Lower Merion Drainage Area

Act 167
Stormwater Management Plan

Executive Summary

June 1997
Montgomery County Planning Commission

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The Lower Merion Drainage Area (LMDA) is comprised of four major creeks that flow into the Schuylkill River. These creeks drain a combined area of approximately 12.78 square miles (see map, Figure 1). Mill Creek, the largest single drainage area, covers 8.59 square miles. The three other creeks, Gulley Run, Rock Creek, and Arrowmink Creek, drain 1.68, 1.45, and 1.06 square miles respectively. The remaining 4.96 square miles of the watershed are drained by smaller creeks or direct drainage areas flowing into the Schuylkill River.

The LMDA is contained within three Montgomery County municipalities and a portion of Delaware County, which includes Villanova University. The Montgomery County municipalities are Lower Merion Township, West Conshohocken Borough, and Narberth Borough. None of the three municipalities is entirely within the watershed.

The Lower Merion Drainage Area is somewhat unique--the majority of the study area is found in Lower Merion Township. Also, the drainage area is made up of four large creeks and several smaller creeks. Initially, this area was part of the Schuylkill River Drainage Basin. For planning purposes under Act 167, the area was redesignated as the Mill Creek, Rock Creek, Gulley Run and Arrowmink Creek Watersheds. This report refers to the area as the Lower Merion Drainage Area.

The Act 167 Planning Process

The stormwater control strategy developed for the Lower Merion Drainage Area allows for new development while ensuring that existing drainage problems do not become worse and new problems do not develop. The plan does not propose solutions to existing stormwater problems. Act 167 was developed to address the control of stormwater flows from new development--rectifying existing problems is outside the focus of the plan. However, existing problem areas were identified during Phase I, and some data was collected. The municipalities in the watershed can use this data in developing solutions to existing problems.

A Watershed Plan Advisory Committee (WPAC) was formed at the beginning of the project. The WPAC consists of representatives from each municipality in the watershed, the Lower Merion Conservancy, the Montgomery County Planning Commission, and the Montgomery County Soil Conservation District. The involvement of Lower Merion Township, Narberth Borough, and West Conshohocken Borough is particularly important. These municipalities will be implementing the plan by adopting and enforcing the standards and criteria. Their input is valuable during the planning process, particularly in developing the model zoning ordinance.

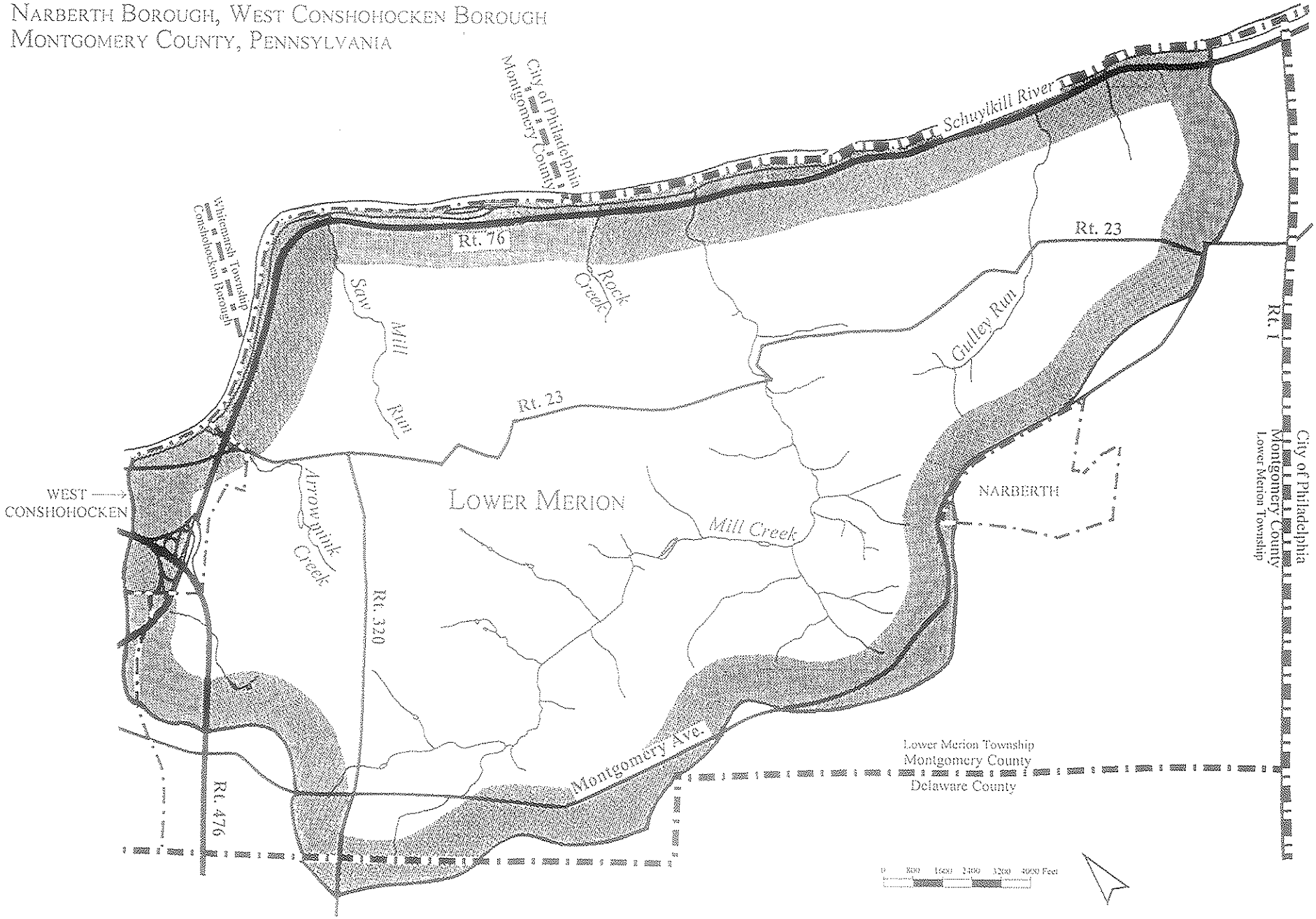
The planning process under Act 167 began with an assessment of the watershed. A future land cover scenario was compiled. This is a best guess of future development over the ten-year planning horizon.

The standards and criteria in the plan are based on a computer modeling of the watershed. The computer model simulated how the stormwater performs in the watershed as it flows down the various stream branches to the main stem and eventually to the mouth of the stream. Because of factors such as topography, stream channel length, soils, and land cover, the time needed for the peak flows in different parts of the watershed to reach the mouth of the stream differs. Timing is an important part of stormwater management planning. If the peak flows converge from different branches of the stream at the same time, flooding may result. The model calculated the time of travel. From this, different levels of control were established for the subareas in the watersheds. These different control levels relate to the timing of peak flows, allowing peak flows from different branches to pass by problem areas or the confluence of branches without the

Figure 1

Lower Merion Drainage Area

Lower Merion Township
Narberth Borough, West Conshohocken Borough
Montgomery County, Pennsylvania



peaks combining.

Once completed, the municipalities will implement the plan. The main implementation tool is the stormwater management ordinance. The plan contains a model ordinance. The municipalities can adopt this as a stand-alone ordinance, or modify their code to conform to the standards and criteria.

Watershed Modeling

To develop appropriate standards and criteria for the control of stormwater, it is necessary to understand the unique hydrologic and hydraulic characteristics of the watershed. This is accomplished by simulating the critical elements of the rainfall-runoff process using a computer model. The computer model analyzes the timing of runoff from specific rain events to determine how an upstream subwatershed contributes to the peak stormwater flows at various downstream locations. To determine this information for the LMDA, the Penn State Runoff Model (PSRM) was used.

The model requires the development of the following watershed modeling parameters:

DELINEATION OF SUBWATERSHED AREAS: The drainage area was initially divided into four major drainage basins. It was necessary to further divide each of the basins into subwatersheds, or subareas, to collect data on the physical characteristics of each basin. The subareas were delineated on a topographic base map of the entire watershed. The following factors were considered when delineating the boundaries for the individual subareas within each major drainage basin:

- The location of existing problems.
- Confluence points of tributaries with the major creeks.
- Other key points of interest.

These factors were used to divide the Lower Merion Drainage Area into 82 subareas. Seventy-two subareas combine to delineate the four major creeks as well as four small, unnamed tributaries to the Schuylkill River. The remaining ten subareas are directly adjacent to the Schuylkill River and drain directly into the river.

MODEL OF EXISTING CONDITIONS: The Penn State Runoff Model requires data on the physical characteristics of each subarea. This information is needed to estimate the quantity of runoff at specific time periods from each subarea. The quantity of runoff computed for each subarea during the storm is then routed downstream, reflecting the travel time required between subarea outlets. Therefore, the flow rate at any point of interest, at any point in time, is simply the sum of flow rates from contributing subareas that have arrived at the point at that moment.

SUBAREA RUNOFF CHARACTERISTICS: For PSRM to develop the runoff hydrographs the following hydrologic characteristics are evaluated for each subarea:

- Other key points of interest.
- The total acreage.
- A composite runoff curve number, using the Soil Conservation Service's soil cover complex method.
- The percentage of impervious cover.
- The average overland slope.
- A characteristic, or average, length of overland flow.

FUTURE LAND USE: An important part of the Act 167 Stormwater Management planning process is the future land use scenario. A future land use scenario was developed for the planning time frame using existing zoning and knowledge of likely development. The LMDA future land use is developed using a ten-year planning horizon. Change in land use brings about a change in impervious surface, and an increase in runoff. The increased stormwater flows are used in the modeling effort. Running the model with the new flow figures identifies areas in the drainage systems where new flooding problems will develop or where existing problems will become worse. The stormwater controls in the ordinance are calculated to avoid these impacts of future flows.

Previous watershed planning efforts elsewhere in the county looked at future development in terms of available vacant land, commercial and industrial zoning, and past development trends. The LMDA plan has modified this approach for a number of reasons. The two boroughs within the drainage area are almost completely developed. Little opportunity for infill and future development exists in the drainage area portion of these boroughs. Very little change is expected over the next ten years.

Lower Merion Township differs from other townships in the county—there are few completely vacant parcels of land. There are, however, many parcels that could be considered underdeveloped, based on zoning. Most of these are large estates. The majority are located in the western end of the drainage basin. This is the area drained by the Mill, Rock, and Arrowmink watersheds. There is a trend for these estates to be subdivided and developed, although this trend occurs very slowly. It is difficult to project future development in this situation. There is no way to know which land owners will choose to develop.

Design Storm Analysis

Physical characteristics determine the relative contributions of runoff from individual subareas at specific times. However, the intensity and duration of the rain event determine the peak and total volume of runoff. The intensity and duration of the rain event used for modeling purposes is referred to as the design storm. Design storm characteristics are not only important in calculating the volume of storm runoff throughout a watershed—they are also an important part of the standards and criteria for a watershed plan. Therefore, a consistent design storm must be used for both watershed modeling and also each municipality in implementing the plan for new development activities. For this plan, the SCS 24-hour, Type II storm distribution was used for the 2-, 5-, 10-, 25-, 50-, and 100-year return periods.

Release Rates

The cumulative impacts of individual site projects can cause flooding from stormwater runoff in watersheds in spite of compliance with stormwater management ordinances. One way to address this is to reduce the volume of stormwater leaving the site through infiltration of the runoff. The second method is to identify an individual subarea's contribution to downstream flooding and compute a level of control for that individual subarea based on its location in a watershed and the timing of its flows. This cause-and-effect type of analysis has resulted in the watershed-level stormwater management approach known as the "release rate concept."

The release rate sets the level at which postdevelopment stormwater flows must be controlled. The release rate figure is expressed as a percentage of the predevelopment flows. For example, at a release rate of 80 percent, on-site stormwater control facilities would be designed to control the postdevelopment peak flow to 80 percent of the predevelopment peak rate of flow.

The release rates in the LMDA watershed were determined by analyzing the PSRM model. The 25-year, 24-hour rainfall event was designated by the WPAC as the design storm for release rates. Rainfall events greater than the 25-year, 24-hour storm will be controlled by the traditional postdevelopment-to-

predevelopment rate. There also are practical considerations for the development of subarea release rates. As illustrated in Figure 11 of the Plan, the release rate approach should prevent upstream stormwater controls from being counterproductive, causing increases in downstream peak runoff rates.

The Stormwater Management Ordinance

The main tool for implementing the standards and criteria in the plan is the stormwater management ordinance. The model ordinance was developed with input from the WPAC. It can be adopted by the municipalities as a stand-alone ordinance, or incorporated into a municipality's existing ordinances.

The standards and criteria are the minimum criteria necessary for the control of stormwater on a watershed-wide basis. Additional criteria may be required by the municipalities, even if it is more strict, although any additional requirements must not conflict with this plan. If the municipality chooses to add additional criteria for stormwater facilities, it must determine that the additional criteria does not conflict with the required release rates, no detention, or direct discharge districts. Additional standards conflicting with those in the plan will impede the effectiveness of the watershed-wide control effort.

The model ordinance is organized into a section containing the ordinance language, followed by appendices. The ordinance language is divided into General Provisions, Definitions, Stormwater Management Standards and Criteria, Drainage Plan Requirements, Inspections, Fees and Expenses, and Maintenance Responsibilities.

Stormwater Management Methods and Controls

Stormwater can be controlled in a variety of ways. Both nonstructural management controls and structural techniques can effectively reduce stormwater. Structural controls can be classified as volume controls or rate controls. Volume controls are designed to prevent a certain amount of total rainfall from becoming runoff by providing for increased infiltration conditions. Rate controls work to minimize the impact of stormwater by controlling the peak rate of discharge from the site. Rate controls reduce peak runoff by impounding stormwater in various types of structures. Nonstructural controls are designed to reduce the amount or location of development through municipal land use regulations.

In most cases, the controls in the plan are appropriate for new development, though some could be used for retrofitting a site. The appropriate control varies with site conditions, including soils, geology, seasonal high water table, topography, and other site conditions. The type of development proposed, stormwater performance criteria, maintenance needs, and municipal policy will also dictate the appropriate technique. It is also possible to combine several control techniques to achieve a desired result. To determine what measures to install, the following parameters should be considered:

- Soil characteristics *(permeability, erodibility, etc.).*
- Subsurface conditions *(depth to seasonal high water table, bedrock, etc.).*
- Topography *(steepness of slope, earth cut, etc.).*
- Existing drainage patterns *(nearby streams, swales, and flooding potential, etc.).*
- Type of development.
- Economics *(costs of facilities and maintenance needs, etc.).*
- Advantages and limitations of techniques.
- Vegetative cover.

Nonstructural Controls

Stormwater management integrates various elements, which can include structural and nonstructural controls. Its success depends on the implementation efforts of the municipalities in each of the different strategies. Nonstructural controls improve water quality by focusing on the pollutants that can be carried to water bodies or groundwater by runoff. The following are examples of nonstructural controls:

- Street Sweeping.
- Solid Waste Collection and Disposal.
- Controlling the Use of Lawn Care Chemicals.
- Highway Deicing Compound Control.
- Nonpoint Source Pollution Control.
- Integrated Pest Management.
- Riparian Corridor Protection.

Rate and Volume Controls

Development increases impervious surfaces, which dramatically increases both the volume and rate of discharge of stormwater. Controlling the volume of stormwater reduces the postdevelopment peak discharge in most cases. It may also improve stormwater quality, as some pollutants settle out in the basin. Many typical runoff control measures can easily be modified to provide a higher degree of pollution control. The Plan describes a number of control methods including:

- Enhanced infiltration.
- Seepage beds or infiltration trenches.
- Dry wells.
- Filter strips.
- Grassed waterways and seepage areas.
- Concrete grid and modular pavement.
- Porous asphalt pavement.
- Dry detention basin.
- Extended detention basin.
- Wet detention basin.
- Constructed wetlands.

Provisions for implementing the plan and periodic review and revision are contained in the final chapters of the plan. The appendix following the plan provides data and other information pertinent to stormwater management and watershed protection. The appendix is organized as follows:

A: Lower Merion Drainage Area Map

B: Release Rates

C: Curve Numbers
Runoff Coefficients
Manning's n Values

D: Type II - 24-Hour Distribution

E: Model Riparian Corridor District

F: Stormwater Basin Design Alternatives

G: Public Hearing/Plan Resolution

For More Information

The Lower Merion Drainage Area Stormwater Management Plan has been completed by the Montgomery County Planning Commission. For more information on the plan, please contact:

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