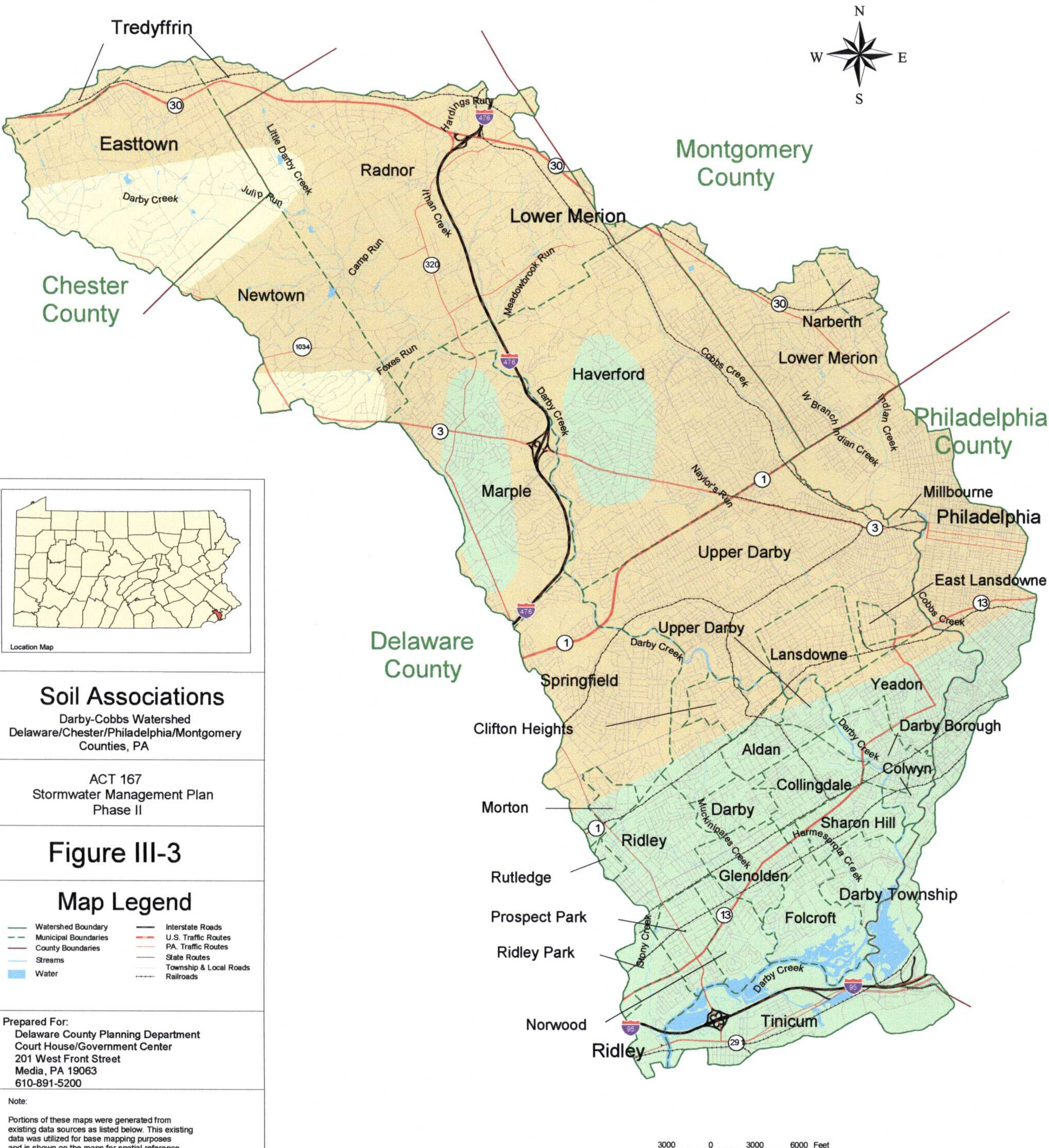

Location Map

Soil Associations

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-3

Map Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
- Water
- Interstate Roads
- U.S. Traffic Routes
- PA. Traffic Routes
- State Routes
- Township & Local Roads
- Railroads

SOIL ASSOCIATIONS

- NESHAMINY-LEHIGH-GLENELG
- CHESTER-GLENELG-MANOR
- URBAN LAND-WESTBROOK-PITS

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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE
Soils - NRCS, STATSGO

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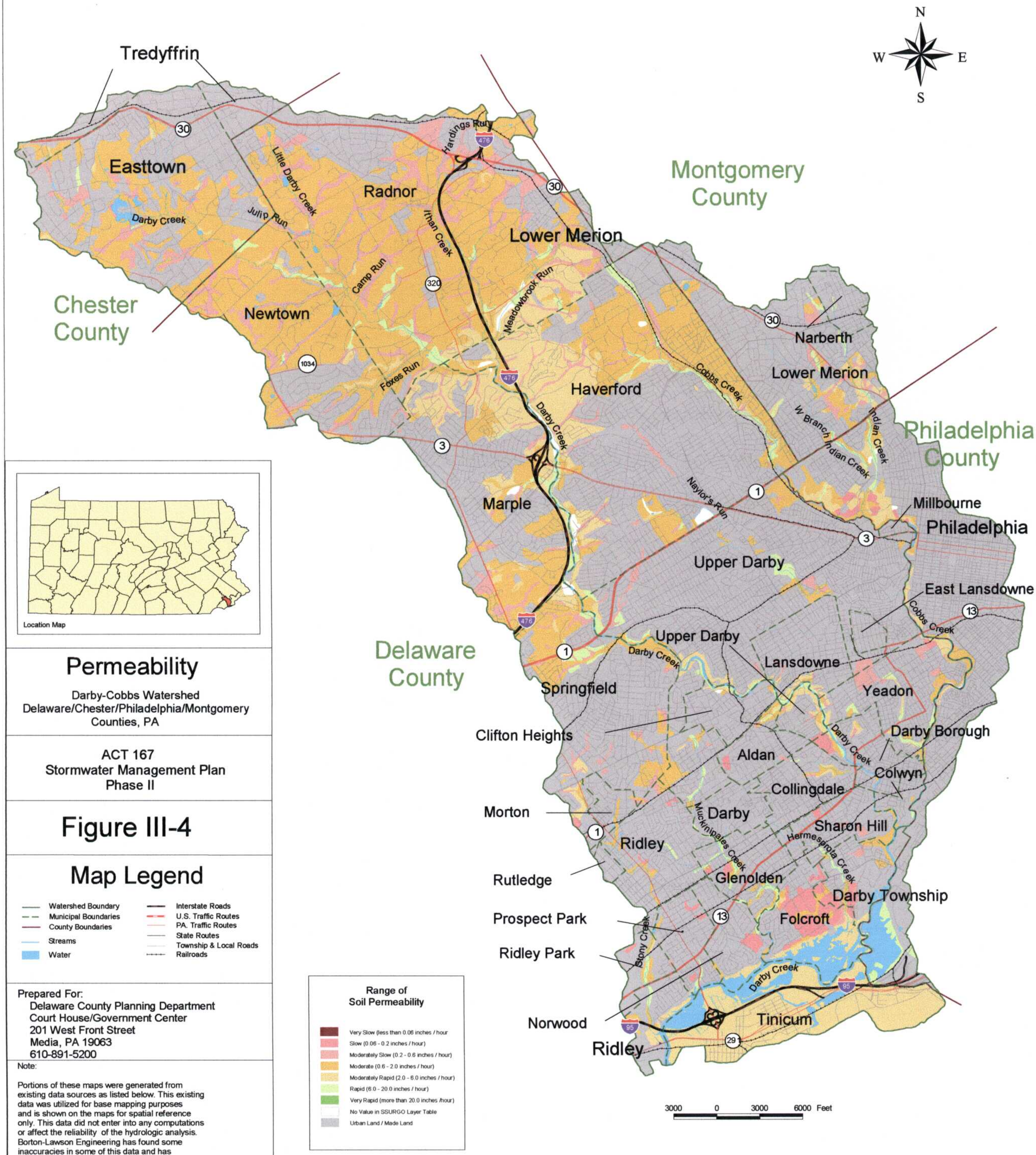
file: p:\99613\00\data\gis\avprojects\wshed.apr\Soil Associations



Permeability

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-4

Map Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
- Water
- Interstate Roads
- U.S. Traffic Routes
- PA. Traffic Routes
- State Routes
- Township & Local Roads
- Railroads

Range of Soil Permeability

- Very Slow (less than 0.06 inches / hour
- Slow (0.06 - 0.2 inches / hour)
- Moderately Slow (0.2 - 0.6 inches / hour)
- Moderate (0.6 - 2.0 inches / hour)
- Moderately Rapid (2.0 - 6.0 inches / hour)
- Rapid (6.0 - 20.0 inches / hour)
- Very Rapid (more than 20.0 inches /hour)
- No Value in SSURGO Layer Table
- Urban Land / Made Land

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Water - PennDOT & BLE
Boundaries - PennDOT & BLE
Soils - NRCS

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Location Map

Erodible Soils

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-5

Map Legend

Watershed Boundary	Interstate Roads
Municipal Boundaries	U.S. Traffic Routes
County Boundaries	PA. Traffic Routes
Streams	State Routes
Water	Township & Local Roads
	Railroads

SOIL ERODIBILITY

- SLIGHT
- MODERATE
- SEVERE
- MADE/URBAN LAND

MADE/URBAN LAND based on NRCS SSURGO data

3000 0 3000 6000 Feet

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Water - PennDOT & BLE
Boundaries - PennDOT & BLE
Soils - NRCS

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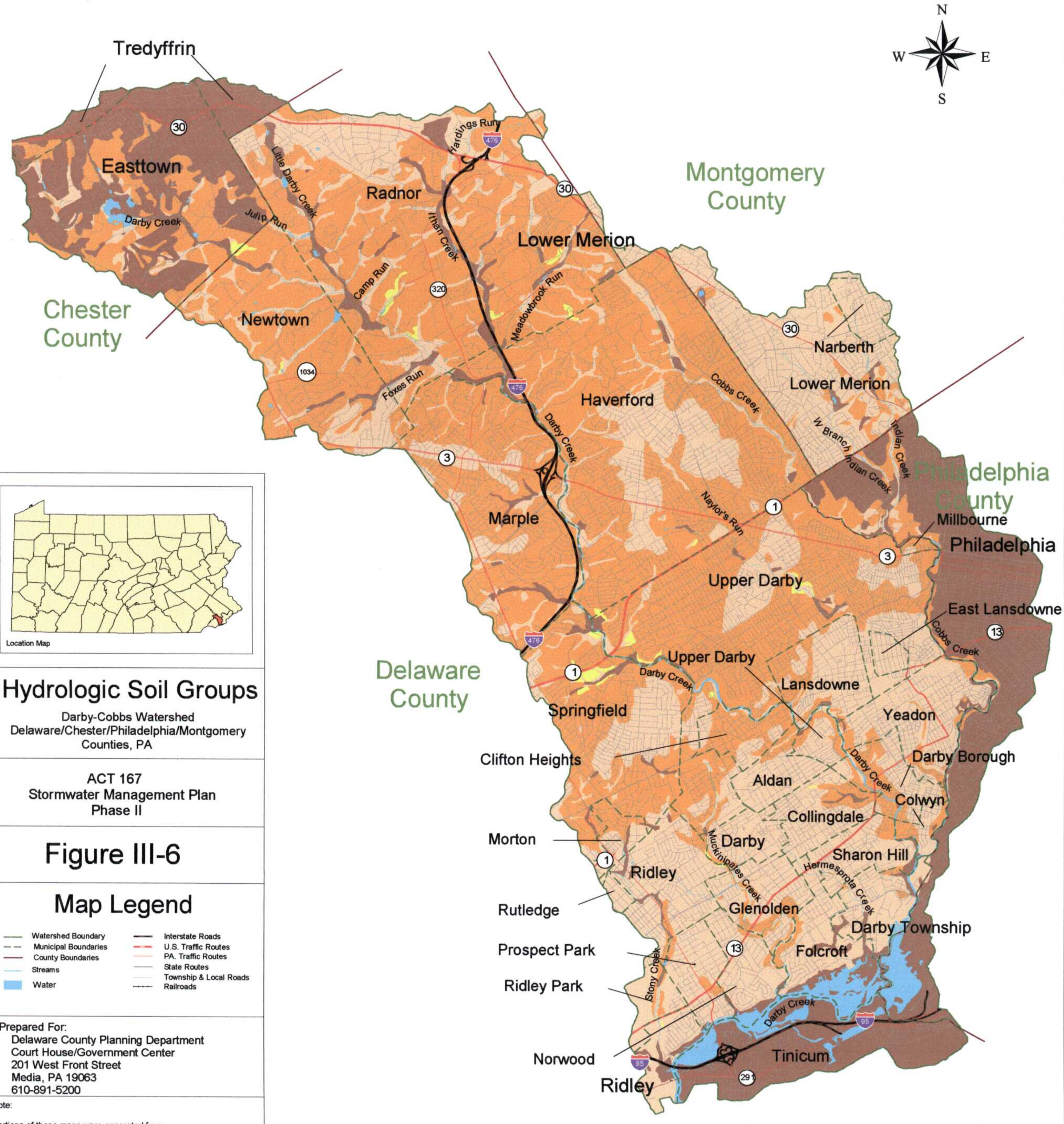

Location Map

Hydrologic Soil Groups

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery
Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-6

Map Legend

Watershed Boundary	Interstate Roads
Municipal Boundaries	U.S. Traffic Routes
County Boundaries	PA. Traffic Routes
Streams	State Routes
Water	Township & Local Roads
	Railroads

Soil Groups

- A - sand, loamy sand, or sandy loam
- B - silt loam or loam
- C - sandy clay loam
- D - clay loam, silty clay loam, sandy clay, silty clay, or clay

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Water - PennDOT & BLE
Boundaries - PennDOT & BLE
Soils - NRCS

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E. Geology

Geology plays a direct role in surface runoff in the Darby-Cobbs watershed because it affects its soil types within the watershed through parent material breakdown. There is no limestone surface geology in the Darby-Cobbs watershed, and, therefore, the presence of limestone sinkholes does not exist. The geologic map of the watershed can be found in Figure III-7. Below is a description of geologic formations in the watershed.

1. **Bryn Mawr Formation -** High level terrace deposits; reddish brown gravelly sand and some silt.

2. **Felsic Gneiss, Hornblende Bearing -** Light, medium grained; includes rocks of probable sedimentary origin.

3. **Felsic Gneiss, Pyroxene Bearing-** Light, medium grained; includes rocks of probable sedimentary origin.

4. **Granite Gneiss and Granite -** Includes Springfield Granodiorite (granitized Wissahickon).

5. **Mafic Gneiss, Hornblende Bearing -** Dark, medium grained; includes rocks of probable sedimentary origin.

6. **Mafic Gneiss, Pyroxene Bearing -** Dark, medium grained; includes rocks of probable sedimentary origin.

7. **Pensauken and Bridgeton Formation -** Undifferentiated dark, reddish-brown, cross stratified, feldspathic quartz sand and some thin beds of fine gravel and rare layers of clay or silt.

8. **Serpentine -** Includes serpentine, steatite, and other products of alteration of peridotites and pyroxenites.

9. **Trenton Gravel -** Gray or pale reddish brown, very gravelly sand interstratified with crossbedded sand and clay-silt beds.

10. **Wissahickon Formation (Albite-Chlorite Schist) -** Includes “Octoraro Schist”-phyllite, some horneblende gneiss, and granitized members.

11. **Wissahickon Formation (Oligoclase Mica Schist) -** Includes some hornblende gneiss, some augen gneiss, and some quartz-rich and feldspar-rich members due to various degrees of granitization.

F. Climate

The Darby-Cobbs watershed has a fairly moderate, humid, continental climate. Winters are comparatively short and mild while the warm season is long and frequently humid. In the summer, the relative humidity can become oppressive, but the average relative humidity for the year is generally higher than 65%. About two thirds of the time, skies are clear to partly cloudy, and the average amount of sunshine is about 57% of the possible amount. Storms are generally numerous enough that they ensure an adequate and dependable supply of moisture throughout the year.

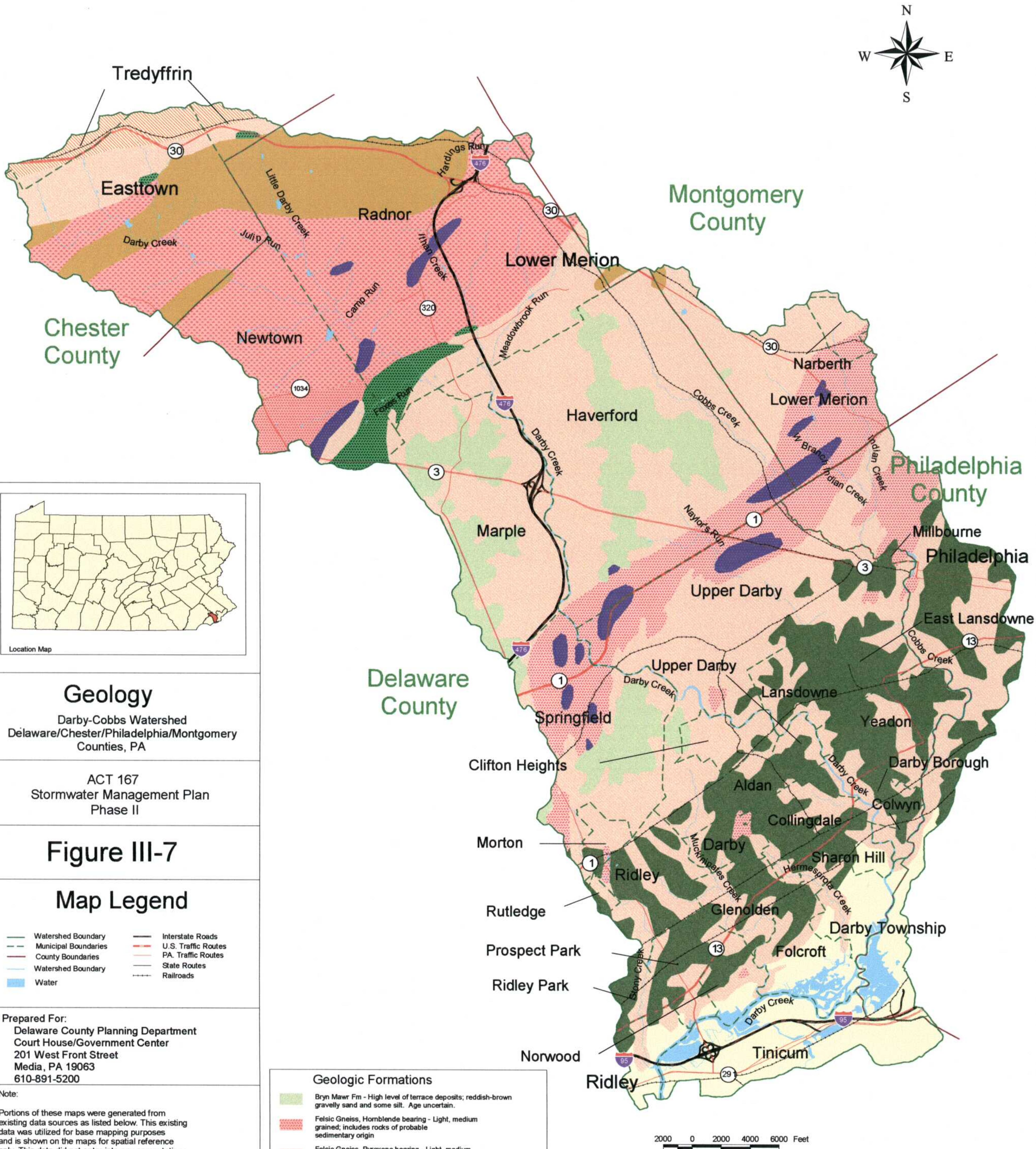
The watershed is near the path of the major weather systems that move across the nation; therefore, the weather is variable. Changes in the temperature, the velocity of the wind, the humidity, and other weather elements tend to occur from day to day and from week to week, and seasonal weather varies from year to year. During winter and spring, changes occur almost daily. During summer and fall, changes are less frequent because the high and low pressure systems that are responsible for the weather move more slowly in these seasons than they do in winter and spring.

From June through October, the weather remains approximately the same for a week or more at a time. Hot humid days and mild nights generally result when a pressure system remains stagnant for several days in the summer. Cool nights are typical when a pressure system remains stagnant for several days in the fall. Several of these spells can be expected in most years, though extreme heat is noticeably absent in some summers. During winter and spring, unseasonably cold spells last for only a few days because the weather systems move more rapidly than in summer and fall.

G. Land Use

The Darby-Cobbs watershed has a long history of settlement and urbanization dating back to the early 17th century. The landscapes of the watershed vary from suburbanized to highly urbanized. While much of the eastern portion of the Cobbs Creek subwatershed lies within the City of Philadelphia, most of the larger Darby-Cobbs watershed falls primarily within the City's inner-ring suburbs of Delaware County, and to a lesser extent Chester and Montgomery Counties. Generally speaking, the central to lower portions of the watershed can be characterized as densely developed with a high degree of urbanization. Most of the central to upper portions of the watershed can be characterized as suburbanized and/or rapidly suburbanizing.

Redevelopment and infill development activities are common throughout the older urbanized areas of the watershed. The limited number of areas that remain open (i.e., large estates and stream valleys at the northern end of the watershed) are experiencing intense development pressure. The natural flow and course of Darby Creek and its tributaries have been significantly altered over the years. Many tributaries in the more urbanized portions of the watershed have been channelized, piped, stabilized, dredged, etc., resulting in little or no natural drainage pattern in many parts of the watershed. There



Geology

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-7

Map Legend

Watershed Boundary	Interstate Roads
Municipal Boundaries	U.S. Traffic Routes
County Boundaries	PA. Traffic Routes
Watershed Boundary	State Routes
Water	Railroads

Geologic Formations

- Bryn Mawr Fm - High level of terrace deposits; reddish-brown gravelly sand and some silt. Age uncertain.
- Felsic Gneiss, Hornblende bearing - Light, medium grained; includes rocks of probable sedimentary origin
- Felsic Gneiss, Pyroxene bearing - Light, medium grained; includes rocks of probable sedimentary origin
- Granite Gneiss and Granite - Includes Springfield Granodiorite (granitized Wissahickon)
- Mafic Gneiss, Hornblende bearing - Dark, medium grained; includes rocks of probable sedimentary origin
- Felsic Gneiss, Pyroxene bearing - Dark, medium grained; includes rocks of probable sedimentary origin
- Pensauken and Bridgeton Formations - Undifferentiated Dark reddish brown, cross-stratified, feldsparthic quartz sand and some thin beds of fine gravel and rare layers of clay or silt
- Serpentine - Includes serpentine, steatite and other products of alteration of peridotites and pyroxenites
- Trenton Gravel - Gray or pale reddish brown, very gravelly sand interstratified with crossbedded sand and clay-silt beds
- Wissahickon Formation (Albite-Chlorite Schist) - Includes "Octoraro Schist", phyllite, some hornblende gneiss and granitized members
- Wissahickon Formation (Oligioclase Mica Schist) - Includes some hornblende gneiss, some augen gneiss, and some quartz-rich and feldspar-rich members due to various degrees of granitization

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Note:

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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE
Geology - PASDA

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Prepared By: SJD | Check By:
Project Number: 99613.01 | Date: 12/13/2004

file: p:\99613\00\data\gis\avprojects\wshed.apr\Geology are a significant number of man-made obstructions including old mills/dams and highway and railroad bridges that contribute to the alteration of natural stream flow. Much of the watershed is extensively paved and is served by storm sewer systems that discharge directly into streams with few, if any, quantity or quality controls. With the exception of Cobbs Creek Park and a few protected areas along tributaries at the top of the watershed, a great deal of development has taken place right up to the edge of the stream bank. This allows for little or no room for conventional riparian buffers to manage stormwater or protect the stream from water quality impacts.

As noted previously, there is intense pressure to develop the few open areas that remain in the northern reaches of the watershed (as evidenced by pressure to develop the Haverford State Hospital site in Haverford Township). Fortunately for the watershed, there are two areas, each at opposite ends of the watershed, which can be considered permanently protected. At the top of the watershed, along the Chester and Delaware County border, approximately 172 acres known as the Waterloo Mills Preserve have been donated to and will be permanently protected and managed by the Brandywine Conservancy. The Conservancy also holds easements on an additional 186.6 acres at the top of the watershed, mostly in Chester County.

At the bottom of the watershed lies the John Heinz National Wildlife Refuge at Tinicum, the largest remaining freshwater tidal marsh in the state. While the Waterloo Mills Preserve is fortunate enough to be located at the headwaters (where it can influence water quality in the watershed), this refuge is at the bottom of the watershed, making it the recipient of all of the water quantity and quality problems that have accumulated along the lengths of Darby and Cobbs Creeks before they enter the refuge as Darby Creek.

The majority of the municipalities within the watershed are urban in nature and largely developed. The predominant land use in the watershed is classified as residential (61%). Approximately 11% of the watershed is undeveloped land (forest or meadow), and 10% is classified as open space (parks, cemeteries, golf courses, etc.). The remaining land is mostly classified as commercial, industrial, and institutional. A total of 2.45% of the watershed lands is classified as “paved” and includes the two interstate highways, portions of Philadelphia Airport, and a few large parking areas. This percentage does not include other smaller roads or driveways.

Figure III-8 displays the existing land use of the watershed while Table III-2 details the land uses by category within the Darby-Cobbs watershed.

In summary, the watershed is primarily developed with large areas that have mixed commercial, residential, and industrial uses. Parts of Chester and Delaware Counties still have some forest land and agriculture (cash and forage crops, pasture, and orchards). The watershed is sited within the inner-ring suburbs of Philadelphia. Therefore, any open land in this area is being developed at an incredible rate.

TABLE III-2
Land Use Status by Category

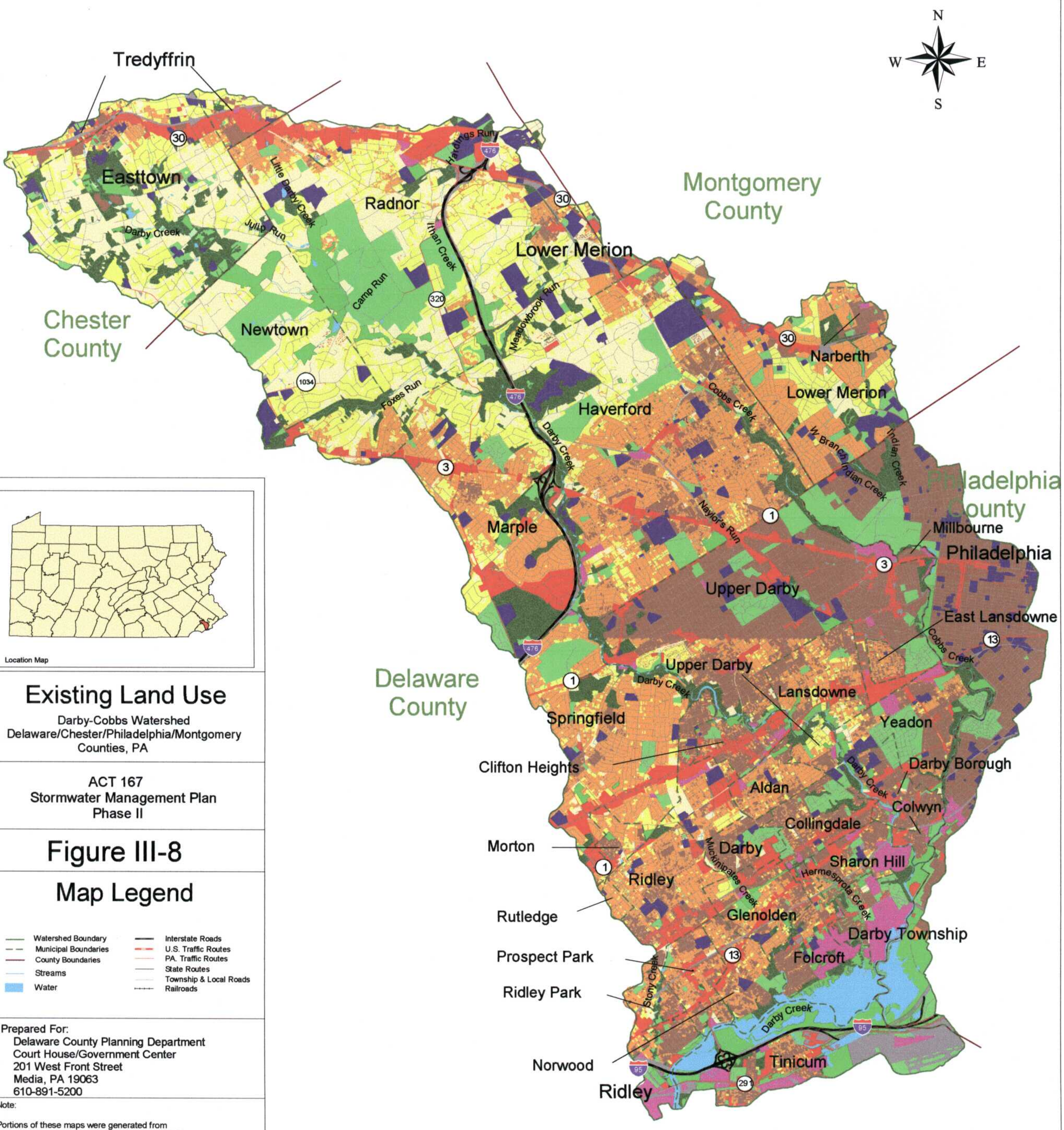
LAND USE	SQUARE MILES	ACRES	PERCENT AREA
Commercial	5.43	3,475.20	7.03
Farmstead	0.02	12.80	0.03
Forest	5.07	3,244.80	6.56
Industrial	1.71	1,094.40	2.21
Institutional	3.90	2,496.00	5.05
Loose Gravel	0.01	6.40	0.01
Meadow	3.13	2,003.20	4.05
Open Space	7.54	4,825.60	9.76
Paved	1.89	1,209.60	2.45
Residential (1 - 4 acre lot size)	8.60	5,504.00	11.13
Residential (1/3 - 1 acre lot size)	10.18	6,515.20	13.18
Residential (1/8 - 1/3 acre lot size)	14.83	9,491.20	19.20
Residential (1/8 acre or less lot size)	13.65	8,736.00	17.67
Water	1.28	819.20	1.66
TOTAL	**77.24**	**49,433.60**	**100.00**

Source: Borton-Lawson Engineering, Inc., 2004

H. Land Development Patterns

There is little undeveloped land in the watershed. Zoning maps were used, along with input from DCPD and the Chester and Montgomery County Planning Commissions, to describe the future land development/growth pattern for the watershed over the next ten years. The majority (approximately 83%) of new development is expected to be residential. Future land use patterns in Philadelphia were estimated by examining the small pockets of undeveloped areas in aerial photographs and then making assumptions about whether these pockets of undeveloped area are likely to be developed in the same manner as the immediately surrounding areas.

The majority of this residential development (approximately 42%) is expected to be single-family dwellings with lot sizes greater than one acre. This type of development is expected to occur in the upper portion of the watershed in Easttown Township in Chester County, Haverford, Marple, Newtown, and Radnor Townships in Delaware County, and Lower Merion Township in Montgomery County. The second largest development impact (approximately 23.5%) is from smaller residential lot development, less than 1/8 acre in lot size and includes townhouses and apartment complexes, which is expected to occur in most parts of the watershed. Commercial development accounts for about 11.4% of the future predicted development within the watershed and is expected to occur primarily near the major road corridors, such as I-476 and Route 3 in Marple Township, I-95 in Tinicum Township, I-476 and Route 30 in Radnor Township, and in Upper Darby Township and Millbourne Borough, which are undergoing redevelopment in Delaware County, and Easttown Township in Chester County. Industrial development accounts for



Existing Land Use

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-8

Map Legend

Watershed Boundary	Interstate Roads
Municipal Boundaries	U.S. Traffic Routes
County Boundaries	PA. Traffic Routes
Streams	State Routes
Water	Township & Local Roads
	Railroads

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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE
Existing Land Use - DCPC, CCPC, MCPC, BLE

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Prepared By: WSB
Check By:
Project Number: 99613.01
Date: 12/13/2004

Land Use/Land Cover

- COMMERCIAL
- FOREST
- MEADOW
- OPENSPACE
- FARMSTEAD
- INDUSTRIAL
- INSTITUTIONAL
- GRAVEL
- PAVED
- R-A (1/8 Acre or less)
- R-B (1/8 to 1/3 Acre)
- R-C (1/3 to 1 Acre)
- R-D (1 to 4 Acres)

file: p:\99613\00\data\gis\avprojects\wshed.apr\ELU about 4.5% of the future predicted development, primarily in Tinicum Township and spread in the northeastern portion of the watershed in Delaware County.

Table III-3 provides an overview of projected development based on a future land use scenario developed through the use of zoning maps, the comprehensive plan, and by developing land use growth trends. The future land use map for the year 2010 projection is shown in Figure III-9. These increased impervious areas were then included in the U.S. Army Corps of Engineers, Hydrologic Engineering Center, Hydrologic Modeling System (HEC-HMS) to develop future condition flows for the 1-, 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 an average of 101.3% of the present 100-year storm hydrograph on Darby Creek above the confluence with Cobbs Creek and an average 100.9% on Cobbs Creek above the confluence with Darby Creek. 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 Volume III, the Technical Appendix. Increased development in a watershed increases runoff peaks, volumes, and velocities. This decreases the time to peak, worsening the frequency of flooding.

I. Present (Existing) 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) prepares Flood Insurance Studies (FISs) and floodplain mapping for the municipalities in the Darby-Cobbs watershed. This activity is now a responsibility of the U.S. Department of Homeland Security. Municipalities and the Pennsylvania Department of Community and Economic Development (DCED) should be contacted as to the latest FIS studies before use.

There are two types of studies conducted in the FIS program: detailed and approximate. Detailed methods included hydrologic computations and detailed HEC-2 or HEC-RAS 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. Areas studied by the approximate methods were areas having low development potential or minimal flood hazards.

Figure III-10 shows the 100-year floodplains classified as detailed and approximate as taken from the FEMA mapping for the Darby-Cobbs watershed. Encroachments of residential, industrial, and commercial land uses are shown by overlaying these areas on the floodplain in the GIS. Approximately 5,236 acres (10.6%) of the watershed are within floodplains. Of these 5,236 acres, 2,092 are developed. The remainder is forest, meadow, open space, or water. Table III-5 provides a summary of the total amount of developed floodplain area.

TABLE III-3
Development Potential by Municipality
Based upon Existing Patterns in the Darby and Cobbs Watershed

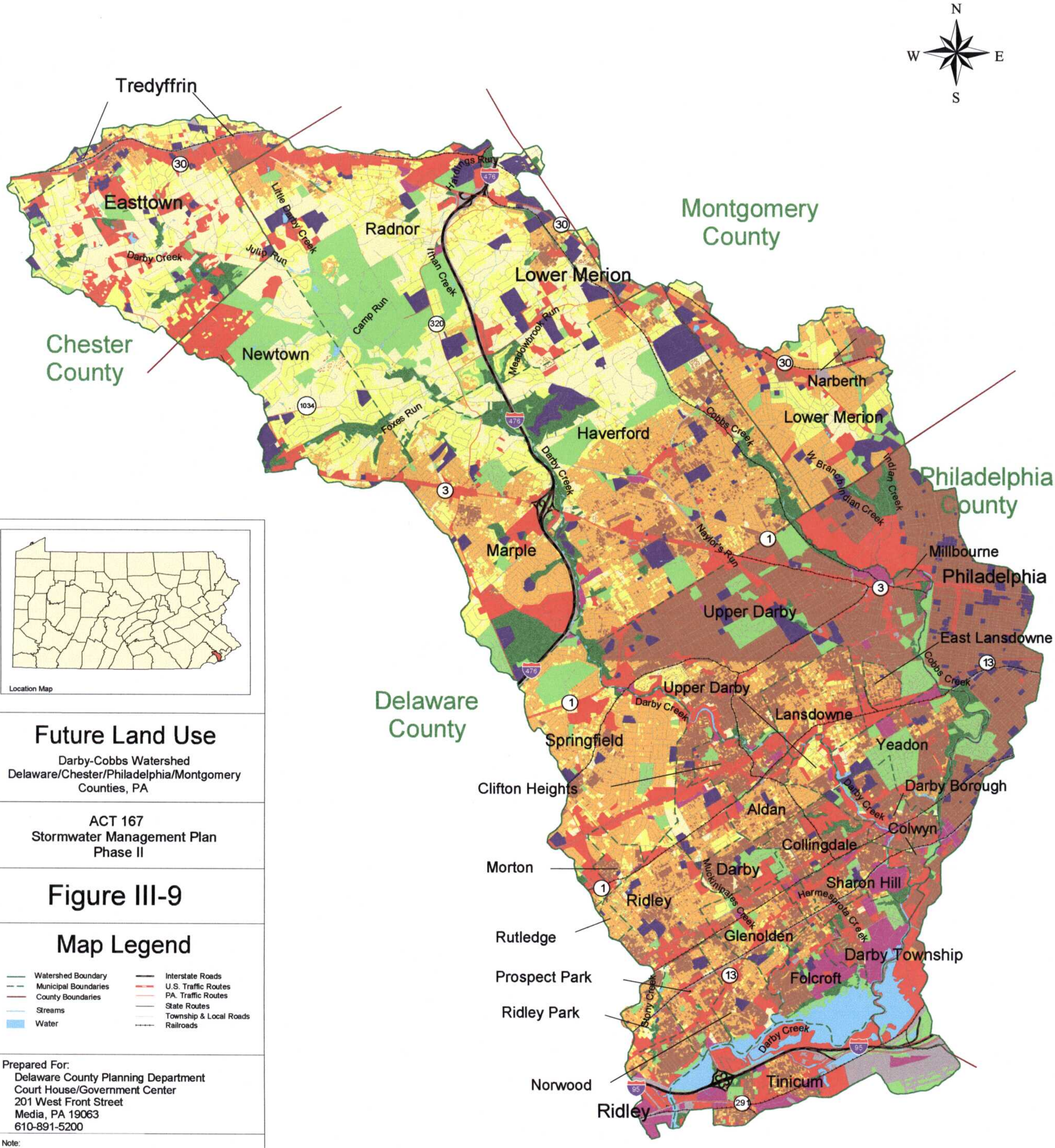
Municipality	R-4	R-3	R-2	R-1	I	C	OS	F
Aldan Borough	--	--	--	--	--	--	--	--
City of Philadelphia	O	--	--	--	O	--	r	--
Clifton Heights Borough	O	--	--	O	--	--	--	--
Collingdale Borough	--	O	--	--	X	--	--	r
Colwyn Borough	O	--	--	--	X	--	r	--
Darby Borough	O	O	O	--	X	--	r	r
Darby Township	O	O	--	--	O	--	r	r
East Lansdowne Borough	--	--	--	--	--	--	--	--
Easttown Township	X	O	O	X	--	O	r	r
Folcroft Borough	O	O	--	--	O	O	r	r
Glenolden Borough	--	O	O	--	--	--	--	r
Haverford Township	O	--	O	O	O	--	r	r
Lansdowne Borough	O	--	O	--	--	O	r	r
Lower Merion Township	X	--	O	O	--	--	r	r
Marple Township	--	--	O	O	--	--	--	r
Millbourne Borough	--	--	--	--	--	X	r	--
Morton Borough	--	--	--	--	--	--	--	--
Narberth Borough	O	O	O	X	--	--	r	r
Newtown Township	--	--	O	O	--	--	r	r
Norwood Borough	--	--	--	--	--	--	--	--
Prospect Park Borough	O	O	O	O	--	--	r	r
Radnor Township	--	--	O	O	--	--	--	r
Ridley Township	O	--	--	O	X	--	r	r
Ridley Park Borough	O	O	--	--	--	O	r	--
Rutledge Borough	--	--	--	--	--	--	--	--
Sharon Hill Borough	O	O	--	--	O	--	r	r
Springfield Township	X	--	--	--	--	--	--	r
Tinicum Township	--	--	--	--	O	--	r	--
Tredyffrin Township	O	--	O	--	--	O	r	r
Upper Darby Township	O	--	O	--	--	O	--	r
Yeadon Borough	O	--	O	--	--	O	r	r

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)

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

I Industrial
C Commercial
OS Open Space
F Forest

Source: Borton-Lawson Engineering, Inc., 2004



Location Map

Future Land Use

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-9

Map Legend

Watershed Boundary	Interstate Roads
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County Boundaries	PA. Traffic Routes
Streams	State Routes
Water	Township & Local Roads
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Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE
Future Land Use - DCPD & BLE

Land Use/Land Cover

- COMMERCIAL
- FOREST
- OPENSPACE/MEADOW
- FARMSTEAD
- INDUSTRIAL
- INSTITUTIONAL
- GRAVEL
- PAVED
- R-A (1/8 Acre or less)
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- R-C (1/3 to 1 Acre)
- R-D (1 to 4 Acres)
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TABLE III-4
Present (Existing) Versus Future Combined Peak Flows –
100-Year 24-Hour Storm
(Please refer to Appendix A of the model ordinance for subarea locations)

Subarea No.	Subarea Area (sq. mi.)	Cumulative Area (sq. mi.)	Existing Peak Q (cfs)	Future Peak Q (cfs)
1	0.55	0.55	631	642
2	0.30	0.85	915	927
3	0.29	0.29	354	360
4	0.18	1.32	1,377	1,393
5	0.66	0.66	655	691
6	0.12	2.10	2,274	2,314
7	0.48	0.48	402	432
8	0.05	2.63	2,270	2,312
9	1.50	1.50	1,383	1,534
10	0.55	4.68	3,807	3,857
11	0.50	0.50	516	516
12	1.05	6.22	4,512	4,583
13	0.31	6.53	4,578	4,657
14	0.68	0.68	482	482
15	0.01	7.22	4,930	5,036
16	2.02	2.02	1,353	1,354
17	0.67	0.67	507	512
18	0.12	2.80	1,847	1,851
19	0.32	0.32	246	246
20	0.16	3.28	2,058	2,063
21	0.32	0.32	268	268
22	0.02	3.61	2,197	2,203
23	0.03	10.86	7,285	7,456
24	0.55	0.55	349	349
25	0.02	0.57	335	335
26	0.03	11.46	7,287	7,457
27	0.31	0.31	273	273
28	0.54	12.31	7,546	7,735
29	0.23	0.23	179	179
30	0.54	13.09	7,701	7,896
31	1.50	1.50	762	764
32	1.41	15.99	8,879	9,090
33	0.37	0.37	369	369
34	0.30	0.30	422	422
35	0.48	1.15	1,198	1,199
36	0.21	0.21	224	224
37	1.32	1.32	879	880

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

Subarea No.	Subarea Area (sq. mi.)	Cumulative Area (sq. mi.)	Existing Peak Q (cfs)	Future Peak Q (cfs)
38	0.05	2.73	2,123	2,125
39	0.14	0.14	159	159
40	0.69	3.57	2,476	2,478
41	0.49	0.49	350	350
42	0.79	4.85	3,173	3,177
43	0.59	0.59	509	514
44	0.75	0.75	661	664
45	1.05	2.39	1,782	1,797
46	0.12	7.37	4,852	4,866
47	2.95	26.31	13,090	13,358
48	1.42	1.42	1,012	1,012
49	1.42	29.15	13,545	13,794
50	1.11	1.11	928	928
51	0.10	30.36	13,693	13,940
52	1.36	31.73	13,832	14,073
53	1.32	1.32	827	827
54	4.42	37.47	14,921	15,132
55	2.12	39.59	14,931	15,122
56	4.64	4.64	1,906	1,924
57	1.99	6.63	2,817	2,842
58	0.56	0.56	761	774
59	0.42	0.98	1,246	1,264
60	0.68	1.66	1,747	1,815
61	1.93	1.93	1,262	1,290
62	0.33	3.92	2,926	3,024
63	1.43	11.97	5,280	5,364
64	1.13	1.13	984	984
65	2.03	3.16	2,178	2,178
66	1.52	4.67	3,168	3,168
67	3.73	20.38	10,226	10,325
68	1.10	1.10	851	851
69	0.27	21.75	10,733	10,838
70	0.42	22.17	10,798	10,893
71	1.00	1.00	780	799
72	0.74	1.74	1,317	1,348
73	3.33	66.82	18,563	18,714
74	2.12	2.12	1,281	1,289
75	0.76	0.76	663	670

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

Subarea No.	Subarea Area (sq. mi.)	Cumulative Area (sq. mi.)	Existing Peak Q (cfs)	Future Peak Q (cfs)
76	0.62	3.51	2,124	2,137
77	0.81	4.32	2,406	2,419
78	2.87	74.01	19,030	19,163
79	0.59	0.59	502	522
80	0.22	0.22	236	240
81	0.22	1.03	859	891
82	0.33	0.33	323	323
83	0.10	0.44	396	396
84	0.78	2.24	1,862	1,891
85	0.71	2.95	2,317	2,338
86	0.16	77.13	19,002	19,134

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.

Source: Borton-Lawson Engineering, Inc., 2004

Table III -5
Summary of the Total Amount of Developed Floodplain Area

Existing Land Use	Acres in Floodplain	Square Miles in Floodplain
Commercial	261.9	0.41
Farmstead	0.3	0.00
Industrial	299.1	0.47
Institutional	66.8	0.10
Paved	587.7	0.92
R1	205.3	0.32
R2	191.7	0.30
R3	234.5	0.37
R4	244.7	0.38
TOTAL	**2,092.0**	**3.27**

Source: Borton-Lawson Engineering, Inc., 2004

The overall evaluation of the municipal questionnaires which were received shows several occurrences of stream flooding throughout the watershed during major storm events, resulting in both private and public property damages, as can be seen in Table III-5 and Figures III-10 and III-11.

Figure III-11
Overbank Flooding – Darby Creek, Borough of Darby

These problems were very evident on September 16, 1999, when Hurricane Floyd hit the East Coast. Many areas across Pennsylvania received up to twelve inches of rain. According to newspaper accounts, Upper Darby Township received seven inches of rain that flooded the banks of Darby Creek. Forty-three houses along Darby Creek were termed uninhabitable. These homes are in the designated floodplain. The area hit the hardest was that of the 1200, 1300, and 1400 blocks of Chestnut Street in Darby Borough. Two homes were also destroyed on Creek Avenue. All of the 43 homeowners agreed to sell to the Borough. Several other property owners who experienced severe flooding also agreed to sell. Most of the flooding was likely due to encroachments onto floodplain areas and undersized storm drainage systems. A large number of these stormwater related problems have also been traced back to uncontrolled runoff from local and upstream areas, inadequate storm drainage systems, and obstructions in the system that are blocking the natural flow of stormwater.

Stormwater management planning is critical in the areas both affected and currently unaffected by stormwater problems in the Darby-Cobbs watershed. For areas which are currently being affected, the frequency of flooding is mainly during larger storm events.

Location Map

Development in Floodplains

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-10

Map Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
- Water
- Floodplains
- Interstate Roads
- U.S. Traffic Routes
- PA. Traffic Routes
- State Routes
- Township & Local Roads
- Railroads

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Note:

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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE
Floodplains - FEMA
Existing Land Use - DVRPC

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Check By:

Project Number: 99613.01
Date: 12/13/2004

Land Use/Land Cover

- COMMERCIAL
- FARMSTEAD
- INDUSTRIAL
- INSTITUTIONAL
- GRAVEL
- PAVED
- R-A (1/8 Acre or less)
- R-B (1/8 to 1/3 Acre)
- R-C (1/3 to 1 Acre)
- R-D (1 to 4 Acres)
- UNDEVELOPED

NOTE:
The light gray area is outside the floodplains.

file: p:\99613\00\data\gis\avprojects\wshed.apr\Develoment in Floodplains

The Act 167 plan can significantly address more frequent flooding problems in the future in these areas by managing runoff from newly developing areas. This plan shall also provide these communities with information essential in evaluating and upgrading current undersized stormwater systems as indicated in Section III-J. For areas currently unaffected by stormwater problems, the Act 167 plan shall provide controls on future development to aid in preventing future stormwater runoff problems.

One of the biggest problems in floodplain management is the increase in peak flow caused by development in the watershed. Recognizing this, the National Flood Insurance Program (NFIP) has developed a community rating system (CRS) to give communities credit for floodplain management activities that exceed the minimum requirements. As part of this rating system, credit points can be awarded to communities if they implement the following:

- regulatory language (ordinance) requiring peak rate of runoff from development to be no greater than the pre-development runoff
- a stormwater master plan (such as this Act 167 plan)
- state review of the stormwater management plan
- requirement for a building's lowest floor to be elevated above flood levels
- erosion and sediment control regulations (such as Chapter 102)
- water quality regulations

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

J. Obstructions

Locations of significant waterway obstructions (i.e., culverts, bridges, etc.) were obtained by inspection of the USGS topographic base map. Data on these obstructions was then obtained from PennDOT, FEMA flood insurance studies, and field surveys.

The obstruction flow 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 and greater without obstructing the flow.

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

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

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

- Those obstructions which are able to pass the 2-year, 24-hour storm and greater 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-12. The obtained data and the obstruction flow capacities can be found in the Technical Appendix.

During the field work phase of this project, project team members noted that there were large numbers of pipes and culverts either in disrepair or clogged to a point that the flow capacity of the pipe was reduced or completely blocked. It is recommended that municipalities take advantage of the data collected and shown in Figure III-12 to rank which culverts may need repair. A program should be established by the municipalities to maintain unobstructed flow at all culverts and bridges.

K. Existing Drainage Problems and Proposed Solutions

Information on drainage problems and proposed solutions was solicited from each municipality within the Darby-Cobbs 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 varied, ranging from regional flooding to minor, local in nature flooding, consisting of mostly clogged or undersized inlets and cross pipes.

The recorded stormwater related problems were analyzed to determine if they were caused by localized (i.e., inadequately sized storm sewers) or regional (i.e., stream overbank flooding) sources. As can be seen in Figure III-11, the problems identified can be classified generally into one of these two classes. One is those directly related to or adjacent to the stream, an indication of a regional or watershed-wide problem. The other problem areas are most likely caused by a localized situation, inadequately sized storm water conveyance systems, sedimentation, or uncontrolled local runoff.

Table III-6 summarizes the problems discussed. These are shown graphically in Figure III-13. Solutions have been proposed both formally and informally because of WPAC discussions.

Obstructions

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-12

Map Legend

- Watershed Boundary
- County Boundaries
- Municipal Boundaries
- Cities
- Townships
- Boroughs
- Streams
- Water
- Interstate Roads
- U.S. Traffic Routes
- PA. Traffic Routes
- State Routes
- Township & Local Roads
- Railroads

Obstructions
- Able to pass 100YR Flow
- Able to pass 50YR flow
- Able to pass 25YR flow
- Able to pass 10YR flow
- Able to pass 5YR flow
- Able to pass 2YR flow
- UNDERSIZED
- NO DATA

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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE
DRGs - USGS
Obstructions - DCPD & BLE

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Project Number: 99613.01
Date: 12/13/2004

file: p:\99613\00\data\gis\avprojects\wshed.apr \Obstructions

TABLE III-6
Darby and Cobbs Creeks Watershed Problems

MUNICIPALITY	TYPES OF PROBLEMS (A)	CAUSES OF PROBLEMS (B)	OCCURRENCES OF PROBLEMS (C)	TYPES OF DAMAGES (D)
Aldan Borough	1	1,2,3,4	1	
City of Philadelphia	*			
Clifton Heights Borough	N/A			
Collingdale Borough	1,6	1,2,3	1,2	
Colwyn Borough	1,2,6	1,2,3,4	1,2	3
Darby Borough	1,2,3,4,6,7	1,2,4,5	1,2	2,3
Darby Township	1,2,6	1,2,3,4	1	3
East Lansdowne Borough	N/A			
Easttown Township	1,2,3,6	1,2,3,4	1,3	3
Folcroft Borough	1,7	1,2,3,4	2	3
Glenolden Borough	*			
Haverford Township	N/A			
Lansdowne Borough	1,2,3,6	1,2,3,4	1,2	3
Lower Merion Township	1,2,3,5	1,2,3,4,5	1,2	3
Marple Township	*			
Millbourne Borough	2,3	1,2,4	3	3
Morton Borough	1,2,3	1,2,3,4	1,2	3
Narberth Borough	1	1	2	3
Newtown Township	7	1,2,3	1	3
Norwood Borough	1,2,3	5	1,3	3
Prospect Park Borough	1,3	1,2,3,4	1,2	
Radnor Township	1,2,3,6	1,2	1,2	3
Ridley Township	1,2,3,6	1,2,3,4	1,2	3
Ridley Park Borough	N/A			
Rutledge Borough	1	1,2,3	1	3
Sharon Hill Borough	1,2	1,2	1	3
Springfield Township	1,2,3,6	1,2,3,4,5	1,2	3
Tinicum Township	1,2,3	1,2,4	1	3
Tredyffrin Township	N/A			
Upper Darby Township	1,6	1,5	1,2	3
Yeadon Borough	1,2,3,6,7	5	2,3	3

N/A No problem areas reported
* No data collection forms received

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 Damages
(D)
1. Loss of life
2. Loss of vital services
3. Property damage

Source: Borton-Lawson Engineering, Inc., 2004

Three hundred and forty-nine (349) 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.

<u>Erosion and Sedimentation</u>

The Chester, Montgomery, and Delaware County Conservation Districts and the City of Philadelphia are responsible for administering PA 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.

<u>Storm Sewers, Culverts, and Outlets</u>

Some of the problems identified in Table III-6 are the result of inadequately sized storm culverts and/or unstable outlets that traverse state, local, 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.

<u>Bridges</u>

Because of the high bed loads of streams within the watershed, gravel deposits reduce the waterway opening which in turn threatens bridge conveyance capacity. 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.

<u>Flooding</u>

As discussed in Section III-I, Darby Creek and its tributaries have caused flooding conditions in the Darby-Cobbs watershed. The areas within the watershed immediately adjacent to Darby 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; however, for instance the flooding in Darby Borough is caused by overbank flooding.

L. Existing and Proposed Stormwater Collection Systems

Based on the information in the data collection forms supplied by the municipalities through the survey, stormwater collection systems in the Darby-Cobbs watershed are located throughout the watershed. These systems are being repaired and expanded as needs arise.

Problem Areas

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-13

Map Legend

- Watershed Boundary
- County Boundaries
- Municipal Boundaries
- Cities
- Townships
- Boroughs
- Streams
- Water
- Interstate Roads
- U.S. Traffic Routes
- PA. Traffic Routes
- State Routes
- Township & Local Roads
- Railroads
- Problem Areas / Points
- Stream Bank Erosion Area

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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE
DRGs - USGS
Problem Areas - DCPD & BLE

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Check By:
Project Number: 99613.01
Date: 12/13/2004

file: p:\99613\00\data\gis\avprojects\wshed.apr\ Problem Areas

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

Several agencies, including the U.S. Army Corps of Engineers, the Delaware River Basin Commission (DRBC), and DEP, studied the problems and proposed solutions for flood control and stream bank erosion control in Springfield and Upper Darby Townships and Lansdowne and Darby Boroughs within the Darby-Cobbs watershed in the 70s and early 80s. An environmental report related to flood control in the Darby Creek and Cobbs Creek watershed was prepared by the U.S. Army Corps of Engineers in early 1970. According to the information collected using data collection forms that were submitted by the municipalities in the Darby-Cobbs watershed, there are various existing flood control projects in the lower middle portion of the watershed. Evidence of dam stabilization and bioengineered stream bank stabilization has been found in Darby Borough along Darby Creek. Upper Darby Township, in the vicinity of Naylor's Run, has several gabion dams and trash rack dams for the 25-year designed flood frequency. In Ridley Township, impoundment and channel widening/riprap control projects are found. Morton Borough has a concrete lined flood control project, and Marple Township has 100 lineal feet of riprap for control of the 100-year flood frequency storm. Several flood control projects were proposed in the Darby Creek watershed by Darby Borough and Morton Borough. Morton Borough has proposed a channel excavation/widening flood control project in the watershed while Darby Borough has finished a preliminary phase study of stream bank stabilization projects along Darby Creek.

N. Existing and Proposed Stormwater Control Facilities

There are many known private stormwater control facilities as shown in Figure III-14. 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.

As part of the modeling effort, an investigation was made into the hydrologic impacts which existing stormwater control facilities have on current watershed flows. A field visit was performed to collect information on several stormwater management facilities within the Darby-Cobbs watershed, such as size, drainage area, and outlet control configurations. Since information on all stormwater control facilities within the watershed could not be collected due to site access constraints or lack of structure information, it was decided to use a representative site, and then extrapolate the impacts of the site's stormwater control facilities to the watershed. The representative site for this investigation was the Harrison Estate's residential subdivision in Newtown Township (Subareas 12 and 17). This site contains four large stormwater control basins which control approximately 68 acres of drainage area, or approximately 0.14% of the total Darby-Cobbs watershed. Table III-7 shows that the basins have minimal impact on the 25-year and 100-year flows on Darby Creek at a point immediately above the confluence with Cobbs Creek. Since no major impacts on watershed flows were noted due to these large basins, it is unlikely that the smaller basins would have any significant impact on watershed flows.

TABLE III-7
Harrison Estate Detention Basins'
Impacts on Watershed Flows

Flow Frequency (yrs)	Flow Without Basins (cfs)	Flow With Basins (cfs)	% Change
2	2,674	2,675	0.00 %
25	9,503	9,501	0.00 %
100	14,931	14,932	0.00 %

Source: Borton-Lawson Engineering, Inc., 2004

There are fifteen known dams in the Darby-Cobbs watershed, according to DEP records. The majority (eleven) of these dams are classified as small impoundments, which have little impact on watershed hydrology. The four larger dams within the watershed were included in the hydrologic model and are listed in Table III-8 below, along with their attenuation impacts and maximum storage volume for the 100-year storm event.

TABLE III-8
Darby and Cobbs Dams'
100-Year Flow Attenuation

			100- Year Flow (cfs)		Maximum Storage Volume*
Lake	DEP ID	Subarea	Into Dam	Out of Dam	(acre-ft)
Devon Detention Basin	D15-327	5	655	645	15.5
Earles Lake	D23-036	24	349	330	51.3
Knox Road Detention Basin	D46-303	58	761	745	8.2
Remington Road Detention Basin	D46-265	59	1,246	1,244	23.7

*Storage above normal pool volume

Source: Borton-Lawson Engineering, Inc., 2004

O. Wetlands

Wetlands were obtained from the NWI maps in digital format and incorporated into the overall GIS. Figure III-15 shows the wetlands for the watershed.

Wetlands play an important part in flood flow attenuation and pollutant filtering. Wetlands within the watershed are primarily found along Darby Creek's overbanks and in the lower portion of the watershed within the John Heinz National Wildlife Refuge. Wetland flood flow attenuation was accounted for in the computer modeling by adjusting

Flood and Stormwater Facilities

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-14

Map Legend

- Watershed Boundary
- County Boundaries
- Municipal Boundaries
- Cities
- Townships
- Boroughs
- Streams
- Water
- Interstate Roads
- U.S. Traffic Routes
- PA. Traffic Routes
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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE
DRGs - USGS
Problem Areas - DCPD & BLE

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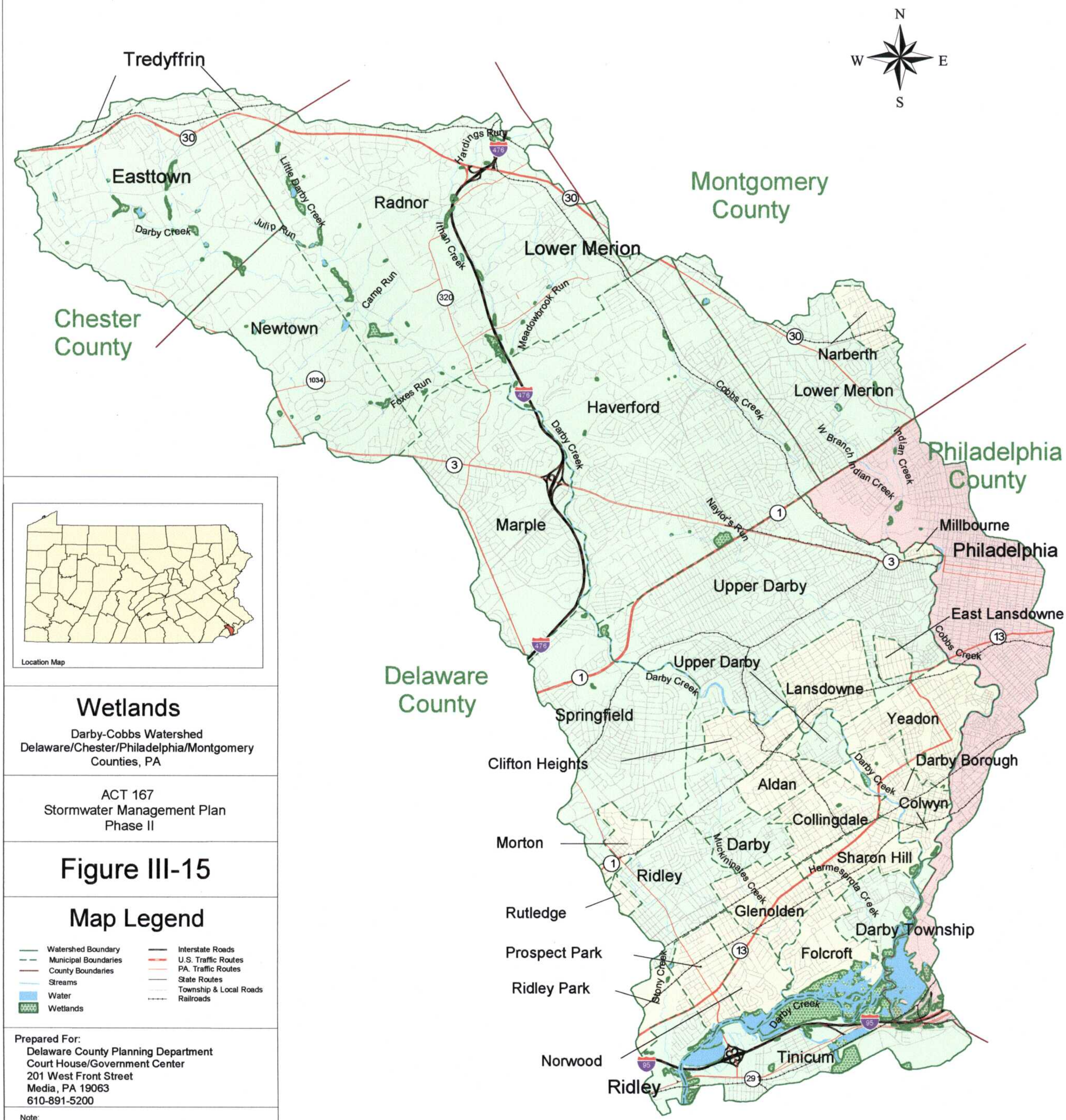
Flood and Stormwater Facilities

- Existing Flood Control Project
- Proposed Flood Control Projects
- Existing Stormwater Control Facilities
- Proposed Stormwater Control Facilities
- Existing Stormwater Collection System
- Present and Protected Development in the Flood Hazard Area
- Proposed Stormwater Collection Systems

Note: Most locations identified on Forms C - J as submitted by municipalities.
Some detention basins were field located by others .
Facilities in close proximity may appear to overlap or be double labeled.

file: p:\99613\00\data\gis\avprojects\wshed.apr\ Figure III-12b Flood and Stormwater Facilities



Wetlands

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery
Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-15

Map Legend

- Watershed Boundary
- Municipal Boundaries
- County Boundaries
- Streams
- Water
- Wetlands
- Interstate Roads
- U.S. Traffic Routes
- PA. Traffic Routes
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- Township & Local Roads
- Railroads

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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Municipal Boundaries - PennDOT & BLE
Wetlands - NWI

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Project Number: 99613.01	Date: 12/13/2004

file: p:\99613\00\data\gis\avprojects\wshed.apr\Wetlands the stream routing time, or stream velocities, for overbank events. Wetlands should be preserved through the joint permit application process.

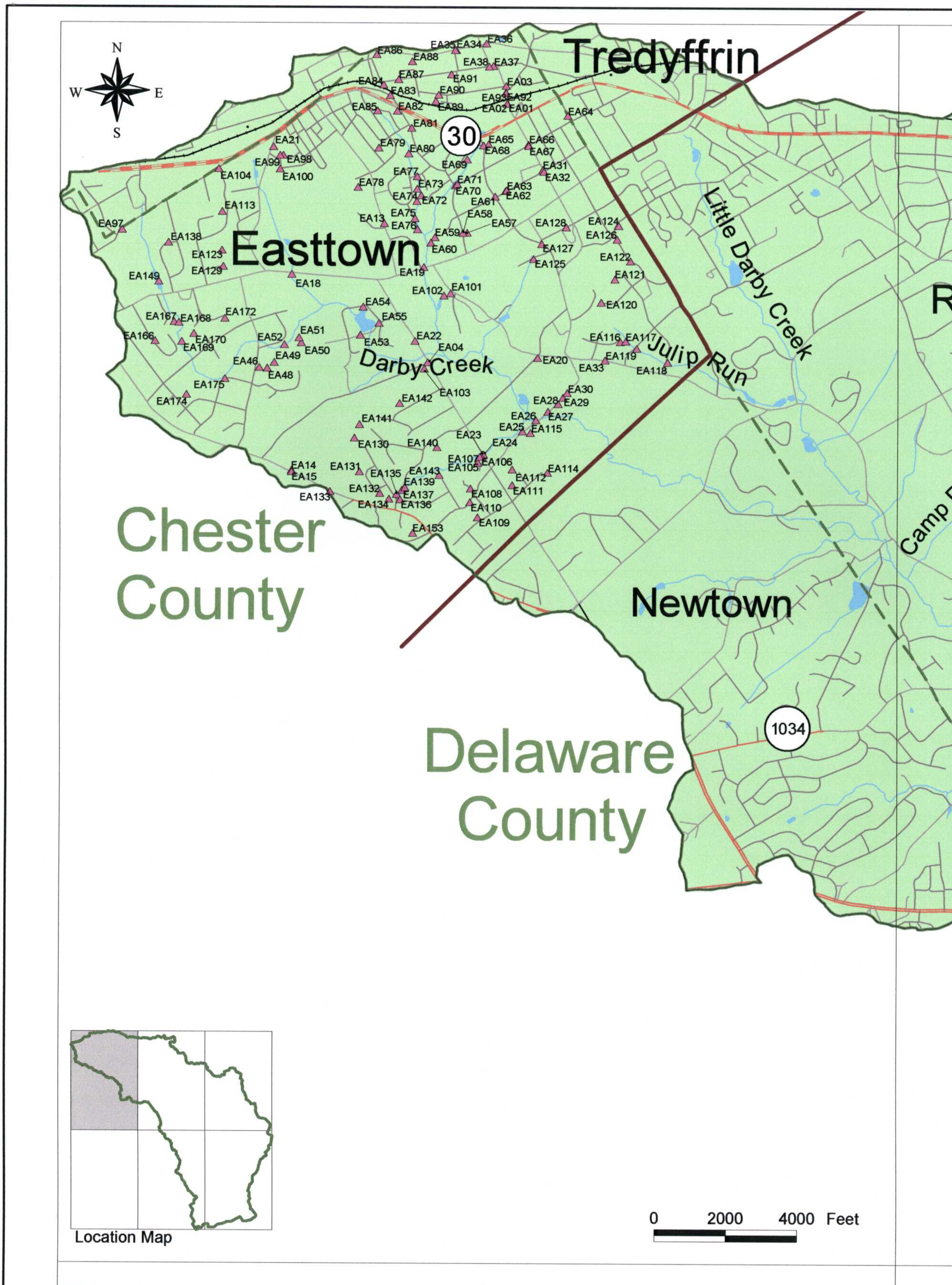
P. Outfalls

Mapping and documenting stormwater outfalls is one of the six minimum control measures (MCMs) itemized in the DEP Municipal Separate Storm Sewer Systems (MS4) Stormwater Management Program Protocol to meet the requirements of the National Pollutant Discharge Elimination System (NPDES) Phase II program. The objective is to detect and eliminate illicit discharges from municipal storm sewers.

The municipalities within the watershed were tasked with locating the storm sewer outfall locations and completing an outfall information form (Form O). Information to be entered on the form included a unique identifier for the outfall, the receiving water, the municipality, basic structural information, and observations that may indicate illicit discharges (colors, odors, etc.).

Maps showing the outfall locations and the forms with the outfall information were provided to Borton-Lawson in both hard copy and digital formats. Not all municipalities submitted data. Borton-Lawson created a point shapefile for each municipality showing the location of the outfalls within the watershed and compiled all of the outfall information into Excel spreadsheets. The individual municipal shapefiles were merged into a single watershed-wide shapefile, and the individual spreadsheets were compiled into a single master spreadsheet.

The master spreadsheet and watershed-wide outfall shapefile were then linked to create a single GIS layer representing storm sewer outfall information in the watershed. Over 600 outfalls were identified, mapped, and labeled. Figures III-16A through III-16E show the outfall locations and IDs at a readable scale. Springfield Township supplied a Microstation file (stormswr.dgn) and an Access database (stormsewer.mdb) of storm sewers. The database did not distinguish outfalls, but they are included in the overall stormwater appurtenances (see Part IV of the Technical Appendix).



OUTFALLS

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-16A

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Map Legend

- Watershed Boundary
- County Boundaries
- Municipal Boundaries
- Cities
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Data Sources:
Roads - PennDOT & BLE
Water - PennDOT & BLE
Boundaries - PennDOT & BLE
Outfalls - Individual Municipalities

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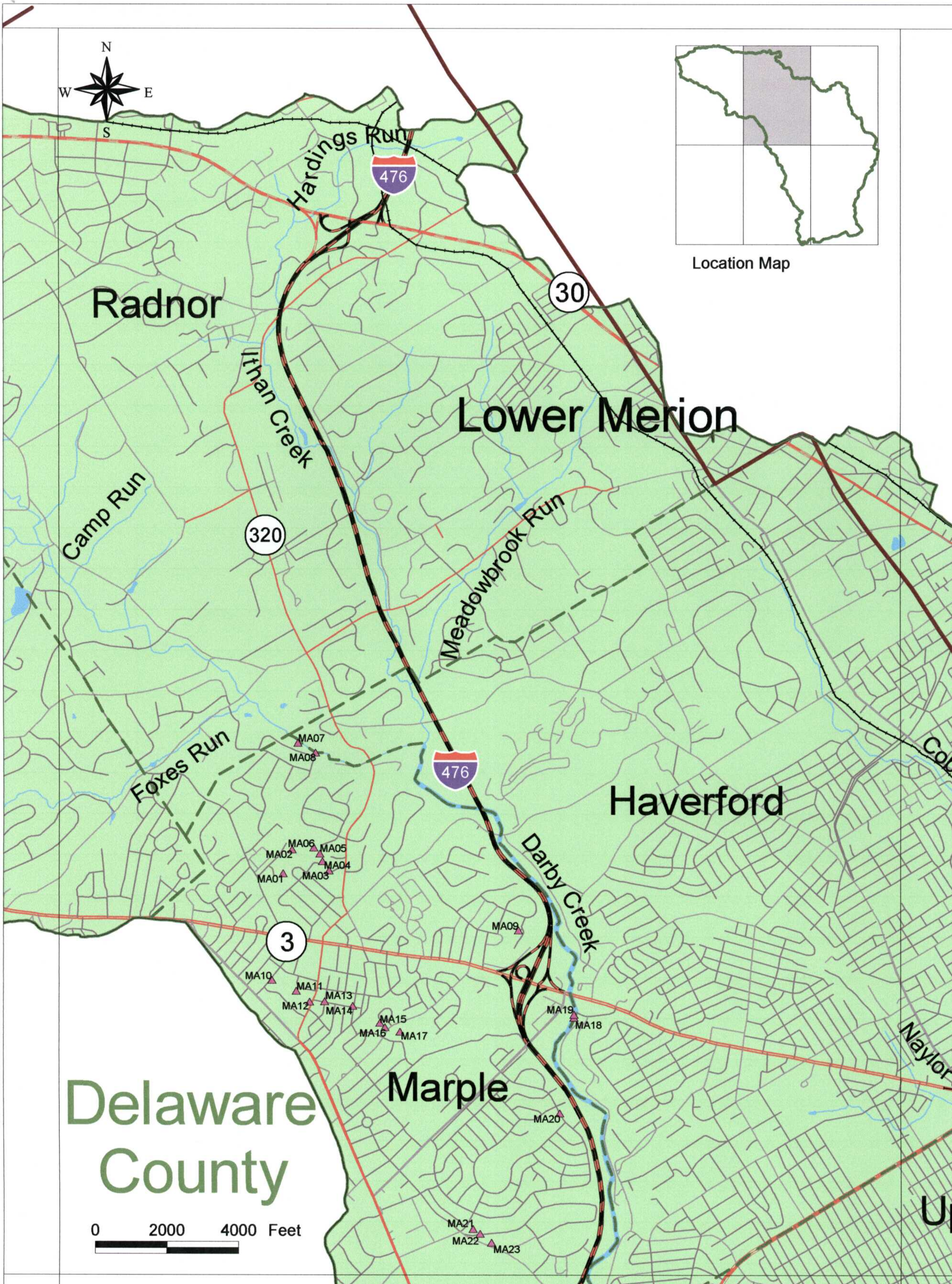

OUTFALLS

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
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Phase II

Figure III-16B

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Map Legend

- Watershed Boundary
- County Boundaries
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- Interstate Roads
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- Township & Local Roads
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Data Sources:
Roads - PennDOT & BLE
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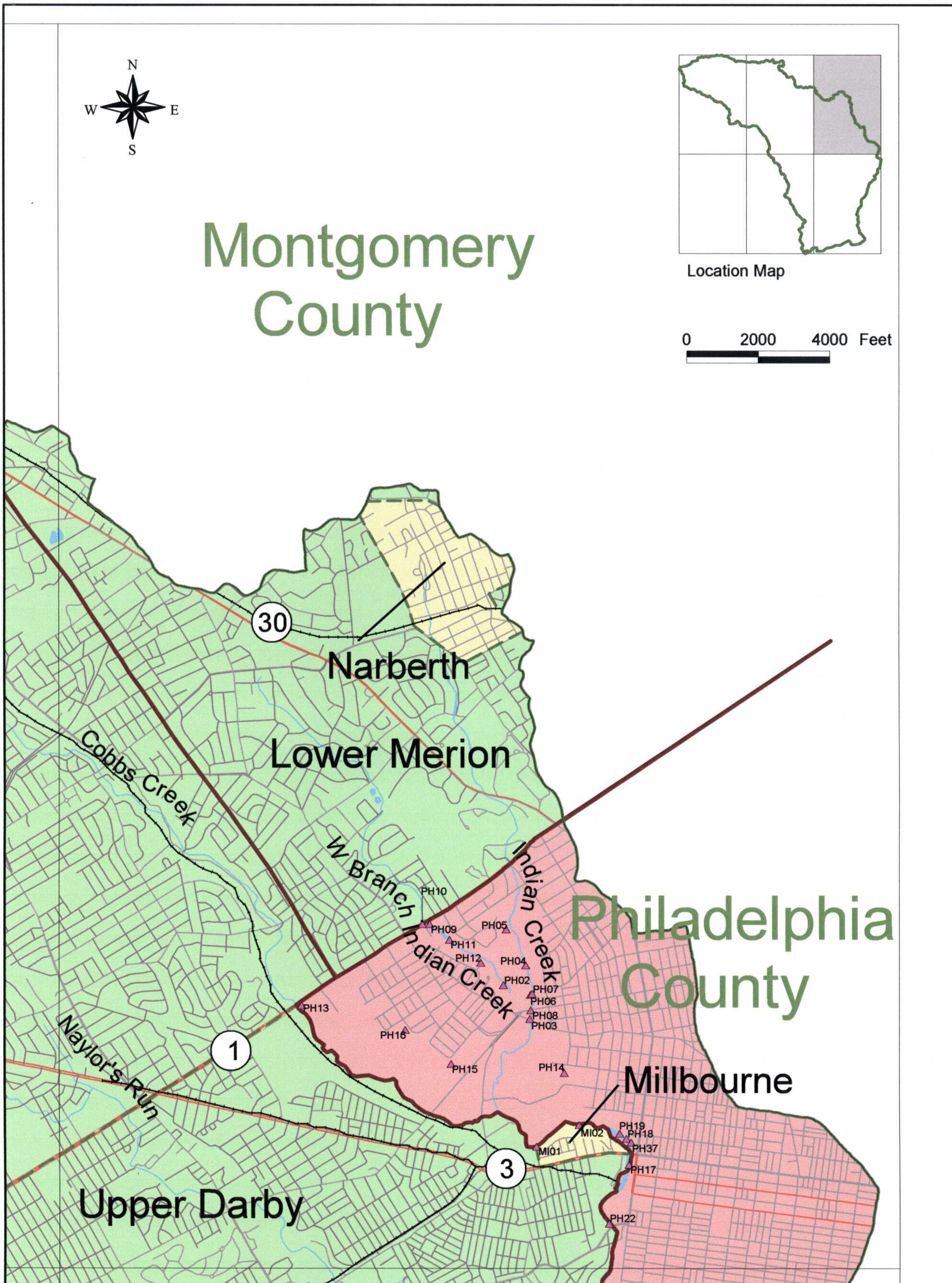

OUTFALLS

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-16C

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Map Legend

- Watershed Boundary
- County Boundaries
- Municipal Boundaries
- Cities
- Townships
- Boroughs
- Streams
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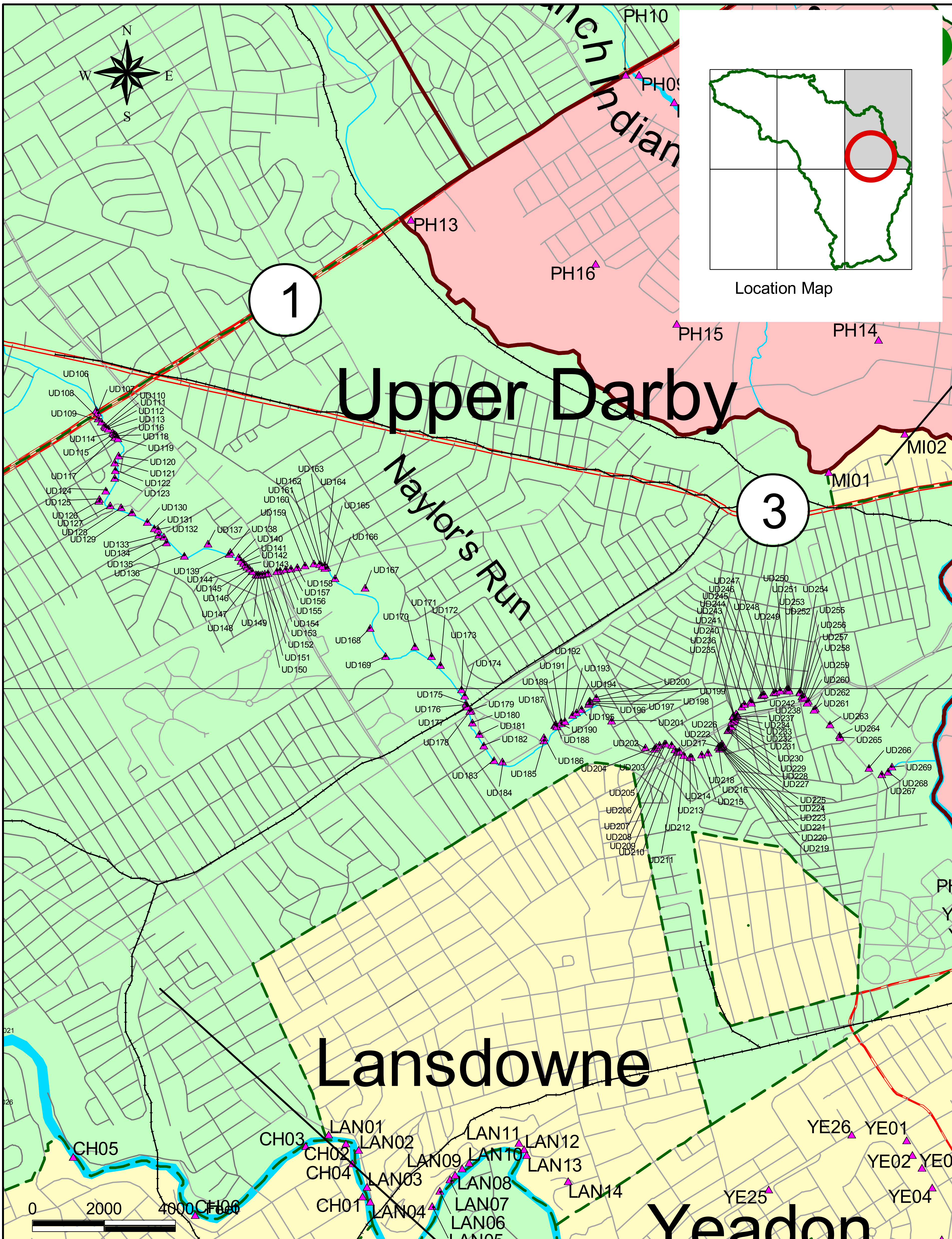

OUTFALLS Darby-Cobbs Watershed Delaware/Chester/Philadelphia/Montgomery Counties, PA	
ACT 167 Stormwater Management Plan Phase II	
Figure III-16C-A NAYLORS RUN -UPPER DARBY	

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Map Legend

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- County Boundaries
- Municipal Boundaries
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OUTFALLS

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-16D

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Map Legend

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- County Boundaries
- Municipal Boundaries
- Cities
- Townships
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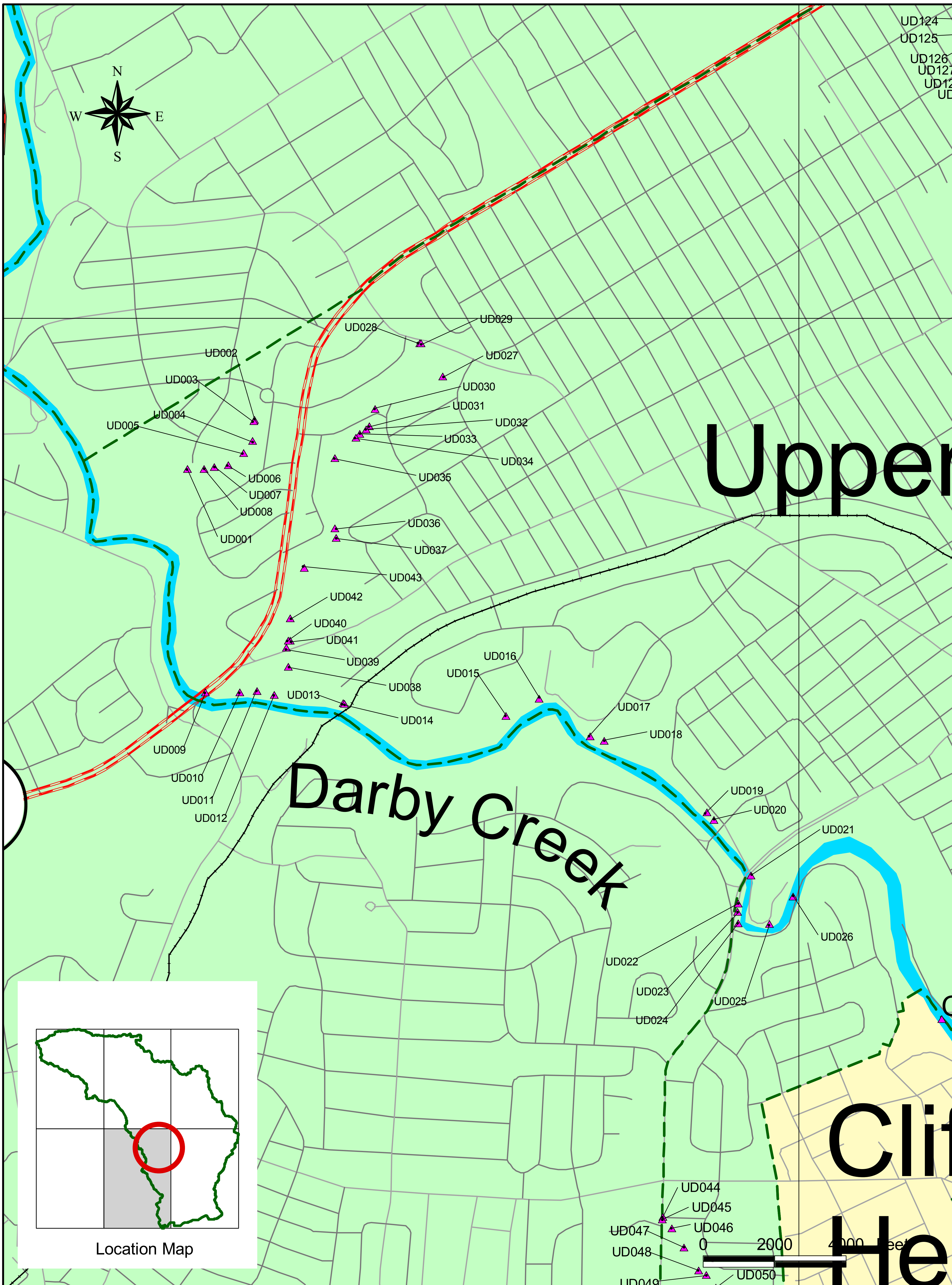

OUTFALLS

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-16D-A
UPPER DARBY

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Map Legend

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- Municipal Boundaries
- Cities
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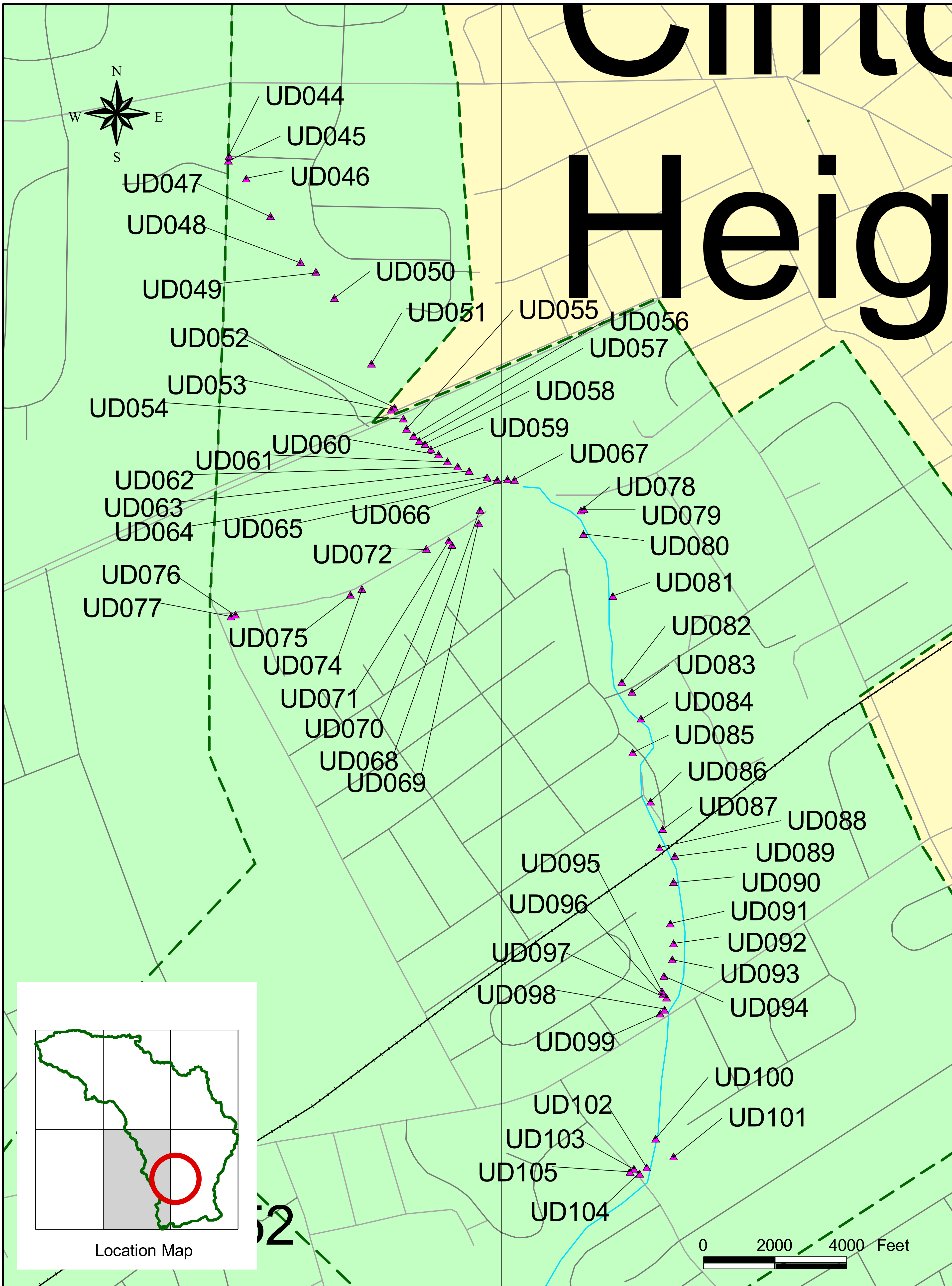

OUTFALLS

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-16D-B
UPPER DARBY

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Map Legend

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OUTFALLS

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Figure III-16E

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Map Legend

- Watershed Boundary
- County Boundaries
- Municipal Boundaries
- Cities
- Townships
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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 U. S. Army Corps of Engineers Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) for the following reasons:

- It had been developed at the Hydrologic Engineering Center specifically for 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 DEP.

Although other models, such as TR-20, may provide essentially the same results as the HEC-HMS, HMS's ability to compare subwatershed contributions in a peak flow presentation table make it specifically attractive for this study. The HEC-HMS model generates runoff flows for selected subareas along the drainage course and compares subarea contributions to the total runoff. 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 HSG maps. The generated curve numbers were then used for input into the computer model. Figure IV-1 displays the subarea delineation for the Darby-Cobbs watershed on digital USGS quadrangles or digital raster graphics (DRGs).

B. Modeling Process

After delineating the Darby-Cobbs watershed on the USGS topographic map, the watersheds were divided into subwatersheds for modeling purposes. The main considerations in the subdivision process were the location of obstructions, problem areas, and tributary confluences. The most downstream point of each of these areas is considered a “point of interest” (POI) where increased runoff must be analyzed for its potential impact.

The reason POIs are selected is to provide watershed runoff control through effective control of individual subarea runoff. Thus, control of stormwater runoff in the entire watershed can be achieved through stormwater management in each subbasin.

The watersheds were then modeled to determine the hydrologic response for the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year for the 24-hour storm events. The results are shown in Volume III, the Technical Appendix, available at the County office.

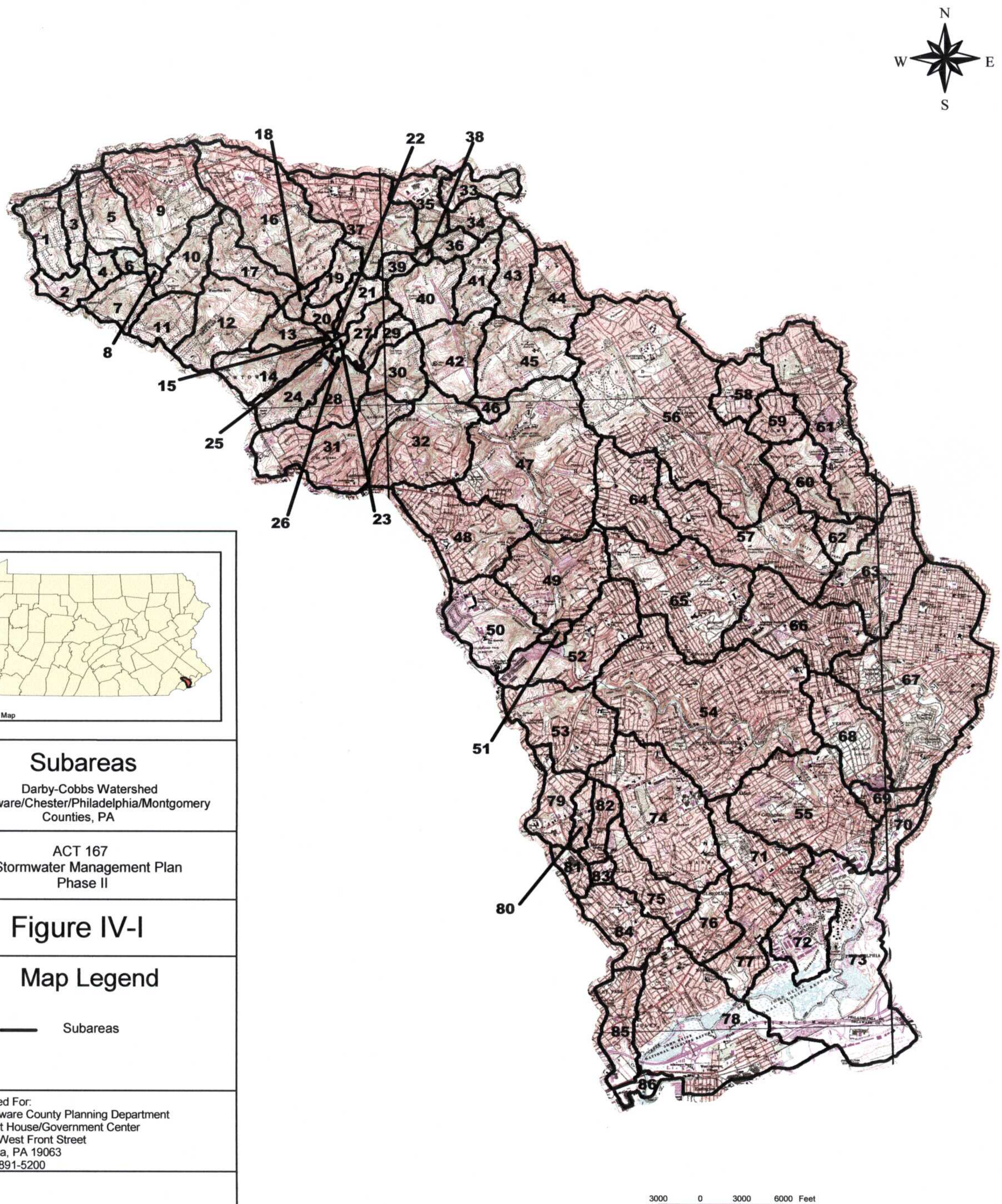
The modeling process addressed:

- 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.

C. Calibration

In order to simulate storm flows for a watershed with confidence and reliability, the computer model must first be calibrated. This involves “fine tuning” the model to provide the most 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 storm events.

When actual storm event data is available (i.e., stream flow and rain gauge data), this information can be input into the model and simulated “hydrographs” developed by the model. Hydrographs are simply a plot of time versus flow in cubic feet per second. 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 utilize actual stream flow and rain gauge data for calibration, sufficient data must be available. Rain gauges must be in close proximity to



Location Map

Subareas

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Delaware/Chester/Philadelphia/Montgomery
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Phase II

Figure IV-I

Map Legend

—— Subareas

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Data Sources:
DRGs - USGS
Subareas - BLE

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Project Number: 99613.01	Date of Plot: July 1, 2003

file: p:\99613\01\data\gis\arcinfo\wshed.apr\Subareas the watershed so that actual rainfall conditions from these gauges are representative of the actual rainfall that occurs over the watershed. Localized events, snowmelt, and unique conditions are typically not used for calibration due to their unique circumstances.

In order to maximize the accuracy of the HEC-HMS model, the model calibration effort was undertaken. At several essential points in the watershed, HEC-HMS generated flows were compared to historic event discharges from USGS gauge data and developed from available regression models typically used in the estimation of design storm peak flow on large watersheds.

FEMA flood insurance studies were also referenced in areas where detailed floodplain information was available. FIS cross-sections were referenced for Manning's values, channel capacities, and channel and overbank velocities. Certain areas were field verified.

There are several potential calibration parameters within HEC-HMS. These include initial abstraction, surface roughness, subbasin time of concentration, runoff curve number, and hydrograph routing velocity and travel time. Several runs were performed for sensitivity analyses of each of these parameters. From these runs, it was determined that the initial rainfall abstraction and subarea travel time 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 from the gauge data.

<u>Historic Storm Calibration Results</u>

In order to calibrate the watershed model against historic storm events, streamflow data was collected from USGS at six available stream gauges (Table IV-1) within the Darby-Cobbs watershed. This data was analyzed to select events which could be modeled using the HEC-HMS model. Typically, events which are results of isolated thunderstorms, snowmelt, or a combination of rainfall/snowmelt are not ideal for modeling since many factors other than rainfall can affect results.

TABLE IV-1
USGS Stream Gauges within the
Darby-Cobbs Watershed

USGS Gauge No.:	Location	Period of Record
01475300	Darby Creek at Waterloo Mills near Devon	1972-97
01475510	Darby Creek near Darby	1964-90
01475530	Cobbs Creek at U.S. 1 at Philadelphia	1965-80
01475550	Cobbs Creek at Darby	1964-90
01475560	Muckinipates Creek at Glenolden	1975-86
01475660	Stony Creek at Prospect Park	1975-86

Accurate rainfall data is also critical to historic event modeling. Since rainfall patterns can vary greatly throughout a watershed area, it is desirable to have many rainfall gauges located within the watershed boundary to accurately model a given storm event. However, for the Darby-Cobbs watershed, no rainfall gauges were located within the watershed boundary. Several gauges were located outside of the Darby-Cobbs watershed boundary within a 30-mile radius of the watershed. Rainfall data from these gauges was collected and reviewed along with the streamflow data in order to select historical events for modeling. The final list of selected events is listed in Table IV-2 along with the recorded peak flow. This table also compares the results of the hydrologic model simulation of these events.

TABLE IV-2
Comparison of Recorded Peak Flows
to Calibrated Model Flows for Selected Events

	Flow Location			
Storm Event	**Darby Creek near Darby**		**Cobbs Creek at Darby**	
Date	**Recorded Flow**	**Model Flow**	**Recorded Flow**	**Model Flow**
July 1984	4,084	4,166	3,940	3,383
April 1984	2,570	2,374	2,040	1,592
September 1985	2,080	2,073	2,540	2,844
December 1986	2,510	2,617	2,270	2,754

Figures IV-2 and IV-3 show a comparison of the recorded hydrographs for the December 1986 storm event to the hydrographs developed by the HEC-HMS model of the Darby-Cobbs watershed. Results of this model showed very good overall results of peak flow, time of peak, and runoff volume when compared to the actual recorded events. Additional plots comparing results of the model for the other historical events can be found in Volume III, the Technical Appendix.

Design Storm Calibration Results

In order to calibrate to develop design event flood flows, the 2-, 10-, and 100- year design storms were analyzed to compare HEC-HMS generated flows to flows developed by the regression models as well as in the available FEMA FISs.

Figures IV-4 through IV-6 show results of the peak flow values developed by the calibrated HEC-HMS model compared to predicted flow values determined from several regression methods at various locations throughout the Darby-Cobbs watershed. Table IV-3 compares the calibrated HEC-HMS 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, on a subwatershed basis, the results may vary.

FIGURE IV-2
Hydrographics Comparison – December 1986 Event and HEC-HMS Model Output at Darby Creek near Darby, PA

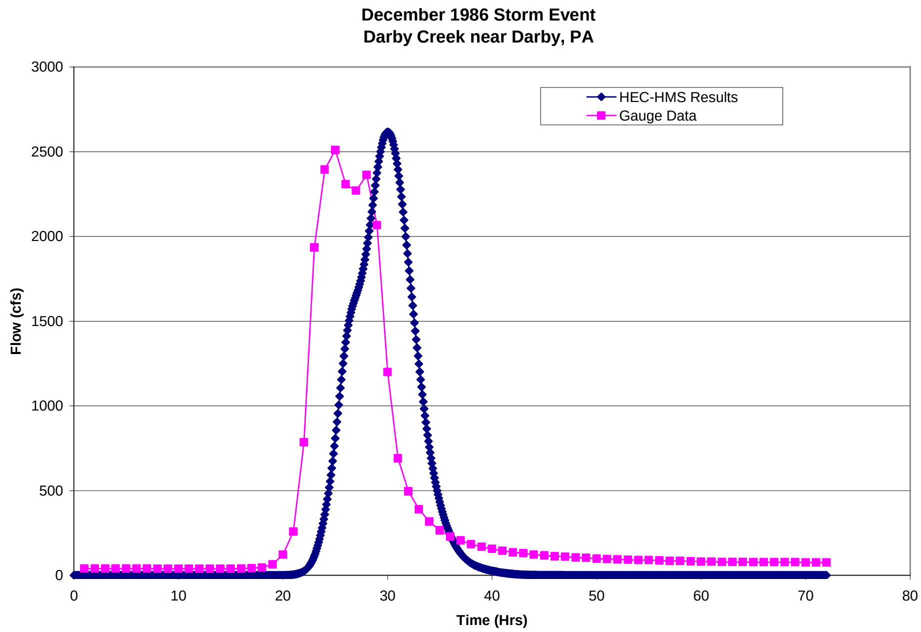


FIGURE IV-3
Hydrographics Comparison – December 1986 Event and HEC-HMS Model Output at Cobbs Creek at Darby, PA

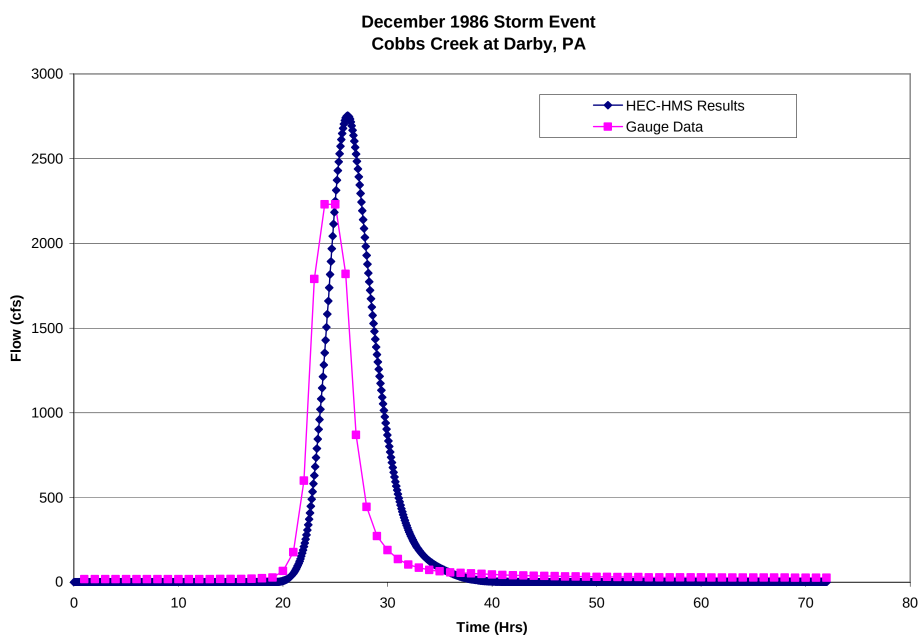


FIGURE IV-4
2-Year Calibrated Model Comparison

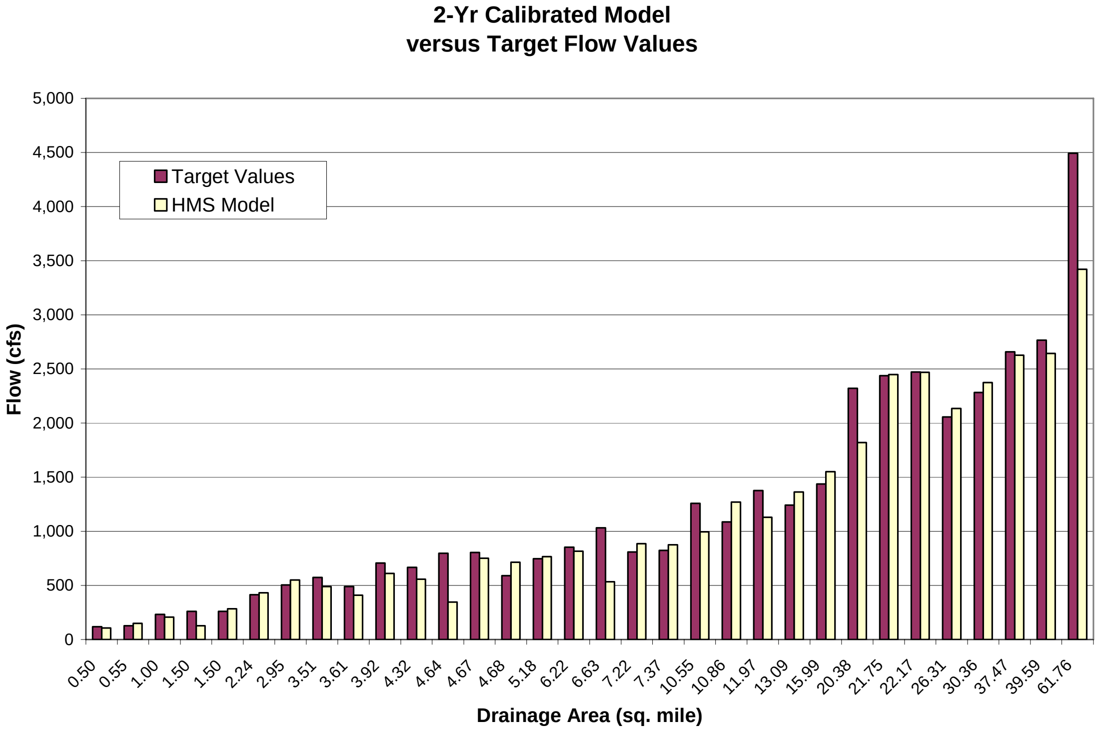


FIGURE IV-5
10-Year Calibrated Model Comparison

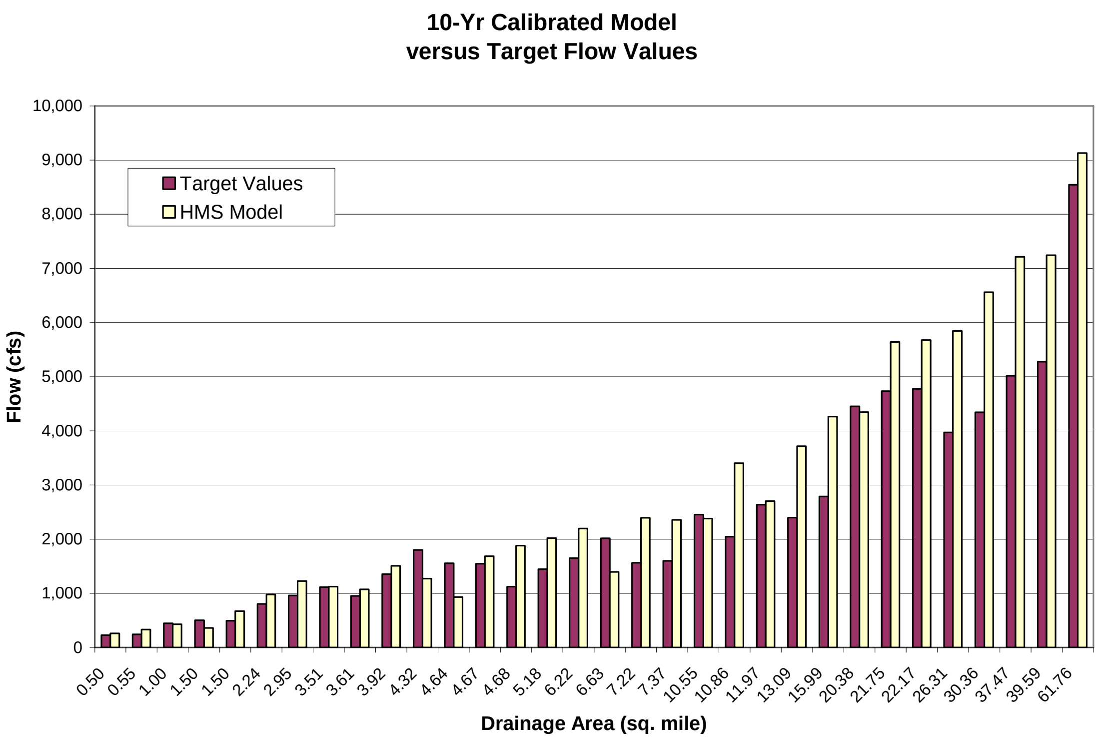


FIGURE IV-6
100-Year Calibrated Model Comparison

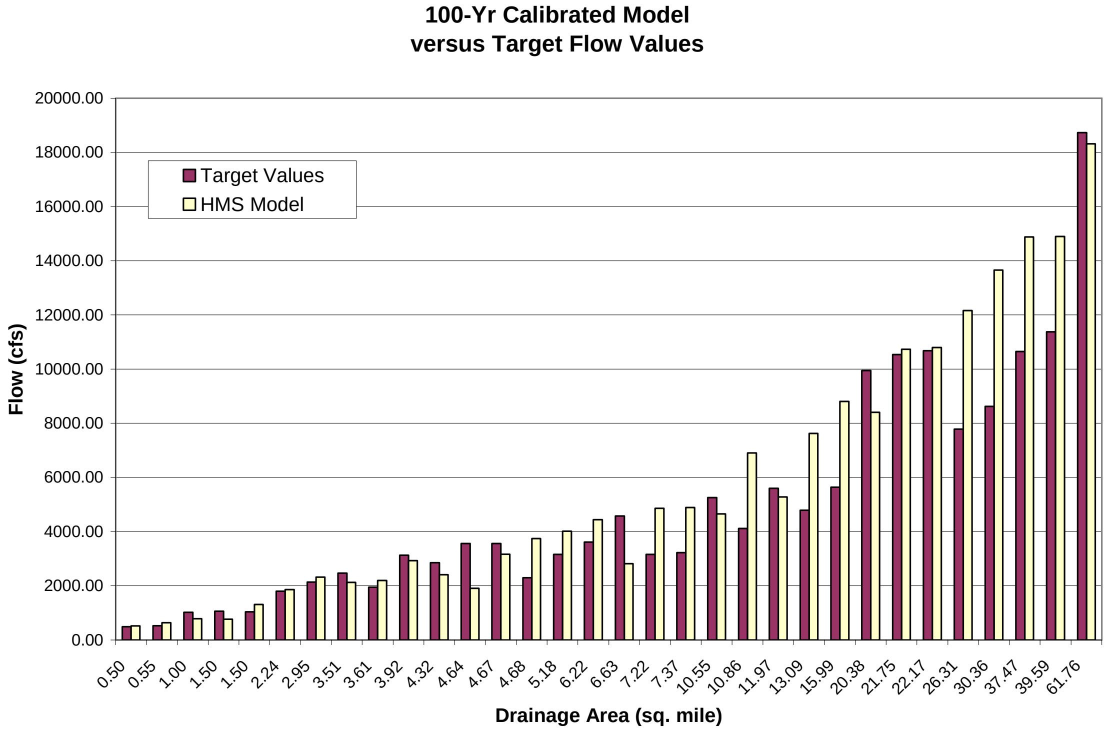


TABLE IV-3
Comparison of Calibrated Model to
100-Year FEMA Flow Values

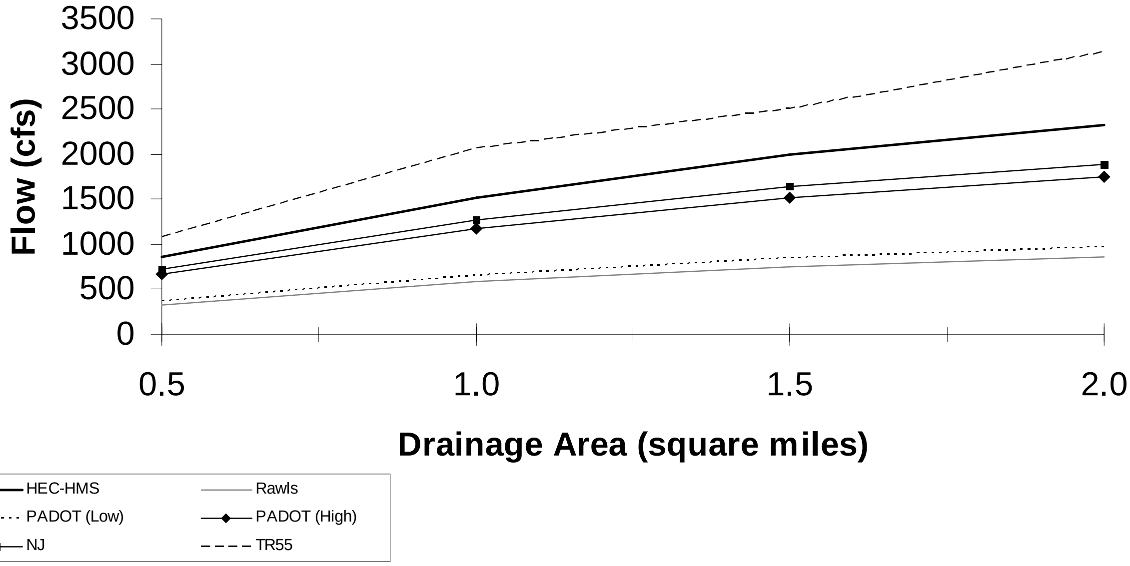
Subarea No.	Drainage Area (sq. miles)	FEMA Flows (cfs)	Calibrated Model Flows (cfs)
13	6.50	4,100	4,578
23	3.60	2,450	2,197
31	1.30	1,000	762
32	15.00	8,100	8,879
55	39.70	17,000	14,931
66	4.50	3,000	3,168
67	16.90	8,400	8,403
70	22.00	11,200	10,798
71	1.00	640	780
78	2.90	1,650	2,317

D. Hydrologic Method Comparison

The calibrated model was run under different scenarios to compare the results obtained by the model with the results from various other calculation methodologies. This evaluation was conducted to determine the applicability of other engineering methods in generating stormwater flows within the watershed. These other methods, which included the SCS Tabular Method and the 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 HEC-HMS model. Figure IV-7 summarizes these comparisons.

Results from this comparison show that either the Curve Number Method or Rational Method could be used in determining pre- and post-development runoff peak rates. These results are valid when using the SCS curve numbers and Rational "C" values specified by the New Jersey Department of Environmental Protection (1984), (given in Ordinance Appendix F).

Figure IV-7
Hydrologic Method Comparison



SECTION V

STANDARDS AND CRITERIA FOR STORMWATER CONTROL

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 in 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 the control of runoff peaks from the site. There are numerous volume controls that can be implemented on site such as infiltration basins, porous pavement, etc. 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. The basic goal is, therefore, the same for both on-site and watershed-level philosophies.

B. NPDES Phase II Requirement

Federal regulations approved in October 1999 required operators of small MS4s to obtain NPDES Phase II permits from DEP by March 2003. This program affects all municipalities in "urbanized areas" of the state. This definition applies to all Darby-Cobbs watershed municipalities as listed in Section III, Table III-1. Therefore, all municipalities within the Darby-Cobbs watershed are subject to the NPDES Phase II requirements mandated by the federal Clean Water Act.

Municipalities required to implement the MS4 program must address the following six MCMs:

- Public Education and Outreach
- Public Involvement/Participation
- Illicit Discharge Detection and Elimination
- Construction Site Stormwater Runoff Control
- Post-Construction Stormwater Management in New Development and Redevelopment
- Pollution Prevention/Good Housekeeping for Municipal Operations

At a minimum, municipal entities regulated under MS4 **must***:*

- Specify best management practices (BMPs) and implement them to the "maximum extent practicable"
- Identify measurable goals for control measures
- Develop an implementation schedule of activities or frequency of activities, and
- Define the entity responsible for implementation

The affected municipalities must, if they already do not have one in place, develop a stormwater management program. If a municipality has an established stormwater management program and is subject to the provisions of the Phase II rule, then provisions of the rule must be implemented to satisfy the federal requirements. Applicable information concerning some of the specifics of this permitting program can be found in Appendix 2 of this plan.

Adoption of the Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan and model ordinance provisions will satisfy the four basic requirements noted above and, at a minimum, one of the six required elements of the NPDES II program, specifically, post-construction stormwater management in new development and redevelopment.

The NPDES program has no exemption criteria; thus, all projects within regulated municipalities will be required to comply with the additional water quality and quantity measures of the regulations. The exemption criteria of the model ordinance (see Section V.L of this plan for further details and Section 106 of the model ordinance for specific exemption language) requires water quality control regardless of project size.

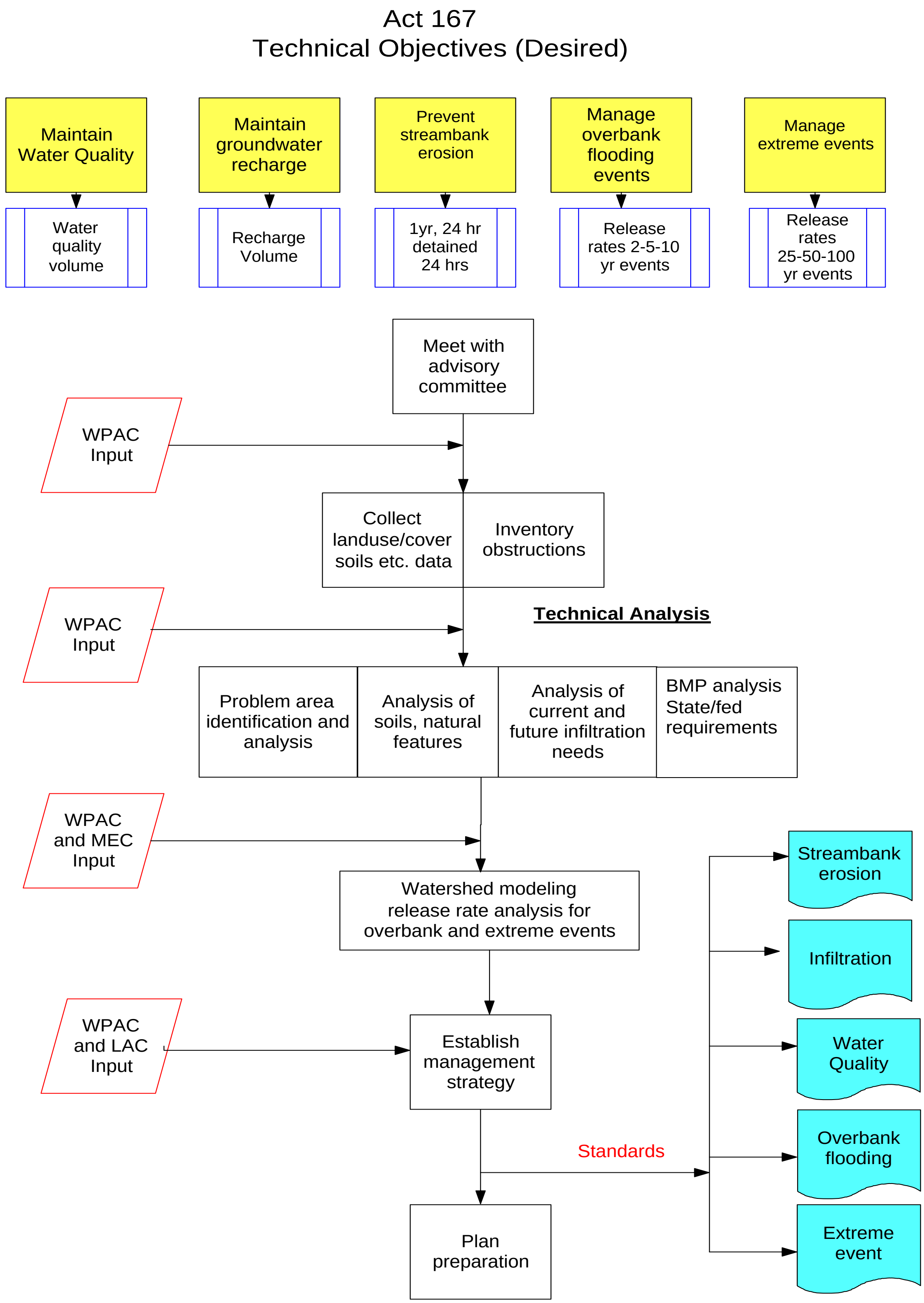
For example, if an activity meets the water **quantity** exemption criteria of the model ordinance, the applicant would still be required to implement specified minimum BMPs to satisfy the water **quality** objectives of the stormwater management plan. This applicant would not need to submit the formal drainage plan but would need to indicate to the municipal Engineer the type of BMP being used. In this way, municipalities adopting the model ordinance provisions will be able to show compliance with one or more of the required elements of the NPDES II regulations.

C. Standards and Criteria – Five Phased Approach

The goal of Act 167 and this stormwater management plan is to encourage planning and management of stormwater runoff that is consistent with sound water and land use practices. In addition, the Act authorized a comprehensive stormwater management program designated to preserve and restore flood-carrying capacities of streams, preserve to the maximum extent practical natural stormwater runoff regimes and the natural course, current, and cross-sections of streams, and protect and conserve groundwaters and groundwater recharge areas. Maintaining the existing hydrologic regime for newly developing areas in the watershed and restoring the previously functioning hydrologic regime in redeveloping areas of the watershed is the best means to accomplish this goal. The technical standards and criteria developed as a part of this task will be watershed-wide in their interpretation and/or application. To strive towards achieving this goal and to address stream bank erosion, flooding, water quality, groundwater recharge, and stormwater management measures on development sites, the following five objectives noted in Figure V-1 should be considered:

- Maintain groundwater recharge
- Maintain or improve water quality

FIGURE V-1
Process Utilized in Analyzing Five Comprehensive Management Objectives



- Reduce channel erosion
- Manage overbank flood events
- Manage extreme flood events

Recommended standards and criteria accommodate various types of land development activities. The standards and criteria provide management practices for the implementation of stormwater control measures.

The standards and criteria also addresses the following:

a. Identification of all areas within the watershed where different criteria apply;

b. Recommended stormwater management districts to manage accelerated runoff from the subareas identified in item a;

c. Recommended design flood frequencies and computational methodologies for stormwater management measures;

d. A list of recommended alternate stormwater collection and control measures;

e. Specifications for construction and maintenance of stormwater systems;

f. Safety requirements for stormwater systems during and after construction.

1. Groundwater Recharge

Recharging rainfall into the ground replenishes the groundwater that provides baseflow to streams (a process that keeps streams flowing during the drier summer months) and maintains groundwater for drinking water purposes. As development occurs and the impervious area increases, less rainfall reaches the groundwater systems, resulting in lower baseflows and smaller groundwater supplies. It has also been found that stream bank capacities are equivalent to approximately the 1½-year storm, and stream banks begin to erode when flows approximate this depth, a term called critical velocity.

Although detention basins can reduce the proposed conditions peak rate of flow to the existing conditions rate, the increased volume of runoff still gets passed downstream unless special provisions are designed into the basin to recharge this increase in runoff volume.

Thus, in highly developed watersheds, it is not uncommon to see dry streams along with severely depleted groundwater drinking supplies during periods of drought. Stormwater management measures such as porous pavement with underground infiltration beds and infiltration/recharge structures or BMPs can be designed to promote groundwater recharge. These measures are encouraged, particularly in HSGs A and B, and should be utilized wherever feasible.

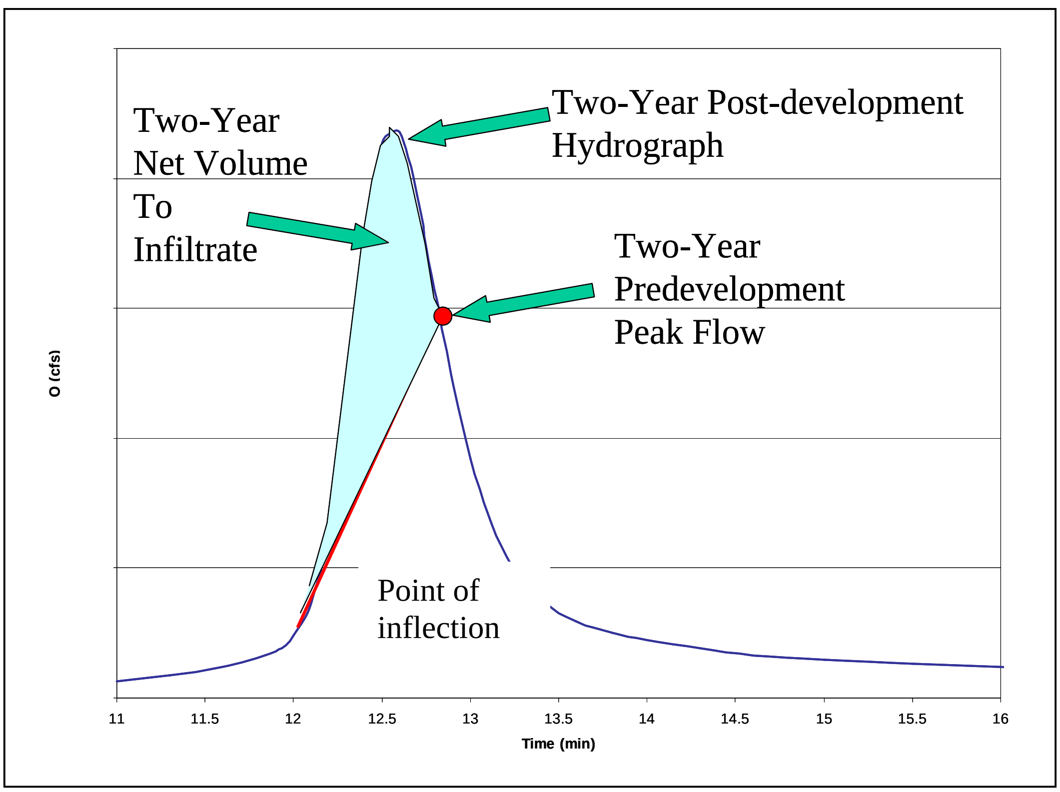
It is realized, however, that due to certain soils and topographic conditions, recharge may not be feasible on every site. It will be up to the design professional, therefore, to show that this cannot be **physically** accomplished. If it can be physically accomplished, then the volume of runoff to be infiltrated shall be determined from the following criteria.

<u>Size of the Infiltration Facility</u>

The size of the infiltration facility shall be based upon the following volume criteria:

a. Net Two-Year Volume Approach - In high quality or exceptional value (HQ/EV) watersheds, the retention (infiltration) volume (Re_v) to be captured and infiltrated shall be the Net Two-Year Volume Approach. The net 2-year volume shall be determined by plotting the 2-year project site post-development hydrograph, drawing a straight line from the point of inflection of the rising limb of the hydrograph to the pre-development 2-year storm, and measuring the volume under the curve as shown in Figure V-2.

FIGURE V-2
Infiltration Hydrograph



b. One Inch from Impervious Surface - In other portions of the watershed that are not classified as HQ/EV, the retention (infiltration) volume (Re_v) will be equal to capturing 1 inch of rainfall over all proposed impervious surfaces.

Re_v = I * impervious area (square feet) ÷ 12 (inches) = cubic feet (cf)

An asterisk (*) in equations denotes multiplication.

c. Obtaining the Re_v volume as described above may not be feasible on every site due to site-specific limitations such as soil type. If it cannot be physically accomplished, then the design professional shall be responsible for showing that this cannot be physically accomplished. If it cannot be physically accomplished, then the retention (infiltration) volume Re_v required shall be as much as can be physically accomplished with a minimum of 0.50 inch, depending on demonstrated site conditions. It has been determined that capturing and infiltrating 0.50 inch of runoff from the impervious areas will aid in maintaining the hydrologic regime (baseflow) of the watershed. If the goals of the Net Two-Year Volume Approach or the One Inch from Impervious Surface Approach cannot be met, then 0.50 inch of rainfall shall be retained and infiltrated from all impervious areas.

The minimum recharge volume (Re_v) required would, therefore, be computed as:

Re_v = I * impervious area (square feet) ÷ 12 (inches) = cubic feet (cf)

An asterisk (*) in equations denotes multiplication.

Where:

I = The maximum equivalent infiltration amount (inches) that the site can physically accept or 0.50 inch, whichever is greater.

The retention volume value derived from the above is the minimum volume the applicant must control through an infiltration BMP facility. However, if a site has areas of soils where additional volume of retention can be achieved, the applicant is encouraged to infiltrate as much of the stormwater runoff from the site as possible.

If the minimum of 0.50 inch of infiltration requirement cannot be achieved, a waiver from ordinance Section 405, Groundwater Recharge, would be required from the municipality.

Soils

A detailed soils evaluation of the project site shall be required to determine the suitability of infiltration facilities. The evaluation shall be performed by a qualified design professional, and at a minimum, address soil permeability, depth to bedrock, and subgrade stability. The general process for designing the infiltration BMP shall be:

a. Analyze HSGs as well as natural and man-made features within the site to determine general areas of suitability for infiltration practices. In areas where development on fill material is under consideration, conduct geotechnical investigations of sub-grade stability; infiltration is not permitted to be ruled out without conducting these tests.

b. Provide field tests such as double ring infiltrometer or hydraulic conductivity tests (at the level of the proposed infiltration surface) to determine the appropriate hydraulic conductivity rate. Percolation tests are not recommended for design purposes.

c. Design the infiltration structure for the required retention (Re_v) volume based on field determined capacity at the level of the proposed infiltration surface.

d. If on-lot infiltration structures are proposed by the applicant's design professional, it must be demonstrated to the municipality that the soils are conducive to infiltration on the lots identified.

Minimum Requirements for All Infiltration BMPs

Infiltration BMPs shall meet the following minimum requirements:

a. Infiltration BMPs intended to receive runoff from developed areas shall be selected based on suitability of soils and site conditions. A detailed soils evaluation of the project site shall be required where practicable to determine the suitability of recharge facilities. The evaluation shall be performed by a qualified design professional, and at a minimum, address soil permeability, depth to bedrock, and subgrade stability.

b. Infiltration BMPs shall be constructed on soils that have a minimum depth of 24 inches between the bottom of the facility and the seasonal high water table and/or bedrock (limiting zones).

c. Infiltration BMPs shall be constructed on soils that have an infiltration rate sufficient to accept the additional stormwater load and drain completely as determined by field tests conducted by the owner's professional designer.

d. The infiltration BMP shall be capable of completely infiltrating the recharge volume within four days (96 hours).

e. Pretreatment shall be provided prior to infiltration.

Designing the Infiltration BMP

Extreme caution shall be exercised where infiltration is proposed in geologically susceptible areas such as limestone. Extreme caution shall also be exercised along roadways and around road salt storage areas where salt or chloride would be a pollutant since soils do little to filter these pollutants, and they may contaminate the groundwater. The qualified design professional shall evaluate the possibility of groundwater contamination from the proposed infiltration/recharge facility and perform a hydrogeologic justification study if necessary. A detailed hydrogeologic investigation may be required by the municipality. The infiltration requirement in HQ/EV waters shall be subject to the Department's Chapter 93 Antidegradation Regulations. The municipality may require the installation of an impermeable liner in detention basins where the possibility of groundwater contamination exists.

Safeguards shall be provided against groundwater contamination for uses that may cause groundwater contamination from a mishap or spill. Extreme caution shall be exercised where infiltration is proposed in source water protection areas (SWPA). Recharge/infiltration facilities should be used in conjunction with other innovative or traditional BMPs, stormwater control facilities, and nonstructural stormwater management alternatives. It is extremely important that strict erosion and sedimentation control measures be applied surrounding infiltration structures during installation to prevent the infiltrative surfaces from becoming clogged.

Stormwater Hotspots

If a proposed site is designated as a hotspot, as defined in Table V-1, it has important implications for how stormwater is managed. First and foremost, untreated stormwater runoff from hotspots shall not be allowed to recharge into groundwater where it may contaminate water supplies. Therefore, the Re_v requirement shall **not** be applied to development sites that fit into the hotspot category (the entire water qualilty volume

Table V-1
Classification of Stormwater Hotspots

- Vehicle salvage yards and recycling facilities
- Vehicle fueling stations
- Vehicle service and maintenance facilities
- Vehicle and equipment cleaning facilities
- Fleet storage areas (bus, truck, etc.)
- Industrial sites (based on SIC codes outlined in the SPDES)
- Marinas (service and maintenance)
- Outdoor liquid container storage
- Outdoor loading/unloading facilities
- Public works storage areas
- Facilities that generate or store hazardous materials
- Commercial container nursery
- Other land uses and activities as designated by an appropriate review authority

Source: Borton-Lawson Engineering, Inc., 2004

(WQv) must still be treated). Second, a greater level of stormwater treatment shall be considered at hotspot sites to prevent pollutant washoff after construction. EPA's NPDES stormwater program requires some industrial sites to prepare and implement a stormwater pollution prevention plan.

The following land uses and activities are not normally considered hotspots:

- Residential streets and rural highways
- Residential development
- Institutional development
- Office developments
- Nonindustrial rooftops
- Pervious areas, except golf courses and nurseries (which may need an integrated pest management (IPM) plan).

While large highways (average daily traffic volume (ADT) greater than 30,000) are not designated as a stormwater hotspot, it is important to ensure that highway stormwater management plans adequately protect groundwater.

- Extreme caution shall be exercised where infiltration is proposed in SWPAs as defined by the local municipality or water authority.

- Infiltration facilities shall be used in conjunction with other innovative or traditional BMPs, stormwater control facilities, and nonstructural stormwater management alternatives.

- Extreme caution shall be exercised where salt or chloride (municipal salt storage) would be a pollutant since soils do little to filter this pollutant, and it may contaminate the groundwater. The qualified design professional shall evaluate the possibility of groundwater contamination from the proposed infiltration facility and perform a hydrogeologic justification study if necessary.

- The infiltration requirement in HQ/EV waters shall be subject to the Department's Chapter 93 Antidegradation Regulations.

- An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists. A detailed hydrogeologic investigation may be required by the municipality.

The municipality shall require the applicant to provide safeguards against groundwater contamination for uses which may cause such contamination, should there be a mishap or spill.

2. Water Quality

Pollutants accumulate on impervious surfaces between rainfall events or during dry weather. Pollutant concentrations in runoff from developed land, therefore, tend to be greatest at the beginning of the storm event, or during the first 1/2 inch to 1 inch of runoff, a phenomenon commonly known as the first flush. It has also been found that approximately 80% of the rainfall events are 1/2 inch of rainfall or less, storms that essentially simulate this "first flush." The majority of the nonpoint source pollutants, therefore, are being washed into streams during this first flush. Capturing this first flush and smaller storms will, depending on the BMP design, allow the stormwater to be detained and will allow pollutants to settle out, allowing biological breakdown or uptake of these pollutants.

Water Quality Standards

The applicant shall comply with the following water quality requirements.

- No regulated earth disturbance activities within the municipality shall commence until approval by the municipality of a plan which demonstrates compliance with state water quality requirements post-construction is complete.

- The BMPs shall be designed, implemented, and maintained to meet state water quality requirements and any other more stringent requirements as determined by the municipality.

- To control post-construction stormwater impacts from regulated earth disturbance activities, state water quality requirements can be met by BMPs, including site design, which provide for replication of pre-construction stormwater infiltration and runoff conditions so that post-construction stormwater discharges do not degrade the physical, chemical, or biological characteristics of the receiving waters. As described in the DEP Comprehensive Stormwater Management Policy (#392-0300-002, September 28, 2002), this may be achieved by the following:

    1. Infiltration: replication of pre-construction stormwater infiltration conditions,
    2. Treatment: use of water quality treatment BMPs to ensure filtering out of the chemical and physical pollutants from the stormwater runoff, and
    3. Stream Bank and Stream Bed Protection: management of volume and rate of post-construction stormwater discharges to prevent physical degradation of receiving waters (e.g., from scouring).

To achieve the water quality goal, the following criterion is established:

Developed areas will provide adequate storage and treatment facilities necessary to capture and treat stormwater runoff specifically for water quality purposes. The recharge volume computed when calculating the groundwater recharge/infiltration volume may be incorporated as a component of the water quality volume (WQv). If the required recharge volume is less than the required water quality volume, only that portion of the water quality volume exceeding the recharge volume may be treated by methods other than recharge/infiltration BMPs.

The required water quality volume (WQv) is the storage capacity needed to capture and to treat a portion of stormwater runoff from the developed areas of the site produced from 1 inch of rainfall. The following calculation formula is to be used to determine the water quality storage volume, (WQv), in acre-feet of storage for the Darby-Cobbs watershed:

$$WQv=[(P)(Rv)(A)]/12$$

Where:

WQv = Water quality volume (acre-feet)
P = 1 inch
A = Area of the project contributing to the water quality BMP (acres)
Rv = 0.05 + 0.009(I) where I is the percent of the area that is impervious surface ((impervious surface/A)*100)

This volume requirement can be accomplished by the permanent volume of a wet basin or the detained volume from other BMPs. Where appropriate, wet basins shall be utilized for water quality control and shall follow the guidelines of the BMP manuals referenced in ordinance Appendix G.

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). The design of the facility shall provide for protection from clogging and unwanted sedimentation.

For areas within defined special protection subwatersheds which include EV and HQ waters, the temperature and quality of water and streams shall be maintained through the use of temperature sensitive BMPs and stormwater conveyance systems.

To accomplish the above, the applicant shall 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 different BMPs.

Evidence of any necessary permit(s) for regulated earth disturbance activities from the appropriate DEP regional office must be provided to the municipality. The issuance of an NPDES Construction Permit (or permit coverage under the statewide General Permit (PAG-2) satisfies the requirements of ordinance Section 406.A. [*This requirement is optional.*]

The WQv shall be utilized to size water quality BMPs. Design of these BMPs shall be in accordance with design specifications outlined in the *Pennsylvania Handbook of Best Management Practices for Developing Areas* or other applicable manuals. The following factors shall be considered when evaluating the suitability of BMPs used to control water quality at a given development site:

1. Total contributing drainage 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 wellheads
6. Erodibility of soils
7. Land availability and configuration of the topography
8. Peak discharge and required volume control
9. Stream bank erosion
10. Efficiency of the BMPs to mitigate potential water quality problems
11. The volume of runoff that will be effectively treated
12. The nature of the pollutant being removed
13. Maintenance requirements
14. Creation/protection of aquatic and wildlife habitat
15. Recreational value
16. Enhancement of aesthetic and property values

Buffers

Maintaining or restoring natural buffers has many stormwater related benefits (see Table V-2) including aiding in groundwater recharge, improving water quality of runoff, and

TABLE V-2
Twenty Benefits of Buffers

1. Reduce watershed impervious area
2. Maintain distance from impervious cover
3. Help prevent small drainage problems and complaints
4. Stream "right-of-way" allows for lateral movement
5. Land area may provide effective floodwater storage
6. Protection from stream bank erosion
7. Increase property values
8. Increased pollutant removal
9. Foundation for present or future greenways
10. Provide food and habitat for wildlife
11. Mitigate stream warming
12. Protection of associated wetlands
13. Prevent disturbance to steep slopes
14. Preserve important terrestrial habitat
15. Corridors for conservation
16. Essential habitat for amphibians
17. Fewer barriers to fish migration
18. Discourage excessive storm drain enclosures/channel hardening
19. Provide space for stormwater ponds
20. Allowance for future restoration

protecting stream banks from erosion. Therefore, if a perennial or intermittent stream passes through the site, the applicant shall create a stream buffer extending a minimum of 50 feet to either side of the top-of-bank of the channel. The buffer area shall be maintained with and encouraged to use appropriate native vegetation (reference Appendix H of the *Pennsylvania Handbook of Best Management Practices for Developing Areas* for plant lists). If the applicable rear or side yard setback is less than 50 feet or a stream traverses a site, the buffer width may be reduced to 25% of the setback and/or to a minimum of 10 feet. If an existing buffer is legally prescribed (i.e., deed, covenant, easement, etc.) and it exceeds the requirements of the ordinance, the existing buffer shall be maintained. Note: The municipality may select a smaller buffer width (above) if desired, but the selected buffer may not be less than 10 feet. This does not include lakes or wetlands.

3. Stream Bank Erosion

Preservation of stream geomorphology is an important aspect of sustainable flood protection and water quality. An FGM survey had previously been conducted on the Cobbs Creek for the City of Philadelphia as part of its NPDES requirements. Therefore, an FGM assessment was also performed on the Darby Creek as part of this Act 167 plan. The purpose of the FGM assessment was to provde stream-specific field data that could be integrated into the associated stormwater quantity and quality control management strategy for the Darby and Cobbs Creeks which includes:

- Identifying the extent to which stream bank erosion, sedimentation, and downstream water quality problems contribute to changes in stormwater flows (both volume and peak).
- Considering living resource protection through aquatic habitat preservation.
- Identifying changes in channel configuration in response to changes in stormwater runoff that might contribute to flooding problems in the future as the stream reaches a new equilibrium.
- Recommending effective and sustainable stream restoration measures.

The results of the FGM assessment, besides providing the framework for future stream restoration work, indicate that there are several stream bank erosion problem areas along the entire length of Darby Creek from its headwaters in Easttown Township in Chester County to its confluence with Cobbs Creek near the fall line in Sharon Hill Borough, Delaware County, as shown in Figure III-13.

As storm flows increase, velocities in the stream also increase, thus exacerbating stream bank erosion problems. The greatest stream velocities and, therefore, the greatest amount of stream bank erosion typically occurs during near bankfull and bankfull flow events. From the separate Darby Creek and Cobbs Creek FGM assessments, bankfull flow has been found to equate to approximately the 1.5-year storm. Therefore, stream flows kept to below the 1.5-year storm flow, or near the 1-year storm flow, would aid in minimizing stream bank erosion. Furthermore, allowing this volume to discharge from the control facility over a minimum of 24 hours would reduce discharge velocities during near bankfull and bankfull flows. Stream bank erosion criteria based upon the above discussion were, therefore, incorporated into the standards and criteria and model ordinance (Section 407). Summarizing this criterion, Section 407 would require detaining the 2-year post-development storm to the 1-year pre-development storm and detaining the 1-year storm a minimum of 24 hours, thereby minimizing the number of storms causing stream bank erosion. This same management criterion also improves the water quality from stormwater runoff. Therefore, applying the groundwater recharge criteria in Section V.C1 above and the water quality criteria in Section V.C2 will also help the stream bank erosion problems.

In addition to the control of water quality volume (in order to minimize the impact of stormwater runoff on downstream stream bank erosion), the primary requirement is to design a BMP to detain the proposed conditions 2-year, 24-hour design storm to the existing conditions 1-year flow using the SCS Type II distribution. Additionally, provisions shall be made (such as adding a small orifice at the bottom of the outlet structure) so that the proposed conditions 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).

The minimum orifice size in the outlet structure to the BMP shall be 3 inches in diameter where possible, and a trash rack shall be installed to prevent clogging. On sites with small contributing drainage areas to this BMP that do not provide enough runoff volume to allow a 24-hour attenuation with the 3-inch orifice, the calculations shall be submitted showing this condition. Orifice sizes of less than 3 inches can be utilized, provided that the design will prevent clogging of the intake.

In "Conditional Direct Discharge Districts" (District C) only (see Section 408 of the model ordinance), the objective is not to attenuate the storms greater than the 2-year recurrence interval. This can be accomplished by configuring the outlet structure not to control the larger storms, or by a bypass channel that diverts only the 2-year stormwater runoff into the basin or conversely, diverts flows in excess of the 2-year storm away from the basin.

4. Overbank Events

Flooding and stormwater problems are caused by excess stormwater quantity. Storm events which result in water exceeding the natural bank of a stream are termed as "overbank" events and are typically defined as an expected frequency of occurrence. Based upon the realization that most bankfull events occur at approximately the 1.5- to 2-year event, events greater than the 2-year storm result in overbank flooding. These "overbank" events typically range from the 2-year to 10-year events. Management of these "overbank" events requires a detailed knowledge of the interrelationship among all contributing areas of a watershed. Analysis of peak runoff, timing of runoff, and duration of runoff from the various areas of a watershed is critical for establishing these criteria. The result of this analysis is the Management District Concept, discussed in Section V.D.

5. Extreme Events

"Extreme" flooding events are separated from "overbank" flooding events by the severity of damage which is incurred. Typically, events such as the 25-, 50-, and 100-year events are labeled as "extreme" events.

While some overbank and extreme flooding events are inevitable, the goal is to control the frequency of occurrence for such events such that the level of overbank flooding is the same over time so that damages to existing conditions infrastructure are not exacerbated by upstream development. Therefore, different management criteria are given for these "overbank" and "extreme" event floods.

It must be recognized that there is a difference between the meanings of storm and flood when considering 5-year storms and 5-year floods. Although a certain quantity of rain may classify a rainfall event as a 5-year storm, this does not mean that the same amount of rain will result in a 5-year flood. For example, if the event would occur during a drought, a 5-year storm may result in only a 2-year flood because of the capacity of the soil and ground to absorb water. However, if the same event occurred on top of a snow melt, then a 10-year flood may occur because of the extra water volume present in the melting snow.

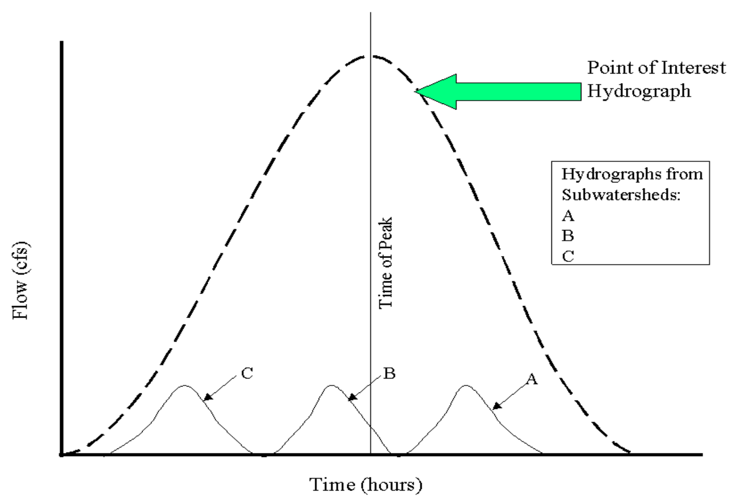
Similarly, the term "5-year flood" does not mean that this event will occur once every five years. Nor does it mean that once a 5-year event occurs, it will be another five years until that event may occur again. A 5-year event refers to the probability that the event will occur in any given year, which is the inverse of the frequency event. Therefore, a 5-year event has a 20% probability of occurring in any given year.

D. Management District Concept (for Overbank and Extreme Events)

Many Act 167 plans were based upon the release rate concept where each subarea of the watershed was assigned a release rate (as a percent value). For any development scenario, the post-development runoff rate must meet a percent (release rate) of the pre-development runoff rate. These release rates were developed by analyzing the individual subarea contribution to the overall watershed runoff. This plan equates release rates to equivalent design storms and places the subareas in separate management districts. The management district concept uses the same idea as the release rate concept; however, it displays the final criteria by grouping subareas into "management districts" rather than assigning a release rate to each individual subarea. Each management district contains specific criteria that are to be met in order to address "overbank" and "extreme" design events.

Figure V-3 shows a simplified version of how various subarea hydrographs would contribute to the peak flow at a particular POI. As can be seen from Figure V-3, hydrograph "A" peaks after the POI hydrograph. In this case, standard detention or reducing post-development flows to existing conditions 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 subarea's hydrograph. 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, if possible, it would be advantageous not to detain these flows. Subareas A, B, and C on the sample would fall into districts A, B, and C as shown on Appendix A 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 the existing flow at all points in the watershed in the future.

FIGURE V-3
Relative Timing of Subwatershed Hydrographs



A major goal of the Darby-Cobbs Act 167 plan 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. Table 5-3 shows how the peak rate of proposed conditions runoff would have to be reduced to the peak rate of existing conditions runoff for the design storms specified. Individual subareas would fall into one of four districts as shown in Table V-3.

TABLE V-3
Stormwater Management Districts in the Darby-Cobbs Watershed

District	Proposed Condition Design Storm	(reduce to)	Existing Condition Design Storm
A	2 - year		1 - year
	5 - year		5 - year
	10 - year		10 - year
	25 - year		25 - year
	100-year		100-year
B-1	2 - year		1- year
	10 - year		5 - year
	25 - year		10 - year
	50- year		25- year
	100-year		100-year
B-2	2 - year		1- year
	5 - year		2 - year
	25 - year		5 - year
	50- year		10- year
	100 - year		100 - year
C *	Conditional Direct Discharge District		

** In District C, development sites which can discharge directly to the Darby-Cobbs 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 greater than the 5-year storm. Sites in District C will still have to comply with the groundwater recharge criteria, the water quality criteria, and stream bank erosion criteria. 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 flows greater than the 2-year pre-development peak flow or will be provided with improvements to furnish the required capacity. When adequate capacity in the 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-year pre-development flows) for the specified design storms.*

Source: Borton-Lawson Engineering, Inc., 2004

In District C, development in those subareas designated on Appendix A-Stormwater Management District Map of the model ordinance 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 that adequately protects health and property from possible injury pursuant to Act 167,**

does not overtax existing conditions drainage facilities, and does not cause erosion or sedimentation. Anyone who proposes no detention must comply with optional Sections 408G and H of the model ordinance if included in the municipal ordinance. Acceptable velocities shall be based upon criteria contained in the DEP *Erosion and Sediment Pollution Control Program Manual.* **The proposed conditions flow that is greater than existing conditions flow can only be released if it would not aggravate a significant obstruction or existing conditions problem area or overload existing conditions 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 must be installed to assure collection of this water by control facilities where required by the stormwater design.

When discharging greater than existing conditions peak flow rates, proper analysis of channel capacity downstream of a development site is essential to ensure that the goal of not creating any new problem areas or aggravating existing conditions 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 latest zoning revision after plan adoption. The analysis must also analyze the future conditions assuming that stormwater detention on development sites is not implemented. This is required to evaluate the impacts of all proposed conditions development to increase flows. In addition, stormwater control measures consistent with the plan must be assumed in analyzing projected development upstream of the point of evaluation.

E. Redevelopment

This plan did not want to create a disincentive to redevelop existing urbanized areas. The stormwater management criteria are based upon meeting the existing conditions flow for a specified design storm. Since existing conditions include any impervious area existing at the site at the time of the proposed development, the criteria, by default, relax the stormwater quantity peak rate of flow by allowing them to match existing conditions for the design storm specified in the management district. However, to encourage redevelopment to consider adding additional open space and properly managing stormwater runoff in the redevelopment design, in lieu of meeting the stormwater quantity control criteria established in Section V.D, the applicant may choose to reduce the total impervious surface on the site by at least 20%, based upon a comparison of existing impervious surface to proposed impervious surface.

F. Process to Accomplish the Standards and Criteria

Table V-4 provides a process to accomplish the required standards and criteria, on a priority basis, looking at means other than detention to promote recharge, improve water quality, and prevent stream bank erosion and to reduce proposed conditions peak flows to the required existing conditions rate.

TABLE V-4
Process to Achieve the Standards and Criteria
in Order of Required Consideration
(Ultimate Goal - Match Existing Conditions Hydrograph)

1. Maximize use of nonstructural stormwater management alternatives
   - Minimize disturbance of natural features
   - Minimize grading
   - Minimize impervious surfaces, consider pervious surfaces
   - Break up large impervious surfaces
2. Satisfy the groundwater recharge (infiltration) objective
3. Satisfy water quality
4. Satisfy stream bank erosion requirements
5. Apply BMPs near the source of the runoff
6. Satisfy the runoff peak attenuation objective considering all measures other than detention basins
7. After satisfying the above requirements, incorporate dual purpose detention measures, if necessary, to attenuate peaks. Dual purpose detention is recommended, e.g., recycling water, wetlands basins, water storage for fire flow, etc.

The sources in the reference section of this plan should be consulted to aid the design engineer in BMP selection and design.

The required standards and criteria developed are summarized in Table V-5 while recommended standards and criteria can be found in Table V-6. The ultimate goal would be to match the pre-development hydrograph, not just the pre-development peak. Nonstructural stormwater management measures (also referred to as conservation design or low impact development (LID)) should be evaluated to help achieve this goal. Conservation design focuses on preserving the areas most beneficial to environmental conservation and developing on the areas most suitable to development. This typically includes development of an opportunity and constraints map. Conservation design measures are discussed in more detail in Section V-G. Pennsylvania's new BMP manual should also be consulted to achieve these goals.

G. Alternative Runoff Control Techniques

Each developer must not allow the runoff from his site to exceed the applicable release rate applied to the subwatershed where 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.

TABLE V-5
Required Standards and Criteria in the Darby-Cobbs Watershed

REQUIRED STANDARD	BENEFIT
Stormwater Management A, B, and C Management Districts	No increase in runoff on a watershed-wide basis, stormwater attenuation.
Recharge/Infiltration/Retention All development proposed should investigate the implementation of infiltration or retention structures for the stormwater control measures as opposed to surface detention (in all HSGs) and adhere to the recharge requirements of the model ordinance. 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.
Water Quality Provide adequate storage and treatment facilities necessary to capture and treat the water quality volume (WQv).	Allows pollutants to settle, thus providing improved water quality.
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 or design storm(s), whichever is more restrictive.	Preserve sewer/culvert capacity, thereby reducing operation and maintenance and replacement costs.
Discharge of Accelerated Runoff Only excess accelerated stormwater runoff (after all criteria have been met) 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 BMP 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 groundwater quality, flow attenuation.
District C Those subareas shown on the Appendix A map in the model ordinance as being in District C shall safely discharge runoff directly into an existing conveyance system with no detention or attenuation of greater than the 5-year storm.	Allows excess runoff to exit the watershed system prior to the peak while still meeting water quality and groundwater recharge goals.
Wetlands Refer wetland impacts to state agency for review.	Infiltration, surface and groundwater recharge, stream baseflow, water quality, flow attenuation, detention.

Note: *See the model ordinance for more detailed standards and criteria.*

TABLE V-6
Recommended Standards and Criteria in the Darby-Cobbs Watershed

RECOMMENDED STANDARD	BENEFIT
Erosion and Sediment Pollution Control Network with administrative and regulatory agencies to sequence and control earth disturbance sites to maintain and protect areas designated for recharge or leave areas of native vegetation intact.	Infiltration, structure integrity, surface water quality, safe conveyance, stream, culvert, and channel capacity.
Floodplains Those floodplains in which the floodplain stores floodwaters shall not be filled or covered with impervious surface so as not to reduce the storage capacity.	Natural stormwater detention/flood control downstream.
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 for reuse.	Promotes infiltration, flow attenuation, and increases runoff time of concentration.
Pervious Surfaces The use of pervious materials will be encouraged for parking surfaces and sidewalks. Compaction of soils is discouraged, and natural or undisturbed areas on site are encouraged in order to keep open space pervious. Aquifer or groundwater recharge beds are encouraged.	Infiltration, groundwater recharge.
Structures Concentrate on locating facilities within areas conducive to recharge and accommodate recharge to meet management district requirements. No stormwater structures that would reduce the storage volume are allowed in floodplains.	Infiltration, groundwater recharge, stream baseflow.
Steep Slopes Regulate activities in critical slope areas where management of stormwater by structure is inappropriate. Slopes should be vegetated with native vegetation.	Stream baseflow, flow attenuation, conveyance integrity, surface water quality.
Stream Bank Protection Reduce 2-year post-development flow to 1-year pre-development flow.	Reduces the number of erosive storms, thereby reducing stream bank erosion.
Green Roof Construct rooftop gardens.	Flow attenuation and small storm retention.
Riparian Buffer Width that is recommended is 50 feet measured from the top-of-bank on both sides of the stream.	Water quality, flood drainage reduction, habitat enhancement, erosion reduction.

Note: *See the model ordinance for more detailed standards and criteria.*

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

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

Some runoff control techniques are “structural” stormwater management controls, meaning that they are physical facilities for runoff abatement. Others are “nonstructural” controls, referring to land use management techniques geared toward minimizing storm runoff impacts through control of the type and extent of new development throughout the study area. The Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan is based on the assumption that new development of various types will occur throughout the study area (except as regulated by floodplain regulations) and that structural controls may be required to minimize the runoff implications of the new development.

1. Nonstructural Runoff Controls - Nonstructural methods of controlling stormwater runoff quantity and quality, such as innovative site planning, impervious area and grading reduction, protection of natural depression areas, temporary ponding on site, and other techniques are recommended. Nonstructural BMPs are increasingly recognized as a critical feature of stormwater BMP plans, particularly with respect to site design. In most cases, nonstructural BMPs shall be combined with structural BMPs to meet all stormwater requirements. The key benefit of nonstructural BMPs is that they can reduce the generation of stormwater from the site, thereby reducing the size and cost of structural BMPs. In addition, they can provide partial removal of many pollutants. The nonstructural BMPs shown in Table V-7 have been classified into broad categories including, but not limited to:

- Natural area conservation
- Limiting disturbed areas
- Conservation design

A more detailed discussion on nonstructural stormwater BMPs can be found in ordinance Appendix E.

2. Structural Runoff Controls - Structural controls for managing storm runoff can be categorized as either volume controls or rate controls. Volume controls are designed to prevent a certain amount of the total rainfall from becoming runoff by providing an opportunity for the rainfall to infiltrate into the ground. Greater opportunity for infiltration can be provided by minimizing the amount of impervious cover associated with development, by draining impervious areas over undisturbed areas or into specific infiltration devices, and by using grassed swales or channels to convey runoff in lieu of

Table V-7
Nonstructural Stormwater BMPs

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

storm sewer systems. Rate controls are designed to regulate the peak discharge of runoff by providing temporary storage of runoff which otherwise would leave the site at an unacceptable peak value. Rate controls, much more so than volume controls, are adaptable to regional considerations for controlling much larger watershed areas than one development site.

a. **Innovative BMPs** - The use of traditional and innovative BMPs is encouraged to meet the recharge, water quality, and water quantity 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), BMP manuals referenced in Section X, or the PA stormwater BMP manual developed subsequent to this plan should be used for design and maintenance of these practices/facilities.

b. **Temperature Sensitive BMPs** - Runoff from blacktop during hot summer months can provide a “slug” of warm water into the streams, which could affect trout. Therefore, for areas within defined special protection subwatersheds which include EV and HQ waters, the temperature and quality of stormwater entering streams shall be maintained through the use of temperature sensitive BMPs and stormwater conveyance systems. Temperature sensitive BMPs are simply those

BMPs which help reduce the temperature of the discharge of the BMP, typically by shading or by providing temporary underground storage. A list of some temperature sensitive BMPs and the source for further information on them can be found in Table V-8.

TABLE V-8
Temperature Sensitive BMPs

To minimize temperature increases caused by new development in watersheds, stormwater BMP designs should:

- Provide shading for pools and channels (particularly south side)
- Maintain existing forested buffers
- Bypass available baseflow and/or springflow
- Utilize underground storage where possible
- Utilize recharge

c. **Quantity Control** - Proposed conditions development runoff from a site must not exceed the applicable existing conditions rate applied to the subwatershed where 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. The applicant must select the technique that is the most appropriate to the type of project and physical characteristics of the site. BMPs can be utilized to manage water quality, groundwater recharge, stream bank erosion, and quantity (peak and volume). The runoff control(s) most applicable to a development site may vary widely depending upon site characteristics such as:

- Type of development proposed
- Soil characteristics (HSG, etc.)
- Subsurface conditions (high water table, bedrock, etc.)
- Topography (steepness of slope, etc.)
- Existing drainage patterns
- Economics
- Advantages and disadvantages of each technique

The use of traditional and innovative BMPs is encouraged to meet the recharge, water quality, and water quantity 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.

Table V-9 provides possible on-site stormwater control methods while Table V-10 explains the advantages and limitations of various on-site stormwater control methods. Table V-11 explains the suitability of control measures in the Darby-Cobbs watershed.

TABLE V-9
Possible On-site Stormwater Control Methods

AREA	REDUCING RUNOFF	DELAYING RUNOFF
Large Flat Roof	1. Cistern storage 2. Rooftop gardens 3. Pool storage or fountain storage	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 beneath parking lots in high value areas 3. Vegetated ponding areas around parking lots 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 or 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 Watersheds. Technical Release No. 55*

TABLE V-10
Advantages and Limitations of Various
On-site Stormwater Control Methods

Bioretention Facility

ADVANTAGES:

1. If designed properly, has shown ability to remove significant amounts of dissolved heavy metals, phosphorous, total suspended solids (TSS), and fine sediments.
2. Requires relatively little engineering design in comparison to other stormwater management facilities (e.g., sand filters).
3. Provides groundwater recharge when the runoff is allowed to infiltrate into the subsurface.
4. Enhances the appearance of parking lots and provides shade and wind breaks, absorbs noise, and improves an area's landscape.
5. Maintenance on a bioretention facility is limited to the removal of leaves from the bioretention area each fall.
6. The vegetation recommended for use in bioretention facilities is generally hardier than the species typically used in parking lot landscapes. This is a particular advantage in urban areas where plants often fare poorly due to poor soils and air pollution.

LIMITATIONS:

1. Low removal of nitrates.
2. Not applicable on steep, unstable slopes or landslide areas (slopes greater than 20%).
3. Requires relatively large areas.
4. Not appropriate at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
5. Clogging may be a problem, particularly if the BMP receives runoff with high sediment loads.

Catch Basin Inserts

ADVANTAGES:

1. Provides moderate removal of larger particles and debris as pretreatment.
2. Low installation costs.
3. Units can be installed in existing traditional stormwater infrastructure.
4. Ease of installation.
5. Requires no additional land area.

LIMITATIONS:

1. Vulnerable to accumulated sediments being resuspended at low flow rates.
2. Severe clogging potential if exposed soil surfaces exist upstream.
3. Maintenance and inspection of catch basin inserts may be required before and after each rainfall event; excessive cleaning and maintenance.
4. Available head to meet design criteria.
5. Dissolved pollutants are not captured by filter media.
6. Limited pollutant removal capabilities.

Cisterns

ADVANTAGES:

1. Low installation cost.
2. Requires little space for installation.
3. Reduces amount of stormwater runoff.
4. Conserves water usage.

LIMITATIONS:

1. Limited amount of stormwater runoff can be captured.
2. Restricted to structure runoff.
3. Aesthetically unpleasing.

TABLE V-10
Advantages and Limitations of Various
On-site Stormwater Control Methods (continued)

Constructed Wetlands

ADVANTAGES:

1. Artificial wetlands offer natural aesthetic qualities, wildlife habitat, erosion control, and pollutant removal.
2. Artificial wetlands can offer good treatment following treatment by other BMPs, such as wet ponds, that rely upon settling of larger sediment particles (Urbonas, 1992). They are useful for large basins when used in conjunction with other BMPs.
3. Wetlands that are permanently flooded are less sensitive to polluted water inflows because the ecosystem does not depend upon the polluted water inflow.
4. Can provide uptake of soluble pollutants such as phosphorous through plant uptake.
5. Can be used as a regional facility.

LIMITATIONS:

1. Although the use of natural wetlands may be more cost effective than the use of an artificial wetland, environmental, permitting, and legal issues may make it difficult to use natural wetlands for this purpose.
2. Wetlands require a continuous baseflow.
3. If not properly maintained, wetlands can accumulate salts and scum which can be flushed out by large storm flows.
4. Regular maintenance, including plant harvesting, is required to provide nutrient removal.
5. Frequent sediment removal is required to maintain the proper functioning of the wetland.
6. A greater amount of space is required for a wetland system than is required for an extended/dry detention basin treating the same amount of area.
7. Although artificial wetlands are designed to act as nutrient sinks, on occasion, the wetland may periodically become a nutrient source.
8. Wetlands that are not permanently flooded are more likely to be affected by drastic changes in inflow of polluted water.
9. Cannot be used on steep, unstable slopes or in densely populated areas.
10. Threat of mosquitoes.
11. Hydraulic capacity may be reduced with plant overgrowth.

Dry Wells

ADVANTAGES:

1. Recommended in residential areas.
2. Requires minimal space to install.
3. Low installation costs.
4. Reduces amount of runoff.
5. Provides groundwater recharge.
6. Can serve small impervious areas like rooftops.
7. Helps to disconnect impervious surfaces.

LIMITATIONS:

1. Offers little pretreatment which may cause clogging.
2. Dry wells should not be installed where hazardous or toxic materials are used, handled, or stored or where a spill of such materials would drain into the dry well.
3. Risk of groundwater contamination in very coarse soils may require groundwater monitoring.
4. Not suitable on fill sites or steep slopes.
5. Must have a minimum of 3 to 4 feet between the bottom of the dry well and the seasonal high water table.

TABLE V-10
Advantages and Limitations of Various
On-site Stormwater Control Methods (continued)

6. Dry wells service a limited drainage area, typically only rooftop runoff.
7. Dry wells must be located at least 10 feet away from building foundations on the down slope side of the structure to prevent seepage.
8. Stormwater runoff carrying bacteria, sediment, fertilizer, pesticides, and other chemicals may flow directly into the groundwater.
9. Loss of infiltrative capacity and high maintenance cost in fine soils.
10. Low removal of dissolved pollutants in very coarse soils.
11. Soils must be permeable.
12. Not recommended for use with commercial rooftops unless adequacy of pretreatment is assured.

Extended / Dry Detention Basins or Underground Tanks

ADVANTAGES:
1. Modest removal efficiencies for the larger particulate fraction of pollutants.
2. Removal of sediment and buoyant materials. Nutrients, heavy metals, toxic materials, and oxygen-demanding particles are also removed with sediment substances associated with the particles.
3. Can be designed for combined flood control and stormwater quality control.
4. Requires less capital cost and land area when compared to a wet pond BMP.
5. Downstream channel protection when properly designed and maintained.

LIMITATIONS:
1. Require sufficient area and hydraulic head to function properly.
2. Generally not effective in removing dissolved and finer particulate size pollutants from stormwater.
3. Some constraints other than the existing topography include, but are not limited to, the location of existing and proposed utilities, depth to bedrock, location and number of existing trees, and wetlands.
4. Extended/dry detention basins have moderate to high maintenance requirements.
5. Sediments can be resuspended if allowed to accumulate over time and escape through the hydraulic control to downstream channels and streams.
6. Some environmental concerns with using extended/dry detention basins include potential impact on wetlands, wildlife habitat, aquatic biota, and downstream water quality.
7. May create mosquito breeding conditions and other nuisances.

Infiltration Basins

ADVANTAGES:
1. High removal capability for particulate pollutants and moderate removal for soluble pollutants.
2. Groundwater recharge helps to maintain dry-weather flows in streams.
3. Can minimize increases in runoff volume.
4. When properly designed and maintained, it can replicate pre-development hydrology more closely than other BMP options.
5. Basins provide more habitat value than other infiltration systems.

LIMITATIONS:
1. High failure rate due to clogging and high maintenance burden.
2. Low removal of dissolved pollutants in very coarse soils.
3. Not suitable on fill slopes or steep slopes.
4. Risk of groundwater contamination in very coarse soils may require groundwater monitoring.
5. Should not be used if significant upstream sediment load exists.
6. Slope of contributing watershed needs to be less than 20%.
7. Not recommended for discharge to a sole source aquifer.
8. Cannot be located within 100 feet of drinking water wells.

TABLE V-10
Advantages and Limitations of Various
On-site Stormwater Control Methods (continued)

9. Metal and petroleum hydrocarbons could accumulate in soils to potentially toxic levels.
10. Relatively large land requirement.
11. Only feasible where soil is permeable and there is sufficient depth to bedrock and water table.
12. Need to be located a minimum of 10 feet down gradient and 100 feet up gradient from building foundations because of seepage problems.

Infiltration Trenches

ADVANTAGES:

1. Provides groundwater recharge.
2. Trenches fit into small areas.
3. Good pollutant removal capabilities.
4. Can minimize increases in runoff volume.
5. Can fit into medians, perimeters, and other unused areas of a development site.
6. Helps replicate pre-development hydrology and increases dry weather baseflow.

LIMITATIONS:

1. Slope of contributing watershed needs to be less than 20%.
2. Soil should have an infiltration rate greater than 0.3 inch per hour and clay content less than 30%.
3. Drainage area should be between 1 and 10 acres.
4. The bottom of the infiltration trench should be at least 4 feet above the underlying bedrock and the seasonal high water table.
5. High failure rates of conventional trenches and high maintenance burden.
6. Low removal of dissolved pollutants in very coarse soils.
7. Not suitable on fill slopes or steep slopes.
8. Risk of groundwater contamination in very coarse soils may require groundwater monitoring.
9. Cannot be located within 100 feet of drinking water wells.
10. Need to be located a minimum of 10 feet down gradient and 100 feet up gradient from building foundations because of seepage problems.
11. Should not be used if upstream sediment load cannot be controlled prior to entry into the trench.
12. Metals and petroleum hydrocarbons could accumulate in soils to potentially toxic levels.

Media Filtration

ADVANTAGES:

1. May require less space than other treatment control BMPs and can be located underground.
2. Does not require continuous baseflow.
3. Suitable for individual developments and small tributary areas up to 100 acres.
4. Does not require vegetation.
5. Useful in watersheds where concerns over groundwater quality or site conditions prevent use of infiltration.
6. High pollutant removal capability.
7. Can be used in highly urbanized settings.
8. Can be designed for a variety of soils.
9. Ideal for aquifer regions.

LIMITATIONS:

1. Given that the amount of available space can be a limitation that warrants the consideration of a sand filter BMP, designing one for a large drainage area where there is room for more conventional structures may not be practical.
2. Available head to meet design criteria.
3. Requires frequent maintenance to prevent clogging.
4. Not effective at removing liquid and dissolved pollutants.

TABLE V-10
Advantages and Limitations of Various
On-site Stormwater Control Methods (continued)

5. Severe clogging potential if exposed soil surfaces exist upstream.
6. Sand filters may need to be placed off-line to protect it during extreme storm events.

Porous Pavement

ADVANTAGES:

1. Porous pavements operate in a similar fashion to infiltration trenches and, thus, provide similar water quality benefits, including reductions in fine-grained sediments, nutrients, organic matter, and trace metals.
2. In addition to water quality benefits, porous pavements also provide significant reductions in surface runoff with up to 90% of rainfall retained within the BMP (Schueler, 1992).
3. An added benefit provided by the on-site infiltration is the extent to which the stormwater runoff is able to contribute to groundwater recharge.
4. Reduces pavement ponding.

LIMITATIONS:

1. Only applicable for low-traffic volume areas.
2. To maintain effectiveness, porous pavements require frequent maintenance.
3. Porous pavements are not intended to remove sediments.
4. Easily clogged by sediments if not situated properly.
5. Porous pavements are limited to treating small areas (0.25 to 10 acres).
6. Contributing drainage area slopes should be 5% or less to limit the amount of sediments that could potentially lead to clogging of the porous pavement.
7. On average, porous pavements clog within 5 years.
8. Underlying soil strata must have an adequate infiltration capacity of at least 0.3 inch per hour but preferably 0.5 inch per hour or more. Adequate soil permeability should extend for a depth of at least 4 feet.
9. The bottom of the reservoir layer should be at least 4 feet above the seasonally high water table. Porous pavements should be no closer than 100 feet from drinking wells and 100 feet up gradient and 10 feet down gradient from building foundations. Due to the risk of groundwater contamination, porous pavements should not be used for gas stations or other areas with a relatively high potential for chemical spills. Similarly, special consideration should be given to the use of porous pavements in wellhead protection areas serviced by sole source aquifers.
10. The porous pavement should not be located where run-on from adjacent areas can introduce sediments to the pavement surface. Similarly, areas subject to wind-blown sediment loads should be avoided.
11. Extended rain can reduce the pavement's load-bearing capacity.
12. More expensive than traditional paving surfaces.

Storm Drain Inserts

ADVANTAGES:

1. Low installation costs.
2. Prefabricated for different standard storm drain designs.
3. Require minimal space to install.

LIMITATIONS:

1. Some devices may be vulnerable to accumulated sediments being resuspended during heavy storms.
2. Can only handle limited amounts of sediment and debris.
3. Maintenance and inspection of storm drain inserts are required before and after each rainfall event.
4. High maintenance costs.
5. Hydraulic losses.

TABLE V-10
Advantages and Limitations of Various
On-site Stormwater Control Methods (continued)

Vegetated Filter Strips

ADVANTAGES:

1. Lowers runoff velocity (Schueler, 1987).
2. Slightly reduces runoff volume (Schueler, 1987).
3. Slightly reduces watershed imperviousness (Schueler, 1987).
4. Slightly contributes to groundwater recharge (Schueler, 1987).
5. Aesthetic benefit of vegetated "open spaces" (Colorado Department of Transportation, 1992).
6. Preserves the character of riparian zones, prevents erosion along stream banks, and provides excellent urban wildlife habitat (Schueler, 1992).

LIMITATIONS:

1. Filter strips cannot treat high velocity flows and do not provide enough storage or infiltration to effectively reduce peak discharges to pre-development levels for design storms (Schueler, 1992). This lack of quantity control dictates use in rural or low-density development.
2. Requires slopes of less than 5%.
3. Requires low to fair permeability of natural subsoil.
4. Large land requirement.
5. Often concentrates water, which significantly reduces effectiveness.
6. Pollutant removal is unreliable in urban settings.

Vegetated Swale

ADVANTAGES:

1. Relatively easy to design, install, and maintain.
2. Vegetated areas that would normally be included in the site layout, if designed for appropriate flow patterns, may be used as a vegetated swale.
3. Relatively inexpensive.
4. Vegetation is usually pleasing to residents.

LIMITATIONS:

1. Irrigation may be necessary to maintain vegetative cover.
2. Potential for mosquito breeding areas.
3. Possibility of erosion and channelization over time.
4. Requires dry soils with good drainage and high infiltration rates for better pollutant removal.

Wet Ponds

ADVANTAGES:

1. Wet ponds have recreational and aesthetic benefits due to the incorporation of permanent pools in the design.
2. Wet ponds offer flood control benefits in addition to water quality benefits.
3. Wet ponds can be used to handle a maximum drainage area of 10 mi^2.
4. High pollutant removal efficiencies for sediment, total phosphorus, and total nitrogen are achievable when the volume of the permanent pool is at least three times the water quality volume (the volume to be treated).
5. A wet pond removes pollutants from water by both physical and biological processes; thus, they are more effective at removing pollutants than extended/dry detention basins.
6. Creation of aquatic and terrestrial habitat.

LIMITATIONS:

1. Wet ponds may be feasible for stormwater runoff in residential or commercial areas with a combined drainage area greater than 20 acres but no less than 10 acres.
2. An adequate source of water must be available to ensure a permanent pool throughout the entire year.

TABLE V-10
Advantages and Limitations of Various
On-site Stormwater Control Methods (continued)

3. If the wet pond is not properly maintained or the pond becomes stagnant, floating debris, scum, algal blooms, unpleasant odors, and insects may appear.
4. Sediment removal is necessary every 5 to 10 years.
5. Heavy storms may cause mixing and subsequent resuspension of solids.
6. Evaporation and lowering of the water level can cause concentrated levels of salt and algae to increase.
7. Cannot be placed on steep, unstable slopes.
8. Pending volume and depth, pond designs may require approval from the State Division of Dams Safety.

Source: *Advantages/Limitations adapted from Los Angeles County Development Planning for Storm Water Management Manual, September 2002.*

H. 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 hydrologically 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 Darby and Cobbs Creeks Watershed Act 167 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 ballfields, open space, volleyball courts, 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 of the property(s) in question. These 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.

TABLE V-11
Suitability of Different Control Measures in the Darby-Cobbs Watershed

1. **Cisterns and Covered Ponds:**
   Recommended in industrial parks where water could be utilized for fire protection; costs vary on size of cistern and material used; low maintenance costs (usually requires periodic sediment removal). Also may be used in existing or newly developed residential areas.

2. **Rooftop Gardens:**
   Recommended in this watershed.

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 the water quality of the receiving stream.

4. **Ponding on Roof, Constricted Downspouts:**
   Possible on large 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. **Reservoirs or Detention Basin:**
   Recommended in entire watershed except in “No Detention” areas; moderate installation and maintenance costs.

10. **Groundwater Recharge:**
    Recommended throughout the watershed, particularly in HSGs A and B.

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

I. Regional Detention Facilities

One option in watershed-wide stormwater 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 Darby-Cobbs 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, the only areas with sufficient open space available for construction of regional detention facilities lie within natural/conservation area lands. For discussion purposes, four potential regional detention facilities were located in these areas along Darby Creek and the Abrahams Run and Camp Run tributaries. Modeling results, shown in Table V-12, do not provide significant downstream benefits for flood protection to justify the placement of these facilities.

TABLE V-12
100-Year HEC-HMS Flows with
Proposed Regional Detention Facilities

Point of Interest	w/o Basins	Basin #1 Only	Basin #2 Only	Basins #1 & #2	Basin #3 Only	Basin #4 Only	Basins #1, #2, #3 & #4
#1	6,902	6,876	6,819	6,791	6,902	6,891	6,788
#2	18,316	18,048	17,715	17,403	18,216	18,264	17,257
#3	18,977	18,732	18,511	18,251	18,888	18,936	18,121

Notes: POI #1 – Below the confluence of Darby Creek and Little Darby Creek
POI #2 – Below the confluence of Darby Creek and Cobbs Creek
POI #3 – Mouth of Darby Creek

J. "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 proven that the post-development conditions will not cause increases in peaks at all critical points downstream.

Several developers within the same subwatershed 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 if 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.

K. "Hardship Option"

The development of the plan and its standards and criteria was designed to maintain existing peak flows throughout the Darby-Cobbs watershed as the watershed becomes developed. There may be certain instances, however, where the standards and criteria established are too restrictive for a particular landowner or developer. The existing drainage network in some areas may be capable of safely transporting slight increases in flows without causing a problem or increasing flows elsewhere. If a developer or homeowner may not be able to possibly meet the stormwater standards due to lot conditions or if conformance would become a hardship to an owner, the hardship option may be applied. The landowner would have to plead his/her case to the municipal governing body with the final determination made by the municipality. Any landowners pleading the "hardship option" will assume all liabilities that may arise due to exercising this option.

L. Stormwater Quantity Control Exemptions

Exemptions for Land Use Activities

The following land use activities are exempt from the drainage plan submission requirements of the ordinance.

a. Use of land for gardening for home consumption.

b. Agriculture when operated in accordance with a conservation plan, nutrient management plan, or erosion and sedimentation control plan approved by the County Conservation District, including activities such as growing crops, rotating crops, tilling of soil, and grazing animals. Installation of new or expansion of existing farmsteads, animal housing, waste storage, and production areas having impervious surfaces that result in a net increase in earth disturbance of greater than 5,000 square feet shall be subject to the provisions of the ordinance.

c. Forest management operations which are following DEP's management practices contained in its publication *Soil Erosion and Sedimentation Control Guidelines for Forestry* and are operating under an approved erosion and sedimentation plan must comply with the stream buffer requirements in ordinance Section 406.G.

d. Road replacement, development, or redevelopment that has less than 2,000 square feet of new, additional, or replaced impervious surface/cover, or in the case of earth disturbance only, less than 5,000 square feet of disturbance, is exempt from the ordinance.

<u>Exemptions for Land Development Activities</u>

The following land development and earthmoving activities are exempt from the drainage plan submission requirements of the ordinance.

a. A maximum of 2,000 square feet of new, additional, or replacement proposed impervious surface.

Or in the case of earth disturbance resulting in less than 2,000 square feet of impervious cover (as noted above).

b. Up to a maximum of 5,000 square feet of disturbed earth.

These criteria shall apply to the total development even if the 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" upon which future subdivisions and respective earth disturbance computations shall be cumulatively considered.

<u>Additional Exemption Criteria</u>

a. Exemption Responsibilities - An exemption shall not relieve the applicant from implementing such measures as are necessary to protect public health, safety, and property.

b. HQ and EV Streams - An exemption shall not relieve the applicant from meeting the special requirements for watersheds draining to identified HQ or EV waters and SWPAs and requirements for nonstructural project design sequencing (ordinance Section 404).

c. Drainage Problems - If a drainage problem is documented or known to exist downstream of or is expected from the proposed activity, then the municipality may require the applicant to comply with the ordinance.

d. Emergency Exemption - Emergency maintenance work performed for the protection of public health, safety, and welfare. A written description of the scope and extent of any emergency work performed shall be submitted to the municipality within two calendar days of the commencement of the activity. If the municipality finds that the work is not an emergency, then the work shall cease immediately, and the requirements of the ordinance shall be addressed as applicable.

e. Maintenance Exemption - Any maintenance to an existing stormwater management system made in accordance with plans and specifications approved by the municipal Engineer or the municipality.

f. Even though the developer is exempt, he is not relieved from complying with other regulations.

SECTION VI

MUNICIPAL ORDINANCE INTRODUCTION

Municipalities within the Commonwealth of Pennsylvania are 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 Storm Water Management Act, Act 167, requires that:

- Counties prepare a watershed stormwater management plan in conformance with the requirements of Act 167 for each watershed within their boundaries.

- The plans evaluate present and future runoff within the watershed and make technical recommendations for the control and management of runoff from new development (both quantity and quality).

- Municipalities implement the plan via a stormwater ordinance developed as part of the plan.

- Developers control the quantity and quality of runoff from new development (including redevelopment) in accordance with each municipality's implementing ordinance.

The Storm Water Management Act emphasizes locally administered stormwater programs with the watershed municipalities taking the lead role. Implementation and enforcement of the watershed plan standards and criteria will require the municipalities to adopt the appropriate ordinance provisions that address subdivision and land development. As part of the preparation of the Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan, a model municipal ordinance has been prepared that will implement the plan provisions presented in the ordinance as a single-purpose ordinance that could be adopted by each municipality with minor changes to fulfill the needs of a particular municipality. 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.

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 cross-reference any applicable provisions pertaining to 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 ordinance should be understandable, applied fairly and uniformly throughout the watershed, and not discourage creative solutions to stormwater management problems. It would be desirable for the municipalities to adopt a uniform regulatory approach for the Darby-Cobbs watershed.

The implementation of the runoff control strategy for development will be through municipal adoption of the appropriate ordinance provisions. The “Darby and Cobbs Creeks 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 the Darby-Cobbs watershed are completely within the watershed. For those portions of the municipality outside of the Darby-Cobbs 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’s Regulations.

- The Act 167 ordinance contains only those minimum stormwater runoff control standards and criteria that are necessary or desirable from a total watershed perspective. Additional stormwater management design criteria (i.e., inlet spacing, inlet type, collection system details, etc.) that 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 following model ordinance has been developed specifically for municipalities within the Darby-Cobbs watershed in order to implement the Darby-Cobbs Stormwater Management Plan. Municipalities may elect to either create a single-purpose stormwater ordinance (recommended) or amend existing subdivision or zoning ordinances to implement the associated stormwater management plan.

All of the provisions within this model ordinance (unless specifically designated as optional) are required to be part of the municipal stormwater ordinance or other ordinances implementing the requirements of the stormwater management plan.

Organization

This ordinance contains the following eight articles, each with specific provisions.

Article I - General Provisions - This article includes general administrative provisions including applicable land areas and regulated activities. This article also includes the stormwater management exemption criteria.

Article II - Definitions - This article provides a list of common terms and associated definitions used throughout the ordinance.

Article III - Drainage Plan Requirements - This article lists the specific requirements for submittal, content, and review of drainage plans required by the ordinance.

Article IV - Stormwater Management - This article represents the technical provisions for stormwater management within the Darby-Cobbs watershed and includes the stormwater management district implementation provisions, water quality requirements, design criteria, calculation methods, and erosion and sedimentation requirements.

Article V - Inspections - This article describes inspection procedures for permanent stormwater management and water quality facilities.

Article VI - Fees and Expenses - This article contains the provisions for a municipal review fee.

Article VII - Maintenance Responsibilities - This article outlines the Applicants' responsibilities for operation and maintenance of stormwater management facilities.

Article VIII - **Prohibitions** - This article, required by NPDES Phase II, prohibits the discharge of nonstormwater flows to any municipal separate storm sewer system with the exception of certain activities found not to contribute pollution to surface waters.

Article IX - Enforcement and Penalties - This article describes municipal enforcement procedures, remedies, and the appeals process.

Appendices - This section of the ordinance contains nine technical support appendices necessary to implement the ordinance provisions.

Please note that the plan and associated ordinance provisions were developed under the authority of and in strict conformance with the requirements of Act 167. These documents were prepared in consultation with a WPAC comprised of designated representatives from each of the watershed municipalities, County Planning and Conservation District staff, the Darby Creek Valley Association, and the Chester County Water Resources Authority. Other advisory members invited to serve on the WPAC include PennDOT, the Delco Anglers, as well as a number of others. Proposed ordinance provisions were reviewed and accepted by a majority of the voting members (noted above) who attended the meetings.

Within six months following adoption and approval of a watershed stormwater plan, each municipality is required to adopt or amend stormwater ordinances as laid out in the plan. These ordinances must regulate development within the municipality in a manner consistent with the watershed stormwater plan and the 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 Darby-Cobbs 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 developments in the Municipality.

For municipalities without an occupancy permit, they may want to adopt the above draft and include other regulatory items in the occupancy permit requirement for their own 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 - Drainage Plan Requirements – Section 302
- Article IV - Design Criteria for Stormwater Management Facilities – Sections 401, 402, 403, 404, 405, 406, 407, 408 (except G, H, and I), 409, 410
- Article V - Inspections (language may be modified by the municipality)
- Article VII - Maintenance Responsibilities (language may be modified by the municipality)
- Article VIII - Prohibitions
- Article IX - Enforcement and Penalties (only when enacting a single-purpose ordinance)

The following ordinance provisions are optional, but recommended to be retained:

- Section 408 - G-I
- Section 709 - Municipal Stormwater Control and BMP Operation and Maintenance Fund
- Article VI - Fees and Expenses

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.

NPDES Requirements

Federal regulations approved October 1999 require operators of small municipal separate storm sewer systems (MS4s) to obtain NPDES Phase II permits from DEP by March 2003. (NPDES II is an acronym for the National Pollutant Discharge Elimination System Phase II Stormwater Permitting Regulations.) This program affects all municipalities in "urbanized areas" of the state. This definition applies to all Darby-Cobbs watershed municipalities. Therefore, all municipalities within the Darby-Cobbs watershed will be subject to the NPDES Phase II requirements mandated by the federal Clean Water Act as administered by DEP. For more information on NPDES II requirements, contact the DEP Regional Office.

Implementation

In order to aid the municipalities and developers in the implementation process, flow charts have been developed as shown in ordinance Appendix D.

Administration

Due to differences in administration of the building permit process in Philadelphia County, the applicability requirements for the Philadelphia portion of the watershed will be based upon earth disturbance as opposed to the amount of proposed impervious area. Table 105.1A summarizes the applicability requirements for the municipalities in Delaware, Chester, and Montgomery Counties. Table 105.1B summarizes the applicability requirements for the City of Philadelphia.

SECTION VII

PRIORITIES FOR IMPLEMENTATION

The Darby and Cobbs Creeks Stormwater Management Plan preparation process is complete with Chester, Delaware, Montgomery, and Philadelphia Counties' adoption of the draft plan and submission of the final plan to DEP for approval. This sets in motion the mandatory schedule of adoption of ordinances needed to implement the stormwater management criteria. As required by the Act, the Darby-Cobbs watershed municipalities have six months from DEP approval to adopt the necessary ordinance provisions. However, the NPDES II deadline of March 10, 2005, for municipal enactment of a water quality ordinance accelerated the ordinance adoption process ahead of actual plan adoption. The typical order of events is as follows.

A. DEP Approval of the Plan

Upon adoption of the watershed plan by Chester, Delaware, Montgomery, and Philadelphia Counties, the plan was submitted to DEP for approval. A draft of the stormwater management plan and draft model ordinance was 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. DEP also reviewed the plan for consistency with municipal floodplain management plans, state programs that regulate dams, encroachments, and other water obstructions, and state and federal flood control programs. The review process also ensures that the plan is compatible with other watershed stormwater plans in the basin and that the plan is consistent with the policies of Act 167.

B. Publishing the Final Plan

Upon DEP approval, DCPD published and provided, at a minimum, one hard copy and one digital copy of the plan to each municipality. The plan includes this report, appendices, figures, and the model ordinance.

C. Municipal Adoption of the Ordinance to Implement the Plan

The essential ingredient for implementation of the stormwater management plan is the adoption of the necessary ordinance provisions by the Darby-Cobbs watershed municipalities. Provided as part of the plan is the "Darby and Cobbs Creeks Watershed Model Act 167 Stormwater Management 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 Appendix 3. The tying provisions would simply direct the user from any applicable provisions pertaining to regulated activities within the Darby-Cobbs 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 and land development ordinance. This way the requirements for management of stormwater will be applicable to all changes in land use and not be limited to activities that are subject to subdivision and land development regulations.

D. Level of Governmental 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" that occurs is primarily a function of a multiple permitting process where 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 according 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. Actions must be taken at the municipal level. Participation by the County in the technical review of stormwater management plans is necessary. In addition, there must be maintenance and operation of the computer model (as necessary) and compilation of data required for periodically updating the plan. In addition, upon adoption of the plan, all future public facilities, facilities for the provision of public utility services, and 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 Chester, Delaware, Montgomery, and Philadelphia County Planning agencies 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 and erosion and sediment pollution control plans by the Delaware, Chester, and Montgomery County Conservation Districts, respectively. 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 Counties will also be responsible for the maintenance of data for performance of review and “no-harm” evaluation. The materials prepared by consultants during the plan preparation process that are 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 that is accessible to users.

E. Countywide 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 an economic and technically sound alternative to the construction of individual, on-site detention basins. There is, however, no organization now 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 Darby-Cobbs 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. However, if in a downstream community the capacity of a drainage channel can be safely increased, more upstream runoff may be released, thus reducing somewhat 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 that allowed the modeling of rainfall routing throughout the watershed and the development of a usable standard for property-level control is also capable of testing numerous, technically feasible solutions that 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. However, 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 interrelated elements of the system 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. 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 the 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 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 the 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 need to have storm flows computed for sizing purposes (i.e., those culverts which were not measured due to lack of maintenance and, therefore, the inability to determine the actual size of the obstruction).

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 transport, storage, and infiltration of stormwater and BMPs to address nonpoint 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 Storm Water Management Act.

I. Landowner's/Developer's 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 ensure that 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 that 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 development consistent with natural resources protection.

SECTION VIII

PLAN REVIEW, ADOPTION, AND UPDATING PROCEDURES

A. County Adoption

Prior to plan completion, Delaware County transmitted a sample of the proposed Darby-Cobbs Stormwater Ordinance for review to affected municipal planning commissions, local governing bodies, the WPAC, and other interested parties. Delaware County then transmitted a draft plan that included the draft ordinance for review to the municipal planning commission and the governing body of each involved municipality, the County Planning Department or Commission, and the WPAC 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 were submitted to the County by official correspondence. The County received, tabulated, and responded to the comments (see Appendix 4). The plan was revised as necessary.

Chester, Delaware, Montgomery, and Philadelphia Counties held a joint public hearing at a location in the watershed. A notice for the hearing was published two weeks prior to the hearing date. The meeting notice contained a summary of the principal provisions of the plan and stated where copies of the plan could be examined or obtained within each municipality. The comments received at the public hearing were reviewed by the County, and appropriate modifications to the plan were considered. The transcript from the public hearing can be found in Appendix 4.

The plan was passed as a resolution by the respective County governing bodies for the purpose of adoption. The resolution included references to the volumes, figures, appendices, and model ordinance. The County resolutions were recorded in the minutes of regular meetings of the Chester, Delaware, Montgomery, and Philadelphia County governing bodies.

Delaware County then submitted to DEP a letter of transmittal and one hard and one digital copy of the adopted plan, the review by each affected municipal planning agency, local governing body, and the County Planning agencies, public hearing notice and minutes, and the resolution of adoption of the plan by each County. The letter of transmittal stated that Delaware County has complied with all procedures outlined in Act 167 and requested that DEP approve the adopted plan.

B. Provisions for Plan Revision

Section 5 of the Storm Water 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 to store it in a central location. This is not only to prepare an updated plan, but also, if required, to make interim runs of the runoff simulation model to analyze the impact of a proposed major development or a proposed major stormwater management facility.

The following recommendations are the minimum requirements to maintain an effective technical position for periodically reviewing and revising the plan.

1. It is recommended that Delaware County Council authorize the County Planning Department in cooperation with the Conservation District to maintain stormwater management plan records and supporting data submitted for review. The Planning Department should also assume responsibility for periodically reviewing, revising, and updating the stormwater management plan.

2. It is recommended that the Delaware County Planning Department 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 Darby-Cobbs watershed but should also include both state and county agencies concerned with stormwater management.

3. It is recommended that the WPAC convene every five years 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 a minimum, the information (to be reviewed by the Committee) will be as follows:

    a. Development activity data as monitored by the County Planning agencies.

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

    c. Zoning and subdivision amendments within the watershed.

    d. Impacts associated with any regional or subregional detention alternatives implemented in 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 Darby-Cobbs watershed.

The WPAC will review the above data and make recommendations to the County for revisions to the Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan. Delaware County will review the recommendations of the WPAC and determine if revisions are to be made. A revised plan would be subject to the same rules of adoption as the original plan. 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. The resolution will then be forwarded to DEP.

SECTION IX

FORMATION OF THE DARBY AND COBBS CREEKS WATERSHED PLAN ADVISORY COMMITTEE

The following is a listing of the meetings held by the WPAC during the preparation and adoption of the detailed watershed stormwater management plan.

WPAC meetings and their purposes were as follows:

Meeting	Date	Purpose
1	11/29/00	Provided an introduction to stormwater management; reviewed Act 167; distributed data collection forms; discussed coordination with other study initiatives; progress report.
2	6/5/01	Watershed characteristics; reviewed coordination with other study initiatives; discussed data collection forms – progress report; reviewed GIS mapping efforts; reviewed infill/redevelopment issues and BMPs; reviewed FGM study; discussed sample Act 167 plan.
3	7/10/03	Progress report – reviewed hydrologic modeling efforts; reviewed groundwater recharge standards and criteria; reviewed Philadelphia Water Department study on Cobbs Creek; reviewed NPDES Phase I criteria and requirements; distributed outfall data collection forms.
4	3/31/04	Reviewed goals of the Darby-Cobbs draft plan; provided an update on Philadelphia Water Department initiatives/coordination; reviewed plan format, standards and criteria, and implementation; NPDES II initiative update; reviewed timeline.
5	9/17/04	Reviewed goals of the Darby-Cobbs draft plan; model ordinance standards and criteria review – draft and final draft, and the history of the changes; NPDES II initiative update; implementation.

SECTION X

REFERENCES

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23. U.S. Army Corps of Engineers, *Special Flood Hazard Report for Darby Creek and Muckinipates Creek, Delaware County* (1977).

24. USDA, Soil Conservation Service (sic Natural Resources Conservation Service), *Soil Survey of Delaware County, PA* (1963) Revised (1972).

25. United States Geological Survey, *Groundwater Resources of Delaware County* (1996).

PLAN APPENDIX 1

MODEL ORDINANCE

PLAN APPENDIX 1

MODEL ORDINANCE

DARBY AND COBBS CREEKS WATERSHED MODEL ACT 167 STORMWATER MANAGEMENT ORDINANCE

OCTOBER 8, 2004

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
Karen Holm, Delaware County Planning Department, at 610-891-5200

[Note: According to DEP requirements, this Model Ordinance must include specific text taken directly from the NPDES II Model Ordinance (effective August 2, 2003). Provisions grayed out in this Model Ordinance are direct language from the NPDES Model Ordinance. This shading is for your information only and should be removed before adopting the Ordinance.]

MUNICIPAL ORDINANCE INTRODUCTION

Municipalities within the Commonwealth of Pennsylvania are 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 "Storm Water Management Act," Act 167, requires that:

- Counties prepare a watershed stormwater management plan in conformance with the requirements of Act 167 for each watershed within their boundaries.
- The plans evaluate present and future runoff within the watershed and make technical recommendations for the control and management of runoff from new development (both quantity and quality).
- Municipalities implement the plan via a stormwater ordinance developed as part of the plan.
- Developers control the quantity and quality of runoff from new development (including redevelopment) in accordance with each municipality's implementing ordinance.

The Storm Water Management Act emphasizes locally administered stormwater programs with the watershed municipalities taking the lead role. Implementation and enforcement of the watershed plan standards and criteria will require the municipalities to adopt the appropriate ordinance provisions that address subdivision and land development. As part of the preparation of the Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan, a model municipal ordinance has been prepared that will implement the plan provisions presented in the ordinance as a single-purpose ordinance that could be adopted by each municipality with minor changes to fulfill the needs of a particular municipality. 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.

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 cross-reference any applicable provisions pertaining to 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 ordinance should be understandable, applied fairly and uniformly throughout the watershed, and not discourage creative solutions to stormwater management problems. It would be desirable for the municipalities to adopt a uniform regulatory approach for the Darby-Cobbs watershed.

The implementation of the runoff control strategy for development will be through municipal adoption of the appropriate ordinance provisions. The "Darby and Cobbs Creeks 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 the Darby-Cobbs watershed are completely within the watershed. For those portions of the municipality outside of the Darby-Cobbs 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's Regulations.

* The Act 167 ordinance contains only those minimum stormwater runoff control standards and criteria that are necessary or desirable from a total watershed perspective. Additional stormwater management design criteria (i.e., inlet spacing, inlet type, collection system details, etc.) that 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 following model ordinance has been developed specifically for municipalities within the Darby-Cobbs watershed in order to implement the Darby-Cobbs Stormwater Management Plan. Municipalities may elect to either create a single-purpose stormwater ordinance (recommended) or amend existing subdivision or zoning ordinances to implement the associated stormwater management plan.

All of the provisions within this model ordinance (unless specifically designated as optional) are required to be part of the municipal stormwater ordinance or other ordinances implementing the requirements of the stormwater management plan.

Organization

This ordinance contains the following eight articles, each with specific provisions.

Article I - General Provisions - This article includes general administrative provisions including applicable land areas and regulated activities. This article also includes the stormwater management exemption criteria.

Article II - Definitions - This article provides a list of common terms and associated definitions used throughout the ordinance.

Article III - Drainage Plan Requirements - This article lists the specific requirements for submittal, content, and review of drainage plans required by the ordinance.

Article IV - Stormwater Management - This article represents the technical provisions for stormwater management within the Darby-Cobbs watershed and includes the stormwater management district implementation provisions, water quality requirements, design criteria, calculation methods, and erosion and sedimentation requirements.

Article V - Inspections - This article describes inspection procedures for permanent stormwater management and water quality facilities.

Article VI - Fees and Expenses - This article contains the provisions for a municipal review fee.

Article VII - Maintenance Responsibilities - This article outlines the Applicants' responsibilities for operation and maintenance of stormwater management facilities.

Article VIII - Prohibitions - This article, required by NPDES Phase II, prohibits the discharge of nonstormwater flows to any municipal separate storm sewer system with the exception of certain activities found not to contribute pollution to surface waters.

Article IX - Enforcement and Penalties - This article describes municipal enforcement procedures, remedies, and the appeals process.

Appendices - This section of the ordinance contains nine technical support appendices necessary to implement the ordinance provisions.

Please note that the plan and associated ordinance provisions were developed under the authority of and in strict conformance with the requirements of Act 167. These documents were prepared in consultation with a WPAC comprised of designated representatives from each of the watershed municipalities, County Planning and Conservation District staff, the Darby Creek Valley Association, and the Chester County Water Resources Authority. Other advisory members invited to serve on the WPAC include PennDOT, the Delco Anglers, as well as a number of others. Proposed ordinance provisions were reviewed and accepted by a majority of the voting members (noted above) who attended the meetings.

Within six months following adoption and approval of a watershed stormwater plan, each municipality is required to adopt or amend stormwater ordinances as laid out in the plan. These ordinances must regulate development within the municipality in a manner consistent with the watershed stormwater plan and the 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 Darby-Cobbs 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 developments in the Municipality.

For municipalities without an occupancy permit, they may want to adopt the above draft and include other regulatory items in the occupancy permit requirement for their own 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 - Drainage Plan Requirements – Section 302
- Article IV - Design Criteria for Stormwater Management Facilities – Sections 401, 402, 403, 404, 405, 406, 407, 408 (except G, H, and I), 409, 410
- Article V - Inspections (language may be modified by the municipality)
- Article VII - Maintenance Responsibilities (language may be modified by the municipality)
- Article VIII - Prohibitions
- Article IX - Enforcement and Penalties (only when enacting a single-purpose ordinance)

The following ordinance provisions are optional, but recommended to be retained:

- Section 408 - G-I
- Section 709 - Municipal Stormwater Control and BMP Operation and Maintenance Fund
- Article VI - Fees and Expenses

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.

NPDES Requirements

Federal regulations approved October 1999 require operators of small municipal separate storm sewer systems (MS4s) to obtain NPDES Phase II permits from DEP by March 2003. (NPDES II is an acronym for the National Pollutant Discharge Elimination System Phase II Stormwater Permitting Regulations.) This program affects all municipalities in "urbanized areas" of the state. This definition applies to all Darby-Cobbs watershed municipalities. Therefore, all municipalities within the Darby-Cobbs watershed will be subject to the NPDES Phase II requirements mandated by the federal Clean Water Act as administered by DEP. For more information on NPDES II requirements, contact the DEP Regional Office.

Implementation

In order to aid the municipalities and developers in the implementation process, flow charts have been developed as shown in ordinance Appendix D.

Administration

Due to differences in administration of the building permit process in Philadelphia County, the applicability requirements for the Philadelphia portion of the watershed will be based upon earth disturbance as opposed to the amount of proposed impervious area. Table 105.1A summarizes the applicability requirements for the municipalities in Delaware, Chester, and Montgomery Counties. Table 105.1B summarizes the applicability requirements for the City of Philadelphia.

DARBY AND COBBS CREEKS WATERSHED STORMWATER MANAGEMENT ORDINANCE

Implementing the requirements of the Darby and Cobbs Creeks Stormwater Management Plan

ORDINANCE NO.________ OF __________

_[*Municipality*], __[*County*] _ COUNTY,

PENNSYLVANIA

Adopted at a Public Meeting held on

_________________, 20__

TABLE OF CONTENTS

ARTICLE I- GENERAL PROVISIONS

Section 101. Short Title

This Ordinance shall be known as the “Darby and Cobbs Creeks Watershed Stormwater Management Ordinance” and may sometimes be cited as the Darby-Cobbs Stormwater Management Ordinance.

Section 102. 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. Inadequate planning and management of stormwater runoff resulting from land development throughout a watershed can also harm surface water resources by changing the natural hydrologic patterns, accelerating stream flows (which increase scour and erosion of stream beds and stream banks, thereby elevating sedimentation), destroying aquatic habitat, and elevating aquatic pollutant concentrations and loadings such as sediments, nutrients, heavy metals, and pathogens. Groundwater resources are also impacted through loss of recharge.

C. A comprehensive program of stormwater management, including minimization of impacts of development, redevelopment, and activities causing accelerated erosion and loss of natural infiltration, is fundamental to the public health, safety, welfare, and the protection of the people of the Municipality and all of the people of the Commonwealth, their resources, and the environment.

D. Stormwater can be an important water resource by providing groundwater recharge for water supplies and baseflow of streams, which also protects and maintains surface water quality.

E. Impacts from stormwater runoff can be minimized by using project designs that maintain the natural hydrologic regime and sustain high water quality, groundwater recharge, stream baseflow, and aquatic ecosystems. The most cost-effective and environmentally advantageous way to manage stormwater runoff is through nonstructural project design that minimizes impervious surfaces and sprawl, avoids sensitive areas (i.e., stream buffers, floodplains, steep slopes), and considers topography and soils to maintain the natural hydrologic regime.

F. Public education on the control of pollution from stormwater is an essential component in successfully addressing stormwater.

G. Federal and state regulations require certain municipalities to implement a program of stormwater controls. These municipalities are required to obtain a permit for stormwater discharges from their separate storm sewer systems under the National Pollutant Discharge Elimination System (NPDES).

H. Nonstormwater discharges to municipal separate storm sewer systems can contribute to pollution of waters of the Commonwealth by the Municipality.

Section 103. Purpose

The purpose of this Ordinance is to promote the public health, safety, and welfare within the Darby and Cobbs Creeks watershed by maintaining the natural hydrologic regime and minimizing the impacts described in Section 102 of this Ordinance through provisions designed to:

A. Promote alternative project designs and layouts that minimize the impacts on surface and groundwater.

B. Promote nonstructural best management practices (BMPs).

C. Minimize increases in stormwater runoff volume.

D. Minimize impervious surfaces.

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

F. Provide review procedures and performance standards for stormwater planning and management.

G. Utilize and preserve existing natural drainage systems as much as possible.

H. Manage stormwater impacts close to the runoff source, requiring a minimum of structures and relying on natural processes.

I. Focus on infiltration of stormwater to maintain groundwater recharge, to prevent degradation of surface and groundwater quality, and to otherwise protect water resources.

J. Maintain existing baseflows and quality of streams and watercourses, where possible.

K. Meet legal water quality requirements under state law, including regulations at 25 Pennsylvania Code Chapter 93.4.a requiring protection and maintenance of “existing uses” and maintenance of the level of water quality to support those uses in all streams, and the protection and maintenance of water quality in “special protection” streams.

L. Address the quality and quantity of stormwater discharges from the development site.

M. Provide a mechanism to identify stormwater controls necessary to meet NPDES permit requirements.

N. Implement an illegal discharge detection and elimination program that addresses nonstormwater discharges into the Municipality’s separate storm sewer system.

O. Preserve the flood-carrying capacity of streams.

P. Prevent scour and erosion of stream banks and stream beds.

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

R. Provide proper operation and maintenance of all permanent stormwater management facilities and BMPs that are implemented in the Municipality.

Section 104. Statutory Authority

The Municipality is empowered to regulate land use activities that affect runoff and surface and groundwater quality and quantity by the authority of:

A. Act of October 4, 1978, 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq., as amended, the “Storm Water Management Act” (hereinafter referred to as “the Act”);

B. Water Resources Management Act of 2002, as amended;

C. Second Class Township Code, 53 P.S. Sections 66501 et seq., 66601 et seq., and the Borough Code, 53 P.S. Section 46201 et seq.;

D. Pennsylvania Municipalities Planning Code, Act 247, as amended.

Section 105. Applicability/Regulated Activities

This Ordinance shall apply to those areas of the Municipality that are located within the Darby-Cobbs watershed, as delineated in Appendix A, which is hereby adopted as part of this Ordinance.

This Ordinance shall only apply to permanent structural and nonstructural stormwater management BMPs constructed as part of any of the regulated activities listed in this section.

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 and applicable state regulations.

The following activities are defined as "regulated activities" and shall be regulated by this Ordinance unless exempted by Section 106:

A. Land development,
B. Subdivisions,
C. Alteration of the natural hydrologic regime,
D. Construction or reconstruction of or addition of new impervious or semi-pervious surfaces (i.e., driveways, parking lots, roads, etc.),
E. Construction of new buildings or additions to existing buildings,
F. Redevelopment,
G. Diversion piping or encroachments in any natural or man-made channel,
H. Nonstructural and structural stormwater management BMPs or appurtenances thereto,
I. Earth disturbance activities of greater than five thousand (5,000) square feet,[1]
J. Any of the above regulated activities which were approved more than five (5) years prior to the effective date of this Ordinance and resubmitted for municipal approval.

[1] This Ordinance applies to any earth disturbance activity greater than or equal to five thousand (5,000) square feet that is associated with a development or redevelopment project. Earth disturbance activities of less than one (1) acre that are associated with redevelopment projects are exempt from the Section 407 stream bank erosion requirements. Earth disturbance activities and associated stormwater management controls are also regulated under existing state law and implementing regulations. This Ordinance shall operate in coordination with those parallel requirements; the requirements of this Ordinance shall be no less restrictive in meeting the purposes of this Ordinance than state law.

Table 105.1A summarizes the applicability requirements for the municipalities in Delaware, Chester, and Montgomery Counties. "Proposed Impervious Surface" in Table 105.1A includes new, additional, or replacement impervious surface/cover. Repaving existing surfaces without reconstruction does not constitute "replacement."

TABLE 105.1A

ORDINANCE APPLICABILITY FOR THE DELAWARE, CHESTER, AND MONTGOMERY COUNTY PORTIONS OF THE WATERSHED

Ordinance Article or Section	Type of Project	Proposed Impervious Surface				Earth Disturbance	
		0-2,000 sq. ft.	**2,000-5,000 sq. ft.**	**5,000 sq. ft.- 1 acre**	**> 1 acre**	**5,000 sq. ft. –1 acre**	**> 1 acre**
Article III Drainage Plan Requirements	Development	N/A	Modified	Yes	Yes	Modified	Yes
	Redevelopment	N/A	Modified	Yes	Yes	Modified	Yes
Section 404 Nonstructural Project Design	Development	N/A	Yes	Yes	Yes	Yes	Yes
	Redevelopment	N/A	Yes	Yes	Yes	Yes	Yes
Section 405 Groundwater Recharge	Development	N/A	Yes	Yes	Yes	N/A	Yes
	Redevelopment	N/A	Yes	Yes	Yes	N/A	Yes
Section 406 Water Quality Requirements	Development	N/A	Yes	Yes	Yes	N/A	Yes
	Redevelopment	N/A	Yes	Yes	Yes	N/A	Yes
Section 407 Stream Bank Erosion Requirements	Development	N/A	Exempt	Yes	Yes	N/A	Yes
	Redevelopment	N/A	Exempt	Exempt	Yes	N/A	Yes
Section 408 Stormwater Peak Rate Control and Management Districts	Development	N/A	Exempt	Yes	Yes	Yes	Yes
	Redevelopment	N/A	Exempt	Yes	Yes	Yes	Yes
Erosion and Sediment Pollution Control Plan Submission to the Conservation District	Earth Disturbance	See Earth Disturbance Requirements	See Earth Disturbance Requirements	See Earth Disturbance Requirements	See Earth Disturbance Requirements	Yes	Yes
		(Refer to municipal earth disturbance requirements, as applicable)					

Legend:
Yes - Drainage plan required with associated section provision.
N/A - Not applicable – exempt from drainage plan submission.
Exempt - Exempt from required section provision – Drainage plan submission may still be required if other section provisions are applicable (yes in box).
Modified - Modified drainage plan required

- Sites with less than two thousand (2,000) square feet of impervious surface but between five thousand (5,000) square feet and one (1) acre of earth disturbance must submit a drainage plan to the Municipality which need only consist of the items in Sections 302.A.2 and 4; 302.B.7, 8, 11, and 22; and 302.D.1 and 3 and related supportive material needed to determine compliance with Sections 404 and 408.
- Sites with more than two thousand (2,000) square feet but less than five thousand (5,000) square feet of impervious surface must submit a drainage plan; however, it need not consist of the items in Sections 407 and 408.

Due to differences in administration of the building permit process in Philadelphia County, the applicability requirements for the Philadelphia portion of the watershed will be based upon earth disturbance as opposed to the amount of proposed impervious area. Table 105.1B summarizes the applicability requirements for Philadelphia County.

TABLE 105.1B

ORDINANCE APPLICABILITY FOR THE PHILADELPHIA COUNTY PORTION OF THE WATERSHED

Ordinance Article or Section	Type of Project	Earth Disturbance Associated with Development		
		0-5,000 sq.ft.	5,000 sq.ft.-1 acre	> 1 acre
Article III Drainage Plan Requirements	Development	N/A	Yes	Yes
	Redevelopment	N/A	Yes	Yes
Section 404 Nonstructural Project Design	Development	N/A	Yes	Yes
	Redevelopment	N/A	Yes	Yes
Section 405 Groundwater Recharge	Development	N/A	Yes	Yes
	Redevelopment	N/A	Yes	Yes
Section 406 Water Quality Requirements	Development	N/A	Yes	Yes
	Redevelopment	N/A	Yes	Yes
Section 407 Stream Bank Erosion Requirements	Development	N/A	Yes	Yes
	Redevelopment	N/A	Exempt	Yes
Section 408 Stormwater Peak Rate Control and Management Districts	Development	N/A	Yes	Yes
	Redevelopment	N/A	Yes (Alternate Criteria - Section 408J)	Yes (Alternate Criteria - Section 408J)

Legend:
Yes – Drainage plan required with required section provision.
N/A – Not applicable – exempt from drainage plan submission.
Exempt – Exempt from required section provision – Drainage plan submission may still be required if other section provisions are applicable (yes in box).

Section 106. Exemptions

A. Exemptions for Land Use Activities

The following land use activities are exempt from the drainage plan submission requirements of this Ordinance.

1. Use of land for gardening for home consumption.

2. Agriculture when operated in accordance with a conservation plan, nutrient management plan, or erosion and sedimentation control plan approved by the County Conservation District, including activities such as growing crops, rotating crops, tilling of soil, and grazing animals. Installation of new or expansion of existing farmsteads, animal housing, waste storage, and production areas having impervious surfaces that result in a net increase in earth disturbance of greater than five thousand (5,000) square feet shall be subject to the provisions of this Ordinance.

3. Forest management operations which are following the Department of Environmental Protection's (DEP) management practices contained in its publication *Soil Erosion and Sedimentation Control Guidelines for Forestry* and are operating under an approved erosion and sedimentation plan must comply with the stream buffer requirements in Section 406.G.

4. Road replacement, development, or redevelopment that has less than two thousand (2,000) square feet of new, additional, or replaced impervious surface/cover, or in the case of earth disturbance only, less than five thousand (5,000) square feet of disturbance, is exempt from this Ordinance.

B. Exemptions for Land Development Activities

The following land development and earthmoving activities are exempt from the drainage plan submission requirements of this Ordinance.

1. A maximum of two thousand (2,000) square feet of new, additional, or replacement proposed impervious surface.

    Or in the case of earth disturbance resulting in less than two thousand (2,000) square feet of impervious cover (as noted above) [*]

2. Up to a maximum of five thousand (5,000) square feet of disturbed earth.

These criteria shall apply to the total development even if the 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" upon which future subdivisions and respective earth disturbance computations shall be cumulatively considered.

The activities exempted above are still encouraged to implement the voluntary stormwater management practices as indicated in Ordinance Appendix B.

*** The following is optional. Please see box below.**

The developer should first determine if the proposed activity will result in the introduction of two thousand (2,000) square feet or more of new, additional, or replacement impervious surface. If not, the developer should next determine if the proposed activity will involve earthmoving of over five thousand (5,000) square feet. If not, then the project is exempt from the drainage plan requirements. Examples:

1. A project introducing twenty-one hundred (2,100) square feet of impervious cover, but only forty-nine hundred (4,900) square feet of earthmoving is regulated by this Ordinance.

2. A project involving fifty-one hundred (5,100) square feet of earthmoving, but resulting in nineteen hundred (1,900) square feet of impervious cover is regulated.

3. A project introducing nineteen hundred (1,900) square feet of impervious cover and involving forty-nine hundred (4,900) square feet of earthmoving is exempt from the drainage plan requirements of this Ordinance.

C. Additional Exemption Criteria

1. Exemption Responsibilities - An exemption shall not relieve the Applicant from implementing such measures as are necessary to protect public health, safety, and property.

2. HQ and EV Streams - An exemption shall not relieve the Applicant from meeting the special requirements for watersheds draining to identified high quality (HQ) or exceptional value (EV) waters and source water protection areas (SWPA) and requirements for nonstructural project design sequencing (Section 404).

3. Drainage Problems - If a drainage problem is documented or known to exist downstream of or is expected from the proposed activity, then the Municipality may require the Applicant to comply with this Ordinance.

4. Emergency Exemption - Emergency maintenance work performed for the protection of public health, safety, and welfare. A written description of the scope and extent of any emergency work performed shall be submitted to the [*Municipality*] within two (2) calendar days of the commencement of the activity. If the [*Municipality*] finds that the work is not an emergency, then the work shall cease immediately, and the requirements of this Ordinance shall be addressed as applicable.

5. Maintenance Exemption - Any maintenance to an existing stormwater management system made in accordance with plans and specifications approved by the municipal Engineer or [*Municipality*].

6. Even though the developer is exempt, he is not relieved from complying with other regulations.

Section 107. 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 108. 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 109. Compatibility with Other Ordinances or Legal 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.

To the extent that this Ordinance imposes more rigorous or stringent requirements for stormwater management, the specific requirements contained in this Ordinance shall be followed.

Nothing in this Ordinance shall be construed to affect any of the Municipality's requirements regarding stormwater matters that do not conflict with the provisions of this Ordinance, such as local stormwater management design criteria (e.g., inlet spacing, inlet type, collection system design and details, outlet structure design, etc.). Conflicting provisions in other municipal ordinances or regulations shall be construed to retain the requirements of this Ordinance addressing state water quality requirements.

ARTICLE II-DEFINITIONS

Section 201. Interpretation

For the purposes of this Ordinance, 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, unit of government, 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.”

Section 202. Definitions

Accelerated Erosion – The removal of the surface of the land through the combined action of man’s activity and the natural processes at 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, mushroom growing, nursery, and sod operations 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 person who has filed an application for approval to engage in any regulated activity defined in Section 105 of this Ordinance.

As-built Drawings – Engineering or site drawings maintained by the contractor as he constructs the project and upon which he documents the actual locations of the building components and changes to the original contract documents. These documents, or a copy of same, are turned over to the municipal Engineer at the completion of the project.

Bankfull – The channel at the top-of-bank or point from where water begins to overflow onto a floodplain.

Baseflow – Portion of stream discharge derived from groundwater; the sustained discharge that does not result from direct runoff or from water diversions, reservoir releases, piped discharges, or other human activities.

Bioretention – A stormwater retention area that utilizes woody and herbaceous plants and soils to remove pollutants before infiltration occurs.

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

Buffer – The area of land immediately adjacent to any stream, measured perpendicular to and horizontally from the top-of-bank on both sides of a stream (see Top-of-bank).

Channel – An open drainage feature through which stormwater flows. Channels include, but shall not be limited to, natural and man-made drainageways, swales, streams, ditches, canals, and pipes flowing partly full.

Channel Erosion – The widening, deepening, or headward cutting of channels and waterways caused by stormwater runoff or bankfull flows.

Cistern – An underground reservoir or tank for storing rainwater.

Conservation District – The [*County Name*] County Conservation District.

Conveyance – A facility or structure used for the transportation or transmission of something from one place to another.

Culvert – A structure with its appurtenant works which carries water under or through an embankment or fill.

Dam – A man-made barrier, together with its appurtenant works, constructed for the purpose of impounding or storing water or another fluid or semifluid. A dam may include a refuse bank, fill, or structure for a highway, railroad, or other purposes which impounds or may impound water or another fluid or semifluid.

Department – The Pennsylvania Department of Environmental Protection.

Design Professional (Qualified) – A Pennsylvania Registered Professional Engineer, Registered Landscape Architect, or Registered Professional Land Surveyor trained to develop stormwater management plans.

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., twenty-four (24) hours), used in the design and evaluation of stormwater management systems.

Designee – The agent of the [*County Name*] County Planning [*Commission or Department*], [*County Name*] County Conservation District, 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 designed to collect and retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate. Detention basins are designed to drain completely soon after a rainfall event and become dry until the next rainfall event.

Developer – A person who seeks to undertake any regulated earth disturbance activities at a project site in the Municipality.

Development – Any human-induced change to improved or unimproved real estate, whether public or private, including, but not limited to, land development, construction, installation, or expansion of a building or other structure, land division, street construction, drilling, and site alteration such as embankments, dredging, grubbing, grading, paving, parking or storage facilities, excavation, filling, stockpiling, or clearing. As used in this Ordinance, development encompasses both new development and redevelopment.

Development Site – The specific tract or parcel of land where any regulated activity set forth in Section 105 is planned, conducted, or maintained.

Diameter at Breast Height (DBH) **–** The outside bark diameter at breast height which is defined as four and one half (4.5) feet (1.37m) above the forest floor on the uphill side of the tree.

Diffused Drainage Discharge – Drainage discharge that is not confined to a single point location or channel, including sheet flow or shallow concentrated flow.

Discharge – 1. (verb) To release water from a project, site, aquifer, drainage basin, or other point of interest. 2. (noun) The rate and volume of flow of water such as in a stream, generally expressed in cubic feet per second (see Peak Discharge).

Discharge Point – The point of discharge for a stormwater facility.

Disturbed Areas – Unstabilized land area where an earth disturbance activity is occurring or has occurred.

Ditch – A man-made waterway constructed for irrigation or stormwater conveyance purposes.

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

Drainage Conveyance Facility – A stormwater management facility designed to transport stormwater runoff that includes channels, swales, pipes, conduits, culverts, and storm sewers.

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 Municipality after the drainage plan has been approved.

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 302.

Earth Disturbance Activity – A construction or other human activity which disturbs the surface of land including, but not limited to, clearing and grubbing, grading, excavations, embankments, land development, agricultural plowing or tilling, timber harvesting activities, road maintenance activities, mineral extraction, and the moving, depositing, stockpiling, or storing of soil, rock, or earth materials.

Emergency Spillway – A conveyance area that is used to pass peak discharge greater than that of the maximum design storm controlled by the stormwater facility.

Encroachment – A structure or activity that changes, expands, or diminishes the course, current, or cross-section of a watercourse, floodway, or body of water.

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

Erosion and Sediment Control Plan – A plan that is designed to minimize accelerated erosion and sedimentation. Said plan must be submitted to and approved by the appropriate Conservation District before construction can begin.

Exceptional Value Waters – Surface waters of high quality which satisfy Pennsylvania Code Title 25 Environmental Protection, Chapter 93, Water Quality Standards, §93.4b(b) (relating to anti-degradation).

Existing Conditions – The initial condition of a project site prior to the proposed alteration. 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 a lower curve number or Rational "C" value, such as forested lands.

Flood – A temporary condition of partial or complete inundation of 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 as delineated by the applicable Department of Housing and Urban Development, Federal Insurance Administration Flood Hazard Boundary Map as being a special flood hazard area.

Floodway – The channel of a 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 the Federal Emergency Management Agency (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 fifty (50) feet from the top-of-bank.

Fluvial Geomorphology – The study of landforms associated with river channels and the processes that form them.

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

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

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

Grassed Waterway – A natural or man-made waterway, usually broad and shallow, covered with erosion-resistant grasses used to convey surface water.

Groundwater – Water beneath the earth's surface that supplies wells and springs and is often between saturated soil and rock.

Groundwater Recharge – The replenishment of existing natural underground water supplies from rain or overland flow.

HEC-HMS – The U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC) - Hydrologic Modeling System (HMS). This model was used to model the Darby and Cobbs Creek watershed during the Act 167 plan development and was the basis for the standards and criteria of this Ordinance.

High Quality Waters – Surface waters having quality which exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water by satisfying Pennsylvania Code Title 25 Environmental Protection, Chapter 93, Water Quality Standards, § 93.4b(a).

Hotspots – Areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater.

Hydrograph – A graph representing the discharge of water versus time for a selected point in the drainage system.

Hydrologic Regime – The hydrologic cycle or balance that sustains quality and quantity of stormwater, baseflow, storage, and groundwater supplies under natural conditions.

Hydrologic Soil Group – A classification of soils by the Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service (SCS), 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.

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

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

Infill – Development that occurs on smaller parcels that remain undeveloped but are within or in very close proximity to urban or densely developed areas. Infill development usually relies on existing infrastructure and does not require an extension of water, sewer, or other public utilities.

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

Infiltration Structures – A structure designed to direct runoff into the underground water (e.g., French drains, seepage pits, or seepage trenches).

Inflow – The flow entering the stormwater management facility and/or BMP.

Inlet – The upstream end of any structure through which water may flow.

Intermittent Stream – A stream that flows only part of the time. Flow generally occurs for several weeks or months in response to seasonal precipitation or groundwater discharge.

Invert – The lowest surface, the floor or bottom of a culvert, drain, sewer, channel, basin, BMP, or orifice.

Land Development – Any of the following activities:

(i) The improvement of one (1) lot or two (2) or more contiguous lots, tracts, or parcels of land for any purpose involving:
   a. A group of two (2) or more residential or nonresidential buildings, whether proposed initially or cumulatively, or a single nonresidential building on a lot or lots regardless of the number of occupants or tenure, or
   b. The division or allocation of land or space, whether initially or cumulatively, between or among two (2) 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) A subdivision of land;

(iii) Development in accordance with Section 503(1.1) of the PA Municipalities Planning Code.

Limiting Zone – A soil horizon or condition in the soil profile or underlying strata that includes one of the following:

(i) A seasonal high water table, whether perched or regional, determined by direct observation of the water table or indicated by soil mottling.

(ii) A rock with open joints, fracture or solution channels, or masses of loose rock fragments, including gravel, with insufficient fine soil to fill the voids between the fragments.

(iii) A rock formation, other stratum, or soil condition that is so slowly permeable that it effectively limits downward passage of water.

Lot – A designated parcel, tract, or area of land established by a plat or otherwise as permitted by law and to be used, developed, or built upon as a unit.

Main Stem (Main Channel) – Any stream segment or other runoff conveyance used as a reach in the Darby and Cobbs Creek hydrologic model.

Manning Equation (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.

Maximum Design Storm – The maximum (largest) design storm that is controlled by the stormwater facility.

Municipal Engineer – A professional engineer licensed as such in the Commonwealth of Pennsylvania, duly appointed as the Engineer for a Municipality, planning agency, or joint planning commission.

Municipality – [*Municipal Name*], [*County Name*] County, Pennsylvania.

Natural Condition – Pre-development condition.

Natural Hydrologic Regime – See Hydrologic Regime.

Natural Recharge Area – Undisturbed surface area or depression where stormwater collects and a portion of which infiltrates and replenishes the underground and groundwater.

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

Nonstormwater Discharges – Water flowing in stormwater collection facilities, such as pipes or swales, which is not the result of a rainfall event or snowmelt.

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

NPDES – National Pollutant Discharge Elimination System, the federal government’s system for issuance of permits under the Clean Water Act, which is delegated to DEP in Pennsylvania.

NRCS – Natural Resources Conservation Service (previously SCS).

Open Channel – A conveyance channel that is not enclosed.

Outfall – “Point source” as described in 40 CFR § 122.2 at the point where the Municipality’s storm sewer system discharges to surface waters of the Commonwealth.

Outflow – The flow exiting the stormwater management facility and/or BMP.

Outlet – Points of water disposal to a stream, river, lake, tidewater, or artificial drain.

Parent Tract – The parcel of land from which a land development or subdivision originates, determined from the date of municipal adoption of this Ordinance.

Parking Lot Storage – Involves the use of 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 – The computer-based hydrologic model developed at Pennsylvania State University.

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

Planning Commission – The Planning Commission of [*Municipal Name*].

Point Source – Any discernible, confined, and discrete conveyance including, but not limited to, any pipe, ditch, channel, tunnel, or conduit from which stormwater is or may be discharged, as defined in state regulations at 25 Pennsylvania Code § 92.1.

Post-construction – Period after construction during which disturbed areas are stabilized, stormwater controls are in place and functioning, and all proposed improvements in the approved land development plan are completed.

Pre-construction – Prior to commencing construction activities.

Pre-development Condition – Undeveloped/natural condition.

Pretreatment – Techniques employed in stormwater BMPs to provide storage or filtering to trap coarse materials and other pollutants before they enter the system, but not necessarily designed to meet the water quality volume requirements of Section 406.

Project Site – The specific area of land where any regulated activities in the Municipality are planned, conducted, or maintained.

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

Reach – Any stream segment or other runoff conveyance used in the Darby and Cobbs Creek hydrologic model.

Recharge – The replenishment of groundwater through the infiltration of rainfall, other surface waters, or land application of water or treated wastewater.

Reconstruction – Demolition and subsequent rebuilding of impervious surfaces.

Record Drawings – Original documents revised to suit the as-built conditions and subsequently provided by the Engineer to the client. The Engineer reviews the contractor's as-builts against his/her own records for completeness, then either turns these over to the client or transfers the information to a set of reproducibles, in both cases for the client's permanent records.

Redevelopment – Any development that requires demolition or removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces. Maintenance activities such as top-layer grinding and repaving are not considered to be redevelopment. Interior remodeling projects and tenant improvements are also not considered to be redevelopment.

Regulated Activities – Actions or proposed actions that have an impact on stormwater runoff quality or quantity and that are specified in Section 105 of this Ordinance.

Regulated Earth Disturbance Activity – Defined under NPDES Phase II regulations as earth disturbance activity of one (1) acre or more with a point source discharge to surface waters or the Municipality's storm sewer system or five (5) acres or more regardless of the planned runoff. This includes earth disturbance on any portion of, part, or during any stage of a larger common plan of development.

Release Rate – The percentage of existing conditions peak rate of runoff from a site or subarea to which the proposed conditions peak rate of runoff must be reduced to protect downstream areas.

Repaving – Replacement of the impervious surface that does not involve reconstruction of an existing paved (impervious) surface.

Replacement Paving – Reconstruction of and full replacement of an existing paved (impervious) surface.

Retention Basin – A structure in which stormwater is stored and not released during the storm event. Retention basins are designed for infiltration purposes and do not have an outlet. The retention basin must infiltrate stored water in four (4) days or less.

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 (25) 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.

Road Maintenance – Earth disturbance activities within the existing road cross-section, such as grading and repairing existing unpaved road surfaces, cutting road banks, cleaning or clearing drainage ditches, and other similar activities.

Roof Drains – A drainage conduit or pipe that collects water runoff from a roof and leads it away from the structure.

Rooftop Detention – The temporary ponding and gradual release of stormwater falling directly onto flat roof surfaces using controlled-flow roof drains in building designs.

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

SALDO – Subdivision and land development ordinance.

Sediment Basin – A barrier, dam, or retention or detention basin located and designed in such a way as to retain rock, sand, gravel, silt, or other material transported by water during construction.

Sediment Pollution – The placement, discharge, or any other introduction of sediment into the waters of the Commonwealth.

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

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 underground water.

Separate Storm Sewer System – A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) primarily used for collecting and conveying stormwater runoff.

Shallow Concentrated Flow – Stormwater runoff flowing in shallow, defined ruts prior to entering a defined channel or waterway.

Sheet Flow – A flow process associated with broad, shallow water movement on sloping ground surfaces that is not channelized or concentrated.

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

Source Water Protection Areas (SWPA) – The zone through which contaminants, if present, are likely to migrate and reach a drinking water well or surface water intake.

Special Protection Subwatersheds – Watersheds that have been designated by DEP as EV or HQ waters.

Spillway – A conveyance that is used to pass the peak discharge of the maximum design storm that is controlled by the stormwater facility.

State Water Quality Requirements – As defined under state regulations -- protection of *designated* and *existing* uses (see 25 Pennsylvania Code Chapters 93 and 96)--including:

A. Each stream segment in Pennsylvania has a "designated use," such as "cold water fishery" or "potable water supply," which is listed in Chapter 93. These uses must be protected and maintained under state regulations.

B. "Existing uses" are those attained as of November 1975, regardless of whether they have been designated in Chapter 93. Regulated earth disturbance activities must be designed to protect and maintain existing uses and maintain the level of water quality necessary to protect those uses in all streams and to protect and maintain water quality in special protection streams.

C. Water quality involves the chemical, biological, and physical characteristics of surface water bodies. After regulated earth disturbance activities are complete, these characteristics can be impacted by the addition of pollutants such as sediment and changes in habitat through increased flow volumes and/or rates as a result of changes in land surface area from those activities. Therefore, permanent discharges to surface waters must be managed to protect the stream bank, stream bed, and structural integrity of the waterway to prevent these impacts.

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 conveys intercepted runoff and stormwater from other sources but excludes domestic sewage and industrial wastes.

Stormwater – The surface runoff generated by precipitation reaching the ground surface.

Stormwater Management District – Those subareas of a watershed in which some type of detention is required to meet the plan requirements and the goals of Act 167.

Stormwater Management Facility – Any structure, natural or man-made, that, due to its condition, design, or construction, conveys, stores, or otherwise affects stormwater runoff quality, rate, or quantity. 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 watershed plan, known as the "Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan," for managing those land use activities that will influence stormwater runoff quality and quantity and that would impact the Darby and Cobbs Creeks watershed adopted by Delaware County, Chester

County, Montgomery County, and Philadelphia County as required by the Act of October 4, 1978, P.L. 864 (Act 167).

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

Stream – A natural watercourse.

Stream Buffer – The land area adjacent to each side of a stream essential to maintaining water quality (see Buffer).

Stream Enclosure – A bridge, culvert, or other structure in excess of one hundred (100) feet in length upstream to downstream which encloses a regulated water of the Commonwealth.

Subarea (Subwatershed) – The smallest drainage unit of a watershed for which stormwater management criteria have been established in the stormwater management plan.

Subdivision – The division or redivision of a lot, tract, or parcel of land by any means into two (2) 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, partition by the court for distribution to heirs or devisees, 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 (10) acres not involving any new street or easement of access or any residential dwelling shall be exempted.

Surface 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 waters, or parts thereof, whether natural or artificial, within or on the boundaries of the Commonwealth.

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

Timber Operations – See Forest Management.

Time-of-concentration (Tc) – The time required 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.

Top-of-bank – Highest point of elevation in a stream channel cross-section at which a rising water level just begins to flow out of the channel and over the floodplain.

Undeveloped Condition – Natural condition (see also Pre-development Condition).

Vernal Pond – Seasonal depressional wetlands that are covered by shallow water for variable periods from winter to spring but may be completely dry for most of the summer and fall.

Watercourse – A channel or conveyance of surface water having a defined bed and banks, whether natural or artificial, with perennial or intermittent flow.

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 the Commonwealth.

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

Wellhead – 1. A structure built over a well. 2. The source of water for a well.

Wellhead Protection Area – The surface and subsurface area surrounding a water supply well, well field, or spring supplying a public water system through which contaminants are reasonably likely to move toward and reach the water source.

Wet Basin – Pond for urban runoff management that is designed to detain urban runoff and always contains water.

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

Woods – A natural groundcover with more than one (1) viable tree of a DBH of six (6) inches or greater per fifteen hundred (1,500) square feet which existed within three (3) years of application; a cover condition for which SCS curve numbers have been assigned or to which equivalent Rational Method runoff coefficients have been assigned.

ARTICLE III-DRAINAGE PLAN REQUIREMENTS

Section 301. 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 earth disturbance activity may not proceed until the Property Owner or Applicant or his/her agent has received written approval of a drainage plan from the Municipality and an adequate erosion and sediment control plan review by the Conservation District.

Section 302. Drainage Plan Contents

The drainage plan shall consist of a general description of the project including sequencing items described in Section 404, calculations, maps, and plans. A note on the maps shall refer to the associated computations and erosion and sediment control plan by title and date. The cover sheet of the computations and erosion and sediment 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 not be accepted for review and shall be returned to the Applicant.

The following items shall be included in the drainage plan:

A. General

1. General description of the project including those areas described in Section 404.B.
2. General description of proposed 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.
4. An erosion and sediment control plan, including all reviews and letters of adequacy from the Conservation District.
5. A general description of proposed nonpoint source pollution controls.
6. The Drainage Plan Application and completed fee schedule form and associated fee (Ordinance Appendix C-1).
7. The Drainage Plan Checklist (Appendix C-2).

B. Maps

Map(s) of the project area shall be submitted on 24-inch x 36-inch sheets and/or shall be prepared in a form that meets the requirements for recording at the office of the Recorder of Deeds of [*County Name*] County. If the SALDO has more stringent criteria than this Ordinance, then the more stringent criteria shall apply. The contents of the map(s) shall include, but not be limited to:

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

2. Existing contours at intervals of two (2) feet. In areas of slopes greater than [___] percent, 5-foot contour intervals may be used.

3. Existing streams, lakes, ponds, or other waters of the Commonwealth within the project area.

4. Other physical features including flood hazard boundaries, stream buffers, 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 fifty (50) feet of property lines.

6. An overlay showing soil names and boundaries.

7. Limits of earth disturbance, 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 of two (2) feet. In areas of steep slopes (greater than [___] percent), 5-foot 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. Location of all open channels.

18. Overland drainage patterns and swales.

19. A 15-foot wide access easement around all stormwater management facilities that would provide ingress to and egress from a public right-of-way.

20. The location of all erosion and sediment control facilities.

21. 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.

22. A statement, signed by the Applicant, acknowledging that any revision to the approved drainage plan must be approved by the Municipality, and that a revised erosion and sediment control plan must be submitted to the Conservation District for a determination of adequacy.

23. The following signature block for the Design Engineer:

    "I, (Design Engineer), on this date (date of signature), hereby certify that the drainage plan meets all design standards and criteria of the Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Ordinance."

C. Supplemental Information to be Submitted to the Municipality

1. A written description of the following information shall be submitted by the Applicant and shall include:

    a. The overall stormwater management concept for the project designed in accordance with Section 404.
    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.
    e. Development stages or project phases, if so proposed.

f. An operation and maintenance plan in accordance with Section 702 of this Ordinance.

2. An erosion and sediment control plan.

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

4. A Declaration of Adequacy and Highway Occupancy Permit from the Pennsylvania Department of Transportation (PennDOT) District office when utilization of a PennDOT 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 infiltration measures 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 303. Plan Submission

The Municipality shall require receipt of a complete drainage plan, as specified in this Ordinance.

A. Proof of application or documentation of required permit(s) or approvals for the programs listed below shall be part of the plan:

1. NPDES Permit for Stormwater Discharges from Construction Activities

2. DEP Joint Permit Application

3. PennDOT Highway Occupancy Permit

4. Chapter 105 (Dam Safety and Waterway Management)

5. Chapter 106 (Floodplain Management)

6. Any other permit under applicable state or federal regulations

B. The plan shall be coordinated with the state and federal permit process and the municipal SALDO review process. The process implementing the provisions in this Ordinance is illustrated in Appendix D.

C. For projects that require SALDO approval, the drainage plan shall be submitted by the Applicant as part of the preliminary plan submission where applicable for the regulated activity.

D. For regulated activities that do not require SALDO approval, see Section 301, General Requirements.

E. Six (6) copies of the drainage plan shall be submitted and distributed as follows:

1. Two (2) copies to the Municipality accompanied by the requisite municipal review fee, as specified in this Ordinance.

2. Two (2) copies to the County Conservation District.

3. One (1) copy to the municipal Engineer.

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

F. Any submissions to the agencies listed above that are found to be incomplete shall not be accepted for review and shall be returned to the Applicant with a notification in writing of the specific manner in which the submission is incomplete.

Section 304. Drainage Plan Review

A. The municipal Engineer shall review the drainage plan for consistency with the adopted Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan. Any found incomplete shall not be accepted for review and shall be returned to the Applicant.

B. The municipal Engineer shall review the drainage plan for any subdivision or land development against the municipal SALDO provisions not otherwise superseded by this Ordinance.

C. The Conservation District, in accordance with established criteria and procedures, shall review the drainage plan for consistency with stormwater management and erosion and sediment pollution control requirements and provide comments to the Municipality. Such comments shall be considered by the Municipality prior to final approval of the drainage plan.

D. For activities regulated by this Ordinance, the municipal Engineer shall notify the Applicant and the Municipality in writing, within [___] calendar days, whether the drainage plan is consistent with the stormwater management plan.

1. If the municipal Engineer determines that the drainage plan is consistent with the stormwater management plan, the municipal Engineer shall forward a letter of consistency to the municipal Secretary who will then forward a copy to the Applicant.

2. If the municipal Engineer determines that the drainage plan is inconsistent or noncompliant with the stormwater management plan, the municipal Engineer shall forward a letter to the municipal Secretary with a copy to the Applicant citing the reason(s) and specific Ordinance sections for the inconsistency or noncompliance. Inconsistency or noncompliance may be due to inadequate information to make a reasonable judgment as to compliance with the stormwater management plan. Any drainage plans that are inconsistent or noncompliant may be revised by the Applicant and resubmitted when consistent with this Ordinance. The municipal Secretary shall then notify the Applicant of the municipal Engineer's findings. Any inconsistent or noncompliant drainage plans may be revised by the Applicant and resubmitted consistent with this Ordinance.

E. For regulated activities specified in Section 105 of this Ordinance that require a building permit, 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 SALDO, whether the drainage plan is consistent with the stormwater management plan. The municipal Building Permit Officer shall forward a copy of the consistency/inconsistency letter to the Applicant. Any drainage plan deemed inconsistent may be revised by the Applicant and resubmitted consistent with this Ordinance.

F. For regulated activities under this Ordinance that require an NPDES Permit Application, the Applicant shall forward a copy of the municipal Engineer's letter stating that the drainage plan is consistent with the stormwater management plan to the Conservation District. DEP and the Conservation District may consider the municipal Engineer's review comments in determining whether to issue a permit.

G. The Municipality shall not grant preliminary or final approval to any subdivision or land development for regulated activities specified in Section 105 of this Ordinance if the drainage plan has been found by the municipal Engineer to be inconsistent with the stormwater management plan. All required permits from DEP must be obtained prior to approval of any subdivision or land development.

H. No building permits for any regulated activity specified in Section 105 of this Ordinance shall be approved by the Municipality if the drainage plan has been found to be inconsistent with the stormwater management plan, as determined by the municipal Engineer and Conservation District (or City of Philadelphia designated agency), or without considering the comments of the municipal Engineer and Conservation District (or City of Philadelphia designated agency).

All required permits from DEP must be obtained prior to issuance of a building permit.

I. The Applicant 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 and/or Highway Occupancy Permit from the PennDOT District office, NPDES Permit, and any other applicable permits or approvals from DEP or the Conservation District. The above permits and approvals must be based on the record drawings.

J. The Municipality's approval of a drainage plan shall be valid for a period not to exceed [*recommended 5*] years commencing 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, record drawings of these facilities have not been approved within this [____] year time period, then the Municipality may consider the drainage plan inconsistent or noncompliant and may revoke any and all permits. Drainage plans that are determined to be inconsistent or noncompliant by the Municipality shall be resubmitted in accordance with Section 306 of this Ordinance.

Section 305. Modification of Plans

A. A modification to a submitted drainage plan under review by the Municipality for a development site that involves the following shall require a resubmission to the Municipality of a modified drainage plan consistent with Section 303 of this Ordinance and be subject to review as specified in Section 304 of this Ordinance:

1. Change in stormwater management facilities or techniques,
2. Relocation or redesign of stormwater management facilities, or
3. Is necessary because soil or other conditions are not as stated on the drainage plan as determined by the municipal Engineer.

B. A modification to an already approved or inconsistent or noncompliant drainage plan shall be submitted to the Municipality, accompanied by the applicable municipal review and inspection fee. 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 municipal review and inspection fee.

Section 306. Resubmission of Inconsistent or Noncompliant Drainage Plans

An inconsistent or noncompliant drainage plan may be resubmitted with the revisions addressing the municipal Engineer's concerns documented in writing. It must be addressed to the municipal Secretary in accordance with Section 303 of this Ordinance, distributed accordingly, and be subject to review as specified in Section 304 of this

Ordinance. The applicable municipal review and inspection fee must accompany a resubmission of an inconsistent or noncompliant drainage plan.

ARTICLE IV - STORMWATER MANAGEMENT

Section 401. General Requirements

A. Applicants proposing regulated activities in the Darby and Cobbs Creeks watershed which do not fall under the exemption criteria shown in Section 106 shall submit a drainage plan consistent with the Darby and Cobbs Creeks Watershed Stormwater Management Plan to the Municipality for review. The stormwater management criteria of this Ordinance shall apply to the total proposed development even if development is to take place in stages.

B. The Applicant is required to find practicable alternatives to the surface discharge of stormwater, the creation of impervious surfaces, and the degradation of waters of the Commonwealth and must maintain as much as possible the natural hydrologic regime.

C. The drainage plan must be designed consistent with the sequencing provisions of Section 404 to ensure maintenance of the natural hydrologic regime, to promote groundwater recharge, and to protect groundwater and surface water quality and quantity. The drainage plan designer must proceed sequentially in accordance with Article IV of this Ordinance.

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

E. Existing points of concentrated drainage that discharge onto adjacent property shall not be altered in any manner which could cause property damage without permission of the affected property owner(s) and shall be subject to any applicable discharge criteria specified in this Ordinance.

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

G. Where a development site is traversed by existing streams, drainage easements shall be provided conforming to the line of such streams. The terms of the easement shall conform to the stream buffer requirements contained in Section 406.G of this Ordinance.

H. Any stormwater management facilities regulated by this Ordinance that would be located in or adjacent to waters of the Commonwealth or delineated wetlands shall be subject to approval by DEP through the Joint Permit Application or the Environmental Assessment Approval process, or where deemed appropriate, by the DEP General Permit process. When there is a question as to whether wetlands may be involved, it is the responsibility of the Applicant 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 DEP.

I. Any proposed stormwater management facilities regulated by this Ordinance that would be located on state highway rights-of-way shall be subject to approval by PennDOT.

J. Minimization of impervious surfaces and infiltration of runoff through seepage beds, infiltration trenches, etc. is encouraged where soil conditions permit in order to reduce the size or eliminate the need for detention facilities or other structural BMPs.

K. All stormwater runoff shall be pretreated for water quality prior to discharge to surface or groundwater.

L. All regulated activities within the Municipality shall be designed, implemented, operated, and maintained to meet the purposes of this Ordinance, through these two elements:

1. Erosion and sediment control during earth disturbance activities (e.g., during construction), and

2. Water quality protection measures after completion of earth disturbance activities (i.e., after construction), including operation and maintenance.

M. No regulated earth disturbance activities within the Municipality shall commence until the requirements of this Ordinance are met.

N. Post-construction water quality protection shall be addressed as required by Section 406.

O. Operation and maintenance of permanent stormwater BMPs shall be addressed as required by Article VII.

P. All BMPs used to meet the requirements of this Ordinance shall conform to the state water quality requirements and any more stringent requirements as set forth by the Municipality.

Q. Techniques described in Appendix E (Low Impact Development) of this Ordinance shall be considered because they reduce the costs of complying with the requirements of this Ordinance and the state water quality requirements.

R. In selecting the appropriate BMPs or combinations thereof, the Applicant shall consider the following:

1. Total contributing area.
2. Permeability and infiltration rate of the site's soils.
3. Slope and depth to bedrock.
4. Seasonal high water table.
5. Proximity to building foundations and wellheads.
6. Erodibility of soils.
7. Land availability and configuration of the topography.
8. Peak discharge and required volume control.
9. Stream bank erosion.
10. Efficiency of the BMPs to mitigate potential water quality problems.
11. The volume of runoff that will be effectively treated.
12. The nature of the pollutant being removed.
13. Maintenance requirements.
14. Creation/protection of aquatic and wildlife habitat.
15. Recreational value.

S. The applicant may meet the stormwater management criteria through off-site stormwater management measures as long as the proposed measures are in the same subwatershed as shown in Ordinance Appendix A.

Section 402. Permit Requirements by Other Governmental Entities

The following permit requirements may apply to certain regulated earth disturbance activities and must be met prior to commencement of regulated earth disturbance activities, as applicable:

A. All regulated earth disturbance activities subject to permit requirements by DEP under regulations at 25 Pennsylvania Code Chapter 102.

B. Work within natural drainageways subject to permit by DEP under 25 Pennsylvania Code Chapter 105.

C. Any stormwater management facility that would be located in or adjacent to surface waters of the Commonwealth, including wetlands, subject to permit by DEP under 25 Pennsylvania Code Chapter 105.

D. Any stormwater management facility that would be located on a state highway right-of-way or require access from a state highway shall be subject to approval by PennDOT.

E. Culverts, bridges, storm sewers, or any other facilities which must pass or convey flows from the tributary area and any facility which may constitute a dam subject to permit by DEP under 25 Pennsylvania Code Chapter 105.

Section 403. Erosion and Sediment Control During Regulated Earth Disturbance Activities

A. No regulated earth disturbance activities within the Municipality shall commence until the Municipality receives an approval from the Conservation District of an erosion and sediment control plan for construction activities.

B. DEP has regulations that require an erosion and sediment control plan for any earth disturbance activity of five thousand (5,000) square feet or more, under 25 Pennsylvania Code § 102.4(b).

C. In addition, under 25 Pennsylvania Code Chapter 92, a DEP "NPDES Construction Activities" Permit is required for regulated earth disturbance activities.

D. Evidence of any necessary permit(s) for regulated earth disturbance activities from the appropriate DEP regional office or County Conservation District must be provided to the Municipality. The issuance of an NPDES Construction Permit (or permit coverage under the statewide General Permit (PAG-2)) satisfies the requirements of subsection 403.A. [*]

[This sentence is optional -- if the Municipality has additional or more stringent requirements than those in state regulations, then this sentence should not be used.]*

E. A copy of the erosion and sediment control plan and any required permit, as required by DEP regulations, shall be available on the project site at all times.

F. Additional erosion and sediment control design standards and criteria are recommended to be applied where infiltration BMPs are proposed. They shall include the following:

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

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

Section 404. Nonstructural Project Design (Sequencing to Minimize Stormwater Impacts)

A. The design of all regulated activities shall include the following to minimize stormwater impacts.

1. The Applicant shall find practicable alternatives to the surface discharge of stormwater, such as those listed in Appendix F, Table F-5, the creation of impervious surfaces, and the degradation of waters of the Commonwealth and must maintain as much as possible the natural hydrologic regime of the site.

2. An alternative is practicable if it is available and capable of implementation after taking into consideration existing technology and logistics in light of overall project purposes and other municipal requirements.

3. All practicable alternatives to the discharge of stormwater are presumed to have less adverse impact on quantity and quality of waters of the Commonwealth unless otherwise demonstrated.

B. The Applicant shall demonstrate that the regulated activities were designed in the following sequence. The goal of the sequence is to minimize the increases in stormwater runoff and impacts to water quality resulting from the proposed regulated activity.

1. Prepare an Existing Resource and Site Analysis Map (ERSAM) showing environmentally sensitive areas including, but not limited to, steep slopes, ponds, lakes, streams, wetlands, hydric soils, vernal pools, stream buffers, and hydrologic soil groups. Land development, any existing recharge areas, and other requirements outlined in the municipal SALDO shall also be included.

2. Establish a stream buffer according to Section 406.G.

3. Prepare a draft project layout avoiding sensitive areas identified in Section 404.B.1.

4. Identify site-specific existing conditions drainage areas, discharge points, recharge areas, and hydrologic soil groups A and B (areas conducive to infiltration).

5. Evaluate nonstructural stormwater management alternatives:

   a. Minimize earth disturbance.

   b. Minimize impervious surfaces.

c. Break up large impervious surfaces.

6. Satisfy the groundwater recharge (infiltration) objective (Section 405) and provide for stormwater pretreatment prior to infiltration.

7. Provide for water quality protection in accordance with Section 406 water quality requirements.

8. Provide stream bank erosion protection in accordance with Section 407 stream bank erosion requirements.

9. Determine into what management district the site falls (Ordinance Appendix A), and conduct an existing conditions runoff analysis.

10. Prepare final project design to maintain existing conditions drainage areas and discharge points, to minimize earth disturbance and impervious surfaces, and, to the maximum extent possible, to ensure that the remaining site development has no surface or point discharge.

11. Conduct a proposed conditions runoff analysis based on the final design that meets the management district requirements (Section 408).

12. Manage any remaining runoff prior to discharge through detention, bioretention, direct discharge, or other structural control.

Section 405. Groundwater Recharge

Maximizing the groundwater recharge capacity of the area being developed is required. Design of the infiltration facilities shall consider groundwater recharge to compensate for the reduction in the recharge that occurs when the ground surface is disturbed or impervious surface is created. It is recommended that roof runoff be directed to infiltration BMPs that may be designed to compensate for the runoff from parking areas. These measures are required to be consistent with Section 103 and to take advantage of utilizing any existing recharge areas.

Infiltration may not be feasible on every site due to site-specific limitations such as soil type. If it cannot be physically accomplished, then the design professional shall be responsible to show that this cannot be **physically** accomplished. If it can be physically accomplished, then the volume of runoff to be infiltrated shall be determined from Section 405.A.2 depending on demonstrated site conditions and shall be the greater of the volumes.

A. Infiltration BMPs shall meet the following minimum requirements:

1. Infiltration BMPs intended to receive runoff from developed areas shall be selected based on suitability of soils and site conditions and shall be constructed on soils that have the following characteristics:

a. A minimum depth of twenty-four (24) inches between the bottom of the BMP and the top of the limiting zone.

b. An infiltration rate sufficient to accept the additional stormwater load and dewater completely as determined by field tests conducted by the Applicant's design professional.

c. The infiltration facility shall be capable of completely infiltrating the retention (infiltration) volume (Re_v) within four (4) days (96 hours).

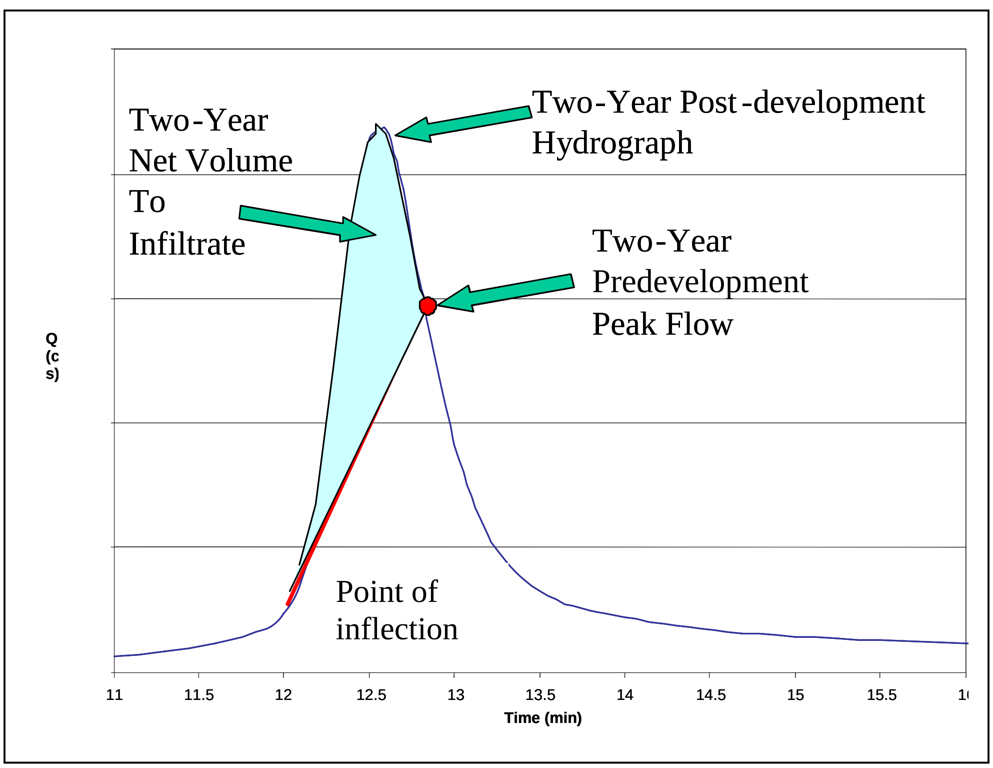
d. Pretreatment shall be provided prior to infiltration.

2. The size of the infiltration facility shall be based upon the following volume criteria:

   a. Net Two-Year Volume Approach - In HQ/EV watersheds, the retention (infiltration) volume (Re_v) to be captured and infiltrated shall be the net 2-year volume. The net 2-year volume shall be determined by plotting the 2-year project site post-development hydrograph, drawing a straight line from the point of inflection of the rising limb of the hydrograph to the pre-development 2-year storm, and measuring the volume under the curve as shown in Figure 405.1.

FIGURE 405.1

INFILTRATION HYDROGRAPH



b. One Inch from Impervious Surface - In other portions of the watershed that are not classified as HQ/EV, the retention (infiltration) volume (Re_v) will be equal to capturing one (1) inch of rainfall over all proposed impervious surfaces.

Re_v = I * impervious area (square feet) ÷ 12 (inches) = cubic feet (cf)

An asterisk (*) in equations denotes multiplication.

c. Obtaining the **Re_v** volume in Section 405.A.2.a (above) may not be feasible on every site due to site-specific limitations such as soil type. If it cannot be physically accomplished, then the design professional shall be responsible for showing that this cannot be **physically** accomplished. If it cannot be physically accomplished, then the retention (infiltration) volume **Re_v** required shall be as much as can be physically accomplished with a minimum of 0.50 inch depending on demonstrated site conditions. It has been determined that capturing and infiltrating 0.50 inch of runoff from the impervious areas will aid in maintaining the hydrologic regime (baseflow) of the watershed. If the goals of Section 405.A.2.a or 405.A.2.b cannot be achieved, then 0.50 inch of rainfall shall be retained and infiltrated from all impervious areas.

The minimum recharge volume (Re_v) required would, therefore, be computed as:

Re_v = I * impervious area (square feet) ÷ 12 (inches) = cubic feet (cf)

An asterisk (*) in equations denotes multiplication.

Where:

I = The maximum equivalent infiltration amount (inches) that the site can physically accept or 0.50 inch, whichever is greater.

The retention volume values derived from the methods in Section 405.A.2.a, 405.A.2.b, and/or Section 405.A.2.c represent the minimum volume the Applicant must control through an infiltration BMP facility. However, if a site has areas of soils where additional volume of retention can be achieved, the Applicant is encouraged to infiltrate as much of the stormwater runoff from the site as possible.

If the minimum of 0.50 inch of infiltration requirement cannot be achieved, a waiver from Section 405, Groundwater Recharge, would be required from the Municipality.

B. Soils - A detailed soils evaluation of the project site shall be required to determine the suitability of infiltration facilities. The evaluation shall be performed by a qualified design professional and at a minimum address soil permeability, depth to bedrock, and subgrade stability. The general process for designing the infiltration BMP shall be:

1. Analyze hydrologic soil groups as well as natural and man-made features within the site to determine general areas of suitability for infiltration practices. In areas where development on fill material is under consideration, conduct geotechnical investigations of sub-grade stability; infiltration may not be ruled out without conducting these tests.

2. Provide field tests such as double ring infiltrometer or hydraulic conductivity tests (at the level of the proposed infiltration surface) to determine the appropriate hydraulic conductivity rate. Percolation tests are not recommended for design purposes.

3. Design the infiltration structure for the required retention (Re_v) volume based on field determined capacity at the level of the proposed infiltration surface.

4. If on-lot infiltration structures are proposed by the Applicant's design professional, it must be demonstrated to the Municipality that the soils are conducive to infiltrate on the lots identified.

C. Stormwater Hotspots – Below is a list of examples of designated hotspots. If a site is designated as a hotspot, it has important implications for how stormwater is managed. First and foremost, untreated stormwater runoff from hotspots shall not be allowed to recharge into groundwater where it may contaminate water supplies. Therefore, the Re_v requirement shall NOT be applied to development sites that fit into the hotspot category (the entire WQ_v must still be treated). Second, a greater level of stormwater treatment shall be considered at hotspot sites to prevent pollutant washoff after construction. The Environmental Protection Agency's (EPA) NPDES stormwater program requires some industrial sites to prepare and implement a stormwater pollution prevention plan.

Examples of hotspots:

- Vehicle salvage yards and recycling facilities
- Vehicle fueling stations

• Vehicle service and maintenance facilities
• Vehicle and equipment cleaning facilities
• Fleet storage areas (bus, truck, etc.)
• Industrial sites based on Standard Industrial Codes
• Marinas (service and maintenance)
• Outdoor liquid container storage
• Outdoor loading/unloading facilities
• Public works storage areas
• Facilities that generate or store hazardous materials
• Commercial container nursery
• Other land uses and activities as designated by an appropriate review authority

The following land uses and activities are not normally considered hotspots:

• Residential streets and rural highways
• Residential development
• Institutional development
• Office developments
• Nonindustrial rooftops
• Pervious areas, except golf courses and nurseries (which may need an integrated pest management (IPM) plan).

While large highways (average daily traffic volume (ADT) greater than thirty thousand (30,000)) are not designated as stormwater hotspots, it is important to ensure that highway stormwater management plans adequately protect groundwater.

D. Extreme caution shall be exercised where infiltration is proposed in SWPAs as defined by the local Municipality or water authority.

E. Infiltration facilities shall be used in conjunction with other innovative or traditional BMPs, stormwater control facilities, and nonstructural stormwater management alternatives.

F. Extreme caution shall be exercised where salt or chloride (municipal salt storage) would be a pollutant since soils do little to filter this pollutant, and it may contaminate the groundwater. The qualified design professional shall evaluate the possibility of groundwater contamination from the proposed infiltration facility and perform a hydrogeologic justification study if necessary.

G. The infiltration requirement in HQ or EV waters shall be subject to the Department's Chapter 93 Anti-degradation Regulations.

H. An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists. A detailed hydrogeologic investigation may be required by the Municipality.

I. The Municipality shall require the Applicant to provide safeguards against groundwater contamination for land uses that may cause groundwater contamination should there be a mishap or spill.

Section 406. Water Quality Requirements

The Applicant shall comply with the following water quality requirements of this Article.

A. No regulated earth disturbance activities within the Municipality shall commence until approval by the Municipality of a plan which demonstrates compliance with post-construction state water quality requirements.

B. The BMPs shall be designed, implemented, and maintained to meet state water quality requirements and any other more stringent requirements as determined by the Municipality.

C. To control post-construction stormwater impacts from regulated earth disturbance activities, state water quality requirements can be met by BMPs, including site design, which provide for replication of pre-construction stormwater infiltration and runoff conditions so that post-construction stormwater discharges do not degrade the physical, chemical, or biological characteristics of the receiving waters. As described in the DEP Comprehensive Stormwater Management Policy (#392-0300-002, September 28, 2002), this may be achieved by the following:

1. Infiltration: replication of pre-construction stormwater infiltration conditions,
2. Treatment: use of water quality treatment BMPs to ensure filtering out of the chemical and physical pollutants from the stormwater runoff, and
3. Stream bank and stream bed protection: management of volume and rate of post-construction stormwater discharges to prevent physical degradation of receiving waters (e.g., from scouring).

D. Developed areas shall provide adequate storage and treatment facilities necessary to capture and treat stormwater runoff. The retention volume computed under Section 405 may be a component of the water quality volume if the Applicant chooses to manage both components in a single facility. If the retention volume is less than the water quality volume, the remaining water quality volume may be captured and treated by methods other than infiltration BMPs. The required water quality volume (WQv) is the storage capacity needed to capture and treat a portion of stormwater runoff from the developed areas of the site.

To achieve this goal, the following criterion is established:

The following calculation formula is to be used to determine the water quality storage volume (WQv) in acre-feet of storage for the Darby-Cobbs watershed:

$$\boxed{\mathbf{WQv = [(P)(Rv)(A)] \div 12}}$$

WQv = Water quality volume (acre-feet)
P = 1 inch
A = Area of the project contributing to the water quality BMP (acres)
Rv = 0.05 + 0.009(I) where I is the percent of the area that is impervious surface ((impervious area/A)*100)

This volume requirement can be accomplished by the permanent volume of a wet basin or the detained volume from other BMPs. Where appropriate, wet basins shall be utilized for water quality control and shall follow the guidelines of the BMP manuals referenced in Ordinance Appendix G.

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). The design of the facility shall provide for protection from clogging and unwanted sedimentation.

E. For areas within defined special protection subwatersheds that include EV and HQ waters, the temperature and quality of water and streams shall be maintained through the use of temperature sensitive BMPs and stormwater conveyance systems.

F. To accomplish the above, the Applicant shall 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 different BMPs.

G. If a perennial or intermittent stream passes through the site, the Applicant shall create a stream buffer extending a minimum of fifty (50) feet to either side of the top-of-bank of the channel. The buffer area shall be maintained with and encouraged to use appropriate native vegetation (refer to Appendix H of the *Pennsylvania Handbook of Best Management Practices for Developing Areas* for plant lists). If the applicable rear or side yard setback is less than fifty (50) feet or if a stream traverses the site, the buffer width may be reduced to twenty-five (25) percent of the setback and/or to a minimum of ten (10) feet. If an existing buffer is legally prescribed (i.e., deed, covenant, easement, etc.) and it exceeds the requirements of this Ordinance, the existing buffer shall be maintained. *[Note: The Municipality may select a smaller buffer width (above) if desired, but the selected buffer may not be less than ten (10) feet]*. This does not include lakes or wetlands.

H. Evidence of any necessary permit(s) for regulated earth disturbance activities from the appropriate DEP regional office must be provided to the Municipality. The issuance of an NPDES Construction Permit (or permit coverage under the statewide General Permit (PAG-2)) satisfies the requirements of subsection 406.A. [*]

[This sentence above is optional -- if the Municipality has additional or more stringent requirements than those in state regulations, then this sentence should not be used.]*

Section 407. Stream Bank Erosion Requirements

A. In addition to the control of water quality volume (in order to minimize the impact of stormwater runoff on downstream stream bank erosion), the primary requirement is to design a BMP to detain the proposed conditions 2-year, 24-hour design storm to the existing conditions 1-year flow using the SCS Type II distribution. Additionally, provisions shall be made (such as adding a small orifice at the bottom of the outlet structure) so that the proposed conditions 1-year storm takes a minimum of twenty-four (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).

B. The minimum orifice size in the outlet structure to the BMP shall be three (3) inches in diameter where possible, and a trash rack shall be installed to prevent clogging. On sites with small drainage areas contributing to this BMP that do not provide enough runoff volume to allow a 24-hour attenuation with the 3-inch orifice, the calculations shall be submitted showing this condition. Orifice sizes less than three (3) inches can be utilized, provided that the design will prevent clogging of the intake.

C. In “Conditional Direct Discharge Districts” (District C) only (see Section 408), the objective is not to attenuate the storms greater than the 2-year recurrence interval. This can be accomplished by configuring the outlet structure not to control the larger storms or by a bypass channel that diverts only the 2-year stormwater runoff into the basin or conversely, diverts flows in excess of the 2-year storm away from the basin.

Section 408. Stormwater Peak Rate Control and Management Districts

A. The Darby and Cobbs Creeks watershed has been divided into stormwater management districts as shown on the Management District Map in Appendix A.

In addition to the requirements specified in Table 408.1 below, the erosion and sedimentation control (Section 403), the nonstructural project design (Section 404), the groundwater recharge (Section 405), the water quality (Section 406), and the stream bank erosion (Section 407) requirements shall be implemented.

Standards for managing runoff from each subarea in the Darby and Cobbs Creeks watershed for the 2-, 5-, 10-, 25-, 50-, and 100-year design storms are shown in Table 408.1. Development sites located in each of the management districts must control proposed conditions runoff rates to existing conditions runoff rates for the design storms in accordance with Table 408.1.

TABLE 408.1

PEAK RATE CONTROL STANDARDS BY STORMWATER MANAGEMENT DISTRICT IN THE DARBY-COBBS CREEK WATERSHED

District	Proposed Condition Design Storm	Existing Condition Design Storm
A	2 - year	1 - year
	5 - year	5 - year
	10 - year	10 - year
	25 - year	25 - year
	100-year	100-year
B-1	2 - year	1- year
	10 - year	5 - year
	25 - year	10 - year
	50- year	25- year
	100-year	100-year
B-2	2 - year	1- year
	5 - year	2 - year
	25 - year	5 - year
	50- year	10- year
	100 - year	100 - year
C	Conditional Direct Discharge District	

In District C, development sites that can discharge directly to the Darby-Cobbs Creek main channel, 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 the proposed conditions peak rate of runoff greater than the 5-year storm. Sites in District C will still have to comply with the groundwater recharge criteria, the water quality criteria, and stream bank erosion criteria. If the proposed conditions 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 flows greater than the 2-year existing conditions peak flow or will be provided with improvements to furnish the required capacity. When adequate capacity in the downstream system does not exist and will not be provided through improvements, the proposed conditions peak rate of runoff must be controlled to the existing conditions peak rate as required in District A provisions (i.e., 10-year proposed conditions flows to 10-year existing conditions flows) for the specified design storms.

B. General - Proposed conditions rates of runoff from any regulated activity shall not exceed the peak release rates of runoff from existing conditions for the design storms specified on the Stormwater Management District Watershed Map (Ordinance Appendix A) and this section of the Ordinance.

C. District Boundaries - The boundaries of the stormwater management districts are shown on an official map that is available for inspection at the municipal and County Planning offices. A copy of the official map at a reduced scale is included in Ordinance Appendix A. 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 2-foot topographic contours (or most accurate data required) provided as part of the drainage plan.

D. Sites Located in More than One (1) District - For a proposed development site located within two (2) or more stormwater management district category subareas, the peak discharge rate from any subarea shall meet the management district criteria for which the discharge is located. 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 discharge site. In this case, peak discharge in any direction may follow Management District A criteria, provided that the overall site discharge meets the management district criteria for which the discharge is located.

E. 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.

F. 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.

The following article provisions are optional. Please see box below.

G. "No Harm" Option - For any proposed development site not located in a Conditional Direct Discharge District, the Applicant has the option of using a less restrictive runoff control (including no detention) if the Applicant can prove that "no harm" would be caused by discharging at a higher runoff rate than that specified by the stormwater management plan. The "no harm" option is used when an Applicant can prove that the proposed conditions hydrographs can match existing conditions hydrographs and if it can be proved that the proposed conditions will not cause increases in peaks at all points downstream.

Proof of “no harm” must be shown based upon the following “downstream impact evaluation” which shall include a “downstream hydraulic capacity analysis” consistent with Section 408.H to determine if adequate hydraulic capacity exists. The Applicant shall submit to the Municipality this evaluation of the impacts due to increased downstream stormwater flows in the watershed. Note: Municipalities might consider rewording on an individual basis.

1. The hydrologic regime of the site must be maintained.

2. 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.

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

4. 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 the Darby-Cobbs watershed. These flow values can be obtained from the original Act 167 watershed stormwater management plans.

5. Applicant-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 408.H.

6. Financial distress shall not constitute grounds for the Municipality to approve the use of the “no-harm” option.

7. Capacity improvements to conveyance facilities or obstructions may be provided as necessary to implement the “no harm” option as long as it can be demonstrated through the “downstream hydraulic capacity analysis” that the improvements would not create any harm downstream.

8. Any “no harm” justifications shall be submitted by the Applicant as part of the drainage plan submission per Article III.

H. “Downstream Hydraulic Capacity Analysis” - Any downstream hydraulic capacity 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 need to 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.

The following article provisions are optional. Please see box below.

I. "Hardship Option" - The standards and criteria outlined in Section 408 of the Ordinance are designed to maintain existing peak flows and volumes throughout the Darby and Cobbs Creeks basins as the watershed becomes developed. There may be certain instances, however, where the standards and criteria established are too restrictive for a particular landowner or Applicant. The existing drainage network in some areas may be capable of safely transporting slight increases in flows without causing a problem or increasing flows elsewhere. This must be demonstrated as per Section 408.H above in order for the hardship option to be considered. If an Applicant or landowner cannot meet the stormwater standards due to lot conditions or if conformance would become a hardship to an owner, the hardship option may be applied. The Applicant would have to plead his/her case to the Governing Body with the final determination made by the Municipality. Any landowners pleading the "hardship option" will assume all liabilities that may arise due to exercising this option. Cost or financial burden cannot be considered a hardship. The Applicant may consider off-site management controls or contributing to the Municipal Stormwater Control and BMP Operation and Maintenance Fund (Section 709) as long as the stormwater management controls are within the same subwatershed as shown in Ordinance Appendix A.

J. Alternate Criteria for Redevelopment Sites - For redevelopment sites, one of the following minimum design parameters shall be accomplished, whichever is most appropriate for the given site conditions as determined by [*Municipality*];

1. Meet the full requirements specified by Table 408.1 and Sections 408.A through 408.J, or

2. Reduce the total impervious surface on the site by at least twenty (20) percent based upon a comparison of existing impervious surface to proposed impervious surface.

Section 409. Calculation Methodology

A. Stormwater runoff from all development sites with a drainage area of greater than two hundred (200) acres shall be calculated using a generally accepted calculation technique that is based on the NRCS Soil Cover Complex Method. Table 409.1 summarizes acceptable computation methods, and the method selected by the design professional shall be 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 two hundred (200) acres. The Soil Cover Complex Method shall be used for drainage areas greater than two hundred (200) acres.

TABLE 409.1

ACCEPTABLE COMPUTATION METHODOLOGIES FOR STORMWATER MANAGEMENT PLANS

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/ HEC-HMS	U.S. Army Corps of Engineers	Applicable where use of a full hydrologic computer model is desirable or necessary.
PSRM	Penn State University	Applicable where use of a hydrologic 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 two hundred (200) acres, or as approved by the Municipality and/or municipal Engineer.
Other Methods	Varies	Other computation methodologies approved by the Municipality and/or municipal Engineer.

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 in which they are located as presented in Table F-1 in Appendix F of this Ordinance. If a hydrologic computer model such as PSRM or HEC-1 / HEC-HMS is used for stormwater runoff calculations, then the duration of rainfall shall be twenty-four (24) hours. The Alternating Block Method shown in Figure F-1 or the SCS Type II S Curve, Figure F-3 in Ordinance Appendix F, shall be used for the rainfall distribution.

C. The following criteria shall be used for runoff calculations:

1. For development sites not considered redevelopment, the ground cover used in determining the existing conditions flow rates shall be as follows:

   a. Wooded sites shall use a ground cover of “woods in good condition.” Portions of a site having more than one viable tree of a DBH of six (6) inches or greater per fifteen hundred (1,500) square feet shall be considered wooded where such trees existed within three (3) years of application.

   b. The undeveloped portion of the site including agriculture, bare earth, and fallow ground shall be considered as “meadow in good condition,” unless the natural ground cover generates a lower curve number (CN) or Rational “C” value (i.e., woods) as listed in Tables F-2 or F-3 in Appendix F of this Ordinance.

2. For development and redevelopment sites, the ground cover used in determining the existing conditions flow rates for the developed portion of the site shall be based upon actual land cover conditions.

D. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times-of-concentration for overland flow and return periods presented in the Region 5 curves from the PennDOT Storm-Duration-Frequency Chart (Figure F-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 F-2 in Appendix F of this Ordinance.

F. Runoff coefficients (C) for both existing and proposed conditions for use in the Rational Method shall be obtained from Table F-3 in Appendix F 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 F-4 in Appendix F of the Ordinance.

H. 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.

I. 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. 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.

Section 410. Other Requirements

A. Any stormwater facility located on state highway rights-of-way shall be subject to approval by PennDOT.

B. All wet basin designs shall incorporate biologic controls consistent with the West Nile Virus Guidance found in Appendix H.

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

D. Any facilities that constitute water obstructions (e.g., culverts, bridges, outfalls, or stream enclosures) and any work involving wetlands governed by DEP Chapter 105 regulations (as amended or replaced from time to time by DEP) shall be designed in accordance with Chapter 105 and will require a permit from DEP.

E. 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 one (1.0) foot of freeboard measured below the lowest point along the top of the roadway. Any facility that constitutes a dam as defined in DEP Chapter 105 regulations may require a permit under dam safety regulations. Any facility located within a PennDOT right-of-way must meet PennDOT minimum design standards and permit submission requirements.

F. Any drainage conveyance facility and/or channel not governed by Chapter 105 regulations must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-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 PennDOT right-of-way must meet PennDOT minimum design standards and permit submission requirements.

G. Storm sewers must be able to convey proposed conditions runoff from a [*5-, 10-, or 25-*] year design storm without surcharging inlets, where appropriate.

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

I. The design of all stormwater management facilities shall incorporate sound engineering principles and practices. The Municipality reserves the right to disapprove any design that would result in construction in or continuation of a stormwater problem area.

ARTICLE V-INSPECTIONS

Section 501. Inspections

A. The municipal Engineer or his municipal designee shall inspect all phases of the installation of the permanent BMPs and/or stormwater management facilities as deemed appropriate by the municipal Engineer.

B. During any stage of the work, if the municipal Engineer or his municipal designee determines that the permanent BMPs and/or stormwater management facilities are not being installed in accordance with the approved stormwater management plan, the Municipality shall revoke any existing permits or other approvals and issue a cease and desist order until a revised drainage plan is submitted and approved, as specified in this Ordinance, and until the deficiencies are corrected.

C. A final inspection of all BMPs and/or stormwater management facilities shall be conducted by the municipal Engineer or his municipal designee to confirm compliance with the approved drainage plan prior to the issuance of any occupancy permit.

ARTICLE VI-FEES AND EXPENSES

Section 601. Municipal Drainage Plan Review and Inspection Fees

Fees shall be established by the Municipality to defray plan review and construction inspection costs incurred by the Municipality. All fees shall be paid by the Applicant at the time of drainage plan submission. A review and inspection fee schedule shall be established 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 and conducting inspections pursuant to Section 501. The Municipality shall periodically update the review and inspection fee schedule to ensure that review costs are adequately reimbursed.

Section 602. 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

A. For subdivisions and land developments, the Applicant shall provide a financial guarantee to the Municipality for the timely installation and proper construction of all stormwater management controls as:

1. Required by the approved drainage plan equal to or greater than the full construction cost of the required controls, or

2. The amount and method of payment provided for in the SALDO.

B. For other regulated activities, the Municipality may require a financial guarantee from the Applicant.

Section 702. Responsibilities for Operation and Maintenance of Stormwater Controls and BMPs

A. No regulated earth disturbance activities within the Municipality shall commence until approval by the Municipality of a stormwater control and BMP operation and maintenance plan that describes how the permanent (e.g., post-construction) stormwater controls and BMPs will be properly operated and maintained.

B. The following items shall be included in the stormwater control and BMP operation and maintenance plan:

1. Map(s) of the project area, in a form that meets the requirements for recording at the Office of the Recorder of Deeds of ________________________County, shall be submitted on_______-inch x-_______inch sheets. The contents of the map(s) shall include, but not be limited to:

   a. Clear identification of the location and nature of permanent stormwater controls and BMPs,
   b. The location of the project site relative to highways, municipal boundaries, or other identifiable landmarks,
   c. Existing and final contours at intervals of two (2) feet, or others as appropriate,
   d. Existing streams, lakes, ponds, or other bodies of water within the project site area,
   e. Other physical features including flood hazard boundaries, sinkholes, streams, existing drainage courses, and areas of natural vegetation to be preserved,
   f. The locations of all existing and proposed utilities, sanitary sewers, and water lines within fifty (50) feet of property lines of the project site,

g. Proposed final changes to the land surface and vegetative cover, including the type and amount of impervious area that would be added,
h. Proposed final structures, roads, paved areas, and buildings, and
i. A 15-foot wide access easement around all stormwater controls and BMPs that would provide ingress to and egress from a public right-of-way.

2. A description of how each permanent stormwater control and BMP will be operated and maintained, and the identity and contact information associated with the person(s) responsible for operations and maintenance,

3. The name of the project site, the name and address of the owner of the property, and the name of the individual or firm preparing the plan, and

4. A statement, signed by the landowner, acknowledging that the stormwater controls and BMPs are fixtures that can be altered or removed only after approval by the Municipality.

C. The stormwater control and BMP operation and maintenance plan for the project site shall establish responsibilities for the continuing operation and maintenance of all permanent stormwater controls and BMPs, as follows:

1. If a plan includes 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 controls and BMPs may also be dedicated to and maintained by the Municipality;

2. If a plan includes operation and maintenance by a single ownership or if sewers and other public improvements are to be privately owned and maintained, then the operation and maintenance of stormwater controls and BMPs shall be the responsibility of the owner or private management entity.

D. The Municipality shall make the final determination on the continuing operation and maintenance responsibilities. The Municipality reserves the right to accept or reject the operation and maintenance responsibility for any or all of the stormwater controls and BMPs.

Section 703. Municipal Review of a Stormwater Control and BMP Operation and Maintenance Plan

A. The Municipality shall review the stormwater control and BMP operation and maintenance plan for consistency with the purposes and requirements of this Ordinance and any permits issued by DEP.

B. The Municipality shall notify the Applicant in writing whether or not the stormwater control and BMP operation and maintenance plan is approved.

C. The Municipality may require a “record drawing” of all stormwater controls and BMPs and an explanation of any discrepancies with the operation and maintenance plan.

Section 704. Adherence to an Approved Stormwater Control and BMP Operation and Maintenance Plan

It shall be unlawful to alter or remove any permanent stormwater control and BMP required by an approved stormwater control and BMP operation and maintenance plan or to allow the property to remain in a condition which does not conform to an approved stormwater control and BMP operation and maintenance plan.

Section 705. Operation and Maintenance Agreement for Privately Owned Stormwater Controls and BMPs

A. The Applicant shall sign an operation and maintenance agreement with the Municipality covering all stormwater controls and BMPs that are to be privately owned. The maintenance agreement shall be transferred with transfer of ownership. The agreement shall be substantially the same as the agreement in Appendix I of this Ordinance.

B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory operation and maintenance of all permanent stormwater controls and BMPs. The agreement shall be subject to the review and approval of the Municipality.

Section 706. Stormwater Management Easements

A. Stormwater management easements are required for all areas used for off-site stormwater control, unless a waiver is granted by the municipal Engineer.

B. Stormwater management easements shall be provided by the Applicant or property owner if necessary for access for inspections and maintenance or the preservation of stormwater runoff conveyance, infiltration, and detention areas and other stormwater controls and BMPs by persons other than the property owner. The purpose of the easement shall be specified in any agreement under Section 705.

Section 707. Maintenance Agreement for Privately Owned Stormwater Facilities

A. Prior to final approval of the site’s drainage plan, the Applicant shall sign and record the maintenance agreement contained in Appendix I 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 708. Recording of an Approved Stormwater Control and BMP Operations and Maintenance Plan and Related Agreements

A. The owner of any land upon which permanent stormwater controls and BMPs will be placed, constructed, or implemented, as described in the stormwater control and BMP operation and maintenance plan, shall record the following documents in the Office of the Recorder of Deeds for ____________ County, within fifteen (15) days of approval of the stormwater control and BMP operation and maintenance plan by the Municipality:

1. The operation and maintenance plan, or a summary thereof,

2. Operation and maintenance agreements under Section 705, and

3. Easements under Section 706.

B. The Municipality may suspend or revoke any approvals granted for the project site upon discovery of failure on the part of the owner to comply with this section.

The following article provisions are optional. Please see box below.

Section 709. Municipal Stormwater Control and BMP Operation and Maintenance Fund

A. Persons installing stormwater controls or BMPs shall be required to pay a specified amount to the Municipal Stormwater Control and BMP Operation and 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 stormwater control or BMP 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 stormwater control or BMP 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 stormwater control or BMP is proposed that also serves as a recreational facility (e.g., ball field or lake), the Municipality may reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreational purposes.

C. If at some future time, a stormwater control or BMP (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.

D. If stormwater controls or BMPs are accepted by the Municipality for dedication, the Municipality may require persons installing stormwater controls or BMPs to pay a specified amount to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to help defray costs of operation and maintenance activities. The amount may be determined as follows:

1. The amount shall cover the estimated costs for operation and maintenance for ten (10) years, as determined by the Municipality.

2. The amount shall then be converted to present worth of the annual series values.

E. If a stormwater control or BMP is proposed that also serves as a recreational facility (e.g., ball field or lake), the Municipality may adjust the amount due accordingly.

F. The Municipality may shall require Applicants to pay a fee to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to cover long-term maintenance of stormwater controls and BMPs.

G. The Municipality may require Applicants to pay a fee to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to cover stormwater related problems which may arise from the land development and earth disturbance.

ARTICLE VIII- PROHIBITIONS

Section 801. Prohibited Discharges

Note: The following language taken from DEP's NPDES program and model NPDES ordinance is required to be incorporated into this Ordinance.

A. No person in the Municipality shall allow, or cause to allow, stormwater discharges into the Municipality's separate storm sewer system which are not composed entirely of stormwater, except (1) as provided in subsection B below, and (2) discharges allowed under a state or federal permit.

B. Discharges that may be allowed based on a finding by the Municipality that the discharge(s) do not significantly contribute to pollution to surface waters of the Commonwealth, are:

1. Discharges from fire fighting activities
2. Potable water sources including dechlorinated water line and fire hydrant flushings
3. Irrigation drainage
4. Routine external building washdown (which does not use detergents or other compounds)
5. Air conditioning condensate
6. Water from individual residential car washing
7. Spring water from crawl space pumps
8. Uncontaminated water from foundation or footing drains
9. Flows from riparian habitats and wetlands
10. Lawn watering
11. Pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spill material has been removed) and where detergents are not used
12. Dechlorinated swimming pool discharges
13. Uncontaminated groundwater

C. In the event that the Municipality determines that any of the discharges identified in Section 801.B significantly contribute to pollution of waters of the Commonwealth, or is so notified by DEP, the Municipality will notify the responsible person to cease the discharge.

D. Upon notice provided by the Municipality under Section 801.C, the discharger will have a reasonable time, as determined by the Municipality, to cease the discharge consistent with the degree of pollution caused by the discharge.

E. Nothing in this section shall affect a discharger's responsibilities under state law.

Section 802. Prohibited Connections

A. The following connections are prohibited, except as provided in Section 801.B above:

1. Any drain or conveyance, whether on the surface or subsurface, which allows any nonstormwater discharge including sewage, process wastewater, and wash water to enter the separate storm sewer system and any connections to the storm drain system from indoor drains and sinks; and

2. Any drain or conveyance connected from a commercial or industrial land use to the separate storm sewer system which has not been documented in plans, maps, or equivalent records and approved by the Municipality.

Section 803. Roof Drains

A. Roof drains shall not be connected to streets, sanitary or storm sewers, or roadside ditches in order to promote overland flow and infiltration/percolation of stormwater where advantageous to do so.

B. When it is more advantageous to connect directly to streets or storm sewers, connections of roof drains to streets or roadside ditches may be permitted on a case by case basis as determined by the Municipality.

C. Roof drains shall discharge to infiltration areas or vegetative BMPs to the maximum extent practicable.

Section 804. Alteration of BMPs

A. No person shall modify, remove, fill, landscape, or alter any existing stormwater control or BMP unless it is part of an approved maintenance program without the written approval of the Municipality.

B. No person shall place any structure, fill, landscaping, or vegetation into a stormwater control or BMP or within a drainage easement which would limit or alter the functioning of the stormwater control or BMP without the written approval of the Municipality.

ARTICLE IX - ENFORCEMENT AND PENALTIES

Section 901. Right-of-Entry

A. 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 implementation, condition, or operation and maintenance of the stormwater controls or BMPs in regard to any aspect governed by this Ordinance.

B. Stormwater control and BMP owners and operators shall allow persons working on behalf of the Municipality ready access to all parts of the premises for the purposes of determining compliance with this Ordinance.

C. Persons working on behalf of the Municipality shall have the right to temporarily locate on any stormwater control or BMP in the Municipality such devices as are necessary to conduct monitoring and/or sampling of the discharges from such stormwater control or BMP.

D. Unreasonable delays in allowing the Municipality access to a stormwater control or BMP is a violation of this Article.

Section 902. 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 903. Enforcement Generally

A. Whenever the Municipality finds that a person has violated a prohibition or failed to meet a requirement of this Ordinance, the Municipality may order compliance by written notice to the responsible person. Such notice may, without limitation, require the following remedies:

1. Performance of monitoring, analyses, and reporting;

2. Elimination of prohibited connections or discharges;

3. Cessation of any violating discharges, practices, or operations;

4. Abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property;

5. Payment of a fine to cover administrative and remediation costs;

6. Implementation of stormwater controls and BMPs; and

7. Operation and maintenance of stormwater controls and BMPs.

B. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of these violations(s). Said notice may further advise that, if applicable, should the violator fail to take the required action within the established deadline, the work will be done by the Municipality or designee, and the expense thereof shall be charged to the violator.

C. Failure to comply within the time specified shall also subject such person to the penalty provisions of this Ordinance. All such penalties shall be deemed cumulative and shall not prevent the Municipality from pursuing any and all other remedies available in law or equity.

Section 904. Suspension and Revocation of Permits and Approvals

A. Any building, land development, or other permit or approval issued by the Municipality may be suspended or revoked by the Municipality for:

1. Noncompliance with or failure to implement any provision of the permit;

2. A violation of any provision of this Ordinance; or

3. 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, health, or property of others.

B. A suspended permit or approval shall be reinstated by the Municipality when:

1. The municipal Engineer or designee has inspected and approved the corrections to the stormwater controls and BMPs or the elimination of the hazard or nuisance, and/or

2. The Municipality is satisfied that the violation of the Ordinance, law, or rule and regulation has been corrected.

C. A permit or approval that has been revoked by the Municipality cannot be reinstated. The Applicant may apply for a new permit under the procedures outlined in this Ordinance.

Section 905. Penalties

A. Any person 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 906. 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 state 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 shall 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 907. 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. It shall be unlawful for any person, firm, or corporation to undertake any regulated activity under Section 105 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 and at the request of the Applicant, the Governing Body will schedule a hearing to discuss the noncompliance if there is no immediate danger to life, public health, or property. The expense of a hearing shall be the Applicant's responsibility.

F. Occupancy Permit

An occupancy permit shall not be issued unless the certification of completion pursuant to Section 907.C.1 has been secured. The occupancy permit shall be required for each lot owner and/or Applicant for all subdivisions and land developments in the Municipality.

Section 908. Appeals

A. Any person aggrieved by any action of the [*Municipal Name*] or its designee may appeal to [*the Municipality's Governing Body*] 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.

ENACTED and ORDAINED at a regular meeting of the ____________________ ___________________________ on the _____ of ______________________, 20__. This Ordinance shall take effect immediately.

____
[Name]

____
[Title]

____
[Name]

____
[Title]

____
[Name]

____
[Title]

____
[Name]

____
[Title]

____
[Name]

____
[Title]

ATTEST:

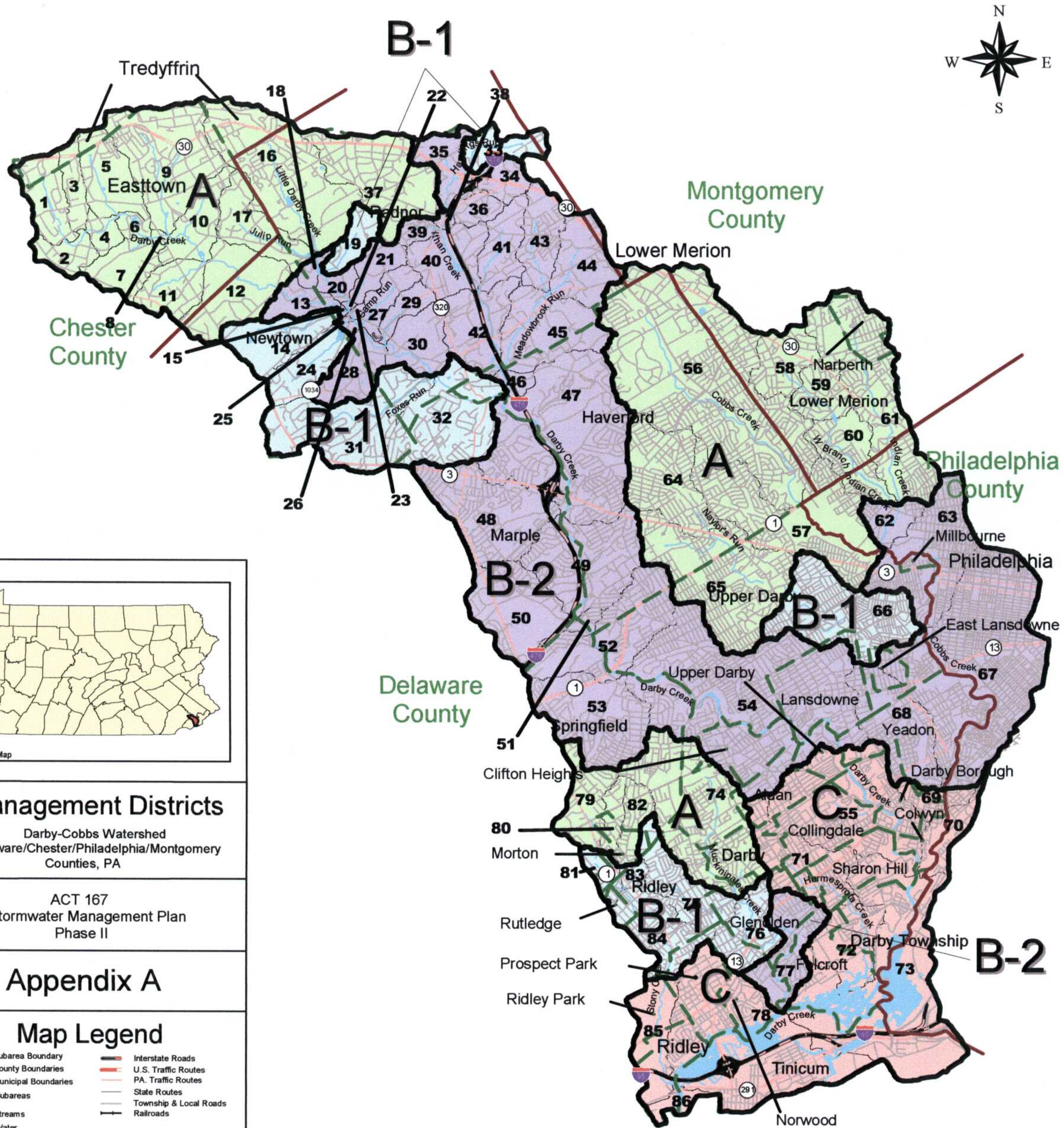
____
Secretary

I hereby certify that the foregoing Ordinance was advertised in the _______________________________________ on __________, 20__, a newspaper of general circulation in the Municipality and was duly enacted and approved as set forth at a regular meeting of the Municipality's Governing Body held on _____________, 20__.

____
Secretary

ORDINANCE APPENDIX A

STORMWATER MANAGEMENT DISTRICT
WATERSHED MAP



Location Map

Management Districts

Darby-Cobbs Watershed
Delaware/Chester/Philadelphia/Montgomery Counties, PA

ACT 167
Stormwater Management Plan
Phase II

Appendix A

Map Legend

- Subarea Boundary
- County Boundaries
- Municipal Boundaries
- Subareas
- Streams
- Water
- Interstate Roads
- U.S. Traffic Routes
- PA. Traffic Routes
- State Routes
- Township & Local Roads
- Railroads

Prepared For:
Delaware County Planning Department
Court House/Government Center
201 West Front Street
Media, PA 19063
610-891-5200

Note:

Portions of these maps were generated from existing data sources as listed below. This existing data was utilized for base mapping purposes and is shown on the maps for spatial reference only. This data did not enter into any computations or affect the reliability of the hydrologic analysis. Borton-Lawson Engineering has found some inaccuracies in some of this data and has corrected the data in locations where these discrepancies were obvious, however, it was not a part of this ACT 167 Plan to correct all of the base data.

Data Sources:
DRGs - USGS
Subareas - BLE

Borton Lawson
ENGINEERING

613 Baltimore Drive
Suite 300
Wilkes-Barre, PA 18702-7903
570-821-1999 Fax 570-821-1990

6814 Chrisphalt Drive
Suite 200
Bath, PA 18014
610-837-5916 Fax 610-837-5918

World Wide Web : http://www.borton-lawson.com

Prepared By: CGF
Check By:
Project Number: 99613.01
Date of Plot: December 2003

Management Districts Legend

	Design Storm Proposed Conditions	Reduce To	Design Storm Existing Conditions
A	2 - Year 5 - Year 10 - Year 25 - Year 100 - Year		1 - Year 5 - Year 10 - Year 25 - Year 100 - Year
B-1	2 - Year 10 - Year 25 - Year 50 - Year 100 - Year		1 - Year 5 - Year 10 - Year 25 - Year 100 - Year
B-2	2 - Year 5 - Year 25 - Year 50 - Year 100 - Year		1 - Year 2 - Year 5 - Year 10 - Year 100 - Year
C*	Provisional Discharge District (see notes below *)		

* If storms greater than the 2 - year storm cannot be conveyed to a stream or watercourse in a safe manner, then District A requirements shall apply. (See model ACT 167 Stormwater Management Ordinance, Article III Section 308 for details.)

In addition to the Management District Criteria above, the groundwater recharge (Section 305), water quality (Section 306), and streambank erosion (Section 307) requirements shall also apply to all Management Districts within the Darby-Cobbs Watershed.

file: p:\99613\01\data\gis\arcinfo\wshed.apr\Appendix A - Management Districts D

The following article provisions are optional.

ORDINANCE APPENDIX B

Voluntary stormwater management procedures for projects with less than two thousand (2,000) square feet of proposed impervious area or less than five thousand (5,000) square feet of earth disturbance

VOLUNTARY STORMWATER MANAGEMENT PROCEDURES FOR PROJECTS MEETING THE LAND COVER EXEMPTION CRITERIA

What are the Act 167 stormwater management requirements?

Pennsylvania Act 167 was authorized on October 4, 1978 (32 P.S., P.L. 864) and gave Pennsylvania Municipalities the power to regulate activities that affect stormwater runoff and surface and groundwater quantity and quality.

Who is affected by these requirements?

The Act 167 stormwater management requirements affect all NEW development in the Darby-Cobbs watershed. Individual home construction projects on single-family lots which result in less than two thousand (2,000) square feet of impervious area (including the building footprint, driveway, sidewalks, and parking areas) or less than five thousand (5,000) square feet of earth disturbance are not required to submit formal drainage plans to the Municipality or County; however, they are still encouraged to address water quality and groundwater recharge criteria specified in the Darby-Cobbs Watershed Stormwater Ordinance (Ordinance Sections 405 and 406).

Do I require professional services to meet these requirements?

This brochure has been developed to assist the individual homeowner in meeting the voluntary water quality and groundwater recharge goals of the Darby-Cobbs Watershed Stormwater Ordinance. If the guidelines presented in this brochure are followed, the individual homeowner will not require professional services to comply with these water quality and groundwater recharge goals.

What do I need to send to the Municipality?

Even though a formal drainage plan is not required for individual lot owners, a brief description of the proposed infiltration facilities, including types of material to be used, total impervious areas and volume calculations as shown above, and a simple sketch plan showing the following information shall be submitted to the municipality prior to construction by the contractor:

- Location of proposed structures, driveways, or other paved areas with approximate size in square feet.
- Location of any existing or proposed on-site septic system and/or potable water wells showing rough proximity to infiltration facilities.

Determination of Recharge Volume

The amount of recharge volume that should be provided can be determined by following the simple steps below. Impervious area calculations should include all areas on the individual lots that are covered by roof area or pavement which would prevent rain from naturally percolating into the ground, including sidewalks, driveways, or parking areas. Sidewalks, driveways, or patios that are constructed with gravel or turf pavers and will not be blacktopped in the future need not be included in this calculation.

Example Recharge Volume:

STEP 1 – Determine Total Impervious Surfaces:

House Roof (Front)	12 ft. x 48 ft.	=	576 sq. ft
House Roof (Rear)	12 ft. x 48 ft.	=	576 sq. ft.
Driveway	12 ft. x 50 ft.	=	600 sq. ft.
Parking Pad	12 ft. x 12 ft.	=	144 sq. ft.
Walkway	6 ft. x 20 ft.	=	120 sq. ft.

			2,016 sq. ft.

STEP 2 – Determine Required Infiltration Volume (Rv) Using the Following Equation

$$Rv = \frac{1.0 \text{ inch} \times (\text{total impervious area in square feet})}{12} = \underline{\qquad\qquad} \text{ cubic feet of recharge}$$

$$Rv = \frac{1.0 \text{ in} \times 2{,}016 \text{ sq. ft.}}{12} = 168 \text{ cu. ft.}$$

STEP 3 – Sizing of Select Infiltration Method

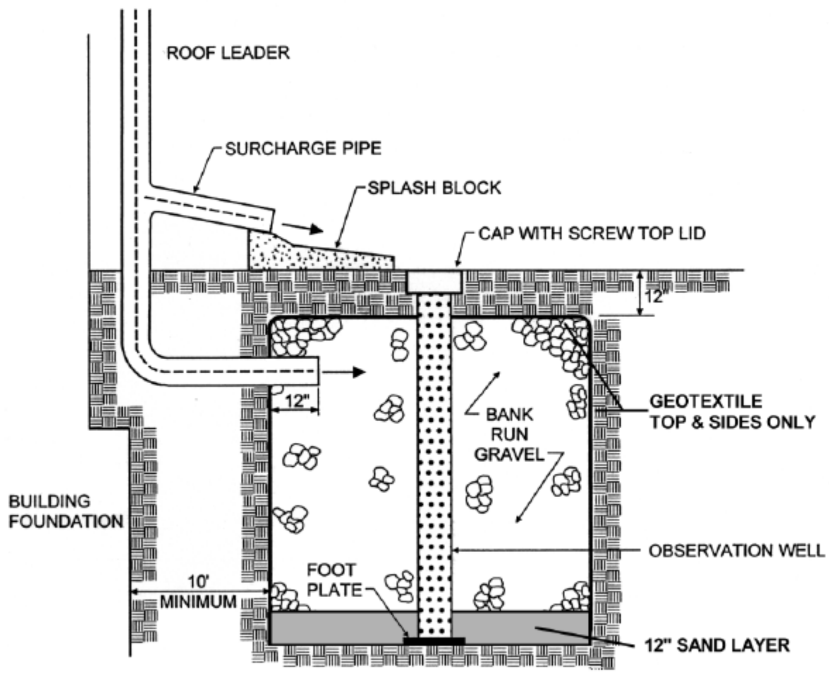
The following pages show several methods of infiltrating stormwater runoff from residential areas. Their appropriateness depends on the amount of infiltration volume required and the amount of land available. More than one method can be implemented on a site, depending on site constraints. Dry wells should be used only for receiving runoff from roof drains. Infiltration trenches are appropriate for receiving runoff from driveways, sidewalk, or parking areas. Other methods may be appropriate, but these should be discussed with the municipal Engineer prior to installation.

Dry Wells

Dry wells are effective methods of infiltrating runoff from roof leaders. These facilities should be located a minimum of ten (10) feet from the building foundation to avoid seepage problems. A dry well can be either a structural prefabricated chamber or an excavated pit filled with aggregate. Construction of a dry well should be performed after all other areas of the site are stabilized to avoid clogging. During construction, compaction of the subgrade soil should be avoided, and construction should be performed with only light machinery. Depth of dry wells in excess of three and one half (3½) feet should be avoided. Gravel fill should be an average one and one half to three (1.5 – 3.0) inches in diameter. Dry wells should be inspected at least four (4) times annually as well as after large storm events.

FIGURE B-1

TYPICAL DRY WELL CONFIGURATION



Source: Maryland Stormwater Design Manual

<u>Example Sizing:</u>

STEP 1 – Determine Total Impervious Surfaces

House Roof Area: 12 ft. x 48 ft. = 576 sq. ft.

STEP 2 – Determine Required Infiltration Volume Using Equation

$$\frac{1.0\text{ in. x }576\text{ sq. ft.}}{12} = 48\text{ cu. ft.}$$

$$\frac{48\text{ cu. ft.}}{0.4*} = 120\text{ cu. ft.}$$ (* assume 40% void ratio in gravel bed)

STEP 3 – Sizing of Select Infiltration Method

Volume of facility = Depth x Width x Length

Set D = 3.5 ft; Set W = L for a square chamber

120 cu. ft. = 3.5 x L x L; L = 5.9 ft.

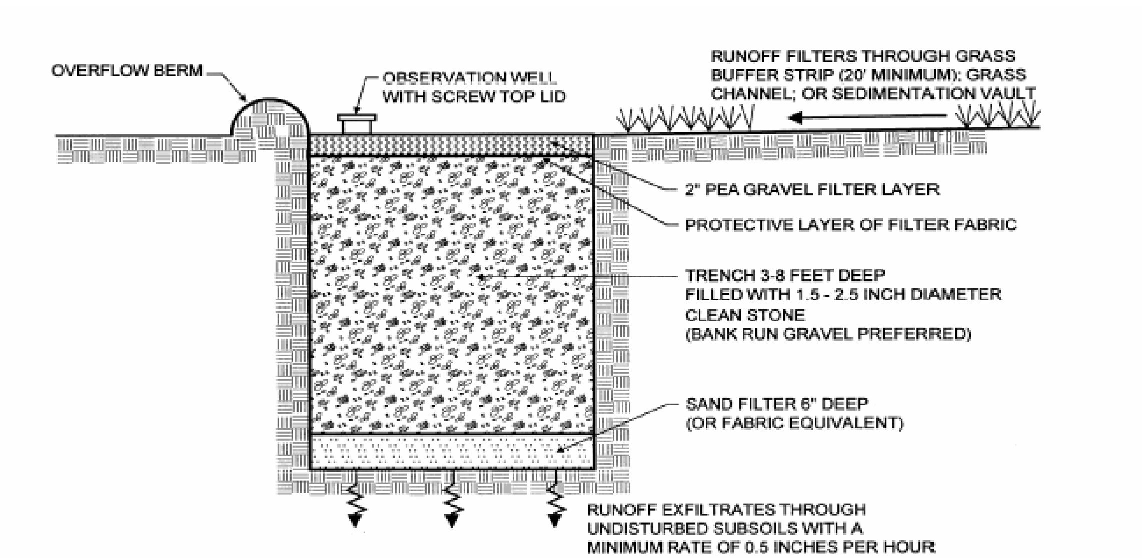
Final facility dimensions: 3.5 ft (D) x 5.9 ft. (W) x 5.9 ft. (L)

Infiltration Trenches

An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. Runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Pretreatment using buffer strips, swales, or detention basins is important for limiting amounts of coarse sediment entering the trench which can clog and render the trench ineffective.

FIGURE B-2

TYPICAL INFILTRATION TRENCH CONFIGURATION



Source: Maryland Stormwater Design Manual

<u>Example Sizing:</u>

STEP 1 – Determine Total Impervious Surfaces

Driveway	12 ft. x 50 ft.	=	600 sq. ft.
Parking Pad	12 ft. x 12 ft.	=	144 sq. ft.
Walkway	6 ft. x 20 ft.	=	120 sq. ft.
			-------------
			864 sq. ft.

STEP 2 – Determine Required Infiltration Volume Using Equation

$$\frac{1.0\,\text{in. x } 864\,\text{sq. ft.}}{12} = 72 \text{ cu. ft.}$$

$$\frac{72\,\text{cu. ft.}}{0.4\,*} = 180 \text{ cu. ft.} \quad \text{(* assume 40\% void ratio in gravel bed)}$$

STEP 3 – Sizing of Select Infiltration Method

Volume of facility = Depth x Width x Length

Set D = 3 ft: determine required surface area of trench

180 cu. ft. / 3 ft. = 60 sq. ft.

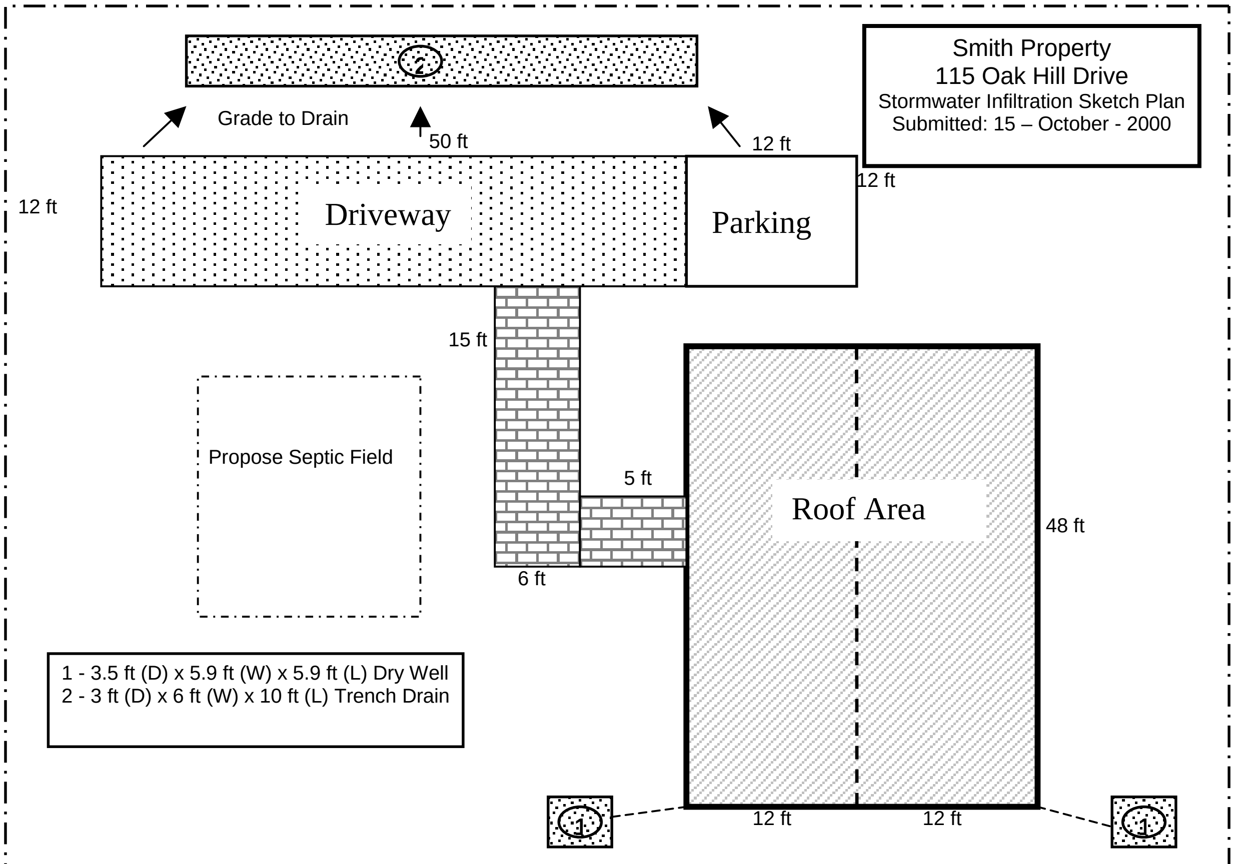
The width of the trench should be greater than 2 times its depth (2 x D); therefore, in this example, a trench width of 6 feet is selected;

Determine trench length: L = 60 sq. ft. / 6 ft. = 10 ft..

Final trench dimensions: 3 ft. (D) x 6 ft. (W) x 10 ft. (L)

FIGURE B-3

SAMPLE SITE SKETCH PLAN



Source: Maryland Stormwater Design Manual

ORDINANCE APPENDIX C - 1

SAMPLE DRAINAGE PLAN APPLICATION

SAMPLE DRAINAGE PLAN APPLICATION

(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 Plan and related data as submitted herewith in accordance with the __________________________Stormwater Management 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____

   Applicant's interest in subdivision or development
   (if other than property owner, give owner's 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. Linear feet of new road proposed____ L.F.

7. Area of proposed and existing impervious area on the 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 existing 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 criteria for the applicable management district?____

   d. Number of subarea(s) from Ordinance Appendix A of the Darby-Cobbs Creek Watershed Stormwater Management Plan____

   e. Type of proposed runoff control____

   f. Does the proposed stormwater control criteria meet the requirements/guidelines of the Stormwater Ordinance?____

   If not, what variances/waivers are requested?_____________________________________
   ____

   Reasons____

   g. Does the plan meet the requirements of Article III of the Stormwater Ordinance?_____

   If not, what variances/waivers are requested?_____________________________________

   Reasons ____
   ____

   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 Name*]___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 wetlands within the property __________________________________

e. Total acreage of wetlands 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 the development______________
____
____

CERTIFICATE OF OWNERSHIP AND ACKNOWLEDGMENT OF APPLICATION:

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF ___[*County Name*]___.

On this the ________ day of ________________, 20_____, before me, the undersigned officer, personally appeared ______________________who, being duly sworn according to law, deposes and says that ___________________________are 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.

____Property Owner

My Commission Expires____20___________
Notary Public____

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)

_____________________________ (Name of) Municipality official submission receipt:

Date complete application received __________________Plan number_______________________

Fees _______________ Date fees paid _______________ Received by_______________________

Official submission receipt date ____

Received by______________________________

____
Municipality

PROPOSED SCHEDULE OF FEES

[It is recommended that Municipalities adopt a fee schedule independent of the Ordinance so that fee schedules can be adjusted as need arises without having to go through the Ordinance revision public hearing process.]

Subdivision name______________________________ Submittal No.___________________________

Owner ______________________________________ Date___________________________________

Engineer____

1. Filing fee	$____________
2. Proposed 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	$____________
2d. Other	$____________
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 3,500-43,560 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.	$____________
5. Stormwater control measures	
5a. Detention basins and other controls which require a review of hydraulic routings ($ 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 25% of the amount of the initial review fee unless a new application is required as per Section 306 of the Stormwater Ordinance. A new fee shall be submitted with each revision in accordance with this schedule.

ORDINANCE APPENDIX C – 2

DRAINAGE PLAN CHECKLIST

Delaware County Conservation District
Rose Tree Park – Hunt Club
1521 N. Providence Rd.
Media, PA 19063
Phone: 610-892-9484
Fax: 610-892-9489
Email: Info@delcocd.org

Project: ______________________________
Municipality: ______________________________
Engineer: ______________________________
Submittal No: ____________________
Date: ____________________
Project ID: ____________________ (for County use ONLY)

ARTICLE I: GENERAL PROVISIONS

Reference: Section 105 Applicability/Regulated Activities

1. Is the Proposed Project within the Darby-Cobbs, Crum or Ridley Creek watershed? ☐ Yes ☐ No
2. Does the Proposed Project meet the definition of a "Regulated Activity"? ☐ Yes ☐ No

STOP – If you have checked NO for either of the above questions, you are not required to submit a Storm Water Management Plan under the Darby-Cobbs Creek Storm Water management Ordinance.

ARTICLE I: GENERAL PROVISIONS

Reference: Section 106 Exemptions

Note: Parent Tract refers to the total parcel configuration on June 30,2005 and includes any subdivision of lands which may have occurred after than date.

Parent Tract Area: __________ acres

Total Existing Impervious Area (as of June 30, 2005): __________ acres
Total New Impervious Area (all Phases): __________ acres

Parcel IS Exempt ☐ Parcel IS NOT Exempt ☐

ARTICLE IV: STORMWATER MANAGEMENT

Reference: Section 404 Nonstructural Project Design

1. Has an Existing Resource and Site Analysis Map (ERSAM) been prepared?

☐ Yes ☐ No, Explain ______________________________
____
____

ARTICLE IV: STORMWATER MANAGMENT (Continued)

2. Are any of the following Environmentally Sensitive areas identified on site?

Steep Slopes	☐ Yes	☐ No	☐ Unknown
Ponds / Lakes / Vernal Pools	☐ Yes	☐ No	☐ Unknown
Streams	☐ Yes	☐ No	☐ Unknown
Wetlands	☐ Yes	☐ No	☐ Unknown
Hydric Soils	☐ Yes	☐ No	☐ Unknown
Flood plains	☐ Yes	☐ No	☐ Unknown
Stream Buffer Zones	☐ Yes	☐ No	☐ Unknown
Hydrologic Soil Groups A or B	☐ Yes	☐ No	☐ Unknown
Recharge Areas	☐ Yes	☐ No	☐ Unknown
Others: ____________________	☐ Yes	☐ No	☐ Unknown

3. Does the site layout plan avoid Environmentally Sensitive Areas identified on site?

   ☐ Yes ☐ No, Explain ____
   ____
   ____

4. Has a stream buffer been established per Section 406.G.?

   ☐ Yes ☐ No, Explain ____
   ____
   ____

ARTICLE IV: STORMWATER MANAGEMENT

Reference: Section 405 Groundwater Recharge

1. Is the proposed activity considered a “Stormwater Hotspot”? ☐ Yes ☐ No

2. Have provisions been installed to promote groundwater recharge on site?

   ☐ Yes ☐ No, Explain ____
   ____
   ____

3. Total Recharge Volume Required:__________ cubic feet (using: ☐ Method A; ☐ Method B)

4. How is the Required Recharge Volume being addressed?

☐ Infiltration Trench	☐ Dry Swales
☐ Infiltration Basin	☐ Other: ____________________
☐ Bioretention	

ARTICLE IV: STORMWATER MANAGEMENT

Reference: Section 406 Water Quality Requirements

1. Have provisions been installed to address stormwater runoff water quality on site?

   ☐ Yes ☐ No, Explain ____
   ____
   ____

2. Total Water Quality Volume Required: __________ acre feet

3. Is the site in a Special Protection watershed which includes Exceptional Value (EV) of High Quality (HQ) waters? ☐ Yes ☐ No

4. How is the Required Water Quality Volume being addressed?

☐ Wet Detention Basin	☐ Sand Filter
☐ Extended Dry Detention Basin	☐ Constructed Wetlands
☐ Bioretention	☐ Other: ____________________

ARTICLE IV: STORMWATER MANAGMENT

Reference: Section 407 Streambank Erosion Requirements

1. Has the 2- year proposed conditions flow been reduced to the 1- year existing conditions flow?

   ☐ Yes ☐ No, Explain ____
   ____
   ____

2. Does the proposed conditions 1- year storm drain over a minimum 24- hour period?

   ☐ Yes ☐ No, Explain ____
   ____
   ____

ARTICLE IV: STORMWATER MANAGEMENT

Reference: Section 408 Stormwater Peak Rate Control and Management Districts

1. In which of the following Storm Water Management District(s) is the site located?

☐ A	☐ B-2
☐ B-1	☐ C

2. Does the Proposed Conditions Runoff meet the Criteria established in Table 408.1?

   ☐ Yes ☐ No, if you answered Yes proceed to Section V.

ARTICLE IV: STORMWATER MANAGEMENT (continued)

a. Are you claiming “No Harm” as described in Section 408.__ in lieu of meeting the requirements of this District?

☐ Yes ☐ No, Explain ____

b. If you are claiming “No Harm”, has a Downstream Impacts Evaluation been prepared in accordance with Section 408.__?

☐ Yes ☐ No, Explain ____

c. Are claiming “Hardship”, as described in Section 408.__. in lieu of meeting the requirements of this District?

☐ Yes ☐ No, Explain ____

ARTICLE IV: STORMWATER MANAGEMENT

Reference: Section 409 Calculation Methodology

1. Which method(s) are utilized in the site stormwater management plan for computing stormwater runoff rates and volumes?

☐ TR-20	☐ PSRM
☐ TR-55	☐ Rational Method
☐ HEC-1 / HEC-HMS	☐ Other:____________________

2. Were Table F-1 or Figure F-4 in Appendix F utilized in rainfall determination?

☐ Yes ☐ No, Explain ____

3. Were Table F-2 (Runoff Curve Numbers) or Table F-3 in the Appendix F (Rational Runoff Coefficients) utilized in calculations for runoff?

☐ Yes ☐ No, Explain ____

4. For any proposed storm water detention facility, were the appropriate design storms routed through the facility using the Storage-Indication Method?

☐ Yes ☐ No, Explain ____

ARTICLE IV: STORMWATER MANAGEMENT

Reference: Section 410 Other Requirements

1. Is this project subject to PENNDOT approval?

   ☐ Yes ☐ No

   a. If "YES" have these plans been forwarded to PENNDOT for review?

      ☐ Yes ☐ No, Explain ____

      ____

2. Have proposed wet detention basins incorporated biologic control consistent with the West Nile Guidelines presented in Appendix H?

   ☐ Yes ☐ No ☐ Not Applicable

3. Are any proposed stormwater facilities subject to PADEP Chapter 105 permitting?

   ☐ Yes ☐ No

   a. If "YES" have these plans been forwarded to PADEP for review?

      ☐ Yes ☐ No, Explain ____

      ____

ARTICLE VII: MAINTENANCE RESPONSIBLITIES

Reference: Section 702 Responsibilities for Operations and Maintenance of Stormwater Controls/BMPs

1. Has a Stormwater Control and BMP Operations and Maintenance Plan been approved by the Municipality?

   ☐ Yes ☐ No, Explain ____

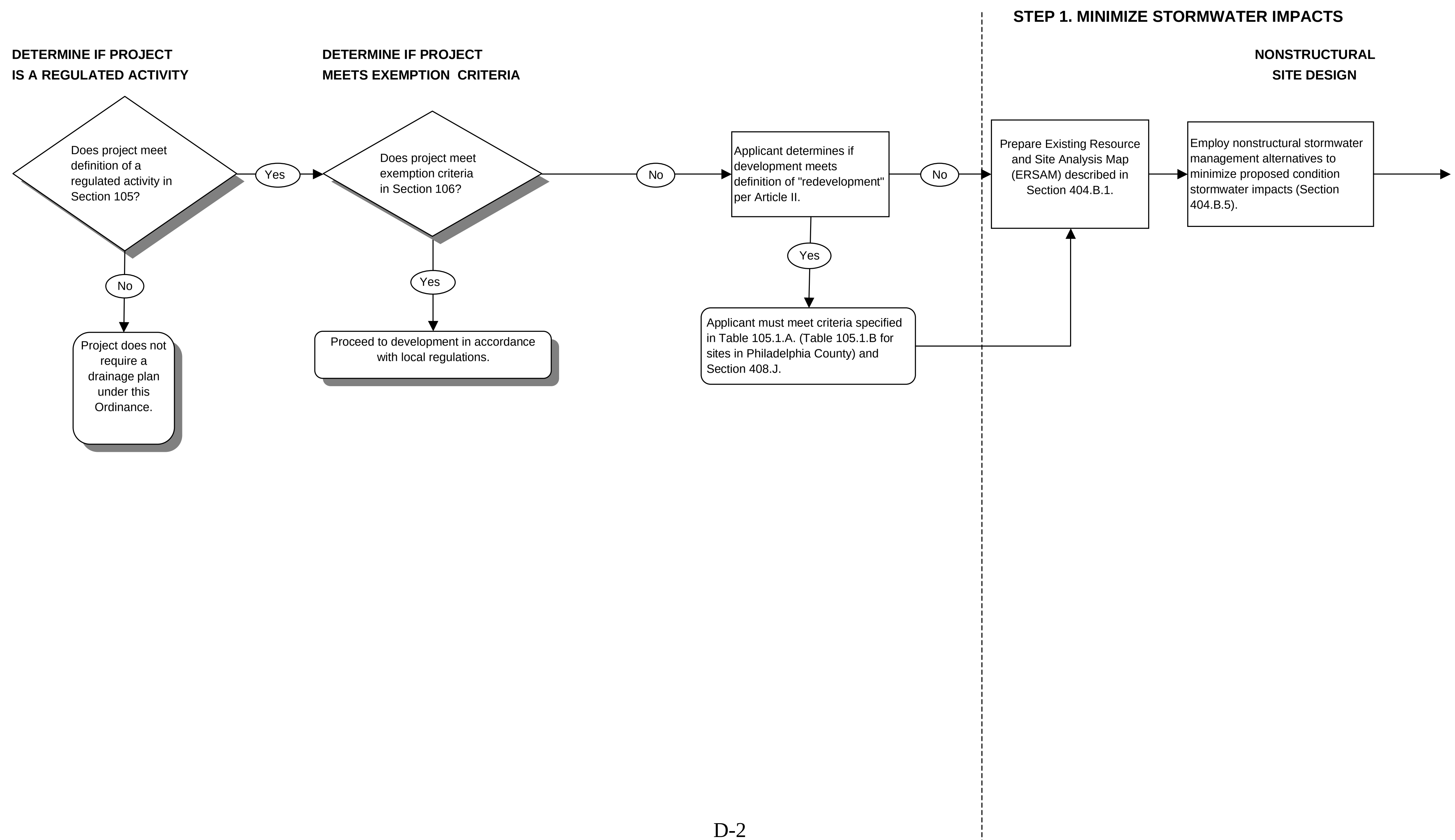
   ____

2. Who shall assume responsibility for implementing the Stormwater Control and BMP Operations and Maintenance Plan?

   ☐ Municipality ☐ Homeowner Association
   ☐ Private Owner ☐ Other ______________

ORDINANCE APPENDIX D
IMPLEMENTATION FLOW CHARTS

DARBY AND COBBS CREEKS WATERSHED STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Applicant Plan Preparation Procedure



DARBY AND COBBS CREEKS WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Applicant Plan Preparation Procedure

STEP 1. MINIMIZE STORMWATER IMPACTS

INFILTRATION REQUIREMENTS

Provide infiltration facilities to address runoff from all impervious surfaces in areas of suitable soil.
infiltration volume shall be based upon criteria in Section 405.

→

WATER QUALITY REQUIREMENTS

Provide water quality best management practices.
Water quality volume shall be based upon criteria in Section 406.

→

STREAM BANK EROSION REQUIREMENTS

Reduce the proposed conditions 2- yr, 24-hour design storm flow to the exisitng conditions 1-yr, 24-hour flow. Drain proposed conditions 1- yr, 24-hour storm over 24 hour period (Section 407).

→

MANAGEMENT DISTRICT REQUIREMENTS

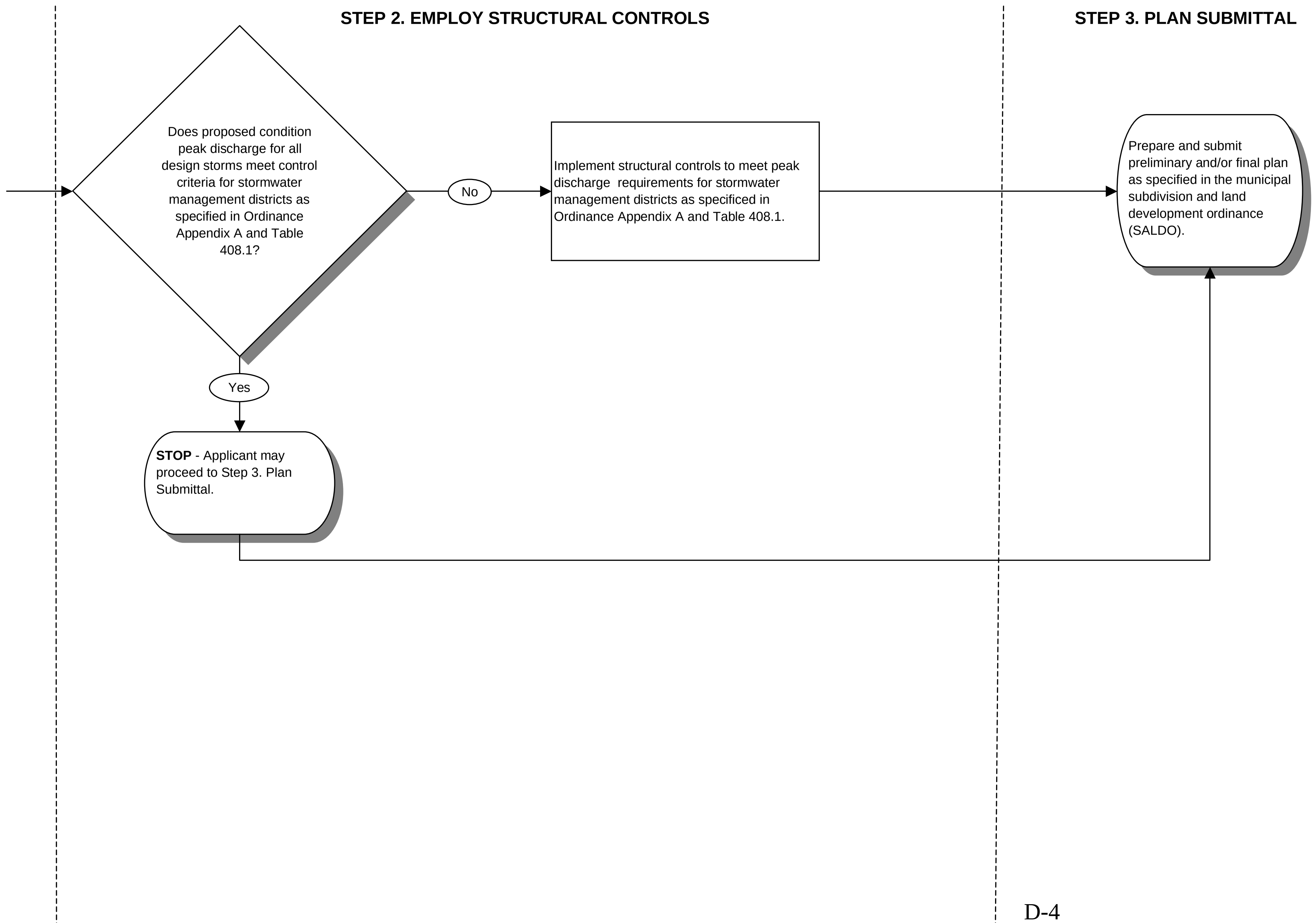
Determine which management district the site falls into (Ordinance Appendix A and Table 408.1). Conduct existing conditions runoff analysis using criteria established in Section 409.

→

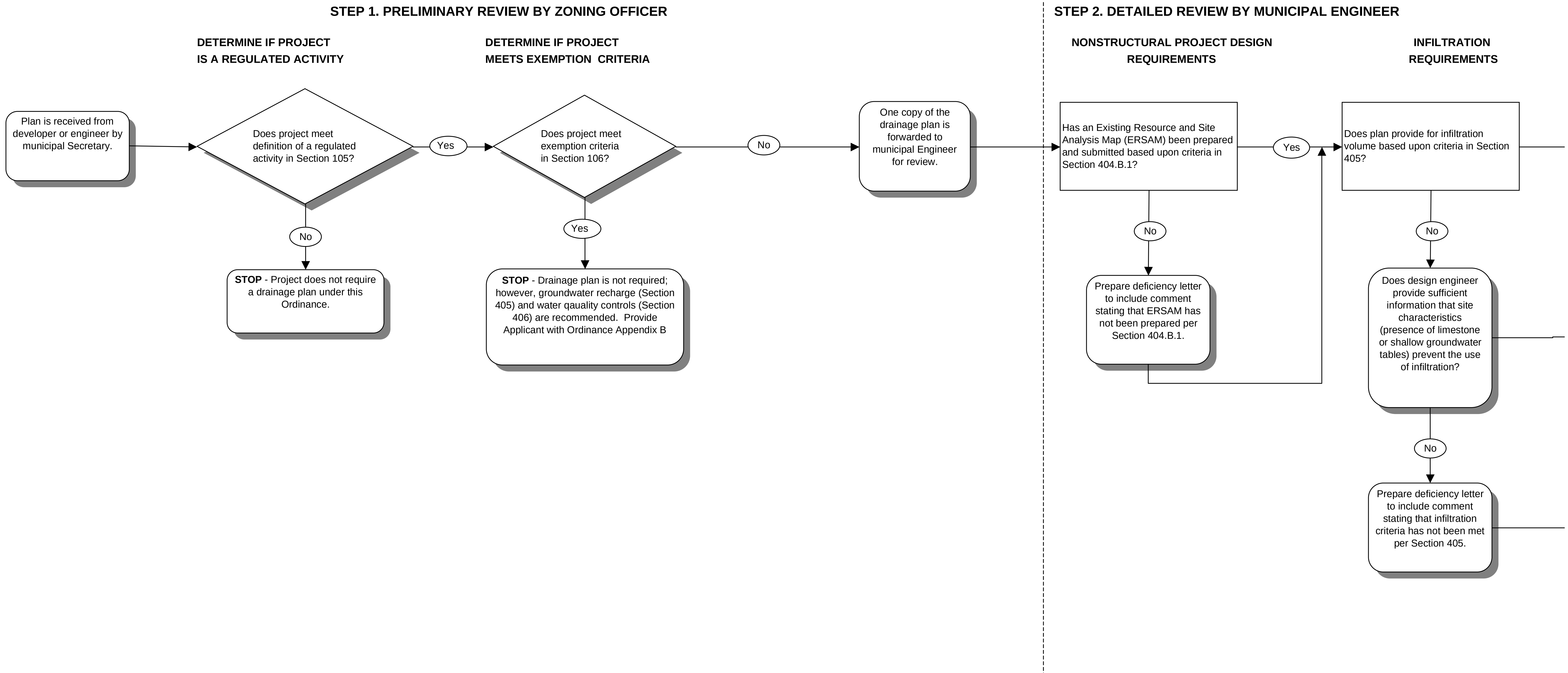
Prepare final project design as specified in Section 404.B.10. Conduct proposed conditions runoff analysis using criteria established in Section 409.

→

DARBY AND COBBS CREEKS WATERSHED STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan Applicant Plan Preparation Procedure

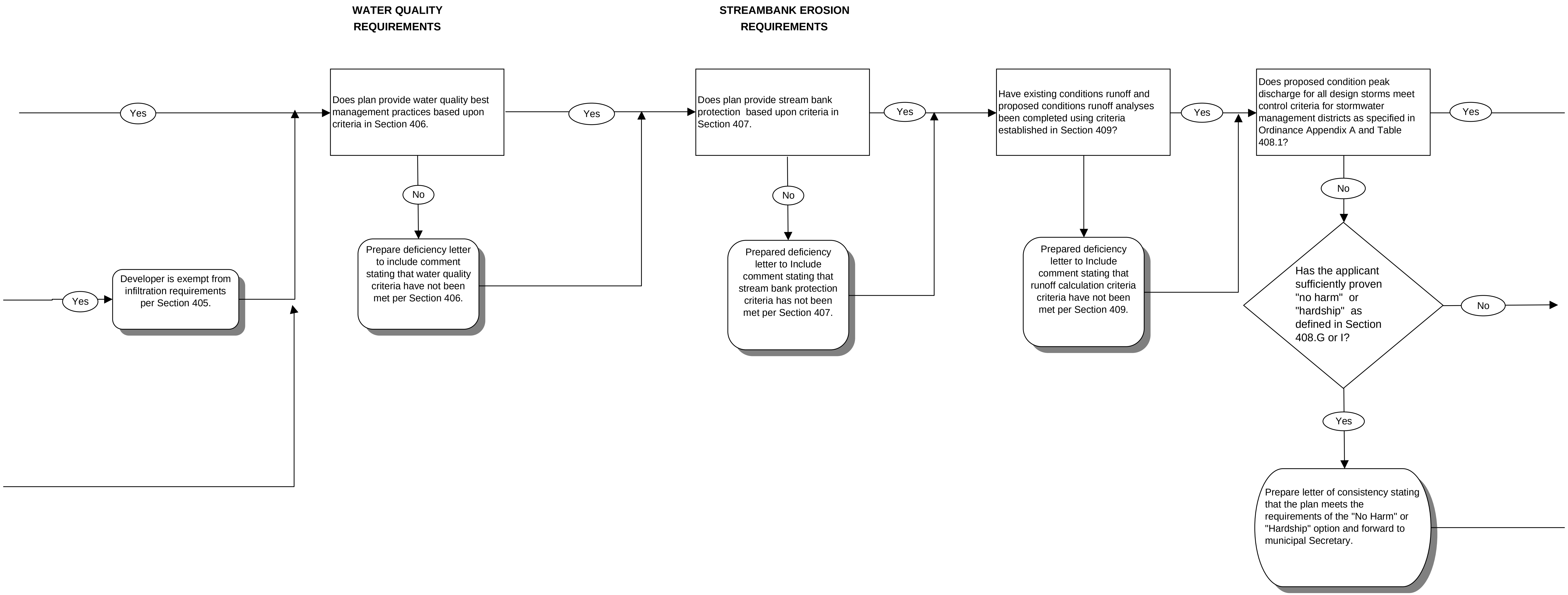


DARBY AND COBBS CREEKS WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Municipal Review Procedure

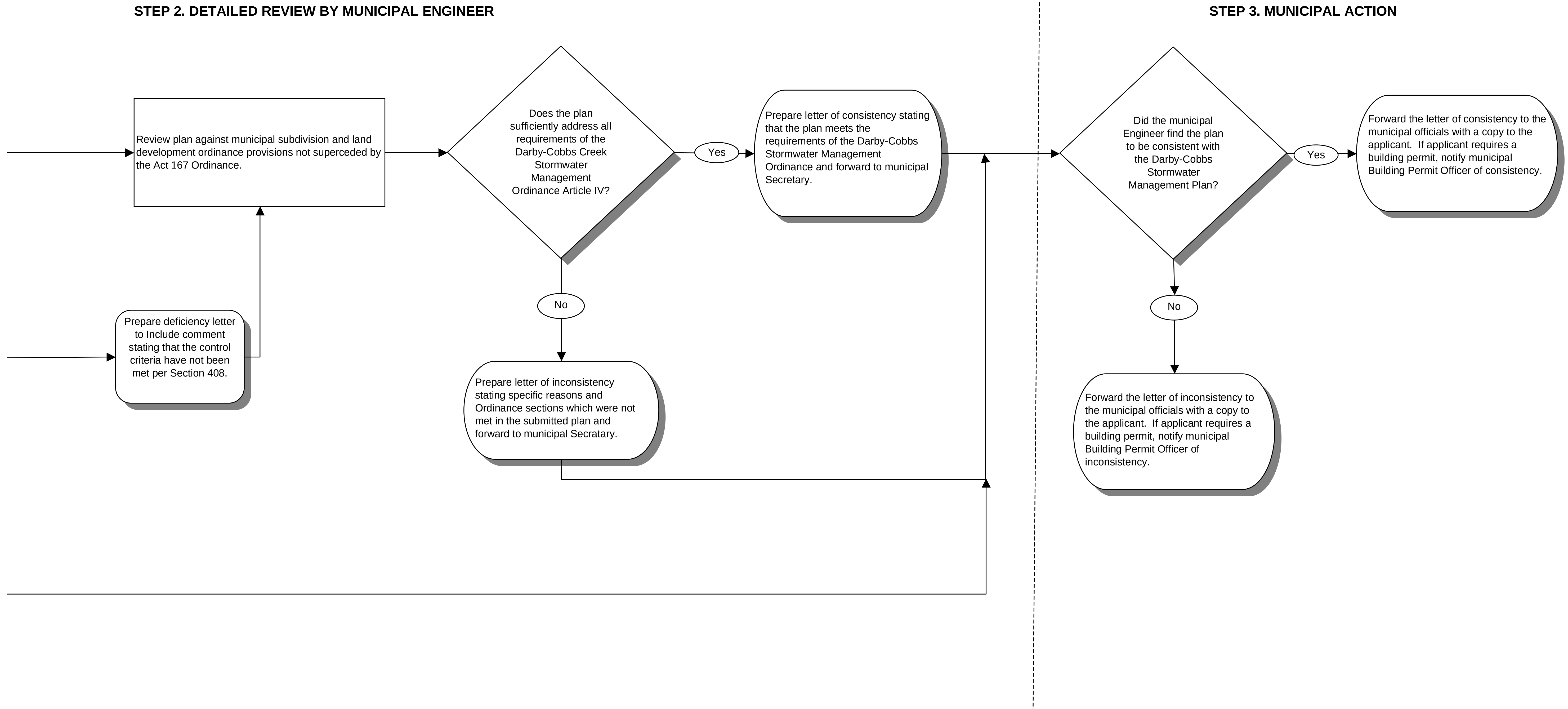


DARBY AND COBBS CREEKS WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Municipal Review Procedure

STEP 2. DETAILED REVIEW BY MUNICIPAL ENGINEER



DARBY AND COBBS CREEKS WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Municipal Review Procedure



ORDINANCE APPENDIX E

LOW IMPACT DEVELOPMENT (LID) PRACTICES

LOW IMPACT DEVELOPMENT (LID) PRACTICES

ALTERNATIVE APPROACH FOR MANAGING STORMWATER RUNOFF

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

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

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

- **Preserving Natural Drainage Features**. Protecting natural drainage features, particularly vegetated drainage swales and channels, is desirable because of their ability to infiltrate and attenuate flows and to filter pollutants. However, this objective is often not accomplished in land development. In fact, commonly held drainage philosophy encourages just the opposite pattern – streets and adjacent storm sewers are typically located in the natural headwater valleys and swales, thereby replacing natural drainage functions with a completely impervious system. As a result, runoff and pollutants generated from impervious surfaces flow directly into storm sewers with no opportunity for attenuation, infiltration, or filtration. Developments designed to fit site topography also minimize the amount of grading on site.

- **Protecting Natural Depression Storage Areas**. Depressional storage areas either have no surface outlet or drain very slowly following a storm event. They can be commonly seen as ponded areas in farm fields during the wet season or after large runoff events. Traditional development practices eliminate these depressions by filling or draining, thereby obliterating their ability to reduce surface runoff volumes and trap pollutants. The volume and release rate characteristics of depressions should be protected in the design of the development site. The depressions can be protected by simply avoiding the depression or by incorporating its storage as additional capacity in required detention facilities.

- **Avoiding Introduction of Impervious Areas**. Careful site planning should consider reducing impervious coverage to the maximum extent possible. Building footprints, sidewalks, driveways, and other features producing impervious surfaces should be evaluated to minimize impacts on runoff.

- **Reducing the Hydraulic Connectivity of Impervious Surfaces**. Impervious surfaces are significantly less of a problem if they are not directly connected to an impervious conveyance system (such as a storm sewer). Two basic ways to reduce hydraulic connectivity are routing of roof runoff over lawns and reducing the use of storm sewers. Site grading should promote increasing travel time of stormwater runoff and should help reduce concentration of runoff to a single point in the development.

- **Routing Roof Runoff Over Lawns**. Roof runoff can be easily routed over lawns in most site designs. The practice discourages direct connection of downspouts to storm sewers or parking lots. The practice also discourages sloping driveways and parking lots to the street. By routing roof drains and crowning the driveway to run off to the lawn, the lawn is essentially used as a filter strip.

- **Reducing the Use of Storm Sewers**. By reducing use of storm sewers for draining streets, parking lots, and back yards, the potential for accelerating runoff from the development can be greatly reduced. The practice requires greater use of swales and may not be practical for some development sites, especially if there are concerns for areas that do not drain in a “reasonable” time. The practice requires educating local citizens and public works officials who expect runoff to disappear shortly after a rainfall event.

- **Reducing Street Widths**. Street widths can be reduced by either eliminating on-street parking or by reducing roadway widths. Municipal planners and traffic designers should encourage narrower neighborhood streets which ultimately could lower maintenance.

- **Limiting Sidewalks to One Side of the Street**. A sidewalk on one side of the street may suffice in low-traffic neighborhoods. The lost sidewalk could be replaced with bicycle/recreational trails that follow back-of-lot lines. Where appropriate, backyard trails should be constructed using pervious materials.

- **Using Permeable Paving Materials**. These materials include permeable interlocking concrete paving blocks or porous bituminous concrete. Such materials should be considered as alternatives to conventional pavement surfaces, especially for low use surfaces such as driveways, overflow parking lots, and emergency access roads.

- **Reducing Building Setbacks**. Reducing building setbacks reduces impervious cover associated with driveway and entry walks and is most readily accomplished along low-traffic streets where traffic noise is not a problem.

- **Constructing Cluster Developments**. Cluster developments can also reduce the amount of impervious area for a given number of lots. The biggest savings occurs with street length, which also will reduce costs of the development. Cluster development groups the construction activity in less-sensitive areas without substantially affecting the gross density of development.

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

ORDINANCE APPENDIX F

STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE F-1
DESIGN STORM RAINFALL AMOUNT

FIGURE F-1
ALTERNATING BLOCK METHOD FOR RAINFALL DISTRIBUTION

FIGURE F-2
PENNDOT DELINEATED REGIONS

FIGURE F-3
NRCS (SCS) TYPE II RAINFALL DISTRIBUTION – S CURVE

FIGURE F-4
PENNDOT REGION 5 STORM INTENSITY-DURATION-FREQUENCY CURVE

TABLE F-2
RUNOFF CURVE NUMBERS

TABLE F-3
RATIONAL RUNOFF COEFFICIENTS

TABLE F-4
MANNING'S ROUGHNESS COEFFICIENTS

TABLE F-5
NONSTRUCTURAL STORMWATER MANAGEMENT MEASURES

MEMORANDUM 1
UPDATED PRECIPITATION ESTIMATES

TABLE F-1

DESIGN STORM RAINFALL AMOUNT (INCHES) *

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

Region 5

Precipitation Depth (in)

Duration	1 Yr	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
5 min	0.33	0.38	0.45	0.50	0.56	0.63	0.68
15 min	0.64	0.75	0.90	1.00	1.15	1.35	1.50
1 hr	1.10	1.35	1.61	1.85	2.15	2.60	2.98
2 hrs	1.34	1.66	2.00	2.34	2.70	3.26	3.76
3 hrs	1.50	1.86	2.28	2.67	3.09	3.69	4.29
6 hrs	1.86	2.28	2.82	3.36	3.90	4.62	5.40
12 hrs	2.28	2.76	3.48	4.20	4.92	5.76	6.72
24 hrs	2.64	3.36	4.32	5.28	6.24	7.20	8.40

Source: *Field Manual of Pennsylvania Department of Transportation*, Storm Intensity-Duration-Frequency Charts, PDT- IDF, May 1986.

* Refer to Memorandum 1, dated March 9, 2005, attached to the end of Appendix F, which permits use of new precipitation estimates from the National Weather Service's Hydrometeorological Design Studies Center

FIGURE F-1

ALTERNATING BLOCK METHOD FOR RAINFALL DISTRIBUTION

The Alternating Block Method can be utilized to develop design hydrographs from the PennDOT Storm Intensity-Duration-Frequency (PDT-IDF) curves. This method redistributes the incremental rainfall values developed from the PDT-IDF curves in a quasi-symmetrical form, where the block of maximum incremental depth is positioned at the middle of the required duration, and the remaining blocks of rainfall are arranged in descending order, alternately to the right and to the left of the central block. Example F-1 below shows this method for a 100-year, 2-hour duration storm with 10-minute time intervals.

Example F-1

100-year, 2-hour Duration Storm Hydrograph Development
Region 5

(1)	(2)	(3)	(4)	(5)
Time (min)	100-yr Rainfall Intensity (inches/hr)	100-yr Accumulated Rainfall Depth (inches)	100-yr Incremental Rainfall Depth (inches)	100-yr Rainfall Distribution (inches)
0	0.00	0.00	0.00	0.00
10	6.91	1.15	1.15	0.07
20	5.34	1.78	0.63	0.15
30	4.41	2.21	0.43	0.21
40	3.78	2.52	0.32	0.26
50	3.33	2.78	0.26	0.43
60	2.98	2.98	0.21	1.15
70	2.75	3.20	0.22	0.63
80	2.51	3.35	0.15	0.32
90	2.28	3.42	0.07	0.22
100	2.15	3.58	0.16	0.16
110	2.01	3.69	0.11	0.11
120	1.88	3.76	0.07	0.07

Source: *Applied Hydrology*, Chow, Maidment, Mays, 1988

Notes :

Values from Column (2) are derived from the appropriate rainfall chart based on the location of the site under analysis. (Region 5 in this example, therefore, use Figure F-3)

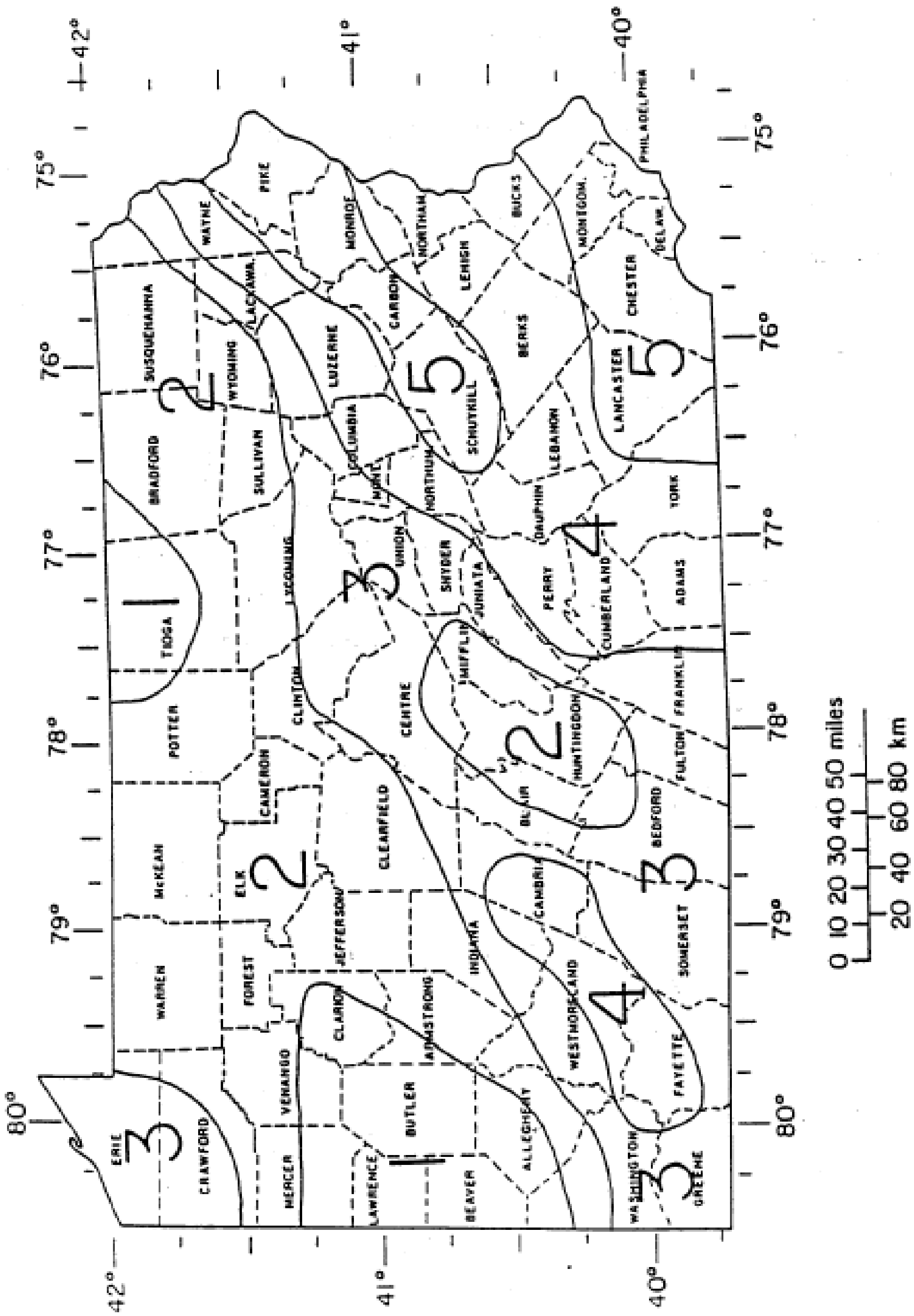
Column (3) = Column (2) * Column (1) / 60 minutes (i.e., 6.91 inches / hr * 10 min / 60 = 1.15).

Column (4) = Difference in Column (3) for each time interval (i.e., 1.78 – 1.15 = 0.63).

Column (5) is Column (4) rearranged with the maximum increment from Column (4) placed at the middle of the event (time = 60 minutes, in this example), then rearranging the remaining values from Column (4) in descending order, alternately right and left (below and above) the central block.

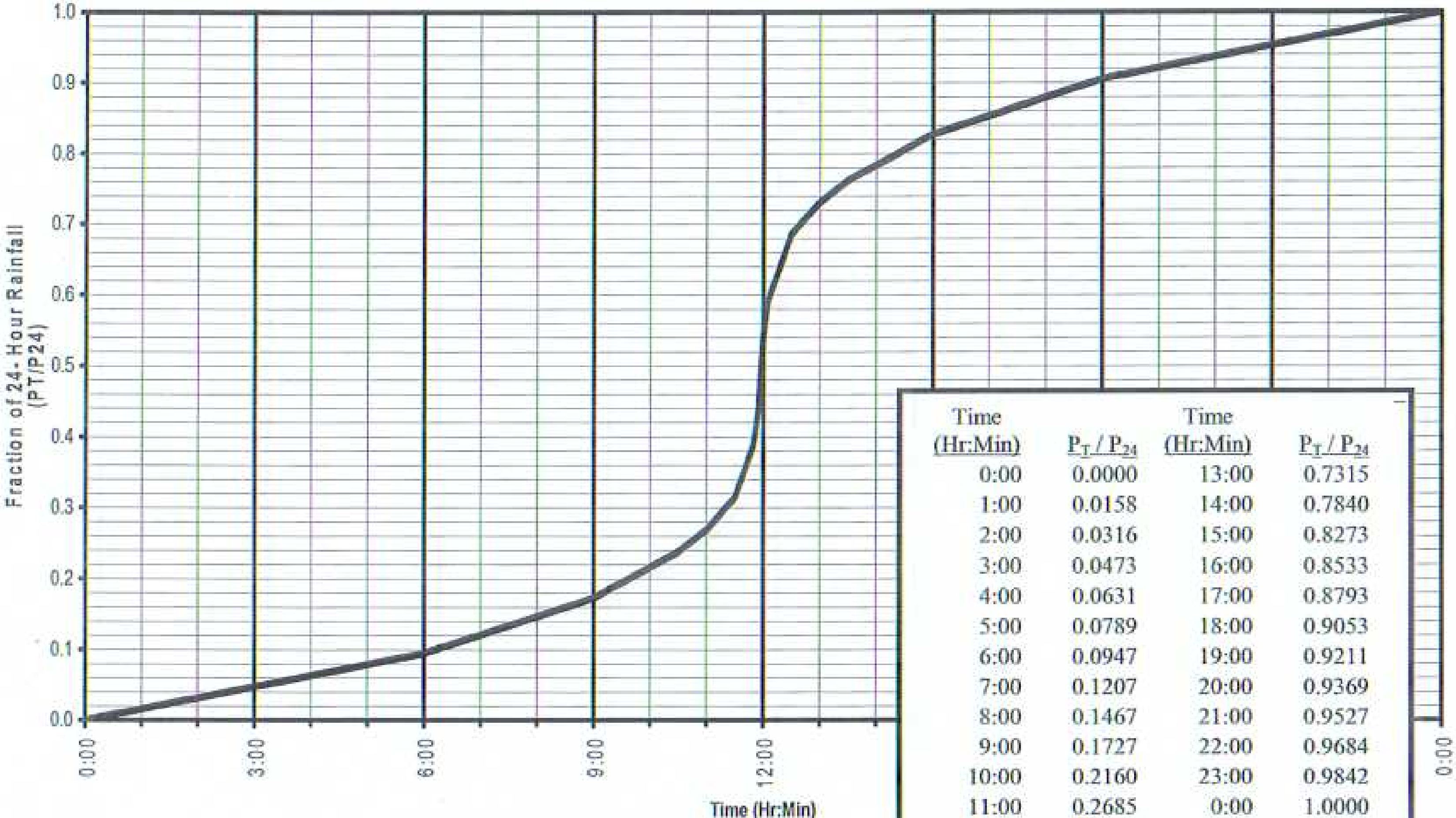
FIGURE F-2

PENNDOT DELINEATED REGIONS



Source: *Field Manual of Pennsylvania Department of Transportation,* Storm Intensity-Duration-Frequency Charts, PDT- IDF, May 1986.

FIGURE F-3
NRCS (SCS) TYPE II
RAINFALL DISTRIBUTION – S CURVE

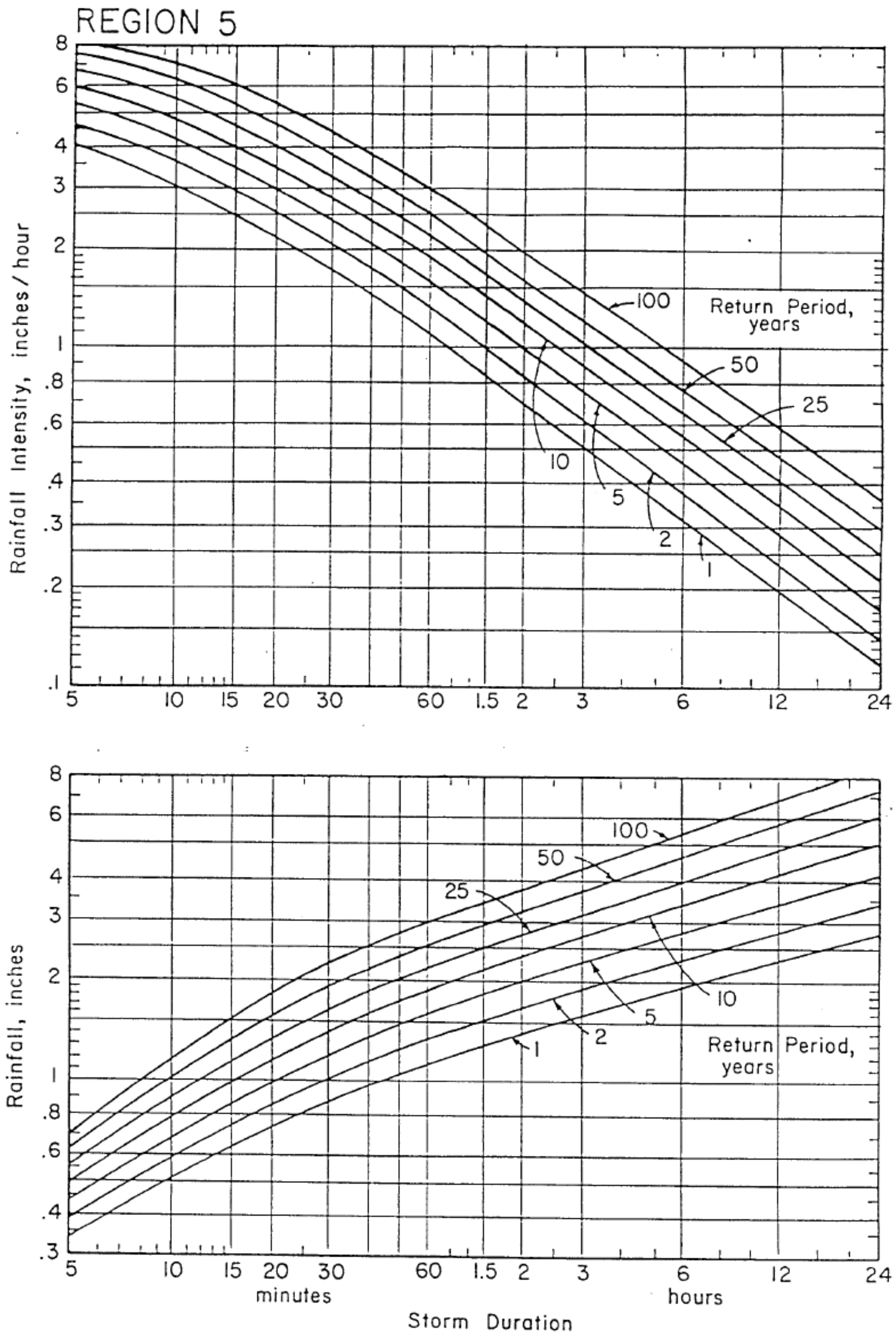


Time (Hr:Min)	P_T / P_{24}	Time (Hr:Min)	P_T / P_{24}
0:00	0.0000	13:00	0.7315
1:00	0.0158	14:00	0.7840
2:00	0.0316	15:00	0.8273
3:00	0.0473	16:00	0.8533
4:00	0.0631	17:00	0.8793
5:00	0.0789	18:00	0.9053
6:00	0.0947	19:00	0.9211
7:00	0.1207	20:00	0.9369
8:00	0.1467	21:00	0.9527
9:00	0.1727	22:00	0.9684
10:00	0.2160	23:00	0.9842
11:00	0.2685	0:00	1.0000
12:00	0.5403		

Note: Rainfall Distribution Curve developed from PennDOT Rainfall Intensity-Duration-Frequency Curves (Aron, 1986)

FIGURE F-4

PENNDOT REGION 5 STORM INTENSITY-DURATION-FREQUENCY CURVE



Source: *Field Manual of Pennsylvania Department of Transportation,*
Storm Intensity-Duration-Frequency Charts, PDT- IDF, May 1986.

TABLE F-2

RUNOFF CURVE NUMBERS

LAND USE DESCRIPTION	Hydrologic Condition	HYDROLOGIC SOIL GROUP A	B	C	D
Open Space					
Grass cover < 50%	Poor	68	79	86	89
Grass cover 50% to 75%	Fair	49	69	79	84
Grass cover > 75%	Good	39	61	74	80
Meadow		30	58	71	78
Agricultural					
Pasture, grassland, or range – Continuous forage for grazing	Poor	68	79	86	89
Pasture, grassland, or range – Continuous forage for grazing	Fair	49	69	79	84
Pasture, grassland, or range – Continuous forage for grazing	Good	39	61	74	80
Brush—brush-weed-grass mixture with brush the major element	Poor	48	67	77	83
Brush—brush-weed-grass mixture with brush the major element	Fair	35	56	70	77
Brush—brush-weed-grass mixture with brush the major element	Good	30	48	65	73
Fallow Bare soil	-------	77	86	91	94
Crop residue cover (CR)	Poor	76	85	90	93
	Good	74	83	88	90
Woods – grass combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77

Commercial	(85% impervious)	89	92	94	95
Industrial	(72% impervious)	81	88	91	93
Institutional	(50% impervious)	71	82	88	90
Residential districts by average lot size:					
	% Impervious				
1/8 acre or less * (townhouses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Farmstead		59	74	82	86
Smooth surfaces (concrete, asphalt, gravel, or bare compacted soil)		98	98	98	98
Water		98	98	98	98
Mining/newly graded areas (pervious areas only)		77	86	91	94

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

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

Source: NRCS (SCS) TR-55

TABLE F-3

RATIONAL RUNOFF COEFFICIENTS

	HYDROLOGIC SOIL GROUP			
LAND USE DESCRIPTION	A	B	C	D
Cultivated land : without conservation treatment	.49	.67	.81	.88
: with conservation treatment	.27	.43	.61	.67
Pasture or range land: poor condition	.38	.63	.78	.84
: good condition	---*	.25	.51	.65
Meadow: good condition	---*	---*	.44	.61
Woods: thin stand, poor cover, no mulch	---*	.34	.59	.70
: good cover	---*	---*	.45	.59
Open spaces, lawns, parks, golf courses, cemeteries				
Good condition: grass cover on 75% or more of the area	---*	.25	.51	.65
Fair condition: grass cover on 50% to 75% of the area	---*	.45	.63	.74
Commercial and business areas (85% impervious)	.84	.90	.93	.96
Industrial districts (72% impervious)	.67	.81	.88	.92
Residential:				
Average lot size — Average % impervious				
1/8 acre or less — 65	.59	.76	.86	.90
1/4 acre — 38	.25	.49	.67	.78
1/3 acre — 30	---*	.49	.67	.78
1/2 acre — 25	---*	.45	.65	.76
1 acre — 20	---*	.41	.63	.74
Paved parking lots, roofs, driveways, etc.	.99	.99	.99	.99
Streets and roads:				
Paved with curbs and storm sewers	.99	.99	.99	.99
Gravel	.57	.76	.84	.88
Dirt	.49	.69	.80	.84

Notes: Values are based on SCS definitions and are average values**.**
Values indicated by ---* should be determined by the design engineer based on site characteristics.

Source : New Jersey Department of Environmental Protection, *Technical Manual for Stream Encroachment,* August 1984

TABLE F-4

MANNING'S ROUGHNESS COEFFICIENTS

Roughness Coefficients (Manning's "n") for Overland Flow

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 Channel Flow

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

(1) Depending upon type, coating, and diameter

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

Source: U.S. Army Corps of Engineers, HEC-1 Users Manual

TABLE F-5

NONSTRUCTURAL STORMWATER MANAGEMENT MEASURES

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

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

Memorandum 1

To: Karen Holm

From: Paul DeBarry

Date: March 9, 2005

Subject: New Rainfall Data

The National Weather Service's Hydrometeorological Design Studies Center recently published updated precipitation estimates for much of the United States, including Pennsylvania. NOAA Atlas 14 supercedes previous precipitation estimates such as Technical Memorandum NWS Hydro 35 and Technical Papers 40 and 49 (TP-40 and TP-49) because the updates are based on more recent and expanded data, current statistical techniques, and enhanced spatial interpolation and mapping procedures. (Bonnin et al., 2003 and NWS, 2004) The "Precipitation-Frequency Atlas of the United States," NOAA Atlas 14, provides estimates of 2-year through 1000-year storm events for durations ranging from 5 minutes to 60 days as shown for Harrisburg in Table 9-2 (available online at http://hdsc.nws.noaa.gov/hdsc/pfds/). Users can select precipitation estimates for Pennsylvania from over 300 observation sites, by entering latitude/longitude coordinates, or by clicking on an interactive map on the Precipitation Frequency Data Server. Data is still being processed, however, if available, these new rainfall estimates may be utilized for all applicable stormwater calculations.

ORDINANCE APPENDIX G
REFERENCES

REFERENCES

BMP Manuals

California
California Stormwater BMP Handbook: New Development and Redevelopment (January 2003) – separate file available at https://www.casqa.org/resources/bmp-handbooks

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

Maryland
2000 Maryland Stormwater Design Manual – https://mde.maryland.gov/programs/water/stormwatermanagementprogram/pages/stormwater_design.aspx

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

Minnesota
Minnesota Urban Small Sites BMP Manual: Stormwater Best Management Practices for Cold Climates (July 2001) – **https://www.pca.state.mn.us/water/stormwater-best-management-practices-manual**

New Jersey
Revised Manual for New Jersey: Best Management Practices for Control of Nonpoint Source Pollution from Stormwater (Fifth Draft May 2000) – NJDEP New Jersey Department of Environmental Protection (state.nj.us)

New York
New York State Stormwater Management Design Manual (2001) – https://www.dec.ny.gov/chemical/29072.html

Pennsylvania
Pennsylvania Association of Conservation Districts, Pennsylvania Handbook of Best Management Practices for Developing Areas, November 14, 1997.

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

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

USEPA Infiltration Trench Fact Sheet (September 1999) –
Document Display | NEPIS | US EPA

Riparian Buffer References

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

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

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

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

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

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

ORDINANCE APPENDIX H

WEST NILE VIRUS GUIDANCE

WEST NILE VIRUS GUIDANCE

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

Monroe County Conservation District Guidance:
Stormwater Management and West Nile Virus

Source: Brodhead McMichaels Creeks Watershed Act 167 Stormwater Management Ordinance Final Draft 2/23/04

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

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

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

Mosquitoes

The questions surrounding mosquito production in wetlands and ponds have intensified in recent years by the outbreak of the mosquito-borne West Nile Virus. As is the case with all vector-borne maladies, the life cycle of West Nile Virus is complicated, traveling from mosquito to bird, back to mosquito, and then to other animals including humans. *Culex pipiens* was identified as the vector species in the first documented cases from New York in 1999. This species is still considered the primary transmitter of the disease across its range. Today there are some 60 species of mosquitoes that inhabit Pennsylvania. Along with *C. pipiens,* three other species have been identified as vectors of West Nile Virus while four more have been identified as potential vectors.

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

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

Stormwater Facilities

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

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

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

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

Conclusion

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

ORDINANCE APPENDIX I

STORMWATER CONTROLS AND BEST MANAGEMENT PRACTICES
OPERATION AND MAINTENANCE AGREEMENT

STORMWATER CONTROLS AND BEST MANAGEMENT PRACTICES
OPERATION AND MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this ____________ day of _________, 200__, 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 Stormwater Controls and BMP Operation and Maintenance Plan approved by the Municipality (hereinafter referred to as the "Plan") for the property identified herein, which is attached hereto as Appendix A and made part hereof, provides for management of stormwater within the confines of the Property through the use of Best Management Practices (BMPs); and

WHEREAS, the Municipality and the Landowner, his successors, and assigns agree that the health, safety, and welfare of the residents of the Municipality and the protection and maintenance of water quality require that on-site stormwater BMPs be constructed and maintained on the Property; and

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

BMP – "Best Management Practice"-activities, facilities, designs, measures, or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and groundwater recharge, and to otherwise meet the purposes of the municipal Stormwater Management Ordinance, including but not limited to infiltration trenches, seepage pits, filter strips, bioretention, wet ponds, permeable paving, rain gardens, grassed swales, forested buffers, sand filters, and detention basins.

- Infiltration Trench – A BMP surface structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,

- Seepage Pit – An underground BMP structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,

- Rain Garden – A BMP overlain with appropriate mulch and suitable vegetation designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or underground aquifer, and

WHEREAS, the Municipality requires, through the implementation of the Plan, that stormwater management BMPs as required by said Plan and the municipal Stormwater Management Ordinance be constructed and adequately operated and maintained by the Landowner, his successors, and assigns.

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

1. The BMPs shall be constructed by the Landowner in accordance with the plans and specifications identified in the Plan.

2. The Landowner shall operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality and in accordance with the specific maintenance requirements noted on the Plan.

3. The Landowner hereby grants permission to the Municipality, its authorized agents, and employees to enter upon the property, at reasonable times and upon presentation of proper identification, to inspect the BMP(s) whenever it deems necessary. Whenever possible, the Municipality shall notify the Landowner prior to entering the property.

4. In the event that the Landowner fails to operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality, the Municipality or its representatives may enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s). This provision shall not be construed to allow the Municipality to erect any permanent structure on the land of the Landowner. 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.

5. In the event that the Municipality, pursuant to this Agreement, performs work of any nature or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within ten (10) days of receipt of an invoice from the Municipality.

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

7. The Landowner, its executors, administrators, assigns, and other successors in interest shall release the Municipality's employees and designated representatives from all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or Municipality. In the event that a claim is asserted against the Municipality, its designated representatives, or employees, the Municipality shall promptly notify the Landowner, and the Landowner shall defend, at his own expense, any suit based on the claim. If any judgment or claims against the Municipality's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.

8. The Municipality shall inspect the BMP(s) at a minimum of once every three (3) years to ensure their continued functioning.

This Agreement shall be recorded at the Office of the Recorder of Deeds 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 interest, 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 **___________**, 200_.

___________________________________ ____

NOTARY PUBLIC **(SEAL)**

PLAN APPENDIX 2

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PHASE II REQUIREMENTS

What is NPDES Phase II?

Polluted stormwater runoff has been determined to be the leading cause of impairment threatening our nation's surface waters. Mandated by Congress under the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) Stormwater Program is a comprehensive two-phased approach to addressing sources of stormwater pollution that affect the quality of the nation's waters.

In Pennsylvania, the Department of Environmental Protection (PADEP) has implemented Phase I of this program which affects certain industrial sites, construction sites over 5 acres, and municipalities with populations over 100,000, which includes Philadelphia, Pittsburgh, Allentown, and Erie. NPDES permits that were issued under this program were the State's first step in addressing the affects of nonpoint source pollution in our lakes and streams.

Building upon the success of this program, Phase II of Pennsylvania's NPDES program will require permitting of over 700 municipal separate storm sewer systems (MS4s) in Pennsylvania. Operators of these regulated MS4s are required to apply for NPDES permit coverage by March 10, 2003. Phase II also requires permitting of all construction sites, regardless of location, with over 1 acre of disturbance.

Am I an MS4 Municipality?

The over 700 MS4s are located in 20 designated Urban Areas (UAs) and 17 potential UAs in Pennsylvania. An Urban Area is defined by the U.S. Census Bureau as "a place and the adjacent densely settled surrounding territory that together have a minimum population of 50,000 people and a density of 1,000 persons/square mile." The list of MS4 municipalities can be obtained from DEP's website, DEP ID 385-2000-012.

Even if your municipality is not a designated MS4, it may be beneficial to adopt some or all of the requirements under Phase II of the NPDES program to address existing stormwater pollution problems within your municipality. Although not mandated by federal or state law, non-MS4 municipalities should consider the goals of the program and the overall return it may provide in improving overall water quality in the community.

What Are the Minimum Stormwater Management Requirements Under Phase II?

The Phase II stormwater regulations specify six program elements that must be addressed by designated MS4 municipalities. The regulations also imply that additional things will need to be done, but the lack of specific requirements gives permit holders a great deal of flexibility, if not a lot of guidance, about what to do about some aspects of stormwater management, chiefly monitoring.

The six required stormwater program elements include:

1. Public Education and Outreach
2. Public Involvement and Participation
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-Construction Runoff Management
6. Pollution Prevention/Good Housekeeping Practices for All Municipal Operations

1. Public Education and Outreach

Awareness of stormwater related environmental issues and problems is generally low. A variety of surveys suggest that public awareness of the fact that storm drains are usually not connected to the sewers or that individual actions around our homes cause significant environmental impact to urban streams is not high! Many citizens do not know that our urban streams and watersheds are being damaged by the effects of urbanization and by the pollutants found in urban environments. Support for stormwater or urban watershed management will not be strong, particularly if new resources are needed, unless citizens are aware of the condition of urban watersheds and stream segments.

In some Phase II communities, the presence of 303d list streams (streams listed by U.S. EPA as impaired streams) and the TMDL (Total Maximum Daily Load) process for reducing pollution and restoring water quality in these streams may help to increase awareness. Nonetheless, a strong, well-designed and ongoing, or at least periodic, educational program will be needed both to build support for the stormwater program and to make citizens aware of changes they can and need to make to reduce unnecessary stormwater impacts. A strong, effective community education program will include general public awareness education as well as more technical education that targets specific groups such as developers, construction contractors, landscapers, lawn care services, and a variety of small businesses. It is important to address specific sectors of the community due to special concerns about pollution or other impacts associated with that activity as well as general things that homeowners and property owners can do to address needless or avoidable pollution.

In many communities there may already be an educator or educators involved in environmental education in the classroom who would be happy to assist the community by developing a stormwater education unit for delivery at appropriate grade levels. Likewise, local scouting organizations or student conservation organizations would probably be willing to conduct educational activities in the neighborhood using activities like the stream walk or storm drain activity. *Hands-on activity and involvement is critical to learning at all ages. Stormwater programs should utilize these existing resources whenever possibl*e.

2. Public Involvement and Participation

It is absolutely vital to involve the public as early as possible in the design and implementation of the stormwater or urban watershed management program. A diverse cross-section of the community representing all of the different stakeholder groups should be represented. This should include the regulated community (developers, builders, business owners or managers, etc.), the taxpayers who will be paying the tab, the property owners who have been impacted by flooding in the past, environmental groups and environmental activists, landowners, educators, volunteer citizen monitors, and others. These are the people who will pay the bills, work with you to reduce pollution from their activities *(or oppose you at every turn if they are not informed and do not buy into the progra*m), work with you to implement school and community education programs, work on clean-ups and assist with monitoring through citizen monitoring programs.

The Phase II U.S. EPA requirements include public involvement, and there is probably no better way to do this than to form a citizen advisory committee. This should not be a committee appointed from political insiders. It should be composed of stakeholders who come to the table and are interested enough to stay with the process and who are in basic agreement that the community or stormwater management area organization is responsible for and must develop a stormwater management program. Truly open public involvement can avoid expensive and time-consuming controversies that often lead to legal actions. They can also reduce the potential of citizen lawsuits from groups or individuals critical of the progress toward addressing stormwater management. As parties involved from the beginning in designing, implementing, and evaluating the program, it is likely that the concerns of all groups will be addressed sufficiently to avoid serious controversy that can be resolved only through legal remedies. Citizen groups and persons fully involved in a meaningful way in the process will not choose expensive legal action to resolve disputes. Furthermore, most Phase II communities are not going to find it easy to fund stormwater management efforts.

Volunteer involvement will probably be a critical component of many successful programs. Volunteers can contribute a lot, whether it is scout troops interested in helping with neighborhood education through activities like storm drain stenciling, educators willing to help design educational materials, citizens interested in working to help via involvement in volunteer water monitoring, or businesses willing to contribute to the support of these citizen efforts or other forms of volunteerism.

3. Illicit Discharge Detection and Elimination

In some areas, pollutants from illicit or illegal discharges may be a significant contribution to pollutant loadings. These may be intentional or unintentional. In older areas they may be discharges that were never rerouted to the sewer system as regulations for discharges were put in place. They may also be things like floor drains that were never properly connected to the sewer system. The task facing permit holders is to develop strategies and methods for detecting these illicit/illegal discharges so that they can be eliminated. A strategy for addressing this problem should first employ education of business owners and operators and homeowners and involve the public in detecting and correcting these problems voluntarily. Addressing the problem will also require a monitoring strategy. Monitoring for illicit/illegal discharges should be kept as simple as possible given resource realities and should progress from simpler, cheaper methods to more complex and more expensive methods as needed. Some techniques for detecting these discharges include:

- Visual inspection along water courses for pipes and unusual discharges (at the same time a check can be made for leaking or broken sewer pipes)
- Visual inspections of business and industrial sites
- Smoke or dye testing to detect or confirm suspected illicit/illegal connections
- Dry weather sampling of suspicious discharges for substances indicative of domestic or industrial wastewater (detergent, optical brighteners, caffeine, or high conductivity)
- Inspection, visual or remote camera, inside stormwater conveyances
- Reconnaissance sampling upstream of where contamination hotspots are found

4. Construction Site Runoff Control

Perhaps one of the most damaging and preventable forms of pollution in rapidly growing urban areas is the excessive sediment loads that can be contributed to streams due to erosion and transport of sediments from construction sites. Communities must have in place measures to control polluted runoff from construction sites. The Phase II rule requires permitting of construction sites down to 1 acre. Also, a robust and effective program for erosion and sediment control from construction sites will require education and enforcement. Since it is the permit holder that will be the most likely target of any clean water suits filed by local citizens or by environmental groups representing citizens who feel that enforcement is inadequate, permit holders should have their own program for enforcement. This means that the community or (in cases of a watershed authority with multiple jurisdictions), the authority, will need to have an erosion and sediment control program. Some suggestions for doing this include:

- ✓ adopt and implement a strong erosion and sediment control ordinance
- ✓ provide education and training for municipal personnel who are involved in municipal construction projects from supervisors to equipment operators
- ✓ encourage erosion and sediment control training for construction contractors and homebuilders or if possible work with others to provide training locally
- ✓ require that at least one appropriate individual (an engineer, landscaper, engineering technician, etc.) become certified as a Certified Professional in Erosion and Sediment Control Specialist (CPESC) and assist that person with the costs associated with certification
- ✓ create a process for review and approval of construction site erosion and sediment control plans and provide for review of significant projects by the CPESC

- ✓ cross-train building inspectors to do initial inspections of construction sites
- ✓ as necessary, have the CPESC conduct more detailed inspections
- ✓ determine whether you wish to develop a local enforcement program

Having an effective erosion and sediment control ordinance and program is a critical part of an effective stormwater management program. An effective erosion and sediment control program coupled with effective public involvement in the stormwater program provides insurance against costly legal actions.

5. Post-Construction Runoff Management

The Phase II minimum requirements also include management of runoff after the active construction period. These requirements assure that a responsible party will take care of maintaining best management practices (BMPs) until the site is stabilized for erosion control practices and that maintenance of detention and retention basins and other structural BMPs will be funded and taken care of in the future. If the permit holder can, through incentives (fee structures, etc.), induce developers to utilize nonstructural BMPs, the potential and actual future obligations of the permit holder or community will be lessened. Even then, it is desirable to have some sort of bonding mechanism in place or some sort of recurring fee so that funds for maintenance will be available when needed. The permit holder or community should research the positive and negative aspects of different mechanisms for post-construction maintenance before choosing an approach that it believes best suits the needs of the community or area.

6. Pollution Prevention and Good Housekeeping for Municipal Operations

The final requirement for stormwater Phase II permit holders is for the municipality or municipalities regulated under the permit to develop and implement pollution reduction and good housekeeping procedures for prevention of pollution from stormwater runoff. This means that a program for prevention of stormwater impacts from municipal facilities and municipal operations will have to be developed or perhaps strengthened if such a program already exists. Elements of such a program might include structural components or such things as fuel and materials storage and handling safeguard improvements, erosion and sediment control on municipal projects, protection or restoration of riparian corridors on municipal property, use of design elements to prevent stormwater runoff and pollution on new projects or redevelopment projects, flow and pollution control BMPs for municipal parking areas, and other actions for prevention or reduction of polluted stormwater runoff. Since careless or thoughtless actions of individuals often contribute to stormwater pollution, a pollution prevention and housekeeping improvement program should include an educational component for appropriate municipal employees and contractors. This public sector pollution prevention and housekeeping component of the stormwater management program can be important, particularly so when a community or permit holder is going to implement voluntary or even regulatory programs for reducing stormwater pollution. The public pollution prevention and housekeeping improvements can be used to demonstrate improvements and, thus, serve as educational activities for private sector businesses and industries in the community.

When Should a Community Do More than the Minimum?

Clearly these six activities represent the minimum requirements for Phase II communities or permit holders. Every community is different, and every community may have issues, concerns, or problems a little different from those in other communities. For example, some communities may have concerns about streams or water bodies that are special, very high quality resources that the community places special value on or which have important economic value. A community may have a Total Maximum Daily Load (TMDL) stream for which special additional actions are needed or required to restore water quality in order to avoid growth restrictions or other possible sanctions. A community might have a specific problem like bacteriological contamination from waterfowl that threatens a public beach, flooding problems, or something else that is a special concern in the community that causes it to desire to do more. Communities should pursue everything that makes sense to do for which there is a public consensus and adequate funding to complete. However, permit holders ***should not*** list anything in their plan or permit (if they are applying for an individual permit) that they do not definitely plan and know that they can and will complete. EPA will hold permit holders to those things that they say they will do as part of the permit. *It is safer for permit holders to do more than they indicated than to list something tenuous and not be able to accomplish it*.

PLAN APPENDIX 3

MUNICIPAL ORDINANCE MATRIX

APPENDIX 3

MUNICIPAL ORDINANCE MATRIX
(WATERSHED STORM MANAGEMENT)

			Within the Subdivision and Land Development Ordinance					
Township/Borough	Zoning	Subdivision Land Dev.	Stormwater	Flood Plain	Road	Grading	Erosion Sedimentation	Other
Aldan Borough	Yes, 1990	Yes, 1990	Sect. 220-34	Ch. 137	Sect. 403	Sect. 407	Ch. 220 Sect. 220.16	- - -
Clifton Heights Borough	Yes, 1993	County Ord., 1981	Sect. 309	Ord. 545	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Collingdale Borough	Yes, 1993	County Ord., 1981	Sect. 309	Ord. 594	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Colwyn Borough	Yes, 1994	County Ord., 1981	Sect. 309	Ord. 374, 479	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Darby Borough	Yes, 1998	County Ord., 1981	Sect. 309	Ch. 77	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Darby Township	Yes, 1965	County Ord., 1981	Sect. 309	Ch. 8, Ord. 540	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
East Lansdowne Borough	Yes, 1995	County Ord., 1981	Sect. 309	Ord. 331	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Folcroft Borough	Yes, 1990	County Ord., 1981	Sect. 309	Ord. 667	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Glenolden Borough	Yes, 1995	County Ord., 1981	Sect. 309	Ord. 916	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Haverford Township	Yes, 1996	Yes, 1993	Ch.160-5(1)G	Ord. 1669	Ch. 160-5(1)E	Ch. 160-5(1)G	Ch. 160-5(1)G.9-10	- - -
Lansdowne Borough	Yes, 1985	County Ord., 1981	Ch.289	Ch. 187, 1982	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Marple Township	Yes, 1999	Yes, 1954	Ch.74 Sect. 74.28	Ord. 77.14, Sect. 74-28	Sect. 74.14	Sect. 74.26	- - -	- - -
Milbourne Borough	Yes, 2001	County Ord., 1981	Sect. 309	County Ord. 77-5	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Morton Borough	Yes, 1995	County Ord., 1981	Sect. 309	Ord. 579	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Newtown Township	Yes, 1995	Yes, 1986	Ch. 148-43	Ch. 91, Ord. 1980-12	Ch.148-27	Ch.148-27-F	Ch.138	- - -
Norwood Borough	Yes, 1990	County Ord., 1981	Sect. 309	Ord. 3-82	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Prospect Park Borough	Yes, 1996	County Ord., 1981	Sect. 309	Ord. 1104	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Radnor Township	Yes, 2000	Yes, 1991	Ch. 255-53	Ord. 77-24	Ch. 255-27	Ch. 255-60, 31	Ch. 255-32	- - -
Ridley Township	Yes, 1990	Yes, 1982	Ch. 260, Ord. 260	Ord. 1714	Ch. 268-22	Ch. 268-32	Ch.124, Ord. 1689	Hazardous Materials: Ch.151, Ord.1658
Ridley Park Borough	Yes, 1990	Yes, 1989	Ord.1028, Sect.618	Ch.109	Sect. 602-611	Sect. 606	Sect. 618A	- - -
Rutledge Borough	Yes, 1997	Yes, 1976	Ch. 22-1102.2	Ord. 337, Ch. 8	- - -	- - -	- - -	- - -
Sharon Hill Borough	Yes, 1995	Yes, 1981	Art. X Ord. 1081,& Sect. 108-15D	Ord. 1236	Sect. 108-10	Sect. 108-10.4, 108-15.B & 108-38	- - -	- - -
Springfield Township	Yes, 1997	Yes, 1995	Sect. 123-36	Art. 13, Sect. 143	Sect. 123-28	Sect. 123-25 A.2, B&C	Sect. 123-37	- - -
Tinicum Township	Yes, 1997	Yes, 1993	Sect. 48A-26	Ord. 890	Sect. 48A-20 to 25	Sect. 48A-24	- - -	- - -
Upper Darby Township	Yes, 1986	County Ord., 1981	Sect. 309	Ord. 2802	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect. 811	- - -
Yeadon Borough	Yes, 1971	County Ord., 1981	Sect. 309	Ch. 1448	Sect. 403, 506, 605, 704, 805	Sect. 403.6, 605.4, 805.6	Sect 811	- - -
Easttown Township	Yes, 1997	Yes, 1997	Sect. 625	Art. 15, Sect. 1501-05 (Zoning Ord.)	Sect. 602-612	- - -	Sect. 626	- - -
Tredyffrin Township	Yes, 1998	Yes, 1998	Sect. 181-53	Sect. 208-15, 208-16 (Zoning Ord.)	Sect. 181-46	- - -	Sect. 181-40	- - -
Lower Merion Township	Yes, 1994	Yes, 1978	Ch.121.4	Ch.155.54	Ch.135.27	Ch.135.39	Ch.121.5	- - -
Narberth Borough	Yes, 1986	Yes, 1984	N/A	Ch.50-103	Sect. 4	N/A	N/A	- - -
Philadelphia, City of	Yes, Title 14	Yes, Ch.14-2100	Ch.14-1603.1	Ch.14-1606	Ch.14-2104.3-9	Ch.14-2104.7	Ch.14-1603.1 (6)b.12c.2(6)a	Title 13, Water & Sewer

Note : Basic Ordinance Matrix to meet ACT 167 Requirements

PLAN APPENDIX 4

PUBLIC COMMENT
AND
RESPONSES
AND
PUBLIC HEARING
TRANSCRIPT

Date	Municipality/Organization/Company	Format
1/29/2004	CDM	e-mail
3/24/2004	Philadelphia Water Department	e-mail
3/24/2004	Chester County Planning Commission	e-mail
4/28/2004	Lansdowne Borough	Letter
4/29/2004	Aldan Borough	e-mail
4/30/2004	Radnor Township	Letter
4/30/2004	Springfield Township	e-mail
4/30/2004	Philadelphia Water Department	e-mail
4/30/2004	Collingdale Borough (Vollmer)	Letter
4/30/2004	Glenolden Borough (Vollmer)	Letter
4/30/2004	Prospect Park Borough (Vollmer)	Letter
6/10/2004	Chester County Water Resources Authority	Letter
8/27/2004	Chester County Planning Commission	e-mail

Section V: Standards and Criteria for Stormwater Control

Last Modified: 1/29/04

5.1 Comments on Content

General

We feel it is important for Section V to be consistent with Section VII, the Model Ordinance. We recommend finalizing Section VII first, then revising Section V for consistency with the final version of the ordinance. This section identifies some statements in the text that are not clear entirely to us and highlights some specific instances where the two sections appear to be inconsistent; it does not necessarily identify all instances of potential inconsistencies.

In general, there are few references or citations throughout the document. It would be helpful to include more references, particularly with respects to the development of the recharge, water quality, and stream bank erosion standards (i.e., provide references for the technical basis for the standards so users have a place to go to find background information and gain perspective). For example, on p. V-21, the plan sometimes references the PA BMP manual and sometimes references the Municipal Handbook for non-structural BMPs. What is the Municipal Handbook? Can a full list of citations can be included with the final report?

Redevelopment Controls

We feel that the proposed new development ("greenfield") controls are appropriate. The infiltration, storage, and release rate requirements are fairly stringent for new development and should help meet watershed goals in areas where new development predominates. In combined-sewered areas, infiltration of 0.55" and storage/detention of an additional 1.5" of runoff as suggested would meet release rate goals for CSO reduction consistent with the draft Cobbs Creek Watershed Management Plan.

Controls on redevelopment, as described in Section V, appear to be lenient. However, the controls required in the model ordinance are much more stringent. In some cases, we feel they are too stringent; please see our comments on that section. Some examples of our concerns in Section V are as follows:

- p. V-2: "Maintaining the existing hydrologic regime in the watershed is the best means to accomplish this goal." This statement does not apply to redevelopment; need to work towards "restoring" or "recovering previous functionality".
- p. V-34, Section V.L: "Stormwater Quantity Control Exemption", appears to exempt some fairly large redevelopment projects from detention requirements. Please see our comments in Section VII for a suggested way to address this.

- Figure B-5 of the model ordinance (appendix to Section VII but referenced in Section V), "Redevelopment Projects: Runoff Criteria Adjustment for Pre-Development Conditions", appears to exempt from control requirements almost any redevelopment that does not increase runoff volumes or peaks compared to the pre-redevelopment condition. In our Section VII comments, we propose an alternative to this approach. If this suggested approach were adopted, this figure and, reference to it, no longer will be necessary. Documentation for the alternative approach would be added to Section V.

Specific BMP Recommendations

We suggest reviewing BMP recommendations in the draft Cobbs Creek Watershed Management Plan. General findings from the BMP study done for the plan are included with our comments on Section IV. Some specific comments are listed below.

- p. V-11, "Buffers". Buffers for urban stream systems do not improve water quality unless runoff is allowed to sheet flow through them. Otherwise, their benefit is primarily recreational and aesthetic. A 50-ft buffer width is mentioned in the model ordinance but not in this section.

- Cisterns are recommended in industrial parks only. Pilot projects with rain barrels in residential areas have been successful locally. Both cisterns and rain barrels must be emptied between storms to provide a stormwater benefit.

- p. V-32: In the advantages/disadvantages section, it says that cisterns have a low installation cost. In the suitability section it says that they're expensive to install. We agree that they can be a relatively low-cost control in most applications.

- We recommend intercepting roof runoff with dry wells in residential areas.

- We agree with the porous pavement recommendation, but suggest that it should include requirements for subsurface gravel storage and appropriate infiltration rates, or slow-release structures especially in cases where infiltration capacity is limited, to provide the greatest benefit. Our modeling efforts indicate that this is the single most effective measure for areas that are highly developed.

- In parking lots where porous pavement is not feasible, bioretention should be considered as another cost-effective alternative option.

- p. V-33, "Regional Detention Facilities" – The draft Cobbs Creek Watershed Management Plan identifies locations for possible creation of regional treatment wetlands. These could be incorporated in Section V.

- Table V-5: Under wetlands, we suggest changing text to "Refer wetland impacts to state agency for review."

- Table V-10: A number of disadvantages mentioned are simply design issues (e.g., mosquitoes, hydraulic capacity reduction due to mature plants). Vegetated filter strips, item 5: This statement is not clear.

- The draft Cobbs Creek Watershed Management Plan recommends that municipalities adopt a requirement for and procedures to conduct an early consultation session with developers based on preliminary concept sketch plans.

- p. V.10 – This page lists factors that will be considered in the selection of a BMP. It is not clear how this list of factors will be incorporated into the BMP selection process. Municipalities should be free to develop stormwater manuals linked to their ordinances with guidance specific to local conditions. However, those manuals should be expected to be consistent with the model ordinance adopted by communities throughout the Darby-Cobbs basin.

Miscellaneous Comments by Page

p. V-4, Figure V-1

It would be helpful if this figure explained the sequence and priority of the different requirements, even though these are explained later in the document.

p. V-5

- Change "The NRCS runoff equation is universally accepted to predict stormwater runoff from precipitation events:" to "The NRCS runoff equation is widely accepted to estimate stormwater runoff from precipitation events:

The definition of the WQ volume formula reads as follows:

Rv = 0.05+0.009(I) where I is the percent of the area that is impervious ((impervious area/A)/100)).

- There is an extra closed parenthesis and it should be *100 not /100.

- Suggest adding a citation

pp. V-5 – V-7

To satisfy the groundwater recharge requirement, developers must infiltrate the existing recharge volume. We need to provide clear guidance on methodology for calculating existing recharge rates. There might be a tendency to underestimate pre-development infiltration and overestimate post-development infiltration rates. See "The Impact of Soil Disturbance During Construction on Bulk Density and Infiltration in Ocean County, New Jersey" by Ocean Count Soil Conservation District, Schnabel Engineering Associates, and USDA Natural Resources Conservation Service, March 2001 (Rev. 06/01/01). This study found that the infiltration rates for disturbed soils with high bulk densities were significantly lower than expected, and the measured infiltration rates of undisturbed wooded and pastured soil were higher than expected.

While we support the requirement of infiltrating 0.55 inches of runoff from impervious areas, to make the idea clearer to users, we suggest including more detail on how the number was determined. Here again, references would be helpful.

p. V-17

This step recommends dual-purpose detention, such as recycling water and water storage for fire. These systems do not ensure that there is available capacity for each rainfall. If stormwater control is combined with other uses, the storage volume needed for stormwater control must still be emptied regularly to be effective.

p. V-18, Table V-5

Under the benefits of stormwater management and management districts, the document states there will be "... no increase in runoff." Does this mean no increase in peak flow rates at a point of interest? The meaning of "no increase in runoff" should be stated clearly.

The recharge and infiltration section says that it "... also pertains to the portions of the watershed that have storm sewers." We believe this requirement should apply everywhere.

5.2 Comments on Wording and Organization

p. V-1, Section A

A. Watershed Level Control Philosophy

This section could be modified to better reflect the watershed wide goals of stormwater management, which are reduction of peak flows, reduction of the duration of peak flows and duration of erosive bank full flows, reduction of stormwater volume, and improvement in the quality of stormwater runoff. The goals of increased groundwater recharge and augmentation of stream baseflow should also be included in this section.

p. V-11

Last paragraph - "stormater" needs to be changed to "stormwater."

Section 3 Stream Bank Erosion has some sentence structure problems that make it difficult to read.

- First paragraph needs to be reworded. One sentence reads "The purpose of the FGM assessment was to integrate the FGM assessment and associated…". Perhaps it could be better worded by saying, "The purpose of the FGM assessment was to collect information about stream morphology and integrate it into the stormwater quantity and quality control management strategy."
- The bulleted items on p. 12 do not have parallel structure.
- The paragraph after the bulleted items should be reworded for clarification

p. V-12

Over-bank Event Section should also be rewritten for clarification.

"This criteria" should to be changed to "these criteria" or "this criterion".

The Over-bank Event section says that the "Management District Concept is described below." However the Extreme Event section is below and the management district concept is on the subsequent page. This reference needs to be rectified.

pp. V-13 and V-20

References are made to Brodhead and McMichaels Creek watersheds. We assume these will be removed in the final document.

pp. V-22 – V-23

The information and bullet list on these pages are the same as the information provided in several other sections. How does the information on these pages differ? Can the plan be structured differently to consolidate some of this information?

Section VII: Model Ordinance

7.1 Comments on Model Ordinance Text

General

We propose to modify requirements to encompass redevelopment more broadly. We feel it is important to institute runoff controls on redevelopment, but we feel the controls as laid out currently in the ordinance may provide a disincentive for redevelopment. The main proposed modification for redevelopment is in the groundwater recharge section.

A flow chart and/or set of worksheets may be useful to help a developer or builder understand the various requirements and priorities. Separate charts (worksheets) may be required for new development and redevelopment.

p. 3, Section 105

We suggest changing the fourth paragraph to read, "This Ordinance applies to any Regulated Earth Disturbance activities within the Municipality, and all stormwater runoff entering into the Municipality's combined or separate storm sewer system from lands within the boundaries of the Municipality."

p. 4, section 105.F

We propose the following wording: "Redevelopment of a site that will increase runoff or change a discharge point. Any redevelopment that does not increase the runoff must still comply with Section 304 (Nonstructural Project Design), Section 305 (Ground Water Recharge), and Section 306 (Water Quality Requirements)."

p. 11, section 202

We propose changing the definition of redevelopment to "The construction, alteration, or improvement exceeding 2,000 square feet of land disturbance performed on sites where existing or previous land use is residential, commercial, industrial or institutional."

p.18, section 304.B

We propose stating that B.9, B.11, and B.12 do not apply to redevelopment.

p. 19, section 305.A.1

We propose modifying the heading of this section: "Minimum Requirements – Infiltration BMPs shall meet the following minimum requirements."

p. 19, section 305.A.2

We propose modifying the first sentence of this section: "For new development, the size of the recharge facility shall be based upon the following volume criteria:".

In the existing equations for Rev, we suggest removing the word "percent". It appears that this term refers to the impervious area in square feet.

We also suggest that the Rev equation be renumbered. It seems that it should be Eqn. 305.2.

We suggest that the Figure on p. 21 be renumbered as Figure 305.1 to match the reference on the previous page.

We propose adding a new section at the end of this section stating requirements for redevelopment:

"For redevelopment, the size of the recharge facility shall be based upon the following volume criteria:

Rev = (post-development impervious area in sq.ft.) * (1.0 in) * (1 ft/12 in)

where Rev = required storage volume (cu.ft.)

Due to certain soils and topographic conditions, recharge may not be feasible on every site. If the full volume cannot be infiltrated within 96 hours (with an appropriate safety factor), then the design professional shall be responsible to show that this cannot be physically accomplished. The volume that cannot infiltrate in the designated time must be detained in a water quality facility as described in Section 306. Acceptable infiltration facilities must be chosen from the stormwater management manual approved by the Municipality."

Discussion: Basing the storage volume on post-redevelopment impervious cover has several advantages. First, the storage required does not depend on the pre-development condition, which can be difficult to define in redeveloping areas. Is the pre-development condition any development that previously existed at the site, development that existed within a certain time period, or the condition of the site on the date construction starts or the date the ordinance is enacted? Second, the proposed impervious area is easily measured. Third, the developer has an incentive to reduce impervious area; the cost of installing landscaping or other source controls will be offset by the decreased cost of storage facilities required. The 1.0-inch requirement is less stringent than the controls required for new development, but is stringent enough to provide significant benefits in both separate-sewered and combined-sewered areas. The BMP manuals referenced in Appendix G all are good sources, but Philadelphia may choose to develop its own manual tied directly to its stormwater ordinance with guidance specific to local conditions. The factor of safety is added to the 96-hour requirement to accommodate uncertainties inherent in the design of such facilities, and to address other issues, such as providing of a higher level of assurance that standing water will not remain long enough to encourage mosquito breeding.

p. 22, Section 305.B

We suggest adding the following sentence to item 1: "In areas where development on fill material is under consideration, conduct geotechnical investigations of sub-grade stability; infiltration is not permitted to be ruled out without conducting these tests."

p. 22, section 305.C

The Stormwater Hotspots paragraph refers to Table 304.1. This should be changed to Table 305.1 to match the labeling of the referenced table.

p. 22, Section 305.D

It may not be clear to the reader how to identify source water protection areas.

p. 24, section 306.D

We propose changing the first sentence of the third paragraph to read "For new development, the following calculation formula is to be used to determine the water quality storage volume, (WQv), in acre-feet of storage for the Darby-Cobbs watershed:"

We propose adding the following paragraph after the paragraph beginning, "The P value for the five…": "For redevelopment, the total volume to be detained is 1.0 inches of runoff from the post-redevelopment impervious area, as defined in Section 305. If the full volume cannot be infiltrated within 96 hours (with an appropriate factor of safety), the remaining volume must be detained in a water quality facility chosen from the stormwater management manual approved by the Municipality.

The volume that can infiltrate within the designated time period may be estimated using the following equation, or more detailed calculations may be performed using the Horton or Green-Ampt methods:

V = [K * 96 hr * F * (1 ft/12 in)] * Acs

where V = volume that must be infiltrated (cu.ft.)

K = saturated vertical infiltration rate (in/hr)
F = 0.75, or alternate value designated in Municipality's manual
Acs = bottom area of BMP exposed to native soil (sq.ft.)

The maximum release rate for the stored volume shall be calculated as follows:

Qp (cfs) = (1-year post-development runoff volume in cu.ft.) / (86400 s)

p. 25, section 306.J

In the fifth line, "reduces" should be "reduced".

p. 29, section 308.I

We suggest that the first section of the Hardship Option be reworded: "The standards and criteria outlined in Section 308 of the Ordinance are designed to maintain existing peak flows and volumes throughout the Darby and Cobbs creeks basins as the watershed becomes developed. There may be certain instances, however, where the standards and criteria established are too restrictive for a particular landowner or Applicant." As worded it seems that landowner might be able to claim the Hardship Option for the Nonstructural Project Design, Ground Water Recharge, Water Quality, and Streambank Protection components of the Ordinance.

p. 29, section 308.J

This section states, "Redevelopment projects shall meet peak discharge requirements based on the adjusted runoff control number (RCN) or "C" value illustrated by Figure B-5 in Appendix B."

p. 34, section 402.B

We are concerned that the wording of this exemption may lead to unintended consequences. As the exemption is worded, a site up to 20,000 sq.ft. may be exempt from the requirements of the ordinance. We feel this may exempt a large number of lots, particularly in the more urbanized areas of the watershed. We propose adding a maximum total lot size to which this exemption will apply. We suggest 10,000 sq.ft.

After the box explaining the exemption criteria, we propose changing the sentence to read "Applicants whose activities are exempted under Section 302.B above shall still be required to meet the Nonstructural Project Design (Section 304), Ground Water Recharge (Section 305), and Water Quality (Section 306) controls of this ordinance."

7.2 Redevelopment Example Calculation

Draft model Act 167 Stormwater Management Ordinance (Sections 305 and 306) applied to a hypothetical redevelopment project:

Site Description:

Existing Conditions:

Area: 4.36 acres
Land Use: 100% of the area is currently occupied by a parking lot
Percent Impervious: 100%
Runoff Curve Number: 98
Assume Saturated Infiltration Rate of Soil: 0.1 in/hr (poorly-drained urban fill, assumed hydrologically similar to a silty sand)

Proposed Conditions:

Area: 4.36 acres
Land Use: 72 4-story residential duplex units including landscaping, private roads, & private driveways
Percent Impervious: 91%
Runoff Curve Number: 92

Section 305 Ground Water Recharge Requirements:
This requirement applies to the entire site since 100% of the area will be disturbed.

Infiltration requirement:

"For redevelopment, the size of the recharge facility shall be based upon the following volume criteria:

Rev = (post-development impervious area in sq.ft.) * (1.0 in) * (1 ft/12 in)

where Rev = required storage volume (cu.ft.)

The recharge volume (Rev) is calculated as:

Rev = 4.36 ac * (43,560 sq.ft./ac) * 91% impervious * 1.0 in * (1 ft/12 in) = 14,400 cu.ft.

To estimate the volume that can infiltrate, it is necessary to perform a preliminary sizing of the facilities. Assume 1% of the site (approximately 2000 sq.ft.) is occupied by a bioretention/infiltration basin 2 feet deep (similar to the photo below from the Portland BMP manual). The facility would provide 4,000 cu.ft. of storage, equivalent to 0.3 inches over the impervious area. At a cost of $7/cu.ft. (based on Brown and Schueler, 1997), this facility would cost $28,000.

Buckman Heights courtyard infiltration basins (430 NE 16th Ave.)

To meet the total volume requirement, an additional 10,400 cu.ft. of storage would be required. On the highly impervious site in this example, the additional storage likely would be subsurface storage under paved surfaces. The bottom of the facility would be open to allow infiltration. Assuming 35% porosity, a 4-ft deep subsurface gravel storage facility under 4% of the site would provide the needed storage. Thus, stormwater facilities would occupy approximately 5% of the site area.

Recent local cost estimates for small storage facilities of this type range from $6 to $10 per gallon of storage. Assuming $7/gal, the total cost for the subsurface tank would be approximately $73,000. The total cost of storage at the site would be $101,000.

A conservative estimate of the stored volume remaining after 48 hours is calculated as follows:

Bioretention basin: {2 ft – [0.1 in/hr * 48 hr * (1 ft/12 in)]} * 2000 sq.ft. = 3200 cu.ft.

Subsurface storage: {[(4 ft * 35% porosity)] – [(0.1 in/hr) * 48 hr * (1 ft/12 in)]} * 7600 sq.ft. = 7600 cu.ft.

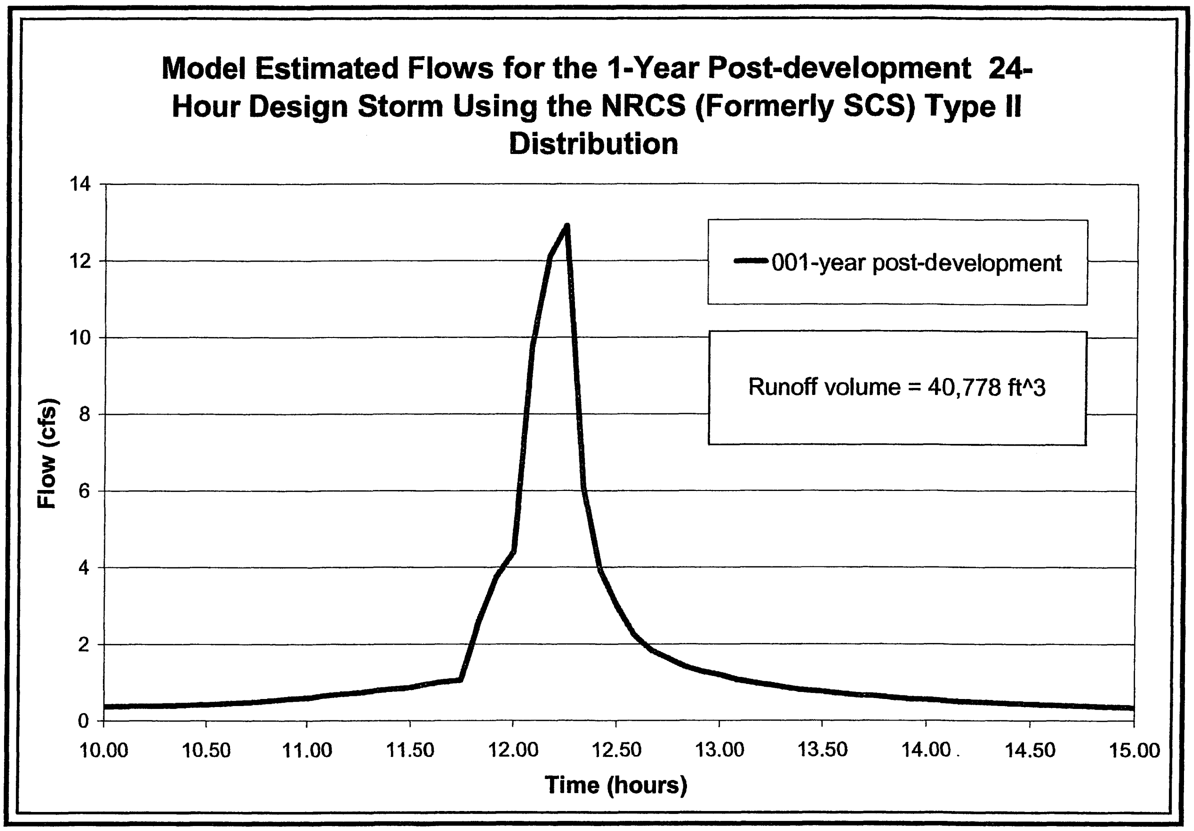
Total volume remaining: 10,800 cu.ft.

Section 306 Water Quality Requirements:
Detention and release requirement:

For redevelopment, the total volume to be detained is 1.0 inches of runoff from the post-redevelopment impervious area, as defined in Section 305. If the full volume cannot be infiltrated within 96 hours, the remaining volume must be detained in a water quality facility chosen from the stormwater management manual approved by the Municipality. The maximum release rate for the stored volume shall be calculated as follows:

Qp (cfs) = (1-year post-development runoff volume in cu.ft.) / (86400 s)

The figure below shows the runoff hydrograph from the post-development 1-year design storm. The runoff volume associated with this hydrograph is 40,778 cu.ft.. In order to release this volume in no less than 24-hours, a release rate of 40,778 cu.ft. per 24 hours or 0.472 cfs must be established.



Summary

Volume to be stored and infiltrated: 3600 cu.ft.
Volume to be stored, treated, and released: 10,800 cu.ft.
Maximum release rate: 0.47 cfs
Approximate area required: 2000 sq.ft. (surface) + 7600 sq.ft. (subsurface) = 9600 sq.ft.
Cost per unit = $1400

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June 11, 2004

Karen Holm, Project Manager
Delaware County Planning Department
201 W. Front Street
Media, PA 19063

RE: Response to Comments on Section V: Standards and Criteria for Stormwater Control by Dwayne Myers of CDM on the DRAFT Darby-Cobbs Creek Act 167 dated January 29, 2004

BL No.: 1996-0613-01

Dear Ms. Holm:

The attached are responses to comments provided by Mr. Dwayne Myers of CDM on the Draft Darby-Cobbs Creek Act 167 dated January 29, 2004. Please note that due to updates which have been made to the final ordinance over the course of the plan development, specific section numbers and pages referenced in the following comments may not directly reflect the final plan. However, the noted changed were made before page and section numbers were changed.

General

Volume II, Section V of the Darby-Cobbs Creek ACT 167 plan has been updated to reflect the standards and criteria in the final version of the model ordinance and has been checked for consistency.

A full list of citations has been included in Volume II, Section X. The Municipal Handbook is a separate document which shall be supplied along with the final plan.

Redevelopment Controls

- p. V-2: The text has been modified to reflect the recommended "restoring previous functionality".
- p. V-34, Section V.L: The final exemption criterion has been modified to remove the exemption of larger development projects and now has an upper allowed impervious area of 2,000 square feet.
- Figure B-5 has been removed from the model ordinance and the requirements for redevelopment projects have been modified.

Specific BMP Recommendations

- p. V-11: Buffers do improve water quality by many means, including reducing stream temperatures due to shading by vegetation paralleling the stream as well as filtering stormwater runoff. The buffer width requirements have been added to this section.
- Table V-11 has been updated to include the recommendation for use of cisterns in residential areas as well as industrial areas.

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- p. V-32: This contradiction in cistern economics has been corrected.

- The use of dry wells to infiltrate roof runoff is an acceptable method as long as the requirements of Ordinance Section 405.A.1. are met.

- Specific design criteria for porous pavement shall be included in the Pennsylvania Stormwater Best Management Practices Manual.

- The Model Ordinance allows the designer to have flexibility in choosing the appropriate BMP's which will meet the standards and requirements of the ordinance.

- P. V-33: The regional detention facilities section highlights the possibilities for developer of adjoining parcels to combine their resources to address stormwater peak rate controls in one regional facility rather a separate facility for each parcel. It would be feasible to create regional wetland facilities to act in a similar way to address water quality; however this is not the focus of this section.

- Table V-5: The recommended text has been included in this table.

- Table V-10: It was unclear which item 5 (advantages or disadvantages) needed clarification; however under advantages, the vegetative filter strip does add aesthetic values as these are typically well vegetated areas which are more appealing than other hard structure facilities. As for disadvantages, care must be taken in the construction of these vegetative filter strips to assure that no low spots are present in the grading which can lead to the concentration of stormwater runoff, which would lead to the "short-circuiting of the facility, thus reducing its effectiveness.

- Preliminary sketch plans are recommended to be informally reviewed with the developer and the municipality before the formal submission of the preliminary plan, which would effectively start the review period time clock.

- p. V-10: These factors are simple guidelines to follow when selecting BMPs for a development site. Further guidelines shall be developed in the Pennsylvania Stormwater Best Management Practices Manual.

<u>Miscellaneous Comments by Page</u>

- p. V-4, Figure V-1: All requirements in this figure hold the same priority.

- p. V-5: The recommended changes to the text have been made in this section.

- p. v-5 – v-7: The groundwater recharge requirements have been revised in the final plan. Documentation of how the minimum infiltration requirement of 0.50 inches from impervious areas in described in detail in Volume III, Appendix F, Water Budget Analysis.

- p. V-17: The secondary use in the dual purpose facilities, such as recycling water and water storage for fire control, should be provided in addition to the primary use of peak rate control. For example, if a detention basin is designed for both peak rate control and fire storage. The fire storage volume would be provided as "dead storage" at the bottom of the basin (i.e. a permanent pool). Storage to address peak rate control would be above this dead storage volume.

- p. V-18, Table V-5: This has been revised to read "no increase in runoff on a watershed wide basis". Groundwater recharge requirements, as explained in the first sentence of this paragraph, should be considered for all development sites.

Comments on Wording and Organization

- p. V-11: The recommended rewording has been made in the final plan.

- p. V-12: The recommended rewording has been made in the final plan.

- p. V-13 and V-20: The noted references have been corrected.

- p. V-22 – V-23: The organization of this section has been modified in the final plan.

Comments on Model Ordinance Text

- General – The entire section on redevelopment has been updated based on comments from the WPAC and the final requirements were reached by a consensus of the group.

  A flow chart now appears in Ordinance Appendix D.

- p. 3:, Section 105: The entire section on Regulated Earth Disturbance activities has been revised in the final model ordinance based upon input from the WPAC.

- p. 4, Section 105.F: The entire section on Regulated Earth Disturbance activities has been revised in the final model ordinance based upon input from the WPAC.

- p. 11, Section 202: The definition of "Redevelopment" has been changed based upon input from the WPAC.

- p. 18, Section 304.B: This comment no longer applies as the entire section on Redevelopment has been revised in the final model ordinance based upon input from the WPAC.

- p.19, Section 305.A.1: The suggested rewording has been made in Section 405 of the final model ordinance.

- p. 19, Section 305.A.2: The suggested changes have been made in Section 405 of the model ordinance.

- p. 22, Section 205.B: The recommended text changes have been made in Section 405.B.1 of the final model ordinance.

- p. 22, Section 305.C: This reference has been removed in the final model ordinance.

- p.22, Section 305.D: Source Water Protection Areas are defined by the local Municipality or water authority.

- p. 24, Section 306.D: This section has been revised based on input from the WPAC and is now Section 406.D. in the final model ordinance.

- p. 25, Section 306.J: The recommended changes have been made.

- p. 29, Section 308.I.: The recommended changes have been made.

- p.29, Section 308.J: The redevelopment requirements have been changed based upon input from the WPAC.

- p. 34, Section 402.B: The section on exemption criteria has been overhauled based upon input from the WPAC.

We appreciate your interest in and review of the Plan and welcome your comments. Your comments will strengthen the Plan and we look forward to the successful implementation of the Plan and Ordinance.

Sincerely,

Paul A. De Barry

Paul A. DeBarry, P.E., P.H.
Greater Lehigh Valley Office

PAD/dth

Chester County Comments
via Wayne Clapp 3/24/04

1. **Resolutions (Chesco, Montco, Phila):** "Whereas the [counties] have entered into a grant contract with DEP..." Only Delco has a contract with DEP. Delco will have an MOU with Montco and Chesco, but Lynn Manahan said that it wasn't absolutely necessary to have one with Phila if we think it may present more work to chase it down. We need revised language. For Chesco and Montco we could probably say something to the effect that they entered into an MOU with Delco that said they would support the development of the plan and consider adoption. For Phila, we may need to say that they cooperated in the production of the plan and would consider adopting the plan (if they say okay). What is usually said about other counties in a plan?

2. **Plan Format (third paragraph):** The text notes that Volume III will be available at the Delaware County Planning Department Office. It was suggested that a copy of Volume III be provided at all county planning offices and Phila Water Dept.(?).

3. **Page VIII-2 (paragraph beginning "The primary County-level..."):** The text says that the model ordinance calls for review of swm plans for development sites by the county planning agencies and e/s plans by the conservation districts. County planning agencies wouldn't review the swm component of a subdivision/land development plan. It was suggested that we rephrase the sentence to indicate that the planning agencies perform the Act 247 review of the land development plan, but the Conservation District/Phila Water would review the swm component of the plan. Okay? [reconcile with the ordinance text]

4. **Page VIII-2 (last sentence on the page onto top of page VIII-3):** The text says that "the counties will be responsible for maintenance of data for performance of review and of 'no-harm'evaluation required in the Act 167 ordinance." The question was – what does this mean?

5. **Page VIII-4 (middle of the page, paragraph beginning "An optimum..."):** Chester County does not support the idea of a County-level institution responsible for all stormwater management functions. I think Delco is neutral on it with regard to discussion in the text. Chesco suggests that the text be removed. I'm not sure how Montco feels about it. It might be worth discussing at a meeting.

6. **Chesco suggests that we prepare a version of the ordinance that can be used across municipal boundaries (as with Chester Creek).** Delaware County supports this because it will be needed to provide Crum Creek municipalities with an ordinance to use until the watershed-specific provisions are available. Once the municipalities and counties agree on the final version of the Darby-Cobbs ordinance, the counties working with the consultant can begin preparation of this ordinance.

7. **Ordinance pages 41-42:** There was some question about the notion of "cumulative" impervious cover (I'm not sure if we resolved the issue or if it still needs to be resolved to Chesco's satisfaction)??

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April 26, 2004

Karen Holm, Project Manager
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201 W. Front Street
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RE: Response to Comments of Wayne Clapp of Chester County on the DRAFT Darby-Cobbs Creek ACT 167 Stormwater Management Plan dated March 24, 2004

BL No.: 1996-0613-01

Dear Ms. Holm:

The following are responses to comments provided by Mr. Wayne Clapp of the Chester County Planning Commission to the Delaware County Planning Commission on March 24, 2004 regarding the Draft Darby-Cobbs Creek ACT 167 Stormwater Management Plan. Please note that due to updates which have been made to the final ordinance over the course of the plan development, specific section numbers and pages referenced in the following comments may not directly reflect the final plan. However, the noted changed were made before page and section numbers were changed.

1. **Resolutions (Chesco, Montco, Phila):** The recommended changes to the Resolution have been made to clarify that Chester, Montgomery and Philadelphia Counties had entered into a Memorandum of Understanding with Delaware County.

2. **Plan Format (third paragraph):** Additional copies of the technical appendix will be made available at the end of the project if the budget allows.

3. **Page VIII-2 (paragraph beginning "The primary County-level... "):** This can be discussed at the workshop meeting.

4. **Page VIII-2 (last sentence on the page onto top of page VIII-3):** This section requires that the reviewing County agency maintain files related to the review of submitted stormwater management plans. These files should include original stormwater management design calculations; reports; plans and any correspondence related to plan review between the County, municipality and the applicant.

5. **Page VIII-4 (middle of the page, paragraph beginning "An optimum... "):** This section discusses county level review of stormwater management plans only as a possible method to consolidate stormwater management, which the county can consider in the future. However, the final decision on the feasibility of such a system would be at the county level.

6. **Chester County suggests that we prepare a version of the ordinance that can be used across municipal boundaries (as with Chester Creek):** The model ordinance which is presented in the draft plan can be used across municipal boundaries, with the exception of the technical criteria in Section 305.A.2.b. (Water Budget Goal) and Section 308 (Management Districts) which are specific to Darby-Cobbs municipalities.

7. **Ordinance pages 41-42:** "Cumulative" impervious cover refers to all impervious cover which was added to the site in question after formal adoption of the stormwater ordinance by the municipality in which the project is proposed. Impervious areas existing on the site prior to adoption are not included in this cumulative assessment.

We appreciate your interest in and review of the Plan and welcome your comments. Your comments will strengthen the Plan and we look forward to the successful implementation of the Plan and Ordinance.

Sincerely,

Paul A DeBarry

Paul A. DeBarry, P.E., P.H.
Greater Lehigh Valley Office

PAD/dth

Borough Of Lansdowne

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Jayne C. Young
Mayor
David R. Forrest
Borough Manager

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☐ AGREEMENT
☐ CONTRACT
PROJECT NO. 1999-0613-01

April 28, 2004

Mr. Paul DeBarry
Borton-Lawson Engineering
Greater Lehigh Valley Office
6814 Chrisphalt Drive
Suite 200
Bath, PA 18014-8503

RE: Model Act 167 Stormwater Management Ordinance

Dear Mr. DeBarry:

On behalf of the Borough of Lansdowne please accept the following comments regarding the above:

1. Overall, I am concerned that the language in the model ordinance is so technical that it will be extremely difficult, if not impossible, for the lay person to understand. I can imagine that municipal elected officials, who will be responsible for passing the ordinance and explaining it to their constituents, will have a very difficult time if the language is not made more accessible. They will look to staff to explain it, and I don't believe we will be able to do a competent job under the circumstances. To be frank, I have read through it several times, and I still don't understand it in any detail. More importantly, residents, business owners and developers will also have a difficult time understanding the ordinance.

2. It appears that it will be much more difficult to implement the ordinance in urban areas than suburban areas. I am particularly concerned that the ordinance will have an adverse impact on redevelopment opportunities in more dense, urban communities with little available land to meet the requirements of the ordinance. For instance, how will a developer effectively address the new storm water requirements when the building to be redeveloped occupies almost 100% of the parcel. This situation will probably be fairly common in communities like Lansdowne. My fear is that the new requirements will create yet another obstacle in the path of revitalizing older communities, as it appears that

compliance will be much easier and less expensive to accomplish on open field sites in suburban communities.

If, on the other hand, it can be demonstrated that the stormwater requirements in the ordinance can be achieved in urban communities without creating an undue burden, this should be explained in some detail in the stormwater management plan. I think a separate section dealing exclusively with urban communities is warranted.

3. The kinds of activities to be regulated under the ordinance seem overbroad. It appears that the ordinance will apply to even small residential jobs like driveways or small additions. Is this the intent of the ordinance, or would it be appropriate to consider a threshold below which the regulations would not apply? I am concerned that the new requirements will make these smaller improvements too expensive and too complicated to complete. Even in the case of a small residential improvement it seems likely that a homeowner will need to hire an engineer to help him or her through the requirements. For the municipality this situation potentially creates a new burden. Property owners will first look to the code enforcement office for guidance on the ordinance when they apply for a permit. Unfortunately, I don't believe our staff will be able to properly guide them. I believe our only option will be to advise them to get the assistance of an engineer. This situation could result in a public relations nightmare for the municipality.

4. Finally, implementation is a serious consideration, regardless of the final content of the plan and ordinance. Municipal officials, residents, contractors and developers need to become familiar with the content of the ordinance well before adoption. Further, as discussed above, these groups need non-technical, easy-to-read information that explains the requirements in language they will understand. I strongly recommend that the County consider creating a task force, composed of a broad spectrum of stakeholders, who will develop an implementation plan that will include significant outreach activities.

Thank you for considering my comments. I look forward to hearing a response at an upcoming meeting.

Sincerely,

David R. Forrest
Borough Manager

Cc: Karen Holm, Delaware County Planning Department

DELAWARE COUNTY PLANNING DEPARTMENT

COURT HOUSE/GOVERNMENT CENTER
201 W. Front St. Media, PA 19063

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BORTON LAWSON LEHIGH VALLEY OFFICE

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PROJECT NO.______

September 10, 2004

David R. Forrest
Lansdowne Borough Manager
12 East Baltimore Avenue
Lansdowne, PA 19050

RE: Response to Lansdowne Borough's Comments on the Act 167 Plan for the Darby and Cobbs Creeks Watershed

Dear Mr. Forrest:

We have reviewed the comments you made regarding the Act 167 Stormwater Management Plan for the Darby and Cobbs Creeks Watershed, Volume II. We thank you for taking the time to review the plan and make comments. In response to your letter, we offer the following remarks:

1. An executive summary that explains the requirements and goals of the plan in plain language has been drafted and is currently being edited. It should help to eliminate any confusion over the purpose and goals of this plan.

2. A section focusing on how stormwater requirements may affect redevelopment is being considered for the plan and accompanying documents.

3. The plan has been rewritten to exempt development that results in less than 2,000 square feet of impervious cover. This would relieve small additions and driveway improvements from the requirements of this plan.

4. DCPD is currently drafting and editing a municipal stormwater management handbook that will explain the components of the plan and ordinance and provide technical information in a more understandable way. This is intended to be a companion document to the plan.

Mrs. Karen Holm
Delaware County Planning Department
Government Center Building
201 West Front Street
Media, PA 19063-2751

Sent Via e-mail holmk@co.delaware.pa.us & regular mail
File #AB-115-b
April 29, 2004

RE: Act 167 SWM Plan
Darby-Cobbs Creek Watershed

Dear Karen:

On behalf of Aldan Borough, Both Charlie Duffy and I attended the March 31st WPAC meeting held at Clifton Heights Borough Building, to discuss the draft Phase II SWM Plan and Draft Model Ordinance. We appreciated the opportunity to participate, and commend all of the members for their hard work on what appears to be a well-planned document.

I was particularly impressed by Paul DeBarry's approach to providing uniformity, simplicity and practicality to the design methods in the plan. This approach will allow landowners, developers and municipalities to achieve the goals of the plan in a reliable and sustainable manner.

At the meeting, you indicated that participants should provide any comments on the Plan or Model Ordinance by April 30, 2004. Upon review of the Model Ordinance, we have the following comments:

1. Figure IV-1 "Subwatersheds" – The municipal boundaries and labels need to be clearly shown so each municipality can determine subwatershed "subareas" within their limits.

2. "Water Quality & Quantity Control Drainage Plan Municipal Review Procedure" Draft Flow Chart – It appears the chart is missing a "Yes" option for the box under "Overbank/Extreme Event Requirements", where it asks: "Has the applicant sufficiently proven "No Harm" or "Hardship" as defined in Section 308.G or I?"

3. 308.D District Boundaries – I believe it is impractical to make land owners, developers and designers review a map of the entire study area (located at the municipal building) to determine the boundaries of the particular stormwater management district that applies to their property. For instance, even in a small Borough like Aldan, we have 4 subareas and 2 SWM Districts. On the large-scale map of the entire study area, it is very difficult to determine exactly where the boundaries are in relation to the streets. I would suggest that each municipality be provided with a much smaller scale map, on an 8 ½ x 11" sheet that just shows the municipality and their respective SWM districts. This will lead to less confusion and misinterpretation. The map should show streets for good points of reference. The municipality's specific map should be included with the ordinance so that both designers and reviewers are clear on the boundaries.

4. If not already considered, I would recommend that each municipality be provided with an electronic copy of the Model Ordinance to reduce administration time and expense to incorporate the document into the existing municipal code.

5. The Model Ordinance contains a number of "blanks" to be filled in by each municipality. There are a number of places where the authors of the Model Ordinance could assist the municipalities by providing suggestions. For example, Sections VI through IX address fees, fines, enforcement penalties, etc. It may be helpful to suggest values for these "blanks", to give municipalities a good starting point and to allow uniformity.

6. Due to the size of the Model Ordinance (99+ pages), the costs for codification, legal, advertising and administration will be significant. To reduce the costs, can a municipality adopt the Model Ordinance by reference, in lieu of incorporating directly into their codified document?

7. Though I could not find this in the Ordinance, it was mentioned at the meeting that the requirement of a "Certification of Approval by the Municipal Engineer" was in the midst of debate between the authors and PADEP. I strongly recommend against this. If a certification is required, it should be by the designer who prepared the plan, not the reviewer. I can think of no other circumstance (i.e. PADEP, Conservation Districts, US Army Corps of Engineers, etc.) where the reviewer is the one who certifies as to the compliance of the plan with the regulations.

We look forward to your responses.

If you have any questions or need additional information, please feel free to contact me.

A.M.D.G.,

Maurice P. (P.J.) Close, P.E.
Aldan Borough Engineer

Enc.

cc: Mr. Joseph A. McCollian, Jr., President

DELAWARE COUNTY PLANNING DEPARTMENT

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September 10, 2004

Maurice P. (P.J.) Close, P.E.
Brinton Lake Corporate Center
600 Evergreen Drive/Suite 640
Glen Mills, PA 19342

RE: Response to Aldan Borough's Comments on the Act 167 Stormwater Management Plan for the Darby and Cobbs Creeks Watershed

Dear Mr. Close:

We have reviewed the comments you made regarding the Act 167 Stormwater Management Plan for the Darby and Cobbs Creek Watershed, Volume II. We thank you for taking the time to review the plan and make comments. In response to your letter, we offer the following remarks:

1. **Figure IV-1 "Subwatersheds" – The municipal boundaries and labels need to be clearly shown so each municipality can determine subwatershed "subareas" within their limits.**

   A large watershed map containing subareas, management districts and other reference data (major roads, etc.) will serve as the official map. However it would also be possible to prepare individual municipal maps for quick reference. Please note that the plan states that the actual boundary for land development plan purposes is based on topo lines.

2. **"Water Quality & Quantity Control Drainage Plan Municipal Review Procedure" Draft Flow Chart – It appears the chart is missing a "Yes" option for the box under "Overbank/Extreme Event Requirements", where it asks: "Has the applicant sufficiently proven "No Harm" or "Hardship" as defined in Section 308.G or I?"**

   The Municipal Review Flow Chart does appear to be missing a "Yes" option under "Overbank/Extreme Event Requirements," this will be corrected in the final draft.

3. **308.D District Boundaries – I believe it is impractical to make land owners, developers and designers review a map of the entire study area (located at the municipal building) to determine the boundaries of the particular stormwater management district that applies to their property. For instance, even in a small Borough like Aldan, we have 4 subareas and 2 SWM Districts. On the large-scale map of the entire study area, it is very difficult to determine exactly where the boundaries are in relation to the streets. I would suggest that each municipality be provided with a much smaller scale map, on an 8 ½ x 11" sheet that just shows the municipality and their respective SWM districts. This will lead to less confusion and misinterpretation. The map should show streets for good points of reference. The municipality's specific map should be included with the ordinance so that both designers and reviewers are clear on the boundaries.**

   See response to comment 1 above.

4. **If not already considered, I would recommend that each municipality be provided with an electronic copy of the Model Ordinance to reduce administration time and expense to incorporate the document into the existing municipal code.**

   At the completion of the plan, each municipality will be provided with an electronic copy of the ordinance.

5. **The Model Ordinance contains a number of "blanks" to be filled in by each municipality. There are a number of places where the authors of the Model Ordinance could assist the municipalities by providing suggestions. For example, Sections VI through IX address fees, fines, enforcement penalties, etc. It may be helpful to suggest values for these "blanks", to give municipalities a good starting point and to allow uniformity.**

   We can work with the municipalities to suggest values to place in the ordinance.

6. **Due to the size of the Model Ordinance (99+ pages), the costs for codification, legal, advertising and administration will be significant. To reduce the costs, can a municipality adopt the Model Ordinance by reference, in lieu of incorporating directly into their codified document?**

   We do not recommend that the ordinance be adopted by reference as it requires a certain amount of personalization for each municipality. However, Chapter 111 funding from DEP allows for 75% reimbursement for the adoption and implementation of this ordinance.

7. **Though I could not find this in the Ordinance, it was mentioned at the meeting that the requirement of a "Certification of Approval by the Municipal Engineer" was in the midst of debate between the authors and PADEP. I strongly recommend against this. If a certification is required, it should be by the designer who prepared the plan, not the reviewer. I can think of no other circumstance**

(i.e. PADEP, Conservation Districts, US Army Corps of Engineers, etc.) where the <u>reviewer</u> is the one who certifies as to the compliance of the plan with the regulations.

It has been changed to that a design engineer is required to review and sign off on the plan.

Should you have any questions or require additional information please do not hesitate to contact me at (610) 891-5213.

Very truly yours,

Karen Holm

Karen Holm, Manager
Environmental Section

Cc: Borton-Lawson Engineering, Inc.
Joseph A. McCollian, Jr., Council President

VOLLMER

BORTON LAWSON ENGINEERING
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April 30, 2004
File No. 200260218, 200460088, 200260224

Delaware County Planning Department
Court House and Government Center
201 W. Front Street
Media, PA 19063

Attn.: Karen Holm

Re: Draft PA Act 167 Stormwater Management Plan for the Darby and Cobbs Creek Watershed

We have reviewed the draft copy of the Act 167 Stormwater Management Plan for the Darby-Cobbs Creek Watershed, Volume II, as prepared by Borton-Lawson Engineering, Inc. We offer the following comments based on our review:

1. Page III-26 compares present and future combined peak flows for the 100-year event. It shows comparisons for up to 86 sub-areas while the mapping has 90.

2. Page III-29 refers to Hurricane Floyd as occurring on September 16, but does not provide the year.

3. Appendix B – Table B-3 provides Rational Method Runoff Coefficients taken from New Jersey Department of Transportation Technical Manual. While we understand that this is a result of the calibration for the modeling, we have a concern that this will conflict with the standards for PennDOT approval for any projects that require a PennDOT permit.

4. Page III-34 Table III-6 shows watershed problems. Glenolden Borough was indicated as no data collection forms were received. We believe forms were completed by Catania Engineering and were submitted to the County. If additional copies are required, please contact us and we will arrange to have them forwarded.

5. Section VII - Model Act 167 Stormwater Management Ordinance, Article VII – Maintenance Responsibilities, Sections 701.C & 701.D and Article IX – Enforcement and Penalties, Sections 907.C and 907.D: These sections indicate that after the owner provides the municipality with 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, that a final inspection shall be conducted by the municipal engineer or

designee to certify compliance with this ordinance. We recommend that these sections of the ordinance be revised to indicate that upon receipt of the certification from the owner, the municipal engineer shall review the certification and the project to acknowledge that the project has been completed in accordance with the plans and specifications.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Eileen M. Nelson / Sue Nelson

Eileen M. Nelson, PE
Associate

EMN/MJK/sn

cc: Borton-Lawson Engineering, Inc.
Steve Beckson, Manager, Borough of Collingdale
Sam Auslander, Esquire, Solicitor, Borough of Collingdale
Brian Hoover, Manager, Borough of Glenolden
Kevin McGarvey, Councilman, Borough of Glenolden
Michael Puppio, Esquire, Solicitor, Borough of Glenolden
Pete Subers, President of Council, Borough of Prospect Park
Richard Tinucci, Esquire, Solicitor, Borough of Prospect Park

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September 10, 2004

Eileen M. Nelson, PE
Vollmer Associates
4513 Pennell Road
Aston, PA 19014

RE: Response to Vollmer Comments on the Act 167 Plan for the Darby and Cobbs Creeks Watershed

Dear Ms. Nelson:

We have reviewed the comments you made regarding the Act 167 Stormwater Management Plan for the Darby and Cobbs Creeks Watershed, Volume II. We thank you for taking the time to review the plan and make comments. In response to your letter, we offer the following remarks:

1. **Page III-26 compares present and future combined peak flows for the 100-year event. It shows comparisons for up to 86 sub-areas while the mapping has 90.**

   Appropriate labeling feature was not adopted in the map. The map has been relabeled using the proper feature and reprinted for the final plan.

2. **Page III-29 refers to Hurricane Floyd as occurring on September 16, but does not provide the year.**

   Hurricane Floyd's complete data, including the year has been changed for the final plan to September 16, 1999.

3. **Appendix B – Table B-3 provides Rational Method Runoff Coefficients taken from the New Jersey Department of Transportation Technical Manual. While we understand that this is a result of the calibration for the modeling, we have a concern that this will conflict with the standards for Penn DOT approval for any projects that require a Penn DOT permit.**

Cc: Borton-Lawson Engineering, Inc.
Steve Beckson, Manager, Borough of Collingdale
Brian Hoover, Manager, Borough of Glenolden
Deborah Luty, Secretary, Borough of Prospect Park

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WILLIAM J. GLEASON, JR.
Treasurer

Ms. Karen Holm
Manager, Environmental Section
Delaware County Planning Department
Delaware County
201 W. Front St
Media, Pa. 19063

4/30/04

Dear Karen;

Thank your for allowing Radnor Township to comment on the Darby-Cobbs Act 167 Plan. The list below may look long, however I believe the list covers minor issues with the plan. Overall I believe a great job was done putting this together.

All maps show the name Lower Merion written over Radnor Township. The label should be moved to the east several inches.

- Page III-6 and 7 refer to figure XYZ
- Page IV-4 random "s" appear in the text
- Appendix F is missing (at least from my copy)

Ordinance notes

- Page 5 Paragraph 102. C. Change first sentence to read: "A comprehensive program of stormwater management (SWM), including minimization of impacts of development, redevelopment and activities causing accelerated erosion and loss ..."
- Page 6 Paragraph 103. E. Eliminate the words: "during construction".
- Page 6 Paragraph 103. J. Change to read: "Restore and maintain existing base flows ..."
- Page 12 "Design Professional" should specify only Engineer's licensed in Penna. may design stormwater management plans. Registered Landscape Architects and Registered surveyors are Design Professional, but they should not be permitted to design stormwater management plans.
- Page 12 "BMPs" -- Change to read: " ... non-structural BMPs"
- Page 12 "Discharge" -- Change to: "The release of water ..."
- Page 12 "NPDES " -- Change to read: "...government's system for issuance of permits for point source discharges of pollution under the Clean Water Act, ..."
- Page 12 "Pretreatment" -- Eliminate "help"
- Page 12 "Development Site" is listed twice
- Page 25 Paragraph 304A.2 Eliminate "cost" from considerations for nonstructural project design. Developers are certainly going to take cost into account in any event, and if it is included as a criterion it will be the driving factor.

- Page 26 Sec. 305. This section should more clearly state the goal that the volume of post-development runoff will be less than or equal to the pre-development volume.
- Page 30 - Can hot spots be recharged if not drinking water supplies are in the area?
  Stormwater Hotspots should be prevented. Therefore this section should be modified to read: "Second, additional stormwater treatment will be required at hotspot sites to prevent pollutant washoff after construction."
- Page 31 Paragraph 305.1. H. Change to read: "An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists."
- Page 33 Paragraph G – This distance works fine if the stream follows the rear or side property line. If the stream cuts through the middle of a rear yard this 50' buffer may not work. Each Municipality should develop the riparian buffer distance.
- Page 35 Paragraph B – Does this only pertain when the entire site is redeveloped. Many times the house is demolished but the driveway is reused and expanded. This paragraph should be clarified.
- Table 308.1 refers to "Conditional" Direct Discharge. However Appendix D, pg 36 refers to "Provisional " Direct Discharge. Are these the same?
- Page 38 Paragraph K – Figure B-5 is not included in Appendix B
- Page 42 – maximum impervious cover limit should be set by the individual Municipality. The maximum amount to be 2,000 sq ft.
- Page 42 Reference made to Section 302 B. I believe it should be 402 B.
- Page 43 Paragraph B.2 Steep slope should be left up to the individual Municipality to define. Our case steep slope is considered above 20%.
- Page 44 Paragraph 19 & page 50 section 702B(i). Is this required even if the system is owned and maintained by a private entity or Homeowners Association?
- Page 44 Paragraph 22. Do all drainage plans, even those under 5,000 sq. ft of coverage now go to the Conservation District?
- Page 46 Paragraph D & E. This should all be handled like a normal review process. This requires additional handling that is never done by our Municipality. Specifically forwarding correspondence through the Municipal Secretary.
- Page 47 Paragraph G. This may delay the approval of a Subdivision or Land Development plan, which would violate the MPC. The issues noted should be permitted to be approved conditionally.

Thank you again, for allowing these comments.

Sincerely,

Daniel E. Malloy, P.E.
Township Engineer

cc Dave Bashore, Township Manager

DELAWARE COUNTY PLANNING DEPARTMENT

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201 W. Front St. Media, PA 19063

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September 10, 2004

Daniel E. Malloy, P.E.
Radnor Township
301 Iven Avenue
Wayne, PA 19087-5297

RE: Response to Radnor Township's Comments on the Act 167 Plan for the Darby and Cobbs Creeks Watershed

Dear Mr. Malloy:

We have reviewed the comments you made regarding the Act 167 Stormwater Management Plan for the Darby and Cobbs Creeks Watershed, Volume II. We thank you for taking the time to review the plan and make comments. In response to your letter, we offer the following remarks:

1. **All maps show the name Lower Merion written over Radnor Township. The label should be moved to the east several inches.**

   The Lower Merion label will be moved.

2. **Page III-6 and 7 refer to figure XYZ**

   Both contain references to figure XYZ that will be replaced in the final plan by the correct figure.

3. **Page IV-4 random "s" appear in the text**

   The random "s" on page IV-4 shall be corrected in the final plan.

Section VII – Model Act 167 Stormwater Management Ordinance Notes

4. **Appendix F is missing (at least from my copy)**

12. **Page 12 "Pretreatment" -- Eliminate "help"**

"Pretreatment" definition - the word "help" will be removed.

13. **Page 12 "Development Site" is listed twice**

This shall be corrected in the final plan.

14. **Page 25 Paragraph 304A.2 Eliminate "cost" from considerations for nonstructural project design. Developers are certainly going to take cost into account in any event, and if it is included as a criterion it will be the driving factor.**

It could be construed by a developer to select the most cost effective method rather then the best method for the control of the Stormwater. As such, the word "cost" will be removed for the final plan

15. **Page 26 Sec. 305. This section should more clearly state the goal that the volume of post-development runoff will be less than or equal to the pre-development volume.**

The goal of ground water recharge is to maintain the natural hydrologic regime of the site to the maximum extent possible.

16. **Page 30 - Can hot spots be recharged if no drinking water supplies are in the area? Stormwater Hotspots should be prevented. Therefore this section should be modified to read: "Second, additional stormwater treatment will be required at hotspot sites to prevent pollutant washoff after construction."**

Stormwater Hotspots should not be recharge even if no existing drinking water supplies are in the area, since the potential exist for future water supply projects. Stormwater runoff from these areas should be treated in water quality facilities. Section 305.C. Hotspots has been revised.

17. **Page 31 Paragraph 305.1. H. Change to read: "An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists."**

The sentence will be changed to read "An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists." for the final draft of this plan.

18. **Page 33 Paragraph G – This distance works fine if the stream follows the rear or side property line. If the stream cuts through the middle of a rear yard this 50' buffer may not work. Each Municipality should develop the riparian buffer distance.**

The access easement allows for future maintenance access to the stormwater management facility by the municipality, homeowner, or homeowners association. Elimination of the easement could prevent required maintenance in the future.

26. Page 44 Paragraph 22. Do all drainage plans, even those under 5,000 sq. ft of coverage now go to the Conservation District

The Conservation Districts will be setting policy to determine which drainage plans resulting in over 2,000 sq. ft of impervious coverage will need to be sent to their offices for a determination of adequacy.

27. Page 46 Paragraph D & E. This should all be handled like a normal review process. This requires additional handling that is never done by our Municipality. Specifically forwarding correspondence through the Municipal Secretary.

These sections may be modified by the Municipality to conform to their existing plan review process.

28. Page 47 Paragraph G. This may delay the approval of a Subdivision or Land Development plan, which would violate the MPC. The issues noted should be permitted to be approved conditionally.

If a plan doesn't have an approved drainage plan, then it should be disapproved until there is one that complies (same as E&S, parking requirements, etc.). Final approval and/or construction (building permits) can be conditional upon receipt of the DEP permits.

Should you have any questions or require additional information please do not hesitate to contact me at (610)-891-5213.

Very truly yours,

Karen Holm

Karen Holm, Manager
Environmental Section

Cc: Borton-Lawson Engineering, Inc.
Dave Bashore, Township Manager

April 30, 2004

Ms. Karen Holm
Environmaental Manager
Delaware County Planning Department
Government Center Building
201 West Front Street
Media, PA 19063-2751

Re: Comments on the Darby and Cobbs Creeks Watershed Act 167 Stormwater Management Plan

Dear Ms. Holm:

I appreciate this opportunity to provide comments on the Darby-Cobbs Act 167 Plan (Plan).

My comments focus mainly on the Model Ordinance contained in Section VII of the Plan and are presented in the same order that information was provided in the Plan package. For your convenience in drafting responses to these comments, I will forward this letter to you electronically in MSWord format.

TABLE OF CONTENTS

The Table of Contents should be updated so the page numbers are correct.

Section VII - Model Act 167 Stormwater Management Ordinance

Table of Contents

Section 803. Roof *Draines* should be Roof Drains

Section 105. Applicability/Regulated Activities

The applicable watershed is delineated by a map which may be scrutinized by applicants trying to avoid these requirements. The watershed and applicability should be approximated by the map and more fully described by the municipality.

Item D under the list of Regulated Activities should be changed from "...reconstruction of, , or additional impervious ..." should read "...reconstruction of impervious ..."

5 Item F mentions a "discharge point" but this term is not defined in the ordinance. The term should be clarified.

Section 202. Definitions

The definition of applicant refers to Section 104. I believe it should refer to Section 105.

Development Site is defined twice.

"Discharge - To release *of* water ..." should read , "Discharge - To release water ..."

The definition of Existing Conditions should not contain the second sentence. The assignment of a runoff values to existing conditions is more appropriately done in the calculation section of the ordinance not in the definitions.

Floodway is defined ".... Unless otherwise specified...". What does that mean? Could the developer of municipality specify a different floodway?

Impervious surface is defined "... Any surface areas designed to *initially* be gravel or crushed stone shall be assumed to be impervious surfaces. What does this sentence mean?

The definition of Lot contains a sentence regarding sewage flows. This sentence should be removed.

The definition of Person is already included at §201C. One of the definitions should be eliminated or they should be consistent.

The definition of Redevelopment contains "...top-layer grinding...". Is that the same as milling? Also the definition includes provisions for determining if utility cuts constitute redevelopment. What is meant by 50% of the street width? Many utility cuts involve half of the street width and therefore would be considered redevelopment.

Regulated Activities is defined as "...runoff quality and quantity...". This should be changed to "...runoff quality or quantity..."

Stormwater Management Facility is defined as "... affects stormwater runoff quality and quantity." This should be changed to "...affect stormwater runoff quality, rate or quantity."

§304A2 requires an economic and technical feasibility study to be done. What are practical and reasonable costs for alternatives?

§304B12 requires management of "remaining runoff". What is "remaining runoff"?

§305A2b reads "...up to a an existing..." This should read "... up to an existing..."

§305B1 ends with quotation marks. These should be removed.

The first sentence of §305C should be removed. Hotspots are defined in the definitions. How is a site designated as a hotspot? Is monitoring data for various site uses available? Also, references to "samples" of hotspots should be changed to "examples" of hotspots.

§306G requires the establishment of a buffer along streams. No specific standards are provided for planting the buffer. Enforcement of buffer management requirements is not practical on private property.

§307 provides requirements for Streambank Restoration projects. Why are these included? Are they required in the ordinance?

§308A paragraph 3 reads "...for the design storms in accord with..." This should read "...for the design storms in accordance with..."

How were the stormwater management districts in §308 determined? Could the districts be changed while still meeting the goals of Act 167?

§308C appears to be the same as §308A paragraph 3.

§308J should be removed from the ordinance. What is the purpose of developing a regional watershed stormwater management plan and at the same time allow municipalities to disregard the quantity control requirements. There are no standards provided for determining a hardship and liability will be very difficult assign to anyone using the hardship option.

§308K refers to Figure B-5 in Appendix B. This figure is missing.

§310B refers to West Nile Virus Guidance in Appendix H. The information in appendix H should be reviewed by the DEP's West Nile program to be sure it is consistent with the DEP program.

§402A1 provides an exemption for "...gardening for home consumption." Does this mean gardening for consumption by the property owner?

§403B paragraph 2 should refer to Section 402.B not 302.B

§404B reads "For these regulated activities..." This should read "For regulated activities..."

§405D2 refers to the "Developer" in the last two sentences. This should be changed to "applicant".

§405G refers to "PaDEP" This should be changed to "DEP" for consistency with the rest of the document.

§702B1 allows submittal of plans on 30" x 42" sheets. The maximum size sheet should be 24" x 36".

§703C appears to be the same as 701C2.

§704 allows a Stormwater Control and BMP to be removed or altered if granted in writing by the municipality. How can the regional watershed be protected if the municipalities are allowed to remove stormwater controls and BMPs? The municipality should not be allowed to grant exceptions as described in §704.

§708 requires the recording of certain document. Is there a provision for recording the Drainage Plan? How will future property owners know it exists and what their responsibilities are?

§709A1 required privately owned facilities to provide payment for inspections for 10 years. The owner should be required to pay for inspections in perpetuity.

§709A2 should require the applicant to pay for the life-cycle cost of maintaining the facilities. It is not appropriate to burden the municipalities with the cost of maintaining, inspecting and reconstructing these facilitates.

§709A3 requires the cost for maintenance to be expressed in present worth. What interest rate should be used? Should an index be included in the ordinance?

§709D1 and §709D2 appear to be the same 709A2

§709E appears to be the same as 709B.

§709F should read "...The municipality ***shall*** require ..."

§907C appears to be the same as §701C.

§907D appears to be the same as §701D.

§907F appears to be the same as §904A

§907G refers to §803.C. I believe it should refer to 907C1.

Of greatest concern is the section of the ordinance that allows municipalities to ignore the quantity requirements if the applicant uses the hardship option. This option appears to allow municipalities to disregard the watershed approach that has been so carefully studied by the county.

Again, thank you for this opportunity to provide comments on these documents. If you need further clarification of any of the comments provided, please feel free to contact me.

Respectfully,

Kevin M. Kane
Township Engineer

Cc: Michael LeFevre, Manager

DELAWARE COUNTY PLANNING DEPARTMENT

COURT HOUSE/GOVERNMENT CENTER
201 W. Front St. Media, PA 19063

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PROJECT NO.

September 10, 2004

Kevin M. Kane, Engineer
Springfield Township
50 Powell Road
Springfield, PA 19064

RE: Response to Springfield Township's Comments on the Act 167 Plan for the Darby and Cobbs Creeks Watershed

Dear Mr. Kane:

We have reviewed the comments you made regarding the Act 167 Stormwater Management Plan for the Darby and Cobbs Creeks Watershed, Volume II. We thank you for taking the time to review the plan and make comments. In response to your comments and concerns, we offer the following remarks:

1. **The Table of Contents should be updated so the page numbers are correct.**

   The Table of Contents will be corrected in the final draft of the plan with the correct page numbers.

Section VII - Model Act 167 Stormwater Management Ordinance

2. **Page 2, Table of Contents: Section 803. Roof *Draines* should be Roof Drains**

   Draines will be changed to drains.

3. **Page 7, Section 105 Applicability/Regulated Activities**
   The applicable watershed is delineated by a map which may be scrutinized by applicants trying to avoid these requirements. The watershed and applicability should be approximated by the map and more fully described by the municipality.

   Individual municipality maps will be produced showing more precisely where the management districts lie. However, as noted in the last sentence of Section separate from existing FEMA funded studies, to revise or better define existing floodway boundaries.

Impervious surface is defined "... Any surface areas designed to *initially* be gravel or crushed stone shall be assumed to be impervious surfaces. What does this sentence mean?

This sentence refers to areas "designed to be gravel or stone. The word "initially can be removed.

The word initially will be removed in the final report.

The definition of lot contains a sentence regarding sewage flows. This sentence should be removed.

The sentence regarding sewage flows will be removed in the final report.

The definition of Person is already included at §201C. One of the definitions should be eliminated or they should be consistent.

The definition of Person in Section 202 will be removed in the final Ordinance.

The definition of Redevelopment contains "...top-layer grinding...". Is that the same as milling? Also the definition includes provisions for determining if utility cuts constitute redevelopment. What is meant by 50% of the street width? Many utility cuts involve half of the street width and therefore would be considered redevelopment.

Top layer grinding and milling achieve the same results, removal of the top surface of pavement, however, are two different processes. Grinding uses diamond saw blades that gently abrade away the top surface and is recommended for concrete. Milling (also called cold planing, rotomilling, and profiling) involves a carbide-tipped milling head which chips away at the surface and is often used on bituminous surface (asphalt). The final ordinance will include milling in the definition of "redevelopment."

The 50% refers to longitudinal cuts. Utility cuts perpendicular across the road such as sewer and water line crossings and culverts would not be redevelopment.

Regulated Activities is defined as "...runoff quality and quantity...". This should be changed to "...runoff quality or quantity..."

The definition will be changed from "...runoff quality and quantity..." to "...runoff quality or quantity..."

- Outdoor liquid container storage
- Outdoor loading/unloading facilities
- Public works storage areas
- Facilities that generate or store hazardous materials
- Commercial container nursery
- Other land uses and activities as designated by an appropriate review authority

The following land uses and activities are not normally considered hotspots:

- Residential streets and rural highways
- Residential development
- Institutional development
- Office developments
- Non-industrial rooftops
- Pervious areas, except golf courses and nurseries (which may need an Integrated Pest
Management (IPM) Plan).

While large highways (average daily traffic volume (ADT) greater than 30,000) are not designated as a stormwater hotspot, it is important to ensure that highway stormwater management plans adequately protect groundwater.

12. **Page 33, Section 306.G requires the establishment of a buffer along streams. No specific standards are provided for planting the buffer. Enforcement of buffer management requirements is not practical on private property.**

Ordinance Appendix G has been updated to include a section on Riparian Buffer references applicable to the southeastern region of Pennsylvania. The riparian buffer requirements are part of the water quality criteria in the overall Stormwater Management. If the requirements of this section are not met by the landowner, the drainage plan would therefore be found inconsistent with the Stormwater Management Plan and neither a land development permit (Section 405.G.) nor building permit (Section 405.H.) shall be approved.

13. **Page 34, Section 307 provides requirements for Streambank Restoration projects. Why are these included? Are they required in the ordinance?**

Ordinance language referring to "Streambank Restoration Projects" has been removed from the model ordinance.

14. **Page 34, Section 308.A, paragraph 3 reads "...for the design storms in accord with..." This should read "...for the design storms in accordance with..."**

The text will be changed.

15. **How were the stormwater management districts in Section 308 determined? Could the districts be changed while still meeting the goals of Act 167?**

22. **Page 45, Section 404.B reads "For these regulated activities..." This should read "For regulated activities..."**

We will change the text.

23. **Page 46, Section 405.D.2 refers to the "Developer" in the last two sentences. This should be changed to "applicant".**

We will make the change.

24. **Page 47, Section 405.G refers to "PaDEP" This should be changed to "DEP" for consistency with the rest of the document.**

We will make the change.

25. **Page 50, Section 702.B.1 allows submittal of plans on 30" x 42" sheets. The maximum size sheet should be 24" x 36".**

The text will be revised to leave a blank to allow municipalities to select the preferred size.

26. **Page 51, Section 703.C appears to be the same as 701.C.2**

Section 703.C refers to the submittal of the Operation and Maintenance plan for the BMP facilities, of which the municipality <u>may</u> require the record drawings to be a part. Section 701.C.2. requires the applicant to submit the record drawings as part of the prerequisite for the release of the performance guarantee.

27. **Page 52, Section 704 allows a Stormwater Control and BMP to be removed or altered if granted in writing by the municipality. How can the regional watershed be protected if the municipalities are allowed to remove stormwater controls and BMPs? The municipality should not be allowed to grant exceptions as described in Section 704.**

The phrase "unless an exception is granted in writing by the Municipality" has been removed from the language of this section.

28. **Section 708 requires the recording of certain document. Is there a provision for recording the Drainage Plan? How will future property owners know it exists and what their responsibilities are?**

This could be done by requiring that stormwater facilities on individual lots (or homeowner association lots) be placed in the deed. We will consider language that requires stormwater management facilities to be documented in deeds.

37. **Page 60, Section 907.F appears to be the same as Section 904.A**

Section 907.F. will be removed in the final text.

38. **Section 907.G refers to Section 803.C. I believe it should refer to 907.C1.**

We will change Section 803.C to 907.C.1. in the final text.

39. **Of greatest concern is the section of the ordinance that allows municipalities to ignore the quantity requirements if the applicant uses the hardship option. This option appears to allow municipalities to disregard the watershed approach that has been so carefully studied by the county.**

Our response is noted under comment 17.

Thank you again for your comments on the document. If you have any questions, please feel free to call me at 610-891-5213.

Very truly yours,

Karen L. Holm

Karen L. Holm, Manager
Environmental Section

Cc: Michael LeFevre, Manager
Borton-Lawson Engineering, Inc.

Philadelphia
PWD
Water Department

April 30, 2004

Karen Holm
Delaware County Planning Department
Government Center Building
201 West Front Street
Media, PA 19063-2751

RE: PA-Act 167 Stormwater Management Plan - Darby and Cobbs Creeks Watershed

Dear Ms. Holm:

On behalf of the Philadelphia Water Department (PWD), I would like thank you for this opportunity to comment on the Stormwater Management Plan developed for the Darby-Cobbs Watershed.

As one of the four watershed partners involved in this project, we appreciate and acknowledge the hard work and dedication contributed by all partners in this challenging endeavor, especially the Delaware County Planning Department and their consultant, Borton-Lawson Engineers. The opportunity we were afforded to participate in the development of technical portions of the Plan was gratifying and we look forward to continuing to work with you on this groundbreaking Plan.

However, after considerable internal review and discussion with the Philadelphia Planning Commission and the city's Department of Licenses and Inspections, we have come to the conclusion that the City of Philadelphia cannot support the Stormwater Management Plan in its current form.

Our primary concern with the Plan is its inclusion of all parcels of land, regardless of size, to require some form of stormwater management. Our fear is that such new requirements for small parcel development or redevelopment will prove far too onerous to implement, and may result in a public backlash against the entire planning effort. We believe that maximum stormwater benefits and cost-effective implementation will be achieved by targeting those parcels over our proposed minimum threshold. In our previous comments, we have offered suggestions as to how the Plan can be modified to address our concerns as well as surpass the minimum provisions which municipalities must comply to meet their NPDES Phase II permit requirements.

Please contact Brian Marengo, Manager of Watershed Engineering and Sciences at 215-685-6245 or via email at brian.marengo@phila.gov for additional information. We look forward to our continued collaboration with you on this extraordinary project.

Sincerely yours,

Howard Neukrug, P.E.
Director, Office of Watersheds

PWD Darby-Cobbs Act 167 Support
Comments on Water Budget Analysis and Section VII, Model Ordinance

Date: April 30, 2004

Recharge Estimate and Water Budget Analysis

The study estimates that recharging 0.55" of runoff during every storm will approximate the natural water balance. However, we have some concerns with the technical basis for recharging 0.55 inches per storm:

- It is based on a one-year rainfall record that may not be representative. Baseflow separation of a long period of record suggests that baseflow as a percentage of rainfall can vary significantly from year to year, and can vary even if total rainfall is similar.

- It is based on the premise of infiltrating all storms with a rainfall total up to 0.55". This approach ignores infiltration that will occur during larger storms. In fact, infiltration will occur during all storms, assuming proper design and sufficient time between storms.

Performing a refined analysis using the long-term rainfall record, we estimate that infiltrating runoff from impervious cover for all storms of 0.3 inches or less, and the first 0.3 inches of storms with greater totals, will approximate the water budget at the Waterloo Mills gauge on a unit-area basis. This is less than the 0.55 inches calculated in Darby Cobbs Act 167 technical memorandum.

The analysis was performed as follows:

- A storm frequency analysis was performed on the long-term rainfall record at Philadelphia International Airport. Mean annual rainfall is approximately 41.5 inches at this gauge.

- A baseflow separation analysis was performed on USGS streamflow records from Waterloo Mills, the same gauge used for the Darby Cobbs Act 167 Study. Baseflow represents approximately 37%, or 15.4 inches, of mean annual precipitation.

- Solve for the amount of infiltration X, where all runoff is infiltrated for storms less than or equal to X inches, and X inches are infiltrated for storms greater than X inches. Using 98 years of record, the analysis shows that to infiltrate an average of 15.4 in/yr, X is approximately 0.3 inches.

Recommendations:

- **Continue to require infiltration of at least 0.5" of runoff, and preferably 1". This amount is required by several innovative ordinances, including the local example of Chester County. Because only a portion of the watershed can be expected to develop or redevelop, it makes sense to aim for a higher infiltration rate in the areas that do develop. The goal of restoring the natural water balance is possible**

only over the very long term, and more progress will be made toward the goal if a larger infiltration amount is specified. Another part of the rationale is the concept that while regional facilities are appropriate for detention and treatment, recharge can best be dispersed throughout the watershed on individual sites. The higher recharge requirement will stimulate the disconnection of impervious surface, and help developers to think more in terms of dispersing, rather than concentrating, runoff.

- **Change the rationale given in the text for the specific infiltration requirement. We believe the water balance study performed for the study is incorrect and should not be given as a rationale. It could serve as a convenient rebuttal point for critics. We do not recommend using the revised analysis as a rationale for *decreasing* the amount of infiltration required, however. In many ordinances, up to 1 inch per storm is the required recharge amount, and no supporting calculations are required because the recharge requirement serves policy goals, and is not a physically based requirement.**

Infiltration should not be a hardship. Where soil conditions permit, infiltration is likely to represent a more cost-effective option than detention-treatment BMPs. The ordinance continues to provide land owners with an exemption from the infiltration requirement if they prove that soil conditions make infiltration infeasible.

Section 105. Applicability/Regulated Activities

According to Section 105, the "Ordinance applies to any Regulated Earth Disturbance activities within the Municipality and all stormwater runoff entering into the Municipality's separate storm sewer system from lands within the boundaries of the municipality." Within Section 202, a Regulated Earth Disturbance is defined as follows:

> **Regulated Earth Disturbance** - Earth disturbance activity one acre or more with a point source discharge to surface waters or the Municipality's storm sewer system, or five acres or more regardless of the planned runoff. This includes earth disturbance on any portion of, part, or during any stage of, a larger common plan of development.

- Based on the Applicability described in Section 105 and the definition of Regulated Earth Disturbance in Section 202, we interpret that the ordinance applies to the following development scenarios:

1. Any development that discharges into a sewer system, regardless of the area of the earth disturbance activity.

2. Any earth disturbance between one acre and five acres that does not discharge to a storm sewer, but discharges directly to surface waters

3. Any earth disturbance greater than 5 acres.

- The description of applicability given verbally at the WPAC meeting on March 31, 2004, indicated that the stormwater ordinance is applicable to all development and all earth disturbance activity, regardless of area of the earth disturbance activity. According to the guidance given at the meeting, this was based on an understanding that NPDES regulations require post-construction stormwater management on all development projects.

- DEP's "Instructions for a General or Individual NPDES Permit for Stormwater Discharges Associated with Construction Activities" dated 12/2002, indicates that Post-Construction Stormwater Management Plans are only required in the following situations:

  1. Earth disturbance of more than five acres.

  2. Earth disturbance of one to less than five acres with a point source discharge to surface waters of the Commonwealth, including discharge to the sewer system.

There seems to be some contradiction among these applicability requirements and we do not feel that any of them represent suitable applicability requirements. We feel that requiring compliance with the Ordinance only for earth disturbance activities greater than one acre is too lenient and will not provide effective stormwater management, however we feel that requiring every earth disturbance that discharges to the sewer system to comply with the ordinance is too restrictive. We are concerned that this level of control would place an excessive and unreasonable burden on municipal reviewers. Philadelphia's Department of Licenses and Inspections issues about 10,000 building permits per year. Currently only about 20 to 30 necessitate a stormwater management review. If every earth disturbance that discharges to the Municipal sewer system is required to comply with all aspects of this ordinance, stormwater reviewers would need to review several thousand permits per year. Secondly, after reviewing several representative redevelopment case studies, we believe that the streambank erosion requirement would be onerous for redevelopment projects with earth disturbance activity of less than one acre.

Based on these concerns, we suggest that Section 105 be modified from paragraph four until the end of the section as follows:

"This Ordinance applies to any earth disturbance activity greater than or equal to 2,000 square feet that is associated with a development or redevelopment project. Earth disturbance activities greater than or equal to 2,000 square feet, but less than 5,000 square feet, that are associated with development or redevelopment projects are exempt from the Drainage Plan Requirements of Article IV of this Ordinance. Earth disturbance activities less than one acre that are associated with redevelopment projects are exempt from the Section 307.Streambank Erosion Requirements. Earth disturbance activities that are less than 2,000 square feet shall be encouraged to implement voluntary stormwater management practices."

We recommend that the "Regulated Activities" that are listed on page 8 be removed from the Ordinance. All of these activities are included in the ordinance through definition, and we feel that including them in this section leads to confusion.

The table below summarizes the applicability of the Ordinance. **We suggest that this table be included in the ordinance to provide clarification.**

Table 1 – Applicability of Proposed Model Ordinance

		Disturbed Earth			
		0-2000 sq.ft.	2000-5000 sq.ft	5000 sq.ft.-1 acre	> 1 acre
Section 304 Nonstructual Project Design	Development	N/A	Yes	Yes	Yes
	Redevelopment	N/A	Yes	Yes	Yes
Section 305 Groundwater Recharge	Development	N/A	Yes	Yes	Yes
	Redevelopment	N/A	Yes	Yes	Yes
Section 306 Water Quality Requirements	Development	N/A	Yes	Yes	Yes
	Redevelopment	N/A	Yes	Yes	Yes
Section 307 Streambank Erosion Requirements	Development	N/A	Yes	Yes	Yes
	Redevelopment	N/A	Exempt	Exempt	Yes
Section 308 Stormwater Quantity Control and Management Districts	Development	N/A	Yes	Yes	Yes
	Redevelopment	N/A	Yes (No Harm Option)	Yes (No Harm Option)	Yes (No Harm Option)
Article IV Drainage Plan Requirements	Development	N/A	Exempt	Yes	Yes
	Redevelopment	N/A	Exempt	Yes	Yes

Section 202. Definitions, p. 18

The definition of "Regulated Earth Disturbance" should be removed from the definitions section. The proposed modifications no longer include a reference to "regulated earth disturbance," and the definition contradicts the proposed modifications.

In its place, the following definition of "Development" should be included in Section 202:

> **Development** - Any human-induced change to improved or unimproved real estate, whether public or private, for which a permit is required, including but not limited to construction, installation, or expansion of a building or other structure, land division, street construction, drilling, and site alteration such as dredging, grading, paving, parking or storage facilities, excavation, filling, or clearing. As used in this ordinance, development encompasses both new development and redevelopment.

We also suggest that the definition of redevelopment be modified as follows:

> **Redevelopment -** Any development that requires demolition or complete removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces. Maintenance activities such as top-layer grinding and re-paving are not considered to be redevelopment. Interior remodeling projects and tenant improvements are also not considered to be redevelopment. Utility trenches in streets are not considered redevelopment unless more than 50% of the street width is removed and re-paved.

Section 304. Nonstructural Project Design

B. 2. – The stream buffer section cited here should be Section 306.G., not Section 306.F.

Section 305.A Groundwater Recharge, pp. 28-29

We suggest removing the word "percent" from the unnumbered equation box at the end of page 28 and the equation box on page 29. It appears that this term refers to the impervious area in square feet.

Section 306. Water Quality Requirements

G. – Language regarding the use of native vegetation should instead include language that "encourages" the use native vegetation and that bans or prohibits the use of invasive species. The necessary lists of suggested native material and prohibited invasive species can be included in an Appendix or BMP Manual.

We agree that the water quality BMPs should be designed and maintained to provide protection from clogging and unwanted sedimentation. **However, we suggest that following sentence be removed: "Discharge orifices shall be no smaller than three inches in diameter."** We are concerned that the specific prohibition against small orifices will make controlled discharge over 24 hours at smaller sites (less than 10 acres) impossible, and inhibit the development of innovative outlet structures that are suitable for small development areas and are resistant to clogging.

Section 307. Streambank Erosion Requirements

We recommend that earth disturbance activity of less than one acre that is associated with redevelopment projects be exempt from the requirements of Section 307. Based on a review of several case studies, it seems that the streambank erosion requirement would be excessively burdensome for these projects.

The explanation of the streambank erosion volume and release rate is somewhat unclear. The ordinance states, "On sites with small contributing drainage areas…[that] do not provide enough runoff volume to allow a 24-hour attenuation with the 3-inch orifice, calculations shall be submitted showing this condition. Installation of the 3-inch orifice in these cases shall meet the requirements of the streambank erosion criteria." We interpret the new section to state that the volume must be constructed even though it might not provide the intended benefit. **We recommended that this section be removed along with all references to 3-inch orifices.** Technological solutions to clogging concerns exist and can be included in BMP manuals. Removing this provision would allow land owners to implement these or other creative solutions.

Section 308. Stormwater Quantity Control and Management Districts

"No Harm" Option – page 36, Section 308.H

The No Harm option states, "For any proposed development site not located in a provisional direct discharge district, the Applicant has the option of using a less restrictive runoff control (including no detention) if the Applicant can prove that "no harm" would be caused by discharging at a higher runoff rate than that specified by the Stormwater Management Plan. The "no harm" option is used when an Applicant can prove that the proposed conditions hydrographs can match existing conditions hydrographs, or if it can be proved that the proposed conditions will not cause increases in peaks at all points downstream"

It seems that most redevelopment projects that are reducing or maintaining existing impervious area will be able to claim the "no harm" option, particularly since they will decrease downstream hydrograph peaks through the groundwater recharge and water quality requirements of the ordinance. Therefore it seems that redevelopment projects that maintain or decrease the current percentage of impervious surface will be exempt from Section 308 Requirements.

We feel that this option will be acceptable for redevelopment in Philadelphia and should remain in the ordinance. However, it seems that there are some municipalities in Delaware County that experience severe flooding problems and we would like to bring this element of the ordinance to their attention. Municipalities might consider rewording the "No Harm" on an individual basis in their own version of this model ordinance.

Section 402. Exemptions (from Drainage Plan Requirements)

We recommend modifying the drainage plan exemption as described in Section 105. We recommend the following wording:

"Earth disturbance activities greater than or equal to 2,000 square feet, but less than 5,000 square feet, that are associated with development or redevelopment projects are exempt from the Drainage Plan Requirements of Article IV of this Ordinance."

This exemption applies to all types of development. **Therefore the references to specific land uses under 402.B should be removed from the ordinance.**

The ordinance states, "Applicants whose activities are exempted under Section 302.B above shall still be required to meet the Groundwater Recharge (Section 305) and Water Quality (Section 306) controls of this Ordinance." **We recommend that this sentence be reworded as follows: "Applicants whose activities are exempted under 402.B above shall still be required to meet the other applicable controls described in this ordinance."**

PWD Darby-Cobbs Act 167 Support
Comments on Comments on Water Budget Analysis and Section VII, Model Ordinance

Date: March 24, 2004

Recharge Estimate and Water Budget Analysis

The study estimates that recharging 0.55" of runoff during every storm will approximate the natural water balance. However, we have some concerns with the technical basis for recharging 0.55 inches per storm:

- It is based on a one-year rainfall record that may not be representative. Baseflow separation of a long period of record suggests that baseflow as a percentage of rainfall can vary significantly from year to year, and can vary even if total rainfall is similar.

- It is based on the premise of infiltrating all storms with a rainfall total up to 0.55". This approach ignores infiltration that will occur during larger storms. In fact, infiltration will occur during all storms, assuming proper design and sufficient time between storms.

Performing a refined analysis using the long-term rainfall record, we estimate that infiltrating runoff from impervious cover for all storms of 0.3 inches less, and the first 0.3 inches of storms with greater totals, will approximate the water budget at the Waterloo Mills gauge on a unit-area basis. This is less than the 0.55 inches calculated in Darby Cobbs Act 167 technical memorandum.

The analysis was performed as follows:

- A storm frequency analysis was performed on the long-term rainfall record at Philadelphia International Airport. Mean annual rainfall is approximately 41.5 inches at this gauge.

- A baseflow separation analysis was performed on USGS streamflow records from Waterloo Mills, the same gauge used for the Darby Cobbs Act 167 Study. Baseflow represents approximately 37%, or 15.4 inches, of mean annual precipitation.

- Solve for the amount of infiltration X, where all runoff is infiltrated for storms less than or equal to X inches, and X inches are infiltrated for storms greater than X inches. Using 98 years of record, the analysis shows that to infiltrate an average of 15.4 in/yr, X is approximately 0.3 inches.

Recommendations:

- Continue to require at least 0.5" of runoff, and preferably 1". This amount is required by several innovative ordinances, including the local example of Chester County. Because only a portion of the watershed can be expected to develop or redevelop, it makes sense to aim for a higher infiltration rate in the areas that do develop. The goal of restoring the natural water balance is possible only over the very long term, and more progress will be made toward the goal if a larger infiltration amount is specified. Another part of the rationale is the concept that while regional facilities are appropriate for detention and treatment, recharge can best be dispersed throughout the watershed on individual sites. The higher recharge requirement will stimulate the disconnection of impervious surface, and help developers to think more in terms of dispersing, rather than concentrating, runoff.

- Change the rationale given in the text for the specific infiltration requirement. We believe the water balance study performed for the study is incorrect and should not be given as a rationale. It could serve as a convenient rebuttal point for critics. We do not recommend using the revised analysis as a rationale for *decreasing* the amount of infiltration required, however. In many ordinances, up to 1 inch per storm is the required recharge amount, and no supporting calculations are required because the recharge requirement serves policy goals, and is not a physically based requirement.

Infiltration should not be a hardship. Where soil conditions permit, infiltration is likely to represent a more cost-effective option than detention-treatment BMPs. The ordinance continues to provide land owners with an exemption from the infiltration requirement if they prove that soil conditions make infiltration infeasible.

Section 105. Applicability/Regulated Activities

The Ordinance currently says it applies to any ***Regulated Earth Disturbance Activities*** and all stormwater runoff entering into sewer systems. Subsequently, within Section 202. Definitions, a Regulated Earth Disturbance is further defined. This definition leads readers to believe one of two scenarios:

1.) That any earth disturbance (and subsequent resultant runoff) less than one acre is not subject to this Ordinance.

or

2.) That any increased runoff resulting from any sized earth disturbance is subject to this Ordinance.

We don't feel that either of these scenarios is or should be the intent of the definition. The definition of Regulated Earth Disturbance Activities should at a minimum be consistent with Phase II requirements/recommendations. The size threshold should be at least 5,000 sq. ft.

In addition, it may be interpreted that a development project that does not tie stormwater runoff infrastructure directly into a municipalities separate storm sewer system may not be subject to this ordinance (if they have a direct stream discharge). This should be not be the case.

The wording also seems to indicate that a redevelopment project that does not increase runoff is exempt from the streambank erosion and stormwater quantity requirements, which we don't think is the case based on conversation during the March 2, 2004 meeting. The ordinance reads as follows: "The following activities are defined as Regulated Activities and shall be regulated by this Ordinance: ...Redevelopment of a site which will increase runoff or change a discharge point. Any redevelopment that does not increase the runoff must still comply with Section 304 (Nonstructural Project Design), Section 305 (Groundwater Recharge), 306 (Water Quality)." This needs to be clarified if all redevelopment is subject to all of the requirements of the ordinance.

Any earth disturbance less than 5,000 sq. ft should not be subject to this ordinance (all components), but can be regulated if an existing municipality so chooses.

Section 202. Definitions, p. 18

The definition of "Redevelopment" no longer includes a minimum area. The definition of "Redevelopment" should include language saying any project resulting in an earth disturbance of less than 5,000 sq. ft. is exempt from the Ordinance requirements.

The definition of "Regulated Earth Disturbance Activity" – Earth Disturbance activity on more than 5,000 sq. feet.

Section 304. Nonstructural Project Design

B. 2. – The stream buffer section cited here should be Section 306.G., not Section 306.F..

Section 305.A Groundwater Recharge, pp. 28-29

We suggest removing the word "percent" from the unnumbered equation box at the end of page 28 and the equation box on page 29. It appears that this term refers to the impervious area in square feet.

Section 306. Water Quality Requirements

G. – Language regarding the use of native vegetation should instead include language that "encourages" the use native vegetation and that bans or prohibits the use of invasive species. The necessary lists of suggested native material and prohibited invasive species can be included in an Appendix or BMP Manual.

We agree that the water quality BMPs should be designed and maintained to provide protection from clogging and unwanted sedimentation. However, we suggest that following sentence be removed: "Discharge orifices shall be no smaller than three inches in diameter." We are concerned that the specific prohibition against small orifices will inhibit the development of innovative outlet structures that resist clogging and are suitable for small development areas. It also seems that the minimum orifice size may discourage developers from dispersing runoff in integrated stormwater management practices on larger development projects.

Section 307. Streambank Erosion Requirements

The explanation of the streambank erosion volume and release rate is somewhat unclear. Based on our discussions at the 3/2/04 meeting, we understood that the streambank erosion volume would not be required if the 24-hour detention time cannot be achieved with a 3-inch or larger orifice. However, we interpret the new section to state that the volume must be constructed even though it might not provide the intended benefit. "On sites with small contributing drainage areas...that do not provide enough runoff volume to allow a 24-hour attenuation with the 3-inch orifice, calculations shall be submitted showing this condition. Installation of the 3-inch orifice in these cases shall meet the requirements of the streambank erosion criteria."

Possible ways to resolve this:

- Exempt small properties from having to build the streambank erosion protection volume. The smallest site that will allow the 3-inch orifice to provide 24-hour detention is approximately 10 acres (assumptions: 70% impervious, 4'-deep subsurface gravel storage, no infiltration from streambank volume). This size requirement would exempt most urban redevelopment sites.

- Remove the 3-inch orifice statements. The Chester ordinance does not appear to contain these statements. We are confident that technological solutions to clogging concerns can be found. Removing this provision would force land owners to find creative solutions; in time, we will research, demonstrate, and document solutions ourselves through our BMP manual. However, removing the minimum size would not solve the question of whether the streambank erosion volume is a hardship on smaller redevelopment sites.

- Develop an alternate standard for small sites that cannot achieve the 24-hour detention time with a 3-inch orifice. For example, there can be a specified maximum release rate or detention time associated with the water quality volume. This release rate can be met through development of an outlet structure other than an orifice.

Section 308. Stormwater Quantity Control and Management Districts

B. – Redevelopment – Include the 5,000 sq. ft. criteria threshold that requires compliance with the Ordinance.

"Any redevelopment with an earth disturbance of 5,000 sq. ft. or more that requires demolition or complete removal ...."

"No Harm" Option – page 36, Section 308.H

The No Harm option states, "For any proposed development site not located in a provisional direct discharge district, the Applicant has the option of using a less restrictive runoff control (including no detention) if the Applicant can prove that "no harm" would be caused by discharging at a higher runoff rate than that specified by the Stormwater Management Plan. The "no harm" option is used when an Applicant can prove that the proposed conditions hydrographs can match existing conditions hydrographs, or if it can be proved that the proposed conditions will not cause increases in peaks at all points downstream"

It seems that most redevelopment projects that are reducing or maintaining existing impervious area will be able to claim the "no harm" option, particularly since they will decrease downstream hydrograph peaks through the groundwater recharge and water quality requirements of the ordinance.

Overall, we feel that this option will be acceptable for redevelopment in Philadelphia and should not be removed from the ordinance. However, it seems that there are some municipalities in Delaware County that experience severe flooding problems and might not want to allow the opportunity to claim "No Harm." Municipalities might consider rewording the "No Harm" on an individual basis.

Section 402. Exemptions (from Drainage Plan Requirements)

B. – Stormwater Quantity Control Exemption Criterion – The ordinance states, "Applicants whose activities are exempted under Section 302.B above shall still be required to meet the Groundwater Recharge (Section 305) and Water Quality (Section 306) controls of this Ordinance."

The Stormwater Quantity Control (Section 308) Exemption states that an activity that results in anything less than 2,000 sq. ft of new or additional impervious cover is exempt from the controls outlined in Section 308, although they still have to meet the Groundwater Recharge Controls (Section 305) and the Water Quality Controls (Section 306).

If the assumptions or recommendations from Section 105 are adopted, the exemption language can be removed, because this level of new or additional impervious cover would not be subject to the Ordinance.

The wording of this statement indicates that the applicants would not be required to meet the streambank erosion controls of the ordinance. Is this the intention of the ordinance? This probably makes sense in most cases, because a residential property is not likely to generate enough runoff volume to allow 24-hour attenuation with the 3-inch orifice.

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June 11, 2004

Karen Holm, Project Manager
Delaware County Planning Department
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Media, PA 19063

RE: Response to Comments on Water Budget Analysis and Section VII, Model Ordinance for PWD for the DRAFT Darby-Cobbs Act 167 Support dated April 30, 2004

BL No.: 1996-0613-01

Dear Ms. Holm:

The following are responses to comments provided by Mr. Howard Neukrug, of the Office of Watersheds, Philadelphia Water Department to the Delaware County Planning Commission on April 30, 2004 regarding the Draft Darby-Cobbs Creek ACT 167 Stormwater Management Plan. Please note that due to updates which have been made to the final ordinance over the course of the plan development, specific section numbers and pages referenced in the following comments may not directly reflect the final plan. However, the noted changed were made before page and section numbers were changed.

Recharge Estimate and Water Budget Analysis

In the comment, the mean annual rainfall, 41.5 inches, at Philadelphia International Airport was used to estimate recharge rate and resulted 0.3 inches.

The average annual precipitation for the watershed was studied intensively in this project. Both daily and extreme event precipitation were examined. Four area stations include Chadds Ford (1945 - 2001), Philadelphia Airport (1948 - 2001), Conshocken (1931 - 2001), and Marcus Hook (1931 - 2001). All the rain gages are not within the watershed. Attachment 1 presents the spatial location and the watershed. The average annual precipitations found were Chadds Ford: 45.1 inches, Marcus:40.0 inches, Philadelphia Airport: 41.0 inches, and Conshocken: 41 inches. As cross reference, the precipitation can be found from Water Resources Bulletin, Bulletin No. 13 Floods in Pennsylvania. The average annual precipitation for the watershed is around 44 to 46 inches (Attachment 2). Therefore, 45.1 inches of precipitation was adopted in this project.

Infiltration occurs during larger storms in pervious areas. However, in the impervious area, water needs to be retained and infiltrated; or the infiltration rate need increases to compensate the loss of infiltration due to impervious area.

Model Ordinance

Section 105.- The paragraph cited from section 105 and the definition of "Regulated Earth Disturbance" are direct language from DEP's NPDES Model Ordinance.

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Section 202.- The definition of "Regulated Earth Disturbance" is direct language from DEP's NPDES Model Ordinance. The definition of "Redevelopment" has been changed, any earth disturbance less than 2,000 sq. ft. is not considered to be redevelopment.

Section 304.- The stream buffer section cited has been changed to Section 306.F.

Section 305.A.- The recommended change has been made in the equation boxes.

Section 306.G.- This section has been changed to Section 306.F. The recommended change has been made to "The buffer area shall be maintained with and encouraged to use appropriate native vegetation (Reference to Appendix H of Pennsylvania Handbook of Best Management Practices for Developing Area for plant lists).".

Section 306.C.- The sentence "Discharge orifices shall be no smaller than three inches in diameter." has been removed.

Section 307. –This section has been reworded to indicate that the use of orifice diameters less than three inches is acceptable as long it can be proven that clogging will not occur. For sites with small drainage areas, for which the 24- hour criteria cannot be met, the designer must still show that an attempt to meet these criteria was made. A low level outflow of three inches or less must still be provided even though the 24-hour criteria has not been met.

Section 308.B.– Redevelopment has been changed to "Any redevelopment with an earth disturbance of 2,000 sq. ft. or more that requires demolition or complete removal of … .".

Section 308.H.- The following has been added to the end of Section 308.H.: "Municipalities might consider rewording on an individual basis."

Section 402. – Under Section 105, redevelopment sites which do not create an increase in impervious area of more than 2,000 sq. ft. would be exempt based upon the criteria of Section 105 and the definition of "Redevelopment". In this case, Section 402 would be redundant. However, Section 105 defines all new land development as Regulated Activities which would be subject to the requirements of the stormwater ordinance. Therefore, in the case of new land development, Section 402 is required to provide an exemption if the new land development does not create more than 2,000 sq. ft. of new impervious area.

We appreciate your interest in and review of the Plan and welcome your comments. Your comments will strengthen the Plan and we look forward to the successful implementation of the Plan and Ordinance.

Sincerely,

Paul A DeBarry

Paul A. DeBarry, P.E., P.H.
Greater Lehigh Valley Office

PAD/dth

To: Karen Holm, Delaware County Planning Department
From: Alfred Wright, P.E.
Date: June 10, 2004
Re: Darby and Cobbs Creeks Draft Model Stormwater Management Ordinance
Cc: Paul DeBarry, P.E., Borton-Lawson Engineering
Jake Michael, Chester County Planning Commission
Janet Bowers, P.G., CCWRA

As part of the Act 167 process for the Darby Creek Watershed, the Chester County Water Resources Authority has performed a review of the latest draft of the Darby and Cobbs Creeks Watershed Stormwater Management Plan Draft Ordinance of March 2004. Specific comments on the language of the ordinance are provided below for consideration. These comments are in addition to any comments provided by the Chester County Planning Commission. The comments below focus primarily on the post construction stormwater management design criteria of Article III.

1. **Section 305** – Groundwater Recharge - Minimum requirements for calculating the recharge volume are given two distinct methods.

   A. Method 1 – NRCS-CN
   This method uses a sliding scale based on SCS curve numbers (CNs). It calculates a volume of runoff from impervious areas (only) that is generated by the change in land cover. Volume II, Section V.C.1.a of the Stormwater Plan explains how the NRCS-CN method is to be applied. The application of this method seems confusing and is inconsistent with the SCS-Soil Cover Complex method, which is where the CN values are derived from. I think this approach will prove confusing or incorrectly applied unless specific documentation (design manual) is provided to the end users (municipalities, designers, township engineers).

   B. Method 2 – Watershed Water Budget (WWB) Goals
   A runoff value of 0.55 inches is established for use in calculating the recharge volume. I tried this value in the hypothetical example in Volume II, Section V.C.1.a (Figure V-3) of the Stormwater Plan and came up with a recharge volume of 0.41 acre-feet. The NRCS-CN method recharge volume per the example is 0.75 acre-feet. This is a large range in values. When I used 1.0 inch in the WWB method I came up with a volume of 0.75 acre-feet. This is a much more consistent value between the two approaches (at least for this example). I also ran the Figure V-3 hypothetical example with a TR-55 Soil-cover-complex model. Two different computer models, Hydraflow Hydrographs version 6.0 and HEC-HMS 2.2.1, where used to assist in the comparisons. These models are widely available and are used extensively in Chester County. For a one-inch rainfall event, the models calculated **a net increase**

in volume of 0.56 and 0.75 acre-feet, respectively. Although the TR-55 model is a different model than the NRCS-CN and WWB methods, both approaches arrived at similar results. We should consider this before we develop and adopt through local ordinances new methods, which may not be necessary and may only complicate the ordinance and its interpretation.

C. With two methods provided in the ordinance, it should be made clear when each are to be applied. Section 305.A.2 states that " ...the volume of runoff to be recharged shall be determined from Sections 305.A.2.a and 305.A.2.b depending on demonstrated site conditions and shall be the greater of the two volumes." It seems that the WWB (0.55 inch) method will probably almost always be a volume less than the NRCS-CN method. Do we want the greater of the two and if so why have two methods?

D. The Chester Creek Act 67 Ordinance of 2002 Section 404.A established the infiltration volume as " The volume of storage to be provided shall be no less than the net increase in runoff from the 2 year storm event, or one (1) inch of runoff from total area draining to the infiltration facility, whichever is greater." The acceptable methods to calculate these values are then established in Section 405 of the Chester Creek Ordinance. Why not follow this same approach for Darby?

E. Summary - The two new methods proposed in the Darby Ordinance seem to have some limitations and may not arrive at values of recharge volume that would not otherwise be determined under current practices. We should carefully evaluate their use and be certain they are appropriate before we have them made part of adopted ordinances that must then be interpreted and enforced by each municipality.

2. **Section 305.B.4** – We should be more explicit about what is required for designing on-lot infiltration practices. Do we want to have each lot field tested for infiltration?

3. **Section 305.C** – Stormwater Hotspots – This ordinance paragraph should be re-written to clearly explain what is required. It sounds like the recharge volume requirement is waived but the water quality volume standard must still be satisfied in hotspot locations. Here is some example ordinance language for consideration on hotspots:

A. Certain industrial sites may be required to prepare and implement a stormwater pollution prevention plan and file notice of intent as required under the provision of the EPA Industrial Stormwater NPDES Permit Requirements. Other industrial sites storing significant quantities of chemicals/wastes should also prepare a prevention plan. Sites that are required by EPA to prepare a plan include, but are not limited to:

1. *Vehicle salvage yards and recycling facilities*
2. *Vehicle and equipment cleaning facilities*
3. *Fleet storage areas for buses, trucks etc.*
4. *Marinas (service and maintenance)*
5. *Facilities that generate or store hazardous materials*

B. Stormwater discharges from land uses or activities with higher potential for pollutant loadings (hotspots) may require the use of specific structural stormwater management practices and pollution prevention practices. In addition, stormwater from a hotspot land use shall be provided with proper pretreatment prior to *infiltration. For the purpose of this ordinance, the sites/facilities listed in Section A, above, are considered hotspots.*

4. **Section 305.D** – Ordinance language cautions the use of recharge practices in Source Water Protection Areas. Section 403 "Drainage Plan Requirements" should include identifying any/ all SWPA on the plans.

5. **Section 305.E** – Does this statement need to be a "shall"?

6. **Section 305.H** – Suggest combining the two paragraphs into one that describes the requirements relative to groundwater contamination.

Section 306 – Water Quality Requirements

7. **Section 306.D** – The term "developed areas" is used here. What is its defined meaning in the ordinance? Do we need this term or is another term available. Do we just use this term here or is it used elsewhere in the ordinance?

8. **Section 306.D** – We should be explicit in stating that the water quality volume standard shall be provided for drainage areas not otherwise addressed by infiltration practices (i.e. Section 305). We should also state that the water quality volume practices shall be located either at the source of the runoff and/or during conveyance away from the source of runoff. Idea is to promote lots of small-scale practices (low impact development style) rather then allowing the runoff to concentrate without any treatment. Here is some suggested ordinance language that could be worked into Section 306.D:

A. Water Quality Volume

1. Treatment of the Water Quality Volume (WQv) of stormwater prior to its release to receiving waters or water bodies shall be provided at all developments where stormwater management is required. The WQv equals the storage volume needed to capture and treat the runoff from storms of one (1) inch or less. Runoff from the first one (1) inch of rainfall transports most of the total pollutant load. The One (1) inch storm event represents 80% of the total volume of rainfall and 95% of all rainfall events that occur in a typical year in Chester County. Thus, capture of a 1-inch storm is established as the criteria for calculating the WQv.

The WQv is based on the following equation:

$$WQv = [(P)(Rv)(A)]/12 \quad \text{(in acre-feet)}$$

Where:

P = rainfall depth in inches (set to 1 inch)

Rv = volumetric runoff coefficient, 0.05 + 0.009(I) where I is percent impervious cover

A = area in acres.

1. The formula assumes approximately five (5) percent runoff from pervious surfaces, and ninety (90) percent runoff from impervious surfaces. A minimum *of 0.2 inches per acre of runoff volume shall be met at sites or in drainage areas that have less than fifteen percent (15%) impervious cover.*

3. *Drainage areas having no impervious cover and no proposed disturbance during development may be excluded from the WQv calculations. However, designers are encouraged to incorporate water quality treatment practices for these areas.*

4. *As a basis for design, the following assumptions may be made:*

   a. *Multiple Drainage Areas: When a project contains or is divided by multiple drainage areas, the WQv volume shall be addressed for each drainage area.*

   b. *Offsite Drainage Areas: The WQv shall be based on the impervious cover of the proposed site. Offsite existing impervious areas may be excluded from the calculation of the water quality volume requirements.*

   c. *Stormwater Quality Treatment: The final WQv shall be treated by an acceptable stormwater management practice(s) from those described in this Section or as approved by the [municipality].*

   d. *The WQv requirements of this section shall be sized and designed in conjunction with the standards under Section 305.*

9. **Section 306.G** - Buffers – Why are we giving stream buffer setbacks as part of the "water quality requirements"?

10. **Section 306.G** – The last sentence of section 306.G states "This does not include lakes and wetlands." I see no benefit in stating this in the ordinance.

Section 307 Streambank Erosion Requirements

11. **Section 307** – the various paragraphs should be outlined (A, B,…).

12. **Section 307** – Minimum orifice size – A 3 inch minimum for a stormwater outlet orifice is a good principle and is preferred unless it cannot accomplish the intended design standard. The ordinance should set the minimum at 3 inches and add a caveat that smaller sizes with appropriate measures to prevent unclogging will be considered on a case-by-case basis (i.e. at the discretion of the municipal engineer).

13. **Section 307** – District C situation – Paragraph explaining how to satisfy streambank erosion control in District C is very confusing. Do we want to require a site to provide detention of 2 year storm if it is in District C even though it will probably have no other structural stormwater practices proposed due to being exempt form peak rate controls for large storm events (see Table 308.1)?

14. **Section 307** – Stream Restoration Projects – Paragraph explains what is to be included in a stream restoration project. Why saying here? When is a restoration project required by ordinance? Do we need in ordinance?

Section 308 Stormwater Quantity Control and Management Districts

15. **Section 308** – Heading of Section 308 is misleading. It is not about "quantity" control It is about peak rate control.

16. **Section 308.A** – this section should be re-written to introduce the topic and give an over view of the concept of districts and release rates. Current wording is confusing.

17. **Table 308.1** – Title of table is misleading. How about we re-title the table " Peak Rate Control Standards by Stormwater Management Districts".

18. **Section308.B** - Redevelopment – This should be a "may" standard not a "must" or "shall".

19. **Section 308.C** – General – This section refers to the very section it is in. No need to do this. We may want to refer to the Table 308.1 that describes the districts instead.

20. **Section 308.G** – The last sentence should say that … stormwater management facilities **are not** subject to the management district criteria.

21. **Section 308.K** – Redevelopment – This item should be combined with 308.B which also addresses redevelopment. Also, this item refers to a Table B-5. Does this table exist? Does it coincide with the 25% reduction in cover we are providing redevelopment sites or is it something different?

Various Other Sections

22. **Section 105 Applicability/Regulated Activities & Section 402 Exemptions**
The set of circumstances that triggers and exemption from some or all of this ordinance is very confusing and disjointed. The language under Section 105 and 402.A. B and C should be reworked to clarify the exemptions and partial exemptions. Let's try to keep it as straight forward as possible to make everyone's job a little easier.

23. **Terminology** – The term **"regulated earth disturbance activity"** is a PADEP defined term as part of the DEP MS4 model ordinance. It is a term we have to live with and make part of our ordinances for stormwater management. However, the term as defined by PA DEP does **NOT** include all the activities or scenarios that the Darby 167 ordinance is intended to cover. Therefore, the term needs to be either redefined or a second term created that covers all the activities regulated by the 167 ordinance. This needs to be weaved into the ordinance so as not to make it any more confusing then it already is.

24. **Section 501** – Inspections - Ordinance is pretty light on details on inspection. What about the PA DEP MS4 ordinance language for inspections, specifically about the "right of entry" provisions, we should consider including them in the Darby ordinance.

CCWRA appreciates the opportunity to provide comment on the Darby and Cobbs Creeks Act 167 ordinance. It there are any questions or comments on the above, please contact me directly at 610-344-5400.

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June 11, 2004

Karen Holm, Project Manager
Delaware County Planning Department
201 W. Front Street
Media, PA 19063

RE: Response to comments of Alfred Wright of Chester County Water Resources Authority on the DRAFT Darby and Cobbs Creek ACT 167 Stormwater Management Plan dated June 10, 2004

BL No.: 1996-0613-01

Dear Ms. Holm:

The following are responses to comments provided by Mr. Alfred Wright, P.E. of the Chester County Planning Commission on June 10, 2004 regarding the Draft Darby-Cobbs Creek ACT 167 Stormwater Management Plan.

Section 305
A. The NRCS method for determining groundwater recharge in Section 305 is meant to be a simplified approach to determining the necessary recharge volume based on the proposed changes in the land cover. The user would enter the X-Axis of the chart in Figure 305.1 knowing the composite curve number (CN) of the site under existing conditions. A line would then be drawn vertically until the plotted curve, "P", is intersected. From this intersection, a line is then drawn horizontally to the Y-Axis where the user reads the Infiltration Requirement (I) in inches. This number is then multiplied by the total proposed impervious area and converted to cubic feet of required recharge volume.

B and C
In 305.A2.b., it states "If the goals of Section 305.A.2.a. cannot be achieved, then 0.50 inches of rainfall shall be recharged from all impervious areas,... ... ". In the case where the infiltration rate calculated from Section 305.A.2.a is achievable and greater than 0.50 inches, it shall be applied.

D. The requirements for recharge presented in Section 305 are based upon a detailed analysis of the affect which changes in land use have on groundwater recharge in developing areas. It is the opinion of the author that following these criteria would allow for groundwater recharge under proposed conditions to more closely mirror site recharge under existing conditions.

E. The recharge requirements and their derivation will be fully explained in the workshop.

Section 305.B.4
To accurately design on lot infiltration facilities, site specific testing should be performed. More specific requirements for site testing will be presented in the Pennsylvania Stormwater BMP Design Manual, currently under preparation.

Section 305.C
The proposed wording related to stormwater hotspots shall be evaluated and considered for inclusion in the Model Ordinance.

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Section 305.D
We will add "Identifying any/all Source Water Protection Areas on the plan" in the Section 403.A.. of the Final Ordinance.

Section 305.E
Yes, in order to fully address the criteria of the ordinance, recharge should be used in conjunction with other water quality BMPs, stormwater quantity control and nonstructural techniques.

Section 305.H
This section has been changed to Section 305.I. We will combine the two paragraphs into one in the Final Ordinance.

Section 306.D
"Development site", which is defined in Section 202, shall be used in place of "Developed Areas" in the Final Ordinance. Note: This section has been changed to Section 306.C.

Section 306.D
The provided recommendation shall be reviewed and considered for the Final Ordinance.

Section 306.G
Stream buffers can prevent/reduce streambank erosion and improves the quality of the water.

Section 306.G
The buffer is a setting along the streambank for prevention /reduction of erosion. The last sentence regarding lakes and wetlands was included to specify that this criterion refers to stream only.

Section 307
The various paragraphs will be outlined in the Final Ordinance.

Section 307 – Minimum Orifice Size
Additional text shall be added to the Model Ordinance to allow for orifice designs of less than three inches if it can be shown that adequate protection to provide clogging has been provided.

Section 307 – District C Situation
Sites in District C shall still require detention of the two-year storm to meet the streambank protection criteria. These facilities should be designed such that storms of greater magnitude will pass through or be diverted around the facility without attenuation.

Section 307 – Stream Restoration Projects
Requirements for stream restoration projects shall be dropped from the Final Model Ordinance.

Section 308
The title of this section has been changed to reflect the recommendation of this comment.

Section 308.A
The concept of the management district is fully provided in Section V.D of the Darby-Cobbs Creek Stormwater Management Plan, Volume II.

Table 308.1
The recommended change to the title of this table has been made in the Model Ordinance.

Section308.B
Section 308.B. has been redefined.

Section 308.C
The purpose of this paragraph is to provide general information about Stormwater Management Districts and referring Stormwater Management District Watershed Maps.

Section 308.G
The last sentence will be changed to "... stormwater management facilities are not subject to the management district criteria" in the Final Ordinance.

Section 308.K
We will combine Section 308.K. with 308.B. Table B-5 has been renumbered as Table B-3 in Appendix B.

Section 105 Applicability/Regulated Activities & Section 402 Exemptions
Text regarding "Regulated Earth Disturbance Activities" has been removed from Section 105 to avoid confusion in terminology.

Terminology – The term "regulated earth disturbance activity"
See above.

Section 501
Right-of-Entry language provided in Section 901 of the Model Ordinance is derived directly from the MS4 Ordinance Provisions.

We appreciate your interest in and review of the Plan and welcome your comments. Your comments will strengthen the Plan and we look forward to the successful implementation of the Plan and Ordinance.

Sincerely,

Paul A DeBarry

Paul A. DeBarry, P.E., P.H.
Greater Lehigh Valley Office

PAD/dth

Paul A. DeBarry

From: Clapp, Wayne [wclapp@chesco.org]
Sent: Friday, August 27, 2004 9:56 AM
To: Paul A. DeBarry
Cc: holmK@co.delaware.pa.us
Subject: RE: Darby Creek Plan document

Paul:

I'm feeling pretty good. Thank you for asking. It is actually good to be back at work even though it's only half days for a couple of weeks. I needed to get my head back into things other than books and the Olympics.

I think I can provide most of my edits/comments via e-mail, so here it goes.

1. On the page listing the various council members and county commissioners ours should be listed as follows:

Carol Aichele, Chairman
Andrew E. Dinniman
Donald Mancini

Also, for our resolution I'd like to add as the 2nd "Whereas" the following:

"Whereas, policies of the Chester County Comprehensive Plan Landscapes, calls for the reduction of public costs from flood damage and the protection of water quality in streams; and".

This same language was in the Chester Creek resolution. We want to draw attention to consistency with Landscapes.

2. On the page with the Chester County Resolution, In the second Whereas, I think to be accurate, the wording should be: "... entered into a grant agreement with Delaware County and the Department to develop..." .

3. Plan Format. In 3rd paragraph text should include that a copy of Volume III will also be on file at CCPC and MCPC.

4. On page V-17 Under Redevelopment 25% is used as it relates to impervious cover. Has this figure changed with all the revisions that have gone on in my absence?

5. On page VIII-2, The last full paragraph on the page calling for the county planning commissions to review stormwater management plans. We do not and will not do this. That has been the roll of the Conservation District. We do not have staff trained for this purpose.

6. Page VIII-4. The paragraph beginning "An optimum management system...", delete " a county-level stormwater management institution". Other than what our Water Resources Authority and CCCD do, this won't sell.

I hope these edits cause too much of a problem. They may have already been discussed w/Karen.

Thanks.

Wayne

-----Original Message-----
From: Paul A. DeBarry [mailto:pdebarry@borton-lawson.com]
Sent: Wednesday, August 25, 2004 12:36 PM
To: Clapp, Wayne
Subject: RE: Darby Creek Plan document

Borton
Lawson
ENGINEERING

September 7, 2004

Karen Holm, Project Manager
Delaware County Planning Department
201 W. Front Street
Media, PA 19063

RE: Response to Comments of Wayne Clapp of Chester County on the FINAL DRAFT Darby-Cobbs Creek ACT 167 Stormwater Management Plan dated August 27, 2004

BL No.: 1996-0613-01

Dear Ms. Holm:

The following are responses to comments provided by Mr. Wayne Clapp of the Chester County Planning Commission to the Delaware County Planning Commission on August 27, 2004 regarding the Final Draft Darby-Cobbs Creek ACT 167 Stormwater Management Plan.

1. **Council members and resolution:** The lists of council members and county commissioners have been updated. Additional resolution has been added.

2. **Chester County Resolution:** The wording has been updated as suggested.

3. **Plan Format:** Suggestion has been included in Plan Format of Volume I (Executive Summary) and II. (Plan Content).

4. **Page V-17 Under Redevelopment 25% is used as it relates to impervious cover:** The recommended amount of impervious cover which must be reduced on site in lieu of meeting the stormwater criteria of Section V.D. of the plan and in Section 408 of the model ordinance has been reduced to 20% in the final version.

5. **Page VIII-2, the last full paragraph:** This paragraph has been updated on page VII-2.

6. **Page VIII-4 (the paragraph beginning with " An optimum management system... "):** This paragraph has been updated on page VII-4.

We appreciate your interest in and review of the Plan and welcome your comments. Your comments will strengthen the Plan and we look forward to the successful implementation of the Plan and Ordinance.

Sincerely,

Paul A DeBarry

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ORIGINAL

PUBLIC HEARING OF THE DELAWARE COUNTY PLANNING DEPARTMENT (DCPD), THE CHESTER COUNTY PLANNING COMMISSION (CCPC), MONTGOMERY COUNTY PLANNING COMMISSION (MCPC), and the CITY OF PHILADELPHIA to receive comments concerning the ACT 167 STORMATER MANAGEMENT PLAN for the DARBY and COBBS CREEK WATERSHED

7:00 P.M., March 29, 2005
Springfield Township Municipal Building
Springfield, Delaware County, Pennsylvania

THE BOARD:

KAREN HOLM, CHAIRPERSON,
DELAWARE COUNTY PLANNING DEPARTMENT

JOANNE DAHME,
PHILADELPHIA WATER DEPARTMENT

WAYNE CLAPP,
CHESTER COUNTY PLANNING COMMISSION

DREW SHAW,
MONTGOMERY COUNTY PLANNING COMMISSION

THOMAS H. NEWSHAM, RDR
Official Court Reporter
Delaware County Courthouse
Media, PA   19063

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(The hearing commenced at 7:00 p.m.)

THE CHAIRMAN: All right. I guess we'll get started. Hello, everybody. I guess we're waiting for Montgomery County to come. I'm sure they'll make it here. They're probably just lost. They've never been to Delaware County before, I don't think.

Thank you all for coming to our Public Hearing on the Darby and Cobbs Creek Stormwater Management Plan which was prepared under the requirements of Pennsylvania Act 167, the Storm water Management Act.

The plan that we prepared was developed in accordance with all of the state requirements, and it contains quite a bit of background information concerning existing and future land use, runoff conditions, existing ordinances and other regulations within the municipalities and actually looked heavily at what some of the existing conditions and problems in the watershed were.

We use this information to hydro logically model the watershed. And we have here our consultant, Paul DeBarry, from Borton-Lawson, and Rob Traver from Villanova University who helped with this.

And as a major component of this planning

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process, as I noted before, we worked with three counties. So we had Joanne Dahme from the City of Philadelphia and Wayne Clapp from Chester County and we also have Jake Michael and Carrie Conwell here from Chester County.

So all of us put this information together and worked with Paul to do stormwater evaluation and we went through five years worth of a lot of hard work to come up with performance standards to achieve several of DEP's technical objectives that are required under Act 167 and those relate to water quality, groundwater recharge, stream bank erosion, management of over bank flooding events and management of storm events.

And the resulting product was not just the plan but also a model ordinance that is currently being implemented by all of the municipalities in the watershed.

This process, just so you don't think it was done in a vacuum, was done through a watershed plan advisory committee and that involved extensive municipal input, county input. We had people from the city water department, from the Darby Creek Valley Association, PennDOT, Chester County Water Resources Authority and held open meetings to anyone who was interested in coming.

So as we went through this whole process, we're feeling comfortable that we've got everybody's plans and wishes and modeling and land use and everything involved in this.

The four counties will be adopting the plan very shortly after our comment period ends on March 31st. The Act itself requires municipalities to adopt a model ordinance within six months of DEP approval, but due to the NPDES deadline of March 10th, 2005, to have a water quality ordinance in place, I would say most of the Darby Creek municipalities either have adopted the ordinance or have it in the works and have already had their first reading of the ordinance. So we're very pleased to have gotten this far after five years.

Does anyone have any comments on the plan or can we answer any questions that we haven't answered in other meetings? Okay. Sandy?

MR. F. CLARK WALTON: Yes, I have a couple of comments and, really, I don't know how to address them.

We represent as an engineering company three towns at the bottom of the route: Yeadon, Darby and Norwood. Our storm sewer systems that we have already segmented, very segmented, and they're only, they're small. In other words, they're in pockets within the town.

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On these storms that we have now, the onslaught of the storms, the drainage is principally in the streets, which at one time were designed for two-year storms. And because of the paving practices and what-have-you with the gutter lines, the sewers can't convey. So it runs up over the sidewalk and down. The localized flooding, okay, within these towns is very important to the town and property management. And there's a significant amount of property damage. I was with Pete Brusco here today and Pete said almost every sewer in Yeadon, which he pinpointed, it comes up through a garage or a cellar or something like that.

Those problems in these periods of high water table, and the rain like we had a few days ago, create a magnificent problem for these towns. And so we can't address our local flooding problems in any way whatsoever because of the fact that system isn't there.

I believe that somewhere down the line that problem has to be addressed. The towns themselves cannot manage because of the financial conditions of new storm sewers and things like that. We can talk all we want about water quality, that water runs down the street and goes for blocks and blocks and blocks before it gets into an inlet and then discharges in the creek. It's picking up an awful lot of pollutants in these towns.

The second thing is, yesterday, I guess, I went down to Darby Creek again at the bridge in Darby. And when I was there, it was within two feet of the top. One thing I noticed was because there was not a lot of wind upstream, I guess, we didn't have a lot of trash and debris coming down. And the trash and debris and the trees that come down the creek, okay, in the watershed plan, we've got to address these trees that are on the creek banks all the way up or they end up coming down and the bridges pick them up and then because of that, the trash is just terrible. We have to address that problem. That is a real problem. I know it is not part of this.

THE CHAIRMAN: It's not actually part of Act 167, unfortunately.

MR. WALTON: No, it is not, but I'm saying that that is the problem with the towns. That's a problem that has not been addressed anywhere down the line. I realize that. I'm not asking you to change your plans. I'm just making some comments because the bridge in Darby, PennDOT has been there almost every storm and it takes a huge excavator to just keep moving there for hours to just keep the water from flowing and to get the trees out of the way. So those

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trees along the banks have to be addressed.

And the last thing that I just wanted to say, the mud color, I was at Cobbs Creek and Whitby Avenue and I was at Darby Creek and MacDade Boulevard, the mud in that creek, it was just a very milky color. And the sediment was just so, I know we've been practicing all these years for erosion and sediment control, but somewhere, okay, that creek is the same color as it's been for as long as I was born and raised there. So I can tell you, the sediment is just as bad now as it's ever been. I just wanted to make those comments.

THE CHAIRMAN: Thank you. I don't have an answer, of course.

We are working on a watershed management plan and Delaware County has certainly been a partner and this Act 167 planning process is so valuable to that because it looks at the stormwater management issues that really empower this plan to do more, and the plan is looking at stream bank restoration and riparian buffers and sediment loading and how you can address trees and other obstructions in the stream. So our goal is to take all the good information that was collected in this plan and use that to support this larger watershed management plan that will address some of those issues. It certainly will take many years to make any improvements.

MR. WALTON: I understand that.

THE CHAIRMAN: Any other questions or comments?

MR. AMBROSE: George Ambrose. I live in Lansdowne but I'm here on behalf of the Cobbs Creek Environmental Education Center and I teach in Darby, and I have historically seen the Borough of Darby take whack after whack with floods and stormwater management. We have a President who keeps denying that we have global warming and change in environmental weather patterns.

Last summer, the 30th of July, and then again with Hurricane Jean in the end of September, we had two five-inch plus rainfalls. We had seven feet of water replace like the 69th Street Boulevard around Marshall Road and the low-lying flooding and the lack of ability to process the storm-water in our lower half of the Darby Creek Watershed is getting dramatically more and more destructive with each event.

Ironically, Fairmount Park, for example, created a wetland to get some of the stormwater runoff from Upper Darby Township right where Naylor's Run flows into Darby Creek and built a five-foot embankment and both of those events last year breached that embankment and flushed native

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plants and wildlife that had established itself in that wetlands. That was also working in the stormwater retention basin and flushed that back wildlife out and brought sediment, trash and fish species into the wetlands and displaced almost the entire population of that wetlands.

We did a ten-hour flow trap sample and took 77 fish in one trap that was only this big out of that wetlands that had no fish in it prior to that event. So that even the piecemeal programs from that basin are not doing what we need to do and the unfortunate victims continue to be the downstream communities.

THE CHAIRMAN: Thank you. Any other comments?

Yes. Your name, please?

MS. CRAIG: My name is Janet Craig and I'm from Colwyn and we're over there in that community, too. And in '99 there was a flood and then we had to decide to work once again. Now it's every time it rains where I am located, the Darby Creek comes up and Cobbs Creek comes down and they meet behind my house and it's like a river every time it rains now. And one of the reasons I was here is because of the stormwater. It looks like we have more stormwater than we've ever had and our community is very, very small. We have to do something for the water coming into our communities. And as they're saying, there's a lot of trees that are knocked down. If you walk our banks now, there's a lot more erosion. So I think a lot of that has to be recognized.

THE CHAIRMAN: Thank you. Any other comments?

MR. AMBROSE: I had the experience before Hurricane Floyd in '99 in Upper Darby Township of having to fight single handed with Upper Darby Township when it came down to the stretch of Naylor's Run from Garrett Road to Marshall Road and it cut down 123 trees that formed a precarious buffer of Naylor's Run Creek and they claimed it was a stormwater prevention problem. And in fact, they exacerbated the flooding by taking those trees out. And I got the Township Solicitor to rule against the Township. He found that they were in violation of their own tree ordinance by cutting those trees down without any kind of a hearing and got them ordered to restore 100 trees along Naylor's Run Creek.

So that oftentimes municipalities in doing some quick stop gap measure, because they had their storm sewers imploding along Marshall Road and came to the solution which was cutting trees down along Naylor's Run and, in fact, it added to the problem. It didn't solve the problem. And I am very nervous hearing people blaming trees as part of their

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problem. I think if we plant the right trees in the right places and form riparian buffers, they stabilize the banks. They cut down on pollutants and effluents and things going through down a watercourse and are part of the solutions, rather than part of the problem.

THE CHAIRMAN: Paul DeBarry has volunteered to come up and explain to you a little bit about how Act 167 planning an ordinance relates to correct problems or not relating to it. I'm sorry.

MR. DeBARRY: Just a little bit of clarification on the Darby Creek, Act 167 plan and some of the problems that you're talking about. The Act 167 process involves looking at the watershed and looking at the different problems and then coming up with standards and criteria which are incorporated into a stormwater management ordinance which is then implemented for any new development that comes into the watershed.

The problems that you're experiencing now is because stormwater has not been handled properly in the past, hasn't been handled consistently. It's been only looking at the large retention basin, as opposed to trying to get some of that water back into the ground and things like that. So everything you're describing here has been basically caused by bad practices throughout the watershed.

The Act 167 Ordinance now, the first step is for the municipalities to adopt the ordinance so that any new development that comes in will get as much of that water it physically can back in the ground, treat the water for water quality so that the outflow is of a better quality than the inflow and also control the quantity of the flooding aspect of the storm water. So that the facilities that are constructed now will look a lot different than they did in the past. That's the first step to help prevent future problems.

The problems that you're talking about need funds to correct those problems, and that's separate from Act 167, but there's two avenues of funds to correct those problems. It would really take the municipalities to take the initiative to get those funds to correct that type of problem. One, is the Growing Greener Program, which I think a lot of you might have heard about. Initially, that was geared only toward water quality but in the later round they've included flooding problems as part of the application. That would be a grant, where you could get a grant from DEP. The applications are due typically in February of every year so you just missed out on this year but you have lots of time to get all

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your ducks in a row and submit a nice application to get funding to correct those problems.

The other source of funding is PennDOT loans. It is a loan and you have to pay them back, but depending on your financial situation, that might be another avenue of funding.

There's actually a third funding source which is related to the stream encroachment program, but typically there isn't enough funds in that program to go around.

So I guess, in summary then, the first step is to adopt the ordinance so that new developments manage their stormwater properly, but then the second step would be for the municipality to target those problems and get an application to submit to the Growing Greener fund.

THE CHAIRMAN: Thank you. I hope that answers some of your questions.

Any other comments? Yes. Drew Shaw from Montgomery County has arrived and is here also.

MS. JOANNE DAHME: Maybe just to give you sort of a, this is a perspective from Philadelphia as how this ordinance helps us improve stormwater management. We are struggling. How do we talk to our public officials about that so they sort of understand it? It became a big issue after those later summer storms, because certainly we had flooding all over the city. We have flooding in our combined sewer areas where people are getting sewage backing up to their properties because the infrastructure wasn't large enough to handle that.

So we've been trying to be very honest with those officials about a plan like this. One can certainly not address catastrophic flooding. You have hundred-year storms. Our systems are going to flood. There's really not a whole lot you can do about that. But regarding like the trees and the stream banks and the erosion that is occurring, this plan allows us to address 95 percent of the storm events that happen in this region, which are what they call like the one-to-two year storms. And those events that continually happen that create this continuing erosion on stream beds and stream banks and where you get that sort of destruction of the riparian buffer.

So for us, we see this as really invaluable because it allows us address those storms. We were already addressing some of the larger storms and now we're able to do this more holistically. And we're sort of selling this to our City Council as saying, "We're downstream, but all of our upstream neighbors are doing the same thing." And if it's

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done on a watershed wide basis, it can have a real impact over the years.

Looking on the land, instead of just looking for infrastructure to have this solution, because the infrastructure alone will never do it. It's impossible to make pipes that big.

THE CHAIRMAN: Any other comments?

MR. AMBROSE: Is Philadelphia using this as a way to look at their CSO problems?

MS. DAHME: We're certainly using this as one of the mechanisms. We have to look at many, many different methodologies. Some is going to require capital improvements but this is certainly a more holistic improvement that allows us to look at stormwater management, which our original CSO permit did not really address.

MR. WALTON: I do have another question, if you don't mind.

So now we have a plan, right? We have a watershed management plan. We're going to have that. So let's say that there's not enough money in the bank to fix all of the various problems that we encounter, the buffer problems that we have along the stream.

So how long is it going to take the Boroughs of

Yeadon and Darby to realize the benefits of this plan, 25 years, 40 years?

THE CHAIRMAN: It may take a very long time.

MR. WALTON: It's not a fair question, I guess, but is it something that's going to take many, many years, I guess.

THE CHAIRMAN: Yes.

MR. WALTON: So that alone is not going to do it. These towns, as the person said, the bridge in Darby, every storm, we only had two inches, two-and-a-half, the other day. My God, you can't believe how close we came. It's going to happen every storm. We still have businesses, the bridge at Cobbs Creek on Whitby Avenue, okay, that's your bridge. It's not the Borough of Yeadon. It's falling apart. It's disintegrating. The damage to the road is so bad because of the seepage underneath the road coming down from up there. All those problems all end up in that creek. The delta at the Whitby Avenue bridge is so bad that you'd think it was the Mississippi delta. It's just really all filled in. There's hardly any clearance for that stream for straight channel flow. Okay. It has to be cleaned out. Those are the types of things. I just want to say that.

THE CHAIRMAN: That's fine.

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MR. WALTON: Those are our problems. We're living with them every day. We go back to our town problems. I go, as I sit here, we need another fifty grand. He looks at me like I'm some kind of nut. That's the problem we're facing, the same as you.

I understand Philadelphia's problem, but we're faced with those problems. When the water goes into somebody's house, when the sewage backs up in somebody's house, there's nothing you can say to a homeowner. There is just absolutely nothing and a cleanup is just as bad as what happened to the property damage. The cleanup is a real problem.

MR. CLAPP: Unfortunately, for good or for bad, Act 167 was never intended to be a corrective action, which is what most of the boroughs need. If it works to its best, it only says you won't have any more, but you've already got more than you can handle.

MR. WALTON: That's a good explanation.

MR. WAYNE CLAPP: Whether it's because of what's coming from upstream or just the fact that you say your stormwater systems were never designed to handle what you get now. I don't foresee where the state is going to change that, except as Paul says, the Invest Program would be.

MR. WALTON: I know that.

MR. PETE BRUSCO: So basically we're talking about new construction, renovations of facilities.

THE CHAIRMAN: Yes, the next time around they're going to have to install stormwater management measures.

MR. BRUSCO: Right.

THE CHAIRMAN: But that is incremental over a very long period of time.

MR. BRUSCO: Right, and you'll have a lot of construction and big changes.

THE CHAIRMAN: I like to use the Home Depot in Upper Darby as a good example. It used to be the Bazaar, and if this were in place. And I think they did implement some underground storage in the parking lot, but that's a good example of how in the future under as shopping centers are redeveloped and single-family homes are torn down and you want to put a twin or some other multi-family housing, next time you're going to have to manage their stormwater, so based on that.

MR. AMBROSE: I heard you introduce someone from Villanova and I know that they're happy to show their BMP.

MR. CLAPP: Why in Darby?

MR. AMBROSE: Is there anything in this ordi-

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nance that requires what kind of actions are taken in new developments to ameliorate storm water problems, like impervious paving and things like that?

THE CHAIRMAN: There's a menu of BMPs that the developers will be required to use as they develop or develop land.

MR. AMBROSE: Is there any mention by which they'll get updated because today's BMP may not be tomorrow's BMP?

MR. CLAPP: I think the Act requires once a plan is adopted that it be updated every five years. So hopefully that will mean that as new technologies come along and you update your plans, they will be brought into the mix, if you will.

Our hope is the BMPs of today aren't found to be, and I don't think they will be, but ineffective. You always run that risk, I guess, in anything we do in this world. What's good today isn't good ten to twenty years from now, but I don't think that's quite the indication here.

MR. WALTON: Actually, the most effective BMP which was the retention basin is the only one that hasn't been modified, because they truly didn't discuss water quality, and so water quality has to be addressed this year, 2005.

MR. CLAPP: Yes.

MR. WALTON: So get it up.

(Laughter)

THE CHAIRMAN: Okay. Any other comments or questions? Did you have one? And your name?

MS. THOMAS: Debbie Thomas, Colwyn.

I was just trying to figure out who actually was invited to be here this evening and why when there are so many municipalities that are involved that they're not even represented.

Unfortunately, it's been my experience that the people that are not in the room are also really primarily responsible for the oversight and negligence that has caused us to be where we are now.

So how we can involve them?

THE CHAIRMAN: Well, they have been involved, from day one. They have been invited to and they have attended and documented on various versions of the draft ordinance and of the plan.

I mean, we have documentation back in the office whose municipalities have sent whatever representatives and we've had great turnout and great input. And actually, just

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this last December, we went out, I held a meeting here. It was a training session for all of the municipal officials, their engineers, their solicitors. And they all came into this room and we explained how to implement the plan through the model ordinance that's contained in it. So we're actually quite pleased at the turnout at the municipal level.

I think at this point going through the public hearing process is really the formality that we need to go through before the four counties can go through the resolution and adoption process, but we've advertised in newspapers in the four counties and Delaware County's website, but I think the municipalities have really participated greatly in the process.

MS. THOMAS: They've been involved prior to now?

THE CHAIRMAN: Oh, for five years. We have attendance records like you wouldn't believe of who came and who didn't and who said what. We changed a lot of things in the ordinance based upon municipal requests and municipal comments. So we had quite an evolution going on.

MR. CLAPP: I think one of the reasons that you don't see some of the other ones tonight, and I can speak for Chester County, which we only have about six square miles in addition to your watershed, but they know their responsibility. Tredryffrin Township has had a pretty sophisticated ordinance now for over a year, most of which affects the rest of the township but does impinge on anybody that develops in the part that comes down to Darby, somewhere in Easttown. And they're all in the process of dealing with the new model because for Act 167 they also have to, it's two programs. So they are thinking about it. They just don't have any questions or any comments to make at the hearing. So that's why I would say the two from Chester County aren't here, anyway.

THE CHAIRMAN: Yes, your name?

MR. BRADINGTON: Andrew Bradington. It was mentioned earlier the Growing Greener Program. There's a Growing Greener Institute. Did that pass? What impact does that have on your Act 167? Is it helping some of the issues? Can that help us out, please?

MR. WALTON: I'm not quite sure what the Growing Greener programs are going to be geared for. I have done some reading. I know it's going to be on state issues and things like that which could relate to the stormwater management.

I'm not sure it will or not, how it's going to work yet. So it's about time we get that together.

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MR. BRADINGTON: It's my understanding a lot more resources will be put into, particularly Southeast Pennsylvania.

MR. TRAVER: I'll tell you my opinion afterward.

MR. CLAPP: Paul?

MR. PAUL DeBARRY: Am I correct? I got a flyer from my rep in the mail. Growing Green Two is being renamed Green, PA or something like that?

MR. BRADINGTON: I got one from my rep.

MS. DAHME: We really need to be creative about other potential funding sources. I know we've been trying to pull in like the Army Corps of Engineers who are really interested in sort of undoing past wrongs and channelization of streams and that sort of thing.

So it often requires a local match to do that, but we've been taking them up and down the Darby and Cobbs Creeks.

MR. AMBROSE: Any of the neighboring boroughs?

MS. DAHME: All those locations, you know, and if they harbor water, the matching plan, we prioritized stream banks that needed the help.

MR. AMBROSE: It doesn't work.

MS. DAHME: Well, you have the Army Corps. You have to be patient. It's a long process. They have to do an assessment first. But we have, these plans give some documentation we can hand off to them and once we identify priority areas and where there's chronic flooding and where we know these stream banks need to be rebuilt, there's a real opportunity. So there is the sort of funding that we're looking to pursue, but, again, that takes years until it really comes to fruition.

MR. WALTON: One of the problems associated with that is that some of the smaller streams, the tributaries, like the Muckinipates and like ones that run in Yeadon and the Muckinipates in Norwood and Glenolden, those streams have their own problems. They're just small tributaries.

They've been made into storm sewers for part of the conveyance. And those problems have really blossomed into a lot of creek damage, and by the time it gets down to the Darby Creek or Cobbs Creek, there's real problems there.

MS. DAHME: Yes, there's small tribs where you have to be really creative. You think about what opportunities you have to throw disconnects and storm drains so they're not feeding into the creek.

We're even looking at where can we disconnect down spouts that might be feeding directly into storm sewers

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and how the runoff in back yards or into rain barrels or any way we can lessen that directly connected, those impervious areas into the storm sewers because we have the same problems. We're using back yard streams as a conduit, and you just can't do that anymore. It's ripping apart private properties, too.

So it's just looking for ways we can sort of manage the stormwater on the land, have it infiltrate, have it contained somewhere, if you have enough yard space, have it go into your back yard. They're the sort of things we're looking at for those smaller streams.

MR. WALTON: Well, most of those smaller streams, that's our local flooding problem and it's immense for us.

THE CHAIRMAN: Another comment?

MR. LEFF: Yes, Michael Leff, News of Pennsylvania Environmental Counsel.

So this is for the stormwater management of the new developments and not a corrective program for existing sites. But this is not for retrofitting. But I did hear that this would be for redevelopment?

THE CHAIRMAN: Yes, for redevelopment.

MR. LEFF: Can you describe what qualifies as redevelopment?

THE CHAIRMAN: Basically, the definition of redevelopment without checking it in the plan is when you tear it out and you put it back in again.

MR. LEFF: So a parking lot?

THE CHAIRMAN: And we do see quite a bit of that.

MR. LEFF: Houses?

THE CHAIRMAN: We see a lot of that.

MS. DAHME: And factories.

THE CHAIRMAN: Yes, factories, homes, shopping centers.

MR. LEFF: That is important to do something that is corrective.

THE CHAIRMAN: We're trying to correct it. I don't want to fool anybody into thinking this plan is going to be the be-all, end-all fix the problems, because it's going to take years and years. It's going to take till every property turns over to do that, but it shouldn't get any worse, if everybody, each of the municipalities actually formats their ordinances. That will help in that sense and then as the redevelopment projects come in, we'll get some improvement, but I don't want to promise it's going to fix

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everything, because it won't.

MR. AMBROSE: It's one quick question. You brought it to my mind by your answer to redevelopment. If it goes on the same footprint, does that have to follow Act 167?

THE CHAIRMAN: It still will have to follow Act 167. You will still have to infiltrate the stormwater for the site. Is that correct?

MS. DAHME: Yes.

THE CHAIRMAN: So this time you're going to have to infiltrate that first inch of runoff over your newly paved area.

So you will still have to infiltrate. There are other systems, and I'll kind of break it up into two pieces. One is the infiltration and one is the basin side of it.

MR. AMBROSE: So with renovation, you're talking about renovation, internal renovation?

THE CHAIRMAN: You're talking about taking your down spouts and now running them over grassy areas and infiltrating ring gardens and things like that. So you're going to have to take whatever's generated from your new payday, put that first inch into the ground.

In terms of the basin side of things and the peak flow and the large quantities, this plan took into account the fact that we have a lot of teeny, tiny urban lots that don't have a lot of space to put a B-52 crater. What happens is the property owner can't put it in there. So on some of the smaller sites we're not requiring peak rate control, but we are making them do the site design and capture that first inch, which is most of what comes down during the floods. That's ninety percent of all of our storms. So you are capturing an awful lot.

MR. ROB TRAVER: I just saw some research from some of our students on the results of our infiltration traffic levels that we built three or four years ago. And I think from, I think it was from September to January which was a lot and it was a lot. 98 percent of the water never left that site and that would have been a one-acre site that was about fifty percent pervious. So the design for that volume is tremendously effective.

THE CHAIRMAN: And on a larger site, we had a provision in there, and, again, we used to recognize, particularly in the urbanized portion of the watershed, we want redevelopment. We want economic growth. So we don't want to chase people away.

So what we've also included in the ordinance is a provision that if you reduce your overall paving on the

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bigger sites by 20 percent, that that amounts to some of the incremental basic size of same and you would be relieved of that size of the basin, but on the little sites it's not an issue.

MR. AMBROSE: Are there intentions for municipalities to have penalties if they don't?

THE CHAIRMAN: Oh, absolutely. I can think of two big ones and that's why they're all adopting it.

First of all, if you just look at Act 167, there are penalties within the Act itself that require municipalities to adopt this ordinance within six months of DEP approval. And DEP has all of its legal mechanisms to enforce that on the municipalities.

On the more immediate side, the NPDES II Program requires municipalities to have a water quality ordinance in place or required by March 10th, actually, it was 2004, but they got a year's extension to 2005, if you were working on a 167 Plan that picked up water quality.

So there are all sorts of federal and state penalties under NPDES for not having that ordinance in place and that's why all of the Delaware County's watershed municipalities have been scrambling to get the ordinance on the books prior to March 10th, because I think they're almost more afraid of the federal and NPDES problems, then they are the six months down the line 167 requirement. So they're all in the process of implementing the ordinances as we speak, which is nice.

Any other comments, questions? Okay. If there aren't any, I'd like to thank you all for coming out tonight and we will be attaching the public comments to our document. The plan itself is a three-volume set that you should be looking - it's huge.

Volume One is an Executive Summary.

Volume Two is that two-inch pile of paper and that doesn't have the 20 11x17 pulled-out maps in it.

And then Volume Three of the Plan will be the technical data that engineers can use that will be housed at each of the four county offices. In the case of the City of Philadelphia it will be at the Water Department, and otherwise, it will be at the Planning Offices.

MR. CLAPP: Karen, are you going to use that third document on the CD as well?

THE CHAIRMAN: We'll give it all to you. A lot of it's not in electronic form. A lot of it's in municipal survey form, for example, when they told us where their problem areas were. We may end up hand xeroxing and giving

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you a scanning or something. We haven't quite figured out how to package it for the other counties, but they will have it and then what we'll make available for public distribution, the Executive Summary, and Volume Two.

MR. CLAPP: A cheaper way to distribute it is assuming most engineers have computers these days, than having, the cost of paper is a lot more than the cost of a CD.

MR. BRADINGTON: Is this available on the Internet?

THE CHAIRMAN: Yes, right now it's posted on Delaware County's website and there's a place to look for it. And it will be both the Executive Summary and the Volume Two document and all the associated maps.

You can go to WWW.CO.DELAWARE.PA.US and that will bring up the County website page and if you go to the left-hand corner, there's a little area called In the Spotlight, and you'll see Darby Creek Hearing. And you click on it and unfortunately we haven't mastered the technology to go straight there, but if you click on that, it will take you to the Planning Department's website. And on the Planning Department's website it will have our Public Hearing Notice that you can click on, as well as the plan itself. And when you open it up, it has every chapter, every map, anything you want.

So you can feel free to print it out and look at it and keep in mind that it's a draft and the process is we hold the public hearing. It's kind of a backwards process, and if I do say so myself, it's very backwards.

The County holds a joint public hearing on this case. Each of the four counties will adopt it by resolution separately over the next couple months or whenever they can act on it.

Then it goes to DEP for approval and the date that we receive formal DEP approval is when that ordinance's six-month time clock starts.

But in the meantime, before we publish the plan, we're awaiting DEP comment. So there may be some minor changes but I don't expect anything major because they've been receiving copies of this throughout the entire process and have actually requested some revisions in the ordinance so far.

So that's sort of the process. It may take till June to get it all the way through, but we're hoping maybe the County would be able to adopt it in the next month or two.

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And then we'll begin whatever we need to do to publish the document. So look for three volumes, but only two will be published. The third one will be available in our office.

Thank you all for coming and we'll incorporate your comments into the document.

(The hearing concluded at 7:55 p.m.)
