ABSTRACT

Title	Guidelines for Environmental Management of Development in Montgomery County
Author	The Montgomery County Department of Park and Planning The Maryland-National Capital Park and Planning Commission
Subject	Protocol for environmental review of projects undergoing Park & Planning review, recommendation, and/or approval
Date	January 2000
Agency	The Maryland-National Capital Park and Planning Commission 8787 Georgia Avenue Silver Spring, Maryland 20910-3760
Source of Copies	The Maryland-National Capital Park and Planning Commission 8787 Georgia Avenue Silver Spring, Maryland 20910-3760
Number of Pages	75
Abstract	This document provides guidance to staff, applicants, and residents regarding appropriate techniques to protect natural resources during the development process. Staff use of these guidelines was approved by the Montgomery County Planning Board on February 13, 1997. The first *Staff Guidelines for the Protection of Steep Slopes and Stream Valleys* were originally approved in 1983.

MONTGOMERY COUNTY PLANNING BOARD, M-NCPPC

Approving Commissioners
February 1997

William H. Hussmann, *Chairman*
Patricia S. Baptiste, *Vice Chairman*
Ruthann Aron
Arthur Holmes, Jr.
Davis M. Richardson

Current Commissioners
January 2000

William H. Hussmann, *Chairman*
Arthur Holmes, Jr., *Vice Chairman*
Allison Bryant
Wendy C. Perdue
Meredith K. Wellington

THE MARYLAND-NATIONAL CAPITAL PARK & PLANNING COMMISSION

The Maryland-National Capital Park and Planning Commission is a bi-county agency created by the General Assembly of Maryland in 1927. The Commission's geographic authority extends to the great majority of Montgomery and Prince George's Counties; the Maryland-Washington Regional District (M-NCPPC planning jurisdiction) comprises 1,001 square miles, while the Metropolitan District (parks) comprises 919 square miles, in the two Counties.

The Commission has three major functions:

(1) The preparation, adoption, and, from time to time, amendment or extension of The General Plan (On Wedges and Corridors) for the Physical Development of the Maryland-Washington Regional District in Montgomery and Prince George's Counties;

(2) The acquisition, development, operation, and maintenance of a public park system; and

(3) In Prince George's County only, the operation of the entire County public recreation program.

The Commission operates in each county through a Planning Board appointed by and responsible to the county government. All local plans, recommendations on zoning amendments, administration of subdivision regulations, and general administration of parks are responsibilities of the Planning Boards.

The Maryland-National Capital Park and Planning Commission encourages the involvement and participation of individuals with disabilities, and its facilities are accessible. For assistance with special needs (i.e., large print materials, listening devices, sign language interpreters, etc.), please contact the Community Relations Office, 301-495-4600 or TDD 301-495-1331.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

BACKGROUND

These guidelines are the latest version of a document that was first approved in 1983 as the *Staff Guidelines for the Protection of Steep Slopes and Stream Valleys*. The first comprehensive revision was completed eight years later, when the renamed *Guidelines for Environmental Management of Development in Montgomery County* were approved in March, 1991. At that time, it was anticipated that these guidelines would be a dynamic product, changing as the available data and science of natural resource protection improved. This version of the Environmental Guidelines, approved in February, 1997, is the result of the second comprehensive revision and is the third edition of the document.

This document is a compilation of existing policies and guidelines that affect the protection of sensitive natural resources during the development process. Maryland's Economic Growth, Resource Protection and Planning Act of 1992 established the requirement that all local governments provide for protection of sensitive areas during the planning and development process. The Environmental Guidelines are the keystone of M-NCPPC's efforts to protect sensitive areas in Montgomery County.

The Environmental Guidelines also aids in the implementation of other State and County programs and laws by providing one streamlined document that includes guidance to meet many different regulations and goals. These guidelines work in concert with the forest conservation legislation to support the goal of the Maryland Stream ReLeaf program to restore and conserve riparian forest buffers throughout the state. Protection of sensitive environmental resources is a key element of the State's Smart Growth strategy. The Chesapeake Bay Tributary Teams are implementing strategies for non-point source pollution reduction, relying on appropriate land use design, stream buffer protection and Best Management Practices (BMPs) such as implemented through the Guidelines.

In addition, federal requirements for lower concentrations of contaminants in waterways can also be partially achieved through the concepts found in the guidelines. The *Countywide Stream Protection Strategy* (CSPS), developed jointly by the County Department of Environmental Protection (DEP) and M-NCPPC, provides assessments of the quality of county watersheds and assigns them to watershed management categories. This document is a key element in implementing the watershed protection tools that are recommended for each CSPS watershed management category.

ACKNOWLEDGEMENTS

Montgomery County Department of Park and Planning

Charles R. Loehr, *Director*
Jeff Zyontz, *Chief, Countywide Planning Division*
Jorge A. Valladares, P.E., *Chief, Environmental Planning*

Project Team

Nazir Baig, P.E., *Coordinator, Environmental Planning*
Stephen Federline, A.I.C.P., *Coordinator, Environmental Planning*

Brenda Sandberg, *Environmental Planning*
Stephanie Taylor, *Environmental Planning* *

Additional Park & Planning Support

Environmental Planning Staff
Natural Resources Management Staff
Community Planning Division
Technical Hearing Writers

Sam Dixon, *Graphic Designer*
Charles Coleman, *Reproduction*

Contributing Agencies & Organizations

Montgomery County Department of Environmental Protection
Montgomery County Department of Permitting Services
Maryland Department of the Environment
Maryland Department of Natural Resources
Audubon Naturalist Society
Maryland-National Capital Building Industry Association

* No longer with M-NCPPC

I. PURPOSE

In order to provide for growth while protecting Montgomery County's natural resources, all proposals for development in Montgomery County will be reviewed in terms of environmental impact and protection before being approved by the Planning Board. These guidelines present environmental management strategies and criteria for staff use in reviewing the elements of development proposals and in formulating recommendations to the Planning Board. The guidelines provide an indication of what conditions would be acceptable for project approval under most circumstances. It is expected that through the identification of existing natural resources and the application of these guidelines, it will be possible to obtain a balance between accommodating the level of development permitted through zoning and protecting the County's existing natural resources.

The intent of these guidelines is to describe the process of preparing a Natural Resources Inventory (NRI) for development sites and to describe techniques to protect natural resources and environmentally sensitive areas being adversely affected by construction activities and development. These guidelines are intended to ensure that adequate consideration is given to the following environmental management objectives throughout the development process:

- Maintenance of biologically viable and diverse streams and wetlands
- Protection and restoration of stream water quality
- Reduction in flood potential
- Protection of water supply reservoirs against sedimentation and eutrophication
- Conservation of forest and trees
- Protection of steep slopes
- Preservation/protection of wildlife habitat, wildlife corridors, and exemplary communities, including rare, threatened, and endangered species
- Protection against development hazards on areas prone to flooding, soil instability, etc.
- Provision of visual amenities and areas for recreation and outdoor education activities
- Implementation of state and county riparian buffer programs

In addition, the *Montgomery County General Plan* and local area master plans articulate County-wide and planning area-wide goals, objectives, principles, and policies to protect sensitive areas from the adverse effects of development, as required in the Annotated Code of Maryland Article 66B (Zoning and Planning), 3.05-01 (viii). These guidelines provide the detailed criteria and methods for regulatory review of development in sensitive areas. Sensitive areas include the following:

- Streams and their buffers
- 100-yr floodplains

- Habitats of threatened and endangered species
- Steep slopes

The guidelines are consistent with existing regulations controlling wetlands, dam breach/danger reach, floodplain, and forest conservation administered at the federal, state, and local level. Forest conservation requirements are in accordance with State and County forest conservation laws and are dealt with in detail in the *Trees: Approved Technical Manual* (M-NCPPC, 1992). In cases dealing with such issues as dam breach/danger reach analysis, stormwater management, and sediment and erosion control, where M-NCPPC is not the lead agency, the information needed for staff use in making recommendations to the Planning Board will be required and reviewed in coordination with the lead agency. In cases where lead agencies' responsibilities overlap in the use of an area on a site, this document gives direction and guidelines as to the criteria to resolving the site design conflict.

Unlike some jurisdictions, zoning regulations do not delete the environmentally sensitive lands from density calculations; however, the amount of constrained area should be considered during the master plan and zoning process to assure that intended densities and housing types can be achieved on the unconstrained areas.

Flexibility shall be shown in the application of these guidelines on a site by site basis to best achieve both environmental and other planning objectives for the site. The Planning Board at their discretion may approve, waive, or amend staff recommendations.

II. INTRODUCTION

Despite substantial effort by citizens, regulators, and the development community to date, development pressures in Montgomery County have placed increasing demands upon the County's natural resources. These demands have caused degradation of the resources and loss of the benefits they provide. If preserved and maintained in their natural condition, resources such as streams, stream valleys, wetlands, floodplains, forests, and trees constitute important physical, aesthetic, educational, recreational, and economic assets to the County.

Residents and the development community have expressed support for the protection and enhancement of natural resources. The effort by the development industry toward meeting current requirements to mitigate impacts is recognized as a critical contribution to the protection of these resources. County government agencies are also taking a lead role in reducing development impacts through public education and new common-sense approaches to enhancing stream quality. However, despite these efforts, increased development pressure has resulted in continuing degradation of the County's natural resources.

Decreased native vegetative cover, increased stormwater flows and flooding, accelerated land surface and stream channel erosion, and increased sediment deposition constitute some of the major interrelated negative effects on the environment that can occur during and after development. Erosion and sedimentation exist at natural background levels in the absence of human activities. However, excess erosion and sedimentation create problems for streams and their watersheds as human activities modify the natural landscape. Of special concern is the disturbance of steep slopes, especially those adjacent to or in close proximity to streams or drainage courses, and the disturbance of natural stream channels, floodplains, and wetlands. The alteration of these areas exacerbates watershed erosion/sedimentation and contributes to water quantity and quality problems.

The negative effects of unmitigated development noted above are directly related to increases in land surface imperviousness and decreases in forest cover. Increases in imperviousness can have significant effects on the County's stream systems through the reduction of the natural stormwater infiltration levels and significant increases in levels of overland flow. These alterations to natural infiltration and overland flow processes result in an increase in the velocity, volume, and peak discharge of stormwater discharged to streams, and a decrease in the lag-time between the onset of rain events and peak stormwater discharge as stormflow is concentrated and rapidly transported to streams via impervious surfaces and storm drains. The effects of these alterations on streams can include enlargement of the channel cross-section, increased water temperature, and impairment of water quality and stream habitat. In addition, the decrease in infiltration of stormwater results in decreased groundwater recharge and decreased stream baseflow levels that in turn can increase stream temperature and reduce available in-stream habitats. Significant impacts to riparian habitats, including wetlands, result from the extreme variation in water levels caused by increased peak discharges and velocities. Impervious surfaces also transport sediment and other pollutants, such as heavy metals, petroleum products, and salts associated with roadways, to County streams. Increased sediment and pollutant loads impair water quality, stream habitats and aquatic life.

These environmental guidelines for development are based on the following principles of comprehensive watershed management and protection:

- Stream valley and floodplain protection
- Minimizing increases in watershed imperviousness
- Protection of both upland and riparian forest resources

- Recognition and protection of the ecological significance and functions of headwater areas
- Need for long-term baseline stream monitoring to understand and protect the County's stream systems and development impact stream monitoring to evaluate watershed response to development
- Consideration of cumulative impacts

These guidelines attempt to address the problems and opportunities encountered in watershed development and identify management strategies designed to minimize adverse impacts. Among these management strategies are:

- Application of judicious land uses that allow for limiting impervious surfaces and maintaining wetlands, floodplains, seeps, springs, etc., in their natural condition.

- Establishment of protected slope areas that address slope gradient, soil erodibility, and proximity to stream channels.

- Use of stream buffers, the widths of which depend upon the stream's Maryland Department of the Environment (MDE) water use designation, the gradient of adjacent slopes, and the presence of erodible soils.

- Provision of healthy forest and tree cover for the purpose of maintaining water quality, preserving wildlife habitat, preventing erosion, mitigating air pollution, controlling stream temperature, and enhancing community amenity in an urbanizing environment.

- Adherence of land-disturbing activities to the State erosion and sediment control standards.

- Provision of stormwater management devices, storm drainage systems, septic fields, and other structural facilities in a manner that respects the integrity and does not impair the natural equilibrium of stream systems.

- Incorporation of effective best management practices into land disturbance activities.

III. NATURAL RESOURCES INVENTORY

Environmental information must be gathered by conducting a Natural Resources Inventory (NRI) of the development site. The NRI is a complete analysis of existing natural resources and must contain specific information covering the development site and the first 100 feet of adjoining land or the width of the adjacent lot, whichever is less (Figure 1). The purpose of the NRI is to provide environmental information early in the concept development phase that will allow for more environmentally-friendly site design. In general, the inventory must be submitted before or with the earliest plan submission for a development site. The NRI is submitted as part of the Natural Resources Inventory/Forest Stand Delineation (NRI/FSD) Summary Map as detailed in *Trees: Approved Technical Manual* (M-NCPPC, 1992).

The following topics shall be addressed as part of the NRI to assure compatibility between the natural and man-made environments.

A. Streams and Floodplains

All streams and/or drainage courses located on or within 200 feet of the subject property must be shown on the NRI/FSD summary map. M-NCPPC 1"=200' scale topographic maps or applicant's field topography will be used to determine whether or not streams and/or drainage courses are present. Streams will be classified as either perennial, intermittent, or ephemeral (see glossary for definition of terms).

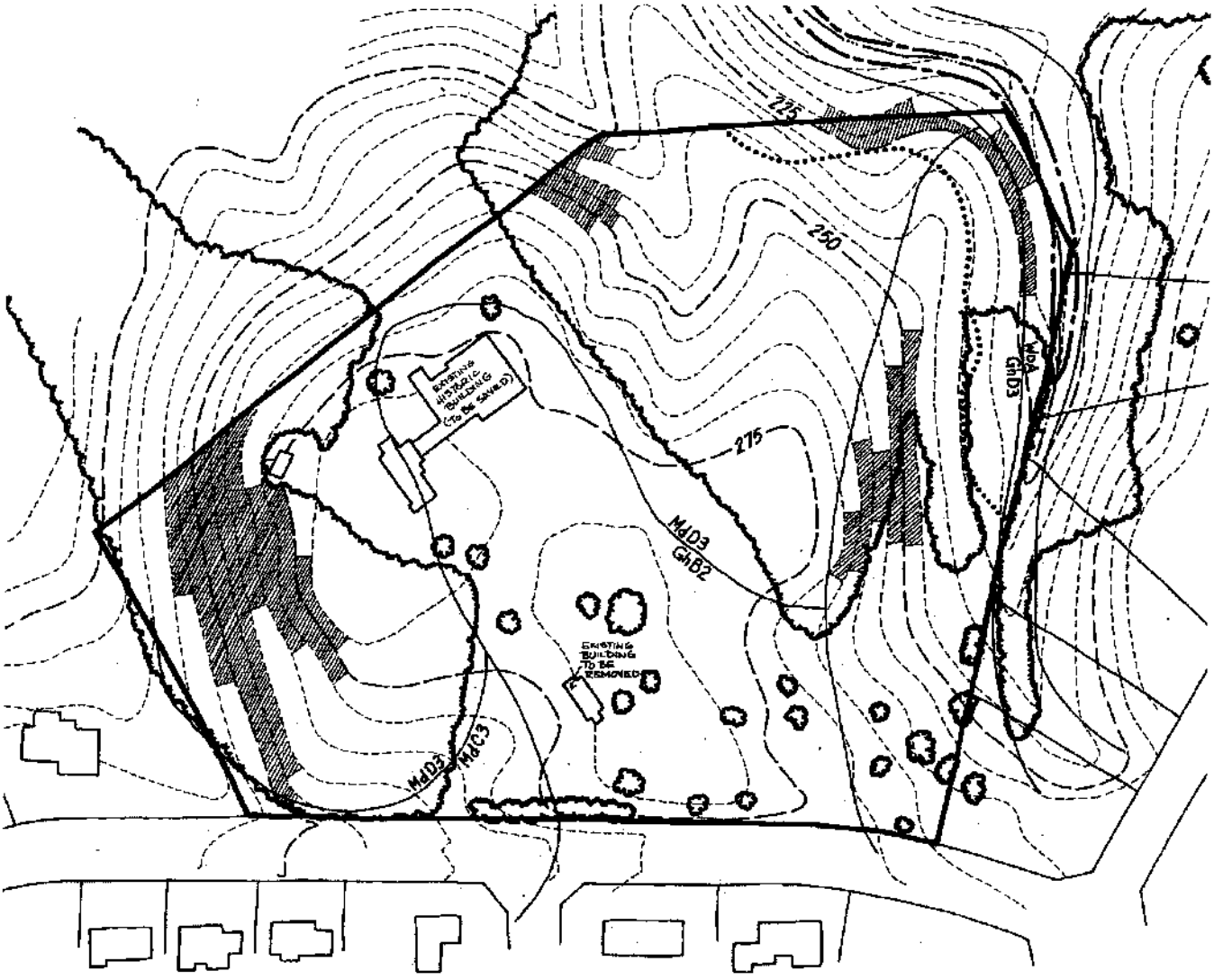
All streams shown on M-NCPPC 1"=200' topographic maps with drainage areas greater than 30 acres are assumed to have a 100-year ultimate floodplain. The floodplain must be shown on the inventory map with a 25 foot Building Restriction Line (BRL). Where M-NCPPC 100-year ultimate floodplain delineation is available, the applicant shall use and identify that information unless more accurate delineation (based on hydrologic/hydraulic computations and/or detailed topography or field survey) is provided. In the absence of M-NCPPC maps, other sources of floodplain information may include Federal Emergency Management Agency (FEMA) Flood Insurance Rate maps, Housing and Urban Development (HUD) Flood Hazard Boundary Map, and engineers' floodplain studies. Final approval of engineers' studies must be given by the Montgomery County Department of Permitting Services (MCDPS) prior to Planning Board approval of development applications.

For drainage areas fewer than 30 acres, a drainage study including delineation of flowpath and limit of flooding may be required, with concurrence from MCDPS. These cases will be determined on an individual basis.

B. Stream Buffers

Stream buffers must be shown on the inventory map in accordance with Table 1 for all perennial and intermittent streams and will include seeps and springs. Ephemeral streams do not require a stream buffer, but they should be protected as much as possible through plan layout and conditions on a voluntary basis. The slope range for use with Table 1 will be determined by taking representative 200 foot cross sections on both sides of the stream, drawn perpendicular to the direction of flow, and measuring the gradient of the slope in the steepest 100 foot horizontal run. This procedure is illustrated

Figure 1. Natural Resources Inventory



Stream

Floodplain

MdD3 / GhB2 Soils Line

Steep Slopes (≥25% or ≥15% with severely erodible soils)

Forest/Tree Canopy

Stream Valley Buffer

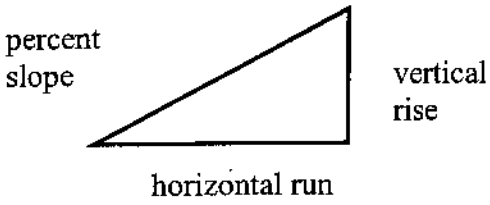
Wetland limited to stream channel.
Areas outside forest is lawn with speciman size trees.

in Figure 2. For hypothetical examples of stream buffer delineation, see Figure 3. Stream buffers will include steep slopes (as defined in section C.Topography), 100-yr floodplains, and wetlands with wetland buffer as defined by State regulations (see section D. Wetlands). Additional buffer requirements for Special Protection Areas (SPAs) and the Patuxent Primary Management Area (PMA) are included in Chapters V and VII of this document .

C. Topography

Slopes must be classified on the inventory map and all steep slope areas must be highlighted. A slope that has a gradient equal to or greater than 25 percent will be considered steep. See Chapter V for variations to the steep slope definition in certain Special Protection Areas.

"Percent slope" is defined as vertical rise in feet divided by horizontal run in feet in the *steepest* 100 foot segment multiplied by 100 percent.



$$\text{Percent Slope} = \left[\frac{\text{vertical rise}}{\text{horizontal run in the steepest 100 foot segment}}\right] \text{ X } 100\%$$

Slopes are classified as being either (1) near stream or hydraulically adjacent, or (2) hydraulically remote. The terms "near stream" and "hydraulically adjacent" generally refer to the area lying within 200 feet of a stream's bank, which is considered to be the most environmentally sensitive or critical portion of the stream valley. If the stream buffer, as determined by the steepest 100 foot section within the hydraulically adjacent area (Table 1), encompasses the toe of a steep slope, the buffer will be expanded beyond the width in Table 1 to include the entire slope. A hydraulically remote area lies outside the stream buffer.

D. Wetlands

All wetlands, as defined by the Maryland Department of the Environment (MDE), must be shown on the preliminary/site plan overlay and the NRI/FSD summary map. Identification of wetlands at this early stage of the development process is necessary to provide flexibility in protecting wetlands. Prior to the submittal of a preliminary/site plan, special exception, or mandatory referral, an applicant must have a qualified individual perform a wetland assessment. The results of the assessment should be either a line denoting the edge of wetlands on the plan overlay or inventory map, or a note stating that no wetlands exist on the site. The name and address of the individual who conducted the wetland assessment must be shown on the plans. For plans that will undergo 59-D-3 site plan review, the U.S. Fish and Wildlife Service National Wetlands Inventory maps, Maryland Department of Natural Resources (DNR) wetlands maps, and other sources designated by MDE may be acceptable at preliminary plan, to be followed by field investigation at the site plan review stage. These instances will be determined by staff on a case-by-case basis. Additional sources of information on wetlands include

Table 1. Recommended Stream Buffer Widths* by Slope Range and State Water Use Designation**
(expressed in feet from the stream bank)

Slope Range (%)	Use I/I-P (Water Contact Rec. and Aquatic Life)	Use III/III-P (Natural Trout Waters)	Use IV/IV-P (Recreational Trout Waters)
0 to<15	100	150	125
15 to <25	125	175	150
25 and greater	150	200	175

* Stream buffer widths may be greater if floodplains, wetlands, or steep slopes extend beyond the buffer line, or as noted in Section VII. In agricultural zones, the requirements for the buffer may be waived when the land will be used for farming. This waiver will be conditioned upon the applicant getting an approved soil and water conservation plan from the Montgomery Soil Conservation District. These instances will be determined on a case-by-case basis.

** Stream Water Use will be determined by the MDE Water Use designation (for definition, listing, and map see Glossary of Terms and Appendix A.)

NOTE: These buffers apply to intermittent and perennial streams only. Plans located in Council-designated Special Protection Areas are subject to the guidelines specified in Chapter V. Plans located in the Patuxent River watershed will be subject to Primary Management Area guidelines (Chapter VII) in addition to the stream buffer widths above.

functional wetland assessments conducted by M-NCPPC staff on selected watersheds in the County and the Digital Ortho Quarter Quad (DOQQ) wetland maps recently produced by the state in cooperation with M-NCPPC based on updated aerial photography.

Wetland buffers based on the State regulations will be incorporated into the stream buffer described in section B. The State mandates a minimum 25 foot buffer around all wetlands, with expansion up to 100' where adjacent areas contain steep slopes or highly erodible soils. These guidelines also include a larger minimum buffer for wetlands on small headwater streams in sensitive Use III and IV watersheds (50 foot and 40 foot, respectively). In addition, the State requires a minimum 100 foot buffer around wetlands of special State concern. Montgomery County contains twelve wetlands unique enough to be designated as wetlands of special State concern. These twelve wetlands include: the C&O Canal bottomland, Germantown Bog, the Great Falls floodplain, the Great Falls National Historic Area, Little Bennett Regional Park, Little Falls, McKee-Beshers West Swamp, the Potomac River at Cropley, Puller Marsh, Sycamore Landing on the Potomac riverside, Unit 1 Spring, and the Violets Lock floodplain. (See COMAR 26.23.01.04 for more information.)

Table 2 shows the recommended wetland buffer widths by State water use categories, stream order, and other sensitivity factors. See Appendix A for a definition of State water use categories and Appendix B for a definition of stream order. See Figures 4 and 5 for illustrations of wetland and stream buffers. Additional wetland buffer requirements for Special Protection Areas (SPAs) are included in Chapter V of this document.

Figure 2. Stream Buffer Determination Using Steep Slopes for a Use I Stream

Cross Section Number	Maximum Slope (steepest 100 feet)	Percent Slope Range	Recommended Stream Buffer Width (feet)
Right Bank (looking downstream):			
1	30%	>25	150
2	17%	15-25	125
3	31%	>25	150
4	17%	15-25	125
Left Bank (looking downstream):			
5	7%	0-15	100
6	8%	0-15	100

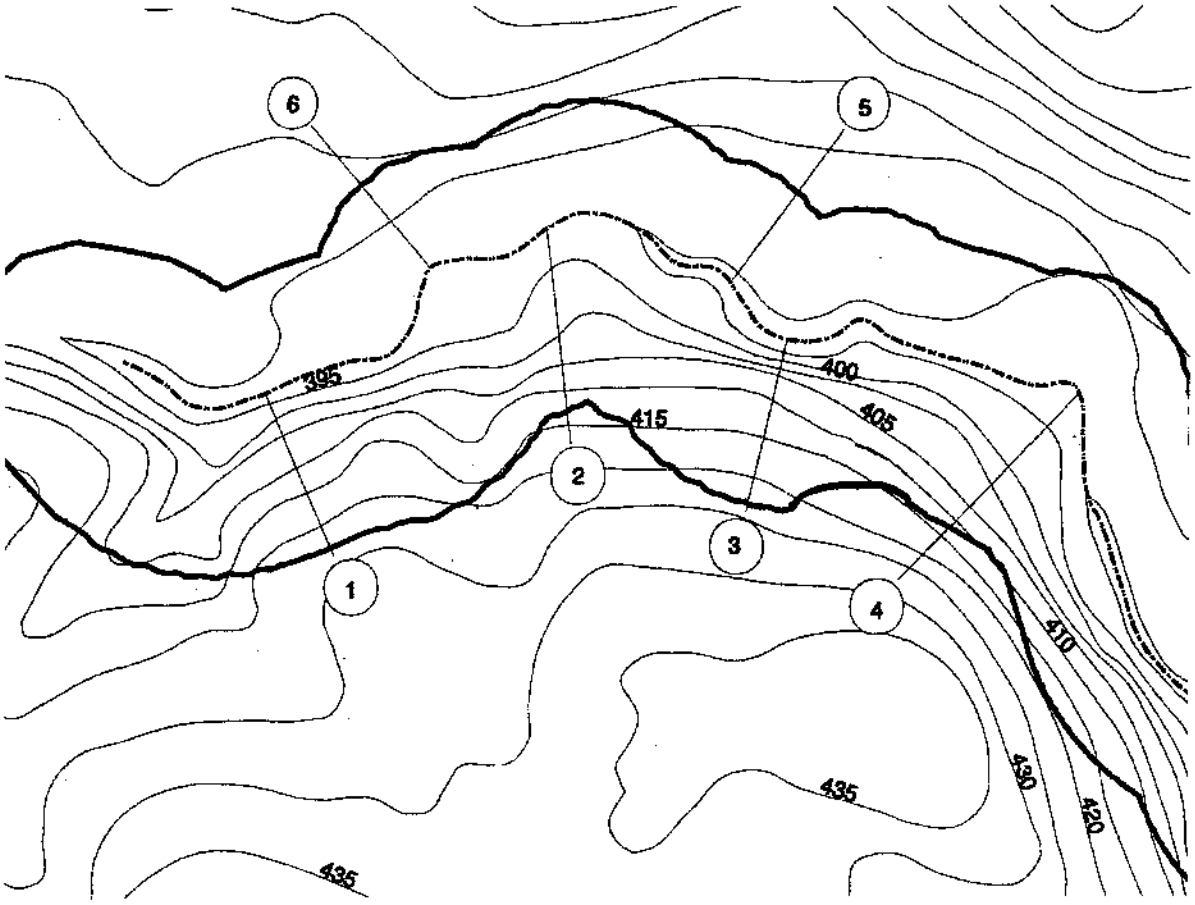
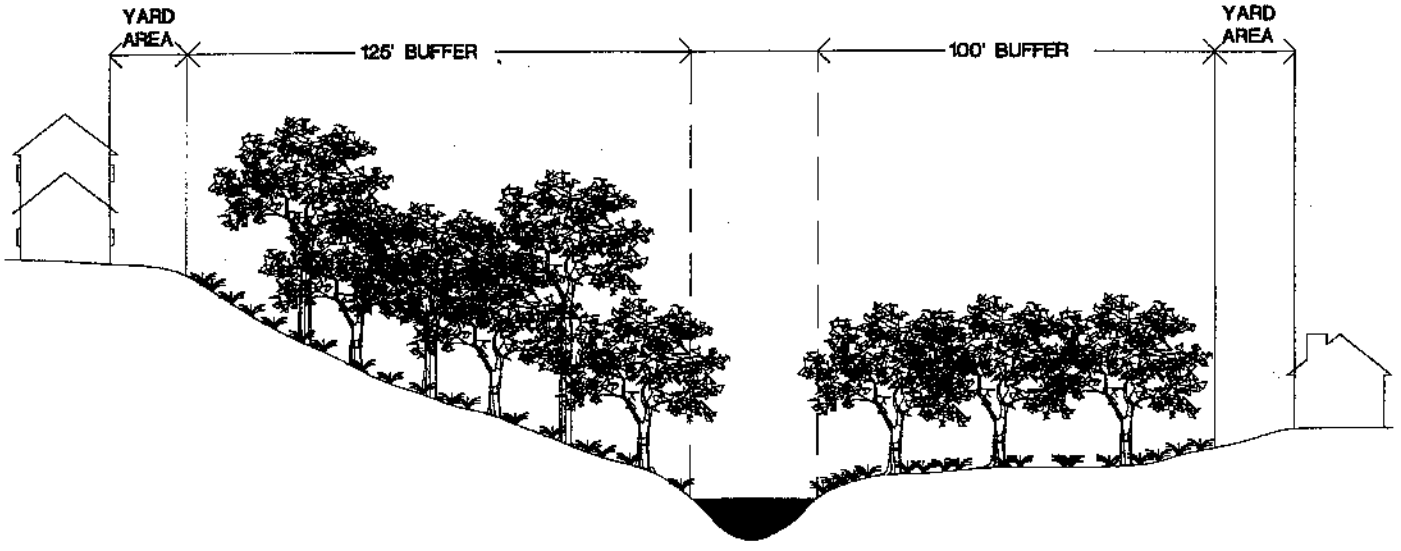
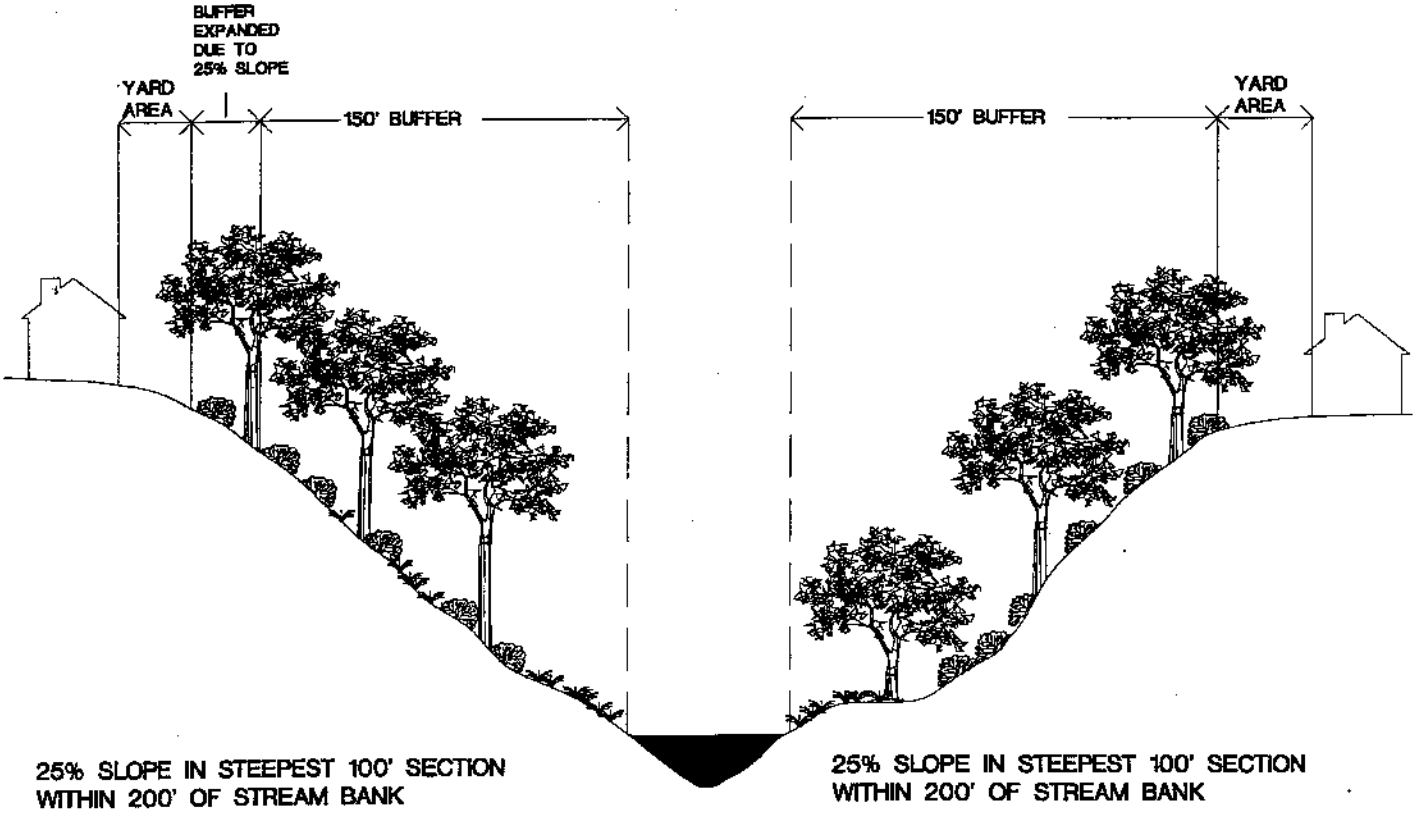


Figure 3. Hypothetical Subdivision with Stream Buffer for a Use I Stream



20% SLOPE IN STEEPEST 100' SECTION WITHIN 200' OF STREAM BANK

8% SLOPE IN STEEPEST 100' SECTION WITHIN 200' OF STREAM BANK



25% SLOPE IN STEEPEST 100' SECTION WITHIN 200' OF STREAM BANK

25% SLOPE IN STEEPEST 100' SECTION WITHIN 200' OF STREAM BANK

E. Forest and Trees

Existing forest and tree cover determined from recent aerial photos must be shown on the NRI/FSD inventory map as a circumferential line around all forest and tree stands that includes the outer perimeter of the branches of the individual trees.

A detailed delineation of forest and trees within these boundaries must also be provided. The requirements and methodology for this delineation are contained in *Trees: Approved Technical Manual* adopted as part of the Montgomery County Forest Conservation Law.

F. Unsafe and Unsuitable Land (Soils)

Environmentally sensitive site design depends on knowledge of the nature and degree of constraints and opportunities offered by a given site. Identification of unsafe or unsuitable land is an integral part of this analysis, both from the standpoint of providing safe and habitable buildings, and for providing protection and conservation of natural resources such as streams, wetlands, floodplains, forests, and trees. The primary reasons for classifying land as unsafe or unsuitable for development are problems with soils/geology, topographic constraints, and surface and subsurface water hazards.

In the past, there have been instances where failure to recognize existing soils constraints have resulted in buildings that experience severe flooding, wetness problems and/or, over the long run, structural problems. Therefore, soil boundaries must be identified on the inventory map. In addition, development limitations must be provided either in a separate report or as a note on the plan drawing. Severely limited areas must be highlighted on the plan drawing. Soils with severe limitations for development are those that have one or more of the following characteristics as identified in the most recent version of the *Soil Survey of Montgomery County, Maryland*, prepared by the United States Department of Agriculture Natural Resources Conservation Service (NRCS):

- Seasonal high water table
- Subject to flood hazard
- Poor drainage
- Wetland/hydric soil conditions
- High shrink/swell potential
- Shallow depth to bedrock
- Excessive slopes
- High susceptibility to erosion

One of the most common of these characteristics in Montgomery County is highly erodible soils. Highly erodible soils are those listed as having a "severe hazard of erosion" in the *1995 Soil Survey of Montgomery County* (see Appendix C for a complete list of highly erodible soil types). Erodible soils on slopes over 15% must be delineated on the NRI and highlighted for potential inclusion in the protected areas of the site.

Table 2. Recommended Buffers for Wetlands, Springs and Seeps Outside SPAs

Stream Use & Order	Wetlands of Special State Concern *	Wetlands with Steep Slopes **	Wetlands with Erodible Soils***	Other Wetlands
Use III, First & Second Order Streams	100'	50-100'	50-100'	50'
Use III, Third & Higher Order Streams	100'	25-100'	25-100'	25'
Use IV, First & Second Order Streams	100'	40-100'	40-100'	40'
Use IV, Third & Higher Order Streams	100'	25-100'	25-100'	25'
Use I, First & Second Order Streams	100'	25-100'	25-100'	25'
Use I, Third & Higher Order Streams	100'	25-100'	25-100'	25'

NOTE: Isolated farm ponds, existing stormwater management ponds or man-made drainage ditches are exempt from these expanded buffer recommendations. See Appendix A for a definition of State Water Use designations and Appendix B for a definition of stream order.

* Wetlands of special State concern, as identified by the Maryland Department of the Environment and the Maryland Department of Natural Resources, are subject to a minimum 100-foot buffer by State regulations.

** Buffer for wetlands adjacent to steep slopes will be expanded to include the steep slopes up to 100 foot maximum. For wetlands outside SPAs, steep slopes are defined as 25% or greater on the steepest 50 feet within the 100 feet adjacent to the wetland.

*** Buffer for wetlands adjacent to erodible soils will be expanded to include the erodible soils up to 100 foot maximum. Erodible soils are those soils classified as having a severe hazard of erosion in the soil profile descriptions of the *Soil Survey of Montgomery County* (July 1995), published by the Natural Resources Conservation Service (formerly SCS) (see Appendix C).

Figure 4. Illustration of Stream Buffers in a Use III Watershed with Wetlands

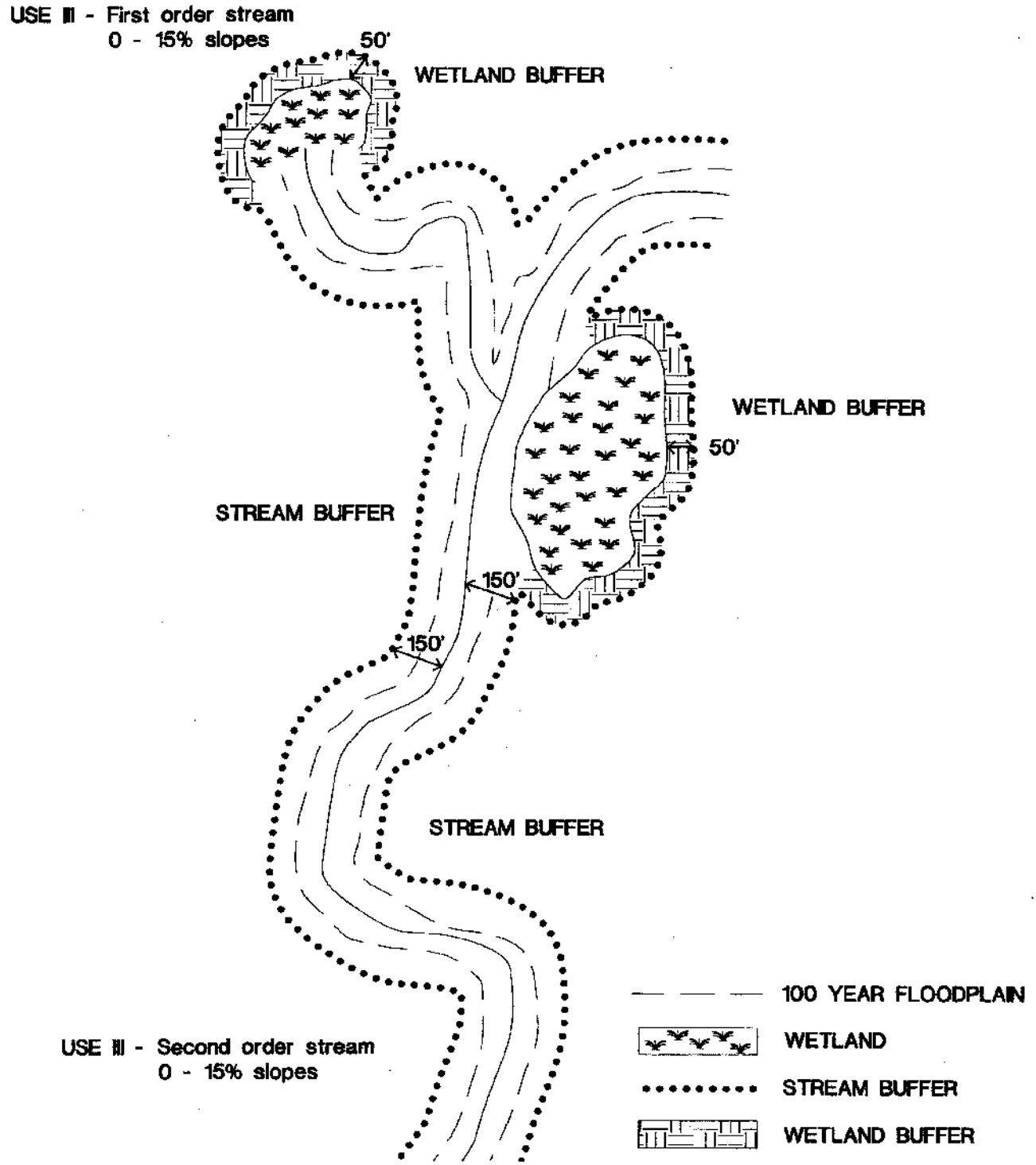
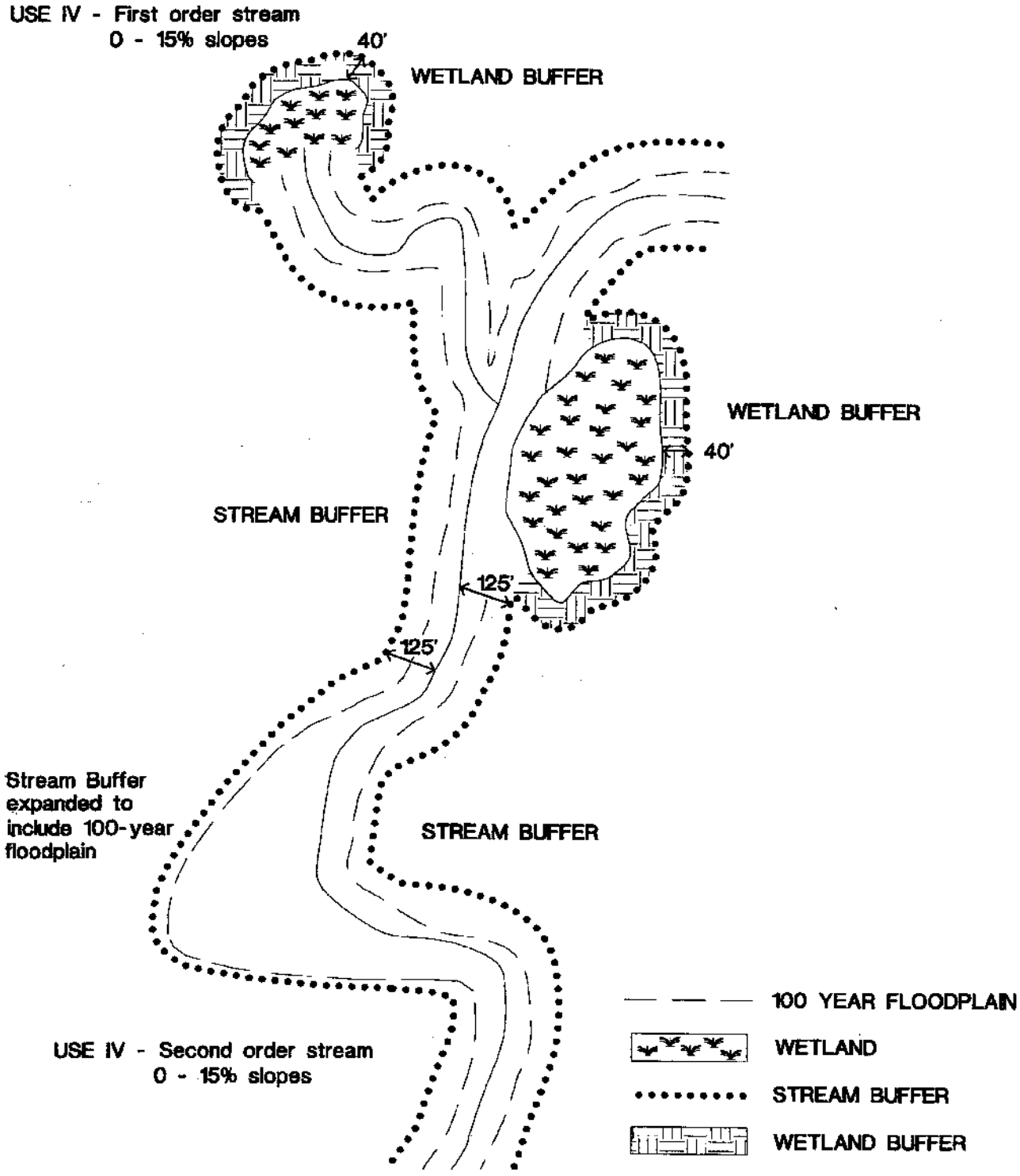


Figure 5. Illustration of Stream Buffers in a Use IV Watershed with Wetlands and Floodplain



G. Danger Reach/Dam Break

M-NCPPC, in consultation with MCDPS and the Maryland Water Resources Administration (WRA), incorporates danger reach/dam break analysis in the NRI submittal in order to identify relevant land use issues early in the process, to protect existing structures against dam failures from new ponds, and to protect proposed subdivisions against an existing or proposed ponds' dam breach. (For proposed ponds, danger reach/dam break information, as described in this section, should be submitted with the preliminary/site plan.)

For all development applications that have a dam, subject to dam breach analysis on site, or where the property is one mile or less downstream of a dam, an applicant must show the danger reach (area inundated by the dam break flood), footprints of existing structures, and spot danger reach water surface elevations on the inventory map. MCDPS shall verify this information. M-NCPPC has maps showing the danger reaches for Little Seneca Lake, Lake Needwood, and Lake Frank.

H. Threatened and Endangered Species and Species in Need of Conservation

If identified during the development review process, the habitat location of flora and fauna that are designated as rare, threatened, endangered, in need of conservation, or as a watchlist species (as designated by the Maryland Natural Heritage Program, Department of Natural Resources), must be shown on the inventory map. To determine if a property contains any significant species, send a vicinity map with a letter requesting identification of significant species to the DNR Natural Heritage Program at the following address:

DNR Natural Heritage Program
Tawes State Office Building
580 Taylor Avenue, E-1
Annapolis, MD 21401

DNR will check their database for known occurances of significant species and will send a response letter that can be submitted with the NRI map.

Environmental Planning staff will work with DNR and the M-NCPPC Parks Division to determine any special buffering measures to help protect known populations of such species and/or their sensitive habitat areas.

V. GUIDELINES FOR DEVELOPMENT

In Montgomery County, protecting and improving the water quality and ecological health of the County's streams is a major planning goal. This goal is particularly important because the County is part of the Chesapeake Bay watershed. Preservation and clean-up of the Bay is a major State priority. Therefore, the environmental guidelines for development are largely based upon the principles of comprehensive watershed and stream valley management.

These guidelines have been developed with consideration of existing policies and practices in other jurisdictions to remain consistent with these other areas. Additionally, these guidelines attempt to consolidate and coordinate environmental site development issues that impact and are impacted by land use decisions. These guidelines are intended to promote and encourage interagency cooperation at the earliest planning stage possible.

The following guidelines will be applied to protect sensitive environmental features on development plans, as identified by the Natural Resources Inventory. They will be the basis for formulation of staff recommendations to the Planning Board.

A. Stream Valley Protection

The slope classification system and stream buffer widths outlined in section III are the basis for the following recommended guidelines that address stream buffers (including hydraulically adjacent slopes, hydraulically remote slopes, and approved clearing and grading within these areas or that affects these areas). The guidelines are designed to provide greater protection, through use of stream buffers, for the more environmentally sensitive areas.

1. Recommended Guidelines For Stream Buffers

a) Streams, natural surface springs, and seeps will be maintained in a natural condition so that the existing hydraulic regimen and State water quality standards can be maintained.

b) No buildings, structures, impervious surfaces, or activities requiring clearing or grading will be permitted in stream buffers, except for infrastructure uses, bikeways, and trails found to be necessary, unavoidable, and minimized by the Park and Planning Department environmental staff working closely with the utility or lead agency.

c) Sediment and erosion control facilities are allowed as a temporary use in unforested areas of the stream buffer when DPS finds that performance of the overall site sediment control system will be measurably improved by placement of a facility at that location. At a minimum, grading must be at least 25 feet from the stream bank, outside wetlands and their State-defined buffer, and outside forest and associated critical root zone areas.

d) Stormwater management (SWM) facilities are generally discouraged within stream buffers since, as a general rule, location of this permanent use within the buffer does not allow maximized accomplishment of all environmental management objectives for the stream buffer. However, maximum long-term effectiveness of SWM facilities is also an important

objective of an overall stream protection strategy, and must be considered together with the buffer objectives in siting decisions. As a general rule, minimized buffer intrusions are allowed for construction of suitable SWM facilities or non-erosive storm drain outfalls, and unavoidable and consolidated sanitary sewer connections.

A SWM facility may be allowed within the stream buffer area on a case-by-case basis. The following factors will be considered by DPS and M-NCPPC staff in the evaluation of which facilities or other Best Management Practices (BMPs) may be appropriate in the buffer:

(1) Documented and measurable improvement in the effectiveness of the SWM control system if placed in the buffer

(2) Minimization of encroachment into the buffer

(3) Avoidance of existing sensitive areas (forest, wetlands and their State-designated buffers, floodplain, steep slopes, and habitat for rare, threatened, and endangered species with their associated protection buffers)

(4) Extent to which the SWM facility or BMP design is consistent with the preferred use of the buffer (for example, preservation of existing forest and natural vegetation within part or all of the flood pool; naturally contoured and vegetated infiltration areas or filter strips; etc.)

(5) Excessive grading caused by an uphill SWM location; and /or the reduction of numerous smaller less efficient structures outside the buffer

(6) Existence of severely degraded conditions within the buffer area that could not be improved if the SWM facility is outside the buffer area

(7) Presence of man-made structures (e.g., farm ponds) in the buffer area under pre-development conditions that can be converted to SWM use without excessive stream disturbance

(8) Ability to provide full or partial compensation for the loss of buffer function from the disturbance and permanent absence of forested areas

M-NCPPC and DPS Water Resources staff will evaluate SWM alternatives that provide effective SWM in a manner closest to the preferred use of the buffer as a stable forested area. The two agencies will jointly determine where SWM facilities are appropriate in stream buffers. When a SWM facility is allowed in the buffer, an area that is of comparable or greater environmental benefit than that used for the SWM facility and not otherwise protected, may be required as a replacement buffer.

e) Small amounts of clearing and grading for other purposes within the stream buffer (such as paving for bikeways) may be recommended for approval by staff on a case-by-case basis so long as the modification is consistent with a comprehensive approach to protecting areas that are critical to preserving or enhancing streams, wetlands, and their ecosystems. The applicant shall provide rationale for stream buffer modifications addressing at a minimum the factors below. The extent to which the proposal meets all the following factors will form the basis

for staff recommendations.

(1) Reasonable alternatives for avoidance of the buffer are not available.

(2) Encroachment into the buffer has been minimized.

(3) Existing sensitive areas have been avoided (forest, wetlands and their state designated buffers, floodplain, steep slopes, and habitat for rare, threatened, and endangered species and their associated protection buffers).

(4) The proposed use is consistent with the preferred use of the buffer (e.g., pervious areas such as tieouts to existing grades, slope stabilizing BMPs, etc.).

(5) The plan design provides compensation for the loss of buffer function.

In reviewing buffer compensation proposals, staff will consider such options as buffer averaging, enhanced forestation, bioengineering practices, and other environmentally beneficial techniques. Buffer averaging provides environmentally-comparable on-site area outside the delineated stream buffer in exchange for the allowance of encroachment elsewhere in the delineated buffer. The concept of enhanced forestation (as described in detail in Chapter V, section C) goes beyond the county legal requirements for forest conservation to enhance existing riparian forest or to accelerate the creation of healthy mature forest in afforestation/reforestation areas.

f) Only unavoidable road and utility crossings will be permitted in the stream buffer when it is clearly demonstrated that no feasible alternatives exist, and every effort is made to locate road alignment and/or utilities to create the least disturbance to existing vegetation, grade, wetlands, trout spawning areas in Use III watersheds, etc.

Where feasible, utility easements must be set back a minimum of 50 feet from all stream banks *or* outside wetlands and their State-defined buffers, whichever provides more protection. In-stream placement of sediment control devices, stream crossings, and channel modifications must be avoided whenever possible.

Multiple utility, bikeway, and trail rights-of-way within the buffer should be consolidated to minimize buffer disturbance. Reduced or overlapping right-of-way and utility easements should be used where feasible.

g) Deposition or stockpiling of any material such as excavated rock, topsoil, stumps and shrubs, grass clippings, and building material within the designated stream buffer is strongly discouraged. Activities such as composting or topsoil stockpiling that are necessary to restore an area within a utility easement or temporary sediment control area may be approved on a case-by-case basis prior to approval of the plan when no other alternative is available. These same activities may be approved by MCDPS, in consultation with Park and Planning Department staff, after approval of the plan and prior to issuing the sediment control permits.

h) Septic fields are prohibited within 25 feet of slopes greater than 25 percent (MCDPS Health Regulation).

i) Septic fields and reserve fields must be set back to keep the septic field outside the stream buffer. Current County regulations requiring septic field setbacks from streams, steep slopes, water supply reservoirs, etc., must also be met.

j) No sewage disposal system may be located within 300 feet of the normal high water level of a water supply reservoir, or within 200 feet of the banks of any stream that feeds therein (MCDPS Health Regulation).

2. Recommended Guidelines For Steep Slopes Outside the Stream Buffers (Hydraulically Remote)

a) Septic fields and reserve fields are prohibited on slopes greater than 25 percent (MDE and County regulations).

b) To the extent possible, hydraulically remote steep slope areas should be incorporated into the site's open space and/or remain undisturbed. However, development of these areas may be approved on a case-by-case basis, where the developer can demonstrate that safety, County road standards, storm drainage/stormwater management, erosion and sediment control, engineering, tree preservation, soil stabilization, design, and planning issues are satisfactorily addressed.

3. Recommended Guidelines for Approved Clearing and Grading in Stream Buffers and Hydraulically Remote Slopes

a) All clearing and grading activities must adhere to the most recent Maryland State standards and specifications. Furthermore, it is strongly recommended that phased clearing and grading be used whenever feasible. In sensitive watershed areas (Use III/III-P, IV/IV-P, and high quality I/I-P streams), phased clearing and grading may be required for plan approval by Park and Planning Department staff in consultation with MCDPS. Close coordination shall be maintained by M-NCPPC staff with the Washington Suburban Sanitary Commission (WSSC) to reduce potential additional disturbance from water and sewer line construction. All disturbed areas should be revegetated as soon as possible as required by the *Maryland Standards and Specifications for Sediment and Erosion Control*. Emphasis should be placed on reforestation of disturbed areas. In many instances, disturbed areas may need replenishment of topsoil before successful reforestation or revegetation can be implemented. Areas without suitable existing vegetated buffers (e.g., cultivation) should be stabilized or seeded prior to grading activity.

b) Stormwater management concept plans that address water quantity and quality must be approved by MCDPS unless a waiver is granted. These plans should incorporate effective best management practices and respect natural stream channels, existing aquatic life, and stream habitat.

c) The location, design and construction of new development and transportation facilities will be carefully reviewed to avoid introduction of toxic materials into stream systems.

d) In instances where a master plan or County-wide program identifies a need for water quality or other monitoring, the Park and Planning staff may recommend stream monitoring to

evaluate impacts of development proposals on the environment. In instances where the Planning Board makes stream monitoring a condition of plan approval, the monitoring will be conducted by the applicant with the guidance and oversight of the M-NCPPC, in consultation with the Department of Environmental Protection, to assure efficient, consistent and comprehensive stream monitoring efforts. Recommended monitoring protocols will follow the sampling procedures developed by the County Biological Monitoring Work Group as presented in the *Montgomery County Water Quality Monitoring Program Stream Monitoring Protocols* (available from MCDEP).

B. Wetland and Floodplain Protection

1. Wetlands

The wetland guidelines are based on the Maryland Nontidal Wetlands Protection Act. It is the goal of the State's program to attain no net overall loss in nontidal wetland acreage and function and to strive for a net resource gain in nontidal wetlands over present conditions. In support of this goal, the following wetland guidelines will be followed during review of plans:

a) Wetlands will be regulated in accordance with State (Code of Maryland Regulations {COMAR} 08.05.04) and Federal Nontidal Wetlands Regulations (Secs. 401 & 404 of the Clean Water Act).

b) A minimum buffer width of 25 feet will be established around nontidal wetland areas. The buffer will be expanded up to 100 feet around wetlands of special State concern and around wetlands with adjacent areas containing steep slopes or highly erodible soils as described in Table 2 (page 12). When a wetland buffer extends beyond the stream buffer that would be required according to Table 1 (page 8) of these guidelines, the stream buffer will be expanded to the wetland buffer line. For example, see Figures 4 and 5. Additional buffers may be required in Special Protection Areas (see Chapter V for details).

c) The Park and Planning Department evaluates proposed wetland impacts under the federal and State avoidance guidelines that are listed in order of preference as follows:

   (1) Avoiding the wetland impact altogether by not taking a certain action or parts of an action
   (2) Minimizing impacts by limiting the degree or magnitude of the action and its implementation
   (3) Rectifying the impacts by repairing, rehabilitating, or restoring the affected environment
   (4) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action
   (5) Compensating for the impact by replacing or providing substitute resources or environments

d) Wetlands and their associated buffer areas must be maintained in their natural condition unless the proposed disturbance is for a project determined to be necessary and unavoidable for the public good, such as:

(1) Road crossings, water and sewer lines, and storm drain outfalls for which no alternative exists
(2) Stormwater management facilities, when it can be demonstrated that upland areas are infeasible or would severely limit the performance/ effectiveness of the facility (see section A.1.d on page 18)
(3) Park projects for wildlife and habitat enhancement
(4) Wetland enhancement projects
(5) Bikeways and trails, when it can be demonstrated that a satisfactory connection cannot be made otherwise

e) Proposed alterations to areas designated as wetlands must be reviewed and approved by MDE, DNR, and the U.S. Army Corps of Engineers (U.S. ACOE), as appropriate, prior to commencement of any alteration activities. Park and Planning staff may recommend deferral of final approval of development plans pending the permit decision for disturbance of wetlands of extraordinary quality or environmental sensitivity. These include:

(1) Nontidal wetlands with threatened or endangered species or species in need of protection
(2) Nontidal wetlands of special State concern

It is strongly recommended that conceptual approval of such alteration be received from these agencies prior to development of a site plan required by Section 59-D-3.

2. Floodplains

Floodplain guidelines are based on existing State and County regulations that govern development activities in these areas.

a) No building/structure will be permitted within the 100-year ultimate floodplain or its associated 25 foot Building Restriction Line (BRL), except as permitted in Chapter 19 of the County Code.

b) Per Section 50-32 of the Subdivision Regulations, the Planning Board must restrict subdivision for development of any property that lies within the 100-year ultimate floodplain.

c) Any construction on platted lots that proposes building within the 100-year ultimate floodplain or its associated 25 foot building restriction line will be governed according to the regulations set forth in the sections of the County Code that relate to floodplain districts. A person must not engage in any land-disturbing activity within the floodplain district or within 25 feet of any boundary of the district unless MCDPS issues a floodplain district permit or exemption from the permit requirement.

d) The extent of floodplains, must be delineated on the record plat, to ensure that the public and affected homeowners are informed, and must include metes and bounds description for the floodplain boundaries.

e) When the floodplain extends beyond the stream buffer that would be required according to Table 1 in these guidelines, the stream buffer will be expanded to include the floodplain. For example, see Figure 5.

C. Forest and Tree Conservation

The requirements for forest and tree conservation are contained in the Montgomery County Forest Conservation Law. A Forest Conservation Plan is required as part of the preliminary/site plan and special exception and mandatory referral applications. Guidelines for determining priority areas and details for submission of Forest Conservation Plans are included in the most recent version of *Trees: Approved Technical Manual.*

D. Unsafe and Unsuitable Land Protection

1. Management Strategies

Development on highly erodible soils and other unsafe and unsuitable lands should be carefully managed to avoid erosion problems and sediment transport to streams and storm sewer systems. Plans showing development on highly erodible soils will be required to propose management strategies in the following order of priority:

a) Avoidance and minimization of disturbance, including expansion of stream buffer
b) Environmentally sensitive site design
c) Reforestation/afforestation and vegetative stabilization
d) Best management practices including expansion of stream buffer and cluster design
e) Innovative and stringent use of sediment and erosion control measures

Development should avoid areas of the site that contain soils with severe limitations. In some cases, development may be prohibited or restricted in these areas as a condition of plan approval. Restrictions can include the requirement for implementation of engineered solutions, the use of building restriction lines, restriction of housing types (such as prohibiting basements), and relocation or deletion of lots.

2. Geotechnical Reports

When no other options exist and development on problem soils cannot be avoided, a geotechnical report, prepared by a certified geotechnical engineer, may be required. This report will describe the soils limitations and the engineering measures necessary to protect against potential development hazards and impacts, as required by MCDPS, the lead agency for problem soils. When staff is convinced that suitable measures have been identified that will mitigate the soils constraints over the long-term, development will be allowed. An agreement between the builder/developer of the property and the M-NCPPC will be required to ensure that development occurs according to the

recommendations of the report.

E. Danger Reach/Dam Break

It is the policy of the Department of Permitting Services and the Planning Board to prohibit all dwelling units inside the area potentially inundated by the Dam Break Flood (Danger Reach). In order to ensure that a minimal risk is posed to public well-being and property, the following techniques are employed where appropriate:

- Use of zoning options that require adequate open space for protection of the danger reach
- Use of cluster provisions in the Zoning Ordinance
- Recommending park dedication, park acquisition, and conservation easements
- Applying regulatory review policies to minimize flood risk

To ensure that the public is informed as to the existence of a dam and its potential to break, the danger reach area will be delineated on the record plat, with reference elevations at critical locations.

F. Threatened and Endangered Species and Species in Need of Conservation

When a rare, threatened or endangered species, a species in need of conservation, or a watchlist species (as designated by the Maryland Natural Heritage Program, Department of Natural Resources) is identified on a development site, the applicant must protect these areas unless an alternate plan is approved by the State and/or M-NCPPC. This includes the applicant identifying any critical habitats necessary to sustain these species that may be affected by development, establishing appropriate buffers, and devising programs for their long-term protection, in conjunction with the Maryland Department of Natural Resources. Initial identification of significant species on a subject property can be obtained from the Natural Heritage Program of DNR (see section III.H, page 16, for details).

G. Site Imperviousness Considerations

Minimizing imperviousness to levels consistent with achievement of zoning densities is one of the best methods for assuring protection of water resources. Evidence clearly indicates a causal relationship between the overall level of watershed imperviousness, water quality, and the health of the aquatic community within the receiving stream.

There are two different levels of control on the amount of impervious area: (1) the County Council mandated imperviousness limits, or caps, that function as a regulatory requirement, and (2) the implementation of general policy contained in master plans, functional master plans, and the water & sewer systems plan that calls for reduced imperviousness in the plan's land use policies and objectives.

1. Impervious Limited (Capped) Areas

Caps specifying maximum levels of imperviousness on a particular property can only be applied after Council approval of such caps as part of an approved and adopted area master plan, watershed plan, Comprehensive Water Supply and Sewerage System Plan, or Council resolution designating a Special Protection Area. Compliance with caps must be documented and enforced during the plan review process. As of October 1999, the following areas outside Special Protection Areas are subject to imperviousness limits. Exact locations are specified in the appropriate master or functional plan.

a) Kingsview Village Analysis Area Two (KI-2) and Neelsville Village Analysis Area One (NE-1) in Little Seneca Creek in Germantown

   Overall, development in these master plan analysis areas should not result in more than *20 percent* total impervious surface.

b) Patuxent Primary Management Area (PMA)

   Overall imperviousness within the PMA transition area of a development site should not exceed *10 percent*. If a higher imperviousness is desirable in the transition area to maintain community character, achieve compatibility and/or accomplish master plan goals, imperviousness may be averaged over the entire site (i.e., not to exceed 10 percent on the entire site).

2. Minimizing Imperviousness Levels Outside Impervious Limited Areas

In SPAs and planning areas where adopted policy documents suggest minimized imperviousness, development on a site should be designed to reduce impervious surfaces wherever possible. In addition to the applicant's site design efforts, implementation agencies and utilities should consider all options for minimizing impervious surfaces, particularly where sensitive water resources have been identified for special protection.

Examples of techniques to minimize imperviousness and enhance groundwater recharge are shown below. These techniques can be used in areas with imperviousness caps or any other area of the County where reduced imperviousness is desirable. This list is not intended to be comprehensive; see the resources in footnote 1 for additional techniques[1].

a) Reduce parking imperviousness by limiting parking spaces to the extent possible, using angled parking and smaller parking stalls, or sharing use of parking areas among nearby land uses.

b) Leave necessary overflow parking spaces unpaved.

c) Utilize natural or informal paths and walkways when such are necessary in the stream buffer.

[1] *Site Planning for Urban Stream Protection*, Metropolitan Washington Council of Governments, December 1995.

Imperviousness Surface Reduction Study, City of Olympia, WA, 1994.

d) Exercise cluster options and/or maximize use of higher density unit types.

e) Preserve areas with highest infiltration capacity for potential use as an infiltration facility or natural recharge area.

f) Implement shared driveways, structured parking, multi-story and/or multi-use office/commercial/community buildings where feasible.

g) Use narrower street and/or sidewalk sections. Provide sidewalks only on one side of the street.

h) Construct higher buildings with smaller footprints.

i) Use cul-de-sac donuts or culs-de-sac with reduced radii.

j) Use swales instead of curb and gutter, and guide runoff toward pervious areas.

k) Where higher levels of imperviousness are necessary and unavoidable, use measures that increase infiltration & reduce adverse effects of imperviousness, such as disconnecting impervious areas, reducing setbacks to shorten driveways, or more reforestation between impervious areas and water bodies.

3. Review of Proposed Individual Zoning Map Amendments, Special Exceptions, and Mandatory Referrals

The increase in intensity or imperviousness associated with a proposed land use change is a factor that may be considered in the environmental review of the above referenced processes for changing land use. The resulting effects on the receiving stream and watershed will be identified and evaluated for pertinence to the findings necessary for grant of the land use change (e.g., consistency with master plan, detriment to use and enjoyment of surrounding properties, adverse effect on health and general welfare, etc.)

4. Guidelines for Calculating Impervious Areas Where Limits Apply

The following items are recommended for inclusion in the calculation of impervious areas:

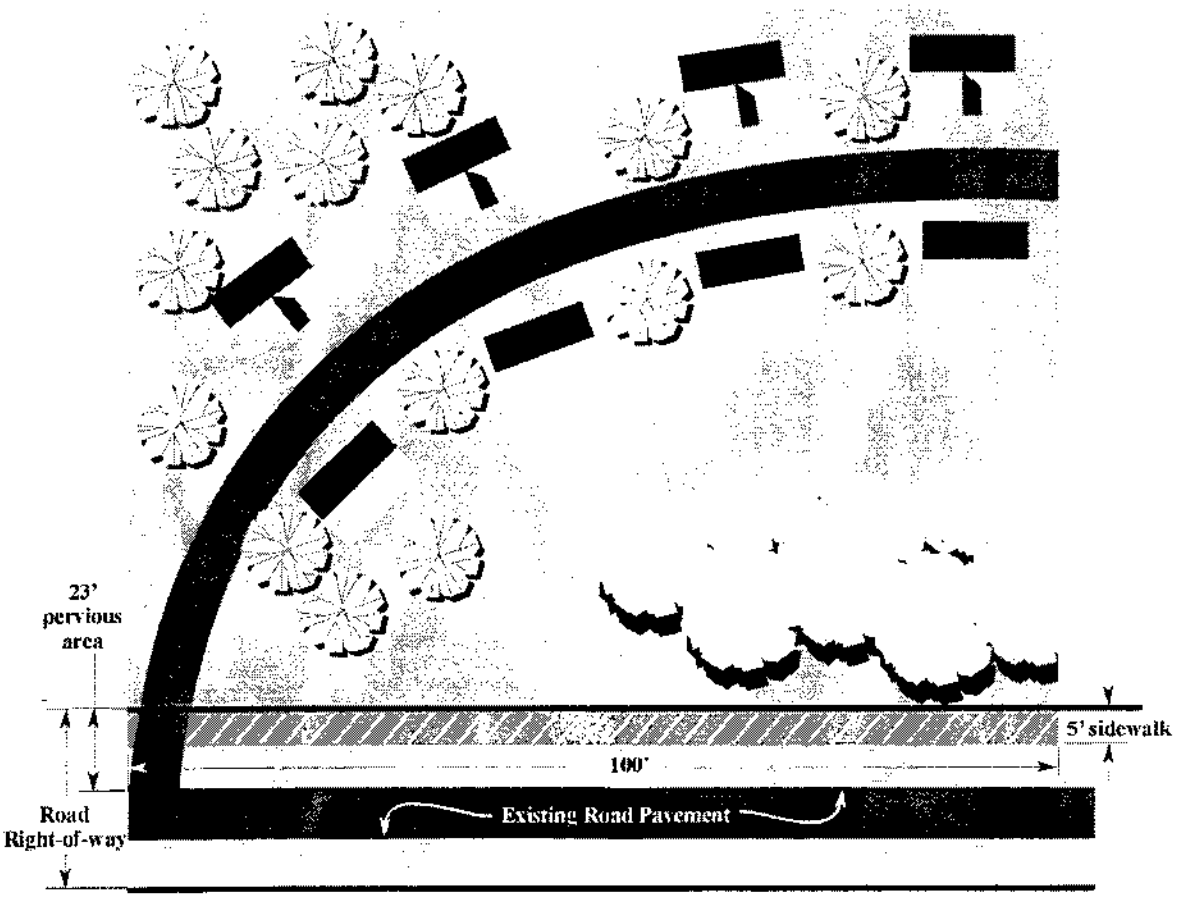
a) All pavement, driveways, sidewalks and paved paths.

b) Estimated building footprints. Use the most conservative (i.e., largest) estimates or average estimates for proposed buildings in the calculations. Each building permit or group of permits must demonstrate conformance with the established estimates by an engineer's certification.

c) All gravel surfaces.

d) Impervious surfaces of public improvements as required by other agencies such as DPWT and SHA along the project's roadway frontage, if contained within the watershed of interest. Examples include a new sidewalk or new turning lane along the project's frontage.

Figure 6. Sample Calculation of Impervious Areas (not to scale)



Sample Scenario

Subject Property:	10 acres
Proposed imperviousness:	0.99 acre within property boundaries
Required off-site improvements:	Five foot wide sidewalk constructed in road right-of-way (ROW) adjacent to property

Impervious Surfaces

On-site:	0.99 acre	=	43,290 s.f.
Off-site (sidewalk)	5' x 100'	=	500 s.f.
Total			43,790 s.f.

Gross Tract Area

Property	10 acres	=	435,600 s.f.
Part of road ROW	100' x 23'	=	2,300 s.f.
(between edge of road pavement & property boundary)			
Total			437,900 s.f.

Site Imperviousness for Proposed Subdivision

43,790 s.f./ 437,900 s.f. X 100% = 10%

For example, if a new sidewalk is required, the sidewalk area would be added to the project's total impervious area calculation, while the area between the project's boundary and the existing roadway edge would be added to the gross tract area to offset the increased impervious surface.

Sample calculation for illustrative purposes (see Figure 6):

(1) 100 linear feet of five-foot wide sidewalk required by DPWT adds 500 square feet to the overall impervious area (100 linear feet x 5-foot sidewalk width = 500 square feet).

(2) The county right-of-way for a typical master plan primary roadway (70' total ROW) contains an area 23 feet wide in pervious area on each side of the roadway. The gross tract area for purposes of impervious calculations is increased by 2300 square feet (100 linear feet of ROW with sidewalk x 23 feet of pervious area in the ROW = 2300 square feet).

(3) Thus, 500 square feet would be added to the site impervious surface area and 2300 square feet added to the gross tract area for purposes of impervious calculation.

The subject property and all dedicated lands must be included in the gross tract area for purposes of imperviousness calculation. Where improvements are required within the ROW, the gross tract area may be increased to include pervious area in the ROW, as illustrated in (d) above.

On a case-by-case basis, the Planning Board may waive the inclusion of part or all off-site impervious surfaces in a project's imperviousness calculations. Staff may make recommendations to the Board based on waiver justification presented by the applicant. The justification must demonstrate that the off-site impervious surfaces will result in a large proportion of a project's total impervious surface and that compensating BMPs are provided for the off-site impervious surface to the satisfaction of DPS.

5. Consideration of Alternative Technologies

Where variations are granted by the Planning Board to imperviousness caps for accomplishment of other public policy and planning objectives, use of extra BMPs and alternative technologies are encouraged to offset the incremental effect on the watershed.

V. SPECIAL PROTECTION AREAS (SPAs)

A. Goals and Objectives for Special Protection Areas

The County's goal in special protection areas is to protect and maintain high-quality or sensitive water resources and related environmental features in identified geographic areas where proposed land uses threaten those resources and a higher level of environmental protection is needed. This protection will be accomplished cooperatively through the control of land use, site design, and protection of environmentally sensitive areas by the Planning Board and the provision of effective design, implementation, maintenance, and monitoring of best management practices by DEP and other County agencies. Both approaches are necessary to achieve the goal of watershed and stream protection.

The Park and Planning Department objective for special protection areas is to maximize protection of natural resources in environmentally sensitive areas through site design features (such as reduced impervious areas) and use of best management practices (such as accelerated forestation and provision of expanded wetland buffers).

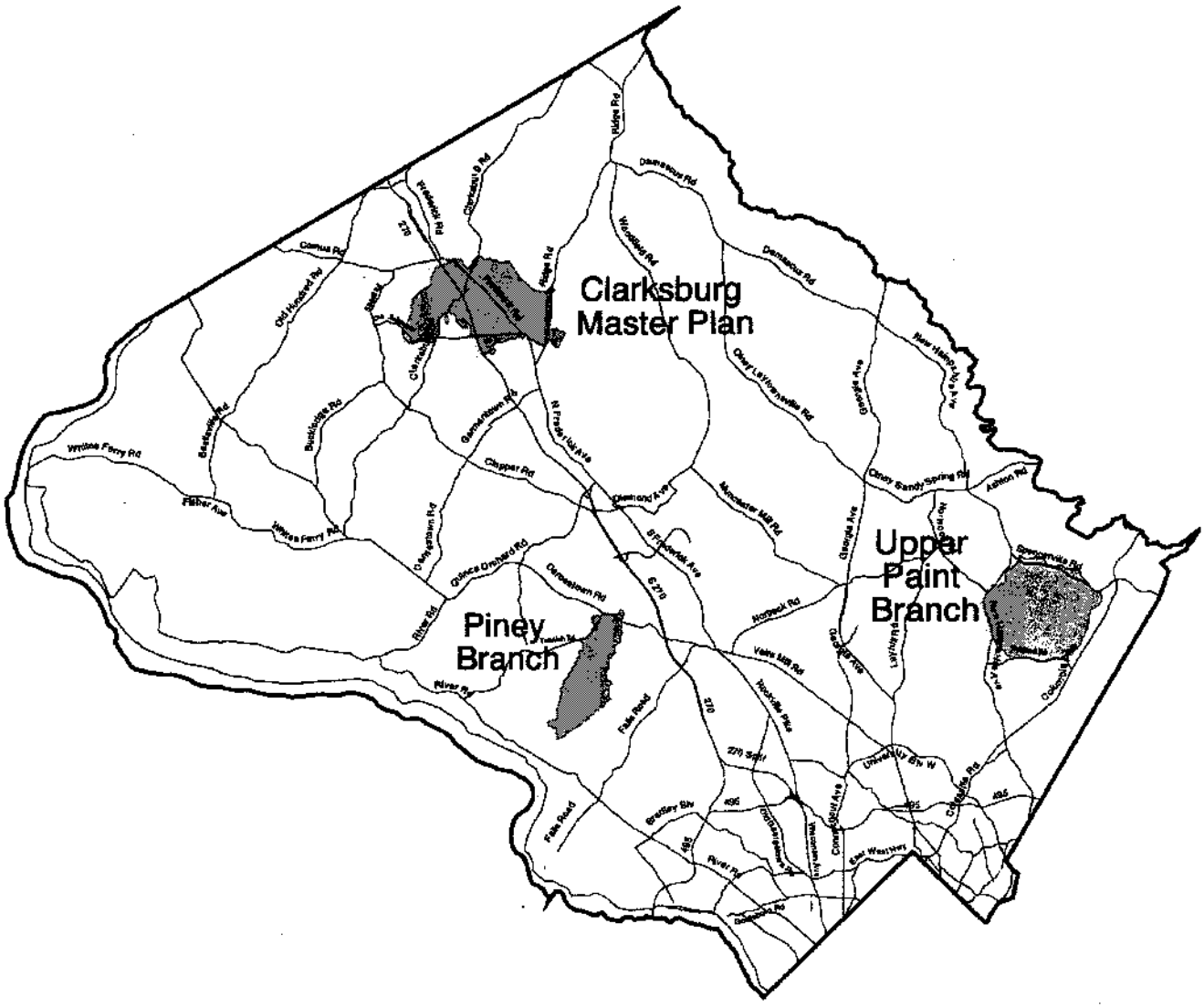
The SPA guidelines, when complemented with the County's water quality review regulations, provide a regulatory framework to accomplish these water resource protection objectives for plans reviewed by the Planning Board and department staff. The tools available to the Department to implement the objectives of special protection areas are:

- Designation of special protection area wetland buffers
- Expanded and accelerated forest conservation
- Imperviousness limitations

The additional protection from disturbance recommended for SPA wetland buffers along with forest and imperviousness provisions will help maintain the high quality characteristics and biological integrity of water resources. This protection should be utilized to better achieve the following objectives:

- Protect, restore, and maintain the chemical, physical, and biological integrity of streams, wetlands, springs, seeps, and other water resources
- Help maintain stream baseflow
- Provide infiltration of runoff
- Reduce erosion and control sedimentation
- Provide riparian wildlife habitat
- Provide organic matter to support the food web of aquatic ecosystems
- Provide spawning and nursery areas for aquatic life

Figure 7. Special Protection Areas in Montgomery County (as of January, 1997)



- Filter overland and non-concentrated stormwater flows through the buffer
- Provide a separation between physical disturbance and sensitive water resources

A coordinated effort in both the public and private sector will be made to protect water resources in special protection areas. Therefore, government agencies (including MCDPWT, MCDEP, MCDPS, M-NCPPC Department of Park and Planning, and WSSC) and utility companies should consider allowing flexibility and innovation to their standard design and regulatory requirements to better address watershed protection objectives in special protection areas and still achieve their statutory mission. As part of the plan review process, agency representatives on the Development Review Committee will work together, in concert with State regulatory agencies and in accordance with lead agency protocols (in place since November 1992), to maximize flexibility in site design and to cooperate with the applicant to reduce stream impacts.

B. Special Protection Area Wetland Buffer

1. Rationale for Expanded Wetland Buffer

A stream ecosystem includes not only the stream channel itself, but also the wetlands, floodplains, near-stream (or riparian) area, seeps, and springs that are linked to the stream. These areas are important for maintaining stream water quality, water temperature, and biological integrity, as well as contributing to baseflow. Protection of these features is essential to the vitality and health of the local aquatic ecosystem by virtue of their function, diversity, size, or location.

Expanded buffers for wetlands in SPAs satisfies the requirement for added protection of natural features that provide a continual supply of clean, cool water to environmentally sensitive streams. The importance of wetlands, springs, and seeps as critical components of the stream ecosystem, when coupled to the high intensity of surrounding development in the SPA, create the need for expanded physical protection of these resources.

All wetlands within Special Protection Areas will be considered for application of expanded buffers[2] with the exception of certain created wetlands that are not hydrologically connected to a stream. The appropriate buffer width will be recommended by Park and Planning Department staff and will range from 25 to 150 feet based on the following factors: (a) the State Water Use for the watershed, (b) stream order,
(c) the presence of steep slopes or highly erodible soils, and (d) designation as a wetland of special State concern. Table 3 describes the appropriate wetland buffer widths after applying the relevant factors.

The following definition for wetlands will be used *solely* for the purposes of determining the applicability of expanded buffers in SPAs. This definition is consistent with the federal and State definition of jurisdictional wetlands as described in the *1987 Corps of Engineers Wetlands*

[2]These buffers are considered "expanded" in relationship to the 25-foot State defined wetland buffer. It should be noted that this 25-foot width is a *minimum* and that the State has regulations allowing expansion.

Delineation Manual. All wetlands within Special Protection Areas that meet this definition will be subject to the expanded buffer recommendations.

> Wetlands - *areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions and are hydrologically connected to a stream.*

The *1987 Corps of Engineers Wetlands Delineation Manual* will be the reference for determining if an area meets the wetland vegetation, soils and hydrology criteria. The assumption will be that all springs, seeps, and emergent and forested wetlands are hydrologically connected to both groundwater and stream systems.

2. Exemptions to Expanded Wetland Buffers

Expanded wetland buffers will not be applied to isolated farm ponds, existing stormwater management ponds, and other man-created wetlands such as highway drainage ditches that are not hydrologically connected to a stream system. However, these created wetlands may be regulated by the Maryland Department of the Environment (MDE) and the U.S. Army Corps of Engineers (COE) and may have a 25 foot buffer applied to their perimeter if MDE/COE takes jurisdiction over these wetlands under the State Nontidal Wetlands Protection Act.

An expanded wetland buffer will not be applicable in situations where wetland soils, vegetation, or hydrology have been legally removed or altered by human activity, as in the case of prior converted croplands. (Prior converted croplands are defined by federal regulation as wetlands that have been drained, dredged, filled, or otherwise manipulated for the production of an agricultural commodity prior to December 23, 1985.) Prior converted croplands are exempt from State and federal wetland regulations.

However, prior converted croplands provide an excellent opportunity for wetland restoration. Therefore, Park and Planning staff will recommend that the area be preserved for future consideration for wetland restoration. Potential wetland restoration sites are essential to the County to offset wetland losses due to unavoidable encroachment for infrastructure associated with public and private development. These sites may be used to mitigate wetland losses in the watershed, as permitted by the Maryland Department of the Environment. Opportunities to provide an expanded buffer will be examined after wetland restoration has occurred.

3. SPA Stream Buffer Determination

To protect all components of the stream system, the SPA stream buffer will be *the outermost limit* of the areas specified below:

a) Regular stream buffer widths found in Table 1 (page 8) in Chapter III (100 to 200 feet) applied from the intermittent or perennial stream bank

b) Steep slopes where the toe of the slope starts within the stream buffer from Table 1. Steep slopes are defined as slopes equal to or greater than 25 percent. The one exception is in the Upper Paint Branch SPA, where steep slopes are defined as equal to or greater than 15

percent.

c) 100-year floodplain

d) Standard wetland buffer width of 25 feet

e) Expanded wetland buffer width, as described in Table 3. Expanded buffers are calculated based on the following criteria. The larger of the following buffers will apply:

(1) Steep Slopes

For SPA wetland buffer determination, slopes greater than 15 percent are considered steep slopes. Steep slopes are calculated by taking the steepest 50 foot run within the 100 feet adjacent to the edge of the wetland. Buffers for wetlands with adjacent steep slopes will be expanded to the outer edge of the steep slope area up to the maximums shown in the second column of Table 3. The minimum buffer is 60 feet, except in the headwater streams (first and second order) in Use IV watersheds where the minimum buffer is 75 feet. For Use III first and second order streams, a flat 150 foot buffer applies.

(2) Highly Erodible Soils

Highly erodible soils are defined as all soils classified as having a *severe hazard of erosion* in the soil profile descriptions of the *Soil Survey of Montgomery County, Maryland* (July, 1995), published by the Natural Resources Conservation Service (formerly the Soil Conservation Service). Wetland buffers will be expanded to include highly erodible soils up to the maximum buffer shown in Table 3.

(3) Watershed Use Category

(a) Use III/III-P Watersheds

Wetlands associated with first and second order streams will be protected by an expanded buffer of *150 feet*. (See Figure 7 for an illustration.)

Wetlands associated with third and higher order streams will be protected by an expanded buffer ranging from *25 - 100 feet* based on the presence of steep slopes, highly erodible soils, or designation as a wetland of special State concern, consistent with non-SPA areas of the County and State standards.

(b) Use IV/IV-P Watersheds

Wetlands associated with first and second order streams will be protected by a buffer ranging from *75 - 125 feet* based on the presence of steep slopes, highly erodible soils, or designation as a wetland of special State concern.

Wetlands associated with third and higher order streams will be protected by an expanded buffer ranging from *25 - 100 feet* based on the presence of steep slopes, highly erodible soils, or designation as a wetland of special State concern, consistent with non-

Table 3. Recommended Buffers for Wetlands, Springs, and Seeps in Special Protection Areas

Stream Use & Order	Wetlands of Special State Concern*	Wetlands with Steep Slopes**	Wetlands with Erodible Soils***	Other Wetlands
Use III, First & Second Order Streams	150'	150'	150'	150'
Use III, Third & Higher Order Streams	100'	60-100'	25-100'	25'
Use IV, First & Second Order Streams	100'	75-125'	75-125'	75'
Use IV, Third & Higher Order Streams	100'	60-100'	25-100'	25'
Use I, First & Second Order Streams	100'	60-100'	50-100'	50'
Use I, Third & Higher Order Streams	100'	60-100'	25-100'	25'

NOTE: Isolated farm ponds, existing stormwater management ponds or man-made drainage ditches are exempt from these expanded buffer recommendations. The buffer widths for Use III first and second order streams are in accordance with the recommendations of the Upper Paint Branch Technical Work Group. See Appendix A for a definition of State Water Use designations and Appendix B for a definition of stream order.

* Wetlands of special State concern, as identified by MDE/DNR, are subject to a minimum 100-foot buffer by State regulations.

** Buffer for wetlands adjacent to steep slopes will be expanded to the outer edge of the steep slopes up to the maximum distance shown in the table. For wetlands inside SPAs, steep slopes are defined as greater than 15% on the steepest 50 feet within the 100 feet adjacent to the wetland.

*** Buffer for wetlands adjacent to erodible soils will be expanded to include the erodible soils up to the maximum distance shown in the table. Erodible soils are those soils classified as having a severe hazard of erosion in the soil profile descriptions of the *Soil Survey of Montgomery County* (July 1995), published by the Natural Resources Conservation Service (see Appendix C).

SPA areas of the County and State standards.

(c) Use I/I-P Watersheds

Wetlands associated with first and second order streams will be protected by a buffer ranging from *50 - 100 feet* based on the presence of steep slopes, highly erodible soils, or designation as a wetland of special State concern.

Wetlands associated with third and higher order streams will be protected by an expanded buffer ranging from *25 - 100 feet* based on the presence of steep slopes, highly erodible soils, or designation as a wetland of special State concern, consistent with non-SPA areas of the County and State standards.

4. Flexibility in Implementation of SPA Wetland Buffers

Table 3 describes the range of buffer widths that may be applied to the perimeter of a wetland within an SPA. Small amounts of clearing and grading for other purposes within the stream buffer (such as paving for bikeways) may be recommended for approval by staff on a case-by-case basis so long as the modification is consistent with a comprehensive approach to protecting areas that are critical to preserving or enhancing streams, wetlands, and their ecosystems. The applicant shall provide rationale for stream buffer modifications addressing at a minimum the factors below. The extent to which the proposal meets all the following factors will form the basis for staff recommendations.

a) Reasonable alternative locations are not available.

b) Encroachment into the buffer has been minimized.

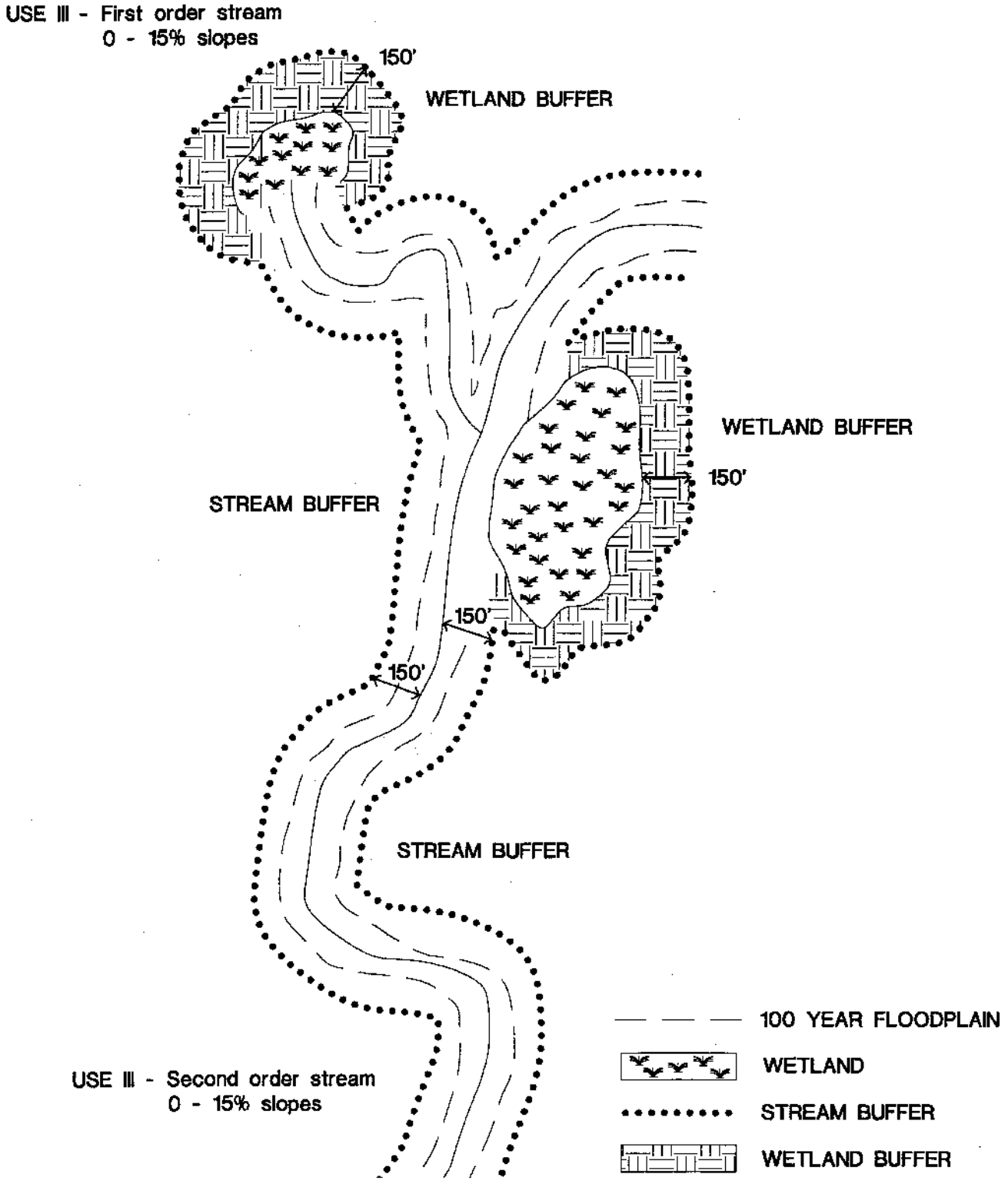
c) Existing sensitive areas have been avoided (forest, wetlands and their state designated buffers, floodplain, steep slopes, and habitat for rare, threatened, and endangered species and their associated protection buffers).

d) The proposed use is consistent with the preferred use of the buffer (e.g., pervious areas such as tieouts to existing grades, slope stabilizing BMPs, etc.).

e) The plan design provides compensation for the loss of buffer function.

In reviewing buffer compensation proposals, staff will consider such options as buffer averaging, enhanced forestation, bioengineering practices, and other environmentally beneficial techniques. Buffer averaging provides environmentally-comparable on-site area outside the delineated stream buffer in exchange for the allowance of encroachment elsewhere in the delineated buffer. The concept of enhanced forestation (as detailed in section C) goes beyond the county legal requirements for forest conservation to enhance existing riparian forest or to accelerate the creation of healthy mature forest in afforestation/reforestation areas.

Figure 8. Illustration of Stream Buffers in a Special Protection Area Use III Watershed with Wetlands



C. Expanded and Accelerated Forest Conservation Opportunities

1. Rationale

As stated in the County's forest conservation manual *(Trees: Approved Technical Manual*, 1992), "*Forest areas in the natural landscape filter ground water, tend to reduce surface runoff, help alleviate flooding, lower stream temperature, and supply necessary habitat for wildlife.*" The forest conservation requirements are specifically intended to preserve existing forest, or provide for forest creation in environmentally sensitive locations. In SPAs, where forests play an important role in protecting water quality and the overall health of the stream ecosystem, the following guidelines will allow healthy, mature forest to be established more rapidly. The longer maintenance period gives a growing forest the opportunity to better establish itself against invasive vegetation so it can more quickly provide the many benefits to water quality.

2. Guidelines

a) The applicant should retain or establish forest in all buffers on a site. Reforestation on SPA sites is to begin as soon as possible after the issuance by DPS of grading permits, with appropriate phasing to allow for the construction of sediment and erosion control structures. On development projects where standard forest conservation requirements do not completely forest the buffer area, the entire buffer should be reforested as part of the development project. This may be accomplished either by the applicant planting the entire buffer and selling the area in excess of their requirements to others as credit toward their off-site requirements, or by the applicant arranging for planting by other applicants.

b) The applicant will provide a five-year maintenance program of forest planting areas to better ensure forest survival, with emphasis to be placed on control of invasive species. Bonding will remain in place for two years only, as required in current regulations.

c) The use of 3- to 4-foot planting stock for trees and 18- to 24-inch planting stock for shrubs will be encouraged in re/afforestation plantings to minimize time to canopy closure.

D. Imperviousness Limitations

The multi-level protection of water quality inherent to the SPA concept requires extra emphasis be placed on opportunities for minimizing imperviousness in SPA areas. Policies and site design guidelines regarding overall levels of imperviousness are detailed in Chapter IV. Lower levels of imperviousness have benefits to all watersheds by providing more opportunity for natural infiltration and pollutant removal and less reliance on SWM controls.

As of publication time, the following SPAs have imperviousness limits specified either in a master plan or a Council resolution designating the SPA. See Chapter IV.G.4 for guidance for calculating imperviousness areas.

1. Paint Branch Special Protection Area

Development should not result in more than 10 percent of the total site area in imperviousness surface (including structures, roadways, parking areas, paths, etc.)[3].

2. Clarksburg Employment Areas west of I-270 in Ten Mile Creek watershed

An impervious limit of 15 percent applies to the entirety of each subject site (see Figure 36 from the *Clarksburg Master Plan and Hyattstown Special Study Area*, June 1994). The imperviousness coverage must be calculated over the entire subject property, not just the portion that is zoned for industrial use.

[3]County Council Resolution No. 13-215 designates the upper Paint Branch watershed as an SPA. The resolution states that this SPA "will best be protected through the combined application of the Special Protection Area law and performance criteria as established in the 1981 Eastern Montgomery County Master Plans." The 1981 master plan performance criteria include a 10 percent maximum limitation for site imperviousness.

VI. IMPLEMENTATION

As outlined in these guidelines, protection of natural features relies on adherence to construction standards and requirements and the establishment of undisturbed natural buffers. In order to identify these measures and ensure that they are carried out during development, the Planning Board may include one or more of the following methods of enforcement into the development plan approval.

A. Development Agreements

When required by the Planning Board, the applicant/owners of the property shall enter into a binding agreement with the M-NCPPC to ensure that the constructed development meets appropriate standards and requirements defined in the conditions for approval of the plan. It is assumed that all County and State environmental requirements will be met through normal regulatory and permitting processes. However, to ensure compliance with the Planning Board's conditions of approval, a development agreement may be required as part of the regulatory process to ensure adherence to:

- Noise mitigation requirements.
- Forest and tree conservation and protection plans (as addressed in *Trees: Approved Technical Manual*).
- Requirements for engineering measures to address soils constraints.
- Construction and maintenance requirements for off-site stormwater management facilities within parkland.
- Homeowners associations (HOA) maintenance requirements for stormwater management facilities.

The agreement must be submitted for approval with the record plat submission. An executed copy is to be recorded with the first record plats and any subsequent plats. In addition, there is to be appropriate language included in the Homeowners Association documentation referencing the agreement and the obligations to be undertaken by the Homeowners Association.

During construction, and until the property and/or facility subject to the agreement is conveyed to the HOA, the responsibility for compliance with the agreement will remain with the developer. The developer must convey such property/facility to the HOA with all customary warranties as to its fitness for the intended usage. When appropriate thereafter, the Homeowners Association must assume responsibility.

Appropriate language for the development agreements will be worked out between the Park and Planning Department staff and the Legal Department. Examples of the agreement language can be obtained from the Legal Department.

B. Conservation Easements

Protection of natural features, as outlined in these guidelines, relies heavily on the establishment of undisturbed natural areas. A problem associated with the establishment of these natural areas is finding the appropriate method of enforcement. Controlling the limits of grading during the construction process is the lowest level of environmental protection. This control is implemented through development agreements or conditions of approval and does not require permanent easements to be recorded on the plat. Under the grading control approach, protection beyond the construction period relies primarily upon the value of the resource to the first and subsequent homeowners.

In some instances, however, the value of the resource requires a more permanent protection mechanism than grading limits. In these cases, a conservation easement may be established to prohibit actions compromising the natural area both during and after construction. The limits of the easement must be recorded along with the easement agreement. M-NCPPC Legal Department versions of the easement agreements will be pre-recorded in the Office of Land Records. These versions may be rewritten to suit specific circumstances and recorded by the applicant.

In general, situations for which long-term protection in the form of a conservation easement is necessary include: 1) all buffers identified in Use III/III-P streams, 2) stream buffers identified in Use I/I-P and IV/IV-P streams where the Planning Board finds that resources of exceptional quality exist, and/or the likelihood of buffer compromise is great, and 3) forest conservation areas (as detailed in *Trees: Approved Technical Manual*).

Conservation easements may also be required to protect trees along the property boundaries of adjacent land for compatibility reasons. Appropriate long-term protection measures may be determined on a case-by-case basis. Applicants are encouraged to suggest methods other than conservation easements for long-term protection of natural areas.

C. Waivers of Base Zone Standards and Specifications for Environmental Reasons

If waivers or variances from base zone standards are requested, various sections of the the Zoning Ordinance require a finding by the Planning Board or County Council that a requested variance will result in a development that is more desirable from an environmental perspective. These sections include: Section 59-C-1.621 concerning waivers of minimum percentages of certain housing types within MPDU developments; Section 59-C-1.395 concerning minimum percentage of housing types within Transferable Development Rights (TDR) developments; Section 59-C-1.532 concerning minimum area for cluster developments within RE-2C and RE-1 zones; Section 59-C-7.131 concerning percentages for one-family and multi-family units; and Section 59-C-1.393(b) regarding a waiver of the requirement for two-thirds (2/3) of the TDR increment for a development.

Staff will make recommendations on these findings based on information supplied by the applicant at the preliminary plan stage. For purposes of comparison, all waiver submissions (except the waiver of provision of 2/3 of the TDR increment) must include a conceptual base zone development plan (i.e., a plan without waivers) that fully responds to environmental guidelines and regulations, and uses all available options to maximize environmentally compatible development on the site. Requirements for justifying the waiver of 2/3 TDRs will be treated separately, since denial of this waiver would require

either more units to be placed on the property, or more of the proposed units to be TDRs.

1. Waiver Justification Based on Water Quality and Quantity Benefits

In high quality watersheds (Use III/III-P, IV/IV-P, and high quality Use I/I-P) and Special Protection Areas as defined in Chapter 19 of the County Code, the primary justification for waivers to the base zone standards specified in the Zoning Ordinance must be based on a finding that the proposed development, with waivers, provides a significant improvement to water quality and/or quantity that correlates to the magnitude of the proposed waiver. The effects of a proposed development shall be compared to the effects of a conceptual base zone development plan, as defined above. In order to fully analyze an application for such waivers based on these benefits, the following minimum information must be included with each submission, comparing the proposed development, with waivers, to development under base zone standards:

a) Discharge computations for the first 0.5" and 1.0" of runoff, including the pre- development land use condition in addition to the base zone and proposed development conditions.

b) Runoff computations for the 2-year and 10-year frequency storm, including the pre-development land use condition in addition to the base zone and proposed development conditions.

c) Expected pollutant loadings and/or concentration levels, and the expected frequency and magnitude of violations of State water quality standards. Include use of appropriate best management practices (BMPs) in the calculations for the base zone and proposed development, and compare the estimated pollutant loadings with that from the pre-development land use condition.

d) Number of acres and the percentage of the site that will be impervious.

e) Number of acres and the percentage of the site that will be disturbed.

f) Number of acres of forest, pasture, and transitional areas.

g) Number of acres within forest conservation areas.

h) Conceptual location and type of stormwater management and storm drainage facilities.

i) Number of acres of wetlands, showing areas of unavoidable disturbance and compensation areas.

2. Waiver Justification Based on Other Environmental Benefits

In all other areas of the County not included under section C.1, or where water quality improvements as required in Special Protection Areas are insufficient for waiver justification and need enhancement, staff will consider innovative and/or extraordinary measures to protect or improve the built and natural environment. Such measures must be demonstrated to be over and above the requirements or guidelines of the County, State, and M-NCPPC. Such measures may include, but not be limited to the following:

a) Enhanced sediment control protection, and use of effective best management practices (BMPs)

b) SWM quantity and/or quality controls for a significant amount of off-site area that would not be controlled under the base zone scenario

c) Correction of existing off-site drainage and/or stream valley degradation problems, (e.g. through extensive reforestation, stream channel improvements, cleanup of debris, etc.)

d) Unique site designs for noise mitigation, or mitigation of noise levels through use of topography or barriers beyond what would ordinarily be required

e) A forest preservation and/or an afforestation/reforestation program beyond the minimum required

f) Dedication of land for conservation easement and/or parkland, if acceptable to the M-NCPPC Department of Park and Planning

g) Stream monitoring, the scope of which shall be determined on a case-by-case basis

The measures listed above represent various means of protecting or improving the environment and will not be accepted as enhancements for waiver justification unless a case can be made that stream health will not be degraded, but rather protected or improved.

3. Waiver Justification for 2/3 Minimum TDR Requirement

The TDR (Transferrable Development Rights) waiver brings into focus the tension that sometimes surfaces between two different, but equally important policy objectives: promotion of a strong TDR program, and environmental compatibility and protection issues. The TDR program strives to maintain a balance between the market supply and demand for TDRs, so that farmers have a place to sell and developers have a place to purchase TDRs. The zoning ordinance requires that a developer utilizing the TDR optional method of development must incorporate into their plan at least two thirds the maximum number of TDRs allowed by the site's zoning and master planning designations. This is intended to maintain a vigorous market for TDRs involving those developers electing to so participate and, further, it is to ensure that sufficient density will be located on the site to warrant the public sector's commitment of providing supporting infrastructure, typically at an accelerated pace. In some instances a site may not be able to accommodate a higher level of density due to environmental or compatibility reasons. At that point, the Board must balance the need to achieve higher TDR density levels against the resulting intrusions that would occur against environmental or compatibility standards and expectations. This balancing is conducted through the TDR waiver request, allowing the Board to approve less density than would ordinarily be available on a less constrained site. Its characterization as a waiver may be misleading in that it is not a request to relax environmental protection to facilitate more density; rather it becomes a justification to realize less density.

In order to obtain the waiver, an applicant must demonstrate and the Planning Board must find that the proposed plan:

- Uses the most efficient combination of unit types to attempt to maximize density within the unconstrained area of the site.
- Is reasonably close to reaching the 2/3 number of TDRs required.
- That the level of encroachment into the constrained area of the site in order to obtain the full 2/3 TDRs is unacceptable from an environmental standpoint, based upon the criteria set forth below.

The following points are derived from the rationale for the waiver justification:

- If the number of TDRs needed to meet the 2/3 requirement is small AND the area of encroachment is considered to be acceptable with appropriate environmental mitigation measures as determined by the Planning Board, the development may be allowed to encroach into the constrained area to meet the TDR requirement. Alternatively, the developer may choose to purchase the remaining TDRs to avoid mitigation measures.

- If the number of TDRs proposed on the plan is NOT reasonably close to the 2/3s required and a different unit mix would not alter the ratio or be feasible, the Board may elect to deny the applicant's election to utilize the TDR optional method of development. Alternatively, the developer may be allowed to purchase the remaining TDRs in order to obtain the higher density.

The following development plan scenarios and elements will be analyzed to determine if the development plan applicant has established a case for justifying the environmental waiver:

- The proposed plan, delineating areas of environmental constraints and indicating the proposed number and the particular unit types (include rationale for rejecting certain unit types over others).
- The plan showing areas of development utilizing the full 2/3 TDRs and development within both constrained and unconstrained areas, including mitigation proposals for development within the constrained area.
- A quantitative analysis of the percent of the constrained area used versus the percent of TDRs obtained.
- An environmental analysis comparing the proposed plan with the full TDR usage plan, in terms of the following elements (to be determined by staff; not all elements may be required):
  - difference in stormwater discharge and runoff computations
  - expected pollutant loadings
  - imperviousness
  - acreage of forest/tree areas disturbed
  - acreage of stream buffer/wetlands disturbed

D. Exceptions to the Guidelines

The guidelines contained in this document form the basis for staff recommendations to the Planning Board, who may then choose to accept, reject, or modify these recommendations on a case-by-case basis. Exceptions to the guidelines may be recommended by the staff on a case-by-case basis where strict compliance with the guidelines herein would result in unreasonable hardship; and when it can be demonstrated that safety, County road standards, storm drainage, stormwater management, erosion and sediment control, engineering, design, or planning issues can be satisfactorily addressed to benefit the environment, the general public, or both. Furthermore, staff are receptive to other ideas and techniques that enhance environmental compatibility and achieve the same purpose as those identified in this document.

VII. THE PATUXENT RIVER WATERSHED PRIMARY MANAGEMENT AREA (PMA)

A. Background and Purpose

The Patuxent River Policy Plan, adopted in 1984 by the Maryland General Assembly and the seven Patuxent watershed counties, was prepared by the Maryland Office of State Planning in order to give policy direction to local and State agencies in carrying out their programs and making regulatory decisions in the Patuxent River watershed. Seven Maryland counties have land area within the watershed: Montgomery, Howard, Prince George's, Anne Arundel, Calvert, Charles, and St. Mary's.

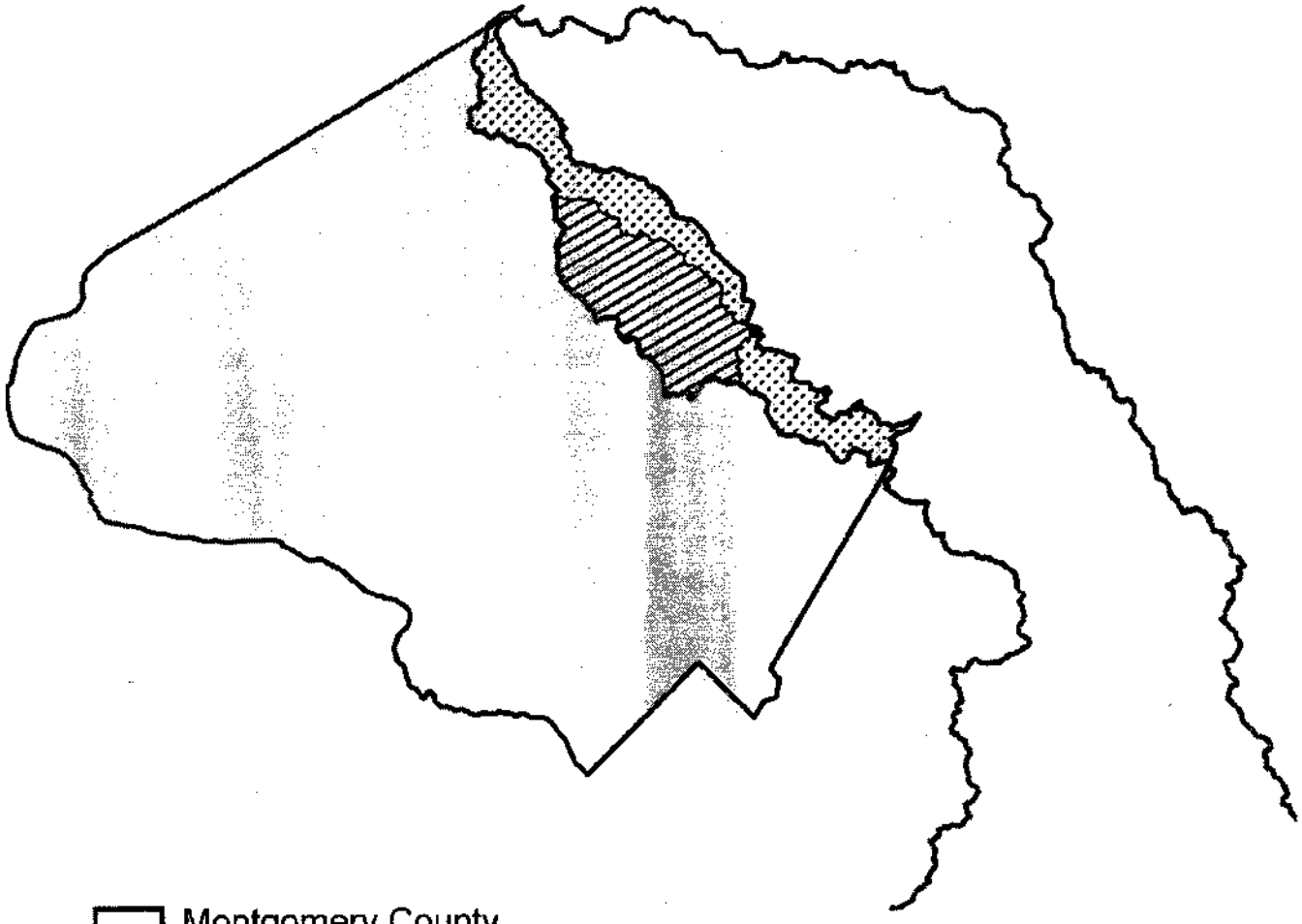
The following pages describe the Patuxent River watershed in Montgomery County and the Primary Management Area (PMA) guidelines used by the Montgomery County Department of Park and Planning to protect the watershed. These PMA guidelines were developed in accordance with the recommendation in the Patuxent River Policy Plan that local governments enact a Primary Management Area. The guidelines address the decline in the Patuxent River's water quality and the need, from an environmental perspective, to protect this resource. In addition, these PMA guidelines respond to the economic necessity of protecting the primary water supply reservoirs and recreational resources provided by the Patuxent River. The purpose of the Montgomery County Patuxent River PMA guidelines is to provide urgently needed land management strategies to help control nonpoint source runoff and preserve, restore, and protect the Patuxent, its drinking water supply reservoirs and the Chesapeake Bay. The guidelines have been approved by the Montgomery County Planning Board for use in the review of development proposals in the Patuxent River watershed.

B. Introduction: The Patuxent River

The Patuxent River watershed, covering 910 square miles, lies entirely in the State of Maryland. This "scenic river", as designated by the State of Maryland, gently meanders through seven counties before draining into the largest and most bountiful estuary in the United States, the Chesapeake Bay. Approximately 61 square miles (39,065 acres) of Montgomery County drain into the headwaters of the Patuxent. In addition to being a tremendous recreational and economic resource, the river serves as a primary drinking water supply, containing both the Triadelphia and Rocky Gorge reservoirs. Both reservoirs are owned and operated by the Washington Suburban Sanitary Commission.

The Patuxent River, the reservoirs and the Chesapeake Bay are being heavily impacted by increasing pollution levels associated with land development and from the ongoing pollution associated with agricultural activities. Pollution impacting the Patuxent River and the Bay originates from both point and nonpoint sources. Point sources primarily include the piped discharge from sewage treatment plants and industry. The 1983 State *208 Water Quality Management Plan for the Patuxent Basin* (208 Plan) contains the strategy for controlling point sources of pollution. Point source pollution is addressed by the appropriate State and County agencies and therefore will not be addressed by these guidelines. The State 208 plan, which was developed pursuant to Section 208 of the Federal Clean Water Act, also addresses the impacts from nonpoint sources of pollution, which are the major source of the total sediment and nutrient pollutant load to the Patuxent River system.

Figure 9. Upper Patuxent River Basin and Hawlings River Subbasin



Nonpoint source pollution is directly related to the land-use practices within the watershed and originates from urban, suburban, and agricultural lands. Effective land management strategies are needed to control the increase of disturbed ground and impervious surfaces within watersheds, from which surface runoff generates, transporting harmful nutrients, sediments, and pollutants to the river and its tributaries and causing adverse temperature changes. The 208 Plan for the Patuxent basin reported a serious decline in the river's water quality. Problems include increases in nutrient loading (particularly nitrogen and phosphorus) that result in harmful algal blooms and consequent harmful reductions in dissolved oxygen. The excessive algae coupled with increased sedimentation has also seriously increased the turbidity of the water. This increased turbidity prevents life-sustaining sunlight from reaching submerged aquatic vegetation and results in reduced habitat and food sources for both waterfowl and juvenile fish, in addition to the reduction of vital dissolved oxygen. In 1981, the WSSC issued a report stating that "the reservoirs are aging at faster than acceptable rates due to high nutrient inputs."

C. The Patuxent River Policy Plan

The Patuxent River Commission and the Maryland Office of State Planning developed the *Patuxent River Policy Plan* (State Policy Plan) in cooperation with all seven Patuxent watershed counties. This Policy Plan was approved by these counties, including Montgomery County, and the General Assembly in 1984. The seven watershed counties and the General Assembly have agreed to accord special management and planning consideration to the lands bordering the streams in the Patuxent watershed. By approving the State Policy Plan, Montgomery County, along with other participating counties, has agreed with the recommendation to develop and implement the primary management area approach to watershed protection.

Based on the recommendations of the State Policy Plan, a conceptual primary management area (PMA) has been proposed for the streams within the Patuxent watershed in Montgomery County. Using the State Policy Plan as a guide, the Montgomery County Department of Park and Planning is proposing a set of criteria and guidelines to be applied to local development reviews. These guidelines could be amended by a joint watershed management policy planning effort between Howard County, Montgomery County, Prince George's County, WSSC, and the M-NCPPC.

The State Policy Plan criteria for designating a PMA are not regulatory standards. Rather, they provide general guidance for developing locally enforceable criteria suited to local conditions. The State Policy Plan contains ten major recommendations to direct land use planning and management toward watershed protection. For a complete list of the Policy Plan's ten recommendations, see Appendix D. Montgomery County's *PMA Guidelines for the Patuxent River Watershed* specifically address four of the ten recommendations put forth in the Policy Plan. These include State Policy Plan recommendations:

- Establishing a Primary Management Area (PMA)
- Providing Best Management Practices (BMPs)
- Preserving Agricultural Land
- Protecting Forest Cover

Montgomery County is in support of all ten of the State Policy Plan's recommendations although at this time these guidelines address only four. It should be noted that not all the Policy Plan's ten

recommendations fall within M-NCPPC jurisdiction. The *Patuxent River Watershed Functional Master Plan* contains a more comprehensive statement that addresses other aspects of the State Policy Plan that fall under M-NCPPC jurisdiction.

D. The Montgomery County Primary Management Area

1. Establishing a Primary Management Area (PMA) for the Patuxent River watershed in Montgomery County

The Primary Management Area (PMA) in Montgomery County is a water quality protection and restoration area where land use activities are managed to protect and enhance water quality in the rivers and streams. The PMA is composed of strips of land that run along the entire length of all streams within the watershed. The recommended land uses and related activities within the PMA are managed through a series of specially designed programs directed to promote water quality in the streams.

The purpose of the Patuxent watershed PMA is to identify and manage land from which nonpoint source pollution is most likely to be transported to the river, to the two water supply reservoirs and ultimately to the Chesapeake Bay.

Montgomery County's PMA for the Patuxent is consistent with the PMA widths recommended in the State's Patuxent River Policy Plan, which are 1/4 mile (1320 feet) for the Patuxent mainstem and 1/8 mile (660 feet) for all tributaries. In addition, Montgomery County is also recommending a 1/4-mile management strip (PMA) for the mainstem of the Hawlings River. The Hawlings River watershed, a subbasin in the Patuxent watershed, lies entirely in Montgomery County (Figure 8). Greenhorne and O'Mara's *Technical Report for the Patuxent River Watershed* (February 1990) has identified the Hawlings River as a major contributor of nonpoint source pollutants to both the upper Patuxent River and to the Rocky Gorge Reservoir.

The area that will constitute the PMA as described above consists of approximately 17,488 acres, or approximately 45 percent of the Patuxent watershed.

a) Applicability

Montgomery County PMA guidelines will be recommended when the criteria in Table 4 (below) apply to a given property. Any properties that meet the criteria will then be required to delineate a Primary Management Area that will consist of a stream buffer and a transition area (Figure 9).

A property will be subject to PMA requirements ONLY when it is submitted to M-NCPPC for subdivision and/or site plan review. Agricultural land located within the Primary Management Area that is NOT submitted for review will not be subject to the recommended PMA - guidelines. Land that remains in agricultural use, as part of a plan for subdivision, however, will be subject to the recommended PMA stream buffer and transition area requirements made herein (Section D.3. Preserving Agricultural Land).

Table 4. Criteria for Determining Primary Management Area Applicability
1. The property contains or borders a stream that is tributary to the Patuxent and/or Hawlings River watersheds, OR the property is within a 1/4 mile of the mainstem or 1/8 mile of a tributary of the Patuxent and/or Hawlings River, and
2. The property has been submitted to M-NCPPC for subdivision and/or site plan review.*
* Requests for lots for children of the property owner in rural zones that fall under the exempt provisions of the Montgomery County Zoning Ordinance, *do not* subject a farm to PMA requirements, provided the farm is operated in compliance with the soil and water quality conservation plan as determined by the Montgomery Soil Conservation District (MSCD)

b) Delineating the Stream Buffer within the PMA

Within the designated PMA, be it 1/4 mile or 1/8 mile, it will be necessary to delineate a stream buffer on the land area directly adjacent to the watercourse. The State's Policy Plan recommends a 100-foot buffer of forest or natural vegetation on each side of the river and its tributaries. Montgomery County is recommending a stream buffer width consistent with its stream buffer guidelines, as identified in Table 1 (page 8). The stream buffer may be expanded to include any environmentally sensitive land features as described in Table 5. It is further recommended that a minimum of 50 feet of this buffer be forested. Afforestation will be necessary in stream buffer areas that do not meet this 50-foot forested minimum. The stream buffer area, based on the recommended widths in Table 1, will consist of approximately 1,257 to 2,515 acres, constituting approximately 7 to 14 percent of the PMA, or approximately 3 to 6 percent of the watershed.

The stream buffer area must be left undisturbed and in its natural state. Land disturbing activities such as clearing and grading will not be permitted in the stream buffer area. Activities that would be encouraged in the stream buffer area include afforestation and, possibly, the implementation of Best Management Practices (BMPs). The control of noxious weed species in the stream buffer area, such as thistles (Asteraceae or compositae), johnsongrass, shattercane and wildcane, and multiflora rose, will be permitted when deemed necessary and when done in a manner that minimizes disturbance to other vegetation. Any disturbance of the stream buffer will require M-NCPPC staff review.

The majority of the area along the Patuxent mainstem and a significant portion of the area adjacent to the Hawlings River mainstem that would be delineated as stream buffer are already included in existing and proposed parkland or WSSC property.

For a complete discussion of stream buffer requirements on agricultural land, refer to section D.3. Preserving Agricultural Land.

Table 5. Recommended Environmentally Sensitive Land Features to be included in the PMA Stream Buffer Area
1) The one-hundred year ultimate floodplain.
2) All wetlands (and associated buffers) adjacent to the stream or to the one-hundred year floodplain.
3) Slopes of twenty-five percent or greater abutting or adjoining the stream, the 100-year ultimate floodplain, or stream-side wetlands.
4) Specific areas of critical habitat for rare or sensitive wildlife and/or vegetation, as defined in COMAR, Title 08.03.08.

c) The Transition Area within the PMA

The land area remaining in the PMA that does not fall into the designated stream buffer will be managed as a transition area. Zoning densities of one unit per two acres or less will be recommended for the transition area. Possible zones include RE-2, RE-2C, Rural, RC, and RDT. New development will be accommodated in ways that minimize impacts on water quality and maximize the protection of existing environmental features. Overall imperviousness within the transition area of each new project development site[4] should not exceed 10 percent. If a higher imperviousness is desirable in the transition area to maintain community character, achieve compatibility, and/or accomplish master plan goals, imperviousness may be averaged over the entire development, not to exceed 10 percent on the entire site.[5] The planning challenge within the transition area will be to resist the tendency toward fragmented suburban sprawl by consciously siting development to optimize existing infrastructure and soil infiltration capacities while minimizing impacts to environmentally sensitive land features. Agricultural activities *will be* permitted in the transition area (see section D.3. Preserving Agricultural Land).

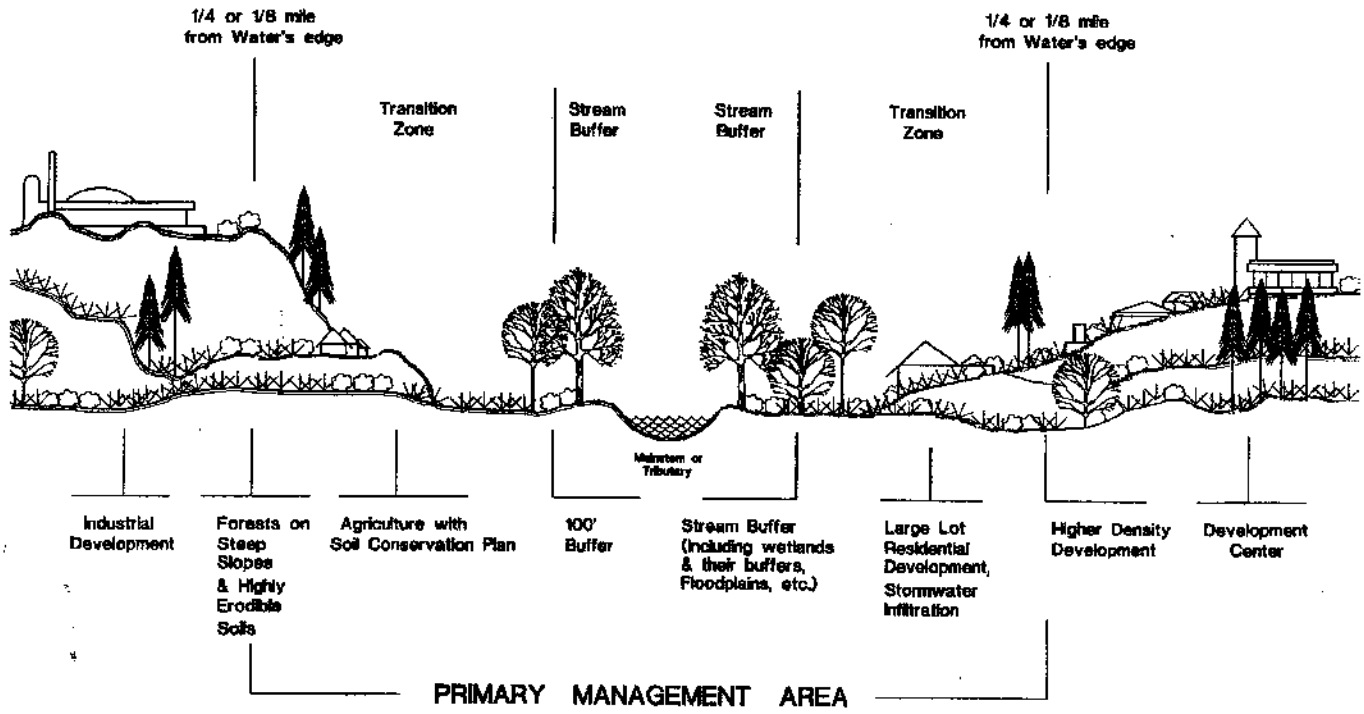
d) Existing Areas in Nonconformance with the PMA Guidelines

Properties for which the PMA guidelines are applicable (Table 4) but that have existing zoning densities greater than RE-2 will be subject to "nonconformance requirements". Nonconformance requirements consist of stormwater management and best management practices applied to the property that will minimize the impacts of higher density zones,

[4]This imperviousness guideline is now applied to new projects that are reviewed by the Planning Board, such as preliminary plans of subdivision, site plans, zoning cases, special exception cases, and mandatory referrals. The guideline would not apply to projects that require only building permit review.

[5]If the property lies within two or more watersheds, only that portion of that property within the Patuxent River watershed (as defined by natural or existing drainage divides) is subject to this imperviousness guideline.

Figure 10. Illustration of the Patuxent River Primary Management Area(PMA)



Conceptual Drawing of this Primary Management Area as Defined in the Patuxent River Policy Plan

NOT TO SCALE

particularly higher levels of imperviousness, on water quality. These requirements will also apply to RE-2C, RC, and RDT zones where use of cluster development results in densities greater than one unit per two acres. Table 6 describes some, but certainly not all, possible BMPs.

2. Providing Best Management Practices (BMPs)

The provision of BMPs in the Primary Management Area is required for all areas where zoning densities are higher than RE-2, as previously discussed. The use of BMPs will also be encouraged in lower density areas during the development review process to facilitate clustering of development and the maximization of soil infiltration capacities. Soil and water conservation plans utilizing BMPs are strongly encouraged on agricultural lands in the PMA, with the incentive of a reduction in the recommended stream buffer width on portions of properties submitted for subdivision and/or site plan review that will be used for agricultural purposes.

Table 6. Possible Best Management Practices (BMPs)
1. Locating and possibly clustering development to maximize suitable developable land areas and to minimize negative impacts to water quality and other environmental considerations such as tree stands and wetlands.
2. Widening the stream buffer area to ensure increased infiltration of pollutants, nutrients, and sediments over the extended run.
3. Afforestation of more than the required 50-foot minimum of forest cover within the stream buffer.
4. Utilizing more innovative and effective stormwater management. Maximize infiltration and design ponds to effectively mitigate for both temperature and nutrient/sediment removal. Design for the ten-year storm rather than the required two-year storm.
NOTE: Applicants may design and implement, upon staff and Planning Board approval, their own innovative BMP(s). The goal with this option is to foster and encourage a genuine effort between the County and developers to devise and implement effective, innovative, and environmentally sensitive land management practices.

3. Preserving Agricultural Land

The preservation of prime and viable agricultural land is a goal of the Patuxent watershed primary management area as it is throughout upper Montgomery County. It is hoped that the designation of the Patuxent PMA will help achieve the delicate balance between development and agriculture while ensuring water quality.

As discussed earlier, these guidelines only apply to properties that are proposed for development (Table 4). Existing agricultural land will not be subject to these guidelines unless it is included in a development proposal application submitted to M-NCPPC.

In order to encourage the retention of agricultural uses on at least a portion of properties proposed for development, the stream buffer will be reduced from the buffer strip widths listed in Table 1, to 100 feet for land that remains in agriculture and has adopted a soil and water conservation plan approved by the Montgomery Soil Conservation District. However, depending on the site, the stream buffer may be extended to include environmentally sensitive land features (Table 5). It is also recommended that a minimum of 50 feet of the 100-foot stream buffer be forested. Agricultural activities utilizing BMPs are encouraged in the transition area of the PMA and the reduction of the stream buffer from that recommended in Table 1 to 100 feet is done in recognition that the maximization of available land is a necessity for a viable farm. The Planning Board may grant a variance to the PMA 100-foot stream buffer requirement on agricultural portions of plans when the applicant can demonstrate to the satisfaction of staff and the Planning Board that water quality would not be degraded by agricultural activities.

It must also be recognized that the intent of the Primary Management Area is to protect and restore water quality conditions in the Patuxent watershed. To this end, the infiltration and nutrient storage capabilities of forested buffer strips are considerable, as are the beneficial effects such a buffer strip would have on water temperatures and habitat. In order to preserve water quality and avoid the increased regulation that may occur if water quality continues to decline, the Montgomery Soil Conservation District is entreated and encouraged not only to comply with the forested buffer strip recommendations made herein, which are based on studies conducted by and endorsed by the Cooperative Extension Service and the U.S. Fish and Wildlife Service, but also to re-examine the buffer strip requirements currently recommended by the USDA Natural Resources Conservation Service (NRCS) (4 times the percent slope up to 99 feet), in order to provide more environmentally sensitive practices, particularly in special management areas such as the Patuxent River watershed.

The 100-foot recommended minimum buffer width is based upon literature reviews conducted by both the Department of Natural Resources and Office of State Planning. To be effective, buffer areas should be disturbed as little as possible; however, disturbance of the stream buffer for the purpose of controlling noxious weeds, such as thistles (Asteraceae or compositae), johnsongrass, shattercane and wildcane, and multiflora rose, will be permitted when deemed necessary and when done in such a manner that the disturbance of other vegetation is minimized.

4. Protecting Forest Cover/Re-establishing Forest Cover

Consistent with the Montgomery County Forest Conservation Program and the State ReLeaf Program, the PMA will be targeted as a potential and logical location for preserving and/or re-establishing forest cover. The widespread benefits of forest cover on water quality include infiltration, sediment and nutrient storage and recycling, minimization of temperature impacts, reduction of wind speeds, providing an energy input into stream ecosystems, and providing potential wildlife habitat.

The opportunity for reforesting a significant portion of publicly owned land in the Patuxent watershed PMA is great and should be maximized. Reforestation/afforestation will be strongly encouraged in the stream buffer area and in already developed and/or disturbed areas within the PMA. Preservation will always be recommended in the stream buffer areas, as well as in the transition area when and where there are large, beneficial, and/or unique tree stands.

The implementation of Montgomery County's Forest Conservation Law and the need to

designate potential tree receiving areas may provide the opportunity for developers to contribute to the reforestation/afforestation of buffers within agricultural areas as an off-site planting alternative. In addition, farmers may pursue incentive programs such as the State Conservation Reserve Program, the Maryland Agricultural Cost-Share Program, and the Green Shores Program in order to comply with the 50 foot forested buffer strip recommendation.

E. Septic Field Requirements within the PMA

County Executive Regulation 28-93AM prohibits the location of sewage disposal systems within 300 feet measured horizontally from the normal high water level of a water supply reservoir or within 200 feet measured horizontally of the banks of a stream that feeds therein. The PMA policy plan recommends a minimum 300 foot septic setback for the Patuxent and Hawlings mainstems and a minimum 200 foot setback for all other watershed tributaries. Septic fields will not be permitted in the stream buffer. Any variance to the provision of septic fields within the transition area will be determined on a case-by-case basis.

A detailed technical study by the WSSC and/or the County Health Department on the health hazards associated with potential septic failures is strongly endorsed along with these PMA guidelines. The technical study should also provide recommendations pertaining to design, siting and minimum buffers required for septic fields.

GLOSSARY OF TERMS

Afforestation — the creation, on a tract that is not presently in forest cover, of a biological community dominated by trees and other woody plants, at a density of at least 100 trees per acre with at least 50 percent of the trees having the capability of growing to a diameter, at 4.5 feet above the ground (diameter at breast height), of 2 inches or more within 7 years.

Conservation Easement — a restriction on the land and the natural features on this land. This easement is shown on the record plat and its terms and conditions are recorded in the County's land records. Most commonly, the agreement prohibits removal of healthy mature trees and shrubs, and changes to the scenic character of the land without written permission from M-NCPPC's Department of Park and Planning.

Diameter at breast height (DBH) — the diameter of a tree as measured at a height 4.5 feet from the ground.

Drainage Course — a natural or man-made drainage network having a defined channel that appears on either M-NCPPC 200 foot scale topographical coverage, a developer's field topographic, or is located in the field.

Ephemeral Stream — a channel at the terminus of an intermittent stream that has flow only in direct response to precipitation.

Erodibility coefficient (k factor) — value assigned to soil types by the USDA Natural Resources Conservation Service that identifies the susceptibility to erosion based on topography and various soil characteristics.

Floodplain — a relatively flat or low land area adjoining a river, stream, pond, stormwater management structure, or watercourse subject to periodic, partial or complete inundation; or an area subject to unusual and rapid accumulation or runoff of surface water as a result of an upstream dam failure.

100-Year Flood — a flood that has a one-percent statistical probability of being equalled or exceeded in a given year (or that would occur on the average of once in every one hundred years). Unless otherwise stated, this calculation is based on the contributing watershed being completely under existing zoning.

100-Year Floodplain — the area along a river, stream, pond, SWM structure, or watercourse that would be inundated by a 100-year flood, based on ultimate development of the watershed under existing zoning.

Forest — a biological community dominated by trees and other woody plants covering a land area of 10,000 square feet or greater. Forest includes:

1) Areas that have at least 100 trees per acre with at least 50 percent of those trees having a 2 inch or greater diameter at breast height.
2) Forest areas that have been cut but not cleared. Forest does not include orchards.

Forest Stand Delineation — a detailed summary of existing forest and trees on a site, prepared by identifying forest stands based on methodology detailed in *Trees: Approved Technical Manual*. The information gathered in the forest stand delineation is overlaid with the natural resources inventory and becomes the basis for determining priority areas for forest and tree retention.

Forest Conservation — the retention of existing forest or the creation of new forest at the levels prescribed by the Planning Board or the Planning Director.

Forest Conservation Plan (FCP) — outlines the strategies and specific plans proposed for retaining, protecting, and reforesting and/or afforesting areas on a site.

Forest Stand Delineation (FSD) — the evaluation of existing vegetation in relation to the natural resources on a site proposed for development or land disturbing activities. A forest survey is conducted to identify and characterize forest stands according to their condition, structure type and retention potential.

Hydraulically Adjacent Slopes — slopes lying within 200 feet (from bank) of a stream/drainage course, that drain directly to the stream/drainage course or its associated floodplain. When the stream buffer encompasses the toe of a steep slope within the 200 foot section, adjacency will apply to the entire slope even if the 200 foot cutoff is in the middle of the slope.

Hydraulically Remote Slopes — slopes lying beyond the area designated as the stream valley buffer of a stream/drainage course, or slopes lying beyond 200 feet (from bank) of a stream/drainage course if the stream buffer is less than 200 feet, that may or may not drain directly to the stream/drainage course or its associated floodplain.

Intermittent Stream — surface waters, contained within a defined channel or bed, that flow at least once per year. An intermittent stream, for purposes of these guidelines, includes one or more of the following characteristics: (1) Defined or distinct channel; (2) hydric soils or wetlands within or adjacent to channel; (3) hydraulically sorted sediments; (4) removal of vegetative litter; or (5) loosely rooted vegetation by the action of moving water.

Local Genetic Origin — refers to plants whose seed source is from an area within a 150-mile range of Montgomery County.

Native — refers to a plant or animal species whose geographic range during pre-colonial times included the Piedmont of Maryland. Information on native plants can be found in *Woody Plants of Maryland* (Brown and Brown, 1972) and *Herbaceous Plants of Maryland* (Brown and Brown, 1984), as well as other literature sources.

Natural Resources Inventory (NRI) — a complete analysis of existing natural features, forest, and tree cover on site. The natural resources inventory must cover the development site and first 100 feet of adjoining land around the perimeter or the width of adjoining lots, whichever is less. Natural features include topography; steep slopes; perennial and intermittent streams and major drainage courses; 100-year floodplain; wetlands; soils and geologic conditions; critical habitats; aerial extent of forest and tree cover; cultural features and historic sites; necessary buffers.

Percent Slope — [(Vertical Rise in feet) / (Horizontal Run in feet in the steepest 100 foot segment)] X 100%. Vertical rise in feet divided by horizontal run in feet in the steepest 100 foot segment, multiplied by 100 percent.

Perennial Stream — a stream that has base flow all year.

Preliminary subdivision plan — a plan subject to the review and approval procedures of Chapter 50, "Subdivision" of the Montgomery County Code.

Primary Management Area (PMA) — an area within the Patuxent watershed critical to the Chesapeake Bay that may be included in plans and zoning ordinances. Preferred land uses in the PMA will be agriculture, forest, and recreation. State and local governments will ensure that land use practices within the PMA shall be of such a nature so as to have no (or minimal) adverse impact on water quality of the Patuxent River.

Reforestation — the creation of a biological community dominated by trees and other woody plants containing at least 100 trees per acre with at least 50 percent of those trees having the potential of attaining a 2 inch or greater diameter at breast height within 7 years.

Riparian Buffer — another term for a stream buffer (defined below). Riparian means "stream-side", so the riparian buffer is the area adjacent to a stream.

River Outwash Savanna — a plant community formed on extensive deposits of the Potomac and dominated by grasses, with hardwoods (often oaks) interspersed. River outwash savannas often provide habitat for many of Maryland's uncommon and State listed (by DNR) plant species.

Serpentine Barren — a plant community underlain by serpentine soils (rich in chromium and magnesium and poor in essential plant nutrients) and dominated by grasses, often with pines interspersed. Serpentine barrens often provide habitat for many of Maryland's uncommon and State listed (by DNR) plant species.

Shale Barren — a plant community occurring on Triassic red shale outcrops and often containing uncommon and State listed (by DNR) plant species.

Shrub — a woody plant, usually with multiple stems, each of which has a dbh (diameter at breast height) of less than three inches. Shrubs are generally less than 20 feet tall at maturity.

Site plan — a plan subject to the review and approval procedures of Chapter 59, "Zoning," Division 59-D-3, "Site Plan" of the Montgomery County Code.

Specimen tree — a tree that is a particularly impressive or unusual example of a species due to its size, shape, age, or any other trait that epitomizes the character of the species.

Steep slope — a slope in which the percent slope equals or exceeds 25 percent.

Stream buffer — an undisturbed strip of natural vegetation contiguous with and parallel to the bank of a perennial or intermittent stream that may be designed to:

- Protect hydraulically adjacent slope areas.
- Maintain or improve the water temperature regimen/water quality of the stream(s).
- Protect natural wetlands.
- Provide groundwater storage/recharge for a stream.
- Complement regulations pertaining to the 100-year ultimate floodplain.
- Provide wildlife habitat, open space, or both.
- Complement on-site erosion/sediment control measures by serving as a back-up natural filter/trap.

Tree — a large, woody plant having one or several self-supporting stems or trunks and numerous branches that reach a height of at least 20 feet at maturity.

Water Uses — a distinct designated water use applied to each surface water of the state by the Maryland Department of the Environment. . The designated water uses and their specific standards are described in detail in Appendix A.

Wetland — an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

APPENDIX A

STATE DESIGNATED WATER USES FOR MONTGOMERY COUNTY STREAMS

The Maryland Department of the Environment applies distinct designated water uses for the surface waters of the State, each having a specific set of standards. Below is a list of the Water Use for each watershed in the County, followed by definitions of each water use and the State anti-degradation policy.

Use	Waters	Extent/Limits
Use I	• Little Paint Branch	Entirety
	• Sligo Creek	Entirety
	• Rock Creek	Below MD Route 28
Use I-P	• Patuxent River and all tributaries except those designated below as Use III-P or IV-P	Upstream of Rocky Gorge Dam, including Rocky Gorge Reservoir
	• Potomac River and all tributaries except those designated as Use III, III-P, IV or IV-P	Upstream of Montgomery County/ Washington DC line
	• Little Seneca Creek and Little Seneca Lake	Between the lake and the B&O Railroad Bridge, and below confluence of Bucklodge Branch incl. Bucklodge Br.
	• Little Monocacy River	Entirety
	• Bennett Creek	Entirety
	• Great Seneca Creek	Entirety
	• Dry Seneca Creek	Entirety
Use II	None	
Use III	• Paint Branch and all tributaries	Upstream of Capital Beltway (I-495)
	• Rock Creek and all tributaries	Upstream of Muncaster Mill Road
	• North Branch Rock Creek and all tributaries	Upstream of Muncaster Mill Road
Use III-P	• Little Bennett Creek and all tributaries	Upstream of Maryland Route 355
	• Furnace Branch and all tributaries	Entirety
	• Patuxent River and all tributaries	Upstream of Triadelphia Reservoir
	• Little Seneca Creek and all tributaries	Between the B&O Railroad Bridge & the confluence with Bucklodge Branch
	• Wildcat Branch and all tributaries	Upstream of confluence with Great Seneca Creek
Use IV	• Rock Creek and all tributaries (including Lake Frank and Lake Needwood)	Between Route 28 and Muncaster Mill Road

	• Northwest Branch & all tributaries	Upstream of East-West Highway (MD Route 410)
Use IV-P	• Patuxent River and all tributaries	Between Rocky Gorge and Triadelphia Reservoirs, and including Triadelphia Reservoir
	• Little Seneca Creek & all tributaries	Upstream of Little Seneca Lake

Definitions of Water Use Categories

A. USE I: WATER CONTACT RECREATION & PROTECTION OF AQUATIC LIFE

Waters that are suitable for: water contact sports; play and leisure time activities where the human body may come in direct contact with the surface water; fishing; the growth and propagation of fish (other than trout); other aquatic life, and wildlife; agricultural water supply; and industrial water supply.

Criteria for Use I waters:

a) Bacteriological - there may not be any source of pathogenic or harmful organisms in sufficient quantities to constitute a public health hazard. Public health hazard will be presumed when:

(i) fecal coliform density exceeds a log mean of 200 per 100 ml based on minimum of 5 samples taken over 30 days;
(ii) 10 percent of total number of samples exceed 400 per 100 ml; or
(iii) except when a sanitary survey approved by the Maryland Department of the Environment discloses no significant health hazard, i and ii do not apply.

b) Dissolved Oxygen - may not be less than 5.0 mg/liter at any time.
c) Temperature - maximum temperature outside the mixing zone may not exceed 90 degrees F (32 degrees C) or the ambient temperature of the surface waters, whichever is greater. A thermal barrier that adversely affects aquatic life may not be established.
d) pH - Normal pH values may not be less than 6.5 or greater than 8.5.
e) Turbidity - may not exceed levels detrimental to aquatic life. Turbidity in the surface water resulting from any discharge may not exceed 150 units at any time or 50 units as a monthly average.
f) Toxic Substances - all toxic substance criteria to protect fresh water and estuarine and salt water aquatic organisms, and the wholesomeness of fish for human consumption, apply in fresh, estuarine and salt waters (see COMAR 26.08.02.03-3).

B. USE I-P: WATER CONTACT RECREATION, PROTECTION OF AQUATIC LIFE, AND PUBLIC WATER SUPPLY

Waters that are suited for all uses identified in Use I and use as a public water supply.

Criteria for Use I-P waters:

a) The criteria for Use I waters (a)-(e)
b) Toxic Substances - all toxic substances criteria for protection of fresh water aquatic organisms and to protect public water supplies and the wholesomeness of fish for human consumption apply.

C. USE II: SHELLFISH HARVESTING WATERS

None in Montgomery County

D. USE III: NATURAL TROUT WATERS

Waters that are suitable for the growth and propagation of trout, and that are capable of supporting self sustaining trout populations and their associated food organisms.

Criteria for Use III waters:

a) Bacteriological - same as Use I waters
b) Dissolved Oxygen - may not be less than 5.0 mg/liter at any time with a minimum daily average of not less than 6.0 mg/liter.
c) Temperature - maximum temperature outside the mixing zone may not exceed 68 degrees F (20 degrees C) or the ambient temperature of the surface water, whichever is greater. A thermal barrier that adversely affects aquatic life may not be established.
d) pH - same as Use I waters
e) Turbidity - same as Use I waters
f) Total Residual Chlorine (TRC) - except as provided in COMAR 26.08.03.06, the Department may not issue a permit allowing the use of chlorine or chlorine compounds in the treatment of wastewater discharging to Use III and III-P waters.
g) Toxic Substances - all criteria to protect fresh water aquatic organisms and the wholesomeness of fish for human consumption apply.

E. USE III-P: NATURAL TROUT WATERS AND PUBLIC WATER SUPPLY

Waters that include all uses identified for Use III waters and use as a public water supply.

Criteria for Use III-P waters:

a) The criteria for Use III waters (a)-(f)
b) Toxic Substances - all toxic substances criteria for protection of fresh water aquatic organisms and to protect public water supplies and the wholesomeness of fish for human consumption apply.

F. USE IV: RECREATIONAL TROUT WATERS

Waters that are capable of holding or supporting adult trout for put and take fishing, and that are managed as a special fishery by periodic stocking and seasonal catching (cold or warm waters).

Criteria for Use IV waters:

a) Bacteriological - same as Use I waters
b) Dissolved Oxygen - same as Use I waters
c) Temperature - maximum temperature outside the mixing zone may not exceed 75 degrees F (23 degrees C) or the ambient temperature of the surface water, whichever is greater. A thermal barrier that adversely affects aquatic life may not be established.
d) pH - same as Use I waters
e) Turbidity - same as Use I waters

f) Toxic Substances - all toxic substance criteria to protect fresh water aquatic organisms and the wholesomeness of fish for human consumption apply.

G. USE IV-P: RECREATIONAL TROUT WATERS AND PUBLIC WATER SUPPLY

Waters that include all uses identified for Use IV waters and use as a public water supply.

Criteria for Use IV-P waters:

a) The criteria for Use IV waters (a)-(e)
b) Toxic Substances - all toxic substances criteria for protection of fresh water aquatic organisms and to protect public water supplies and the wholesomeness of fish for human consumption apply.

COMAR 26.08.02.04 Anti-Degradation Policy

A. Certain waters of this State possess an existing quality which is better than the water quality standards established for them. The quality of these waters shall be maintained unless:

(1) The Department determines a change is justifiable as a result of necessary economic or social development; and
(2) A change will not diminish uses made of, or presently possible, in these waters.

B. To accomplish the objective of maintaining existing water quality:

(1) New and existing point sources shall achieve the highest applicable statutory and regulatory effluent requirements; and
(2) Nonpoint sources shall achieve all cost effective and reasonable best management practices for nonpoint source control.

C. The Department shall discourage the downgrading of any stream from a designated use with more stringent criteria to one with less stringent criteria. Downgrading may only be considered if:

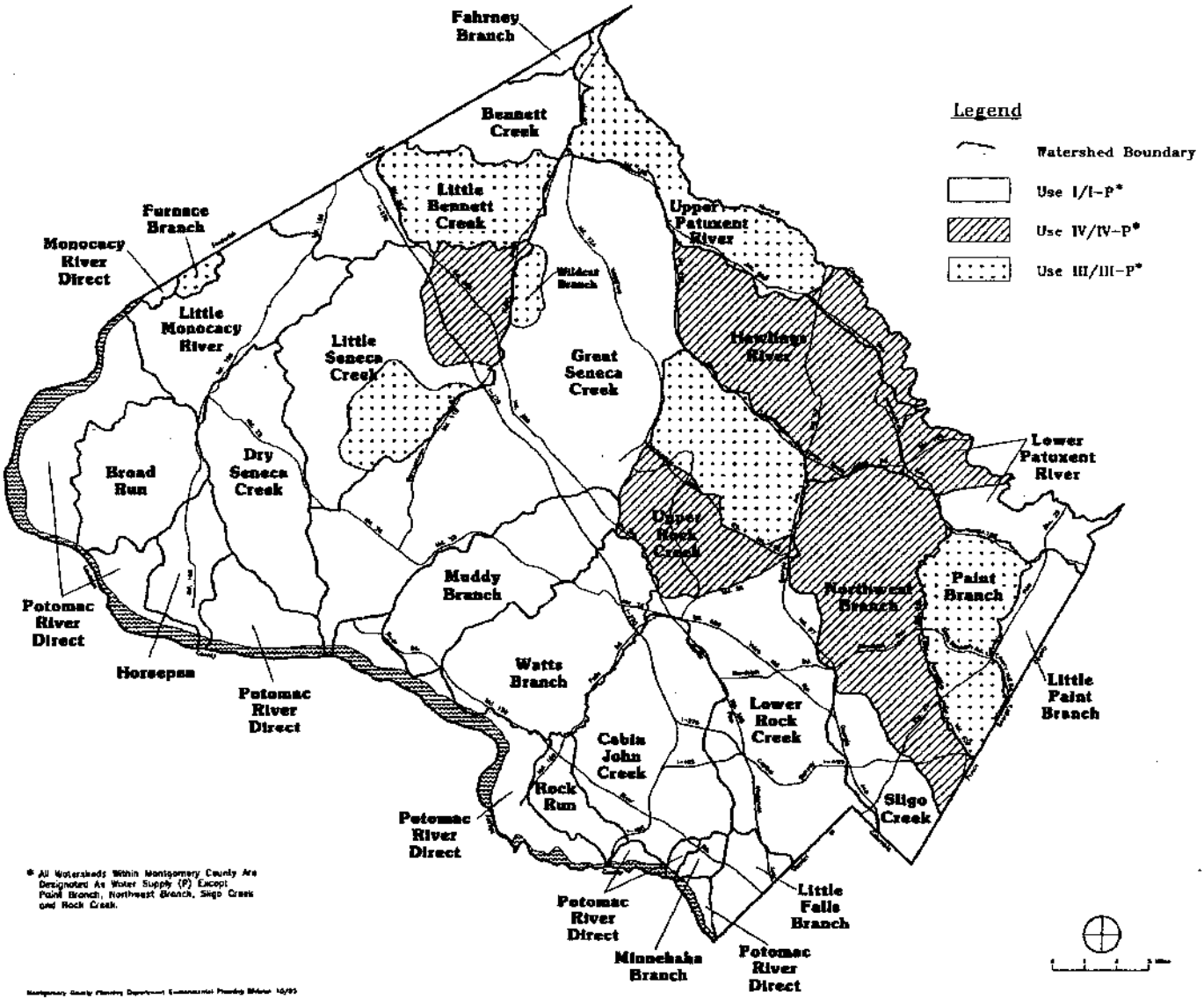
(1) The designated use is not attainable because of natural causes;
(2) The designated use is not attainable because of irretrievable man-induced conditions; or
(3) Controls more stringent than the effluent limitations and national performance standards mandated by the Federal Act, and required by the Department, would result in substantial and widespread economic and social impact.

D. The Department shall provide public notice and opportunity for a public hearing on the proposed change before:

(1) Permitting a change in high quality waters; or
(2) Downgrading any stream use designation.

E. Water which does not meet the standards established for it shall be improved to meet the standards.

Figure 11. State Water Use Designations for Montgomery County



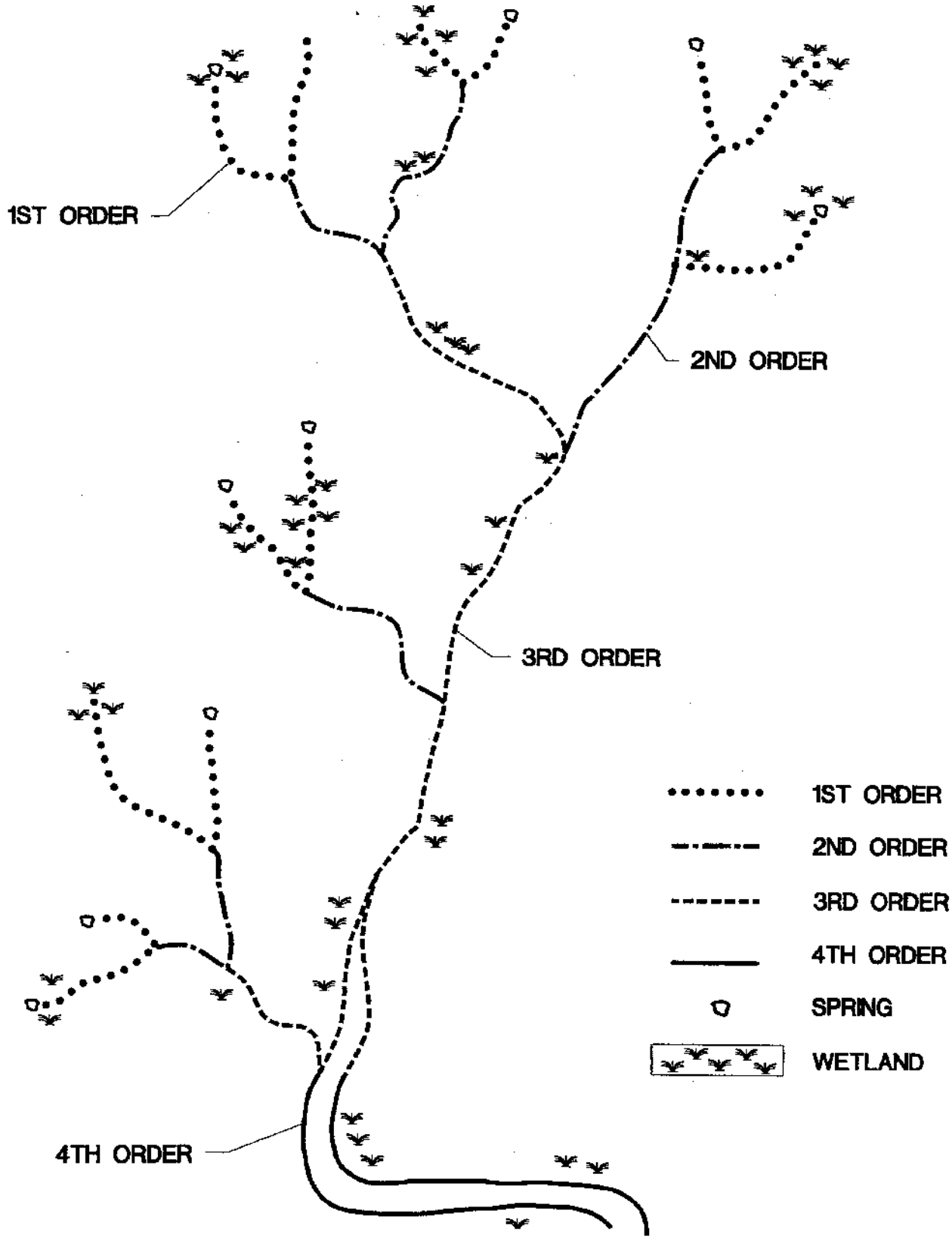
APPENDIX B

STREAM ORDER DETERMINATION

Stream order is used in these guidelines as one factor that determines appropriate wetland buffer widths. Smaller headwater streams, classified as order one and two, are given more wetland protection than the larger downstream reaches classified as order three and four (see Chapters III and V for details). Stream order is determined from a standard map set. For these guidelines, stream order shall be determined from M-NCPPC 1:200' scale topography and stream maps.

Stream order is determined starting at the headwaters of a watershed and continuing until the stream reaches the ocean. All initial headwater perennial streams are classified as first order streams. Wherever two first order streams conjoin to form a larger stream, that reach of stream is labeled second order. Wherever two second order streams conjoin, the next reach is labeled as third order. Note that a first order and a second order stream joining still remains a second order stream; it only becomes third order when the second order one joins another second order. An example of how to determine stream order is found in Figure 11 on the following page.

Figure 12. Stream Order Determination



APPENDIX C

ERODIBLE SOILS LIST

(Source: U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), *1995 Soil Survey of Montgomery County, Maryland*)

The following soils are classified as having a *severe hazard of erosion* by the NRCS, based on the erodibility index of a soil map unit. These soils are severely erodible and must be incorporated into wetland buffers according to the guidance in chapters III and V. These severely erodible soils should also be incorporated into the property's open space as much as possible and carefully managed during construction.

16D	Brinklow-Blocktown channery silt loams, 15 to 25% slopes
18E	Penn silt loam, 15 to 45% slopes, very stony
21D	Penn silt loam, 15 to 25% slopes
21E	Penn silt loam, 25 to 45% slopes
21F	Nestoria-Rock Outcrop Complex, 25 to 50% slopes
57D	Chillum silt loam, 15 to 25% slopes
61D	Croom gravelly loam, 15 to 25% slopes
61E	Croom gravelly loam, 25 to 40% slopes
109E	Hyattstown channery silt loam, 25 to 45% slopes, very rocky
116E	Blocktown channery silt loam, 25 to 45% slopes, very rocky

APPENDIX D

STATE PATUXENT RIVER POLICY RECOMMENDATIONS

The following excerpt from the State *Patuxent River Policy Plan* (1984) includes the ten final recommendations of the plan.

RECOMMENDATIONS

1. ESTABLISHING A PRIMARY MANAGEMENT AREA (PMA)

A PRIMARY MANAGEMENT AREA, DELINEATING THE AREA ALONG THE RIVER AND ITS TRIBUTARIES, WILL BE ESTABLISHED TO IDENTIFY AND MANAGE LAND FROM WHICH POLLUTION IS MOST LIKELY TO BE TRANSPORTED INTO THE RIVER.

The PMA shall be considered to be an area critical to the Chesapeake Bay and its tributaries;

Local governments will include the PMA in their plans and zoning ordinances;

Preferred land uses in the PMA will be agriculture, forest, and recreation;

Local governments will prepare plans for the PMA to minimize dense and intensive development and large impervious areas in the PMA;

State agencies, in regulatory activities, technical assistance, and grant programs, will target the PMA as a priority area; and

State and local governments will ensure that land use practices within the PMA shall be of such a nature so as to have no (or at least minimal) adverse impact on water quality of the Patuxent River.

2. PROVIDING BEST MANAGEMENT PRACTICES (BMPS) AND VEGETATIVE BUFFERS

PROGRAMS FOR PROVIDING BMPS AND VEGETATIVE BUFFERS IMMEDIATELY ADJACENT TO THE RIVER AND ITS TRIBUTARIES WILL BE DEVELOPED.

State and local governments will provide BMPs on their publicly owned lands, including buffers where appropriate;

The State will require BMPs on State assisted projects, including buffers where appropriate;

Local governments will adopt subdivision and zoning provisions that require BMPs, including buffers where appropriate, in all new development;

BMPs, including filter strips and field borders, will be encouraged on agricultural land through education, voluntary action, incentive, compensation, and through implementation of the Maryland Agricultural Water Quality Management Plan;

Implementation of soil conservation plans, including filter strips and field borders where appropriate, will be required on lands acquired in easements;

The federal government will be requested to provide BMPs including buffers where appropriate, on its lands; and

The State Department of Transportation will protect roadside buffers by eliminating its practice of broadcast spraying of herbicides along roadsides.

3. IDENTIFYING MAJOR NONPOINT POLLUTION SITES

THE STATE, IN CONJUNCTION WITH LOCAL GOVERNMENTS, WILL SURVEY THE WATERSHED AND IDENTIFY MAJOR NONPOINT POLLUTION SITES.

Existing State regulatory and corrective programs will consider these sites as priority areas.

4. RETROFITTING EXISTING DEVELOPMENT

THE STATE WILL DEVELOP A COST-SHARING PROGRAM TO AID LOCAL GOVERNMENTS IN CORRECTING AND MANAGING STORMWATER POLLUTION FROM EXISTING DEVELOPED AREAS.

Local governments will pursue a program of abating pollution in existing developed areas;

State and local governments will curtail nonpoint pollution coming from their facilities; and

The State will establish priorities among developed areas causing nonpoint pollution and address problems in order of priority.

5. ACCOMMODATING FUTURE DEVELOPMENT

FUTURE DEVELOPMENT WILL BE ACCOMMODATED IN WAYS TO MINIMIZE IMPACT ON WATER QUALITY AND MAXIMIZE EXISTING OPPORTUNITIES.

Development will be concentrated where possible, outside the PMA;

Development will optimize the use of existing facilities and utilities;

Development will be sited to maximize use of soil infiltration capacity;

Development will be sited away from sensitive areas, such as reservoirs, wetlands, steep slopes, and aquifer recharge areas;

Sites within the watershed that offer unique opportunities for development and redevelopment will be identified and planned; and

New public facilities (schools, parks, highways) will incorporate best management practices.

6. INCREASING RECREATION AND OPEN SPACE

ADDITIONAL RECREATION AND OPEN SPACE LANDS WILL BE ACQUIRED IN THE PATUXENT WATERSHED BY THE STATE AND LOCAL GOVERNMENTS.

State and local governments will review their recreation and open space plans for the Patuxent Watershed;

Acquisition will be concentrated along the river and tributaries and in the lower portion of the watershed;

Federal holdings in the watershed must be retained for open space and research; and

An acquisition program for the lower portion of the watershed will be prepared.

7. PROTECTING FOREST COVER

EXISTING FOREST COVER WILL BE RETAINED AND IMPORTANT SENSITIVE AREAS WILL BE REFORESTED TO PROTECT WATER QUALITY.

Existing State programs, like Program Open Space and Agricultural Preservation will be examined and amended for their application to forest protection;

Buffering with forested strips will be encouraged; and

The State will institute a reforestation program for developed areas.

8. PRESERVING AGRICULTURAL LAND

PRIME AND PRODUCTIVE AGRICULTURAL LAND WILL BE PRESERVED IN THE PATUXENT WATERSHED

Easement purchases will include requirements for implementing soil conservation plans including buffer strips where appropriate; and

The Agricultural Cost-Sharing program will target the Patuxent watershed.

9. EXTRACTING SAND AND GRAVEL

SAND AND GRAVEL ACTIVITIES WILL BE MANAGED TO ALLOW EXTRACTION OF THE RESOURCE WITHOUT DAMAGE TO THE RIVER.

Abandoned sand and gravel sites will be reclaimed;

Sensitive control of active and future sites, particularly those in the PMA, will be required;

Penalties for allowing sediment to enter the Patuxent River resulting from washing operations are to be increased to a minimum of $1,000 per day for every day a violation is found to exist by the appropriate State agency; and

The location of the resources will be identified, and county resource management strategies developed.

10. ADOPTING AN ANNUAL ACTION PROGRAM

THE PATUXENT RIVER COMMISSION WILL ANNUALLY DEVELOP AND ADOPT AN ACTION PROGRAM TO IMPLEMENT THE STRATEGIES.

The action program will contain a schedule and indicate responsibilities in carrying out specific actions to implement the plan;

A community education program will be an integral part of the action program; and

The Commission will prepare an annual report on progress in implementing the plan.

The recommendations and proposed actions in this plan are a starting point. The Policy Plan has been approved by county governments and the General Assembly. Approval of the plan indicates concurrence and commitment to improving the Patuxent River. The combined work of local and State governments, citizens, land owners, and private industry is required to transform the proposals into an improved river.

While prepared for the Patuxent, the land management recommendations contained in this plan can serve as a model for managing any watershed and the Chesapeake Bay.

REFERENCES

Alliance for the Chesapeake Bay. "Riparian Forest Buffers." White Paper Report. January 1996.

American Society of Planning Officials. "Performance Controls for Sensitive Lands: A Practical Guide for Local Administrators." Planning Advisory Service Report Nos. 307, 308. July 1975.

Belt, G.H., J. O'Laughlin, and R. Merrill. "Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature." Forest, Wildlife and Range Policy Analysis Group Report No. 8. University of Idaho. June 1992.

Brown, R.G. and M.L. Brown. Woody Plants of Maryland. Port City Press: Baltimore. 1972.

Brown, R.G. and M.L. Brown. Herbaceous Plants of Maryland. Port City Press: Baltimore. 1984.

Chesapeake Bay Commission. "An Analysis of Riparian Forest Buffer Policies in Maryland, Virginia, and Pennsylvania." Issues and Actions paper. Annapolis, MD. January 1995.

Chesapeake Bay Program. Riparian Forest Buffers: Restoring and Managing a Vital Chesapeake Resource. Conference Proceedings. Ellicott City, MD. October 5-6, 1994.

Chester County Water Resources Authority. "The Brandywine Plan: A plan for the Upper East Branch of Brandywine Creek West." Chester, Pennsylvania. 1968.

COMAR 26.03.04. Non-tidal Wetlands Protection Act. June 1996.

Cowardin, L.M. "Classification of Wetlands and Deepwater Habitats of the United States." U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C. 1979.

Davis, W. J. "Sediment Basin Trap Efficiency Study, Montgomery County, Maryland." Paper No.78-2564 American Society of Agricultural Engineers, pp. 14-27. 1978.

Doyle, R.C., D. C. Wolfe, and D. F. Bezdicek. "Effectiveness of forest buffer strips in improving the water quality of manure polluted runoff." In: Proceedings of 3rd. International Symposium on Livestock Wastes, American Society of Engineers, pp. 299-302. 1974.

"Executive Council calls for policy promoting forest buffers." Bay Journal. p.8. November 1994.

Franks, E.C. and J.W. Reeves. "A Formula for Assessing the Ecological Value of Trees." Journal of Arboriculture, 14 (10). 1988.

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. "An Ecosystem Perspective of Riparian Zones." BioScience, Vol. 41, No. 8. pp.540-551. 1991.

International Society of Arboriculture. Valuation of Landscape Trees, Shrubs, and Other Plants (seventh ed.). 1988.

Karr, J.R., and I.J. Schlasser. Impact of near stream vegetation and stream morphology on water quality and stream biota. EPA-600/3-77-097. U.S. Environmental Protection Agency. Athens, Georgia. 91 pp. 1977.

Klein, Richard D. "Urbanization and Stream Quality Impairment." Water Resources Bulletin, vol 15, no. 4. American Water Resources Association. pp.948-963. 1979.

Lowrance, R., R. Leonard, and J. Sheridan. "Managing Riparian Ecosystems to Control Nonpoint pollution." Journal of Soil and Water Conservation, January-February 1985. pp. 87-91. 1985.

Lowrance, R., et al. "Riparian Forests as Nutrient Filters in Agricultural Watersheds." BioScience, Vol. 34, No. 6. pp.374-377. 1984.

Lynch, J.A., E.S. Corbett, and W.E. Sopper. "Evaluation of management practices on the biological and chemical characteristics of stream flow from forested watersheds." Institute for Research on Land and Water Resources, Pennsylvania State University, pp. 6-11. 1980.

Maryland Department of Health and Mental Hygiene. Draft Patuxent River Basin 208 Plan. September, 1982.

Maryland Office of Planning. "Achieving Environmentally Sensitive Design in Growth Areas through Flexible and Innovative Regulations". Managing Maryland's Growth: Models and Guidelines, No. 11. April 1995.

Maryland Ornithological Society. "Maryland and D.C. Breeding Bird Atlas Project Handbook, 1983-1987." Supplement to: Maryland Birdlife, Vol.38, 1982.

Montgomery County, Maryland. Montgomery County Zoning Ordinance.

Montgomery County (Maryland) Department of Environmental Protection and Maryland-National Capital Park and Planning Commission. Montgomery County Stream Protection Strategy. Montgomery County, MD. 1998.

Naiman, R.J., H. Decamps, and M. Pollock. "The Role of Riparian Corridors in Maintaining Regional Biodiversity." Ecological Applications. Vol.3, No.2, pp.209-212. 1993.

Ohlander, C.A. "Defining the sediment trapping characteristics of a vegetative buffer. Special Case: Road erosion." NTIS PB-245100 Proc. Fed. Interagency Sedimentation Conf., Denver, Colorado., pp 77-82. 1976.

U.S. Department of Agriculture, Natural Resources Conservation Service. Soil Survey of Montgomery County, Maryland. 1995.

Terrene Institute. "Chapter 3: Maintaining Vegetative Buffer Zones." Local Ordinances: A User's Guide. In cooperation with U.S.EPA Region V. 1995.

Welsch, David J. "Riparian Forest Buffers: Function and Design for Protection and Enhancement of Water Resources." U.S. Department of Agriculture Forest Service. NA-PR-07-91. Radnor, PA. 1991.

Welsch, David J., et al. "Forested Wetlands: Functions, Benefits, and the Use of Best Management Practices." USDA Forest Service, USDA Natural Resources Conservation Service, U.S. Army Corps of Engineers, USEPA Region III, and USDI Fish and Wildlife Service. NA-PR-01-95. Radnor, PA. 1995.

Whipple, William, *et al.* "Erosional aspects of managing urban streams." Rutgers University. Water Resources Research Institute. New Brunswick, N.J. 1980.

Yorke, T.H. and W.J. Herb. "Effects of Urbanization on stream flow and sediment transport in the Rock Creek and Anacostia River Basins, Montgomery County, Maryland 1962-74." U.S. Geol. Survey Prof. Paper 1003, pp. 51-56. 1974.